

# 565/575 FEEDER MANAGEMENT RELAY®

## Instruction Manual

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**MULTILIN**

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## Protection Requirements of Feeders

Protection of three phase feeders is necessary to avoid equipment damage and personnel injury during fault conditions. The fact that continuous reliable power must be provided to the distribution network means that the feeder protection relay must protect the network and personnel and yet not cause unnecessary loss of power or nuisance tripping.

The ideal Feeder Management Relay should at least monitor phase current, ground current and voltage in the network, provide indications if any of these reach predetermined levels and provide appropriate trip signals if fault conditions develop.

The advent of current microprocessor technology has enabled the development of feeder management relays which do this task much better than conventional relays and provide other desirable features. Measured values of phase current, ground current and voltage can be displayed.

Entering setpoints to the microprocessor based Relay is made easier by use of a keypad and a LCD display to guide the user. A "help" menu is available at all times.

## Relay Features

The Multilin Feeder Management Relay is designed to provide complete and accurate feeder protection under all operating conditions. The relay provides complete Time/Overcurrent phase and ground protection by monitoring feeder phase currents and ground currents. These are sensed by current transformers (CT's).

Overcurrent phase and ground current trip setpoints are programmed by a comprehensive selection of industry standard curve shapes including moderately inverse, normal inverse, very inverse, and extremely inverse. In addition to the pre-selected curves there is also a programmable custom curve. If none of the pre-selected curves are suitable for the application, the user can enter his own data to form the custom curve.

## Setpoint Programming

The relay can have its setpoints programmed locally, from the front panel. In this case the alphanumeric display guides the user through the setup, step by step, giving clear English language instructions. There is also a HELP key which can be pressed at any time to get information and assistance about the current programming step.

The status of the system is clearly displayed at all times by LED indicators and more detailed information can be shown on the display screen if requested through the keypad.

When an output relay is activated to cause a trip/alarm the Relay will display the cause of the trip/alarm.

All setpoints are tamper-proof. This is achieved through the use of a combination of a Access wire jumper at the back of the relay and personalized codes. These codes allow even the wire jumper to be overridden, for added security.

## Inputs

The Relay has inputs which can be used for indication of breaker status or external differential trips such as the industry standard '87T'.

One set of inputs is designated "Analog Select", and can be connected to four dry contacts of a programmable logic controller (PLC). Selected outputs can be requested one by one, through these inputs by the PLC. Information can be requested on values such as individual phase currents and the Relay will send the requested value through the analog output terminals in either 0-1mA or 4-20mA format as required.

## Outputs

Six electromechanical output relays are included in the 565/575 Relay. These are named Trip, Close, Aux. 1, 2, 3, and 4. These relays can be allocated various functions, by using the flexibility of the software programming.

Actual value and Setpoint information is sent out through the RS485 port on the rear of the relay. *\*\* An RS232 printer driver port is also available for printing out events from the event recorder if an Option Card is installed. \*\** In addition, a front panel RS232 programming port is provided.

## Memory Features

In order to simplify fault analysis and thus improve system reliability, several memory features have been built into the Relay. The event recording feature provides a record of the events leading to a trip so that the faulty feeder system component can be located easily.

The memory feature provides a record of the cause of all trips. This is extremely useful in determining preventive maintenance requirements and identifying problem areas.

## Typical Applications

The Relay is ideally suited for primary protection of medium and high voltage distribution systems.

## INTRODUCTION



### Ordering Information

To order the Feeder Protection Relays you must specify it as shown in Figure 1.1.

Many features of the Relay are field programmable. Those

listed in Figure 1.1 are not, and must be specified when ordering.

Additional features may be available for special orders. Contact GE MULTILIN for further details.

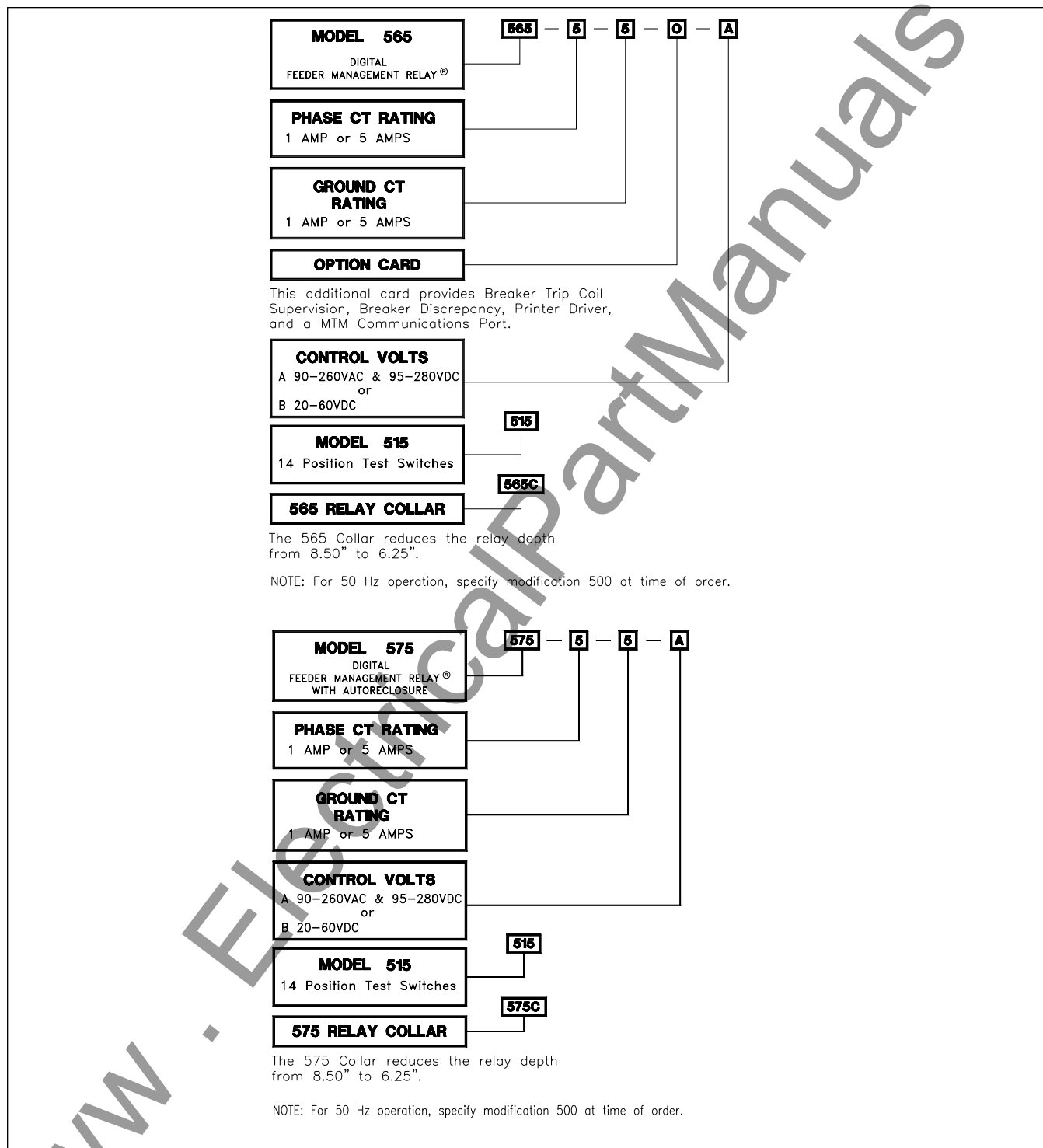


Figure 1.1 Order Codes

## Unpacking the Unit

The shipping container should contain your Relay and this manual. Inspect the unit and inform GE MULTILIN of any damage. If re-shipment is required the original container and packing should be used.

## Mounting the Relay

The Relay is designed to be panel mounted. It should be located so that the keypad is accessible with the door opening from the right. The unit should be mounted so that the display is easily visible. It is recommended that the relay be mounted as far away as possible from heavy current sources and strong magnetic fields.

The 4 mounting studs of the Relay are equipped with (1) #10 internal star lockwasher, (1) 10-32 threaded hex spacer 0.25" long, (1) #10 split lockwasher, and (1) 10-32 hex nut. Remove only the split lockwasher and the 10-32 hex nut before installing the Relay in the panel. Then use this split lockwasher and hex nut to secure the Relay in the panel.

The dimensions of the unit and the necessary cutout dimensions are shown in Figure 2.1.

To reduce the required space behind the mounting panel an optional depth reducer is available. This reduces the depth to 6.25". It increases the width of the front panel to 15.33". For mounting dimensions see Fig. 2.2.

## Making Wiring Connections

All wiring connections to the Relay are made at the back of the unit as shown in Figure 2.10. All terminals are also identified in Table 2-1 with their functions.

Figure 2.5 shows the connections for a typical installation. The actual connections made to the Relay will vary according to the application. All contacts in the figure are shown in the state they will have with control power applied to the unit. The contacts are shown in the "non-active" state.

The relay can be removed from the outside case for the purpose of checking and/or calibration. The wiring is to the outside and remains intact.

### WARNING

Extreme caution must be exercised when the chassis is withdrawn from an in service unit as this exposes live terminals.

## Power Supply Connections

Depending upon the ordered power supply, the Relay is

designed to operate within one of the following voltage ranges:

1. 90-260 VAC and 95-280 VDC
2. 20-60 VDC

No internal or external adjustments are required to use any of the above supply voltages.

Power supply connections are made at terminals 63 and 64. The relay is grounded by connecting terminal 62 directly to the dedicated ground entering the switchgear enclosure.

## Surge Ground Connection

For safety and optimum noise immunity due to transients, a low impedance connection must be made between the surge ground terminal and the switchgear ground. This must be a separate, dedicated wire tied directly to the switchgear copper bus strip (flat, braided wire is ideal).

### CAUTION

FAILURE TO MAKE PROPER GROUND CONNECTIONS MAY CAUSE DAMAGE TO THE RELAY.

## Current Transformers

The three current transformers supply the Relay with currents proportional to the current in each of the phases of the feeder being protected. They are connected to terminals 49 to 54 as shown in Figure 2.5. Observe correct polarity when connecting the current transformers to the unit.

The CT terminal with the dot marked on it must be connected to the terminal marked ":5/1". Each CT should have the same physical orientation, with polarity connected as shown in Figure 2.5. The sides of the CT which are not marked with a polarity dot are connected together and grounded.

Residual ground sensing is provided by connecting the common terminals of the three CTs together through the ground sensing input terminal 56 as shown in the wiring diagram, Figure 2.5. These connections allow the relay to check the vector sum of all three phase currents. If this is not zero, a ground fault condition is sensed by the unit.

For typical CT wiring of the Relay with the optional Metering Transducer Module (MTM) see Figure 2.7A and Figure 2.7B.

## Voltage Transformers

Separate voltage transformers are needed for voltage sensing and terminals 35 to 38 are used for this. The transformers can be connected in either Wye or Open Delta configuration as shown in Figure 2.6.

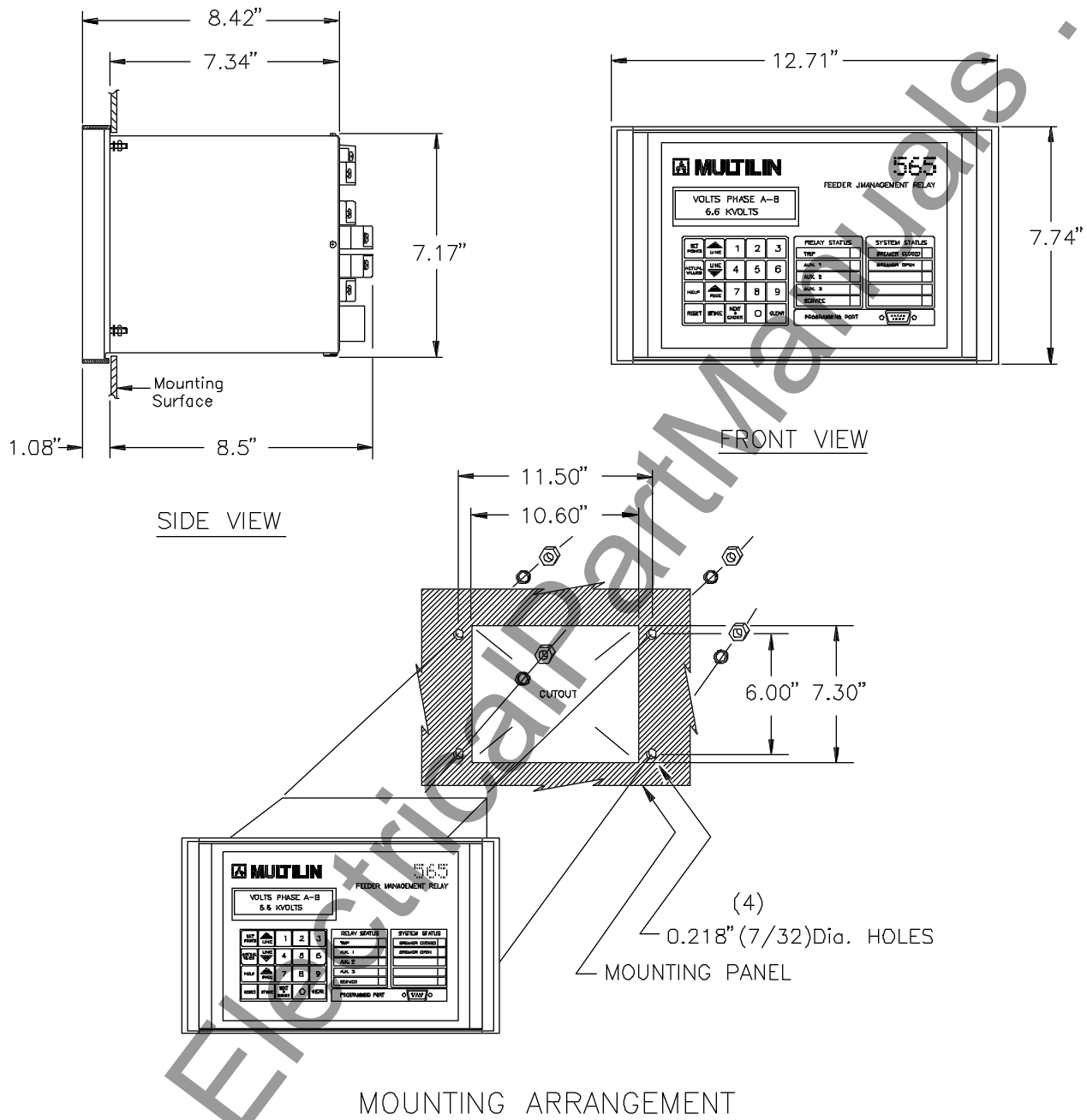
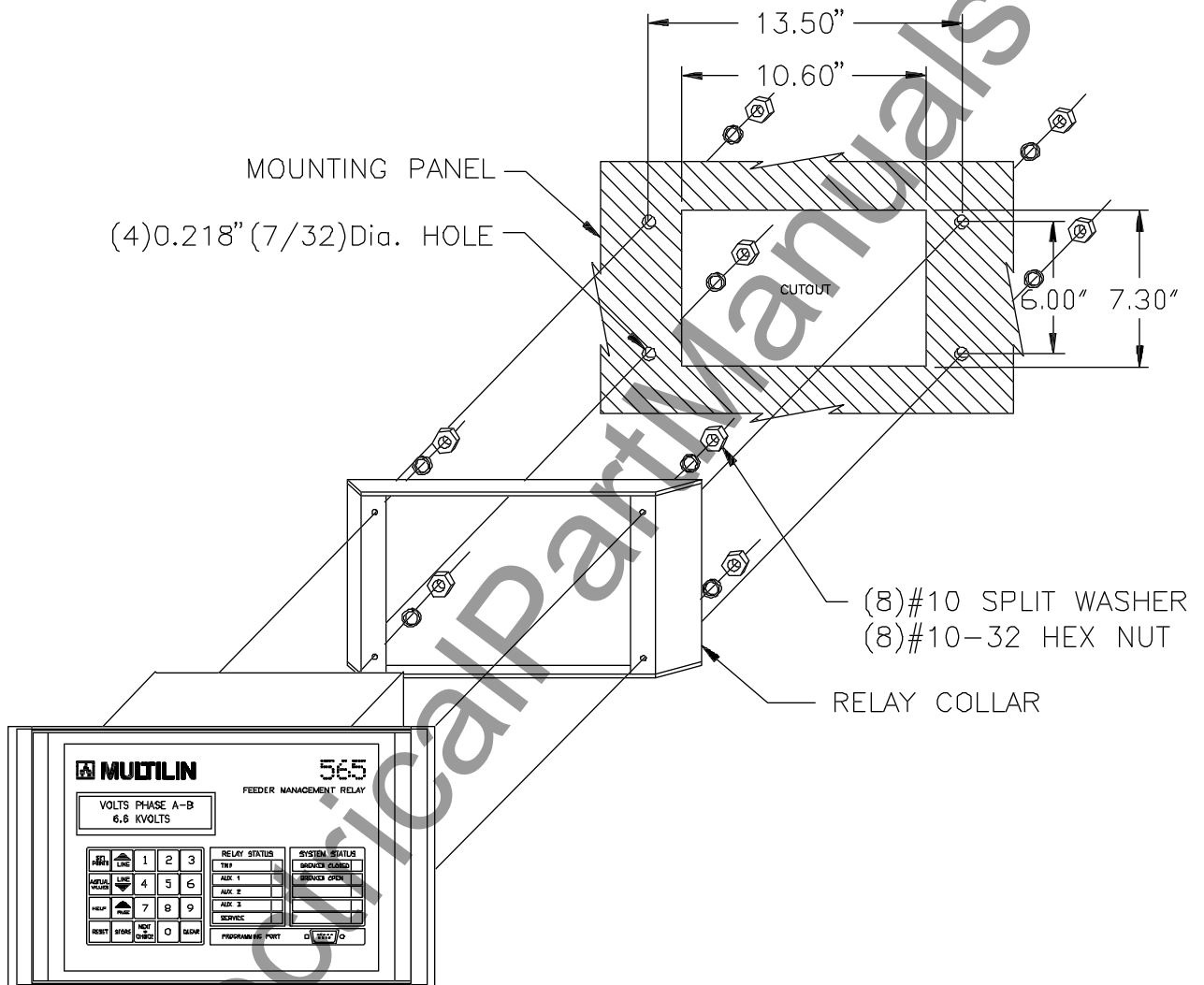


Figure 2.1 Mounting Details

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MOUNTING ARRANGEMENT

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**Figure 2.2** Mounting Arrangement with Relay Collar

## INSTALLATION



### Breaker Status and Control Connections

The Feeder breaker status indications are given to the Relay from the auxiliary 52a/52b contacts on the breaker. The connections are made to terminals 9 and 10 for the Breaker open indication (52b) and at terminals 11 and 10, for breaker closed (52a) as shown in Figure 2.5. The breaker status input connections must be made.

### Aux 1 Contacts

The contacts of the Aux 1 are 43 N.O., 59 common, 46 N.C. This relay function is programmable.

### Aux 2 Contacts

The contacts of Aux 2 are 44 N.O., 60 common, 47 N.C. This relay function is programmable.

### Aux 3 Contacts

The contacts of Aux 3 are 45 N.C., 61 common, 48 N.O. This relay is hot coil failsafe and monitors control power loss, and trip coil supervision. It is not programmable.

### Aux 4 Contacts

The contacts of Aux 4 are 30 N.O., 31 common, 32 N.C. This relay activates on a Breaker Discrepancy function if enabled.

\*\* Available only with Option Card \*\*.

### Block Tap Changer (575 only)

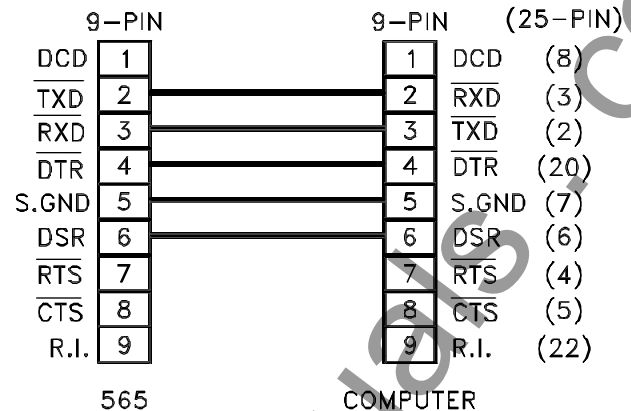
The contacts of the Block Tap Changer are 16 N.O., 15 common, and 26 N.C. This relay operates to block operation of an external transformer tap changer. It also acts as "Auto Reclosure in Progress" indicator.

### Programming Port

A programming port (RS232 type) is supplied on the front panel of the relay. This port can be connected to a computer which then can be used to store setpoints in and read measured values from the relay.

This port has priority over the communication port on the rear. If the relay senses the DTR line being pulled high, all communications at the rear are suspended.

The connection to a computer is made via a standard modem type cable and is shown in figure 2.3.



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Figure 2.3 Computer Interface Cable for RelayCom Package

### Communication Port

Up to 32 relays can be daisy-chained together and connected to a computer or a programmable controller using the RS485 type communication port in the rear. A shielded twisted pair should be used and proper polarity has to be observed, ie. positive to terminal 65, negative to terminal 66, while the shield is connected to terminal 67.

After each 565/575 Relay is assigned a unique address, the master device (computer) can read measured values or store setpoints. The address is assigned via the keypad on the front panel. See also Programming Port information above.

### MTM Port

The MTM port, terminals 67, 68, and 69, is required when connecting the separate MTM Metering Transducer Module to the 565/575 Relay. The MTM receives current and voltage inputs and calculates KW, KVAR, PF and transmits the information to the 565/575 Relay. The connections are made by means of a shielded twisted pair of length no greater than 50 ft. MTM port polarity must be observed, ie. positive to 68, negative to 69, and the shield to 67. \*\* Available only with Option Card \*\*.

### Printer Port

The printer port can be used to connect a printer to record event recording output. This is a 1200 baud serial output with even parity and requires the printer to accept serial data. The word length is eleven bits with the data frame constructed as follows: there is a start bit (*Low*), eight data bits (*LSB to MSB*), an even parity bit, and a stop bit (*High*). The connection is made at the rear of the relay via a 9 pin D-type null modem connector. The pinout is as follows:

- 2 = transmit data to printer
- 3 = receive data from printer
- 4 = Clear To Send from printer
- 5 = signal ground.

See your printer manual for connections at the printer. *\*\* Available only with the Option Card installed \*\**

## Analog Output Terminals

Terminals 17 and 18 provide a single output that can be programmed as 4-20 mA or 0-1 mA to correspond from zero to full scale.

Using the analog select terminals 19-22, and 71, outputs can be selected by placing a binary code on inputs A-D. This code can be PLC controlled for changing the output selection. This allows monitoring and plotting measured values such as phase current, using a single analog input channel of a programmable controller.

If a single output parameter is desired, this is achieved through setpoint programming without external connections to inputs A-D.

## Analog In Terminals

The 565/575 Relay is designed to accept an input from standard 4 to 20 mA source such as a Multilin TS3 Temperature Monitor. This input can be used to provide status or trip signals related to the level of the input, a transformer winding temperature, for example. The setup of the trip, alarm or status indications are done during the software programming in the Setpoints mode.

The input terminals are positive 24, and negative 23.

## External Switches 1 to 8

The 565/575 Relay can accept switch inputs from eight external switches, through terminals 1 to 8. The function of switches 1 to 8 is user definable. They can be programmed to perform functions such as preventing certain feeder breaker trips or introducing a time delayed alarm. These features are assigned to the switches in the Configuration page of Setpoints mode.

### CAUTION

External Switch inputs should be connected to dry circuits only to prevent damage to the relay.

No external voltage should be applied to these terminals as the contacts are energized internally from the 565/575 and opto-coupled to the sensing circuitry. Switches should be isolated from each other for correct operation. The maximum input impedance to these external switches is 2 k $\Omega$ .

## Access Terminals

Terminals 33 and 34 can be connected to a keyswitch. The 565/575 Relay setpoints cannot be changed unless this keyswitch is closed (ie. 33 and 34 are connected together). This prevents unauthorized personnel from tampering with the setpoints once they are set up. This function can be defeated using the Security feature. Refer to Setpoint Programming.

## Remote Trip/Close Terminals

When terminals 39 and 40 are "open", the 565/575 relay is operating in Local Mode. If this is the case, terminals 26, 27, and 28 will have no effect upon either the Close (terminals 42 and 58) or Trip (terminals 25, 57, and 41) output relays.

When terminals 39 and 40 are "closed", the 565/575 relay is operating in Remote Mode. Now if terminals 27 and 28 are shorted, the Close output relay becomes energized and if terminals 26 and 27 are shorted, the Trip output relay becomes energized. Note that each relay will be picked up for as long as the appropriate switch input remains closed.

This operation is completely independent of software and is strictly under hardware control.

## Removal of Cradle

To remove the cradle from the case, open the door and unscrew the locking screw fasteners. The cradle can now be removed simply by pulling on the front handle. Caution should be taken when the cradle is removed as this exposes live terminals in the case.

## Inserting Cradle

To insert the cradle, align the aluminum guides on the sides of the cradle with those inside the case and slide the cradle into place. Ease in with constant pressure. Once inserted, the yellow guideline should be visible. The locking screw fasteners can now be screwed in and tightened. NOTE: The locking screw fasteners should be locked at all times while the cradle is inserted to ensure that proper connection to the rear terminals is maintained.

### CAUTION

Do not press on the LCD display when removing or installing the unit.

## INSTALLATION



### Metering Transducer Module

The Metering Transducer Module is an optional unit which gives the 565/575 additional functionality. The mounting arrangement is shown in Figure 2.9 and the typical wiring for PT's and CT's is shown in Figure 2.7A and Figure 2.7B. Additional analog outputs can be wired as shown in Figure 2.8A and Figure 2.8B.

### Hi-Pot Testing

The Relay has been tested at the factory for 1 second at 1800 VAC in order to verify its dielectric strength. Hi-pot testing to verify the wiring into the gear must be done with the inner relay cradle removed from the outer case. JMP1 must be removed before Hi-pot testing. This jumper can be located by viewing Figure 2.4.

Hi-pot testing should only be performed on the terminals mentioned in the enclosed table of this addendum. With these points in mind, here are the necessary steps for Hi-potting a 565/575 Relay when wired into the gear.

1. Remove the 565/575 Relay inner chassis from the outer case. Failure to remove the relay from the outer case can cause failure of the relay.
2. Remove jumper JMP1 from the outer case's rear motherboard. Please see Figure 2.4 for this jumper's location.
3. Hi-pot the following terminals with respect to surge ground for 1 second at 1800 VAC:
  - #16
  - #29, #30, #31, #32
  - #42, #43, #44, #45, #46, #47, #48
  - #58, #59, #60, #61, #62, #63, #64
4. Ensure that jumper JMP1 is properly inserted after Hi-pot. This should be on the two right most pins of the group of three pins. If not, the unit will not be properly grounded.
5. Install the relay's inner chassis into the outer case.

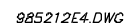
Figure 2.4 Removal of Hi-Pot Screw

**Table 2-1 - Terminal Identification**

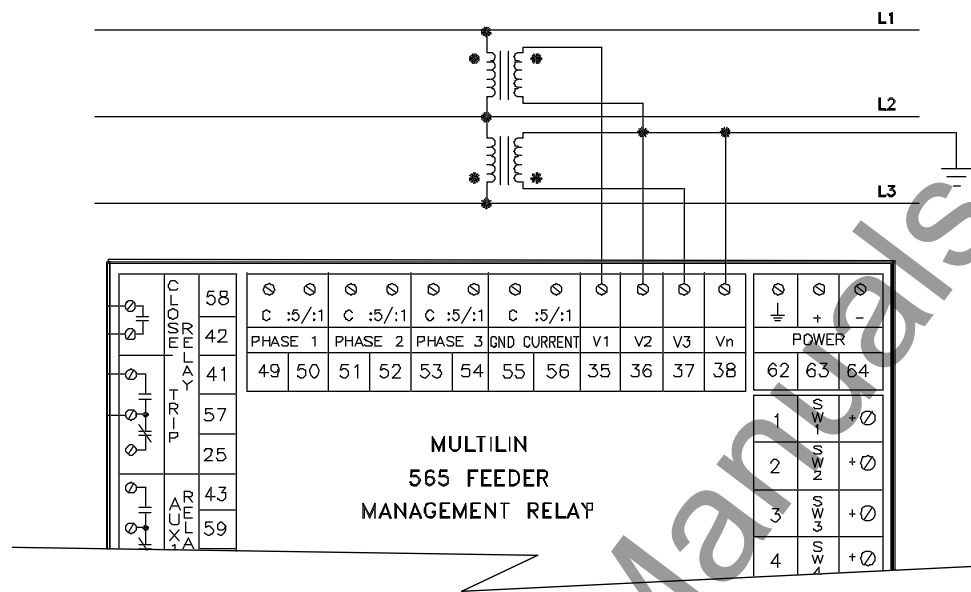
| Terminal | Function                 | Terminal | Function                   |
|----------|--------------------------|----------|----------------------------|
| 1        | Ext. Switch #1 "+"       | 37       | Voltage Input V3           |
| 2        | Ext. Switch #2 "+"       | 38       | Voltage Input Vn           |
| 3        | Ext. Switch #3 "+"       | 39       | 43 Remote "+"              |
| 4        | Ext. Switch #4 "+"       | 40       | 43 Remote "-"              |
| 5        | Ext. Switch #5 "+"       | 41       | Trip Relay N.O.            |
| 6        | Ext. Switch #6 "+"       | 42       | Close Relay Contact 1      |
| 7        | Ext. Switch #7 "+"       | 43       | Aux 1 Relay N.O.           |
| 8        | Ext. Switch #8 "+"       | 44       | Aux 2 Relay N.O.           |
| 9        | Breaker Open (52b) "+"   | 45       | Aux 3 Relay N.C.           |
| 10       | Breaker Common "-"       | 46       | Aux 1 Relay N.C.           |
| 11       | Breaker Closed (52a) "+" | 47       | Aux 2 Relay N.C.           |
| 12       | Reclosure Enable "+"     | 48       | Aux 3 Relay N.O.           |
| 13       | Reclosure Common "-"     | 49       | Phase 1 Common             |
| 14       | Reclosure Disable "+"    | 50       | Phase 1 Input :5/:1        |
| 15       | Block TC Common          | 51       | Phase 2 Common             |
| 16       | Block TC N.O.            | 52       | Phase 2 Input :5/:1        |
| 17       | Analog Out "-"           | 53       | Phase 3 Common             |
| 18       | Analog Out "+"           | 54       | Phase 3 Input :5/:1        |
| 19       | Analog Select A          | 55       | Ground Current Common      |
| 20       | Analog Select B          | 56       | Ground Current Input :5/:1 |
| 21       | Analog Select C          | 57       | Trip Relay Common          |
| 22       | Analog Select D          | 58       | Close Relay Contact 2      |
| 23       | Analog In "-"            | 59       | Aux 1 Relay Common         |
| 24       | Analog In "+"            | 60       | Aux 2 Relay Common         |
| 25       | Trip Relay N.C.          | 61       | Aux 3 Relay Common         |
| 26       | Remote Trip "+"          | 62       | Control Voltage GND        |
| 27       | Remote Common "-"        | 63       | Supply Voltage "+"         |
| 28       | Remote Close "+"         | 64       | Supply Voltage "-"         |
| 29       | Block TC N.C.            | 65       | RS485 Port "+"             |
| 30 **    | Aux 4 Relay N.O.         | 66       | RS485 Port "-"             |
| 31 **    | Aux 4 Relay Common       | 67       | MTM/RS485 Shield           |
| 32 **    | Aux 4 Relay N.C.         | 68 **    | MTM RS485 "+"              |
| 33 **    | Access Switch "+"        | 69 **    | MTM RS485 "-"              |
| 34 **    | Access Switch "-"        | 70       | IRIG-B                     |
| 35       | Voltage Input V1         | 71       | Analog Select Common       |
| 36       | Voltage Input V2         | 72       | Ext. Switch Common         |

*575 only*
*575 only*

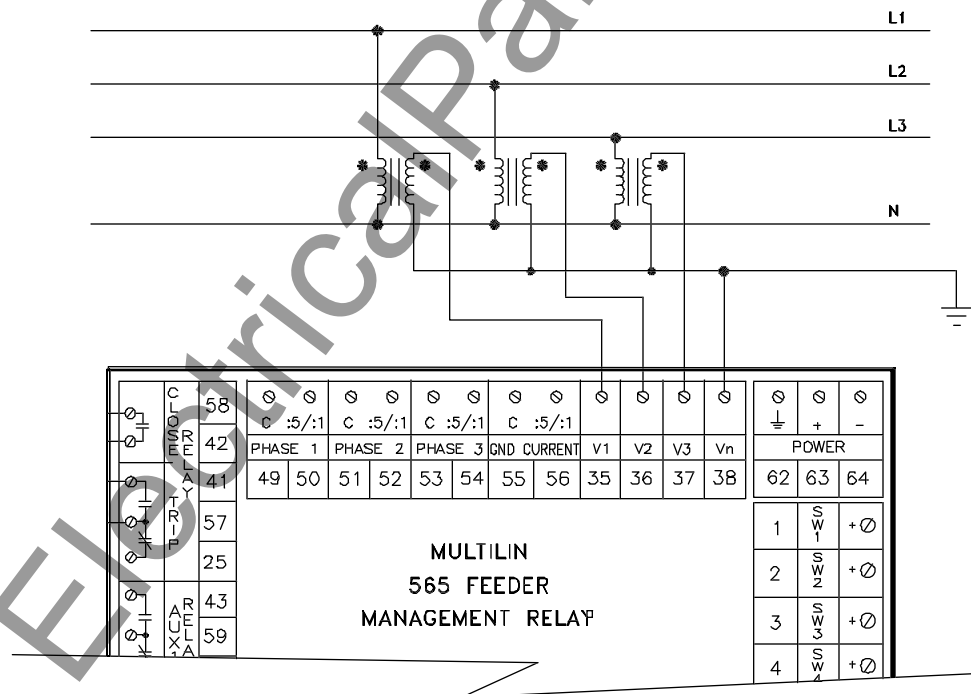
\*\* 565 requires Option Card



2-8



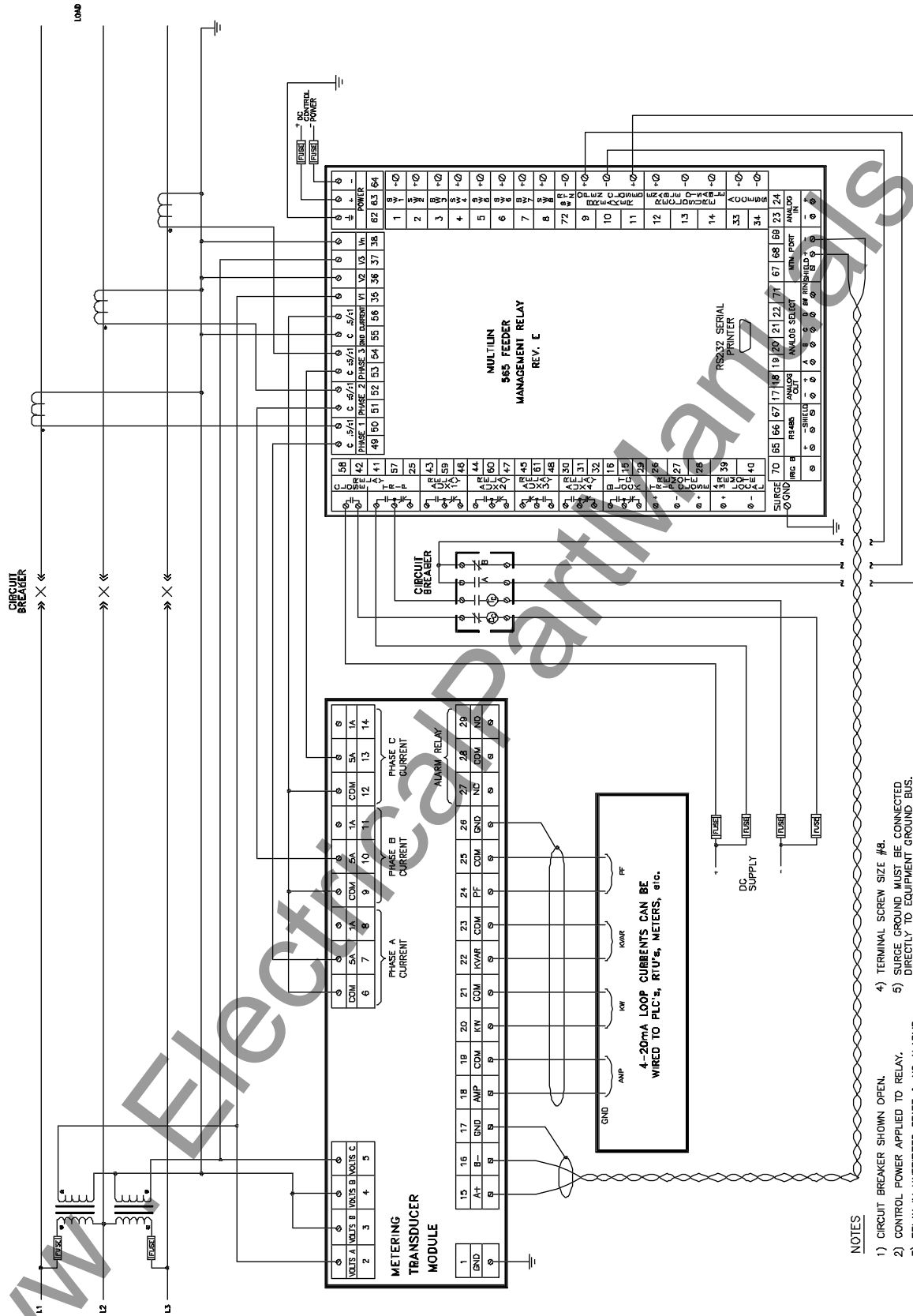
VOLTAGE TRANSFORMER CONNECTIONS – OPEN DELTA SYSTEM



VOLTAGE TRANSFORMER CONNECTIONS – WYE SYSTEM

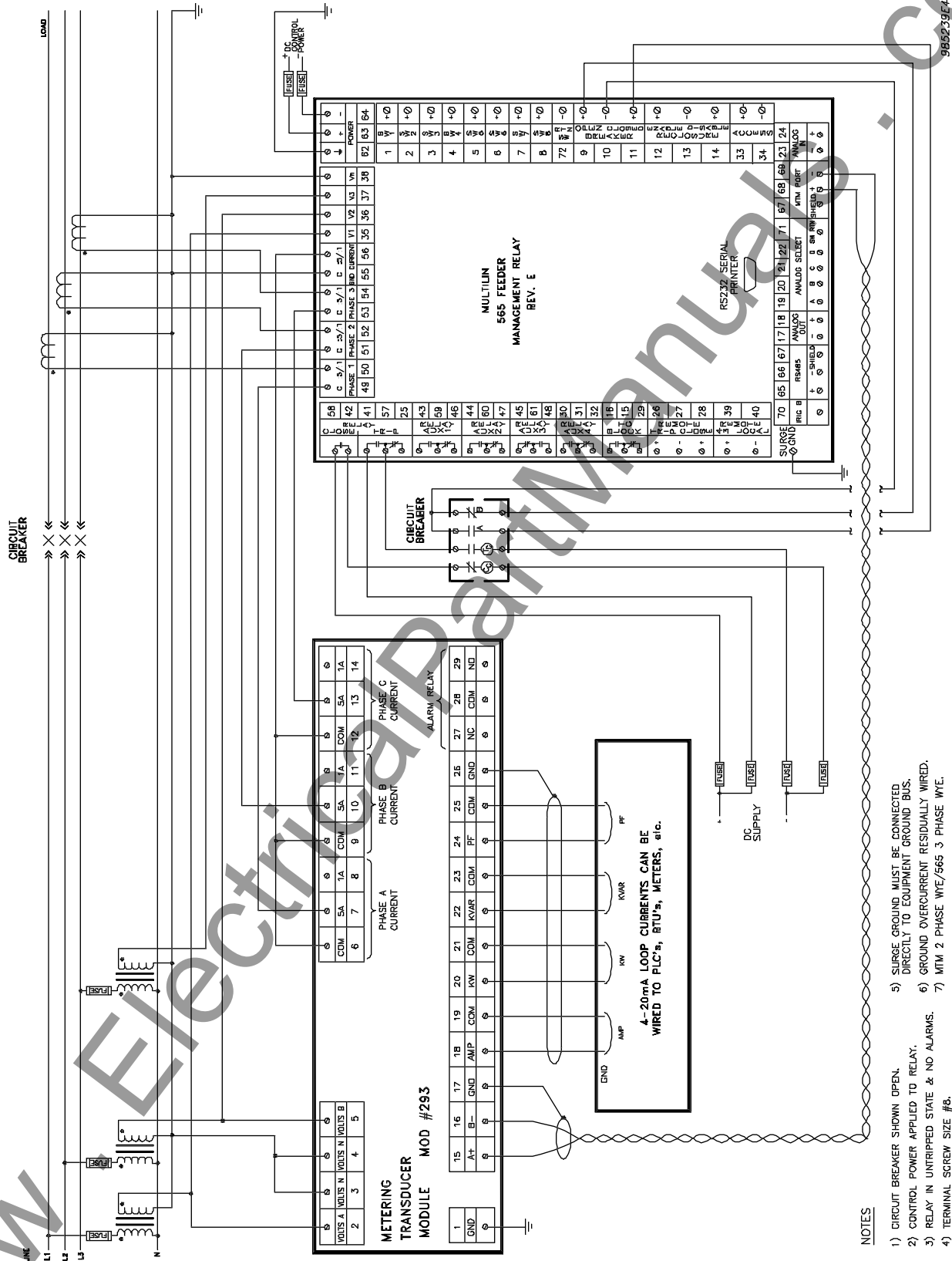
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**Figure 2.6** Voltage Sensing Wire

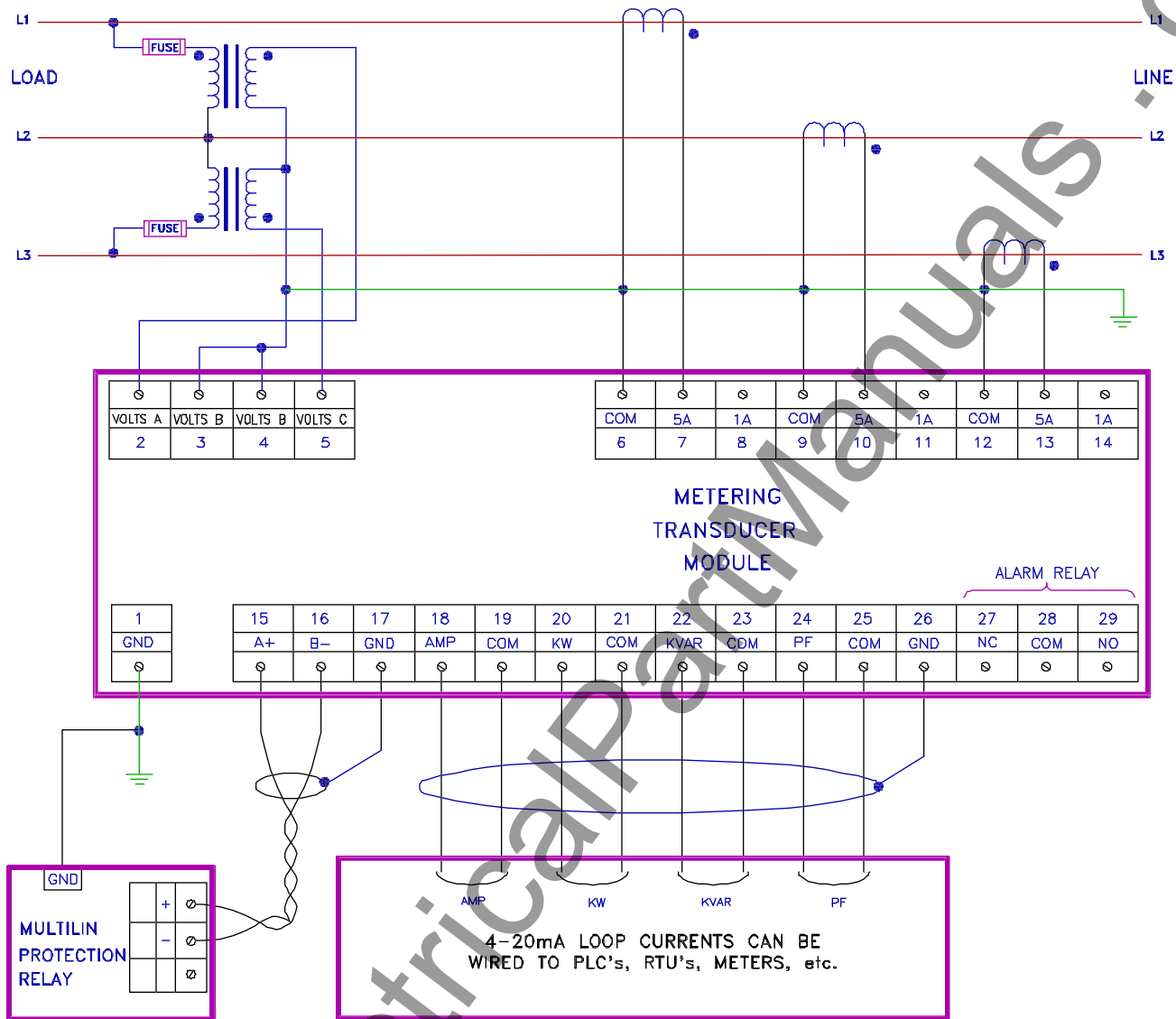


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Figure 2.7A 565 with MTM CT and Open Delta VT Typical Wiring



**Figure 2.7B 565 with MTM CT and Wye VT Typical Wiring**

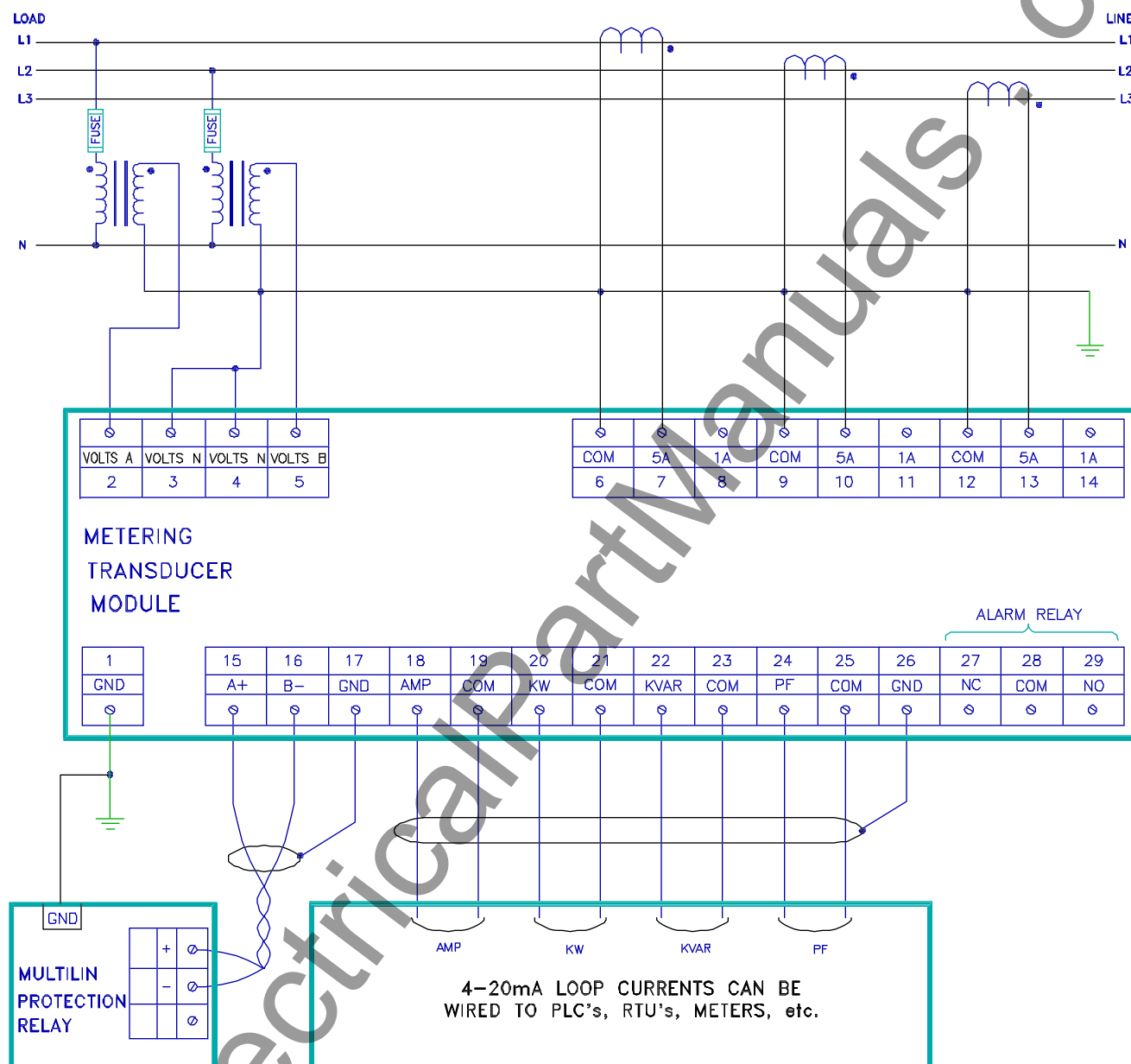


## NOTE:

1. TYPICAL WIRING FOR METERING TRANSFORMERS AND ANALOG OUTPUTS.
2. THE MTM AND PROTECTION RELAY SHOULD BE CONNECTED TO THE SAME GROUNDING TERMINAL.
3. GROUNDING OF CT SECONDARIES SHOULD BE AT ONE LOCATION ONLY.
4. TERMINALS 17 & 26 ARE INTERNALLY GROUND TO TERMINAL 1 AND SHOULD NOT BE EXTERNALLY GROUND.
5. SHIELDED WIRE USED FOR RS485 AND ISOLATED ANALOG OUTPUT CONNECTIONS SHOULD BE GROUND AT ONE END ONLY.
6. MULTILIN PROTECTION RELAY REQUIRES CT CONNECTIONS WHEN USED WITH THE MTM.

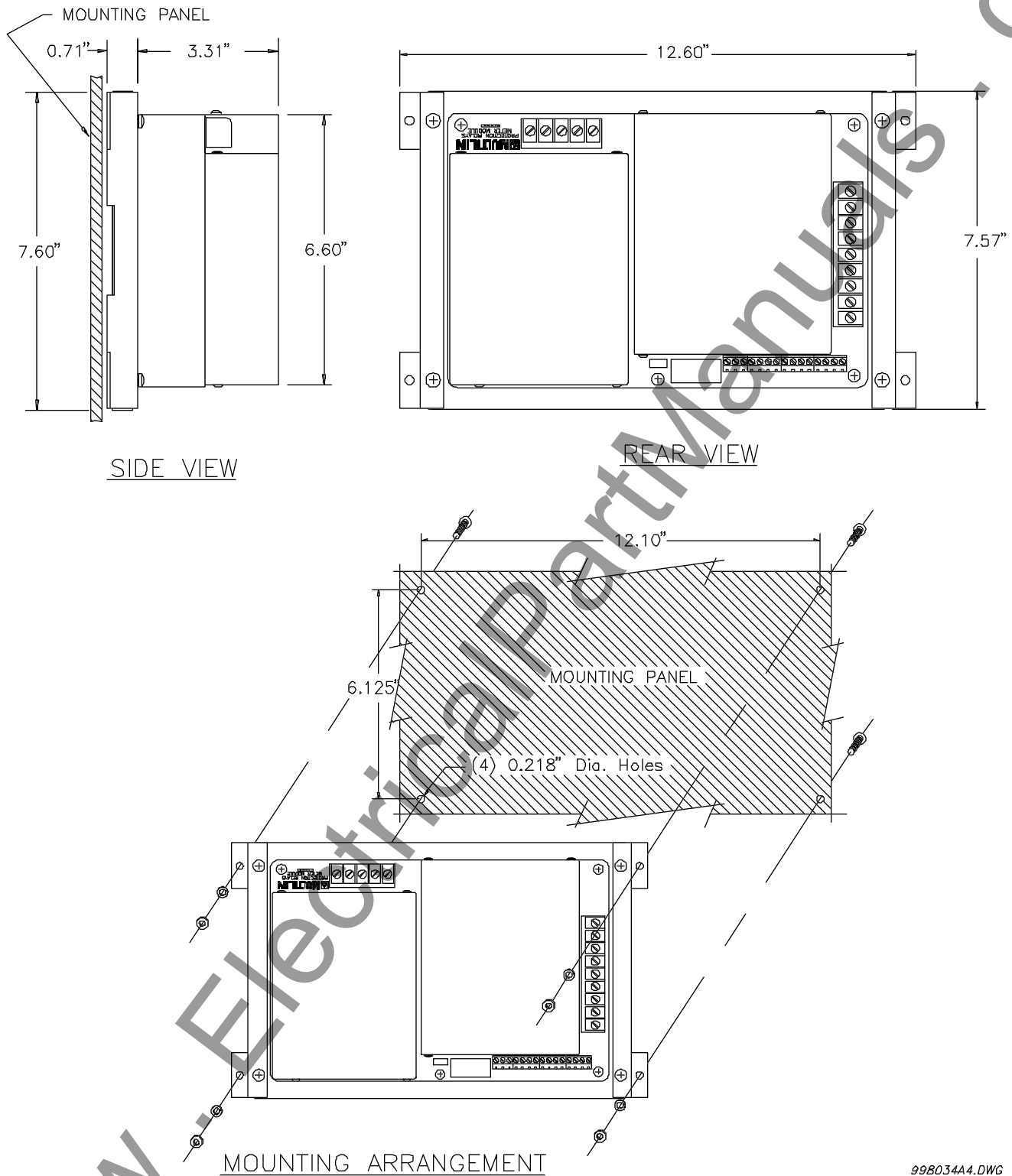
998033A7

**Figure 2.8A** Open Delta VT and CT MTM Typical Wiring



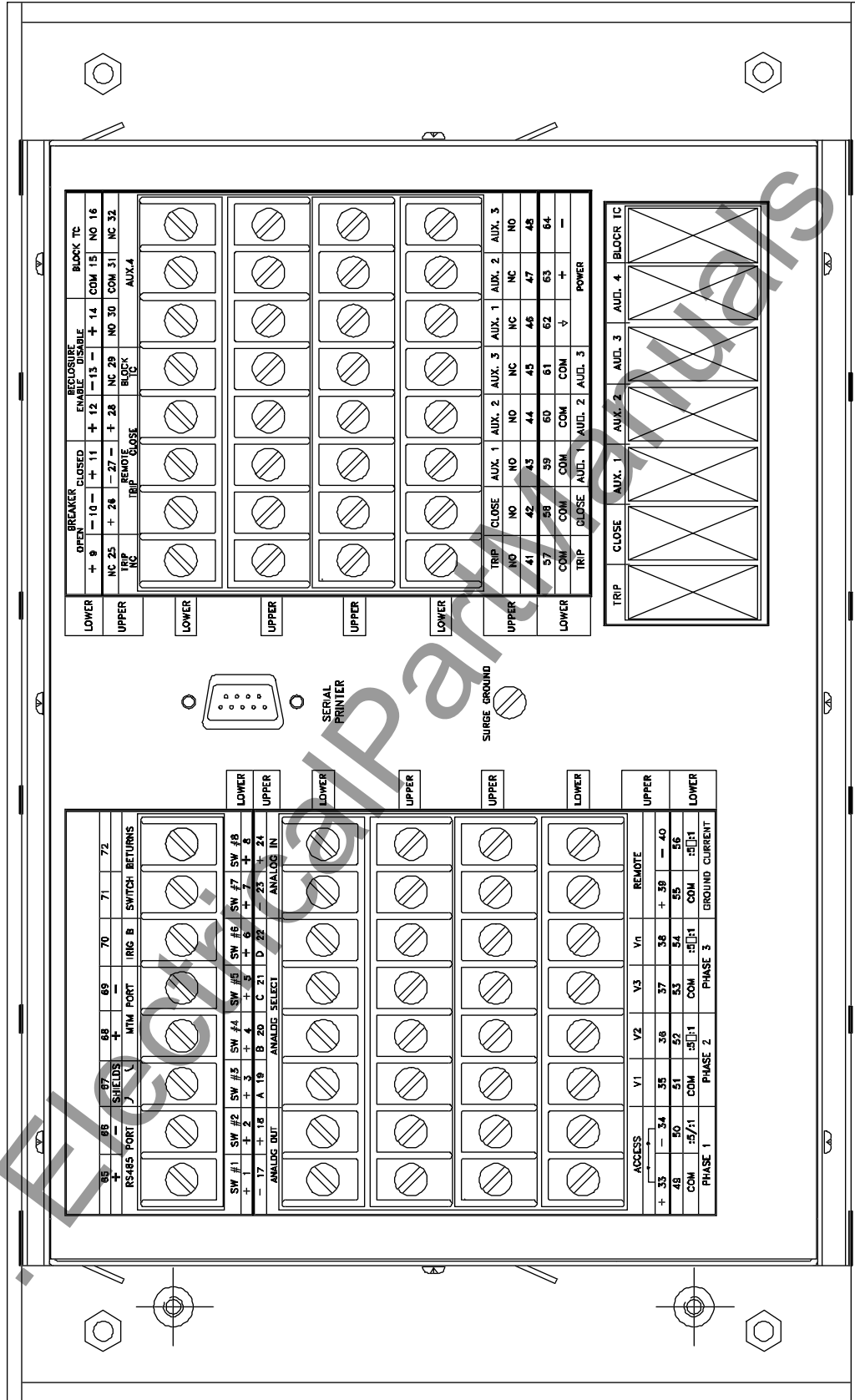
998040A1.DWG

**Figure 2.8B** Wye VT and CT MTM Typical Wiring



998034A4.DWG

**Figure 2.9** MTM Mounting Dimensions



985218E3.DWG

**Figure 2.10** 565 Rear Panel Layout

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Once the electrical connections have been made to the 565/575 Relay and control power is applied, it is ready to be programmed for the particular application. Any key referred to in this section can be located in Figure 4.1, which shows the keypad and front panel. If more information is needed about any key or indicator, refer to the following pages which describe the function and use of these.

## Display Modes

The 565/575 Relay is capable of operating in three modes and the display is used for viewing information, in each of these modes. The modes of operation are:

1. Actual Values mode.
2. Setpoints mode.
3. Help mode.

The information in modes 1 and 2 above is laid out in "book" format, that is, each mode has a number of "pages" containing related information. Each page has "lines" containing a message which can be read from the display. The lines are read by entering the required mode by pressing the ACTUAL VALUES, SETPOINTS, or HELP key and using the LINE UP and LINE DOWN keys to view the lines.

## Actual Values Mode

In actual values mode, any of the parameters monitored by the 565/575 Relay can be viewed by the user. The message lines in each page of this mode are shown and explained in the Actual Values Mode section of this manual.

When this mode is entered, by pressing the ACTUAL VALUES key, the display will show the following message:

**ACTUAL VALUES  
CURRENT**

This is the first line of page one. The remaining lines of page one can be examined by using the LINE DOWN key. When the last line of the page is reached, the PAGE key is used to view the first line of page two. The LINE DOWN key can be used to read each line of the page as before. This can be repeated for all pages in the Actual Values mode. When the last page is reached, pressing the PAGE key will return the display to the first line of page one.

For example, as indicated earlier, the first line of page one shows:

**ACTUAL VALUES  
CURRENT**

If the LINE DOWN key is now pressed, the phase A current

can be read from the following message:

**PHASE A CURRENT  
710 A**

The LINE DOWN key is then pressed again to view the next message and so on to the last message of the page. When the end of the page is reached, the following message will be displayed:

**CURRENT  
END OF PAGE**

The PAGE key can now be pressed to move to the first line of the next page. The display will then show:

**ACTUAL VALUES  
ANALOG INPUT**

The PAGE and LINE keys can now be used to view the remaining lines in the Actual Values mode. Refer to the Actual Values section for an explanation of each message.

If the relay is left in actual values mode and no key is pressed for more than four minutes, the display returns to the default line which is setup in actual values mode. The default display will be the display which is visible during normal daily operation of the 565/575 Relay.

## Setpoints Mode

This mode is used to view and enter the setpoints of the relay. There are several pages of data, each of which contains different information about the relay's configuration, trip and alarm settings. The lines in each page are shown in the Setpoints Mode section of this manual. To place the relay in setpoints mode, press the SETPOINTS key. The following message will appear:

**SETPOINTS  
USER LEVEL**

which is the first line of page one in setpoints mode. The LINE UP and LINE DOWN keys can then be used to view the individual lines in the setpoints mode. For example, if the LINE DOWN key is pressed when the above message is on display, the display changes to:

**USER LEVEL  
ADVANCED**

which is the second line of page one of setpoints. When the end of a page is reached, pressing the LINE DOWN key

## DISPLAY AND KEYBOARD



causes the following display:

USER LEVEL  
END OF PAGE

This message indicates the end of the page and no more lines are available. To move to the first line of the next page, use the PAGE key.

If the relay is left in the setpoints mode with no key being pressed for more than four minutes, the display changes to the default page and line in actual values.

To enter or change setpoints a jumper or access key must first be connected across terminals 33 & 34 and the setpoints mode entered.

If an attempt is made to store a setpoint without enabling the access terminals, the following message will appear:

ILLEGAL ACCESS

and the setpoint will not be stored. This prevents unauthorized changing of setpoints. Stored values remain in the Relay's memory, even when control power is removed. The ability of the relay to provide protection depends on the values entered in the setpoints mode, therefore these values should be complete, accurate and very carefully entered.

Once a setpoint is displayed and the access jumper is installed, it can be changed by either:

1. Entering new numerical values from the Keypad and storing them in the relay's memory using the STORE key, or
2. Making selections from a list of items using the NEXT CHOICE key.

If the selection is to be made using the NEXT CHOICE key then the 565/575 Relay will inform you by flashing the following message on the bottom line of the display:

Use NEXT CHOICE

The possible choices will appear in the display one by one, each time the NEXT CHOICE key is pressed. When the last item in the list is reached pressing the key again will cycle the display through the choices again.

Display the required choice and enter the value into the Relay's memory using the STORE key. The following message will appear for two seconds to indicate that the setpoint has been stored by the Relay.

NEW SETPOINT  
STORED

If the STORE key is not pressed the relay will keep the old setpoint regardless of which choice is displayed.

The LINE DOWN key may now be used to move to the next line of the setpoints page and further values entered as described in the Setpoints Mode section.

When the end of a page in setpoints has been reached the PAGE key can be used to view the setpoints on the next page.

### Help Mode

This display mode should be used whenever help is required in using the 565 relay. It is entered by pressing the HELP key while the display is on any line in any page. The HELP key can provide information about the currently displayed actual value or setpoint message. Pressing the HELP key has no effect when a flash message or HELP message is on the display.

If the HELP key is pressed with the display on the first line of page one the following message will appear:

PRESS ANY KEY  
OR HELP

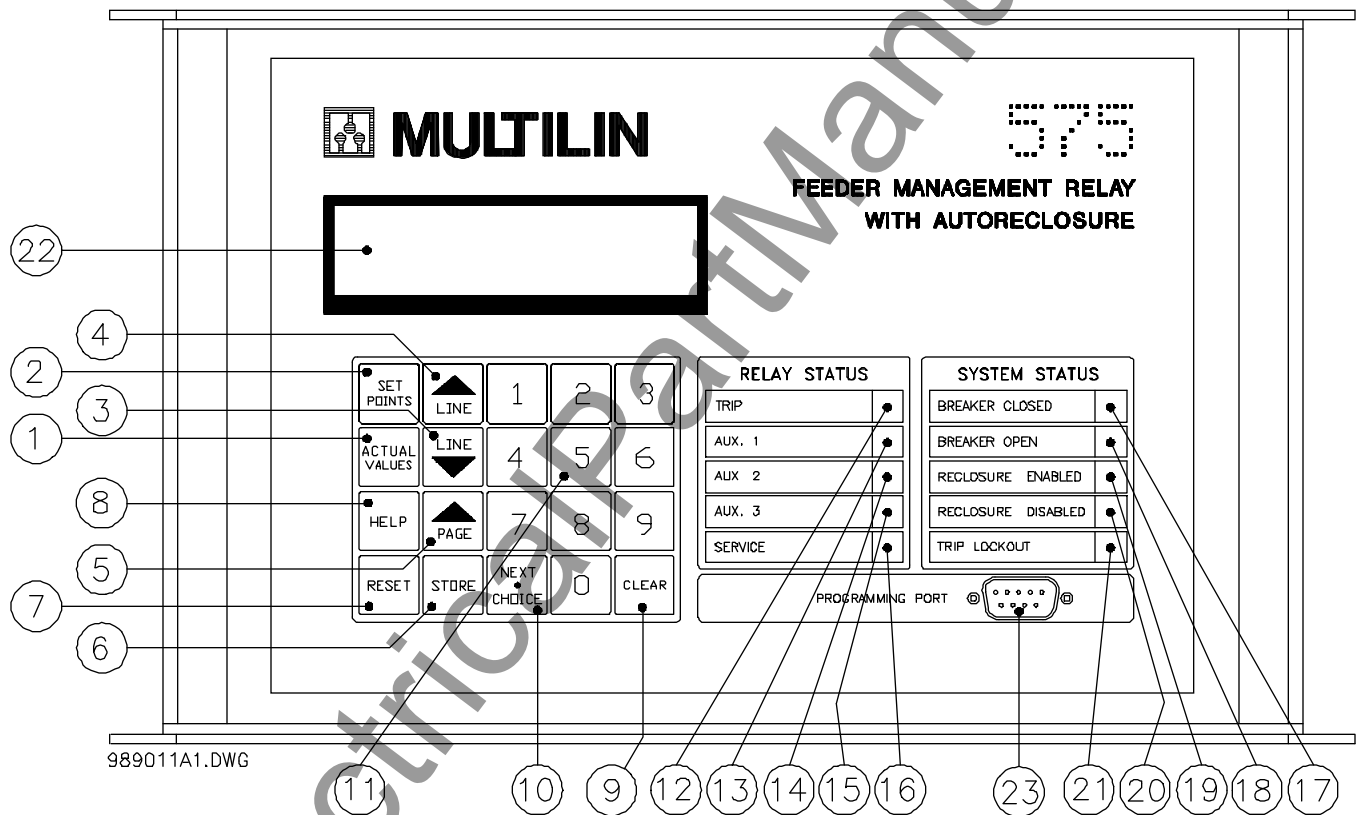
The user should then press the key for which instruction is required or press the HELP key again to access information on the previously displayed actual value or setpoint message. When the desired key is pressed the display will show the message:

PRESS LINE DOWN  
TO SCROLL

The LINE DOWN key can then be used to display the HELP message which will give information about the line or key in question.

If the HELP key is pressed while displaying any line other than a page header the HELP message shown will relate to the line which was displayed when the HELP key was pressed. This applies when the 565/575 Relay is in actual values or setpoints.

Pressing the CLEAR key at any time during the help message will return the display to the page and line of the mode in effect when the HELP key was originally pressed. The ACTUALVALUES and SETPOINTS keys may also be pressed to exit HELP mode.

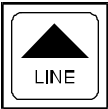
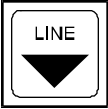


**Figure 4.1** 565 Relay Front Panel

## DISPLAY AND KEYBOARD



This section describes the front panel controls and indications. The "No." column gives the number of each of the keys and indications shown in Figure 4.1. The "Name" column shows the name of the key or indicator in question and the description column gives information about the use of the key or indicator.

| Number | Name                                                                                                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      |                                                                                        | <p>The ACTUAL VALUES key allows the user to examine all the information in the pages of actual values described in the ACTUAL VALUES MODE section. Pressing this key causes the following message to appear, which indicates the first line of page one of the Actual Values mode:</p> <div> <p>ACTUAL VALUES<br/>CURRENT</p> </div>                                                                                                                                                                                                                                                                                                                                           |
| 2      |                                                                                        | <p>The SETPOINTS key allows the user to examine and change all the user-programmable setpoints in the pages of setpoint data as described in the SETPOINTS MODE section. Pressing this key will cause this message to appear, also indicating the first line of page one of the Setpoints mode:</p> <div> <p>SETPOINTS<br/>USER LEVEL</p> </div>                                                                                                                                                                                                                                                                                                                               |
| 3,4    | <br> | <p>These keys allow the user to view the previous or next line of the current page, as indicated by the arrow pointing up or down respectively. If either key is held pressed for more than two seconds then the next or previous lines will be displayed at a fast rate. If the display already shows the last line of any page then pressing the LINE DOWN key will cause the following message to be displayed:</p> <div> <p>END OF PAGE</p> </div>                                                                                                                                                                                                                        |
| 5      |                                                                                      | <p>The PAGE key allows the user to move from any line in a page to the first line in the next page. For example, if you are currently viewing any line in page 2 of the Actual Values mode, pressing this key will cause the display to move to the first line of page 3, Actual Values. If this key is pressed on the last page of either Actual Values or Setpoints then the display will move to the first page of that section. As with the LINE keys, holding down the PAGE key will cause the pages to be displayed rapidly.</p>                                                                                                                                                                                       |
| 6      |                                                                                      | <p>The STORE key is used to store all new setpoints in the 565/575 Relay's memory. When this key is pressed, the value being displayed will be stored as a new setpoint in the relay's memory and the following message will appear for 2 seconds (provided the Access jumper is installed):</p> <div> <p>NEW SETPOINT<br/>STORED</p> </div> <p>The numeric keypad or the NEXT CHOICE keys are used to display the correct value as seen later. The STORE key can only be used to store data within the ranges accepted by the 565/575 Relay. It is also used to set the default display in actual values as described in the Actual Values Mode section of this manual.</p> |
| 7      |                                                                                      | <p>The RESET key returns the trip or any latched output relay to its inactive state and extinguishes the associated LED after a fault condition has caused it to become active. This key will only be effective if the fault condition has been removed. Otherwise, resetting will not be possible and pressing the key will result in one the following messages:</p> <div> <p>RESET IMPOSSIBLE<br/>FAULT PRESENT</p> </div>                                                                                                                                                                                                                                                |

| Number | Name | Description |
|--------|------|-------------|
|--------|------|-------------|

8



RESET IMPOSSIBLE  
ALARM PRESENT

The HELP key provides the user with information on the function and use of each key on the keypad. It also provides information about the currently displayed actual values or setpoints message. If information is needed on the use of any of the keys on the keypad, use the LINE UP or PAGE key to display the first line of any page. Then press the HELP key and the following message will appear:

PRESS ANY KEY  
OR HELP

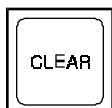
The user should then press the key for which instruction is required, for example, the PAGE key. If information is needed on the previously displayed actual values or setpoints message, press HELP again.

The HELP key can also be pressed on any line of either setpoints or actual values to get information on that particular setpoint or actual value. If this is done the following message will appear:

PRESS LINE DOWN  
TO SCROLL

Pressing LINE DOWN will allow the help message to be viewed. Pressing CLEAR will return the display to the line where help was requested. Continue pressing LINE DOWN to display the entire help message.

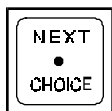
9



The CLEAR key performs two functions.

1. In the setpoints mode, pressing this key will return an altered unstored setpoint to its original value. This might be used if you keyed in an incorrect value and had not yet stored it. Once a value is stored it cannot be altered using the CLEAR key.
2. In the Help mode the key allows the user to return to the previous display mode as described in number 8.

10



This key, which also functions as the decimal point key is used to view a list of items which cannot be shown on the display at once. Pressing the NEXT CHOICE key once will cause the first item from the list to be displayed, pressing it again will display the second item, and so on. When the last item is reached pressing the key will cause the first item to be displayed again. The entire list can thus be viewed as many times as needed. The following example shows the use of the NEXT CHOICE key.

For example, in Setpoints Mode page 3, the ground protection curve is chosen from a list of 5 curves. When this line is first read it will display the curve in use, the Extremely Inverse curve being shown below.

GND O/C CURVE  
SHAPE: EXTREM INV

To advise the user that the NEXT CHOICE key may be used to display other curves, the bottom line of this display will change for two seconds, and the following display will be seen:

## DISPLAY AND KEYBOARD



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| Number | Name | Description |
|--------|------|-------------|
|--------|------|-------------|

GND O/C CURVE  
Use NEXT CHOICE

The display will then return to displaying the Extremely Inverse curve. The other curves can now be viewed one at a time by pressing the NEXT CHOICE key. For example, the Custom Curve will be seen the next time the key is pressed as shown in the following display.

GND O/C CURVE  
SHAPE: CUSTOM

The remaining curves can be viewed in the same way. The display will cycle through all the curves as the key is pressed. Note that the curve in use by the 565/575 Relay will not be changed by displaying the various choices. To change the curve in use, it must be displayed and stored. See the STORE key description.

|    |  |                                                                                                                                                                                                                                                                                                                                                    |
|----|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 |  | The Numeric keypad has the numbers 0 to 9 and the decimal point. These keys are used to enter the numerical values of the various setpoints with or without a decimal. The decimal point key also functions as the NEXT CHOICE key. In this case it is used to display one choice at a time from a list of items. See NEXT CHOICE key description. |
|----|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 |  | The Trip LED indicates the state of the trip output relay which is used to trip the Feeder Breaker monitored by the 565/575 Relay. When the LED is on, the Trip relay is active with the cause of the trip condition shown on the LCD display. A flashing LED indicates that the relay was active, and has returned to its inactive state. This can occur when the fault condition disappears and the relay is programmed as pulsed. The LED will be extinguished by pressing the RESET key only if the fault condition causing the relay to be activated has been removed. |
|----|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13 |  | The Aux 1 LED indicates the state of the output relay, Aux 1, which can be used for a function chosen by the user. When the LED is on, the relay is active. If pulsed or unlatched operation is chosen for this relay, the LED will flash if a trip condition is removed or will be extinguished when the condition causing an alarm is removed. If latched operation is chosen the RESET key must be pressed to return the relay to its no fault state and extinguish the LED indicator. |
|----|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14 |  | The Aux 2 LED indicates the state of the output relay, Aux 2, which can be used for a function chosen by the user. When the LED is on, the relay is active. If pulsed or unlatched operation is chosen for this relay, the LED will flash if a trip condition is removed or will be extinguished when the condition causing an alarm is removed. If latched operation is chosen the RESET key must be pressed to return the relay to its no fault state and extinguish the LED indicator. |
|----|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                                     |
|----|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 |  | The Aux.3 LED indicates the state of the output relay, Aux.3. When the LED is on, as during a trip coil supervision alarm, the Aux 3 relay is inactive (cold coil). |
|----|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                                                                            |
|----|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16 |  | If the Service LED illuminates steadily, the supply voltage may be too low. This LED may come on momentarily when the 565/575 Relay is powered up. This is normal and does not indicate a fault condition. |
|----|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                        |
|----|--|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17 |  | The Breaker Closed LED indicates the status of the Feeder Breaker being monitored by the 565/575 Relay. The LED is on if the Feeder Breaker is closed. |
|----|--|--------------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                    |
|----|--|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 18 |  | The Breaker Open LED indicates the status of the Feeder Breaker being monitored by the 565/575 Relay. The LED is on if the Feeder Breaker is open. |
|----|--|----------------------------------------------------------------------------------------------------------------------------------------------------|

|    |  |                                                                                                                                                                                                        |
|----|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19 |  | RS232 program port. This port allows for programming from a personal computer. When a cable is connected to this port and the DTR line is pulled high, the rear RS485 communications port is disabled. |
|----|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Number | Name                                                                              | Description                                                                                                                                                                                                                     |
|--------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20     |  | The display is a 32 character alphanumeric type. This display visually shows in English all values, setpoints, and messages, through a series of lines within the pages of 3 display modes: Actual Values, Setpoints, and Help. |

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All the messages displayed by the 565/575 Relay in the actual values mode are listed and explained in this section. As already seen, the messages are laid out in book form with pages containing lines, each of which displays one message. The 565/575 Relay has two user levels, "basic" and "advanced". The messages seen depend on this user level, which is chosen in page one of setpoints. The basic level allows the user to operate the relay using the minimum of the features necessary. The advanced level allows the user to use all the 565/575 Relay features.

The advanced user sees all the messages shown. The messages which will only be seen by the advanced user and not the basic user are marked "L<sub>A</sub>", for "Level-advanced".

The actual value mode has pages with the following information:

## Page Contents

1. Current data.
2. Analog Input data.
3. Maintenance data.
4. Operations data.
5. Pretrip data.
6. Voltage and Frequency related data.
7. Event-Recording data.
8. Amps Demand Metering data.
9. MTM Metering data.

The numbers in the "Location" column to the left of each message in this section give the page and line of that message in the 565/575 Relay's memory. For example, the message to the right of A 1.3 in the "Location" column will appear on page 1 and line 3 when the Relay is in actual values Mode and is referred to as "message A 1.3". If the letters "L<sub>A</sub>" appear below a message in this column, this indicates that the message will only appear if the advanced user level is selected. The message will not appear if the basic user level is selected.

The "Message Line" column shows the actual message which can be read from the LCD display on the front panel of the unit.

Quantities shown in display boxes are typical values only. Different quantities will be displayed in each particular application.

Note: When finished viewing a message, press the LINE DOWN key to view the next line. When the last line of a page is reached, press the PAGE key to view the first line of the next page.

When the last line of the last page in actual values is reached, pressing the PAGE key will return the display to the first page again.

## Default Message Selection

The default message is the message which will be displayed by the Relay under normal operating conditions. The display will show the selected message if no key on the keypad is pressed for more than four minutes and no alarm or trip condition is present. Any message in actual values except page headers, end of page markers, and messages A 3.2, A 3.7, A 4.9, A 7.4, A 7.9, A 7.10, A 8.6, A 8.10 and A 8.14 may be selected as the default message. The above messages cannot be used as their function is to allow data to be entered into the Relay. To select any other message as the default message, proceed as follows:

Use the PAGE key to select the page on which the required message is located, in actual values, and use the LINE DOWN key to display the message. Pressing the STORE key will cause the following message to be displayed:

NEW DEFAULT  
LINE SELECTED

The message selected is now the new default message.

## Actual Values Message Abbreviations.

The following abbreviations are used in the actual values messages:

|       |                             |
|-------|-----------------------------|
| A     | Amperes.                    |
| AC    | Access.                     |
| BRKR  | Breaker.                    |
| CL'D  | Cleared.                    |
| DEG C | Degrees Celsius.            |
| DEM'D | Demand.                     |
| Hz    | Hertz.                      |
| INS   | Installed.                  |
| INST  | Instantaneous.              |
| KA    | Kiloamps.                   |
| kVAR  | Kilovars.                   |
| kV    | Kilovolts.                  |
| kW    | Kilowatts.                  |
| MTM   | Metering Transducer Module. |
| MWHR  | Megawatt Hours.             |
| No.   | Number.                     |
| O/C   | Overcurrent.                |
| PH    | Phase.                      |
| TEMP  | Temperature.                |
| TRANS | Transformer.                |
| WNDG  | Winding.                    |

## ACTUAL VALUES MODE



### Summary of Actual Value Page Contents

| Page | Contents                                                                                                                                                                                                                            | Page | Contents                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------|
| 1.   | Current Data.<br><br>Phase currents<br>Ground currents                                                                                                                                                                              | 8.   | Demand Metering Data.<br><br>Peak demand amps<br>Peak KW demand<br>Peak KVAR demand |
| 2.   | Analog Input Data.<br><br>Analog input scaled values                                                                                                                                                                                | 9.   | Metering Data.<br><br>Power factor<br>MTM frequency<br>kW<br>kVAR<br>MWhrs          |
| 3.   | Maintenance Data.<br><br>Breaker date<br>Breaker trips<br>Accumulated KA                                                                                                                                                            |      |                                                                                     |
| 4.   | Operations Data.<br><br>Timed phase overcurrent trips<br>Instantaneous phase overcurrent trips<br>Timed ground overcurrent trips<br>Inst. ground overcurrent trips<br>Overvoltage trips<br>Undervoltage trips<br>Analog input trips |      |                                                                                     |
| 5.   | Pretrip Data.<br><br>Cause of present alarm<br>Cause of last trip<br>Phase trip current<br>Ground trip current<br>Phase trip voltage<br>Frequency at trip<br>Date of trip<br>Time of trip                                           |      |                                                                                     |
| 6.   | Voltage Data.<br><br>Phase voltage<br>Frequency of feeder                                                                                                                                                                           |      |                                                                                     |
| 7.   | Event Recording Data.<br><br>No. of events<br>View events<br>Events<br>Print events<br>Clear events                                                                                                                                 |      |                                                                                     |

| Location                                                                               | Message Line                                                   | Description                                                                                                                            |
|----------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| A 1.1                                                                                  | <div>ACTUAL VALUES<br/>CURRENT</div>                           | The actual values page 1 header. This page gives information on the feeder phase and ground currents being monitored by the 565 Relay. |
| A 1.2                                                                                  | <div>PHASE A CURRENT<br/>710 A</div>                           | This is the actual monitored RMS current flowing in phase A of the feeder.                                                             |
| A 1.3                                                                                  | <div>PHASE B CURRENT<br/>715 A</div>                           | This is the actual monitored RMS current flowing in phase B of the feeder..                                                            |
| A 1.4                                                                                  | <div>PHASE C CURRENT<br/>710 A</div>                           | This is the actual monitored RMS current flowing in phase C of the feeder.                                                             |
| <i>Message A 1.5 will only appear if Ground Sensing has been enabled in setpoints.</i> |                                                                |                                                                                                                                        |
| A 1.5                                                                                  | <div>GROUND CURRENT<br/>10 A</div>                             | This is the actual leakage current flowing to ground in the system.                                                                    |
| A 1.6                                                                                  | <div>PHASES      A= 710<br/>B= 715      C= 710</div>           | This message allows all three phase currents to be displayed if they are greater than 2% CT.                                           |
|                                                                                        | <div>PHASES      A&lt;2% CT<br/>B&lt;2% CT    C&lt;2% CT</div> | When the breaker is closed and the current is less than 2% of CT, the three phase display will reflect this with "<2% CT".             |
| A 1.7                                                                                  | <div>CURRENT<br/>END OF PAGE</div>                             | The last line of page 1, actual values. Press the PAGE key to view page 2.                                                             |

## ACTUAL VALUES MODE - ANALOG INPUT



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| Location                                                                           | Message Line                              | Description                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 2.1                                                                              | <div>ACTUAL VALUES<br/>ANALOG INPUT</div> | The actual values page 2 header. The 565/575 Relay can accept an analog signal from 4 to 20 mA from any device such as a temperature monitor, and provide trip or alarm signals at a user programmed value. The value of this temperature, for example, is displayed in this page in whatever units you select in the setpoints mode. Degrees Celsius are shown. |
| <i>Message A 2.2 will only appear if Analog-In has been disabled in setpoints.</i> |                                           |                                                                                                                                                                                                                                                                                                                                                                  |
| A 2.2                                                                              | <div>ANALOG INPUT<br/>DISABLED</div>      | If Analog-In has been disabled in setpoints, this will be the only message displayed.                                                                                                                                                                                                                                                                            |
| <i>Message A 2.3 will only appear if Analog In has been enabled in setpoints.</i>  |                                           |                                                                                                                                                                                                                                                                                                                                                                  |
| A 2.3<br>L <sub>A</sub>                                                            | <div>TRANS WNDG TEMP<br/>87 DEG C</div>   | This is the present value of the analog signal being monitored by the Relay, if this option is used. In this example, the temperature of a transformer winding is being monitored and degrees Celsius units have been chosen. Other names and units can be selected, in setpoints mode.                                                                          |
| A 2.4                                                                              | <div>ANALOG INPUT<br/>END OF PAGE</div>   | The last line of page 2. Press the PAGE key to view page 3.                                                                                                                                                                                                                                                                                                      |

| Location                | Message Line                                             | Description                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 3.1                   | <div>ACTUAL VALUES<br/>MAINTENANCE DATA</div>            | The actual values page 3 header. This page allows the maintenance related data, which the Relay has collected, to be viewed. This data remains in memory even if the control power is removed from the Relay. Information on the number of breaker trips and accumulated breaker trip current is stored on this page for use in scheduling breaker maintenance. |
| A 3.2                   | <div>BRKR           mm/dd/yy<br/>DATE AUG 23, 1988</div> | <p>The new breaker in service date is entered here in the form:</p> <p>Month:Day:Year.</p> <p>For example, if August 04, 1992 was the date then the following would be entered:</p> <p>08:04:92</p>                                                                                                                                                             |
| A 3.3<br>L <sub>A</sub> | <div>BREAKER TRIPS<br/>79</div>                          | This is the total number of times that the feeder circuit breaker controlled by the Relay has been tripped since the breaker was put in service. The maximum number of trips displayable is 10000. If the maximum number of trips exceeds 10000, *** will be displayed. This figure may be useful for scheduling mechanical inspections of the breaker.         |
| A 3.4                   | <div>ACCUMULATED KA<br/>PHASE A   566</div>              | This is the square of the Kiloamps feeder current measured right at the time that the breaker delay rating has elapsed and the breaker is open. This measurement is made at each trip of the breaker and added to the previous accumulated value. This accumulated value gives an indication of breaker pole wear and can be used to schedule inspections.      |
| A 3.5                   | <div>ACCUMULATED KA<br/>PHASE B   568</div>              | This is the accumulated sum of the Kiloamps squared phase B current.                                                                                                                                                                                                                                                                                            |
| A 3.6                   | <div>ACCUMULATED KA<br/>PHASE C   765</div>              | This is the accumulated sum of the Kiloamps squared phase C current.                                                                                                                                                                                                                                                                                            |
| A 3.7                   | <div>MAINTENANCE DATA<br/>CLEAR?           NO</div>      | This message asks if you want to clear the maintenance data which has been collected to date. Use the NEXT CHOICE key to display YES or NO and then store the value.                                                                                                                                                                                            |
| A 3.8                   | <div>DATA CLEARED<br/>LAST:AUG 04, 1992</div>            | This is the date on which the maintenance data was last cleared in message A 3.7. This date is automatically entered by the Relay, when the data is cleared. All the maintenance data in this page has been collected from the date shown here.                                                                                                                 |
| A 3.9                   | <div>MAINTENANCE DATA<br/>END OF PAGE</div>              | The last line of page 3, actual values. Press the PAGE key to view page 4.                                                                                                                                                                                                                                                                                      |

## ACTUAL VALUES MODE - OPERATIONS DATA



| Location                                                                                                 | Message Line                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 4.1                                                                                                    | ACTUAL VALUES<br>OPERATIONS DATA   | The actual values page 4 header. This page allows the feeder operation related data, which the Relay has collected, to be viewed. Information on the number and types of trips issued by the Relay can be viewed in this page. This data remains in memory even if the control power is removed from the 565/575 Relay. The maximum number of trips which can be displayed is 10,000. If the maximum number of trips exceeds 10,000, *** will be displayed. |
| A 4.2                                                                                                    | TIMED PHASE O/C<br>TRIPS 23        | This is the number of times that the feeder breaker controlled by the 565/575 Relay has been tripped due to the current flowing through it exceeding the timed phase overcurrent level set up in the setpoints mode.                                                                                                                                                                                                                                        |
| A 4.3                                                                                                    | INST PHASE O/C<br>TRIPS 5          | This is the number of times that the feeder breaker has been tripped by the Relay due to the current in the three phase system exceeding the phase instantaneous limits set up in the setpoints mode.                                                                                                                                                                                                                                                       |
| A 4.4                                                                                                    | TIMED GROUND O/C<br>TRIPS 45       | This is the number of times that the feeder breaker has been tripped by the Relay due to ground current in the three phase system exceeding the programmed level set up in the setpoints mode.                                                                                                                                                                                                                                                              |
| A 4.5                                                                                                    | INST GROUND O/C<br>TRIPS 6         | This is the number of times that the feeder breaker has been tripped by the 565 Relay due to the ground current exceeding the instantaneous limits set up in the setpoints mode.                                                                                                                                                                                                                                                                            |
| <i>Messages A 4.6 and A 4.7 will only be shown if the Voltage feature has been enabled in Setpoints.</i> |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| A 4.6                                                                                                    | OVERVOLTAGE<br>TRIPS 3             | This is the number of times that the feeder breaker has been tripped by the Relay due to an overvoltage exceeding the programmed level set up in setpoints mode.                                                                                                                                                                                                                                                                                            |
| A 4.7                                                                                                    | UNDERVOLTAGE<br>TRIPS 3            | This is the number of times that the feeder breaker has been tripped by the Relay due to an undervoltage exceeding the programmed level set up in setpoints mode.                                                                                                                                                                                                                                                                                           |
| A 4.8                                                                                                    | ANALOG INPUT<br>TRIPS 3            | This is the number of times that the feeder breaker has been tripped by the Relay due to analog input exceeding the programmed level set up in setpoints mode.                                                                                                                                                                                                                                                                                              |
| A 4.9                                                                                                    | CLEAR OPERATIONS<br>DATA? NO       | This message allows the user to clear the data in messages A 4.2 to 4.8. To clear the data use the NEXT CHOICE key to select YES and then press the STORE key. YES should only be selected if you are prepared to lose the old data. The new data will be collected from the date that the clearing was done. Select NO to continue using the old data.                                                                                                     |
| A 4.10                                                                                                   | DATA CLEARED<br>LAST: AUG 04, 1992 | This is the date when the operations data was last cleared in message A 4.9. This date is automatically entered by the Relay when the data is cleared. This message can be referred to at any time to check the date that the present data collecting originated.                                                                                                                                                                                           |
| A 4.11                                                                                                   | OPERATIONS DATA<br>END OF PAGE     | The last line of page 4, actual values. Press the PAGE key to view page 5.                                                                                                                                                                                                                                                                                                                                                                                  |

| Location | Message Line                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 5.1    | ACTUAL VALUES<br>PRE-TRIP DATA | The actual values page 5 header. This page displays the cause of the current alarm and the cause of the last trip. It also gives data on the condition of the feeder when a trip was last initiated by the 565/575 Relay. This page can be viewed immediately after an alarm or trip to determine its cause. Also, if an overcurrent trip has occurred, then the phase currents can be inspected to check which phase or phases caused this. |
| A 5.2    | ALARM: PHASE O/C               | This message will only appear if the condition causing the alarm is present. In this case the current in any or all of the phases is exceeding the phase alarm limit set up in setpoints mode.                                                                                                                                                                                                                                               |
|          | ALARM: GROUND<br>O/C           | This message indicates that the present alarm is caused by the ground current exceeding the limits specified in setpoints mode.                                                                                                                                                                                                                                                                                                              |
|          | ALARM: OVERVOLT                | This message indicates that the present alarm is caused by the voltage sensed between phases or between a phase and the neutral line rose above the limits specified in setpoints mode.                                                                                                                                                                                                                                                      |
|          | ALARM: UNDERVOLT               | This message indicates that the present alarm is caused by the voltage sensed between phases or between a phase and the neutral line dropped below the limits specified in setpoints mode.                                                                                                                                                                                                                                                   |
|          | ALARM: ANALOG<br>INPUT         | This message indicates that the present alarm is caused by the analog input exceeding the limits specified in setpoints mode.                                                                                                                                                                                                                                                                                                                |
|          | ALARM:<br>ACCUMULATED KA       | This message indicates that the present alarm is caused by the Accumulated KA exceeding the limits specified in setpoints mode.                                                                                                                                                                                                                                                                                                              |
|          | SWITCH ALARM 1                 | This message indicates that the present alarm is caused by the external switch programmed to create a Definite Time alarm.                                                                                                                                                                                                                                                                                                                   |
|          | ALARM: AMPS<br>DEMAND          | This message indicates that the present alarm is caused by the Amps Demand exceeding the limits specified in setpoints mode.                                                                                                                                                                                                                                                                                                                 |
|          | ALARM: KW DEMAND               | This message indicates that the present alarm is caused by the kW Demand exceeding the limits specified in setpoints mode. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                                                                                             |
|          | ALARM: KVAR<br>DEMAND          | This message indicates that the present alarm is caused by the kVAR Demand exceeding the limits specified in setpoints mode. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                                                                                           |
|          | ALARM: POWER<br>FACTOR         | This message indicates that the present alarm is caused by the MTM Power Factor exceeding the limits specified in setpoints mode. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                                                                                      |
|          | ALARM: FREQUENCY               | This message indicates that the present alarm is caused by the MTM Frequency exceeding the limits specified in setpoints mode. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                                                                                         |
|          | ALARM: BREAKER<br>DISCREPANCY  | This message indicates that the present alarm is caused by the feeder breaker not responding within the time limit specified in setpoints mode.                                                                                                                                                                                                                                                                                              |

## ACTUAL VALUES MODE - PRE-TRIP DATA



| Location | Message Line                    | Description                                                                                                                                                                                                                                                                                                                                                         |
|----------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | ALARM: TRIP COIL                | This message indicates that the present alarm is caused by an open in the trip coil circuit. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                                                  |
|          | ALARM: MTM COMM                 | This message indicates that the present alarm is caused by failure in MTM communications. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                                                     |
| A 5.3    | CAUSE OF LAST TRIP:             | This message appears on the display for 2 seconds to advise the user that the cause of the last trip will be displayed next. It will then disappear to be replaced by the next message which will give the reason for the last trip of the feeder breaker. One of the following messages will then be displayed.                                                    |
| A 5.4    | TIME OVERCURRENT<br>PHASE A B C | This message indicates that the feeder breaker trip was caused by the current in any or all of the phases A, B or C of the feeder exceeding the phase time/overcurrent limits programmed in the setpoints mode. Phases A, B and C are shown here.                                                                                                                   |
|          | TIME OVERCURRENT<br>GROUND      | This message indicates that the trip was caused by the ground current sensed by the 565 Relay exceeding the limits set by the timed/overcurrent curve which was programmed in the setpoints mode.                                                                                                                                                                   |
|          | INST OVERCURRENT<br>PHASE B     | This message indicates that the trip was caused by the current in any or all of the phases A, B or C exceeding the instantaneous limit set up in setpoints mode. Phase B is shown here.                                                                                                                                                                             |
|          | INST OVERCURRENT<br>GROUND      | This message indicates that the feeder breaker was tripped due to the ground current exceeding the instantaneous setpoint entered in setpoints mode.                                                                                                                                                                                                                |
|          | UNDERVOLTAGE<br>FAULT           | This message indicates that the voltage sensed between phases or between a phase and the neutral line dropped below the undervoltage limits set in setpoints mode, causing a feeder breaker trip.                                                                                                                                                                   |
|          | OVERVOLTAGE<br>FAULT            | This message indicates that the voltage sensed between phases or between a phase and the neutral line rose above the overvoltage limits set in setpoints mode, causing a feeder breaker trip.                                                                                                                                                                       |
|          | EXTERNAL TRIP #1<br>SWITCH 3    | This message indicates which of four external trips, indicated by the switch named, caused the breaker to trip. There are eight user programmable switches named SW.1 to SW.8. Each of these may be assigned to one external trip.                                                                                                                                  |
|          | ANALOG INPUT<br>TRANS WNDG TEMP | This display indicates that the trip was caused by the analog input to the 565 Relay exceeding the limits specified in setpoints mode. If a name was assigned to this analog input in setpoints mode, then this name will appear in the message. A typical user-assigned name, "TRANS WNDG TEMP" indicating a transformer winding temperature is shown for example. |
|          | POWER FACTOR<br>FAULT           | This message indicates that the trip was caused by the MTM power factor exceeding the limits specified in the setpoints mode. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                 |
|          | FREQUENCY<br>FAULT              | This message indicates that the trip was caused by the MTM frequency exceeding the limits specified in the setpoints mode. <b>** 565 requires Option Card **</b>                                                                                                                                                                                                    |

| Location | Message Line                        | Description                                                                                                                                                  |
|----------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 5.5    | PHASE A PRE-TRIP<br>CURRENT 16100 A | This is the RMS current flowing in phase A measured over one cycle of feeder current, at the time that the 565/575 Relay initiated the breaker trip.         |
| A 5.6    | PHASE B PRE-TRIP<br>CURRENT 15900 A | This is the RMS current flowing in phase B measured over one cycle of feeder current, at the time that the 565/575 Relay initiated the breaker trip.         |
| A 5.7    | PHASE C PRE-TRIP<br>CURRENT 16200 A | This is the RMS current flowing in phase C measured over one cycle of feeder current, at the time that the 565/575 Relay initiated the breaker trip.         |
| A 5.8    | GROUND PRE-TRIP<br>CURRENT 250 A    | This is the RMS ground current sensed by the Relay measured over one cycle of feeder current, at the time when the 565/575 Relay initiated the breaker trip. |

Messages A 5.9 to 5.11 will only appear if an Open Delta system is chosen in Setpoints mode.

|        |                                  |                                                                                                                            |
|--------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| A 5.9  | PRE-TRIP VOLTAGE<br>A-B 13.80 kV | This is the voltage between phases A and B when the 565 Relay caused the feeder breaker to trip due to a system fault.     |
| A 5.10 | PRE-TRIP VOLTAGE<br>B-C 13.80 kV | This is the voltage between phases B and C when the 565/575 Relay caused the feeder breaker to trip due to a system fault. |
| A 5.11 | PRE-TRIP VOLTAGE<br>C-A 13.80 kV | This is the voltage between phases C and A when the 565/575 Relay caused the feeder breaker to trip due to a system fault. |

Messages A 5.12 to 5.14 will only appear if a Wye system is chosen in Setpoints mode.

|                          |                                 |                                                                                                                                                                                                                                |
|--------------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 5.12                   | PRE-TRIP VOLTAGE<br>A-N 7.85 kV | This is the voltage between phase A and the neutral line when the 565/575 Relay caused the feeder breaker to trip due to a system fault.                                                                                       |
| A 5.13                   | PRE-TRIP VOLTAGE<br>B-N 7.85 kV | This is the voltage between phase B and the neutral line when the 565/575 Relay caused the feeder breaker to trip due to a system fault.                                                                                       |
| A 5.14                   | PRE-TRIP VOLTAGE<br>C-N 7.85 kV | This is the voltage between phase C and the neutral line when the 565/575 Relay caused the feeder breaker to trip due to a system fault.                                                                                       |
| A 5.15<br>L <sub>A</sub> | FREQUENCY AT<br>TRIP 60.2 Hz    | This is the feeder frequency, measured in Hz, at the time when the 565/575 Relay caused the breaker to trip. If an MTM is communicating with the 565/575 at the time of the trip, the frequency recorded will be from the MTM. |

|        |                              |                                                                                                                                          |
|--------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| A 5.16 | DATE OF TRIP<br>AUG 04, 1992 | This is the date when the 565/575 Relay last tripped the feeder breaker due to a system fault.                                           |
| A 5.17 | TIME OF TRIP<br>14:20:42     | This is the time when the 565/575 Relay last tripped the feeder breaker. It is laid out in the following form:<br><br>Hour:Minute:Second |

## ACTUAL VALUES MODE - PRE-TRIP DATA



MULTILIN

| Location | Message Line                 | Description                                                                |
|----------|------------------------------|----------------------------------------------------------------------------|
| A 5.18   | PRE-TRIP DATA<br>END OF PAGE | The last line of page 5, actual values. Press the PAGE key to view page 6. |

| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

Messages A 6.1 to 6.9 will only appear if voltage sensing has been enabled in setpoints mode.

|       |                                  |                                                                                                                                                      |
|-------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 6.1 | <b>ACTUAL VALUES<br/>VOLTAGE</b> | The actual values page 6 header. This page gives values of the voltage and frequency of the three phase feeder being monitored by the 565/575 Relay. |
|-------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|

Messages A 6.2 to 6.4 will only appear if an Open Delta system is chosen in Setpoints mode.

|       |                                |                                                                                        |
|-------|--------------------------------|----------------------------------------------------------------------------------------|
| A 6.2 | <b>VOLTAGE A-B<br/>4.16 kV</b> | The voltage between phases A and B of the feeder being monitored by the 565/575 Relay. |
|-------|--------------------------------|----------------------------------------------------------------------------------------|

|       |                                |                                                                                        |
|-------|--------------------------------|----------------------------------------------------------------------------------------|
| A 6.3 | <b>VOLTAGE B-C<br/>4.16 kV</b> | The voltage between phases B and C of the feeder being monitored by the 565/575 Relay. |
|-------|--------------------------------|----------------------------------------------------------------------------------------|

|       |                                |                                                                                        |
|-------|--------------------------------|----------------------------------------------------------------------------------------|
| A 6.4 | <b>VOLTAGE C-A<br/>4.16 kV</b> | The voltage between phases C and A of the feeder being monitored by the 565/575 Relay. |
|-------|--------------------------------|----------------------------------------------------------------------------------------|

Messages A 6.5 to 6.7 will only appear if a Wye system is chosen in setpoints mode.

|       |                                |                                                                                                      |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------|
| A 6.5 | <b>VOLTAGE A-N<br/>2.30 kV</b> | The voltage between phase A and the neutral line of the feeder being monitored by the 565/575 Relay. |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------|

|       |                                |                                                                                                      |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------|
| A 6.6 | <b>VOLTAGE B-N<br/>2.30 kV</b> | The voltage between phase B and the neutral line of the feeder being monitored by the 565/575 Relay. |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------|

|       |                                |                                                                                                      |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------|
| A 6.7 | <b>VOLTAGE C-N<br/>2.30 kV</b> | The voltage between phase C and the neutral line of the feeder being monitored by the 565/575 Relay. |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------|

The following message will be displayed if no Metering Transducer Module (MTM) has been connected. If a MTM is used and an Option Card is installed, see METERING DATA page in Actual Values for frequency reading.

|       |                                        |                                                                                                                                                                                                                                                 |
|-------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 6.8 | <b>FREQUENCY OF<br/>FEEDER 60.1 Hz</b> | This is the frequency of the feeder voltage being monitored by the 565/575 Relay. The frequency measurements are also enhanced. They are accurate to better than 0.1% of nominal frequency (0.05 Hz). Displayed data resolution is now 0.01 Hz. |
|-------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|       |                                |                                                                            |
|-------|--------------------------------|----------------------------------------------------------------------------|
| A 6.9 | <b>VOLTAGE<br/>END OF PAGE</b> | The last line of page 6, actual values. Press the PAGE key to view page 7. |
|-------|--------------------------------|----------------------------------------------------------------------------|

## ACTUAL VALUES MODE - EVENT



| Location                                                                                                    | Message Line                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 7.1                                                                                                       | <div>ACTUAL VALUES<br/>EVENT</div>               | <p>The Actual Values page 7 header. This page allows the recorded events to be viewed.</p> <p>* NOTE: See Section 7 for more information on Event Recording.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <i>Message A 7.2 will only appear if event recording has been disabled in setpoints.</i>                    |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| A 7.2                                                                                                       | <div>EVENT RECORDING<br/>DISABLED</div>          | <p>This message is used to inform the user that event recording has been disabled.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Messages A 7.3 to A 7.11 will only appear if event recording has been enabled in the setpoints mode.</i> |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| A 7.3                                                                                                       | <div>NO. OF EVENTS:<br/>XX</div>                 | <p>This message shows the number of recorded events.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| A 7.4                                                                                                       | <div>VIEW EVENTS?<br/>NO</div>                   | <p>This message asks if the user wants to view events. Use the NEXT CHOICE key to display YES or NO and press STORE to select the choice. If YES is selected, the event template will appear for 2 seconds. Following this, the first event will be displayed. Viewing of Event Recorder data is in natural order — last event is first viewed.</p>                                                                                                                                                                                                                                                    |
| A 7.5                                                                                                       | <div>## EVENT CAUSE<br/>t mm/dd/yy hh:mm</div>   | <p>Event template: The top line shows the event number and the cause of event fields. The second line shows the event type, date and time fields.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| A 7.6                                                                                                       | <div>01 PH-A TIME O/C<br/>T 04/19/90 22:30</div> | <p>This message shows an example of a trip event - Phase A Timed Overcurrent Trip, occurred at 10:30pm on April 19, 1990. Press LINE DOWN key to display the next event.</p>                                                                                                                                                                                                                                                                                                                                                                                                                           |
| A 7.7                                                                                                       | <div>02 UNDERVOLTAGE<br/>A 04/19/90 22:31</div>  | <p>This message shows an example of an alarm event - Undervoltage Alarm.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| A 7.8                                                                                                       | <div>03 AC JUMPER INS<br/>O 04/20/90 11:15</div> | <p>This message shows an example of "other" event - Access Jumper Installed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| A 7.9                                                                                                       | <div>04 SERIAL TRIP<br/>O 03/17/94 11:14</div>   | <p>This message shows an example of "other" event - Serial Trip. This message is displayed if the breaker is closed when the 565/575 receives the Modbus Serial Trip command. If the breaker is open when this Serial Trip command is issued, it will be ignored.</p>                                                                                                                                                                                                                                                                                                                                  |
| A 7.10                                                                                                      | <div>05 SERIAL CLOSE<br/>O 03/17/94 11:15</div>  | <p>This message shows an example of "other" event - Serial Close, if the breaker is open when the 565/575 receives the Modbus Serial Close command. If the breaker does not close successfully within the breaker discrepancy delay time, a breaker discrepancy will be declared. If the breaker is closed when this Serial Close command is issued, it will be ignored.</p> <p>In order to prevent conflicts with the Remote Trip/Close commands via hardware, the communication commands will only function if the Remote/Local switch at terminals #39 and #40 is in the "open" Local position.</p> |
| A 7.11                                                                                                      | <div>PRINT EVENTS?<br/>NO</div>                  | <p>After all the events are viewed, pressing LINE DOWN key will show this message, which asks users if event printout is desired. Press NEXT CHOICE key to toggle YES or NO options and press STORE key to select it. (NOTE: Printer is presumably connected to the rear RS232 port). Press</p>                                                                                                                                                                                                                                                                                                        |

| Location | Message Line                                   | Description                                                                   |
|----------|------------------------------------------------|-------------------------------------------------------------------------------|
|          |                                                | LINE DOWN key to continue to the next message.                                |
| A 7.12   | <div>CLEAR EVENTS?<br/>NO</div>                | This message prompts the user to erase the event data displayed on this page. |
| A 7.13   | <div>EVENTS CLEARED<br/>LAST:AUG 04,1992</div> | This message shows users when events were last cleared.                       |
| A 7.14   | <div>EVENTS<br/>END OF PAGE</div>              | The last line of EVENT page. Press the PAGE key to view page 8.               |

## ACTUAL VALUES MODE - DEMAND DATA



| Location                                                                                                                                                                                                         | Message Line                        | Description                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------|
| A 8.1                                                                                                                                                                                                            | ACTUAL VALUES<br>DEMAND DATA        | The actual values page 8 header. This page allows the demand metering related data to be viewed.        |
| <i>Message A 8.2 will only appear if AMPS DEMAND is disabled in setpoints.</i>                                                                                                                                   |                                     |                                                                                                         |
| A 8.2<br>L <sub>A</sub>                                                                                                                                                                                          | AMPS DEMAND<br>DISABLED             | This message informs the user that Amps Demand has been disabled.                                       |
| <i>Messages A 8.3 to A 8.5 will only be shown if the Amp Demand feature has been enabled in setpoints.</i>                                                                                                       |                                     |                                                                                                         |
| A 8.3                                                                                                                                                                                                            | PH-A PEAK DEMAND<br>1050 A          | This message shows the peak amps demand value of phase A since the last clearing of the function data.  |
| A 8.4                                                                                                                                                                                                            | PH-B PEAK DEMAND<br>1100 A          | This message shows the peak amps demand value of phase B since the last clearing of the function data.  |
| A 8.5                                                                                                                                                                                                            | PH-C PEAK DEMAND<br>1070 A          | This message shows the peak amps demand value of phase C since the last clearing of the function data.  |
| A 8.6                                                                                                                                                                                                            | CLEAR AMP DEMAND<br>DATA? NO        | This message prompts the user if Demand Amps data is to be cleared. If YES, data stored will be erased. |
| A 8.7                                                                                                                                                                                                            | DATA CLEARED<br>LAST:AUG 04, 1992   | This message shows users when data was last cleared.                                                    |
| <i>The following messages are only displayed if a Metering Transducer Module (MTM) has been connected to the 565/575, an Option Card has been installed in the 565, and the communications has been enabled.</i> |                                     |                                                                                                         |
| <i>Message A 8.8 will appear only if the KW Demand feature has been disabled.</i>                                                                                                                                |                                     |                                                                                                         |
| A 8.8                                                                                                                                                                                                            | KW DEMAND<br>DISABLED               | This message informs the user the KW Demand has been disabled.                                          |
| <i>Message A 8.9 will only appear if the KW Demand feature has been enabled.</i>                                                                                                                                 |                                     |                                                                                                         |
| A 8.9                                                                                                                                                                                                            | PEAK KW DEMAND<br>65000 kW          | This message shows the peak kW demand value since the last clearing.                                    |
| A 8.10                                                                                                                                                                                                           | CLEAR KW DEMAND<br>DATA? NO         | This prompts the user if kW demand data is to be cleared. If YES, data stored will be erased.           |
| A 8.11                                                                                                                                                                                                           | KW DEMAND DATA<br>CL'D:AUG 04, 1992 | This message shows the date when data was last cleared.                                                 |

| Location                                                                              | Message Line                                                                                                                                     | Description                                                                                     |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <i>Message A 8.12 will only appear if KVAR Demand has been disabled in setpoints.</i> |                                                                                                                                                  |                                                                                                 |
| A 8.12                                                                                | <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">           KVAR DEMAND<br/>DISABLED         </div>                | This message informs the user that KVAR Demand has been disabled.                               |
| <i>Message A 8.13 will only appear if the KVAR Demand feature has been enabled.</i>   |                                                                                                                                                  |                                                                                                 |
| A 8.13                                                                                | <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">           PEAK KVAR DEMAND<br/>65000 KVAR         </div>         | This message shows the peak kVAR demand value since the last clearing.                          |
| A 8.14                                                                                | <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">           CLEAR KVAR DEM'D<br/>DATA? NO         </div>           | This prompts the user if KVAR demand data is to be cleared. If YES, data stored will be erased. |
| A 8.15                                                                                | <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">           KVAR DEMAND DATA<br/>CL'D: AUG 04, 1992         </div> | This message shows the date when data was last cleared.                                         |
| A 8.16                                                                                | <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">           DEMAND DATA<br/>END OF PAGE         </div>             | The last line of DEMAND DATA page. Press the PAGE key to view page 9.                           |

## ACTUAL VALUES MODE - METERING DATA



| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

\*\*\* Available only with Option Card installed \*\*

|       |                                |                                                                                   |
|-------|--------------------------------|-----------------------------------------------------------------------------------|
| A 9.1 | ACTUAL VALUES<br>METERING DATA | The Actual Values page 9 header. This page allows the metering data to be viewed. |
|-------|--------------------------------|-----------------------------------------------------------------------------------|

Messages A 9.2 to A 9.6 will only appear if the Metering Transducer Module (MTM) has been enabled in setpoints.

|       |                              |                                                    |
|-------|------------------------------|----------------------------------------------------|
| A 9.2 | POWER FACTOR<br>LAGGING 0.75 | The Power Factor is displayed during this message. |
|-------|------------------------------|----------------------------------------------------|

|       |                          |                                      |
|-------|--------------------------|--------------------------------------|
| A 9.3 | FREQUENCY MTM<br>60.1 Hz | This message displays the frequency. |
|-------|--------------------------|--------------------------------------|

|       |                        |                                                                                                                                                |
|-------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| A 9.4 | REAL POWER<br>65000 kW | This message displays the current real power delivered. If communicating with a rev. E MTM or MTM Plus, the kW polarity sign will be included. |
|-------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|

|       |                              |                                                                                                                                          |
|-------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| A 9.5 | REACTIVE POWER<br>65000 kVAR | This message displays the current reactive power. If communicating with a rev. E MTM or MTM Plus, the kW polarity sign will be included. |
|-------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|

|       |                            |                                            |
|-------|----------------------------|--------------------------------------------|
| A 9.6 | ENERGY USED<br>65000 MWHRS | This message displays the real power used. |
|-------|----------------------------|--------------------------------------------|

|       |                               |                                                                                                                                                                             |
|-------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A 9.7 | CLEAR ENERGY<br>USED DATA? NO | This prompts the user if Energy Used Data is to be cleared. If YES, data stored will be erased. The MWhrs should be cleared after 65,000 in order to ensure safe operation. |
|-------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

MWh data on MTM can be cleared now by using 565/575 Relay's keypad or Modbus communication command.

|       |                              |                                                                              |
|-------|------------------------------|------------------------------------------------------------------------------|
| A 9.7 | METERING DATA<br>END OF PAGE | The last line of METERING DATA page. This is the last page of ACTUAL VALUES. |
|-------|------------------------------|------------------------------------------------------------------------------|

All the messages displayed by the 565 Relay in the setpoints mode are shown and explained in this section. As for actual values, the messages are laid out in book form with a number of pages. Each page contains lines displaying a message. The setpoints section has several pages, the contents of which are as follows:

## Page Contents

1. User Level setpoints.
2. Phase Current setpoints.
3. Ground Current setpoints.
4. Configuration setpoints.
5. Analog Input setpoints.
6. Analog Output setpoints.
7. Communications setpoints.
8. Calibration Mode setpoints.
9. Voltage setpoints.
10. Demand Metering setpoints.
11. MTM Metering setpoints.

The numbers in the "Location" column to the left of each message in this section give the page and line of that message in the 565 Relay's memory. For example, the message to the right of the number S 1.2 in the "Location" column will appear on page 1 and line 2 when the Relay is in setpoints mode. The "Message Line" column shows the actual message which can be read from the LCD display on the front panel of the unit. The 565 Relay has two user levels, "basic" and "advanced". The messages seen depend on this user level, which is chosen in page one of setpoints. The basic level allows the user to operate the relay using the minimum of the features necessary. The advanced level allows the user to use all the 565 Relay features.

The messages which will only be seen by the advanced user and not the basic user, are marked "L<sub>A</sub>", for "Level-advanced" in the Location column.

Quantities shown in display boxes are typical values only. Different quantities will be displayed in each particular application.

## Relay Selection

The 565/575 Relay has six internal relays. They are called Trip, Close, Aux. 1, 2, 3, and 4. The following are the combinations of relays which you can select to have activated by any alarm or trip condition. This selection must be made in the setpoints mode.

### ALARM RELAY SELECTION

1. Aux 1
2. Aux 2
3. Aux 1&2 (565 only)

### TRIP RELAY SELECTION

1. Trip
2. Aux 1 (565 only)
3. Aux 2 (565 only)
4. Trip & Aux 1
5. Trip & Aux 2 (565 only)

6. Aux 1&2
7. Trip & Aux 1&2

The relay(s) to be activated can be displayed by pressing the NEXT CHOICE key. The display will show one of the options above, each time the key is pressed. When the last item is reached, the display will go back to the first item the next time the NEXT CHOICE key is pressed.

For example, say a combination of relays is being assigned to the undervoltage trip condition in setpoints. If the Trip relay and Auxiliary 1 relay need to be activated by this condition, the NEXT CHOICE key is pressed until the display shows

**UNDERVOLT TRIP  
RELAY TRIP&AUX1**

The STORE key is then pressed to store the selected relay or combination of relays in the 565/575 Relay's memory. The following message will appear for two seconds to verify that this has been done.

**NEW SETPOINT  
STORED**

When more than one relay is selected as shown, all the selected relays will be energized simultaneously. The contacts of the selected relay(s) can then be used to provide remote alarms or trips. These contacts are available at the rear of the 565 Relay panel. See the wiring diagram for terminal numbers.

## Setpoint Message Abbreviations

The following abbreviations are used in the messages in the setpoints pages:

|          |                        |
|----------|------------------------|
| A        | Ampere                 |
| AL'M     | Alarm                  |
| AUX      | Auxiliary              |
| COMM     | Communications         |
| CT       | Current Transformer    |
| CURR     | Current                |
| CYC      | Cycles                 |
| DISCREP. | Discrepancy            |
| EXTREM   | Extremely              |
| FREQ     | Frequency              |
| GND      | Ground                 |
| Hz       | Hertz                  |
| INST     | Instantaneous          |
| INV      | Inverse                |
| KA       | Kiloamps               |
| KV       | Kilovolts              |
| KVAR     | Kilovars               |
| KW       | Kilowatts              |
| LCD      | Liquid Crystal Display |
| mA       | Milliamps              |

## SETPOINTS MODE



|           |                            |
|-----------|----------------------------|
| MAX       | Maximum                    |
| MIN       | Minimum, or Minutes        |
| MOD       | Moderately                 |
| mS        | Milliseconds               |
| MTM       | Metering Transducer Module |
| O/C       | Overcurrent                |
| OVERVOLT  | Overvoltage                |
| P/F       | Power Factor               |
| REV       | Revision                   |
| SEC       | Secondary, or Second       |
| SW        | Switch                     |
| UNDERVOLT | Undervoltage               |
| VOLTS     | Voltage                    |
| VT        | Voltage Transformer        |
| × P/U     | Multiple of Pickup Level   |
| ZERO SEQ  | Zero Sequence              |

## Summary of Setpoint Page Contents

| Page | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Page | Contents                                                                                                                                                                                           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.   | User Level setpoints.<br><br>User level<br>Security Feature/Access code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 5.   | Analog Input setpoints.<br><br>Analog input title and units<br>Min and max current scale values<br>Analog input trip<br>Analog input alarm                                                         |
| 2.   | Phase Current setpoints.<br><br>Phase CT primary rating<br>Phase overcurrent pickup level<br>Phase overcurrent curve shape<br>Phase overcurrent time dial<br>Phase overcurrent trip relay<br>Phase overcurrent alarm<br>Phase instantaneous trip (565 only)<br>Phase custom curve trip times (565 only)<br>Phase HISET instantaneous trip (575 only)<br>Phase autoblock HISET (575 only)<br>Phase LOSET instantaneous trip (575 only)<br>Phase custom curves 1 trip times (575 only)                                                                                                                                                                                  | 6.   | Analog Output setpoints.<br><br>Analog output parameters<br>Analog output range                                                                                                                    |
| 3.   | Ground Current setpoints.<br><br>Ground sensing system<br>Ground CT primary rating<br>Ground overcurrent pickup level<br>Ground overcurrent curve shape (565 only)<br>Ground overcurrent curve 1 shape (575 only)<br>Ground overcurrent time dial (565 only)<br>Ground overcurrent time dial 1 (575 only)<br>Ground overcurrent trip relay<br>Ground overcurrent alarm<br>Ground instantaneous trip (565 only)<br>Ground HISET instantaneous trip (575 only)<br>Ground autoblock HISET (575 only)<br>Ground LOSET instantaneous trip (575 only)<br>Ground autoblock LOSET (575 only)<br>Ground custom curve trip times<br>Ground custom curve 1 trip times (575 only) | 7.   | Communications setpoints.<br><br>Relay address<br>Baud rate                                                                                                                                        |
| 4.   | Configuration Setpoints.<br><br>Clock<br>Switch contact functions<br>Switch contact configurations<br>Relay assignments<br>Breaker response delay<br>Breaker discrepancy delay<br>Trip coil supervision<br>Accumulated KA<br>Event recording<br>Event printing<br>Cold load P/U delay<br>MTM communications enable                                                                                                                                                                                                                                                                                                                                                    | 8.   | Calibration Mode setpoints.<br><br>Exercise relay<br>Status of switch inputs<br>LCD display contrast<br>Multilin 565 Relay Revision                                                                |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 9.   | Voltage setpoints.<br><br>VT connection<br>VT nominal secondary volts<br>VT primary volts<br>Zero volts detect<br>Undervoltage trip<br>Undervoltage alarm<br>Overvoltage trip<br>Overvoltage alarm |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10.  | Demand Metering setpoints.<br><br>Amps demand<br>KW demand<br>KVAR demand                                                                                                                          |

## SETPOINTS MODE



MULTILIN

### Summary of Setpoint Page Contents

| Page | Contents                                                                                                                                                                                                                         | Page | Contents |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 11.  | MTM Metering setpoints.<br><br>MTM communications alarm<br>MTM CT select<br>MTM CT primary rating<br>Power factor alarm<br>Power factor trip<br>Frequency alarm<br>Frequency trip<br>MTM scaling factor<br>Voltage reversal trip |      |          |
| 12.  | Auto Reclosure setpoints. (575 only)<br><br>Number of reclosure shots<br>Shot dead times<br>Scheme reset time<br>Reclosure enable relay                                                                                          |      |          |
| 13.  | Phase Curves setpoints. (575 only)<br><br>Phase curve changeover time<br>Phase overcurrent curve 2 shape<br>Phase overcurrent time dial 2<br>Phase custom curve 2 trip times                                                     |      |          |
| 14.  | Ground Curves setpoints. (575 only)<br><br>Ground curves setpoints<br>Ground overcurrent curve 2 shape<br>Ground overcurrent time dial 2<br>Ground custom curve 2 trip times                                                     |      |          |

| Setpoint Name                   | Factory Default           | Range                                                                                        | Step    |
|---------------------------------|---------------------------|----------------------------------------------------------------------------------------------|---------|
| 1. User Level setpoints.        |                           |                                                                                              |         |
| User Level                      | Advanced.                 | Basic/Advanced                                                                               |         |
| Security Feature                | Disabled.                 | Enabled/Disabled                                                                             |         |
| Setpoint Access                 | Enabled.                  | Enabled/Disabled                                                                             |         |
| Change Access Code              | No.                       | Yes/No                                                                                       |         |
| 2. Phase Current setpoints.     |                           |                                                                                              |         |
| Phase CT Rating Primary         | 100 A.                    | 10 to 5000A                                                                                  | 5A      |
| Phase Timed O/C Pickup          | 100% CT.                  | 25 to 250%                                                                                   | 1%      |
| Phase O/C Curve Shape           | EXTREM INV.               | MOD INV, NORMAL INV, VERY INV, EXTREM INV, and CUSTOM                                        |         |
| Phase O/C Time Dial             | 1.                        | 1 to 32                                                                                      | 1       |
| Phase O/C Trip Relay            | Trip. (Trip&Aux1 for 575) | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 (575: Trip, Trip&Aux1, Aux2) |         |
| Phase O/C Alarm                 | Disabled.                 | Enabled/Disabled                                                                             |         |
| Phase O/C Alarm Level           | 1.5 × P/U                 | 0.5 to 3                                                                                     | 0.1     |
| Phase O/C Alarm Delay           | 1 Sec.                    | 1 to 255 sec                                                                                 | 1 sec   |
| Phase O/C Alarm Relay           | Aux1. (Aux2 for 575)      | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                       |         |
| Phase Inst Trips                | Enabled.                  | Enabled/Disabled                                                                             |         |
| Phase Inst Trip Level           | 3.0 × P/U (565)           | 1 to 18                                                                                      | 0.5     |
| Phase Inst Trip Delay           | Inst. (565)               | 0 (Inst.) to 40 cycles                                                                       | 1 cycle |
| Phase Inst Trip Relay           | Trip. (565)               | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2                              |         |
| Phase HISET Inst Trips          | Enabled.                  | Enabled/Disabled                                                                             |         |
| Phase HISET Inst Trip           | 3.0 × P/U                 | 1 to 18                                                                                      | 0.5     |
| Phase HISET Inst Delay          | Inst.                     | 0 (Inst.) to 40 cycles                                                                       | 1 cycle |
| Phase HISET Inst Relay          | Trip & Aux1.              | Trip, Trip&Aux1, Aux2                                                                        |         |
| Phase Autoblock Inst HISET      | Disabled.                 | Enabled/Disabled                                                                             |         |
| Ph. Autoblock HISET After Recl. | #4. (575)                 | 1 to 4                                                                                       | 1       |
| Phase LOSET Inst Trips          | Enabled.                  | Enabled/Disabled                                                                             |         |
| Phase LOSET Inst Trip           | 2.0 × P/U                 | 1 to 18                                                                                      | 0.5     |
| Phase LOSET Inst Delay          | Inst.                     | 0 (Inst.) to 40 cycles                                                                       | 1 cycle |
| Phase LOSET Inst Relay          | Trip & Aux 1.             | Trip, Trip&Aux1, Aux2                                                                        |         |
| Phase Autoblock Inst LOSET      | Disabled.                 | Enabled/Disabled                                                                             |         |
| Ph. Autoblock LOSET After Recl. | #4                        | 1 to 4                                                                                       |         |
| Trip Time (Sec) × P/U           | 1.0                       | 0.1 to 1092.2 sec                                                                            | 0.1 sec |
| 3. Ground Current setpoints.    |                           |                                                                                              |         |
| Ground Current Sensing          | Enabled.                  | Enabled/Disabled                                                                             |         |
| Sensing System                  | Residual.                 | Residual/Zero Seq                                                                            |         |
| CT Ratio Primary                | 100 A.                    | 10 to 5000A                                                                                  | 5A      |
| Ground Timed O/C Pickup         | 40% CT.                   | 5 to 100%                                                                                    | 1%      |
| Gnd O/C Curve Shape             | EXTREM INV.               | MOD INV, NORMAL INV, VERY INV, EXTREM INV, and CUSTOM                                        |         |
| Ground O/C Time Dial            | 1.                        | 1 to 32                                                                                      | 1       |
| Ground O/C Relay                | Trip. (Trip&Aux1 for 575) | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 (575: Trip, Trip&Aux1, Aux2) |         |
| Ground O/C Alarm                | Disabled.                 | Enabled/Disabled                                                                             |         |
| Gnd O/C Alarm Level             | 1.5 × P/U                 | 0.5 to 1                                                                                     | 0.1     |
|                                 |                           | 1 to 3                                                                                       | 0.5     |
| Gnd O/C Alarm Delay             | 1 Sec.                    | 1 to 255 sec                                                                                 | 1 sec   |
| Gnd O/C Alarm Relay             | Aux1. (Aux2 for 575)      | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                       |         |
| Ground Inst Trips               | Enabled.                  | Enabled/Disabled                                                                             |         |
| Gnd Inst Trip Level             | 3.0 × P/U                 | 1 to 7                                                                                       | 0.5     |

## SETPOINTS MODE



| Setpoint Name                   | Factory Setpoint | Range                                                           | Step    |
|---------------------------------|------------------|-----------------------------------------------------------------|---------|
| Gnd Inst Trip 2 Level           | $3.0 \times P/U$ | 1 to 8                                                          | 0.1     |
| Gnd Inst Trip Delay             | Inst.            | 0 (Inst.) to 40 cycles                                          | 1 cycle |
| Gnd Inst Trip Relay             | Trip.            | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 |         |
| Gnd HISET Inst Trips            | Enabled.         | Enabled/Disabled                                                |         |
| Gnd HISET Inst Trip             | $3.0 \times P/U$ | 1 to 7                                                          | 0.5     |
| Gnd HISET Inst Delay            | Inst.            | 0 (Inst.) to 40 cycles                                          | 1 cycle |
| Gnd HISET Inst Relay            | Trip&Aux1        | Trip, Trip&Aux1, Aux2                                           |         |
| Gnd Autoblock Inst HISET        | Disabled.        | Enabled/Disabled                                                |         |
| Gnd Autoblock HISET After Recl. | #4.              | 1 to 4                                                          | 1       |
| Gnd LOSET Inst Trips            | Enabled.         | Enabled/Disabled                                                |         |
| Gnd LOSET Inst Trip             | $2.0 \times P/U$ | 1 to 7.0                                                        | 0.5     |
| Gnd LOSET Inst Delay            | Inst.            | 0 (Inst.) to 40 cycles                                          | 1 cycle |
| Gnd LOSET Inst Relay            | Trip&Aux1.       | Trip, Trip&Aux1, Aux2                                           |         |
| Gnd Autoblock Inst LOSET        | Disabled.        | Enabled/Disabled                                                |         |
| Gnd Autoblock LOSET After Recl. | #4.              | 1 to 4                                                          | 1       |
| Trip Time (Sec) $\times P/U$    | 1.0              | 0.1 to 1092.2 sec                                               | 0.1 sec |

#### 4. Configuration setpoints.

|          |                          |                              |        |
|----------|--------------------------|------------------------------|--------|
| Set Time | Current time. (hh:mm:ss) | 00:00:00 to 23:59:59         | 1 sec. |
| Set Date | Current date. (mm/dd/yy) | Jan 01, 1969 to Dec 31, 2068 | 1 day  |

#### Switch Contact Function.

|                        |                  |                                                                    |         |
|------------------------|------------------|--------------------------------------------------------------------|---------|
| Reset Blocked          | Disabled.        | Disabled, SW1 to SW8                                               |         |
| Block Inst Trips       | Disabled.        | Disabled, SW1 to SW8                                               |         |
| Block Timed O/C Trips  | Disabled.        | Disabled, SW1 to SW8                                               |         |
| Block Gnd Trips        | Disabled.        | Disabled, SW1 to SW8                                               |         |
| Definite Time #1 Alarm | Disabled.        | Disabled, SW1 to SW8                                               |         |
| Definite Time #1 Delay | 1 Sec.           | 1 to 255 sec                                                       | 1 sec   |
| Definite Time #1 Relay | Aux2.            | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)             |         |
| Definite Time #2 Alarm | Disabled.        | Disabled, SW1 to SW8                                               |         |
| Definite Time #2 Delay | 1 Sec.           | 1 to 255 sec                                                       | 1 sec   |
| Definite Time #2 Relay | Aux2.            | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)             |         |
| External Trip #1       | Disabled.        | Disabled, SW1 to SW8                                               |         |
| External Trip #1 Relay | Trip & Aux1.     | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2    |         |
| External Trip #1 Delay | 0 cyc.           | 0 (Inst.) to 60 cycles                                             | 1 cyc   |
| External Trip #2       | Disabled.        | Disabled, SW1 to SW8                                               |         |
| External Trip #2 Relay | Trip & Aux1.     | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2    |         |
| External Trip #2 Delay | 0 cyc.           | 0 (Inst.) to 60 cycles                                             | 1 cyc   |
| External Trip #3       | Disabled.        | Disabled, SW1 to SW8                                               |         |
| External Trip #3 Relay | Trip & Aux1.     | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2    |         |
| External Trip #3 Delay | 0 cyc.           | 0 (Inst.) to 60 cycles                                             | 1 cyc   |
| External Trip #4       | Disabled.        | Disabled, SW1 to SW8                                               |         |
| External Trip #4 Relay | Trip & Aux1.     | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&Aux2 |         |
| External Trip #4 Delay | 0 cyc.           | 0 (Inst.) to 60 cycles                                             | 1 cyc   |
| Curve Adjustment       | Disabled.        | Disabled, SW1 to SW8                                               |         |
| External Reset         | Disabled.        | Disabled, SW1 to SW8                                               |         |
| External Trip          | Disabled. (575)  | Disabled, SW1 to SW8                                               |         |
| External Trip Relay    | Trip&Aux1. (575) | Trip, Trip&Aux1, Aux2                                              |         |
| External Trip Delay    | Inst. (575)      | 0 (Inst.) to 60 cycles                                             | 1 cycle |
| Reclosable Trip        | Disabled. (575)  | Disabled, SW1 to SW8                                               |         |

| Setpoint Name                 | Factory Setpoint            | Range                                                           | Step    |
|-------------------------------|-----------------------------|-----------------------------------------------------------------|---------|
| Reclosable Trip Relay         | Trip&Aux1.                  | Trip, Trip&Aux1, Aux2                                           |         |
| Programmable Trip             | Disabled.                   | Disabled, SW1 to SW8                                            |         |
| Programmable Trip Relay       | Trip&Aux1.                  | Trip, Trip&Aux1, Aux2                                           |         |
| Programmable Trip Type        | Non-Recls.                  | Recls/Non-Recls                                                 |         |
| Curve Adjustment              | Disabled.                   | Disabled, SW1 to SW8                                            |         |
| Alternative Phase Curve       | Disabled.                   | Disabled, SW1 to SW8                                            |         |
| Alternative Ground Curve      | Disabled.                   | Disabled, SW1 to SW8                                            |         |
| Auto-Reclosure Block          | Disabled.                   | Disabled, SW1 to SW8                                            |         |
| External Reset                | Disabled.                   | Disabled, SW1 to SW8                                            |         |
| Switch Contact Configuration. |                             |                                                                 |         |
| SW1 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW2 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW3 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW4 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW5 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW6 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW7 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| SW8 Contact                   | Normally Open (inactive).   | Open/Closed                                                     |         |
| Output Relay Operation.       |                             |                                                                 |         |
| Trip Relay                    | Pulsed. (565)               | Latched/Pulsed                                                  |         |
| Trip Relay Pulse Time         | 0.6 Sec. (565)              | 0.1 to 0.6 sec                                                  | 0.1 sec |
| Aux1 Relay                    | Unlatched. (Pulsed for 575) | Latched, Unlatched, and Pulsed                                  |         |
| Aux1 Relay Pulse Time         | 0.6 Sec. (0.1 Sec. for 575) | 0.1 to 0.6 sec                                                  | 0.1 sec |
| Aux2 Relay                    | Unlatched.                  | Latched, Unlatched, and Pulsed                                  |         |
| Aux2 Relay Pulse Time         | 0.6 Sec.                    | 0.1 to 0.6 sec                                                  | 0.1 sec |
| 575 Features.                 |                             |                                                                 |         |
| Breaker Response Delay        | 1ms.                        | 1 to 167ms                                                      | 1ms     |
| Breaker Discrep.              | Disabled. (565)             | Enabled/Disabled                                                |         |
| Breaker Discrep. Delay        | 1000mS.                     | 100 to 1000mS                                                   | 10mS    |
| Trip Coil Supervision         | Disabled.                   | Enabled/Disabled                                                |         |
| Accumulated KA Alarm          | Disabled.                   | Enabled/Disabled                                                |         |
| Accumulated KA Alarm          | 5000.                       | 5000 to 100,000KA                                               | 10KA    |
| KA Alarm Relay                | Aux1. (Aux2 for 575)        | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)          |         |
| Event Recording               | Enabled.                    | Enabled/Disabled                                                |         |
| Event Printing                | Offline.                    | Online/Offline                                                  |         |
| Cold Load P/U Block           | Lowset. (575)               | Lowset, Highset, Both                                           |         |
| Cold Load P/U Delay           | 0.0 Sec.                    | 0 to 10 sec                                                     | 0.1 sec |
| MTM Comm                      | Enabled.                    | Enabled/Disabled                                                |         |
| 5. Analog Input setpoints.    |                             |                                                                 |         |
| Analog Input                  | Disabled.                   | Enabled/Disabled                                                |         |
| Edit Analog Input Title?      | No.                         | Yes/No                                                          |         |
| Edit Analog Input Units?      | No.                         | Yes/No                                                          |         |
| Min Curr Scale Value          | 4.00.                       | 0 to 1023                                                       | 0.01    |
| Max Curr Scale Value          | 20.00.                      | 0 to 1023                                                       | 0.01    |
| Analog Input Trip             | Disabled.                   | Enabled/Disabled                                                |         |
| Analog In Trip                | 16.00.                      | Min Curr Scale Value to Max Curr Scale Value                    |         |
| Analog In Trip Delay          | 1 Sec.                      | 1 to 255 sec                                                    | 1 sec   |
| Analog In Trip Relay          | Trip. (Trip&Aux1 for 575)   | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 |         |
| Analog Input Alarm            | Disabled.                   | Enabled/Disabled                                                |         |

## SETPOINTS MODE



| Setpoint Name                  | Factory Setpoint          | Range                                                                                                                                                                    | Step    |
|--------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Analog In Alarm                | 12.00.                    | Min Curr Scale Value to Max Curr Scale Value                                                                                                                             |         |
| Analog In Alarm Delay          | 1 Sec.                    | 1 to 255 sec                                                                                                                                                             | 1 sec   |
| Analog In Alarm Relay          | Aux1. (Aux2 for 575)      | Aux1, Aux2, Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                                                                                                       |         |
| 6. Analog Output setpoints.    |                           |                                                                                                                                                                          |         |
| Analog Output Parameter        | Phase A Current.          | Phase A Current, Phase B Current, Phase C Current, Ground Current, Phase A-X Voltage, Phase B-X Voltage, Phase C-X Voltage, Feeder Frequency, and External Analog Select |         |
| Analog Output Range:           | 4-20 mA.                  | 0-1mA or 4-20mA                                                                                                                                                          |         |
| 7. Communication setpoints.    |                           |                                                                                                                                                                          |         |
| Relay Address                  | 1.                        | 1 to 254                                                                                                                                                                 | 1       |
| Baud Rate                      | 2400 BAUD.                | 1200, 2400, 4800, and 9600 Baud                                                                                                                                          |         |
| 8. Calibration Mode setpoints. |                           |                                                                                                                                                                          |         |
| Exercise Relay                 | Trip.                     | Trip, Aux1, Aux2, Aux3, and All (565)<br>Trip, Aux1, Aux2, Aux3, Aux4, Block Tap Changer, and All (575)                                                                  |         |
| (Status of Switch Inputs)      |                           |                                                                                                                                                                          |         |
| LCD Display Contrast           | 5.                        | 0 to 10                                                                                                                                                                  | 1       |
| 9. Voltage setpoints.          |                           |                                                                                                                                                                          |         |
| VT Connection                  | Wye.                      | Wye, Open Delta, Delta/Wye and None                                                                                                                                      |         |
| VT Nominal Sec Volts           | 120 Volts.                | 48 to 240 Volts                                                                                                                                                          |         |
| VT Primary Volts               | 1.2 kV.                   | 0.1 to 69 kV                                                                                                                                                             | 0.01 kV |
| Zero Volts Detect              | Disabled.                 | Enabled/Disabled                                                                                                                                                         |         |
| Undervolt Trip                 | Disabled.                 | Enabled/Disabled                                                                                                                                                         |         |
| Undervolt Trip Level           | 80% VT                    | 50 to 100%                                                                                                                                                               | 1%      |
| Undervolt Trip Delay           | 1.0 Sec.                  | 0.1 to 25.5 sec                                                                                                                                                          | 0.1 sec |
| Undervolt Trip Relay           | Trip & Aux1.              | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 (575: Trip, Trip&Aux1, Aux2)                                                                             |         |
| Undervolt Alarm                | Disabled.                 | Enabled/Disabled                                                                                                                                                         |         |
| Undervolt Alarm Level          | 85% VT                    | 50 to 100%                                                                                                                                                               | 1%      |
| Undervolt Alarm Delay          | 1.0 Sec.                  | 0.1 to 25.5 sec                                                                                                                                                          | 0.1 sec |
| Undervolt Alarm Relay          | Aux2.                     | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                                                                                                   |         |
| Overvolt Trip                  | Disabled.                 | Enabled/Disabled                                                                                                                                                         |         |
| Overvolt Trip Level            | 120% VT                   | 101 to 125%                                                                                                                                                              | 1%      |
| Overvolt Trip Delay            | 1.0 Sec.                  | 0.1 to 25.5 sec                                                                                                                                                          | 0.1 sec |
| Overvolt Trip Relay            | Trip. (Trip&Aux1 for 575) | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 (575: Trip, Trip&Aux1, Aux2)                                                                             |         |
| Overvolt Alarm                 | Disabled.                 | Enabled/Disabled                                                                                                                                                         |         |
| Overvolt Alarm Level           | 115% VT                   | 101 to 125%                                                                                                                                                              | 1%      |
| Overvolt Alarm Delay           | 1.0 Sec.                  | 0.1 to 25.5 sec                                                                                                                                                          | 0.1 sec |
| Overvolt Alarm Relay           | Aux1. (Aux2 for 575)      | Aux1, Aux2, Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                                                                                                       |         |
| 10. Demand Metering setpoints. |                           |                                                                                                                                                                          |         |
| Amps Demand                    | Enabled.                  | Enabled/Disabled                                                                                                                                                         |         |
| Amps Demand Time Period        | 5 Min.                    | 5 to 120 Min                                                                                                                                                             | 1 Min   |
| Amps Demand Alarm              | Disabled.                 | Enabled/Disabled                                                                                                                                                         |         |
| Amp Demand Alarm Level         | 100 A.                    | 10 to 5000 A                                                                                                                                                             | 5 A     |

| Location                | Message Line         | Description                                        |
|-------------------------|----------------------|----------------------------------------------------|
| Amp Demand Alarm Relay  | Aux1. (Aux2 for 575) | Aux1, Aux2, Aux1&2 (575: None, Aux1, Aux2, Aux1&2) |
| KW Demand               | Enabled.             | Enabled/Disabled                                   |
| KW Demand Time Period   | 5 Min.               | 5 to 120 Min 1 Min                                 |
| KW Demand Alarm         | Disabled.            | Enabled/Disabled                                   |
| KW Demand Alarm Level   | 1000 kW.             | 100 to 65,000 kW 100 kW                            |
| KW Demand Alarm Relay   | Aux1. (Aux2 for 575) | Aux1, Aux2, Aux1&2 (575: None, Aux1, Aux2, Aux1&2) |
| KVAR Demand             | Enabled.             | Enabled/Disabled                                   |
| KVAR Demand Time Period | 5 Min.               | 5 to 120 Min 1 Min                                 |
| KVAR Demand Alarm       | Disabled.            | Enabled/Disabled                                   |
| KVAR Demand Al'm Level  | 1000 kVAR.           | 100 to 65,000 kVAR 100 kVAR                        |
| KVAR Demand Al'm Relay  | Aux1. (Aux2 for 575) | Aux1, Aux2, Aux1&2 (575: None, Aux1, Aux2, Aux1&2) |

#### 11. MTM Metering setpoints.

|                         |                           |                                                                                                |
|-------------------------|---------------------------|------------------------------------------------------------------------------------------------|
| MTM Comm. Alarm         | Disabled.                 | Enabled/Disabled                                                                               |
| MTM Comm. Alarm Relay   | Aux2.                     | Aux1, Aux2, Aux1&2                                                                             |
| MTM CT Select           | Common.                   | Common/Separate                                                                                |
| MTM CT Rating Primary   | 100 A.                    | 5 to 5000 A 5 A                                                                                |
| Power Factor Alarm      | Disabled.                 | Enabled/Disabled                                                                               |
| P/F Leading Alarm Level | 0.75.                     | 0 to 1 0.05                                                                                    |
| P/F Lagging Alarm Level | 0.75.                     | 0 to 1 0.05                                                                                    |
| P/F Alarm Delay         | 5.0 Sec.                  | 1 to 127 sec 0.5 sec                                                                           |
| P/F Alarm Relay         | Aux1. (Aux2 for 575)      | Aux1, Aux2, and Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                         |
| Power Factor Trip       | Disabled.                 | Enabled/Disabled                                                                               |
| P/F Leading Trip Level  | 0.70.                     | 0 to 1 0.05                                                                                    |
| P/F Lagging Trip Level  | 0.70.                     | 0 to 1 0.05                                                                                    |
| P/F Trip Delay          | 1.0 Sec.                  | 1 to 127 sec 0.5 sec                                                                           |
| P/F Trip Relay          | Aux1. (Trip&Aux1 for 575) | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 (575: Trip, Trip&Aux1, Aux2)   |
| Frequency Alarm         | Disabled.                 | Enabled/Disabled                                                                               |
| Under Freq. Alarm Level | 58.0 Hz.                  | 40 to 60 Hz 0.1 Hz                                                                             |
| Over Freq. Alarm Level  | 62.0 Hz.                  | 50 to 72 Hz 0.1 Hz                                                                             |
| Frequency Alarm Delay   | 5.0 Sec.                  | 1 to 127 sec 0.5 sec                                                                           |
| Frequency Alarm Relay   | Aux1. (Aux2 for 575)      | Aux1, Aux2, Aux1&2 (575: None, Aux1, Aux2, Aux1&2)                                             |
| Frequency Trip          | Disabled.                 | Enabled/Disabled                                                                               |
| Under Freq. Trip Level  | 56.0 Hz.                  | 40 to 60 Hz 0.1 Hz                                                                             |
| Over Freq. Trip Level   | 64.0 Hz.                  | 50 to 72 Hz 0.1 Hz                                                                             |
| Frequency Trip Delay    | 1.0 Sec.                  | 1 to 127 sec 0.5 sec                                                                           |
| Frequency Trip Relay    | Aux1. (Trip&Aux1 for 575) | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&2, and Trip&Aux1&2 (575: Trip, Trip&Aux1, Aux2)   |
| MTM Scaling Factor      | 655.                      | 1 to 655 1                                                                                     |
| Voltage Reversal Trip   | Disabled.                 | Enabled/Disabled                                                                               |
| Voltage Reversal Delay  | 1.0 sec.                  | 1 to 127 sec. 0.5 sec                                                                          |
| Voltage Reversal Relay  | Trip                      | Trip, Aux1, Aux2, Trip&Aux1, Trip&Aux2, Aux1&Aux2, Trip&Aux1&Aux2 (575: Trip, Trip&Aux1, Aux2) |

#### 12. Auto Reclosure setpoints. (575 only)

|                        |           |                          |
|------------------------|-----------|--------------------------|
| Auto Reclosure         | Disabled. | Enabled/Disabled         |
| No. Of Reclose Shots   | 4.        | 0 to 4 1                 |
| Shot 1 Dead Time       | 2.0 sec.  | 0.3 to 300 sec. 0.1 sec. |
| Shot 2 Dead Time       | 4.0 sec.  | 0.3 to 300 sec. 0.1 sec. |
| Shot 3 Dead Time       | 6.0 sec.  | 0.3 to 300 sec. 0.1 sec. |
| Shot 4 Dead Time       | 8.0 sec.  | 0.3 to 300 sec. 0.1 sec. |
| Scheme Reset Time      | 5.0 sec.  | 1 to 255 sec. 1 sec.     |
| Reclosure Enable Relay | Aux2.     | None, Aux1, Aux2, Aux1&2 |

#### 13. Phase Curves setpoints. (575 only)

## SETPOINTS MODE



MULTILIN

| Setpoint Name                          | Factory Setpoint | Range                                                  | Step     |
|----------------------------------------|------------------|--------------------------------------------------------|----------|
| Phase Curve Change                     | Disabled.        | Enabled/Disabled                                       |          |
| Switch to Curve 2 After Recls.         | #1.              | 1 to 4                                                 | 1        |
| Phase O/C Curve 2 Shape                | EXTREM INV.      | MOD INV, NORMAL INV, VERY INV, EXTREM INV, and CUSTOM2 |          |
| Phase O/C Time Dial 2                  | 1.               | 1 to 32                                                | 1        |
| Trip Time 2 (sec) × P/U                | 1.0              | 0.1 to 1092.2 sec.                                     | 0.1 sec. |
| 14. Ground Curve setpoints. (575 only) |                  |                                                        |          |
| Ground Curve Change                    | Disabled.        | Enabled/Disabled                                       |          |
| Switch to Curve 2 After Recls.         | #1.              | 1 to 4                                                 | 1        |
| Ground O/C Curve 2 Shape               | EXTEM INV.       | MOD INV, NORMAL INV, VERY INV, EXTREM INV, and CUSTOM2 |          |
| Ground O/C Time Dial 2                 | 1.               | 1 to 32                                                | 1        |
| Trip Time 2 (sec) × P/U                | 1.0              | 0.1 to 1092.2 sec.                                     | 0.1 sec. |

## Setpoints.

| Location | Message Line                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 1.1    | <div>SETPOINTS<br/>USER LEVEL</div> | The setpoints page 1 header. In this page the setpoints for selecting the user level and for enabling the security feature are entered.                                                                                                                                                                                                                                                                                                                                                                           |
| S 1.2    | <div>USER LEVEL:<br/>ADVANCED</div> | This message allows the user to select one of two possible levels, which are Basic and Advanced. If the Basic level is chosen, then the user will only see those messages essential to the setup of the 565/575 relay. If the Advanced level is chosen, all the features of the relay will be made available to the user. The extra messages only seen by the advanced user are marked "L <sub>A</sub> " in the "Location" column. Select either BASIC or ADVANCED using the NEXT CHOICE key and store the value. |

**NOTE:** For simple step-by-step instructions on installation and use of the access code, see information at end of USER LEVEL setpoint page.

|       |                                          |                                                                                                                                                                                                                                                                                                                |
|-------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 1.3 | <div>SECURITY FEATURE<br/>DISABLED</div> | This message allows the user to enable a feature which uses a numeric code, as well as the access jumper, to prevent unauthorized personnel from changing setpoints. The Security Feature cannot be enabled on the 565 if the Security Feature and local Setpoint Access setpoints are disabled via Relaycom™. |
|-------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

*Messages S 1.4 to S 1.9 will only appear if ENABLE is selected and stored in message S 1.3.*

|       |                                        |                                                                                                                                                                                                            |
|-------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 1.4 | <div>SETPOINT ACCESS<br/>ENABLED</div> | If enabled is selected and stored in this message, access to setpoints is permitted. If disabled is selected and stored, the security access code is in effect and all access to setpoints will be denied. |
|-------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**NOTE:** The first time the security feature is enabled the message "SETPOINT ACCESS" will be set to enabled. This will allow entry of a personalized code using message S 1.6. Once "SETPOINT ACCESS" is set to disabled, the access code will be required to enable access again. If this is done before an access code has been stored, the factory default value for access is 0.

*Message S 1.5 will only appear if message S 1.4 is changed to enabled from previously being disabled.*

|       |                                  |                                                                                                                                                                                                                                                                                                     |
|-------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 1.5 | <div>ENTER ACCESS<br/>CODE</div> | <p>This message asks for the access code which must be entered before setpoint access is enabled.</p> <p>Note that as the code is being entered the cursor "_" will appear instead of the numbers to verify the entry of the numbers, and prevent unauthorized personnel from reading the code.</p> |
|-------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|       |                                      |                                                                                                                                 |
|-------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| S 1.6 | <div>CHANGE ACCESS<br/>CODE NO</div> | This message is used to set up the access code for the first time, and then to change the access code whenever the need arises. |
|-------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|

*Messages S 1.7 to S 1.9 will only appear if YES is selected and stored in message S 1.6.*

|       |                                         |                                                                                                      |
|-------|-----------------------------------------|------------------------------------------------------------------------------------------------------|
| S 1.7 | <div>ENTER NEW ACCESS<br/>CODE</div>    | This message asks the user to enter their own personalized code. Any number from 0-9999 can be used. |
| S 1.8 | <div>RE-ENTER NEW<br/>ACCESS CODE</div> | This message asks that the new access code be re-entered to ensure that the correct code is stored.  |

## SETPOINTS MODE



| Location | Message Line              | Description                                                                                                                       |
|----------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| S 1.9    | NEW ACCESS CODE<br>STORED | This is a flash message that appears for two seconds to tell the user that the new access code is now stored in the 565's memory. |
| S 1.10   | USER LEVEL<br>END OF PAGE | This is the last line of page 1, setpoints. Press PAGE to view page 2.                                                            |

**Installation of Security Feature:**

STEP 1 : Display message S 1.3 "Security Feature". Press NEXT CHOICE to display enabled and press store.

STEP 2 : Display message S 1.6 "Change Access Code". Press NEXT CHOICE to display YES and press store.

STEP 3 : By pressing store in step 2, message S 1.7 now appears. Any number from 0-9999 can now be entered for an access code. Enter number and press STORE.

STEP 4 : Re-enter access code, press STORE.

STEP 5 : Display message S 1.4. Use NEXT CHOICE to display disabled and press STORE.

**Use of Access Code:**

STEP 1 : Display message S 1.4 "SETPOINT ACCESS". Press NEXT CHOICE to display enabled and press STORE.

STEP 2 : Enter your personalized code and press STORE.

STEP 3 : Access to setpoints is now permitted.

STEP 4 : After all changes have been made, display message S 1.4 "SETPOINT ACCESS". Press NEXT CHOICE to display disabled and press STORE.

STEP 5 : Setpoint access is now disabled. An attempt to alter a setpoint will result in an "ILLEGAL ACCESS" message.

## SETPOINTS MODE - PHASE CURRENT



| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

|       |                            |
|-------|----------------------------|
| S 2.1 | SETPOINTS<br>PHASE CURRENT |
|-------|----------------------------|

The setpoints page 2 header. In this page you must enter information about the phase current transformers being used in your application. This allows the 565/575 Relay to accurately sense the feeder currents. This page also allows you to set the levels for various overcurrent alarms and trips and assign relays to be activated by these.

*Each of the four phase currents are sampled at a rate of approximately 960 samples per second.*

|       |                                  |
|-------|----------------------------------|
| S 2.2 | PHASE CT RATING<br>PRIMARY 100 A |
|-------|----------------------------------|

Enter the primary current rating of the phase current transformers being used. This value is found on the transformer nameplate. Values can be entered in the range of 10 to 5000 Amps, in steps of 5 Amp. If an attempt is made to enter a value outside this range an OUT OF RANGE error message will flash. If your transformer has a rating outside this range contact MULTILIN for information. Note that all three phase CT's must have the same rating.

|       |                                   |
|-------|-----------------------------------|
| S 2.3 | PHASE TIMED O/C<br>PICKUP 100 %CT |
|-------|-----------------------------------|

The phase overcurrent pickup level is entered here. This is given as a percentage of the CT rating, in the range of 25% to 250% in steps of 1%. This setting will determine the level of current which the 565 Relay will identify as too high, and then initiate a timed overcurrent trip of the breaker, according to the selected curve shape.

For example, if 50% is entered here, then the 565/575 Relay will initiate a timed trip of the feeder breaker when at least one of the phase currents reaches 50% of the full CT rating entered in message S 2.2. Determine this value by referring to the feeder design specifications.

|       |                                     |
|-------|-------------------------------------|
| S 2.4 | PHASE O/C CURVE<br>SHAPE EXTREM INV |
|-------|-------------------------------------|

The shape of the required protection curve must be entered here. The curve names are shown below together with the shortened form of the name which is displayed in this message.

| CURVE<br>NAME          | DISPLAYED<br>NAME |
|------------------------|-------------------|
| 1. Moderately inverse. | MOD INV.          |
| 2. Normal Inverse.     | NORMAL INV.       |
| 3. Very Inverse.       | VERY INV.         |
| 4. Extremely Inverse.  | EXTREM INV.       |
| 5. Custom Curve.       | CUSTOM            |
| 6. IEC                 | IEC A             |
| 7. IEC                 | IEC B             |
| 8. IEC                 | IEC C             |

Once the correct curve has been chosen for your application, press the NEXT CHOICE key until the required curve is displayed in message S 2.4 and store the selected curve using the STORE key. The extremely inverse curve is shown in this example.

*Message S 2.5 will not appear if CUSTOM CURVE is selected in message S 2.4.*

|       |                          |
|-------|--------------------------|
| S 2.5 | PHASE O/C<br>TIME DIAL 1 |
|-------|--------------------------|

The phase overcurrent time dial number is entered here. This allows the user to fit the selected curve to the system requirements. Any of the 32 possible plots of the selected curve shape may be selected by entering the corresponding number between 1 and 32 here. Select the curve number by referring to the "use of standard curves" in section 3.

|       |                              |
|-------|------------------------------|
| S 2.6 | PHASE O/C TRIP<br>RELAY TRIP |
|-------|------------------------------|

This message allows the user to select the relay which the phase overcurrent trip will activate.

| Location                | Message Line                | Description                                                                                                                           |
|-------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| S 2.7<br>L <sub>A</sub> | PHASE O/C ALARM<br>DISABLED | This message allows the user to enable or disable the phase overcurrent alarm. Use the NEXT CHOICE key to select enabled or disabled. |

Messages S 2.8 to 2.10 will only appear if ENABLED is selected in message S 2.7.

|                         |                                    |                                                                                                                                                                                                                                                    |
|-------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.8<br>L <sub>A</sub> | PHASE O/C ALARM<br>LEVEL 1.5 X P/U | This is the value of current flowing in any phase which will cause the Relay to initiate an alarm. This value is entered as a multiple of the phase timed overcurrent pickup level chosen in message S 2.3. Values can be entered in these ranges: |
|-------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

1). 0.5 to 3 in steps of 0.1.

If a value which is not an exact multiple of 0.1 or 0.5 is entered, the 565 Relay will select the closest number to the value entered, display and use it. For example, if 1.4 is entered then a value of 1.5 will be displayed and used by the 565 Relay. Attempting to enter a value outside these ranges will cause an OUT OF RANGE error message to flash.

Choose alarm values lower than the trip pickup levels by an amount which will give adequate warning of impending problems. For example a value of 80% of the phase timed overcurrent level might be chosen, and 0.8 would be entered here. A level of 1 times pickup can be programmed. The LCD will then indicate when the Relay is operating above pickup.

|                         |                                |                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.9<br>L <sub>A</sub> | PHASE O/C ALARM<br>DELAY 1 SEC | The value of the timed overcurrent alarm delay is entered here in the range of 1 to 255, in steps of 1 second. The purpose of the time delay is to prevent alarms due to momentary high currents which occur when large equipment is switched on or off the feeder. If the current drops below the alarm setting before the time delay which you select, no alarm will be initiated. |
|-------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                          |                               |                                                                                                            |
|--------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------|
| S 2.10<br>L <sub>A</sub> | PHASE O/C ALARM<br>RELAY AUX1 | This message allows the user to select the relay which the alarm generated in message S 2.8 will activate. |
|--------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------|

|        |                                   |                                                                                                                |
|--------|-----------------------------------|----------------------------------------------------------------------------------------------------------------|
| S 2.11 | PHASE INST TRIPS<br>ENABLED       | This setpoint allows the user to enable or disable the phase instantaneous trip protection in the 565 and 575. |
| (575)  | PHASE HISET INST<br>TRIPS ENABLED |                                                                                                                |

Messages S 2.12 to 2.14 will only appear if ENABLED is selected in message S 2.11.

|        |                                    |                                                                                                                                                                                                                                                                                                 |
|--------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.12 | PHASE INST TRIP<br>LEVEL 3.0 X P/U | The instantaneous overcurrent trip level for all phases is entered here as a multiple of the pickup level already set in message S 2.3. The range is 1 to 18 in steps of 0.5. This feature protects the feeder from sudden very high currents which cannot be tolerated without machine damage. |
|--------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|       |                                     |                                                                                                                                                                                                                                                                             |
|-------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (575) | PHASE HISET INST<br>TRIPS 3.0 X P/U | For example, if the phase overcurrent pickup level was 100 Amps, and a setting of 5 was chosen here then a current of 500 or higher amps in any phase, for longer than the time specified in the next message will cause a trip signal to be produced by the 565/575 Relay. |
|-------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## SETPOINTS MODE - PHASE CURRENT



| Location                                                                                                                       | Message Line                                                                                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.13                                                                                                                         | <div>PHASE INST TRIP<br/>DELAY INST</div> <div>(575) PHASE HISET INST<br/>DELAY INST</div>          | <p>The intentional delay on the phase instantaneous trip is set here in the range 0 to 40 cycles in steps of one cycle. If 0 is selected, INST will be displayed and there will be no intentional delay. There is, however, a 1 cycle delay which is necessary for the 565/575 relay to react to the fault condition. If any other value is entered within the above range, the trip will occur in this above reaction time plus the entered value. Thus, for an entered delay of 2 cycles on a 60 Hz system, the actual time to trip on phase instantaneous is <math>3 \times 16.6 \text{ ms} = 50 \text{ ms}</math>.</p> <p>Definite time characteristics can be implemented by using the phase instantaneous trip and appropriate time delays. For example, the phase instantaneous trip setpoint can be enabled and a delay between 0–40 cycles programmed. This effectively will simulate a Definite Time curve.</p> |
| S 2.14                                                                                                                         | <div>PHASE INST TRIP<br/>RELAY TRIP</div> <div>(575) PHASE HISET INST<br/>RELAY TRIP&amp;AUX1</div> | <p>This message allows the user to select the relay or combination of relays which the trip generated in message S 2.11 will activate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>Messages S 2.15 to S 2.22 pertain to the 575 only. The remaining messages beginning at S 2.23 are for both the 565/575.</i> |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| S 2.15                                                                                                                         | <div>PH AUTOBLK INST<br/>HISET DISABLED</div>                                                       | <p>This setpoint allows the user to enable or disable the phase autoblock HISET feature.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <i>Message S 2.16 will only appear if ENABLED is selected in message S 2.15.</i>                                               |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| S 2.16                                                                                                                         | <div>PH AUTOBLK HISET<br/>AFTER RECL.# 4</div>                                                      | <p>Determined after which reclosure the Phase Instantaneous Hiset Trip will be disabled (blocked).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 2.17                                                                                                                         | <div>PHASE LOSET INST<br/>TRIPS ENABLED</div>                                                       | <p>Same as PHASE HISET INST TRIP feature except any two phases must be over the trip level to cause a trip.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <i>Messages S 2.18 to S 2.22 will only appear if ENABLED is selected in message S 2.17.</i>                                    |                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| S 2.18                                                                                                                         | <div>PHASE LOSET INST<br/>TRIPS 2.0 X P/U</div>                                                     | <p>Similar to PHASE HISET INST TRIP feature (see above).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| S 2.19                                                                                                                         | <div>PHASE LOSET INST<br/>DELAY INST</div>                                                          | <p>Similar to PHASE HISET INST TRIP feature (see above).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| S 2.20                                                                                                                         | <div>PHASE LOSET INST<br/>RELAY TRIP&amp;AUX1</div>                                                 | <p>Select the desired output contact(s) to activate on a PHASE LOSET INST TRIP.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 2.21                                                                                                                         | <div>PH AUTOBLK INST<br/>LOSET DISABLED</div>                                                       | <p>This setpoint allows the user to enable or disable the phase autoblock LOSET feature.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

Message S 2.22 will only appear if ENABLED is selected in message S 2.21.

|        |                                                   |                                                                                        |
|--------|---------------------------------------------------|----------------------------------------------------------------------------------------|
| S 2.22 | <div> PH AUTOBLK LOSET<br/> AFTER RECL.# 4 </div> | Determines after which reclosure the PHASE LOSET INST TRIP will be disabled (blocked). |
|--------|---------------------------------------------------|----------------------------------------------------------------------------------------|

Messages S 2.23 and S 2.24 will only appear if CUSTOM CURVE1 was selected in message S 2.4.

|        |                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.23 | <div> TRIP TIME (SEC)<br/> 1.03 xPU= 1.0 </div> | <p>The programmable curve for the phase overcurrent protection is set up in the following messages. The trip time for the first breakpoint is requested here. There are 79 breakpoints in total, each corresponding to a multiple of the pickup current. A time to trip must be entered for each breakpoint, in the range of 0.1 seconds to 1092.2 seconds in steps of 0.1 second. Determine the required times by referring to the system plot. In the following messages the trip times are entered for each multiple of the pickup current in these ranges:</p> |
|--------|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

L<sub>A</sub>

- a) 1.03, and 1.1 to 5.9 in steps of 0.1.
- b) 6.0 to 20.0 in steps of 0.5.

All the values in these ranges will appear in the following messages automatically as the LINE DOWN key is pressed. As each message appears, enter the time to trip for current represented by this multiple of pickup current, and store the value. When the LINE DOWN is pressed, the message with the next increment of pickup current multiplier will appear until a multiplier of 20.0 is reached as shown in message S 2.16. The intermediate messages are in the same format and are not shown. When a time multiplier of 20 is reached, pressing the LINE DOWN key will cause the display to return to message S 2.15. When finished entering values, press the PAGE key to view setpoints page 3.

|        |                                                 |                                                                                                                                                                                         |
|--------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.24 | <div> TRIP TIME (SEC)<br/> 20.0 xPU= 1.0 </div> | The trip time for the last breakpoint, 20 times the pickup level, is entered here. The Custom Curve should not be programmed with uphill specs since no positive slopes are maintained. |
|--------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|        |                                             |                                                                                                                                            |
|--------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| S 2.25 | <div> PHASE CURRENT<br/> END OF PAGE </div> | This is the last line of page 2 Setpoints when the custom curve is not selected as the overcurrent curve shape. Press PAGE to view page 3. |
|--------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|

## SETPOINTS MODE - GROUND CURRENT



| Location                                                                  | Message Line                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
|---------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------|-----------------------|----------|-------------------|-------------|-----------------|-----------|----------------------|-------------|-----------------|---------|--------|-------|--------|-------|--------|-------|
| S 3.1                                                                     | SETPOINTS<br>GROUND CURRENT             | The setpoints page 3 header. In this page the setpoints which determine the ground current protection are entered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| S 3.2                                                                     | GROUND CURRENT<br>SENSING   ENABLED     | This message allows the user to enable or disable the Ground Current protection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| Only message S 3.19 will appear if DISABLED is selected in message S 3.2. |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| S 3.3                                                                     | SENSING SYSTEM<br>RESIDUAL              | This message is asking if your system uses a separate zero sequence CT or if the phase CT's are connected in a residual sensing configuration to detect ground currents. Either RESIDUAL or ZERO SEQ can be selected. Select the one corresponding to your sensing system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| Message S 3.4 will only appear if ZERO SEQ was selected in Message S 3.3. |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| S 3.4                                                                     | CT RATIO PRIMARY<br>100 A               | This message asks for the primary ratio of the zero sequence transformer being used in your application. The range of values for this setpoint is 10 to 5000 in steps of 5 Amp. This value will be on the transformer nameplate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| S 3.5                                                                     | GROUND TIMED O/C<br>PICKUP       40% CT | <p>The ground overcurrent pickup level is entered here as a percentage of the CT rating. The range of values allowed is 5% to 150% in steps of 1%. This setpoint sets the level of current at which the 565 Relay initiates a timed trip of the feeder breaker according to the curve selected in message S 3.6.</p> <p>For example, if 50% is entered here, then the 565/575 Relay will initiate a programmed trip of the feeder breaker when the ground current reaches 50% of the full CT rating. The CT rating used will be either:</p> <ol style="list-style-type: none"><li>1) The phase CT primary rating entered in message S 2.2, if residual current sensing is chosen in message S 3.3.</li><li>2) The zero sequence CT primary rating, if zero sequence sensing is chosen in message S 3.3.</li></ol> <p>If the ground current exceeds the limits of the Time/Overcurrent curve in use, a feeder breaker trip will occur. Determine the ground current pickup level for your application according to the grounding system used.</p> |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| S 3.6                                                                     | GND O/C CURVE<br>SHAPE:EXTREM INV       | <p>The shape of the required ground current protection curve must be entered here. The available curves are shown below, together with the shortened form of the name which is displayed in the message.</p> <table><tr><th>CURVE<br/>NAME</th><th>DISPLAYED<br/>NAME</th></tr><tr><td>1. Moderately Inverse</td><td>MOD INV.</td></tr><tr><td>2. Normal Inverse</td><td>NORMAL INV.</td></tr><tr><td>3. Very Inverse</td><td>VERY INV.</td></tr><tr><td>4. Extremely Inverse</td><td>EXTREM INV.</td></tr><tr><td>5. Custom Curve</td><td>CUSTOM.</td></tr><tr><td>6. IEC</td><td>IEC A</td></tr><tr><td>7. IEC</td><td>IEC B</td></tr><tr><td>8. IEC</td><td>IEC C</td></tr></table>                                                                                                                                                                                                                                                                                                                                                           | CURVE<br>NAME | DISPLAYED<br>NAME | 1. Moderately Inverse | MOD INV. | 2. Normal Inverse | NORMAL INV. | 3. Very Inverse | VERY INV. | 4. Extremely Inverse | EXTREM INV. | 5. Custom Curve | CUSTOM. | 6. IEC | IEC A | 7. IEC | IEC B | 8. IEC | IEC C |
| CURVE<br>NAME                                                             | DISPLAYED<br>NAME                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 1. Moderately Inverse                                                     | MOD INV.                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 2. Normal Inverse                                                         | NORMAL INV.                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 3. Very Inverse                                                           | VERY INV.                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 4. Extremely Inverse                                                      | EXTREM INV.                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 5. Custom Curve                                                           | CUSTOM.                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 6. IEC                                                                    | IEC A                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 7. IEC                                                                    | IEC B                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |
| 8. IEC                                                                    | IEC C                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                       |          |                   |             |                 |           |                      |             |                 |         |        |       |        |       |        |       |

| Location                                                                                  | Message Line                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Message S 3.7 will not appear if CUSTOM CURVE is selected in message S 3.6.</i>        |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| S 3.7                                                                                     | GROUND O/C TIME<br>DIAL 1         | The ground overcurrent time dial number is entered here. This allows the user to select a curve to match the system requirements. Refer to the "Use of standard curves" in section 3 to determine the correct curve and select it by entering its number here. Any number between 1 and 32 may be entered.                                                                                                                                                                                                                                                                                                                                                                                                                      |
| S 3.8                                                                                     | GROUND O/C RELAY<br>TRIP          | This message allows the user to select the relay which the ground overcurrent trip will activate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| S 3.9<br>L <sub>A</sub>                                                                   | GROUND O/C ALARM<br>DISABLED      | This message asks if you want the ground overcurrent alarm ENABLED or DISABLED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Messages S 3.10 to 3.12 will only appear if ENABLED is selected in message S 3.9.</i>  |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| S 3.10<br>L <sub>A</sub>                                                                  | GND O/C ALARM<br>LEVEL 1.5 X P/U  | The ground overcurrent alarm level is entered here as a multiple of the pickup level. The range of values allowed is 0.5 to 3 in steps of 0.1. This setpoint sets the level of ground current at which the 565 Relay initiates an alarm. A level of 1 times pickup can be programmed. The LCD will then indicate when the Relay is operating above pickup.<br><br>For example, if 0.5 is entered here, then the 565 Relay will initiate an alarm when the ground current reaches 50% of the pickup level entered in message S 3.5. Determine the alarm level for your application by referring to the feeder design specifications. The alarm must be far enough below the trip setting to allow corrective action to be taken. |
| S 3.11<br>L <sub>A</sub>                                                                  | GND O/C ALARM<br>DELAY 1 SEC      | The time delay for the ground alarm is entered here. This feature prevents the alarm for the timed period and stops nuisance alarms due to momentary high ground currents. Should the alarm condition persist beyond the timed period the alarm will occur. The range for this setpoint is 1 to 255 seconds in steps of 1 second.                                                                                                                                                                                                                                                                                                                                                                                               |
| S 3.12<br>L <sub>A</sub>                                                                  | GND O/C ALARM<br>RELAY AUX1       | This message allows the user to select the relay which the alarm signal generated in message S 3.10 will activate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| S 3.13                                                                                    | GROUND INST<br>TRIPS ENABLED      | This message asks if you want the ground instantaneous trip ENABLED or DISABLED.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| (575)                                                                                     | GND HISET INST<br>TRIPS ENABLED   | NOTE: This setpoint must be enabled and a proper trip level must be selected if a pickup level has been selected greater than 100% of CT (5A tap only). See caution in section "Protection Application Information."                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>Messages S 3.14 to 3.16 will only appear if ENABLED is selected in message S 3.13.</i> |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| S 3.14<br>(575)                                                                           | GND HISET TRIP<br>LEVEL 3.0 X P/U | The instantaneous ground current trip level is entered here as a multiple of the pickup level already chosen in message S 3.5. This feature protects the feeder from sudden very high ground current. For example, say the ground pickup level is 50 amps, and a setting of 2 was chosen here. If a ground current of 100 or more amps lasts for longer than the time delay set in message S 3.15, then a trip signal will be produced by the 565 Relay. The range of the ground current protection will be set by the value of the ground overcurrent pickup level. In addition, the pickup level selects the appropri-                                                                                                        |
|                                                                                           | GND HISET INST<br>TRIP 3.0 X P/U  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## SETPOINTS MODE - GROUND CURRENT



| Location                                                                                                                              | Message Line                                                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                       |                                                                                            | ate Ground Instantaneous Trip Level setpoint.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                       |                                                                                            | If a Ground Overcurrent Pickup Level is selected between 5 and 24%, the range of the ground protection will be from 1 to 8 times pickup. As a result, the Ground Instantaneous Trip Level setpoint at address 138 <sub>HEX</sub> will appear. With this setpoint, instantaneous trip levels will be selectable from 1 to 7 times pickup in steps of 0.1. The setpoint message will appear as above.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                                                                                                                       |                                                                                            | If a Ground Overcurrent Pickup Level is selected between 25 and 150%, the range of the ground protection will be from 1 to 20 times pickup. As a result, the Ground Instantaneous Trip Level setpoint at address 145 <sub>HEX</sub> will appear. With this setpoint, instantaneous trip levels will be selectable from 1 to 18 times pickup in steps of 0.1. The setpoint message will appear as below. (The preceding discussion addresses the Ground Current Autoranging feature.)                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                                                                                       |                                                                                            | <div>GND INST TRIP 2<br/>LEVEL 3.0 X P/U</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 3.15                                                                                                                                | <div>GND INST TRIP<br/>DELAY INST</div> <div>GND HISET INST<br/>DELAY INST</div>           | <p>An intentional delay on the ground instantaneous trip is entered here, in the range of 0 to 40 cycles, in steps of 1 cycle. This prevents nuisance trips due to momentary high ground currents. Should the condition persist beyond the timed period the trip will occur. If 0 is selected, the message will display INST and there will be no intentional delay on the trip. There is, however, a 1 cyc delay which is necessary for the 565 relay to react to the fault condition. If any other value is entered within the above range, the trip will occur in the above reaction time plus the entered value.</p> <p>Definite Time characteristics can be implemented by using the ground instantaneous trip and the appropriate time delays. For example, the ground instantaneous trip can be enabled and a delay between 0–40 cycles programmed. This effectively will simulate a Definite Time curve.</p> |
| S 3.16                                                                                                                                | <div>GND HISET TRIP<br/>RELAY TRIP</div> <div>GND HISET INST<br/>RELAY TRIP&amp;AUX1</div> | <p>This message allows the user to select the relay which the trip signal generated in message S 3.14, will activate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>Messages S 3.17 to S 3.24 are specific to the 575 only. The remaining messages beginning with S 3.25 are for both the 565/575.</p> |                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| S 3.17                                                                                                                                | <div>GND AUTOBLK INST<br/>HISET DISABLED</div>                                             | <p>This setpoint allows the user to enable or disable the ground autoblock hiset feature.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p>Message S 3.18 will only appear if ENABLED is selected in message S 3.17.</p>                                                      |                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| S 3.18                                                                                                                                | <div>GND AUTOBLK HISET<br/>AFTER RECL.# 4</div>                                            | <p>The GND HISET TRIP will be blocked after the selected reclosure shot.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Location                                                                                                                                                                                                                                                                                                                                     | Message Line                        | Description                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 3.19                                                                                                                                                                                                                                                                                                                                       | GND LOSET INST<br>TRIPS ENABLED     | Set to ENABLED to enable loset ground element.                                                                                                                       |
| <i>Messages S 3.20 to S 3.24 will only appear if ENABLED is selected in message S 3.19.</i>                                                                                                                                                                                                                                                  |                                     |                                                                                                                                                                      |
| S 3.20                                                                                                                                                                                                                                                                                                                                       | GND LOSET INST<br>TRIP 2.0 X P/U    | Same as GND HISET INST TRIP feature.<br>Range: 1.0–7.0, increments of 0.5.                                                                                           |
| S 3.21                                                                                                                                                                                                                                                                                                                                       | GND LOSET INST<br>DELAY INST        | Same as GND HISET INST TRIP DELAY.<br>Range: 0–40 cycles.                                                                                                            |
| S 3.22                                                                                                                                                                                                                                                                                                                                       | GND LOSET INST<br>RELAY TRIP&AUX1   | Select the desired output contact(s) to activate on a GND LOSET INST trip.                                                                                           |
| S 3.23                                                                                                                                                                                                                                                                                                                                       | GND AUTOBLK INST<br>LOSET DISABLED  | This setpoint allows the user to enable or disable the ground autoblock loset feature.                                                                               |
| <i>Message S 3.24 will only appear if ENABLED is selected in message S 3.23.</i>                                                                                                                                                                                                                                                             |                                     |                                                                                                                                                                      |
| S 3.24                                                                                                                                                                                                                                                                                                                                       | GND AUTOBLK LOSET<br>AFTER RECL.# 4 | The G/F LOSET INST TRIP will be blocked after the selected reclosure shot.                                                                                           |
| <i>Messages S 3.25 and 3.26 will only appear if CUSTOM CURVE1 was selected in message S 3.6.</i>                                                                                                                                                                                                                                             |                                     |                                                                                                                                                                      |
| S 3.25<br>L <sub>A</sub>                                                                                                                                                                                                                                                                                                                     | TRIP TIME (SEC)<br>1.03 xPU= 1.0    | The trip time for the first breakpoint of the programmable curve for ground current protection is entered here. The breakpoints are multiples of the pickup current. |
| <i>The remainder of the messages in this section are identical to those in the phase current programmable curve setup. Follow all the same steps until message S 3.18 appears. When the time for this multiple of pickup is entered and stored, pressing the PAGE key will cause the display to move to the next page of setpoints mode.</i> |                                     |                                                                                                                                                                      |
| <i>NOTE: When the overload is greater than eight times pickup, the 575 will cause a Ground Timed Overcurrent Trip in the time programmed for an eight times overload. This is regardless of how the Custom Curve is programmed for overloads greater than eight times pickup.</i>                                                            |                                     |                                                                                                                                                                      |
| S 3.26<br>L <sub>A</sub>                                                                                                                                                                                                                                                                                                                     | TRIP TIME (SEC)<br>20.0 xPU= 1.0    | The trip time for the last breakpoint, a current of 20 times the pickup level is entered here.                                                                       |
| S 3.27                                                                                                                                                                                                                                                                                                                                       | GROUND CURRENT<br>END OF PAGE       | The last line of page 3, setpoints. Press the PAGE key to view page 4.                                                                                               |

## SETPOINTS MODE - CONFIGURATION



| Location                | Message Line                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |         |         |         |         |         |         |         |  |
|-------------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|---------|---------|---------|---------|---------|---------|---------|--|
| S 4.1                   | <div>SETPOINTS<br/>CONFIGURATION</div>                    | <p>The setpoints page 4 header. In this page, switch and relay characteristics are set up to suit the particular application. These switch inputs are provided on the 565 Relay back panel to accept external signals for customer use. The use of switches 1 to 8 is user definable. External switches can have either normally open (N.O) or normally closed (N.C) contacts. A normally open switch will have its contacts in the open (non-conducting) state under inactive conditions. Similarly, a normally closed switch will have its contacts closed (conducting) in the inactive state. This information must be given to the 565 Relay if it is to use these inputs. Other features such as the time and date are also setup on this page.</p>                                          |             |         |         |         |         |         |         |         |         |  |
| S 4.2                   | <div>SET        hh:mm:ss<br/>TIME       13:33:10</div>    | <p>The current time must be entered here in the following format:</p> <p>Hour:Minute:Second</p> <p>For example if the time is 33 minutes and 10 seconds past one in the afternoon, it would be entered as:</p> <p>13:33:10</p> <p>This time setting will not be lost if power supply to the 565 Relay is interrupted, because a lithium battery maintains the real time clock.</p>                                                                                                                                                                                                                                                                                                                                                                                                                |             |         |         |         |         |         |         |         |         |  |
| S 4.3                   | <div>SET        mm/dd/yy<br/>DATE      AUG 04, 1992</div> | <p>The current date must be entered in this message. The Relay will use this to keep a record of when trips occurred. The date setting is laid out in the following form:</p> <p>Month:Day:Year</p> <p>For example, if the date is the 4th of August 1992 then the following data would be entered:</p> <p>08:04:92</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |         |         |         |         |         |         |         |  |
| S 4.4<br>L <sub>A</sub> | <div>RESET BLOCKED<br/>DISABLED</div>                     | <p>This message allows the user to assign an external switch to the reset lockout function. This function assignment means that when the appropriate switch is active, it will stop a reset from occurring. This function can be used to provide an “interlock”. For example, it could be used to prevent a breaker closure after a trip without permission from a remote source.</p> <p>Select the intended switch for the function, using the NEXT CHOICE key. The switch choices are:</p> <table><tr><td>1) DISABLED</td><td>6) SW.5</td></tr><tr><td>2) SW.1</td><td>7) SW.6</td></tr><tr><td>3) SW.2</td><td>8) SW.7</td></tr><tr><td>4) SW.3</td><td>9) SW.8</td></tr><tr><td>5) SW.4</td><td></td></tr></table> <p>The complete list of function/switch setpoints is shown as follows:</p> | 1) DISABLED | 6) SW.5 | 2) SW.1 | 7) SW.6 | 3) SW.2 | 8) SW.7 | 4) SW.3 | 9) SW.8 | 5) SW.4 |  |
| 1) DISABLED             | 6) SW.5                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |         |         |         |         |         |         |         |  |
| 2) SW.1                 | 7) SW.6                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |         |         |         |         |         |         |         |  |
| 3) SW.2                 | 8) SW.7                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |         |         |         |         |         |         |         |  |
| 4) SW.3                 | 9) SW.8                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |         |         |         |         |         |         |         |  |
| 5) SW.4                 |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |         |         |         |         |         |         |         |  |
| S 4.5<br>L <sub>A</sub> | <div>BLOCK INST TRIPS<br/>DISABLED</div>                  | <p>This setpoint will stop an instantaneous trip from occurring when the switch is active.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |         |         |         |         |         |         |         |  |
| S 4.6<br>L <sub>A</sub> | <div>BLOCK TIMED O/C<br/>TRIPS        DISABLED</div>      | <p>If a switch is assigned this function it will stop all timed overcurrent trips when the switch is active.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |         |         |         |         |         |         |         |         |  |

| Location                                                                                                             | Message Line                                           | Description                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.7                                                                                                                | <div>BLOCK GND TRIPS<br/>DISABLED</div>                | If this function is assigned, all ground tripping is blocked for the length of time the external switch is active.                                                                                                                                                                                                                                         |
| S 4.8<br>L <sub>A</sub>                                                                                              | <div>DEFINITE TIME #1<br/>ALARM      DISABLED</div>    | This function will assign a time delayed alarm to the selected switch. The switch will then have to be held active for the programmed delay time before an alarm occurs.                                                                                                                                                                                   |
| Message S 4.9 and S 4.10 will only appear if the Definite Time function in message S 4.8 is assigned to a switch.    |                                                        |                                                                                                                                                                                                                                                                                                                                                            |
| S 4.9<br>L <sub>A</sub>                                                                                              | <div>DEFINITE TIME #1<br/>DELAY        1 SEC</div>     | This message asks for any time delay needed on the operation of the switch. This means that if one of the internal relays is to be energized by this switch it will only be energized if the switch is activated for the assigned time. The range for this setpoint is 1 to 255 seconds, in steps of 1 second.                                             |
| S 4.10<br>L <sub>A</sub>                                                                                             | <div>DEFINITE TIME #1<br/>RELAY        AUX2</div>      | The switch being configured can be used to activate one of the internal relays in the 565 Relay. This message is asking you to select the relay or relays which the definite time function will activate. There are two relays to which the signal can be sent, called Aux.1 and 2. See Relay selection section for details of how to make this selection. |
| S 4.11<br>L <sub>A</sub>                                                                                             | <div>DEFINITE TIME #2<br/>ALARM      DISABLED</div>    | This function will assign a time delayed alarm to the selected switch. The switch will then have to be held active for the programmed delay time before an alarm occurs.                                                                                                                                                                                   |
| Messages S 4.12 and S 4.13 will only appear if the Definite Time function in message S 4.11 is assigned to a switch. |                                                        |                                                                                                                                                                                                                                                                                                                                                            |
| S 4.12<br>L <sub>A</sub>                                                                                             | <div>DEFINITE TIME #2<br/>DELAY        1 SEC</div>     | Enter the amount of time the above switch must be active before an alarm will occur.                                                                                                                                                                                                                                                                       |
| S 4.13<br>L <sub>A</sub>                                                                                             | <div>DEFINITE TIME #2<br/>RELAY        AUX2</div>      | Enter which output relay will activate when the above alarm occurs.                                                                                                                                                                                                                                                                                        |
| S 4.14<br>L <sub>A</sub>                                                                                             | <div>EXTERNAL TRIP #1<br/>DISABLED</div>               | If this function is assigned to a switch then it will cause the input to act as an external trip for the feeder breaker. External trip devices are called "3T" devices.                                                                                                                                                                                    |
| (575)                                                                                                                | <div>EXTERNAL TRIP<br/>DISABLED</div>                  |                                                                                                                                                                                                                                                                                                                                                            |
| Messages S 4.15 and S 4.16 will appear only if the External Trip function in message S 4.14 is assigned to a switch. |                                                        |                                                                                                                                                                                                                                                                                                                                                            |
| S 4.15<br>L <sub>A</sub>                                                                                             | <div>EXTERNAL TRIP #1<br/>RELAY    TRIP&amp;AUX1</div> | Enter which output relay will activate when the above trip occurs.                                                                                                                                                                                                                                                                                         |
| (575)                                                                                                                | <div>EXTERNAL TRIP<br/>RELAY    TRIP&amp;AUX1</div>    |                                                                                                                                                                                                                                                                                                                                                            |

## SETPOINTS MODE - CONFIGURATION



| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

The following are messages specific to the 565; messages specific to the 575 will be indicated as required.

|                          |                                 |                                                                                                                                                                                                                                                                                                                     |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.16<br>L <sub>A</sub> | EXTERNAL TRIP #1<br>DELAY 0 CYC | This message asks for any time delay needed on the operation of the switch. This means that if one of the internal relays is to be energized by this switch it will only be energized if the switch is activated for the assigned time. The range for this setpoint is 0 (Inst.) to 60 cycles, in steps of 1 cycle. |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                          |                              |                                                                                                                          |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| S 4.17<br>L <sub>A</sub> | EXTERNAL TRIP #2<br>DISABLED | If this function is assigned to a switch then it will cause the input to act as an external trip for the feeder breaker. |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------|

Message S 4.18 and S 4.19 will appear only if the External Trip function in message S 4.17 is assigned to a switch.

|                          |                                     |                                                                    |
|--------------------------|-------------------------------------|--------------------------------------------------------------------|
| S 4.18<br>L <sub>A</sub> | EXTERNAL TRIP #2<br>RELAY TRIP&AUX1 | Enter which output relay will activate when the above trip occurs. |
|--------------------------|-------------------------------------|--------------------------------------------------------------------|

|                          |                                 |                                                                                                                                                                                                                                                                                                                     |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.19<br>L <sub>A</sub> | EXTERNAL TRIP #2<br>DELAY 0 CYC | This message asks for any time delay needed on the operation of the switch. This means that if one of the internal relays is to be energized by this switch it will only be energized if the switch is activated for the assigned time. The range for this setpoint is 0 (Inst.) to 60 cycles, in steps of 1 cycle. |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                          |                              |                                                                                                                          |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| S 4.20<br>L <sub>A</sub> | EXTERNAL TRIP #3<br>DISABLED | If this function is assigned to a switch then it will cause the input to act as an external trip for the feeder breaker. |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------|

Message S 4.21 and S 4.22 will appear only if the External Trip function in message S 4.20 is assigned to a switch.

|                          |                                     |                                                                    |
|--------------------------|-------------------------------------|--------------------------------------------------------------------|
| S 4.21<br>L <sub>A</sub> | EXTERNAL TRIP #3<br>RELAY TRIP&AUX1 | Enter which output relay will activate when the above trip occurs. |
|--------------------------|-------------------------------------|--------------------------------------------------------------------|

|                          |                                 |                                                                                                                                                                                                                                                                                                                     |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.22<br>L <sub>A</sub> | EXTERNAL TRIP #3<br>DELAY 0 CYC | This message asks for any time delay needed on the operation of the switch. This means that if one of the internal relays is to be energized by this switch it will only be energized if the switch is activated for the assigned time. The range for this setpoint is 0 (Inst.) to 60 cycles, in steps of 1 cycle. |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                          |                              |                                                                                                                          |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| S 4.23<br>L <sub>A</sub> | EXTERNAL TRIP #4<br>DISABLED | If this function is assigned to a switch then it will cause the input to act as an external trip for the feeder breaker. |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------|

Messages S 4.24 and S 4.25 will appear only if the External Trip function in message S 4.23 is assigned to a switch.

|                          |                                     |                                                                    |
|--------------------------|-------------------------------------|--------------------------------------------------------------------|
| S 4.24<br>L <sub>A</sub> | EXTERNAL TRIP #4<br>RELAY TRIP&AUX1 | Enter which output relay will activate when the above trip occurs. |
|--------------------------|-------------------------------------|--------------------------------------------------------------------|

|                          |                                 |                                                                                                                                                                                                                                                                                                                     |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.25<br>L <sub>A</sub> | EXTERNAL TRIP #4<br>DELAY 0 CYC | This message asks for any time delay needed on the operation of the switch. This means that if one of the internal relays is to be energized by this switch it will only be energized if the switch is activated for the assigned time. The range for this setpoint is 0 (Inst.) to 60 cycles, in steps of 1 cycle. |
|--------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                          |                              |                                                                                                                                                                                                                                                                                                                 |
|--------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.26<br>L <sub>A</sub> | CURVE ADJUSTMENT<br>DISABLED | If an external switch is assigned this function then the timed overcurrent curve in use will not start to time out until the current is above pickup by 10%. Essentially, the bottom part of the curve that falls between 100 and 110% disappears, yet the time to trip above this level would remain the same. |
|--------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Location                                                                                                                        | Message Line                         | Description                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>The following messages pertain to the 575.</i>                                                                               |                                      |                                                                                                                                                                                                                                                                                                                                                   |
| S 4.16                                                                                                                          | RECLOSABLE TRIP<br>DISABLED          | This function will provide an instantaneous trip that will allow the reclosing scheme to initiate/continue through the reclosure.                                                                                                                                                                                                                 |
| <i>Message S 4.17 will appear only if the Reclosable Trip function in message S 4.16 is assigned to a switch.</i>               |                                      |                                                                                                                                                                                                                                                                                                                                                   |
| S 4.17                                                                                                                          | RECLOSABLE TRIP<br>RELAY TRIP&AUX1   | Enter which output relay will activate when the above trip occurs.                                                                                                                                                                                                                                                                                |
| S 4.18                                                                                                                          | PROGRAMMABLE TRIP<br>DISABLED        | This function will provide an instantaneous trip that will or will not allow the reclosing scheme to initiate/continue depending on setpoint S 4.20.                                                                                                                                                                                              |
| <i>Messages S 4.19 and S 4.20 will only appear if the Programmable Trip function in message S 4.18 is assigned to a switch.</i> |                                      |                                                                                                                                                                                                                                                                                                                                                   |
| S 4.19                                                                                                                          | PROGRAMMABLE TRIP<br>RELAY TRIP&AUX1 | Enter which output relay(s) will activate when the above trip occurs.                                                                                                                                                                                                                                                                             |
| S 4.20                                                                                                                          | PROGRAMMABLE TRIP<br>TYPE NON-RECLS  | This setpoint allows you to define this function to allow the reclosing scheme to initiate/continue or go straight to lockout.                                                                                                                                                                                                                    |
| S 4.21                                                                                                                          | CURVE ADJUSTMENT<br>DISABLED         | If an external switch is assigned this function then the timed overcurrent curve in use will not start to time out until the current is above pickup by 10%. Essentially, the bottom part of the curve that falls between 100 and 110% disappears, yet the time to trip above this level would remain the same.                                   |
| S 4.22                                                                                                                          | ALTERNATE PHASE<br>CURVE DISABLED    | This function will switch the phase overcurrent curve to an alternative programmed curve after the specified autoreclosure shot if the assigned switch is active. Curve 1 is restored once autoreclosure reaches lockout or the scheme resets. This curve changeover will occur automatically if phase curve change is enabled in message S 13.2. |
| S 4.23                                                                                                                          | ALTERNATE GROUND<br>CURVE DISABLED   | This function is the same as described above except it acts upon the ground overcurrent curve.                                                                                                                                                                                                                                                    |
| S 4.24                                                                                                                          | AUTO-RECLOSURE<br>BLOCK DISABLED     | When active, all reclosures are blocked.                                                                                                                                                                                                                                                                                                          |
| S 4.25<br>(565/575)                                                                                                             | EXTERNAL RESET<br>DISABLED           | This input operates just as the front RESET key would operate.                                                                                                                                                                                                                                                                                    |
| S 4.26<br>(565/575)                                                                                                             | SW.1 CONTACT:<br>NORMALLY OPEN       | This message allows the contact sense of the selected switch to be entered into the 565 Relay's memory. Determine whether the switch is normally open or normally closed from the manufacturer's data or system wiring diagram.                                                                                                                   |
| When switch 1 contact sense has been assigned, message S 4.28 will repeat for switches 2 through 8.                             |                                      |                                                                                                                                                                                                                                                                                                                                                   |

## SETPOINTS MODE - CONFIGURATION



Location      Message Line      Description

|        |             |
|--------|-------------|
| S 4.27 | TRIP RELAY  |
| (565)  | PULSED      |
|        | AUX 1 RELAY |
| (575)  | PULSED      |

This display indicates that the Trip relay is ready to have its mode of operation set up. This controls whether the relay will operate in a pulsed or latched mode, as follows:

### Pulsed Operation

If pulsed operation is selected, the Trip relay is energized and the pulse timer is initiated upon a trip declaration. If the fault current drops below pick up before the pulse timer expires, this is taken as an indication that the breaker has opened successfully. In this case, the Trip relay will become de-energized when the pulse time does expire. Note that this pulse time, which is programmed in message S4.30, will be the minimum amount of time that the Trip relay will remain energized. On the other hand, if the pulse timer expires before the fault current drops below pick up, the relay will remain energized. When the fault current eventually drops below pick up, the 565 seal-in timer is initiated. After this 2.5 - 3.5 cycle seal-in delay elapses, the Trip relay de-energizes.

**NOTE: The 565 relays are not designed to regularly break inductive current. Pulsed relay becomes latched to act as the seal-in contact as used in electromechanical relays.**

| CONDITION                  | OUTPUT TRIP RELAY | FACEPLATE TRIP LED | MODBUS READ EXCEPTION STATUS |
|----------------------------|-------------------|--------------------|------------------------------|
| NO TRIP                    | DE-ENERGIZED      | OFF                | 00H                          |
| TRIPPED<br>(Current > P/U) | ENERGIZED         | ON                 | 88H                          |
| TRIPPED<br>(Current < P/U) | DE-ENERGIZED      | FLASHING           | 08H                          |
| KEYPAD RESET               | DE-ENERGIZED      | OFF                | 00H                          |

### Latched Operation

If latched operation is chosen for the Trip relay, it will energize when a trip occurs. Pressing the RESET key on the front panel will unlatch the Trip relay only if the current is below the programmed trip level. This may be convenient if the relay is being used to annunciate a fault condition.

| CONDITION                         | OUTPUT TRIP RELAY | FACEPLATE TRIP LED | MODBUS READ EXCEPTION STATUS |
|-----------------------------------|-------------------|--------------------|------------------------------|
| NO TRIP                           | DE-ENERGIZED      | OFF                | 00H                          |
| TRIPPED<br>(Current > Trip Level) | ENERGIZED         | ON                 | 88H                          |
| TRIPPED<br>(Current < Trip Level) | ENERGIZED         | ON                 | 88H                          |
| KEYPAD RESET                      | DE-ENERGIZED      | OFF                | 00H                          |

Message S 4.28 will only appear if pulsed operation is assigned to the Trip relay.

|        |                   |
|--------|-------------------|
| S 4.28 | TRIP RELAY PULSE  |
| (565)  | TIME      0.6 SEC |

This message allows the user to set the length of the pulse for the Trip relay when selected for pulse operation. The pulse time controls the minimum length of time that the relay will be energized. The range of values for this setpoint is 0.1 to 0.6 seconds in steps of 0.1 seconds.

**NOTE: The 565 Trip relay does not look at the status of the 52a/52b**

| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

contacts.

Message S 4.29 will only appear if pulsed operation is assigned to the Aux. 1 relay.

|        |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.29 | AUX1 RELAY PULSE<br>TIME 0.1 SEC | This message allows the user to set the length of the pulse for the Trip relay when selected for pulse operation. The pulse time controls the minimum length of time that the relay will be energized. The range of values for this setpoint is 0.1 to 0.6 seconds in steps of 0.1 seconds. Aux. 1 will act as Trip Annunciate with Trip & Aux. 1 acting together when a trip function is programmed to Trip & Aux. 1. |
| (575)  |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                        |

|        |                          |                                                                                                                                                                 |
|--------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.30 | AUX 2 RELAY<br>UNLATCHED | As with the Aux. 1 relay, this setpoint allows the mode of operation for the Aux. 2 relay to be selected. The available modes are pulsed, latched or unlatched. |
| (575)  |                          |                                                                                                                                                                 |

|        |                          |                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.31 | AUX 1 RELAY<br>UNLATCHED | This setpoint allows the user to select the mode of operation for the Aux 1 relay. The available modes are pulsed, latched, or unlatched. If the Aux 1 relay is programmed as pulsed, only trip conditions should be assigned to it. When programmed in this pulsed mode, Aux 1 is intended to be used as a trip follower. Alarm conditions assigned to a pulsed Aux 1 will only reset if the breaker is open. |
| (565)  |                          |                                                                                                                                                                                                                                                                                                                                                                                                                |

#### Pulsed Operation

If pulsed operation is selected, the Aux 1 relay is energized and the pulse timer is initiated upon a trip/alarm declaration. In order for the 565 to determine that the breaker has opened successfully, two conditions must be met. First, the fault current must be below pick up. Secondly, either the 52a contact must be detected as open or the 52b contact must be detected as closed. When this happens before the pulse timer expires, the Aux 1 relay will become de-energized when the pulse time does expire. Note that this pulse time which is programmed in message S4.32 will be the minimum amount of time that the trip relay will remain energized. On the other hand, if the pulse timer expires before the fault current drops below pick up and the 52a/52b contacts respond, the relay will remain energized. When these two conditions eventually occur, the 565 seal-in timer is initiated. After this 2.5 - 3.5 cycle seal-in delay elapses, the Aux 1 relay de-energizes.

| CONDITION                                  | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|--------------------------------------------|---------------------|----------------------|------------------------------|
| NO TRIP                                    | DE-ENERGIZED        | OFF                  | 00H                          |
| TRIPPED<br>(Current > P/U)                 | ENERGIZED           | ON                   | 44H                          |
| TRIPPED<br>(Current < P/U)<br>(Brkr. Open) | DE-ENERGIZED        | FLASHING             | 04H                          |
| KEYPAD RESET                               | DE-ENERGIZED        | OFF                  | 00H                          |

## SETPOINTS MODE - CONFIGURATION



Location      Message Line      Description

| CONDITION                                            | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|------------------------------------------------------|---------------------|----------------------|------------------------------|
| NO ALARM                                             | DE-ENERGIZED        | OFF                  | 00H                          |
| ALARM<br>(Alarm Level < Curr. < P/U)<br>(Brkr. Open) | PULSES              | ON                   | 40H                          |
| ALARM<br>(Curr. > Alarm & P/U Level)                 | ENERGIZED           | OFF                  | 40H                          |
| ALARM<br>(Curr. < Alarm & P/U Level)<br>(Brkr. Open) | DE-ENERGIZED        | OFF                  | 00H                          |
| KEYPAD RESET                                         | DE-ENERGIZED        | OFF                  | 00H                          |

### Latched

If latched operation is chosen for the Aux 1 relay, it will energize when a trip/alarm occurs. Pressing the RESET key on the front panel will unlatch the Aux 1 relay only if the fault current is below the trip/alarm level. This may be convenient if the relay is being used to annunciate a fault condition. When programmed as latched, the Aux 1 relay does not look at the 52a/52b contacts.

| CONDITION                         | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|-----------------------------------|---------------------|----------------------|------------------------------|
| NO TRIP                           | DE-ENERGIZED        | OFF                  | 00H                          |
| TRIPPED<br>(Current > Trip Level) | ENERGIZED           | ON                   | 44H                          |
| TRIPPED<br>(Current < Trip Level) | ENERGIZED           | ON                   | 44H                          |
| KEYPAD RESET                      | DE-ENERGIZED        | OFF                  | 00H                          |

| CONDITION                        | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|----------------------------------|---------------------|----------------------|------------------------------|
| NO ALARM                         | DE-ENERGIZED        | OFF                  | 00H                          |
| ALARM<br>(Current > Alarm Level) | ENERGIZED           | ON                   | 40H                          |
| ALARM<br>(Current < Alarm Level) | ENERGIZED           | ON                   | 40H                          |
| KEYPAD RESET                     | DE-ENERGIZED        | OFF                  | 00H                          |

### Unlatched

If unlatched operation is selected, the Aux 1 relay becomes energized upon declaration of a fault/ alarm condition. When current drops below the alarm/trip level, the relay will de-energize. When programmed as unlatched, the Aux 1 relay does not look at the 52a/52b contacts.

Location      Message Line      Description

| CONDITION                         | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|-----------------------------------|---------------------|----------------------|------------------------------|
| NO TRIP                           | DE-ENERGIZED        | OFF                  | 00H                          |
| TRIPPED<br>(Current > Trip Level) | ENERGIZED           | ON                   | 44H                          |
| TRIPPED<br>(Current < Trip Level) | DE-ENERGIZED        | FLASHING             | 04H                          |
| KEYPAD RESET                      | DE-ENERGIZED        | OFF                  | 00H                          |

| CONDITION                        | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|----------------------------------|---------------------|----------------------|------------------------------|
| NO ALARM                         | DE-ENERGIZED        | OFF                  | 00H                          |
| ALARM<br>(Current > Alarm Level) | ENERGIZED           | ON                   | 40H                          |
| ALARM<br>(Current < Alarm Level) | DE-ENERGIZED        | OFF                  | 00H                          |
| KEYPAD RESET                     | DE-ENERGIZED        | OFF                  | 00H                          |

Message S4.32 will only appear if pulsed operation is assigned to the Aux 1 relay.

S 4.32

(565)

AUX1 RELAY PULSE  
TIME      0.6 SEC

This message allows the user to set the length of the pulse for the Aux 1 relay when selected for pulse operation. The pulse time controls the minimum length of time that the relay will be energized. The range of values for this setpoint is 0.1 to 0.6 seconds in steps of 0.1 seconds.

Message S4.33 will only appear if pulsed operation is assigned to the Aux . 2 relay.

S 4.33

(575)

AUX2 RELAY PULSE  
TIME      0.6 SEC

As with the Aux. 1 relay, this message allows the user to set the length of the pulse for the Aux. 2 relay.

S 4.34

AUX 2 RELAY  
UNLATCHED

This setpoint allows the user to select the mode of operation for the Aux 2 relay. The available modes are pulsed, latched or unlatched. The Aux 2 relay does not look at the 52a/52b contacts. **If the Aux 2 relay is programmed as pulsed, only alarm conditions should be assigned to it.**

#### Pulsed Operation

If pulsed operation is selected and a fault condition develops, the Aux 2 relay is energized and de-energized repeatedly. The rate at which the Aux 2 relay toggles is determined by the Aux 2 relay pulse timer setpoint S 4.34. Only when the fault current drops below pick up will Aux 2 relay stop pulsating.

# SETPOINTS MODE - CONFIGURATION



Location      Message Line      Description

| CONDITION                  | OUTPUT<br>AUX. 2 RELAY | FACEPLATE<br>AUX. 2 LED | MODBUS READ EXCEPTION<br>STATUS |
|----------------------------|------------------------|-------------------------|---------------------------------|
| NO TRIP                    | DE-ENERGIZED           | OFF                     | 00H                             |
| TRIPPED<br>(Current > P/U) | PULSES                 | ON                      | 22H                             |
| TRIPPED<br>(Current < P/U) | DE-ENERGIZED           | FLASHING                | 02H                             |
| KEYPAD RESET               | DE-ENERGIZED           | OFF                     | 00H                             |

| CONDITION                        | OUTPUT<br>AUX. 2 RELAY | FACEPLATE<br>AUX. 2 LED | MODBUS READ EXCEPTION<br>STATUS |
|----------------------------------|------------------------|-------------------------|---------------------------------|
| NO ALARM                         | DE-ENERGIZED           | OFF                     | 00H                             |
| ALARM<br>(Current > Alarm Level) | PULSES                 | ON                      | 20H                             |
| ALARM<br>(Current < Alarm Level) | DE-ENERGIZED           | OFF                     | 00H                             |
| KEYPAD RESET                     | DE-ENERGIZED           | OFF                     | 00H                             |

## Latched

If latched operation is chosen for the Aux 2 relay, it will energize when a trip occurs. Pressing the RESET key on the front panel will unlatch the Aux 2 relay only if the fault current is below pick up. This may be convenient if the relay is being used to annunciate a fault condition.

| CONDITION                         | OUTPUT<br>AUX. 2 RELAY | FACEPLATE<br>AUX. 2 LED | MODBUS READ EXCEPTION<br>STATUS |
|-----------------------------------|------------------------|-------------------------|---------------------------------|
| NO TRIP                           | DE-ENERGIZED           | OFF                     | 00H                             |
| TRIPPED<br>(Current > Trip Level) | ENERGIZED              | ON                      | 22H                             |
| TRIPPED<br>(Current < Trip Level) | ENERGIZED              | ON                      | 22H                             |
| KEYPAD RESET                      | DE-ENERGIZED           | OFF                     | 00H                             |

| CONDITION                        | OUTPUT<br>AUX. 2 RELAY | FACEPLATE<br>AUX. 2 LED | MODBUS READ EXCEPTION<br>STATUS |
|----------------------------------|------------------------|-------------------------|---------------------------------|
| NO ALARM                         | DE-ENERGIZED           | OFF                     | 00H                             |
| ALARM<br>(Current > Alarm Level) | ENERGIZED              | ON                      | 20H                             |
| ALARM<br>(Current < Alarm Level) | ENERGIZED              | ON                      | 20H                             |
| KEYPAD RESET                     | DE-ENERGIZED           | OFF                     | 00H                             |

## Unlatched

If unlatched operation is selected, the Aux 2 relay becomes energized upon declaration of a fault condition. When current drops below pick up, the relay will de-energize.

Location      Message Line      Description

| CONDITION                         | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|-----------------------------------|---------------------|----------------------|------------------------------|
| NO TRIP                           | DE-ENERGIZED        | OFF                  | 00H                          |
| TRIPPED<br>(Current > Trip Level) | ENERGIZED           | ON                   | 22H                          |
| TRIPPED<br>(Current < Trip Level) | DE-ENERGIZED        | FLASHING             | 02H                          |
| KEYPAD RESET                      | DE-ENERGIZED        | OFF                  | 00H                          |

| CONDITION                        | OUTPUT AUX. 1 RELAY | FACEPLATE AUX. 1 LED | MODBUS READ EXCEPTION STATUS |
|----------------------------------|---------------------|----------------------|------------------------------|
| NO ALARM                         | DE-ENERGIZED        | OFF                  | 00H                          |
| ALARM<br>(Current > Alarm Level) | ENERGIZED           | ON                   | 20H                          |
| ALARM<br>(Current < Alarm Level) | DE-ENERGIZED        | OFF                  | 00H                          |
| KEYPAD RESET                     | DE-ENERGIZED        | OFF                  | 00H                          |

Message S4.34 will only appear if pulsed operation is assigned to the Aux 2 relay.

S 4.35

**AUX2 RELAY PULSE  
TIME      0.6 SEC**

This message allows the user to set the length of the pulse for the Aux 2 relay when selected for pulse operation. The pulse time controls the minimum length of time that the relay will be energized. The range of values for this setpoint is 0.1 to 0.6 seconds in steps of 0.1 seconds.

**Note: The Auxiliary 3 relay is failsafe and designed to operate in an unlatched mode only. It is not programmable.**

| CONDITION                   | OUTPUT AUX. 3 RELAY | FACEPLATE AUX. 3 LED | MODBUS READ EXCEPTION STATUS |
|-----------------------------|---------------------|----------------------|------------------------------|
| NO ALARM                    | ENERGIZED           | OFF                  | 00H                          |
| ALARM<br>(Open Trip Coil)   | DE-ENERGIZED        | ON                   | 10H                          |
| ALARM<br>(Closed Trip Coil) | ENERGIZED           | OFF                  | 00H                          |
| KEYPAD RESET                | ENERGIZED           | OFF                  | 00H                          |

S 4.36

**BREAKER RESPONSE  
DELAY      1 mS**

This setpoint allows the user to enter the actual delay between the time when the trip contact closure is sent to the breaker and the opening of the breaker contacts. After the time delay specified, the 565/575 will begin to accumulate the KA<sup>2</sup> value of the breaker interruption. Determine this quantity from the breaker manufacturer's data of breaker opening time. The range of values which may be entered is 1 to 167 mS.

S 4.37

**BREAKER DISCREP.  
DISABLED**

This message asks if you want the Breaker Discrepancy Alarm ENABLED or DISABLED (Aux4). This feature monitors the 52a and 52b breaker auxiliary contact and gives an alarm indication in two possible situations:

a) The TRIP relay was activated but the breaker remained closed.

## SETPOINTS MODE - CONFIGURATION



| Location                                                                                             | Message Line                        | Description                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                      |                                     | b) The CLOSE relay was activated but the breaker remained open.<br><br>A breaker discrepancy causes the reclosure scheme to immediately lockout.                                                                                                                                                        |
|                                                                                                      | OPTION NOT AVAILABLE                | This message appears if ENABLED is selected in S 4.36 but the 565 does not have the option card installed.                                                                                                                                                                                              |
| <i>Message S 4.38 will only appear if enable is selected and stored in message S 4.36.</i>           |                                     |                                                                                                                                                                                                                                                                                                         |
| S 4.38                                                                                               | BREAKER DISCREP.<br>DELAY 1000 mS   | This setpoint defines the amount of time that the breaker has to clear a fault. If the 52b contact does not respond after this time, a Breaker Discrepancy Alarm occurs and Aux 4 output is activated.                                                                                                  |
| S 4.39                                                                                               | TRIP COIL SUPER-<br>VISION DISABLED | This feature allows a small current to flow through the trip coil of the breaker to ensure it is continuous and the breaker will trip when called to do so. The function is only active when the breaker is closed. If the current flow is less than 0.8 mA, the failsafe Aux 3 relay will de-energize. |
|                                                                                                      | OPTION NOT AVAILABLE                | This message appears if ENABLED is selected in S 4.39 but the 565 does not have the option card installed.                                                                                                                                                                                              |
| S 4.40                                                                                               | ACCUMULATED KA<br>ALARM DISABLED    | This message asks if you want the accumulated KA <sup>2</sup> alarm enabled or disabled.                                                                                                                                                                                                                |
| <i>Messages S 4.40 and 4.41 will only appear if enable is selected and stored in message S 4.39.</i> |                                     |                                                                                                                                                                                                                                                                                                         |
| S 4.41                                                                                               | ACCUMULATED KA<br>ALARM 5000        | The accumulated KA <sup>2</sup> alarm level is entered here in the range of 5000 to 100000 in steps of 10. This accumulated value gives an indication of breaker pole wear and the alarm can be used to indicate when an inspection should occur.                                                       |
| S 4.42                                                                                               | KA ALARM RELAY<br>AUX1              | This message allows the user to select the relay which the alarm signal generated in message S 4.39 will activate.                                                                                                                                                                                      |
| S 4.43                                                                                               | EVENT RECORDING:<br>ENABLED         | This message allows the user to enable/disable the built in event recorder. The event recorder in the 575 will also recognize all events associated with autoreclosure. These include: trips, reclosures, alarms and lockout.                                                                           |
| L <sub>A</sub>                                                                                       | OPTION NOT AVAILABLE                | This message appears if ENABLED is selected in S 4.43 but the 565 does not have the option card installed.                                                                                                                                                                                              |
| S 4.44                                                                                               | EVENT PRINTING:<br>OFFLINE          | This message allows users to choose whether to print events as they occur or not. If ONLINE is selected, each event is printed as it occurs.                                                                                                                                                            |
| L <sub>A</sub>                                                                                       |                                     |                                                                                                                                                                                                                                                                                                         |
| S 4.45                                                                                               | COLD LOAD P/U<br>BLOCK LOSET        | This setpoint allows the user to select whether LOWSET, HIGHSET, or BOTH types of instantaneous trips should be blocked after a manual breaker close.                                                                                                                                                   |
| L <sub>A</sub> (575)                                                                                 |                                     |                                                                                                                                                                                                                                                                                                         |
| S 4.45                                                                                               | COLD LOAD P/U<br>DELAY 0.0 SEC      | The time period after a manual breaker closure for which instantaneous phase and ground trips will be blocked is entered here. The range is 0 to 10 seconds in steps of 0.1 seconds. Entering a value of 0.0 disables this feature.                                                                     |
| L <sub>A</sub>                                                                                       |                                     |                                                                                                                                                                                                                                                                                                         |

| Location | Message Line                 | Description                                                                                                                                         |
|----------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| S 4.46   | MTM COMM. :<br>ENABLED       | This message allows the user to enable or disable the Metering Transducer Module (MTM) communications. <i>** Available only with Option Card **</i> |
| S 4.47   | CONFIGURATION<br>END OF PAGE | The last line of page 4, setpoints. Press the PAGE key to view page 5.                                                                              |

## SETPOINTS MODE - ANALOG INPUT



| Location                | Message Line              | Description                                                                                            |
|-------------------------|---------------------------|--------------------------------------------------------------------------------------------------------|
| S 5.1<br>L <sub>A</sub> | SETPOINTS<br>ANALOG INPUT | The setpoints page 5 header. This page allows the setpoints related to the analog input to be entered. |
| S 5.2<br>L <sub>A</sub> | ANALOG INPUT:<br>DISABLED | This message allows the user to enable or disable the analog input function.                           |

Only message S 5.17 will appear if DISABLED is selected in message 5.2.

|                         |                                |                                                                                                                                                                                                                                                              |
|-------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 5.3<br>L <sub>A</sub> | EDIT ANALOG<br>INPUT TITLE? NO | This setpoint allows the user to enter any name of up to 16 characters, for the analog input. This name will then appear in the relevant displays. Use the NEXT CHOICE key to select YES and store this, if you intend to assign a name to the analog input. |
|-------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

If YES is selected in message S 5.3, a brief description on how to store titles is displayed followed by message S 5.4.

|                         |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 5.4<br>L <sub>A</sub> | ___ USER TITLE | The display shows that the 565 Relay is ready to have the analog input name assigned. Press the LINE UP or LINE DOWN key to display each letter of the alphabet, one at a time. When the desired letter is displayed, press the NEXT CHOICE key to move the cursor to the next position. Repeat the same procedure for each additional letter of the title. Once the complete title is displayed, press the STORE key to save it in the 565 memory. After the STORE key has been pressed, the screen will return to message S 5.3. |
|-------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                         |                                |                                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 5.5<br>L <sub>A</sub> | EDIT ANALOG<br>INPUT UNITS? NO | This setpoint allows the user to enter any name of up to 8 characters, for the analog input unit. This name will then appear in the relevant displays. Use the NEXT CHOICE key to select YES and store this, if you intend to assign a name to the analog input units. |
|-------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

If YES is selected in message S 5.5 a brief description on how to store units is displayed followed by message S 5.6.

|                         |       |                                                                                                                                                                                                                                                                                                        |
|-------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 5.6<br>L <sub>A</sub> | UNITS | This display appears when the 565 Relay is ready to have the analog input unit name assigned. Enter the required unit name, such as "DEG C" on the left hand side of the display, as described in message S 5.4. When the last character is displayed, press the STORE key to return to message S 5.5. |
|-------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                         |                               |                                                                                                                                                                                         |
|-------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 5.7<br>L <sub>A</sub> | MIN CURR SCALE<br>VALUE: 4.00 | The 565 Relay has the ability to accept an analog input signal in the range of 4-20 mA and this display asks for the scale factor which you intend to use for the minimum analog input. |
|-------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The quantity being monitored might be the temperature of a transformer on the feeder. This input can be used to initiate alarms if it exceeds safe levels. A scale factor can be chosen to change the displayed value from milliamps to degrees centigrade. The use of the minimum scale factor is shown by the following example. The 565 Relay logic is configured so that the value which you will see displayed when the analog signal is 4 mA will be the scale factor minimum value. Refer to the manufacturer's instructions for the monitor or device to determine the temperature (or other quantity) corresponding to its 4 mA output.

If this value is 50 degrees centigrade, for example, then set the minimum scale factor at 50. Now when a 4 mA input is presented to the 565 Relay it will display 50 indicating a temperature, which is more useful than a milliamp reading.

The range of possible values for the minimum scale factor is 0 to 1023 in

| Location                                                                                  | Message Line                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                           |                                            | steps of 0.01. When the minimum scale factor has been set press STORE to place the value in the 565 memory.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| S 5.8<br>L <sub>A</sub>                                                                   | <div>MAX CURR SCALE<br/>VALUE: 20.00</div> | <p>This display asks for the scale factor which you intend to use for the maximum analog input. In a similar way to the minimum scale factor, the maximum scale factor is used to set the value which will be displayed when the analog signal into the relay is 20 mA. Again, refer to the manufacturer's instructions for the monitor or device which you intend to use to determine the magnitude of the temperature (or other quantity) corresponding to its 20 mA output. Set the maximum scale value to this figure. Now, when a 20 mA input is presented to the 565 Relay it will display this figure, indicating a temperature for example, rather than a mA reading. The range of possible values for the maximum scale factor is 0 to 1023 in steps of 0.01.</p> <p>Once the minimum and maximum scale factors are set the 565 Relay logic will ensure that all milliamp values between these two will be linearly displayed.</p> |
| S 5.9<br>L <sub>A</sub>                                                                   | <div>ANALOG INPUT<br/>TRIP DISABLED</div>  | <p>This message allows the user to enable or disable analog input trips.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>Messages S 5.10 to 5.12 will only appear if ENABLED is selected in message S 5.9</i>   |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| S 5.10<br>L <sub>A</sub>                                                                  | <div>ANALOG IN TRIP<br/>16.00 UNITS</div>  | <p>This line allows the user to specify at what level of the input analog signal the 565 Relay will initiate a trip of the feeder breaker. The level must be entered within the range of the scaled values, see messages S 5.7 and 5.8. The units displayed here will be those entered in message S 5.6.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| S 5.11<br>L <sub>A</sub>                                                                  | <div>ANALOG IN TRIP<br/>DELAY 1 SEC</div>  | <p>The delay on the feeder breaker trip caused by the analog input is entered here, in the range of 1 to 255 seconds in steps of 1 second. This prevents nuisance trips due to momentary (normal) high levels. Should the condition persist beyond the timed period the trip will occur.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| S 5.12<br>L <sub>A</sub>                                                                  | <div>ANALOG IN TRIP<br/>RELAY TRIP</div>   | <p>This message allows the user to select the relay which the trip signal generated in message S 5.9, will activate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 5.13<br>L <sub>A</sub>                                                                  | <div>ANALOG INPUT<br/>ALARM DISABLED</div> | <p>This message allows the user to enable or disable analog input alarms.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <i>Messages S 5.14 to 5.16 will only appear if ENABLED is selected in message S 5.13.</i> |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| S 5.14<br>L <sub>A</sub>                                                                  | <div>ANALOG IN ALARM<br/>12.00 UNITS</div> | <p>This line allows the user to specify at what level of input analog signal the 565 Relay will initiate an alarm. The level must be entered within the range of the scaled values, see messages S 5.7 and 5.8. The units displayed here will be those entered in message S 5.6.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| S 5.15<br>L <sub>A</sub>                                                                  | <div>ANALOG IN ALARM<br/>DELAY 1 SEC</div> | <p>The delay on the alarm for the analog input is entered here, in the range of 1 to 255 seconds in steps of 1 second. This prevents nuisance alarms due to momentary (normal) high signals. Should the condition persist beyond the timed period the alarm will occur.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| S 5.16<br>L <sub>A</sub>                                                                  | <div>ANALOG IN ALARM<br/>RELAY AUX1</div>  | <p>This message allows the user to select the relay which the alarm signal generated in message S 5.13, will activate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## SETPOINTS MODE - ANALOG INPUT



| Location                 | Message Line                | Description                                                            |
|--------------------------|-----------------------------|------------------------------------------------------------------------|
| S 5.17<br>L <sub>A</sub> | ANALOG INPUT<br>END OF PAGE | The last line of page 5, setpoints. Press the PAGE key to view page 6. |

| Location                   | Message Line                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
|----------------------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------|-------------------|-------------|--------------------|--------------------------------------|-------------------|---|-----------------------------------|--------------|-------|-------------------------|--------------|-------|-------------------------|-----|-----|-----|----|------------------|-----|-----|----|-----|------------------|-----|-----|----|----|-----------------|-----|----|-----|-----|--------------------|-----|----|-----|----|--------------------|-----|----|----|-----|--------------------|-----|----|----|----|-------------------|
| S 6.1<br>L <sub>A</sub>    | SETPOINTS<br>ANALOG OUTPUT      | The setpoints page 6 header. This page allows the setpoints related to the analog output to be entered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| S 6.2<br>L <sub>A</sub>    | ANALOG OUTPUT<br>PARAMETER      | This message appears for two seconds to indicate that the analog output parameter can now be specified. The 565 Relay is capable of sending out any one of 8 actual values as analog quantities from its Analog Out terminal on the rear of the unit. This message is replaced by a message showing the current selection for the analog out parameter. The NEX CHOICE key can then be used to select the desired analog out parameter. These parameters are the 3 phase currents, the 3 phase voltages, the ground current, and the feeder frequency.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| S 6.3<br>L <sub>A</sub>    | PHASE A CURRENT                 | <p>If external analog select is stored, the analog output parameter will be chosen by an external device such as a programmable controller via the 565 rear. The device can request any output by presenting the correct code at the 4 analog select terminals (A,B,C,D) on the unit. The outputs are shown in the figure below with ON for logic 1 and OFF for logic 0. "ON" indicates a closure or jumper between the specified terminal and the switch return. For example an input of 1 is at terminals A, and 0 at B and C and D, the analog out parameter will be Phase B current.</p> <table><tr><th colspan="4">INPUT AT<br/>TERMINAL</th><th>SELECTED<br/>OUTPUT</th></tr><tr><th>D</th><th>C</th><th>B</th><th>A</th><th></th></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Phase A current.</td></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>Phase B current.</td></tr><tr><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>Phase C current.</td></tr><tr><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>Ground current.</td></tr><tr><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>Phase A-X voltage.</td></tr><tr><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td><td>Phase B-X voltage.</td></tr><tr><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td><td>Phase C-X voltage.</td></tr><tr><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>Feeder frequency.</td></tr></table> | INPUT AT<br>TERMINAL       |                    |                   |             | SELECTED<br>OUTPUT | D                                    | C                 | B | A                                 |              | OFF   | OFF                     | OFF          | OFF   | Phase A current.        | OFF | OFF | OFF | ON | Phase B current. | OFF | OFF | ON | OFF | Phase C current. | OFF | OFF | ON | ON | Ground current. | OFF | ON | OFF | OFF | Phase A-X voltage. | OFF | ON | OFF | ON | Phase B-X voltage. | OFF | ON | ON | OFF | Phase C-X voltage. | OFF | ON | ON | ON | Feeder frequency. |
| INPUT AT<br>TERMINAL       |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                            | SELECTED<br>OUTPUT |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| D                          | C                               | B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A                          |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | OFF                             | OFF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | OFF                        | Phase A current.   |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | OFF                             | OFF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ON                         | Phase B current.   |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | OFF                             | ON                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | OFF                        | Phase C current.   |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | OFF                             | ON                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ON                         | Ground current.    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | ON                              | OFF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | OFF                        | Phase A-X voltage. |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | ON                              | OFF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ON                         | Phase B-X voltage. |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | ON                              | ON                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | OFF                        | Phase C-X voltage. |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| OFF                        | ON                              | ON                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ON                         | Feeder frequency.  |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| S 6.4<br>L <sub>A</sub>    | ANALOG OUTPUT<br>RANGE: 4-20 mA | <p>The range of the analog output may be selected using this message. Use the NEXT CHOICE key to select either 4-20 mA or 0-1 mA depending on the input range of the device to which the analog output is being sent. Store the selected value. The magnitude of the analog output will then vary linearly with the magnitude of the selected analog output parameter within the selected range.</p> <table><tr><th>Analog Output<br/>Parameter</th><th>Minimum<br/>Output</th><th>Maximum<br/>Output</th></tr><tr><td>1) Currents</td><td>0</td><td>2 times pickup<br/>(Phase and Ground)</td></tr><tr><td>2) Phase Voltages</td><td>0</td><td>2 times nominal feeder<br/>voltage</td></tr><tr><td>3) Frequency</td><td>57 Hz</td><td>63 Hz (60 cycle feeder)</td></tr><tr><td>4) Frequency</td><td>47 Hz</td><td>53 Hz (50 cycle feeder)</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Analog Output<br>Parameter | Minimum<br>Output  | Maximum<br>Output | 1) Currents | 0                  | 2 times pickup<br>(Phase and Ground) | 2) Phase Voltages | 0 | 2 times nominal feeder<br>voltage | 3) Frequency | 57 Hz | 63 Hz (60 cycle feeder) | 4) Frequency | 47 Hz | 53 Hz (50 cycle feeder) |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| Analog Output<br>Parameter | Minimum<br>Output               | Maximum<br>Output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| 1) Currents                | 0                               | 2 times pickup<br>(Phase and Ground)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| 2) Phase Voltages          | 0                               | 2 times nominal feeder<br>voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| 3) Frequency               | 57 Hz                           | 63 Hz (60 cycle feeder)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| 4) Frequency               | 47 Hz                           | 53 Hz (50 cycle feeder)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |
| S 6.5<br>L <sub>A</sub>    | ANALOG OUTPUT<br>END OF PAGE    | The last line of page 6, setpoints. Press the PAGE key to view page 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                            |                    |                   |             |                    |                                      |                   |   |                                   |              |       |                         |              |       |                         |     |     |     |    |                  |     |     |    |     |                  |     |     |    |    |                 |     |    |     |     |                    |     |    |     |    |                    |     |    |    |     |                    |     |    |    |    |                   |

## SETPOINTS MODE - COMMUNICATION



MULTILIN

| Location | Message Line                  | Description                                                                                                                                                                                                                    |
|----------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 7.1    | SETPOINTS<br>COMMUNICATIONS   | The setpoints page 7 header. This page contains setpoints which affect how the 565 Relay communicates with other devices.                                                                                                      |
| S 7.2    | RELAY ADDRESS<br>1            | This message is used to assign each relay a different address or number to distinguish it from all other relays being used in a serial communication link. The range of values which may be entered is 1 to 254 in steps of 1. |
| S 7.3    | BAUDRATE<br>2400 BAUD         | This setpoint is used to select the data transfer rate for serial communications via the front Programming Port or the rear Communication Port. Use NEXT CHOICE key to select either 1200, 2400, 4800, or 9600 BAUD.           |
| S 7.4    | COMMUNICATIONS<br>END OF PAGE | The last line of page 7, setpoints. Press the PAGE key to view page 7.                                                                                                                                                         |

| Location | Message Line                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 8.1    | <div>SETPOINTS<br/>CALIBRATION MODE</div> | The setpoints page 8 header. This page is used to test the operation of the 565 switch inputs and output relays. As well, the LCD display contrast can be adjusted on this page.                                                                                                                                                                                                                                                                                                    |
| S 8.2    | <div>EXERCISE RELAY<br/>TRIP</div>        | <p>This message is used to test the operation of the output relay contacts. The following choices are available:</p> <div> <div>1) Trip.</div> <div>2) Aux. 1.</div> <div>3) Aux. 2.</div> <div>4) Aux. 3.</div> <div>5) Aux. 4 (575 only)</div> <div>6) Block Tap Changer (575 only)</div> <div>7) ALL</div> </div> <p>Select the required relay using the NEXT CHOICE key. Press the store key to simulate the presence of a condition that will activate the selected relay.</p> |

Before testing, verify that it is safe to do so. **(These tests can only be done with the feeder breaker open.)** If the breaker is closed, the following flash message will be displayed:

|                          |                                             |                                                                                                                                                                                                                                                                                  |
|--------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <div>BREAKER MUST<br/>BE OPEN</div>         |                                                                                                                                                                                                                                                                                  |
| S 8.3                    | <div>PRESS STORE<br/>TO END TEST...</div>   | This message appears while the activating condition is present. The relay will be tested in the mode of operation assigned to it. For example, a latched relay will be energized and will then remain latched. Press the STORE key to remove the simulated activating condition. |
| S 8.4                    | <div>PRESS RESET TO<br/>RESET RELAY</div>   | This message appears on the display for two seconds to remind the user that if a latched relay has been tested, then the reset key must now be pressed to return the relay to its inactive state.                                                                                |
| S 8.5<br>L <sub>A</sub>  | <div>SWITCH NUMBER 1<br/>STATUS OPEN</div>  | This message allows each of the external switches to have its status checked. Use the LINE DOWN key to display each of the switches. The status of each switch, either OPEN or CLOSED will appear in the message.                                                                |
| S 8.6<br>L <sub>A</sub>  | <div>BREAKER OPEN<br/>STATUS YES</div>      | This message allows the breaker open external contacts to have their status checked.                                                                                                                                                                                             |
| S 8.7<br>L <sub>A</sub>  | <div>BREAKER CLOSED<br/>STATUS NO</div>     | This message allows the breaker closed external contacts to have their status checked.                                                                                                                                                                                           |
| S 8.8<br>L <sub>A</sub>  | <div>ANALOG SELECT A<br/>STATUS OFF</div>   | This message allows each of the analog select switches to have its status checked. Use the LINE DOWN key to display each of the switches. The status of each switch, either ON or OFF, will appear in the messages.                                                              |
| S 8.9<br>L <sub>A</sub>  | <div>ACCESS JUMPER<br/>STATUS ENABLED</div> | This message indicates the status of the access jumper. ENABLED indicates jumper installed. DISABLED indicates jumper not installed.                                                                                                                                             |
| S 8.10<br>L <sub>A</sub> | <div>REMOTE/LOCAL 43<br/>STATUS LOCAL</div> |                                                                                                                                                                                                                                                                                  |
| S 8.11<br>L <sub>A</sub> | <div>RECLOSE ENABLED<br/>STATUS YES</div>   | This message indicates the status of the internal hardware relay which enables or disables the reclosing scheme.                                                                                                                                                                 |

## SETPOINTS MODE - CALIBRATION



MULTILIN

| Location | Message Line                                | Description                                                                                                                                          |
|----------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 8.12   | <div>RECLOSE DISABLED<br/>STATUS NO</div>   | This message indicates the status of the internal hardware relay which enables or disables the reclosing scheme.                                     |
| S 8.13   | <div>LCD DISPLAY<br/>CONTRAST 5</div>       | This message allows the contrast of the display to be adjusted to suit the user. The range of adjustment is 0-10.                                    |
| S 8.14   | <div>58E271B.000<br/>MAR 28, 1994</div>     | This is the 565 Relay Firmware revision identifier.                                                                                                  |
| S 8.15   | <div>SERVICE USE ONLY<br/>CODE 0</div>      | This message is used by service personnel for calibration and service of the 565 Relay. It is not intended for use by other than MULTILIN personnel. |
| S 8.16   | <div>CALIBRATION MODE<br/>END OF PAGE</div> | The last line of page 8, setpoints. Press the PAGE key to view page 9.                                                                               |

| Location | Message Line                     | Description                                                                                                                                               |
|----------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.1    | <div>SETPOINTS<br/>VOLTAGE</div> | The setpoints page 9 header. The 565 Relay can provide protection against voltage related faults. In this page the voltage related setpoints are entered. |

Table 6-1 Phase Configuration for Voltage Alarms and Trips

| VT CONNECTION | UNDERVOLTAGE TRIP               | UNDERVOLTAGE ALARM              | OVERVOLTAGE TRIP                | OVERVOLTAGE ALARM               |
|---------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| WYE           | ANY TWO PHASE                   | ANY SINGLE PHASE                | ANY SINGLE PHASE                | ANY SINGLE PHASE                |
| OPEN DELTA    | TWO MEASURED PHASES (Vab & Vbc) | ONE MEASURED PHASE (Vab OR Vbc) | ONE MEASURED PHASE (Vab OR Vbc) | ONE MEASURED PHASE (Vab OR Vbc) |

|       |                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.2 | <div>VT CONNECTION<br/>WYE</div> | <p>This message asks for the type of voltage transformer sensing which you intend to use. There are three possible systems, as shown in wiring Figure 2.6. The choices for the setpoint are:</p> <ol style="list-style-type: none"> <li>1. Wye.</li> <li>2. Open Delta.</li> <li>3. Delta/Wye</li> <li>4. None</li> </ol> <p>The Delta/Wye choice allows the 565/575 to measure secondary voltages wired as Wye and display them as phase to phase quantities on the primary side of a Delta/Wye connected transformer. Hence, selecting Delta/Wye does not multiply the result by <math>\sqrt{3}</math>. For example:</p> <p>In a 2.4 kV:120V PT system (i.e. 120V into the relay), WYE displays 2.4 kV A-N, DELTA/WYE displays 2.4 kV A-B, <u>NOT</u> <math>2.4 \text{ kV} \times \sqrt{3}</math>.</p> <p>If none is selected, voltage sensing will be disabled.</p> <p>Refer to your system specifications or one line diagram to determine which your system is. Use the NEXT CHOICE key to select the appropriate one and press the STORE Key to save the new value.</p> |
|-------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Only message S 9.21 will appear if the VT connection is selected as NONE in message S 9.2.

|       |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.3 | <div>VT NOMINAL SEC<br/>VOLTS 120 VOLTS</div> | <p>The voltage transformer which you are using to sense voltage may operate at various secondary voltages depending on the sensing system used.</p> <p>The 565/575 has the ability to be programmed for the desired secondary rating, which should be the rated secondary voltage stamped on the transformer's nameplate. This will be the phase to neutral voltage for a Wye system, or a phase to phase voltage for an Open Delta system. The range is from 48 to 240 V in steps of 0.1 V.</p> |
| S 9.4 | <div>VT PRIMARY VOLTS<br/>1.20 kV</div>       | <p>The primary voltage of the VT which monitors the feeder is entered here. This is the "nameplate" primary voltage. The voltage transformer primary rating range is from 0.10 to 69 kV in steps of 0.01 kV.</p>                                                                                                                                                                                                                                                                                 |
| S 9.5 | <div>ZERO VOLTS<br/>DETECT ENABLED</div>      | <p>When enabled, this setpoint allows undervoltage alarms and trips to occur with the 565/575 reading <u>all</u> phase voltages as zero. For the 565/575, zero is when the voltage is below 48% of the nominal rating. When disabled, <u>all</u> phases reading below 48% are considered a normal no voltage condition. Thus, no alarms or trips will be declared. As always, undervoltage trips</p>                                                                                             |

## SETPOINTS MODE - VOLTAGE



| Location                                                                                  | Message Line                                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                           |                                                        | only occur when the breaker is detected as closed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 9.6                                                                                     | <div> UNDERVOLT TRIP<br/>DISABLED </div>               | <p>This message allows the undervoltage trip to be enabled or disabled. The Undervoltage Trip feature will activate when any two line-to-line voltages stay below the trip setpoint for the selected time delay. NOTE: When an undervoltage condition is present the reclosure scheme will not issue a close command to the breaker. When the undervoltage condition is no longer present, the breaker should be closed manually.</p>                                                                                                                                                                                 |
| <i>Messages S 9.7 to S 9.9 will only appear if ENABLED is selected in message S 9.6.</i>  |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 9.7                                                                                     | <div> UNDERVOLT TRIP<br/>LEVEL      80 %VT </div>      | <p>The undervoltage trip level is entered here as a percentage of the VT rating. Feeder undervoltage protection is necessary because a significant drop in feeder voltage indicates a system fault.</p> <p>The 565/575 Relay monitors the phase voltages while the breaker is closed and provides a trip signal if the level drops to the value which you enter here. The range of possible settings for the undervoltage setpoint is 50% to 100% of the VT rating in steps of 1%. Refer to Table 2.1 to determine how many phases must be below the trip level to cause a trip for the VT connection being used.</p> |
| S 9.8                                                                                     | <div> UNDERVOLT TRIP<br/>DELAY      1.0 SEC </div>     | <p>The delay on the undervoltage trip is entered here, in the range of 0.1 to 25.5 seconds in steps of 0.1 seconds. This prevents nuisance trips caused by momentary low voltages due to sudden switching of heavy loads on or off the feeder. Should the condition persist beyond the timed period the trip will occur.</p>                                                                                                                                                                                                                                                                                          |
| S 9.9                                                                                     | <div> UNDERVOLT TRIP<br/>RELAY    TRIP&amp;AUX1 </div> | <p>This message allows the user to select the relay which the trip signal generated in message S 9.6 will activate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| S 9.10                                                                                    | <div> UNDERVOLT ALARM<br/>DISABLED </div>              | <p>This message allows the undervoltage alarm to be enabled or disabled.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| L <sub>A</sub>                                                                            |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <i>Messages S 9.11 to 9.13 will only appear if ENABLED is selected in message S 9.10.</i> |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 9.11                                                                                    | <div> UNDERVOLT ALARM<br/>LEVEL      85 %VT </div>     | <p>The undervoltage alarm level is entered here as a percentage of the VT rating. Feeder undervoltage alarms are necessary to warn of impending voltage related problems. The range of possible settings for the undervoltage alarm setpoint is 50% to 100% of the VT rating in steps of 1%. Refer to Table 2.1 to determine how many phases must be below the alarm level to cause an alarm for the VT connection being used.</p>                                                                                                                                                                                    |
| L <sub>A</sub>                                                                            |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 9.12                                                                                    | <div> UNDERVOLT ALARM<br/>DELAY      1.0 SEC </div>    | <p>The delay on the undervoltage alarm is entered here, in the range of 0.1 to 25.5 seconds in steps of 0.1 seconds. See message S 9.8 for more information.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| L <sub>A</sub>                                                                            |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 9.13                                                                                    | <div> UNDERVOLT ALARM<br/>RELAY      AUX2 </div>       | <p>This message allows the user to select the relay which the alarm signal generated in message S 9.10 will activate.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| L <sub>A</sub>                                                                            |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 9.14                                                                                    | <div> OVERVOLT TRIP<br/>DISABLED </div>                | <p>This message allows the overvoltage trip to be enabled or disabled. The overvoltage trip feature will activate when any phase voltage stays above the trip setpoint for the selected time delay. NOTE: When an overvoltage condition is present the reclosure scheme will not issue a close command to the breaker. When the overvoltage condition is no longer present, the breaker should be closed manually.</p>                                                                                                                                                                                                |
| L <sub>A</sub>                                                                            |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| Location | Message Line | Description |
|----------|--------------|-------------|
|----------|--------------|-------------|

Messages S 9.15 to 9.17 will only appear if ENABLED is selected in message S 9.14.

|        |                                              |                                                                                                                                                                                                                                                                                                                                                                                                |
|--------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.15 | <div> OVERVOLT TRIP<br/>LEVEL 120 %VT </div> | The overvoltage trip level is entered here as a percentage of the VT rating. The range of possible settings for the overvoltage trip setpoint is 101% to 125% of the VT rating in steps of 1%. The breaker must be closed for overvoltage trips to be detected. Refer to Table 2.1 to determine how many phases must be above the trip level to cause a trip for the VT connection being used. |
|--------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|        |                                              |                                                                                                                                                                                                                               |
|--------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.16 | <div> OVERVOLT TRIP<br/>DELAY 1.0 SEC </div> | The delay on the overvoltage trip is entered here, in the range of 0.1 to 25.5 seconds in steps of 0.1 seconds. This delay prevents nuisance trips. Should the condition persist beyond the timed period the trip will occur. |
|--------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|        |                                           |                                                                                                                    |
|--------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| S 9.17 | <div> OVERVOLT TRIP<br/>RELAY TRIP </div> | This message allows the user to select the relay which the trip signal generated in message S 9.14, will activate. |
|--------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------|

|        |                                          |                                                                      |
|--------|------------------------------------------|----------------------------------------------------------------------|
| S 9.18 | <div> OVERVOLT ALARM<br/>DISABLED </div> | This message allows the overvoltage alarm to be enabled or disabled. |
|--------|------------------------------------------|----------------------------------------------------------------------|

Messages S 9.19 to 9.21 will only appear if ENABLED is selected in message S 9.18.

|        |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.19 | <div> OVERVOLT ALARM<br/>LEVEL 115 %VT </div> | The overvoltage alarm level is entered here as a percentage of the VT rating. The 565 Relay monitors the phase voltages and provides an alarm if the level rises to the level which you enter here. The range of possible settings for the overvoltage alarm setpoint is 101% to 125% of the VT rating in steps of 1%. Refer to Table 2.1 to determine how many phases must be above the alarm level to cause an alarm for the VT connection being used. |
|--------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|        |                                               |                                                                                                                                                                                                                                                                                                |
|--------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 9.20 | <div> OVERVOLT ALARM<br/>DELAY 1.0 SEC </div> | The delay on the overvoltage alarm is entered here, in the range of 0.1 to 25.5 seconds in steps of 0.1 seconds. As for the undervoltage delay, this delay prevents nuisance trips due to momentary high signals. Should the overvoltage persist beyond the timed period the alarm will occur. |
|--------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|        |                                            |                                                                                                                    |
|--------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| S 9.21 | <div> OVERVOLT ALARM<br/>RELAY AUX1 </div> | This message allows the user to select the relay which the alarm signal generated in message S 9.18 will activate. |
|--------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------|

|        |                                      |                                                                       |
|--------|--------------------------------------|-----------------------------------------------------------------------|
| S 9.22 | <div> VOLTAGE<br/>END OF PAGE </div> | The last line of page 9, setpoints. Use the PAGE key to view page 10. |
|--------|--------------------------------------|-----------------------------------------------------------------------|

## SETPOINTS MODE - DEMAND METERING



| Location                                                                                                                                                                                                       | Message Line                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 10.1                                                                                                                                                                                                         | <div>SETPOINTS<br/>DEMAND METERING</div>     | Setpoints page 10 header. In this page are the setpoints which set up the demand metering functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| S 10.2                                                                                                                                                                                                         | <div>AMPS DEMAND<br/>ENABLED</div>           | <p>This message allows the user to enable or disable the Amps Demand feature. If this feature is disabled, the Peak Amps Demand value will be the last peak value before the function was disabled. The peak amps demand of each phase is obtained by a "sliding window" averaging scheme by which the current (averaged RMS values) is monitored at 1 minute intervals over the chosen demand time window and stored in memory. The demand time window is user selectable over the range 5–120 min. in 1 min. steps. The peak demand amps is updated only when the demand window current average exceeds the previous stored peak value.</p> <p>The 565/575 also allows the user to select and store an alarm level for peak demand which can be assigned to an output relay.</p> |
| <i>Messages S 10.3 to S 10.6 will only appear if ENABLED is selected in message S 10.2.</i>                                                                                                                    |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 10.3                                                                                                                                                                                                         | <div>AMPS DEMAND TIME<br/>PERIOD 5 MIN</div> | <p>This message allows the user to specify Amps Demand time period. The range of values is 5 to 120 in steps of 1 minute. This value is essentially the number of RMS current values used to determine the current demand. NOTE: If this setpoint or the Phase CT Primary Rating are changed, the Amps Demand function will be reset and the Peak Demand values shown in the Meter Data will be cleared.</p>                                                                                                                                                                                                                                                                                                                                                                       |
| S 10.4<br>L <sub>A</sub>                                                                                                                                                                                       | <div>AMPS DEMAND<br/>ALARM DISABLED</div>    | This message allows users to enable or disable the alarm function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Messages S 10.5 and S 10.6 will only appear if ENABLED is selected in message S 10.4.</i>                                                                                                                   |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 10.5<br>L <sub>A</sub>                                                                                                                                                                                       | <div>AMP DEMAND ALARM<br/>LEVEL 100 A</div>  | The Amps Demand alarm level is specified here. The range of values allowed is 10 to 5000 in steps of 5 amps.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| S 10.6<br>L <sub>A</sub>                                                                                                                                                                                       | <div>AMP DEMAND ALARM<br/>RELAY AUX1</div>   | This message allows users to assign Aux.1 and/or Aux.2 relays to the alarm. When an alarm occurs, the selected relay will be activated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>The following messages will only be displayed if the Metering Transducer Module (MTM) has been enabled in page 4 of setpoints. Note that these features only function when an Option Card is installed.</i> |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 10.7                                                                                                                                                                                                         | <div>KW DEMAND<br/>ENABLED</div>             | <p>This message allows the user to enable or disable the kW demand feature. If this feature is disabled the peak kW demand value will be the last peak value before the feature was disabled.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <i>Messages S 10.8 to S 10.11 will only appear if ENABLED is selected in message S 10.7.</i>                                                                                                                   |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 10.8                                                                                                                                                                                                         | <div>KW DEMAND TIME<br/>PERIOD 5 MIN</div>   | <p>This message allows the user to specify the time period over which the kW demand is calculated. The range of values is 5 to 120 minutes in steps of 1 minute. NOTE: If this setpoint or the Phase CT Primary rating are changed the kW demand function will be reset and the peak kW demand value shown in the Metering Data will be cleared.</p>                                                                                                                                                                                                                                                                                                                                                                                                                               |
| S 10.9                                                                                                                                                                                                         | <div>KW DEMAND ALARM<br/>DISABLED</div>      | This message allows the user to enable or disable the alarm function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Location                                                                                                             | Message Line                                    | Description                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Messages S 10.10 and S 10.11 will only appear if the Demand KW Alarm feature is enabled in message S 10.9.</i>    |                                                 |                                                                                                                                                                                                                                                                                                                                                     |
| S 10.10                                                                                                              | <div>KW DEMAND ALARM<br/>LEVEL 1000 kW</div>    | The kW Demand alarm level is specified here. The range is 100 to 65000 kW in steps of 100 kW.                                                                                                                                                                                                                                                       |
| S 10.11                                                                                                              | <div>KW DEMAND ALARM<br/>RELAY AUX1</div>       | This message allows the user to select the relay which will be activated when an alarm occurs.                                                                                                                                                                                                                                                      |
| S 10.12                                                                                                              | <div>KVAR DEMAND<br/>ENABLED</div>              | This message allows the user to enable or disable the kVAR demand feature. If this feature is disabled the Peak kVAR Demand value will be the last peak value before the feature was disabled.                                                                                                                                                      |
| <i>Messages S 10.13 to S 10.16 will only appear if ENABLED is selected in message S 10.12.</i>                       |                                                 |                                                                                                                                                                                                                                                                                                                                                     |
| S 10.13                                                                                                              | <div>KVAR DEMAND TIME<br/>PERIOD 5 MIN</div>    | This message allows the user to specify the time period over which the kVAR demand is calculated. The range of values is 5 to 120 minutes in steps of 1 minute. NOTE: If this setpoint or the Phase CT Primary rating are changed the kVAR demand function will be reset and the peak kVAR Demand value shown in the Metering Data will be cleared. |
| S 10.14                                                                                                              | <div>KVAR DEMAND<br/>ALARM DISABLED</div>       | This message allows the user to enable or disable the alarm function.                                                                                                                                                                                                                                                                               |
| <i>Messages S 10.15 and S 10.16 will only appear if the Demand kVAR Alarm feature is enabled in message S 10.14.</i> |                                                 |                                                                                                                                                                                                                                                                                                                                                     |
| S 10.15                                                                                                              | <div>KVAR DEMAND AL'M<br/>LEVEL 1000 kVAR</div> | The kVAR Demand alarm level is specified here. The range is 100 to 65000 kW in steps of 100 kW.                                                                                                                                                                                                                                                     |
| S 10.16                                                                                                              | <div>KVAR DEMAND AL'M<br/>RELAY AUX1</div>      | The user is allowed to select the relay which will be activated when an alarm occurs.                                                                                                                                                                                                                                                               |
| S 10.17                                                                                                              | <div>DEMAND METERING<br/>END OF PAGE</div>      | End of page 10, setpoints. Press the PAGE key to view page 11.                                                                                                                                                                                                                                                                                      |

## SETPOINTS MODE - MTM METERING



| Location                                                                                                                              | Message Line                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 11.1                                                                                                                                | SETPOINTS<br>MTM METERING       | The setpoints page 11 header. In this page the MTM related setpoints are entered.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                       | OPTION NOT<br>AVAILABLE         | This message appears if ENABLED is selected in S 11.1 but the 565 does not have the option card installed.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <i>The following messages will only be displayed if the Metering Transducer Module (MTM) has been enabled in page 4 of setpoints.</i> |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| S 11.2                                                                                                                                | MTM COMM. ALARM<br>DISABLED     | <p>This message allows the user to enable or disable the MTM alarm feature. When enabled, an MTM communications breakdown will activate an alarm.</p> <p>A typical communication breakdown is confusion of whether the source of the MTM default power is LINE or PT. The default is line, not PT. If PT is required this must be selected by using the switches on the MTM.</p> <p>In order for a 565/575 Relay to communicate with an MTM Plus device prior to rev. E, the MTM Plus baud rate must be set to 1200.</p> |
| <i>Message S 11.3 will only appear if ENABLED is selected in message S 11.2.</i>                                                      |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| S 11.3                                                                                                                                | MTM COMM. ALARM<br>RELAY AUX2   | This message lets the user assign a relay to be activated by the MTM communications alarm.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| S 11.4                                                                                                                                | MTM CT SELECT<br>COMMON         | When the MTM is connected, the same CTs can be used (COMMON) or another (SEPARATE) set of CTs are used.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <i>Message S 11.5 will only appear if SEPARATE is selected in message S 11.4.</i>                                                     |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| S 11.5                                                                                                                                | MTM CT RATING<br>PRIMARY 100 A  | Enter the CT ratio for the MTM if you have chosen a SEPARATE set of CTs as selected above.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| S 11.6                                                                                                                                | POWER FACTOR<br>ALARM DISABLED  | This message allows the user to enable or disable the alarm feature for the Power Factor.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>Messages S 11.7 to 11.10 will appear only if the Power Factor Alarm feature has been enabled in message S 11.6.</i>                |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| S 11.7                                                                                                                                | P/F LEADING<br>ALARM LEVEL 0.75 | The leading alarm level is chosen here. The range is 0 to 1 in steps of 0.05.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| S 11.8                                                                                                                                | P/F LAGGING<br>ALARM LEVEL 0.75 | The lagging alarm level is chosen here. The range is 1 to 0 in steps of 0.05.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| S 11.9                                                                                                                                | P/F ALARM DELAY<br>5.0 SEC      | The delay time before an alarm is given can be selected here. Range is 1 - 127 seconds in steps of 0.5 seconds.                                                                                                                                                                                                                                                                                                                                                                                                          |
| S 11.10                                                                                                                               | P/F ALARM RELAY<br>AUX1         | This message indicates which relay will be activated when the alarm level is exceeded. The choices are: AUX1, AUX2, or AUX1&AUX2. For 575, they are: NONE, AUX1, AUX2, or AUX1&2.                                                                                                                                                                                                                                                                                                                                        |

| Location                                                                                                             | Message Line                             | Description                                                                                              |
|----------------------------------------------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------|
| S 11.11                                                                                                              | POWER FACTOR<br>TRIP        DISABLED     | This message allows the user to enable or disable the trip feature for the Power Factor.                 |
| <i>Messages S 11.12 to S 11.15 appear only if the Power Factor Trip feature has been enabled in message S 11.11.</i> |                                          |                                                                                                          |
| S 11.12                                                                                                              | P/F LEADING TRIP<br>LEVEL        0.70    | The leading trip level is chosen here. The range is 0 to 1 in steps of 0.05.                             |
| S 11.13                                                                                                              | P/F LAGGING TRIP<br>LEVEL        0.70    | The lagging trip level is chosen here. The range is 1 to 0 in steps of 0.05.                             |
| S 11.14                                                                                                              | P/F TRIP DELAY<br>1.0 SEC                | The delay time before a trip is given can be selected here. Range is 1 - 127 sec. in steps of 0.5 sec.   |
| S 11.15                                                                                                              | P/F TRIP RELAY<br>AUX1                   | This message indicates which relay will be activated when the trip level is exceeded.                    |
| S 11.16                                                                                                              | FREQUENCY ALARM<br>DISABLED              | This message allows the user to enable or disable the frequency alarm feature.                           |
| <i>Messages S 11.17 to S 11.20 appear only if the Frequency Alarm feature has been enabled in message S 11.16.</i>   |                                          |                                                                                                          |
| S 11.17                                                                                                              | UNDER FREQ ALARM<br>LEVEL        58.0 Hz | The under frequency alarm level is chosen here. The range is 40 - 60 Hz in steps of 0.1.                 |
| S 11.18                                                                                                              | OVER FREQ ALARM<br>LEVEL        62.0 Hz  | The over frequency alarm level is chosen here. The range is 50 - 72 Hz in steps of 0.1.                  |
| S 11.19                                                                                                              | FREQUENCY ALARM<br>DELAY        5.0 SEC  | The delay time before an alarm is given can be selected here. Range is 1 - 127 sec. in steps of 0.5 sec. |
| S 11.20                                                                                                              | FREQUENCY ALARM<br>RELAY        AUX1     | This message indicates which relay will be activated when the alarm level is exceeded.                   |
| S 11.21                                                                                                              | FREQUENCY TRIP<br>DISABLED               | This message allows the user to enable or disable the frequency trip feature.                            |
| <i>Messages S 11.22 to S 11.25 appear only if the Frequency Trip feature has been enabled in message S 11.21.</i>    |                                          |                                                                                                          |
| S 11.22                                                                                                              | UNDER FREQ. TRIP<br>LEVEL        56.0 Hz | The under frequency trip level is chosen here. The range is 40 - 60 Hz in steps of 0.1.                  |
| S 11.23                                                                                                              | OVER FREQ. TRIP<br>LEVEL        64.0 Hz  | The over frequency trip level is chosen here. The range is 50 - 72 Hz in steps of 0.1.                   |

## SETPOINTS MODE - MTM METERING



| Location | Message Line                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 11.24  | FREQUENCY TRIP<br>DELAY 1.0 SEC   | The delay time before a trip is given can be selected here. Range is 1 - 127 sec. in steps of 0.5 sec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| S 11.25  | FREQUENCY TRIP<br>RELAY AUX1      | This message indicates which relay will be activated when the trip level is exceeded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| S 11.26  | MTM SCALING<br>FACTOR 655         | This setpoint ranges from 1 to 655 and is used to set the full scale value for the MTM analog outputs (KWatts and KVars). Full scale would then be as follows:<br>100KW × scaling factor<br>30KVar × scaling factor                                                                                                                                                                                                                                                                                                                                                                                      |
| S 11.27  | VOLTAGE REVERSAL<br>TRIP ENABLED  | The 565/575 Relay incorporates the Voltage Reversal Trip feature. In order to operate the feature successfully, the 565/575 must be communicating with the MTM or MTM Plus, since the MTM/MTM Plus performs the calculations to determine phase reversals. The 565/575 Relay provides only Trip Relay Output and Programmable Trip Delay. The Phase Reversal Trip of the 565/575 is independent of the Phase Reversal setpoint in the MTM/MTM Plus. This means that whether the setpoint is ENABLED or DISABLED in the MTM/MTM Plus, the 565/575 still polls for and receives report on phase reversals. |
| S 11.28  | VOLTAGE REVERSAL<br>DELAY 1.0 SEC | The Voltage Phase Reversal Delay is entered here in the range of 1 to 127 sec. in steps of 0.5 sec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| S 11.29  | VOLTAGE REVERSAL<br>RELAY TRIP    | This setpoint allows the selection of the relay that will be activated when a voltage reversal is detected.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| S 11.30  | MTM METERING<br>END OF PAGE       | This is the last line of Setpoints, page 11. This is the last page of setpoints.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

NOTE: Prior to describing the setpoints pertaining to Autoreclosure, the following is a discussion of the Multilin 575 reclosure scheme and input terminals.

## Auto-Reclosure Application for 575

### 1. Introduction

Utility statistics indicate that a large percentage of feeder faults are of a transient nature, for example, phase conductors blown together by the wind, branches falling across phase conductors, or animals shorting to a grounded structure. In most cases, after the fault arc is initiated, the shorting media is burned off and the feeder is cleared.

A variety of overcurrent protective devices are used on feeders, starting with a feeder circuit breaker at the distribution station and fused sectionalizers as well as various reclosers downstream. All these devices are in series with each other. Should the transient fault current magnitude be larger than the melting current of the fuses, sections of the feeder will be incapacitated until line crews are sent out to locate the open device, replace the fuses and place the feeder back in service. Many customers will then be inconvenienced unnecessarily. It is for this reason that reclosure is necessary.

Ideally, when a fault is sensed on a feeder, the relaying scheme at the distribution station will cause the appropriate circuit breaker to trip, thus clearing the fault regardless of its location along the feeder. At the same time a reclosure scheme will be initiated causing only a very short disturbance to the system if the fault is transient.

Essentially, a reclosure scheme is a pre-programmed sequence of commands to reclose a circuit breaker a pre-determined number of times (or shots) after pre-determined time delays (dead times), after the feeder circuit breaker is tripped initially by the feeder protection scheme. When the maximum number of reclosures has been reached the breaker will be locked out since the fault has not been cleared and thus is likely not of a transient nature.

Sequentially, the events leading to a lockout situation in a four shot reclosure scheme are as follows:

1. First trip.
2. Wait until dead time #1 has expired.
3. Reclose breaker.
4. Second trip.
5. Wait until dead time #2 has expired.
6. Reclose breaker.
7. Third trip.
8. Wait until dead time #3 has expired.
9. Reclose breaker.
10. Fourth trip.
11. Wait until dead time #4 has expired.
12. Reclose breaker.
13. Fifth trip.
14. Breaker is locked out.

After this sequence of events the reclosure & relay must be manually reset at the relay or through remote supervisory.

Certain trip features may also be blocked (disabled) after the

nth reclosure attempt. For example, Phase Lowset Instantaneous trips may be blocked after the nth reclosure to allow whatever is causing the fault to burn off at a higher fault current level than that allowed by the Phase Lowset setting. Phase Lowset trips would then be re-enabled after the scheme is reset.

The scheme can be "reset" to its initial condition if, after any of the reclosures, a reclaim or reset timer expires without a new trip being initiated.

### 2. Multilin 575 Reclosure Scheme

The Multilin 575 reclosure scheme is based on a scheme developed by some major North American utilities. The scheme follows the overview shown in Figure 3.5 with some additional features unique to the Multilin 575, but allows some flexibility through user setpoint programming. Note that Figure 3.5 is a conceptual drawing to develop the 575 software and is not intended to be implemented in hardware.

Two modes of 575 operation are provided: LOCAL and REMOTE. LOCAL mode indicates that control is provided by the 575 keypad. REMOTE mode indicates that control is provided by dry contacts external to the 575.

Reclosure Enable/Disable can be executed in either LOCAL or REMOTE mode. A LOCAL/REMOTE switch (device #43) must be wired to the 575 to select the mode.

A hardware latching relay is used in the 575 to enable or disable the reclosure scheme. This is implemented in hardware to provide another level of security. If the reclosure scheme is disabled the breaker cannot be reclosed by incorrect operation of the reclosure algorithm.

The reclosure routine will not perform any function until the reclosure scheme is enabled (either locally or remotely) and one of the following conditions occurs:

1. Low set instantaneous trip (any two phases or ground).
2. High set instantaneous trip (any phase or ground).
3. Timed overcurrent trip (phase or ground).
4. External Initiate of Reclosing.

To improve co-ordination with OCR line reclosures the 575 can be programmed to change the time overcurrent curve shapes during reclosure. The curve shapes are custom, extremely inverse, very inverse, normal inverse and moderately inverse.

As soon as the scheme is initiated the BLOCKTAP CHANGER output relay activates to block operation of a transformer tap changer. This relay resets when lockout condition is reached or the reset time causes the scheme to reset. Thus, this output relay is also an indication of "auto-reclosure in progress".

The PHASE INST HISET and/or GROUND INST HISET trip feature can be blocked (disabled) after any reclosure if

## SETPOINTS MODE - AUTORECLOSURE



selected. The PHASE INST LOSET and/or GROUND INST LOSET trip feature can also be blocked after any reclosure as selected.

The scheme will be reset to its initial condition if, after any of the reclosures, the breaker closes and the current in all phases is less than the PHASE O/C PICKUP setpoint for a time greater than the reclosure SCHEME RESET time delay. This is an improvement over the traditional "reclaim" time since current sensing is used to ensure that the phase current is below the pickup level. The scheme will also be reset if the RESET key is pressed after a lockout condition has been reached.

### 3. 575 Output Relays

The following 575 output relays are used by the reclosure scheme:

| NAME              | FUNCTION                                                                                                            | TERMINALS              | CONTACT    |
|-------------------|---------------------------------------------------------------------------------------------------------------------|------------------------|------------|
| TRIP              | Trips C.B.                                                                                                          | 41 and 57<br>25 and 57 | N/O<br>N/C |
| CLOSE             | Closes C.B.                                                                                                         | 42 and 58              | N/O        |
| AUX. 1            | Operates with TRIP relay or is programmable to alarm function.                                                      | 43 and 59<br>46 and 59 | N/O<br>N/C |
| AUX. 2            | Programmable alarm function.                                                                                        | 44 and 60<br>47 and 60 | N/O<br>N/C |
| AUX. 3            | Failsafe operation on loss of control volts, and trip coil supervision.                                             | 45 and 61<br>48 and 61 | N/C<br>N/O |
| AUX. 4            | Operates on occurrence of Breaker Discrepancy Alarm only.                                                           | 30 and 31<br>32 and 31 | N/O<br>N/C |
| BLOCK TAP CHANGER |                                                                                                                     |                        |            |
|                   | Operates to block operation of external transformer tap changer or can be used as reclosure in progress indication. | 16 and 15<br>29 and 15 | N/O<br>N/C |

### 4. 575 Input Terminals

The following inputs are required by the 575:

#### TERMINALS      FUNCTION

- 9 and 10      Breaker auxiliary contacts (52b) must be wired here. These contacts are closed when the breaker is open.
- 11 and 10      Breaker auxiliary contacts (52a) must be wired here. These contacts are open when the breaker is open.
- 39 and 40      A LOCAL/REMOTE selector switch (43) should be wired here. When these contacts are open LOCAL mode is selected. When these contacts are closed REMOTE mode is selected.
- 26 and 27      Remote Trip contacts can be wired here. A contact closure here will cause the TRIP output relay to activate for as long as the input remains shorted.
- 28 and 27      Remote Close contacts can be wired here. A

contact closure here will cause the CLOSE output relay to activate for as long as the input remains shorted.

12 and 13      Remote Reclose Enable contacts can be wired here. When REMOTE mode is selected a contact closure here will cause the reclosure scheme to be enabled. These contacts drive a hardware latching relay in the 575 and can therefore be momentary.

14 and 13      Remote Reclose Disable contacts can be wired here. When remote mode is selected a contact closure here will cause the reclosure scheme to be disabled. These contacts drive a hardware latching relay in the 575 and can therefore be momentary.

### Analog Input Trip and External Switch Trip

When either of these trips occur, the reclosure scheme will immediately go to the lockout condition. The lockout is software driven and not shown in hardware form on the Autoreclose logic schematic.

| Location | Message Line                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 12.1   | SETPOINTS<br>AUTO RECLOSURE    | The setpoints page 12 header. All the setpoints required for Auto Reclosure are entered in this page.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| S 12.2   | AUTO RECLOSURE<br>DISABLED     | <p>This setpoint determines whether the reclosure scheme is enabled or disabled when LOCAL mode is selected. When REMOTE mode is selected this setpoint cannot be changed and the flash message</p> <div>ILLEGAL STORE<br/>IN REMOTE MODE</div> <p>will be displayed.</p> <p>The setpoints in messages S12.3 to S12.9 can only be stored while autoreclosure is disabled. If an attempt is made to store a setpoint while reclosure is enabled, the following message will flash:</p> <div>NO STORE WHILE<br/>RECLOSE ENABLE</div> <p>Range: DISABLED/ENABLED.</p> |
| S 12.3   | NO. OF RECLOSE<br>SHOTS 4      | <p>This setpoint determines the number of reclose shots to implement.<br/>Range: 0-4.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| S 12.4   | SHOT 1 DEAD TIME<br>2.0 SEC    | <p>This setpoint determines the dead time after the first trip. The first reclosure will be initiated after this time has elapsed.<br/>Range: 0.3-300 sec.<br/>This is part of 79R14 in the Autoreclosure Logic schematic.</p>                                                                                                                                                                                                                                                                                                                                     |
| S 12.5   | SHOT 2 DEAD TIME<br>4.0 SEC    | <p>Same as above for the second trip.<br/>Range: 0.3-300 sec.<br/>This is part of 79R14 in the Autoreclosure Logic schematic.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| S 12.6   | SHOT 3 DEAD TIME<br>6.0 SEC    | <p>Same as above for the third trip.<br/>Range: 0.3-300 sec.<br/>This is part of 79R14 in the Autoreclosure Logic schematic.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| S 12.7   | SHOT 4 DEAD TIME<br>8.0 SEC    | <p>Same as above for the fourth trip.<br/>Range: 0.3-300 sec.<br/>This is part of 79R14 in the Autoreclosure Logic schematic.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| S 12.8   | SCHEME RESET<br>TIME 5 SEC     | <p>The time required for the reclosure TIME scheme to reset itself. This timer will not operate unless the phase current in all phases is below the pickup level.<br/>Range: 1-255, increments of 1.<br/>This is 79TR18, 79TR20, 79TR22, and 79TR24 in the Autoreclosure Logic schematic.</p>                                                                                                                                                                                                                                                                      |
| S 12.9   | RECLOSURE ENABLE<br>RELAY AUX2 | <p>This setpoint determines which relay will activate when reclosure is enabled.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## SETPOINTS MODE - AUTORECLOSURE



MULTILIN

| Location | Message Line                  | Description                                                                       |
|----------|-------------------------------|-----------------------------------------------------------------------------------|
| S 12.10  | AUTO RECLOSURE<br>END OF PAGE | Last line of Setpoints, page 12, autoreclosure. Use the PAGE key to view page 13. |

| Location                                                                                                           | Message Line                        | Description                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 13.1                                                                                                             | SETPOINTS<br>PHASE CURVES           | The setpoints page 13 header. Setpoints required to program an alternate phase curve are entered here.                                                   |
| S 13.2                                                                                                             | PHASE CURVE<br>CHANGE DISABLED      | This will enable the changing of the phase curve when enabled.                                                                                           |
| <i>Only message S 13.8 will appear if DISABLED is selected in message S 13.2.</i>                                  |                                     |                                                                                                                                                          |
| S 13.3                                                                                                             | SWITCH TO CURVE2<br>AFTER RECL. # 1 | Enter which reclosure you wish to close onto using the alternative phase curve. Alternative curves will remain until lockout occurs.                     |
| S 13.4                                                                                                             | PH. O/C CURVE 2<br>SHAPE EXTREM INV | Enter the curve shape for the alternative phase curve.                                                                                                   |
| <i>Message S 13.5 will not appear if CUSTOM2 was selected in message S 13.4.</i>                                   |                                     |                                                                                                                                                          |
| S 13.5                                                                                                             | PHASE O/C<br>TIME DIAL 2 1          | Enter the time dial for the alternative phase curve.                                                                                                     |
| <i>Messages S13.6 and S13.7 will only appear if CUSTOM2 was selected in message S13.4.</i>                         |                                     |                                                                                                                                                          |
| S 13.6<br>L <sub>A</sub>                                                                                           | TRIP TIME2 (SEC)<br>1.03 xP/U= 1.0  | The trip time for the first breakpoint of the programmable alternative phase curve is entered here. The breakpoints are multiples of the pickup current. |
| The remainder of the messages in this section are identical to those found in the PHASE CURRENT page of setpoints. |                                     |                                                                                                                                                          |
| S 13.7<br>L <sub>A</sub>                                                                                           | TRIP TIME2 (SEC)<br>20.0 xP/U= 1.0  | The last trip time is entered here.                                                                                                                      |
| S 13.8                                                                                                             | PHASE CURVES<br>END OF PAGE         | Last line of Setpoints, page 13. Use the PAGE key to view page 14.                                                                                       |

## SETPOINTS MODE - GROUND CURVES



| Location                                                                                                            | Message Line                        | Description                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| S 14.1                                                                                                              | SETPOINTS<br>GROUND CURVES          | The setpoints page 14 header. Setpoints required to program an alternate ground curve are entered here.                                                   |
| S 14.2                                                                                                              | GROUND CURVE<br>CHANGE DISABLED     | This will enable the changing of the ground curve.                                                                                                        |
| <i>Only message S 14.8 will appear if DISABLED is selected in message S 14.2.</i>                                   |                                     |                                                                                                                                                           |
| S 14.3                                                                                                              | SWITCH TO CURVE2<br>AFTER RECL. # 1 | Enter which reclosure you wish to close onto using the alternative ground curve. Alternative curves will remain until lockout occurs.                     |
| S 14.4                                                                                                              | GND O/C CURVE 2<br>SHAPE EXTREM INV | Enter the curve shape for the alternative ground curve.                                                                                                   |
| <i>Message S 14.5 will not appear if CUSTOM2 was selected in message S 14.4.</i>                                    |                                     |                                                                                                                                                           |
| S 14.5                                                                                                              | GROUND O/C TIME<br>DIAL 2 1         | Enter the time dial for the alternative ground curve.                                                                                                     |
| <i>Messages S14.6 and S14.7 will only appear if CUSTOM2 was selected in message S14.4.</i>                          |                                     |                                                                                                                                                           |
| S 14.6<br>L <sub>A</sub>                                                                                            | TRIP TIME2 (SEC)<br>1.03 xP/U= 1.0  | The trip time for the first breakpoint of the programmable alternative ground curve is entered here. The breakpoints are multiples of the pickup current. |
| The remainder of the messages in this section are identical to those found in the GROUND CURRENT page of setpoints. |                                     |                                                                                                                                                           |
| S 14.7<br>L <sub>A</sub>                                                                                            | TRIP TIME2 (SEC)<br>20.0 xP/U= 1.0  | The last trip time is entered here.                                                                                                                       |
| S 14.8                                                                                                              | GROUND CURVES<br>END OF PAGE        | Last line of Setpoints, page 14. This is the last page of Setpoints.                                                                                      |

## Event Recording Information

Event recording is a feature of the 565 feeder relays. Data relating to one or more "events" is saved in memory and can be viewed by the operator through the front panel display or the rear RS232 printer port.

In order to use the Event Recording feature, the function must be enabled. In Setpoint mode, the lines of the Configuration page allow users to enable the Event Recording and Event Printing features.

### (1.0) "Event" Definition

An "event" is defined as:

- a) occurrence of any set trip conditions,
- b) occurrence or disappearance of any set alarm condition, or
- c) occurrence of other extraordinary event (eg. install/removal of access jumper, enable/disable curve adjustment ...etc).

#### (1.1) Trip Event

Currently available trip events:

- a) any of the 4 timed overcurrent trips,
- b) any of the 4 instantaneous overcurrent trips,
- c) overvoltage or undervoltage trip,
- d) analog input trip,
- e) any of 4 external trips,
- f) power factor, and frequency trip (with Option Card).

#### (1.2) Alarm Event

Currently available alarm events:

- a) any of the 2 overcurrent alarms,
- b) overvoltage alarm,
- c) undervoltage alarm,
- d) analog input alarm,
- e) accumulated KA2 alarm,
- f) definite time alarms (or switch alarms),
- g) amps demand metering
- h) kW, and kVAR demand alarms (with Option Card),
- i) power factor and frequency alarms (with Option Card),
- j) breaker discrepancy and trip coil supervision alarms (with Option Card),
- k) MTM communications alarm (with Option Card).

#### (1.3) "Others" Event

Currently available "others" events:

- a) installation/removal of the access jumper,

- b) enable/disable of block instantaneous trip,
- c) enable/disable of block non-instantaneous trip,
- d) enable/disable of overcurrent curve adjustment,
- e) illegal access to setpoint,
- f) disappearance of alarm conditions,
- g) system manual reset,
- h) local/remote mode switch.

### (2.0) Event Storage

All events will be stored in a memory buffer of the 565 unit, and up to 40 events will be accumulated. The buffer is operated in First-In-First-Out (FIFO) mode. If the buffer is full with 40 stored events, then as each new event occurs the oldest will be lost.

#### (2.1) Event Format

Each event is characterized by cause, time and date, and the magnitude of several measured feeder parameters, which are pertinent to the event, at the time of occurrence. The parameters which will be saved are:

- a) the cause of the event;
- b) the time and date of the event;
- c) each of the 4 RMS currents if it was a trip or alarm event, with the exception of Analog Input Trip, Analog Input Alarm and Accumulated KA2 Alarm events; and
- d) each of the 3 RMS phase (or line) voltages if it was a trip or an alarm event, with the exception of Analog Input Trip, Analog Input Alarm and Accumulated KA2 Alarm.

### (3.0) Event Display Format

To view all the recorded events, users must enter the Actual Value mode, and select the "Event" page.

## FEATURE INFORMATION



| Cause of Event                      | Displayed Message |
|-------------------------------------|-------------------|
| 1) Phase A Timed O/C Trip           | PH-A TIME O/C T   |
| 2) Phase B Timed O/C Trip           | PH-B TIME O/C T   |
| 3) Phase C Timed O/C Trip           | PH-C TIME O/C T   |
| 4) Ground Timed O/C Trip            | GND TIMED O/C T   |
| 5) Phase A Inst Trip                | PH-A INST O/C T   |
| 6) Phase B Inst Trip                | PH-B INST O/C T   |
| 7) Phase C Inst Trip                | PH-C INST O/C T   |
| 8) Ground Inst Trip                 | GND INST O/C T    |
| 9) Overvoltage Trip                 | OVERVOLTAGE T     |
| 10) Undervoltage Trip               | UNDERVOLTAGE T    |
| 11) Analog Input Trip               | ANALOG INPUT T    |
| 12) External Trip #1                | EXT. TRIP #1 T    |
| 13) External Trip #2                | EXT. TRIP #2 T    |
| 14) External Trip #3                | EXT. TRIP #3 T    |
| 15) External Trip #4                | EXT. TRIP #4 T    |
| 16) Power Factor Trip               | P/F TRIP T        |
| 17) Frequency Trip                  | FREQ. TRIP T      |
| 18) Phase O/C Alarm                 | PH O/C ALARM A    |
| 19) Ground O/C Alarm                | GND O/C ALARM A   |
| 20) Overvoltage Alarm               | OVERVOLTAGE A     |
| 21) Undervoltage Alarm              | UNDERVOLTAGE A    |
| 22) Analog Input Alarm              | ANALOG INPUT A    |
| 23) Accumulated KA2 Alarm           | ACCUM KA A        |
| 24) Definite Time Alarm 1           | SWITCH ALARM1 A   |
| 25) Definite Time Alarm 2           | SWITCH ALARM2 A   |
| 26) Amps Demand Alarm               | AMPS DEMAND A     |
| 27) KW Demand Alarm                 | KW DEMAND A       |
| 28) KVAR Demand Alarm               | KVAR DEMAND A     |
| 29) Power Factor Alarm              | P/F ALARM A       |
| 30) Frequency Alarm                 | FREQ. ALARM A     |
| 31) Breaker Discrepancy Alarm       | BRK DISCRPNCY A   |
| 32) Trip Coil Alarm                 | TRIP COIL A       |
| 33) MTM Communications Alarm        | MTM COMM ALM A    |
| 34) Phase O/C Alarm Reset           | PH OC ALM RST O   |
| 35) Ground O/C Alarm Reset          | GD OC ALM RST O   |
| 36) Overvoltage Alarm Reset         | OV ALARM RST O    |
| 37) Undervoltage Alarm Reset        | UV ALARM RST O    |
| 38) Analog Input Alarm Reset        | AI ALARM RST O    |
| 39) Definite Time Alarm1 Reset      | SW ALM1 RST O     |
| 40) Definite Time Alarm2 Reset      | SW ALM2 RST O     |
| 41) Breaker Discrepancy Alarm Reset | BRK ALM RST O     |
| 42) Access Jumper Installed         | AC JUMPER INS O   |
| 43) Access Jumper Removed           | AC JUMPER REM O   |
| 44) Block Inst Trip Enabled         | INST-BLOCK EN O   |
| 45) Block Inst Trip Disabled        | INST-BLOCK DI O   |
| 46) Block Timed O/C Trips Enabled   | TIMED-BLK ENB O   |
| 47) Block Timed O/C Trips Disabled  | TIMED-BLK DIS O   |
| 48) Curve Adjust Enabled            | CURVE ADJ. EN O   |
| 49) Curve Adjust Disabled           | CURVE ADJ. DI O   |
| 50) Illegal Setpoint Access         | ILL-ACCESS O      |
| 51) System Manual Reset             | MANUAL RESET O    |
| 52) Control Switch to Remote        | SWITCH REMOTE O   |
| 53) Control Switch to Local         | SWITCH LOCAL O    |

#### (4.0) Event Print Format

Since there is a large variety of printers and it is impossible to interface with all of them, the 565 feeder relays are standardized to interface with EPSON FX-80 printers with serial input or other compatible printer. See section 2 of this manual for additional details.

The format of the event printout is specified as follows:

a) page size of 8.5"x11".

b) a header line is printed at the top of each page, on which the column fields are specified; they are:

- event reference number
- cause of event
- date and time
- any applicable measured parameters at the time of event (ie. 4 currents and 3 voltages)

c) each event takes two lines (because both cause of event and time/date fields require two lines).

For event printing, the header line is printed at the top of each page.

The following is an example of event printout:

| No. | Cause of Event              | Time/Date            | Ia<br>(A) | Ib<br>(A) | Ic<br>(A) | Ig<br>(A) | Vax<br>(KV) | Vbx<br>(KV) | Vcx<br>(KV) |
|-----|-----------------------------|----------------------|-----------|-----------|-----------|-----------|-------------|-------------|-------------|
| 01  | Phase A Timed<br>O/C Trip   | 16:42:56<br>03/15/92 | 1800      | 400       | 400       | 0         | 2.3         | 4.6         | 4.6         |
| 02  | System Manual<br>Reset      | 16:06:35<br>03/15/92 |           |           |           |           |             |             |             |
| 03  | Undervolt Alarm<br>Reset    | 09:57:43<br>03/15/92 | 400       | 400       | 400       | 0         | 4.6         | 4.6         | 4.6         |
| 04  | Undervoltage<br>Alarm       | 09:53:09<br>03/15/92 | 400       | 400       | 400       | 0         | 4.2         | 4.6         | 4.6         |
| 05  | Analog Input<br>Alarm Reset | 09:49:32<br>03/15/92 |           |           |           |           |             |             |             |
| 06  | Analog Input<br>Alarm       | 21:02:16<br>03/14/92 |           |           |           |           |             |             |             |

## FEATURE INFORMATION



The following lists all "Cause of Event" printout messages:

| Cause of Event                           | Printout Message          |
|------------------------------------------|---------------------------|
| 1) Phase A Timed Overcurrent Trip        | Phase A Timed<br>O/C Trip |
| 2) Phase B Timed Overcurrent Trip        | Phase B Timed<br>O/C Trip |
| 3) Phase C Timed Overcurrent Trip        | Phase C Timed<br>O/C Trip |
| 4) Ground Timed Overcurrent Trip         | Ground Timed<br>O/C Trip  |
| 5) Phase A Instantaneous Trip            | Phase A Inst.<br>O/C Trip |
| 6) Phase B Instantaneous Trip            | Phase B Inst.<br>O/C Trip |
| 7) Phase C Instantaneous Trip            | Phase C Inst.<br>O/C Trip |
| 8) Ground Instantaneous Overcurrent Trip | Ground Inst.<br>O/C Trip  |
| 9) Overvoltage Trip                      | Overvoltage<br>Trip       |
| 10) Undervoltage Trip                    | Undervoltage<br>Trip      |
| 11) Analog Input Trip                    | Analog Input<br>Trip      |
| 12) External Trip #1                     | External Trip<br>#1       |
| 13) External Trip #2                     | External Trip<br>#2       |
| 14) External Trip #3                     | External Trip<br>#3       |
| 15) External Trip #4                     | External Trip<br>#4       |
| 16) Power Factor Trip                    | Power Factor<br>Trip      |
| 17) Frequency Trip                       | Frequency<br>Trip         |
| 18) Phase Overcurrent Alarm              | Phase O/C<br>Alarm        |
| 19) Ground Overcurrent Alarm             | Ground O/C<br>Alarm       |
| 20) Overvoltage Alarm                    | Overvoltage<br>Alarm      |
| 21) Undervoltage Alarm                   | Undervoltage<br>Alarm     |
| 22) Analog Input Alarm                   | Analog Input<br>Alarm     |
| 23) Accumulate KA2 Alarm                 | Accumulated KA<br>Alarm   |
| 24) Definite Time Alarm 1                | Switch Alarm<br>#1        |
| 25) Definite Time Alarm 2                | Switch Alarm<br>#2        |
| 26) Amps Demand Alarm                    | Amps Demand<br>Alarm      |
| 27) KW Demand Alarm                      | KW Demand<br>Alarm        |
| 28) KVAR Demand Alarm                    | KVAR Demand<br>Alarm      |

|                                              |                            |
|----------------------------------------------|----------------------------|
| 29) Power Factor Alarm                       | Power Factor Alarm         |
| 30) Frequency Alarm                          | Frequency Alarm            |
| 31) Breaker Discrepancy Alarm                | Breaker Discrep. Alarm     |
| 32) Trip Coil Alarm                          | Trip Coil Alarm            |
| 33) MTM Communications Alarm                 | MTM Comm. Alarm            |
| 34) Phase Overcurrent Alarm Condition Reset  | Phase O/C Alarm Reset      |
| 35) Ground Overcurrent Alarm Condition Reset | Ground O/C Alarm Reset     |
| 36) Overvoltage Alarm Condition Reset        | Overvoltage Alarm Reset    |
| 37) Undervoltage Alarm Condition Reset       | Undervoltage Alarm Reset   |
| 38) Analog Input Alarm Condition Reset       | Analog Input Alarm Reset   |
| 39) Definite Time Alarm 1 Condition Reset    | Switch Alarm#1 Reset       |
| 40) Definite Time Alarm 2 Condition Reset    | Switch Alarm#2 Reset       |
| 41) Breaker Discrepancy Alarm Reset          | Breaker Alarm Reset        |
| 42) Installation of the Access Jumper        | Access Jumper Installed    |
| 43) Removal of the Access Jumper             | Access Jumper Removed      |
| 44) Enable of Block Instantaneous Trip       | Block Inst. Trip Enabled   |
| 45) Disable of Block Instantaneous Trip      | Block Inst. Trip Disabled  |
| 46) Enable of Block Timed Overcurrent Trips  | Block Timed Trips Enabled  |
| 47) Disable of Block Timed Overcurrent Trips | Block Timed Trips Disabled |
| 48) Enable of Overcurrent Curve Adjustment   | Curve Adjust. Enabled      |
| 49) Disable of Overcurrent Curve Adjustment  | Curve Adjust. Disabled     |
| 50) Illegal Access to Setpoint               | Illegal Setpoint Access    |
| 51) System Manual Reset                      | System Manual Reset        |
| 52) Control Switch to Remote                 | Control Switch to Remote   |
| 53) Control Switch to Local                  | Control Switch to Local    |

## FEATURE INFORMATION



### AEG MODICON MODBUS PROTOCOL

#### Overview

The 565 Feeder Management Relay implements a subset of the AEG Modicon Modbus serial communication standard. Modbus protocol is hardware-independent. That is, the physical layer can be any of a variety of standard hardware configurations. This includes RS232, RS422, RS485, fibre optics, etc. Modbus is a single master/multiple slave type of protocol suitable for a multi-drop configuration as provided by RS485 hardware. The 565 Feeder Management Relay Modbus implementation employs two-wire RS485 hardware. Using RS485, up to 32 slaves can be daisy-chained together on a single communication channel.

565 Feeder Management Relays are always Modbus slaves. They can not be programmed as Modbus masters. Computers or PLCs are commonly programmed as masters.

Modbus protocol exists in two versions: Remote Terminal Unit (RTU, binary) and ASCII. Only the RTU version is supported by the 565 Feeder Management Relay.

Both monitoring and control are possible using read and write register commands. Additional commands are supported to provide additional functions.

This information is also available on diskette for customers who wish to write their own communications programs.

#### Electrical Interface

The hardware or electrical interface in the 565 Feeder Management Relay is two-wire RS485. In a two-wire link data flow is bidirectional. That is, data is transmitted and received over the same two wires. This means that the data flow is half duplex. That is, data is never transmitted and received at the same time.

RS485 lines should be connected in a daisy chain configuration with terminating resistors installed at each end of the link (ie. at the master end and at the slave farthest from the master). The value of the terminating resistors should be approximately equal to the characteristic impedance of the line. This will be approximately 120 ohms for standard #22 AWG twisted pair wire. Shielded wire should always be used to minimize noise.

Note: polarity is important in RS485 communications. The '+' terminals of every device must be connected together.

#### Data Frame Format and Rate

One data frame of an asynchronous transmission to or from a 565 Feeder Management Relay consists of 1 start bit, 8 data bits, and 1 stop bit. This produces a 10 bit data frame. This is important for transmission through modems at high bit rates (11 bit data frames are not supported by Hayes

modems at bit rates of greater than 300 bps).

Modbus protocol can be implemented at any standard communication speed. The 565 Feeder Management Relay supports operation at 1200, 2400, 4800 and 9600 baud.

#### Data Packet Format

A complete request/response sequence consists of the following bytes (transmitted as separate data frames):

##### Master Request Transmission:

|               |                                                       |
|---------------|-------------------------------------------------------|
| SLAVE ADDRESS | - 1 byte                                              |
| FUNCTION CODE | - 1 byte                                              |
| DATA          | - variable number of bytes depending on FUNCTION CODE |
| CRC           | - 2 bytes                                             |

##### Slave Response Transmission:

|               |                                                       |
|---------------|-------------------------------------------------------|
| SLAVE ADDRESS | - 1 byte                                              |
| FUNCTION CODE | - 1 byte                                              |
| DATA          | - variable number of bytes depending on FUNCTION CODE |
| CRC           | - 2 bytes                                             |

**SLAVE ADDRESS** - This is the first byte of every transmission. This byte represents the user-assigned address of the slave device that is to receive the message sent by the master. Each slave device must be assigned a unique address and only the addressed slave will respond to a transmission that starts with its address.

In a master request transmission the **SLAVE ADDRESS** represents the address of the slave to which the request is being sent.

In a slave response transmission the **SLAVE ADDRESS** represents the address of the slave that is sending the response.

**NOTE:** A master transmission with a **SLAVE ADDRESS** of 0 indicates a broadcast command. All slaves on the communication link will take action based on the transmission but no response will be made.

**FUNCTION CODE** - This is the second byte of every transmission. Modbus defines function codes of 1 to 127. The 565 Feeder Management Relay implements some of these functions.

In a master request transmission the **FUNCTION CODE** tells the slave what action to perform.

In a slave response transmission if the **FUNCTION CODE** sent from the slave is the same as the **FUNCTION CODE** sent from the master then the slave performed the function as requested. If the high order bit of the **FUNCTION CODE** sent from the slave is a 1 (ie. if the **FUNCTION CODE** is > 127) then the slave did not perform the function as requested and is sending an error or exception response.

**DATA** - This will be a variable number of bytes depending on the **FUNCTION CODE**. This may be addresses, actual values or setpoints, sent by the master to the slave or by the slave to the master.

**CRC** - This is a two byte error checking code.

## Error Checking

The RTU version of Modbus includes a two byte CRC-16 (16 bit cyclic redundancy check) with every transmission. The CRC-16 algorithm essentially treats the entire data stream (data bits only; start, stop and parity ignored) as one continuous binary number. This number is first shifted left 16 bits and then divided by a characteristic polynomial (11000000000000101B). The 16 bit remainder of the division is appended to the end of the transmission, MSByte first. The resulting message including CRC, when divided by the same polynomial at the receiver will give a zero remainder if no transmission errors have occurred.

If a 565 Feeder Management Relay Modbus slave device receives a transmission in which an error is indicated by the CRC-16 calculation, the slave device will not respond to the transmission. A CRC-16 error indicates that one or more bytes of the transmission were received incorrectly and thus the entire transmission should be ignored in order to avoid the slave device performing any incorrect operation.

The CRC-16 calculation is an industry standard method used for error detection. An algorithm is included here to assist programmers in situations where no standard CRC-16 calculation routines are available.

### CRC-16 Algorithm

Once the following algorithm is complete, the working register "A" will contain the CRC value to be transmitted. Note that this algorithm requires the characteristic polynomial to be reverse bit ordered. The MSbit of the characteristic polynomial is dropped since it does not affect the value of the remainder. The following symbols are used in the algorithm:

—> data transfer  
 A 16 bit working register  
 AL low order byte of A  
 AH high order byte of A  
 CRC 16 bit CRC-16 value  
 i,j loop counters  
 (+) logical "exclusive or" operator  
 Di i-th data byte (i = 0 to N-1)  
 G 16 bit characteristic polynomial = 1010000000000001 with MSbit dropped and bit order reversed

shr(x) shift right (the LSbit of the low order byte of x shifts into a carry flag, a '0' is shifted into the MSbit of the high order byte of x, all other bits shift right one location)

algorithm:

1. FFFF hex —> A
2. 0 —> i
3. 0 —> j
4. Di (+) AL —> AL
5. j+1 —> j
6. shr(A)
7. is there a carry? No: go to 8.  
     Yes: G (+) A —> A
8. is j = 8? No: go to 5.  
     Yes: go to 9.

9. i+1 —> i
10. is i = N? No: go to 3.  
     Yes: go to 11.
11. A —> CRC

## Timing

Data packet synchronization is maintained by timing constraints. The receiving device must measure the time between the reception of characters. If three and one half character times elapse without a new character or completion of the packet, then the communication link must be reset (ie. all slaves start listening for a new transmission from the master). Thus at 9600 baud a delay of greater than  $3.5 \times 1/9600 \times 10 = 3.65$  ms will cause the communication link to be reset.

## Explanation of 565 Supported Functions

The following functions are supported by the 565 Feeder Management Relay:

- 03 - Read Holding Registers (Read Setpoints)
- 04 - Read Input registers (Read Actual Values)
- 05 - Force Single Coil (Execute Operation)
- 06 - Preset Single Register (Store Single Setpoint)
- 07 - Read Exception Status (Read Device Status)
- 16 - Preset Multiple Registers (Store Multiple Setpoints)

### FUNCTION CODE 03

Modbus implementation: Read Holding Registers

565 Feeder Management Relay implementation: Read Setpoints

This function code allows the master to read a group of setpoints from a slave device. The maximum number of holding registers that can be read in one transmission is 125. Number of holding registers should match the total length of required setpoints. In other words, reading half of a setpoint is not recommended. For the 565 Feeder Management Relay implementation of Modbus, "holding registers" are equivalent to 565 Feeder Management Relay setpoints. Holding registers are 16 bit (two byte) values transmitted high order byte first. But all 565 Feeder Management Relay setpoints are not made of two bytes. Some of them are four bytes long and in that case two consecutive holding register addresses are used to transmit data of one setpoint. Holding register with lower address number carries two more significant bytes.

The slave response to this function code is the slave address, function code, a count of the number of data bytes to follow, the data itself and the CRC. Each data item (setpoint) is sent as a two byte number with the high order byte sent first.

Note: Broadcast mode is not allowed with this function code. The master transmission will be ignored by all slaves if broadcast mode is used with this function code.

## FEATURE INFORMATION



MULTILIN

### Message Format and Example (numbers are expressed in HEX)

Request slave 11 to respond with 3 setpoints starting at address 006B. For this example the setpoints data in these addresses is:

| Address | Data |
|---------|------|
| 006B    | 022B |
| 006C    | 0000 |
| 006D    | 0064 |

Master Transmission:

| 11      | 03            | HI LO         | HI LO          | HI LO |
|---------|---------------|---------------|----------------|-------|
| ADDRESS | FUNCTION CODE | START ADDRESS | SETPOINT COUNT | CRC   |
| 11      | 03            | 00 6B         | 00 03          | ?? ?? |

Slave Response:

| 11      | 03            | 06         | HI LO | HI LO | HI LO | HI LO |
|---------|---------------|------------|-------|-------|-------|-------|
| ADDRESS | FUNCTION CODE | BYTE COUNT | 02 2B | 00 00 | 00 64 | ?? ?? |
| 11      | 03            | 06         | 02 2B | 00 00 | 00 64 | ?? ?? |

### **FUNCTION CODE 04**

Modbus Implementation: Read Input Registers

565 Feeder Management Relay Implementation: Read Actual Values

This function code allows the master to read a group of actual values from a slave device. The maximum number of input registers that can be read in one transmission is 125. Number of input registers should match the total length of required actual values. In other words, reading half of an actual value is not recommended. For the 565 Feeder Management Relay implementation of Modbus, "input registers" are equivalent to 565 Feeder Management Relay actual values. Input registers are 16 bit (two byte) values transmitted high order byte first. But all 565 Feeder Management Relay actual values are not made of two bytes. Some of them are four bytes long and in that case two consecutive input register addresses are used to transmit data of one actual value. Input register with lower address number carries two more significant bytes.

The slave response to this function code is the slave address, function code, a count of the number of data bytes to follow, the data itself, and the CRC. Each data item (actual value) is sent as a two byte number with the high order byte sent first.

Note: Broadcast mode is not allowed with this function code. The master transmission will be ignored by all slaves if broadcast mode is used with this function code.

### Message Format and Example

Request slave 11 to respond with 1 actual value starting at address 0008. For this example the actual value in this address (0008) is 0000.

Master Transmission:

| 11      | 04            | HI LO         | HI LO           | HI LO |
|---------|---------------|---------------|-----------------|-------|
| ADDRESS | FUNCTION CODE | START ADDRESS | ACT. VAL. COUNT | CRC   |
| 11      | 04            | 00 08         | 00 01           | ?? ?? |

Slave Response:

| 11      | 04            | 02         | HI LO | HI LO |
|---------|---------------|------------|-------|-------|
| ADDRESS | FUNCTION CODE | BYTE COUNT | 00 00 | ?? ?? |
| 11      | 04            | 02         | 00 00 | ?? ?? |

### **FUNCTION CODE 05**

Modbus Implementation: Force Single Coil

565 Feeder Management Relay Implementation: Execute Operation

This function code allows the master to request the 565 Feeder Management Relay to perform specific operations. The operations that can be performed by the 565 Feeder Management Relay are as follows:

| Operation Code | Function                  |
|----------------|---------------------------|
| 00             | Reset (keypad)            |
| 01             | End of Relay Test         |
| 02             | End of LED Test           |
| 03             | End of Analog Output Test |
| 04             | Test LCD Display          |
| 05             | Test LEDs                 |
| 0FH            | Clear Maintenance Data    |
| 10H            | Clear Operations Data     |
| 11H            | Clear Amp Demand Data     |
| 12H            | Clear KW Demand Data      |
| 13H            | Clear KVAR Demand Data    |
| 14H            | Clear Events              |

Note: Broadcast mode is allowed with this function code. When a broadcast transmission is sent by the master (ie. SLAVE ADDRESS = 0) the selected operation will be executed by all slave devices on the communication link. No response will be sent from any of the slaves.

### Message Format and Example

Request slave 11 to execute operation code 1.

Master Transmission:

| 11                 | 05            | HI LO          | HI LO      | HI LO |
|--------------------|---------------|----------------|------------|-------|
| ADDRESS            | FUNCTION CODE | OPERATION CODE | CODE VALUE | CRC   |
| 11                 | 05            | 00 01          | FF 00      | ?? ?? |
| (Perform Function) |               |                |            |       |

Slave Response:

| 11      | 05            | HI LO          | HI LO      | HI LO |
|---------|---------------|----------------|------------|-------|
| ADDRESS | FUNCTION CODE | OPERATION CODE | CODE VALUE | CRC   |
| 11      | 05            | 00 01          | FF 00      | ?? ?? |

### **FUNCTION CODE 06**

Modbus Implementation: Preset Single Register

565 Feeder Management Relay Implementation: Store Sin-

### gle Setpoint

This command allows the master to store a single setpoint into the memory of a slave device. Only two bytes setpoints can be stored via this function. The slave device response to this function code is to echo the entire master transmission.

Note: Broadcast mode is allowed with this function code. When a broadcast transmission is sent by the master (ie. SLAVE ADDRESS = 0) the selected setpoint will be stored by all slave devices on the communication link. No response will be sent from any of the slaves.

### Message Format and Example

Request slave 11 to store the value 039E in setpoint address 0087. After the transmission in this example is complete, setpoints address 0087 will contain the value 039E.

Master Transmission:

| 11      | 06            | HI LO         | HI LO | HI LO |
|---------|---------------|---------------|-------|-------|
| ADDRESS | FUNCTION CODE | START ADDRESS | DATA  | CRC   |
|         |               | 00 87         | 03 9E | ?? ?? |

Slave Response:

| 11      | 06            | HI LO         | HI LO | HI LO |
|---------|---------------|---------------|-------|-------|
| ADDRESS | FUNCTION CODE | START ADDRESS | DATA  | CRC   |
|         |               | 00 87         | 03 9E | ?? ?? |

### FUNCTION CODE 07

Modbus Implementation: Read Exception Status  
565 Feeder Management Relay Implementation: Read Device Status

This is a function used to quickly read the status of a selected device. A short message length allows for rapid reading of status. The status byte returned will have individual bits set to 1 or 0 depending on the status of the slave device.

Note: Broadcast mode is not allowed with this function code. The master transmission will be ignored by all slaves if broadcast mode is used with this function code.

### Message Format and Example

Request status from slave 11.

Master Transmission:

| 11      | 07            | HI LO |
|---------|---------------|-------|
| ADDRESS | FUNCTION CODE | CRC   |
|         |               | ?? ?? |

Slave Response:

| 11      | 07            | HI LO          |
|---------|---------------|----------------|
| ADDRESS | FUNCTION CODE | DEVICES STATUS |
|         |               | 6D             |
|         |               | 01101101       |

### FUNCTION CODE 16

Modbus Implementation: Preset Multiple Registers  
565 Feeder Management Relay Implementation: Store Multiple Setpoints

This function code allows the master to store a group of setpoints. The maximum number of holding registers that can be stored in one transmission is 60. Number of holding registers has to match the total length of required setpoints. In the other words writing half of a setpoint is not allowed. Modbus "registers" are 16 bit (two byte) values transmitted high order byte first. But all 565 Feeder Management Relay setpoints are not made of two bytes. Some of them are four bytes long and in that case two consecutive holding register addresses are used to transmit data of one setpoint. Holding register with lower address number carries two more significant bytes. The slave device response to this function code is to echo the slave address, function code, starting address, the number of setpoints loaded, and the CRC.

Note: Broadcast mode is allowed with this function code. When a broadcast transmission is sent by the master (ie. SLAVE ADDRESS = 0) the selected setpoint(s) will be stored by all slave devices on the communication link. No response will be sent from any of the slaves.

### Message Format and Example

Request slave 11 to store the value 000A to setpoint address 0087 and the value 0102 to setpoint address 0088. After the transmission in this example is complete, 565 Feeder Management Relay slave 11 will have the following setpoints information stored:

| Address | Data |
|---------|------|
| 0087    | 000A |
| 0088    | 0102 |

Master Transmission:

| 11      | 10            | HI LO         | HI LO          | 04         | HI LO | HI LO | HI LO |
|---------|---------------|---------------|----------------|------------|-------|-------|-------|
| ADDRESS | FUNCTION CODE | START ADDRESS | SETPOINT COUNT | BYTE COUNT | DATA  | DATA  | CRC   |
|         |               | 00 87         | 00 02          |            | 00 0a | 01 02 | ?? ?? |

Slave Response:

| 11      | 10            | HI LO         | HI LO          | HI LO |
|---------|---------------|---------------|----------------|-------|
| ADDRESS | FUNCTION CODE | START ADDRESS | SETPOINT COUNT | CRC   |
|         |               | 00 87         | 00 02          | ?? ?? |

### Error Responses

When a 565 Feeder Management Relay detects an error other than a CRC error, a response will be sent to the master. The MSbit of the FUNCTION CODE byte will be set to 1 (ie. the function code sent from the slave will be equal to the function code sent from the master plus 128). The following byte will be an exception code indicating the type of error that occurred. Transmissions received from the master with CRC errors will be ignored by the 565 Feeder Management Relay.

## FEATURE INFORMATION



The slave response to an error (other than CRC error) will be:

|                |                                |
|----------------|--------------------------------|
| SLAVE ADDRESS  | - 1 byte                       |
| FUNCTION CODE  | - 1 byte (with MSbit set to 1) |
| EXCEPTION CODE | - 1 byte                       |
| CRC            | - 2 bytes                      |

The 565 Feeder Management Relay implements or reserves the following exception response codes:

### **01 - ILLEGAL FUNCTION**

The function code transmitted is not one of the functions supported by the 565 Feeder Management Relay.

### **02 - ILLEGAL DATA ADDRESS**

The address referenced in the data field transmitted by the master is not an allowable address for the 565 Feeder Management Relay, or requested number of registers does not match total length of referenced internal registers.

### **03 - ILLEGAL DATA VALUE**

The value referenced in the data field transmitted by the master is not within range for the selected data address. Could be implemented in the future.

### **04 - FAILURE IN ASSOCIATED DEVICE**

A device connected to the addressed slave device has failed and the data requested cannot be sent.

### **06 - BUSY, REJECTED MESSAGE**

The transmission was received without error but the request could not be performed. Reserved.

### **08 - MEMORY PARITY ERROR**

A hardware error has occurred in the 565 Feeder Management Relay. For example, a RAM failure has occurred and the data requested cannot be sent. Reserved.

| 565/575 MEMORY MAP (REVISION E2.73) |                  |                     |                                                     |              |      |                 |       |                |                    |
|-------------------------------------|------------------|---------------------|-----------------------------------------------------|--------------|------|-----------------|-------|----------------|--------------------|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP               | DESCRIPTION                                         | RANGE        | STEP | UNITS           | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |                  |                     |                                                     |              |      |                 |       |                |                    |
| 0000                                | 0000             | PRODUCT I.D.        | MULTILIN PRODUCT DEVICE CODE                        | 18 or 58     | ---  | ---             | ---   | F1             | 18 (565), 58 (575) |
| 0001                                | 0001             |                     | 565/575 HARDWARE REVISION                           | A to Z       | ---  | ---             | ---   | F2             | E                  |
| 0002                                | 0002             |                     | 565/575 FIRMWARE REVISION                           | 0.00 to 2.73 | ---  | ---             | ---   | F3             | 2.73               |
| 0003                                | 0003             |                     | 565/575 FIRMWARE MODIFICATION                       | 0 to 508     | ---  | ---             | ---   | F4             | 0                  |
| 0004                                | 0004             |                     | RESERVED                                            |              |      |                 |       |                |                    |
| :                                   | :                |                     | :                                                   |              |      |                 |       |                |                    |
| 0024                                | 0018             |                     | RESERVED                                            |              |      |                 |       |                |                    |
| 0025                                | 0019             | STATUS              | START OF EVENT QUEUE (POINTER TO MOST RECENT EVENT) | ---          | ---  | ---             | ---   | F5             | ---                |
| 0026                                | 001A             |                     | 565/575 TRIP STATUS                                 | 0 or 1       | ---  | ---             | ---   | F6             | 0                  |
| 0027                                | 001B             |                     | BREAKER POSITION STATUS                             | 16 or 32     | ---  | ---             | ---   | F7             | ---                |
| 0028                                | 001C             |                     | ALARM STATUS I                                      | ---          | ---  | ---             | ---   | F8             | ---                |
| 0029                                | 001D             |                     | ALARM STATUS II                                     | ---          | ---  | ---             | ---   | F9             | ---                |
| 0030                                | 001E             |                     | EXTERNAL SWITCH STATUS                              | ---          | ---  | ---             | ---   | F10            | ---                |
| 0031                                | 001F             |                     | OUTPUT CONTACT STATUS                               | ---          | ---  | ---             | ---   | F11            | ---                |
| 0032                                | 0020             | CURRENT             | PHASE A CURRENT                                     | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0034                                | 0022             |                     | PHASE B CURRENT                                     | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0036                                | 0024             |                     | PHASE C CURRENT                                     | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0038                                | 0026             |                     | GROUND CURRENT                                      | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0040                                | 0028             |                     | SEE ACTUAL VALUES VOLTAGE GROUP                     |              |      |                 |       |                |                    |
| :                                   | :                |                     | :                                                   |              |      |                 |       |                |                    |
| 0043                                | 002B             |                     | SEE ACTUAL VALUES VOLTAGE GROUP                     |              |      |                 |       |                |                    |
| 0044                                | 002C             | ANALOG INPUT        | ANALOG INPUT                                        | ---          | ---  | ---             | 0.01  | F12            | ---                |
| 0046                                | 002E             |                     | RESERVED                                            |              |      |                 |       |                |                    |
| :                                   | :                |                     | :                                                   |              |      |                 |       |                |                    |
| 0047                                | 002F             |                     | RESERVED                                            |              |      |                 |       |                |                    |
| 0048                                | 0030             | MAINTENANCE<br>DATA | BREAKER DATE                                        | ---          | ---  | ---             | ---   | F13            | ---                |
| 0050                                | 0032             |                     | BREAKER TRIPS                                       | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0051                                | 0033             |                     | PHASE A ACCUMULATED KA                              | 0 TO 9999999 | ---  | KA <sup>2</sup> | 0.01  | F12            | ---                |
| 0053                                | 0035             |                     | PHASE B ACCUMULATED KA                              | 0 TO 9999999 | ---  | KA <sup>2</sup> | 0.01  | F12            | ---                |
| 0055                                | 0037             |                     | PHASE C ACCUMULATED KA                              | 0 TO 9999999 | ---  | KA <sup>2</sup> | 0.01  | F12            | ---                |
| 0057                                | 0039             |                     | MAINTENANCE DATA CLEAR? (RESERVED)                  |              |      |                 |       |                |                    |
| 0058                                | 003A             |                     | DATA CLEARED LAST:                                  | ---          | ---  | ---             | ---   | F13            | ---                |
| 0060                                | 003C             | OPERATIONS<br>DATA  | TIMED PHASE O/C TRIPS                               | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0061                                | 003D             |                     | INST PHASE O/C TRIPS                                | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0062                                | 003E             |                     | TIMED GROUND O/C TRIPS                              | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0063                                | 003F             |                     | INST GROUND O/C TRIPS                               | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0064                                | 0040             |                     | OVERVOLTAGE TRIPS                                   | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0065                                | 0041             |                     | UNDERVOLTAGE TRIPS                                  | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0066                                | 0042             |                     | ANALOG INPUT TRIPS                                  | 0 TO 10000   | ---  | ---             | 1.00  | F14            | ---                |
| 0067                                | 0043             |                     | CLEAR OPERATIONS DATA? (RESERVED)                   |              |      |                 |       |                |                    |
| 0068                                | 0044             |                     | DATA CLEARED LAST?                                  | ---          | ---  | ---             | ---   | F13            | ---                |
| 0070                                | 0046             |                     | RESERVED                                            |              |      |                 |       |                |                    |
| :                                   | :                |                     | :                                                   |              |      |                 |       |                |                    |
| 0071                                | 0047             |                     | RESERVED                                            |              |      |                 |       |                |                    |
| 0072                                | 0048             | PRETRIP DATA        | CAUSE OF LAST TRIP                                  | ---          | ---  | ---             | ---   | F15            | ---                |
| 0074                                | 004A             |                     | PHASE A PRE-TRIP CURRENT                            | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0076                                | 004C             |                     | PHASE B PRE-TRIP CURRENT                            | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0078                                | 004E             |                     | PHASE C PRE-TRIP CURRENT                            | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0080                                | 0050             |                     | GROUND PRE-TRIP CURRENT                             | 0 TO 100000  | ---  | AMPS            | 0.01  | F12            | ---                |
| 0082                                | 0052             |                     | PHASE A-X PRE-TRIP VOLTAGE                          | 0 TO 431.25  | ---  | KVOLTS          | 0.01  | F14            | ---                |
| 0083                                | 0053             |                     | PHASE B-X PRE-TRIP VOLTAGE                          | 0 TO 431.25  | ---  | KVOLTS          | 0.01  | F14            | ---                |
| 0084                                | 0054             |                     | PHASE C-X PRE-TRIP VOLTAGE                          | 0 TO 431.25  | ---  | KVOLTS          | 0.01  | F14            | ---                |
| 0085                                | 0055             |                     | FREQUENCY AT TRIP                                   | ---          | ---  | Hz              | 0.01  | F14            | ---                |
| 0086                                | 0056             |                     | DATE OF TRIP                                        | ---          | ---  | ---             | ---   | F13            | ---                |
| 0088                                | 0058             |                     | TIME OF TRIP                                        | ---          | ---  | ---             | ---   | F13            | ---                |

| 565/575 MEMORY MAP (REVISION E2.73) |      |                      |                                                                  |                |      |        |       |                |                    |
|-------------------------------------|------|----------------------|------------------------------------------------------------------|----------------|------|--------|-------|----------------|--------------------|
| ADDRESS<br>(DEC) (HEX)              |      | GROUP                | DESCRIPTION                                                      | RANGE          | STEP | UNITS  | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |      |                      |                                                                  |                |      |        |       |                |                    |
| 0090                                | 005A | VOLTAGE              | RESERVED                                                         |                |      |        |       |                |                    |
| 0091                                | 005B |                      | RESERVED                                                         |                |      |        |       |                |                    |
| 0040                                | 0028 |                      | VOLTS PHASE A-X                                                  | 0 TO 431.25    | ---  | KVOLTS | 0.01  | F14            | ---                |
| 0041                                | 0029 |                      | VOLTS PHASE B-X                                                  | 0 TO 431.25    | ---  | KVOLTS | 0.01  | F14            | ---                |
| 0042                                | 002A |                      | VOLTS PHASE C-X                                                  | 0 TO 431.25    | ---  | KVOLTS | 0.01  | F14            | ---                |
| 0043                                | 002B |                      | FREQUENCY OF FEEDER                                              | ---            | ---  | Hz     | 0.01  | F14            | ---                |
| 0092                                | 005C |                      | SEE ACTUAL VALUES DEMAND & METERING DATA                         |                |      |        |       |                |                    |
| 0114                                | 0072 | EVENT                | SEE ACTUAL VALUES DEMAND & METERING DATA                         |                |      |        |       |                |                    |
| 0115                                | 0073 |                      | RESERVED                                                         |                |      |        |       |                |                    |
| 0116                                | 0074 |                      | NO. OF EVENTS:                                                   | 0 TO 40        | ---  | ---    | 1.00  | F14            | ---                |
| 0117                                | 0075 |                      | VIEW EVENTS? (RESERVED)                                          |                |      |        |       |                |                    |
| 0118                                | 0076 |                      | RESERVED                                                         |                |      |        |       |                |                    |
| 0119                                | 0077 |                      | PRINT EVENTS? (RESERVED)                                         |                |      |        |       |                |                    |
| 0120                                | 0078 |                      | CLEAR EVENTS? (RESERVED)                                         |                |      |        |       |                |                    |
| 0121                                | 0079 | EVENTS CLEARED LAST: | ---                                                              | ---            | ---  | ---    | F13   | ---            |                    |
| 0092                                | 005C | DEMAND DATA          | PH-A PEAK DEMAND                                                 | ---            | ---  | AMPS   | 0.01  | F12            | ---                |
| 0094                                | 005E |                      | PH-B PEAK DEMAND                                                 | ---            | ---  | AMPS   | 0.01  | F12            | ---                |
| 0096                                | 0060 |                      | PH-C PEAK DEMAND                                                 | ---            | ---  | AMPS   | 0.01  | F12            | ---                |
| 0098                                | 0062 |                      | CLEAR AMP DEMAND DATA? (RESERVED)                                |                |      |        |       |                |                    |
| 0099                                | 0063 |                      | DATA CLEARED LAST:                                               | ---            | ---  | ---    | ---   | F13            | ---                |
| 0101                                | 0065 |                      | PEAK KW DEMAND                                                   | ---            | ---  | KW     | 1.00  | F14            | ---                |
| 0102                                | 0066 |                      | CLEAR KW DEMAND DATA? (RESERVED)                                 |                |      |        |       |                |                    |
| 0103                                | 0067 |                      | KW DEMAND DATA CL'D:                                             | ---            | ---  | ---    | ---   | F13            | ---                |
| 0105                                | 0069 |                      | PEAK KVAR DEMAND                                                 | ---            | ---  | KVAR   | 1.00  | F14            | ---                |
| 0106                                | 006A |                      | CLEAR KVAR DEM'D DATA? (RESERVED)                                |                |      |        |       |                |                    |
| 0107                                | 006B |                      | KVAR DEMAND DATA CL'D:                                           | ---            | ---  | ---    | ---   | F13            | ---                |
| 0109                                | 006D | METERING<br>DATA     | KW AND KVAR POWER SIGNS                                          | ---            | ---  | ---    | ---   | F16            | ---                |
| 0110                                | 006E |                      | POWER FACTOR                                                     | ---            | ---  | ---    | 0.01  | F17            | ---                |
| 0111                                | 006F |                      | FREQUENCY MTM                                                    | ---            | ---  | Hz     | 0.10  | F14            | ---                |
| 0112                                | 0070 |                      | REAL POWER                                                       | 0 TO +/- 65535 | ---  | KW     | 1.00  | F18            | ---                |
| 0113                                | 0071 |                      | REACTIVE POWER                                                   | 0 TO +/- 65535 | ---  | KVAR   | 1.00  | F18            | ---                |
| 0114                                | 0072 |                      | REAL ENERGY USED                                                 | ---            | ---  | MWHR   | 1.00  | F14            | ---                |
| 0123                                | 007B |                      | RESERVED                                                         |                |      |        |       |                |                    |
| 0255                                | 00FF |                      | RESERVED                                                         |                |      |        |       |                |                    |
| Setpoints - READ/WRITE              |      |                      |                                                                  |                |      |        |       |                |                    |
| 0256                                | 0100 | USER LEVEL           | USER LEVEL                                                       | 0 or 1         | -    | -      | -     | F19            | 1                  |
| 0257                                | 0101 |                      | SECURITY FEATURE                                                 | 0 or 1         | -    | -      | -     | F20            | 1                  |
| 0258                                | 0102 |                      | SETPOINT ACCESS                                                  | 0 or 1         | -    | -      | -     | F20            | 0                  |
| 0259                                | 0103 |                      | RESERVED                                                         |                |      |        |       |                |                    |
| 0260                                | 0104 | PHASE CURRENT        | PHASE CT RATING PRIMARY                                          | 10 - 5000      | 5    | AMPS   | 1.00  | F14            | 100                |
| 0261                                | 0105 |                      | SEE SETPOINTS PHASE CURRENT GROUP                                |                |      |        |       |                |                    |
| 0262                                | 0106 |                      | PHASE TIMED O/C PICKUP                                           | 25 - 250       | 1    | %CT    | 1.00  | F14            | 100                |
| 0261                                | 0105 |                      | PHASE O/C CURVE SHAPE (565) or PH. O/C CURVE 1 SHAPE (575)       | 0 - 7          | -    | -      | -     | F21            | 3                  |
| 0263                                | 0107 |                      | PHASE O/C TIME DIAL (565) or PHASE O/C TIME DIAL 1 (575)         | 1 - 32         | 1    | -      | 1.00  | F14            | 1                  |
| 0264                                | 0108 |                      | PHASE O/C TRIP RELAY                                             | 0 - 6          | -    | -      | -     | F22            | 0 (565), 1 (575)   |
| 0265                                | 0109 |                      | PHASE O/C ALARM                                                  | 0 or 1         | -    | -      | -     | F20            | 1                  |
| 0266                                | 010A |                      | PHASE O/C ALARM LEVEL                                            | 0.5 - 3.0      | 0.1  | X P/U  | 0.10  | F14            | 1.5                |
| 0267                                | 010B |                      | PHASE O/C ALARM DELAY                                            | 1 - 255        | 1    | SEC    | 1.00  | F14            | 1                  |
| 0268                                | 010C |                      | PHASE O/C ALARM RELAY                                            | 0 - 3          | -    | -      | -     | F23            | 0 (565), 1 (575)   |
| 0269                                | 010D |                      | PHASE INST TRIPS (565) or PHASE HISET INST TRIPS (575)           | 0 or 1         | -    | -      | -     | F20            | 0                  |
| 0270                                | 010E |                      | PHASE INST TRIP LEVEL (565) or PHASE HISET INST TRIP LEVEL (575) | 1.0 - 18.0     | 0.1  | X P/U  | 0.10  | F14            | 3.0                |
| 0271                                | 010F |                      | PHASE INST TRIP DELAY (565) or PHASE HISET INST DELAY (575)      | 0 - 40         | 1    | CYC    | 1.00  | F14            | 0                  |
| 0272                                | 0110 |                      | PHASE INST TRIP RELAY (565) or PHASE HISET INST RELAY (575)      | 0 - 6          | -    | -      | -     | F22            | 0 (565), 1 (575)   |
| 0273                                | 0111 | (575 Only)           | PH AUTOBLK INST HISET                                            | 0 or 1         | -    | -      | -     | F20            | 1                  |
| 0274                                | 0112 | (575 Only)           | PH AUTOBLK HISET AFTER RECL.#                                    | 1 - 4          | 1    | -      | 1.00  | F14            | 4                  |
| 0275                                | 0113 | (575 Only)           | PHASE LOSET INST TRIPS                                           | 0 or 1         | -    | -      | -     | F20            | 0                  |
| 0276                                | 0114 | (575 Only)           | PHASE LOSET INST TRIP LEVEL                                      | 1.0 - 18.0     | 0.1  | X P/U  | 0.10  | F14            | 2.0                |
| 0277                                | 0115 | (575 Only)           | PHASE LOSET INST DELAY                                           | 0 - 40         | 1    | CYC    | 1.00  | F14            | 0                  |
| 0278                                | 0116 | (575 Only)           | PHASE LOSET INST RELAY                                           | 0 - 2          | -    | -      | -     | F22            | 1                  |
| 0279                                | 0117 | (575 Only)           | PH AUTOBLK INST LOSET                                            | 0 or 1         | -    | -      | -     | F20            | 1                  |
| 0280                                | 0118 | (575 Only)           | PH AUTOBLK LOSET AFTER RECL.#                                    | 1 - 4          | 1    | -      | 1.00  | F14            | 4                  |



## 565/575 MEMORY MAP (REVISION E2.73)

| ADDRESS<br>(DEC) (HEX)    | GROUP | DESCRIPTION                                                            | RANGE             | STEP       | UNITS        | SCALE       | FORMAT<br>CODE | FACTORY<br>DEFAULT      |
|---------------------------|-------|------------------------------------------------------------------------|-------------------|------------|--------------|-------------|----------------|-------------------------|
| Actual Values - READ ONLY |       |                                                                        |                   |            |              |             |                |                         |
| 0281                      | 0119  | TRIP TIME (SEC) (RESERVED)                                             |                   |            |              |             |                |                         |
| 0282                      | 011A  | RESERVED                                                               |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0299                      | 012B  | RESERVED                                                               |                   |            |              |             |                |                         |
| 0300                      | 012C  | GROUND CURRENT SENSING                                                 | 0 or 1            | -          | -            | -           | F20            | 0                       |
| 0301                      | 012D  | SENSING SYSTEM                                                         | 0 or 1            | -          | -            | -           | F24            | 0                       |
| 0302                      | 012E  | CT RATIO PRIMARY                                                       | 10 - 5000         | 5          | AMPS         | 1.00        | F14            | 100                     |
| 0303                      | 012F  | SEE SETPOINTS GROUND CURRENT GROUP                                     |                   |            |              |             |                |                         |
| 0304                      | 0130  | GROUND TIMED O/C PICKUP                                                | 5 - 150           | 1          | % CT         | 1.00        | F14            | 40                      |
| 0303                      | 012F  | <b>GND O/C CURVE SHAPE (565) or GND O/C CURVE 1 SHAPE (575)</b>        | <b>0 - 7</b>      | -          | -            | -           | <b>F21</b>     | <b>3</b>                |
| 0305                      | 0131  | GROUND O/C TIME DIAL (565) or GROUND O/C TIME DIAL 1 (575)             | 1 - 32            | 1          | -            | 1.00        | F14            | 1                       |
| 0306                      | 0132  | GROUND O/C RELAY                                                       | 0 - 6             | -          | -            | -           | F22            | 0 (565), 1 (575)        |
| 0307                      | 0133  | GROUND O/C ALARM                                                       | 0 or 1            | -          | -            | -           | F20            | 1                       |
| 0308                      | 0134  | GND O/C ALARM LEVEL                                                    | 0.5 - 3.0         | 0.1        | X P/U        | 0.10        | F14            | 1.5                     |
| 0309                      | 0135  | GND O/C ALARM DELAY                                                    | 1 - 255           | 1          | SEC          | 1.00        | F14            | 1                       |
| 0310                      | 0136  | GND O/C ALARM RELAY                                                    | 0 - 3             | -          | -            | -           | F23            | 0 (565), 1 (575)        |
| 0311                      | 0137  | GROUND INST TRIPS (565) or GND HISET INST TRIPS (575)                  | 0 or 1            | -          | -            | -           | F20            | 0                       |
| 0312                      | 0138  | GND INST TRIP LEVEL (565) or GND HISET INST TRIP LEVEL (575)           | 1.0 - 7.0         | 0.1        | X P/U        | 0.10        | F14            | 3.0                     |
| 0325                      | 0145  | <b>GND INST TRIP 2 LEVEL (565) or GND HISET INST TRIP2 LEVEL (575)</b> | <b>1.0 - 18.0</b> | <b>0.1</b> | <b>X P/U</b> | <b>0.10</b> | <b>F14</b>     | <b>3.0</b>              |
| 0313                      | 0139  | GND INST TRIP DELAY (565) or GND HISET INST DELAY (575)                | 0 - 40            | 1          | CYC          | 1.00        | F14            | 0                       |
| 0314                      | 013A  | GND INST TRIP RELAY (565) or GND HISET INST RELAY (575)                | 0 - 6             | -          | -            | -           | F22            | 0 (565), 1 (575)        |
| 0315                      | 013B  | (575 Only) GND AUTOBLK INST HISET                                      | 0 or 1            | -          | -            | -           | F20            | 1                       |
| 0316                      | 013C  | (575 Only) GND AUTOBL HISET AFTER RECL.#                               | 1 - 4             | 1          | -            | 1.00        | F14            | 4                       |
| 0317                      | 013D  | (575 Only) GND LOSET INST TRIPS                                        | 0 or 1            | -          | -            | -           | F20            | 0                       |
| 0318                      | 013E  | (575 Only) GND LOSET INST TRIP LEVEL                                   | 1.0 - 7.0         | 0.1        | X P/U        | 0.10        | F14            | 3.0                     |
| 0326                      | 0146  | <b>(575 Only) GND LOSET INST TRIP2 LEVEL</b>                           | <b>1.0 - 18.0</b> | <b>0.1</b> | <b>X P/U</b> | <b>0.10</b> | <b>F14</b>     | <b>3.0</b>              |
| 0319                      | 013F  | (575 Only) GND LOSET INST DELAY                                        | 0 - 40            | 1          | CYC          | 1.00        | F14            | 0                       |
| 0320                      | 0140  | (575 Only) GND LOSET INST RELAY                                        | 0 - 2             | -          | -            | -           | F22            | 1                       |
| 0321                      | 0141  | (575 Only) GND AUTOBLK INST LOSET                                      | 0 or 1            | -          | -            | -           | F20            | 1                       |
| 0322                      | 0142  | (575 Only) GND AUTOBLK LOSET AFTER RECL.#                              | 1 - 4             | 1          | -            | 1.00        | F14            | 4                       |
| 0323                      | 0143  | TRIP TIME (SEC) (RESERVED)                                             |                   |            |              |             |                |                         |
| 0324                      | 0144  | RESERVED                                                               |                   |            |              |             |                |                         |
| 0325                      | 0145  | SEE SETPOINTS GROUND CURRENT GROUP                                     |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0326                      | 0146  | SEE SETPOINTS GROUND CURRENT GROUP                                     |                   |            |              |             |                |                         |
| 0327                      | 0147  | RESERVED                                                               |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0328                      | 0148  | RESERVED                                                               |                   |            |              |             |                |                         |
| 0329                      | 0149  | CONFIGURATION SEE SETPOINTS CONFIGURATION GROUP                        |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0339                      | 0153  | SEE SETPOINTS CONFIGURATION GROUP                                      |                   |            |              |             |                |                         |
| 0340                      | 0154  | SET TIME                                                               | -                 | -          | -            | -           | F13            | -                       |
| 0342                      | 0156  | SET DATE                                                               | -                 | -          | -            | -           | F13            | -                       |
| 0344                      | 0158  | RESET BLOCKED                                                          | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0345                      | 0159  | BLOCK INST TRIPS                                                       | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0346                      | 015A  | BLOCK TIMED O/C TRIPS                                                  | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0339                      | 0153  | <b>BLOCK GND TRIPS</b>                                                 | <b>0 - 8</b>      | -          | -            | -           | <b>F26</b>     | <b>0</b>                |
| 0347                      | 015B  | DEFINITE TIME #1 ALARM                                                 | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0348                      | 015C  | DEFINITE TIME #1 DELAY                                                 | 1 - 255           | 1          | SEC          | 1.00        | F14            | 1                       |
| 0349                      | 015D  | DEFINITE TIME #1 RELAY                                                 | 0 - 3             | -          | -            | -           | F23            | 1 (565), 2 (575)        |
| 0373                      | 0175  | <b>DEFINITE TIME #2 ALARM</b>                                          | <b>0 - 8</b>      | -          | -            | -           | <b>F26</b>     | <b>0</b>                |
| 0374                      | 0176  | <b>DEFINITE TIME #2 DELAY</b>                                          | <b>1 - 255</b>    | <b>1</b>   | <b>SEC</b>   | <b>1.00</b> | <b>F14</b>     | <b>1</b>                |
| 0375                      | 0177  | <b>DEFINITE TIME #2 RELAY</b>                                          | <b>0 - 3</b>      | -          | -            | -           | <b>F23</b>     | <b>1 (565), 2 (575)</b> |
| 0350                      | 015E  | EXTERNAL TRIP #1 (565) or EXTERNAL TRIP (575)                          | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0351                      | 015F  | EXTERNAL TRIP #1 RELAY (565) or EXTERNAL TRIP RELAY (575)              | 0 - 6             | -          | -            | -           | F22            | 3 (565), 1 (575)        |
| 0329                      | 0149  | <b>(565 Only) EXTERNAL TRIP #1 DELAY</b>                               | <b>0 - 60</b>     | <b>1</b>   | <b>CYC</b>   | <b>1.00</b> | <b>F14</b>     | <b>0</b>                |
| 0352                      | 0160  | SEE SETPOINTS CONFIGURATION GROUP                                      |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0362                      | 016A  | SEE SETPOINTS CONFIGURATION GROUP                                      |                   |            |              |             |                |                         |
| 0363                      | 016B  | RESERVED                                                               |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0364                      | 016C  | RESERVED                                                               |                   |            |              |             |                |                         |
| 0365                      | 016D  | SEE SETPOINTS CONFIGURATION GROUP                                      |                   |            |              |             |                |                         |
| :                         | :     | :                                                                      |                   |            |              |             |                |                         |
| 0375                      | 0177  | SEE SETPOINTS CONFIGURATION GROUP                                      |                   |            |              |             |                |                         |
| 0376                      | 0178  | EXTERNAL TRIP #2 (565) or RECLOSABLE TRIP (575)                        | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0377                      | 0179  | EXTERNAL TRIP #2 RELAY (565) or RECLOSABLE TRIP RELAY (575)            | 0 - 6             | -          | -            | -           | F22            | 3 (565), 1 (575)        |
| 0330                      | 014A  | <b>(565 Only) EXTERNAL TRIP #2 DELAY</b>                               | <b>0 - 60</b>     | <b>1</b>   | <b>CYC</b>   | <b>1.00</b> | <b>F14</b>     | <b>0</b>                |
| 0378                      | 017A  | EXTERNAL TRIP #3 (565) or PROGRAMMABLE TRIP (575)                      | 0 - 8             | -          | -            | -           | F26            | 0                       |
| 0379                      | 017B  | EXTERNAL TRIP #3 RELAY (565) or PROGRAMMABLE TRIP RELAY (575)          | 0 - 6             | -          | -            | -           | F22            | 3 (565), 1 (575)        |



| 565/575 MEMORY MAP (REVISION E2.73) |                  |                  |                                     |                                  |      |       |       |                |                      |
|-------------------------------------|------------------|------------------|-------------------------------------|----------------------------------|------|-------|-------|----------------|----------------------|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP            | DESCRIPTION                         | RANGE                            | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT   |
| Actual Values - READ ONLY           |                  |                  |                                     |                                  |      |       |       |                |                      |
| 0331                                | 014B             | (565 Only)       | EXTERNAL TRIP #3 DELAY              | 0 - 60                           | 1    | CYC   | 1.00  | F14            | 0                    |
| 0380                                | 017C             | (575 Only)       | PROGRAMABLE TRIP TYPE               | 0 or 1                           | -    | -     | -     | F27            | 0                    |
| 0332                                | 014C             | (565 Only)       | EXTERNAL TRIP #4                    | 0 - 8                            | -    | -     | -     | F26            | 0                    |
| 0333                                | 014D             | (565 Only)       | EXTERNAL TRIP #4 RELAY              | 0 - 6                            | -    | -     | -     | F22            | 3 (565), 1 (575)     |
| 0334                                | 014E             | (565 Only)       | EXTERNAL TRIP #4 DELAY              | 0 - 60                           | 1    | CYC   | 1.00  | F14            | 0                    |
| 0352                                | 0160             |                  | CURVE ADJUSTMENT                    | 0 - 8                            | -    | -     | -     | F26            | 0                    |
| 0380                                | 017C             |                  | SEE SETPOINTS CONFIGURATION GROUP   |                                  |      |       |       |                |                      |
| 0381                                | 017D             | (575 Only)       | ALTERNATE PHASE CURVE               | 0 - 8                            | -    | -     | -     | F26            | 0                    |
| 0382                                | 017E             | (575 Only)       | ALTERNATE GROUND CURVE              | 0 - 8                            | -    | -     | -     | F26            | 0                    |
| 0383                                | 017F             | (575 Only)       | AUTO-RECLOSURE BLOCK                | 0 - 8                            | -    | -     | -     | F26            | 0                    |
| 0384                                | 0180             |                  | EXTERNAL RESET                      | 0 - 8                            | -    | -     | -     | F26            | 0                    |
| 0353                                | 0161             |                  | SW 1 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0354                                | 0162             |                  | SW 2 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0355                                | 0163             |                  | SW 3 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0356                                | 0164             |                  | SW 4 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0385                                | 0181             |                  | SW 5 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0386                                | 0182             |                  | SW 6 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0387                                | 0183             |                  | SW 7 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0388                                | 0184             |                  | SW 8 CONTACT: NORMALLY              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0357                                | 0165             | (565 Only)       | TRIP RELAY                          | 0 or 1                           | -    | -     | -     | F29            | 1                    |
| 0358                                | 0166             | (565 Only)       | TRIP RELAY PULSE TIME               | 0.1 - 0.6                        | 0.1  | SEC   | 0.10  | F14            | 0.6                  |
| 0359                                | 0167             |                  | AUX 1 RELAY                         | 0 - 2                            | -    | -     | -     | F30            | 1 (565), 2 (575)     |
| 0360                                | 0168             |                  | AUX 1 RELAY PULSE TIME              | 0.1 - 0.6                        | 0.1  | SEC   | 0.10  | F14            | 0.6 (565), 0.1 (575) |
| 0361                                | 0169             |                  | AUX 2 RELAY                         | 0 - 2                            | -    | -     | -     | F30            | 1                    |
| 0362                                | 016A             |                  | AUX 2 RELAY PULSE TIME              | 0.1 - 0.6                        | 0.1  | SEC   | 0.10  | F14            | 0.6                  |
| 0365                                | 016D             |                  | BREAKER RESPONSE DELAY              | 1 - 167                          | 1    | ms    | 1.00  | F14            | 1                    |
| 0335                                | 014F             | (565 Only)       | BREAKER DISCREP.                    | 0 or 1                           | -    | -     | -     | F20            | 1                    |
| 0389                                | 0185             |                  | BREAKER DISCREP. DELAY              | 100 - 1000                       | 10   | ms    | 1.00  | F14            | 1000                 |
| 0338                                | 0152             |                  | TRIP COIL SUPER-VISION              | 0 or 1                           | -    | -     | -     | F20            | 1                    |
| 0366                                | 016E             |                  | ACCUMULATED KA ALARM                | 0 or 1                           | -    | -     | -     | F20            | 1                    |
| 0367                                | 016F             |                  | ACCUMULATED KA ALARM LEVEL          | 5000 - 100000                    | 10   | kA    | 1.00  | F12            | 5000                 |
| 0369                                | 0171             |                  | KA ALARM RELAY                      | 0 - 3                            | -    | -     | -     | F23            | 0                    |
| 0370                                | 0172             |                  | EVENT RECORDING                     | 0 or 1                           | -    | -     | -     | F20            | 0                    |
| 0371                                | 0173             |                  | EVENT PRINTING                      | 0 or 1                           | -    | -     | -     | F31            | 0                    |
| 0336                                | 0150             | (575 Only)       | COLD LOAD P/U BLOCK                 | 0 - 2                            | -    | -     | -     | F25            | 0                    |
| 0337                                | 0151             |                  | COLD LOAD P/U DELAY                 | 0.0 - 10.0                       | 0.1  | SEC   | 0.10  | F14            | 0.0                  |
| 0372                                | 0174             |                  | MTM COMM.:                          | 0 or 1                           | -    | -     | -     | F20            | 0                    |
| 0390                                | 0186             | ANALOG INPUT     | ANALOG INPUT:                       | 0 or 1                           | -    | -     | -     | F20            | 1                    |
| 0391                                | 0187             |                  | EDIT ANALOG INPUT TITLE? (RESERVED) |                                  |      |       |       |                |                      |
| 0392                                | 0188             |                  | EDIT ANALOG INPUT UNITS? (RESERVED) |                                  |      |       |       |                |                      |
| 0393                                | 0189             |                  | MIN CURR SCALE VALUE:               | 0.00 - 1023.00                   | 0.01 | -     | 0.01  | F12            | 4.00                 |
| 0395                                | 018B             |                  | MAX CURR SCALE VALUE                | 0.00 - 1023.00                   | 0.01 | -     | 0.01  | F12            | 20.00                |
| 0397                                | 018D             |                  | ANALOG INPUT TRIP                   | 0 or 1                           | -    | -     | -     | F20            | 1                    |
| 0398                                | 018E             |                  | ANALOG IN TRIP LEVEL                | (See 393 to 396 <sub>DEC</sub> ) | -    | -     | -     | F32            | 16.00                |
| 0400                                | 0190             |                  | ANALOG IN TRIP DELAY                | 1 - 255                          | 1    | SEC   | 1.00  | F14            | 1                    |
| 0401                                | 0191             |                  | ANALOG IN TRIP RELAY                | 0 - 6                            | -    | -     | -     | F22            | 0 (565), 1 (575)     |
| 0402                                | 0192             |                  | ANALOG INPUT ALARM                  | 0 or 1                           | -    | -     | -     | F20            | 1                    |
| 0403                                | 0193             |                  | ANALOG IN ALARM LEVEL               | (See 393 to 396 <sub>DEC</sub> ) | -    | -     | -     | F32            | 12.00                |
| 0405                                | 0195             |                  | ANALOG IN ALARM DELAY               | 1 - 255                          | 1    | SEC   | 1.00  | F14            | 1                    |
| 0406                                | 0196             |                  | ANALOG IN ALARM RELAY               | 0 - 3                            | -    | -     | -     | F23            | 0 (565), 2 (575)     |
| 0407                                | 0197             |                  | RESERVED                            |                                  |      |       |       |                |                      |
| 0419                                | 01A3             |                  | RESERVED                            |                                  |      |       |       |                |                      |
| 0420                                | 01A4             | ANALOG OUTPUT    | ANALOG OUTPUT PARAMETER             | 0 - 8                            | -    | -     | -     | F33            | 0                    |
| 0421                                | 01A5             |                  | ANALOG OUTPUT RANGE                 | 0 or 1                           | -    | -     | -     | F34            | 1                    |
| 0422                                | 01A6             |                  | RESERVED                            |                                  |      |       |       |                |                      |
| 0429                                | 01AD             |                  | RESERVED                            |                                  |      |       |       |                |                      |
| 0430                                | 01AE             | COMMUNICATIONS   | RELAY ADDRESS                       | 1 - 254                          | 1    | -     | 1.00  | F14            | 1                    |
| 0431                                | 01AF             |                  | BAUDRATE                            | 0 - 3                            | -    | -     | -     | F35            | 1                    |
| 0432                                | 01B0             |                  | RESERVED                            |                                  |      |       |       |                |                      |
| 0439                                | 01B7             |                  | RESERVED                            |                                  |      |       |       |                |                      |
| 0440                                | 01B8             | CALIBRATION MODE | EXERCISE RELAY                      | 0 - 6                            | -    | -     | -     | F36            | 0                    |
| 0441                                | 01B9             |                  | SWITCH NUMBER 1 STATUS              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0442                                | 01BA             |                  | SWITCH NUMBER 2 STATUS              | 0 or 1                           | -    | -     | -     | F28            | 0                    |
| 0443                                | 01BB             |                  | SWITCH NUMBER 3 STATUS              | 0 or 1                           | -    | -     | -     | F28            | 0                    |

| 565/575 MEMORY MAP (REVISION E2.73) |                  |                 |                                      |               |      |       |       |                |                    |  |
|-------------------------------------|------------------|-----------------|--------------------------------------|---------------|------|-------|-------|----------------|--------------------|--|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP           | DESCRIPTION                          | RANGE         | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |  |
| Actual Values - READ ONLY           |                  |                 |                                      |               |      |       |       |                |                    |  |
| 0444                                | 01BC             |                 | SWITCH NUMBER 4 STATUS               | 0 or 1        | -    | -     | -     | F28            | 0                  |  |
| 0471                                | 01D7             |                 | SWITCH NUMBER 5 STATUS               | 0 or 1        | -    | -     | -     | F28            | 0                  |  |
| 0472                                | 01D8             |                 | SWITCH NUMBER 6 STATUS               | 0 or 1        | -    | -     | -     | F28            | 0                  |  |
| 0473                                | 01D9             |                 | SWITCH NUMBER 7 STATUS               | 0 or 1        | -    | -     | -     | F28            | 0                  |  |
| 0474                                | 01DA             |                 | SWITCH NUMBER 8 STATUS               | 0 or 1        | -    | -     | -     | F28            | 0                  |  |
| 0445                                | 01BD             |                 | BREAKER OPEN STATUS                  | 0 or 1        | -    | -     | -     | F37            | 0                  |  |
| 0446                                | 01BE             |                 | BREAKER CLOSED STATUS                | 0 or 1        | -    | -     | -     | F37            | 0                  |  |
| 0447                                | 01BF             |                 | ANALOG SELECT A STATUS               | 0 or 1        | -    | -     | -     | F38            | 0                  |  |
| 0448                                | 01C0             |                 | ANALOG SELECT B STATUS               | 0 or 1        | -    | -     | -     | F38            | 0                  |  |
| 0449                                | 01C1             |                 | ANALOG SELECT C STATUS               | 0 or 1        | -    | -     | -     | F38            | 0                  |  |
| 0450                                | 01C2             |                 | ANALOG SELECT D STATUS               | 0 or 1        | -    | -     | -     | F38            | 0                  |  |
| 0451                                | 01C3             |                 | ACCESS JUMPER STATUS                 | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0452                                | 01C4             |                 | REMOTE/LOCAL 43 STATUS               | 0 or 1        | -    | -     | -     | F39            | 0                  |  |
| 0453                                | 01C5             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| :                                   | :                |                 |                                      |               |      |       |       |                |                    |  |
| 0454                                | 01C6             |                 | (575 Only)                           | RESERVED      |      |       |       |                |                    |  |
| 0455                                | 01C7             | (575 Only)      | RECLOSE ENABLE STATUS                | 0 or 1        | -    | -     | -     | F37            | 0                  |  |
| 0456                                | 01C8             |                 | RECLOSE DISABLE STATUS               | 0 or 1        | -    | -     | -     | F37            | 1                  |  |
| 0457                                | 01C9             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| :                                   | :                |                 |                                      |               |      |       |       |                |                    |  |
| 0459                                | 01CB             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| 0460                                | 01CC             |                 | LCD DISPLAY CONTRAST                 | 0 - 10        | 1    | -     | 1.00  | F14            | 5                  |  |
| 0461                                | 01CD             |                 | SOFTWARE RELEASE DATE                |               |      | -     | -     | F13            | Mar 12, 1996       |  |
| 0463                                | 01CF             | FACTORY SERVICE | RESERVED                             |               |      |       |       |                |                    |  |
| 0464                                | 01D0             |                 | ANALOG OUTPUT FORCED TO              | 0 - 255       | 1    | -     | 1.00  | F14            | 0                  |  |
| 0465                                | 01D1             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| 0466                                | 01D2             |                 | TEST LCD DISPLAY? (RESERVED)         |               |      |       |       |                |                    |  |
| 0467                                | 01D3             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| 0468                                | 01D4             |                 | LOAD FACTORY SETTINGS (RESERVED)     |               |      |       |       |                |                    |  |
| 0469                                | 01D5             |                 | CAL. ANALOG IN AT 4 mA (RESERVED)    |               |      |       |       |                |                    |  |
| 0470                                | 01D6             |                 | CAL. ANALOG IN AT 20 mA (RESERVED)   |               |      |       |       |                |                    |  |
| 0471                                | 01D7             |                 | SEE SETPOINTS CALIBRATION MODE GROUP |               |      |       |       |                |                    |  |
| :                                   | :                |                 |                                      |               |      |       |       |                |                    |  |
| 0474                                | 01DA             | VOLTAGE         | SEE SETPOINTS CALIBRATION MODE GROUP |               |      |       |       |                |                    |  |
| 0475                                | 01DB             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| :                                   | :                |                 |                                      |               |      |       |       |                |                    |  |
| 0489                                | 01E9             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| 0490                                | 01EA             |                 | VT CONNECTION                        | 0 - 3         | -    | -     | -     | F40            | 1                  |  |
| 0491                                | 01EB             |                 | VT NOMINAL SEC VOLTS                 | 48.0 - 240.0  | 0.1  | VOLTS | 0.10  | F14            | 120.0              |  |
| 0492                                | 01EC             |                 | VT PRIMARY VOLTS                     | 0.10 - 138.00 | 0.01 | kV    | 0.01  | F14            | 1.20               |  |
| 0615                                | 0267             |                 | ZERO VOLTS DETECT                    | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0493                                | 01ED             |                 | UNDERVOLT TRIP                       | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0494                                | 01EE             |                 | UNDERVOLT TRIP LEVEL                 | 50 - 100      | 1    | %VT   | 1.00  | F14            | 80                 |  |
| 0495                                | 01EF             |                 | UNDERVOLT TRIP DELAY                 | 0.1 - 25.5    | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 0496                                | 01F0             |                 | UNDERVOLT TRIP RELAY                 | 0 - 6         | -    | -     | -     | F22            | 3 (565), 1 (575)   |  |
| 0497                                | 01F1             |                 | UNDERVOLT ALARM                      | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0498                                | 01F2             |                 | UNDERVOLT ALARM LEVEL                | 50 - 100      | 1    | %VT   | 1.00  | F14            | 85                 |  |
| 0499                                | 01F3             |                 | UNDERVOLT ALARM DELAY                | 0.1 - 25.5    | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 0500                                | 01F4             |                 | UNDERVOLT ALARM RELAY                | 0 - 3         | -    | -     | -     | F23            | 1 (565), 2 (575)   |  |
| 0501                                | 01F5             |                 | OVERVOLT TRIP                        | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0502                                | 01F6             |                 | OVERVOLT TRIP LEVEL                  | 101 - 125     | 1    | %VT   | 1.00  | F14            | 120                |  |
| 0503                                | 01F7             |                 | OVERVOLT TRIP DELAY                  | 0.1 - 25.5    | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 0504                                | 01F8             |                 | OVERVOLT TRIP RELAY                  | 0 - 6         | -    | -     | -     | F22            | 0 (565), 1 (575)   |  |
| 0505                                | 01F9             | DEMAND METERING | OVERVOLT ALARM                       | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0506                                | 01FA             |                 | OVERVOLT ALARM LEVEL                 | 101 - 125     | 1    | %VT   | 1.00  | F14            | 115                |  |
| 0507                                | 01FB             |                 | OVERVOLT ALARM DELAY                 | 0.1 - 25.5    | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 0508                                | 01FC             |                 | OVERVOLT ALARM RELAY                 | 0 - 3         | -    | -     | -     | F23            | 0                  |  |
| 0509                                | 01FD             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| :                                   | :                |                 |                                      |               |      |       |       |                |                    |  |
| 0519                                | 0207             |                 | RESERVED                             |               |      |       |       |                |                    |  |
| 0520                                | 0208             |                 | AMPS DEMAND                          | 0 or 1        | -    | -     | -     | F20            | 0                  |  |
| 0521                                | 0209             |                 | AMPS DEMAND TIME PERIOD              | 5 - 120       | 1    | MIN   | 1.00  | F14            | 5                  |  |
| 0522                                | 020A             |                 | AMPS DEMAND ALARM                    | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0523                                | 020B             |                 | AMP DEMAND ALARM LEVEL               | 10 - 5000     | 5    | AMPS  | 1.00  | F14            | 100                |  |
| 0524                                | 020C             |                 | AMP DEMAND ALARM RELAY               | 0 - 3         | -    | -     | -     | F23            | 0 (565), 2 (575)   |  |
| 0525                                | 020D             |                 | KW DEMAND                            | 0 or 1        | -    | -     | -     | F20            | 0                  |  |
| 0526                                | 020E             |                 | KW DEMAND TIME PERIOD                | 5 - 120       | 1    | MIN   | 1.00  | F14            | 5                  |  |
| 0527                                | 020F             |                 | KW DEMAND ALARM                      | 0 or 1        | -    | -     | -     | F20            | 1                  |  |
| 0528                                | 0210             |                 | KW DEMAND ALARM LEVEL                | 100 - 65000   | 100  | kW    | 1.00  | F14            | 1000               |  |
| 0529                                | 0211             |                 | KW DEMAND ALARM RELAY                | 0 - 3         | -    | -     | -     | F23            | 0 (565), 2 (575)   |  |
| 0530                                | 0212             |                 | KVAR DEMAND                          | 0 or 1        | -    | -     | -     | F20            | 0                  |  |

| 565/575 MEMORY MAP (REVISION E2.73) |                  |                        |                                |              |      |       |       |                |                    |
|-------------------------------------|------------------|------------------------|--------------------------------|--------------|------|-------|-------|----------------|--------------------|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP                  | DESCRIPTION                    | RANGE        | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |                  |                        |                                |              |      |       |       |                |                    |
| 0531                                | 0213             | MTM METERING           | KVAR DEMAND TIME PERIOD        | 5 - 120      | 1    | MIN   | 1.00  | F14            | 5                  |
| 0532                                | 0214             |                        | KVAR DEMAND ALARM              | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0533                                | 0215             |                        | KVAR DEMAND AL'M LEVEL         | 100 - 65000  | 100  | KVAR  | 1.00  | F14            | 1000               |
| 0534                                | 0216             |                        | KVAR DEMAND AL'M RELAY         | 0 - 3        | -    | -     | -     | F23            | 0 (565), 2 (575)   |
| 0535                                | 0217             |                        | RESERVED                       |              |      |       |       |                |                    |
| :                                   | :                |                        | :                              |              |      |       |       |                |                    |
| 0545                                | 0221             |                        | RESERVED                       |              |      |       |       |                |                    |
| 0546                                | 0222             |                        | MTM COMM. ALARM                | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0547                                | 0223             |                        | MTM COMM. ALARM RELAY          | 0 - 3        | -    | -     | -     | F23            | 1 (565), 2 (575)   |
| 0548                                | 0224             |                        | MTM CT SELECT                  | 0 or 1       | -    | -     | -     | F41            | 0                  |
| 0549                                | 0225             |                        | MTM CT RATING PRIMARY          | 5 - 5000     | 5    | AMPS  | 1.00  | F14            | 100                |
| 0550                                | 0226             |                        | POWER FACTOR ALARM             | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0551                                | 0227             |                        | P/F LEADING ALARM LEVEL        | 0.00 - 1.00  | 0.05 | -     | 0.01  | F14            | 0.75               |
| 0552                                | 0228             |                        | P/F LAGGING ALARM LEVEL        | 0.00 - 1.00  | 0.05 | -     | 0.01  | F14            | 0.75               |
| 0553                                | 0229             |                        | P/F ALARM DELAY                | 1.0 - 127.0  | 0.5  | SEC   | 0.10  | F14            | 5.0                |
| 0554                                | 022A             |                        | P/F ALARM RELAY                | 0 - 3        | -    | -     | -     | F23            | 0 (565), 2 (575)   |
| 0555                                | 022B             |                        | POWER FACTOR TRIP              | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0556                                | 022C             |                        | P/F LEADING TRIP LEVEL         | 0.00 - 1.00  | 0.05 | -     | 0.01  | F14            | 0.70               |
| 0557                                | 022D             |                        | P/F LAGGING TRIP LEVEL         | 0.00 - 1.00  | 0.05 | -     | 0.01  | F14            | 0.70               |
| 0558                                | 022E             |                        | P/F TRIP DELAY                 | 1.0 - 127.0  | 0.5  | SEC   | 0.10  | F14            | 1.0                |
| 0559                                | 022F             |                        | P/F TRIP RELAY                 | 0 - 6        | -    | -     | -     | F22            | 1                  |
| 0560                                | 0230             |                        | FREQUENCY ALARM                | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0561                                | 0231             |                        | UNDER FREQ ALARM LEVEL         | 40.0 - 60.0  | 0.1  | Hz    | 0.10  | F14            | 58.0               |
| 0562                                | 0232             |                        | OVER FREQ. ALARM LEVEL         | 50.0 - 72.0  | 0.1  | Hz    | 0.10  | F14            | 62.0               |
| 0563                                | 0233             |                        | FREQUENCY ALARM DELAY          | 1.0 - 127.0  | 0.5  | SEC   | 0.10  | F14            | 5.0                |
| 0564                                | 0234             |                        | FREQUENCY ALARM RELAY          | 0 - 3        | -    | -     | -     | F23            | 0 (565), 1 (575)   |
| 0565                                | 0235             |                        | FREQUENCY TRIP                 | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0566                                | 0236             |                        | UNDER FREQ. TRIP LEVEL         | 40.0 - 60.0  | 0.1  | Hz    | 0.10  | F14            | 56.0               |
| 0567                                | 0237             |                        | OVER FREQ. TRIP LEVEL          | 50.0 - 72.0  | 0.1  | Hz    | 0.10  | F14            | 64.0               |
| 0568                                | 0238             |                        | FREQUENCY TRIP DELAY           | 1.0 - 127.0  | 0.5  | SEC   | 0.10  | F14            | 1.0                |
| 0569                                | 0239             |                        | FREQUENCY TRIP RELAY           | 0 - 6        | -    | -     | -     | F22            | 1                  |
| 0570                                | 023A             |                        | MTM SCALING FACTOR             | 1 - 655      | 1    | -     | 1.00  | F14            | 655                |
| 0571                                | 023B             |                        | VOLTAGE REVERSAL TRIP          | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0572                                | 023C             |                        | VOLTAGE REVERSAL DELAY         | 1.0 - 127.0  | 0.5  | SEC   | 0.10  | F14            | 1.0                |
| 0573                                | 023D             |                        | VOLTAGE REVERSAL RELAY         | 0 - 6        | -    | -     | -     | F22            | 0                  |
| 0574                                | 023E             |                        | RESERVED                       |              |      |       |       |                |                    |
| :                                   | :                |                        | :                              |              |      |       |       |                |                    |
| 0582                                | 0246             | AUTO RECLOSURE         | RESERVED                       |              |      |       |       |                |                    |
| 0583                                | 0247             |                        | AUTO RECLOSURE                 | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0584                                | 0248             |                        | NO. OF RECLOSE SHOTS           | 1 - 4        | 1    | -     | 1.00  | F14            | 4                  |
| 0585                                | 0249             |                        | SHOT 1 DEAD TIME               | 0.3 - 300.0  | 0.1  | SEC   | 0.10  | F14            | 2.0                |
| 0586                                | 024A             |                        | SHOT 2 DEAD TIME               | 0.3 - 300.0  | 0.1  | SEC   | 0.10  | F14            | 4.0                |
| 0587                                | 024B             |                        | SHOT 3 DEAD TIME               | 0.3 - 300.0  | 0.1  | SEC   | 0.10  | F14            | 6.0                |
| 0588                                | 024C             |                        | SHOT 4 DEAD TIME               | 0.3 - 300.0  | 0.1  | SEC   | 0.10  | F14            | 8.0                |
| 0589                                | 024D             |                        | SCHEME RESET TIME              | 1 - 255      | 1    | SEC   | 1.00  | F14            | 5                  |
| 0590                                | 024E             |                        | RECLOSURE ENABLE RELAY         | 0 - 3        | -    | -     | -     | F23            | 2                  |
| 0591                                | 024F             |                        | RESERVED                       |              |      |       |       |                |                    |
| :                                   | :                | PHASE CURVES           | :                              |              |      |       |       |                |                    |
| 0599                                | 0257             |                        | RESERVED                       |              |      |       |       |                |                    |
| 0600                                | 0258             |                        | PHASE CURVE CHANGE             | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0601                                | 0259             |                        | SWITCH TO CURVE2 AFTER RECL. # | 1 - 4        | 1    | -     | 1.00  | F14            | 1                  |
| 0602                                | 025A             |                        | PH. O/C CURVE 2 SHAPE          | 0 - 7        | -    | -     | -     | F21            | 3                  |
| 0603                                | 025B             |                        | PHASE O/C TIME DIAL 2          | 1 - 32       | 1    | -     | 1.00  | F14            | 1                  |
| 0604                                | 025C             |                        | TRIP TIME2 (SEC) (RESERVED)    |              |      |       |       |                |                    |
| 0610                                | 0262             | GROUND CURVES          | GROUND CURVE CHANGE            | 0 or 1       | -    | -     | -     | F20            | 1                  |
| 0611                                | 0263             |                        | SWITCH TO CURVE2 AFTER RECL. # | 1 - 4        | 1    | -     | 1.00  | F14            | 1                  |
| 0612                                | 0264             |                        | GND O/C CURVE 2 SHAPE          | 0 - 7        | -    | -     | -     | F21            | 3                  |
| 0613                                | 0265             |                        | GROUND O/C TIME DIAL 2         | 1 - 32       | 1    | -     | 1.00  | F14            | 1                  |
| 0614                                | 0266             |                        | TRIP TIME2 (SEC) (RESERVED)    |              |      |       |       |                |                    |
| 0615                                | 0267             | CUSTOM PHASE<br>CURVE1 | SEE SETPOINTS VOLTAGE GROUP    |              |      |       |       |                |                    |
| 0616                                | 0268             |                        | RESERVED                       |              |      |       |       |                |                    |
| :                                   | :                |                        | :                              |              |      |       |       |                |                    |
| 0999                                | 03E7             |                        | RESERVED                       |              |      |       |       |                |                    |
| 1000                                | 03E8             |                        | 1.03 x PU =                    | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1001                                | 03E9             |                        | 1.1 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1002                                | 03EA             |                        | 1.2 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1003                                | 03EB             |                        | 1.3 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1004                                | 03EC             |                        | 1.4 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1005                                | 03ED             |                        | 1.5 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1006                                | 03EE             |                        | 1.6 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1007                                | 03EF             |                        | 1.7 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1008                                | 03F0             |                        | 1.8 x PU =                     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |

| 565/575 MEMORY MAP (REVISION E2.73) |       |             |              |      |       |       |                |                    |  |
|-------------------------------------|-------|-------------|--------------|------|-------|-------|----------------|--------------------|--|
| ADDRESS<br>(DEC) (HEX)              | GROUP | DESCRIPTION | RANGE        | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |  |
| Actual Values - READ ONLY           |       |             |              |      |       |       |                |                    |  |
| 1009                                | 03F1  | 1.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1010                                | 03F2  | 2.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1011                                | 03F3  | 2.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1012                                | 03F4  | 2.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1013                                | 03F5  | 2.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1014                                | 03F6  | 2.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1015                                | 03F7  | 2.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1016                                | 03F8  | 2.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1017                                | 03F9  | 2.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1018                                | 03FA  | 2.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1019                                | 03FB  | 2.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1020                                | 03FC  | 3.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1021                                | 03FD  | 3.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1022                                | 03FE  | 3.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1023                                | 03FF  | 3.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1024                                | 0400  | 3.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1025                                | 0401  | 3.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1026                                | 0402  | 3.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1027                                | 0403  | 3.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1028                                | 0404  | 3.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1029                                | 0405  | 3.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1030                                | 0406  | 4.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1031                                | 0407  | 4.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1032                                | 0408  | 4.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1033                                | 0409  | 4.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1034                                | 040A  | 4.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1035                                | 040B  | 4.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1036                                | 040C  | 4.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1037                                | 040D  | 4.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1038                                | 040E  | 4.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1039                                | 040F  | 4.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1040                                | 0410  | 5.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1041                                | 0411  | 5.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1042                                | 0412  | 5.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1043                                | 0413  | 5.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1044                                | 0414  | 5.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1045                                | 0415  | 5.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1046                                | 0416  | 5.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1047                                | 0417  | 5.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1048                                | 0418  | 5.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1049                                | 0419  | 5.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1050                                | 041A  | 6.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1051                                | 041B  | 6.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1052                                | 041C  | 7.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1053                                | 041D  | 7.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1054                                | 041E  | 8.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1055                                | 041F  | 8.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1056                                | 0420  | 9.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1057                                | 0421  | 9.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1058                                | 0422  | 10.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1059                                | 0423  | 10.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1060                                | 0424  | 11.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1061                                | 0425  | 11.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1062                                | 0426  | 12.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1063                                | 0427  | 12.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1064                                | 0428  | 13.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1065                                | 0429  | 13.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1066                                | 042A  | 14.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1067                                | 042B  | 14.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1068                                | 042C  | 15.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1069                                | 042D  | 15.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1070                                | 042E  | 16.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1071                                | 042F  | 16.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1072                                | 0430  | 17.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1073                                | 0431  | 17.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1074                                | 0432  | 18.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1075                                | 0433  | 18.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1076                                | 0434  | 19.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1077                                | 0435  | 19.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1078                                | 0436  | 20.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |  |
| 1079                                | 0437  | RESERVED    |              |      |       |       |                |                    |  |

| 565/575 MEMORY MAP (REVISION E2.73) |                  |                          |             |              |      |       |       |                    |
|-------------------------------------|------------------|--------------------------|-------------|--------------|------|-------|-------|--------------------|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP                    | DESCRIPTION | RANGE        | STEP | UNITS | SCALE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |                  |                          |             |              |      |       |       |                    |
| 1099                                | 044B             | CUSTOM GROUND<br>CURVE 1 | RESERVED    |              |      |       |       |                    |
| 1100                                | 044C             |                          | 1.03 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1101                                | 044D             |                          | 1.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1102                                | 044E             |                          | 1.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1103                                | 044F             |                          | 1.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1104                                | 0450             |                          | 1.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1105                                | 0451             |                          | 1.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1106                                | 0452             |                          | 1.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1107                                | 0453             |                          | 1.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1108                                | 0454             |                          | 1.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1109                                | 0455             |                          | 1.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1110                                | 0456             |                          | 2.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1111                                | 0457             |                          | 2.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1112                                | 0458             |                          | 2.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1113                                | 0459             |                          | 2.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1114                                | 045A             |                          | 2.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1115                                | 045B             |                          | 2.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1116                                | 045C             |                          | 2.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1117                                | 045D             |                          | 2.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1118                                | 045E             |                          | 2.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1119                                | 045F             |                          | 2.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1120                                | 0460             |                          | 3.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1121                                | 0461             |                          | 3.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1122                                | 0462             |                          | 3.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1123                                | 0463             |                          | 3.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1124                                | 0464             |                          | 3.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1125                                | 0465             |                          | 3.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1126                                | 0466             |                          | 3.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1127                                | 0467             |                          | 3.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1128                                | 0468             |                          | 3.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1129                                | 0469             |                          | 3.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1130                                | 046A             |                          | 4.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1131                                | 046B             |                          | 4.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1132                                | 046C             |                          | 4.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1133                                | 046D             |                          | 4.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1134                                | 046E             |                          | 4.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1135                                | 046F             |                          | 4.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1136                                | 0470             |                          | 4.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1137                                | 0471             |                          | 4.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1138                                | 0472             |                          | 4.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1139                                | 0473             |                          | 4.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1140                                | 0474             |                          | 5.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1141                                | 0475             |                          | 5.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1142                                | 0476             |                          | 5.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1143                                | 0477             |                          | 5.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1144                                | 0478             |                          | 5.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1145                                | 0479             |                          | 5.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1146                                | 047A             |                          | 5.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1147                                | 047B             |                          | 5.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1148                                | 047C             |                          | 5.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1149                                | 047D             |                          | 5.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1150                                | 047E             |                          | 6.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1151                                | 047F             |                          | 6.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1152                                | 0480             |                          | 7.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1153                                | 0481             |                          | 7.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1154                                | 0482             |                          | 8.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1155                                | 0483             |                          | 8.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1156                                | 0484             |                          | 9.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1157                                | 0485             |                          | 9.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1158                                | 0486             |                          | 10.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1159                                | 0487             |                          | 10.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1160                                | 0488             |                          | 11.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1161                                | 0489             |                          | 11.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1162                                | 048A             |                          | 12.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1163                                | 048B             |                          | 12.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1164                                | 048C             |                          | 13.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1165                                | 048D             |                          | 13.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1166                                | 048E             |                          | 14.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1167                                | 048F             |                          | 14.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1168                                | 0490             |                          | 15.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1169                                | 0491             |                          | 15.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |
| 1170                                | 0492             |                          | 16.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | 1.0                |



| 565/575 MEMORY MAP (REVISION E2.73) |                  |              |             |              |      |       |       |                |                    |
|-------------------------------------|------------------|--------------|-------------|--------------|------|-------|-------|----------------|--------------------|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP        | DESCRIPTION | RANGE        | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |                  |              |             |              |      |       |       |                |                    |
| 1171                                | 0493             |              | 16.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1172                                | 0494             |              | 17.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1173                                | 0495             |              | 17.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1174                                | 0496             |              | 18.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1175                                | 0497             |              | 18.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1176                                | 0498             |              | 19.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1177                                | 0499             |              | 19.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1178                                | 049A             |              | 20.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1179                                | 049B             |              | RESERVED    |              |      |       |       |                |                    |
| 1199                                | 04AF             |              | RESERVED    |              |      |       |       |                |                    |
| 1200                                | 04B0             | CUSTOM PHASE | 1.03 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1201                                | 04B1             | CURVE 2      | 1.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1202                                | 04B2             | (575 Only)   | 1.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1203                                | 04B3             | (575 Only)   | 1.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1204                                | 04B4             | (575 Only)   | 1.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1205                                | 04B5             | (575 Only)   | 1.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1206                                | 04B6             | (575 Only)   | 1.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1207                                | 04B7             | (575 Only)   | 1.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1208                                | 04B8             | (575 Only)   | 1.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1209                                | 04B9             | (575 Only)   | 1.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1210                                | 04BA             | (575 Only)   | 2.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1211                                | 04BB             | (575 Only)   | 2.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1212                                | 04BC             | (575 Only)   | 2.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1213                                | 04BD             | (575 Only)   | 2.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1214                                | 04BE             | (575 Only)   | 2.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1215                                | 04BF             | (575 Only)   | 2.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1216                                | 04C0             | (575 Only)   | 2.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1217                                | 04C1             | (575 Only)   | 2.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1218                                | 04C2             | (575 Only)   | 2.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1219                                | 04C3             | (575 Only)   | 2.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1220                                | 04C4             | (575 Only)   | 3.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1221                                | 04C5             | (575 Only)   | 3.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1222                                | 04C6             | (575 Only)   | 3.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1223                                | 04C7             | (575 Only)   | 3.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1224                                | 04C8             | (575 Only)   | 3.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1225                                | 04C9             | (575 Only)   | 3.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1226                                | 04CA             | (575 Only)   | 3.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1227                                | 04CB             | (575 Only)   | 3.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1228                                | 04CC             | (575 Only)   | 3.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1229                                | 04CD             | (575 Only)   | 3.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1230                                | 04CE             | (575 Only)   | 4.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1231                                | 04CF             | (575 Only)   | 4.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1232                                | 04D0             | (575 Only)   | 4.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1233                                | 04D1             | (575 Only)   | 4.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1234                                | 04D2             | (575 Only)   | 4.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1235                                | 04D3             | (575 Only)   | 4.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1236                                | 04D4             | (575 Only)   | 4.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1237                                | 04D5             | (575 Only)   | 4.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1238                                | 04D6             | (575 Only)   | 4.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1239                                | 04D7             | (575 Only)   | 4.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1240                                | 04D8             | (575 Only)   | 5.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1241                                | 04D9             | (575 Only)   | 5.1 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1242                                | 04DA             | (575 Only)   | 5.2 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1243                                | 04DB             | (575 Only)   | 5.3 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1244                                | 04DC             | (575 Only)   | 5.4 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1245                                | 04DD             | (575 Only)   | 5.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1246                                | 04DE             | (575 Only)   | 5.6 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1247                                | 04DF             | (575 Only)   | 5.7 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1248                                | 04E0             | (575 Only)   | 5.8 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1249                                | 04E1             | (575 Only)   | 5.9 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1250                                | 04E2             | (575 Only)   | 6.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1251                                | 04E3             | (575 Only)   | 6.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1252                                | 04E4             | (575 Only)   | 7.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1253                                | 04E5             | (575 Only)   | 7.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1254                                | 04E6             | (575 Only)   | 8.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1255                                | 04E7             | (575 Only)   | 8.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1256                                | 04E8             | (575 Only)   | 9.0 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1257                                | 04E9             | (575 Only)   | 9.5 x PU =  | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1258                                | 04EA             | (575 Only)   | 10.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1259                                | 04EB             | (575 Only)   | 10.5 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1260                                | 04EC             | (575 Only)   | 11.0 x PU = | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |

| 565/575 MEMORY MAP (REVISION E2.73) |       |               |             |              |       |       |                |                    |     |
|-------------------------------------|-------|---------------|-------------|--------------|-------|-------|----------------|--------------------|-----|
| ADDRESS<br>(DEC) (HEX)              | GROUP | DESCRIPTION   | RANGE       | STEP         | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |     |
| Actual Values - READ ONLY           |       |               |             |              |       |       |                |                    |     |
| 1261                                | 04ED  | (575 Only)    | 11.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1262                                | 04EE  | (575 Only)    | 12.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1263                                | 04EF  | (575 Only)    | 12.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1264                                | 04F0  | (575 Only)    | 13.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1265                                | 04F1  | (575 Only)    | 13.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1266                                | 04F2  | (575 Only)    | 14.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1267                                | 04F3  | (575 Only)    | 14.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1268                                | 04F4  | (575 Only)    | 15.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1269                                | 04F5  | (575 Only)    | 15.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1270                                | 04F6  | (575 Only)    | 16.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1271                                | 04F7  | (575 Only)    | 16.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1272                                | 04F8  | (575 Only)    | 17.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1273                                | 04F9  | (575 Only)    | 17.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1274                                | 04FA  | (575 Only)    | 18.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1275                                | 04FB  | (575 Only)    | 18.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1276                                | 04FC  | (575 Only)    | 19.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1277                                | 04FD  | (575 Only)    | 19.5 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1278                                | 04FE  | (575 Only)    | 20.0 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1279                                | 04FF  | RESERVED      |             |              |       |       |                |                    |     |
| :                                   | :     | :             |             |              |       |       |                |                    |     |
| 1299                                | 0513  | RESERVED      |             |              |       |       |                |                    |     |
| 1300                                | 0514  | CUSTOM GROUND | 1.03 x PU = | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1301                                | 0515  | CURVE 2       | 1.1 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1302                                | 0516  | (575 Only)    | 1.2 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1303                                | 0517  | (575 Only)    | 1.3 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1304                                | 0518  | (575 Only)    | 1.4 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1305                                | 0519  | (575 Only)    | 1.5 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1306                                | 051A  | (575 Only)    | 1.6 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1307                                | 051B  | (575 Only)    | 1.7 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1308                                | 051C  | (575 Only)    | 1.8 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1309                                | 051D  | (575 Only)    | 1.9 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1310                                | 051E  | (575 Only)    | 2.0 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1311                                | 051F  | (575 Only)    | 2.1 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1312                                | 0520  | (575 Only)    | 2.2 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1313                                | 0521  | (575 Only)    | 2.3 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1314                                | 0522  | (575 Only)    | 2.4 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1315                                | 0523  | (575 Only)    | 2.5 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1316                                | 0524  | (575 Only)    | 2.6 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1317                                | 0525  | (575 Only)    | 2.7 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1318                                | 0526  | (575 Only)    | 2.8 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1319                                | 0527  | (575 Only)    | 2.9 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1320                                | 0528  | (575 Only)    | 3.0 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1321                                | 0529  | (575 Only)    | 3.1 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1322                                | 052A  | (575 Only)    | 3.2 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1323                                | 052B  | (575 Only)    | 3.3 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1324                                | 052C  | (575 Only)    | 3.4 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1325                                | 052D  | (575 Only)    | 3.5 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1326                                | 052E  | (575 Only)    | 3.6 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1327                                | 052F  | (575 Only)    | 3.7 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1328                                | 0530  | (575 Only)    | 3.8 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1329                                | 0531  | (575 Only)    | 3.9 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1330                                | 0532  | (575 Only)    | 4.0 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1331                                | 0533  | (575 Only)    | 4.1 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1332                                | 0534  | (575 Only)    | 4.2 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1333                                | 0535  | (575 Only)    | 4.3 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1334                                | 0536  | (575 Only)    | 4.4 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1335                                | 0537  | (575 Only)    | 4.5 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1336                                | 0538  | (575 Only)    | 4.6 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1337                                | 0539  | (575 Only)    | 4.7 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1338                                | 053A  | (575 Only)    | 4.8 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1339                                | 053B  | (575 Only)    | 4.9 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1340                                | 053C  | (575 Only)    | 5.0 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1341                                | 053D  | (575 Only)    | 5.1 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1342                                | 053E  | (575 Only)    | 5.2 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1343                                | 053F  | (575 Only)    | 5.3 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1344                                | 0540  | (575 Only)    | 5.4 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1345                                | 0541  | (575 Only)    | 5.5 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1346                                | 0542  | (575 Only)    | 5.6 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1347                                | 0543  | (575 Only)    | 5.7 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1348                                | 0544  | (575 Only)    | 5.8 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1349                                | 0545  | (575 Only)    | 5.9 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |
| 1350                                | 0546  | (575 Only)    | 6.0 x PU =  | 0.1 - 1092.2 | 0.1   | SEC   | 0.10           | F14                | 1.0 |

| 565/575 MEMORY MAP (REVISION E2.73) |                  |                |                 |              |      |       |       |                |                    |
|-------------------------------------|------------------|----------------|-----------------|--------------|------|-------|-------|----------------|--------------------|
| ADDRESS<br>(DEC)                    | ADDRESS<br>(HEX) | GROUP          | DESCRIPTION     | RANGE        | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |                  |                |                 |              |      |       |       |                |                    |
| 1351                                | 0547             | (575 Only)     | 6.5 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1352                                | 0548             | (575 Only)     | 7.0 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1353                                | 0549             | (575 Only)     | 7.5 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1354                                | 054A             | (575 Only)     | 8.0 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1355                                | 054B             | (575 Only)     | 8.5 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1356                                | 054C             | (575 Only)     | 9.0 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1357                                | 054D             | (575 Only)     | 9.5 x PU =      | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1358                                | 054E             | (575 Only)     | 10.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1359                                | 054F             | (575 Only)     | 10.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1360                                | 0550             | (575 Only)     | 11.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1361                                | 0551             | (575 Only)     | 11.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1362                                | 0552             | (575 Only)     | 12.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1363                                | 0553             | (575 Only)     | 12.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1364                                | 0554             | (575 Only)     | 13.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1365                                | 0555             | (575 Only)     | 13.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1366                                | 0556             | (575 Only)     | 14.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1367                                | 0557             | (575 Only)     | 14.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1368                                | 0558             | (575 Only)     | 15.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1369                                | 0559             | (575 Only)     | 15.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1370                                | 055A             | (575 Only)     | 16.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1371                                | 055B             | (575 Only)     | 16.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1372                                | 055C             | (575 Only)     | 17.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1373                                | 055D             | (575 Only)     | 17.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1374                                | 055E             | (575 Only)     | 18.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1375                                | 055F             | (575 Only)     | 18.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1376                                | 0560             | (575 Only)     | 19.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1377                                | 0561             | (575 Only)     | 19.5 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1378                                | 0562             | (575 Only)     | 20.0 x PU =     | 0.1 - 1092.2 | 0.1  | SEC   | 0.10  | F14            | 1.0                |
| 1379                                | 0563             |                | RESERVED        |              |      |       |       |                |                    |
| 1535                                | 05FF             |                | RESERVED        |              |      |       |       |                |                    |
| 1536                                | 0600             | EVENT RECORDER | EVENT RECORD 1  | -            | -    | -     | -     | F42            | -                  |
| 1555                                | 0613             |                | EVENT RECORD 1  | -            | -    | -     | -     | F42            | -                  |
| 1556                                | 0614             |                | EVENT RECORD 2  | -            | -    | -     | -     | F42            | -                  |
| 1575                                | 0627             |                | EVENT RECORD 2  | -            | -    | -     | -     | F42            | -                  |
| 1576                                | 0628             |                | EVENT RECORD 3  | -            | -    | -     | -     | F42            | -                  |
| 1595                                | 063B             |                | EVENT RECORD 3  | -            | -    | -     | -     | F42            | -                  |
| 1596                                | 063C             |                | EVENT RECORD 4  | -            | -    | -     | -     | F42            | -                  |
| 1615                                | 064F             |                | EVENT RECORD 4  | -            | -    | -     | -     | F42            | -                  |
| 1616                                | 0650             |                | EVENT RECORD 5  | -            | -    | -     | -     | F42            | -                  |
| 1635                                | 0663             |                | EVENT RECORD 5  | -            | -    | -     | -     | F42            | -                  |
| 1636                                | 0664             |                | EVENT RECORD 6  | -            | -    | -     | -     | F42            | -                  |
| 1655                                | 0677             |                | EVENT RECORD 6  | -            | -    | -     | -     | F42            | -                  |
| 1656                                | 0678             |                | EVENT RECORD 7  | -            | -    | -     | -     | F42            | -                  |
| 1675                                | 068B             |                | EVENT RECORD 7  | -            | -    | -     | -     | F42            | -                  |
| 1676                                | 068C             |                | EVENT RECORD 8  | -            | -    | -     | -     | F42            | -                  |
| 1695                                | 069F             |                | EVENT RECORD 8  | -            | -    | -     | -     | F42            | -                  |
| 1696                                | 06A0             |                | EVENT RECORD 9  | -            | -    | -     | -     | F42            | -                  |
| 1715                                | 06B3             |                | EVENT RECORD 9  | -            | -    | -     | -     | F42            | -                  |
| 1716                                | 06B4             |                | EVENT RECORD 10 | -            | -    | -     | -     | F42            | -                  |
| 1735                                | 06C7             |                | EVENT RECORD 10 | -            | -    | -     | -     | F42            | -                  |
| 1736                                | 06C8             |                | EVENT RECORD 11 | -            | -    | -     | -     | F42            | -                  |
| 1755                                | 06DB             |                | EVENT RECORD 11 | -            | -    | -     | -     | F42            | -                  |
| 1756                                | 06DC             |                | EVENT RECORD 12 | -            | -    | -     | -     | F42            | -                  |
| 1775                                | 06EF             |                | EVENT RECORD 12 | -            | -    | -     | -     | F42            | -                  |
| 1776                                | 06F0             |                | EVENT RECORD 13 | -            | -    | -     | -     | F42            | -                  |
| 1795                                | 0703             |                | EVENT RECORD 13 | -            | -    | -     | -     | F42            | -                  |
| 1796                                | 0704             |                | EVENT RECORD 14 | -            | -    | -     | -     | F42            | -                  |

| 565/575 MEMORY MAP (REVISION E2.73) |      |       |                 |       |      |       |       |                |                    |
|-------------------------------------|------|-------|-----------------|-------|------|-------|-------|----------------|--------------------|
| ADDRESS<br>(DEC) (HEX)              |      | GROUP | DESCRIPTION     | RANGE | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |      |       |                 |       |      |       |       |                |                    |
| 1815                                | 0717 |       | EVENT RECORD 14 | -     | -    | -     | -     | F42            | -                  |
| 1816                                | 0718 |       | EVENT RECORD 15 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1835                                | 072B |       | EVENT RECORD 15 | -     | -    | -     | -     | F42            | -                  |
| 1836                                | 072C |       | EVENT RECORD 16 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1855                                | 073F |       | EVENT RECORD 16 | -     | -    | -     | -     | F42            | -                  |
| 1856                                | 0740 |       | EVENT RECORD 17 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1875                                | 0753 |       | EVENT RECORD 17 | -     | -    | -     | -     | F42            | -                  |
| 1876                                | 0754 |       | EVENT RECORD 18 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1895                                | 0767 |       | EVENT RECORD 18 | -     | -    | -     | -     | F42            | -                  |
| 1896                                | 0768 |       | EVENT RECORD 19 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1915                                | 077B |       | EVENT RECORD 19 | -     | -    | -     | -     | F42            | -                  |
| 1916                                | 077C |       | EVENT RECORD 20 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1935                                | 078F |       | EVENT RECORD 20 | -     | -    | -     | -     | F42            | -                  |
| 1936                                | 0790 |       | EVENT RECORD 21 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1955                                | 07A3 |       | EVENT RECORD 21 | -     | -    | -     | -     | F42            | -                  |
| 1956                                | 07A4 |       | EVENT RECORD 22 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1975                                | 07B7 |       | EVENT RECORD 22 | -     | -    | -     | -     | F42            | -                  |
| 1976                                | 07B8 |       | EVENT RECORD 23 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 1995                                | 07CB |       | EVENT RECORD 23 | -     | -    | -     | -     | F42            | -                  |
| 1996                                | 07CC |       | EVENT RECORD 24 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2015                                | 07DF |       | EVENT RECORD 24 | -     | -    | -     | -     | F42            | -                  |
| 2016                                | 07E0 |       | EVENT RECORD 25 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2035                                | 07F3 |       | EVENT RECORD 25 | -     | -    | -     | -     | F42            | -                  |
| 2036                                | 07F4 |       | EVENT RECORD 26 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2055                                | 0807 |       | EVENT RECORD 26 | -     | -    | -     | -     | F42            | -                  |
| 2056                                | 0808 |       | EVENT RECORD 27 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2075                                | 081B |       | EVENT RECORD 27 | -     | -    | -     | -     | F42            | -                  |
| 2076                                | 081C |       | EVENT RECORD 28 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2095                                | 082F |       | EVENT RECORD 28 | -     | -    | -     | -     | F42            | -                  |
| 2096                                | 0830 |       | EVENT RECORD 29 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2115                                | 0843 |       | EVENT RECORD 29 | -     | -    | -     | -     | F42            | -                  |
| 2116                                | 0844 |       | EVENT RECORD 30 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2135                                | 0857 |       | EVENT RECORD 30 | -     | -    | -     | -     | F42            | -                  |
| 2136                                | 0858 |       | EVENT RECORD 31 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2155                                | 086B |       | EVENT RECORD 31 | -     | -    | -     | -     | F42            | -                  |
| 2156                                | 086C |       | EVENT RECORD 32 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2175                                | 087F |       | EVENT RECORD 32 | -     | -    | -     | -     | F42            | -                  |
| 2176                                | 0880 |       | EVENT RECORD 33 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2195                                | 0893 |       | EVENT RECORD 33 | -     | -    | -     | -     | F42            | -                  |
| 2196                                | 0894 |       | EVENT RECORD 34 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2215                                | 08A7 |       | EVENT RECORD 34 | -     | -    | -     | -     | F42            | -                  |
| 2216                                | 08A8 |       | EVENT RECORD 35 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2235                                | 08BB |       | EVENT RECORD 35 | -     | -    | -     | -     | F42            | -                  |
| 2236                                | 08BC |       | EVENT RECORD 36 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2255                                | 08CF |       | EVENT RECORD 36 | -     | -    | -     | -     | F42            | -                  |
| 2256                                | 08D0 |       | EVENT RECORD 37 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2275                                | 08E3 |       | EVENT RECORD 37 | -     | -    | -     | -     | F42            | -                  |
| 2276                                | 08E4 |       | EVENT RECORD 38 | -     | -    | -     | -     | F42            | -                  |



| 565/575 MEMORY MAP (REVISION E2.73) |      |       |                 |       |      |       |       |                |                    |
|-------------------------------------|------|-------|-----------------|-------|------|-------|-------|----------------|--------------------|
| ADDRESS<br>(DEC) (HEX)              |      | GROUP | DESCRIPTION     | RANGE | STEP | UNITS | SCALE | FORMAT<br>CODE | FACTORY<br>DEFAULT |
| Actual Values - READ ONLY           |      |       |                 |       |      |       |       |                |                    |
| 2295                                | 08F7 |       | EVENT RECORD 38 | -     | -    | -     | -     | F42            | -                  |
| 2296                                | 08F8 |       | EVENT RECORD 39 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2315                                | 090B |       | EVENT RECORD 39 | -     | -    | -     | -     | F42            | -                  |
| 2316                                | 090C |       | EVENT RECORD 40 | -     | -    | -     | -     | F42            | -                  |
| :                                   | :    |       | :               |       |      |       |       |                |                    |
| 2335                                | 091F |       | EVENT RECORD 40 | -     | -    | -     | -     | F42            | -                  |

**565/575 DATA FORMATS (REVISION E2.73)**

| FORMAT CODE | APPLICABLE BITS                         | DEFINITION                                                                          |
|-------------|-----------------------------------------|-------------------------------------------------------------------------------------|
| <b>F1</b>   | <b>16 bits</b>                          | <b>MULTILIN PRODUCT DEVICE CODE</b>                                                 |
|             | 0000 0000 0001 0010 (BIN) or 0012 (HEX) | 18 (DEC) = 565 Feeder Management Relay                                              |
|             | 0000 0000 0011 1010 (BIN) or 003A (HEX) | 58 (DEC) = 575 Feeder Management Relay                                              |
| <b>F2</b>   | <b>16 bits</b>                          | <b>565/575 HARDWARE REVISION</b>                                                    |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Undefined                                                                |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = A                                                                        |
|             | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 02 (DEC) = B                                                                        |
|             | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 03 (DEC) = C                                                                        |
|             | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 04 (DEC) = D                                                                        |
|             | 0000 0000 0000 0101 (BIN) or 0005 (HEX) | 05 (DEC) = E                                                                        |
|             | :                                       | :                                                                                   |
|             | 0000 0000 0001 1010 (BIN) or 001A (HEX) | 26 (DEC) = Z                                                                        |
| <b>F3</b>   | <b>16 bits</b>                          | <b>565/575 FIRMWARE REVISION</b>                                                    |
|             | 0000 XXXX 0000 0000 (BIN) or 0X00 (HEX) | Major Revision Digits (0 through 9 only)                                            |
|             | 0000 0000 XXXX 0000 (BIN) or 00X0 (HEX) | Minor Revision Digits (0 through 9 only)                                            |
|             | 0000 0000 0000 XXXX (BIN) or 000X (HEX) | Ultra Minor Revision Digits (0 through 9 only)                                      |
|             | 0000 0010 0111 0011 (BIN) or 0273 (HEX) | Example: Revision 2.73 Stored As 0273 (HEX)                                         |
| <b>F4</b>   | <b>16 bits</b>                          | <b>565/575 FIRMWARE MODIFICATION</b>                                                |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 000 (DEC) = No Modification (Standard Feeder Management Relay)                      |
|             | 0000 0001 0010 1011 (BIN) or 012B (HEX) | 299 (DEC) = Modification 299                                                        |
| <b>F5</b>   | <b>16 bits</b>                          | <b>START OF EVENT QUEUE (POINTER TO MOST RECENT EVENT)</b>                          |
|             | 0000 0000 XXXX XXXX (BIN) or 00XX (HEX) | Points To Most Recent Event Record Number (0 through 39 only)                       |
|             | XXXX XXXX 0000 0000 (BIN) or XX00 (HEX) | Wrap Around Counter Incremented Every 40 Events                                     |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 000 (DEC) = No. Of Events Register At 74 (HEX) Points To Most Recent Event Record   |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 001 (DEC) = Points To Event Record 01 As The Most Recent Event                      |
|             | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 002 (DEC) = Points To Event Record 02 As The Most Recent Event                      |
|             | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 003 (DEC) = Points To Event Record 03 As The Most Recent Event                      |
|             | :                                       | :                                                                                   |
|             | 0000 0000 0010 0111 (BIN) or 0027 (HEX) | 039 (DEC) = Points To Event Record 39 As The Most Recent Event                      |
|             | 0000 0001 0000 0000 (BIN) or 0100 (HEX) | 256 (DEC) = Points To Event Record 40 As The Most Recent Event                      |
|             | 0000 0001 0000 0001 (BIN) or 0101 (HEX) | 257 (DEC) = Points To Event Record 01 As The Most Recent Event                      |
| <b>F6</b>   | <b>16 bits</b>                          | <b>565/575 TRIP STATUS</b>                                                          |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 0 (DEC) = 565/575 Not Tripped Since Last Reset                                      |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 1 (DEC) = 565/575 Tripped Since Last Reset                                          |
| <b>F7</b>   | <b>16 bits</b>                          | <b>BREAKER POSITION STATUS</b>                                                      |
|             | 0000 0000 0001 0000 (BIN) or 0010 (HEX) | 16 (DEC) = Breaker Open                                                             |
|             | 0000 0000 0010 0000 (BIN) or 0020 (HEX) | 32 (DEC) = Breaker Closed                                                           |
| <b>F8</b>   | <b>16 bits</b>                          | <b>ALARM STATUS I</b>                                                               |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 001 (DEC) = Undefined                                                               |
|             | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 002 (DEC) = MTM Communication Alarm                                                 |
|             | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 004 (DEC) = Switch Alarm 2                                                          |
|             | 0000 0000 0000 1000 (BIN) or 0008 (HEX) | 008 (DEC) = Trip Coil Supervision Alarm                                             |
|             | 0000 0000 0001 0000 (BIN) or 0010 (HEX) | 016 (DEC) = Frequency Alarm                                                         |
|             | 0000 0000 0010 0000 (BIN) or 0020 (HEX) | 032 (DEC) = Power Factor Alarm                                                      |
|             | 0000 0000 0100 0000 (BIN) or 0040 (HEX) | 064 (DEC) = KVAR Demand Alarm                                                       |
|             | 0000 0000 1000 0000 (BIN) or 0080 (HEX) | 128 (DEC) = KW Demand Alarm                                                         |
|             |                                         | Note: Multiple Alarms Can Be Reported                                               |
| <b>F9</b>   | <b>16 bits</b>                          | <b>ALARM STATUS II</b>                                                              |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 001 (DEC) = Amps Demand Alarm                                                       |
|             | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 002 (DEC) = Accumulated KA Alarm                                                    |
|             | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 004 (DEC) = Overvoltage Alarm                                                       |
|             | 0000 0000 0000 1000 (BIN) or 0008 (HEX) | 008 (DEC) = Undervoltage Alarm                                                      |
|             | 0000 0000 0001 0000 (BIN) or 0010 (HEX) | 016 (DEC) = Analog In Alarm                                                         |
|             | 0000 0000 0010 0000 (BIN) or 0020 (HEX) | 032 (DEC) = Switch Alarm 1                                                          |
|             | 0000 0000 0100 0000 (BIN) or 0040 (HEX) | 064 (DEC) = Ground Alarm                                                            |
|             | 0000 0000 1000 0000 (BIN) or 0080 (HEX) | 128 (DEC) = Phase Alarm                                                             |
|             |                                         | Note: Multiple Alarms Can Be Reported                                               |
| <b>F10</b>  | <b>16 bits</b>                          | <b>EXTERNAL SWITCH STATUS</b>                                                       |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 001 (DEC) = External Switch 1 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 002 (DEC) = External Switch 2 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 004 (DEC) = External Switch 3 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 0000 1000 (BIN) or 0008 (HEX) | 008 (DEC) = External Switch 4 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 0001 0000 (BIN) or 0010 (HEX) | 016 (DEC) = External Switch 5 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 0010 0000 (BIN) or 0020 (HEX) | 032 (DEC) = External Switch 6 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 0100 0000 (BIN) or 0040 (HEX) | 064 (DEC) = External Switch 7 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             | 0000 0000 1000 0000 (BIN) or 0080 (HEX) | 128 (DEC) = External Switch 8 Active (N/O Switch Is Closed) or (N/C Switch Is Open) |
|             |                                         | Note: Multiple Switches Can Be Reported                                             |
| <b>F11</b>  | <b>16 bits</b>                          | <b>OUTPUT CONTACT STATUS</b>                                                        |
|             | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 001 (DEC) = Aux 3 Relay Is Or Has Been Activated By A Trip Since Last Reset (*)     |
|             | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 002 (DEC) = Aux 2 Relay Is Or Has Been Activated By A Trip Since Last Reset (*)     |
|             | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 004 (DEC) = Aux 1 Relay Is Or Has Been Activated By A Trip Since Last Reset (*)     |
|             | 0000 0000 0000 1000 (BIN) or 0008 (HEX) | 008 (DEC) = Trip Relay Is Or Has Been Activated By A Trip Since Last Reset (*)      |

**565/575 DATA FORMATS (REVISION E2.73)**

| FORMAT CODE | APPLICABLE BITS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | DEFINITION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | 0000 0000 0001 0000 (BIN) or 0010 (HEX)<br>0000 0000 0010 0000 (BIN) or 0020 (HEX)<br>0000 0000 0100 0000 (BIN) or 0040 (HEX)<br>0000 0000 1000 0000 (BIN) or 0080 (HEX)                                                                                                                                                                                                                                                                                                                                                                  | 016 (DEC) = Aux 3 Relay Is Activated By A Trip Or An Alarm At Moment Of Request<br>032 (DEC) = Aux 2 Relay Is Activated By A Trip Or An Alarm At Moment Of Request<br>064 (DEC) = Aux 1 Relay Is Activated By A Trip Or An Alarm At Moment Of Request<br>128 (DEC) = Trip Relay Is Activated By A Trip At Moment Of Request<br>(*) An Alarm Condition Will Not Activate This Bit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>F12</b>  | <b>32 bits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>ULONG (4 BYTE UNSIGNED INTEGER TO BE MULTIPLIED BY SCALING FACTOR)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | XX XX 00 00 (HEX)<br>00 00 XX XX (HEX)<br><br>XX XX XX XX (HEX)<br>00 03 5C 71 (HEX)                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Lower Address Contains The Most Significant 16 bits<br>Upper Address Contains The Least Significant 16 bits<br>Example:<br>XXXXXX (DEC) * Scaling Factor = Result<br>220273 (DEC) * 0.01 = 2202.73 Amps<br>Note: This Register Should Be Read As Four Continuous Bytes<br>Note: Only Reading The Upper Address Will Return Zero, As This Register Is Non-existent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>F13</b>  | <b>32 bits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>LONG (BCD FORMAT FOR TIME AND DATE)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|             | XX SS MM HH (BCD)<br><br>81 48 58 07 (BCD)<br><br>:<br>XX DD MM YY (BCD)<br><br>00 18 07 95 (BCD)                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lower Address Contains Don't Care And The Seconds<br>Upper Address Contains The Minutes And The Hour<br>Example: 07 (Hour) : 58 (Minutes) : 48 (Seconds)<br>Range: 00:00:00 To 23:59:59<br>:<br>Lower Address Contains Don't Care And The Day<br>Upper Address Contains The Month And The Year<br>Example: July 18, 1995<br>Range: Jan 01, 1969 To Dec 31, 2068<br>Note: This Register Should Be Read As Four Continuous Bytes<br>Note: Only Reading The Upper Address Will Return Zero, As This Register Is Non-existent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>F14</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>UNSIGNED VALUE (2 BYTE UNSIGNED INTEGER TO BE MULTIPLIED BY SCALING FACTOR)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | XXXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>0000 0001 1010 0000 (BIN) or 01A0 (HEX)                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Example:<br>XXX (DEC) * Scaling Factor = Result<br>416 (DEC) * 0.01 = 4.16 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>F15</b>  | <b>32 bits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>CAUSE OF LAST TRIP</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | 00 00 00 00 (HEX)<br>00 00 00 01 (HEX)<br>00 00 00 02 (HEX)<br>00 00 00 04 (HEX)<br>00 00 00 08 (HEX)<br>00 00 00 10 (HEX)<br>00 00 00 20 (HEX)<br>00 00 00 40 (HEX)<br>00 00 00 80 (HEX)<br>00 00 01 00 (HEX)<br>00 00 02 00 (HEX)<br>00 00 04 00 (HEX)<br>00 00 08 00 (HEX)<br>00 00 10 00 (HEX)<br>00 00 20 00 (HEX)<br>00 00 40 00 (HEX)<br>00 00 80 00 (HEX)<br>01 00 00 00 (HEX)<br>02 00 00 00 (HEX)<br>04 00 00 00 (HEX)<br>08 00 00 00 (HEX)<br>10 00 00 00 (HEX)<br>20 00 00 00 (HEX)<br>40 00 00 00 (HEX)<br>80 00 00 00 (HEX) | 00000 (DEC) = No Trips Reported<br>00001 (DEC) = Undefined (565), Phase A Loset Overcurrent (575)<br>00002 (DEC) = Undefined (565), Phase B Loset Overcurrent (575)<br>00004 (DEC) = Undefined (565), Phase C Loset Overcurrent (575)<br>00008 (DEC) = Undefined (565), Ground Loset Overcurrent (575)<br>00016 (DEC) = Undefined<br>00032 (DEC) = Undefined<br>00064 (DEC) = Undefined<br>00128 (DEC) = Voltage Phase Reversal<br>00256 (DEC) = External Switch Trip #1<br>00512 (DEC) = External Switch Trip #4 (565)<br>01024 (DEC) = Undefined<br>02048 (DEC) = Analog Input<br>04096 (DEC) = Power Factor<br>08192 (DEC) = Frequency<br>16384 (DEC) = External Switch Trip #2 (565), Reclosable Trip (575)<br>32768 (DEC) = External Switch Trip #3 (565), Programmable Trip (575)<br>6.554 EXP 04 (DEC) = Undefined<br>1.311 EXP 05 (DEC) = Undefined<br>2.621 EXP 05 (DEC) = Undefined<br>5.243 EXP 05 (DEC) = Undefined<br>1.049 EXP 06 (DEC) = Undefined<br>2.097 EXP 06 (DEC) = Undefined<br>4.194 EXP 06 (DEC) = Overvoltage<br>8.389 EXP 06 (DEC) = Undervoltage<br>1.678 EXP 07 (DEC) = Phase A Timed O/C<br>3.355 EXP 07 (DEC) = Phase B Timed O/C<br>6.711 EXP 07 (DEC) = Phase C Timed O/C<br>1.342 EXP 08 (DEC) = Ground Timed O/C<br>2.684 EXP 08 (DEC) = Phase A Inst. O/C (565), Phase A Hiset Overcurrent (575)<br>5.369 EXP 08 (DEC) = Phase B Inst. O/C (565), Phase B Hiset Overcurrent (575)<br>1.074 EXP 09 (DEC) = Phase C Inst. O/C (565), Phase C Hiset Overcurrent (575)<br>2.147 EXP 09 (DEC) = Ground Inst. O/C (565), Ground Hiset Overcurrent (575)<br>Note: Multiple Trips Can Be Reported If Occurring In The Same Cycle<br>Note: This Register Should Be Read As Four Continuous Bytes<br>Note: Only Reading The Upper Address Will Return Zero, As This Register Is Non-existent |
| <b>F16</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>kW AND kVAR POWER SIGNS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | XXXX XXXX 0000 0000 (BIN) or XX00 (HEX)<br>0000 0000 XXXX XXXX (BIN) or 00XX (HEX)<br><br>0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 1111 1111 (BIN) or 00FF (HEX)<br>1111 1111 0000 0000 (BIN) or FF00 (HEX)                                                                                                                                                                                                                                                                                                                   | Most Significant Byte Contains The Real Power Sign (kW)<br>Least Significant Byte Contains The Reactive Power Sign (kVAR)<br>Example:<br>00000 (DEC) = Real Power Is Positive, Reactive Power Is Positive<br>00255 (DEC) = Real Power Is Positive, Reactive Power Is Negative<br>65280 (DEC) = Real Power Is Negative, Reactive Power Is Positive                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**565/575 DATA FORMATS (REVISION E2.73)**

| FORMAT CODE | APPLICABLE BITS                                                                                                                                                                                                                                                                                                                                      | DEFINITION                                                                                                                                                                                                                                               |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | 1111 1111 1111 1111 (BIN) or FFFF (HEX)                                                                                                                                                                                                                                                                                                              | 65535 (DEC) = Real Power Is Negative, Reactive Power Is Negative                                                                                                                                                                                         |
| <b>F17</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>2's COMPLEMENT (2 BYTE SIGNED INTEGER TO BE MULTIPLIED BY SCALING FACTOR)</b>                                                                                                                                                                         |
|             | 0XXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>0000 0000 0110 0000 (BIN) or 0060 (HEX)                                                                                                                                                                                                                                                                   | Positive Sign Bit And Magnitude In True Magnitude Form:<br>True Magnitude Form (DEC) * Scaling Factor = Result<br>0096 (DEC) * 0.01 = 0.96 Leading Power Factor                                                                                          |
|             | 1XXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>1111 1111 1010 0101 (BIN) or FFA5 (HEX)<br>0000 0000 0101 1010 (BIN) or 005A (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0000 0000 0101 1011 (BIN) or 005B (HEX)                                                                                                                                  | Negative Sign Bit And Magnitude In 2's Complement Form:<br>2's Complement Form (DEC) * Scaling Factor = Result<br>{Complement Each Bit<br>And Add 1<br>To Get The 2's Complement}<br>0091 (DEC) * 0.01 = 0.91 Lagging Power Factor                       |
| <b>F18</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>2's COMPLEMENT (SPECIAL FOR REAL AND REACTIVE POWER)</b>                                                                                                                                                                                              |
|             | 0000 0000 XXXX XXXX (BIN) or 00XX (HEX)<br>XXXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>1111 0001 1000 1010 (BIN) or F18A (HEX)                                                                                                                                                                                                                        | Positive Real Power Sign In Register 006D (HEX) And Magnitude In True Magnitude Form:<br>True Magnitude Form (DEC) * Scaling Factor = Result<br>61834 (DEC) * 1.00 = 61834 kW                                                                            |
|             | 1111 1111 XXXX XXXX (BIN) or FFXX (HEX)<br>XXXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>1010 1101 1111 1110 (BIN) or AD FE (HEX)<br>0101 0010 0000 0001 (BIN) or 5201 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0101 0010 0000 0010 (BIN) or 5202 (HEX)                                                                                      | Negative Real Power Sign In Register 006D (HEX) And Magnitude In 2's Complement Form:<br>2's Complement Form (DEC) * Scaling Factor = Result<br>{Complement Each Bit<br>And Add 1<br>To Get The 2's Complement}<br>-20994 (DEC) * 1.00 = -20994 kW       |
|             | XXXX XXXX 0000 0000 (BIN) or XX00 (HEX)<br>XXXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>1111 1100 1111 0010 (BIN) or FCF2 (HEX)                                                                                                                                                                                                                        | Positive Reactive Power Sign In Register 006D (HEX) And Magnitude In True Magnitude Form:<br>True Magnitude Form (DEC) * Scaling Factor = Result<br>64754 (DEC) * 1.00 = 64754 kVAR                                                                      |
|             | XXXX XXXX 1111 1111 (BIN) or XXFF (HEX)<br>XXXX XXXX XXXX XXXX (BIN) or XXXX (HEX)<br>1001 1100 1110 1001 (BIN) or 9CE9 (HEX)<br>0110 0011 0001 0110 (BIN) or 6316 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0110 0011 0001 0111 (BIN) or 6317 (HEX)                                                                                       | Negative Reactive Power Sign In Register 006D (HEX) And Magnitude In 2's Complement Form:<br>2's Complement Form (DEC) * Scaling Factor = Result<br>{Complement Each Bit<br>And Add 1<br>To Get The 2's Complement}<br>-25367 (DEC) * 1.00 = -25367 kVAR |
| <b>F19</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>USER LEVEL SELECTION</b>                                                                                                                                                                                                                              |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)                                                                                                                                                                                                                                                                   | 00 (DEC) = Basic<br>01 (DEC) = Advanced                                                                                                                                                                                                                  |
| <b>F20</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>SETPOINT STATE SELECTION</b>                                                                                                                                                                                                                          |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)                                                                                                                                                                                                                                                                   | 00 (DEC) = Enabled<br>01 (DEC) = Disabled                                                                                                                                                                                                                |
| <b>F21</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>CURVE SHAPE SELECTION</b>                                                                                                                                                                                                                             |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0000 0000 0000 0010 (BIN) or 0002 (HEX)<br>0000 0000 0000 0011 (BIN) or 0003 (HEX)<br>0000 0000 0000 0100 (BIN) or 0004 (HEX)<br>0000 0000 0000 0101 (BIN) or 0005 (HEX)<br>0000 0000 0000 0110 (BIN) or 0006 (HEX)<br>0000 0000 0000 0111 (BIN) or 0007 (HEX) | 00 (DEC) = Moderately Inverse<br>01 (DEC) = Normally Inverse<br>02 (DEC) = Very Inverse<br>03 (DEC) = Extremely Inverse<br>04 (DEC) = Custom (565), Custom 1 or Custom 2 (575)<br>05 (DEC) = IEC A<br>06 (DEC) = IEC B<br>07 (DEC) = IEC C               |
| <b>F22</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>OUTPUT CONTACT SELECTION FOR TRIPS</b>                                                                                                                                                                                                                |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0000 0000 0000 0010 (BIN) or 0002 (HEX)<br>0000 0000 0000 0011 (BIN) or 0003 (HEX)<br>0000 0000 0000 0100 (BIN) or 0004 (HEX)<br>0000 0000 0000 0101 (BIN) or 0005 (HEX)<br>0000 0000 0000 0110 (BIN) or 0006 (HEX)                                            | 00 (DEC) = Trip (565, 575)<br>01 (DEC) = Aux 1 (565), Trip & Aux 1 (575)<br>02 (DEC) = Aux 2 (565, 575)<br>03 (DEC) = Trip & Aux 1 (565)<br>04 (DEC) = Trip & Aux 2 (565)<br>05 (DEC) = Aux 1 & 2 (565)<br>06 (DEC) = Trip & Aux 1 & 2 (565)             |
| <b>F23</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>OUTPUT CONTACT SELECTION FOR ALARMS</b>                                                                                                                                                                                                               |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0000 0000 0000 0010 (BIN) or 0002 (HEX)<br>0000 0000 0000 0011 (BIN) or 0003 (HEX)                                                                                                                                                                             | 00 (DEC) = Aux 1 (565), None (575)<br>01 (DEC) = Aux 2 (565), Aux 1 (575)<br>02 (DEC) = Aux 1 & 2 (565), Aux 2 (575)<br>03 (DEC) = Aux 1 & 2 (575)                                                                                                       |
| <b>F24</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>GROUND CURRENT SENSING TYPE SELECTION</b>                                                                                                                                                                                                             |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)                                                                                                                                                                                                                                                                   | 00 (DEC) = Residual<br>01 (DEC) = Zero Sequence                                                                                                                                                                                                          |
| <b>F25</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>COLD LOAD P/U BLOCK TYPE SELECTION</b>                                                                                                                                                                                                                |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0000 0000 0000 0010 (BIN) or 0002 (HEX)                                                                                                                                                                                                                        | 00 (DEC) = Loset (575)<br>01 (DEC) = Hiset (575)<br>02 (DEC) = Both (575)                                                                                                                                                                                |
| <b>F26</b>  | <b>16 bits</b>                                                                                                                                                                                                                                                                                                                                       | <b>EXTERNAL SWITCH SELECTION</b>                                                                                                                                                                                                                         |
|             | 0000 0000 0000 0000 (BIN) or 0000 (HEX)<br>0000 0000 0000 0001 (BIN) or 0001 (HEX)<br>0000 0000 0000 0010 (BIN) or 0002 (HEX)                                                                                                                                                                                                                        | 00 (DEC) = Disabled<br>01 (DEC) = SW. 1<br>02 (DEC) = SW. 2                                                                                                                                                                                              |

| 565/575 DATA FORMATS (REVISION E2.73) |                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FORMAT CODE                           | APPLICABLE BITS                         | DEFINITION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 03 (DEC) = SW. 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 04 (DEC) = SW. 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0101 (BIN) or 0005 (HEX) | 05 (DEC) = SW. 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0110 (BIN) or 0006 (HEX) | 06 (DEC) = SW. 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0111 (BIN) or 0007 (HEX) | 07 (DEC) = SW. 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 1000 (BIN) or 0008 (HEX) | 08 (DEC) = SW. 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>F27</b>                            | <b>16 bits</b>                          | <b>PROGRAMMABLE SWITCH TRIP OPERATION MODE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Non-Recl. (575)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Recl. (575)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>F28</b>                            | <b>16 bits</b>                          | <b>EXTERNAL SWITCH CONFIGURATION/STATUS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Open                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Closed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>F29</b>                            | <b>16 bits</b>                          | <b>TRIP RELAY OPERATION MODE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Latched (565)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Pulsed (565)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>F30</b>                            | <b>16 bits</b>                          | <b>AUXILIARY RELAY OPERATION MODE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Latched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Unlatched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                       | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 02 (DEC) = Pulsed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>F31</b>                            | <b>16 bits</b>                          | <b>EVENT PRINTING OPERATION MODE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Offline                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Online                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>F32</b>                            | <b>32 bits</b>                          | <b>ULONG (SPECIAL FOR ANALOG IN ALARM/TRIP THRESHOLDS)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | XX XX 00 00 (HEX)                       | Lower Address Contains The Most Significant 16 bits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                       | 00 00 XX XX (HEX)                       | Upper Address Contains The Least Significant 16 bits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                       |                                         | Example:<br>XXXXXX (DEC) * Scaling Factor = Result<br>Use The Following To Determine The Scaling Factor:<br>(1) [(Maximum Current Scale Value - Minimum Current Scale Value) < 40.89] = 0.01<br>(2) [(Maximum Current Scale Value - Minimum Current Scale Value) > 40.88]<br>And<br>[(Maximum Current Scale Value - Minimum Current Scale Value) < 408.80] = 0.1<br>(3) [(Maximum Current Scale Value - Minimum Current Scale Value > 408.79)] = 1.0<br>Note: Only Reading The Upper Address Will Return Zero, As This Register Is Non-existent |
| <b>F33</b>                            | <b>16 bits</b>                          | <b>ANALOG OUT PARAMETER SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Phase A Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Phase B Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 02 (DEC) = Phase C Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 03 (DEC) = Ground Current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                                       | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 04 (DEC) = Phase A-X Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                       | 0000 0000 0000 0101 (BIN) or 0005 (HEX) | 05 (DEC) = Phase B-X Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                       | 0000 0000 0000 0110 (BIN) or 0006 (HEX) | 06 (DEC) = Phase C-X Voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                       | 0000 0000 0000 0111 (BIN) or 0007 (HEX) | 07 (DEC) = Feeder Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                       | 0000 0000 0000 1000 (BIN) or 0008 (HEX) | 08 (DEC) = External Analog Select                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>F34</b>                            | <b>16 bits</b>                          | <b>ANALOG OUT RANGE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = 0 - 1 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = 4 - 20 mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>F35</b>                            | <b>16 bits</b>                          | <b>COMMUNICATION BAUDRATE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = 1200 Baud                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = 2400 Baud                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                       | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 02 (DEC) = 4800 Baud                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                       | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 03 (DEC) = 9600 Baud                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>F36</b>                            | <b>16 bits</b>                          | <b>OUTPUT CONTACT TEST SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Trip                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Aux 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 02 (DEC) = Aux 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 03 (DEC) = Aux 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0100 (BIN) or 0004 (HEX) | 04 (DEC) = All (565), Aux 4 (575)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                       | 0000 0000 0000 0101 (BIN) or 0005 (HEX) | 05 (DEC) = Block Tap Change (575)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                       | 0000 0000 0000 0110 (BIN) or 0006 (HEX) | 06 (DEC) = All (575)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>F37</b>                            | <b>16 bits</b>                          | <b>BREAKER OPEN/CLOSE STATUS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>F38</b>                            | <b>16 bits</b>                          | <b>ANALOG SELECT STATUS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Off                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = On                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>F39</b>                            | <b>16 bits</b>                          | <b>LOCAL/REMOTE STATUS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Local                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Remote                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>F40</b>                            | <b>16 bits</b>                          | <b>VT CONNECTION TYPE SELECTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                       | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                       | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Wye                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| FORMAT CODE                                                                                              | APPLICABLE BITS                         | DEFINITION                                                   |
|----------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------|
|                                                                                                          | 0000 0000 0000 0010 (BIN) or 0002 (HEX) | 02 (DEC) = Open Delta                                        |
|                                                                                                          | 0000 0000 0000 0011 (BIN) or 0003 (HEX) | 03 (DEC) = Delta/Wye                                         |
| <b>F41</b>                                                                                               | <b>16 bits</b>                          | <b>MTM CT SELECTION</b>                                      |
|                                                                                                          | 0000 0000 0000 0000 (BIN) or 0000 (HEX) | 00 (DEC) = Common                                            |
|                                                                                                          | 0000 0000 0000 0001 (BIN) or 0001 (HEX) | 01 (DEC) = Separate                                          |
| <b>F42</b>                                                                                               | <b>40 bytes</b>                         | <b>EVENT RECORD DATA</b>                                     |
|                                                                                                          | Data Byte 00                            | Unused                                                       |
|                                                                                                          | Data Byte 01                            | :                                                            |
|                                                                                                          | Data Byte 02                            | :                                                            |
|                                                                                                          | Data Byte 03                            | Cause Of Event (See Accompanying Cause Of Event Table)       |
|                                                                                                          | Data Byte 04                            | Time Of Event (See F13)                                      |
|                                                                                                          | Data Byte 05                            | :                                                            |
|                                                                                                          | Data Byte 06                            | :                                                            |
|                                                                                                          | Data Byte 07                            | :                                                            |
|                                                                                                          | Data Byte 08                            | Date Of Event (See F13)                                      |
|                                                                                                          | Data Byte 09                            | :                                                            |
|                                                                                                          | Data Byte 10                            | :                                                            |
|                                                                                                          | Data Byte 11                            | :                                                            |
|                                                                                                          | Data Byte 12                            | Phase A Current (See Accompanying Number Format Description) |
|                                                                                                          | Data Byte 13                            | :                                                            |
|                                                                                                          | Data Byte 14                            | :                                                            |
|                                                                                                          | Data Byte 15                            | :                                                            |
|                                                                                                          | Data Byte 16                            | Phase B Current (See Accompanying Number Format Description) |
|                                                                                                          | Data Byte 17                            | :                                                            |
|                                                                                                          | Data Byte 18                            | :                                                            |
|                                                                                                          | Data Byte 19                            | :                                                            |
|                                                                                                          | Data Byte 20                            | Phase C Current (See Accompanying Number Format Description) |
|                                                                                                          | Data Byte 21                            | :                                                            |
|                                                                                                          | Data Byte 22                            | :                                                            |
|                                                                                                          | Data Byte 23                            | :                                                            |
|                                                                                                          | Data Byte 24                            | Ground Current (See Accompanying Number Format Description)  |
|                                                                                                          | Data Byte 25                            | :                                                            |
|                                                                                                          | Data Byte 26                            | :                                                            |
|                                                                                                          | Data Byte 27                            | :                                                            |
|                                                                                                          | Data Byte 28                            | Voltage A-X (See Accompanying Number Format Description)     |
|                                                                                                          | Data Byte 29                            | :                                                            |
|                                                                                                          | Data Byte 30                            | :                                                            |
|                                                                                                          | Data Byte 31                            | :                                                            |
|                                                                                                          | Data Byte 32                            | Voltage B-X (See Accompanying Number Format Description)     |
|                                                                                                          | Data Byte 33                            | :                                                            |
|                                                                                                          | Data Byte 34                            | :                                                            |
|                                                                                                          | Data Byte 35                            | :                                                            |
|                                                                                                          | Data Byte 36                            | Voltage C-X (See Accompanying Number Format Description)     |
|                                                                                                          | Data Byte 37                            | :                                                            |
|                                                                                                          | Data Byte 38                            | :                                                            |
|                                                                                                          | Data Byte 39                            | :                                                            |
| <b>CAUSE OF EVENT TABLE</b>                                                                              |                                         |                                                              |
| (*) = Only Those Events Marked With An Asterisk Will Have Their Current And Voltage Parameters Recorded. |                                         |                                                              |
| 01 <sub>HEX</sub>                                                                                        | (*)                                     | Phase A Timed Overcurrent Trip (565, 575)                    |
| 02 <sub>HEX</sub>                                                                                        | (*)                                     | Phase B Timed Overcurrent Trip (565, 575)                    |
| 03 <sub>HEX</sub>                                                                                        | (*)                                     | Phase C Timed Overcurrent Trip (565, 575)                    |
| 04 <sub>HEX</sub>                                                                                        | (*)                                     | Ground Timed Overcurrent Trip (565, 575)                     |
| 05 <sub>HEX</sub>                                                                                        | (*)                                     | Phase A Instantaneous Overcurrent Trip (565)                 |
| 06 <sub>HEX</sub>                                                                                        | (*)                                     | Phase B Instantaneous Overcurrent Trip (565)                 |
| 07 <sub>HEX</sub>                                                                                        | (*)                                     | Phase C Instantaneous Overcurrent Trip (565)                 |
| 08 <sub>HEX</sub>                                                                                        | (*)                                     | Ground Instantaneous Overcurrent Trip (565)                  |
| 09 <sub>HEX</sub>                                                                                        | (*)                                     | Phase A Hiset Instantaneous Trip (575)                       |
| 0A <sub>HEX</sub>                                                                                        | (*)                                     | Phase B Hiset Instantaneous Trip (575)                       |
| 0B <sub>HEX</sub>                                                                                        | (*)                                     | Phase C Hiset Instantaneous Trip (575)                       |
| 0C <sub>HEX</sub>                                                                                        | (*)                                     | Ground Hiset Instantaneous Trip (575)                        |
| 0D <sub>HEX</sub>                                                                                        | (*)                                     | Phase A Loset Instantaneous Trip (575)                       |
| 0E <sub>HEX</sub>                                                                                        | (*)                                     | Phase B Loset Instantaneous Trip (575)                       |
| 0F <sub>HEX</sub>                                                                                        | (*)                                     | Phase C Loset Instantaneous Trip (575)                       |
| 10 <sub>HEX</sub>                                                                                        | (*)                                     | Ground Loset Instantaneous Trip (575)                        |
| 11 <sub>HEX</sub>                                                                                        | (*)                                     | Overvoltage Trip (565, 575)                                  |
| 12 <sub>HEX</sub>                                                                                        | (*)                                     | Undervoltage Trip (565, 575)                                 |
| 13 <sub>HEX</sub>                                                                                        |                                         | Analog Input Trip (565, 575)                                 |
| 14 <sub>HEX</sub>                                                                                        |                                         | External Trip #1 (565)                                       |
| 15 <sub>HEX</sub>                                                                                        |                                         | External Trip #2 (565)                                       |

**565/575 DATA FORMATS (REVISION E2.73)**

| FORMAT CODE                                | APPLICABLE BITS                                                                 | DEFINITION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            |                                                                                 | 16 <sub>HEX</sub> External Trip #3 (565)<br>17 <sub>HEX</sub> External Trip #4 (565)<br>18 <sub>HEX</sub> External Trip (575)<br>19 <sub>HEX</sub> Reclosable Trip (575)<br>1A <sub>HEX</sub> Programmable Trip (575)<br>1B <sub>HEX</sub> Power Factor Trip (565, 575)<br>1C <sub>HEX</sub> Frequency Trip (565, 575)<br>1D <sub>HEX</sub> Voltage Phase Reversal Trip (565, 575)<br>1E <sub>HEX</sub> Phase Overcurrent Alarm (565, 575)<br>1F <sub>HEX</sub> Ground Overcurrent Alarm (565, 575)<br>20 <sub>HEX</sub> Overvoltage Alarm (565, 575)<br>21 <sub>HEX</sub> Undervoltage Alarm (565, 575)<br>22 <sub>HEX</sub> Analog Input Alarm (565, 575)<br>23 <sub>HEX</sub> Accumulated KA Alarm (565, 575)<br>24 <sub>HEX</sub> Switch Alarm #1 (565, 575)<br>25 <sub>HEX</sub> Switch Alarm #2 (565, 575)<br>26 <sub>HEX</sub> Amps Demand Alarm (565, 575)<br>27 <sub>HEX</sub> kW Demand Alarm (565, 575)<br><br>28 <sub>HEX</sub> kVAR Demand Alarm (565, 575)<br>29 <sub>HEX</sub> Power Factor Alarm (565, 575)<br>2A <sub>HEX</sub> Frequency Alarm (565, 575)<br>2B <sub>HEX</sub> Breaker Discrepancy Alarm (565, 575)<br>2C <sub>HEX</sub> Trip Coil Alarm (565, 575)<br>2D <sub>HEX</sub> MTM Communication Alarm (565, 575)<br><br>2E <sub>HEX</sub> Phase Overcurrent Alarm Reset (565, 575)<br>2F <sub>HEX</sub> Ground Overcurrent Alarm Reset (565, 575)<br>30 <sub>HEX</sub> Overvoltage Alarm Reset (565, 575)<br>31 <sub>HEX</sub> Undervoltage Alarm Reset (565, 575)<br>32 <sub>HEX</sub> Analog Input Alarm Reset (565, 575)<br>33 <sub>HEX</sub> Switch Alarm #1 Reset (565, 575)<br>34 <sub>HEX</sub> Switch Alarm #2 Reset (565, 575)<br>35 <sub>HEX</sub> Breaker Alarm Reset (565, 575)<br>36 <sub>HEX</sub> Access Jumper Installed (565, 575)<br>37 <sub>HEX</sub> Access Jumper Removed (565, 575)<br>38 <sub>HEX</sub> Block Instantaneous Trip Enabled (565, 575)<br>39 <sub>HEX</sub> Block Instantaneous Trip Disabled (565, 575)<br>3A <sub>HEX</sub> Block Timed Trips Enabled (565, 575)<br>3B <sub>HEX</sub> Block Timed Trips Disabled (565, 575)<br>3C <sub>HEX</sub> Curve Adjust Enabled (565, 575)<br>3D <sub>HEX</sub> Curve Adjust Disabled (565, 575)<br>40 <sub>HEX</sub> Illegal Setpoint Access (565, 575)<br>41 <sub>HEX</sub> System Manual Reset (565, 575)<br>42 <sub>HEX</sub> Reclosure Enabled (575)<br>43 <sub>HEX</sub> Reclosure Disabled (575)<br>44 <sub>HEX</sub> Control Switch to Remote (565, 575)<br>45 <sub>HEX</sub> Control Switch to Local (565, 575)<br><br>46 <sub>HEX</sub> Reclosure #1 (575)<br>47 <sub>HEX</sub> Reclosure #2 (575)<br>48 <sub>HEX</sub> Reclosure #3 (575)<br>49 <sub>HEX</sub> Reclosure #4 (575)<br>4A <sub>HEX</sub> Reclosure Lockout (575)<br>4B <sub>HEX</sub> Reclosure Scheme Reset (575)<br>4C <sub>HEX</sub> Serial Communication Trip (565, 575)<br>4D <sub>HEX</sub> Serial Communication Close (565, 575) |
| NUMBER FORMAT DISCRPTION                   |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| X0000000 00000000 00000000 00000000 (BIN)  | Sign Bit (0 = Positive, 1 = Negative)                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 0XXXXXXXX X0000000 00000000 00000000 (BIN) | Exponent Bits                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 00000000 0XXXXXXXX XXXXXXXX XXXXXXXX (BIN) | Mantissa Bits                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Example:                                   |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 01000011 01001110 11101101 10110011 (BIN)  | Sign (2 <sup>(Exponent-150)</sup> ) X (2 <sup>23</sup> + Mantissa) = Result     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 0XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX (BIN) | Sign = +                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| X1000011 0XXXXXXXX XXXXXXXX XXXXXXXX (BIN) | Exponent = 86(HEX) = 134(DEC)                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| XXXXXXXX X1001110 11101101 10110011 (BIN)  | Mantissa = 4EEDB3(HEX) = 5172659(DEC)                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                            | +(2 <sup>(134-150)</sup> ) X (2 <sup>23</sup> + 5172659) = 206.93 Amos or Volts |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Metering Specification - 565/575 with MTM

The Metering Transducer Module is an optional unit which can be connected to the 565/575 unit to give additional functionality. The MTM is used to obtain data for specific functions which are displayed in the 565/575 or used for further processing. *\*\* 565 requires Option Card \*\**

### Metering Functions

The following data is supplied by the MTM to the 565/575:

- Power Factor
- Frequency
- Kilowatts (kW)
- Kilovars (kVAR)
- Megawatthours (MWhr)

Various alarms and trip levels are set in the 565 for the above parameters as required.

The following levels are derived from MTM data and calculated in the 565/575. They are:

- Kilowatt Demand
- Kilovars Demand

### MTM Communications

The 565/575 communicates with the MTM via a dedicated port and uses a proprietary protocol.

#### Port Information

The dedicated port uses the RS485 type arrangement and requires a shielded twisted pair cable. The MTM is used as a slave and responds only after a request by the 565/575. A request is sent every 500 ms. The MTM responds with data which must occur within a set period of time.

A checksum of the data packet is used to verify data transmissions. If an error has occurred or the MTM will not respond, the 565/575 will resend the request. In the event that the 565/575 has requested data three times and no response has been received an MTM communications alarm will occur, if enabled.

#### Revision Number

A revision Number is used in the transmission protocol between the MTM and the 565/575 to identify the software level in the 565/575 and the MTM. If the revisions are not compatible then an MTM communications alarm is declared.

### Function Enhancement with MTM

The following functions with their specifications become available when an MTM and Option Card has been added to the 565/575.

#### Power Factor

Ratio of real power (kW) to apparent power (kVAR). The range is from 0 leading (+ve values) to 1 to 0 lagging (-ve values) to 1.

#### Setpoints:

|             |                                                                                               |
|-------------|-----------------------------------------------------------------------------------------------|
| Alarm level | 0 leading to 1 and 0 lagging to 1, in steps of 0.05. Default values 0.75 leading and lagging. |
| Alarm delay | 1-127 sec, in steps of 0.5 sec. Default 5 seconds.                                            |
| Alarm relay | AUX 1, 2 and AUX 1&2. Default AUX 1.                                                          |
| Trip level  | 0 leading to 1 and 0 lagging to 1, in steps of 0.05. Default values 0.7 leading and lagging.  |
| Trip delay  | 1-127 sec, in steps of 0.5 sec. Default 1 second.                                             |
| Trip relay  | TRIP, AUX 1, 2, TRIP & AUX1, TRIP & AUX2, AUX 1&2, and TRIP & AUX 1&2. Default AUX 1.         |

#### Frequency

Line frequency measured between the phases A and B voltages.

The range is 40-72 Hz. This allows for measurements of up to  $\pm 20\%$  of 50 or 60 Hz. The resolution is 0.1 Hz.

#### Setpoints:

|             |                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------|
| Alarm level | 40-60Hz for Underfrequency and 50-72Hz for Overfrequency, in steps of 0.1 Hz. Default value 58 and 62 for Under/Over freq. |
| Alarm delay | 1-127 sec, in steps of 0.5 sec. Default value 5 seconds.                                                                   |
| Alarm relay | AUX 1, 2, and AUX 1&2. Default AUX 1.                                                                                      |
| Trip level  | 40-60Hz for Underfrequency and 50-72Hz for Overfrequency, in steps of 0.1 Hz. Default value 56 and 64 for Under/Over freq. |
| Trip delay  | 1-127 sec, in steps of 0.5 sec. Default value 1 second.                                                                    |
| Trip relay  | TRIP, AUX 1, 2, TRIP & AUX1, TRIP & AUX2, AUX 1&2, and TRIP & AUX 1&2. Default AUX 1.                                      |

#### kW

This measures real power and is supplied by the MTM for metering purposes only. There are no alarm or trip functions.

Range is up to 65 000 kW (65 MW).

Accuracy is  $\pm 2\%$  of displayed.

Resolution display is 1 kW.

#### kVAR

This is a measure of reactive power. This value is supplied by the MTM and is for metering purposes only. There are no alarm or trip functions.

## FEATURE INFORMATION



Range is up to 65 000 kVAR (65 MVAR).  
Accuracy is  $\pm 2\%$  of displayed.  
Resolution display is 1 kVAR.

### Signed Real and Reactive Power Readings

If the 565/575 is communicating with a revision E MTM or MTM Plus, the kW and kvar readings sent to the 565/575 will also include the polarity sign. The 565/575 will display this information as shown below.

|                                         |
|-----------------------------------------|
| <b>REAL POWER</b><br>+VE      65 000 kW |
|-----------------------------------------|

|                                             |
|---------------------------------------------|
| <b>REACTIVE POWER</b><br>+VE      65 000 kW |
|---------------------------------------------|

To interpret the real power readings at Modbus register 70h and the reactive power readings at Modbus register 71h, one must first read register 6Dh. This latter register indicates the sign of the real and reactive power readings. Refer to the 565/575 DATA MAP for an explanation of the data format for register 60h. With knowledge of the real and reactive power signs, the formatting of the Power Data at register 70h and 71h is indicated in the 565/575 Data Map.

Generally, if the sign at data register 6Dh is zero, the corresponding data can be read directly. If the sign data at register 6Dh is not zero, a 2's complement operation should be performed on the data first.

### MWhrs

This is real power used. This value is supplied by the MTM and is for metering purposes only. There are no alarm or trip functions.

Range is up to 65 000 MWhrs.  
Accuracy is  $\pm 2\%$  of displayed.  
Resolution displayed is 1 MWhr.

### kW Demand

This measures average real power demanded over time. The kW value is supplied by the MTM while the demand value is averaged by the 565.

#### Setpoints:

Time period 5-120 min, in steps of 1 min. Default value 5 minutes.  
Alarm level 100 - 65 000 kW in steps of 100 kW. Default value 1 000 kW.  
Alarm relay AUX 1, 2, and AUX 1&2. Default AUX 1.

### kVAR Demand

This measures average reactive power demanded over time. This value is supplied by the MTM but averaged by the 565.

#### Setpoints:

Time period 5-120 min, in steps of 1 min. Default value 5 minutes.  
Alarm level 100 - 65 000 kVAR in steps of 100 kVAR. Default value 1 000 kVAR.  
Alarm relay AUX 1, 2, and AUX 1&2. Default AUX 1.

The 565/575 contains a line which allows the clearing of the MWhrs data calculated by the MTM/MTM Plus. This setpoint can be found in the Actual Values Metering Data page and appears as below:

|                                    |           |
|------------------------------------|-----------|
| <b>CLEAR ENERGY<br/>USED DATA?</b> | <b>NO</b> |
|------------------------------------|-----------|

This MTM/MTM Plus parameter can also be cleared with the Modbus "Force Single Coil" function code 05h and operation code 15h.

### Retrieval of Event Records via Serial Communication

To facilitate the retrieval of event records, a register called the Start of Event Queue is implemented at memory location 19h. The low order byte of this register gives the record number of the most recent event (0 to 27h). The high order byte is a free running wraparound counter incremented every 40 events. The Start of Event Queue register will be reset to zero if the event recorder is cleared.

For the first 40 events, the Start of Event Queue register will read 00h. In this case, the record number of the most recent event will correspond to the Number of Events found at register 74h. With more than 40 events, the record number of the most recent event will be the lower order byte of the Start of Event Queue register. A reading of 00h in this lower order byte coincides with event record 28h.

The event record number points to the following memory map addresses:

|                   |                   |
|-------------------|-------------------|
| RECORD 01h – 600h | RECORD 15h – 790h |
| RECORD 02h – 614h | RECORD 16h – 7A4h |
| RECORD 03h – 628h | RECORD 17h – 7B8h |
| RECORD 04h – 63Ch | RECORD 18h – 7CCh |
| RECORD 05h – 650h | RECORD 19h – 7E0h |
| RECORD 06h – 664h | RECORD 1Ah – 7F4h |
| RECORD 07h – 678h | RECORD 1Bh – 808h |
| RECORD 08h – 68Ch | RECORD 1Ch – 81Ch |
| RECORD 09h – 6A0h | RECORD 1Dh – 830h |
| RECORD 0Ah – 6B4h | RECORD 1Eh – 844h |
| RECORD 0Bh – 6C8h | RECORD 1Fh – 858h |
| RECORD 0Ch – 6DCh | RECORD 20h – 86Ch |
| RECORD 0Dh – 6F0h | RECORD 21h – 880h |
| RECORD 0Eh – 704h | RECORD 22h – 894h |
| RECORD 0Fh – 718h | RECORD 23h – 8A8h |
| RECORD 10h – 72Ch | RECORD 24h – 8BCh |
| RECORD 11h – 740h | RECORD 25h – 8D0h |
| RECORD 12h – 754h | RECORD 26h – 8E4h |
| RECORD 13h – 768h | RECORD 27h – 8F8h |
| RECORD 14h – 77Ch | RECORD 28h – 90Ch |

Each of the event records is composed of 40 bytes as shown below:

| DATA BYTE | DEFINITION                               | FORMAT                           |
|-----------|------------------------------------------|----------------------------------|
| 0-2       | Unused                                   |                                  |
| 3         | Cause of event                           | Refer to next table              |
| 4-7       | Time of event                            | Binary (-, Second, Minute, Hour) |
| 8-11      | Date of event                            | Binary (-, Day, Month, Year)     |
| 12-15     | Phase A Current<br>(If applicable)       | Unsigned long integer            |
| 16-19     | Phase B Current<br>(If applicable)       | Unsigned long integer            |
| 20-23     | Phase C Current<br>(If applicable)       | Unsigned long integer            |
| 24-27     | Ground Current<br>(If applicable)        | Unsigned long integer            |
| 28-31     | Voltage A<br>(Phase/Line, if applicable) | Unsigned long integer            |
| 32-35     | Voltage B<br>(Phase/Line, if applicable) | Unsigned long integer            |
| 36-39     | Voltage C<br>(Phase/Line, if applicable) | Unsigned long integer            |

The phase currents, ground current, and phase voltages are of a double precision number format which is composed of 1 sign bit, 8 exponential bits, and 23 mantissa bits.

The following lists the possible events and the corresponding hexadecimal number which will be found at byte 3 of each event record. Only those events marked with an asterisk will have their current and voltage parameters recorded.

| EVENT NO | DESCRIPTION                      | APPLICABLE TO |
|----------|----------------------------------|---------------|
| 01h (*)  | Phase A timed overcurrent trip   | 565/575       |
| 02h (*)  | Phase B timed overcurrent trip   | 565/575       |
| 03h (*)  | Phase C timed overcurrent trip   | 565/575       |
| 04h (*)  | Ground timed overcurrent trip    | 565/575       |
| 05h (*)  | Phase A inst. overcurrent trip   | 565           |
| 06h (*)  | Phase B inst. overcurrent trip   | 565           |
| 07h (*)  | Phase C inst. overcurrent trip   | 565           |
| 08h (*)  | Ground inst. overcurrent trip    | 565           |
| 09h (*)  | Phase A hiset instantaneous trip | 575           |

| EVENT NO | DESCRIPTION                       | APPLICABLE TO |
|----------|-----------------------------------|---------------|
| 0Ah (*)  | Phase B hiset instantaneous trip  | 575           |
| 0Bh (*)  | Phase C hiset instantaneous trip  | 575           |
| 0Ch (*)  | Ground hiset instantaneous trip   | 575           |
| 0Dh (*)  | Phase A loiset instantaneous trip | 575           |
| 0Eh (*)  | Phase B loiset instantaneous trip | 575           |
| 0Fh (*)  | Phase C loiset instantaneous trip | 575           |
| 10h (*)  | Ground loiset instantaneous trip  | 575           |
| 11h (*)  | Overvoltage trip                  | 565/575       |
| 12h (*)  | Undervoltage trip                 | 565/575       |
| 13h      | Analog input trip                 | 565/575       |
| 14h (*)  | External trip #1                  | 565           |
| 15h (*)  | External trip #2                  | 565           |
| 16h (*)  | External trip #3                  | 565           |
| 17h (*)  | External trip #4                  | 565           |
| 18h (*)  | External trip                     | 575           |
| 19h (*)  | Reclosable trip                   | 575           |
| 1Ah (*)  | Programmable trip                 | 575           |
| 1Bh      | Power factor trip                 | 565/575       |
| 1Ch      | Frequency trip                    | 565/575       |
| 1Dh      | Voltage phase reversal trip       | 565/575       |
| 1Eh      | Phase overcurrent alarm           | 565/575       |
| 1Fh      | Ground overcurrent alarm          | 565/575       |
| 20h      | Overvoltage alarm                 | 565/575       |
| 21h      | Undervoltage alarm                | 565/575       |
| 22h      | Analog input alarm                | 565/575       |
| 23h      | Accumulated KA alarm              | 565/575       |
| 24h      | Switch alarm #1                   | 565/575       |
| 25h      | Switch alarm #2                   | 565/575       |
| 26h      | Amps demand alarm                 | 565/575       |
| 27h      | kW demand alarm                   | 565/575       |
| 28h      | kvar demand alarm                 | 565/575       |
| 29h      | Power factor alarm                | 565/575       |
| 2Ah      | Frequency alarm                   | 565/575       |
| 2Bh      | Breaker discrepancy alarm         | 565/575       |
| 2Ch      | Trip coil alarm                   | 565/575       |
| 2Dh      | MTM communication alarm           | 565/575       |
| 2Eh      | Phase overcurrent alarm reset     | 565/575       |
| 2Fh      | Ground overcurrent alarm reset    | 565/575       |
| 30h      | Overvoltage alarm reset           | 565/575       |
| 31h      | Undervoltage alarm reset          | 565/575       |
| 32h      | Analog input alarm reset          | 565/575       |
| 33h      | Switch alarm #1 reset             | 565/575       |
| 34h      | Switch alarm #2 reset             | 565/575       |
| 35h      | Breaker alarm reset               | 565/575       |
| 36h      | Access jumper installed           | 565/575       |
| 37h      | Access jumper removed             | 565/575       |
| 38h      | Block instantaneous trip enabled  | 565/575       |
| 39h      | Block instantaneous trip disabled | 565/575       |
| 3Ah      | Block timed trips enabled         | 565/575       |
| 3Bh      | Block timed trips disabled        | 565/575       |
| 3Ch      | Curve adjust enabled              | 565/575       |
| 3Dh      | Curve adjust disabled             | 565/575       |
| 40h      | Illegal setpoint access           | 565/575       |
| 41h      | System manual reset               | 565/575       |
| 42h      | Reclosure enabled                 | 575           |
| 43h      | Reclosure disabled                | 575           |
| 44h      | Control switch to remote          | 565/575       |
| 45h      | Control switch to local           | 565/575       |
| 46h      | Reclosure #1                      | 575           |
| 47h      | Reclosure #2                      | 575           |

## FEATURE INFORMATION



| <u>EVENT NO</u> | <u>DESCRIPTION</u>         | <u>APPLICABLE TO</u> |
|-----------------|----------------------------|----------------------|
| 48h             | Reclosure #3               | 575                  |
| 49h             | Reclosure #4               | 575                  |
| 4Ah             | Reclosure lockout          | 575                  |
| 4Bh             | Reclosure scheme reset     | 575                  |
| 4Ch             | Serial communication trip  | 565/575              |
| 4Dh             | Serial communication close | 565/575              |

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## Overcurrent Protection

The 565/575 Relay continuously monitors the three phase currents and ground current in the feeder through its CT's and initiates an alarm and/or feeder breaker trip if any rise above the pick-up level. The setting for phase and ground are independent of each other and the time for either action to be initiated is based on the chosen time/overcurrent curve and overload level. Note that smaller overcurrents can be tolerated for longer periods than larger ones.

The 565/575 Relay allows the following curves to be chosen:

1. Moderately Inverse.
2. Normal Inverse.
3. Very Inverse.
4. Extremely Inverse.
5. IEC A
6. IEC B
7. IEC C
8. Programmable Curve

## Use of Standard Curves

If it is intended to use the standard curves, for overcurrent protection, then the curve shape and number must be determined and entered into the 565/575 Relay. For each shape, there are 32 different curves corresponding to a different time dial. The selection of protection curve shape, pick-ups and time dial must be determined from a system co-ordination study. To determine the curve shape and number most suited to your system proceed as follows:

Plot the time/overcurrent characteristics of all the related system equipment to the feeder on a blank log/log sheet. Alternately only the most critical items may be plotted. This is called the System Plot.

Now choose an overcurrent value on the system plot, preferably the one which is most critical to the device being protected. Next select the standard curve shape which most closely matches the time/overcurrent characteristics of the item to be protected. Finally, the curve number must be selected to position this curve in the correct vertical location.

The standard curves which are programmed into the 565/575 relay are shown in Figure 7.1 through Figure 7.8.

## Use of Custom Curve

In addition to the standard curves, the 565/575 Relay also has a user-programmable curve. This curve can be defined by the user and thus be closely matched to the needs of the particular application. This is a vast improvement on conventional feeder protection devices which forced the user to compromise on protection by using a standard curve which might not exactly match the protection requirements of the particular system.

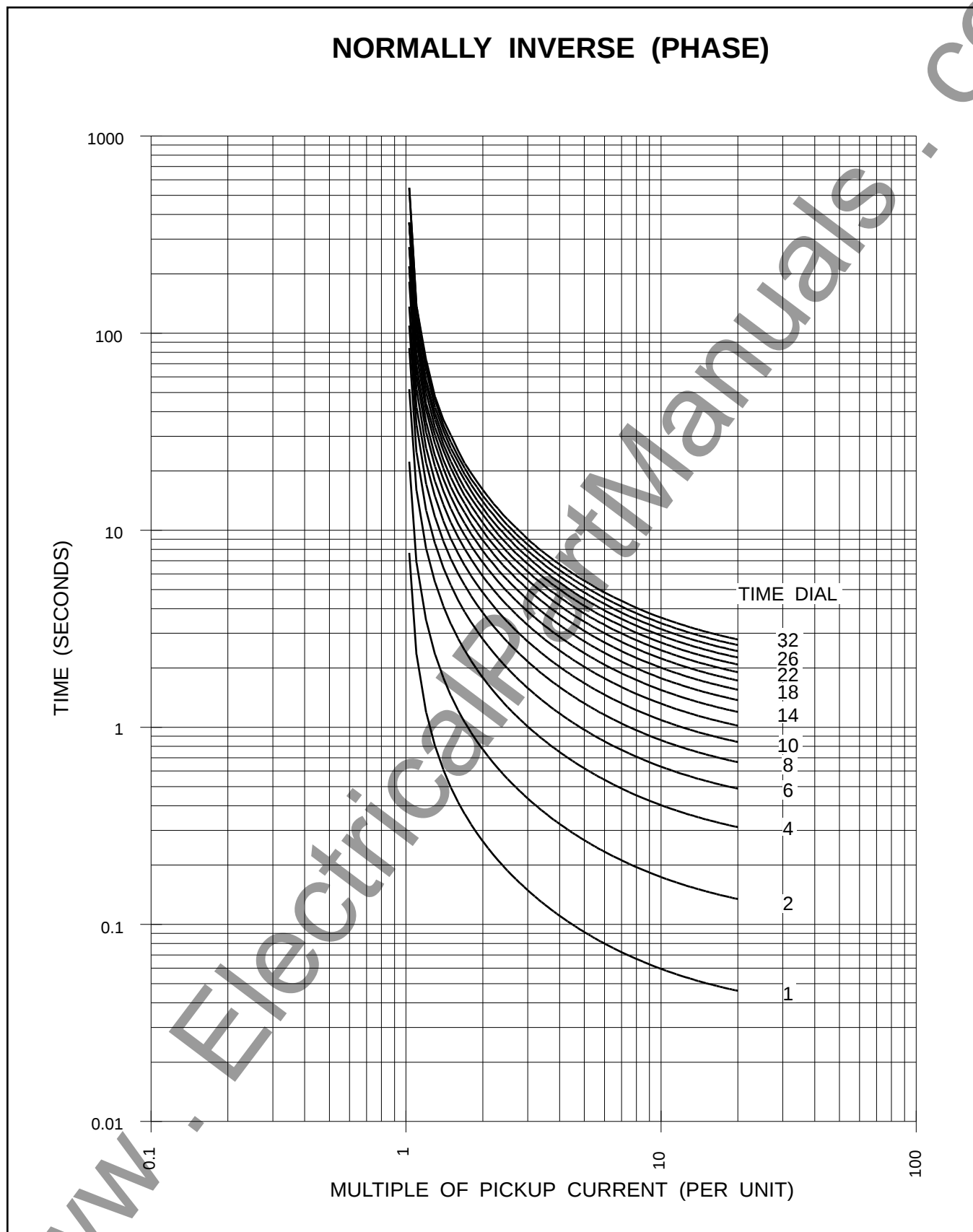
Alternately, the custom curve can be used to match the system requirements very closely.

### CAUTION

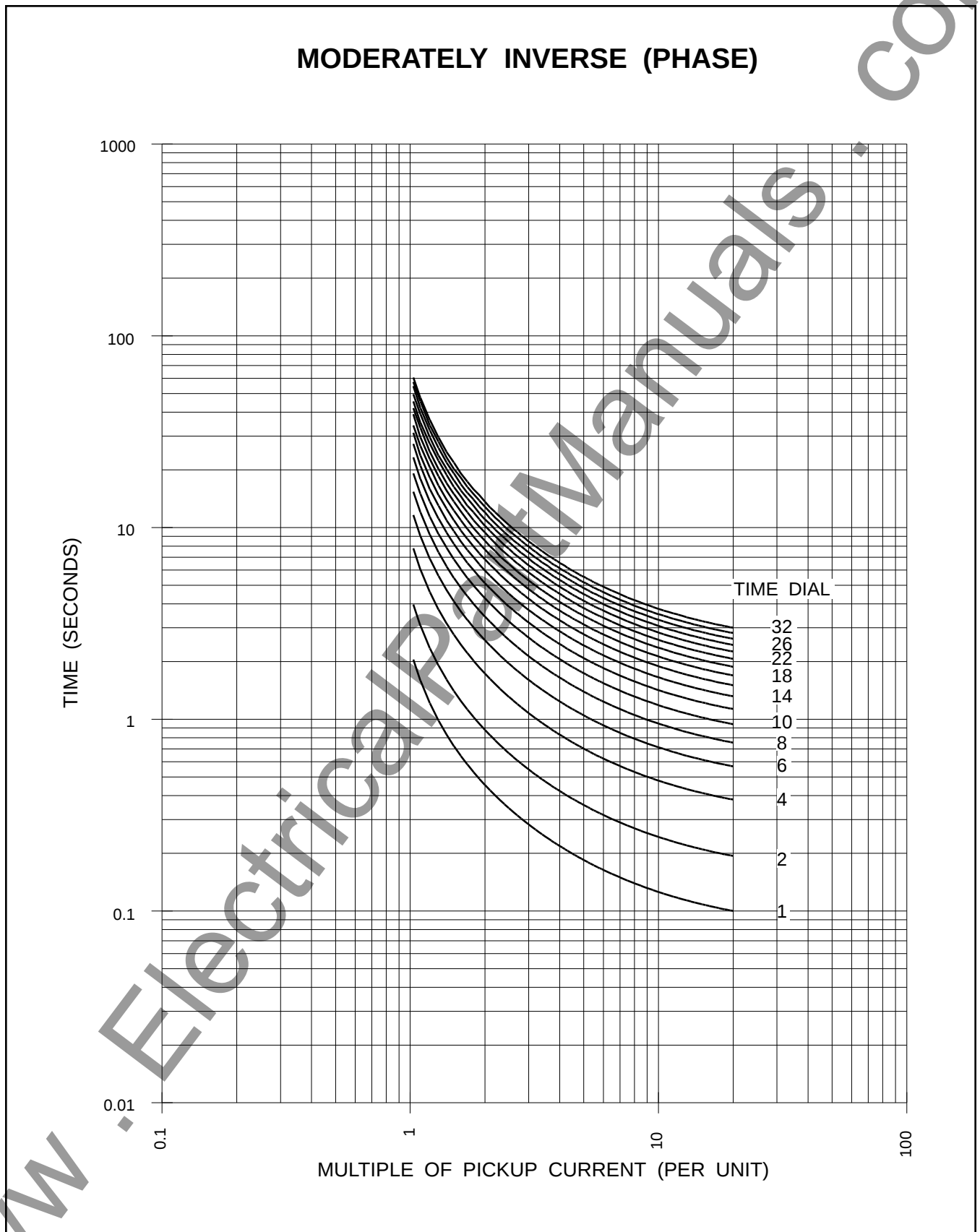
Ensure when selecting a curve, either preprogrammed or custom, and the delays to trip the feeder breaker, that the maximum current into the relay at the rear terminals of the 565 shall not exceed 100A for more than 3 seconds.

Failure to ensure the maximum current vs. delay can cause damage to the relay which may result in loss of relay protection.

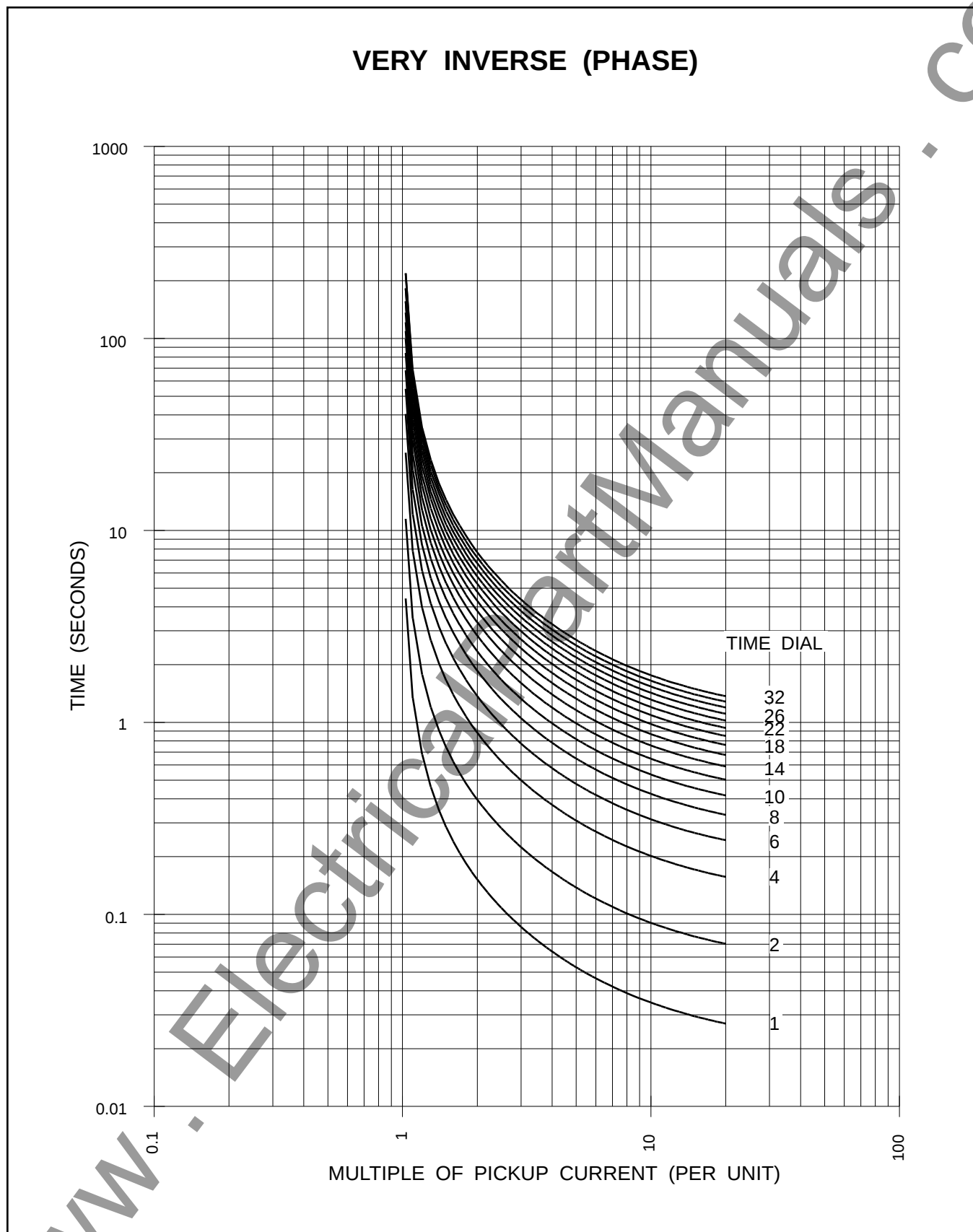
Example: Any time a pickup level is selected greater than 100% of CT using the 5A tap, care must be taken to ensure that current to the relay is limited to 100A for 3 seconds maximum. If a pickup level of 150% is selected with a maximum of 20 times pickup then 150A will be flowing into the 565 relay. Therefore, an instantaneous trip must be selected for any current above 100A. ie.  $13.3 \times$  pickup level.



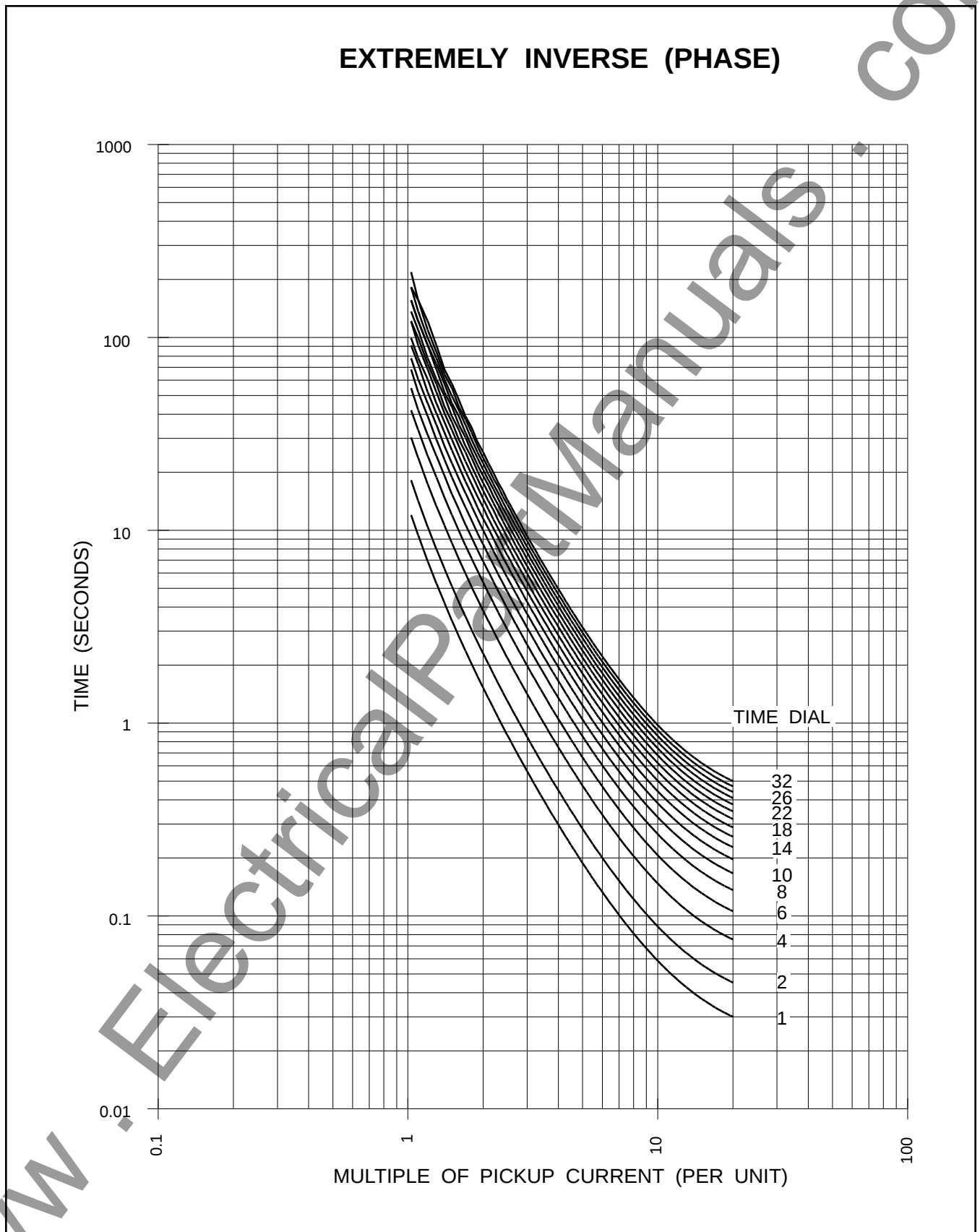
**Figure 7.1** Normal Inverse Time/Phase Overcurrent Curves



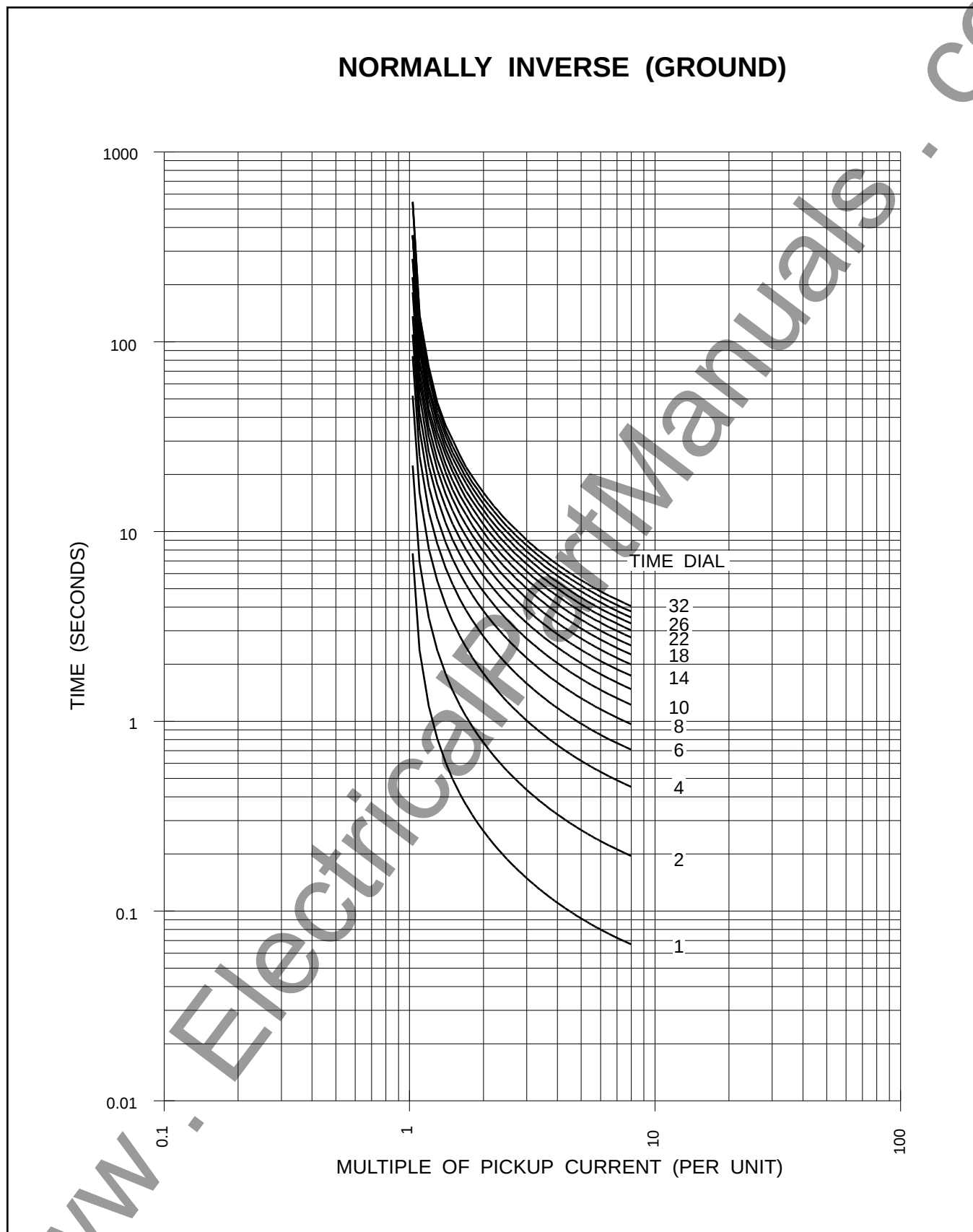
**Figure 7.2** Moderately Inverse Time/Phase Overcurrent Curves



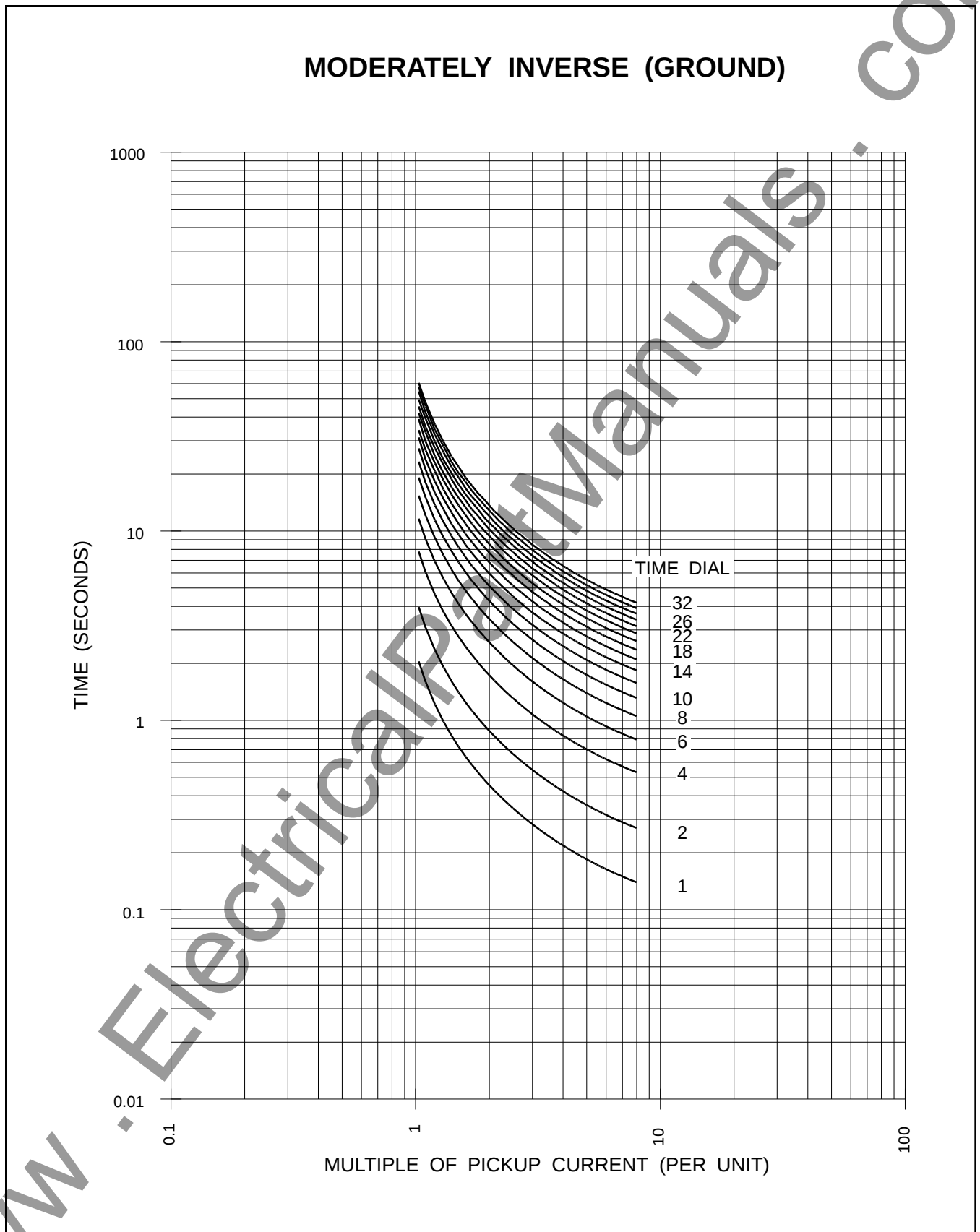
**Figure 7.3** Very Inverse Time/Phase Overcurrent Curves



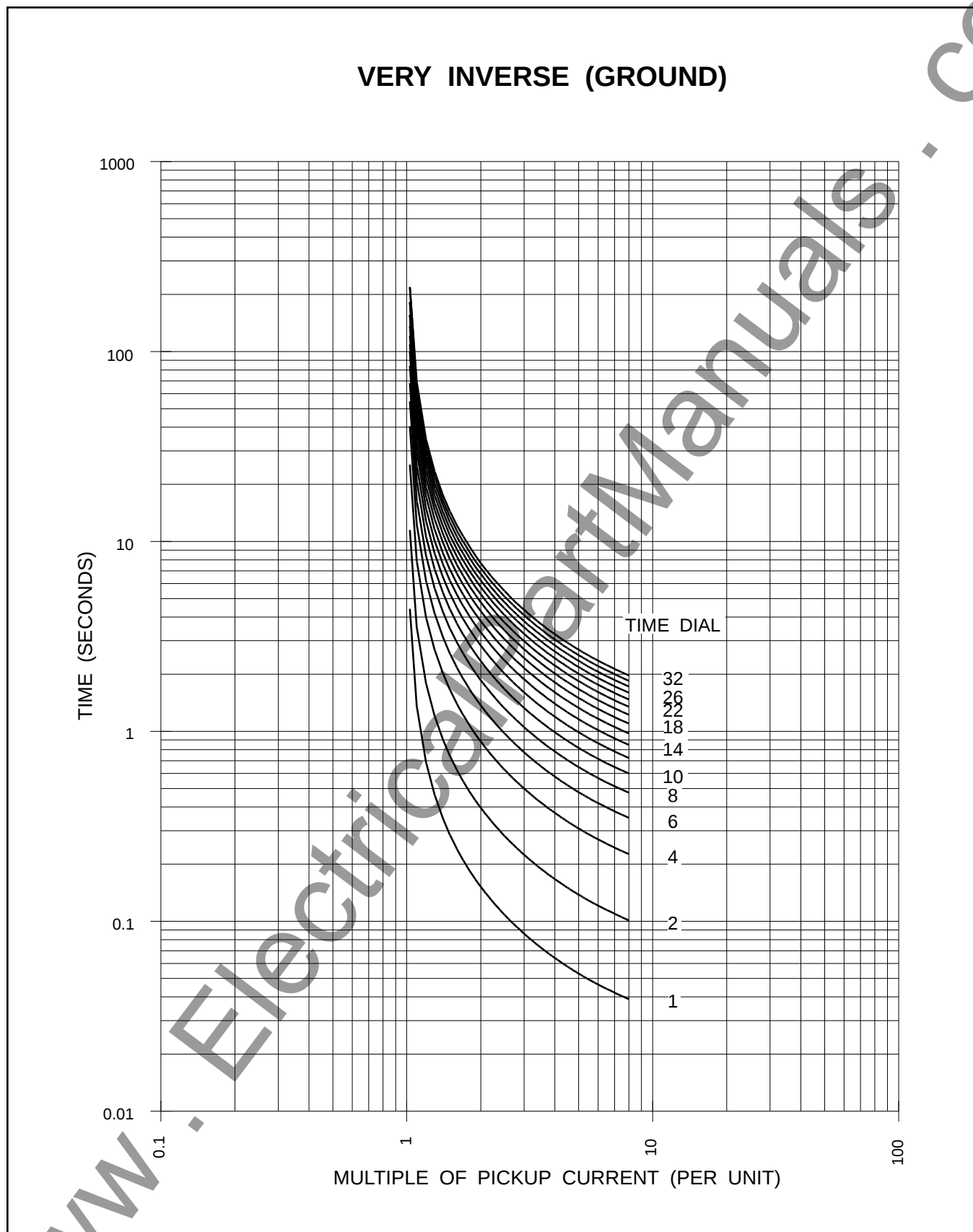
**Figure 7.4** Extremely Inverse Time/Phase Overcurrent Curves



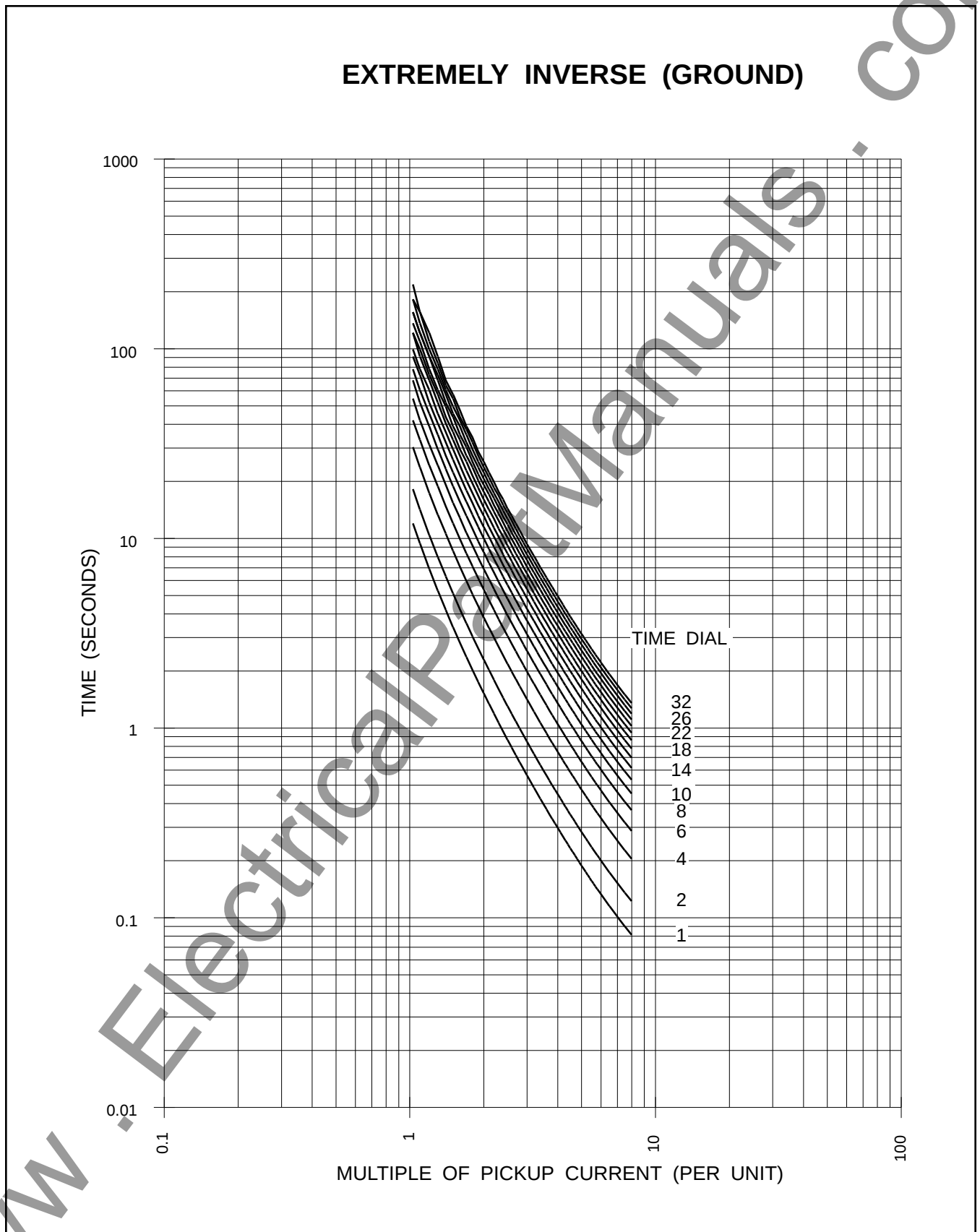
**Figure 7.5** Normal Inverse Time/Ground Overcurrent Curves



**Figure 7.6** Moderately Inverse Time/Ground Overcurrent Curves



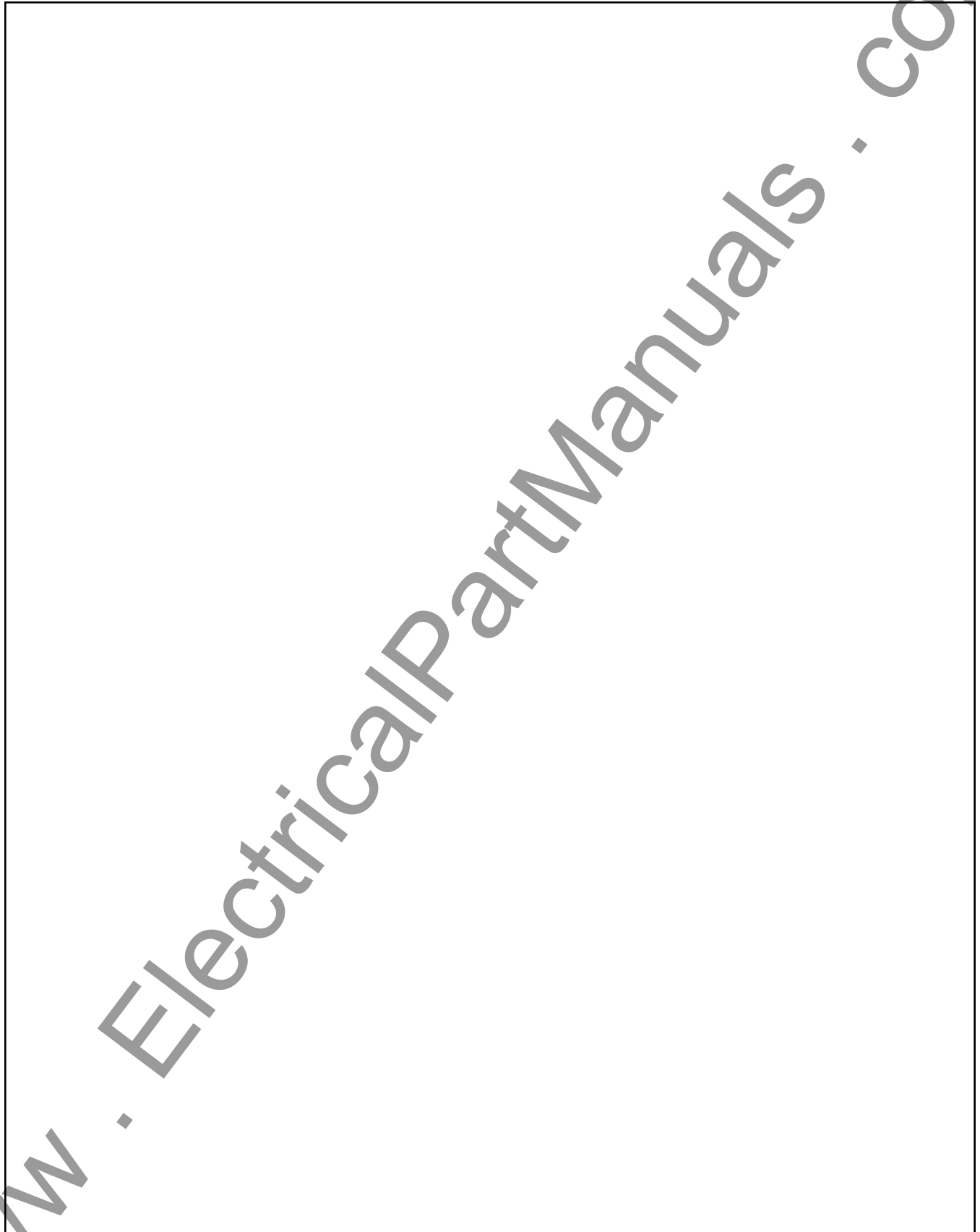
**Figure 7.7** Very Inverse Time/Ground Overcurrent Curves



**Figure 7.8** Extremely Inverse Time/Ground Overcurrent Curves



Figure 7.9 IEC A Curves



**Figure 7.10** IEC B Curves

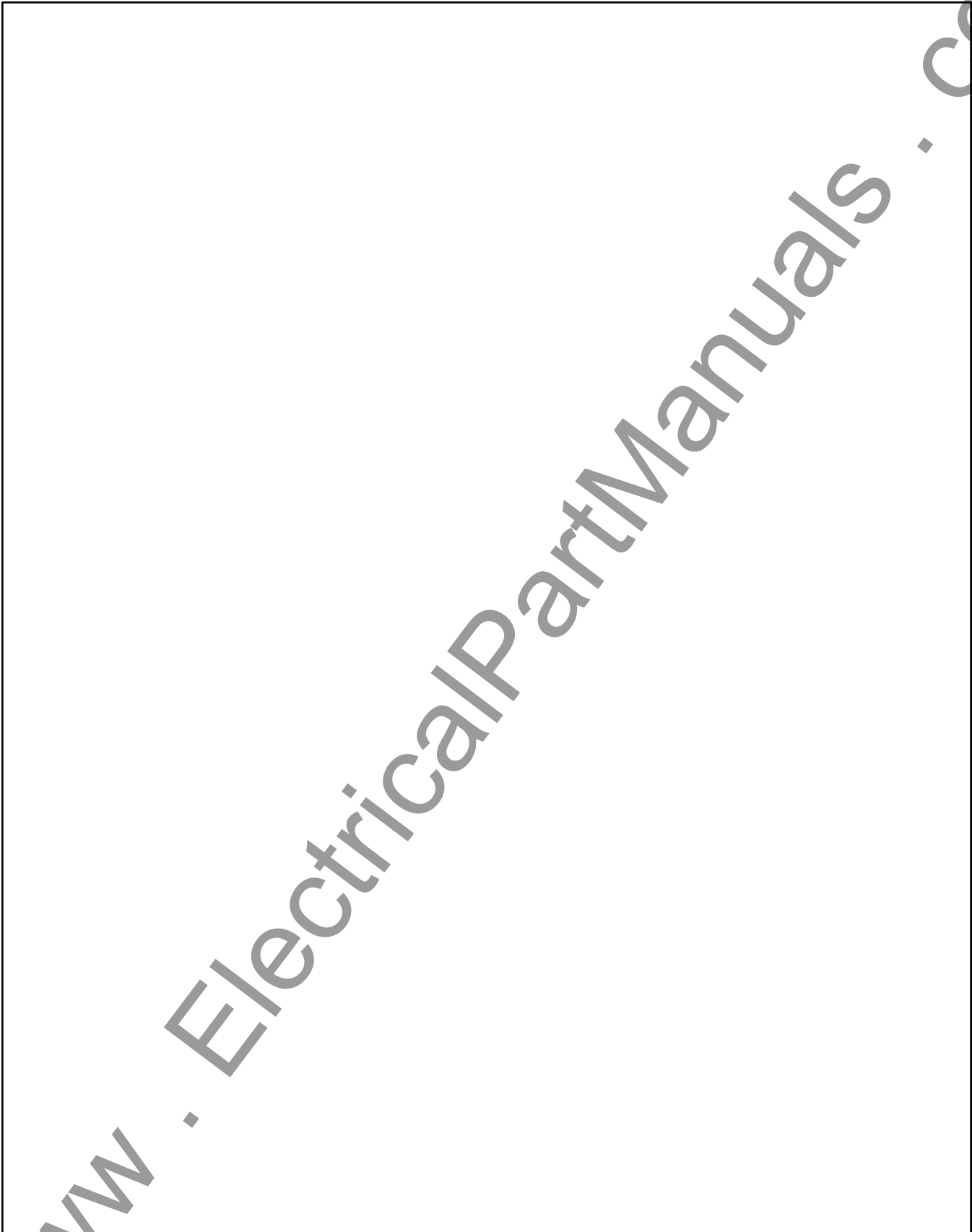


Figure 7.11 IEC C Curves

Below are the 565 Timed Overcurrent Curve Equations. Overload values from 1.03 to 20.0 times pickup and Time Dials from 1 to 32 may be entered into these equations.

## MODERATELY INVERSE

$$\text{Trip Time} = \left[ 525 + \frac{3121}{(\text{Overload} - 0.8)} \right] \times \left[ \frac{0.1 + (3 - 0.1) \times \left( \frac{\text{Time Dial} - 1}{31} \right)}{525 + \frac{3121}{(20 - 0.8)}} \right]$$

## NORMALLY INVERSE

$$\text{Trip Time} = \left[ 478 + \frac{3245.7}{(\text{Overload} - 1)} \right] \times \left[ \frac{0.046 + (2.788 - 0.046) \times \left( \frac{\text{Time Dial} - 1}{31} \right)}{478 + \frac{3245.7}{(20 - 1)}} \right]$$

## VERY INVERSE

$$\text{Trip Time} = \left[ 310 + \frac{20415}{(\text{Overload} - 1)} \right] \times \left[ \frac{0.027 + (1.368 - 0.027) \times \left( \frac{\text{Time Dial} - 1}{31} \right)}{310 + \frac{20415}{(20 - 1)}} \right]$$

## EXTREMELY INVERSE

$$\text{Trip Time} = \left[ 110 + \frac{17640}{(\text{Overload} - 0.5)^2} \right] \times \left[ \frac{0.03 + (0.5 - 0.03) \times \left( \frac{\text{Time Dial} - 1}{31} \right)}{110 + \frac{17640}{(20 - 0.5)^2}} \right]$$

The preceding four equations, and the three IEC equations, represent the theoretical trip times for the 565 and not the actual trip times. This is because the relay uses look up tables where a 16 bit number (0-65,535) is stored. This number represents the number of trips per 65,535 cycles or 1092.25 seconds. The relay does not store the theoretical trip times in memory and as a result there are rounding off errors. The following will simulate how the relay operates. By performing these operations on the theoretical trip times, you can calculate the exact 565 trip times for various overload levels and time dials. First of all, calculate the number of trips per 65,535 cycles. This is based on the theoretical trip time.

$$\text{Number of trips per 65,535 cycles} = \frac{1092.25 \text{ seconds}}{\text{Theoretical Trip Time}}$$

Since only integer numbers can be stored in the 565 look up tables, this value must be rounded off. Working backwards with this rounded off value, the number of cycles before a trip occurs can be calculated.

$$\text{Number of cycles per trip} = \frac{65,535}{\# \text{ trips per 65,535 cycles}}$$

Finally, the actual trip time would be based on this number of

cycles.

$$\text{Actual Trip Time} = \frac{\text{Number of cycles per trip}}{60}$$

## EXAMPLE:

Extremely Inverse  
Overload Level = 3.0 x pickup  
Time Dial = 4

Theoretical Trip Time = 1.415 seconds.

$$\begin{aligned} \text{Number of trips per 65,535 cycles} &= \frac{1092.25 \text{ seconds}}{\text{Theoretical Trip Time}} \\ &= \frac{1092.25 \text{ seconds}}{1.415 \text{ seconds}} \\ &= 771.91 \end{aligned}$$

This value is then rounded off to 2 and stored in the relay's memory. Working backwards...

$$\begin{aligned} \text{Number of cycles per trip} &= \frac{65,535}{\text{Number of trips per 65,535 cycles}} \\ &= \frac{65,535}{771} \end{aligned}$$

Now in terms of time:

$$\begin{aligned} \text{Actual Trip Time} &= \frac{\text{Number of cycles per trip}}{60} \\ &= \frac{85}{60} \\ &= 1.417 \text{ seconds} \end{aligned}$$

## IEC CURVES

Three new curve shapes, IEC A, IEC B, and IEC C, are now present in addition to the standard Moderately Inverse, Normally Inverse, Very Inverse, and Extremely Inverse shapes. The formulas below characterize the IEC curve shapes.

$$\text{IEC A: } t = \frac{0.14}{\left[ \frac{\text{Actual Current}}{\text{Pickup Current}} \right]^{0.02} - 1} \times \text{Multiplier}$$

$$\text{IEC B: } t = \frac{13.5}{\left[ \frac{\text{Actual Current}}{\text{Pickup Current}} \right] - 1} \times \text{Multiplier}$$

$$\text{IEC C: } t = \frac{80.0}{\left[ \frac{\text{Actual Current}}{\text{Pickup Current}} \right]^2 - 1} \times \text{Multiplier}$$

Once the curve shape is chosen, one of the 32 time dials for that shape should be selected. The relationship between the

## CURVE INFORMATION AND TABLES



multiplier in the formula and the selected time dial is as follows:

$$\text{Multiplier} = \frac{\text{Time Dial}}{20}$$

The additional overcurrent curve shapes are selectable with Modbus protocol communications. The following memory map registers reflect this change.

| Address | Dec  | Hex | Chapter   | Page | Line                                | Unit | Type of data |
|---------|------|-----|-----------|------|-------------------------------------|------|--------------|
| 261     | 0105 |     | SETPOINTS |      | PHASE CURRENT PHASE O/C CURVE SHAPE |      | Unsigned     |
| 261     | *    | *** | ****      |      | 0: MOD INV                          |      |              |
| 261     | *    | *** | ****      |      | 1: NORMAL INV                       |      |              |
| 261     | *    | *** | ****      |      | 2: VERY INV                         |      |              |
| 261     | *    | *** | ****      |      | 3: EXTREM INV                       |      |              |
| 261     | *    | *** | ****      |      | 4: CUSTOM                           |      |              |
| 261     | *    | *** | ****      |      | 5: IEC A                            |      |              |
| 261     | *    | *** | ****      |      | 6: IEC B                            |      |              |
| 261     | *    | *** | ****      |      | 7: IEC C                            |      |              |
| 303     | 012F |     | SETPOINTS |      | GROUND CURRENT GND O/C CURVE SHAPE  |      | Unsigned     |
| 303     | *    | *** | ****      |      | 0: MOD INV                          |      |              |
| 303     | *    | *** | ****      |      | 1: NORMAL INV                       |      |              |
| 303     | *    | *** | ****      |      | 2: VERY INV                         |      |              |
| 303     | *    | *** | ****      |      | 3: EXTREM INV                       |      |              |
| 303     | *    | *** | ****      |      | 4: CUSTOM                           |      |              |
| 303     | *    | *** | ****      |      | 5: IEC A                            |      |              |
| 303     | *    | *** | ****      |      | 6: IEC B                            |      |              |
| 303     | *    | *** | ****      |      | 7: IEC C                            |      |              |

On the following pages are the curve tables for the ANSI curves Moderately Inverse, Normal Inverse, Very Inverse, and Extremely Inverse.

# CURVE INFORMATION AND TABLES



## Curve: Normal Inverse

| Curve#: | 1                      | 2      | 3      | 4      | 5      | 6      | 7      | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      |
|---------|------------------------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| × P/U   | Time to trip (seconds) |        |        |        |        |        |        |         |         |         |         |         |         |         |         |         |
| 1.03    | 7.692                  | 22.291 | 37.664 | 52.012 | 68.266 | 84.019 | 99.295 | 109.225 | 121.361 | 136.531 | 156.036 | 182.042 | 182.042 | 218.450 | 218.450 | 218.450 |
| 1.10    | 2.334                  | 6.827  | 11.260 | 15.830 | 20.227 | 24.824 | 29.520 | 34.133  | 37.664  | 42.010  | 47.489  | 52.012  | 57.487  | 60.681  | 64.250  | 68.266  |
| 1.20    | 1.185                  | 3.467  | 5.749  | 8.031  | 10.304 | 12.555 | 14.760 | 17.066  | 19.504  | 21.845  | 23.745  | 26.006  | 28.743  | 31.207  | 33.098  | 35.234  |
| 1.30    | 0.801                  | 2.339  | 3.887  | 5.434  | 6.957  | 8.533  | 10.021 | 11.620  | 13.160  | 14.760  | 16.302  | 17.617  | 19.162  | 21.005  | 22.291  | 23.745  |
| 1.40    | 0.609                  | 1.782  | 2.952  | 4.122  | 5.302  | 6.463  | 7.638  | 8.808   | 10.021  | 11.145  | 12.272  | 13.485  | 14.760  | 15.830  | 17.066  | 18.204  |
| 1.50    | 0.494                  | 1.445  | 2.395  | 3.340  | 4.300  | 5.251  | 6.206  | 7.139   | 8.091   | 9.027   | 10.021  | 10.923  | 11.872  | 12.850  | 13.826  | 14.760  |
| 1.60    | 0.417                  | 1.220  | 2.023  | 2.822  | 3.629  | 4.422  | 5.226  | 6.035   | 6.827   | 7.638   | 8.467   | 9.256   | 10.021  | 10.814  | 11.620  | 12.412  |
| 1.70    | 0.363                  | 1.059  | 1.756  | 2.454  | 3.148  | 3.846  | 4.551  | 5.251   | 5.936   | 6.620   | 7.331   | 8.031   | 8.738   | 9.416   | 10.113  | 10.814  |
| 1.80    | 0.322                  | 0.940  | 1.558  | 2.176  | 2.793  | 3.413  | 4.030  | 4.648   | 5.277   | 5.872   | 6.501   | 7.139   | 7.746   | 8.338   | 8.953   | 9.581   |
| 1.90    | 0.290                  | 0.846  | 1.404  | 1.961  | 2.517  | 3.077  | 3.629  | 4.185   | 4.749   | 5.302   | 5.872   | 6.425   | 6.957   | 7.533   | 8.091   | 8.669   |
| 2.00    | 0.264                  | 0.772  | 1.279  | 1.788  | 2.295  | 2.801  | 3.310  | 3.819   | 4.317   | 4.833   | 5.328   | 5.841   | 6.350   | 6.869   | 7.380   | 7.858   |
| 2.10    | 0.243                  | 0.711  | 1.178  | 1.645  | 2.113  | 2.582  | 3.051  | 3.512   | 3.986   | 4.458   | 4.920   | 5.381   | 5.841   | 6.314   | 6.784   | 7.233   |
| 2.20    | 0.226                  | 0.660  | 1.093  | 1.528  | 1.961  | 2.395  | 2.830  | 3.260   | 3.703   | 4.137   | 4.570   | 4.987   | 5.434   | 5.872   | 6.314   | 6.742   |
| 2.30    | 0.211                  | 0.616  | 1.022  | 1.428  | 1.833  | 2.238  | 2.645  | 3.051   | 3.456   | 3.860   | 4.267   | 4.668   | 5.080   | 5.489   | 5.904   | 6.277   |
| 2.40    | 0.198                  | 0.579  | 0.961  | 1.342  | 1.723  | 2.105  | 2.488  | 2.867   | 3.251   | 3.629   | 4.016   | 4.387   | 4.770   | 5.152   | 5.544   | 5.904   |
| 2.50    | 0.187                  | 0.547  | 0.908  | 1.267  | 1.628  | 1.990  | 2.349  | 2.710   | 3.068   | 3.424   | 3.793   | 4.153   | 4.513   | 4.876   | 5.226   | 5.601   |
| 2.60    | 0.178                  | 0.519  | 0.861  | 1.203  | 1.545  | 1.886  | 2.229  | 2.570   | 2.913   | 3.251   | 3.593   | 3.943   | 4.283   | 4.628   | 4.965   | 5.302   |
| 2.70    | 0.169                  | 0.495  | 0.820  | 1.146  | 1.470  | 1.796  | 2.121  | 2.449   | 2.772   | 3.094   | 3.424   | 3.753   | 4.076   | 4.404   | 4.728   | 5.057   |
| 2.80    | 0.162                  | 0.473  | 0.784  | 1.094  | 1.406  | 1.717  | 2.026  | 2.339   | 2.651   | 2.960   | 3.270   | 3.581   | 3.887   | 4.201   | 4.513   | 4.833   |
| 2.90    | 0.155                  | 0.453  | 0.751  | 1.049  | 1.347  | 1.645  | 1.944  | 2.243   | 2.540   | 2.837   | 3.139   | 3.435   | 3.728   | 4.030   | 4.334   | 4.628   |
| 3.00    | 0.149                  | 0.435  | 0.722  | 1.009  | 1.294  | 1.581  | 1.867  | 2.154   | 2.438   | 2.724   | 3.009   | 3.300   | 3.581   | 3.873   | 4.153   | 4.440   |
| 3.10    | 0.143                  | 0.419  | 0.695  | 0.971  | 1.247  | 1.523  | 1.799  | 2.073   | 2.349   | 2.626   | 2.905   | 3.175   | 3.456   | 3.728   | 4.001   | 4.283   |
| 3.20    | 0.138                  | 0.405  | 0.671  | 0.938  | 1.204  | 1.470  | 1.736  | 2.004   | 2.271   | 2.534   | 2.801   | 3.068   | 3.330   | 3.605   | 3.873   | 4.137   |
| 3.30    | 0.134                  | 0.391  | 0.649  | 0.906  | 1.164  | 1.422  | 1.680  | 1.937   | 2.193   | 2.454   | 2.710   | 2.968   | 3.222   | 3.479   | 3.741   | 4.001   |
| 3.40    | 0.130                  | 0.379  | 0.629  | 0.878  | 1.128  | 1.377  | 1.628  | 1.877   | 2.125   | 2.374   | 2.626   | 2.874   | 3.121   | 3.371   | 3.629   | 3.873   |
| 3.50    | 0.126                  | 0.368  | 0.610  | 0.853  | 1.094  | 1.337  | 1.578  | 1.820   | 2.065   | 2.304   | 2.546   | 2.786   | 3.034   | 3.270   | 3.512   | 3.753   |
| 3.60    | 0.122                  | 0.358  | 0.593  | 0.829  | 1.064  | 1.299  | 1.534  | 1.770   | 2.004   | 2.238   | 2.477   | 2.710   | 2.944   | 3.184   | 3.413   | 3.653   |
| 3.70    | 0.119                  | 0.348  | 0.577  | 0.806  | 1.035  | 1.264  | 1.494  | 1.723   | 1.950   | 2.180   | 2.411   | 2.638   | 2.867   | 3.094   | 3.330   | 3.558   |
| 3.80    | 0.116                  | 0.339  | 0.562  | 0.786  | 1.009  | 1.231  | 1.454  | 1.678   | 1.903   | 2.125   | 2.349   | 2.570   | 2.793   | 3.017   | 3.241   | 3.467   |
| 3.90    | 0.113                  | 0.331  | 0.549  | 0.766  | 0.984  | 1.202  | 1.420  | 1.638   | 1.854   | 2.073   | 2.290   | 2.511   | 2.724   | 2.944   | 3.166   | 3.382   |
| 4.00    | 0.111                  | 0.323  | 0.536  | 0.749  | 0.961  | 1.174  | 1.386  | 1.599   | 1.811   | 2.023   | 2.238   | 2.449   | 2.664   | 2.874   | 3.085   | 3.300   |
| 4.10    | 0.108                  | 0.316  | 0.524  | 0.732  | 0.940  | 1.147  | 1.355  | 1.563   | 1.770   | 1.979   | 2.189   | 2.395   | 2.601   | 2.808   | 3.017   | 3.222   |
| 4.20    | 0.106                  | 0.309  | 0.513  | 0.716  | 0.919  | 1.123  | 1.327  | 1.530   | 1.734   | 1.937   | 2.142   | 2.344   | 2.546   | 2.751   | 2.952   | 3.157   |
| 4.30    | 0.104                  | 0.303  | 0.502  | 0.702  | 0.900  | 1.100  | 1.299  | 1.498   | 1.699   | 1.896   | 2.096   | 2.295   | 2.494   | 2.697   | 2.890   | 3.094   |
| 4.40    | 0.102                  | 0.297  | 0.492  | 0.687  | 0.883  | 1.078  | 1.273  | 1.468   | 1.665   | 1.861   | 2.053   | 2.252   | 2.444   | 2.638   | 2.837   | 3.034   |
| 4.50    | 0.100                  | 0.291  | 0.483  | 0.674  | 0.866  | 1.057  | 1.250  | 1.441   | 1.633   | 1.823   | 2.015   | 2.207   | 2.401   | 2.588   | 2.779   | 2.976   |
| 4.60    | 0.098                  | 0.286  | 0.474  | 0.662  | 0.850  | 1.038  | 1.226  | 1.415   | 1.602   | 1.791   | 1.979   | 2.167   | 2.354   | 2.540   | 2.731   | 2.920   |
| 4.70    | 0.096                  | 0.281  | 0.466  | 0.650  | 0.835  | 1.020  | 1.204  | 1.390   | 1.574   | 1.759   | 1.944   | 2.129   | 2.314   | 2.499   | 2.684   | 2.867   |
| 4.80    | 0.094                  | 0.276  | 0.458  | 0.639  | 0.821  | 1.002  | 1.185  | 1.365   | 1.547   | 1.728   | 1.910   | 2.092   | 2.276   | 2.454   | 2.638   | 2.815   |
| 4.90    | 0.093                  | 0.272  | 0.450  | 0.629  | 0.807  | 0.986  | 1.164  | 1.343   | 1.521   | 1.701   | 1.880   | 2.057   | 2.238   | 2.416   | 2.594   | 2.772   |
| 5.00    | 0.091                  | 0.267  | 0.443  | 0.619  | 0.794  | 0.970  | 1.146  | 1.322   | 1.498   | 1.673   | 1.848   | 2.026   | 2.202   | 2.374   | 2.552   | 2.731   |
| 5.10    | 0.090                  | 0.263  | 0.436  | 0.609  | 0.782  | 0.956  | 1.128  | 1.302   | 1.474   | 1.647   | 1.820   | 1.993   | 2.167   | 2.339   | 2.511   | 2.684   |
| 5.20    | 0.089                  | 0.259  | 0.430  | 0.600  | 0.771  | 0.942  | 1.112  | 1.282   | 1.452   | 1.623   | 1.794   | 1.964   | 2.133   | 2.304   | 2.477   | 2.645   |
| 5.30    | 0.087                  | 0.255  | 0.424  | 0.592  | 0.760  | 0.928  | 1.096  | 1.264   | 1.432   | 1.599   | 1.767   | 1.937   | 2.105   | 2.271   | 2.438   | 2.607   |
| 5.40    | 0.086                  | 0.252  | 0.418  | 0.583  | 0.749  | 0.915  | 1.080  | 1.247   | 1.411   | 1.578   | 1.745   | 1.910   | 2.077   | 2.243   | 2.406   | 2.570   |
| 5.50    | 0.085                  | 0.249  | 0.412  | 0.575  | 0.739  | 0.903  | 1.066  | 1.230   | 1.393   | 1.556   | 1.720   | 1.883   | 2.045   | 2.211   | 2.374   | 2.540   |
| 5.60    | 0.084                  | 0.245  | 0.407  | 0.568  | 0.729  | 0.891  | 1.052  | 1.214   | 1.374   | 1.536   | 1.699   | 1.858   | 2.019   | 2.180   | 2.344   | 2.505   |
| 5.70    | 0.083                  | 0.242  | 0.401  | 0.561  | 0.720  | 0.879  | 1.038  | 1.198   | 1.357   | 1.517   | 1.675   | 1.836   | 1.993   | 2.154   | 2.314   | 2.471   |
| 5.80    | 0.082                  | 0.239  | 0.396  | 0.554  | 0.711  | 0.868  | 1.026  | 1.183   | 1.340   | 1.498   | 1.655   | 1.811   | 1.972   | 2.129   | 2.285   | 2.444   |
| 5.90    | 0.081                  | 0.236  | 0.392  | 0.547  | 0.703  | 0.858  | 1.013  | 1.169   | 1.324   | 1.480   | 1.635   | 1.791   | 1.947   | 2.100   | 2.257   | 2.411   |
| 6.00    | 0.080                  | 0.234  | 0.387  | 0.541  | 0.694  | 0.848  | 1.002  | 1.156   | 1.310   | 1.462   | 1.616   | 1.770   | 1.923   | 2.077   | 2.229   | 2.385   |
| 6.50    | 0.076                  | 0.221  | 0.367  | 0.513  | 0.658  | 0.804  | 0.950  | 1.096   | 1.241   | 1.386   | 1.532   | 1.678   | 1.823   | 1.968   | 2.113   | 2.261   |
| 7.00    | 0.072                  | 0.211  | 0.350  | 0.489  | 0.628  | 0.767  | 0.906  | 1.044   | 1.183   | 1.322   | 1.462   | 1.599   | 1.739   | 1.877   | 2.015   | 2.154   |
| 7.50    | 0.069                  | 0.203  | 0.336  | 0.469  | 0.602  | 0.736  | 0.869  | 1.002   | 1.135   | 1.269   | 1.402   | 1.534   | 1.668   | 1.802   | 1.933   | 2.069   |
| 8.00    | 0.067                  | 0.195  | 0.324  | 0.452  | 0.580  | 0.709  | 0.837  | 0.966   | 1.093   | 1.222   | 1.350   | 1.478   | 1.606   | 1.736   | 1.864   | 1.993   |
| 8.50    | 0.065                  | 0.189  | 0.313  | 0.437  | 0.561  | 0.685  | 0.810  | 0.934   | 1.057   | 1.182   | 1.307   | 1.430   | 1.554   | 1.678   | 1.802   | 1.926   |
| 9.00    | 0.063                  | 0.183  | 0.304  | 0.424  | 0.544  | 0.665  | 0.785  | 0.906   | 1.027   | 1.147   | 1.267   | 1.388   | 1.509   | 1.628   | 1.750   | 1.870   |

**Curve: Normal Inverse**

| Curve#:<br>× P/U | 1                      | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 9.50             | 0.061                  | 0.178 | 0.295 | 0.413 | 0.530 | 0.647 | 0.764 | 0.882 | 0.998 | 1.116 | 1.233 | 1.350 | 1.468 | 1.585 | 1.701 | 1.820 |
| 10.00            | 0.059                  | 0.174 | 0.288 | 0.402 | 0.517 | 0.631 | 0.746 | 0.860 | 0.974 | 1.088 | 1.203 | 1.318 | 1.432 | 1.545 | 1.660 | 1.773 |
| 10.50            | 0.058                  | 0.170 | 0.282 | 0.393 | 0.505 | 0.617 | 0.729 | 0.840 | 0.952 | 1.064 | 1.176 | 1.287 | 1.399 | 1.511 | 1.623 | 1.734 |
| 11.00            | 0.057                  | 0.166 | 0.276 | 0.385 | 0.494 | 0.604 | 0.713 | 0.822 | 0.932 | 1.041 | 1.151 | 1.260 | 1.370 | 1.480 | 1.588 | 1.699 |
| 11.50            | 0.056                  | 0.163 | 0.270 | 0.378 | 0.485 | 0.592 | 0.700 | 0.807 | 0.914 | 1.022 | 1.128 | 1.236 | 1.343 | 1.451 | 1.558 | 1.665 |
| 12.00            | 0.055                  | 0.160 | 0.266 | 0.371 | 0.476 | 0.582 | 0.687 | 0.793 | 0.898 | 1.003 | 1.109 | 1.214 | 1.319 | 1.424 | 1.530 | 1.635 |
| 12.50            | 0.054                  | 0.158 | 0.261 | 0.365 | 0.468 | 0.572 | 0.676 | 0.780 | 0.883 | 0.987 | 1.090 | 1.194 | 1.297 | 1.400 | 1.504 | 1.609 |
| 13.00            | 0.053                  | 0.155 | 0.257 | 0.359 | 0.461 | 0.563 | 0.665 | 0.768 | 0.870 | 0.972 | 1.073 | 1.176 | 1.277 | 1.379 | 1.482 | 1.583 |
| 13.50            | 0.052                  | 0.153 | 0.253 | 0.354 | 0.455 | 0.555 | 0.656 | 0.756 | 0.857 | 0.957 | 1.058 | 1.158 | 1.258 | 1.360 | 1.460 | 1.560 |
| 14.00            | 0.052                  | 0.151 | 0.250 | 0.349 | 0.448 | 0.547 | 0.647 | 0.746 | 0.845 | 0.944 | 1.043 | 1.143 | 1.243 | 1.342 | 1.441 | 1.541 |
| 14.50            | 0.051                  | 0.149 | 0.247 | 0.345 | 0.443 | 0.541 | 0.639 | 0.737 | 0.834 | 0.933 | 1.030 | 1.128 | 1.226 | 1.324 | 1.422 | 1.519 |
| 15.00            | 0.050                  | 0.147 | 0.244 | 0.341 | 0.437 | 0.534 | 0.631 | 0.728 | 0.824 | 0.921 | 1.018 | 1.115 | 1.211 | 1.308 | 1.406 | 1.502 |
| 15.50            | 0.050                  | 0.145 | 0.241 | 0.337 | 0.432 | 0.528 | 0.624 | 0.720 | 0.815 | 0.911 | 1.007 | 1.102 | 1.198 | 1.294 | 1.390 | 1.484 |
| 16.00            | 0.049                  | 0.144 | 0.239 | 0.333 | 0.428 | 0.523 | 0.617 | 0.712 | 0.807 | 0.901 | 0.996 | 1.090 | 1.185 | 1.280 | 1.374 | 1.470 |
| 16.50            | 0.049                  | 0.142 | 0.236 | 0.330 | 0.424 | 0.517 | 0.611 | 0.705 | 0.798 | 0.892 | 0.986 | 1.079 | 1.173 | 1.267 | 1.360 | 1.454 |
| 17.00            | 0.048                  | 0.141 | 0.234 | 0.327 | 0.420 | 0.512 | 0.605 | 0.698 | 0.791 | 0.884 | 0.976 | 1.070 | 1.162 | 1.255 | 1.348 | 1.441 |
| 17.50            | 0.048                  | 0.140 | 0.232 | 0.324 | 0.416 | 0.508 | 0.600 | 0.692 | 0.784 | 0.876 | 0.967 | 1.059 | 1.152 | 1.244 | 1.335 | 1.428 |
| 18.00            | 0.047                  | 0.139 | 0.230 | 0.321 | 0.412 | 0.503 | 0.595 | 0.686 | 0.777 | 0.868 | 0.959 | 1.050 | 1.141 | 1.233 | 1.324 | 1.415 |
| 18.50            | 0.047                  | 0.137 | 0.228 | 0.318 | 0.409 | 0.499 | 0.590 | 0.680 | 0.771 | 0.861 | 0.951 | 1.042 | 1.132 | 1.223 | 1.313 | 1.404 |
| 19.00            | 0.047                  | 0.136 | 0.226 | 0.316 | 0.406 | 0.495 | 0.585 | 0.675 | 0.765 | 0.855 | 0.944 | 1.034 | 1.124 | 1.214 | 1.303 | 1.393 |
| 19.50            | 0.046                  | 0.135 | 0.225 | 0.314 | 0.403 | 0.492 | 0.581 | 0.670 | 0.759 | 0.848 | 0.937 | 1.027 | 1.116 | 1.204 | 1.294 | 1.383 |
| 20.00            | 0.046                  | 0.134 | 0.223 | 0.311 | 0.400 | 0.488 | 0.577 | 0.665 | 0.754 | 0.842 | 0.930 | 1.019 | 1.108 | 1.196 | 1.285 | 1.372 |

# CURVE INFORMATION AND TABLES



## Curve: Normal Inverse

| Curve#: | 17                     | 18      | 19      | 20      | 21      | 22      | 23      | 24      | 25      | 26      | 27      | 28      | 29      | 30      | 31      | 32      |
|---------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| × P/U   | Time to trip (seconds) |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 1.03    | 273.063                | 273.063 | 273.063 | 273.063 | 273.063 | 364.083 | 364.083 | 364.083 | 364.083 | 364.083 | 364.083 | 364.083 | 364.083 | 546.125 | 546.125 | 546.125 |
| 1.10    | 72.817                 | 78.018  | 84.019  | 91.021  | 91.021  | 99.295  | 99.295  | 109.225 | 109.225 | 109.225 | 121.361 | 121.361 | 121.361 | 136.531 | 136.531 | 136.531 |
| 1.20    | 37.664                 | 40.454  | 42.010  | 43.690  | 47.489  | 49.648  | 52.012  | 54.613  | 54.613  | 57.487  | 60.681  | 64.250  | 64.250  | 68.266  | 68.266  | 72.817  |
| 1.30    | 25.401                 | 27.306  | 28.743  | 30.340  | 31.207  | 33.098  | 35.234  | 36.408  | 37.664  | 39.009  | 40.454  | 42.010  | 43.690  | 45.510  | 47.489  | 47.489  |
| 1.40    | 19.504                 | 20.608  | 21.845  | 22.755  | 24.272  | 25.401  | 26.640  | 27.306  | 28.743  | 29.520  | 31.207  | 32.125  | 33.098  | 34.133  | 35.234  | 36.408  |
| 1.50    | 15.604                 | 16.549  | 17.617  | 18.513  | 19.504  | 20.608  | 21.417  | 22.291  | 23.239  | 24.272  | 25.401  | 26.006  | 27.306  | 28.006  | 28.743  | 30.340  |
| 1.60    | 13.320                 | 14.003  | 14.962  | 15.604  | 16.549  | 17.337  | 18.204  | 18.832  | 19.859  | 20.608  | 21.417  | 22.291  | 22.755  | 23.745  | 24.272  | 25.401  |
| 1.70    | 11.497                 | 12.272  | 12.850  | 13.653  | 14.372  | 14.962  | 15.604  | 16.302  | 17.066  | 17.906  | 18.513  | 19.162  | 19.859  | 20.608  | 21.417  | 21.845  |
| 1.80    | 10.208                 | 10.814  | 11.497  | 12.003  | 12.701  | 13.320  | 14.003  | 14.563  | 15.170  | 15.830  | 16.302  | 17.066  | 17.617  | 18.204  | 18.832  | 19.504  |
| 1.90    | 9.179                  | 9.752   | 10.304  | 10.923  | 11.378  | 12.003  | 12.555  | 13.160  | 13.653  | 14.185  | 14.760  | 15.384  | 15.830  | 16.549  | 17.066  | 17.617  |
| 2.00    | 8.402                  | 8.880   | 9.416   | 9.930   | 10.402  | 10.923  | 11.378  | 12.003  | 12.412  | 13.003  | 13.485  | 14.003  | 14.563  | 14.962  | 15.604  | 16.063  |
| 2.10    | 7.746                  | 8.212   | 8.669   | 9.102   | 9.581   | 10.021  | 10.502  | 11.033  | 11.497  | 11.872  | 12.412  | 12.850  | 13.320  | 13.826  | 14.185  | 14.760  |
| 2.20    | 7.186                  | 7.585   | 8.031   | 8.467   | 8.880   | 9.335   | 9.752   | 10.208  | 10.604  | 11.033  | 11.497  | 12.003  | 12.412  | 12.850  | 13.320  | 13.653  |
| 2.30    | 6.701                  | 7.093   | 7.533   | 7.915   | 8.338   | 8.738   | 9.102   | 9.498   | 9.930   | 10.304  | 10.708  | 11.145  | 11.620  | 12.003  | 12.412  | 12.850  |
| 2.40    | 6.314                  | 6.660   | 7.047   | 7.430   | 7.802   | 8.212   | 8.600   | 8.953   | 9.335   | 9.752   | 10.113  | 10.502  | 10.923  | 11.260  | 11.620  | 12.003  |
| 2.50    | 5.936                  | 6.314   | 6.660   | 7.047   | 7.380   | 7.746   | 8.091   | 8.467   | 8.808   | 9.179   | 9.581   | 9.930   | 10.304  | 10.604  | 11.033  | 11.378  |
| 2.60    | 5.659                  | 6.001   | 6.314   | 6.660   | 7.002   | 7.331   | 7.692   | 8.031   | 8.402   | 8.738   | 9.027   | 9.416   | 9.752   | 10.113  | 10.402  | 10.814  |
| 2.70    | 5.381                  | 5.689   | 6.035   | 6.350   | 6.660   | 7.002   | 7.331   | 7.638   | 7.973   | 8.275   | 8.600   | 8.953   | 9.256   | 9.581   | 9.930   | 10.304  |
| 2.80    | 5.128                  | 5.461   | 5.749   | 6.068   | 6.387   | 6.701   | 7.002   | 7.331   | 7.638   | 7.915   | 8.275   | 8.533   | 8.880   | 9.179   | 9.498   | 9.840   |
| 2.90    | 4.920                  | 5.226   | 5.516   | 5.810   | 6.102   | 6.425   | 6.701   | 7.002   | 7.331   | 7.585   | 7.915   | 8.212   | 8.533   | 8.808   | 9.102   | 9.416   |
| 3.00    | 4.728                  | 5.010   | 5.302   | 5.601   | 5.872   | 6.171   | 6.463   | 6.742   | 7.002   | 7.331   | 7.585   | 7.858   | 8.151   | 8.467   | 8.738   | 9.027   |
| 3.10    | 4.551                  | 4.833   | 5.104   | 5.381   | 5.659   | 5.936   | 6.206   | 6.501   | 6.784   | 7.047   | 7.331   | 7.585   | 7.858   | 8.151   | 8.402   | 8.669   |
| 3.20    | 4.404                  | 4.668   | 4.942   | 5.201   | 5.461   | 5.719   | 6.001   | 6.277   | 6.540   | 6.784   | 7.047   | 7.331   | 7.585   | 7.858   | 8.151   | 8.402   |
| 3.30    | 4.250                  | 4.513   | 4.770   | 5.033   | 5.277   | 5.544   | 5.810   | 6.068   | 6.314   | 6.580   | 6.827   | 7.093   | 7.331   | 7.585   | 7.858   | 8.091   |
| 3.40    | 4.122                  | 4.369   | 4.628   | 4.876   | 5.128   | 5.381   | 5.630   | 5.872   | 6.102   | 6.350   | 6.620   | 6.869   | 7.139   | 7.380   | 7.638   | 7.858   |
| 3.50    | 4.001                  | 4.250   | 4.476   | 4.728   | 4.965   | 5.201   | 5.461   | 5.689   | 5.936   | 6.171   | 6.425   | 6.660   | 6.913   | 7.139   | 7.380   | 7.638   |
| 3.60    | 3.887                  | 4.122   | 4.352   | 4.589   | 4.833   | 5.057   | 5.302   | 5.544   | 5.779   | 6.001   | 6.241   | 6.463   | 6.701   | 6.957   | 7.186   | 7.430   |
| 3.70    | 3.779                  | 4.016   | 4.250   | 4.476   | 4.708   | 4.920   | 5.152   | 5.381   | 5.630   | 5.841   | 6.068   | 6.314   | 6.540   | 6.742   | 7.002   | 7.233   |
| 3.80    | 3.690                  | 3.915   | 4.137   | 4.352   | 4.589   | 4.812   | 5.033   | 5.251   | 5.461   | 5.689   | 5.904   | 6.136   | 6.350   | 6.580   | 6.827   | 7.047   |
| 3.90    | 3.593                  | 3.819   | 4.030   | 4.250   | 4.476   | 4.688   | 4.898   | 5.128   | 5.328   | 5.544   | 5.779   | 6.001   | 6.206   | 6.425   | 6.660   | 6.869   |
| 4.00    | 3.512                  | 3.728   | 3.943   | 4.153   | 4.369   | 4.570   | 4.791   | 5.010   | 5.226   | 5.434   | 5.630   | 5.841   | 6.068   | 6.277   | 6.501   | 6.701   |
| 4.10    | 3.435                  | 3.641   | 3.846   | 4.060   | 4.267   | 4.476   | 4.688   | 4.898   | 5.104   | 5.302   | 5.516   | 5.719   | 5.936   | 6.136   | 6.350   | 6.540   |
| 4.20    | 3.361                  | 3.569   | 3.766   | 3.972   | 4.169   | 4.387   | 4.589   | 4.791   | 4.987   | 5.201   | 5.407   | 5.601   | 5.810   | 6.001   | 6.206   | 6.425   |
| 4.30    | 3.290                  | 3.490   | 3.690   | 3.887   | 4.091   | 4.283   | 4.495   | 4.688   | 4.876   | 5.080   | 5.277   | 5.489   | 5.689   | 5.872   | 6.068   | 6.277   |
| 4.40    | 3.222                  | 3.424   | 3.617   | 3.806   | 4.001   | 4.201   | 4.404   | 4.589   | 4.791   | 4.987   | 5.177   | 5.381   | 5.573   | 5.779   | 5.969   | 6.171   |
| 4.50    | 3.166                  | 3.361   | 3.546   | 3.741   | 3.929   | 4.122   | 4.317   | 4.513   | 4.688   | 4.898   | 5.080   | 5.277   | 5.461   | 5.659   | 5.841   | 6.035   |
| 4.60    | 3.103                  | 3.300   | 3.479   | 3.665   | 3.860   | 4.045   | 4.234   | 4.422   | 4.609   | 4.791   | 4.987   | 5.177   | 5.354   | 5.544   | 5.749   | 5.936   |
| 4.70    | 3.051                  | 3.241   | 3.424   | 3.605   | 3.793   | 3.972   | 4.153   | 4.352   | 4.532   | 4.708   | 4.898   | 5.080   | 5.277   | 5.461   | 5.630   | 5.810   |
| 4.80    | 3.001                  | 3.184   | 3.361   | 3.546   | 3.728   | 3.915   | 4.091   | 4.267   | 4.458   | 4.628   | 4.812   | 4.987   | 5.177   | 5.354   | 5.544   | 5.719   |
| 4.90    | 2.952                  | 3.130   | 3.310   | 3.490   | 3.665   | 3.846   | 4.016   | 4.201   | 4.387   | 4.551   | 4.728   | 4.920   | 5.104   | 5.277   | 5.461   | 5.630   |
| 5.00    | 2.905                  | 3.077   | 3.251   | 3.435   | 3.605   | 3.779   | 3.957   | 4.137   | 4.317   | 4.495   | 4.668   | 4.833   | 5.010   | 5.201   | 5.354   | 5.544   |
| 5.10    | 2.859                  | 3.034   | 3.203   | 3.382   | 3.546   | 3.728   | 3.901   | 4.076   | 4.250   | 4.422   | 4.589   | 4.770   | 4.942   | 5.104   | 5.277   | 5.461   |
| 5.20    | 2.815                  | 2.984   | 3.157   | 3.330   | 3.501   | 3.665   | 3.846   | 4.016   | 4.185   | 4.352   | 4.513   | 4.688   | 4.854   | 5.033   | 5.201   | 5.381   |
| 5.30    | 2.779                  | 2.944   | 3.112   | 3.280   | 3.446   | 3.617   | 3.779   | 3.957   | 4.122   | 4.283   | 4.458   | 4.628   | 4.791   | 4.965   | 5.128   | 5.302   |
| 5.40    | 2.737                  | 2.905   | 3.068   | 3.232   | 3.403   | 3.569   | 3.728   | 3.901   | 4.060   | 4.234   | 4.387   | 4.570   | 4.728   | 4.898   | 5.057   | 5.226   |
| 5.50    | 2.704                  | 2.867   | 3.026   | 3.194   | 3.350   | 3.523   | 3.678   | 3.846   | 4.016   | 4.169   | 4.334   | 4.495   | 4.668   | 4.833   | 4.987   | 5.152   |
| 5.60    | 2.664                  | 2.830   | 2.984   | 3.148   | 3.310   | 3.467   | 3.629   | 3.793   | 3.957   | 4.122   | 4.283   | 4.440   | 4.609   | 4.770   | 4.920   | 5.080   |
| 5.70    | 2.632                  | 2.793   | 2.952   | 3.112   | 3.270   | 3.424   | 3.593   | 3.741   | 3.901   | 4.060   | 4.217   | 4.387   | 4.551   | 4.708   | 4.854   | 5.010   |
| 5.80    | 2.601                  | 2.758   | 2.913   | 3.068   | 3.222   | 3.382   | 3.546   | 3.703   | 3.860   | 4.016   | 4.169   | 4.334   | 4.495   | 4.648   | 4.812   | 4.965   |
| 5.90    | 2.570                  | 2.724   | 2.882   | 3.034   | 3.194   | 3.350   | 3.501   | 3.653   | 3.806   | 3.972   | 4.122   | 4.283   | 4.440   | 4.589   | 4.749   | 4.898   |
| 6.00    | 2.540                  | 2.690   | 2.844   | 3.001   | 3.157   | 3.310   | 3.466   | 3.617   | 3.766   | 3.915   | 4.076   | 4.234   | 4.387   | 4.532   | 4.688   | 4.833   |
| 6.50    | 2.406                  | 2.552   | 2.697   | 2.844   | 2.984   | 3.130   | 3.280   | 3.424   | 3.569   | 3.715   | 3.860   | 4.001   | 4.153   | 4.300   | 4.440   | 4.589   |
| 7.00    | 2.295                  | 2.433   | 2.570   | 2.710   | 2.852   | 2.992   | 3.130   | 3.270   | 3.403   | 3.546   | 3.690   | 3.819   | 3.957   | 4.106   | 4.234   | 4.387   |
| 7.50    | 2.202                  | 2.334   | 2.466   | 2.601   | 2.731   | 2.867   | 3.001   | 3.130   | 3.270   | 3.403   | 3.535   | 3.665   | 3.806   | 3.929   | 4.060   | 4.201   |
| 8.00    | 2.121                  | 2.247   | 2.380   | 2.505   | 2.632   | 2.765   | 2.890   | 3.017   | 3.148   | 3.280   | 3.403   | 3.535   | 3.665   | 3.793   | 3.915   | 4.045   |
| 8.50    | 2.049                  | 2.176   | 2.299   | 2.422   | 2.546   | 2.671   | 2.793   | 2.920   | 3.042   | 3.166   | 3.290   | 3.413   | 3.546   | 3.665   | 3.793   | 3.915   |
| 9.00    | 1.990                  | 2.113   | 2.229   | 2.354   | 2.471   | 2.594   | 2.710   | 2.837   | 2.952   | 3.077   | 3.194   | 3.320   | 3.435   | 3.558   | 3.678   | 3.793   |
| 9.50    | 1.937                  | 2.053   | 2.171   | 2.290   | 2.406   | 2.523   | 2.638   | 2.758   | 2.874   | 2.992   | 3.112   | 3.222   | 3.340   | 3.456   | 3.581   | 3.690   |
| 10.00   | 1.890                  | 2.004   | 2.117   | 2.234   | 2.344   | 2.460   | 2.576   | 2.690   | 2.801   | 2.920   | 3.034   | 3.148   | 3.260   | 3.371   | 3.490   | 3.605   |
| 10.50   | 1.845                  | 1.957   | 2.069   | 2.180   | 2.295   | 2.406   | 2.517   | 2.626   | 2.737   | 2.852   | 2.960   | 3.077   | 3.184   | 3.300   | 3.413   | 3.523   |
| 11.00   | 1.806                  | 1.916   | 2.026   | 2.137   | 2.243   | 2.354   | 2.466   | 2.576   | 2.684   | 2.793   | 2.905   | 3.009   | 3.121   | 3.232   | 3.340   | 3.446   |
| 11.50   | 1.773                  | 1.880   | 1.986   | 2.096   | 2.202   | 2.309   | 2.416   | 2.523   | 2.632   | 2.737   | 2.844   | 2.952   | 3.060   | 3.166   | 3.270   | 3.382   |
| 12.00   | 1.742                  | 1.845   | 1.950   | 2.057   | 2.163   | 2.266   | 2.374   | 2.477   | 2.582   | 2.690   | 2.793   | 2.897   | 3.009   | 3.112   | 3.213   | 3.320   |
| 12.50   | 1.712                  | 1.814   | 1.920   | 2.023   | 2.125   | 2.229   | 2.334   | 2.438   | 2.540   | 2.645   | 2.751   | 2.852   | 2.952   | 3.060   | 3.166   | 3.270   |

**Curve: Normal Inverse**

| Curve#: | 17    | 18    | 19    | 20    | 21    | 22    | 23    | 24                     | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|---------|-------|-------|-------|-------|-------|-------|-------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| × P/U   |       |       |       |       |       |       |       | Time to trip (seconds) |       |       |       |       |       |       |       |       |
| 13.00   | 1.686 | 1.788 | 1.890 | 1.993 | 2.092 | 2.198 | 2.299 | 2.401                  | 2.499 | 2.607 | 2.704 | 2.808 | 2.913 | 3.009 | 3.112 | 3.213 |
| 13.50   | 1.662 | 1.762 | 1.864 | 1.964 | 2.065 | 2.163 | 2.266 | 2.364                  | 2.466 | 2.564 | 2.664 | 2.765 | 2.867 | 2.968 | 3.068 | 3.166 |
| 14.00   | 1.640 | 1.739 | 1.836 | 1.937 | 2.034 | 2.133 | 2.234 | 2.334                  | 2.433 | 2.534 | 2.632 | 2.731 | 2.830 | 2.928 | 3.026 | 3.130 |
| 14.50   | 1.618 | 1.715 | 1.814 | 1.913 | 2.012 | 2.109 | 2.207 | 2.304                  | 2.401 | 2.499 | 2.594 | 2.697 | 2.793 | 2.890 | 2.992 | 3.085 |
| 15.00   | 1.599 | 1.696 | 1.794 | 1.890 | 1.986 | 2.084 | 2.180 | 2.276                  | 2.374 | 2.471 | 2.564 | 2.664 | 2.758 | 2.859 | 2.952 | 3.051 |
| 15.50   | 1.581 | 1.675 | 1.773 | 1.867 | 1.964 | 2.061 | 2.154 | 2.252                  | 2.344 | 2.444 | 2.540 | 2.632 | 2.731 | 2.822 | 2.920 | 3.017 |
| 16.00   | 1.565 | 1.657 | 1.753 | 1.848 | 1.944 | 2.038 | 2.133 | 2.225                  | 2.319 | 2.416 | 2.511 | 2.607 | 2.697 | 2.793 | 2.890 | 2.984 |
| 16.50   | 1.547 | 1.642 | 1.736 | 1.830 | 1.923 | 2.015 | 2.109 | 2.202                  | 2.299 | 2.390 | 2.482 | 2.576 | 2.671 | 2.765 | 2.859 | 2.952 |
| 17.00   | 1.534 | 1.625 | 1.720 | 1.811 | 1.906 | 1.997 | 2.088 | 2.185                  | 2.276 | 2.369 | 2.460 | 2.552 | 2.645 | 2.737 | 2.830 | 2.928 |
| 17.50   | 1.519 | 1.611 | 1.704 | 1.796 | 1.886 | 1.979 | 2.073 | 2.163                  | 2.257 | 2.349 | 2.438 | 2.534 | 2.626 | 2.717 | 2.808 | 2.897 |
| 18.00   | 1.507 | 1.597 | 1.688 | 1.779 | 1.870 | 1.961 | 2.053 | 2.146                  | 2.238 | 2.329 | 2.416 | 2.511 | 2.601 | 2.690 | 2.786 | 2.874 |
| 18.50   | 1.494 | 1.585 | 1.675 | 1.765 | 1.858 | 1.947 | 2.038 | 2.129                  | 2.220 | 2.309 | 2.401 | 2.488 | 2.582 | 2.671 | 2.758 | 2.852 |
| 19.00   | 1.482 | 1.572 | 1.662 | 1.753 | 1.842 | 1.930 | 2.023 | 2.113                  | 2.202 | 2.290 | 2.380 | 2.471 | 2.558 | 2.651 | 2.737 | 2.830 |
| 19.50   | 1.472 | 1.560 | 1.650 | 1.739 | 1.827 | 1.916 | 2.008 | 2.096                  | 2.185 | 2.276 | 2.364 | 2.449 | 2.540 | 2.632 | 2.717 | 2.808 |
| 20.00   | 1.462 | 1.549 | 1.638 | 1.726 | 1.814 | 1.903 | 1.993 | 2.080                  | 2.167 | 2.257 | 2.344 | 2.433 | 2.523 | 2.613 | 2.697 | 2.786 |

# CURVE INFORMATION AND TABLES



## Curve: Moderately Inverse

| Curve#: | 1                      | 2     | 3     | 4     | 5     | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     |
|---------|------------------------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| × P/U   |                        |       |       |       |       |        |        |        |        |        |        |        |        |        |        |        |
|         | Time to trip (seconds) |       |       |       |       |        |        |        |        |        |        |        |        |        |        |        |
| 1.03    | 2.049                  | 3.972 | 5.872 | 7.802 | 9.752 | 11.620 | 13.485 | 15.384 | 17.337 | 19.162 | 21.417 | 23.239 | 24.824 | 27.306 | 28.743 | 31.207 |
| 1.10    | 1.590                  | 3.077 | 4.570 | 6.035 | 7.533 | 9.027  | 10.502 | 12.003 | 13.485 | 14.962 | 16.549 | 17.906 | 19.504 | 21.005 | 22.291 | 23.745 |
| 1.20    | 1.211                  | 2.344 | 3.479 | 4.609 | 5.749 | 6.869  | 8.031  | 9.179  | 10.304 | 11.378 | 12.555 | 13.653 | 14.760 | 15.830 | 17.066 | 18.204 |
| 1.30    | 0.984                  | 1.906 | 2.822 | 3.741 | 4.668 | 5.601  | 6.501  | 7.430  | 8.338  | 9.256  | 10.208 | 11.145 | 12.003 | 13.003 | 13.826 | 14.760 |
| 1.40    | 0.833                  | 1.611 | 2.390 | 3.166 | 3.943 | 4.728  | 5.516  | 6.277  | 7.047  | 7.858  | 8.600  | 9.416  | 10.208 | 10.923 | 11.745 | 12.555 |
| 1.50    | 0.725                  | 1.402 | 2.080 | 2.758 | 3.435 | 4.122  | 4.791  | 5.461  | 6.136  | 6.827  | 7.481  | 8.212  | 8.880  | 9.581  | 10.208 | 10.923 |
| 1.60    | 0.644                  | 1.245 | 1.848 | 2.449 | 3.051 | 3.653  | 4.250  | 4.854  | 5.461  | 6.068  | 6.660  | 7.282  | 7.858  | 8.467  | 9.102  | 9.666  |
| 1.70    | 0.581                  | 1.124 | 1.668 | 2.211 | 2.751 | 3.300  | 3.846  | 4.387  | 4.920  | 5.461  | 6.001  | 6.540  | 7.093  | 7.638  | 8.212  | 8.738  |
| 1.80    | 0.530                  | 1.027 | 1.523 | 2.019 | 2.517 | 3.009  | 3.512  | 4.001  | 4.495  | 4.987  | 5.489  | 6.001  | 6.501  | 7.002  | 7.481  | 7.973  |
| 1.90    | 0.489                  | 0.946 | 1.404 | 1.861 | 2.319 | 2.779  | 3.232  | 3.690  | 4.153  | 4.609  | 5.057  | 5.516  | 5.969  | 6.425  | 6.913  | 7.331  |
| 2.00    | 0.455                  | 0.880 | 1.305 | 1.731 | 2.154 | 2.582  | 3.009  | 3.435  | 3.860  | 4.283  | 4.708  | 5.128  | 5.544  | 5.969  | 6.425  | 6.827  |
| 2.10    | 0.425                  | 0.824 | 1.222 | 1.621 | 2.019 | 2.416  | 2.815  | 3.213  | 3.605  | 4.016  | 4.404  | 4.812  | 5.201  | 5.601  | 6.001  | 6.387  |
| 2.20    | 0.401                  | 0.775 | 1.150 | 1.525 | 1.900 | 2.276  | 2.651  | 3.026  | 3.403  | 3.779  | 4.153  | 4.532  | 4.898  | 5.277  | 5.659  | 6.035  |
| 2.30    | 0.379                  | 0.734 | 1.088 | 1.443 | 1.796 | 2.150  | 2.505  | 2.859  | 3.213  | 3.569  | 3.929  | 4.283  | 4.628  | 4.987  | 5.354  | 5.689  |
| 2.40    | 0.360                  | 0.697 | 1.033 | 1.370 | 1.707 | 2.045  | 2.380  | 2.717  | 3.051  | 3.392  | 3.728  | 4.060  | 4.404  | 4.749  | 5.080  | 5.407  |
| 2.50    | 0.343                  | 0.665 | 0.986 | 1.307 | 1.628 | 1.950  | 2.271  | 2.594  | 2.913  | 3.232  | 3.558  | 3.873  | 4.201  | 4.513  | 4.833  | 5.152  |
| 2.60    | 0.328                  | 0.636 | 0.943 | 1.251 | 1.558 | 1.864  | 2.171  | 2.482  | 2.786  | 3.094  | 3.403  | 3.715  | 4.016  | 4.317  | 4.628  | 4.942  |
| 2.70    | 0.315                  | 0.610 | 0.905 | 1.200 | 1.494 | 1.791  | 2.084  | 2.380  | 2.677  | 2.968  | 3.260  | 3.558  | 3.860  | 4.153  | 4.440  | 4.749  |
| 2.80    | 0.303                  | 0.587 | 0.871 | 1.155 | 1.439 | 1.723  | 2.004  | 2.290  | 2.576  | 2.859  | 3.139  | 3.424  | 3.703  | 3.986  | 4.283  | 4.551  |
| 2.90    | 0.293                  | 0.566 | 0.840 | 1.113 | 1.388 | 1.660  | 1.933  | 2.207  | 2.482  | 2.758  | 3.026  | 3.300  | 3.581  | 3.846  | 4.122  | 4.404  |
| 3.00    | 0.283                  | 0.547 | 0.811 | 1.076 | 1.340 | 1.604  | 1.870  | 2.133  | 2.401  | 2.664  | 2.928  | 3.194  | 3.456  | 3.715  | 3.986  | 4.250  |
| 3.10    | 0.274                  | 0.530 | 0.786 | 1.042 | 1.297 | 1.554  | 1.811  | 2.065  | 2.324  | 2.576  | 2.837  | 3.094  | 3.350  | 3.605  | 3.860  | 4.122  |
| 3.20    | 0.265                  | 0.514 | 0.762 | 1.010 | 1.258 | 1.507  | 1.756  | 2.004  | 2.252  | 2.499  | 2.751  | 3.001  | 3.241  | 3.490  | 3.741  | 3.986  |
| 3.30    | 0.258                  | 0.499 | 0.741 | 0.981 | 1.223 | 1.464  | 1.707  | 1.947  | 2.189  | 2.427  | 2.671  | 2.913  | 3.157  | 3.392  | 3.641  | 3.873  |
| 3.40    | 0.251                  | 0.486 | 0.720 | 0.956 | 1.190 | 1.424  | 1.660  | 1.893  | 2.129  | 2.364  | 2.601  | 2.830  | 3.068  | 3.300  | 3.535  | 3.766  |
| 3.50    | 0.244                  | 0.473 | 0.702 | 0.930 | 1.160 | 1.388  | 1.616  | 1.845  | 2.073  | 2.304  | 2.534  | 2.758  | 2.992  | 3.222  | 3.446  | 3.678  |
| 3.60    | 0.238                  | 0.462 | 0.685 | 0.908 | 1.131 | 1.353  | 1.576  | 1.799  | 2.023  | 2.247  | 2.471  | 2.690  | 2.913  | 3.139  | 3.361  | 3.581  |
| 3.70    | 0.233                  | 0.451 | 0.668 | 0.887 | 1.104 | 1.322  | 1.541  | 1.759  | 1.975  | 2.193  | 2.411  | 2.632  | 2.844  | 3.068  | 3.280  | 3.501  |
| 3.80    | 0.228                  | 0.441 | 0.654 | 0.867 | 1.079 | 1.293  | 1.507  | 1.717  | 1.933  | 2.146  | 2.359  | 2.570  | 2.786  | 2.992  | 3.213  | 3.424  |
| 3.90    | 0.223                  | 0.431 | 0.639 | 0.848 | 1.056 | 1.264  | 1.474  | 1.683  | 1.890  | 2.100  | 2.309  | 2.517  | 2.724  | 2.928  | 3.139  | 3.350  |
| 4.00    | 0.218                  | 0.422 | 0.627 | 0.831 | 1.034 | 1.238  | 1.443  | 1.647  | 1.851  | 2.057  | 2.261  | 2.466  | 2.671  | 2.874  | 3.077  | 3.280  |
| 4.10    | 0.214                  | 0.414 | 0.614 | 0.815 | 1.014 | 1.215  | 1.415  | 1.616  | 1.814  | 2.015  | 2.216  | 2.416  | 2.613  | 2.815  | 3.017  | 3.213  |
| 4.20    | 0.210                  | 0.406 | 0.602 | 0.799 | 0.995 | 1.191  | 1.388  | 1.585  | 1.782  | 1.975  | 2.171  | 2.369  | 2.564  | 2.765  | 2.960  | 3.157  |
| 4.30    | 0.206                  | 0.399 | 0.592 | 0.784 | 0.977 | 1.169  | 1.362  | 1.556  | 1.748  | 1.940  | 2.133  | 2.324  | 2.517  | 2.710  | 2.905  | 3.094  |
| 4.40    | 0.202                  | 0.392 | 0.581 | 0.771 | 0.960 | 1.150  | 1.339  | 1.528  | 1.717  | 1.906  | 2.096  | 2.285  | 2.477  | 2.664  | 2.852  | 3.042  |
| 4.50    | 0.199                  | 0.385 | 0.572 | 0.757 | 0.944 | 1.130  | 1.316  | 1.502  | 1.688  | 1.873  | 2.061  | 2.247  | 2.433  | 2.619  | 2.808  | 2.992  |
| 4.60    | 0.196                  | 0.379 | 0.562 | 0.746 | 0.929 | 1.112  | 1.294  | 1.478  | 1.662  | 1.845  | 2.026  | 2.211  | 2.395  | 2.576  | 2.758  | 2.944  |
| 4.70    | 0.193                  | 0.373 | 0.553 | 0.734 | 0.914 | 1.094  | 1.275  | 1.454  | 1.635  | 1.814  | 1.997  | 2.176  | 2.354  | 2.534  | 2.717  | 2.897  |
| 4.80    | 0.190                  | 0.367 | 0.545 | 0.722 | 0.900 | 1.078  | 1.255  | 1.433  | 1.611  | 1.788  | 1.964  | 2.142  | 2.319  | 2.499  | 2.677  | 2.852  |
| 4.90    | 0.187                  | 0.362 | 0.537 | 0.712 | 0.887 | 1.063  | 1.237  | 1.413  | 1.588  | 1.762  | 1.937  | 2.113  | 2.285  | 2.460  | 2.638  | 2.815  |
| 5.00    | 0.184                  | 0.357 | 0.529 | 0.702 | 0.874 | 1.047  | 1.219  | 1.391  | 1.565  | 1.736  | 1.910  | 2.080  | 2.257  | 2.427  | 2.601  | 2.772  |
| 5.10    | 0.182                  | 0.352 | 0.522 | 0.693 | 0.863 | 1.032  | 1.203  | 1.374  | 1.543  | 1.715  | 1.883  | 2.053  | 2.225  | 2.395  | 2.564  | 2.737  |
| 5.20    | 0.180                  | 0.348 | 0.515 | 0.684 | 0.851 | 1.019  | 1.187  | 1.355  | 1.523  | 1.691  | 1.858  | 2.026  | 2.193  | 2.364  | 2.528  | 2.697  |
| 5.30    | 0.177                  | 0.343 | 0.509 | 0.675 | 0.840 | 1.006  | 1.172  | 1.339  | 1.504  | 1.670  | 1.836  | 2.000  | 2.167  | 2.334  | 2.499  | 2.664  |
| 5.40    | 0.175                  | 0.339 | 0.502 | 0.666 | 0.830 | 0.994  | 1.157  | 1.321  | 1.484  | 1.650  | 1.811  | 1.975  | 2.142  | 2.304  | 2.466  | 2.632  |
| 5.50    | 0.173                  | 0.335 | 0.496 | 0.658 | 0.820 | 0.982  | 1.144  | 1.305  | 1.468  | 1.628  | 1.791  | 1.954  | 2.113  | 2.276  | 2.438  | 2.601  |
| 5.60    | 0.171                  | 0.331 | 0.491 | 0.651 | 0.810 | 0.970  | 1.131  | 1.290  | 1.451  | 1.611  | 1.770  | 1.930  | 2.088  | 2.247  | 2.411  | 2.570  |
| 5.70    | 0.169                  | 0.327 | 0.485 | 0.643 | 0.801 | 0.960  | 1.118  | 1.276  | 1.433  | 1.592  | 1.750  | 1.910  | 2.065  | 2.225  | 2.385  | 2.540  |
| 5.80    | 0.167                  | 0.324 | 0.480 | 0.636 | 0.793 | 0.949  | 1.106  | 1.261  | 1.419  | 1.574  | 1.731  | 1.886  | 2.042  | 2.198  | 2.354  | 2.511  |
| 5.90    | 0.165                  | 0.320 | 0.475 | 0.630 | 0.784 | 0.939  | 1.093  | 1.248  | 1.402  | 1.558  | 1.712  | 1.867  | 2.023  | 2.176  | 2.329  | 2.488  |
| 6.00    | 0.164                  | 0.317 | 0.470 | 0.623 | 0.776 | 0.929  | 1.083  | 1.236  | 1.388  | 1.541  | 1.693  | 1.848  | 2.000  | 2.154  | 2.309  | 2.460  |
| 6.50    | 0.156                  | 0.302 | 0.448 | 0.594 | 0.740 | 0.886  | 1.031  | 1.177  | 1.324  | 1.470  | 1.616  | 1.762  | 1.906  | 2.053  | 2.198  | 2.344  |
| 7.00    | 0.150                  | 0.289 | 0.429 | 0.569 | 0.709 | 0.849  | 0.989  | 1.130  | 1.269  | 1.409  | 1.549  | 1.688  | 1.830  | 1.968  | 2.109  | 2.247  |
| 7.50    | 0.144                  | 0.279 | 0.414 | 0.549 | 0.684 | 0.818  | 0.953  | 1.088  | 1.223  | 1.357  | 1.492  | 1.628  | 1.762  | 1.896  | 2.030  | 2.167  |
| 8.00    | 0.139                  | 0.270 | 0.400 | 0.531 | 0.661 | 0.791  | 0.922  | 1.052  | 1.182  | 1.313  | 1.443  | 1.574  | 1.704  | 1.836  | 1.964  | 2.096  |
| 8.50    | 0.135                  | 0.262 | 0.388 | 0.515 | 0.642 | 0.768  | 0.895  | 1.022  | 1.149  | 1.275  | 1.400  | 1.528  | 1.655  | 1.782  | 1.906  | 2.034  |
| 9.00    | 0.132                  | 0.255 | 0.378 | 0.501 | 0.624 | 0.748  | 0.871  | 0.994  | 1.118  | 1.241  | 1.364  | 1.488  | 1.611  | 1.734  | 1.858  | 1.979  |
| 9.50    | 0.129                  | 0.249 | 0.369 | 0.489 | 0.610 | 0.730  | 0.850  | 0.970  | 1.090  | 1.211  | 1.330  | 1.451  | 1.572  | 1.691  | 1.811  | 1.933  |
| 10.00   | 0.126                  | 0.243 | 0.361 | 0.478 | 0.596 | 0.713  | 0.831  | 0.949  | 1.067  | 1.183  | 1.302  | 1.419  | 1.536  | 1.655  | 1.773  | 1.890  |
| 10.50   | 0.123                  | 0.238 | 0.354 | 0.469 | 0.584 | 0.699  | 0.815  | 0.930  | 1.045  | 1.160  | 1.275  | 1.390  | 1.507  | 1.621  | 1.736  | 1.851  |
| 11.00   | 0.121                  | 0.234 | 0.347 | 0.460 | 0.573 | 0.686  | 0.799  | 0.912  | 1.026  | 1.139  | 1.251  | 1.365  | 1.478  | 1.590  | 1.704  | 1.817  |
| 11.50   | 0.119                  | 0.230 | 0.341 | 0.452 | 0.563 | 0.674  | 0.785  | 0.897  | 1.008  | 1.119  | 1.230  | 1.342  | 1.452  | 1.563  | 1.675  | 1.785  |
| 12.00   | 0.117                  | 0.226 | 0.336 | 0.445 | 0.554 | 0.664  | 0.773  | 0.882  | 0.992  | 1.101  | 1.211  | 1.319  | 1.430  | 1.538  | 1.647  | 1.756  |
| 12.50   | 0.115                  | 0.223 | 0.331 | 0.438 | 0.546 | 0.654  | 0.762  | 0.869  | 0.977  | 1.085  | 1.192  | 1.300  | 1.408  | 1.515  | 1.623  | 1.731  |

**Curve: Moderately Inverse**

| Curve#: | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8                      | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|---------|-------|-------|-------|-------|-------|-------|-------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| × P/U   |       |       |       |       |       |       |       | Time to trip (seconds) |       |       |       |       |       |       |       |       |
| 13.00   | 0.114 | 0.220 | 0.326 | 0.432 | 0.539 | 0.645 | 0.751 | 0.857                  | 0.963 | 1.070 | 1.176 | 1.282 | 1.388 | 1.494 | 1.602 | 1.707 |
| 13.50   | 0.112 | 0.217 | 0.322 | 0.427 | 0.532 | 0.637 | 0.742 | 0.846                  | 0.951 | 1.056 | 1.161 | 1.266 | 1.370 | 1.476 | 1.581 | 1.686 |
| 14.00   | 0.111 | 0.214 | 0.318 | 0.422 | 0.525 | 0.629 | 0.733 | 0.836                  | 0.939 | 1.043 | 1.147 | 1.250 | 1.353 | 1.458 | 1.560 | 1.665 |
| 14.50   | 0.109 | 0.212 | 0.314 | 0.417 | 0.519 | 0.622 | 0.724 | 0.826                  | 0.929 | 1.031 | 1.134 | 1.236 | 1.339 | 1.441 | 1.543 | 1.645 |
| 15.00   | 0.108 | 0.210 | 0.311 | 0.412 | 0.514 | 0.615 | 0.716 | 0.818                  | 0.919 | 1.021 | 1.121 | 1.223 | 1.324 | 1.426 | 1.528 | 1.628 |
| 15.50   | 0.107 | 0.208 | 0.308 | 0.408 | 0.508 | 0.609 | 0.709 | 0.810                  | 0.909 | 1.010 | 1.110 | 1.211 | 1.311 | 1.411 | 1.511 | 1.611 |
| 16.00   | 0.106 | 0.206 | 0.305 | 0.404 | 0.504 | 0.603 | 0.702 | 0.802                  | 0.901 | 1.000 | 1.100 | 1.199 | 1.299 | 1.399 | 1.498 | 1.597 |
| 16.50   | 0.105 | 0.204 | 0.302 | 0.401 | 0.499 | 0.598 | 0.696 | 0.794                  | 0.893 | 0.991 | 1.090 | 1.189 | 1.287 | 1.386 | 1.484 | 1.583 |
| 17.00   | 0.104 | 0.202 | 0.300 | 0.397 | 0.495 | 0.593 | 0.690 | 0.788                  | 0.886 | 0.983 | 1.080 | 1.178 | 1.276 | 1.374 | 1.472 | 1.569 |
| 17.50   | 0.104 | 0.200 | 0.297 | 0.394 | 0.491 | 0.588 | 0.685 | 0.781                  | 0.879 | 0.975 | 1.072 | 1.169 | 1.266 | 1.362 | 1.460 | 1.556 |
| 18.00   | 0.103 | 0.199 | 0.295 | 0.391 | 0.487 | 0.583 | 0.679 | 0.776                  | 0.872 | 0.967 | 1.064 | 1.160 | 1.257 | 1.352 | 1.449 | 1.545 |
| 18.50   | 0.102 | 0.197 | 0.293 | 0.388 | 0.484 | 0.579 | 0.675 | 0.770                  | 0.865 | 0.961 | 1.056 | 1.152 | 1.247 | 1.342 | 1.437 | 1.534 |
| 19.00   | 0.101 | 0.196 | 0.291 | 0.386 | 0.480 | 0.575 | 0.670 | 0.765                  | 0.859 | 0.954 | 1.049 | 1.144 | 1.238 | 1.334 | 1.428 | 1.523 |
| 19.50   | 0.101 | 0.195 | 0.289 | 0.383 | 0.477 | 0.571 | 0.666 | 0.760                  | 0.854 | 0.948 | 1.042 | 1.137 | 1.230 | 1.324 | 1.419 | 1.513 |
| 20.00   | 0.100 | 0.194 | 0.287 | 0.381 | 0.474 | 0.568 | 0.661 | 0.755                  | 0.849 | 0.942 | 1.035 | 1.130 | 1.223 | 1.316 | 1.409 | 1.502 |

# CURVE INFORMATION AND TABLES



## Curve: Moderately Inverse

| Curve#: | 17                     | 18     | 19     | 20     | 21     | 22     | 23     | 24     | 25     | 26     | 27     | 28     | 29     | 30     | 31     | 32     |
|---------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| × P/U   | Time to trip (seconds) |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 1.03    | 33.098                 | 34.133 | 36.408 | 39.009 | 40.454 | 42.010 | 43.690 | 45.510 | 47.489 | 49.648 | 52.012 | 54.613 | 54.613 | 57.487 | 60.681 | 60.681 |
| 1.10    | 25.401                 | 26.640 | 28.006 | 29.520 | 31.207 | 33.098 | 34.133 | 35.234 | 37.664 | 39.009 | 40.454 | 42.010 | 43.690 | 45.510 | 45.510 | 47.489 |
| 1.20    | 19.504                 | 20.608 | 21.417 | 22.755 | 23.745 | 24.824 | 26.006 | 27.306 | 28.743 | 29.520 | 30.340 | 32.125 | 33.098 | 34.133 | 35.234 | 36.408 |
| 1.30    | 15.604                 | 16.549 | 17.617 | 18.513 | 19.504 | 20.227 | 21.417 | 22.291 | 23.239 | 23.745 | 24.824 | 26.006 | 26.640 | 28.006 | 28.743 | 29.520 |
| 1.40    | 13.320                 | 14.003 | 14.760 | 15.604 | 16.302 | 17.066 | 17.906 | 18.832 | 19.504 | 20.227 | 21.005 | 21.845 | 22.755 | 23.239 | 24.272 | 24.824 |
| 1.50    | 11.620                 | 12.272 | 13.003 | 13.653 | 14.372 | 14.962 | 15.604 | 16.302 | 17.066 | 17.617 | 18.204 | 19.162 | 19.859 | 20.227 | 21.005 | 21.845 |
| 1.60    | 10.304                 | 10.923 | 11.497 | 12.136 | 12.701 | 13.320 | 13.826 | 14.563 | 15.170 | 15.604 | 16.302 | 16.804 | 17.617 | 18.204 | 18.832 | 19.162 |
| 1.70    | 9.256                  | 9.840  | 10.402 | 10.923 | 11.497 | 12.003 | 12.555 | 13.003 | 13.653 | 14.185 | 14.760 | 15.170 | 15.830 | 16.302 | 16.804 | 17.337 |
| 1.80    | 8.467                  | 8.953  | 9.498  | 9.930  | 10.402 | 10.923 | 11.497 | 12.003 | 12.412 | 13.003 | 13.485 | 14.003 | 14.372 | 14.962 | 15.384 | 15.830 |
| 1.90    | 7.802                  | 8.275  | 8.738  | 9.179  | 9.666  | 10.113 | 10.604 | 11.033 | 11.497 | 11.872 | 12.412 | 12.850 | 13.320 | 13.826 | 14.185 | 14.760 |
| 2.00    | 7.282                  | 7.692  | 8.091  | 8.533  | 8.953  | 9.416  | 9.840  | 10.208 | 10.708 | 11.033 | 11.497 | 12.003 | 12.412 | 12.850 | 13.160 | 13.653 |
| 2.10    | 6.784                  | 7.186  | 7.585  | 7.973  | 8.402  | 8.808  | 9.179  | 9.581  | 10.021 | 10.402 | 10.814 | 11.145 | 11.620 | 12.003 | 12.412 | 12.701 |
| 2.20    | 6.387                  | 6.784  | 7.139  | 7.533  | 7.915  | 8.275  | 8.669  | 9.027  | 9.416  | 9.752  | 10.113 | 10.502 | 10.923 | 11.260 | 11.620 | 12.003 |
| 2.30    | 6.068                  | 6.387  | 6.742  | 7.093  | 7.481  | 7.802  | 8.151  | 8.533  | 8.880  | 9.256  | 9.581  | 9.930  | 10.304 | 10.708 | 11.033 | 11.378 |
| 2.40    | 5.749                  | 6.102  | 6.425  | 6.742  | 7.093  | 7.430  | 7.746  | 8.091  | 8.467  | 8.808  | 9.102  | 9.416  | 9.752  | 10.113 | 10.502 | 10.814 |
| 2.50    | 5.489                  | 5.810  | 6.136  | 6.463  | 6.784  | 7.093  | 7.430  | 7.746  | 8.031  | 8.402  | 8.669  | 9.027  | 9.335  | 9.666  | 10.021 | 10.304 |
| 2.60    | 5.251                  | 5.544  | 5.872  | 6.171  | 6.463  | 6.784  | 7.093  | 7.380  | 7.692  | 8.031  | 8.338  | 8.600  | 8.953  | 9.256  | 9.581  | 9.840  |
| 2.70    | 5.033                  | 5.328  | 5.630  | 5.904  | 6.206  | 6.501  | 6.784  | 7.093  | 7.380  | 7.692  | 7.973  | 8.275  | 8.600  | 8.880  | 9.179  | 9.498  |
| 2.80    | 4.833                  | 5.128  | 5.407  | 5.689  | 5.969  | 6.277  | 6.540  | 6.827  | 7.093  | 7.380  | 7.692  | 7.973  | 8.275  | 8.533  | 8.808  | 9.102  |
| 2.90    | 4.668                  | 4.942  | 5.226  | 5.489  | 5.779  | 6.035  | 6.314  | 6.580  | 6.869  | 7.139  | 7.430  | 7.692  | 7.973  | 8.212  | 8.533  | 8.808  |
| 3.00    | 4.513                  | 4.770  | 5.033  | 5.302  | 5.573  | 5.841  | 6.102  | 6.350  | 6.620  | 6.913  | 7.139  | 7.430  | 7.692  | 7.973  | 8.212  | 8.467  |
| 3.10    | 4.369                  | 4.628  | 4.876  | 5.128  | 5.407  | 5.659  | 5.904  | 6.171  | 6.425  | 6.660  | 6.913  | 7.186  | 7.430  | 7.692  | 7.973  | 8.212  |
| 3.20    | 4.234                  | 4.495  | 4.728  | 4.987  | 5.226  | 5.489  | 5.719  | 5.969  | 6.241  | 6.463  | 6.742  | 6.957  | 7.233  | 7.481  | 7.692  | 7.973  |
| 3.30    | 4.122                  | 4.352  | 4.609  | 4.833  | 5.080  | 5.328  | 5.573  | 5.810  | 6.035  | 6.277  | 6.540  | 6.784  | 7.002  | 7.233  | 7.481  | 7.746  |
| 3.40    | 4.001                  | 4.250  | 4.476  | 4.708  | 4.942  | 5.177  | 5.407  | 5.659  | 5.872  | 6.136  | 6.350  | 6.580  | 6.827  | 7.047  | 7.282  | 7.533  |
| 3.50    | 3.901                  | 4.137  | 4.369  | 4.589  | 4.812  | 5.057  | 5.277  | 5.516  | 5.719  | 5.969  | 6.206  | 6.425  | 6.660  | 6.869  | 7.093  | 7.331  |
| 3.60    | 3.806                  | 4.030  | 4.250  | 4.476  | 4.708  | 4.920  | 5.152  | 5.381  | 5.601  | 5.810  | 6.035  | 6.277  | 6.501  | 6.701  | 6.913  | 7.139  |
| 3.70    | 3.715                  | 3.943  | 4.153  | 4.369  | 4.589  | 4.812  | 5.033  | 5.251  | 5.461  | 5.689  | 5.904  | 6.102  | 6.350  | 6.540  | 6.784  | 7.002  |
| 3.80    | 3.641                  | 3.846  | 4.060  | 4.267  | 4.495  | 4.708  | 4.920  | 5.128  | 5.328  | 5.544  | 5.779  | 5.969  | 6.206  | 6.387  | 6.620  | 6.827  |
| 3.90    | 3.558                  | 3.766  | 3.972  | 4.185  | 4.387  | 4.609  | 4.812  | 5.010  | 5.226  | 5.434  | 5.630  | 5.841  | 6.068  | 6.277  | 6.463  | 6.701  |
| 4.00    | 3.490                  | 3.690  | 3.887  | 4.091  | 4.300  | 4.513  | 4.708  | 4.920  | 5.128  | 5.328  | 5.516  | 5.719  | 5.936  | 6.136  | 6.350  | 6.540  |
| 4.10    | 3.413                  | 3.617  | 3.819  | 4.016  | 4.217  | 4.422  | 4.609  | 4.812  | 5.010  | 5.226  | 5.407  | 5.630  | 5.810  | 6.001  | 6.206  | 6.425  |
| 4.20    | 3.350                  | 3.546  | 3.741  | 3.943  | 4.137  | 4.334  | 4.532  | 4.728  | 4.920  | 5.128  | 5.302  | 5.516  | 5.719  | 5.904  | 6.102  | 6.314  |
| 4.30    | 3.290                  | 3.479  | 3.678  | 3.873  | 4.060  | 4.250  | 4.440  | 4.648  | 4.833  | 5.033  | 5.226  | 5.407  | 5.601  | 5.810  | 6.001  | 6.171  |
| 4.40    | 3.232                  | 3.424  | 3.617  | 3.806  | 3.986  | 4.185  | 4.369  | 4.551  | 4.749  | 4.942  | 5.128  | 5.328  | 5.516  | 5.689  | 5.872  | 6.068  |
| 4.50    | 3.175                  | 3.361  | 3.546  | 3.741  | 3.929  | 4.106  | 4.300  | 4.476  | 4.668  | 4.854  | 5.033  | 5.226  | 5.407  | 5.601  | 5.779  | 5.969  |
| 4.60    | 3.130                  | 3.310  | 3.490  | 3.678  | 3.860  | 4.045  | 4.234  | 4.404  | 4.589  | 4.770  | 4.965  | 5.152  | 5.328  | 5.516  | 5.689  | 5.872  |
| 4.70    | 3.077                  | 3.260  | 3.435  | 3.617  | 3.793  | 3.986  | 4.153  | 4.334  | 4.513  | 4.708  | 4.876  | 5.057  | 5.251  | 5.434  | 5.601  | 5.779  |
| 4.80    | 3.034                  | 3.213  | 3.382  | 3.569  | 3.741  | 3.915  | 4.091  | 4.267  | 4.458  | 4.628  | 4.812  | 4.987  | 5.152  | 5.328  | 5.516  | 5.689  |
| 4.90    | 2.984                  | 3.166  | 3.340  | 3.512  | 3.690  | 3.860  | 4.030  | 4.217  | 4.387  | 4.570  | 4.728  | 4.920  | 5.080  | 5.251  | 5.434  | 5.601  |
| 5.00    | 2.944                  | 3.121  | 3.290  | 3.467  | 3.641  | 3.806  | 3.986  | 4.153  | 4.317  | 4.495  | 4.668  | 4.833  | 5.010  | 5.177  | 5.354  | 5.544  |
| 5.10    | 2.905                  | 3.077  | 3.241  | 3.413  | 3.581  | 3.753  | 3.929  | 4.091  | 4.267  | 4.440  | 4.609  | 4.770  | 4.942  | 5.128  | 5.277  | 5.461  |
| 5.20    | 2.867                  | 3.034  | 3.203  | 3.371  | 3.535  | 3.703  | 3.873  | 4.045  | 4.217  | 4.387  | 4.551  | 4.708  | 4.876  | 5.057  | 5.226  | 5.381  |
| 5.30    | 2.830                  | 2.992  | 3.166  | 3.330  | 3.490  | 3.653  | 3.819  | 3.986  | 4.153  | 4.317  | 4.495  | 4.648  | 4.812  | 4.987  | 5.152  | 5.328  |
| 5.40    | 2.793                  | 2.960  | 3.121  | 3.290  | 3.446  | 3.617  | 3.779  | 3.943  | 4.106  | 4.267  | 4.440  | 4.589  | 4.770  | 4.920  | 5.080  | 5.251  |
| 5.50    | 2.758                  | 2.920  | 3.085  | 3.251  | 3.413  | 3.569  | 3.728  | 3.887  | 4.060  | 4.217  | 4.387  | 4.532  | 4.708  | 4.854  | 5.033  | 5.177  |
| 5.60    | 2.731                  | 2.890  | 3.051  | 3.213  | 3.371  | 3.523  | 3.690  | 3.846  | 4.016  | 4.169  | 4.334  | 4.495  | 4.648  | 4.812  | 4.965  | 5.128  |
| 5.70    | 2.697                  | 2.859  | 3.017  | 3.175  | 3.330  | 3.490  | 3.653  | 3.806  | 3.957  | 4.122  | 4.283  | 4.440  | 4.589  | 4.749  | 4.920  | 5.080  |
| 5.80    | 2.671                  | 2.822  | 2.984  | 3.139  | 3.290  | 3.446  | 3.605  | 3.766  | 3.915  | 4.076  | 4.234  | 4.387  | 4.551  | 4.708  | 4.854  | 5.010  |
| 5.90    | 2.638                  | 2.793  | 2.952  | 3.103  | 3.260  | 3.413  | 3.569  | 3.728  | 3.873  | 4.030  | 4.185  | 4.334  | 4.495  | 4.648  | 4.812  | 4.965  |
| 6.00    | 2.613                  | 2.765  | 2.920  | 3.068  | 3.222  | 3.382  | 3.535  | 3.690  | 3.832  | 3.986  | 4.137  | 4.300  | 4.458  | 4.609  | 4.749  | 4.920  |
| 6.50    | 2.494                  | 2.638  | 2.779  | 2.928  | 3.077  | 3.222  | 3.371  | 3.512  | 3.653  | 3.806  | 3.943  | 4.091  | 4.250  | 4.387  | 4.532  | 4.688  |
| 7.00    | 2.390                  | 2.528  | 2.671  | 2.808  | 2.944  | 3.085  | 3.232  | 3.371  | 3.512  | 3.653  | 3.793  | 3.929  | 4.060  | 4.201  | 4.352  | 4.495  |
| 7.50    | 2.299                  | 2.438  | 2.570  | 2.704  | 2.837  | 2.976  | 3.112  | 3.241  | 3.382  | 3.512  | 3.653  | 3.779  | 3.915  | 4.060  | 4.185  | 4.317  |
| 8.00    | 2.225                  | 2.354  | 2.488  | 2.619  | 2.744  | 2.874  | 3.009  | 3.139  | 3.270  | 3.403  | 3.535  | 3.665  | 3.793  | 3.915  | 4.045  | 4.185  |
| 8.50    | 2.159                  | 2.285  | 2.411  | 2.540  | 2.664  | 2.793  | 2.920  | 3.042  | 3.175  | 3.300  | 3.424  | 3.558  | 3.678  | 3.806  | 3.929  | 4.060  |
| 9.00    | 2.105                  | 2.225  | 2.349  | 2.471  | 2.594  | 2.717  | 2.844  | 2.968  | 3.085  | 3.213  | 3.340  | 3.456  | 3.581  | 3.703  | 3.832  | 3.957  |
| 9.50    | 2.053                  | 2.171  | 2.295  | 2.411  | 2.534  | 2.651  | 2.772  | 2.897  | 3.017  | 3.139  | 3.251  | 3.371  | 3.501  | 3.617  | 3.741  | 3.860  |
| 10.00   | 2.008                  | 2.125  | 2.243  | 2.359  | 2.477  | 2.594  | 2.710  | 2.830  | 2.944  | 3.068  | 3.184  | 3.300  | 3.413  | 3.535  | 3.653  | 3.766  |
| 10.50   | 1.968                  | 2.080  | 2.198  | 2.314  | 2.427  | 2.540  | 2.658  | 2.772  | 2.890  | 3.001  | 3.121  | 3.232  | 3.350  | 3.467  | 3.581  | 3.690  |
| 11.00   | 1.930                  | 2.042  | 2.154  | 2.271  | 2.380  | 2.494  | 2.607  | 2.724  | 2.837  | 2.944  | 3.060  | 3.175  | 3.290  | 3.403  | 3.512  | 3.629  |
| 11.50   | 1.896                  | 2.008  | 2.121  | 2.229  | 2.339  | 2.454  | 2.564  | 2.677  | 2.786  | 2.897  | 3.009  | 3.121  | 3.232  | 3.340  | 3.456  | 3.558  |
| 12.00   | 1.867                  | 1.975  | 2.084  | 2.193  | 2.304  | 2.411  | 2.523  | 2.632  | 2.744  | 2.852  | 2.960  | 3.068  | 3.175  | 3.290  | 3.392  | 3.512  |
| 12.50   | 1.839                  | 1.947  | 2.053  | 2.163  | 2.271  | 2.380  | 2.482  | 2.594  | 2.704  | 2.808  | 2.913  | 3.026  | 3.130  | 3.241  | 3.350  | 3.456  |

**Curve: Moderately Inverse**

| Curve#:<br>× P/U | 17                     | 18    | 19    | 20    | 21    | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.00            | 1.814                  | 1.920 | 2.026 | 2.133 | 2.238 | 2.344 | 2.449 | 2.558 | 2.664 | 2.772 | 2.874 | 2.984 | 3.085 | 3.194 | 3.300 | 3.403 |
| 13.50            | 1.791                  | 1.896 | 2.000 | 2.105 | 2.211 | 2.314 | 2.422 | 2.523 | 2.632 | 2.731 | 2.837 | 2.944 | 3.051 | 3.157 | 3.260 | 3.361 |
| 14.00            | 1.767                  | 1.873 | 1.975 | 2.080 | 2.185 | 2.285 | 2.390 | 2.494 | 2.594 | 2.704 | 2.808 | 2.905 | 3.009 | 3.112 | 3.222 | 3.320 |
| 14.50            | 1.748                  | 1.851 | 1.954 | 2.057 | 2.159 | 2.261 | 2.364 | 2.466 | 2.570 | 2.671 | 2.772 | 2.874 | 2.976 | 3.077 | 3.184 | 3.280 |
| 15.00            | 1.731                  | 1.830 | 1.933 | 2.034 | 2.133 | 2.238 | 2.339 | 2.438 | 2.540 | 2.645 | 2.744 | 2.844 | 2.944 | 3.051 | 3.148 | 3.251 |
| 15.50            | 1.712                  | 1.811 | 1.913 | 2.012 | 2.113 | 2.216 | 2.314 | 2.416 | 2.517 | 2.613 | 2.717 | 2.815 | 2.913 | 3.017 | 3.121 | 3.213 |
| 16.00            | 1.696                  | 1.796 | 1.896 | 1.993 | 2.092 | 2.193 | 2.295 | 2.390 | 2.494 | 2.588 | 2.690 | 2.786 | 2.890 | 2.984 | 3.085 | 3.184 |
| 16.50            | 1.680                  | 1.779 | 1.877 | 1.975 | 2.077 | 2.171 | 2.271 | 2.369 | 2.471 | 2.570 | 2.664 | 2.765 | 2.859 | 2.960 | 3.060 | 3.157 |
| 17.00            | 1.668                  | 1.765 | 1.861 | 1.961 | 2.057 | 2.154 | 2.252 | 2.349 | 2.449 | 2.546 | 2.645 | 2.737 | 2.837 | 2.936 | 3.034 | 3.130 |
| 17.50            | 1.652                  | 1.750 | 1.848 | 1.944 | 2.042 | 2.137 | 2.234 | 2.329 | 2.427 | 2.523 | 2.619 | 2.717 | 2.815 | 2.913 | 3.009 | 3.103 |
| 18.00            | 1.640                  | 1.736 | 1.833 | 1.930 | 2.026 | 2.121 | 2.216 | 2.314 | 2.411 | 2.505 | 2.601 | 2.697 | 2.793 | 2.890 | 2.984 | 3.085 |
| 18.50            | 1.628                  | 1.726 | 1.820 | 1.916 | 2.012 | 2.105 | 2.202 | 2.295 | 2.390 | 2.488 | 2.582 | 2.677 | 2.772 | 2.867 | 2.968 | 3.060 |
| 19.00            | 1.618                  | 1.712 | 1.808 | 1.903 | 1.997 | 2.092 | 2.185 | 2.280 | 2.374 | 2.471 | 2.564 | 2.658 | 2.751 | 2.852 | 2.944 | 3.042 |
| 19.50            | 1.606                  | 1.701 | 1.796 | 1.890 | 1.982 | 2.077 | 2.171 | 2.266 | 2.359 | 2.454 | 2.546 | 2.645 | 2.737 | 2.830 | 2.928 | 3.017 |
| 20.00            | 1.597                  | 1.691 | 1.785 | 1.877 | 1.972 | 2.065 | 2.159 | 2.252 | 2.344 | 2.438 | 2.534 | 2.626 | 2.717 | 2.815 | 2.905 | 3.001 |

# CURVE INFORMATION AND TABLES



## Curve: Very Inverse

| Curve#: | 1                      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16      |
|---------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| × P/U   |                        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |
|         | Time to trip (seconds) |        |        |        |        |        |        |        |        |        |        |        |        |        |        |         |
| 1.03    | 4.422                  | 11.497 | 18.513 | 25.401 | 33.098 | 40.454 | 47.489 | 54.613 | 60.681 | 68.266 | 72.817 | 84.019 | 91.021 | 99.295 | 99.295 | 109.225 |
| 1.10    | 1.340                  | 3.490  | 5.630  | 7.802  | 9.930  | 12.136 | 14.185 | 16.302 | 18.513 | 20.608 | 22.755 | 24.824 | 27.306 | 29.520 | 31.207 | 33.098  |
| 1.20    | 0.680                  | 1.770  | 2.859  | 3.943  | 5.033  | 6.136  | 7.233  | 8.338  | 9.416  | 10.502 | 11.620 | 12.701 | 13.826 | 14.760 | 15.830 | 17.066  |
| 1.30    | 0.460                  | 1.198  | 1.933  | 2.671  | 3.413  | 4.153  | 4.876  | 5.630  | 6.350  | 7.093  | 7.858  | 8.600  | 9.335  | 10.021 | 10.814 | 11.497  |
| 1.40    | 0.350                  | 0.911  | 1.472  | 2.034  | 2.594  | 3.157  | 3.715  | 4.283  | 4.833  | 5.407  | 5.969  | 6.540  | 7.093  | 7.638  | 8.212  | 8.738   |
| 1.50    | 0.284                  | 0.740  | 1.195  | 1.650  | 2.105  | 2.558  | 3.017  | 3.467  | 3.929  | 4.387  | 4.833  | 5.302  | 5.749  | 6.206  | 6.660  | 7.093   |
| 1.60    | 0.240                  | 0.625  | 1.009  | 1.395  | 1.779  | 2.163  | 2.546  | 2.936  | 3.320  | 3.703  | 4.091  | 4.476  | 4.854  | 5.251  | 5.630  | 6.001   |
| 1.70    | 0.209                  | 0.543  | 0.877  | 1.212  | 1.547  | 1.880  | 2.216  | 2.552  | 2.882  | 3.222  | 3.558  | 3.887  | 4.217  | 4.551  | 4.898  | 5.226   |
| 1.80    | 0.185                  | 0.482  | 0.778  | 1.075  | 1.372  | 1.668  | 1.964  | 2.261  | 2.558  | 2.852  | 3.148  | 3.446  | 3.741  | 4.045  | 4.334  | 4.628   |
| 1.90    | 0.167                  | 0.434  | 0.701  | 0.968  | 1.236  | 1.502  | 1.770  | 2.038  | 2.304  | 2.570  | 2.837  | 3.103  | 3.371  | 3.641  | 3.901  | 4.169   |
| 2.00    | 0.152                  | 0.396  | 0.639  | 0.883  | 1.127  | 1.370  | 1.613  | 1.858  | 2.100  | 2.344  | 2.588  | 2.830  | 3.077  | 3.320  | 3.558  | 3.806   |
| 2.10    | 0.140                  | 0.365  | 0.589  | 0.813  | 1.038  | 1.263  | 1.486  | 1.712  | 1.937  | 2.159  | 2.385  | 2.607  | 2.837  | 3.060  | 3.280  | 3.512   |
| 2.20    | 0.130                  | 0.338  | 0.547  | 0.755  | 0.964  | 1.172  | 1.381  | 1.590  | 1.796  | 2.004  | 2.216  | 2.422  | 2.632  | 2.837  | 3.051  | 3.260   |
| 2.30    | 0.122                  | 0.317  | 0.511  | 0.706  | 0.901  | 1.096  | 1.291  | 1.486  | 1.680  | 1.877  | 2.069  | 2.266  | 2.460  | 2.658  | 2.852  | 3.042   |
| 2.40    | 0.114                  | 0.298  | 0.481  | 0.664  | 0.847  | 1.030  | 1.214  | 1.397  | 1.581  | 1.765  | 1.947  | 2.129  | 2.314  | 2.494  | 2.677  | 2.859   |
| 2.50    | 0.108                  | 0.281  | 0.454  | 0.628  | 0.801  | 0.973  | 1.147  | 1.321  | 1.494  | 1.668  | 1.839  | 2.012  | 2.185  | 2.359  | 2.534  | 2.704   |
| 2.60    | 0.103                  | 0.267  | 0.431  | 0.596  | 0.760  | 0.924  | 1.089  | 1.253  | 1.417  | 1.581  | 1.745  | 1.910  | 2.077  | 2.238  | 2.406  | 2.570   |
| 2.70    | 0.098                  | 0.254  | 0.411  | 0.567  | 0.724  | 0.881  | 1.037  | 1.194  | 1.350  | 1.507  | 1.662  | 1.820  | 1.975  | 2.133  | 2.290  | 2.444   |
| 2.80    | 0.093                  | 0.243  | 0.393  | 0.542  | 0.692  | 0.841  | 0.991  | 1.141  | 1.291  | 1.441  | 1.590  | 1.739  | 1.890  | 2.038  | 2.189  | 2.339   |
| 2.90    | 0.090                  | 0.233  | 0.377  | 0.520  | 0.664  | 0.807  | 0.951  | 1.093  | 1.237  | 1.381  | 1.523  | 1.668  | 1.811  | 1.954  | 2.096  | 2.243   |
| 3.00    | 0.086                  | 0.224  | 0.362  | 0.500  | 0.638  | 0.776  | 0.913  | 1.051  | 1.190  | 1.327  | 1.464  | 1.604  | 1.742  | 1.880  | 2.015  | 2.154   |
| 3.10    | 0.083                  | 0.216  | 0.349  | 0.482  | 0.614  | 0.747  | 0.880  | 1.013  | 1.146  | 1.279  | 1.411  | 1.545  | 1.678  | 1.811  | 1.944  | 2.077   |
| 3.20    | 0.080                  | 0.208  | 0.337  | 0.465  | 0.593  | 0.721  | 0.850  | 0.978  | 1.107  | 1.234  | 1.364  | 1.492  | 1.621  | 1.748  | 1.877  | 2.004   |
| 3.30    | 0.077                  | 0.202  | 0.326  | 0.450  | 0.574  | 0.698  | 0.822  | 0.946  | 1.070  | 1.195  | 1.319  | 1.443  | 1.567  | 1.691  | 1.814  | 1.940   |
| 3.40    | 0.075                  | 0.195  | 0.316  | 0.436  | 0.556  | 0.676  | 0.797  | 0.917  | 1.037  | 1.157  | 1.277  | 1.399  | 1.519  | 1.638  | 1.759  | 1.880   |
| 3.50    | 0.073                  | 0.190  | 0.306  | 0.423  | 0.540  | 0.656  | 0.774  | 0.890  | 1.007  | 1.124  | 1.240  | 1.357  | 1.474  | 1.590  | 1.707  | 1.823   |
| 3.60    | 0.071                  | 0.184  | 0.298  | 0.411  | 0.525  | 0.638  | 0.752  | 0.865  | 0.979  | 1.092  | 1.206  | 1.319  | 1.433  | 1.547  | 1.660  | 1.773   |
| 3.70    | 0.069                  | 0.179  | 0.290  | 0.400  | 0.511  | 0.621  | 0.732  | 0.842  | 0.953  | 1.064  | 1.173  | 1.283  | 1.395  | 1.504  | 1.616  | 1.726   |
| 3.80    | 0.067                  | 0.175  | 0.283  | 0.390  | 0.498  | 0.605  | 0.713  | 0.821  | 0.929  | 1.036  | 1.144  | 1.251  | 1.359  | 1.466  | 1.574  | 1.683   |
| 3.90    | 0.066                  | 0.171  | 0.276  | 0.381  | 0.486  | 0.591  | 0.696  | 0.801  | 0.906  | 1.011  | 1.117  | 1.222  | 1.327  | 1.432  | 1.536  | 1.642   |
| 4.00    | 0.064                  | 0.167  | 0.269  | 0.372  | 0.475  | 0.577  | 0.680  | 0.782  | 0.885  | 0.988  | 1.090  | 1.194  | 1.296  | 1.399  | 1.500  | 1.604   |
| 4.10    | 0.063                  | 0.163  | 0.263  | 0.364  | 0.464  | 0.564  | 0.665  | 0.765  | 0.865  | 0.966  | 1.067  | 1.167  | 1.267  | 1.367  | 1.468  | 1.567   |
| 4.20    | 0.061                  | 0.160  | 0.258  | 0.356  | 0.454  | 0.552  | 0.651  | 0.749  | 0.847  | 0.946  | 1.043  | 1.141  | 1.240  | 1.339  | 1.437  | 1.534   |
| 4.30    | 0.060                  | 0.156  | 0.253  | 0.349  | 0.445  | 0.541  | 0.638  | 0.734  | 0.830  | 0.926  | 1.023  | 1.119  | 1.215  | 1.311  | 1.408  | 1.504   |
| 4.40    | 0.059                  | 0.153  | 0.248  | 0.342  | 0.436  | 0.531  | 0.625  | 0.720  | 0.814  | 0.908  | 1.002  | 1.097  | 1.191  | 1.285  | 1.379  | 1.474   |
| 4.50    | 0.058                  | 0.150  | 0.243  | 0.335  | 0.428  | 0.521  | 0.613  | 0.706  | 0.798  | 0.891  | 0.983  | 1.076  | 1.168  | 1.261  | 1.353  | 1.447   |
| 4.60    | 0.057                  | 0.148  | 0.238  | 0.329  | 0.420  | 0.511  | 0.602  | 0.693  | 0.784  | 0.874  | 0.966  | 1.056  | 1.147  | 1.238  | 1.329  | 1.420   |
| 4.70    | 0.056                  | 0.145  | 0.234  | 0.324  | 0.413  | 0.502  | 0.592  | 0.681  | 0.770  | 0.859  | 0.949  | 1.038  | 1.127  | 1.216  | 1.307  | 1.395   |
| 4.80    | 0.055                  | 0.143  | 0.230  | 0.318  | 0.406  | 0.494  | 0.582  | 0.669  | 0.757  | 0.845  | 0.933  | 1.021  | 1.109  | 1.196  | 1.283  | 1.372   |
| 4.90    | 0.054                  | 0.140  | 0.227  | 0.313  | 0.399  | 0.486  | 0.572  | 0.658  | 0.745  | 0.831  | 0.918  | 1.004  | 1.090  | 1.177  | 1.263  | 1.350   |
| 5.00    | 0.053                  | 0.138  | 0.223  | 0.308  | 0.393  | 0.478  | 0.563  | 0.648  | 0.733  | 0.818  | 0.903  | 0.988  | 1.073  | 1.158  | 1.243  | 1.329   |
| 5.10    | 0.052                  | 0.136  | 0.220  | 0.303  | 0.387  | 0.471  | 0.555  | 0.638  | 0.722  | 0.805  | 0.889  | 0.973  | 1.057  | 1.140  | 1.224  | 1.308   |
| 5.20    | 0.051                  | 0.134  | 0.216  | 0.299  | 0.382  | 0.464  | 0.546  | 0.629  | 0.712  | 0.794  | 0.877  | 0.959  | 1.041  | 1.124  | 1.207  | 1.290   |
| 5.30    | 0.051                  | 0.132  | 0.213  | 0.295  | 0.376  | 0.457  | 0.539  | 0.620  | 0.702  | 0.782  | 0.864  | 0.946  | 1.027  | 1.108  | 1.190  | 1.270   |
| 5.40    | 0.050                  | 0.130  | 0.210  | 0.291  | 0.371  | 0.451  | 0.531  | 0.612  | 0.692  | 0.772  | 0.852  | 0.932  | 1.012  | 1.092  | 1.173  | 1.253   |
| 5.50    | 0.049                  | 0.129  | 0.208  | 0.287  | 0.366  | 0.445  | 0.524  | 0.603  | 0.683  | 0.762  | 0.841  | 0.920  | 0.999  | 1.078  | 1.157  | 1.237   |
| 5.60    | 0.049                  | 0.127  | 0.205  | 0.283  | 0.361  | 0.439  | 0.517  | 0.596  | 0.674  | 0.752  | 0.830  | 0.908  | 0.986  | 1.065  | 1.143  | 1.220   |
| 5.70    | 0.048                  | 0.125  | 0.202  | 0.280  | 0.357  | 0.434  | 0.511  | 0.588  | 0.665  | 0.743  | 0.819  | 0.897  | 0.973  | 1.051  | 1.128  | 1.206   |
| 5.80    | 0.048                  | 0.124  | 0.200  | 0.276  | 0.352  | 0.429  | 0.505  | 0.581  | 0.657  | 0.734  | 0.810  | 0.886  | 0.962  | 1.038  | 1.115  | 1.191   |
| 5.90    | 0.047                  | 0.122  | 0.198  | 0.273  | 0.348  | 0.424  | 0.499  | 0.574  | 0.649  | 0.725  | 0.800  | 0.875  | 0.951  | 1.026  | 1.101  | 1.177   |
| 6.00    | 0.046                  | 0.121  | 0.195  | 0.270  | 0.344  | 0.419  | 0.493  | 0.567  | 0.642  | 0.716  | 0.791  | 0.865  | 0.940  | 1.014  | 1.089  | 1.163   |
| 6.50    | 0.044                  | 0.115  | 0.185  | 0.256  | 0.326  | 0.397  | 0.468  | 0.538  | 0.609  | 0.679  | 0.750  | 0.821  | 0.891  | 0.961  | 1.032  | 1.103   |
| 7.00    | 0.042                  | 0.109  | 0.177  | 0.244  | 0.312  | 0.379  | 0.446  | 0.514  | 0.581  | 0.649  | 0.716  | 0.784  | 0.851  | 0.918  | 0.986  | 1.053   |
| 7.50    | 0.040                  | 0.105  | 0.170  | 0.234  | 0.299  | 0.364  | 0.428  | 0.493  | 0.558  | 0.622  | 0.687  | 0.752  | 0.816  | 0.881  | 0.946  | 1.010   |
| 8.00    | 0.039                  | 0.101  | 0.164  | 0.226  | 0.288  | 0.351  | 0.413  | 0.475  | 0.538  | 0.600  | 0.662  | 0.725  | 0.787  | 0.849  | 0.912  | 0.974   |
| 8.50    | 0.038                  | 0.098  | 0.158  | 0.219  | 0.279  | 0.339  | 0.400  | 0.460  | 0.520  | 0.581  | 0.641  | 0.702  | 0.762  | 0.822  | 0.882  | 0.942   |
| 9.00    | 0.037                  | 0.095  | 0.154  | 0.212  | 0.271  | 0.329  | 0.388  | 0.447  | 0.505  | 0.564  | 0.622  | 0.681  | 0.740  | 0.798  | 0.857  | 0.915   |
| 9.50    | 0.036                  | 0.093  | 0.150  | 0.207  | 0.264  | 0.321  | 0.378  | 0.435  | 0.492  | 0.549  | 0.606  | 0.663  | 0.720  | 0.777  | 0.834  | 0.891   |
| 10.00   | 0.035                  | 0.090  | 0.146  | 0.202  | 0.257  | 0.313  | 0.369  | 0.424  | 0.480  | 0.535  | 0.591  | 0.647  | 0.702  | 0.758  | 0.813  | 0.869   |
| 10.50   | 0.034                  | 0.088  | 0.143  | 0.197  | 0.251  | 0.306  | 0.360  | 0.415  | 0.469  | 0.523  | 0.578  | 0.632  | 0.687  | 0.741  | 0.796  | 0.850   |
| 11.00   | 0.033                  | 0.087  | 0.140  | 0.193  | 0.246  | 0.300  | 0.353  | 0.406  | 0.460  | 0.513  | 0.566  | 0.619  | 0.673  | 0.726  | 0.779  | 0.833   |
| 11.50   | 0.033                  | 0.085  | 0.137  | 0.189  | 0.242  | 0.294  | 0.346  | 0.398  | 0.451  | 0.503  | 0.555  | 0.607  | 0.660  | 0.712  | 0.764  | 0.817   |
| 12.00   | 0.032                  | 0.083  | 0.135  | 0.186  | 0.237  | 0.289  | 0.340  | 0.391  | 0.443  | 0.494  | 0.546  | 0.597  | 0.648  | 0.700  | 0.751  | 0.803   |
| 12.50   | 0.032                  | 0.082  | 0.133  | 0.183  | 0.234  | 0.284  | 0.335  | 0.385  | 0.436  | 0.486  | 0.537  | 0.587  | 0.638  | 0.688  | 0.739  | 0.789   |

**Curve: Very Inverse**

| Curve#: | 1                      | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|---------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| × P/U   | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.00   | 0.031                  | 0.081 | 0.131 | 0.180 | 0.230 | 0.280 | 0.330 | 0.379 | 0.429 | 0.479 | 0.529 | 0.578 | 0.628 | 0.678 | 0.728 | 0.777 |
| 13.50   | 0.031                  | 0.080 | 0.129 | 0.178 | 0.227 | 0.276 | 0.325 | 0.374 | 0.423 | 0.472 | 0.521 | 0.570 | 0.619 | 0.668 | 0.717 | 0.766 |
| 14.00   | 0.030                  | 0.079 | 0.127 | 0.175 | 0.224 | 0.272 | 0.321 | 0.369 | 0.417 | 0.466 | 0.514 | 0.562 | 0.611 | 0.659 | 0.708 | 0.756 |
| 14.50   | 0.030                  | 0.078 | 0.125 | 0.173 | 0.221 | 0.269 | 0.317 | 0.364 | 0.412 | 0.460 | 0.508 | 0.556 | 0.603 | 0.651 | 0.699 | 0.747 |
| 15.00   | 0.029                  | 0.077 | 0.124 | 0.171 | 0.218 | 0.266 | 0.313 | 0.360 | 0.407 | 0.455 | 0.502 | 0.549 | 0.596 | 0.644 | 0.691 | 0.738 |
| 15.50   | 0.029                  | 0.076 | 0.123 | 0.169 | 0.216 | 0.263 | 0.309 | 0.356 | 0.403 | 0.450 | 0.496 | 0.543 | 0.590 | 0.637 | 0.683 | 0.730 |
| 16.00   | 0.029                  | 0.075 | 0.121 | 0.168 | 0.214 | 0.260 | 0.306 | 0.352 | 0.399 | 0.445 | 0.491 | 0.537 | 0.583 | 0.630 | 0.676 | 0.722 |
| 16.50   | 0.029                  | 0.074 | 0.120 | 0.166 | 0.212 | 0.257 | 0.303 | 0.349 | 0.395 | 0.441 | 0.486 | 0.532 | 0.578 | 0.624 | 0.669 | 0.715 |
| 17.00   | 0.028                  | 0.074 | 0.119 | 0.164 | 0.210 | 0.255 | 0.300 | 0.346 | 0.391 | 0.436 | 0.482 | 0.527 | 0.572 | 0.618 | 0.663 | 0.708 |
| 17.50   | 0.028                  | 0.073 | 0.118 | 0.163 | 0.208 | 0.253 | 0.298 | 0.343 | 0.388 | 0.433 | 0.478 | 0.522 | 0.567 | 0.612 | 0.657 | 0.702 |
| 18.00   | 0.028                  | 0.072 | 0.117 | 0.162 | 0.206 | 0.251 | 0.295 | 0.340 | 0.384 | 0.429 | 0.473 | 0.518 | 0.563 | 0.607 | 0.652 | 0.696 |
| 18.50   | 0.028                  | 0.072 | 0.116 | 0.160 | 0.204 | 0.249 | 0.293 | 0.337 | 0.381 | 0.425 | 0.470 | 0.514 | 0.558 | 0.602 | 0.647 | 0.691 |
| 19.00   | 0.027                  | 0.071 | 0.115 | 0.159 | 0.203 | 0.247 | 0.291 | 0.335 | 0.378 | 0.422 | 0.466 | 0.510 | 0.554 | 0.598 | 0.642 | 0.686 |
| 19.50   | 0.027                  | 0.071 | 0.114 | 0.158 | 0.201 | 0.245 | 0.289 | 0.332 | 0.376 | 0.419 | 0.463 | 0.506 | 0.550 | 0.594 | 0.637 | 0.681 |
| 20.00   | 0.027                  | 0.070 | 0.114 | 0.157 | 0.200 | 0.243 | 0.287 | 0.330 | 0.373 | 0.416 | 0.460 | 0.503 | 0.546 | 0.589 | 0.632 | 0.676 |

# CURVE INFORMATION AND TABLES



## Curve: Very Inverse

| Curve#: | 17                     | 18      | 19      | 20      | 21      | 22      | 23      | 24      | 25      | 26      | 27      | 28      | 29      | 30      | 31      | 32      |
|---------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| × P/U   | Time to trip (seconds) |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 1.03    | 121.361                | 121.361 | 136.531 | 136.531 | 156.036 | 156.036 | 156.036 | 156.036 | 182.042 | 182.042 | 182.042 | 182.042 | 218.450 | 218.450 | 218.450 | 218.450 |
| 1.10    | 35.234                 | 37.664  | 40.454  | 42.010  | 43.690  | 45.510  | 49.648  | 49.648  | 52.012  | 54.613  | 57.487  | 60.681  | 60.681  | 64.250  | 64.250  | 68.266  |
| 1.20    | 18.204                 | 19.162  | 20.227  | 21.417  | 22.291  | 23.745  | 24.824  | 26.006  | 26.640  | 28.006  | 28.743  | 30.340  | 31.207  | 32.125  | 33.098  | 34.133  |
| 1.30    | 12.272                 | 13.003  | 13.653  | 14.563  | 15.170  | 15.830  | 16.804  | 17.337  | 18.204  | 18.832  | 19.504  | 20.227  | 21.005  | 21.845  | 22.755  | 23.239  |
| 1.40    | 9.335                  | 9.930   | 10.402  | 11.033  | 11.620  | 12.136  | 12.701  | 13.320  | 13.826  | 14.372  | 14.962  | 15.604  | 16.063  | 16.549  | 17.066  | 17.617  |
| 1.50    | 7.585                  | 8.031   | 8.467   | 8.953   | 9.416   | 9.840   | 10.304  | 10.708  | 11.260  | 11.620  | 12.136  | 12.555  | 13.003  | 13.485  | 14.003  | 14.372  |
| 1.60    | 6.387                  | 6.784   | 7.186   | 7.533   | 7.915   | 8.338   | 8.738   | 9.102   | 9.498   | 9.840   | 10.208  | 10.604  | 11.033  | 11.378  | 11.745  | 12.136  |
| 1.70    | 5.544                  | 5.904   | 6.241   | 6.580   | 6.913   | 7.233   | 7.585   | 7.915   | 8.212   | 8.600   | 8.880   | 9.256   | 9.581   | 9.930   | 10.208  | 10.604  |
| 1.80    | 4.920                  | 5.226   | 5.516   | 5.810   | 6.102   | 6.425   | 6.701   | 7.002   | 7.282   | 7.585   | 7.915   | 8.212   | 8.467   | 8.808   | 9.102   | 9.416   |
| 1.90    | 4.440                  | 4.708   | 4.965   | 5.251   | 5.516   | 5.779   | 6.035   | 6.314   | 6.580   | 6.827   | 7.093   | 7.380   | 7.638   | 7.915   | 8.212   | 8.467   |
| 2.00    | 4.045                  | 4.300   | 4.532   | 4.791   | 5.033   | 5.277   | 5.516   | 5.749   | 6.001   | 6.241   | 6.501   | 6.742   | 6.957   | 7.233   | 7.481   | 7.692   |
| 2.10    | 3.728                  | 3.957   | 4.185   | 4.404   | 4.628   | 4.854   | 5.080   | 5.302   | 5.516   | 5.749   | 5.969   | 6.206   | 6.425   | 6.660   | 6.869   | 7.093   |
| 2.20    | 3.467                  | 3.678   | 3.887   | 4.091   | 4.300   | 4.513   | 4.708   | 4.920   | 5.128   | 5.328   | 5.544   | 5.749   | 5.969   | 6.171   | 6.387   | 6.580   |
| 2.30    | 3.241                  | 3.435   | 3.629   | 3.819   | 4.016   | 4.217   | 4.404   | 4.609   | 4.791   | 4.987   | 5.177   | 5.381   | 5.573   | 5.779   | 5.969   | 6.171   |
| 2.40    | 3.042                  | 3.232   | 3.413   | 3.593   | 3.779   | 3.957   | 4.153   | 4.334   | 4.513   | 4.688   | 4.876   | 5.057   | 5.251   | 5.434   | 5.601   | 5.810   |
| 2.50    | 2.882                  | 3.051   | 3.222   | 3.403   | 3.569   | 3.741   | 3.915   | 4.091   | 4.267   | 4.440   | 4.609   | 4.791   | 4.965   | 5.128   | 5.302   | 5.489   |
| 2.60    | 2.731                  | 2.897   | 3.060   | 3.222   | 3.392   | 3.558   | 3.715   | 3.887   | 4.045   | 4.217   | 4.369   | 4.532   | 4.708   | 4.876   | 5.033   | 5.201   |
| 2.70    | 2.601                  | 2.758   | 2.913   | 3.077   | 3.232   | 3.382   | 3.546   | 3.703   | 3.860   | 4.016   | 4.169   | 4.317   | 4.476   | 4.648   | 4.791   | 4.942   |
| 2.80    | 2.488                  | 2.638   | 2.786   | 2.936   | 3.085   | 3.232   | 3.382   | 3.535   | 3.690   | 3.832   | 3.986   | 4.137   | 4.283   | 4.440   | 4.589   | 4.728   |
| 2.90    | 2.385                  | 2.528   | 2.671   | 2.815   | 2.960   | 3.103   | 3.241   | 3.392   | 3.535   | 3.678   | 3.819   | 3.957   | 4.106   | 4.250   | 4.387   | 4.532   |
| 3.00    | 2.295                  | 2.433   | 2.570   | 2.704   | 2.844   | 2.984   | 3.121   | 3.260   | 3.392   | 3.535   | 3.678   | 3.806   | 3.943   | 4.091   | 4.217   | 4.369   |
| 3.10    | 2.207                  | 2.344   | 2.477   | 2.607   | 2.737   | 2.874   | 3.009   | 3.139   | 3.270   | 3.403   | 3.535   | 3.665   | 3.806   | 3.929   | 4.076   | 4.201   |
| 3.20    | 2.133                  | 2.261   | 2.390   | 2.517   | 2.645   | 2.772   | 2.905   | 3.034   | 3.157   | 3.290   | 3.413   | 3.546   | 3.678   | 3.806   | 3.929   | 4.060   |
| 3.30    | 2.065                  | 2.189   | 2.309   | 2.438   | 2.558   | 2.684   | 2.808   | 2.928   | 3.060   | 3.184   | 3.300   | 3.424   | 3.558   | 3.678   | 3.806   | 3.929   |
| 3.40    | 2.000                  | 2.121   | 2.238   | 2.359   | 2.482   | 2.601   | 2.724   | 2.844   | 2.960   | 3.085   | 3.203   | 3.320   | 3.446   | 3.558   | 3.678   | 3.806   |
| 3.50    | 1.940                  | 2.057   | 2.176   | 2.290   | 2.406   | 2.523   | 2.638   | 2.758   | 2.874   | 2.992   | 3.112   | 3.222   | 3.340   | 3.456   | 3.569   | 3.690   |
| 3.60    | 1.886                  | 2.000   | 2.113   | 2.229   | 2.339   | 2.454   | 2.570   | 2.684   | 2.793   | 2.905   | 3.026   | 3.139   | 3.251   | 3.361   | 3.479   | 3.593   |
| 3.70    | 1.836                  | 1.947   | 2.057   | 2.167   | 2.280   | 2.390   | 2.499   | 2.607   | 2.717   | 2.830   | 2.944   | 3.051   | 3.166   | 3.270   | 3.382   | 3.490   |
| 3.80    | 1.791                  | 1.896   | 2.004   | 2.113   | 2.220   | 2.329   | 2.438   | 2.546   | 2.651   | 2.758   | 2.867   | 2.976   | 3.085   | 3.194   | 3.300   | 3.403   |
| 3.90    | 1.748                  | 1.851   | 1.957   | 2.061   | 2.167   | 2.271   | 2.380   | 2.482   | 2.588   | 2.690   | 2.801   | 2.905   | 3.009   | 3.112   | 3.222   | 3.320   |
| 4.00    | 1.707                  | 1.808   | 1.913   | 2.015   | 2.117   | 2.220   | 2.324   | 2.427   | 2.528   | 2.632   | 2.731   | 2.837   | 2.936   | 3.042   | 3.148   | 3.251   |
| 4.10    | 1.668                  | 1.770   | 1.870   | 1.968   | 2.069   | 2.171   | 2.271   | 2.369   | 2.471   | 2.570   | 2.671   | 2.772   | 2.874   | 2.976   | 3.077   | 3.175   |
| 4.20    | 1.633                  | 1.731   | 1.830   | 1.926   | 2.026   | 2.125   | 2.225   | 2.319   | 2.416   | 2.517   | 2.613   | 2.710   | 2.815   | 2.913   | 3.009   | 3.103   |
| 4.30    | 1.599                  | 1.696   | 1.794   | 1.890   | 1.986   | 2.080   | 2.176   | 2.276   | 2.369   | 2.466   | 2.564   | 2.658   | 2.751   | 2.852   | 2.944   | 3.042   |
| 4.40    | 1.569                  | 1.662   | 1.756   | 1.851   | 1.947   | 2.042   | 2.133   | 2.229   | 2.324   | 2.416   | 2.511   | 2.607   | 2.704   | 2.793   | 2.890   | 2.984   |
| 4.50    | 1.538                  | 1.630   | 1.723   | 1.817   | 1.910   | 2.000   | 2.092   | 2.189   | 2.280   | 2.374   | 2.466   | 2.558   | 2.651   | 2.744   | 2.837   | 2.928   |
| 4.60    | 1.511                  | 1.602   | 1.693   | 1.785   | 1.873   | 1.964   | 2.057   | 2.146   | 2.238   | 2.329   | 2.422   | 2.511   | 2.601   | 2.690   | 2.786   | 2.874   |
| 4.70    | 1.484                  | 1.574   | 1.662   | 1.753   | 1.842   | 1.930   | 2.019   | 2.109   | 2.198   | 2.290   | 2.380   | 2.466   | 2.558   | 2.645   | 2.737   | 2.822   |
| 4.80    | 1.460                  | 1.547   | 1.635   | 1.723   | 1.811   | 1.900   | 1.986   | 2.073   | 2.163   | 2.247   | 2.339   | 2.427   | 2.511   | 2.601   | 2.690   | 2.779   |
| 4.90    | 1.435                  | 1.521   | 1.609   | 1.696   | 1.782   | 1.867   | 1.954   | 2.042   | 2.125   | 2.211   | 2.299   | 2.385   | 2.471   | 2.558   | 2.645   | 2.731   |
| 5.00    | 1.413                  | 1.498   | 1.583   | 1.668   | 1.753   | 1.839   | 1.923   | 2.008   | 2.092   | 2.180   | 2.261   | 2.349   | 2.433   | 2.517   | 2.601   | 2.690   |
| 5.10    | 1.391                  | 1.476   | 1.560   | 1.642   | 1.726   | 1.811   | 1.893   | 1.979   | 2.061   | 2.146   | 2.229   | 2.314   | 2.395   | 2.482   | 2.564   | 2.645   |
| 5.20    | 1.372                  | 1.454   | 1.536   | 1.618   | 1.701   | 1.785   | 1.867   | 1.950   | 2.030   | 2.113   | 2.198   | 2.280   | 2.359   | 2.444   | 2.528   | 2.607   |
| 5.30    | 1.352                  | 1.433   | 1.515   | 1.597   | 1.678   | 1.759   | 1.839   | 1.920   | 2.004   | 2.084   | 2.167   | 2.247   | 2.329   | 2.411   | 2.488   | 2.570   |
| 5.40    | 1.334                  | 1.413   | 1.494   | 1.574   | 1.655   | 1.734   | 1.814   | 1.896   | 1.975   | 2.057   | 2.133   | 2.216   | 2.295   | 2.374   | 2.454   | 2.534   |
| 5.50    | 1.316                  | 1.395   | 1.474   | 1.554   | 1.633   | 1.712   | 1.791   | 1.870   | 1.947   | 2.026   | 2.109   | 2.185   | 2.266   | 2.344   | 2.422   | 2.505   |
| 5.60    | 1.299                  | 1.377   | 1.454   | 1.532   | 1.611   | 1.688   | 1.767   | 1.845   | 1.923   | 2.000   | 2.080   | 2.159   | 2.234   | 2.314   | 2.390   | 2.471   |
| 5.70    | 1.282                  | 1.360   | 1.437   | 1.513   | 1.590   | 1.668   | 1.745   | 1.823   | 1.900   | 1.975   | 2.053   | 2.129   | 2.207   | 2.285   | 2.364   | 2.438   |
| 5.80    | 1.267                  | 1.343   | 1.419   | 1.496   | 1.572   | 1.647   | 1.723   | 1.799   | 1.877   | 1.954   | 2.030   | 2.105   | 2.180   | 2.257   | 2.334   | 2.411   |
| 5.90    | 1.251                  | 1.327   | 1.402   | 1.478   | 1.554   | 1.628   | 1.704   | 1.779   | 1.854   | 1.930   | 2.004   | 2.080   | 2.154   | 2.229   | 2.304   | 2.380   |
| 6.00    | 1.237                  | 1.311   | 1.386   | 1.460   | 1.536   | 1.609   | 1.683   | 1.759   | 1.833   | 1.906   | 1.982   | 2.057   | 2.129   | 2.207   | 2.280   | 2.354   |
| 6.50    | 1.173                  | 1.244   | 1.314   | 1.384   | 1.456   | 1.525   | 1.597   | 1.668   | 1.739   | 1.808   | 1.880   | 1.950   | 2.019   | 2.092   | 2.163   | 2.234   |
| 7.00    | 1.120                  | 1.187   | 1.255   | 1.322   | 1.390   | 1.456   | 1.525   | 1.592   | 1.660   | 1.726   | 1.794   | 1.861   | 1.930   | 1.997   | 2.065   | 2.129   |
| 7.50    | 1.075                  | 1.140   | 1.204   | 1.269   | 1.334   | 1.399   | 1.462   | 1.528   | 1.592   | 1.657   | 1.723   | 1.788   | 1.851   | 1.916   | 1.979   | 2.045   |
| 8.00    | 1.036                  | 1.099   | 1.161   | 1.223   | 1.287   | 1.348   | 1.411   | 1.472   | 1.536   | 1.597   | 1.660   | 1.723   | 1.785   | 1.848   | 1.910   | 1.972   |
| 8.50    | 1.003                  | 1.064   | 1.124   | 1.183   | 1.244   | 1.305   | 1.365   | 1.426   | 1.486   | 1.545   | 1.606   | 1.668   | 1.728   | 1.788   | 1.848   | 1.910   |
| 9.00    | 0.973                  | 1.032   | 1.091   | 1.150   | 1.208   | 1.267   | 1.326   | 1.384   | 1.443   | 1.500   | 1.560   | 1.618   | 1.675   | 1.734   | 1.794   | 1.851   |
| 9.50    | 0.948                  | 1.005   | 1.061   | 1.119   | 1.176   | 1.233   | 1.290   | 1.347   | 1.404   | 1.460   | 1.517   | 1.574   | 1.633   | 1.688   | 1.745   | 1.802   |
| 10.00   | 0.925                  | 0.980   | 1.036   | 1.091   | 1.147   | 1.203   | 1.258   | 1.314   | 1.370   | 1.426   | 1.482   | 1.536   | 1.592   | 1.647   | 1.704   | 1.759   |
| 10.50   | 0.904                  | 0.959   | 1.013   | 1.068   | 1.121   | 1.176   | 1.230   | 1.285   | 1.340   | 1.393   | 1.449   | 1.502   | 1.556   | 1.611   | 1.665   | 1.720   |
| 11.00   | 0.886                  | 0.939   | 0.992   | 1.045   | 1.099   | 1.152   | 1.206   | 1.258   | 1.311   | 1.365   | 1.419   | 1.472   | 1.525   | 1.578   | 1.633   | 1.686   |
| 11.50   | 0.869                  | 0.921   | 0.973   | 1.026   | 1.078   | 1.131   | 1.182   | 1.234   | 1.287   | 1.340   | 1.391   | 1.445   | 1.496   | 1.549   | 1.602   | 1.652   |
| 12.00   | 0.854                  | 0.905   | 0.956   | 1.008   | 1.059   | 1.110   | 1.162   | 1.214   | 1.264   | 1.316   | 1.367   | 1.419   | 1.470   | 1.521   | 1.574   | 1.623   |
| 12.50   | 0.840                  | 0.890   | 0.941   | 0.991   | 1.042   | 1.092   | 1.143   | 1.194   | 1.244   | 1.294   | 1.345   | 1.395   | 1.447   | 1.496   | 1.547   | 1.597   |

**Curve: Very Inverse**

| Curve#: | 17                     | 18    | 19    | 20    | 21    | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|---------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| × P/U   | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.00   | 0.827                  | 0.877 | 0.926 | 0.976 | 1.027 | 1.076 | 1.126 | 1.176 | 1.224 | 1.275 | 1.324 | 1.374 | 1.424 | 1.474 | 1.523 | 1.574 |
| 13.50   | 0.815                  | 0.864 | 0.913 | 0.962 | 1.011 | 1.060 | 1.110 | 1.158 | 1.208 | 1.257 | 1.307 | 1.355 | 1.404 | 1.452 | 1.502 | 1.551 |
| 14.00   | 0.804                  | 0.853 | 0.901 | 0.950 | 0.998 | 1.046 | 1.094 | 1.144 | 1.191 | 1.240 | 1.288 | 1.337 | 1.386 | 1.433 | 1.482 | 1.530 |
| 14.50   | 0.794                  | 0.842 | 0.890 | 0.938 | 0.986 | 1.033 | 1.081 | 1.130 | 1.177 | 1.224 | 1.273 | 1.321 | 1.369 | 1.417 | 1.464 | 1.511 |
| 15.00   | 0.785                  | 0.833 | 0.879 | 0.927 | 0.974 | 1.022 | 1.069 | 1.116 | 1.163 | 1.211 | 1.257 | 1.305 | 1.352 | 1.399 | 1.447 | 1.494 |
| 15.50   | 0.777                  | 0.823 | 0.870 | 0.917 | 0.963 | 1.010 | 1.057 | 1.103 | 1.150 | 1.198 | 1.244 | 1.291 | 1.337 | 1.384 | 1.430 | 1.478 |
| 16.00   | 0.769                  | 0.815 | 0.861 | 0.907 | 0.953 | 0.999 | 1.046 | 1.092 | 1.138 | 1.185 | 1.231 | 1.277 | 1.324 | 1.369 | 1.415 | 1.462 |
| 16.50   | 0.761                  | 0.807 | 0.853 | 0.898 | 0.944 | 0.989 | 1.035 | 1.081 | 1.127 | 1.173 | 1.219 | 1.264 | 1.310 | 1.355 | 1.402 | 1.447 |
| 17.00   | 0.754                  | 0.799 | 0.845 | 0.890 | 0.935 | 0.980 | 1.026 | 1.071 | 1.117 | 1.162 | 1.207 | 1.253 | 1.299 | 1.343 | 1.388 | 1.433 |
| 17.50   | 0.747                  | 0.792 | 0.837 | 0.882 | 0.927 | 0.972 | 1.017 | 1.061 | 1.107 | 1.152 | 1.196 | 1.241 | 1.287 | 1.332 | 1.376 | 1.422 |
| 18.00   | 0.741                  | 0.785 | 0.830 | 0.874 | 0.919 | 0.964 | 1.009 | 1.053 | 1.098 | 1.143 | 1.187 | 1.231 | 1.276 | 1.321 | 1.365 | 1.409 |
| 18.50   | 0.735                  | 0.779 | 0.824 | 0.868 | 0.912 | 0.956 | 1.000 | 1.044 | 1.089 | 1.133 | 1.177 | 1.222 | 1.266 | 1.310 | 1.353 | 1.399 |
| 19.00   | 0.730                  | 0.774 | 0.817 | 0.861 | 0.905 | 0.949 | 0.993 | 1.036 | 1.080 | 1.125 | 1.168 | 1.212 | 1.255 | 1.300 | 1.343 | 1.388 |
| 19.50   | 0.724                  | 0.768 | 0.811 | 0.855 | 0.898 | 0.942 | 0.986 | 1.029 | 1.073 | 1.116 | 1.160 | 1.203 | 1.247 | 1.291 | 1.334 | 1.377 |
| 20.00   | 0.719                  | 0.762 | 0.805 | 0.849 | 0.892 | 0.935 | 0.979 | 1.022 | 1.066 | 1.109 | 1.152 | 1.195 | 1.238 | 1.282 | 1.324 | 1.369 |

# CURVE INFORMATION AND TABLES



## Curve: Extremely Inverse

| Curve#: | 1                      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     |
|---------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| × P/U   | Time to trip (seconds) |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| 1.03    | 12.003                 | 18.204 | 24.272 | 30.340 | 36.408 | 42.010 | 49.648 | 54.613 | 60.681 | 68.266 | 72.817 | 78.018 | 84.019 | 91.021 | 99.295 | 99.295 |
| 1.10    | 9.416                  | 14.185 | 18.832 | 23.745 | 28.743 | 33.098 | 37.664 | 42.010 | 47.489 | 52.012 | 57.487 | 60.681 | 68.266 | 72.817 | 78.018 | 78.018 |
| 1.20    | 6.913                  | 10.402 | 14.003 | 17.337 | 21.005 | 24.272 | 28.006 | 31.207 | 35.234 | 39.009 | 42.010 | 45.510 | 49.648 | 52.012 | 54.613 | 60.681 |
| 1.30    | 5.302                  | 7.973  | 10.708 | 13.320 | 16.063 | 18.832 | 21.417 | 24.272 | 26.640 | 29.520 | 32.125 | 35.234 | 37.664 | 40.454 | 43.690 | 45.510 |
| 1.40    | 4.201                  | 6.314  | 8.467  | 10.604 | 12.701 | 14.760 | 16.804 | 19.162 | 21.005 | 23.239 | 25.401 | 27.306 | 29.520 | 32.125 | 34.133 | 36.408 |
| 1.50    | 3.403                  | 5.128  | 6.827  | 8.600  | 10.304 | 12.003 | 13.653 | 15.384 | 17.066 | 18.832 | 20.608 | 22.291 | 24.272 | 26.006 | 27.306 | 29.520 |
| 1.60    | 2.815                  | 4.234  | 5.659  | 7.093  | 8.533  | 9.930  | 11.378 | 12.850 | 14.185 | 15.604 | 17.066 | 18.513 | 19.859 | 21.417 | 22.755 | 24.272 |
| 1.70    | 2.369                  | 3.569  | 4.770  | 5.969  | 7.186  | 8.338  | 9.581  | 10.708 | 12.003 | 13.160 | 14.372 | 15.604 | 16.804 | 17.906 | 19.162 | 20.227 |
| 1.80    | 2.023                  | 3.042  | 4.076  | 5.080  | 6.102  | 7.139  | 8.151  | 9.179  | 10.208 | 11.260 | 12.272 | 13.320 | 14.372 | 15.384 | 16.302 | 17.337 |
| 1.90    | 1.748                  | 2.632  | 3.512  | 4.404  | 5.277  | 6.171  | 7.047  | 7.915  | 8.808  | 9.666  | 10.604 | 11.497 | 12.412 | 13.160 | 14.185 | 14.962 |
| 2.00    | 1.525                  | 2.295  | 3.068  | 3.832  | 4.609  | 5.381  | 6.136  | 6.913  | 7.692  | 8.467  | 9.256  | 10.021 | 10.814 | 11.497 | 12.272 | 13.160 |
| 2.10    | 1.343                  | 2.023  | 2.704  | 3.382  | 4.060  | 4.728  | 5.407  | 6.102  | 6.784  | 7.430  | 8.151  | 8.808  | 9.498  | 10.208 | 10.814 | 11.497 |
| 2.20    | 1.192                  | 1.794  | 2.395  | 3.001  | 3.605  | 4.201  | 4.812  | 5.407  | 6.001  | 6.620  | 7.233  | 7.802  | 8.402  | 9.027  | 9.666  | 10.208 |
| 2.30    | 1.066                  | 1.604  | 2.142  | 2.684  | 3.222  | 3.753  | 4.300  | 4.833  | 5.381  | 5.904  | 6.463  | 7.002  | 7.533  | 8.091  | 8.600  | 9.179  |
| 2.40    | 0.958                  | 1.443  | 1.926  | 2.411  | 2.897  | 3.382  | 3.860  | 4.352  | 4.833  | 5.328  | 5.810  | 6.277  | 6.784  | 7.233  | 7.746  | 8.212  |
| 2.50    | 0.867                  | 1.305  | 1.745  | 2.180  | 2.619  | 3.060  | 3.501  | 3.929  | 4.369  | 4.812  | 5.251  | 5.689  | 6.136  | 6.580  | 7.002  | 7.430  |
| 2.60    | 0.789                  | 1.187  | 1.585  | 1.982  | 2.380  | 2.779  | 3.175  | 3.581  | 3.972  | 4.369  | 4.770  | 5.177  | 5.573  | 5.969  | 6.350  | 6.784  |
| 2.70    | 0.720                  | 1.085  | 1.449  | 1.811  | 2.176  | 2.540  | 2.905  | 3.270  | 3.629  | 4.001  | 4.352  | 4.728  | 5.080  | 5.461  | 5.810  | 6.171  |
| 2.80    | 0.661                  | 0.995  | 1.329  | 1.662  | 1.997  | 2.329  | 2.664  | 3.001  | 3.330  | 3.665  | 4.001  | 4.334  | 4.668  | 5.010  | 5.328  | 5.659  |
| 2.90    | 0.608                  | 0.916  | 1.223  | 1.532  | 1.839  | 2.146  | 2.454  | 2.758  | 3.068  | 3.382  | 3.690  | 3.986  | 4.300  | 4.609  | 4.920  | 5.226  |
| 3.00    | 0.562                  | 0.847  | 1.131  | 1.415  | 1.699  | 1.982  | 2.266  | 2.552  | 2.837  | 3.121  | 3.403  | 3.690  | 3.972  | 4.250  | 4.551  | 4.833  |
| 3.10    | 0.522                  | 0.785  | 1.049  | 1.313  | 1.576  | 1.839  | 2.105  | 2.369  | 2.632  | 2.897  | 3.157  | 3.424  | 3.690  | 3.943  | 4.217  | 4.476  |
| 3.20    | 0.485                  | 0.731  | 0.976  | 1.220  | 1.466  | 1.712  | 1.957  | 2.202  | 2.449  | 2.690  | 2.936  | 3.184  | 3.424  | 3.678  | 3.915  | 4.169  |
| 3.30    | 0.453                  | 0.681  | 0.910  | 1.139  | 1.367  | 1.597  | 1.827  | 2.053  | 2.285  | 2.511  | 2.737  | 2.968  | 3.194  | 3.424  | 3.653  | 3.887  |
| 3.40    | 0.424                  | 0.638  | 0.851  | 1.066  | 1.279  | 1.494  | 1.707  | 1.923  | 2.137  | 2.349  | 2.564  | 2.779  | 2.992  | 3.203  | 3.424  | 3.629  |
| 3.50    | 0.397                  | 0.598  | 0.798  | 0.999  | 1.200  | 1.400  | 1.602  | 1.802  | 2.004  | 2.202  | 2.406  | 2.607  | 2.808  | 3.009  | 3.203  | 3.403  |
| 3.60    | 0.373                  | 0.562  | 0.751  | 0.939  | 1.127  | 1.316  | 1.504  | 1.693  | 1.883  | 2.073  | 2.261  | 2.449  | 2.638  | 2.822  | 3.017  | 3.203  |
| 3.70    | 0.352                  | 0.529  | 0.707  | 0.884  | 1.063  | 1.240  | 1.417  | 1.595  | 1.773  | 1.950  | 2.129  | 2.304  | 2.482  | 2.664  | 2.837  | 3.017  |
| 3.80    | 0.332                  | 0.499  | 0.667  | 0.835  | 1.003  | 1.171  | 1.339  | 1.507  | 1.673  | 1.842  | 2.008  | 2.176  | 2.344  | 2.511  | 2.677  | 2.844  |
| 3.90    | 0.314                  | 0.472  | 0.631  | 0.790  | 0.948  | 1.107  | 1.266  | 1.424  | 1.583  | 1.742  | 1.900  | 2.057  | 2.216  | 2.374  | 2.534  | 2.690  |
| 4.00    | 0.297                  | 0.448  | 0.598  | 0.748  | 0.898  | 1.048  | 1.199  | 1.348  | 1.500  | 1.650  | 1.799  | 1.950  | 2.100  | 2.252  | 2.401  | 2.552  |
| 4.10    | 0.282                  | 0.425  | 0.567  | 0.710  | 0.853  | 0.996  | 1.138  | 1.280  | 1.424  | 1.565  | 1.709  | 1.851  | 1.993  | 2.137  | 2.280  | 2.422  |
| 4.20    | 0.268                  | 0.404  | 0.539  | 0.675  | 0.811  | 0.946  | 1.081  | 1.218  | 1.353  | 1.488  | 1.623  | 1.759  | 1.896  | 2.030  | 2.167  | 2.304  |
| 4.30    | 0.255                  | 0.385  | 0.514  | 0.643  | 0.772  | 0.901  | 1.030  | 1.160  | 1.288  | 1.417  | 1.547  | 1.675  | 1.805  | 1.933  | 2.061  | 2.193  |
| 4.40    | 0.244                  | 0.367  | 0.490  | 0.613  | 0.736  | 0.859  | 0.982  | 1.106  | 1.229  | 1.352  | 1.474  | 1.597  | 1.720  | 1.845  | 1.968  | 2.088  |
| 4.50    | 0.233                  | 0.350  | 0.468  | 0.585  | 0.703  | 0.821  | 0.938  | 1.055  | 1.173  | 1.291  | 1.408  | 1.525  | 1.642  | 1.762  | 1.877  | 1.997  |
| 4.60    | 0.222                  | 0.335  | 0.447  | 0.560  | 0.672  | 0.784  | 0.897  | 1.009  | 1.121  | 1.234  | 1.347  | 1.458  | 1.572  | 1.683  | 1.796  | 1.910  |
| 4.70    | 0.213                  | 0.320  | 0.428  | 0.536  | 0.643  | 0.751  | 0.859  | 0.967  | 1.074  | 1.181  | 1.290  | 1.397  | 1.504  | 1.611  | 1.720  | 1.827  |
| 4.80    | 0.204                  | 0.307  | 0.410  | 0.514  | 0.617  | 0.720  | 0.823  | 0.926  | 1.029  | 1.133  | 1.236  | 1.339  | 1.443  | 1.545  | 1.647  | 1.750  |
| 4.90    | 0.196                  | 0.295  | 0.394  | 0.493  | 0.592  | 0.691  | 0.790  | 0.889  | 0.988  | 1.087  | 1.186  | 1.285  | 1.384  | 1.482  | 1.583  | 1.680  |
| 5.00    | 0.188                  | 0.283  | 0.378  | 0.473  | 0.569  | 0.664  | 0.759  | 0.854  | 0.949  | 1.044  | 1.139  | 1.234  | 1.329  | 1.424  | 1.519  | 1.616  |
| 5.10    | 0.181                  | 0.273  | 0.364  | 0.455  | 0.547  | 0.638  | 0.730  | 0.821  | 0.913  | 1.004  | 1.096  | 1.187  | 1.279  | 1.370  | 1.462  | 1.554  |
| 5.20    | 0.174                  | 0.262  | 0.350  | 0.438  | 0.527  | 0.615  | 0.703  | 0.791  | 0.879  | 0.967  | 1.055  | 1.144  | 1.231  | 1.319  | 1.408  | 1.496  |
| 5.30    | 0.168                  | 0.253  | 0.338  | 0.423  | 0.508  | 0.592  | 0.677  | 0.762  | 0.847  | 0.932  | 1.017  | 1.102  | 1.187  | 1.272  | 1.357  | 1.441  |
| 5.40    | 0.162                  | 0.244  | 0.326  | 0.408  | 0.490  | 0.572  | 0.653  | 0.735  | 0.817  | 0.899  | 0.981  | 1.063  | 1.145  | 1.227  | 1.308  | 1.390  |
| 5.50    | 0.156                  | 0.236  | 0.315  | 0.394  | 0.473  | 0.552  | 0.631  | 0.710  | 0.789  | 0.868  | 0.947  | 1.027  | 1.106  | 1.185  | 1.263  | 1.342  |
| 5.60    | 0.151                  | 0.228  | 0.304  | 0.380  | 0.457  | 0.533  | 0.610  | 0.686  | 0.763  | 0.839  | 0.916  | 0.992  | 1.068  | 1.145  | 1.220  | 1.297  |
| 5.70    | 0.146                  | 0.220  | 0.294  | 0.368  | 0.442  | 0.516  | 0.590  | 0.664  | 0.738  | 0.811  | 0.885  | 0.959  | 1.033  | 1.107  | 1.181  | 1.255  |
| 5.80    | 0.142                  | 0.213  | 0.285  | 0.356  | 0.428  | 0.499  | 0.571  | 0.643  | 0.714  | 0.785  | 0.857  | 0.929  | 1.000  | 1.072  | 1.144  | 1.215  |
| 5.90    | 0.137                  | 0.206  | 0.276  | 0.345  | 0.414  | 0.484  | 0.553  | 0.622  | 0.692  | 0.761  | 0.830  | 0.900  | 0.969  | 1.038  | 1.108  | 1.177  |
| 6.00    | 0.133                  | 0.200  | 0.267  | 0.335  | 0.402  | 0.469  | 0.536  | 0.603  | 0.671  | 0.738  | 0.805  | 0.872  | 0.939  | 1.007  | 1.074  | 1.141  |
| 6.50    | 0.115                  | 0.173  | 0.231  | 0.290  | 0.348  | 0.406  | 0.464  | 0.522  | 0.580  | 0.639  | 0.697  | 0.755  | 0.813  | 0.871  | 0.930  | 0.988  |
| 7.00    | 0.101                  | 0.152  | 0.203  | 0.255  | 0.306  | 0.357  | 0.408  | 0.459  | 0.510  | 0.562  | 0.613  | 0.664  | 0.715  | 0.766  | 0.817  | 0.868  |
| 7.50    | 0.090                  | 0.136  | 0.181  | 0.227  | 0.272  | 0.318  | 0.364  | 0.409  | 0.455  | 0.500  | 0.546  | 0.591  | 0.637  | 0.683  | 0.728  | 0.774  |
| 8.00    | 0.081                  | 0.122  | 0.163  | 0.204  | 0.246  | 0.287  | 0.328  | 0.369  | 0.410  | 0.451  | 0.492  | 0.533  | 0.574  | 0.615  | 0.656  | 0.697  |
| 8.50    | 0.074                  | 0.111  | 0.149  | 0.186  | 0.224  | 0.261  | 0.298  | 0.336  | 0.373  | 0.410  | 0.448  | 0.485  | 0.523  | 0.560  | 0.598  | 0.635  |
| 9.00    | 0.068                  | 0.102  | 0.137  | 0.171  | 0.205  | 0.240  | 0.274  | 0.308  | 0.343  | 0.377  | 0.411  | 0.446  | 0.480  | 0.514  | 0.549  | 0.583  |
| 9.50    | 0.063                  | 0.095  | 0.126  | 0.158  | 0.190  | 0.222  | 0.254  | 0.285  | 0.317  | 0.349  | 0.381  | 0.412  | 0.444  | 0.476  | 0.508  | 0.540  |
| 10.00   | 0.059                  | 0.088  | 0.118  | 0.147  | 0.177  | 0.207  | 0.236  | 0.266  | 0.296  | 0.325  | 0.355  | 0.384  | 0.414  | 0.444  | 0.473  | 0.503  |
| 10.50   | 0.055                  | 0.083  | 0.110  | 0.138  | 0.166  | 0.194  | 0.222  | 0.249  | 0.277  | 0.305  | 0.333  | 0.360  | 0.388  | 0.416  | 0.444  | 0.471  |
| 11.00   | 0.052                  | 0.078  | 0.104  | 0.130  | 0.157  | 0.183  | 0.209  | 0.235  | 0.261  | 0.287  | 0.314  | 0.340  | 0.366  | 0.392  | 0.418  | 0.444  |
| 11.50   | 0.049                  | 0.074  | 0.099  | 0.123  | 0.148  | 0.173  | 0.198  | 0.223  | 0.247  | 0.272  | 0.297  | 0.322  | 0.347  | 0.371  | 0.396  | 0.421  |
| 12.00   | 0.047                  | 0.070  | 0.094  | 0.117  | 0.141  | 0.165  | 0.188  | 0.212  | 0.235  | 0.259  | 0.283  | 0.306  | 0.330  | 0.353  | 0.377  | 0.401  |
| 12.50   | 0.045                  | 0.067  | 0.090  | 0.112  | 0.135  | 0.157  | 0.180  | 0.202  | 0.225  | 0.247  | 0.270  | 0.293  | 0.315  | 0.338  | 0.360  | 0.383  |

**Curve: Extremely Inverse**

| Curve#: | 1                      | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|---------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| × P/U   | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.00   | 0.043                  | 0.064 | 0.086 | 0.108 | 0.129 | 0.151 | 0.172 | 0.194 | 0.216 | 0.237 | 0.259 | 0.280 | 0.302 | 0.324 | 0.345 | 0.367 |
| 13.50   | 0.041                  | 0.062 | 0.083 | 0.103 | 0.124 | 0.145 | 0.166 | 0.187 | 0.207 | 0.228 | 0.249 | 0.270 | 0.290 | 0.311 | 0.332 | 0.353 |
| 14.00   | 0.040                  | 0.060 | 0.080 | 0.100 | 0.120 | 0.140 | 0.160 | 0.180 | 0.200 | 0.220 | 0.240 | 0.260 | 0.280 | 0.300 | 0.320 | 0.340 |
| 14.50   | 0.038                  | 0.058 | 0.077 | 0.097 | 0.116 | 0.135 | 0.155 | 0.174 | 0.193 | 0.213 | 0.232 | 0.252 | 0.271 | 0.290 | 0.310 | 0.329 |
| 15.00   | 0.037                  | 0.056 | 0.075 | 0.094 | 0.112 | 0.131 | 0.150 | 0.169 | 0.188 | 0.206 | 0.225 | 0.244 | 0.263 | 0.282 | 0.300 | 0.319 |
| 15.50   | 0.036                  | 0.054 | 0.073 | 0.091 | 0.109 | 0.127 | 0.146 | 0.164 | 0.182 | 0.201 | 0.219 | 0.237 | 0.255 | 0.274 | 0.292 | 0.310 |
| 16.00   | 0.035                  | 0.053 | 0.071 | 0.089 | 0.106 | 0.124 | 0.142 | 0.160 | 0.177 | 0.195 | 0.213 | 0.231 | 0.249 | 0.266 | 0.284 | 0.302 |
| 16.50   | 0.034                  | 0.052 | 0.069 | 0.086 | 0.104 | 0.121 | 0.138 | 0.156 | 0.173 | 0.190 | 0.208 | 0.225 | 0.242 | 0.260 | 0.277 | 0.294 |
| 17.00   | 0.034                  | 0.050 | 0.067 | 0.084 | 0.101 | 0.118 | 0.135 | 0.152 | 0.169 | 0.186 | 0.203 | 0.220 | 0.237 | 0.254 | 0.271 | 0.288 |
| 17.50   | 0.033                  | 0.049 | 0.066 | 0.083 | 0.099 | 0.116 | 0.132 | 0.149 | 0.165 | 0.182 | 0.199 | 0.215 | 0.232 | 0.248 | 0.265 | 0.282 |
| 18.00   | 0.032                  | 0.048 | 0.065 | 0.081 | 0.097 | 0.113 | 0.130 | 0.146 | 0.162 | 0.178 | 0.195 | 0.211 | 0.227 | 0.243 | 0.260 | 0.276 |
| 18.50   | 0.032                  | 0.047 | 0.063 | 0.079 | 0.095 | 0.111 | 0.127 | 0.143 | 0.159 | 0.175 | 0.191 | 0.207 | 0.223 | 0.239 | 0.255 | 0.271 |
| 19.00   | 0.031                  | 0.047 | 0.062 | 0.078 | 0.094 | 0.109 | 0.125 | 0.141 | 0.156 | 0.172 | 0.188 | 0.203 | 0.219 | 0.235 | 0.250 | 0.266 |
| 19.50   | 0.030                  | 0.046 | 0.061 | 0.077 | 0.092 | 0.107 | 0.123 | 0.138 | 0.154 | 0.169 | 0.184 | 0.200 | 0.215 | 0.231 | 0.246 | 0.261 |
| 20.00   | 0.030                  | 0.045 | 0.060 | 0.075 | 0.091 | 0.106 | 0.121 | 0.136 | 0.151 | 0.166 | 0.182 | 0.197 | 0.212 | 0.227 | 0.242 | 0.257 |

# CURVE INFORMATION AND TABLES



## Curve: Extremely Inverse

| Curve#: | 17                     | 18      | 19      | 20      | 21      | 22      | 23      | 24      | 25      | 26      | 27      | 28      | 29      | 30      | 31      | 32      |
|---------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| × P/U   | Time to trip (seconds) |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 1.03    | 109.225                | 121.361 | 121.361 | 121.361 | 136.531 | 136.531 | 156.036 | 156.036 | 156.036 | 156.036 | 182.042 | 182.042 | 182.042 | 182.042 | 182.042 | 218.450 |
| 1.10    | 84.019                 | 91.021  | 99.295  | 99.295  | 109.225 | 109.225 | 109.225 | 121.361 | 121.361 | 121.361 | 136.531 | 136.531 | 136.531 | 156.036 | 156.036 | 156.036 |
| 1.20    | 64.250                 | 68.266  | 68.266  | 72.817  | 78.018  | 78.018  | 84.019  | 91.021  | 91.021  | 91.021  | 99.295  | 99.295  | 109.225 | 109.225 | 109.225 | 121.361 |
| 1.30    | 47.489                 | 52.012  | 54.613  | 57.487  | 57.487  | 60.681  | 64.250  | 68.266  | 68.266  | 72.817  | 72.817  | 78.018  | 78.018  | 84.019  | 84.019  | 91.021  |
| 1.40    | 37.664                 | 40.454  | 42.010  | 43.690  | 47.489  | 49.648  | 52.012  | 52.012  | 54.613  | 57.487  | 60.681  | 60.681  | 64.250  | 64.250  | 68.266  | 68.266  |
| 1.50    | 31.207                 | 33.098  | 34.133  | 36.408  | 37.664  | 39.009  | 42.010  | 43.690  | 45.510  | 45.510  | 47.489  | 49.648  | 52.012  | 54.613  | 54.613  | 57.487  |
| 1.60    | 25.401                 | 27.306  | 28.743  | 29.520  | 31.207  | 33.098  | 34.133  | 35.234  | 36.408  | 39.009  | 40.454  | 42.010  | 42.010  | 43.690  | 45.510  | 47.489  |
| 1.70    | 21.417                 | 22.755  | 23.745  | 25.401  | 26.640  | 27.306  | 28.743  | 30.340  | 31.207  | 32.125  | 33.098  | 35.234  | 36.408  | 37.664  | 37.664  | 39.009  |
| 1.80    | 18.513                 | 19.504  | 20.608  | 21.417  | 22.291  | 23.745  | 24.272  | 25.401  | 26.640  | 27.306  | 28.743  | 29.520  | 30.340  | 32.125  | 33.098  | 34.133  |
| 1.90    | 15.830                 | 16.804  | 17.617  | 18.513  | 19.504  | 20.227  | 21.005  | 21.845  | 22.755  | 23.745  | 24.824  | 25.401  | 26.640  | 27.306  | 28.006  | 28.743  |
| 2.00    | 13.826                 | 14.563  | 15.384  | 16.063  | 17.066  | 17.617  | 18.513  | 19.162  | 19.859  | 20.688  | 21.417  | 22.291  | 23.239  | 23.745  | 24.824  | 25.401  |
| 2.10    | 12.136                 | 12.850  | 13.485  | 14.185  | 14.962  | 15.604  | 16.302  | 17.066  | 17.617  | 18.204  | 18.832  | 19.504  | 20.227  | 21.005  | 21.845  | 22.291  |
| 2.20    | 10.814                 | 11.378  | 12.003  | 12.701  | 13.320  | 13.826  | 14.372  | 14.962  | 15.604  | 16.302  | 16.804  | 17.337  | 18.204  | 18.513  | 19.162  | 19.859  |
| 2.30    | 9.666                  | 10.208  | 10.708  | 11.260  | 11.872  | 12.412  | 12.850  | 13.485  | 14.003  | 14.563  | 15.170  | 15.604  | 16.063  | 16.804  | 17.337  | 17.617  |
| 2.40    | 8.738                  | 9.179   | 9.666   | 10.208  | 10.604  | 11.145  | 11.620  | 12.136  | 12.555  | 13.003  | 13.485  | 14.003  | 14.563  | 14.962  | 15.384  | 16.063  |
| 2.50    | 7.858                  | 8.338   | 8.738   | 9.179   | 9.666   | 10.113  | 10.502  | 10.923  | 11.378  | 11.872  | 12.272  | 12.701  | 13.160  | 13.653  | 14.003  | 14.372  |
| 2.60    | 7.186                  | 7.585   | 7.973   | 8.338   | 8.738   | 9.179   | 9.581   | 9.930   | 10.304  | 10.708  | 11.145  | 11.497  | 12.003  | 12.412  | 12.701  | 13.160  |
| 2.70    | 6.540                  | 6.913   | 7.282   | 7.638   | 7.973   | 8.338   | 8.738   | 9.102   | 9.416   | 9.840   | 10.208  | 10.502  | 10.923  | 11.260  | 11.620  | 12.003  |
| 2.80    | 6.001                  | 6.350   | 6.660   | 7.002   | 7.331   | 7.692   | 8.031   | 8.338   | 8.669   | 9.027   | 9.335   | 9.666   | 10.021  | 10.304  | 10.708  | 11.033  |
| 2.90    | 5.516                  | 5.841   | 6.136   | 6.463   | 6.742   | 7.047   | 7.380   | 7.692   | 7.973   | 8.275   | 8.600   | 8.880   | 9.256   | 9.498   | 9.840   | 10.113  |
| 3.00    | 5.104                  | 5.407   | 5.689   | 5.969   | 6.241   | 6.540   | 6.827   | 7.093   | 7.380   | 7.692   | 7.973   | 8.212   | 8.533   | 8.808   | 9.102   | 9.335   |
| 3.10    | 4.749                  | 5.010   | 5.277   | 5.544   | 5.810   | 6.068   | 6.314   | 6.580   | 6.869   | 7.093   | 7.380   | 7.638   | 7.915   | 8.151   | 8.402   | 8.669   |
| 3.20    | 4.404                  | 4.648   | 4.898   | 5.152   | 5.381   | 5.630   | 5.872   | 6.136   | 6.387   | 6.620   | 6.869   | 7.093   | 7.331   | 7.585   | 7.858   | 8.091   |
| 3.30    | 4.106                  | 4.334   | 4.570   | 4.791   | 5.033   | 5.251   | 5.489   | 5.719   | 5.936   | 6.171   | 6.387   | 6.620   | 6.869   | 7.093   | 7.331   | 7.533   |
| 3.40    | 3.846                  | 4.060   | 4.283   | 4.495   | 4.708   | 4.920   | 5.128   | 5.354   | 5.573   | 5.779   | 6.001   | 6.206   | 6.425   | 6.620   | 6.827   | 7.047   |
| 3.50    | 3.605                  | 3.806   | 4.016   | 4.217   | 4.404   | 4.609   | 4.812   | 5.010   | 5.201   | 5.407   | 5.601   | 5.810   | 6.001   | 6.206   | 6.425   | 6.620   |
| 3.60    | 3.392                  | 3.581   | 3.766   | 3.957   | 4.153   | 4.334   | 4.513   | 4.708   | 4.898   | 5.080   | 5.277   | 5.461   | 5.659   | 5.841   | 6.035   | 6.206   |
| 3.70    | 3.194                  | 3.371   | 3.546   | 3.728   | 3.901   | 4.076   | 4.267   | 4.440   | 4.609   | 4.791   | 4.965   | 5.152   | 5.328   | 5.516   | 5.689   | 5.872   |
| 3.80    | 3.017                  | 3.184   | 3.350   | 3.523   | 3.690   | 3.860   | 4.016   | 4.185   | 4.352   | 4.532   | 4.688   | 4.854   | 5.033   | 5.201   | 5.354   | 5.544   |
| 3.90    | 2.852                  | 3.009   | 3.166   | 3.330   | 3.490   | 3.641   | 3.806   | 3.957   | 4.122   | 4.283   | 4.440   | 4.589   | 4.749   | 4.920   | 5.080   | 5.226   |
| 4.00    | 2.704                  | 2.852   | 3.001   | 3.157   | 3.300   | 3.456   | 3.605   | 3.753   | 3.901   | 4.060   | 4.201   | 4.352   | 4.513   | 4.648   | 4.812   | 4.965   |
| 4.10    | 2.564                  | 2.704   | 2.852   | 2.992   | 3.139   | 3.280   | 3.424   | 3.558   | 3.703   | 3.846   | 3.986   | 4.137   | 4.283   | 4.422   | 4.570   | 4.708   |
| 4.20    | 2.438                  | 2.576   | 2.710   | 2.844   | 2.976   | 3.112   | 3.251   | 3.382   | 3.523   | 3.653   | 3.793   | 3.929   | 4.060   | 4.201   | 4.334   | 4.476   |
| 4.30    | 2.319                  | 2.449   | 2.582   | 2.710   | 2.837   | 2.968   | 3.094   | 3.222   | 3.350   | 3.479   | 3.617   | 3.741   | 3.873   | 4.001   | 4.122   | 4.250   |
| 4.40    | 2.211                  | 2.334   | 2.460   | 2.582   | 2.704   | 2.830   | 2.952   | 3.077   | 3.194   | 3.320   | 3.446   | 3.569   | 3.690   | 3.819   | 3.943   | 4.060   |
| 4.50    | 2.113                  | 2.229   | 2.349   | 2.466   | 2.582   | 2.704   | 2.815   | 2.936   | 3.051   | 3.175   | 3.290   | 3.403   | 3.523   | 3.641   | 3.753   | 3.873   |
| 4.60    | 2.019                  | 2.133   | 2.247   | 2.359   | 2.471   | 2.582   | 2.697   | 2.808   | 2.920   | 3.034   | 3.148   | 3.260   | 3.371   | 3.479   | 3.593   | 3.703   |
| 4.70    | 1.933                  | 2.042   | 2.150   | 2.257   | 2.364   | 2.471   | 2.582   | 2.690   | 2.793   | 2.905   | 3.009   | 3.121   | 3.222   | 3.330   | 3.446   | 3.546   |
| 4.80    | 1.854                  | 1.957   | 2.061   | 2.163   | 2.266   | 2.369   | 2.471   | 2.576   | 2.677   | 2.786   | 2.890   | 2.992   | 3.094   | 3.194   | 3.300   | 3.403   |
| 4.90    | 1.779                  | 1.880   | 1.979   | 2.077   | 2.176   | 2.276   | 2.374   | 2.471   | 2.570   | 2.671   | 2.772   | 2.867   | 2.968   | 3.068   | 3.166   | 3.260   |
| 5.00    | 1.709                  | 1.805   | 1.900   | 1.997   | 2.092   | 2.185   | 2.280   | 2.374   | 2.471   | 2.564   | 2.664   | 2.758   | 2.852   | 2.944   | 3.042   | 3.139   |
| 5.10    | 1.645                  | 1.736   | 1.827   | 1.920   | 2.012   | 2.100   | 2.193   | 2.285   | 2.374   | 2.466   | 2.558   | 2.651   | 2.744   | 2.837   | 2.928   | 3.017   |
| 5.20    | 1.583                  | 1.673   | 1.759   | 1.848   | 1.937   | 2.023   | 2.113   | 2.202   | 2.290   | 2.374   | 2.466   | 2.552   | 2.638   | 2.731   | 2.815   | 2.905   |
| 5.30    | 1.525                  | 1.611   | 1.696   | 1.782   | 1.867   | 1.950   | 2.034   | 2.121   | 2.207   | 2.290   | 2.374   | 2.460   | 2.546   | 2.632   | 2.717   | 2.801   |
| 5.40    | 1.472                  | 1.554   | 1.635   | 1.717   | 1.799   | 1.883   | 1.964   | 2.045   | 2.129   | 2.211   | 2.290   | 2.374   | 2.454   | 2.534   | 2.619   | 2.704   |
| 5.50    | 1.422                  | 1.500   | 1.581   | 1.660   | 1.736   | 1.817   | 1.896   | 1.975   | 2.053   | 2.133   | 2.211   | 2.290   | 2.369   | 2.449   | 2.528   | 2.607   |
| 5.60    | 1.374                  | 1.451   | 1.528   | 1.604   | 1.680   | 1.756   | 1.833   | 1.910   | 1.986   | 2.061   | 2.137   | 2.216   | 2.290   | 2.369   | 2.444   | 2.523   |
| 5.70    | 1.329                  | 1.402   | 1.476   | 1.551   | 1.625   | 1.699   | 1.773   | 1.845   | 1.920   | 1.993   | 2.069   | 2.142   | 2.216   | 2.290   | 2.364   | 2.438   |
| 5.80    | 1.287                  | 1.359   | 1.430   | 1.500   | 1.572   | 1.645   | 1.715   | 1.788   | 1.858   | 1.930   | 2.000   | 2.073   | 2.146   | 2.216   | 2.290   | 2.359   |
| 5.90    | 1.245                  | 1.316   | 1.384   | 1.454   | 1.523   | 1.592   | 1.662   | 1.731   | 1.799   | 1.870   | 1.940   | 2.008   | 2.077   | 2.146   | 2.216   | 2.285   |
| 6.00    | 1.208                  | 1.276   | 1.342   | 1.409   | 1.476   | 1.545   | 1.611   | 1.678   | 1.745   | 1.814   | 1.880   | 1.947   | 2.015   | 2.080   | 2.150   | 2.216   |
| 6.50    | 1.046                  | 1.104   | 1.162   | 1.220   | 1.279   | 1.337   | 1.395   | 1.452   | 1.511   | 1.569   | 1.628   | 1.686   | 1.745   | 1.802   | 1.861   | 1.920   |
| 7.00    | 0.919                  | 0.971   | 1.022   | 1.073   | 1.124   | 1.176   | 1.226   | 1.277   | 1.329   | 1.379   | 1.432   | 1.482   | 1.534   | 1.585   | 1.635   | 1.686   |
| 7.50    | 0.819                  | 0.865   | 0.910   | 0.956   | 1.001   | 1.047   | 1.092   | 1.138   | 1.183   | 1.229   | 1.275   | 1.321   | 1.365   | 1.411   | 1.456   | 1.502   |
| 8.00    | 0.739                  | 0.780   | 0.821   | 0.861   | 0.903   | 0.944   | 0.985   | 1.026   | 1.067   | 1.108   | 1.149   | 1.190   | 1.231   | 1.272   | 1.313   | 1.353   |
| 8.50    | 0.672                  | 0.710   | 0.747   | 0.784   | 0.822   | 0.859   | 0.897   | 0.934   | 0.971   | 1.009   | 1.046   | 1.084   | 1.120   | 1.158   | 1.195   | 1.233   |
| 9.00    | 0.617                  | 0.652   | 0.686   | 0.720   | 0.755   | 0.789   | 0.823   | 0.857   | 0.892   | 0.926   | 0.961   | 0.995   | 1.029   | 1.064   | 1.098   | 1.132   |
| 9.50    | 0.571                  | 0.603   | 0.635   | 0.667   | 0.698   | 0.730   | 0.762   | 0.794   | 0.826   | 0.857   | 0.889   | 0.921   | 0.952   | 0.984   | 1.016   | 1.048   |
| 10.00   | 0.532                  | 0.562   | 0.592   | 0.621   | 0.651   | 0.681   | 0.710   | 0.740   | 0.769   | 0.799   | 0.829   | 0.858   | 0.888   | 0.917   | 0.947   | 0.977   |
| 10.50   | 0.499                  | 0.527   | 0.555   | 0.583   | 0.610   | 0.638   | 0.666   | 0.693   | 0.721   | 0.749   | 0.777   | 0.804   | 0.833   | 0.860   | 0.888   | 0.916   |
| 11.00   | 0.471                  | 0.497   | 0.523   | 0.549   | 0.575   | 0.601   | 0.628   | 0.654   | 0.680   | 0.706   | 0.733   | 0.759   | 0.785   | 0.811   | 0.837   | 0.863   |
| 11.50   | 0.446                  | 0.471   | 0.495   | 0.520   | 0.545   | 0.570   | 0.595   | 0.620   | 0.644   | 0.669   | 0.694   | 0.719   | 0.744   | 0.768   | 0.793   | 0.818   |
| 12.00   | 0.424                  | 0.448   | 0.471   | 0.495   | 0.519   | 0.542   | 0.566   | 0.589   | 0.613   | 0.637   | 0.660   | 0.684   | 0.707   | 0.731   | 0.754   | 0.778   |
| 12.50   | 0.405                  | 0.428   | 0.450   | 0.473   | 0.495   | 0.518   | 0.540   | 0.563   | 0.586   | 0.608   | 0.631   | 0.653   | 0.676   | 0.698   | 0.721   | 0.744   |

**Curve: Extremely Inverse**

| Curve#: | 17                     | 18    | 19    | 20    | 21    | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|---------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| × P/U   | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.00   | 0.389                  | 0.410 | 0.432 | 0.453 | 0.475 | 0.496 | 0.518 | 0.540 | 0.561 | 0.583 | 0.604 | 0.626 | 0.648 | 0.669 | 0.691 | 0.712 |
| 13.50   | 0.374                  | 0.394 | 0.415 | 0.436 | 0.457 | 0.478 | 0.498 | 0.519 | 0.540 | 0.561 | 0.582 | 0.602 | 0.623 | 0.644 | 0.665 | 0.685 |
| 14.00   | 0.360                  | 0.380 | 0.401 | 0.421 | 0.441 | 0.461 | 0.481 | 0.501 | 0.521 | 0.541 | 0.561 | 0.581 | 0.601 | 0.621 | 0.641 | 0.661 |
| 14.50   | 0.349                  | 0.368 | 0.387 | 0.407 | 0.426 | 0.445 | 0.465 | 0.484 | 0.504 | 0.523 | 0.543 | 0.562 | 0.581 | 0.601 | 0.620 | 0.639 |
| 15.00   | 0.338                  | 0.357 | 0.376 | 0.394 | 0.413 | 0.432 | 0.451 | 0.470 | 0.488 | 0.507 | 0.526 | 0.545 | 0.564 | 0.582 | 0.601 | 0.620 |
| 15.50   | 0.328                  | 0.347 | 0.365 | 0.383 | 0.401 | 0.420 | 0.438 | 0.456 | 0.474 | 0.493 | 0.511 | 0.529 | 0.547 | 0.566 | 0.584 | 0.602 |
| 16.00   | 0.320                  | 0.338 | 0.355 | 0.373 | 0.391 | 0.409 | 0.426 | 0.444 | 0.462 | 0.480 | 0.498 | 0.515 | 0.533 | 0.551 | 0.569 | 0.586 |
| 16.50   | 0.312                  | 0.329 | 0.347 | 0.364 | 0.381 | 0.398 | 0.416 | 0.433 | 0.451 | 0.468 | 0.485 | 0.503 | 0.520 | 0.537 | 0.555 | 0.572 |
| 17.00   | 0.305                  | 0.322 | 0.339 | 0.355 | 0.372 | 0.389 | 0.406 | 0.423 | 0.440 | 0.457 | 0.474 | 0.491 | 0.508 | 0.525 | 0.542 | 0.559 |
| 17.50   | 0.298                  | 0.315 | 0.331 | 0.348 | 0.364 | 0.381 | 0.398 | 0.414 | 0.431 | 0.447 | 0.464 | 0.481 | 0.497 | 0.514 | 0.530 | 0.547 |
| 18.00   | 0.292                  | 0.308 | 0.325 | 0.341 | 0.357 | 0.373 | 0.390 | 0.406 | 0.422 | 0.438 | 0.455 | 0.471 | 0.487 | 0.503 | 0.520 | 0.536 |
| 18.50   | 0.287                  | 0.303 | 0.319 | 0.334 | 0.350 | 0.366 | 0.382 | 0.398 | 0.414 | 0.430 | 0.446 | 0.462 | 0.478 | 0.494 | 0.510 | 0.526 |
| 19.00   | 0.282                  | 0.297 | 0.313 | 0.328 | 0.344 | 0.360 | 0.375 | 0.391 | 0.407 | 0.423 | 0.438 | 0.454 | 0.470 | 0.485 | 0.501 | 0.516 |
| 19.50   | 0.277                  | 0.292 | 0.308 | 0.323 | 0.338 | 0.354 | 0.369 | 0.385 | 0.400 | 0.415 | 0.431 | 0.446 | 0.462 | 0.477 | 0.492 | 0.508 |
| 20.00   | 0.273                  | 0.288 | 0.303 | 0.318 | 0.333 | 0.348 | 0.364 | 0.379 | 0.394 | 0.409 | 0.424 | 0.439 | 0.455 | 0.470 | 0.485 | 0.500 |

# CURVE INFORMATION AND TABLES



Curve: IEC A

| Curve #: | 1                      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      |
|----------|------------------------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|
| x P/U    | Time to trip (seconds) |        |        |        |        |        |        |        |         |         |         |         |         |         |         |         |
| 1.03     | 11.872                 | 23.745 | 35.234 | 47.489 | 60.681 | 72.817 | 84.019 | 91.021 | 109.225 | 121.361 | 136.531 | 136.531 | 156.036 | 156.036 | 182.042 | 182.042 |
| 1.10     | 3.665                  | 7.331  | 11.033 | 14.760 | 18.204 | 21.845 | 25.401 | 29.520 | 33.098  | 36.408  | 40.454  | 43.690  | 47.489  | 52.012  | 54.613  | 57.487  |
| 1.20     | 1.916                  | 3.832  | 5.749  | 7.638  | 9.581  | 11.497 | 13.485 | 15.384 | 17.337  | 19.162  | 21.005  | 22.755  | 24.824  | 26.640  | 28.743  | 30.340  |
| 1.30     | 1.330                  | 2.664  | 3.986  | 5.328  | 6.660  | 7.973  | 9.335  | 10.604 | 12.003  | 13.320  | 14.563  | 16.063  | 17.337  | 18.513  | 19.859  | 21.417  |
| 1.40     | 1.036                  | 2.073  | 3.112  | 4.153  | 5.177  | 6.206  | 7.233  | 8.275  | 9.335   | 10.402  | 11.378  | 12.412  | 13.485  | 14.563  | 15.604  | 16.549  |
| 1.50     | 0.860                  | 1.720  | 2.582  | 3.435  | 4.300  | 5.152  | 6.035  | 6.869  | 7.746   | 8.600   | 9.498   | 10.304  | 11.145  | 12.003  | 12.850  | 13.826  |
| 1.60     | 0.741                  | 1.482  | 2.225  | 2.968  | 3.703  | 4.440  | 5.177  | 5.936  | 6.660   | 7.430   | 8.151   | 8.880   | 9.666   | 10.402  | 11.145  | 11.872  |
| 1.70     | 0.656                  | 1.313  | 1.968  | 2.626  | 3.280  | 3.943  | 4.589  | 5.251  | 5.904   | 6.580   | 7.233   | 7.858   | 8.533   | 9.179   | 9.840   | 10.502  |
| 1.80     | 0.592                  | 1.183  | 1.776  | 2.369  | 2.960  | 3.546  | 4.137  | 4.728  | 5.328   | 5.904   | 6.501   | 7.093   | 7.692   | 8.275   | 8.880   | 9.498   |
| 1.90     | 0.542                  | 1.084  | 1.625  | 2.167  | 2.710  | 3.251  | 3.793  | 4.334  | 4.876   | 5.407   | 5.969   | 6.501   | 7.047   | 7.585   | 8.151   | 8.669   |
| 2.00     | 0.501                  | 1.003  | 1.504  | 2.004  | 2.505  | 3.009  | 3.512  | 4.016  | 4.513   | 5.010   | 5.516   | 6.001   | 6.501   | 7.002   | 7.533   | 8.031   |
| 2.10     | 0.468                  | 0.937  | 1.404  | 1.873  | 2.339  | 2.808  | 3.280  | 3.741  | 4.217   | 4.688   | 5.152   | 5.630   | 6.102   | 6.540   | 7.002   | 7.481   |
| 2.20     | 0.440                  | 0.881  | 1.321  | 1.762  | 2.202  | 2.645  | 3.085  | 3.523  | 3.957   | 4.404   | 4.854   | 5.277   | 5.719   | 6.171   | 6.620   | 7.047   |
| 2.30     | 0.417                  | 0.833  | 1.250  | 1.668  | 2.084  | 2.499  | 2.920  | 3.330  | 3.753   | 4.169   | 4.589   | 5.010   | 5.407   | 5.841   | 6.241   | 6.660   |
| 2.40     | 0.396                  | 0.793  | 1.189  | 1.585  | 1.982  | 2.380  | 2.772  | 3.166  | 3.569   | 3.957   | 4.352   | 4.749   | 5.152   | 5.544   | 5.936   | 6.350   |
| 2.50     | 0.378                  | 0.757  | 1.135  | 1.515  | 1.893  | 2.271  | 2.651  | 3.026  | 3.403   | 3.779   | 4.169   | 4.551   | 4.920   | 5.302   | 5.689   | 6.068   |
| 2.60     | 0.363                  | 0.726  | 1.088  | 1.451  | 1.814  | 2.176  | 2.540  | 2.905  | 3.260   | 3.629   | 3.986   | 4.352   | 4.708   | 5.080   | 5.434   | 5.810   |
| 2.70     | 0.349                  | 0.698  | 1.046  | 1.395  | 1.745  | 2.092  | 2.444  | 2.793  | 3.139   | 3.490   | 3.832   | 4.185   | 4.532   | 4.876   | 5.226   | 5.573   |
| 2.80     | 0.336                  | 0.673  | 1.009  | 1.345  | 1.683  | 2.019  | 2.354  | 2.690  | 3.026   | 3.361   | 3.703   | 4.030   | 4.369   | 4.708   | 5.057   | 5.381   |
| 2.90     | 0.325                  | 0.651  | 0.976  | 1.300  | 1.625  | 1.950  | 2.276  | 2.601  | 2.928   | 3.251   | 3.581   | 3.901   | 4.234   | 4.551   | 4.876   | 5.201   |
| 3.00     | 0.315                  | 0.630  | 0.946  | 1.260  | 1.576  | 1.890  | 2.207  | 2.523  | 2.837   | 3.148   | 3.467   | 3.779   | 4.091   | 4.404   | 4.728   | 5.033   |
| 3.10     | 0.306                  | 0.612  | 0.918  | 1.223  | 1.530  | 1.836  | 2.142  | 2.449  | 2.751   | 3.060   | 3.361   | 3.665   | 3.972   | 4.283   | 4.589   | 4.898   |
| 3.20     | 0.297                  | 0.595  | 0.892  | 1.190  | 1.488  | 1.785  | 2.080  | 2.380  | 2.677   | 2.976   | 3.270   | 3.569   | 3.873   | 4.169   | 4.458   | 4.749   |
| 3.30     | 0.290                  | 0.579  | 0.869  | 1.158  | 1.449  | 1.739  | 2.026  | 2.319  | 2.607   | 2.897   | 3.184   | 3.479   | 3.766   | 4.060   | 4.352   | 4.628   |
| 3.40     | 0.283                  | 0.565  | 0.847  | 1.130  | 1.413  | 1.696  | 1.979  | 2.261  | 2.540   | 2.822   | 3.112   | 3.392   | 3.678   | 3.957   | 4.234   | 4.513   |
| 3.50     | 0.276                  | 0.552  | 0.827  | 1.103  | 1.379  | 1.655  | 1.930  | 2.207  | 2.482   | 2.758   | 3.034   | 3.310   | 3.581   | 3.860   | 4.137   | 4.422   |
| 3.60     | 0.270                  | 0.539  | 0.809  | 1.079  | 1.348  | 1.618  | 1.890  | 2.159  | 2.427   | 2.697   | 2.968   | 3.241   | 3.512   | 3.779   | 4.045   | 4.317   |
| 3.70     | 0.264                  | 0.528  | 0.792  | 1.056  | 1.321  | 1.585  | 1.848  | 2.113  | 2.374   | 2.638   | 2.905   | 3.166   | 3.435   | 3.703   | 3.957   | 4.217   |
| 3.80     | 0.259                  | 0.517  | 0.776  | 1.034  | 1.294  | 1.551  | 1.811  | 2.069  | 2.329   | 2.588   | 2.844   | 3.103   | 3.361   | 3.617   | 3.887   | 4.137   |
| 3.90     | 0.254                  | 0.507  | 0.761  | 1.015  | 1.269  | 1.521  | 1.776  | 2.030  | 2.285   | 2.534   | 2.793   | 3.042   | 3.300   | 3.546   | 3.806   | 4.060   |
| 4.00     | 0.249                  | 0.498  | 0.747  | 0.996  | 1.245  | 1.494  | 1.742  | 1.993  | 2.243   | 2.488   | 2.737   | 2.984   | 3.241   | 3.490   | 3.741   | 3.986   |
| 4.10     | 0.245                  | 0.489  | 0.734  | 0.978  | 1.223  | 1.468  | 1.712  | 1.957  | 2.202   | 2.444   | 2.690   | 2.936   | 3.175   | 3.424   | 3.665   | 3.915   |
| 4.20     | 0.240                  | 0.481  | 0.721  | 0.961  | 1.202  | 1.443  | 1.683  | 1.923  | 2.163   | 2.406   | 2.645   | 2.882   | 3.130   | 3.361   | 3.605   | 3.846   |
| 4.30     | 0.236                  | 0.473  | 0.709  | 0.946  | 1.182  | 1.419  | 1.655  | 1.893  | 2.129   | 2.364   | 2.601   | 2.837   | 3.077   | 3.310   | 3.546   | 3.779   |
| 4.40     | 0.233                  | 0.466  | 0.698  | 0.931  | 1.163  | 1.397  | 1.630  | 1.861  | 2.096   | 2.329   | 2.558   | 2.793   | 3.026   | 3.260   | 3.490   | 3.728   |
| 4.50     | 0.229                  | 0.458  | 0.688  | 0.917  | 1.146  | 1.376  | 1.604  | 1.833  | 2.065   | 2.290   | 2.523   | 2.751   | 2.976   | 3.213   | 3.435   | 3.665   |
| 4.60     | 0.226                  | 0.452  | 0.678  | 0.903  | 1.130  | 1.355  | 1.581  | 1.808  | 2.034   | 2.257   | 2.482   | 2.710   | 2.936   | 3.166   | 3.392   | 3.617   |
| 4.70     | 0.223                  | 0.445  | 0.668  | 0.891  | 1.113  | 1.335  | 1.558  | 1.782  | 2.004   | 2.225   | 2.449   | 2.671   | 2.897   | 3.121   | 3.340   | 3.558   |
| 4.80     | 0.220                  | 0.439  | 0.659  | 0.879  | 1.098  | 1.318  | 1.538  | 1.756  | 1.975   | 2.198   | 2.416   | 2.638   | 2.852   | 3.077   | 3.290   | 3.512   |
| 4.90     | 0.217                  | 0.433  | 0.650  | 0.867  | 1.084  | 1.300  | 1.517  | 1.734  | 1.950   | 2.167   | 2.385   | 2.601   | 2.815   | 3.034   | 3.251   | 3.467   |
| 5.00     | 0.214                  | 0.428  | 0.642  | 0.856  | 1.070  | 1.283  | 1.498  | 1.712  | 1.926   | 2.142   | 2.354   | 2.570   | 2.779   | 2.992   | 3.213   | 3.424   |
| 5.10     | 0.211                  | 0.423  | 0.634  | 0.845  | 1.056  | 1.269  | 1.480  | 1.691  | 1.903   | 2.113   | 2.324   | 2.534   | 2.744   | 2.960   | 3.166   | 3.382   |
| 5.20     | 0.209                  | 0.418  | 0.626  | 0.835  | 1.044  | 1.253  | 1.462  | 1.670  | 1.880   | 2.088   | 2.295   | 2.505   | 2.717   | 2.920   | 3.130   | 3.340   |
| 5.30     | 0.206                  | 0.413  | 0.619  | 0.826  | 1.032  | 1.238  | 1.445  | 1.650  | 1.858   | 2.065   | 2.271   | 2.477   | 2.684   | 2.890   | 3.094   | 3.300   |
| 5.40     | 0.204                  | 0.408  | 0.612  | 0.816  | 1.020  | 1.224  | 1.428  | 1.633  | 1.836   | 2.042   | 2.243   | 2.449   | 2.651   | 2.859   | 3.060   | 3.260   |
| 5.50     | 0.202                  | 0.404  | 0.605  | 0.807  | 1.009  | 1.211  | 1.413  | 1.616  | 1.817   | 2.019   | 2.220   | 2.422   | 2.626   | 2.822   | 3.026   | 3.232   |
| 5.60     | 0.200                  | 0.399  | 0.599  | 0.799  | 0.998  | 1.198  | 1.399  | 1.597  | 1.796   | 1.997   | 2.198   | 2.395   | 2.594   | 2.793   | 2.992   | 3.194   |
| 5.70     | 0.198                  | 0.395  | 0.593  | 0.790  | 0.988  | 1.186  | 1.383  | 1.581  | 1.779   | 1.975   | 2.176   | 2.369   | 2.570   | 2.765   | 2.968   | 3.166   |
| 5.80     | 0.196                  | 0.391  | 0.587  | 0.782  | 0.978  | 1.173  | 1.369  | 1.565  | 1.762   | 1.957   | 2.150   | 2.349   | 2.546   | 2.737   | 2.936   | 3.130   |
| 5.90     | 0.194                  | 0.387  | 0.581  | 0.775  | 0.968  | 1.162  | 1.355  | 1.549  | 1.742   | 1.937   | 2.129   | 2.324   | 2.517   | 2.710   | 2.905   | 3.103   |
| 6.00     | 0.192                  | 0.384  | 0.575  | 0.768  | 0.959  | 1.151  | 1.343  | 1.534  | 1.726   | 1.920   | 2.109   | 2.304   | 2.494   | 2.684   | 2.874   | 3.068   |
| 6.50     | 0.184                  | 0.367  | 0.551  | 0.734  | 0.918  | 1.101  | 1.285  | 1.468  | 1.652   | 1.836   | 2.019   | 2.202   | 2.385   | 2.570   | 2.751   | 2.936   |
| 7.00     | 0.176                  | 0.353  | 0.529  | 0.706  | 0.882  | 1.058  | 1.234  | 1.411  | 1.588   | 1.765   | 1.940   | 2.117   | 2.295   | 2.471   | 2.645   | 2.822   |
| 7.50     | 0.170                  | 0.340  | 0.511  | 0.681  | 0.851  | 1.022  | 1.191  | 1.362  | 1.532   | 1.701   | 1.873   | 2.042   | 2.211   | 2.385   | 2.552   | 2.724   |
| 8.00     | 0.165                  | 0.330  | 0.494  | 0.659  | 0.824  | 0.989  | 1.153  | 1.319  | 1.484   | 1.647   | 1.814   | 1.979   | 2.142   | 2.309   | 2.471   | 2.638   |
| 8.50     | 0.160                  | 0.320  | 0.480  | 0.640  | 0.800  | 0.961  | 1.120  | 1.280  | 1.441   | 1.602   | 1.762   | 1.920   | 2.080   | 2.243   | 2.401   | 2.564   |
| 9.00     | 0.156                  | 0.312  | 0.467  | 0.623  | 0.779  | 0.935  | 1.091  | 1.247  | 1.402   | 1.558   | 1.715   | 1.870   | 2.026   | 2.180   | 2.339   | 2.494   |
| 9.50     | 0.152                  | 0.304  | 0.456  | 0.608  | 0.760  | 0.912  | 1.064  | 1.216  | 1.369   | 1.519   | 1.673   | 1.823   | 1.975   | 2.129   | 2.280   | 2.433   |
| 10.00    | 0.149                  | 0.297  | 0.446  | 0.594  | 0.743  | 0.891  | 1.039  | 1.189  | 1.337   | 1.486   | 1.633   | 1.782   | 1.930   | 2.080   | 2.229   | 2.374   |
| 10.50    | 0.145                  | 0.291  | 0.436  | 0.582  | 0.727  | 0.872  | 1.018  | 1.163  | 1.308   | 1.454   | 1.599   | 1.745   | 1.890   | 2.034   | 2.180   | 2.324   |
| 11.00    | 0.142                  | 0.285  | 0.427  | 0.570  | 0.712  | 0.855  | 0.997  | 1.140  | 1.282   | 1.424   | 1.567   | 1.709   | 1.851   | 1.993   | 2.137   | 2.280   |
| 11.50    | 0.140                  | 0.280  | 0.419  | 0.559  | 0.699  | 0.839  | 0.979  | 1.119  | 1.258   | 1.399   | 1.538   | 1.678   | 1.817   | 1.957   | 2.096   | 2.238   |
| 12.00    | 0.137                  | 0.275  | 0.412  | 0.549  | 0.687  | 0.824  | 0.961  | 1.099  | 1.237   | 1.374   | 1.511   | 1.647   | 1.785   | 1.923   | 2.061   | 2.198   |
| 12.50    | 0.135                  | 0.270  | 0.405  | 0.540  | 0.675  | 0.811  | 0.946  | 1.080  | 1.216   | 1.352   | 1.486   | 1.621   | 1.756   | 1.893   | 2.026   | 2.163   |

**Curve: IEC A**

| Curve #: | 1                      | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|----------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| x P/U    | Time to trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.00    | 0.133                  | 0.266 | 0.399 | 0.532 | 0.665 | 0.798 | 0.931 | 1.064 | 1.196 | 1.330 | 1.462 | 1.597 | 1.728 | 1.861 | 1.993 | 2.129 |
| 13.50    | 0.131                  | 0.262 | 0.393 | 0.524 | 0.655 | 0.786 | 0.917 | 1.048 | 1.180 | 1.310 | 1.441 | 1.572 | 1.704 | 1.833 | 1.964 | 2.096 |
| 14.00    | 0.129                  | 0.258 | 0.387 | 0.517 | 0.646 | 0.775 | 0.904 | 1.033 | 1.162 | 1.291 | 1.420 | 1.549 | 1.678 | 1.808 | 1.937 | 2.065 |
| 14.50    | 0.127                  | 0.255 | 0.382 | 0.510 | 0.637 | 0.764 | 0.892 | 1.019 | 1.147 | 1.275 | 1.402 | 1.530 | 1.657 | 1.785 | 1.913 | 2.038 |
| 15.00    | 0.126                  | 0.252 | 0.377 | 0.503 | 0.629 | 0.755 | 0.880 | 1.006 | 1.132 | 1.258 | 1.384 | 1.509 | 1.635 | 1.762 | 1.886 | 2.012 |
| 15.50    | 0.124                  | 0.248 | 0.373 | 0.497 | 0.621 | 0.746 | 0.870 | 0.994 | 1.118 | 1.243 | 1.367 | 1.490 | 1.616 | 1.739 | 1.864 | 1.986 |
| 16.00    | 0.123                  | 0.246 | 0.368 | 0.491 | 0.614 | 0.737 | 0.859 | 0.982 | 1.104 | 1.227 | 1.350 | 1.474 | 1.597 | 1.720 | 1.842 | 1.964 |
| 16.50    | 0.121                  | 0.243 | 0.364 | 0.485 | 0.607 | 0.728 | 0.850 | 0.971 | 1.092 | 1.214 | 1.335 | 1.456 | 1.578 | 1.699 | 1.820 | 1.944 |
| 17.00    | 0.120                  | 0.240 | 0.360 | 0.480 | 0.600 | 0.720 | 0.840 | 0.961 | 1.080 | 1.200 | 1.321 | 1.441 | 1.560 | 1.680 | 1.802 | 1.920 |
| 17.50    | 0.119                  | 0.238 | 0.356 | 0.475 | 0.594 | 0.713 | 0.832 | 0.951 | 1.070 | 1.189 | 1.307 | 1.426 | 1.545 | 1.662 | 1.782 | 1.900 |
| 18.00    | 0.118                  | 0.235 | 0.353 | 0.471 | 0.588 | 0.706 | 0.823 | 0.941 | 1.058 | 1.176 | 1.294 | 1.411 | 1.530 | 1.647 | 1.765 | 1.883 |
| 18.50    | 0.116                  | 0.233 | 0.350 | 0.466 | 0.583 | 0.699 | 0.816 | 0.932 | 1.048 | 1.164 | 1.282 | 1.399 | 1.515 | 1.630 | 1.748 | 1.864 |
| 19.00    | 0.115                  | 0.231 | 0.346 | 0.462 | 0.577 | 0.693 | 0.808 | 0.923 | 1.038 | 1.155 | 1.270 | 1.384 | 1.500 | 1.616 | 1.731 | 1.845 |
| 19.50    | 0.114                  | 0.229 | 0.343 | 0.457 | 0.572 | 0.686 | 0.801 | 0.915 | 1.029 | 1.144 | 1.258 | 1.372 | 1.486 | 1.602 | 1.715 | 1.830 |
| 20.00    | 0.113                  | 0.227 | 0.340 | 0.453 | 0.567 | 0.680 | 0.794 | 0.907 | 1.020 | 1.134 | 1.247 | 1.360 | 1.474 | 1.588 | 1.701 | 1.814 |

# CURVE INFORMATION AND TABLES



Curve: IEC A

| Curve #: | 17                     | 18      | 19      | 20      | 21      | 22      | 23      | 24      | 25      | 26      | 27      | 28      | 29      | 30      | 31      | 32      |
|----------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| x P/U    | Time to Trip (seconds) |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 1.03     | 218.450                | 218.450 | 218.450 | 218.450 | 273.063 | 273.063 | 273.063 | 273.063 | 273.063 | 273.063 | 364.083 | 364.083 | 364.083 | 364.083 | 364.083 | 364.083 |
| 1.10     | 60.681                 | 64.250  | 68.266  | 72.817  | 78.018  | 78.018  | 84.019  | 91.021  | 91.021  | 99.295  | 99.295  | 99.295  | 109.225 | 109.225 | 109.225 | 121.361 |
| 1.20     | 32.125                 | 34.133  | 36.408  | 37.664  | 40.454  | 42.010  | 43.690  | 45.510  | 47.489  | 49.648  | 52.012  | 54.613  | 54.613  | 57.487  | 60.681  | 60.681  |
| 1.30     | 22.755                 | 23.745  | 25.401  | 26.640  | 28.006  | 29.520  | 30.340  | 32.125  | 33.098  | 34.133  | 36.408  | 37.664  | 39.009  | 40.454  | 42.010  | 42.010  |
| 1.40     | 17.617                 | 18.513  | 19.859  | 20.608  | 21.845  | 22.755  | 23.745  | 24.824  | 26.006  | 26.640  | 28.006  | 28.743  | 30.340  | 31.207  | 32.125  | 33.098  |
| 1.50     | 14.563                 | 15.384  | 16.302  | 17.066  | 18.204  | 18.832  | 19.859  | 20.608  | 21.417  | 22.291  | 23.239  | 24.272  | 24.824  | 26.006  | 26.640  | 27.306  |
| 1.60     | 12.555                 | 13.320  | 14.003  | 14.760  | 15.604  | 16.302  | 17.066  | 17.906  | 18.513  | 19.162  | 19.859  | 20.608  | 21.417  | 22.291  | 22.755  | 23.745  |
| 1.70     | 11.145                 | 11.872  | 12.412  | 13.160  | 13.826  | 14.372  | 15.170  | 15.830  | 16.302  | 17.066  | 17.617  | 18.513  | 19.162  | 19.859  | 20.227  | 21.005  |
| 1.80     | 10.021                 | 10.604  | 11.260  | 11.872  | 12.412  | 13.003  | 13.653  | 14.185  | 14.760  | 15.384  | 16.063  | 16.549  | 17.066  | 17.617  | 18.204  | 18.832  |
| 1.90     | 9.179                  | 9.752   | 10.304  | 10.814  | 11.378  | 11.872  | 12.412  | 13.003  | 13.485  | 14.003  | 14.563  | 15.170  | 15.604  | 16.302  | 16.804  | 17.337  |
| 2.00     | 8.533                  | 9.027   | 9.498   | 10.021  | 10.502  | 11.033  | 11.497  | 12.003  | 12.555  | 13.003  | 13.485  | 14.003  | 14.563  | 14.962  | 15.604  | 16.063  |
| 2.10     | 7.973                  | 8.402   | 8.880   | 9.335   | 9.840   | 10.304  | 10.814  | 11.260  | 11.745  | 12.136  | 12.701  | 13.160  | 13.653  | 14.003  | 14.563  | 14.962  |
| 2.20     | 7.481                  | 7.915   | 8.338   | 8.808   | 9.256   | 9.666   | 10.113  | 10.604  | 11.033  | 11.497  | 11.872  | 12.272  | 12.701  | 13.160  | 13.653  | 14.003  |
| 2.30     | 7.093                  | 7.481   | 7.915   | 8.338   | 8.738   | 9.179   | 9.581   | 10.021  | 10.402  | 10.814  | 11.260  | 11.620  | 12.136  | 12.555  | 12.850  | 13.320  |
| 2.40     | 6.742                  | 7.139   | 7.533   | 7.915   | 8.338   | 8.738   | 9.102   | 9.498   | 9.930   | 10.304  | 10.708  | 11.145  | 11.497  | 11.872  | 12.272  | 12.701  |
| 2.50     | 6.425                  | 6.827   | 7.186   | 7.585   | 7.973   | 8.338   | 8.738   | 9.102   | 9.498   | 9.840   | 10.208  | 10.604  | 10.923  | 11.378  | 11.745  | 12.136  |
| 2.60     | 6.171                  | 6.540   | 6.913   | 7.233   | 7.638   | 7.973   | 8.338   | 8.738   | 9.102   | 9.416   | 9.752   | 10.113  | 10.502  | 10.923  | 11.260  | 11.620  |
| 2.70     | 5.936                  | 6.277   | 6.620   | 6.957   | 7.331   | 7.692   | 8.031   | 8.402   | 8.738   | 9.102   | 9.416   | 9.752   | 10.113  | 10.502  | 10.814  | 11.145  |
| 2.80     | 5.719                  | 6.068   | 6.387   | 6.742   | 7.047   | 7.380   | 7.746   | 8.091   | 8.402   | 8.738   | 9.102   | 9.416   | 9.752   | 10.113  | 10.402  | 10.814  |
| 2.90     | 5.516                  | 5.841   | 6.171   | 6.501   | 6.827   | 7.139   | 7.481   | 7.802   | 8.151   | 8.467   | 8.808   | 9.102   | 9.416   | 9.752   | 10.113  | 10.402  |
| 3.00     | 5.354                  | 5.659   | 6.001   | 6.314   | 6.620   | 6.913   | 7.233   | 7.585   | 7.858   | 8.212   | 8.533   | 8.808   | 9.102   | 9.416   | 9.752   | 10.113  |
| 3.10     | 5.201                  | 5.516   | 5.810   | 6.102   | 6.425   | 6.742   | 7.047   | 7.331   | 7.638   | 7.973   | 8.275   | 8.533   | 8.880   | 9.179   | 9.498   | 9.752   |
| 3.20     | 5.057                  | 5.354   | 5.659   | 5.936   | 6.241   | 6.540   | 6.827   | 7.139   | 7.430   | 7.746   | 8.031   | 8.338   | 8.600   | 8.953   | 9.256   | 9.498   |
| 3.30     | 4.920                  | 5.226   | 5.516   | 5.779   | 6.068   | 6.387   | 6.660   | 6.957   | 7.233   | 7.533   | 7.802   | 8.091   | 8.402   | 8.669   | 8.953   | 9.256   |
| 3.40     | 4.812                  | 5.080   | 5.381   | 5.659   | 5.936   | 6.206   | 6.501   | 6.784   | 7.047   | 7.331   | 7.638   | 7.915   | 8.212   | 8.467   | 8.738   | 9.027   |
| 3.50     | 4.688                  | 4.965   | 5.251   | 5.516   | 5.779   | 6.068   | 6.350   | 6.620   | 6.913   | 7.186   | 7.430   | 7.746   | 7.973   | 8.275   | 8.533   | 8.808   |
| 3.60     | 4.589                  | 4.854   | 5.128   | 5.407   | 5.659   | 5.936   | 6.206   | 6.463   | 6.742   | 7.002   | 7.282   | 7.533   | 7.802   | 8.091   | 8.338   | 8.600   |
| 3.70     | 4.495                  | 4.749   | 5.010   | 5.277   | 5.544   | 5.810   | 6.068   | 6.350   | 6.620   | 6.869   | 7.139   | 7.380   | 7.638   | 7.915   | 8.212   | 8.467   |
| 3.80     | 4.404                  | 4.648   | 4.920   | 5.177   | 5.434   | 5.689   | 5.936   | 6.206   | 6.463   | 6.742   | 7.002   | 7.233   | 7.481   | 7.746   | 8.031   | 8.275   |
| 3.90     | 4.317                  | 4.570   | 4.812   | 5.080   | 5.328   | 5.573   | 5.841   | 6.102   | 6.350   | 6.580   | 6.869   | 7.093   | 7.380   | 7.585   | 7.858   | 8.091   |
| 4.00     | 4.234                  | 4.476   | 4.728   | 4.987   | 5.226   | 5.489   | 5.719   | 5.969   | 6.241   | 6.463   | 6.742   | 6.957   | 7.233   | 7.481   | 7.692   | 7.973   |
| 4.10     | 4.153                  | 4.404   | 4.648   | 4.898   | 5.128   | 5.381   | 5.630   | 5.872   | 6.102   | 6.350   | 6.620   | 6.827   | 7.093   | 7.331   | 7.585   | 7.802   |
| 4.20     | 4.091                  | 4.334   | 4.570   | 4.812   | 5.057   | 5.277   | 5.516   | 5.779   | 6.001   | 6.241   | 6.501   | 6.742   | 6.957   | 7.233   | 7.430   | 7.692   |
| 4.30     | 4.016                  | 4.250   | 4.495   | 4.728   | 4.965   | 5.201   | 5.434   | 5.689   | 5.904   | 6.136   | 6.387   | 6.620   | 6.869   | 7.093   | 7.331   | 7.585   |
| 4.40     | 3.957                  | 4.185   | 4.422   | 4.648   | 4.898   | 5.128   | 5.354   | 5.573   | 5.810   | 6.068   | 6.277   | 6.501   | 6.742   | 7.002   | 7.233   | 7.430   |
| 4.50     | 3.901                  | 4.122   | 4.352   | 4.589   | 4.812   | 5.033   | 5.277   | 5.489   | 5.719   | 5.969   | 6.206   | 6.425   | 6.660   | 6.869   | 7.093   | 7.331   |
| 4.60     | 3.846                  | 4.060   | 4.283   | 4.513   | 4.749   | 4.965   | 5.201   | 5.434   | 5.659   | 5.872   | 6.102   | 6.314   | 6.540   | 6.784   | 7.002   | 7.233   |
| 4.70     | 3.779                  | 4.001   | 4.234   | 4.458   | 4.668   | 4.898   | 5.128   | 5.354   | 5.573   | 5.779   | 6.001   | 6.241   | 6.463   | 6.660   | 6.913   | 7.139   |
| 4.80     | 3.728                  | 3.957   | 4.169   | 4.387   | 4.609   | 4.833   | 5.057   | 5.277   | 5.489   | 5.719   | 5.936   | 6.136   | 6.387   | 6.580   | 6.827   | 7.047   |
| 4.90     | 3.690                  | 3.901   | 4.122   | 4.334   | 4.551   | 4.770   | 4.987   | 5.201   | 5.407   | 5.630   | 5.841   | 6.068   | 6.277   | 6.501   | 6.701   | 6.957   |
| 5.00     | 3.641                  | 3.846   | 4.060   | 4.283   | 4.495   | 4.708   | 4.920   | 5.128   | 5.354   | 5.573   | 5.779   | 6.001   | 6.206   | 6.425   | 6.620   | 6.827   |
| 5.10     | 3.593                  | 3.806   | 4.016   | 4.234   | 4.440   | 4.648   | 4.854   | 5.080   | 5.277   | 5.489   | 5.719   | 5.904   | 6.136   | 6.350   | 6.540   | 6.742   |
| 5.20     | 3.546                  | 3.753   | 3.972   | 4.169   | 4.387   | 4.589   | 4.812   | 5.010   | 5.226   | 5.434   | 5.630   | 5.841   | 6.068   | 6.277   | 6.463   | 6.701   |
| 5.30     | 3.512                  | 3.715   | 3.915   | 4.122   | 4.334   | 4.532   | 4.749   | 4.942   | 5.152   | 5.354   | 5.573   | 5.779   | 6.001   | 6.206   | 6.387   | 6.620   |
| 5.40     | 3.467                  | 3.678   | 3.873   | 4.076   | 4.283   | 4.495   | 4.688   | 4.898   | 5.104   | 5.302   | 5.516   | 5.719   | 5.904   | 6.136   | 6.314   | 6.540   |
| 5.50     | 3.435                  | 3.629   | 3.832   | 4.030   | 4.234   | 4.440   | 4.648   | 4.854   | 5.057   | 5.251   | 5.461   | 5.659   | 5.841   | 6.068   | 6.241   | 6.463   |
| 5.60     | 3.392                  | 3.593   | 3.793   | 4.001   | 4.201   | 4.387   | 4.589   | 4.791   | 4.987   | 5.201   | 5.381   | 5.601   | 5.779   | 6.001   | 6.206   | 6.387   |
| 5.70     | 3.361                  | 3.558   | 3.753   | 3.957   | 4.153   | 4.352   | 4.551   | 4.749   | 4.942   | 5.128   | 5.328   | 5.544   | 5.719   | 5.936   | 6.136   | 6.314   |
| 5.80     | 3.330                  | 3.523   | 3.715   | 3.915   | 4.106   | 4.300   | 4.495   | 4.688   | 4.898   | 5.080   | 5.277   | 5.489   | 5.659   | 5.872   | 6.068   | 6.277   |
| 5.90     | 3.290                  | 3.490   | 3.678   | 3.873   | 4.060   | 4.267   | 4.458   | 4.648   | 4.833   | 5.033   | 5.226   | 5.434   | 5.630   | 5.810   | 6.001   | 6.206   |
| 6.00     | 3.260                  | 3.456   | 3.641   | 3.832   | 4.030   | 4.217   | 4.404   | 4.609   | 4.791   | 4.987   | 5.177   | 5.381   | 5.573   | 5.749   | 5.936   | 6.136   |
| 6.50     | 3.121                  | 3.300   | 3.490   | 3.665   | 3.860   | 4.030   | 4.217   | 4.404   | 4.589   | 4.770   | 4.965   | 5.128   | 5.328   | 5.516   | 5.689   | 5.872   |
| 7.00     | 3.001                  | 3.175   | 3.350   | 3.523   | 3.703   | 3.887   | 4.060   | 4.234   | 4.404   | 4.589   | 4.770   | 4.942   | 5.104   | 5.302   | 5.461   | 5.630   |
| 7.50     | 2.897                  | 3.068   | 3.232   | 3.403   | 3.569   | 3.741   | 3.915   | 4.091   | 4.250   | 4.422   | 4.589   | 4.770   | 4.942   | 5.104   | 5.277   | 5.434   |
| 8.00     | 2.801                  | 2.968   | 3.130   | 3.300   | 3.456   | 3.629   | 3.793   | 3.957   | 4.122   | 4.283   | 4.458   | 4.609   | 4.791   | 4.942   | 5.104   | 5.277   |
| 8.50     | 2.724                  | 2.882   | 3.042   | 3.203   | 3.361   | 3.523   | 3.678   | 3.846   | 4.001   | 4.169   | 4.317   | 4.476   | 4.648   | 4.812   | 4.965   | 5.128   |
| 9.00     | 2.651                  | 2.808   | 2.960   | 3.121   | 3.270   | 3.424   | 3.581   | 3.741   | 3.901   | 4.045   | 4.201   | 4.369   | 4.513   | 4.668   | 4.833   | 4.987   |
| 9.50     | 2.582                  | 2.737   | 2.890   | 3.042   | 3.194   | 3.340   | 3.501   | 3.653   | 3.806   | 3.957   | 4.106   | 4.250   | 4.404   | 4.551   | 4.708   | 4.854   |
| 10.00    | 2.523                  | 2.671   | 2.822   | 2.968   | 3.121   | 3.270   | 3.413   | 3.569   | 3.715   | 3.860   | 4.016   | 4.153   | 4.300   | 4.458   | 4.609   | 4.749   |
| 10.50    | 2.471                  | 2.619   | 2.765   | 2.905   | 3.051   | 3.194   | 3.340   | 3.490   | 3.629   | 3.779   | 3.929   | 4.076   | 4.217   | 4.369   | 4.513   | 4.648   |
| 11.00    | 2.422                  | 2.564   | 2.710   | 2.852   | 2.992   | 3.139   | 3.280   | 3.424   | 3.558   | 3.703   | 3.846   | 3.986   | 4.137   | 4.267   | 4.422   | 4.551   |
| 11.50    | 2.380                  | 2.517   | 2.658   | 2.793   | 2.936   | 3.077   | 3.213   | 3.361   | 3.501   | 3.641   | 3.779   | 3.915   | 4.060   | 4.201   | 4.334   | 4.476   |
| 12.00    | 2.334                  | 2.471   | 2.613   | 2.744   | 2.882   | 3.026   | 3.157   | 3.300   | 3.435   | 3.569   | 3.715   | 3.846   | 3.986   | 4.122   | 4.267   | 4.404   |
| 12.50    | 2.295                  | 2.433   | 2.564   | 2.704   | 2.837   | 2.976   | 3.103   | 3.241   | 3.382   | 3.512   | 3.653   | 3.779   | 3.915   | 4.060   | 4.185   | 4.317   |
| 13.00    | 2.261                  | 2.395   | 2.528   | 2.658   | 2.793   | 2.928   | 3.060   | 3.194   | 3.320   | 3.456   | 3.593   | 3.728   | 3.860   | 3.986   | 4.122   | 4.250   |

**Curve: IEC A**

| Curve #: | 17                     | 18    | 19    | 20    | 21    | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|----------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| x P/U    | Time to Trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.50    | 2.229                  | 2.359 | 2.488 | 2.619 | 2.751 | 2.882 | 3.017 | 3.148 | 3.280 | 3.403 | 3.535 | 3.665 | 3.806 | 3.929 | 4.060 | 4.185 |
| 14.00    | 2.198                  | 2.324 | 2.454 | 2.582 | 2.710 | 2.844 | 2.968 | 3.103 | 3.232 | 3.361 | 3.490 | 3.617 | 3.741 | 3.873 | 4.001 | 4.137 |
| 14.50    | 2.167                  | 2.295 | 2.422 | 2.546 | 2.677 | 2.801 | 2.928 | 3.060 | 3.184 | 3.310 | 3.446 | 3.569 | 3.690 | 3.819 | 3.943 | 4.076 |
| 15.00    | 2.137                  | 2.266 | 2.390 | 2.517 | 2.638 | 2.765 | 2.890 | 3.017 | 3.148 | 3.270 | 3.392 | 3.523 | 3.653 | 3.779 | 3.901 | 4.030 |
| 15.50    | 2.113                  | 2.238 | 2.359 | 2.482 | 2.607 | 2.731 | 2.859 | 2.984 | 3.103 | 3.232 | 3.350 | 3.479 | 3.605 | 3.728 | 3.846 | 3.972 |
| 16.00    | 2.088                  | 2.211 | 2.334 | 2.454 | 2.576 | 2.704 | 2.822 | 2.944 | 3.068 | 3.194 | 3.310 | 3.435 | 3.558 | 3.678 | 3.806 | 3.929 |
| 16.50    | 2.065                  | 2.185 | 2.304 | 2.427 | 2.552 | 2.671 | 2.793 | 2.913 | 3.034 | 3.157 | 3.280 | 3.403 | 3.523 | 3.641 | 3.766 | 3.887 |
| 17.00    | 2.042                  | 2.163 | 2.280 | 2.401 | 2.523 | 2.645 | 2.758 | 2.882 | 3.001 | 3.121 | 3.241 | 3.361 | 3.479 | 3.605 | 3.728 | 3.846 |
| 17.50    | 2.019                  | 2.137 | 2.257 | 2.374 | 2.494 | 2.613 | 2.731 | 2.852 | 2.968 | 3.085 | 3.213 | 3.330 | 3.446 | 3.569 | 3.678 | 3.806 |
| 18.00    | 2.000                  | 2.117 | 2.234 | 2.354 | 2.471 | 2.588 | 2.704 | 2.822 | 2.944 | 3.060 | 3.175 | 3.290 | 3.413 | 3.523 | 3.641 | 3.766 |
| 18.50    | 1.979                  | 2.096 | 2.216 | 2.329 | 2.449 | 2.564 | 2.677 | 2.793 | 2.913 | 3.026 | 3.148 | 3.260 | 3.382 | 3.490 | 3.617 | 3.728 |
| 19.00    | 1.961                  | 2.077 | 2.193 | 2.309 | 2.422 | 2.540 | 2.651 | 2.772 | 2.882 | 3.001 | 3.112 | 3.232 | 3.350 | 3.467 | 3.581 | 3.690 |
| 19.50    | 1.944                  | 2.057 | 2.171 | 2.285 | 2.401 | 2.517 | 2.632 | 2.744 | 2.859 | 2.976 | 3.085 | 3.203 | 3.320 | 3.435 | 3.546 | 3.665 |
| 20.00    | 1.926                  | 2.042 | 2.154 | 2.266 | 2.380 | 2.494 | 2.607 | 2.724 | 2.837 | 2.944 | 3.060 | 3.175 | 3.290 | 3.403 | 3.512 | 3.629 |

# CURVE INFORMATION AND TABLES



Curve: IEC B

| Curve #: | 1                      | 2      | 3      | 4      | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      |
|----------|------------------------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| x P/U    | Time to Trip (seconds) |        |        |        |         |         |         |         |         |         |         |         |         |         |         |         |
| 1.03     | 22.291                 | 45.510 | 68.266 | 91.021 | 109.225 | 136.531 | 156.036 | 182.042 | 218.450 | 218.450 | 273.063 | 273.063 | 273.063 | 364.083 | 364.083 | 364.083 |
| 1.10     | 6.742                  | 13.485 | 20.227 | 27.306 | 34.133  | 40.454  | 47.489  | 54.613  | 60.681  | 68.266  | 72.817  | 84.019  | 91.021  | 91.021  | 99.295  | 109.225 |
| 1.20     | 3.371                  | 6.742  | 10.113 | 13.485 | 16.804  | 20.227  | 23.745  | 27.306  | 30.340  | 34.133  | 37.664  | 40.454  | 43.690  | 47.489  | 49.648  | 54.613  |
| 1.30     | 2.252                  | 4.495  | 6.742  | 9.027  | 11.260  | 13.485  | 15.830  | 17.906  | 20.227  | 22.291  | 24.824  | 27.306  | 29.520  | 31.207  | 34.133  | 36.408  |
| 1.40     | 1.688                  | 3.371  | 5.057  | 6.742  | 8.467   | 10.113  | 11.872  | 13.485  | 15.170  | 16.804  | 18.513  | 20.227  | 21.845  | 23.745  | 25.401  | 27.306  |
| 1.50     | 1.350                  | 2.697  | 4.045  | 5.407  | 6.742   | 8.091   | 9.416   | 10.814  | 12.136  | 13.485  | 14.760  | 16.302  | 17.617  | 18.832  | 20.227  | 21.417  |
| 1.60     | 1.125                  | 2.252  | 3.371  | 4.495  | 5.630   | 6.742   | 7.858   | 9.027   | 10.113  | 11.260  | 12.412  | 13.485  | 14.563  | 15.830  | 16.804  | 17.906  |
| 1.70     | 0.964                  | 1.930  | 2.890  | 3.860  | 4.812   | 5.779   | 6.742   | 7.692   | 8.669   | 9.666   | 10.604  | 11.620  | 12.555  | 13.485  | 14.372  | 15.384  |
| 1.80     | 0.843                  | 1.688  | 2.528  | 3.371  | 4.217   | 5.057   | 5.904   | 6.742   | 7.585   | 8.467   | 9.256   | 10.113  | 10.923  | 11.872  | 12.701  | 13.485  |
| 1.90     | 0.750                  | 1.500  | 2.252  | 3.001  | 3.753   | 4.495   | 5.251   | 6.001   | 6.742   | 7.481   | 8.275   | 9.027   | 9.752   | 10.502  | 11.260  | 12.003  |
| 2.00     | 0.675                  | 1.350  | 2.026  | 2.697  | 3.371   | 4.045   | 4.728   | 5.407   | 6.068   | 6.742   | 7.430   | 8.091   | 8.808   | 9.416   | 10.113  | 10.814  |
| 2.10     | 0.614                  | 1.227  | 1.842  | 2.454  | 3.068   | 3.678   | 4.300   | 4.920   | 5.516   | 6.136   | 6.742   | 7.380   | 7.973   | 8.600   | 9.179   | 9.840   |
| 2.20     | 0.562                  | 1.125  | 1.688  | 2.252  | 2.815   | 3.371   | 3.943   | 4.495   | 5.057   | 5.630   | 6.171   | 6.742   | 7.331   | 7.858   | 8.467   | 9.027   |
| 2.30     | 0.519                  | 1.038  | 1.558  | 2.077  | 2.594   | 3.112   | 3.629   | 4.153   | 4.668   | 5.201   | 5.719   | 6.241   | 6.742   | 7.282   | 7.802   | 8.338   |
| 2.40     | 0.482                  | 0.964  | 1.447  | 1.930  | 2.411   | 2.890   | 3.371   | 3.860   | 4.334   | 4.812   | 5.302   | 5.779   | 6.277   | 6.742   | 7.233   | 7.692   |
| 2.50     | 0.450                  | 0.900  | 1.350  | 1.799  | 2.252   | 2.697   | 3.148   | 3.605   | 4.045   | 4.495   | 4.942   | 5.407   | 5.841   | 6.314   | 6.742   | 7.186   |
| 2.60     | 0.422                  | 0.843  | 1.266  | 1.688  | 2.109   | 2.528   | 2.952   | 3.371   | 3.793   | 4.217   | 4.648   | 5.057   | 5.489   | 5.904   | 6.314   | 6.742   |
| 2.70     | 0.397                  | 0.794  | 1.191  | 1.588  | 1.986   | 2.385   | 2.779   | 3.175   | 3.569   | 3.972   | 4.369   | 4.770   | 5.152   | 5.573   | 5.969   | 6.350   |
| 2.80     | 0.375                  | 0.750  | 1.125  | 1.500  | 1.873   | 2.252   | 2.626   | 3.001   | 3.371   | 3.753   | 4.122   | 4.495   | 4.876   | 5.251   | 5.630   | 6.001   |
| 2.90     | 0.355                  | 0.711  | 1.066  | 1.420  | 1.776   | 2.133   | 2.488   | 2.844   | 3.194   | 3.558   | 3.915   | 4.267   | 4.628   | 4.965   | 5.328   | 5.689   |
| 3.00     | 0.338                  | 0.675  | 1.012  | 1.350  | 1.688   | 2.026   | 2.364   | 2.697   | 3.034   | 3.371   | 3.715   | 4.045   | 4.387   | 4.728   | 5.057   | 5.407   |
| 3.10     | 0.321                  | 0.643  | 0.964  | 1.285  | 1.606   | 1.930   | 2.252   | 2.570   | 2.890   | 3.213   | 3.535   | 3.860   | 4.185   | 4.495   | 4.812   | 5.152   |
| 3.20     | 0.307                  | 0.614  | 0.920  | 1.227  | 1.534   | 1.842   | 2.146   | 2.454   | 2.758   | 3.068   | 3.371   | 3.678   | 3.986   | 4.300   | 4.609   | 4.920   |
| 3.30     | 0.293                  | 0.587  | 0.880  | 1.174  | 1.468   | 1.762   | 2.053   | 2.349   | 2.638   | 2.936   | 3.232   | 3.523   | 3.819   | 4.106   | 4.404   | 4.688   |
| 3.40     | 0.281                  | 0.562  | 0.843  | 1.125  | 1.406   | 1.688   | 1.968   | 2.252   | 2.528   | 2.815   | 3.094   | 3.371   | 3.653   | 3.943   | 4.217   | 4.495   |
| 3.50     | 0.270                  | 0.540  | 0.810  | 1.080  | 1.350   | 1.621   | 1.890   | 2.159   | 2.433   | 2.697   | 2.968   | 3.241   | 3.512   | 3.779   | 4.045   | 4.317   |
| 3.60     | 0.260                  | 0.519  | 0.779  | 1.038  | 1.299   | 1.558   | 1.817   | 2.077   | 2.339   | 2.594   | 2.859   | 3.112   | 3.371   | 3.629   | 3.901   | 4.153   |
| 3.70     | 0.250                  | 0.500  | 0.750  | 1.000  | 1.250   | 1.500   | 1.750   | 2.000   | 2.252   | 2.499   | 2.751   | 3.001   | 3.251   | 3.501   | 3.753   | 4.001   |
| 3.80     | 0.241                  | 0.482  | 0.723  | 0.964  | 1.206   | 1.447   | 1.688   | 1.930   | 2.171   | 2.411   | 2.651   | 2.890   | 3.130   | 3.371   | 3.617   | 3.860   |
| 3.90     | 0.233                  | 0.466  | 0.698  | 0.931  | 1.163   | 1.397   | 1.630   | 1.861   | 2.096   | 2.329   | 2.558   | 2.793   | 3.026   | 3.260   | 3.490   | 3.728   |
| 4.00     | 0.225                  | 0.450  | 0.675  | 0.900  | 1.125   | 1.350   | 1.576   | 1.799   | 2.026   | 2.252   | 2.477   | 2.697   | 2.928   | 3.148   | 3.371   | 3.605   |
| 4.10     | 0.218                  | 0.436  | 0.653  | 0.871  | 1.089   | 1.307   | 1.523   | 1.742   | 1.961   | 2.176   | 2.395   | 2.613   | 2.830   | 3.051   | 3.270   | 3.479   |
| 4.20     | 0.211                  | 0.422  | 0.633  | 0.843  | 1.054   | 1.266   | 1.476   | 1.688   | 1.900   | 2.109   | 2.319   | 2.528   | 2.744   | 2.952   | 3.166   | 3.371   |
| 4.30     | 0.205                  | 0.409  | 0.614  | 0.818  | 1.023   | 1.227   | 1.432   | 1.638   | 1.842   | 2.045   | 2.252   | 2.454   | 2.658   | 2.867   | 3.068   | 3.270   |
| 4.40     | 0.199                  | 0.397  | 0.596  | 0.794  | 0.993   | 1.191   | 1.390   | 1.588   | 1.788   | 1.986   | 2.185   | 2.385   | 2.582   | 2.779   | 2.976   | 3.175   |
| 4.50     | 0.193                  | 0.386  | 0.579  | 0.771  | 0.964   | 1.157   | 1.350   | 1.543   | 1.736   | 1.930   | 2.121   | 2.314   | 2.505   | 2.697   | 2.890   | 3.085   |
| 4.60     | 0.188                  | 0.375  | 0.562  | 0.750  | 0.938   | 1.125   | 1.313   | 1.500   | 1.688   | 1.873   | 2.061   | 2.252   | 2.438   | 2.626   | 2.815   | 3.001   |
| 4.70     | 0.182                  | 0.365  | 0.547  | 0.730  | 0.912   | 1.094   | 1.277   | 1.460   | 1.642   | 1.823   | 2.008   | 2.189   | 2.369   | 2.552   | 2.737   | 2.920   |
| 4.80     | 0.178                  | 0.355  | 0.533  | 0.711  | 0.888   | 1.066   | 1.244   | 1.420   | 1.599   | 1.776   | 1.954   | 2.133   | 2.309   | 2.488   | 2.664   | 2.844   |
| 4.90     | 0.173                  | 0.346  | 0.519  | 0.692  | 0.865   | 1.038   | 1.211   | 1.384   | 1.558   | 1.731   | 1.903   | 2.077   | 2.252   | 2.422   | 2.594   | 2.772   |
| 5.00     | 0.169                  | 0.338  | 0.506  | 0.675  | 0.843   | 1.012   | 1.181   | 1.350   | 1.519   | 1.688   | 1.858   | 2.026   | 2.193   | 2.364   | 2.528   | 2.697   |
| 5.10     | 0.165                  | 0.329  | 0.494  | 0.658  | 0.823   | 0.988   | 1.152   | 1.318   | 1.482   | 1.647   | 1.811   | 1.975   | 2.142   | 2.304   | 2.471   | 2.632   |
| 5.20     | 0.161                  | 0.321  | 0.482  | 0.643  | 0.804   | 0.964   | 1.125   | 1.285   | 1.447   | 1.606   | 1.767   | 1.930   | 2.088   | 2.252   | 2.411   | 2.570   |
| 5.30     | 0.157                  | 0.314  | 0.471  | 0.628  | 0.785   | 0.942   | 1.099   | 1.255   | 1.413   | 1.569   | 1.726   | 1.883   | 2.042   | 2.198   | 2.354   | 2.511   |
| 5.40     | 0.153                  | 0.307  | 0.460  | 0.614  | 0.767   | 0.920   | 1.074   | 1.227   | 1.381   | 1.534   | 1.688   | 1.842   | 1.993   | 2.146   | 2.299   | 2.454   |
| 5.50     | 0.150                  | 0.300  | 0.450  | 0.600  | 0.750   | 0.900   | 1.050   | 1.200   | 1.350   | 1.500   | 1.650   | 1.799   | 1.950   | 2.100   | 2.252   | 2.401   |
| 5.60     | 0.147                  | 0.293  | 0.440  | 0.587  | 0.734   | 0.880   | 1.028   | 1.174   | 1.321   | 1.468   | 1.613   | 1.762   | 1.906   | 2.053   | 2.202   | 2.349   |
| 5.70     | 0.144                  | 0.287  | 0.431  | 0.575  | 0.718   | 0.861   | 1.006   | 1.149   | 1.293   | 1.435   | 1.581   | 1.723   | 1.867   | 2.012   | 2.154   | 2.299   |
| 5.80     | 0.141                  | 0.281  | 0.422  | 0.562  | 0.703   | 0.843   | 0.984   | 1.125   | 1.266   | 1.406   | 1.547   | 1.688   | 1.830   | 1.968   | 2.109   | 2.252   |
| 5.90     | 0.138                  | 0.276  | 0.413  | 0.551  | 0.689   | 0.827   | 0.964   | 1.102   | 1.240   | 1.377   | 1.515   | 1.652   | 1.791   | 1.930   | 2.065   | 2.202   |
| 6.00     | 0.135                  | 0.270  | 0.405  | 0.540  | 0.675   | 0.810   | 0.945   | 1.080   | 1.215   | 1.350   | 1.484   | 1.621   | 1.756   | 1.890   | 2.026   | 2.159   |
| 6.50     | 0.123                  | 0.245  | 0.368  | 0.491  | 0.614   | 0.737   | 0.859   | 0.982   | 1.104   | 1.227   | 1.350   | 1.472   | 1.595   | 1.717   | 1.842   | 1.964   |
| 7.00     | 0.112                  | 0.225  | 0.338  | 0.450  | 0.562   | 0.675   | 0.787   | 0.900   | 1.012   | 1.125   | 1.237   | 1.350   | 1.462   | 1.576   | 1.688   | 1.799   |
| 7.50     | 0.104                  | 0.208  | 0.312  | 0.415  | 0.519   | 0.623   | 0.727   | 0.831   | 0.934   | 1.038   | 1.143   | 1.247   | 1.350   | 1.454   | 1.558   | 1.662   |
| 8.00     | 0.096                  | 0.193  | 0.289  | 0.386  | 0.482   | 0.579   | 0.675   | 0.771   | 0.868   | 0.964   | 1.060   | 1.157   | 1.254   | 1.350   | 1.447   | 1.543   |
| 8.50     | 0.090                  | 0.180  | 0.270  | 0.360  | 0.450   | 0.540   | 0.630   | 0.720   | 0.810   | 0.900   | 0.990   | 1.080   | 1.169   | 1.260   | 1.350   | 1.439   |
| 9.00     | 0.084                  | 0.169  | 0.253  | 0.338  | 0.422   | 0.506   | 0.591   | 0.675   | 0.760   | 0.843   | 0.928   | 1.012   | 1.097   | 1.181   | 1.266   | 1.350   |
| 9.50     | 0.079                  | 0.159  | 0.238  | 0.318  | 0.397   | 0.477   | 0.556   | 0.635   | 0.715   | 0.794   | 0.874   | 0.953   | 1.032   | 1.112   | 1.191   | 1.270   |
| 10.00    | 0.075                  | 0.150  | 0.225  | 0.300  | 0.375   | 0.450   | 0.525   | 0.600   | 0.675   | 0.750   | 0.825   | 0.900   | 0.975   | 1.050   | 1.125   | 1.200   |
| 10.50    | 0.071                  | 0.142  | 0.213  | 0.284  | 0.355   | 0.426   | 0.497   | 0.568   | 0.639   | 0.711   | 0.782   | 0.853   | 0.924   | 0.995   | 1.066   | 1.137   |
| 11.00    | 0.068                  | 0.135  | 0.202  | 0.270  | 0.338   | 0.405   | 0.472   | 0.540   | 0.607   | 0.675   | 0.743   | 0.810   | 0.877   | 0.945   | 1.012   | 1.080   |
| 11.50    | 0.064                  | 0.129  | 0.193  | 0.257  | 0.321   | 0.386   | 0.450   | 0.514   | 0.579   | 0.643   | 0.707   | 0.771   | 0.836   | 0.900   | 0.964   | 1.028   |
| 12.00    | 0.061                  | 0.123  | 0.184  | 0.245  | 0.307   | 0.368   | 0.430   | 0.491   | 0.552   | 0.614   | 0.675   | 0.737   | 0.798   | 0.859   | 0.920   | 0.982   |
| 12.50    | 0.059                  | 0.117  | 0.176  | 0.235  | 0.293   | 0.352   | 0.411   | 0.470   | 0.528   | 0.587   | 0.646   | 0.704   | 0.763   | 0.822   | 0.880   | 0.939   |
| 13.00    | 0.056                  | 0.112  | 0.169  | 0.225  | 0.281   | 0.338   | 0.394   | 0.450   | 0.506   | 0.562   | 0.619   | 0.675   | 0.731   | 0.787   | 0.843   | 0.900   |

**Curve: IEC B**

| Curve #: | 1                      | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|----------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| x P/U    | Time to Trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.50    | 0.054                  | 0.108 | 0.162 | 0.216 | 0.270 | 0.324 | 0.378 | 0.432 | 0.486 | 0.540 | 0.594 | 0.648 | 0.702 | 0.756 | 0.810 | 0.864 |
| 14.00    | 0.052                  | 0.104 | 0.156 | 0.208 | 0.260 | 0.312 | 0.363 | 0.415 | 0.467 | 0.519 | 0.571 | 0.623 | 0.675 | 0.727 | 0.779 | 0.831 |
| 14.50    | 0.050                  | 0.100 | 0.150 | 0.200 | 0.250 | 0.300 | 0.350 | 0.400 | 0.450 | 0.500 | 0.550 | 0.600 | 0.650 | 0.700 | 0.750 | 0.800 |
| 15.00    | 0.048                  | 0.096 | 0.145 | 0.193 | 0.241 | 0.289 | 0.338 | 0.386 | 0.434 | 0.482 | 0.530 | 0.579 | 0.627 | 0.675 | 0.723 | 0.771 |
| 15.50    | 0.047                  | 0.093 | 0.140 | 0.186 | 0.233 | 0.279 | 0.326 | 0.372 | 0.419 | 0.466 | 0.512 | 0.559 | 0.605 | 0.652 | 0.698 | 0.745 |
| 16.00    | 0.045                  | 0.090 | 0.135 | 0.180 | 0.225 | 0.270 | 0.315 | 0.360 | 0.405 | 0.450 | 0.495 | 0.540 | 0.585 | 0.630 | 0.675 | 0.720 |
| 16.50    | 0.044                  | 0.087 | 0.131 | 0.174 | 0.218 | 0.261 | 0.305 | 0.348 | 0.392 | 0.436 | 0.479 | 0.523 | 0.566 | 0.610 | 0.653 | 0.697 |
| 17.00    | 0.042                  | 0.084 | 0.127 | 0.169 | 0.211 | 0.253 | 0.295 | 0.338 | 0.380 | 0.422 | 0.464 | 0.506 | 0.548 | 0.591 | 0.633 | 0.675 |
| 17.50    | 0.041                  | 0.082 | 0.123 | 0.164 | 0.205 | 0.245 | 0.286 | 0.327 | 0.368 | 0.409 | 0.450 | 0.491 | 0.532 | 0.573 | 0.614 | 0.654 |
| 18.00    | 0.040                  | 0.079 | 0.119 | 0.159 | 0.199 | 0.238 | 0.278 | 0.318 | 0.357 | 0.397 | 0.437 | 0.477 | 0.516 | 0.556 | 0.596 | 0.635 |
| 18.50    | 0.039                  | 0.077 | 0.116 | 0.154 | 0.193 | 0.231 | 0.270 | 0.309 | 0.347 | 0.386 | 0.424 | 0.463 | 0.501 | 0.540 | 0.579 | 0.617 |
| 19.00    | 0.037                  | 0.075 | 0.112 | 0.150 | 0.188 | 0.225 | 0.262 | 0.300 | 0.338 | 0.375 | 0.412 | 0.450 | 0.487 | 0.525 | 0.562 | 0.600 |
| 19.50    | 0.036                  | 0.073 | 0.109 | 0.146 | 0.182 | 0.219 | 0.255 | 0.292 | 0.328 | 0.365 | 0.401 | 0.438 | 0.474 | 0.511 | 0.547 | 0.584 |
| 20.00    | 0.036                  | 0.071 | 0.107 | 0.142 | 0.178 | 0.213 | 0.249 | 0.284 | 0.320 | 0.355 | 0.391 | 0.426 | 0.462 | 0.497 | 0.533 | 0.568 |

# CURVE INFORMATION AND TABLES



Curve: IEC B

| Curve #: | 17                     | 18      | 19      | 20      | 21      | 22      | 23      | 24      | 25      | 26      | 27      | 28      | 29      | 30      | 31      | 32      |
|----------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| x P/U    | Time to Trip (seconds) |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |
| 1.03     | 364.083                | 364.083 | 364.083 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 | 546.125 |
| 1.10     | 109.225                | 121.361 | 121.361 | 136.531 | 136.531 | 156.036 | 156.036 | 156.036 | 182.042 | 182.042 | 182.042 | 182.042 | 182.042 | 218.450 | 218.450 | 218.450 |
| 1.20     | 57.487                 | 60.681  | 64.250  | 68.266  | 72.817  | 72.817  | 78.018  | 84.019  | 84.019  | 91.021  | 91.021  | 91.021  | 99.295  | 99.295  | 109.225 | 109.225 |
| 1.30     | 37.664                 | 40.454  | 42.010  | 45.510  | 47.489  | 49.648  | 52.012  | 54.613  | 57.487  | 57.487  | 60.681  | 64.250  | 64.250  | 68.266  | 68.266  | 72.817  |
| 1.40     | 28.743                 | 30.340  | 32.125  | 34.133  | 35.234  | 37.664  | 39.009  | 40.454  | 42.010  | 43.690  | 45.510  | 47.489  | 49.648  | 49.648  | 52.012  | 54.613  |
| 1.50     | 22.755                 | 24.272  | 25.401  | 27.306  | 28.006  | 29.520  | 31.207  | 32.125  | 34.133  | 35.234  | 36.408  | 37.664  | 39.009  | 40.454  | 42.010  | 43.690  |
| 1.60     | 19.162                 | 20.227  | 21.417  | 22.291  | 23.745  | 24.824  | 26.006  | 27.306  | 28.006  | 29.520  | 30.340  | 31.207  | 33.098  | 34.133  | 35.234  | 36.408  |
| 1.70     | 16.302                 | 17.337  | 18.204  | 19.162  | 20.227  | 21.417  | 22.291  | 23.239  | 24.272  | 24.824  | 26.006  | 27.306  | 28.006  | 28.743  | 29.520  | 31.207  |
| 1.80     | 14.372                 | 15.170  | 16.063  | 16.804  | 17.617  | 18.513  | 19.504  | 20.227  | 21.005  | 21.845  | 22.755  | 23.745  | 24.272  | 25.401  | 26.006  | 27.306  |
| 1.90     | 12.701                 | 13.485  | 14.185  | 14.962  | 15.830  | 16.549  | 17.337  | 17.906  | 18.832  | 19.504  | 20.227  | 21.005  | 21.845  | 22.291  | 23.239  | 23.745  |
| 2.00     | 11.497                 | 12.136  | 12.850  | 13.485  | 14.185  | 14.760  | 15.604  | 16.302  | 16.804  | 17.617  | 18.204  | 18.832  | 19.504  | 20.227  | 21.005  | 21.417  |
| 2.10     | 10.402                 | 11.033  | 11.620  | 12.272  | 12.850  | 13.485  | 14.185  | 14.760  | 15.384  | 16.063  | 16.549  | 17.066  | 17.906  | 18.513  | 19.162  | 19.504  |
| 2.20     | 9.581                  | 10.113  | 10.708  | 11.260  | 11.872  | 12.412  | 13.003  | 13.485  | 14.003  | 14.563  | 15.170  | 15.830  | 16.302  | 16.804  | 17.337  | 17.906  |
| 2.30     | 8.808                  | 9.335   | 9.840   | 10.402  | 10.923  | 11.378  | 12.003  | 12.412  | 13.003  | 13.485  | 14.003  | 14.563  | 14.962  | 15.604  | 16.063  | 16.549  |
| 2.40     | 8.212                  | 8.669   | 9.179   | 9.666   | 10.113  | 10.604  | 11.145  | 11.620  | 12.003  | 12.555  | 13.003  | 13.485  | 14.003  | 14.372  | 14.962  | 15.384  |
| 2.50     | 7.638                  | 8.091   | 8.533   | 9.027   | 9.416   | 9.930   | 10.304  | 10.814  | 11.260  | 11.745  | 12.136  | 12.555  | 13.003  | 13.485  | 14.003  | 14.372  |
| 2.60     | 7.186                  | 7.585   | 8.031   | 8.467   | 8.880   | 9.256   | 9.666   | 10.113  | 10.502  | 10.923  | 11.378  | 11.872  | 12.272  | 12.701  | 13.003  | 13.485  |
| 2.70     | 6.742                  | 7.139   | 7.533   | 7.915   | 8.338   | 8.738   | 9.102   | 9.498   | 9.930   | 10.304  | 10.708  | 11.145  | 11.497  | 11.872  | 12.272  | 12.701  |
| 2.80     | 6.387                  | 6.742   | 7.139   | 7.481   | 7.858   | 8.275   | 8.600   | 9.027   | 9.335   | 9.752   | 10.113  | 10.502  | 10.923  | 11.260  | 11.620  | 12.003  |
| 2.90     | 6.035                  | 6.387   | 6.742   | 7.093   | 7.481   | 7.802   | 8.151   | 8.533   | 8.880   | 9.256   | 9.581   | 9.930   | 10.304  | 10.708  | 11.033  | 11.378  |
| 3.00     | 5.749                  | 6.068   | 6.425   | 6.742   | 7.093   | 7.430   | 7.746   | 8.091   | 8.467   | 8.808   | 9.102   | 9.416   | 9.752   | 10.113  | 10.502  | 10.814  |
| 3.10     | 5.461                  | 5.779   | 6.102   | 6.425   | 6.742   | 7.093   | 7.380   | 7.692   | 8.031   | 8.338   | 8.669   | 9.027   | 9.335   | 9.666   | 9.930   | 10.304  |
| 3.20     | 5.226                  | 5.516   | 5.841   | 6.136   | 6.425   | 6.742   | 7.047   | 7.380   | 7.692   | 7.973   | 8.275   | 8.600   | 8.880   | 9.179   | 9.498   | 9.840   |
| 3.30     | 4.987                  | 5.277   | 5.573   | 5.872   | 6.171   | 6.463   | 6.742   | 7.047   | 7.331   | 7.638   | 7.915   | 8.212   | 8.533   | 8.808   | 9.102   | 9.416   |
| 3.40     | 4.791                  | 5.057   | 5.354   | 5.630   | 5.904   | 6.171   | 6.463   | 6.742   | 7.047   | 7.331   | 7.585   | 7.858   | 8.151   | 8.467   | 8.738   | 9.027   |
| 3.50     | 4.589                  | 4.854   | 5.128   | 5.407   | 5.659   | 5.936   | 6.206   | 6.463   | 6.742   | 7.002   | 7.282   | 7.585   | 7.858   | 8.091   | 8.402   | 8.669   |
| 3.60     | 4.422                  | 4.668   | 4.942   | 5.201   | 5.461   | 5.719   | 5.969   | 6.241   | 6.501   | 6.742   | 7.002   | 7.282   | 7.533   | 7.802   | 8.031   | 8.338   |
| 3.70     | 4.250                  | 4.495   | 4.749   | 5.010   | 5.251   | 5.489   | 5.749   | 6.001   | 6.241   | 6.501   | 6.742   | 7.002   | 7.233   | 7.481   | 7.746   | 7.973   |
| 3.80     | 4.091                  | 4.334   | 4.589   | 4.812   | 5.057   | 5.302   | 5.544   | 5.779   | 6.035   | 6.277   | 6.501   | 6.742   | 7.002   | 7.233   | 7.481   | 7.692   |
| 3.90     | 3.957                  | 4.185   | 4.422   | 4.648   | 4.898   | 5.128   | 5.354   | 5.573   | 5.810   | 6.068   | 6.277   | 6.501   | 6.742   | 7.002   | 7.233   | 7.430   |
| 4.00     | 3.819                  | 4.045   | 4.283   | 4.495   | 4.728   | 4.942   | 5.177   | 5.407   | 5.630   | 5.841   | 6.068   | 6.314   | 6.540   | 6.742   | 6.957   | 7.186   |
| 4.10     | 3.703                  | 3.915   | 4.137   | 4.352   | 4.570   | 4.791   | 5.010   | 5.226   | 5.434   | 5.659   | 5.872   | 6.102   | 6.314   | 6.540   | 6.742   | 6.957   |
| 4.20     | 3.581                  | 3.793   | 4.001   | 4.217   | 4.422   | 4.648   | 4.854   | 5.057   | 5.277   | 5.489   | 5.689   | 5.904   | 6.102   | 6.314   | 6.540   | 6.742   |
| 4.30     | 3.479                  | 3.678   | 3.887   | 4.091   | 4.300   | 4.495   | 4.708   | 4.920   | 5.104   | 5.328   | 5.516   | 5.719   | 5.936   | 6.136   | 6.350   | 6.540   |
| 4.40     | 3.371                  | 3.569   | 3.766   | 3.972   | 4.169   | 4.369   | 4.570   | 4.770   | 4.965   | 5.152   | 5.354   | 5.573   | 5.749   | 5.969   | 6.171   | 6.350   |
| 4.50     | 3.280                  | 3.467   | 3.665   | 3.860   | 4.045   | 4.250   | 4.440   | 4.628   | 4.812   | 5.010   | 5.201   | 5.407   | 5.601   | 5.779   | 5.969   | 6.171   |
| 4.60     | 3.184                  | 3.371   | 3.558   | 3.753   | 3.943   | 4.122   | 4.317   | 4.495   | 4.688   | 4.876   | 5.057   | 5.251   | 5.434   | 5.630   | 5.810   | 6.001   |
| 4.70     | 3.103                  | 3.280   | 3.467   | 3.653   | 3.832   | 4.016   | 4.201   | 4.387   | 4.570   | 4.749   | 4.920   | 5.104   | 5.302   | 5.461   | 5.659   | 5.841   |
| 4.80     | 3.017                  | 3.194   | 3.371   | 3.558   | 3.728   | 3.915   | 4.091   | 4.267   | 4.440   | 4.628   | 4.791   | 4.965   | 5.152   | 5.328   | 5.516   | 5.689   |
| 4.90     | 2.944                  | 3.112   | 3.290   | 3.456   | 3.629   | 3.806   | 3.986   | 4.153   | 4.334   | 4.495   | 4.668   | 4.854   | 5.010   | 5.201   | 5.354   | 5.544   |
| 5.00     | 2.867                  | 3.034   | 3.203   | 3.371   | 3.546   | 3.715   | 3.887   | 4.045   | 4.217   | 4.387   | 4.551   | 4.728   | 4.898   | 5.057   | 5.226   | 5.407   |
| 5.10     | 2.801                  | 2.960   | 3.130   | 3.290   | 3.456   | 3.617   | 3.793   | 3.957   | 4.122   | 4.283   | 4.440   | 4.609   | 4.770   | 4.942   | 5.104   | 5.277   |
| 5.20     | 2.731                  | 2.890   | 3.051   | 3.213   | 3.371   | 3.535   | 3.703   | 3.860   | 4.016   | 4.185   | 4.334   | 4.495   | 4.668   | 4.812   | 4.987   | 5.152   |
| 5.30     | 2.671                  | 2.822   | 2.984   | 3.139   | 3.300   | 3.456   | 3.605   | 3.766   | 3.929   | 4.076   | 4.234   | 4.387   | 4.551   | 4.708   | 4.876   | 5.033   |
| 5.40     | 2.607                  | 2.758   | 2.913   | 3.068   | 3.222   | 3.371   | 3.523   | 3.678   | 3.832   | 3.986   | 4.137   | 4.300   | 4.440   | 4.609   | 4.749   | 4.920   |
| 5.50     | 2.552                  | 2.697   | 2.852   | 3.001   | 3.148   | 3.300   | 3.446   | 3.605   | 3.753   | 3.901   | 4.045   | 4.201   | 4.352   | 4.495   | 4.648   | 4.791   |
| 5.60     | 2.494                  | 2.638   | 2.786   | 2.936   | 3.085   | 3.232   | 3.371   | 3.523   | 3.665   | 3.819   | 3.957   | 4.106   | 4.250   | 4.404   | 4.551   | 4.688   |
| 5.70     | 2.444                  | 2.582   | 2.731   | 2.874   | 3.017   | 3.157   | 3.300   | 3.446   | 3.593   | 3.728   | 3.873   | 4.016   | 4.169   | 4.300   | 4.458   | 4.589   |
| 5.80     | 2.390                  | 2.528   | 2.671   | 2.815   | 2.952   | 3.094   | 3.232   | 3.371   | 3.512   | 3.653   | 3.793   | 3.943   | 4.076   | 4.217   | 4.352   | 4.495   |
| 5.90     | 2.344                  | 2.482   | 2.619   | 2.758   | 2.890   | 3.034   | 3.166   | 3.310   | 3.446   | 3.581   | 3.715   | 3.860   | 4.001   | 4.137   | 4.267   | 4.404   |
| 6.00     | 2.295                  | 2.433   | 2.564   | 2.697   | 2.837   | 2.968   | 3.103   | 3.241   | 3.371   | 3.512   | 3.641   | 3.779   | 3.915   | 4.045   | 4.185   | 4.317   |
| 6.50     | 2.084                  | 2.211   | 2.334   | 2.454   | 2.576   | 2.697   | 2.822   | 2.944   | 3.068   | 3.194   | 3.310   | 3.435   | 3.558   | 3.678   | 3.806   | 3.929   |
| 7.00     | 1.913                  | 2.026   | 2.137   | 2.252   | 2.364   | 2.477   | 2.588   | 2.697   | 2.815   | 2.928   | 3.034   | 3.148   | 3.260   | 3.371   | 3.490   | 3.605   |
| 7.50     | 1.765                  | 1.870   | 1.972   | 2.077   | 2.180   | 2.285   | 2.390   | 2.494   | 2.594   | 2.697   | 2.801   | 2.905   | 3.009   | 3.112   | 3.222   | 3.320   |
| 8.00     | 1.640                  | 1.736   | 1.833   | 1.930   | 2.026   | 2.121   | 2.220   | 2.314   | 2.411   | 2.505   | 2.601   | 2.697   | 2.793   | 2.890   | 2.992   | 3.085   |
| 8.50     | 1.530                  | 1.621   | 1.709   | 1.799   | 1.890   | 1.979   | 2.069   | 2.159   | 2.252   | 2.339   | 2.433   | 2.523   | 2.613   | 2.697   | 2.793   | 2.882   |
| 9.00     | 1.435                  | 1.519   | 1.604   | 1.688   | 1.773   | 1.858   | 1.940   | 2.026   | 2.109   | 2.193   | 2.280   | 2.364   | 2.449   | 2.528   | 2.613   | 2.697   |
| 9.50     | 1.350                  | 1.430   | 1.509   | 1.588   | 1.668   | 1.748   | 1.827   | 1.906   | 1.986   | 2.065   | 2.146   | 2.225   | 2.304   | 2.385   | 2.460   | 2.540   |
| 10.00    | 1.275                  | 1.350   | 1.426   | 1.500   | 1.576   | 1.650   | 1.726   | 1.799   | 1.873   | 1.950   | 2.026   | 2.100   | 2.176   | 2.252   | 2.324   | 2.401   |
| 10.50    | 1.208                  | 1.279   | 1.350   | 1.420   | 1.492   | 1.563   | 1.635   | 1.704   | 1.776   | 1.848   | 1.920   | 1.990   | 2.061   | 2.133   | 2.202   | 2.276   |
| 11.00    | 1.147                  | 1.215   | 1.282   | 1.350   | 1.417   | 1.484   | 1.551   | 1.621   | 1.688   | 1.756   | 1.823   | 1.890   | 1.957   | 2.026   | 2.092   | 2.159   |
| 11.50    | 1.093                  | 1.157   | 1.222   | 1.285   | 1.350   | 1.415   | 1.478   | 1.543   | 1.606   | 1.673   | 1.736   | 1.799   | 1.864   | 1.930   | 1.993   | 2.057   |
| 12.00    | 1.043                  | 1.104   | 1.166   | 1.227   | 1.288   | 1.350   | 1.411   | 1.472   | 1.534   | 1.595   | 1.657   | 1.717   | 1.779   | 1.842   | 1.903   | 1.964   |
| 12.50    | 0.997                  | 1.056   | 1.116   | 1.174   | 1.233   | 1.291   | 1.350   | 1.409   | 1.468   | 1.525   | 1.585   | 1.642   | 1.701   | 1.762   | 1.820   | 1.877   |
| 13.00    | 0.956                  | 1.012   | 1.069   | 1.125   | 1.181   | 1.237   | 1.294   | 1.350   | 1.406   | 1.462   | 1.519   | 1.576   | 1.630   | 1.688   | 1.745   | 1.799   |

**Curve: IEC B**

| Curve #:<br>x P/U | 17                     | 18    | 19    | 20    | 21    | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|-------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                   | Time to Trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.50             | 0.918                  | 0.972 | 1.026 | 1.080 | 1.134 | 1.189 | 1.243 | 1.296 | 1.350 | 1.404 | 1.458 | 1.513 | 1.567 | 1.621 | 1.675 | 1.728 |
| 14.00             | 0.883                  | 0.934 | 0.987 | 1.038 | 1.090 | 1.143 | 1.194 | 1.247 | 1.299 | 1.350 | 1.402 | 1.454 | 1.507 | 1.558 | 1.609 | 1.662 |
| 14.50             | 0.850                  | 0.900 | 0.950 | 1.000 | 1.050 | 1.100 | 1.150 | 1.200 | 1.250 | 1.300 | 1.350 | 1.400 | 1.451 | 1.500 | 1.549 | 1.599 |
| 15.00             | 0.819                  | 0.868 | 0.916 | 0.964 | 1.012 | 1.060 | 1.109 | 1.157 | 1.206 | 1.254 | 1.302 | 1.350 | 1.399 | 1.447 | 1.494 | 1.543 |
| 15.50             | 0.791                  | 0.838 | 0.884 | 0.931 | 0.978 | 1.024 | 1.071 | 1.117 | 1.163 | 1.211 | 1.257 | 1.303 | 1.350 | 1.397 | 1.443 | 1.490 |
| 16.00             | 0.765                  | 0.810 | 0.855 | 0.900 | 0.945 | 0.990 | 1.035 | 1.080 | 1.125 | 1.169 | 1.215 | 1.260 | 1.305 | 1.350 | 1.395 | 1.439 |
| 16.50             | 0.741                  | 0.784 | 0.827 | 0.871 | 0.915 | 0.958 | 1.002 | 1.045 | 1.089 | 1.132 | 1.176 | 1.219 | 1.263 | 1.307 | 1.350 | 1.393 |
| 17.00             | 0.717                  | 0.760 | 0.801 | 0.843 | 0.886 | 0.928 | 0.970 | 1.012 | 1.054 | 1.097 | 1.139 | 1.181 | 1.223 | 1.266 | 1.308 | 1.350 |
| 17.50             | 0.695                  | 0.737 | 0.777 | 0.818 | 0.859 | 0.900 | 0.941 | 0.982 | 1.023 | 1.064 | 1.104 | 1.145 | 1.186 | 1.227 | 1.269 | 1.310 |
| 18.00             | 0.675                  | 0.715 | 0.754 | 0.794 | 0.834 | 0.874 | 0.913 | 0.953 | 0.993 | 1.032 | 1.072 | 1.112 | 1.151 | 1.191 | 1.231 | 1.270 |
| 18.50             | 0.656                  | 0.694 | 0.733 | 0.771 | 0.810 | 0.849 | 0.887 | 0.926 | 0.964 | 1.003 | 1.041 | 1.080 | 1.119 | 1.157 | 1.196 | 1.234 |
| 19.00             | 0.638                  | 0.675 | 0.712 | 0.750 | 0.787 | 0.825 | 0.863 | 0.900 | 0.938 | 0.975 | 1.012 | 1.050 | 1.088 | 1.125 | 1.162 | 1.200 |
| 19.50             | 0.620                  | 0.657 | 0.693 | 0.730 | 0.766 | 0.803 | 0.839 | 0.876 | 0.912 | 0.949 | 0.985 | 1.022 | 1.058 | 1.094 | 1.131 | 1.168 |
| 20.00             | 0.604                  | 0.639 | 0.675 | 0.711 | 0.746 | 0.782 | 0.817 | 0.853 | 0.888 | 0.924 | 0.959 | 0.995 | 1.030 | 1.066 | 1.101 | 1.137 |

# CURVE INFORMATION AND TABLES



Curve: IEC C

| Curve #: | 1                      | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11       | 12       | 13       | 14       | 15       | 16       |
|----------|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|
| x P/U    | Time to Trip (seconds) |         |         |         |         |         |         |         |         |         |          |          |          |          |          |          |
| 1.03     | 64.250                 | 136.531 | 182.042 | 273.063 | 364.083 | 364.083 | 546.125 | 546.125 | 546.125 | 546.125 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 |
| 1.10     | 19.162                 | 37.664  | 57.487  | 78.018  | 99.295  | 109.225 | 136.531 | 156.036 | 182.042 | 182.042 | 218.450  | 218.450  | 273.063  | 273.063  | 273.063  | 273.063  |
| 1.20     | 9.102                  | 18.204  | 27.306  | 36.408  | 45.510  | 54.613  | 64.250  | 72.817  | 84.019  | 91.021  | 99.295   | 109.225  | 121.361  | 121.361  | 136.531  | 136.531  |
| 1.30     | 5.810                  | 11.620  | 17.337  | 23.239  | 28.743  | 35.234  | 40.454  | 45.510  | 52.012  | 57.487  | 64.250   | 68.266   | 78.018   | 84.019   | 84.019   | 91.021   |
| 1.40     | 4.169                  | 8.338   | 12.555  | 16.549  | 21.005  | 24.824  | 29.520  | 33.098  | 37.664  | 42.010  | 45.510   | 49.648   | 54.613   | 57.487   | 64.250   | 68.266   |
| 1.50     | 3.203                  | 6.387   | 9.581   | 12.850  | 16.063  | 19.162  | 22.291  | 25.401  | 28.743  | 32.125  | 35.234   | 39.009   | 42.010   | 45.510   | 47.489   | 52.012   |
| 1.60     | 2.564                  | 5.128   | 7.692   | 10.304  | 12.850  | 15.384  | 17.906  | 20.608  | 23.239  | 25.401  | 28.006   | 31.207   | 33.098   | 36.408   | 39.009   | 40.454   |
| 1.70     | 2.117                  | 4.234   | 6.350   | 8.467   | 10.604  | 12.701  | 14.760  | 16.804  | 19.162  | 21.005  | 23.239   | 25.401   | 27.306   | 29.520   | 32.125   | 34.133   |
| 1.80     | 1.785                  | 3.569   | 5.354   | 7.139   | 8.953   | 10.708  | 12.555  | 14.372  | 16.063  | 17.906  | 19.504   | 21.417   | 23.239   | 24.824   | 26.640   | 28.743   |
| 1.90     | 1.532                  | 3.068   | 4.589   | 6.136   | 7.638   | 9.179   | 10.708  | 12.272  | 13.826  | 15.384  | 16.804   | 18.513   | 19.859   | 21.417   | 22.755   | 24.272   |
| 2.00     | 1.334                  | 2.664   | 4.001   | 5.328   | 6.660   | 7.973   | 9.335   | 10.708  | 12.003  | 13.320  | 14.760   | 16.063   | 17.337   | 18.513   | 19.859   | 21.417   |
| 2.10     | 1.173                  | 2.344   | 3.523   | 4.688   | 5.872   | 7.047   | 8.212   | 9.416   | 10.604  | 11.745  | 12.850   | 14.003   | 15.170   | 16.302   | 17.617   | 18.832   |
| 2.20     | 1.041                  | 2.084   | 3.121   | 4.169   | 5.201   | 6.241   | 7.282   | 8.338   | 9.335   | 10.402  | 11.497   | 12.555   | 13.485   | 14.563   | 15.604   | 16.549   |
| 2.30     | 0.933                  | 1.864   | 2.801   | 3.728   | 4.668   | 5.601   | 6.540   | 7.481   | 8.402   | 9.335   | 10.304   | 11.145   | 12.136   | 13.003   | 14.003   | 14.962   |
| 2.40     | 0.840                  | 1.680   | 2.523   | 3.361   | 4.201   | 5.033   | 5.872   | 6.742   | 7.585   | 8.402   | 9.256    | 10.113   | 10.923   | 11.745   | 12.555   | 13.485   |
| 2.50     | 0.762                  | 1.523   | 2.285   | 3.051   | 3.806   | 4.570   | 5.328   | 6.102   | 6.869   | 7.638   | 8.402    | 9.179    | 9.930    | 10.708   | 11.378   | 12.136   |
| 2.60     | 0.694                  | 1.390   | 2.084   | 2.779   | 3.467   | 4.169   | 4.854   | 5.544   | 6.241   | 6.957   | 7.638    | 8.338    | 9.027    | 9.752    | 10.402   | 11.145   |
| 2.70     | 0.636                  | 1.272   | 1.906   | 2.546   | 3.175   | 3.819   | 4.458   | 5.080   | 5.719   | 6.350   | 7.002    | 7.638    | 8.275    | 8.880    | 9.498    | 10.208   |
| 2.80     | 0.585                  | 1.169   | 1.753   | 2.339   | 2.920   | 3.512   | 4.091   | 4.688   | 5.251   | 5.841   | 6.425    | 7.002    | 7.585    | 8.212    | 8.738    | 9.335    |
| 2.90     | 0.540                  | 1.079   | 1.621   | 2.159   | 2.697   | 3.241   | 3.779   | 4.317   | 4.854   | 5.407   | 5.936    | 6.463    | 7.002    | 7.533    | 8.091    | 8.669    |
| 3.00     | 0.500                  | 1.000   | 1.500   | 2.000   | 2.499   | 3.001   | 3.501   | 4.001   | 4.495   | 5.010   | 5.489    | 6.001    | 6.501    | 7.002    | 7.481    | 7.973    |
| 3.10     | 0.465                  | 0.929   | 1.393   | 1.858   | 2.324   | 2.786   | 3.251   | 3.715   | 4.185   | 4.648   | 5.104    | 5.573    | 6.035    | 6.501    | 6.957    | 7.430    |
| 3.20     | 0.433                  | 0.865   | 1.299   | 1.731   | 2.163   | 2.594   | 3.034   | 3.467   | 3.901   | 4.334   | 4.770    | 5.201    | 5.630    | 6.068    | 6.501    | 6.913    |
| 3.30     | 0.404                  | 0.809   | 1.214   | 1.618   | 2.023   | 2.427   | 2.830   | 3.232   | 3.641   | 4.045   | 4.440    | 4.854    | 5.251    | 5.659    | 6.068    | 6.463    |
| 3.40     | 0.379                  | 0.757   | 1.137   | 1.515   | 1.893   | 2.271   | 2.651   | 3.034   | 3.413   | 3.793   | 4.169    | 4.551    | 4.920    | 5.302    | 5.689    | 6.068    |
| 3.50     | 0.356                  | 0.711   | 1.067   | 1.422   | 1.779   | 2.133   | 2.488   | 2.844   | 3.203   | 3.558   | 3.915    | 4.267    | 4.628    | 4.987    | 5.328    | 5.689    |
| 3.60     | 0.334                  | 0.669   | 1.003   | 1.339   | 1.673   | 2.008   | 2.339   | 2.677   | 3.009   | 3.340   | 3.678    | 4.016    | 4.352    | 4.688    | 5.010    | 5.354    |
| 3.70     | 0.315                  | 0.630   | 0.946   | 1.261   | 1.576   | 1.890   | 2.207   | 2.523   | 2.837   | 3.148   | 3.467    | 3.779    | 4.091    | 4.404    | 4.728    | 5.033    |
| 3.80     | 0.298                  | 0.595   | 0.893   | 1.191   | 1.488   | 1.785   | 2.084   | 2.380   | 2.677   | 2.976   | 3.270    | 3.569    | 3.873    | 4.169    | 4.458    | 4.770    |
| 3.90     | 0.282                  | 0.563   | 0.845   | 1.126   | 1.408   | 1.688   | 1.972   | 2.252   | 2.534   | 2.815   | 3.094    | 3.382    | 3.665    | 3.943    | 4.217    | 4.495    |
| 4.00     | 0.267                  | 0.533   | 0.800   | 1.067   | 1.334   | 1.599   | 1.867   | 2.133   | 2.401   | 2.664   | 2.936    | 3.203    | 3.467    | 3.728    | 4.001    | 4.267    |
| 4.10     | 0.253                  | 0.506   | 0.759   | 1.012   | 1.266   | 1.517   | 1.770   | 2.023   | 2.276   | 2.528   | 2.786    | 3.034    | 3.290    | 3.546    | 3.793    | 4.045    |
| 4.20     | 0.240                  | 0.481   | 0.721   | 0.961   | 1.202   | 1.443   | 1.683   | 1.923   | 2.163   | 2.406   | 2.645    | 2.882    | 3.121    | 3.361    | 3.605    | 3.846    |
| 4.30     | 0.229                  | 0.457   | 0.686   | 0.915   | 1.144   | 1.372   | 1.602   | 1.830   | 2.057   | 2.285   | 2.517    | 2.744    | 2.976    | 3.203    | 3.435    | 3.665    |
| 4.40     | 0.218                  | 0.436   | 0.654   | 0.872   | 1.089   | 1.307   | 1.525   | 1.742   | 1.961   | 2.180   | 2.395    | 2.613    | 2.830    | 3.051    | 3.270    | 3.490    |
| 4.50     | 0.208                  | 0.416   | 0.623   | 0.831   | 1.039   | 1.247   | 1.454   | 1.662   | 1.870   | 2.077   | 2.285    | 2.494    | 2.704    | 2.913    | 3.121    | 3.320    |
| 4.60     | 0.198                  | 0.397   | 0.595   | 0.794   | 0.992   | 1.191   | 1.390   | 1.588   | 1.785   | 1.986   | 2.185    | 2.380    | 2.582    | 2.779    | 2.976    | 3.175    |
| 4.70     | 0.190                  | 0.379   | 0.569   | 0.759   | 0.948   | 1.138   | 1.327   | 1.517   | 1.707   | 1.896   | 2.084    | 2.276    | 2.466    | 2.658    | 2.844    | 3.034    |
| 4.80     | 0.181                  | 0.363   | 0.544   | 0.726   | 0.907   | 1.089   | 1.270   | 1.452   | 1.633   | 1.814   | 1.997    | 2.176    | 2.359    | 2.540    | 2.724    | 2.905    |
| 4.90     | 0.174                  | 0.348   | 0.522   | 0.695   | 0.869   | 1.043   | 1.216   | 1.391   | 1.565   | 1.739   | 1.913    | 2.084    | 2.261    | 2.433    | 2.607    | 2.779    |
| 5.00     | 0.167                  | 0.333   | 0.500   | 0.667   | 0.833   | 1.000   | 1.167   | 1.334   | 1.500   | 1.668   | 1.833    | 2.000    | 2.167    | 2.334    | 2.499    | 2.664    |
| 5.10     | 0.160                  | 0.320   | 0.480   | 0.640   | 0.800   | 0.960   | 1.119   | 1.279   | 1.439   | 1.599   | 1.759    | 1.920    | 2.080    | 2.238    | 2.401    | 2.558    |
| 5.20     | 0.154                  | 0.307   | 0.461   | 0.614   | 0.768   | 0.922   | 1.075   | 1.229   | 1.383   | 1.536   | 1.691    | 1.842    | 1.997    | 2.150    | 2.304    | 2.460    |
| 5.30     | 0.148                  | 0.295   | 0.443   | 0.591   | 0.739   | 0.886   | 1.033   | 1.181   | 1.329   | 1.476   | 1.625    | 1.773    | 1.920    | 2.069    | 2.216    | 2.364    |
| 5.40     | 0.142                  | 0.284   | 0.426   | 0.568   | 0.710   | 0.852   | 0.995   | 1.137   | 1.279   | 1.420   | 1.563    | 1.704    | 1.848    | 1.990    | 2.129    | 2.271    |
| 5.50     | 0.137                  | 0.273   | 0.410   | 0.547   | 0.684   | 0.821   | 0.957   | 1.094   | 1.231   | 1.367   | 1.504    | 1.640    | 1.779    | 1.913    | 2.053    | 2.189    |
| 5.60     | 0.132                  | 0.264   | 0.395   | 0.527   | 0.659   | 0.790   | 0.923   | 1.054   | 1.186   | 1.318   | 1.449    | 1.581    | 1.712    | 1.845    | 1.975    | 2.109    |
| 5.70     | 0.127                  | 0.254   | 0.381   | 0.508   | 0.635   | 0.762   | 0.889   | 1.016   | 1.144   | 1.270   | 1.397    | 1.523    | 1.652    | 1.779    | 1.906    | 2.034    |
| 5.80     | 0.123                  | 0.245   | 0.368   | 0.490   | 0.613   | 0.736   | 0.858   | 0.980   | 1.103   | 1.226   | 1.348    | 1.470    | 1.592    | 1.715    | 1.839    | 1.961    |
| 5.90     | 0.118                  | 0.237   | 0.355   | 0.473   | 0.592   | 0.710   | 0.828   | 0.946   | 1.065   | 1.183   | 1.302    | 1.420    | 1.538    | 1.657    | 1.776    | 1.893    |
| 6.00     | 0.114                  | 0.229   | 0.343   | 0.457   | 0.572   | 0.686   | 0.800   | 0.914   | 1.028   | 1.143   | 1.257    | 1.372    | 1.486    | 1.599    | 1.715    | 1.830    |
| 6.50     | 0.097                  | 0.194   | 0.291   | 0.388   | 0.485   | 0.582   | 0.679   | 0.776   | 0.872   | 0.970   | 1.067    | 1.163    | 1.261    | 1.357    | 1.454    | 1.551    |
| 7.00     | 0.083                  | 0.167   | 0.250   | 0.333   | 0.417   | 0.500   | 0.583   | 0.667   | 0.750   | 0.833   | 0.916    | 1.000    | 1.084    | 1.167    | 1.250    | 1.334    |
| 7.50     | 0.072                  | 0.145   | 0.217   | 0.290   | 0.362   | 0.434   | 0.507   | 0.579   | 0.652   | 0.724   | 0.796    | 0.869    | 0.941    | 1.013    | 1.086    | 1.158    |
| 8.00     | 0.063                  | 0.127   | 0.190   | 0.254   | 0.317   | 0.381   | 0.444   | 0.508   | 0.572   | 0.635   | 0.698    | 0.762    | 0.826    | 0.889    | 0.952    | 1.016    |
| 8.50     | 0.056                  | 0.112   | 0.168   | 0.225   | 0.281   | 0.337   | 0.393   | 0.449   | 0.505   | 0.561   | 0.617    | 0.674    | 0.730    | 0.786    | 0.842    | 0.898    |
| 9.00     | 0.050                  | 0.100   | 0.150   | 0.200   | 0.250   | 0.300   | 0.350   | 0.400   | 0.450   | 0.500   | 0.550    | 0.600    | 0.650    | 0.700    | 0.750    | 0.800    |
| 9.50     | 0.045                  | 0.090   | 0.134   | 0.179   | 0.224   | 0.269   | 0.314   | 0.359   | 0.403   | 0.448   | 0.493    | 0.538    | 0.583    | 0.627    | 0.672    | 0.717    |
| 10.00    | 0.040                  | 0.081   | 0.121   | 0.162   | 0.202   | 0.242   | 0.283   | 0.323   | 0.364   | 0.404   | 0.444    | 0.485    | 0.525    | 0.566    | 0.606    | 0.646    |
| 10.50    | 0.037                  | 0.073   | 0.110   | 0.146   | 0.183   | 0.220   | 0.256   | 0.293   | 0.329   | 0.366   | 0.403    | 0.439    | 0.476    | 0.513    | 0.549    | 0.586    |
| 11.00    | 0.033                  | 0.067   | 0.100   | 0.133   | 0.167   | 0.200   | 0.233   | 0.267   | 0.300   | 0.333   | 0.367    | 0.400    | 0.433    | 0.467    | 0.500    | 0.533    |
| 11.50    | 0.030                  | 0.061   | 0.091   | 0.122   | 0.152   | 0.183   | 0.213   | 0.244   | 0.274   | 0.305   | 0.335    | 0.366    | 0.396    | 0.427    | 0.457    | 0.488    |
| 12.00    | 0.028                  | 0.056   | 0.084   | 0.112   | 0.140   | 0.168   | 0.196   | 0.224   | 0.252   | 0.280   | 0.308    | 0.336    | 0.364    | 0.392    | 0.420    | 0.448    |
| 12.50    | 0.026                  | 0.052   | 0.077   | 0.103   | 0.129   | 0.155   | 0.180   | 0.206   | 0.232   | 0.258   | 0.283    | 0.309    | 0.335    | 0.361    | 0.387    | 0.412    |
| 13.00    | 0.024                  | 0.048   | 0.071   | 0.095   | 0.119   | 0.143   | 0.167   | 0.190   | 0.214   | 0.238   | 0.262    | 0.286    | 0.310    | 0.333    | 0.357    | 0.381    |

**Curve: IEC C**

| Curve #:<br>x P/U | 1                      | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15    | 16    |
|-------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                   | Time to Trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.50             | 0.022                  | 0.044 | 0.066 | 0.088 | 0.110 | 0.132 | 0.154 | 0.177 | 0.199 | 0.221 | 0.243 | 0.265 | 0.287 | 0.309 | 0.331 | 0.353 |
| 14.00             | 0.021                  | 0.041 | 0.062 | 0.082 | 0.103 | 0.123 | 0.144 | 0.164 | 0.185 | 0.205 | 0.226 | 0.246 | 0.267 | 0.287 | 0.308 | 0.328 |
| 14.50             | 0.019                  | 0.038 | 0.057 | 0.076 | 0.096 | 0.115 | 0.134 | 0.153 | 0.172 | 0.191 | 0.210 | 0.229 | 0.249 | 0.268 | 0.287 | 0.306 |
| 15.00             | 0.018                  | 0.036 | 0.054 | 0.071 | 0.089 | 0.107 | 0.125 | 0.143 | 0.161 | 0.179 | 0.196 | 0.214 | 0.232 | 0.250 | 0.268 | 0.286 |
| 15.50             | 0.017                  | 0.033 | 0.050 | 0.067 | 0.084 | 0.100 | 0.117 | 0.134 | 0.150 | 0.167 | 0.184 | 0.201 | 0.217 | 0.234 | 0.251 | 0.268 |
| 16.00             | 0.016                  | 0.031 | 0.047 | 0.063 | 0.078 | 0.094 | 0.110 | 0.125 | 0.141 | 0.157 | 0.173 | 0.188 | 0.204 | 0.220 | 0.235 | 0.251 |
| 16.50             | 0.015                  | 0.029 | 0.044 | 0.059 | 0.074 | 0.088 | 0.103 | 0.118 | 0.133 | 0.147 | 0.162 | 0.177 | 0.192 | 0.206 | 0.221 | 0.236 |
| 17.00             | 0.014                  | 0.028 | 0.042 | 0.056 | 0.069 | 0.083 | 0.097 | 0.111 | 0.125 | 0.139 | 0.153 | 0.167 | 0.181 | 0.194 | 0.208 | 0.222 |
| 17.50             | 0.013                  | 0.026 | 0.039 | 0.052 | 0.066 | 0.079 | 0.092 | 0.105 | 0.118 | 0.131 | 0.144 | 0.157 | 0.170 | 0.183 | 0.197 | 0.210 |
| 18.00             | 0.012                  | 0.025 | 0.037 | 0.050 | 0.062 | 0.074 | 0.087 | 0.099 | 0.111 | 0.124 | 0.136 | 0.149 | 0.161 | 0.173 | 0.186 | 0.198 |
| 18.50             | 0.012                  | 0.023 | 0.035 | 0.047 | 0.059 | 0.070 | 0.082 | 0.094 | 0.105 | 0.117 | 0.129 | 0.141 | 0.152 | 0.164 | 0.176 | 0.188 |
| 19.00             | 0.011                  | 0.022 | 0.033 | 0.044 | 0.056 | 0.067 | 0.078 | 0.089 | 0.100 | 0.111 | 0.122 | 0.133 | 0.144 | 0.156 | 0.167 | 0.178 |
| 19.50             | 0.011                  | 0.021 | 0.032 | 0.042 | 0.053 | 0.063 | 0.074 | 0.084 | 0.095 | 0.105 | 0.116 | 0.127 | 0.137 | 0.148 | 0.158 | 0.169 |
| 20.00             | 0.010                  | 0.020 | 0.030 | 0.040 | 0.050 | 0.060 | 0.070 | 0.080 | 0.090 | 0.100 | 0.110 | 0.120 | 0.130 | 0.140 | 0.150 | 0.160 |

# CURVE INFORMATION AND TABLES



Curve: IEC C

| Curve #: | 17                     | 18       | 19       | 20       | 21       | 22       | 23       | 24       | 25       | 26       | 27       | 28       | 29       | 30       | 31       | 32       |
|----------|------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| x P/U    | Time to Trip (seconds) |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| 1.03     | 1092.250               | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 | 1092.250 |
| 1.10     | 364.083                | 364.083  | 364.083  | 364.083  | 364.083  | 364.083  | 546.125  | 546.125  | 546.125  | 546.125  | 546.125  | 546.125  | 546.125  | 546.125  | 546.125  | 546.125  |
| 1.20     | 156.036                | 156.036  | 182.042  | 182.042  | 182.042  | 218.450  | 218.450  | 218.450  | 218.450  | 218.450  | 273.063  | 273.063  | 273.063  | 273.063  | 273.063  | 273.063  |
| 1.30     | 99.295                 | 109.225  | 109.225  | 121.361  | 121.361  | 121.361  | 136.531  | 136.531  | 136.531  | 156.036  | 156.036  | 156.036  | 182.042  | 182.042  | 182.042  | 182.042  |
| 1.40     | 72.817                 | 72.817   | 78.018   | 84.019   | 91.021   | 91.021   | 99.295   | 99.295   | 109.225  | 109.225  | 109.225  | 121.361  | 121.361  | 121.361  | 136.531  | 136.531  |
| 1.50     | 54.613                 | 57.487   | 60.681   | 64.250   | 68.266   | 68.266   | 72.817   | 78.018   | 78.018   | 84.019   | 84.019   | 91.021   | 91.021   | 99.295   | 99.295   | 99.295   |
| 1.60     | 43.690                 | 45.510   | 49.648   | 52.012   | 54.613   | 57.487   | 57.487   | 60.681   | 64.250   | 68.266   | 68.266   | 72.817   | 72.817   | 78.018   | 78.018   | 84.019   |
| 1.70     | 36.408                 | 37.664   | 40.454   | 42.010   | 43.690   | 47.489   | 49.648   | 49.648   | 52.012   | 54.613   | 57.487   | 60.681   | 60.681   | 64.250   | 64.250   | 68.266   |
| 1.80     | 30.340                 | 32.125   | 34.133   | 35.234   | 37.664   | 39.009   | 40.454   | 43.690   | 45.510   | 45.510   | 47.489   | 49.648   | 52.012   | 54.613   | 54.613   | 57.487   |
| 1.90     | 26.006                 | 27.306   | 28.743   | 30.340   | 32.125   | 34.133   | 35.234   | 36.408   | 37.664   | 40.454   | 42.010   | 43.690   | 43.690   | 45.510   | 47.489   | 49.648   |
| 2.00     | 22.755                 | 23.745   | 25.401   | 26.640   | 28.006   | 29.520   | 30.340   | 32.125   | 33.098   | 34.133   | 36.408   | 37.664   | 39.009   | 40.454   | 42.010   | 42.010   |
| 2.10     | 19.859                 | 21.005   | 22.291   | 23.239   | 24.824   | 26.006   | 27.306   | 28.006   | 29.520   | 30.340   | 32.125   | 33.098   | 34.133   | 35.234   | 36.408   | 37.664   |
| 2.20     | 17.617                 | 18.832   | 19.859   | 21.005   | 21.845   | 22.755   | 23.745   | 24.824   | 26.006   | 27.306   | 28.006   | 29.520   | 30.340   | 31.207   | 32.125   | 33.098   |
| 2.30     | 15.830                 | 16.804   | 17.617   | 18.513   | 19.504   | 20.608   | 21.417   | 22.291   | 23.239   | 24.272   | 25.401   | 26.006   | 27.306   | 28.006   | 28.743   | 29.520   |
| 2.40     | 14.372                 | 15.170   | 16.063   | 16.804   | 17.617   | 18.513   | 19.162   | 20.227   | 21.005   | 21.845   | 22.755   | 23.745   | 24.272   | 25.401   | 26.006   | 26.640   |
| 2.50     | 13.003                 | 13.653   | 14.563   | 15.170   | 16.063   | 16.804   | 17.617   | 18.204   | 19.162   | 19.859   | 20.608   | 21.417   | 22.291   | 22.755   | 23.745   | 24.272   |
| 2.60     | 11.745                 | 12.555   | 13.160   | 13.826   | 14.563   | 15.384   | 16.063   | 16.549   | 17.337   | 18.204   | 18.832   | 19.504   | 20.227   | 21.005   | 21.417   | 22.291   |
| 2.70     | 10.814                 | 11.497   | 12.136   | 12.701   | 13.320   | 14.003   | 14.563   | 15.170   | 15.830   | 16.549   | 17.066   | 17.906   | 18.513   | 19.162   | 19.859   | 20.227   |
| 2.80     | 9.930                  | 10.502   | 11.145   | 11.745   | 12.272   | 12.850   | 13.485   | 14.003   | 14.563   | 15.170   | 15.830   | 16.302   | 17.066   | 17.617   | 18.204   | 18.832   |
| 2.90     | 9.179                  | 9.752    | 10.304   | 10.814   | 11.378   | 11.872   | 12.412   | 13.003   | 13.485   | 14.003   | 14.563   | 15.170   | 15.604   | 16.302   | 16.804   | 17.337   |
| 3.00     | 8.467                  | 9.027    | 9.498    | 10.021   | 10.502   | 11.033   | 11.497   | 12.003   | 12.555   | 13.003   | 13.485   | 14.003   | 14.563   | 14.962   | 15.604   | 16.063   |
| 3.10     | 7.915                  | 8.338    | 8.808    | 9.256    | 9.752    | 10.208   | 10.708   | 11.145   | 11.620   | 12.136   | 12.555   | 13.003   | 13.485   | 14.003   | 14.372   | 14.962   |
| 3.20     | 7.380                  | 7.802    | 8.212    | 8.669    | 9.102    | 9.498    | 9.930    | 10.402   | 10.814   | 11.260   | 11.745   | 12.136   | 12.555   | 13.003   | 13.485   | 13.826   |
| 3.30     | 6.869                  | 7.282    | 7.692    | 8.091    | 8.467    | 8.880    | 9.335    | 9.666    | 10.113   | 10.502   | 10.923   | 11.378   | 11.745   | 12.136   | 12.555   | 13.003   |
| 3.40     | 6.425                  | 6.827    | 7.186    | 7.585    | 7.973    | 8.338    | 8.738    | 9.102    | 9.498    | 9.840    | 10.208   | 10.604   | 11.033   | 11.378   | 11.745   | 12.136   |
| 3.50     | 6.035                  | 6.387    | 6.742    | 7.093    | 7.481    | 7.802    | 8.151    | 8.533    | 8.880    | 9.256    | 9.581    | 9.930    | 10.304   | 10.708   | 11.033   | 11.378   |
| 3.60     | 5.689                  | 6.035    | 6.350    | 6.701    | 7.002    | 7.380    | 7.692    | 8.031    | 8.338    | 8.669    | 9.027    | 9.335    | 9.666    | 10.021   | 10.402   | 10.708   |
| 3.70     | 5.354                  | 5.659    | 6.001    | 6.314    | 6.620    | 6.913    | 7.233    | 7.585    | 7.858    | 8.212    | 8.533    | 8.808    | 9.179    | 9.416    | 9.752    | 10.113   |
| 3.80     | 5.057                  | 5.354    | 5.659    | 5.969    | 6.241    | 6.540    | 6.827    | 7.139    | 7.430    | 7.746    | 8.031    | 8.338    | 8.600    | 8.953    | 9.256    | 9.498    |
| 3.90     | 4.791                  | 5.057    | 5.354    | 5.630    | 5.904    | 6.206    | 6.463    | 6.742    | 7.047    | 7.331    | 7.585    | 7.858    | 8.151    | 8.467    | 8.738    | 9.027    |
| 4.00     | 4.532                  | 4.791    | 5.057    | 5.328    | 5.601    | 5.872    | 6.136    | 6.387    | 6.660    | 6.913    | 7.186    | 7.481    | 7.746    | 7.973    | 8.275    | 8.533    |
| 4.10     | 4.300                  | 4.551    | 4.812    | 5.057    | 5.302    | 5.573    | 5.810    | 6.068    | 6.314    | 6.580    | 6.827    | 7.093    | 7.331    | 7.585    | 7.858    | 8.091    |
| 4.20     | 4.091                  | 4.334    | 4.570    | 4.812    | 5.057    | 5.277    | 5.516    | 5.779    | 6.001    | 6.241    | 6.501    | 6.742    | 6.957    | 7.233    | 7.430    | 7.692    |
| 4.30     | 3.887                  | 4.122    | 4.352    | 4.570    | 4.812    | 5.033    | 5.251    | 5.489    | 5.719    | 5.936    | 6.171    | 6.387    | 6.620    | 6.869    | 7.093    | 7.331    |
| 4.40     | 3.703                  | 3.915    | 4.137    | 4.352    | 4.570    | 4.791    | 5.010    | 5.226    | 5.434    | 5.659    | 5.872    | 6.102    | 6.314    | 6.540    | 6.742    | 6.957    |
| 4.50     | 3.535                  | 3.741    | 3.943    | 4.153    | 4.369    | 4.570    | 4.770    | 4.987    | 5.201    | 5.407    | 5.601    | 5.810    | 6.035    | 6.241    | 6.425    | 6.660    |
| 4.60     | 3.371                  | 3.569    | 3.766    | 3.972    | 4.169    | 4.369    | 4.570    | 4.770    | 4.965    | 5.152    | 5.354    | 5.544    | 5.749    | 5.969    | 6.136    | 6.350    |
| 4.70     | 3.222                  | 3.413    | 3.605    | 3.793    | 3.986    | 4.169    | 4.369    | 4.551    | 4.749    | 4.942    | 5.128    | 5.302    | 5.489    | 5.689    | 5.872    | 6.068    |
| 4.80     | 3.085                  | 3.270    | 3.446    | 3.629    | 3.806    | 3.986    | 4.169    | 4.352    | 4.532    | 4.728    | 4.898    | 5.080    | 5.251    | 5.434    | 5.630    | 5.810    |
| 4.90     | 2.952                  | 3.130    | 3.300    | 3.479    | 3.653    | 3.819    | 4.001    | 4.169    | 4.352    | 4.513    | 4.688    | 4.876    | 5.033    | 5.226    | 5.381    | 5.573    |
| 5.00     | 2.830                  | 3.001    | 3.166    | 3.330    | 3.501    | 3.665    | 3.832    | 4.001    | 4.169    | 4.334    | 4.495    | 4.668    | 4.833    | 5.010    | 5.177    | 5.328    |
| 5.10     | 2.717                  | 2.882    | 3.042    | 3.203    | 3.361    | 3.523    | 3.678    | 3.832    | 4.001    | 4.153    | 4.317    | 4.476    | 4.648    | 4.791    | 4.965    | 5.128    |
| 5.20     | 2.613                  | 2.765    | 2.920    | 3.068    | 3.222    | 3.382    | 3.535    | 3.690    | 3.846    | 4.001    | 4.153    | 4.300    | 4.458    | 4.609    | 4.770    | 4.920    |
| 5.30     | 2.511                  | 2.658    | 2.808    | 2.952    | 3.103    | 3.251    | 3.392    | 3.546    | 3.690    | 3.832    | 3.986    | 4.137    | 4.283    | 4.422    | 4.570    | 4.728    |
| 5.40     | 2.416                  | 2.558    | 2.697    | 2.844    | 2.984    | 3.121    | 3.270    | 3.413    | 3.546    | 3.690    | 3.832    | 3.972    | 4.122    | 4.267    | 4.404    | 4.551    |
| 5.50     | 2.324                  | 2.460    | 2.601    | 2.737    | 2.874    | 3.009    | 3.148    | 3.280    | 3.424    | 3.558    | 3.690    | 3.832    | 3.972    | 4.106    | 4.234    | 4.369    |
| 5.60     | 2.238                  | 2.369    | 2.505    | 2.632    | 2.765    | 2.897    | 3.034    | 3.166    | 3.290    | 3.424    | 3.558    | 3.690    | 3.819    | 3.957    | 4.091    | 4.217    |
| 5.70     | 2.159                  | 2.285    | 2.411    | 2.540    | 2.671    | 2.793    | 2.920    | 3.051    | 3.175    | 3.300    | 3.435    | 3.558    | 3.678    | 3.806    | 3.943    | 4.060    |
| 5.80     | 2.084                  | 2.207    | 2.329    | 2.449    | 2.576    | 2.697    | 2.815    | 2.944    | 3.060    | 3.184    | 3.310    | 3.435    | 3.558    | 3.678    | 3.793    | 3.915    |
| 5.90     | 2.012                  | 2.129    | 2.247    | 2.364    | 2.482    | 2.601    | 2.724    | 2.837    | 2.960    | 3.077    | 3.194    | 3.310    | 3.435    | 3.546    | 3.665    | 3.779    |
| 6.00     | 1.944                  | 2.057    | 2.171    | 2.285    | 2.401    | 2.517    | 2.626    | 2.744    | 2.859    | 2.968    | 3.085    | 3.203    | 3.310    | 3.424    | 3.546    | 3.653    |
| 6.50     | 1.647                  | 1.745    | 1.842    | 1.940    | 2.038    | 2.133    | 2.229    | 2.329    | 2.422    | 2.523    | 2.619    | 2.717    | 2.815    | 2.913    | 3.009    | 3.103    |
| 7.00     | 1.417                  | 1.500    | 1.583    | 1.668    | 1.750    | 1.833    | 1.916    | 2.000    | 2.084    | 2.167    | 2.252    | 2.334    | 2.416    | 2.499    | 2.582    | 2.664    |
| 7.50     | 1.231                  | 1.303    | 1.376    | 1.449    | 1.521    | 1.592    | 1.665    | 1.736    | 1.811    | 1.883    | 1.954    | 2.026    | 2.100    | 2.171    | 2.243    | 2.319    |
| 8.00     | 1.079                  | 1.143    | 1.207    | 1.270    | 1.334    | 1.397    | 1.460    | 1.523    | 1.588    | 1.650    | 1.715    | 1.779    | 1.842    | 1.906    | 1.968    | 2.030    |
| 8.50     | 0.955                  | 1.010    | 1.067    | 1.123    | 1.180    | 1.236    | 1.291    | 1.347    | 1.404    | 1.460    | 1.515    | 1.572    | 1.628    | 1.683    | 1.739    | 1.796    |
| 9.00     | 0.850                  | 0.900    | 0.950    | 1.000    | 1.050    | 1.100    | 1.150    | 1.200    | 1.250    | 1.300    | 1.350    | 1.400    | 1.451    | 1.500    | 1.549    | 1.599    |
| 9.50     | 0.762                  | 0.807    | 0.851    | 0.896    | 0.941    | 0.986    | 1.030    | 1.076    | 1.120    | 1.166    | 1.210    | 1.255    | 1.300    | 1.345    | 1.390    | 1.433    |
| 10.00    | 0.687                  | 0.727    | 0.768    | 0.808    | 0.849    | 0.889    | 0.930    | 0.970    | 1.010    | 1.050    | 1.091    | 1.132    | 1.172    | 1.212    | 1.253    | 1.293    |
| 10.50    | 0.622                  | 0.659    | 0.696    | 0.732    | 0.769    | 0.805    | 0.842    | 0.879    | 0.916    | 0.952    | 0.988    | 1.026    | 1.061    | 1.099    | 1.135    | 1.172    |
| 11.00    | 0.567                  | 0.600    | 0.633    | 0.667    | 0.700    | 0.734    | 0.766    | 0.800    | 0.833    | 0.867    | 0.900    | 0.934    | 0.967    | 1.000    | 1.033    | 1.067    |
| 11.50    | 0.518                  | 0.549    | 0.579    | 0.610    | 0.640    | 0.671    | 0.701    | 0.732    | 0.762    | 0.793    | 0.823    | 0.853    | 0.884    | 0.914    | 0.945    | 0.975    |
| 12.00    | 0.476                  | 0.504    | 0.532    | 0.560    | 0.588    | 0.615    | 0.643    | 0.671    | 0.699    | 0.727    | 0.755    | 0.783    | 0.811    | 0.839    | 0.867    | 0.895    |
| 12.50    | 0.438                  | 0.464    | 0.490    | 0.515    | 0.541    | 0.567    | 0.593    | 0.618    | 0.644    | 0.670    | 0.696    | 0.721    | 0.747    | 0.773    | 0.798    | 0.824    |
| 13.00    | 0.405                  | 0.429    | 0.452    | 0.476    | 0.500    | 0.524    | 0.547    | 0.572    | 0.595    | 0.619    | 0.643    | 0.667    | 0.690    | 0.714    | 0.738    | 0.762    |

**Curve: IEC C**

| Curve #:<br>x P/U | 17                     | 18    | 19    | 20    | 21    | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    | 31    | 32    |
|-------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                   | Time to Trip (seconds) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 13.50             | 0.375                  | 0.397 | 0.419 | 0.441 | 0.463 | 0.485 | 0.508 | 0.530 | 0.552 | 0.574 | 0.596 | 0.618 | 0.640 | 0.662 | 0.684 | 0.706 |
| 14.00             | 0.349                  | 0.369 | 0.390 | 0.410 | 0.431 | 0.451 | 0.472 | 0.492 | 0.513 | 0.533 | 0.554 | 0.574 | 0.595 | 0.615 | 0.636 | 0.656 |
| 14.50             | 0.325                  | 0.344 | 0.363 | 0.382 | 0.401 | 0.421 | 0.440 | 0.459 | 0.478 | 0.497 | 0.516 | 0.535 | 0.554 | 0.573 | 0.593 | 0.612 |
| 15.00             | 0.304                  | 0.321 | 0.339 | 0.357 | 0.375 | 0.393 | 0.411 | 0.429 | 0.446 | 0.464 | 0.482 | 0.500 | 0.518 | 0.536 | 0.554 | 0.572 |
| 15.50             | 0.284                  | 0.301 | 0.318 | 0.334 | 0.351 | 0.368 | 0.385 | 0.401 | 0.418 | 0.435 | 0.451 | 0.468 | 0.485 | 0.501 | 0.518 | 0.535 |
| 16.00             | 0.267                  | 0.282 | 0.298 | 0.314 | 0.329 | 0.345 | 0.361 | 0.377 | 0.392 | 0.408 | 0.424 | 0.439 | 0.455 | 0.471 | 0.486 | 0.502 |
| 16.50             | 0.251                  | 0.265 | 0.280 | 0.295 | 0.310 | 0.324 | 0.339 | 0.354 | 0.369 | 0.383 | 0.398 | 0.413 | 0.428 | 0.442 | 0.457 | 0.472 |
| 17.00             | 0.236                  | 0.250 | 0.264 | 0.278 | 0.292 | 0.306 | 0.319 | 0.333 | 0.347 | 0.361 | 0.375 | 0.389 | 0.403 | 0.417 | 0.431 | 0.444 |
| 17.50             | 0.223                  | 0.236 | 0.249 | 0.262 | 0.275 | 0.288 | 0.301 | 0.314 | 0.328 | 0.341 | 0.354 | 0.367 | 0.380 | 0.393 | 0.406 | 0.419 |
| 18.00             | 0.211                  | 0.223 | 0.235 | 0.248 | 0.260 | 0.272 | 0.285 | 0.297 | 0.310 | 0.322 | 0.334 | 0.347 | 0.359 | 0.372 | 0.384 | 0.396 |
| 18.50             | 0.199                  | 0.211 | 0.223 | 0.234 | 0.246 | 0.258 | 0.270 | 0.281 | 0.293 | 0.305 | 0.317 | 0.328 | 0.340 | 0.352 | 0.363 | 0.375 |
| 19.00             | 0.189                  | 0.200 | 0.211 | 0.222 | 0.233 | 0.244 | 0.256 | 0.267 | 0.278 | 0.289 | 0.300 | 0.311 | 0.322 | 0.333 | 0.344 | 0.356 |
| 19.50             | 0.179                  | 0.190 | 0.200 | 0.211 | 0.222 | 0.232 | 0.243 | 0.253 | 0.264 | 0.274 | 0.285 | 0.295 | 0.306 | 0.316 | 0.327 | 0.338 |
| 20.00             | 0.170                  | 0.180 | 0.190 | 0.200 | 0.211 | 0.221 | 0.231 | 0.241 | 0.251 | 0.261 | 0.271 | 0.281 | 0.291 | 0.301 | 0.311 | 0.321 |

## Primary Injection Testing

Complete system operation can be checked by injecting current through the phase and ground CT's, and by providing a potential source. To do this a primary (high current) test set is required. The operation of the entire system including CT's can then be checked. If this equipment is not available, secondary injection tests can be done to check everything except the CT's. This procedure is described in the following sections.

## Secondary Injection Testing

Single phase secondary injection testing can be performed using the test setup in Figure 8.1. The tests described here apply to the relay with factory setpoints unchanged. Similar tests can be performed when new setpoints have been stored. Make a note of any setpoints changed so that these can be returned to their original values. To avoid unnecessary breaker tripping and alarms it is recommended that related connections be removed during these tests.

If a trip has been assigned to another relay instead of the trip relay, then the latching relay in Figure 8.1, should be connected to this relay's contacts for the tests. Refer to sections 5 & 6 of this manual to locate the messages referred to in these test procedures. Note that these tests cannot be performed unless the correct access code is entered in page 1 of setpoints and the access jumper or keyswitch is closed. When values are stored, by pressing the STORE key, verify that the NEW SETPOINT STORED message appears.

## Phase Current Input Function Check

The 565/575 Relay must read the phase current signals from the CT's correctly to provide the instantaneous and timed overcurrent protection. To determine if the 565/575 Relay is reading the correct current values with the test setup in Figure 8.1, apply control power, change the phase overcurrent pickup level to 100% of the CT primary in page 2 of setpoints, and put the 565/575 Relay into actual values mode. Use the test set current adjustment to set the phase current injected into the phases, to a mid value, which is read from the ammeter. This can be 2 Amps if a 5 Amp CT is being used or 0.4 Amps if a 1 Amp CT is being used.

Read the displayed value of current for the selected phase from actual values Page 1, message A 1.2, 1.3, or 1.4. With the factory setpoints the CT ratio will be set at 100/5. Verify that the displayed current is:

Displayed current = Injected current  $\times$  CT Primary Rating  $\div$  CT Secondary Rating

For example, if 5 Amp CT's are being used, and the ammeter reading has been adjusted to 2 Amps, the display should read:

Displayed current =  $2 \times 100/5$  or 40 Amps.

If a CT ratio other than this is used, it should be entered in the above equation. Turn the phase current off.

## Phase Instantaneous Pickup and Trip Check

Test phase A instantaneous overcurrent pickup as follows:

Press the SETPOINTS key to enter setpoints mode and the PAGE key to view page 2. Using the LINE DOWN key read the phase CT primary rating from message S 2.2 and verify that the phase instantaneous trips are enabled by viewing message S 2.11. If not, select enabled using the NEXT CHOICE key and store the value. Use the LINE UP key to view message S 2.3 and set the Phase overcurrent pickup level to 25%. View message S 2.12 and enter a value for the phase instantaneous overcurrent trip level, as a multiple of the overcurrent pickup level, for example, 3.

Set the phase instantaneous trip time delay to instantaneous as follows:

Use the LINE DOWN key to view message S 2.13, phase instantaneous trip delay. Enter 0 for this setpoint. Press STORE to store the setpoint in the 565/575 Memory. Verify that INST is displayed by message S 2.13.

Using the test setup variac, slowly increase the phase current injected until the trip or other assigned relay is activated and the corresponding LED is illuminated. Verify that the injected current at the time of trip corresponds to the instantaneous pickup value entered in the setpoints message S 2.12,  $\pm 5\%$ . In this case, the pickup level was set at 25% of the CT secondary rating, (5 Amps) or 1.25 Amps. The trip level is three times this or 3.75 Amps.

Check that the actual values page 5 message gives Phase A instantaneous overcurrent, as the cause of last trip. Slowly decrease the phase current and check that the trip relay can be reset at or below 95% of the pickup level.

## Phase Overcurrent Curve Verification

With factory settings view setpoints message S 2.4. This gives the curve shape currently in use for the overcurrent protection. Note which curve has been selected.

View message S 2.3, which gives the phase overcurrent pickup level. Use the LINE DOWN key to view message S 2.5, which is the phase overcurrent curve number. Enter and store a value of 1 for this. Using the test setup current adjustment, set the phase current to the trip level and turn off. In this example, this was three times the pickup, or 3.75 Amps as described above. Without changing the current setting, press the test set start button, to activate the timer. Check the time elapsed when the trip or other assigned relay

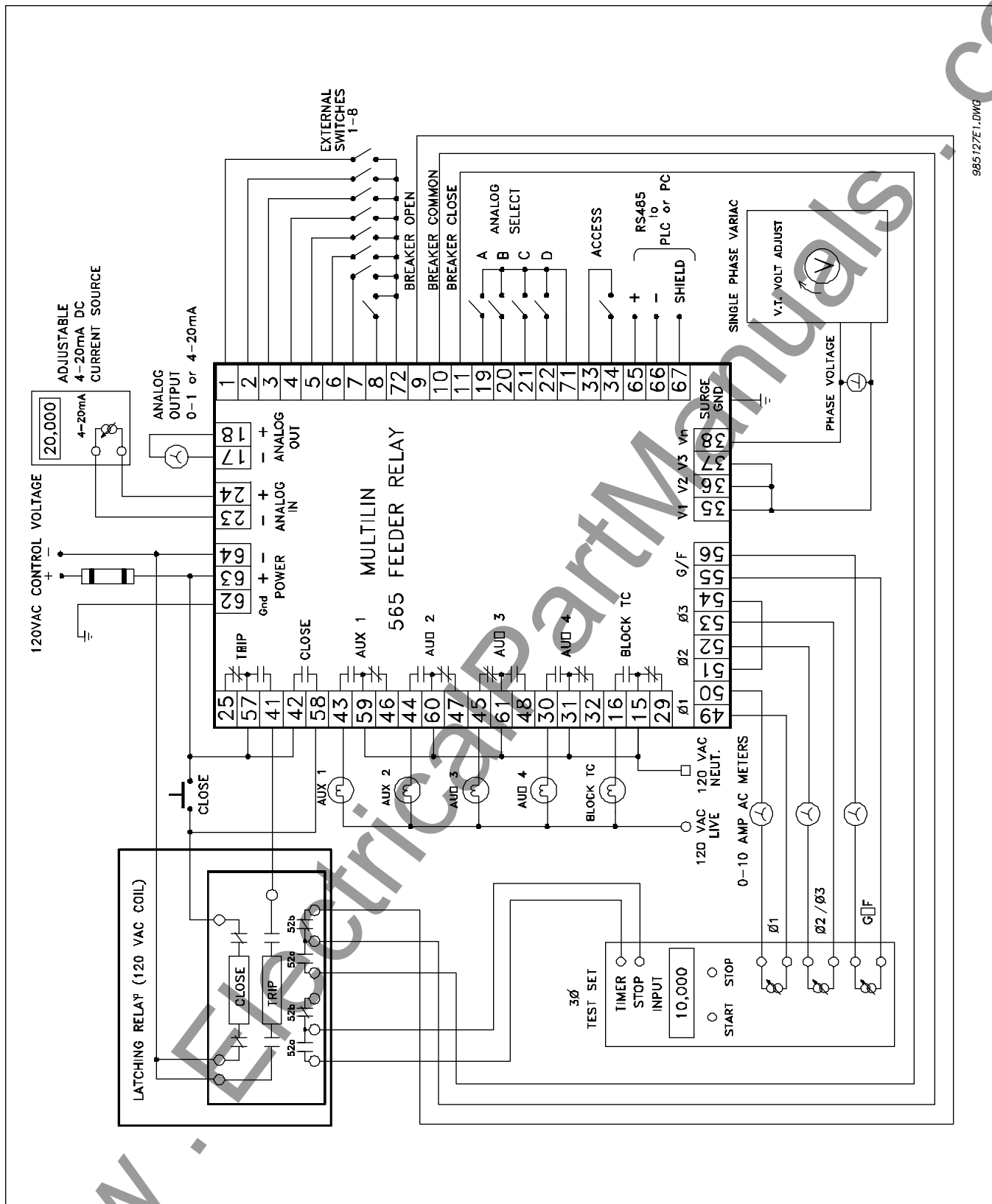


Figure 8.1 Secondary Injection Test Setup

LED is illuminated. Select the curve in use from Appendix D and read the time to trip for the chosen current. Verify that the measured time corresponds to the time indicated for this current by the curve, within the accuracy given in the specifications, Section 9 of this manual. This test can be repeated for other currents, as a further check.

## Ground Current Input Function Check

This test determines if the 565/575 Relay is reading the correct ground current values. Using the test set of Figure 8.1, apply control power and put the relay into the setpoints mode. Use the LINE DOWN key to view message S 3.5 and adjust the ground overcurrent pickup level to 40% of the CT rating.

Check the setpoints message S 3.2 to verify that the ground sensing is enabled. If not, select and store ENABLED for this setpoint. Press the LINE DOWN key and read the sensing system selected from message S 3.3. If zero sequence sensing has been selected, view message S 3.4 to determine the primary CT rating. If residual sensing has been selected in message S 3.3, determine the phase current CT rating, as described in the phase current input function check. Using a CT ratio of 100/5 as an example, the displayed current can be calculated as follows:

Displayed current = Injected current  $\times$  CT Primary Rating  $\div$  CT Secondary Rating.

Use the test set current adjustment to set the injected ground current, read from the ammeter, to a convenient value, for example, 1.5 Amps, if a 5 Amp CT is being used. The display should read:

Displayed current =  $1.5 \times 100/5$  or 30 Amps.

If a CT ratio other than this is used, it should be entered in the above equation.

Read the displayed value of ground current from actual values Page 1, message A 1.5 and verify that it agrees with the calculated value.

## Ground Instantaneous Pickup and Trip Check

Ground overcurrent conditions may be detected by either residual current sensing or zero sequence sensing. The test setup shown in Figure 8.1 may be used in either case. Ground protection is tested by injecting a current at terminals 55 and 56 of the 565/575 Relay to simulate ground overcurrent conditions.

First view message S 3.2 to verify that ground sensing is enabled. If not, enable it. Use the LINE DOWN key to view the CT rating for zero sequence current, or refer to phase CT ratio for residual currents. Make a note of this value.

Use the LINE DOWN key to view setpoints message S 3.5 and verify that the ground overcurrent pickup is set at 12%. If not, enter and store this value. View message S 3.13 and check that the ground instantaneous trips are enabled. If not, select and store ENABLED in this message. View message S 3.14, and enter the chosen value for the ground instantaneous trip level, as a multiple of the overcurrent pickup level, for example, 3.

View message S 3.15, ground instantaneous delay. Select 0 for this value to set the delay off. Press the STORE key to store the setpoint and verify that the message displays INST. Read message S 3.16 to check which relay the ground trip has been assigned. The factory setpoint will be the trip relay.

In this example, the pickup level is 12% of 5 Amps (the CT ratio or CT rating depending on which sensing system is chosen) or 0.6 Amps. The trip level was chosen to be 3 times this pickup level or 1.8 Amps. Using the test setup current adjustment, slowly increase the current injected until the ammeter reads 1.8 Amps. Verify that the trip relay, or whichever relay to which the signal was assigned, is activated and the corresponding LED is illuminated.

Check that the actual values section gives ground instantaneous overcurrent as the cause of last trip. Using the test set current adjustment, decrease the injected current slowly and check that the trip or other assigned relay can be reset at 95% of the pickup setting.

## Ground Curve Verification

With the above settings unchanged, view message S 3.6, which gives the ground protection curve in use. Record which curve has been selected. Use LINE DOWN to view setpoints message S 3.7 which is the ground overcurrent curve number. Enter and store a value of 1 for this.

Enter the actual values mode, and use LINE DOWN to view message A 1.5 which displays ground current. Using the test setup, slowly increase the injected current until the ammeter indicates a convenient value higher than the pickup value. Two times the pickup level is chosen here so if the CT rating is 5 Amps and 12% is chosen as the pickup level, then the injected current should be set at two times 12% of 5 (0.6) or 1.2 Amps.

Without changing the current setting, press the start button on the test set. This will activate the timer until the trip or other assigned relay is activated. When the assigned ground relay is activated and the corresponding LED illuminates, check the time indicated on the test set timer. Refer to the ground curve in use in Appendix D of this manual. Verify that the measured time corresponds to the curve time, within the accuracy stated in the specifications in Section 9 of this manual.

Repeat the test for other values of ground current and verify that the trip time corresponds to the time on the curve as

before. This verifies the accuracy of the curve in use.

When the tests are complete, reprogram the ground instantaneous trip delay, overcurrent pickup, and curve number setpoints to their original values.

### Voltage Input Function Check

Enter the setpoints mode and read the VT nominal secondary voltage from message S 9.3. Adjust the single phase variac in the test setup until the phase voltage meter reads the nominal voltage. Put the 565/575 Relay in Actual values mode, and read the phase voltage from messages A 6.2 to 6.4 or A 6.5 to 6.7, depending on the sensing system. Verify that these correspond to the feeder primary volts entered in S 9.4.

### Undervoltage Trip and Alarm Check

View message S 9.5 to determine if the undervoltage trip is enabled. If not, select and store ENABLED in this message. Read the undervoltage trip level from message S 9.6 and set this at a convenient value, say 90%. Set the undervoltage time delay to 1 second in message S 9.7. Check the relay to which the undervoltage trip has been assigned in message S 9.8. For the purposes of this test, the trip and Aux 1 relays are used.

Slowly lower the phase voltage injected by the test set variac to 90% of the nominal level and verify that the assigned relays are activated. For example, if the nominal secondary voltage is 240 Volts, and the trip level was selected as 90%, the selected relays should be activated when the voltage is dropped below 90% of 240 or 216 Volts. Note that the breaker must be closed.

The undervoltage alarm function operation can now be checked by following a similar procedure, with reference to messages S 9.9 to 9.12 instead of S 9.5 to 9.8.

### Overvoltage Trip and Alarm Check

View message S 9.13 to determine if the overvoltage trip is enabled. If not, select and store ENABLED in this message. Read the overvoltage trip level from message S 9.14 and set this at a convenient value, say 115%. Set the overvoltage time delay to 1 second in message S 9.15. Check the relay to which the overvoltage trip has been assigned in message S 9.16, for the purposes of this test, the trip relay is used.

Slowly increase the phase voltage injected by the test set variac to 115% of the nominal level and verify that the trip or other assigned relay is activated. For example, if the nominal voltage is 240 Volts, and the trip level was selected as 115%, the selected trip relay should be activated when the voltage is increased above 115% of 240 or 276 Volts. Note that the

breaker must be closed.

The overvoltage alarm function operation can now be checked by following a similar procedure with reference to messages S 9.17 to 9.20 instead of S 9.13 to 9.16.

### Output Relay Functional Check

The operation of the output relays can be checked by entering the setpoints mode page 8 and energizing each in turn using messages S 8.2 to S 8.4. Energizing each relay should cause the corresponding light on the test setup to illuminate, when the relay normally open contacts close. Note that the Aux 3 relay is failsafe and that its corresponding LED will go out. The corresponding front panel LED will also indicate the status of the relay. The normally closed contacts of each relay may also be checked, by first disconnecting the AC voltage which is present at the contacts. Now connect an ohmmeter across the contact and energize the corresponding relay, as above. For example, terminals 59 and 46 are used for Auxiliary relay 1 normally closed contact. Verify that the contact is first closed (conducting) and then indicates an open state when the relay is energized. Once again, note that Aux 3 is failsafe and that its normally open contacts can be tested in a similar manner. At first the contacts should be open and then after energizing they should be closed (conducting).

### Analog Input Function Check

The analog input may be checked by injecting known analog signals and verifying that the correct values are displayed. First check that the analog input feature is enabled, in message S 5.2 of setpoints. If not, select enabled, using the NEXT CHOICE key. Read and make a note of the minimum and maximum scale factors in use from messages S 5.7 and 5.8. Set the injected current on the milliamp current source adjustment to 4 milliamps. Read the value of the analog input from message A 2.3. This should be the same as the minimum scale factor read in setpoints. Adjust the injected current on the milliamp current source to 20 milliamps. Read the value of the analog input from message A 2.3 of actual values. This should be the same as the maximum scale factor read in page 5 of setpoints.

### Analog Output Function Check

The analog output feature can be checked as follows. First set the analog out parameter in page 6 of Setpoints to external analog select. Next select an output parameter by setting the correct combination of analog select switches. For example, to select phase A current as the output parameter, switches A to D are open. Adjust the test set phase current adjustment to inject a convenient level of phase current. For example, 0.5 Amps might be injected for a relay with a 1 Amp CT secondary or 2.5 Amps for a 5 Amp CT secondary. Read the value of the analog output at terminals

17 and 18 using a suitable meter. Verify that this output is 8mA DC with a phase overcurrent pickup level of 100%

### **Power Loss Check**

This can be done when the above checks have been completed. First, make a note of any setpoint and then with power applied, trip the Relay on any fault. For example this can be done by simply increasing the injected current to simulate a ground overcurrent and waiting for the timed overcurrent curve to come into operation. When the trip relay or other assigned relay is activated and the associated LED illuminated, remove all power and current from the 565/575 Relay. Leave it in this condition for a short time, say one minute.

Restore power and verify that the fault indication remains, ie, the LED on the front panel remains illuminated. Select setpoints mode and view the earlier noted message. Verify that the relay still displays the same value. This verifies that trip annunciations and setpoints are unaffected by loss of power.

Enable all functions which were disabled for these tests. Return the injected current to zero and return all setpoints to their original values. Finally, remove the access jumper or open the keyswitch. Remove all test apparatus and return the system wiring to normal.

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## Technical Specifications

### Phase Overcurrent Protection:

Timed overcurrent pickup:  
Range 25%-250% of CT in steps of 1%.  
Time dial: 32 selections.  
Instantaneous overcurrent pickup:  
Range 1 to 18 times phase pickup, in steps of 0.5.  
Instantaneous trip delay:  
No delay after first cycle of detected overcurrent if "Inst" is selected. Otherwise, 1 to 40 cycles delay after first cycle of detected overcurrent.

### Ground Overcurrent Protection:

Timed overcurrent pickup:  
Range 5% to 100% of CT in steps of 1%.  
Time dial: 32 selections.  
Instantaneous overcurrent pickup:  
Range 1 to 7 times ground pickup, in steps of 0.5.  
Instantaneous trip delay:  
No delay after first cycle of detected overcurrent if "Inst" is selected. Otherwise, 1 to 40 cycles delay after first cycle of detected overcurrent.

### Phase and Ground Timed Overcurrent Curves:

Normal Inverse.  
Very Inverse.  
Extremely Inverse.  
Moderately Inverse.  
IEC A.  
IEC B.  
IEC C.  
Custom Curve. 79 Breakpoints, user programmable.

### Timing Accuracy for Phase and Ground:

Instantaneous: Less than three cycles.  
Timed: current  $\geq 1.5 \times$  pickup:  $\pm 3\%$  of table value,  $\pm 0.1$  seconds, whichever is greater.  
current  $< 1.5 \times$  pickup:  $\pm 10\%$  of table value.

### Measurements:

Response: RMS Responding.  
Display accuracy for load currents:  
 $\pm 3\%$  from 25-100% CT primary.  
Bandwidth: 0-120 Hz.  
Display update rate:  
Greater than once per 2 seconds.

### Phase Current Inputs:

CT secondary: 1 Amp or 5 Amp.  
Saturation: 20 Times CT.  
CT primary: 10-5000 Amp in 5 Amp steps.  
CT burden: Less than 0.2 VA per phase at 100% of CT.  
CT rating: 15 Amps continuous  
Momentary:  $20 \times$  CT input rating for 3 seconds

### Ground Current Input:

CT secondary: 1 Amp or 5 Amp.  
Saturation: 20 times the programmed overcurrent pickup level.  
CT primary: 10-5000 Amps in 5 Amp steps.  
CT burden: Less than 0.2 VA per phase at rated CT secondary current.  
CT rating: 15 Amps continuous.  
Momentary:  $20 \times$  CT input rating for 3 seconds

### Phase and Ground Overcurrent Alarm.

Alarm level: 0.5 to 3.0 times overcurrent pickup in steps of 0.1.  
Time delay: 1 to 255 seconds in steps of one second.

### Voltage Inputs:

Inputs (WYE, DELTA, or DELTA/WYE):  
48 to 240  
VT burden: less than 0.2 VA at rated input.  
Display accuracy:  $\pm 3\%$  of nominal input.  
Display: RMS values for Va-b, Vb-c, Vc-a, (Va-n, Vb-n, Vc-n line to neutral connection).  
Display update rate:  
Greater than once per 3 seconds.

### Overvoltage Alarm and Trip:

Pickup: 101 to 125% in steps of 1%.  
Delay: 0.1 to 25.5 seconds in steps of 0.1 seconds.

### Undervoltage Alarm and Trip:

Pickup: 30 to 100% nominal, in steps of 1%.  
Delay: 0.1 to 25.5 seconds in steps of 0.1 seconds.

### Frequency Measurement:

Accuracy:  $\pm 0.1$  Hz.  
Measured: across Phase A.

### Output Contacts:

10 Amp/250 VAC resistive.  
10 Amp/30 volt DC resistive. - 20 Amp Make and Carry  
0.4 Amp/125 Volt DC (L/R = 7mS).  
Maximum voltage 380VAC/125VDC.  
10 Amp continuous, maximum voltage 300 VDC.

## SPECIFICATIONS



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### Analog Output (Isolated):

Accuracy:  $\pm 5\%$  of full scale reading.  
Range: 0 to 1 mA or 4 to 20 mA, software selectable.  
Maximum Volts: maximum 30V (DC or p-pAC) can be present at terminals.

### Control Power:

AC voltage: 120 VAC and 240 VAC nominal. Range 90-260 VAC, 60 Hz.  
DC voltage: 125 VDC and 250 VDC nominal. Range 95 to 280 VDC.  
Maximum supply power:  
50 Watts.

or

DC voltage: 48 VDC nominal. Range 20-60 VDC.  
Maximum supply power:  
25 Watts.

### Environment:

|                              | 565/575 Relay  | Display Only   |
|------------------------------|----------------|----------------|
| Operating Temperature Range: | -30°C to +80°C | -20°C to +70°C |
| Storage Temperature:         | -30°C to +80°C | -30°C to +80°C |

NOTE: At extremely low temperatures (below -20°C), the 565/575 LCD display exhibits very slow responses to alphanumeric changes. At high temperatures (60°C and above) the LCD display darkens, making it difficult to view displayed messages which indicate the relay's status.

### Tests:

Dielectric strength: Hipot tested to:  
Drawout case and terminal block: 2500 VAC, 50/60 Hz for 1 min.  
Relay and drawout case: 1500 VAC, 50/60 Hz for 1 min.

### Interference:

ANSI/IEEE: C37.90.1

### Dimensions:

Overall depth behind mounting surface:  
12.78"x7.75"x8.75"

Unit Weight: 20 lbs.

Shipping Weight: 24 lbs.

### Burn In Temperature:

60°C for 24 hours.

Design and specifications subject to change without notice.

## Customer service

For customer service and assistance contact your nearest MULTILIN agent or one of the MULTILIN offices listed below quoting the appropriate part number and the 565/575 Relay serial and revision number.

Before shipping any parts either as part of a warranty claim or which have been damaged in transit, contact the nearest regional office or Multilin office to obtain a Return Authorization number (RA).

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## Troubleshooting guide.

The 565/575 Relay is fully tested before leaving the factory. Should the relay seem not to function when power is applied, first verify that the service LED on the front panel of the relay is not illuminated. If the service LED is illuminated, contact Multilin product support. If not, check that all wiring connec-

tions have been correctly made and that all tests are performed in the order listed. If all tests fail to isolate the fault, contact Multilin customer support. Note that before doing any tests, the access jumper (or keyswitch if installed) must be installed as described in section 2 of this manual, and the access code must be entered in page 1 of setpoints. The table below lists some of the more common reasons for apparent malfunctions.

| MALFUNCTION                                                          | ACTION                                                                                                                                                                                                                                                                                                                                                                                          | REFERENCE                                                                                                               |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| 1. Display does not light up.                                        | <ol style="list-style-type: none"> <li>1. Check control power voltage and connections at terminals 62 to 64.</li> <li>2. Verify that the control voltage is within the limits indicated on the serial number label which is found on the side of the relay chassis.</li> <li>3. Check control power fuses.</li> <li>4. Check that the relay is fully inserted into the drawout case.</li> </ol> | <p>Relay wiring diagram</p> <p>Relay wiring diagram</p> <p>Instruction manual installation instructions, section 2.</p> |
| 2. Display lights but power up message does not appear.              | <ol style="list-style-type: none"> <li>1. Verify that the control voltage is within the limits indicated on the serial number which is found on the side of the relay chassis.</li> </ol>                                                                                                                                                                                                       | Relay wiring diagram.                                                                                                   |
| 3. No phase current readings displayed.                              | <ol style="list-style-type: none"> <li>1. Verify that the current readings are selected for display. Press the ACTUAL VALUES key the LINE DOWN key to view the messages in actual values page 1.</li> <li>2. Verify that the phase current wiring is correct.</li> <li>3. Perform the phase current input function check.</li> </ol>                                                            | <p>Actual values page 1.</p> <p>Relay wiring diagram.</p> <p>Instruction manual section 8.</p>                          |
| 4. Incorrect phase current readings displayed.                       | <ol style="list-style-type: none"> <li>1. Measure the current flowing into the 565 CT terminals, using a clamp-on ammeter.</li> <li>2. Check that the correct phase CT primary rating has been entered and stored in setpoints.</li> </ol>                                                                                                                                                      | Setpoints page 2.                                                                                                       |
| 5. No voltage readings displayed.                                    | <ol style="list-style-type: none"> <li>1. Verify that the voltage readings are selected for display. Use the LINE DOWN key to view the messages in actual values page 6.</li> <li>2. Verify that the VT wiring connections have been correctly made.</li> </ol>                                                                                                                                 | <p>Actual values page 6.</p> <p>Relay wiring diagram.</p>                                                               |
| 6. Incorrect voltage readings displayed.                             | <ol style="list-style-type: none"> <li>1. Check that the correct voltage is appearing at the 565 VT terminals.</li> <li>2. Check that the correct voltage transformer sensing system, nominal secondary voltage and feeder primary voltage has been entered in setpoints.</li> </ol>                                                                                                            | <p>Relay wiring diagram.</p> <p>Setpoints page 9.</p>                                                                   |
| 7. Under or Overvoltage trip relay not energized by fault condition. | <ol style="list-style-type: none"> <li>1. Check that the under or overvoltage trip is enabled in setpoints.</li> </ol>                                                                                                                                                                                                                                                                          | Setpoints page 9.                                                                                                       |

## APPENDIX B



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| MALFUNCTION                                                   | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | REFERENCE                                                                                                                                                 |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                               | <ol style="list-style-type: none"> <li>2. Check that the correct voltage transformer sensing system, secondary voltage and VT feeder primary voltage have been entered in setpoints. Verify that all the voltage sensing wiring is correct.</li> <li>3. Ensure that the trip relay wiring to the breaker trip circuit is correct at terminals 41 and 57.</li> <li>4. Verify which relay(s) has been selected to be activated by the under or overvoltage condition, in the voltage setpoints.</li> <li>5. Check the under or overvoltage trip level setpoint and verify that the voltage is exceeding this level. Determine the under or overvoltage trip delay from the setpoints, and verify that the fault condition is present for longer than this time.</li> <li>6. Perform calibration mode relay test to verify the operation of the trip relay.</li> </ol> | <p>Setpoints page 9 and relay wiring diagram.</p> <p>Relay wiring diagram.</p> <p>Setpoints page 9.</p> <p>Setpoints page 9.</p> <p>Setpoints page 8.</p> |
| 8. Phase overcurrent protection not energizing trip relay(s). | <ol style="list-style-type: none"> <li>1. Check phase CT rating, connections and polarity.</li> <li>2. Verify that the correct protection curve, pickup level and curve number have been entered in setpoints.</li> <li>3. If the custom curve has been chosen, use the Line Down key to check the time to trip for each breakpoint.</li> <li>4. Perform calibration mode relay test to verify the operation of the trip relay.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>Setpoints page 2 and instruction manual section 6.</p> <p>Setpoints page 2.</p> <p>Setpoints page 8.</p>                                               |
| 9. Phase overcurrent protection causes trip but no alarm.     | <ol style="list-style-type: none"> <li>1. Check that the phase overcurrent alarm is enabled in setpoints.</li> <li>2. Verify the relay to which the alarm signal has been assigned.</li> <li>3. Check that the alarm level setpoint is less than the trip level setpoint and that the fault current is between these two values.</li> <li>4. Check the phase overcurrent alarm time delay setpoint and ensure that the alarm condition is present for longer than this time. Note that if the overcurrent level rises to the trip level before the timed period, a trip will occur before the alarm.</li> <li>5. Perform calibration mode relay test to verify operation of the assigned relay(s).</li> </ol>                                                                                                                                                       | <p>Setpoints page 2.</p> <p>Setpoints page 2.</p> <p>Setpoints page 2.</p> <p>Setpoints page 2.</p> <p>Setpoints page 8.</p>                              |
| 10. Phase instantaneous trips not operating.                  | <ol style="list-style-type: none"> <li>1. Check that the phase instantaneous trips are enabled in setpoints.</li> <li>2. Check the phase instantaneous trip level setpoint and verify that the current is exceeding this level.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>Setpoints page 2.</p> <p>Setpoints page 2.</p>                                                                                                         |

| MALFUNCTION                                               | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | REFERENCE                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                           | 3. Read the phase instantaneous trip delay and verify that the overcurrent condition is present for longer than this time.<br><br>4. Ensure that the trip relay wiring to the breaker is correct at terminals 41 and 57.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Setpoints page 2.<br><br>Relay wiring diagram.                                                                                                                                                                                                                         |
| 11. Ground fault protection not energizing trip relay(s). | 1. Verify that the ground fault sensing is enabled in setpoints mode.<br><br>2. Check that the sensing system selected in setpoints, either Residual or Zero sequence, corresponds to your system.<br><br>3. For Zero sequence sensing systems, verify that the CT primary ratio entered in setpoints mode correspond to the installed CT.<br><br>4. Check that the correct ground fault overcurrent pickup has been entered in setpoints.<br><br>5. Verify that the correct protection curve, pickup level and curve number have been selected for the level of ground fault encountered.<br><br>6. Ensure that the fault current is present for longer than the time necessary to trip according to the selected time/overcurrent curve.<br><br>7. Check all system wiring.<br><br>8. Perform calibration mode relay test to verify the operation of the trip relay. | Setpoints page 3.<br><br>Setpoints page 3.<br><br>Setpoints page 3.<br><br>Setpoints page 3.<br><br>Setpoints page 3 and Instruction manual section 6.<br><br>Setpoints page 3 and Instruction manual section 6.<br><br>Relay wiring diagram.<br><br>Setpoints page 8. |
| 12. Ground fault protection causes trip but no alarm.     | 1. Check that the ground fault alarm is enabled in setpoints.<br><br>2. Identify the relay to which the alarm has been assigned from setpoints mode page 3. Ensure that it is correctly wired to the alarm annunciation.<br><br>3. Check that the ground fault alarm level is low enough to cause an alarm before the trip level is reached.<br><br>4. Read the ground fault alarm time delay and ensure that the alarm condition is present for longer than this time. Note that if the ground fault current level rises to the trip level before the timed period, a trip will occur before the alarm.<br><br>5. Perform calibration mode relay test to verify the operation of the assigned relay(s).                                                                                                                                                               | Setpoints page 3.<br><br>Setpoints page 3 and relay wiring diagram.<br><br>Setpoints page 3.<br><br>Setpoints page 3.<br><br>Setpoints page 8.                                                                                                                         |
| 13. Ground fault instantaneous trips not operating.       | 1. Check that the ground fault instantaneous trips are enabled in setpoints.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Setpoints page 3.                                                                                                                                                                                                                                                      |

## APPENDIX B



| MALFUNCTION                                                | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | REFERENCE                                                                                                                                                                           |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                            | <ol style="list-style-type: none"> <li>2. Check the ground fault instantaneous trip level setpoint and verify that the current is exceeding this level.</li> <li>3. Read the ground fault instantaneous trip delay and verify that the overcurrent condition is present for longer than this time.</li> <li>4. Ensure that the trip relay wiring to the breaker is correct at terminals 41 and 57.</li> <li>5. Perform calibration mode relay test to verify the operation of the trip relay.</li> </ol>                                                                                                                                                                                                               | <p>Setpoints page 3.</p> <p>Setpoints page 3.</p> <p>Relay wiring diagram.</p> <p>Setpoints page 8.</p>                                                                             |
| 14. No display for analog in signal in actual values mode. | <ol style="list-style-type: none"> <li>1. Verify that the analog input feature is enabled.</li> <li>2. Check that the analog input signal appears at relay terminals 23 and 24.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>Setpoints page 5.</p> <p>Relay wiring diagram.</p>                                                                                                                               |
| 15. Displayed scaled value for analog input incorrect.     | <ol style="list-style-type: none"> <li>1. Check maximum and minimum scale factors.</li> <li>2. Check that the analog input current range being input into the relay is within the limits of 4 to 20 mA.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>Setpoints page 5.</p>                                                                                                                                                            |
| 16. Analog input trip not operating.                       | <ol style="list-style-type: none"> <li>1. Verify that the analog input trip is enabled.</li> <li>2. Verify that the trip signal has been assigned to the intended relay in the setpoints mode.</li> <li>3. Check the assigned relay wiring to the breaker trip circuit.</li> <li>4. Read the scaled value of the analog input in the actual values page 2, and ensure that it is above the trip level setpoint entered in setpoints mode.</li> <li>5. Read the analog input trip time delay from the setpoints mode page 5, and ensure that the analog signal is above the trip level for longer than this time.</li> <li>6. Perform calibration mode relay test to verify the operation of the trip relay.</li> </ol> | <p>Setpoints page 5.</p> <p>Setpoints page 5.</p> <p>Relay wiring diagram.</p> <p>Actual Values page 2, and setpoints page 5.</p> <p>Setpoints page 5.</p> <p>Setpoints page 8.</p> |
| 17. Analog input alarm not operating.                      | <ol style="list-style-type: none"> <li>1. Verify that the analog input alarm is enabled.</li> <li>2. Verify that the intended relay has been selected in the setpoints and that the selected relay is correctly wired to the alarm circuit.</li> <li>3. Read the scaled value of the analog input in the actual values page 2, and ensure that it is above the alarm level setpoint entered in setpoints mode.</li> <li>4. Read the analog input alarm time delay from the setpoints mode page 5, and ensure that the analog signal is above the trip level for longer than this time.</li> </ol>                                                                                                                      | <p>Setpoints page 5.</p> <p>Setpoints page 5 and relay wiring diagram.</p> <p>Actual Values page 2, and setpoints page 5.</p> <p>Setpoints page 5.</p>                              |

| MALFUNCTION                                  | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | REFERENCE                                                                                                                           |                                                          |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------|---------|---------|---------|---------|-------------------------------------------------------|---------|---------|---------|----------------------------------------------------------|---------|---------|---------|-------------------------------------------------------|---------|---------|---------|-------------------------------------------------------|---------|---------|---------|----------------------------------------------------------|--|
|                                              | 5. Perform the calibration mode relay test to verify the operation of the assigned relay(s).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Setpoints page 8.                                                                                                                   |                                                          |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 18. Analog output parameter not operating.   | <div>1. Check that the circuit connected to the Analog out terminal and verify that no external voltage larger than 30V ( DC or peak to peak AC )is present.</div> <div>2. Verify the requested parameter is as intended by viewing the analog output parameter message.</div> <div>a) If the selected analog output parameter is feeder frequency, phase or ground fault current or phase voltage these values can be read from the relevant page in the actual values mode. Verify from the actual values that the parameter does not have a value of zero, in which case no output will be present.</div> <div>b) If the selected analog output parameter is external analog select, then the analog output is determined by the input presented at the Analog Select terminals. Refer to the Instruction manual to determine the correct inputs to these terminals for any output.</div>                                                                                                                         | <div>Relay wiring diagram.</div> <div>Setpoints page 6.</div> <div>Instruction Manual section 5.</div> <div>Setpoints page 6.</div> |                                                          |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 19. No MTM communication.                    | <div>1. Check MTM communication setpoint.</div> <div>2. Check MTM default power switch. The MTM can be powered from the PTs or line. The default is line; the switch must be toggled for PT.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <div>Setpoint page 4.</div> <div>See MTM power selection diagram.</div>                                                             |                                                          |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 20. Poor Open Delta voltage readings.        | <div>1. Check and verify the secondary voltages measured at 565/575 terminals 35, 36, 37 and 38.</div> <div>2. Check the wiring. See the following table for commonly made errors. The correct nominal voltage in each example should be 4.16 kV.</div> <table><thead><tr><th>V<sub>AB</sub></th><th>V<sub>BC</sub></th><th>V<sub>CA</sub></th><th>PROBLEM</th></tr></thead><tbody><tr><td>4.16 kV</td><td>0.00 kV</td><td>4.16 kV</td><td>VT connection setpoint programmed as Wye or Delta/Wye</td></tr><tr><td>2.50 kV</td><td>2.50 kV</td><td>4.16 kV</td><td>V<sub>B</sub> to V<sub>N</sub> jumper missing at relay</td></tr><tr><td>4.16 kV</td><td>4.16 kV</td><td>7.00 kV</td><td>V<sub>A</sub> swapped with V<sub>B</sub> at one PT.</td></tr><tr><td>4.16 kV</td><td>4.16 kV</td><td>7.00 kV</td><td>V<sub>B</sub> swapped with V<sub>C</sub> at one PT.</td></tr><tr><td>4.16 kV</td><td>4.16 kV</td><td>3.90 kV</td><td>V<sub>A</sub> swapped with V<sub>C</sub> at one relay.</td></tr></tbody></table> | V <sub>AB</sub>                                                                                                                     | V <sub>BC</sub>                                          | V <sub>CA</sub> | PROBLEM | 4.16 kV | 0.00 kV | 4.16 kV | VT connection setpoint programmed as Wye or Delta/Wye | 2.50 kV | 2.50 kV | 4.16 kV | V <sub>B</sub> to V <sub>N</sub> jumper missing at relay | 4.16 kV | 4.16 kV | 7.00 kV | V <sub>A</sub> swapped with V <sub>B</sub> at one PT. | 4.16 kV | 4.16 kV | 7.00 kV | V <sub>B</sub> swapped with V <sub>C</sub> at one PT. | 4.16 kV | 4.16 kV | 3.90 kV | V <sub>A</sub> swapped with V <sub>C</sub> at one relay. |  |
| V <sub>AB</sub>                              | V <sub>BC</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | V <sub>CA</sub>                                                                                                                     | PROBLEM                                                  |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 4.16 kV                                      | 0.00 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 4.16 kV                                                                                                                             | VT connection setpoint programmed as Wye or Delta/Wye    |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 2.50 kV                                      | 2.50 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 4.16 kV                                                                                                                             | V <sub>B</sub> to V <sub>N</sub> jumper missing at relay |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 4.16 kV                                      | 4.16 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 7.00 kV                                                                                                                             | V <sub>A</sub> swapped with V <sub>B</sub> at one PT.    |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 4.16 kV                                      | 4.16 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 7.00 kV                                                                                                                             | V <sub>B</sub> swapped with V <sub>C</sub> at one PT.    |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 4.16 kV                                      | 4.16 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3.90 kV                                                                                                                             | V <sub>A</sub> swapped with V <sub>C</sub> at one relay. |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |
| 21. Undervoltage Trip feature does not work. | <div>1. Check and verify that all the required phases are below the programmed threshold.</div> <div>2. For a Wye configuration, one phase must be below the programmed threshold for an alarm while two phases are required to be below the threshold for a trip. The same is true for an Open Delta connection, but with the additional criteria that the phases must be measured (V<sub>AB</sub> &amp; V<sub>BC</sub>) and not calculated (V<sub>AC</sub>).</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Setpoints page 9.                                                                                                                   |                                                          |                 |         |         |         |         |                                                       |         |         |         |                                                          |         |         |         |                                                       |         |         |         |                                                       |         |         |         |                                                          |  |



| MALFUNCTION                                                  | ACTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | REFERENCE                |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
|                                                              | <p>3. Check breaker position. Due to applications where the potential transformers are located on the local side of the breaker, the 565/575 must see the breaker closed at terminals 9, 10, and 11 before issuing an undervoltage trip. This prevents the relay from issuing an undervoltage trip each time the breaker is opened.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                          |
| <p>22. "Illegal Access," even with the jumper installed.</p> | <p>1. Check if access setpoint is disabled via communication with Relaycom®.</p> <p>Functioning in series with the hardware access jumper is the relay's Setpoint Access/Software Code setpoint that is only visible when the Security Feature setpoint is enabled. When the 565/575 is shipped from the factory, the Setpoint Access/Software Code setpoint is enabled and the Security Feature is disabled. Therefore, you cannot see the Setpoint Access/Software Code setpoint and only the hardware jumper at terminals 33 and 34 will determine whether you can store setpoints.</p> <p>If you now establish communications with a 565/575 using Relaycom®, the Setpoint Access/Software Code setpoint can be disabled independent of the Security Feature setpoint. Relaycom® calls this "Local Setpoint Access." Suppose one disabled "Local Setpoint Access" using Relaycom®. The next time one tries to store a new setpoint using the 565/575 keypad, they will get the "Illegal Access" message even though the access jumper is in place. This will cause confusion because the Security Feature is disabled and this normally means the Setpoint Access/Software Code setpoint is enabled.</p> <p>This is not the case. The Setpoint Access/Software Code setpoint is disabled and you cannot view it because the Security Feature setpoint is also disabled. To make matters worse, you cannot enable the Security Feature setpoint to allow you to enable the Setpoint Access/Software Code setpoint. Setpoint access is disabled. The only way to re-establish setpoint access is to enable "Local Setpoint Access" in Relaycom®.</p> | <p>Setpoints page 1.</p> |

## Block Diagrams

The figures on the following pages show the 565/575 Relay hardware block diagrams. The following shows the name and contents of each figures:

### Figure Contents

- |    |                                            |
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| C1 | System controller block diagram, part 1/2. |
| C2 | System controller block diagram, part 2/2. |



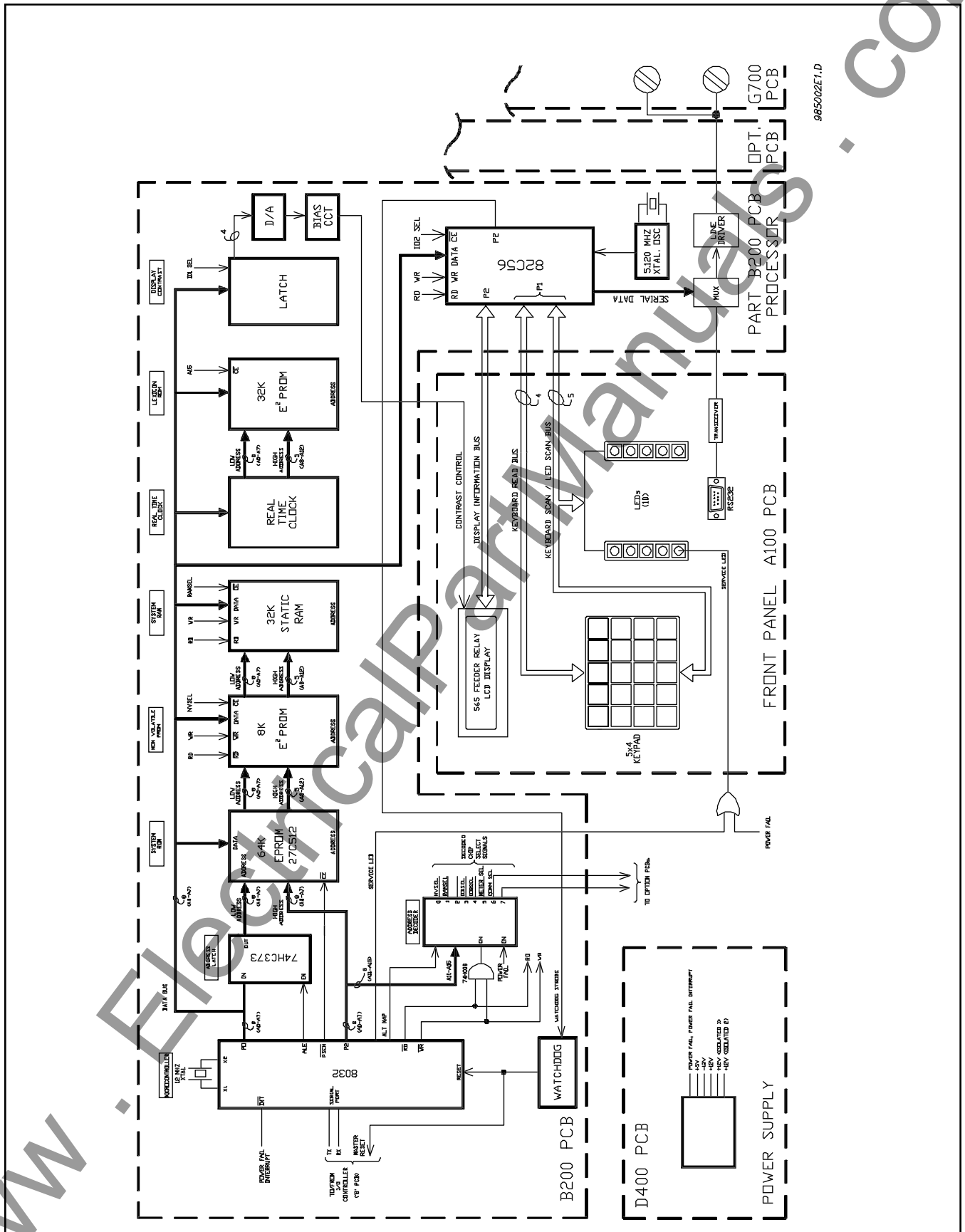


Figure C2. System Controller Block Diagram (2/2)

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## INTENT

This manual describes the function, operation and use of the Multilin Model 565/575 Feeder Management Relays.

## REVISION HISTORY

| <u>Manual Part No.</u> | <u>Software Revision</u> | <u>Release Date</u>                         |
|------------------------|--------------------------|---------------------------------------------|
| 1601-0017-E1           | E2.2                     | 02/26/92                                    |
| 1601-0017-E2           | E2.3                     | 05/28/92                                    |
| 1601-0017-E3           | E2.4                     | 09/17/92                                    |
| 1601-0017-E4           | E2.4                     | 03/28/93 (manual format changed)            |
| 1601-0017-E5           | E2.4                     | 04/26/95                                    |
| 1601-0017-E6           | E2.73                    | ??/??/96 (565 & 575 combined into 1 manual) |

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### **GE MULTILIN RELAY WARRANTY**

General Electric Multilin Inc. (GE Multilin) warrants each relay it manufactures to be free from defects in material and workmanship under normal use and service for a period of 24 months from date of shipment from factory.

In the event of a failure covered by warranty, GE Multilin will undertake to repair or replace the relay providing the warrantor determined that it is defective and it is returned with all transportation charges prepaid to an authorized service centre or the factory. Repairs or replacement under warranty will be made without charge.

Warranty shall not apply to any relay which has been subject to misuse, negligence, accident, incorrect installation or use not in accordance with instructions nor any unit that has been altered outside a GE Multilin authorized factory outlet.

GE Multilin is not liable for special, indirect or consequential damages or for loss of profit or for expenses sustained as a result of a relay malfunction, incorrect application or adjustment.

For complete text of Warranty (including limitations and disclaimers) refer to GE Multilin Standard Conditions of Sale.

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