SIEMENS

Electronic Metering Package

4700 Power Meter

Instructions
Installation
Operation
SG-6018

SIEMENS

Important Bulletin

4700 Power Meter

Rev B Release

New features for the 4700 Power Meter

Siemens will be releasing a new version of the 4700 Power Meter digital power instrumentation package in February 1992. This new Rev B release of the 4700 Power Meter has been given a number of new hardware features which improve performance, simplify wiring, improve the isolation of some inputs, and provide an upgrade path for new features under development.

The general operation of the new Rev B will remain identical to the earlier Rev A; however, Rev B differs significantly in appearance and wiring requirements from the earlier Rev A release. These differences are outlined below.

New attractive look

The new Rev B version has also been given a new look, with a wide black molded bezel surrounding the faceplate (on models with a front panel display). To further differentiate between the new Rev B version and the earlier Rev A, the label found on the rear panel of the unit will indicate:

PRODUCT REV: B

Important similarities and differences between Rev B and Rev A

Mounting

Mounting requirements for the new Rev B are identical to Rev A.

Wiring

Changes in wiring installation for Rev B are minor, **but it is important that these new requirements be followed correctly for safe, accurate, and reliable operation of the 4700 Power Meter.**

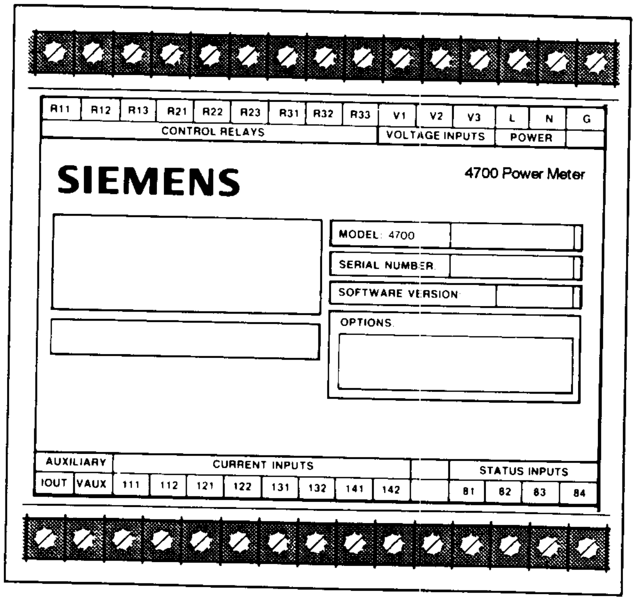
a) Connection to switchgear chassis ground is now made to a chassis ground lug attached to one of the mounting studs (or holes, in the case of a -TRAN model) on the chassis of the meter.

b) A voltage reference terminal (VREF) has been added. This input is used as the zero voltage reference terminal for the phase voltage readings, and is independent of the 4700 Power Meter earth ground connection. The connection point for this input is dependent on the system configuration. This is illustrated in detail in the 4700 Power Meter Rev B manual.

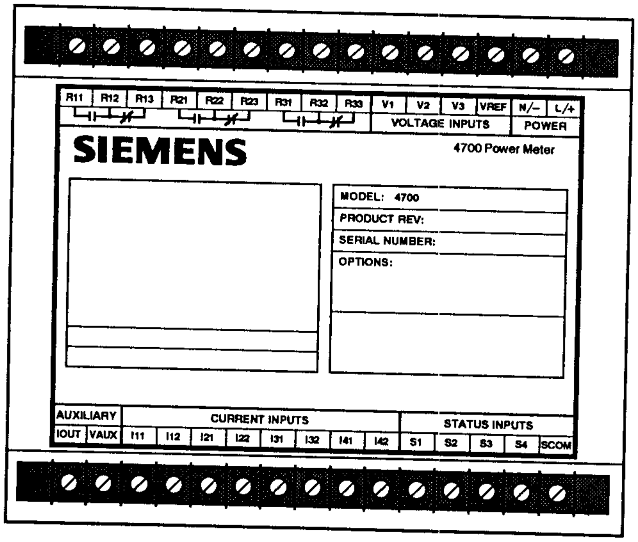
c) Status input terminals have been repositioned. An S^{COM} terminal has been added as the status input supply/ground common, providing improved isolation for the status inputs. This input is connected either to ground or to a suitable supply voltage, depending on the specific application. This configuration simplifies wiring and allows for greater flexibility when using the status inputs for sensing of dry contact conditions or voltage levels.

d) Power supply terminals (L/+ and N/-) have been repositioned on the terminal strip.

The rear panel diagrams below illustrate terminal positions and functions for Rev A and the new Rev B.



Rev A Terminal Blocks



Rev B Terminal Blocks

Rev B ordering

Orders taken for the 4700 Power Meter after December 31, 1991 will automatically be filled with the new Rev B version, unless otherwise specified. The earlier Rev A version will still be available from Siemens; however, we recommend the new Rev B version, to take advantage of the new performance provided.

For more information, please contact your local Siemens sales representative, or contact Siemens directly at:

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& Automation, Inc.
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Description

The 4700 Power Meter is a microprocessor-based instrumentation package for low, medium or high voltage electrical equipment and substations. It is a state-of-the-art alternative to traditional analog electro-mechanical metering devices. The unit is economical and very simple to install and operate. It requires no external transducers. The 4700 power meter replaces up to 12 traditional analog devices with a single package.

Performance Features

The 4700 Power Meter offers major improvements in accuracy, communications capability, data logging, control capability, ease of use, and cost compared to traditional analog components or first generation digital metering systems. The 4700 will operate as a stand alone switchboard, switchgear, motor control center or substation instrument, and it serves as a data collection point for Siemens Access Electrical Distribution Communication System.

The unit is based around a 12 MHz, 16 bit microcontroller chip. This provides very high computational throughput, allowing the unit's sophisticated software to process information in real time. The unit is self contained and its readings and set up parameters are maintained in nonvolatile memory.

Displays and Measurements

In the display version of the product, the user may view the readings from the easy-to-read alphanumeric display consisting of:

- 4 digit voltage display phase indication
- 4 digit amperage display
- 8 digit power function display.

The unit may be configured to operate in Wye (Star), Delta, or Single phase voltage modes. The following measurements are available:

- Current on each phase
- A fourth current input
- Line to line voltages
- Line to neutral voltages
- Frequency
- Power factor
- kVA
- kW
- kVAR
- kW Demand
- V_{aux} (auxiliary voltage input)
- Total MWhr
- Total MVARhr

Minimum and maximum values for each of the readings are also available. The unit may be set to take snapshots of all readings at user-definable intervals and maintain them in nonvolatile memory. The snapshot data is read using the serial communications output.

Auxiliary Voltage Input

All 4700 models provide an auxiliary voltage sense input which allows an additional external voltage (1.25 VAC max.) to be monitored and its value displayed.

Auxiliary Current Output

An optional analog current output can be programmed for 0 to 20 mA or 4 to 20mA current output proportional to any measured parameter.

Communications

All 4700 power meters support optional plug-in communications cards which allow remote access to the device data. One card supports both RS-232C and RS-485 communications. A second communications card provides 500V galvanic isolation and supports only RS-485. If the 4700 power meter is ordered without a communications card, it may be field-retrofitted at a later date.

Using the RS-485 mode, up to 32 units may be controlled. The distance limitation for RS-485 using minimum 22 gauge shielded twisted pair cable is 4000 feet.

Control Relays

The 4700 power meter can optionally provide three control relays which may function as:

- Alarm relays and setpoint relays which operate as a function of any measured parameter for demand, power factor, or load control.
- Remote control relays, operated by command via the communications bus.
- kWhr/kVARhr pulse outputs.

Status Inputs

The 4700 power meter can also provide four optional status inputs which can each be used to sense the state of an external contact. The status of these inputs can be viewed and logged by a Power Monitor™ display and monitoring unit or other computer using the communications option.

Logging Capability

The 4700 power meter can provide up to three data logs:

- EVENT Log. This log records events such as power up, parameter changes, alarm conditions, relay changes, and status input changes. The 50 most recent events may be retrieved from this log. The event log can only be read using the communications option.
- SNAPSHOT Log. This optional log contains voltage, current, and all power values which are recorded at user-defined time intervals. The 100 most recent snapshots may be retrieved from this log using the communications option.
- MIN/MAX Log. This log records the extreme values for voltages, currents, power, and other measured parameters. Min/Max data can be read using the integral display or using the communications option.

All log entries (events, snapshots, and min/max values) are time stamped to the second.

System Applications

Because of its unique measurement, storage, set point (load shedding) and display characteristics the 4700 power meter should be considered for use in:

1. Utility Installations
2. Industrial Buildings
3. Office Buildings
4. Commercial Buildings
5. Hospitals
6. Telephone Exchanges
7. Factories
8. Pulp Mills
9. Saw Mills
10. Shopping Centers
11. Large Stores
12. Hotels
13. Substation Metering
14. Co-generation Systems
15. Chemical Process Plants
16. Multi User Sites where allocation of electrical costs is desirable
17. Any other installation which uses significant amounts of electrical energy.
18. Any other locations where remote monitoring and control is needed.

Catalog Identification

Appendix E shows the available catalog numbers and related features and options.

Location

The 4700 power meter should be mounted in a dry, dirt free environment away from heat sources and very high electric fields. Temperatures should not exceed 50°C (122°F) or fall below 0°C (32°F).

Mounting

Appendix A provides the mounting dimensions for the 4700 power meter.

The standard 4700 power meter with display may be panel mounted for easy access and viewing, and provides four mounting studs to facilitate this. A 5 inch depth is required behind the front panel.

The 4700 power meter without display can be mounted flush against any flat surface. The unit provides four mounting holes for this purpose (these replace the four mounting studs of the display version 4700 power meter). The unit can also be mounted through a display version 4700 power meter panel cutout, if desired.

Power Supply

The standard 4700 power meter can be powered by 85 to 132 Volts AC (47 to 440 Hz) or 110 to 170 Volts DC, both at 0.2 Amps. This unit can be powered from a dedicated fused feed, or it may be powered by the voltage source which it is monitoring, as long as it is a 120 Volt system. Optional power supplies are available for 24 VDC, 48 VDC, and 240 VAC.

Wiring

Connections to the 4700 power meter are made to two terminal strips located on the rear of the unit. Appendix A provides 4700 power meter terminal block dimensions. Ring or spade terminals are recommended for all connections.

Phasing and polarity of the AC current and voltage inputs and their relationship is critical to the correct operation of the unit. **Figures 1** to **5** in the "Installation" section of this manual provide wiring diagrams to ensure correct installation.

PT and CT Transformer Selection

For proper monitoring, correct selection of CTs and PTs (if required) is critical. The following paragraphs provide the information required to choose these transformers.

PT Selection

Whether or not potential transformers (PTs) are required depends on the nature of the system being monitored, the voltage levels to be monitored, and the model of the 4700 power meter. The 120VAC (full scale) input model* may be used for direct connection to 120/208 systems, or for use with PTs that have a 120 Volt secondary. The 277 VAC (full scale) input model* may be used for direct connection to 277/480 Volt systems, and, 350 VAC (full scale) input model* may be used for direct connection to 350/600V systems. If system voltages are over 350/600, PTs are required.

Potential transformers are used to scale down the system L-N (Wye) or L-L (Delta) voltage to 120 Volts full scale, which is the nominal full scale input of the 4700 power meter. The PTs are selected as follows:

a) Wye (Star): PT primary rating = system L-N voltage or nearest higher standard size. PT secondary rating = 120 Volts.

b) Delta: PT primary rating = system L-L voltage. PT secondary rating = 120 Volts.

PT quality directly affects system accuracy. The PTs must provide good linearity and maintain the proper phase relationship between voltage and current in order for the Volts, kW, and PF readings to be valid. Instrument Accuracy Class 1 or better is recommended.

*Refer to Appendix E for 4700 power meter model numbering and options information.

CT Selection

The 4700 power meter uses current transformers (CTs) to sense the current in each phase of the power feed. The selection of the CTs is important because it directly affects accuracy.

The CT secondary rating is always 5 Amps with a burden capacity greater than 3 VA.

The CT primary rating is normally selected to be equal to the Amp rating of the power feed protection device. However, if the peak anticipated load is much less than the rated system capacity then improved accuracy and resolution can be obtained by selecting a lower rated CT. In this case the CT size should be the maximum expected peak current +25%, rounded up to the nearest standard CT size.

Other factors may affect CT accuracy. The length of the CT cabling should be minimized because long cabling will contribute to inaccuracy. Also, the CT burden rating must exceed the combined burden of the 4700 power meter plus cabling plus any other connected devices (burden is the amount of load being fed by the CT, measured in Volt-Amps).

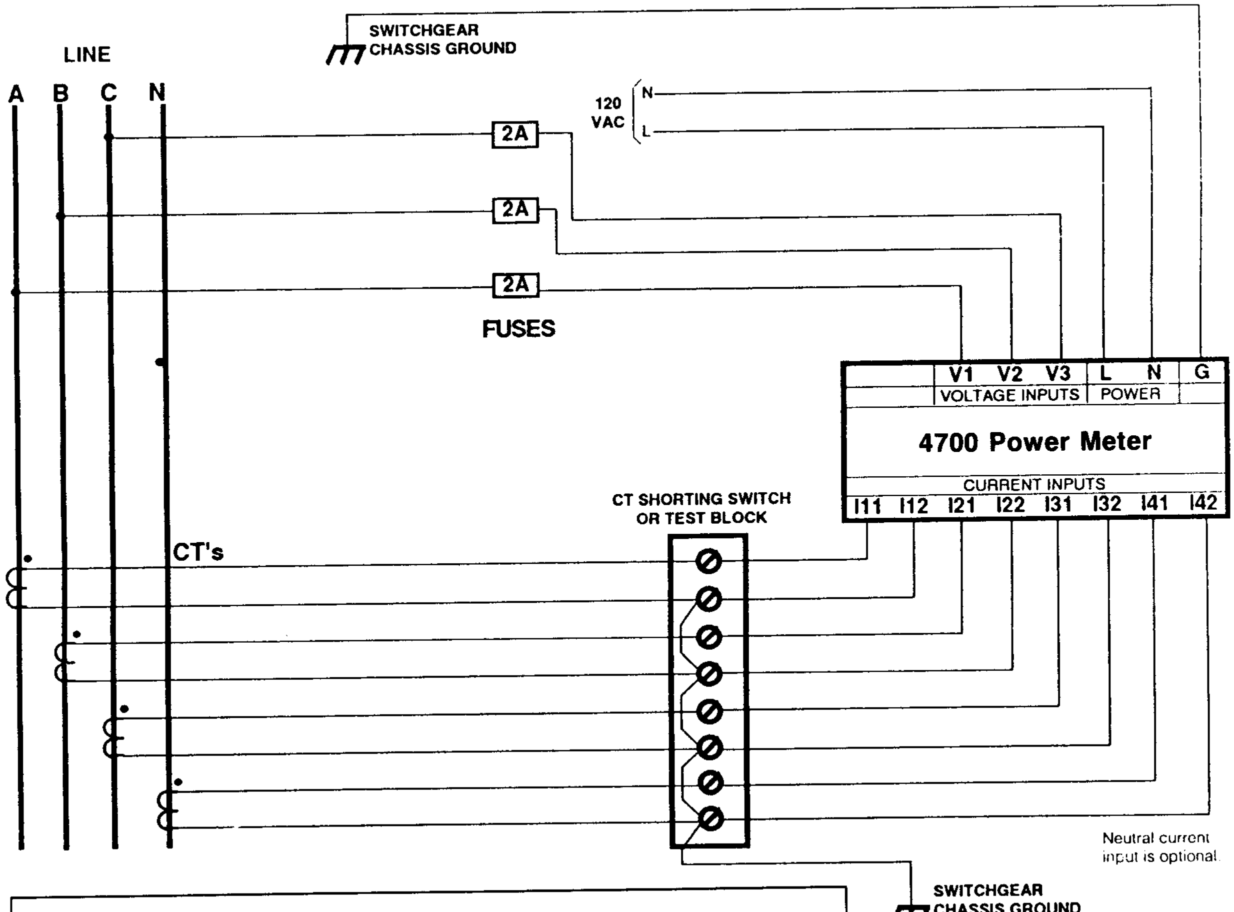
Overall accuracy is dependent on the combined accuracies of the 4700 power meter, the CTs, and the PTs (if used). Instrument accuracy Class 1 or better is recommended.

Connection for Three Phase Wye (Star) 4 Wire Systems

Figures 1 and **2** provide wiring diagrams for WYE system configuration. The VOLT MODE of the 4700 power meter should be set to "0" for 4 wire systems (see "General Operation" on Field Programming).

The 4700 power meter senses the line to neutral (or ground) voltage of each phase. If the power system to be monitored is a 120/208 Volt system, a standard 120 VAC input model meter can be used with direct sensing of each phase. If the system is a 277/480 Volt system, a 277 VAC input model meter may be connected directly. Refer to Appendix E for 4700 power meter model numbering and options information.

The wiring diagram for these configurations is shown in **Figure 1** below.

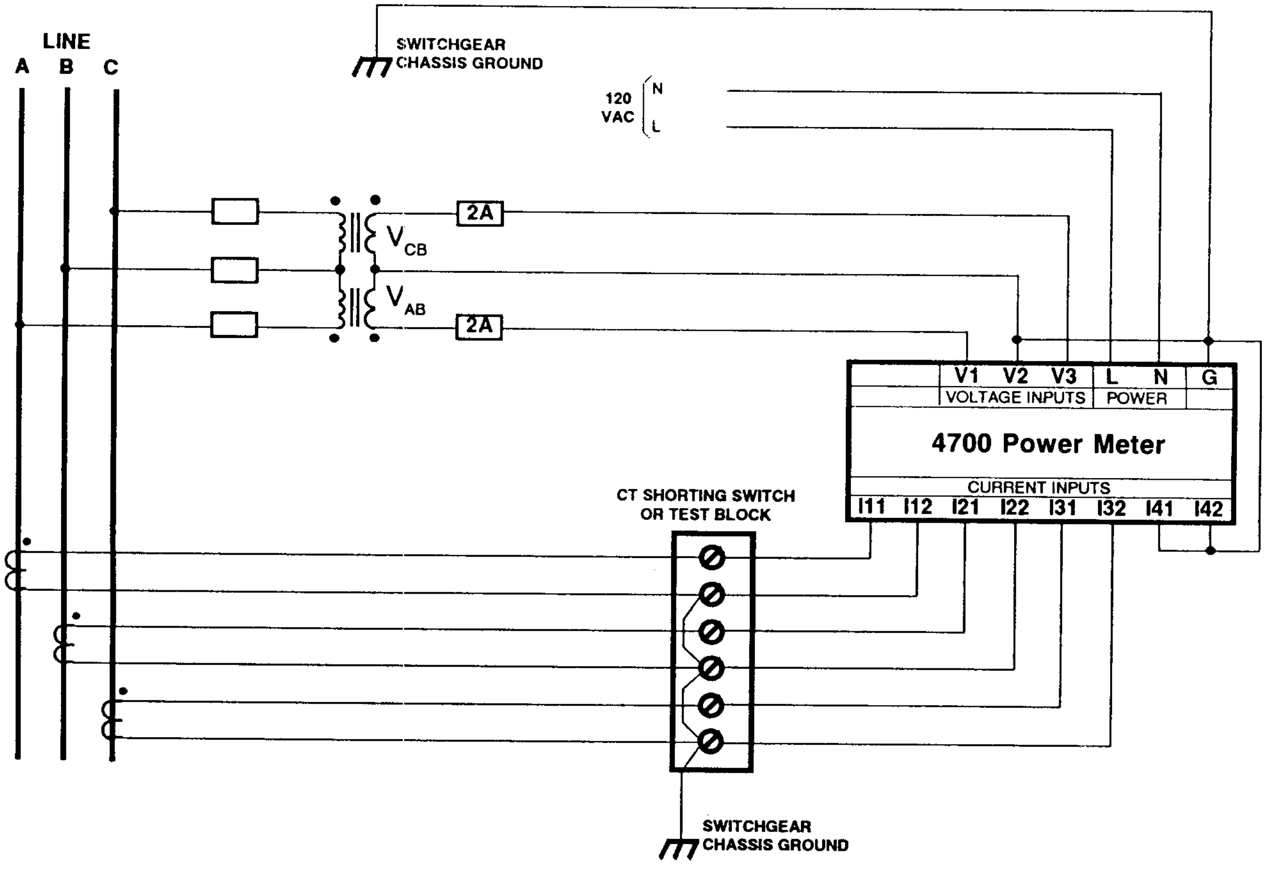


NOTES

1. VOLT MODE = 0 (WYE MODE)
2. Use 120 VAC (full range) input model for 120/208 Volt systems. Use 277 VAC (full range input model for 277/480 VAC systems. Use 350 VAC (full range) input model for 350/600 VAC systems (refer to Appendix E).
3. Only relevant 4700 power meter terminal block connection points are illustrated.

Figure 1. 4-Wire Direct Connection for 120/208 Volt, 277/480 Volt, or 350/600 Volt Systems.

When configured for ungrounded (floating) Delta operation, the 4700 power meter requires PTs and senses the L-L voltages between each of the phases. VOLTS MODE of the 4700 power meter should be set to "1". In the open Delta configuration, the 4700 power meter may be connected in either of two ways: using 2 or 3 CTs. **Figure 4** below shows ungrounded Delta connection using 3 CTs.

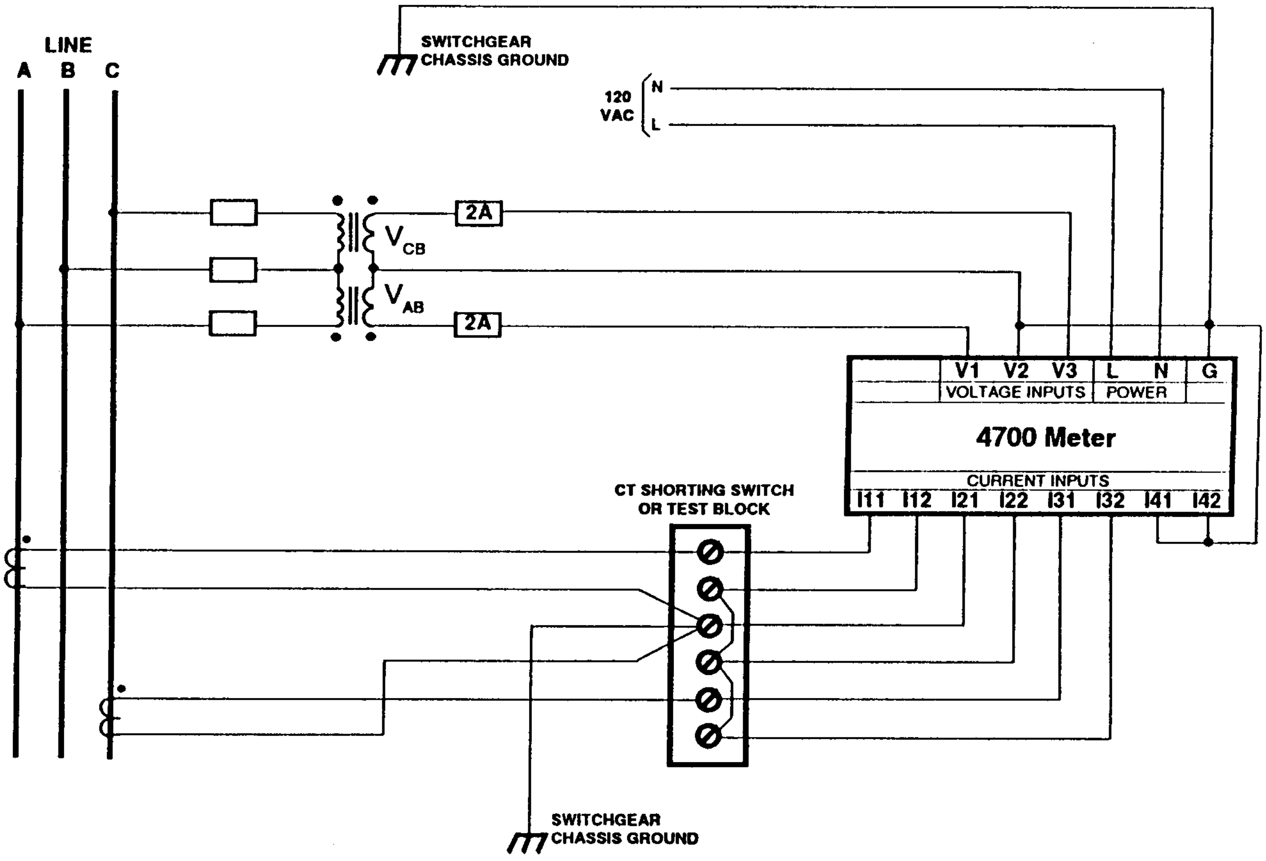


NOTES

1. VOLT MODE = 1 (DELTA MODE)
2. Use 120 VAC (full range) input model (refer to Appendix E).
3. Only relevant 4700 power meter terminal block connection points are illustrated.

Figure 4. Open Delta System Connection Using 2 PTs and 3 CTs.

Figure 5 below shows ungrounded Delta connection using 2 CTs.



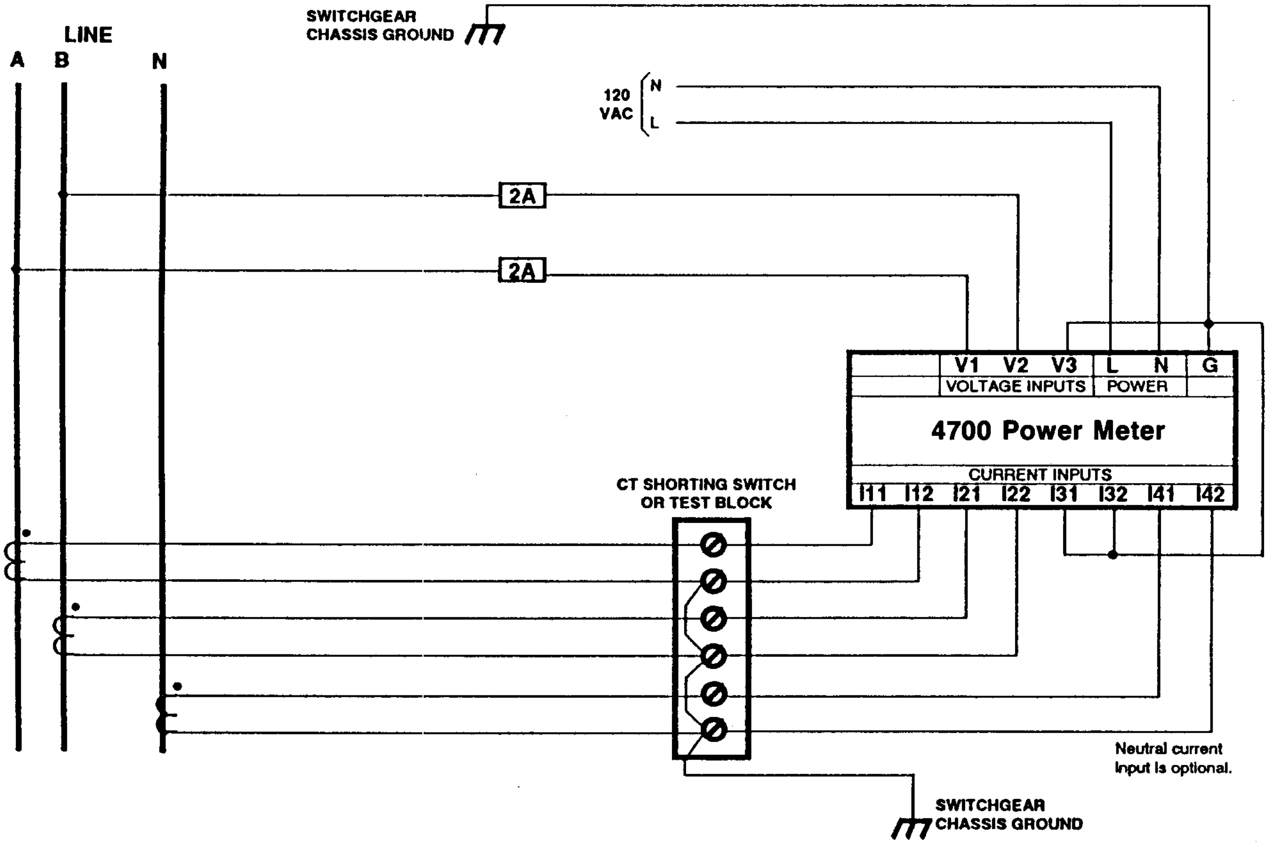
NOTES

1. VOLT MODE = 1
2. Use 120 VAC (full range) input model (refer to Appendix E).
3. Only relevant 4700 power meter terminal block connection points are illustrated.

Figure 5. Open Delta System Connection Using 2 PTs and 2 CTs.

Connection for Single Phase 3 Wire Systems

Wiring for single phase systems is performed by connecting the two 120 VAC phases (each 180 degrees with respect to each other) to the V_1 and V_2 inputs of the 4700 power meter, and the outputs of the two corresponding current transformers to the I_1 input pair and I_2 input pair. This is illustrated in **Figure 6** below. Note that the V_3 input and I_3 input pair are unused and should all be grounded. For single phase systems, the VOLT MODE of the 4700 power meter should be set to "2".



NOTES

1. VOLT MODE = 2 (SINGLE PHASE MODE)
2. Use 120 VAC (full range) input model for 120/240 Volt systems (refer to Appendix E).
3. Only relevant 4700 power meter terminal block connection points are illustrated.

Figure 6. Single Phase 3-Wire Direct Connection

Ground Connection

The ground connection, "G", to the 4700 power meter serves as the measurement reference point, as well as the chassis ground connection for the meter. This lead must be connected to earth ground.

A good, low impedance chassis ground is essential for accurate measurement. It is also necessary for the 4700 power meter surge and transient protection circuitry to function effectively. Do not rely on metal door hinges as a ground path.

⚠CAUTION

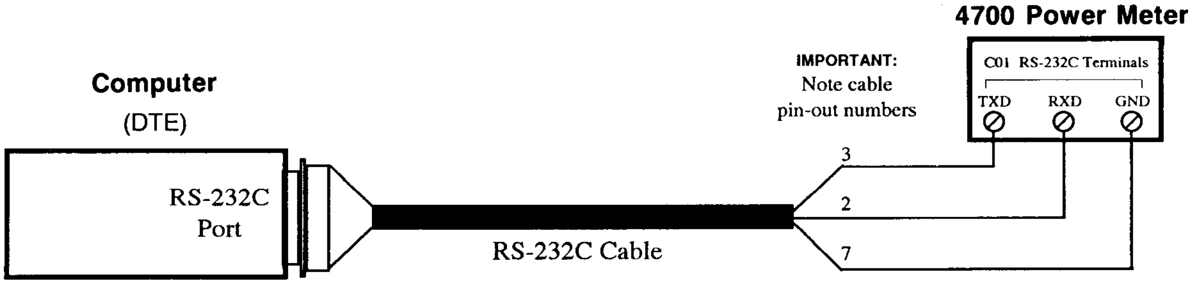
The 4700 power meter ground must be connected to the switchgear earth ground using a dedicated 14 gauge (or larger) wire in order for the noise and surge protection circuitry to function correctly. Failure to do so will void the warranty.

Communications Connections

The unit may be ordered with a communications card already installed. If no card is installed, a plain rectangular plate will be found on the right side of the case back cover. Field retrofitting of cards is possible, and is described below.

Communications Using the C01 Communications Card

The C01 card allows the 4700 power meter to communicate using either the RS-232C or RS-485 communications standards. Connections are made to the terminal strip on the communications card. **Figures 7** and **8** illustrate the wiring connection requirements for RS-232C and RS-485 communications using this card. The C04 card supports RS-485 only, as shown in **Figure 8**.

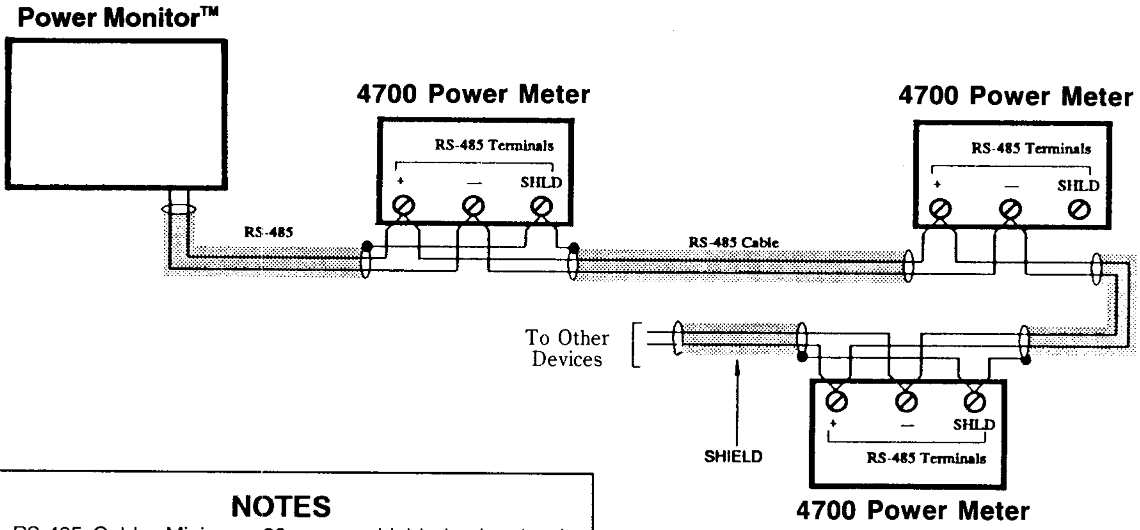


NOTES

1. RS-232C Cable: 25 pin DB25 or 9 pin DB9, plug (male) or socket (female) depending on mating connector at computer serial port, 50 feet maximum length.
2. If connected directly to an IBM-compatible PC RS-232C port, the Tx and Rx leads may need to be reversed at the 4700 power meter, depending on whether the PC RS-232C port is configured as DCE or DTE.

   You need to ensure Tx from the 4700 goes to Rx on the PC, and vice versa.

Figure 7. RS-232C Communication Connections



NOTES

1. RS-485 Cable: Minimum 22 gauge shielded twisted pair. Total length: 4000 ft. maximum.
2. The shield **must be** grounded at **one end only**.
3. Up to 32 devices are allowed on the RS-485 bus.

Figure 8. RS-485 Communication Connections

IMPORTANT

When the C01 card is shipped from the factory, it is set to operate in RS-232C mode. If RS-485 mode is required, a jumper on the card must be moved. See the following section and **Figure 9** for details.

Field Retrofit and Configuration of the C01 and C04 Communication Cards

This section explains the procedure for installing a C01 or C04 communication card or changing the communications mode.

The C01 card has a jumper block to allow the user to select RS-232C or RS-485 mode. The card's currently selected communications mode may be viewed from the optional front display, if the unit is operating, (see Section "General Operation" on Field Programming), or by removing the card and examining the position of the jumper block. See **Figure 9**.

Removing an Existing Communications Card

⚠CAUTION

An anti-static wrist grounding strap must be worn at all times while performing any modifications to the 4700 power meter or communication card. Failing to do so may permanently damage the static-sensitive components inside the meter.

1. Turn off the power to the 4700 power meter.
2. Remove the four machine screws holding the rectangular C01 or C04 card mounting plate to the 4700 power meter case back cover.
3. Carefully pull the plate away from the 4700 power meter chassis to remove the card.

Configuring the C01 Card

The C01 circuit card has a jumper labelled J1. This jumper has two positions labelled "A" and "B". If the jumper is in position "A", the card will be set to RS-485 mode. If the jumper is in position "B", the card will be set to RS-232 mode (see **Figure 9**). Move the jumper to the correct position.

Reinstalling (or Field Retrofitting) the C01 or C04 Card

1. Make sure that the power to the 4700 power meter is off.
2. If field retrofitting a 4700 power meter, first remove the communications port cover plate on the rear cover of the meter.
3. Install the new C01 or C04 card as follows:

a) Insert the communications card into the communications port, ensuring that the circuit card is oriented such that it will mate properly with the edge connector on the main board inside 4700 power meter.

b) Align the holes in the mounting plate of the card with the mounting holes in the meter's rear cover while lowering the card towards its seating. The installer will be able to feel when the card has found the correct alignment with the edge connector.

c) Once the board is resting in proper alignment on the edge connector, carefully press down to plug the card into the edge connector.

d) Install the four mounting screws into the mounting plate to secure the card.

The card is now ready for use. Make all necessary communications connections as described above.

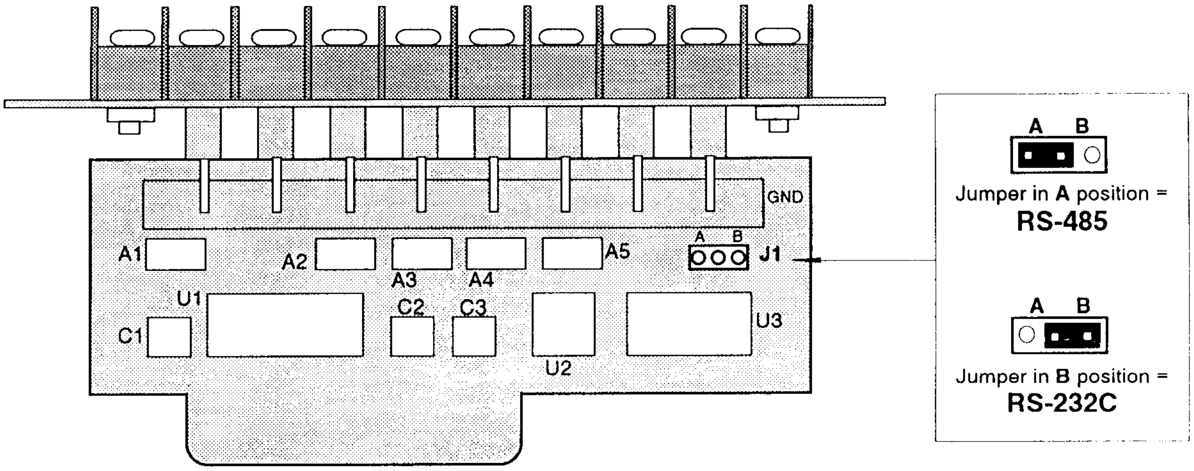


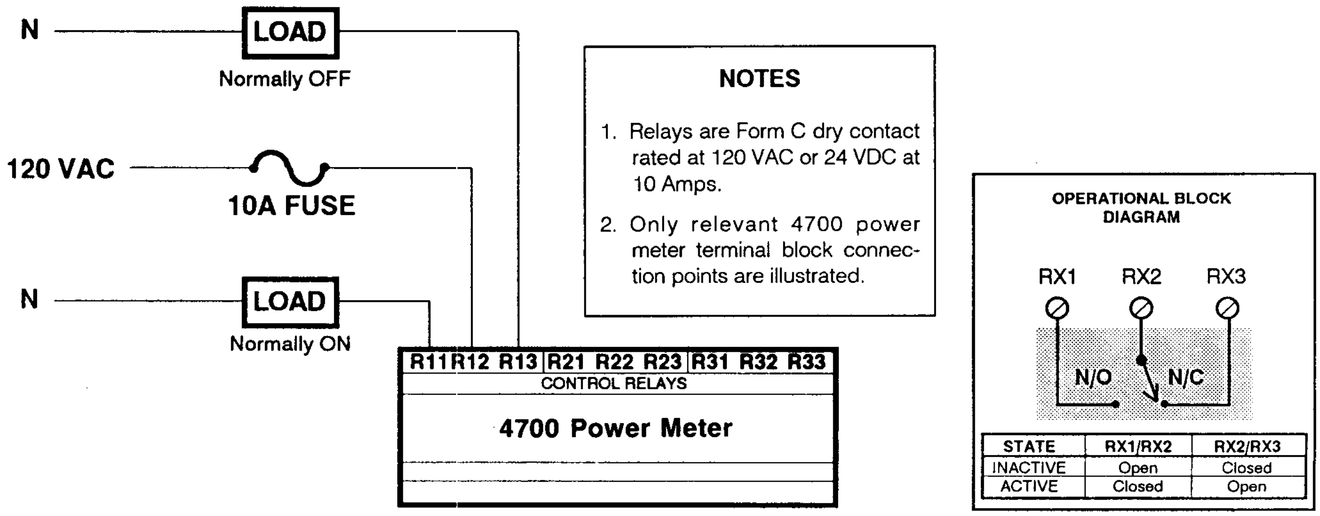
Figure 9. C01 Communication Card Jumper Configuration

Control Relay Connections

Figure 10 illustrates the wiring connection requirements for the control relays. Section "General Operation" describes the operation of the relays.

Status Input Connections

Figure 11 illustrates a number of possible wiring connection methods and applications for the status inputs. Section "General Operation" describes the operation of the status inputs.

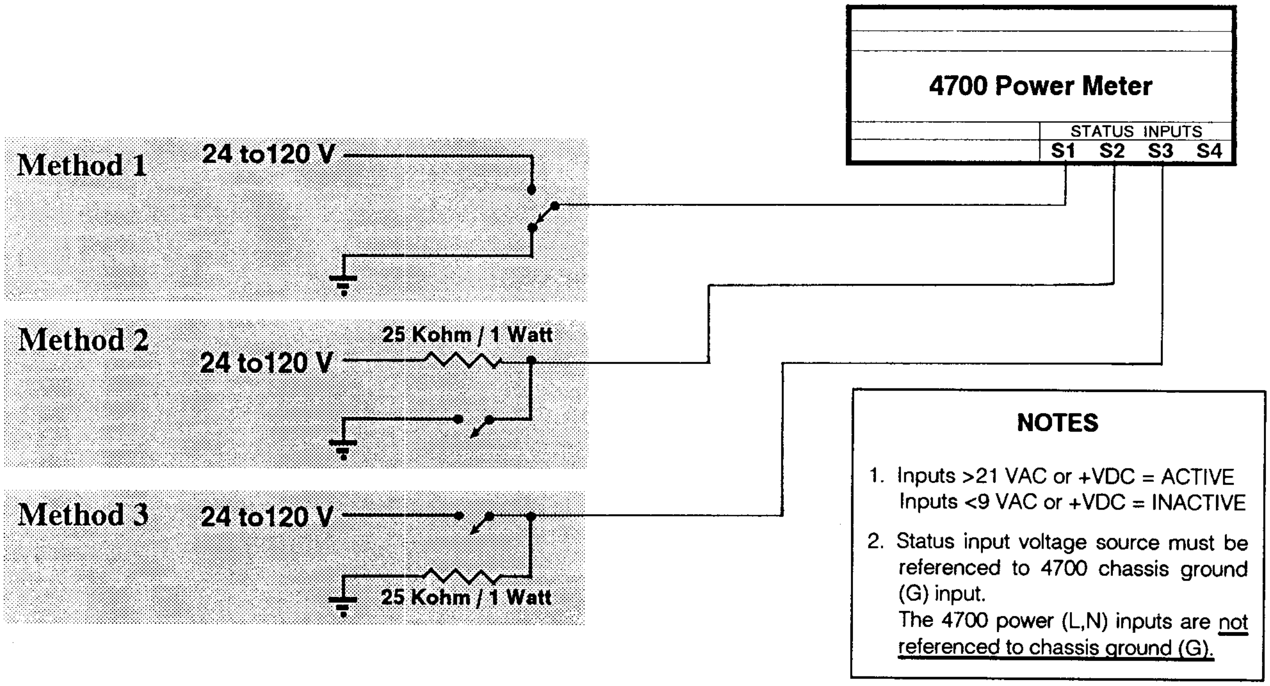


NOTES

1. Relays are Form C dry contact rated at 120 VAC or 24 VDC at 10 Amps.
2. Only relevant 4700 power meter terminal block connection points are illustrated.

STATE	RX1/RX2	RX2/RX3
INACTIVE	Open	Closed
ACTIVE	Closed	Open

Figure 10. Control Relay Connections



NOTES

1. Inputs >21 VAC or +VDC = ACTIVE
   Inputs <9 VAC or +VDC = INACTIVE
2. Status input voltage source must be referenced to 4700 chassis ground (G) input.
   The 4700 power (L,N) inputs are not referenced to chassis ground (G).

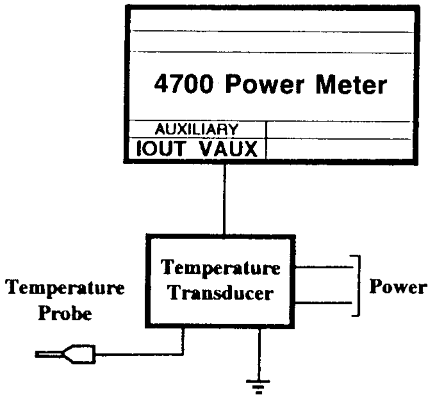
Figure 11. Status Input Connections

V_{aux} Auxiliary Voltage Input Connections

Figure 12 illustrates a number of possible wiring connection methods and applications for the V_{aux} input. The "General Operation" section describes the operation of this input.

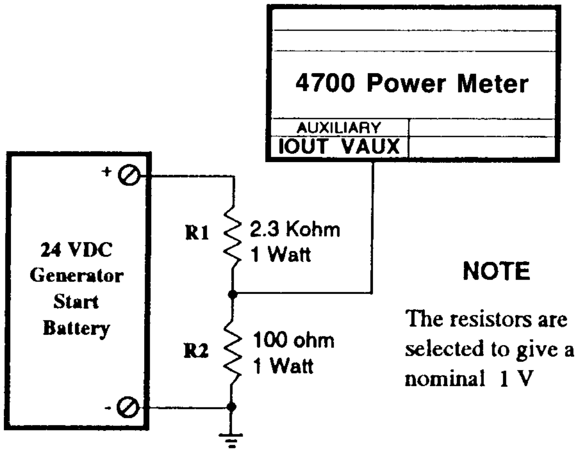
V_{aux} APPLICATION #1

Temperature Sensing



V_{aux} APPLICATION #2

Battery Voltage Sensing



NOTE

The resistors are selected to give a nominal 1 V

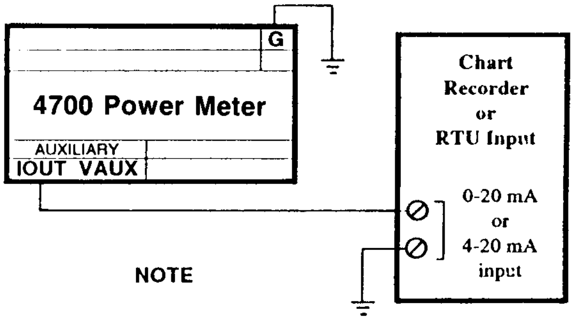
Figure 12. Auxiliary Voltage Input Connections

I_{out} Auxiliary Current Output Connections

Figure 13 illustrates a number of possible wiring connection methods and applications for the I_{out} output. Section "General Operation" describes the operation of this output.

I_{out} APPLICATION #1

Output to a Chart Recorder or RTU Input



NOTE

Maximum 100 ohm load.

I_{out} APPLICATION #2

Output to an Analog Meter

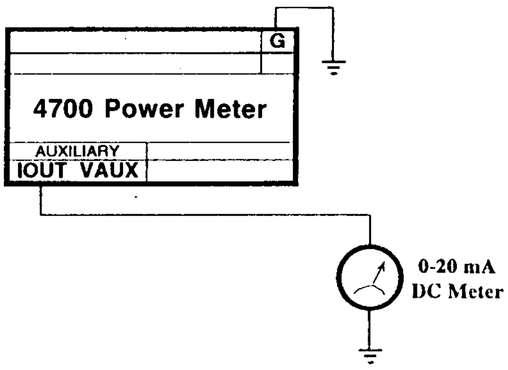


Figure 13. Auxiliary Current Output Connections

Fourth Current Input Connections

The 4700 power meter can be equipped with a fourth current input, which has identical ratings and specifications to the three phase current inputs. This input is typically used to measure the current flow in the neutral conductor. **Figure 14** shows I_4 in this configuration. The "General Operation" section describes the operation of this input.

Maintenance

The 4700 power meter contains a battery backed non-volatile memory. The rated life of the battery is 70 years at 50°C, 28 years at 60°C, and 11 years at 70°C.

If the unit operates at less than 50°C for 60% of the time, less than 60°C for 90% of the time, and less than 70°C for 100% of the time, the expected battery life is 35 years. If the meter is operating in an environment where the temperatures regularly exceed 60°C, the battery should be replaced every ten years.

NOTE

When the battery is replaced, historic data will be lost. Setup parameters and calibration of the unit will not be affected.

Other than non-volatile memory battery replacement, the 4700 power meter does not require any regular maintenance.

Calibration

The calibration interval for the 4700 power meter depends on the user's accuracy requirements. The rated accuracy drift is 0.1% per year.

The calibration procedure consists of connection of a portable Calibration Set to the two terminal strips of the 4700 power meter, and performing a simple calibration routine using a portable computer.

Field Service Considerations

In the event that the 4700 power meter unit should fail, it will generally be serviced by exchanging the unit for a replacement unit. The initial installation should be done in a way which makes this as convenient as possible:

1. A CT shorting block should be provided so that the 4700 power meter current inputs can be disconnected without open circuiting the CT's. The shorting block should be wired so that any CT connection to protective relaying is not affected.
2. All wiring should be routed to allow easy removal of the connections to the 4700 power meter terminal strips, the 4700 power meter rear cover, and the 4700 power meter itself.

NOTES

1. I_4 CT must have the same current rating as the line CTs.
2. Only relevant 4700 power meter terminal block connection points are illustrated.

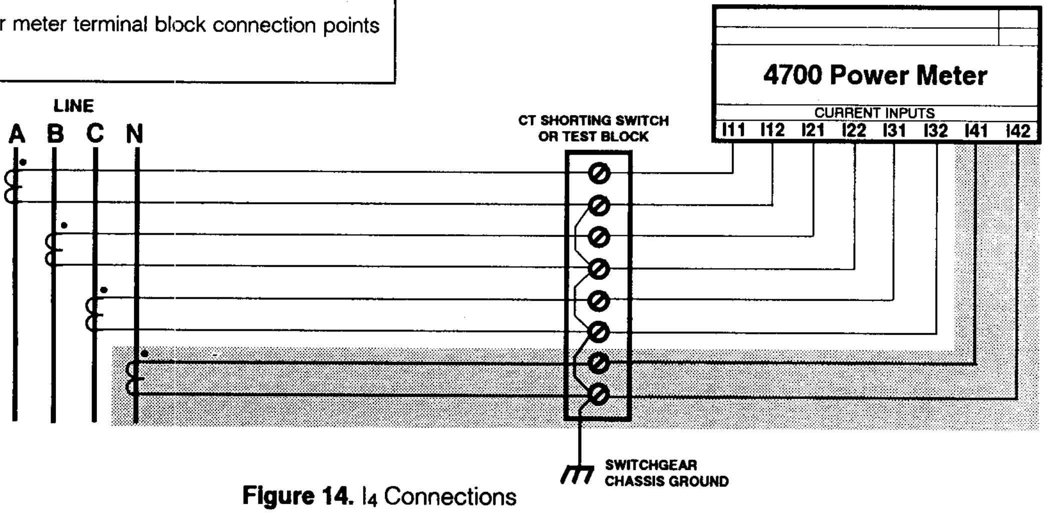


Figure 14. I_4 Connections

NOTE

The non-display versions of the 4700 power meter provide no front panel display or keypad. All measured data is read via the communications port. All field programming of operating parameters must also be performed via the communications port. Refer to Appendix F for instructions regarding the non-display versions. For the non-display versions, please disregard all references made to front panel display or keypad operations.

Power Up

After all installation wiring is complete and has been double checked, the unit may be powered up. The 4700 power meter will display Volts, Amps, and kW. The values initially appearing will probably not be correct since the unit has not yet been told a number of necessary pieces of information about the installation. The process of giving the 4700 power meter this information is known as field programming. This is described below.

Front Panel Operation

The 4700 power meter's front panel has been set up to be as simple to operate as possible. It has two modes of operation: display mode and programming mode. In display mode, the unit shows three fields: VOLTS, AMPS and POWER FUNCTION. There are four labeled buttons used to control the information presented on the display:

Phase: The phase button selects the phase (A, B, C, or Average) for which the volt and amp values are displayed. The "*" symbol indicates the average volts and amps values.

In Wye mode (VOLT MODE =0), the PHASE button will increment through all line to neutral values, the line to neutral average, and all line to line values. Note that the line to line values are displayed with a comma after the phase indicator (ex. A,).

In Delta mode (VOLT MODE =1), the PHASE button will increment through all line to line values for all the phases as well as the average (of the three phases).

In Single Phase mode (VOLT MODE = 2), the PHASE button will increment through a sequence of A, B, L. A indicates the A phase voltage and current. B indicates the B phase voltage and current. L indicates the line to line voltage along with the average of the two line currents.

Function: The function button selects which power function is displayed. The 4700 power meter displays volts, amps and KW when it is first powered up. Pressing the function button once changes the KW field to KVA. Pressing it again changes it to KVAR and so on. The complete sequence is: KW, KVA, KVAR, power factor, frequency, KW demand, Amp demand, V_{aux}, I_4, KW hours, and KVAR hours. kWhr and kVARhr use the entire display to show up to 10 digits of data.

Minimum and Maximum: These buttons display the minimum and maximum values, respectively, of volts, amps and power functions. Min/Max values are displayed for 3 seconds before returning to the real time display. Values displayed are Min/Max values logged since the last CLEAR MIN/MAX function was performed (refer to **Figure 15**).

FunctionLabel

Kilowatts	KW (MW)
Kilovoltamperes	KVA (MVA)
Kilovoltamperes (Reactive)	KQ
Power Factor	PF
Frequency	HZ
Kilowat Demand	KWD (MWD)
Amp Demand	AMD
V_{aux}	VX
Fourth Current Input	I_4
Kilowatt Hours	KWHRS
Kilovoltampere (Reactive) Hours	KVARHRS

Field Programming

Entering Programming Mode

Pressing the function and minimum buttons at the same time causes the 4700 power meter to enter the programming mode. When programming mode is first entered, PROGRAMMING MODE will be shown on the display. Once in this mode, the same action will cause the unit to return to display mode. Avoid pressing the function button first, because it would alter the selected parameter.

Programming Button Functions

In programming mode, the three right hand buttons of the front panel take on new programming functions. The label below each button indicates its alternate function (eg. the Maximum button now functions as PARAMETER SELECT).

The parameter select button selects which parameter is displayed. The CURSOR and INCREMENT buttons change the value of the displayed parameter. Specifically, pressing the CURSOR key moves the cursor left one digit (it will wrap around the number) and the INCREMENT key increments the digit under the cursor.

Certain parameters have yes or no values, such as CLEAR MIN/MAX? In this case pressing the INCREMENT key will cause the yes or no value to toggle.

Other parameters, such as BAUD RATE, have a number of possible values, and pressing INCREMENT will cause the display to scroll through them.

Entering the Password

The first parameter of the programming mode is the PASSWORD. When the 4700 Power Meter is shipped, the PASSWORD will be 0. This PASSWORD must be entered if any parameter values are to be changed. If the password is not entered, the programming may still be viewed, but it will be impossible to change any values. The password may be changed, as explained in this section under "Setting the Password." There is a backup password that can be issued by Siemens in the event the password is forgotten.

Skipping Over the Setpoint Parameters

To skip the setpoint parameters (explained in Section 4) enter a setpoint number of 00 (which is the default). If another number is entered, the 4700 power meter will keep going through the setpoint parameters. This makes it easy to examine and/or change multiple setpoints. If the setpoint number is 0, and the PARAMETER SELECT button is pressed, the setpoint items will be passed over.

Parameter Wrap-Around

The parameter list wraps around. If a parameter is missed, the PARAMETER SELECT button may be pressed repeatedly until the parameter is on the screen again.

Returning to Display Mode

Once all parameters have been set to their desired values, pressing and holding "minimum", then pressing "function" at the same time will cause the 4700 to return to display mode.

Operating Parameter Descriptions

Figures 15 and **16** provide a brief description of each parameter that may be programmed from the front panel display. Detailed descriptions of operating parameters and their application are provided in the following Sections of this manual. Note that Setpoint Operation, Demand and Communications are described in subsequent sections.

Setting the Password

To change the password, the programming mode should be entered, and the PARAMETER SELECT button should be pressed. The present value of the password must be entered (which means that the password must be known for it to be changed). To change the password the PARAMETER SELECT button should be pressed repeatedly until the password parameter is displayed again. This time the new password should be entered. Once this has been done, returning to display mode will cause the password to be changed.

Setting the Volt Scale, Amp Scale, and Volt Mode

The VOLT and AMP SCALES of the 4700 power meter must be set to correspond with the full scale levels which are being measured by the meter. The scale is the value the meter will display when the input is at full scale.

Volts Scale

In a direct connect configuration, the VOLT SCALE is normally set to 120 for a 120 VAC system, 277 for a 277 VAC system, or 350 for a 350 VAC system. If PTs are used for connection to higher voltage systems (using a 120 VAC model), the VOLT SCALE should be set to the primary rating of the PT. Note that this only applies if the PTs have secondaries rated at 120 VAC. If the secondaries of the PTs are not 120 VAC, the following formula should be used to determine the required VOLT SCALE:

$$\text{VOLT SCALE} = \frac{\text{PT Primary Rating x 120 VAC}}{\text{PT Secondary Rating}}$$

Amps Scale

The AMPS SCALE should be set to the Primary Rating of the CTs being used. Similarly, this only applies if the CTs used are rated for a 5 Amp full scale output. If the CT is not rated for a 5 Amp full scale output, the following formula should be used to determine the required AMP SCALE:

$$\text{AMP SCALE} = \frac{\text{CT Primary Rating x 5 A}}{\text{CT Secondary Rating}}$$

Field Programmable Operating Parameters

Parameter	Description	Range
PASSWORD	Must be entered to change the setup parameters or clear any function	0-9999
SETPOINT NUM	Selects a setpoint to be programmed. Note: If left at 0, no setpoint is selected and pressing Parameter Select will skip directly to VOLTS SCALE.	0 = no setpoint selected 1 to 17 = setpoint number
SP$_n$ TYPE	Select a code corresponding to the type of parameter the selected setpoint is to monitor (ex. Over KW, Volts Unbalanced, etc.). Pushing the INCREMENT button displays the choices.	See **Figure 20**
	Note: In the parameter names below, $_n$ indicates the currently selected wetpoint number.	
SP$_n$ HI LIMIT	Sets High Limit for the selected setpoint.	0 to 999,999
SP$_n$ LO LIMIT	Sets Low Limit for the selected setpoint.	0 to 999,999
SP$_n$ TD OPERATE	Time Delay to operate for the selected setpoint.	0 to 32,000 seconds
SP$_n$ TD RELEASE	Time delay to release for the selected setpoint.	0 to 32,000 seconds
SP$_n$ RELAY NUMBER	Selects which one of three on-board relays the selected setpoint controls. Selecting a value of 0 will use no relay. Note: After setting this parameter, pressing Parameter Select will return to the SETPOINT NUM display set to 0. The user may then select another setpoint to program or advance to VOLTS SCALE (below) by pressing Parameter Select again.	0 = no relay 1 to 3 = relay number
	For more information, see "Setpoint Operation."	
VOLT SCALE	Sets full-scale AC input voltage. See "General Operation".	0 to 999,999 Volts

System Configuration	Volts Scale
120/208 V direct connect	120
277/480 V direct connect	277
350/600 v direct connect	350
Systems which use PT's	PT primary rating

AMP SCALE	Sets full-scale AC input current (CT primary current rating). See "General Operation".	0 to 9,999 Amps
VAUX SCALE	Sets full-scale auxiliary voltage input reading.	0 to 999,999 Volts
VOLTS MODE	Sets Volts Mode. 0=WYE, 1=DELTA, 2=SINGLE PHASE, 3=DEMO	

Figure 15. Field Programmable Operating Parameters I

Field Programmable Operating Parameters

Parameter	Description	Range
UNIT ID	Sets Seabus communication address for 4700 power meter. Note: The number 0 may not be used for an ID as it is reserved for other purposes.	1 to 254
BAUD RATE	Baud Rate at which the 4700 power meter transmits and receives information.	300, 1200, 2400, 4800, 9600 Baud
COMMUNICATION MODE	Specifies the communications format used by the 4700 power meter. This parameter is controlled by the physical jumper block located on the optional plug-in Communications Card. See "Demand" section of this manual.	Reads: RS 232 or RS 485
DISPLAY TIMEOUT	Number of minutes after last button push until the display turns itself off. This extends the life and brightness of the display. A timeout interval of 180 minutes is recommended.	0 = display stays on 1 to 999 = timeout minutes
CLEAR MAX/MIN	Pressing increment button clears the max/min array.	No, Yes
CLEAR KW/KVARHRS	Pressing increment button resets the KW hours and KVAR hour readings to 0.	No, Yes
DEMAND PERIOD	Selects "Sync" mode, or length of each demand period to be used in calculating demand values.	0 = Demand Sync Mode 1 to 99 = minutes
NUM DMD PERIODS	Number of demand periods to be averaged to calculate demand values.	1 to 15
	For more information see "Demand".	
KWHR PULSE	Number of KW hours between KW hour pulses on Relay 3 .	0 = feature disabled 1 to 65,535 = KW hours/pulse
KVARHR PULSE	Number of KVAR hours between KVAR hour pulses on Relay 2.	0 = feature disabled 1 to 65,535 = KVAR hours/pulse
PHASE ROTATION	Specifies the normal phase sequence. This is used for PF polarity detection in delta mode, and for the phase reversal detection setpoint. See "Setpoint Operation."	ABC, ACB
I OUT KEY	Parameter code specifying with which measured value the current output will be proportional.	0 to 25 See **Figure 17**
I OUT SCALE	Scale of current output.	0 to 999,999
I OUT RANGE	Indicates 0 to 20 mA or 4 to 20 mA proportional current output.	0 = 0 to 20 mA 1 = 4 to 20 mA

Figure 16. Field Programmable Operating Parameters II

NOTE

The fourth CT rating must be the same as the phase CTs. See "Fourth Current Input Operation" in this section.

Volts Mode

The VOLTS MODE should be set according to the system connection configuration. Refer to the "Installation" section and **Figures 1** to **6** for more information.

V_{aux} Auxiliary Voltage Input Operation

The 4700 power meter has an auxiliary voltage input which allows an external voltage (1 VAC nominal, 1.25 VAC max.) to be measured and displayed. The V_{aux} Scale parameter defines what the meter will display with a 1.000 VAC_{RMS} full scale input applied.

Note that this 1 volt input is not a 120 volt input like V1, V2 and V3.

I_{out} Auxiliary Current Output Operation

The 4700 power meter can be equipped with an analog current output that may be programmed to deliver a current proportional to any measured parameter. The maximum load on the current output is 100 ohms resistive.

This output is controlled from the programming mode. Three parameters must be set:

a) I OUT KEY. This is a number specifying to which measured parameter the current output will be proportional. **Figure 17** shows the values for I OUT KEY corresponding to each measured parameter.

b) I OUT SCALE. This selects the value of the parameter corresponding to full scale current output.

c) I OUT RANGE. This indicates whether the output mode is 0 to 20 mA or 4 to 20 mA.

i) I OUT RANGE = 0
indicates 0 to 20mA.

ii) I OUT RANGE = 1
indicates 4 to 20mA.

I Out Key	Measured Parameter
0	Voltage, Phase A (or Vab for Delta)
1	Voltage, Phase B (or Vca for Delta)
2	Voltage, Phase C (or Vbc for Delta)
3	Current, Phase A
4	Current, Phase B
5	Current, Phase C
6	KW, Phase A
7	KW, Phase B
8	KW, Phase C
9	KVA, Phase A
10	KVA, Phase B
11	KVA, Phase C
12	KVAR, Phase A
13	KVAR, Phase B
14	KVAR, Phase C
15	Voltage, Average
16	Current, Average
17	KW, Total
18	KVA, Total
19	KVAR, Total
20	Power Factor
21	KW Demand
22	AMP Demand
23	Frequency
24	V_{aux}
25	I_4

Figure 17. I Out Key Parameter Values

Control Relay Operation

The 4700 power meter optionally provides three control relays (R1 to R3) which may be used for a number of applications including activation of alarms or load control. Each relay can switch a.c. loads of up to 120 VAC and d.c. loads of up to 24 VDC at 10 Amps. The operation of each relay may be controlled directly by the user through remote commands via the communications port.

The relays may also be operated from setpoints on selected measured parameters, controlled by user-definable conditions. Setpoint operation is described in detail in the next section "Setpoint Operation."

A third use for the relays is for KWHR (Relay 3) and KVARHR (Relay 2) pulsed output (see **Figure 16**)

The "Installation" section provides wiring requirements for the control relays.

Status Input Operation

The 4700 power meter optionally provides four status inputs (S1 to S4) which can each be used to sense the state of an external contact. If the input voltage is below 9 VAC or VDC, the input will be sensed as inactive. If it is over 20 VAC or VDC, it will be sensed as active.

The status of these inputs can only be viewed using a Power Monitor display and monitoring unit (or other computer) connected to the 4700 power meter's communications port.

4700 power meter units can be programmed to use Status Input #4 (S4) to provide KW Demand Synchronization. Refer to "Demand" section for more information.

The 4700 power meter maintains a counter for the Status Input #1 (S1). The maximum frequency the counter will accurately follow is 0.3 Hz. This counter may be zeroed at any time via the Power Monitor panel or other computer connected to the optional communications port.

The "Installation" section provides wiring diagrams illustrating various connection methods for the status inputs.

Fourth Current Input Operation

The 4700 power meter has an optional fourth current input, designated I_4. This input uses connections I41 and I42 on the terminal strip. The ratings of this input are identical to the three phase current inputs (5 Amperes nominally). The AMPS SCALE parameter of the 4700 power meter specifies the scaling for all four current inputs. This requires that the CT primary rating of the I_4 current input be the same as the CT primary ratings for the three phase current inputs.

Typically, this input is used to measure current in the neutral conductor. In installations with non-linear loads, odd harmonics can fail to cancel, producing significant currents in the neutral conductor. **Figure 14** shows the wiring connections for neutral conductor current measurement.

The I_4 reading may be displayed from the front panel, or viewed remotely. To view I_4 from the front panel, the FUNCTION button is pressed repeatedly until I_4 is displayed.

NOTE

The non-display versions of the 4700 power meter provide no front panel display or keypad. Setpoint parameters must be programmed via the communications port. Refer to Appendix F.

Introduction

The 4700 power meter is capable of monitoring many parameters at the same time and generating alarms and controlling relays based on these parameters values. The 4700 power meter uses setpoints to do this. A setpoint is a group of six parameters that tell the unit:

1) Which parameter to monitor (setpoint type), Over or under.
2) High Limit.
3) Low Limit.
4) Activate Delay.
5) Deactivate Delay.
6) Which relay to operate, if any, if too high or too low.

Setpoints can function either as over setpoints or under setpoints. An over setpoint becomes active if the given parameter becomes too large (Eg. over current). An under setpoint becomes active if the parameter becomes too low (Eg. under voltage or under frequency). Over and under setpoints are very similar. A description of each is provided below.

Over Setpoint

An over setpoint will become active when the parameter that is being monitored goes over the high limit (and stays over the limit) for a number of seconds greater than the activate delay to operate parameter. When a setpoint becomes active it will operate the given relay (unless the relay number is zero, in which case it does not change any of the relays). When a setpoint becomes active, its change of status is stored in the event log with the time and the value of the parameter at that instant. An over setpoint becomes inactive when the given parameter falls below the low limit for longer than the deactivate delay (refer to **Figure 18**). This change in status is also logged (along with the time of return within limit and the most out-of-limit value).

Under Setpoint

An under setpoint differs only in that the meanings of high limit and low limit are reversed. The setpoint becomes active when the parameter falls below the low limit for a number of seconds greater than the activate delay parameter (refer to **Figure 19**). The under setpoint becomes inactive when the parameter goes over the high limit for a number of seconds greater than the deactivate delay parameter. Except for these differences the under and over setpoints are treated identically.

Applications

The 4700 power meter currently supports 17 different setpoints simultaneously. These are numbered from 1 to 17. All the setpoints are accessible from the front panel, when provided. **Figure 20** describes the parameters that the setpoints may monitor. Each relay may be used for any one of the following:

1. Trip Relay - to shunt trip a breaker.
2. Alarm Relay - to activate an alarm buzzer or light.
3. Control Relay - to control an external piece of equipment.
4. Remote Control Relay - to control an external piece of equipment via the communications port.
5. kWhr Pulse Output Relay (relay 3)
6. kVARhr Pulse Output Relay (relay 2)

Any relay (one of three) may be assigned to any of the setpoints. Multiple setpoints may be assigned to one relay. A relay will be activated if any of the setpoints controlling it become active. Relays 2 and 3 may also be used for kVARhr and kWhr pulsing, so care must be taken that relays are not used in a conflicting fashion.

CAUTION

The response time of the relays is 1 to 2 seconds up to 5 seconds after initial meter power up and it is disabled when the 4700 is in programming mode. The 4700 power meter should not be used for protective functions which require faster operation. Use separate reliable AC or DC control power where shortest possible reaction times are needed.

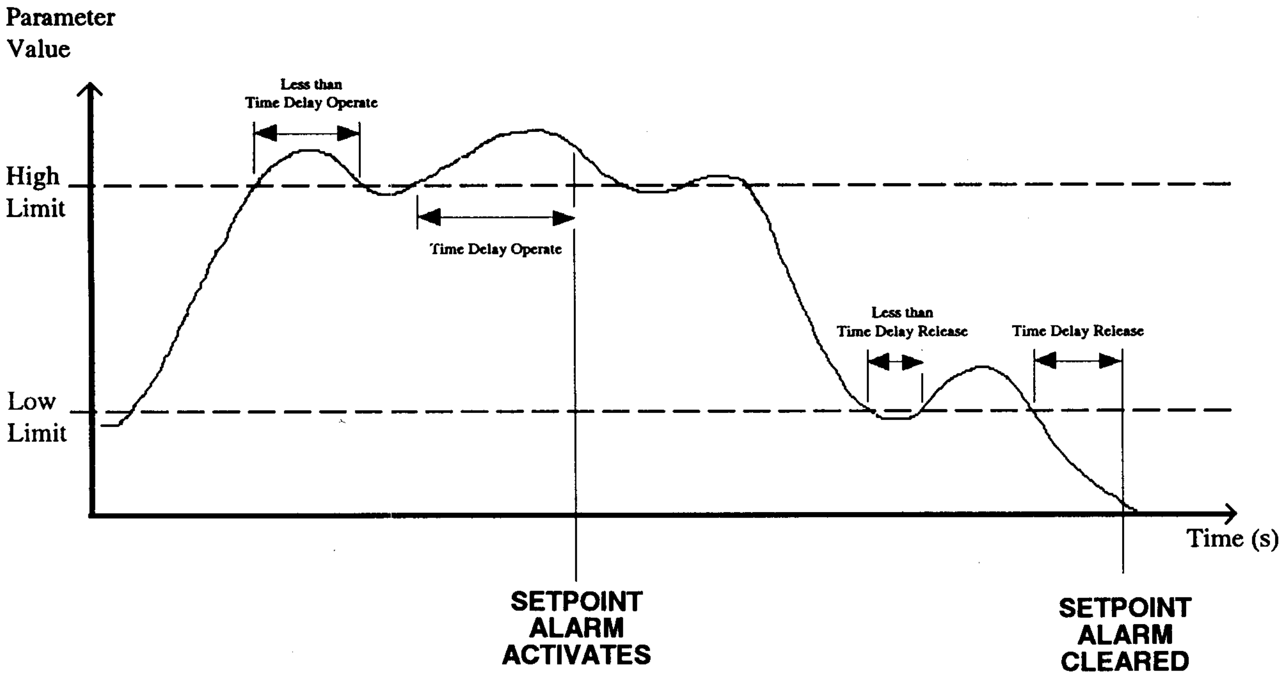


Figure 18. Over Setpoint Operation

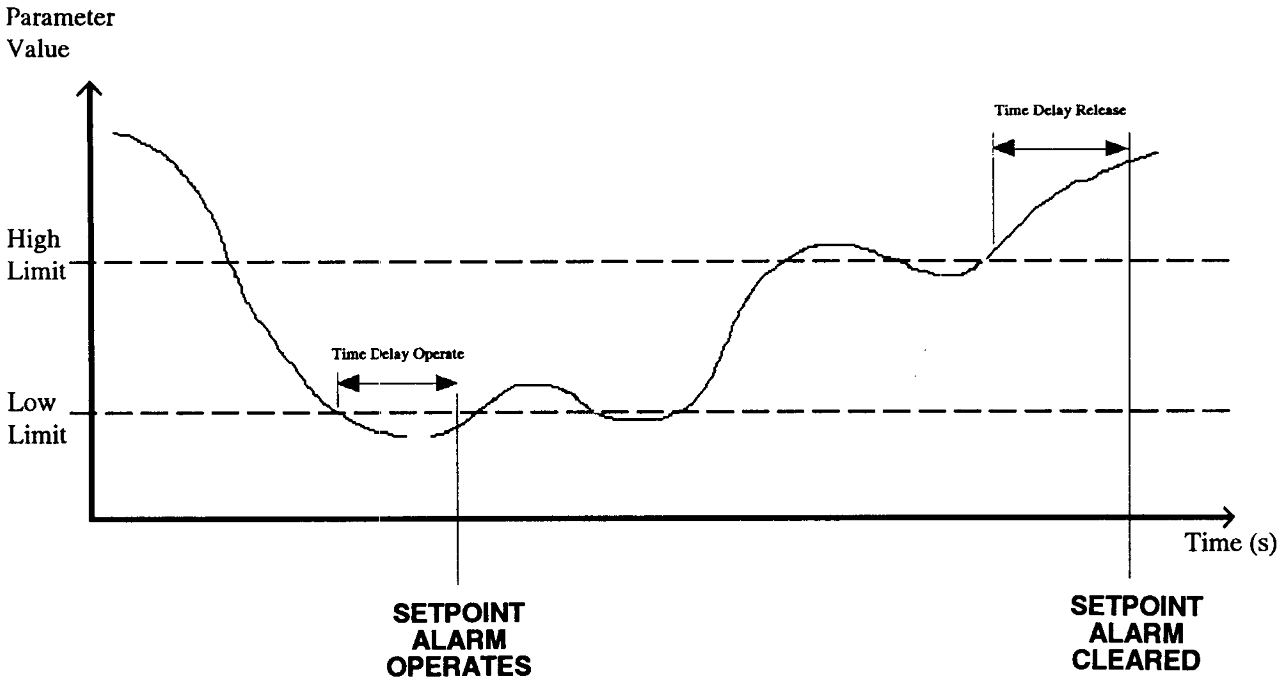


Figure 19. Under Setpoint Operation

Setpoint Types

Type	Description
NOT USED	A setpoint which is not being used.
OVER VOLT	Over voltage (highest phase voltage).
UNDER VOLT	Under voltage (lowest phase voltage).
VOLTAGE UNBAL	% difference of most deviant phase voltage from the average.
OVER CURRENT	Over current (highest phase current).
CURRENT UNBAL	% difference of most deviant phase current from the average.
OVER KVA	Over KVA.
OVER KW	Over KW.
OVER KWREV	Over negative KW (feeding power into utility grid).
OVER KVAR	Over KVAR.
OVER KWD	Over KW demand.
OVER AMPD	Over amp demand.
OVER FREQUENCY	Over frequency. (Enter: Frequency x 10 [ie. 60 Hz = 600])
UNDER FREQUENCY	Under frequency. (Enter: Frequency x 10 [ie. 60 Hz = 600])
OVER VAUX	Over auxiliary voltage.
UNDER VAUX	Under auxiliary voltage.
PHASE REVERSAL	Phase reversal. Operates if the phase rotation does not match the programmed normal rotation.
UNDER PF LAG	Under power factor lagging.
UNDER PF LEAD	Under power factor leading.
OVER I_4	Over I_4 current.

Figure 20. Setpoint Types

Programming Setpoints

Setpoints may be programmed by entering the 4700 power meter program mode, entering the correct password, then entering a number from 1 to 17 for the SETPOINT NUMBER parameter. The user may then step through and enter new values for all parameters associated with the selected setpoint.

⚠CAUTION

After the correct password has been entered in programming mode, no setpoint-controlled relay operation will occur until after the user has exited the programming mode. The 4700 power meter will then assess the status of each setpoint and perform any required operations.

It is recommended that setpoint utilization be planned using a Setpoint Parameter Form. This form contains the setpoint information that the user programs into the 4700 power meter. A copy of this information should be kept with the meter. Appendix B provides a blank Setpoint Parameter Form for this purpose. **Figure 21** is an example of using a Setpoint Parameter Form to plan setpoint usage.

EXAMPLE

Relay 1 is used as an alarm relay, with over voltage, under voltage, voltage unbalance, and phase reversal trips enabled. The relay is connected to the breaker shunt trip input. Relay 2 is used as an alarm relay to warn of loads which are over 70% of the breaker rating. Its output is connected to a buzzer. Relay 3 is used as a KW demand control relay. The form contains all of the information required to program the 4700 power meter to perform the operations described above.

Forced Relay Operate/Release

The relays can be forced operated or forced released by commands sent via the communications port. Forced operate/release commands override all programmed setpoint control functions.

Power Outages

When the power feed to the 4700 power meter is interrupted, even momentarily, the output relays will release. When power is restored, the 4700 power meter will allow a 3 second settling time, then the setpoint conditions will be re-evaluated, and, if appropriate, the relays will operate after the programmed time delays.

If any relay has been forced operated or forced released via the communications port, it will be released and then resume normal setpoint operation after a power outage.

Setpoint Parameter Form

Setpoint Number	Setpoint Type	High Limit	TD Operate	Low Limit	TD Release	Relay/Function
1	Over Volts	332	5	290	1	1 Trip
2	Under Volts	270	5	220	1	1 Trip
3	Volts unbal.	30%	5	10%	1	1 Trip
4	Phase Reversal	—	1	—	1	1 Trip
5	Not Used					
6	Not Used					
7	Over Amps	2100	10	2000	1	2 Alarm
8	Over Volts	300	10	290	1	2 Alarm
9	Under PF Lag	90	10	85	10	2 Alarm
10	Under PF Lead	90	10	85	10	2 Alarm
11	Over KWD	1200	10	900	10	3 Demand control
12						
13						
14						
15						
16						
17						

Figure 21. Setpoint Parameter Form

Industry Demand Measurement Methods

Power utilities generally bill commercial customers based on both their energy consumption (in kWhr) and their peak usage levels, called peak demand in kW. Demand is a measure of average power consumption over a fixed time period, typically 30 minutes. Peak demand is the highest demand level recorded over the billing period.

Demand measurement methods and intervals vary from power utility to power utility. Some common methods include: thermal averaging, the fixed interval technique, and the sliding window technique. For thermal averaging, the demand indicator responds to heating of a thermal element in the Watt hour meter. The demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes. The fixed interval technique measures average usage electronically over each period. The highest recorded value is the peak demand. The sliding window technique (or rolling interval method) divides the demand interval into sub periods and the demand is measured electronically based on the average load level over the most recent set of subperiods. This has the effect of improving the response times as compared to the fixed interval method. For example, with a 6x5 minute (30 minutes total) sliding window method, demand will be the average power consumption over the last six 5 minute periods.

Internally-Timed Demand Measurement

The 4700 power meter uses the sliding window method to measure demand. Both the DEMAND PERIOD (1 to 99 minutes) and NUMBER OF DEMAND PERIODS to be averaged (1 to 15) are user programmable. This allows the user to match virtually any utility demand measurement method as illustrated in Figure 22.

Demand Synchronization

4700 power meter units provide the following additional feature. When the DEMAND PERIOD parameter is set to zero, the Demand Sync Mode is selected and the 4700 power meter no longer internally times the duration of each demand period used in the kW demand calculation. Instead, it looks for a pulse (INACTIVE to ACTIVE transition) on Status Input #4 (S4) to indicate the start of the subsequent demand interval. The user is still free to choose the NUMBER OF DEMAND PERIODS as with the self-timed mode of operation described above.

UTILITY METHOD	**4700 PROGRAMMING**	
	Demand Period (in minutes)	**Number of Demand Periods (must be 15 or less)**
Fixed Interval (Note 1)	Utility Period	1
Fixed Interval Emulation	Utility Period%15	15
Thermal	Utility Period%15	15
Sliding Window	Utility Sub Period	Utility # of Sub Periods

Note With the fixed interval method, the 4700 Meter maximum reading and the utility reading will not necessarily be the same unless the demand periods are time synchronized. The best way to resolve this problem is to use the sliding window mthod with the same total demand period as the utility as shown above. The 4700 Meter maximum redemand reading will then always be as high or slightly higher than the utility readings.

Figure 22. Demand Calculation Chart.

Description

The 4700 power meter is available in models equipped with a communication card, allowing data transfer between the 4700 power meter unit and other display and monitoring devices such as the Power Monitor unit. The Power Monitor panel provides complete control of several 4700 meters and other "ACCESS™—compatible" field devices connected together through a common RS-485 network.

Before communication is possible, the user must program the communication parameters of the 4700 power meter. This may be performed via the front panel of the unit, or over the communications bus. The ADDRESS for each 4700 power meter must be set to a unique value (see description of RS-485 communication below). The BAUD RATE of the 4700 power meter must be set to correspond with the baud rate selected for the network. The COMM. MODE (communication mode) of the 4700 power meter is set by the jumper position on the C01 communications card, as explained in "General Operation, Field Programming. 4700 power meter communication modes are described below.

RS-232C Communication

The C01 communication card can be optionally configured as RS-485 or RS-232C. RS-232C communication is used for direct connection between a computer and a single 4700 power meter (distance less than 50 feet).

RS-485 Communication

RS-485 communication mode can be used to concurrently connect up to thirty-two 4700 power meter units to one network, each given a unique ADDRESS. In this way, each 4700 power meter unit may be monitored and controlled from one location by a single Power Monitor panel or other computer.

The total distance limitation for RS-485 communication is 4000 feet using 22 gauge twisted pair shielded cable. Refer to Section 2 for connection diagrams.

⚠CAUTION

It is important that the shield of each leg of RS-485 cable be grounded at one end only.

Description

A number of problems can cause the 4700 power meter not to function properly. This section lists a number of symptoms, and explains how to correct them.

1. If the display does not operate:

a) Check that there is at least 110 volts available to the power supply (L and N connections on the terminal strip).

b) Confirm that the G terminal is connected directly to ground.

c) Press the "Display" button.

2. If the voltage or current readings are incorrect:

a) Check that the volt mode is properly set for the given wiring.

b) Check that the voltage and current scales are properly set.

c) Make sure the G terminal is properly grounded.

d) Check the quality of the CTs and PTs being used.

e) Make the following voltage tests:

i) V1, V2, V3 to G should be 120 VAC (or rated full scale values of 277 or 350VAC)

ii) G to switchgear earth ground should be 0 V.

iii) L to G should be 120 VAC or DC (or optional rated control power voltage).

iv) N to G should be less than 2 VAC.

v) All current inputs should be less than 1 VAC with respect to G.

3. If the kW or power factor readings are incorrect but Voltage and Current readings are okay:

a) Make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.

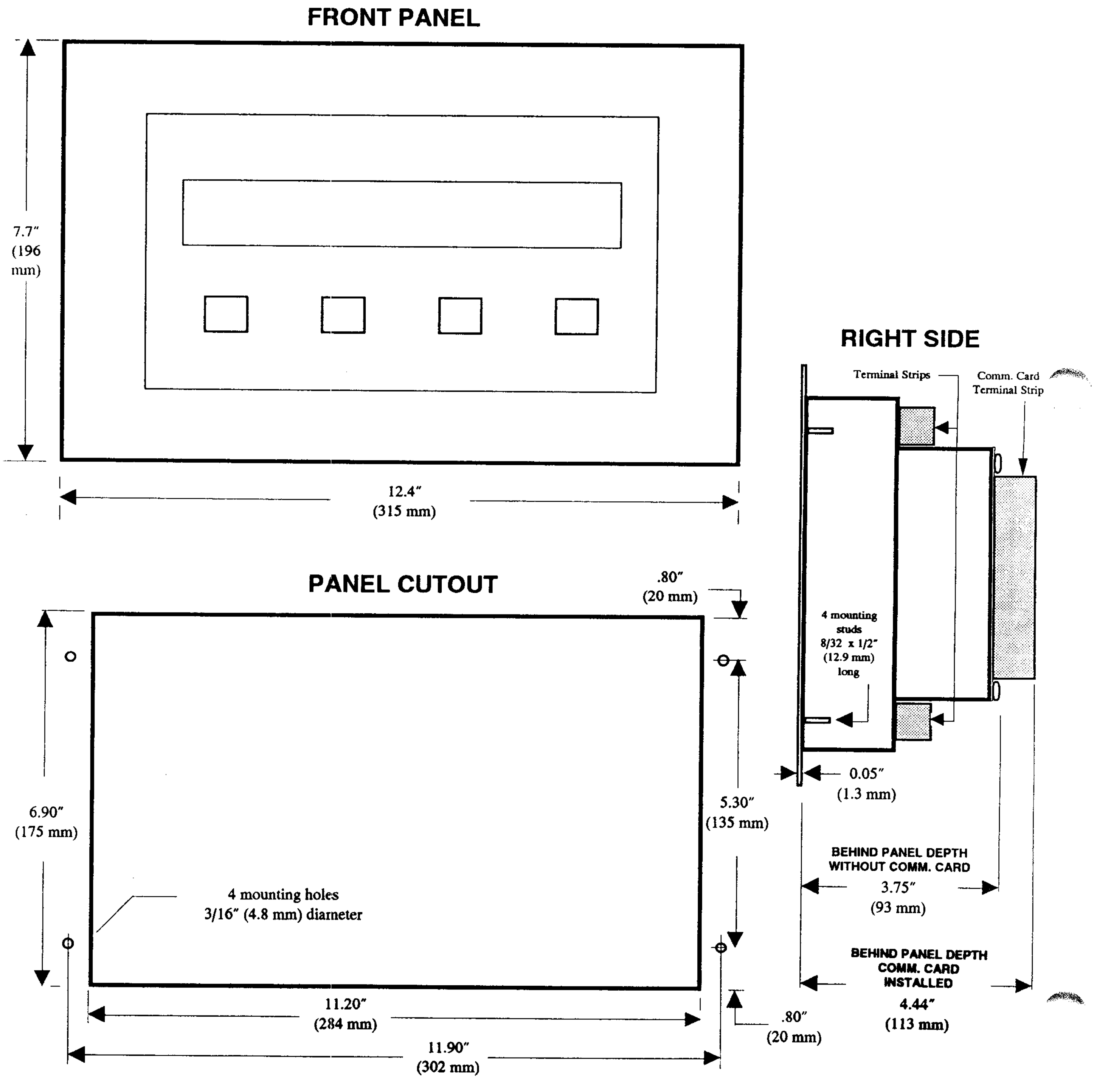
4. If RS-232 or RS-485 communication does not work:

a) Check the baud rate matches that of the Power Monitor device or other computer.

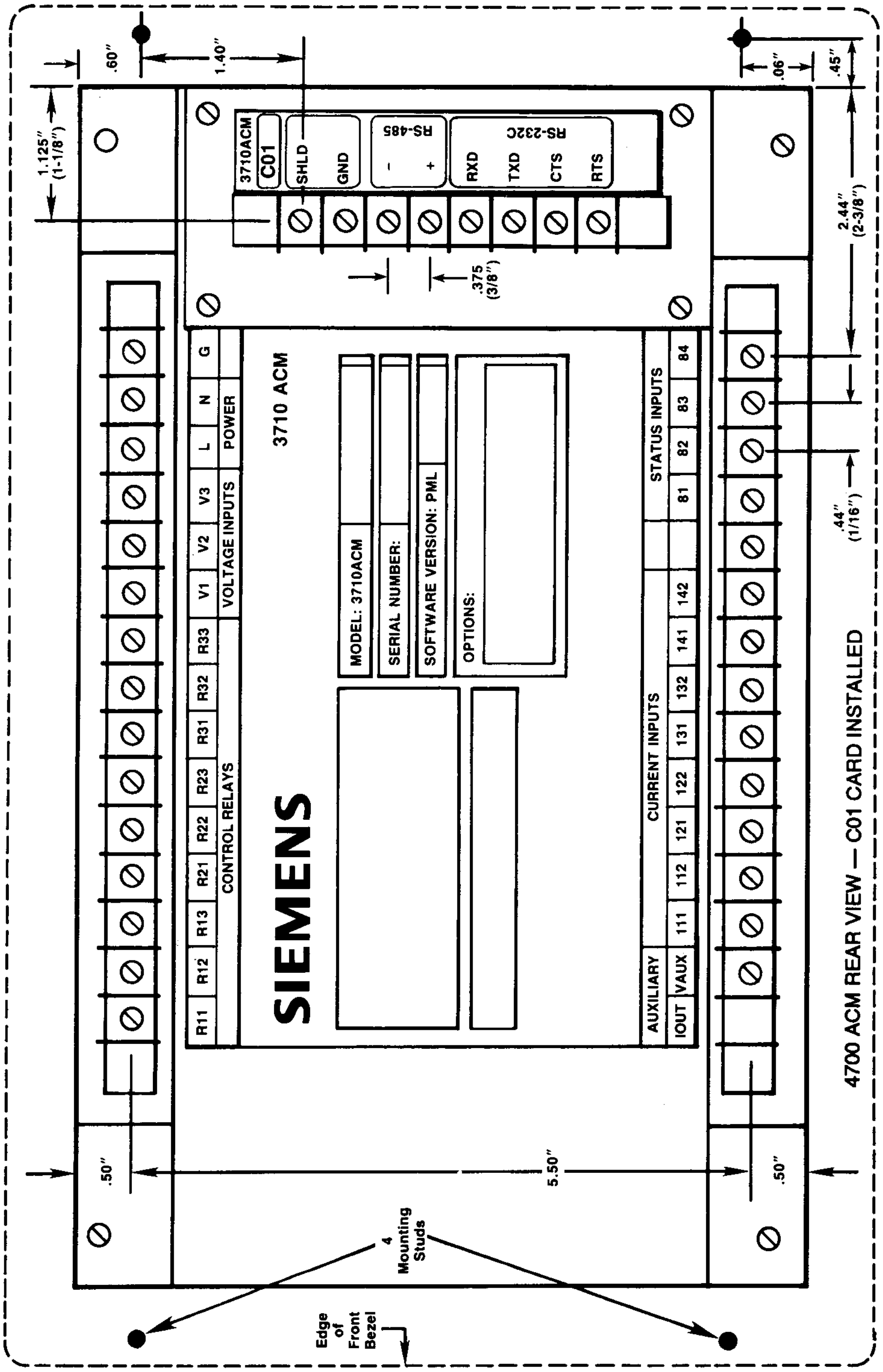
b) The communications mode (RS-232 or RS-485) set by the jumper on the communications card is correct for the given installation (see "Installation" section on Field Retrofit and Configuration of the C03 communication card).

c) Check the ADDRESS at the 4700 power meter matches that configured at the Power Monitor panel or other computer.

4700 Mechanical Dimensions—Mounting



4700 Mechanical Dimensions—Terminal Block



4700 ACM REAR VIEW — C01 CARD INSTALLED

Setpoint Parameter Form

SETPOINT	FUNCTION	HIGH LIMIT	TD OPERATE	LOW LIMIT	TD RELEASE	RELAY/FUNCTION
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

4700 Power Meter Software Versions

This following table lists each software version release for the 4700 power meter and the new features or performance enhancements added with each release.

The version number is identified on the label on the rear cover of the 4700 power meter. If yours is currently using a software version older than the most recent version listed in the table below, you may upgrade the software in that unit by contacting your local representative or the manufacturer. Upgrades to the 4700 power meter require a simple replacement of the EPROM (integrated circuit "chip") which contains the operating software inside the unit. This must be done by a trained electronic serviceman.

VERSION	RELEASE DATE	DESCRIPTION
V2.0	October 1989	Initial Release
V2.0.0.1	December 1989	Added 3600 Communication Emulation
V2.0.0.2	December 1989	Fixed Negative kVAR in 3600 Communications
V2.0.0.3	January 1990	Fixed Volt Mode 4 in 3600 Communications Fixed Overflow in Average Voltages
V2.0.0.4	March 1990	Fixed Negative kW in 3600 Communications Fixed Min/Max Flag in 3600 Communications

4700 Power Meter Technical Specifications

Parameter	Accuracy	Resolution	Range
Volts	0.2%	0.1%	0-999,999 (1)
Amps (L & N)	0.2%	0.1%	0-9,999
KVA	0.4%	0.1%	0-999,999 (2)
KW	0.4%	0.1%	0-999,999 (2)
KVAR	0.4%	0.1%	0-999,999 (2)
PF	1.0%	1.0%	1.0 to +/-0.6
FREQUENCY	0.2 Hz	0.1 Hz	40 to 70 Hz
KW DEMAND	0.4%	0.1%	0-999,999
AMPS DEMAND	0.2%	0.1%	0-9,999
KWHR	0.4%	1 KWHR	0-999,999,999
KVARHR	0.4%	1 KVARHR	0-999,999,999
V_{aux} (1 VAC scale)	0.25%	0.1%	0-999,999
Neutral Current	0.2%	0.1%	0-9,999

Notes

(1) Reads in KV for voltages over 9,999
(2) Reads in MVA, MW, MVAR for readings over 9,999

Input Ratings

Voltage Inputs: (V1, V2, V3)	120 VAC nominal full scale input version Overload withstand: 1500 VAC continuous, 2500 VAC for 1 Sec Input impedance: 2 Megohm 277 VAC nominal full scale input version (Option-277) Overload withstand: 1500 VAC continuous, 2500 VAC for 1 Sec Input impedance: 2 Megohm 347 VAC nominal full scale input version (Option-347) Overload withstand: 1500 VAC continuous, 2500 VAC for 1 Sec Input impedance: 2 Megohm
Aux. Voltage Input: (V_{aux})	1.0 VAC/VDC nominal full scale input (1.25 VAC/VDC max.) Overload withstand: 120 V continuous, 1000 V for 1 Sec Input impedance: 200 Kohm
Current Inputs: (I11, I12, I21, I22, I31, I32, I41, I42)	5.000 Amps AC nominal full scale input Overload withstand: 15 Amps continuous, 300 Amps for 1 Sec Input impedance: 0.05 ohm, Burden: 1.25 VA
Status Inputs: (S1, S2, S3, S4)	>20 VAC/VDC = active, <9 VAC/VDC= inactive (S1, S2, S3, S4)Input impedance: 2 Megohm Overload withstand: 1500 V continuous, 2500 V for 1 Sec
Control Relays: (R1, R2, R3)	Form C dry contact relays 120 VAC or 24 VDC @ 10 Amp maximum load current
Power Supply:	Standard North American: 85 to 132 VAC/0.2 Amps/47 to 440 Hz or 110 to 170 VDC/0.2 Amps European/Optional: 85 to 264 VAC/0.2 Amps/47 to 440 Hz or 110 to 340 VDC/0.2 Amps Other Available Options: 24 VDC and 48 VDC
Operating Temperature:	0°C to 50°C (32°F to 122°F) ambient air temperature range

Voltage, Current, Status, Relay and Power inputs all pass the ANSI C37.90A surge withstand and fast transient tests.

4700 Series Power Meter Model/Ordering Information

Table 1. 4700 Product Designations

Features	Available Basic Product Designations							
	D	DR	DC	DRC	C	RC	DMC	DRMC
15 metered parameters	X	X	X	X	X	X	X	X
Min/Max log	X	X	X	X	X	X	X	X
Aux voltage (1Vac/1Vdc nominal)	X	X	X	X	X	X	X	X
20 character display	X	X	X	X			X	X
Four discrete inputs		X		X		X		X
Three programmable relay outputs		X		X		X		X
One analog output (4 to 20mA)		X		X		X		X
Extended memory (100 snapshots)							X	X
Communications module installed			X	X	X	X	X	X

Examples:

"4700-C4-11S" defines a power meter without integral display with an isolated RS-485 communications module installed, a 120Vac/125Vdc power supply, 120Vac nominal measured phase voltage inputs and standard 1%/2% accuracy.

"4700-DR-12HN" defines a power meter with integral display, status inputs and relay outputs, 120Vac/125Vdc power supply, 277Vac nominal measured phase voltage inputs, high accuracy (.25%/.50%) and a fourth current input for neutral or ground currents.

4700 Power Meter Catalog Number Designations

4700 - DRMC 3 - 1 2 S N

Basic Product Designations:
(See Table 1.)
D = 20 Character display
R = Relays & discrete inputs
M = Extended snapshot memory
C = Communications module installed

Communications Options:
3 = RS-232 & 485 (set to 232)
4 = RS-485 (with isolation)

Power Supply Voltage:
1 = 120Vac/125Vdc
2 = 240Vac/250Vdc
4 = 48Vdc
5 = 24Vdc

Measured Phase Voltage (Ref to Neutral):
1 = 120Vac (50/60Hz)
2 = 277Vac (50/60Hz)
3 = 350Vac (50/60Hz)

Accuracy Class:
S = Standard accuracy (1.0%/2.0%)
H = High accuracy (.25%/.50%)

Additional Options:
N = Neutral/ground current input
F = 400Hz metering application
T = Extended temperature capability (-30° to +70° C)

4700 Non-Display Unit Operation

Introduction

The TRANSDUCER version of the 4700 provides all the functions of the 4700, except that it has no front panel display or keypad. All front panel display and keypad functions described in the 4700 Operation Manual should be disregarded for this model.

The mounting requirements differ slightly for the non-display unit model. These are described in "Monitoring."

The user interface/communications for the non-display unit model also differ from the standard 4700. These are described below.

Communications

All information and measured data is extracted from the 4700 TRANSDUCER model via its communications port; provided by the Communications Card. All TRANSDUCER model setup parameters are also accessed via the meter's communications port.

All TRANSDUCER models are shipped from the factory with a Communications Card installed. The card is user-configurable to operate in either the RS-485 or RS-232C communications standard (see "Field Retrofit and Configuration of the C01 Communications Card"). "Communications Connections" describes all necessary communications connections.

⚠CAUTION

Be certain not to connect RS-232C configured devices to RS-485 configured devices as this will cause damage to the meters or other devices.

The data collected by the TRANSDUCER model can be displayed on a Siemens Power Monitor™ Display and Monitoring unit, which allows the user to remotely configure, monitor or control one or more power meters.

To initiate communications with the TRANSDUCER model, the factory-set UNIT I.D. and BAUD RATE must be used. The TRANSDUCER model is shipped with its UNIT I.D. and BAUD RATE set as follows:

a) UNIT I.D. The UNIT I.D. of the TRANSDUCER model is set at the factory to be the last 4 digits of the unit's serial number, which can be found ont he rear cover of the unit. For example, a unit with serial number 71317 will be preset to UNIT I.D. of 1317.

b) BAUD RATE. The BAUD RATE of the TRANSDUCER model is set at the factory to 9600 baud.

Programming

Once communication has been established using the factory defaults, 4700 TRANSDUCER model operating parameters may be changed through use of the Power Monitor™. The user may also set the UNIT I.D. of the TRANSDUCER model to any other desired value, as well as resetting the BAUD RATE.

NOTE

Refer to "Communications" of the 4700 Operation Manual for important information on resetting the BAUD RATE.

SIEMENS

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SIEMENS

Electronic Metering Package

4700 Power Meter

Addendum to
Installation
Operation
SG-6018

Table of Contents

List of Figures

1 Introduction

The enclosed 4700 power meter is a REV B version; however, the enclosed installation and operation manual describes the previous REV A (revision A) version. This addendum describes the differences between the two releases and provides all revised wiring connection diagrams and other information necessary to install and operate the REV B release.

This addendum also describes all new 4700 features provided by the latest firmware release: 2.3.0.4.

Disregard all associated information in the enclosed manual for which revised information is provided in this addendum.

OVERVIEW OF REV B DIFFERENCES

The REV B release of the 4700 differs significantly from the earlier REV A release. Many terminal connections have been altered or modified in their positions or functions.

The two releases can be easily differentiated. On models with a front panel display, the REV B version has a dark grey plastic bezel surrounding the faceplate. On all models, the serial number label found on the rear panel of the unit indicates the release.

REV B differs functionally from REV A as follows:

a) Power supply terminals (L/+ and N/-) have been repositioned.

b) Voltage reference terminal (VREF) has been added as the reference for phase voltage sense inputs.

c) Earth ground terminal (G) has been removed and replaced by a chassis ground lug, attached to one of the mounting studs/holes.

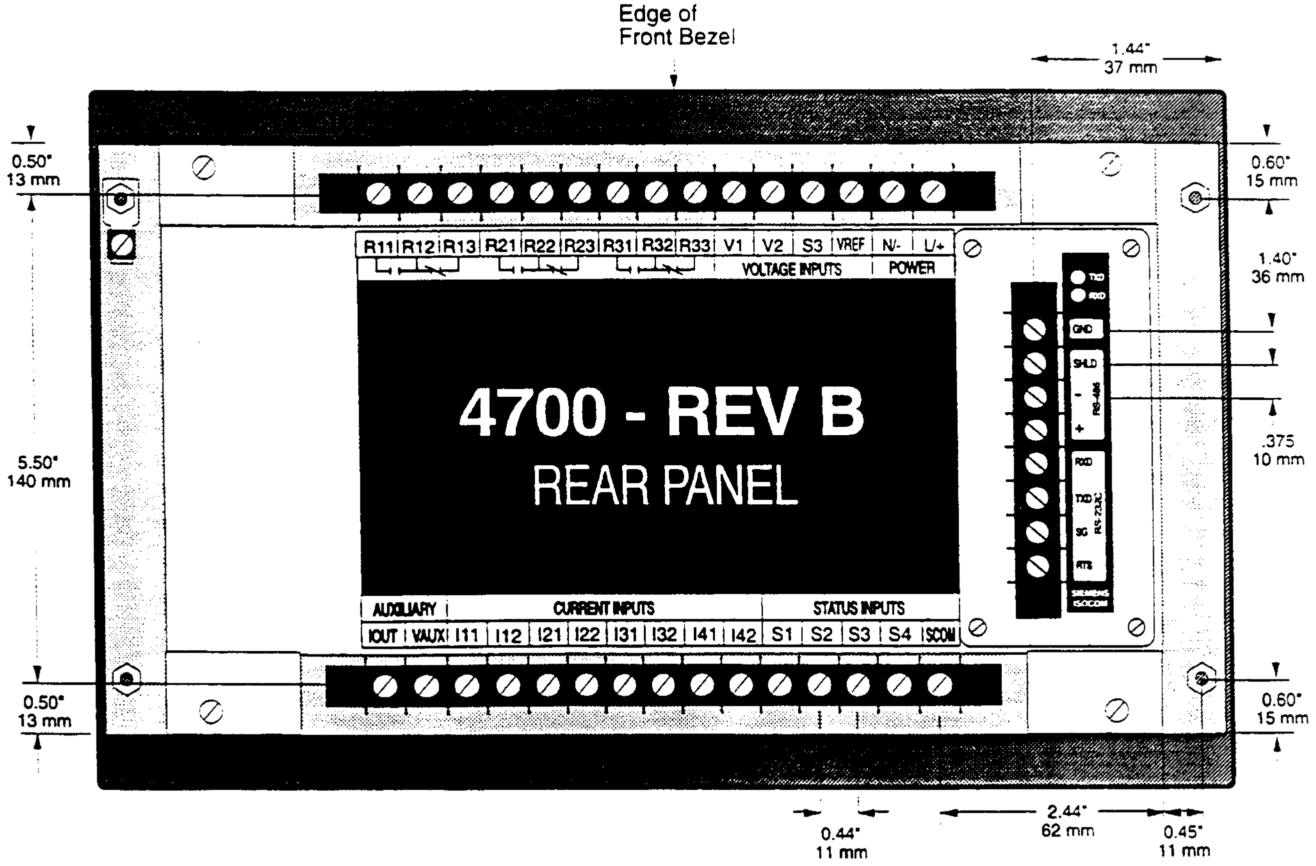
d) Status input terminals have been repositioned. SCOM terminal has been added as the common for all status inputs.

Refer to Figure 1 for an illustration of the new REV B terminal strip layout.

ISOCOM COMMUNICATIONS CARD

A new communications interface card has also been introduced for the 4700. The ISOCOM card provides the same RS-232C or RS-485 communications capability as the previous C01 card with extended opto-isolation protection. Two communications activity LED indicators and an SG (signal ground) terminal have also been added. The ISOCOM card terminal block position relative to the 4700 chassis has been moved slightly (see Figure 1).

Figure 1 4700 REV B Rear Terminal Block Dimensions and Functions



2. Installation for REV B

DANGER

During normal operation of this device hazardous voltages are present which can cause severe injury or death. These voltages are present on the terminal strips of the device and throughout the connected potential transformer (PT), current transformer (CT), status input, relay, and control power circuits. Installation and servicing should be performed only by qualified, properly trained personnel.

2.1 General Mounting and Wiring Considerations

Location, mounting, wiring, and power supply considerations for the REV B version of the 4700 are the same as for the REV A version. Refer to the enclosed manual.

2.2 Chassis Ground Connection

The chassis of the 4700 REV B must be connected to earth ground. A good, low impedance chassis ground is essential for the 4700 surge and transient protection circuitry to function effectively. Do not rely on metal door hinges as a ground path.

Ground wire connection to the chassis of a standard 4700 (with display) can be made using the supplied ground lug attached to one of the four mounting studs.

For the 4700 model without display, ground wire connection can be made to the supplied ground lug attached to one of the four bolts which are used to secure the device.

In both cases, ensure that the ground lug screw has been tightened down securely onto the ground wire, and that the nut has been tightened down securely onto the lug.

CAUTION

The 4700 chassis ground lug must be connected to the switchgear earth ground using a dedicated 14 gauge (or larger) wire in order for the noise and surge protection circuitry to function correctly. Failure to do so will void the warranty.

2.3 Phase Voltage and Phase Current Input Connections

PT AND CT CONSIDERATIONS

PT and CT selection considerations for the REV B version of the 4700 are the same as for the REV A version. Refer to the enclosed manual.

All phase voltage sense leads should be protected by breakers or fuses at their source. In cases where PTs are required, if the power rating of the PTs is over 25 Watts the secondaries should be fused.

CTs should be connected to the device via a shorting block or test block to facilitate the safe connection and disconnection of the CTs.

Questions regarding proper working procedures should be referred to qualified personnel.

VOLTAGE REFERENCE CONNECTION

The voltage reference terminal, VREF, of the 4700 REV B serves as the zero voltage reference for voltage readings. A good, low impedance VREF connection is essential for accurate measurement. It should be made using a dedicated 14 gauge wire to a point where there will be no voltage error due to distribution voltage drops.

The connection point for VREF is dependent on the system configuration. Each of the following configurations is illustrated in Figures 2 to 8:

a) If the system being monitored is 4-wire Wye or Single Phase, VREF must be connected to the neutral conductor.

b) If the system is 3-wire grounded (Delta), VREF must be connected to the line transformer neutral.

c) For 3-wire ungrounded (Open Delta) systems, and for systems where PTs are being used, VREF must be connected to the PT common leads.

WAVEFORM CAPTURE CONNECTIONS

The 4700 waveform capture feature allows signals at each of its voltage (V1, V2, V3, Vaux) inputs and current (I1, I2, I3, I4) inputs to be digitally sampled. The 4700 uses the V1 input as the triggering reference for waveform capture, and to maintain phase relationships between all sampled signals. The V1 input must be connected for waveform capture to work. No other special wiring considerations are necessary. Waveform capture is accessible only via communications. See Section 3.3 of this addendum for more information on waveform capture operation.

I4 CURRENT INPUT CONNECTIONS

The 4700 is equipped with a fourth current input, named I4. This input is typically used to measure the current flow in the neutral or ground conductor. The use of this input is optional. If not used, the I41 and I42 terminal should be connected to earth ground.

The secondary rating of the CT connected to the I4 input must be identical to that of the three phase current inputs. This rating depends on the current input option installed in the 4700 .

The primary rating for the CT connected to the I4 input can be different than for the three phase inputs, since the I4 input scaling can be programmed independently.

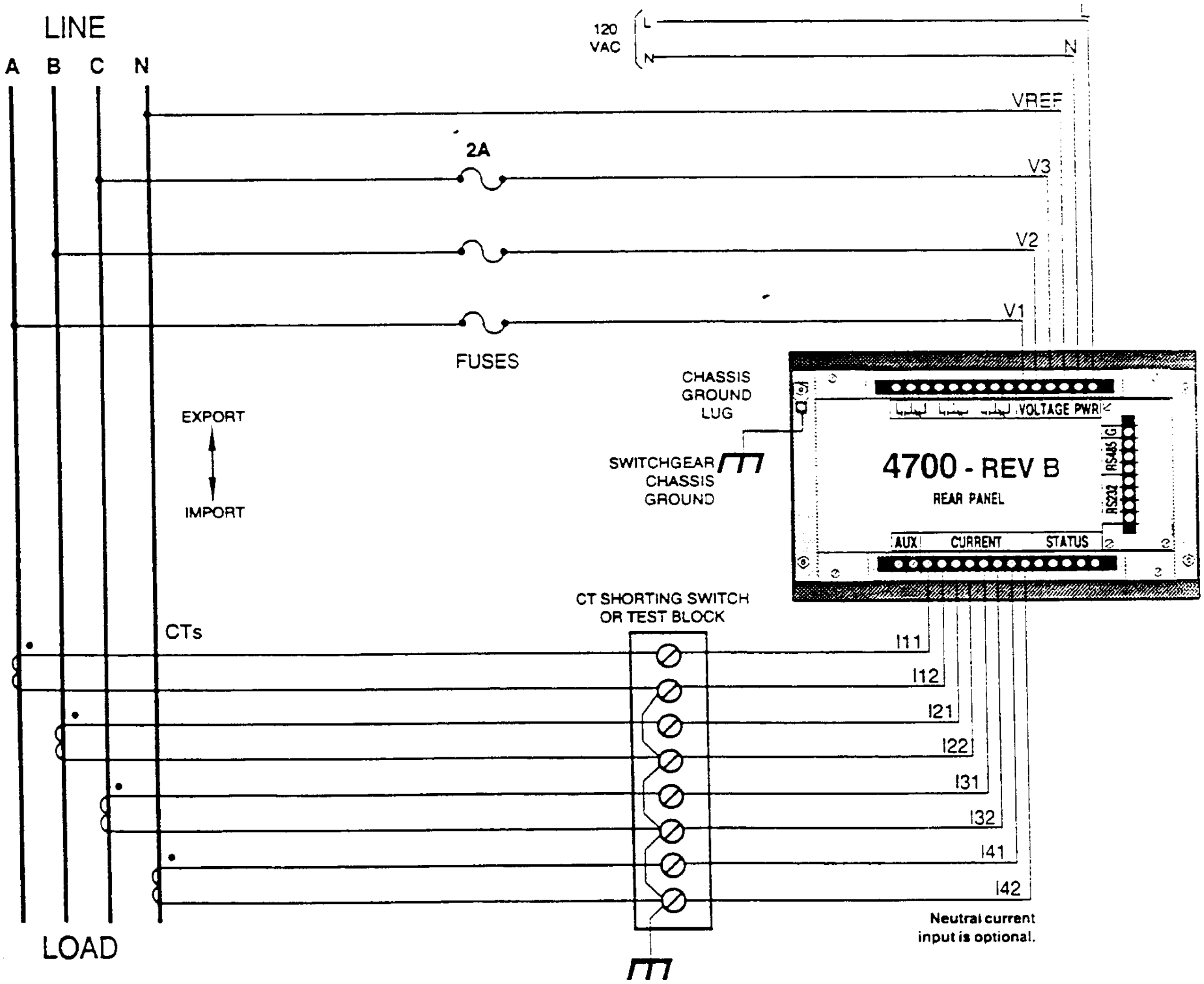
CONNECTION FOR 3 PHASE WYE (STAR) SYSTEMS

For a 4 wire Wye system, the 4700 senses the line to neutral (or ground) voltage of each phase and current of each phase, making for an equivalent 3 element metering configuration.

If the power system to be monitored is a 120/208 Volt system, the standard 120 VAC input model can be used with direct sensing of each phase, without the need for PTs. If the system is a 277/480 or 347/600 Volt system, models with the 277 VAC or 347 VAC input models (respectively) may be connected directly.

The wiring diagram for these voltage ranges is shown in Figure 2 below. Set VOLTS MODE to 4W-WYE.

Figure 2 4 Wire Wye: 3 Element Direct Connection

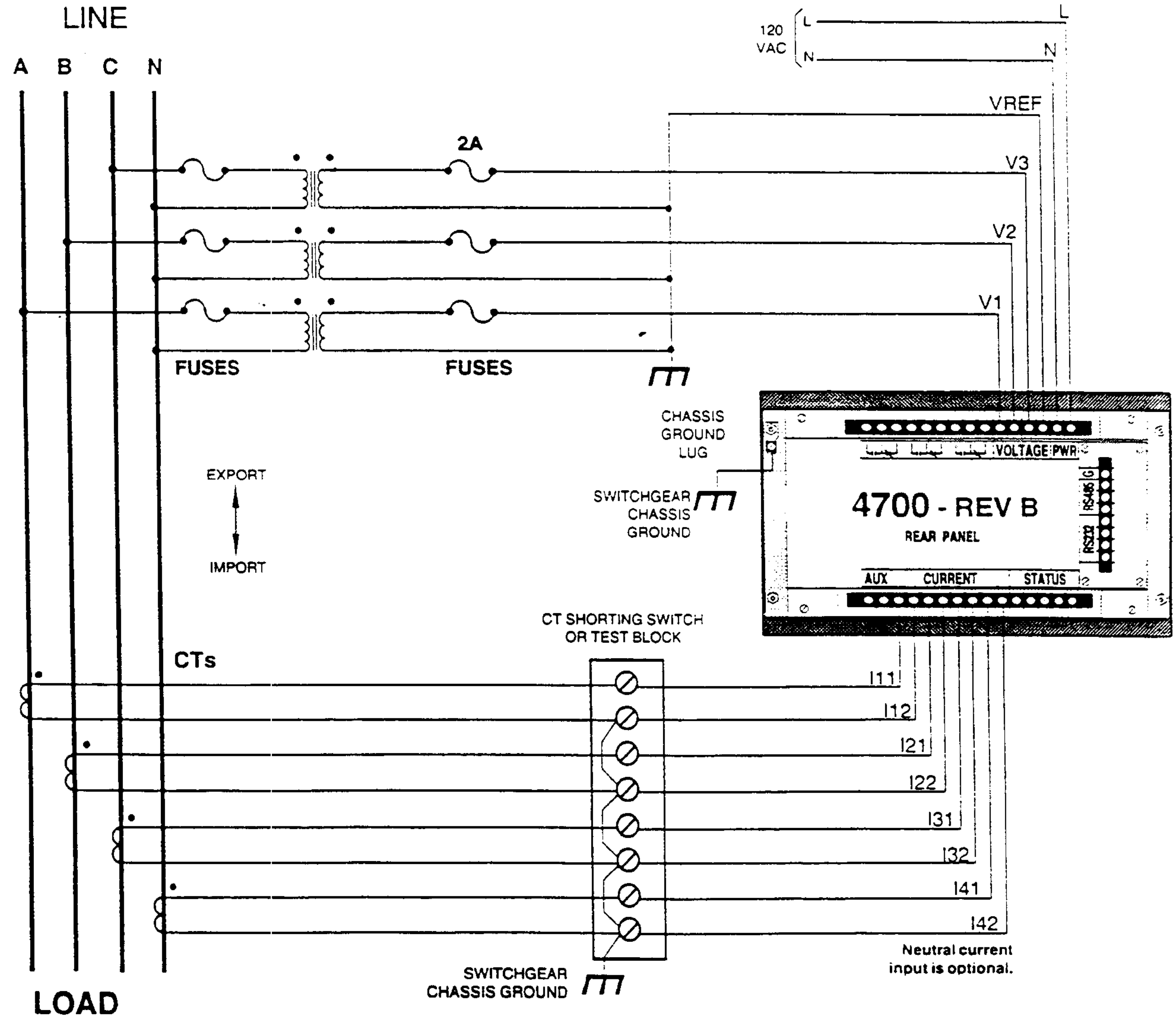


VOLTS MODE:	INPUT OPTION:		
4W-WYE	120/208 V	Systems:	Standard Model
	277/480 V	Systems:	277 VAC Model
	347/600 V	Systems:	347 VAC Model

For Wye system voltages over 347/600 Volts, PTs must be used. When PTs are used, both the PT primary and secondary must be wired in a Wye (Star). Wiring must be exactly as shown for correct operation.

This configuration is shown in Figure 3 below. VOLTS MODE should be set to 4W-WYE.

Figure 3 4 Wire Wye: 3 Element Using 3 PTs



VOLTS MODE:	INPUT OPTION:
4W-WYE	Standard (120V) Model

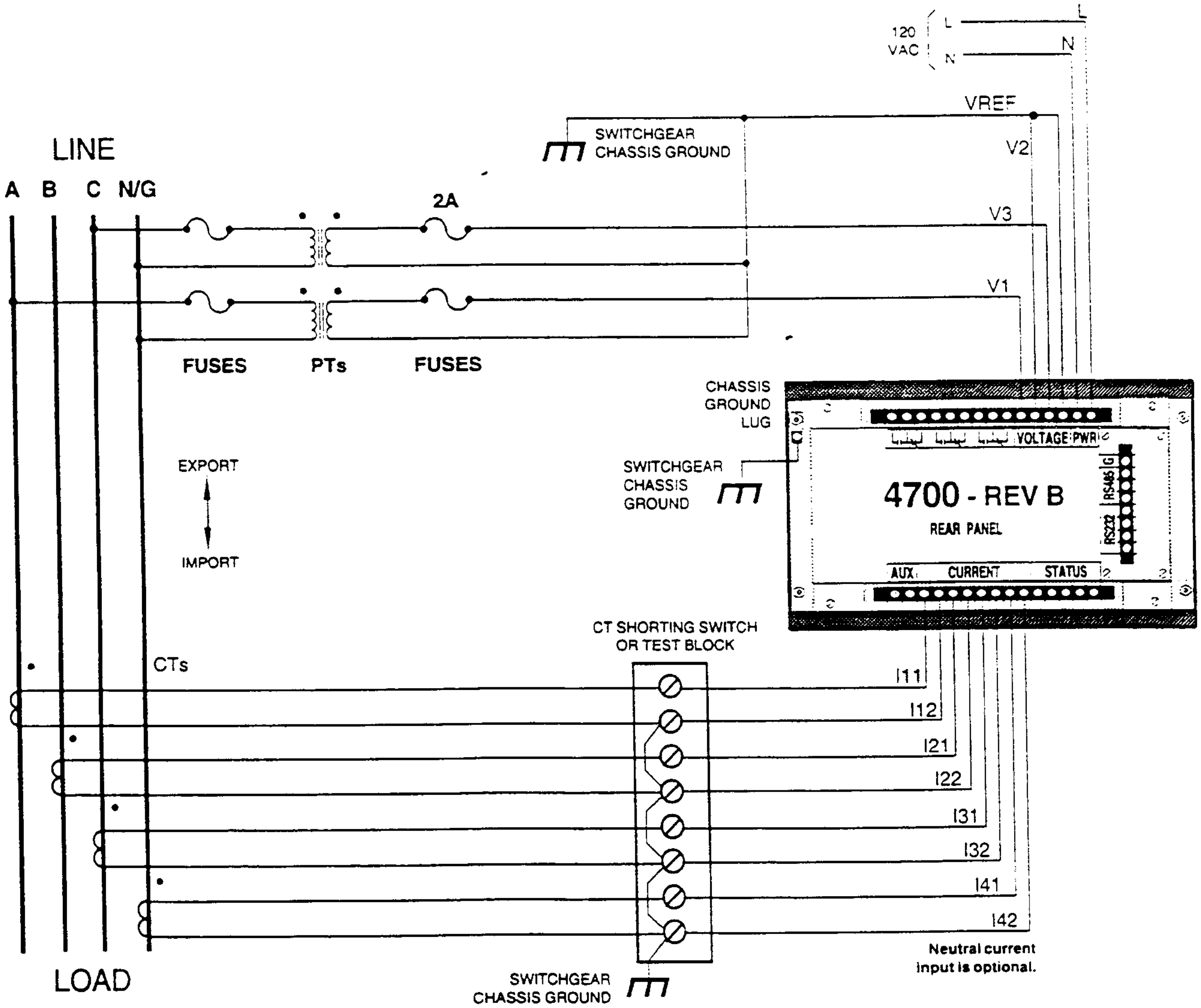
The 4700 also supports a 2½-element connection scheme which requires only two PTs. In this mode, the phase B voltage displayed on the front panel is derived from the available voltages.

This configuration is shown in Figure 4. VOLTS MODE should be set to 3W-WYE.

WARNING

VOLTS MODE=3W-WYE will only provide accurate power measurement if the voltages are balanced. If the phase B voltage is not equal to the phase A and C voltages, the power readings may not meet the 4700 accuracy specifications.

Figure 4 4 Wire Wye: 2½ Element Using 2 PTs



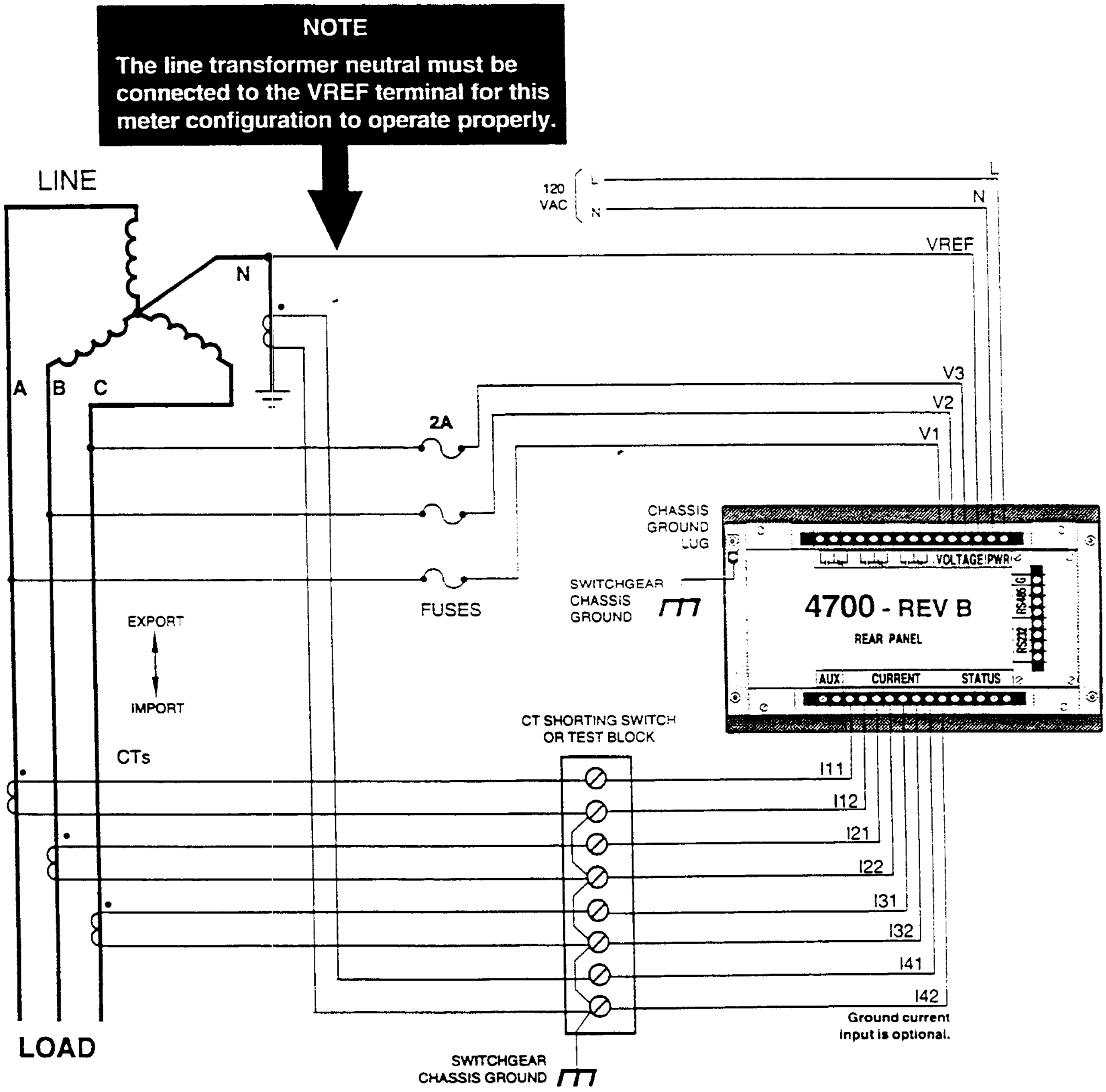
Neutral current input is optional.

VOLTS MODE:	**INPUT OPTION:**
3W-WYE	Standard (120V) Model

When the Star point of a 3 wire Wye system is grounded, the 4700 may be connected directly without the use of PTs (provided the voltages are within the input range of the unit).

This configuration is shown in Figure 5. The VOLTS MODE should be set to 4W-WYE.

Figure 5 3 Wire Grounded Wye: 3 Element Direct Connection



NOTE

The line transformer neutral must be connected to the VREF terminal for this meter configuration to operate properly.

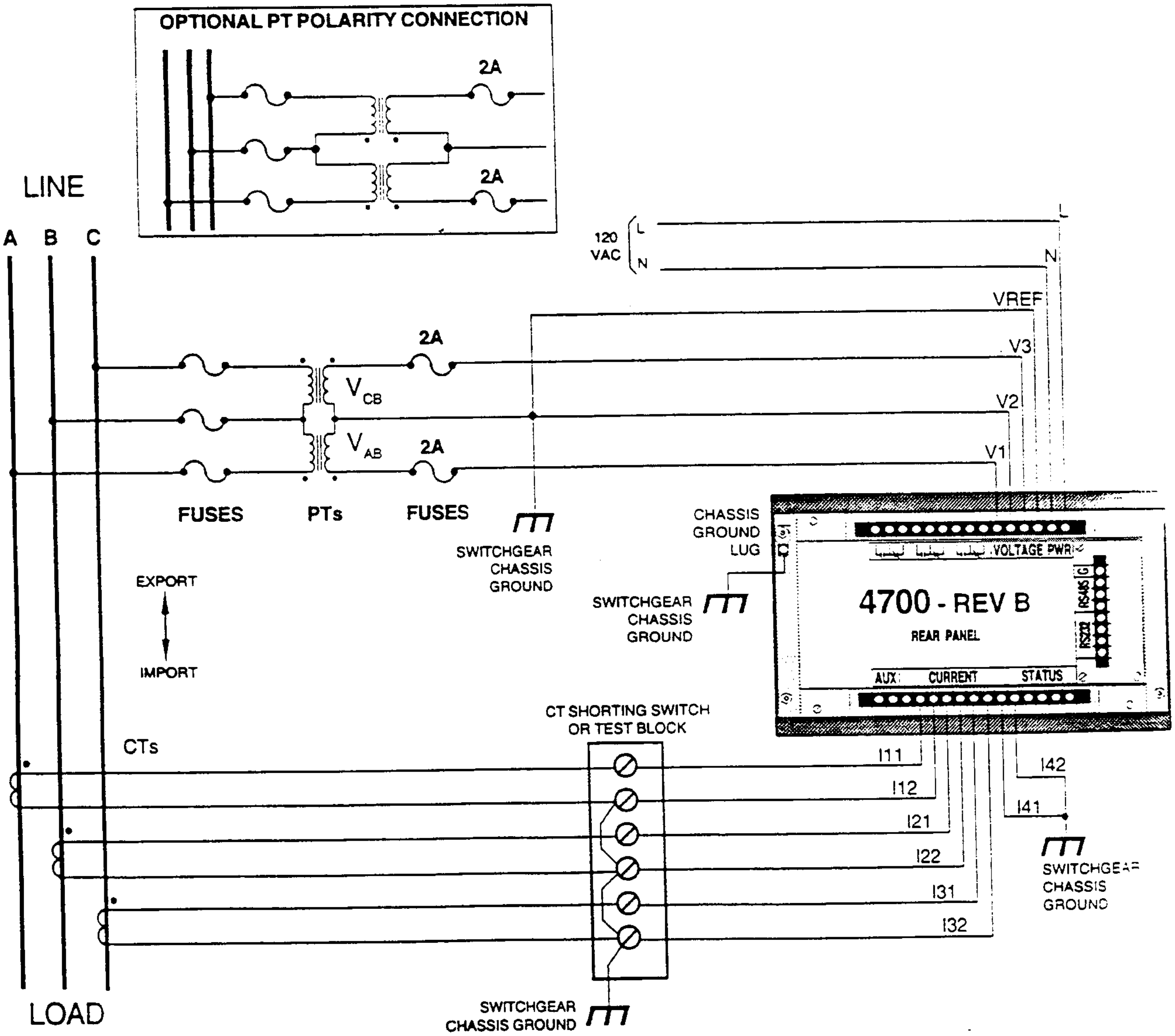
VOLTS MODE:	**INPUT OPTION:**
4W-WYE	Standard (120V) Model

CONNECTION FOR 3 PHASE DELTA SYSTEMS

For ungrounded (floating) 3 wire Delta systems, the 4700 always requires PTs and senses the L-L voltages between each of the phases.

The 4700 may be connected in either of two ways: using 2 or 3 CTs. Figure 6 below shows ungrounded Delta connection using 3 CTs. VOLTS MODE should be set to DELTA.

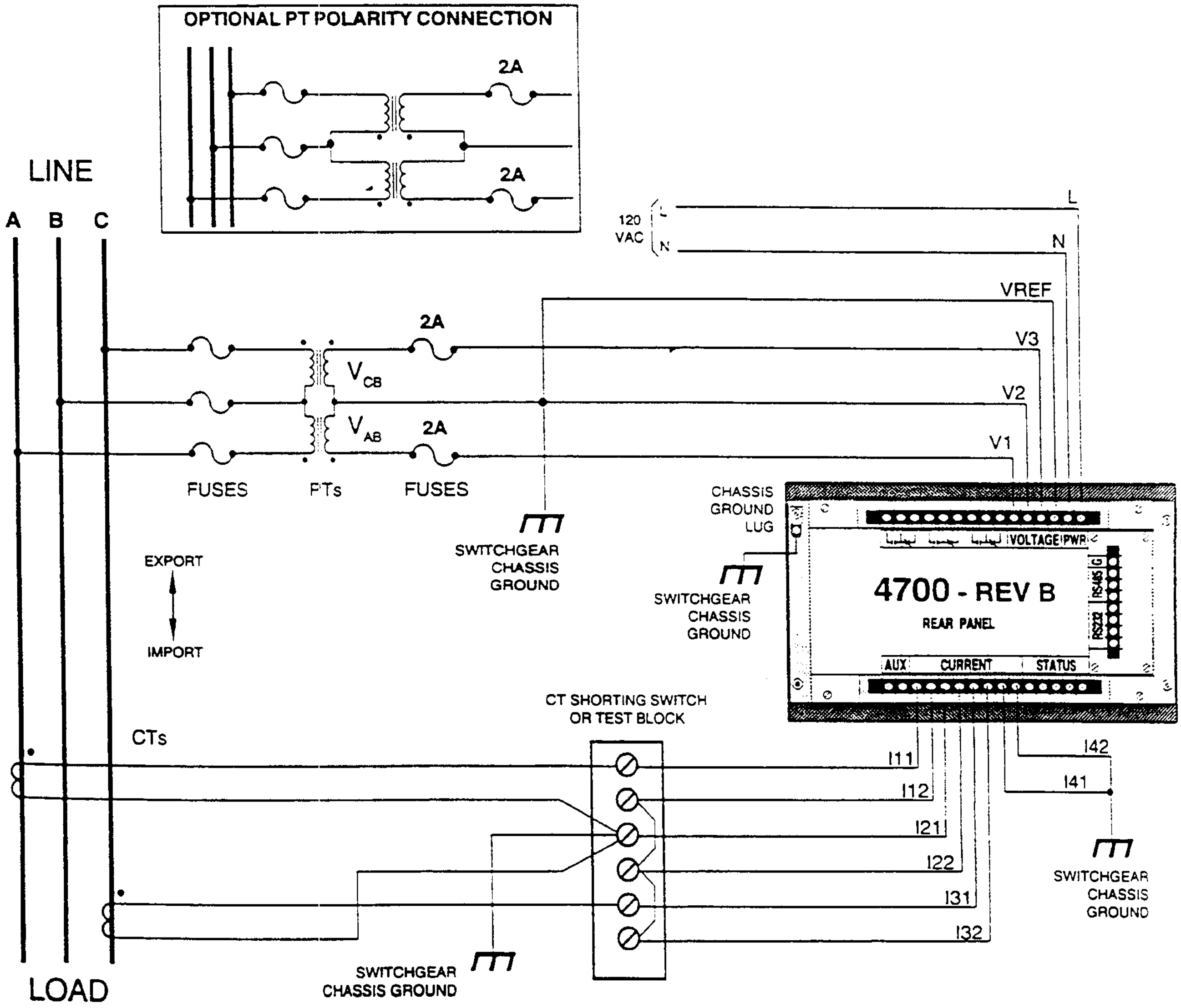
Figure 6 3 Wire Delta: 2½ Element Connection Using 2 PTs & 3 CTs



VOLTS MODE:	**INPUT OPTION:**
DELTA	Standard (120V) Model

Figure 7 below shows ungrounded Delta connection using 2 CTs. VOLTS MODE should be set to DELTA.

Figure 7 3 Wire Delta: 2 Element Connection Using 2 PTs & 2 CTs

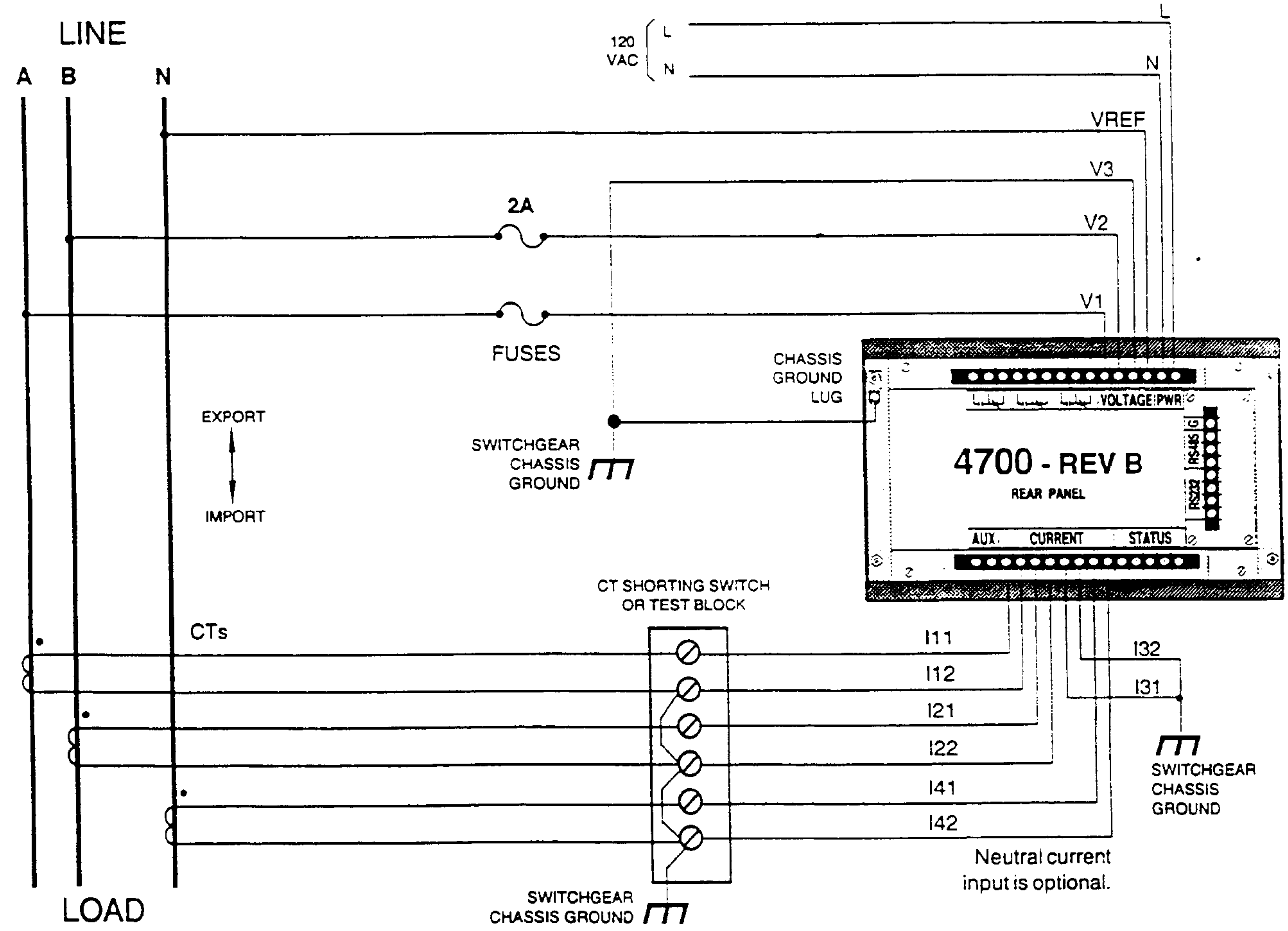


VOLTS MODE:	**INPUT OPTION:**
DELTA	Standard (120V) Model

CONNECTION FOR SINGLE PHASE SYSTEMS

Wiring for Single Phase systems is performed by connecting the two voltage phases (each 180 degrees with respect to each other) to the V_1 and V_2 inputs of the 4700, and the outputs of the two corresponding current transformers to the I1 input pair and I2 input pair. This is illustrated in Figure 8 below. Note that the V3 input and I3 input pair are unused and should all be grounded. For Single Phase systems, the VOLT MODE of the 4700 should be set to SINGLE.

Figure 8 3 Wire Single Phase: 2 Element Direct Connection



VOLTS MODE:	INPUT OPTION:		
SINGLE	120/208 V	Systems:	Standard Model
	277/480 V	Systems:	277 VAC Model
	347/600 V	Systems:	347 VAC Model

2.4 Communications Connections

Introduction

The communications option of the 4700 provides an ISOCOM communications card. The communications card allows the 4700 to communicate using either the RS-232C or RS-485 standards. The ISOCOM provides full isolation for both RS-232C and RS-485. Optical coupling provides isolation between the communications lines and the metering equipment. Protection circuitry provides protection from common mode voltages and incorrect connection of the ISOCOM. All inputs pass the ANSI/IEEE C37-90A-1989 surge withstand and fast transient tests.

The following sections describe configuration instructions and wiring requirements for direct connection with a master computer station. Refer to the manual for information regarding communications setup parameters and remote connections made via modem.

IMPORTANT

The communications card is shipped with a label affixed to the mounting plate indicating the communications mode (RS-485 or RS-232C) set at the factory. If the mode is incorrect for your application, see the following section.

Configuration of the ISOCOM

This section explains the procedure for changing the *Comm. Mode.* The card has a jumper block to allow the user to select RS-232C or RS-485 mode. The currently selected communications mode may be viewed from the front panel, if the unit is operating, (see manual for instructions on Field Programming), or by removing the card and examining the position of the jumper block.

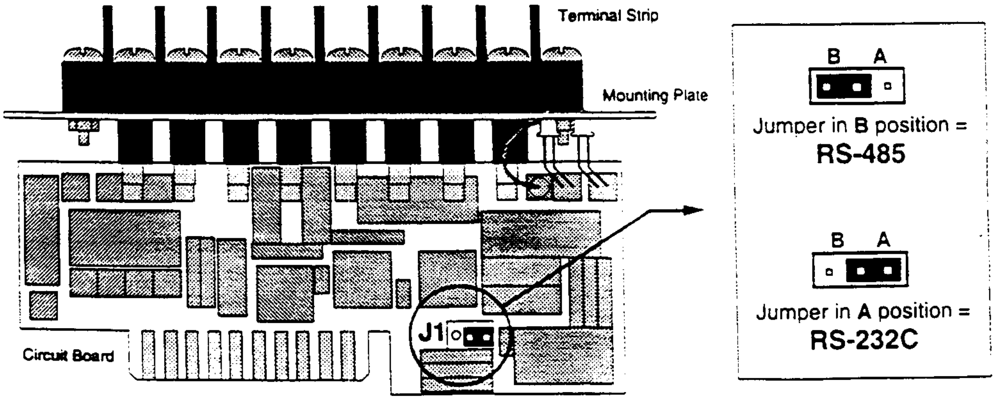
REMOVING AND REINSTALLING THE CARD

Refer to the manual for instructions on these procedures.

CONFIGURING THE CARD

The circuit board of the communications card has a jumper labelled J1. This jumper has two positions, labelled "A" and "B", which determine the communications mode. Figure 9 illustrates the jumper position required for RS-485 or RS-232C mode. Move the jumper to the correct position.

Figure 9 ISOCOM Card Jumper Configuration



NOTE

Jumper block labelling for the ISOCOM communications card is opposite to that of the previously used C01 type communications card. However, the left-right orientation of the jumper for each comm. mode remains the same (ie. RS-485 mode = left position, etc.).

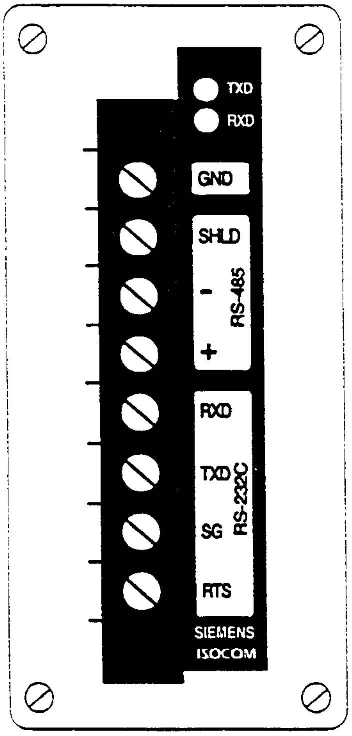
ISOCOM Terminal and LED Indicator Functions

The ISOCOM communications card provides a barrier-style terminal strip. Terminal functions include:

Ground	GND	Chassis Ground
RS-485	SHLD	RS-485 Shield (electrically connected to chassis ground)
	-	RS-485 Data Minus
	+	RS-485 Data Plus
RS-232C	RXD	RS-232C Receive Data (ie. data into device)
	TXD	RS-232C Transmit Data (ie. data out of device)
	SG	RS-232C Signal Ground
	RTS	RS-232C Request To Send (optional, see Section 3.5)

Two LED indicators, TXD and RXD, show activity on the RS-485 or RS-232C communications lines and can be used to verify correct communications operation. The TXD indicator will flash when data is being sent out by the device. The RXD indicator will flash when data is being received by the device.

Figure 10 ISOCOM Terminal Block



RS-232C Connections

Figure 11 illustrates the wiring connection requirements for RS-232C communications. The RS-232C standard allows only one device to exist on the communications connection.

The RS-232C cable is a custom cable with a 25 pin DB25 or 9 pin DB9 with a plug (male) or socket (female) connector at one end, depending on the mating connector at the computer serial port. Cable length is 50 feet (15.2 m) maximum. Figure 13 illustrates RS-232C cable wiring connections.

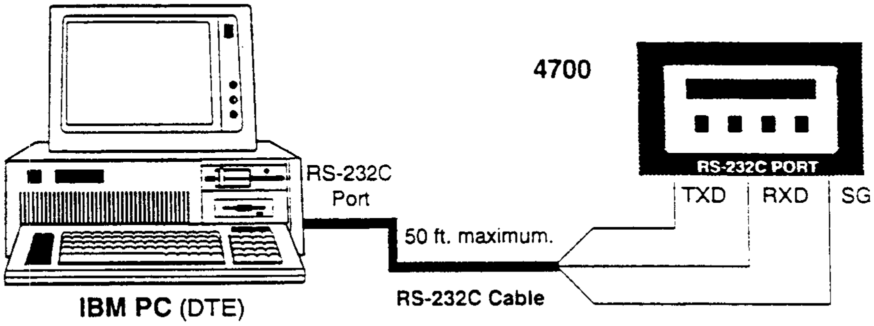
If connected directly to an IBM PC RS-232C port, the Tx and Rx leads may need to be reversed at the remote device, depending on whether the PC RS-232C port is configured as DCE or DTE.

RS-485 Connections

Figure 12 illustrates the wiring connection requirements for RS-485 communications. RS-485 allows up to 32 devices to exist on the communications connection.

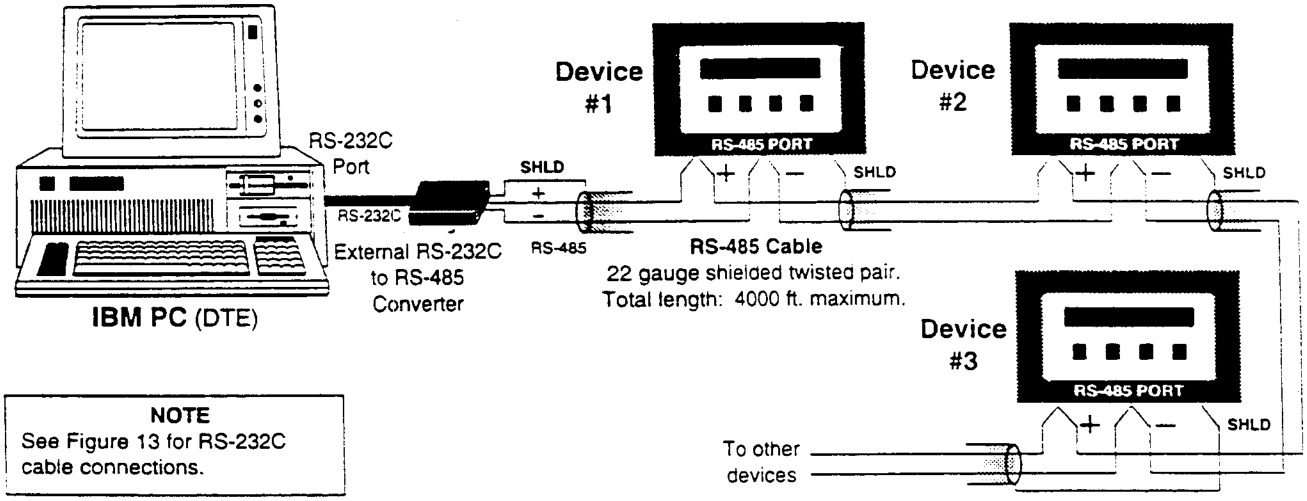
The RS-485 cable is a 22 AWG (0.6 mm diameter) shielded twisted pair. Overall length cannot exceed 4000 feet (1219 m). The RS-485 cable shields must each be grounded at one end only.

Figure 11 RS-232C Communications Connections



NOTE
See Figure 13 for RS-232C cable connections.

Figure 12 RS-485 Communications Connections



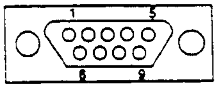
NOTE
See Figure 13 for RS-232C cable connections.

Figure 13 RS-232C Cable Wiring Specifications

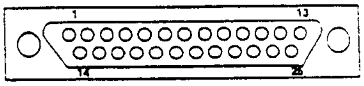
Connector Pinouts

Pin No.	Computer (DTE)	Converter
1	RLSD	RLSD
2	RX	TX
3	TX	RX
4	DTR	DTR
5	Ground	Ground
6	DSR	DSR
7	RTS	RTS
8	CTS	CTS
9	RI	RI
1	Ground	Ground
2	TX	RX
3	RX	TX
4	RTS	RTS
5	CTS	CTS
6	DSR	DSR
7	Ground	Ground
8	RLSD	RLSD
20	DTR	DTR
22	RI	RI

DB9 Type



DB25 Type



Cable Wiring

Computer	Converter
TX	RX
RX	TX
Ground	Ground
RTS	RTS
CTS	CTS
DSR	DSR
DTR	DTR
RLSD	RLSD

Computer	Remote Device[1] RS-232C Port
TX	RX
RX	TX
Ground	SG[2]
RTS	
CTS	
DSR	
DTR	

[1] Compatible Siemens products.

[2] SG on ISOCOM. GND on CO1.

2.5 Status Input Connections

INTRODUCTION

This section illustrates a number of possible wiring connection methods and applications for the status inputs.

The 4700 (REV B) uses a current sensing technique to monitor the status of an external dry contact, or the presence of an external voltage.

DRY (VOLTS FREE) CONTACT SENSING

Dry contact sensing is performed using external excitation as illustrated in Figure 14. External excitation is provided via the SCOM terminal. A 20 to 277 VAC/VDC external power source is required. Various options include:

a) an auxiliary 24 VDC power supply.

b) a 24 to 277 VAC transformer with fused output.

c) direct 120 VAC or 240 VAC fused power.

Figure 14 Status Input Connections for Dry Contact Sensing

NOTE

CONTACTS OPEN = INACTIVE
CONTACTS CLOSED = ACTIVE

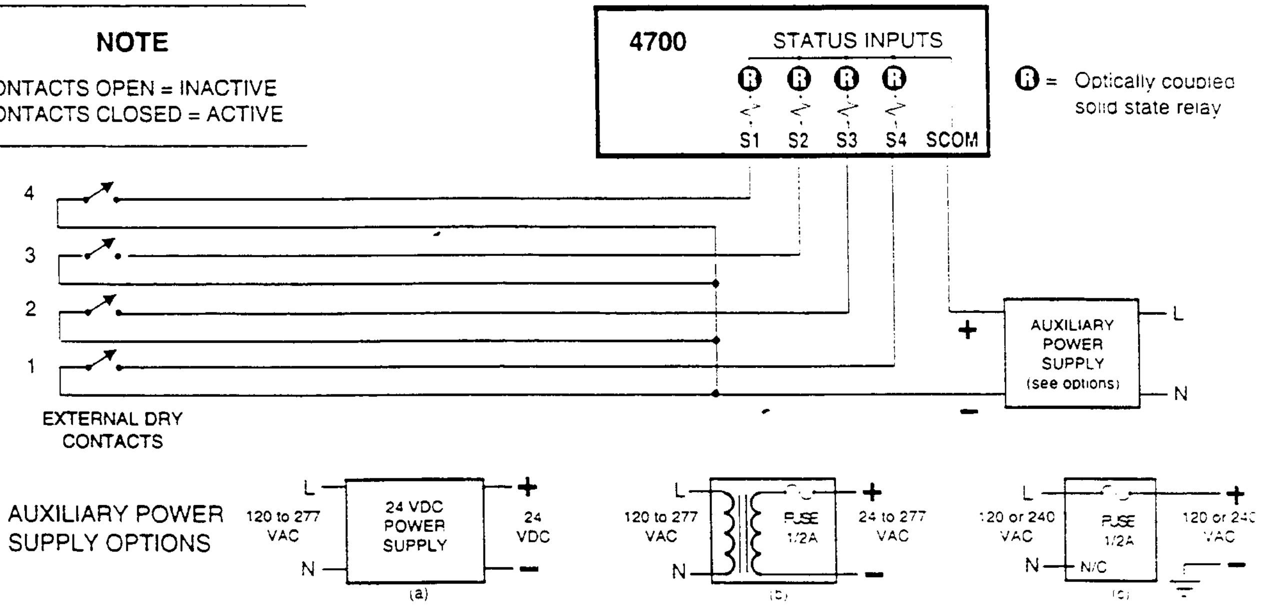
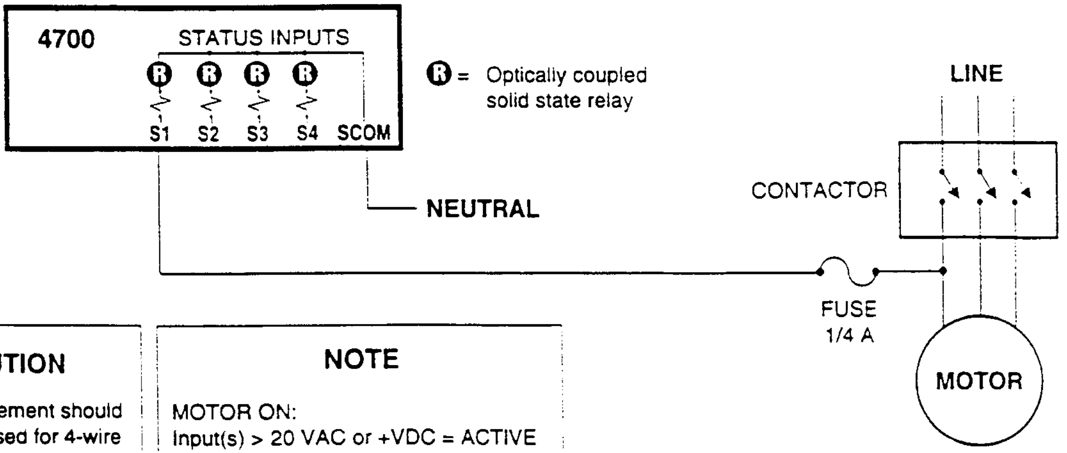


Figure 15 Status Input Connections for Voltage Sensing



CAUTION

This arrangement should ONLY be used for 4-wire Wye systems operating at 277/480 Volts or less.

NOTE

MOTOR ON:
Input(s) > 20 VAC or +VDC = ACTIVE

MOTOR OFF:
Input(s) < 6 VAC or +VDC = INACTIVE

CAUTIONS

1. For this application the SCOM terminal MUST be connected to a suitable supply voltage. Do not leave the SCOM terminal floating.
2. Up to 277 V could normally be present at the S1 to S4 terminals, depending on the external supply voltage.

When the external contact is open, there will be no current flow and the status input will register as INACTIVE. When the external contact closes, the current flow via the external supply will cause the status input to register as ACTIVE.

VOLTAGE SENSING

Status inputs can be used to sense the presence or absence of voltage on a power feeder. This can be used to monitor whether a piece of equipment, such as a motor, is energized (see Figure 15).

CAUTIONS

1. For this application the SCOM terminal must be connected to ground. Do not leave the SCOM terminal floating.
2. Up to 277 V could normally be present at the S1 to S4 terminals, depending on the external voltage being sensed.

When the motor is on, there will be voltage at the sense point, and the status input will register as ACTIVE. When the motor is off, there will be no voltage at the sense point, and the status input will register as INACTIVE.

3 New Features with Firmware 2.3.0.4

3.1 New Setpoint Parameters

Two new setpoint trigger parameters have been provided:

OVER kVAR FWD	Over forward (imported) reactive power
OVER kVAR REV	Over reverse (exported) reactive power

These replace the OVER kVAR trigger parameter which represented kVAR Total (absolute value).

3.2 Relay Pulse Mode

Each of the three relays can now be assigned to setpoint operation in *latch* or *pulse* mode, or to kWH pulsing or kVARH pulsing.

ACCESS TO RELAY PARAMETERS

The new RELAY OPERATION? parameter is used to gain access to the relay parameters. Selecting a value of 0 (zero) will skip over all relay parameters when PARAMETER SELECT is pressed. This parameter is also used to select which relay is to be programmed. Selecting 1, 2, or 3 will gain access to the programmable parameters for the selected relay.

SETPOINT RELAY OPERATION

For setpoint operation, the relays can provide latched or pulsed operation. In latch mode, the relay will be operated (ie. normally open contacts are closed) for the duration that the assigned setpoint is active. In pulsed mode, when the setpoint becomes active the relay will operate for a specified pulse duration.

Set Rx MODE to SETPOINT for setpoint operation. Set Rx VALUE to select latch mode (Rx VALUE = 0), or to set the pulse duration for pulse mode operation (in seconds).

CAUTION

While the user is programming from the front panel or via communications, no setpoint-controlled relay operation will occur until after the user has exited the programming mode. The meter will then assess the status of each setpoint and perform any required operations.

KWH OR KVARH PULSE OPERATION

When a relay is configured for kWH or kVARH pulsing, the pulses are based on the total energy imported (forward) and exported (reverse). Set Rx MODE to kWH PULSE or kVARH PULSE. In these modes, Rx HRS/PULSE is used set the number of unit-hours between pulses.

> **NOTE**
>
> A relay configured for kWH or kVARH pulsing will not respond to an assigned setpoint that becomes active.

MANUAL FORCED RELAY OPERATIONS

Only a setpoint relay (Rx MODE = SETPOINT) may be forced operated or released using commands made via communications. Manual commands override any current setpoint condition.

If the relay is operating in *pulse* mode (Rx VALUE > 0), a forced operate command will initiate a pulse of length equivalent to the value set by the Rx VALUE parameter for that relay. This operation is logged in the event log and indicates that the relay was pulsed. A forced release command has no effect.

If the relay is operating in *latch* mode (Rx VALUE = 0), it behaves normally for forced operate, forced release, and return to normal (return to setpoint control) commands.

See below for manual relay control special cases.

RELAY EVENT LOGGING

For a relay assigned to setpoint operation (Rx MODE = SETPOINT), the event log will log relay operations in one of two ways, depending on whether the relay has been set to operate in latch or pulse mode.

a) Latch mode (Rx VALUE = 0): The event log will record that the relay was operated (ON) when the setpoint becomes active and released (OFF) when the setpoint returns to an inactive state.

b) Pulse mode (Rx VALUE > 0): The event log will show that the relay is pulsed when the setpoint becomes active. When the setpoint returns to its inactive state, the setpoint event is logged, but does not indicate the relay, since no pulse is generated.

If the relay is assigned to kWH or kVAH pulsing, no relay operations are logged.

Manual forced relay command will be logged in the event log; however special cases exist which are described below.

MANUAL RELAY COMMAND SPECIAL CASES

If a manual *forced operate* command for a selected relay is received while that relay is currently in a forced operated state, the relay command will be ignored, and will not be logged. This also holds true for a forced release command to a relay already in a forced released state. Manual relay commands made to relays which are in a KWH or KVARH pulse mode will also not be logged.

3.3 Waveform Capture

New digital waveform capture capabilities can be used for detailed power quality analysis. Waveform recording can assist in analyzing short duration events such as faults, surges, etc.

Waveform capture allows the user to perform high-speed sampling of the V1, V2, V3, Vaux, I1, I2, I3, or I4 (neutral current) inputs. One full cycle of the signal at a *single* selected input is sampled at a rate of 128 samples per cycle. All samples are taken synchronous to the line frequency and within one input cycle.

Sampled waveform data is stored in on-board memory and can be read via the communications port. The high sampling rate used produces high-resolution data which allows analysis of frequency components to the 63rd harmonic.

Captured waveform data can be uploaded to a master computer station to display the waveforms on the computer screen and to perform Fast Fourier Transforms on each waveform to provide an indication of total harmonic distortion and a breakdown of individual frequency components.

The computer operator must manually initiate capture of individual selected 4700 inputs from the master station. A command from the computer causes capture to be immediately initiated at the 4700. The computer then uploads the waveform data. Waveform capture is re-armed automatically when the current data in the 4700 on-board waveform memory is read via communications.

3.4 Programmable Display Format

The front panel display can now present numeric information and phase labels in a number of different formats which reflect various world standards.

The FORMAT parameter allows the user to select formats for numeric information and for phase labels. This parameter is displayed in the following way:

FORMAT= ABC 1,234.5

The three letters indicate the format used for the phase labels. The possible values are ABC (default), XYZ, RBY and RST. The number indicates the format for display numbers. The possible values are:

a) A comma for the thousands delimiter (radix) and a decimal point for the decimal delimiter. Example: 1,234.5 This is the default.

b) No thousands delimiter and a comma for the decimal delimiter. Example: 1234,5

The CURSOR key cycles between the phase label parameter and display number parameter. The INCREMENT or DECREMENT keys are used to select the option for that parameter.

3.5 RTS Operation

If RS-232C communications are being used, a new RTS ACTIVE LVL parameter can be used to set the logic level of the RTS line when it is asserted by the 4700 during transmission.

3.6 19.2 Kbaud Operation

4700 communications now supports 19.2 Kbaud operation. This applies to both RS-232C and RS-485 standards.

3.7 Volts Mode and Iout Key Labels

The numeric codes used for VOLTS MODE options and IOUT KEY options have now been replaced with descriptive labels.

The options for VOLTS MODE are now displayed as:

4W-WYE, DELTA, SINGLE, DEMO

The new option labels for IOUT KEY are listed in Figure 16.

Figure 16 IOUT KEY Parameter Options

IOUT KEY	MEASURED PARAMETER
VOLTAGE A	Voltage, Phase A (or Vab for Delta)
VOLTAGE B	Voltage, Phase B (or Vca for Delta)
VOLTAGE C	Voltage, Phase C (or Vbc for Delta)
CURRENT A	Current, Phase A
CURRENT B	Current, Phase B
CURRENT C	Current, Phase C
kW A	kW, Phase A
kW B	kW, Phase B
kW C	kW, Phase C
kVA A	kVA, Phase A
kVA B	kVA, Phase B
kVA C	kVA, Phase C
kVAR A	kVAR, Phase A
kVAR B	kVAR, Phase B
KVAR C	kVAR, Phase C
VOLTAGE AV	Voltage, average
CURRENT AV	Current, average
kW TOTAL	kW, total
kVA TOTAL	kVA, total
kVAR TOTAL	kVAR, total
PF	Power Factor, total
kWD	kW Demand, total
AMPD	Amps Demand, total
FREQUENCY	Frequency
VAUX	V_{aux}
CURRENT I4	I_4 (neutral or ground current)

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SIEMENS

4700 Power Meter

Operator's Manual

Manual No. SG-6018-01

DANGER

Hazardous voltages are present in the equipment that will cause severe personal injury and equipment damage. Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which can cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

NOTE

Authorized and qualified personnel—

For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

(a) is trained and authorized to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

(c) is trained in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office, listed on back of this instruction guide.

The contents of this instruction manual should not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between the parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Table of Contents

1. Introduction

1.1 About the 4700 Power Meter

The 4700 power meter is a microprocessor-based instrumentation package for low, medium or high voltage electrical equipment and substations. It is a state-of-the-art alternative to traditional analog electromechanical metering devices. The unit is economical and is easy to install and operate. It requires no external transducers.

This manual supersedes all previous publication versions on the installation and operation of the 4700 power meter.

1.2 Performance Features

The 4700 power meter offers major improvements in accuracy, communications capability, data logging, control capability, ease of use, and cost, compared to traditional analog components or first generation digital metering systems. The 4700 power meter operates as a stand-alone switchboard, switchgear, motor control center or substation instrument, and serves as a data collection point for Siemens ACCESS™ electrical distribution communication system.

The unit uses a 12 MHz, 16-bit microcontroller chip. This provides very high computational throughput, allowing the sophisticated software to process information in real time. The unit is self-contained and its readings and setup parameters are maintained in nonvolatile memory. Connections to the 4700 power meter are on the rear of the unit, as shown in Figure 1-1.

1.3 Measurement Functions and Displays

You can view readings from the alphanumeric display. Readings are displayed in the following format:

- 4-digit voltage display phase indication
- 4-digit amperage display
- 8-digit power function display

The unit can be configured to operate in Wye (Star), Delta, or single-phase voltage modes. The following measurements are available:

- Current on each phase
- A fourth current input (I4)
- Line-to-line voltages
- Frequency
- Power factor
- KVA
- KW
- KVAR
- KW Demand
- V_{aux} (auxiliary voltage input)
- Total MWhr
- Total MVARhr

Minimum and maximum values for each of the readings are available. You can also set the unit to take snapshots of all readings at specified intervals and maintain them in nonvolatile memory. The snapshot data is read using the serial communications port.

1.4 Other Functions

Logging Capability

The 4700 power meter can record up to three data logs.

- EVENT Log. This log records events such as power up, parameter changes, alarm conditions, relay changes, and status input changes. The 50 most recent events are retrievable from this log using the communications port.
- SNAPSHOT Log. This log contains voltage, current, and all power values recorded at user-defined time intervals. The 100 most recent snapshots are retrievable from this log using the communications port.
- MIN/MAX Log. This log records the extreme values for voltages, currents, power, and other measured parameters. Min/Max data is read using the integral display or the communications port.

All log contents (events, snapshots, and min/max values) are time-stamped to the second.

Control Relays

The 4700 power meter has three control relay options.

- Alarm relays and setpoint relays. These can operate as a function of any measured parameter for demand, power factor, or load control.
- Remote control relays, operated by command via the communications port.
- KVARH, KWH pulse outputs.

Status Inputs

The 4700 power meter also has four status input options available, which can each sense the state of an external contact, active or inactive. The status of these inputs is viewed and logged by a Power Monitor™ display and monitoring unit, or by another computer through the communications port.

Auxiliary Voltage Input

All 4700 power meter models have an auxiliary voltage input that allows monitoring and display of an additional external voltage (1.25 VAC max).

Auxiliary Current Output

You can program an optional analog current output for 0 to 20 mA or 4 to 20 mA, in proportion to any measured parameter.

1.5 Communications and ACCESS Compatibility

The 4700 power meter is equipped with an optically isolated communications port for displaying data on remote supervisory devices. These devices and programs allow the meter to operate in the ACCESS electrical distribution communication system. Examples of supervisory devices include the Power Monitor display and monitoring unit, a standard personal computer running the Power Monitor PC™ communications and supervisory software, and Siemens Microsoft® Windows™-based SIEServe™ or WinPM™ communication software.

1.6 System Applications

The unique features of the 4700 power meter, including measurement, storage, setpoint (load shedding) and display characteristics, make it suitable for use in:

- Utility Installations
- Industrial Buildings
- Office Buildings
- Commercial Buildings
- Hospitals
- Telephone Exchanges
- Factories
- Pulp Mills
- Saw Mills
- Shopping Centers
- Large Stores
- Hotels
- Substation Metering
- Co-generation Systems
- Chemical Process Plants
- Multi-user sites where allocation of electrical cost is desirable
- Any other installation that uses significant amounts of electrical energy
- Any other location where remote monitoring and control is needed.

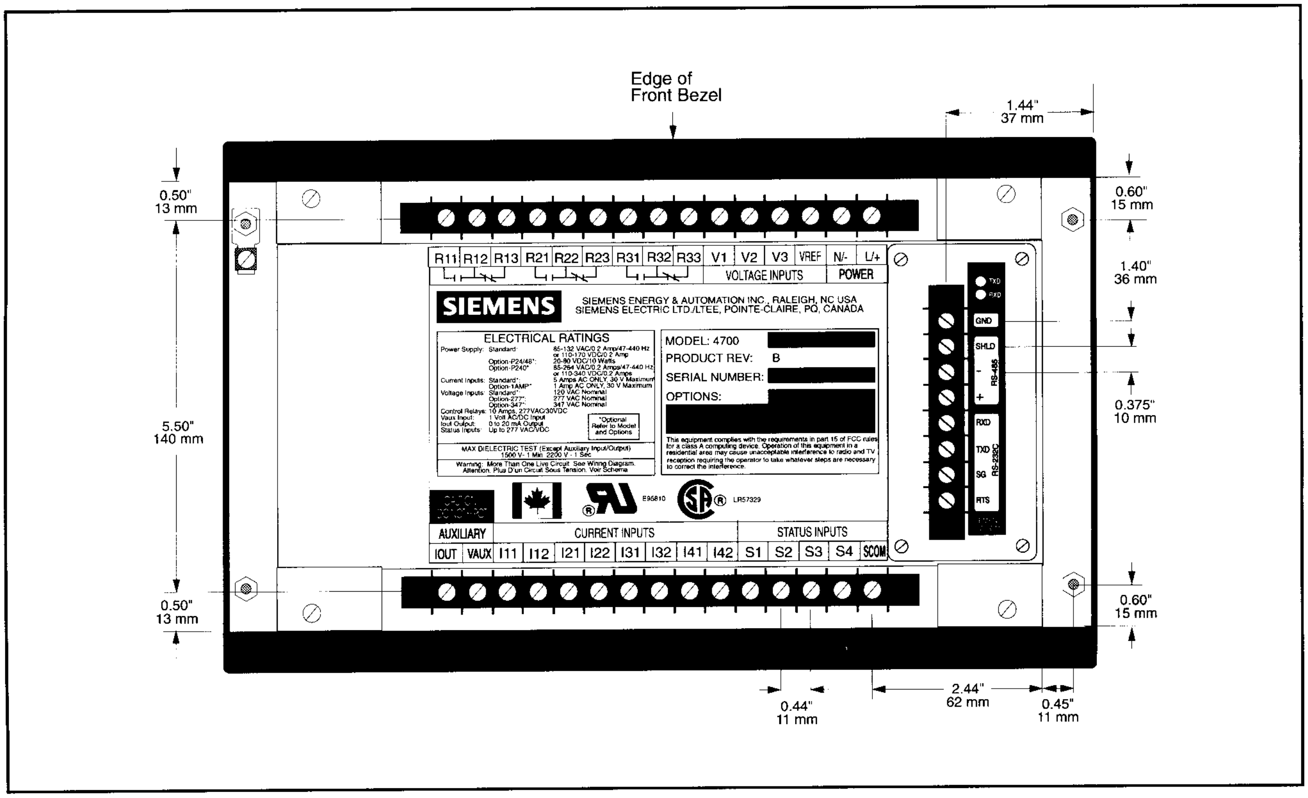


Figure 1-1 4700 Power Meter Rear Terminal Block Dimensions and Functions

2. Installing the 4700 Power Meter

DANGER

During normal operation of this device hazardous voltages are present, which can cause severe injury or death. These voltages are present on the terminal strips of the device and throughout the connected voltage transformer (VT), current transformer (CT), status input, relay, and control power circuits. It is recommended that installation and servicing is performed by qualified, properly trained personnel only.

2.1 Location and Mounting

Locate the 4700 power meter in a dry, dirt-free environment, away from heat sources and very high electric fields. Temperatures must not exceed 50°C (122°F) or fall below 0°C (32°F).

The 4700 power meter can be panel-mounted for easy access and viewing. The meter has four studs to facilitate panel mounting. Five inches of available depth in the panel are required.

Refer to Appendix A for the mounting dimensions of the 4700 power meter.

2.2 Power Supply

The standard 4700 power meter requires 85 to 132 Volts AC (47 to 440 Hz) or 110 to 170 Volts DC, both at 0.2 Amps. The power can be supplied by a dedicated fused feed, or by the monitored voltage source (120 Volt system). Optional power supplies are available for 24 VDC/48 VDC, and 240 VAC/250 VDC.

2.3 Wiring the 4700 Power Meter

Connections to the 4700 power meter are made to two terminal strips located on the rear of the unit. Refer to Figure 1-1 for the 4700 power meter terminal block dimensions. Ring or spade terminals are recommended for all connections.

The phasing and polarity of AC current and voltage inputs, and their relationship, is critical to the operation of the power meter. Refer to Figures 2-1 through 2-6 for wiring diagrams to ensure correct installation.

2.3.1 Chassis Ground Connection

You must connect the chassis of the 4700 power meter to earth ground. A good, low-impedance chassis ground is essential for the 4700 power meter surge and transient protection circuitry to function effectively. Do not rely on metal door hinges as a ground path.

Connect the ground wire to the chassis of a standard 4700 power meter using the supplied ground lug attached to one of the four mounting studs.

In both cases, ensure that the ground lug screw is tightened securely onto the ground wire, and that the nut is tightened securely onto the lug.

CAUTION

You must connect the 4700 power meter chassis ground lug to the switchgear earth ground using a dedicated 14-gauge (or larger) wire, so the transient and surge protection circuitry functions correctly. Failure to do so voids the warranty.

2.3.2 Voltage Reference Connection

The voltage reference terminal, VREF, of the 4700 power meter serves as the zero voltage reference for voltage readings. A good, low-impedance VREF connection is essential for accurate measurement. Use a dedicated 14-gauge wire for a connection at a point where there are no voltage errors due to distribution voltage drops.

The connection point for VREF is dependent on the system configuration. Each of the following configurations is illustrated in Figures 2-1 through 2-6:

a) If the system you want to monitor is a 4-wire Wye or Single Phase, then you must connect the VREF to the neutral conductor.

b) If the system is a 3-wire grounded (Delta), then you must connect the VREF to the line transformer neutral.

c) For 3-wire ungrounded (Open Delta) systems, and for systems where VTs are used, you must connect the VREF to the VT common leads.

2.3.3 Fourth Current Input Connections

The 4700 power meter is equipped with a fourth current input, labeled I4. This input is typically used to measure the current flow in the neutral or ground conductor. The use of this input is optional. If not used, connect the I41 and I42 terminals to earth ground.

The secondary rating of the CT connected to the I4 input must match the three phase current inputs. This rating depends on the presently installed input option in the 4700 power meter.

The primary rating for the CT connected to the I4 input can differ from the three phase inputs, since the I4 input scaling is independently programmable.

2.3.4 Waveform Capture Connections

The 4700 power meter waveform capture feature allows digital sampling of signals at each of its voltage (V1, V2, V3, Vaux) inputs and current (I1, I2, I3, I4) inputs. The 4700 power meter uses the V1 input as the triggering reference for waveform capture, and to maintain phase relationships between all sampled signals. You must connect the V1 input for waveform capture to work. No other special wiring considerations are necessary. Waveform capture is accessible only via communications. See Section 3.8, "Waveform Capture," for more information.

2.4 Selecting Voltage and Current Transformers

Selection of correct Current Transformers (CTs) and Voltage Transformers (VTs) is critical to proper monitoring. This section describes how to choose transformers.

2.4.1 Selecting VTs

The requirement and selection of VTs depends on three criteria: the system monitored, the voltage levels monitored, and the model of the 4700 power meter.

For connecting directly to 120/208 Volt systems, the *120 VAC* (full scale) input model is used. It is also used for systems with VTs having a 120 Volt secondary. For connecting directly to a 277/480 Volt system, the *277 VAC* (full scale) input model is used. For connecting a 347/600 Volt system, the *347 VAC* (full scale) input model is used. If system voltages are over 347/600 Volts, then VTs are required.

VTs are used to scale down the system L-N (Wye) or L-L (Delta) voltage to 120 Volts full scale, which is the nominal scale input of the 4700 power meter.

The VTs are selected as follows:

a) Wye (Star): VT primary rating = system L-N voltage or nearest higher standard size. VT secondary rating = 120 volts.

b) Delta: VT primary rating = system L-L voltage. VT secondary rating = 120 volts.

VT quality directly affects system accuracy. Therefore, for valid Volts, KW and PF readings, the VTs must provide good linearity and maintain the proper phase relationship between voltage and current. Instrument Accuracy Class 1 or better is recommended.

2.4.2 Selecting CTs

The 4700 power meter uses CTs to sense the current in each phase of the power feed. The selection of the CTs is important because it directly affects accuracy.

The CT secondary rating is always 5 Amps with a burden capacity greater than 3 VA (burden is the amount of load fed by the CT, measured in Volt-Amps).

Normally, the CT primary rating is selected equal to the Amp rating of the power feed protection device. However, if the anticipated peak load is much less than the rated system capacity, then improved accuracy and resolution is obtained by selecting a lower rated CT. In this case, choose the CT size equal to the maximum anticipated peak current plus 25%, rounded up to the nearest standard CT size available.

Other factors affect CT accuracy. Because long cable runs contribute to inaccuracy, try to minimize the length of the CT cable. Also, the CT burden rating must exceed the combined burden of the 4700 power meter plus cabling and any other connected devices.

VT and CT Considerations

Protect all phase voltage leads with breakers or fuses at their source. In cases where VTs are required and the power rating of the VTs is over 25 Watts, fuse the secondaries.

Connect CTs to the device via a shorting block or test block to facilitate safe connection and disconnection.

Refer questions regarding proper working procedures to qualified personnel.

2.5 Connecting to 3-Phase, Wye (Star) Systems

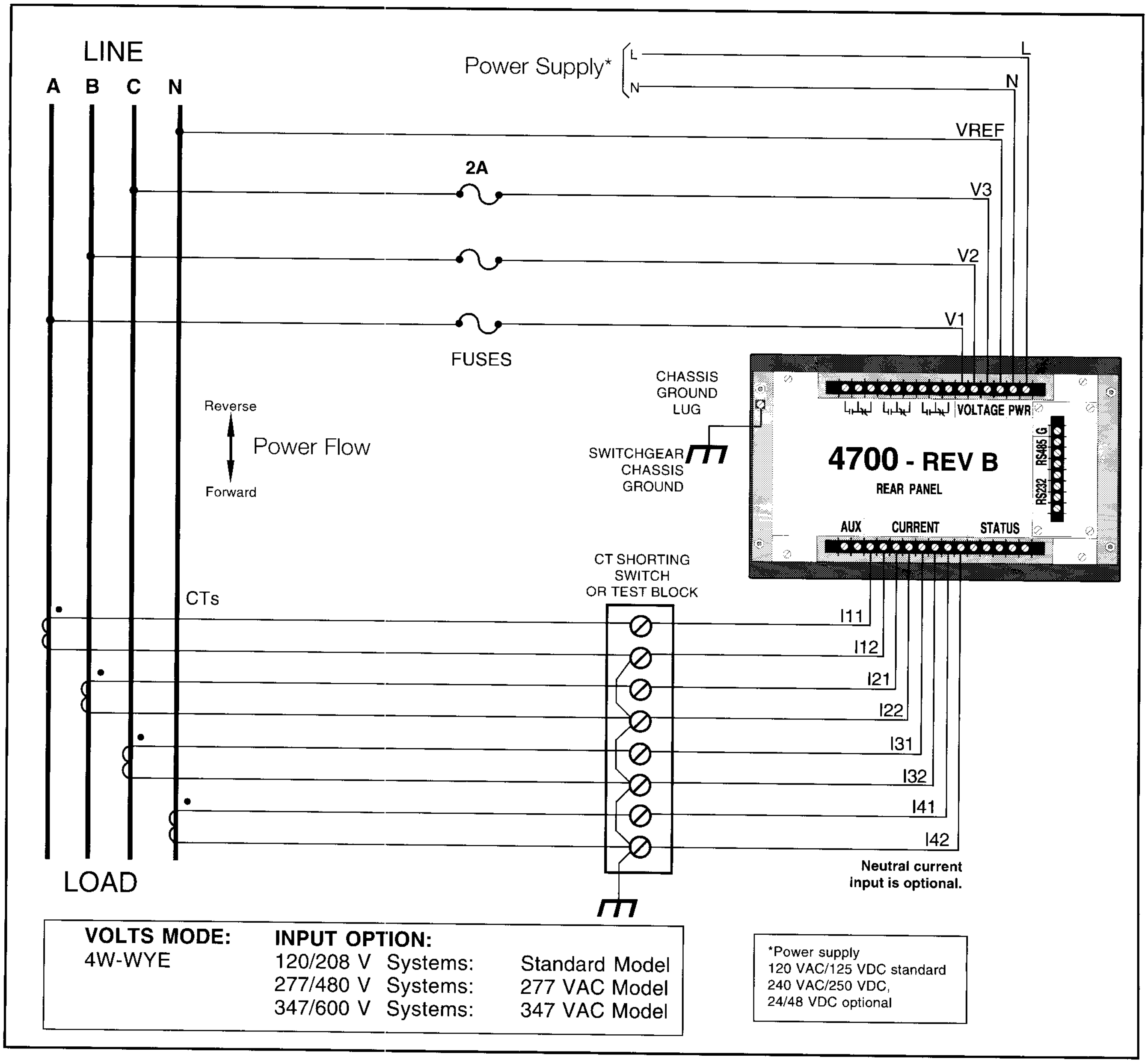
Without VTs

For a 4-wire Wye system, the 4700 power meter senses both the line-to-neutral (or ground) voltage and the current of each phase. This is the equivalent of a 3-element metering configuration.

If the power system you want to monitor is a 120/208 Volt system, then use the standard 120 VAC input model with direct sensing of each phase, without the need for VTs. If the system is a 277/480 or 347/600 Volt system, then use the 277 VAC or 347 VAC input models connected directly.

Note: Although the 277 VAC and 347 VAC models can be connected directly, VTs may be required to meet local electrical codes when the 4700 is panel mounted.

The wiring diagram for these voltage ranges is shown in Figure 2-1. Set VOLTS MODE to 4W-WYE.



Neutral current input is optional.

VOLTS MODE:	**INPUT OPTION:**		
4W-WYE	120/208 V	Systems:	Standard Model
	277/480 V	Systems:	277 VAC Model
	347/600 V	Systems:	347 VAC Model

*Power supply
120 VAC/125 VDC standard
240 VAC/250 VDC,
24/48 VDC optional

Figure 2-1 4-Wire Wye: 3-Element Direct Connection

With VTs

For Wye system voltages over 347/600 Volts, you must use VTs. Wire both the VT primary and secondary in a Wye (Star), exactly as shown for correct operation.

This configuration is shown in Figure 2-2. Set the VOLTS MODE to 4W-WYE.

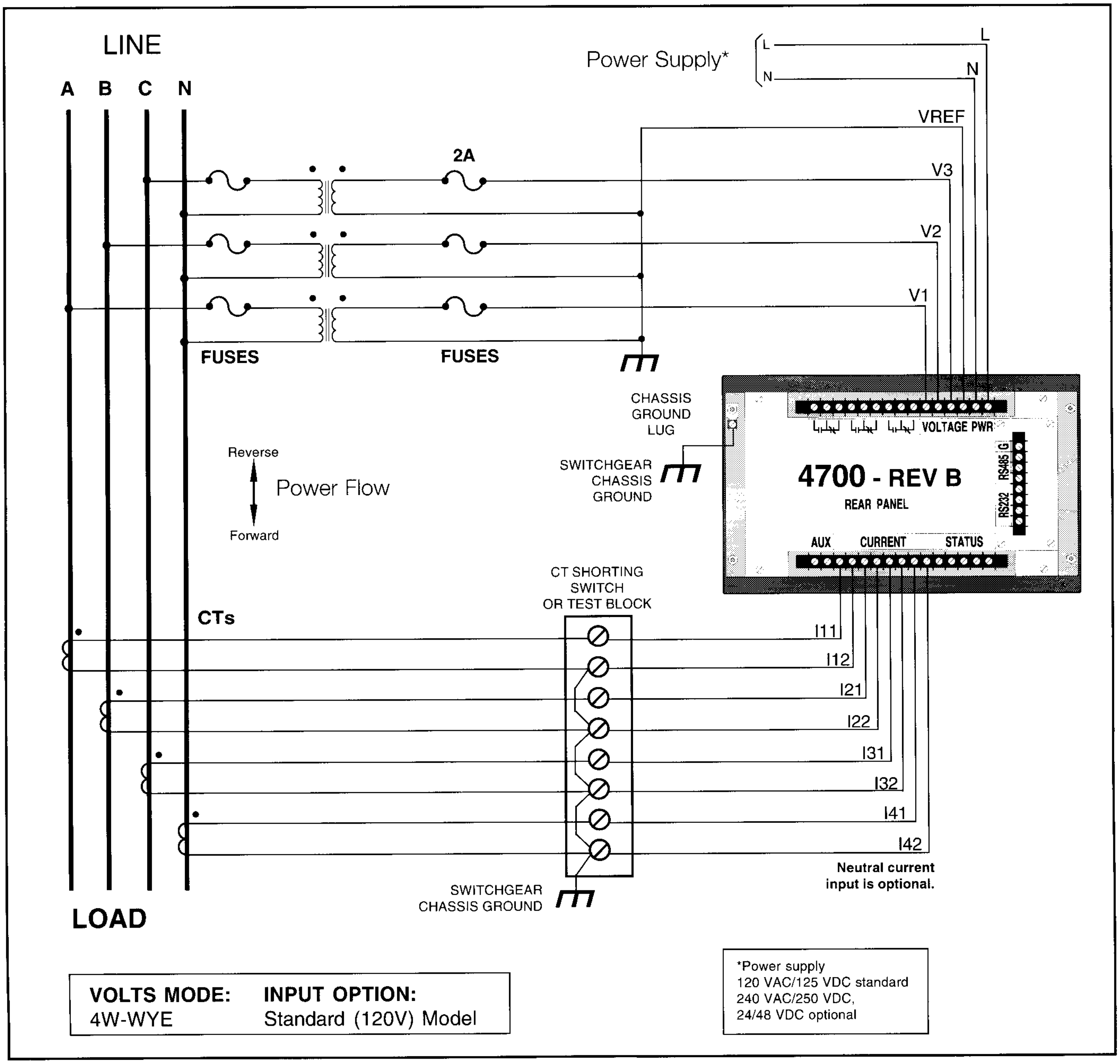
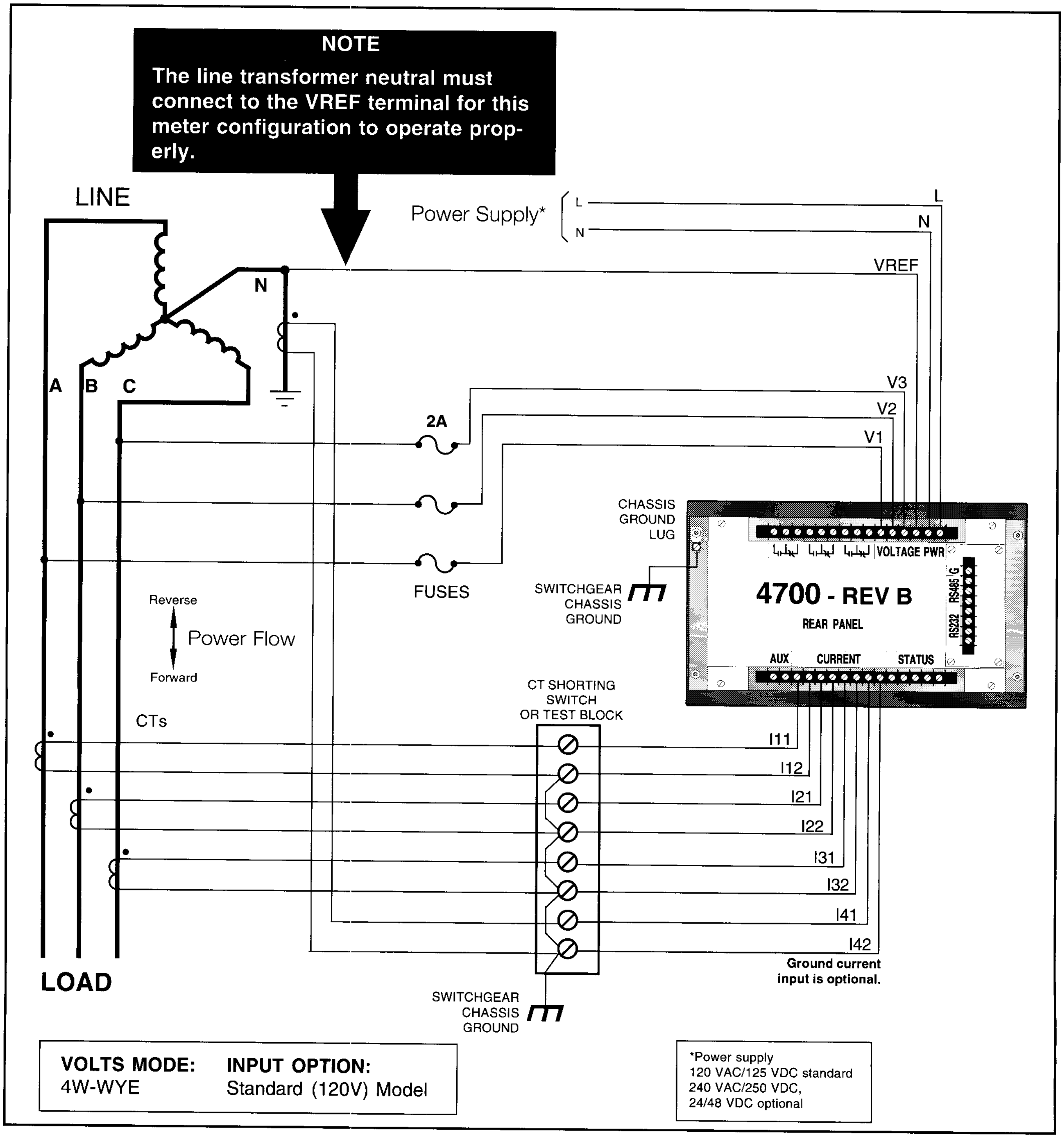


Figure 2-2 4-Wire Wye: 3-Element Using 3 VTs

3-Wire Grounded Wye Without VTs

When the starpoint of a 3-wire Wye system is grounded, then connect the 4700 power meter directly, without the use of VTs. (Ensure that the voltages are within the input range of the unit.)

This configuration is shown in Figure 2-3. Set the VOLTS MODE to 4W-WYE.



NOTE

The line transformer neutral must connect to the VREF terminal for this meter configuration to operate properly.

VOLTS MODE: 4W-WYE

INPUT OPTION: Standard (120V) Model

*Power supply
120 VAC/125 VDC standard
240 VAC/250 VDC,
24/48 VDC optional

Figure 2-3 3-Wire Grounded Wye: 3-Element Direct Connection

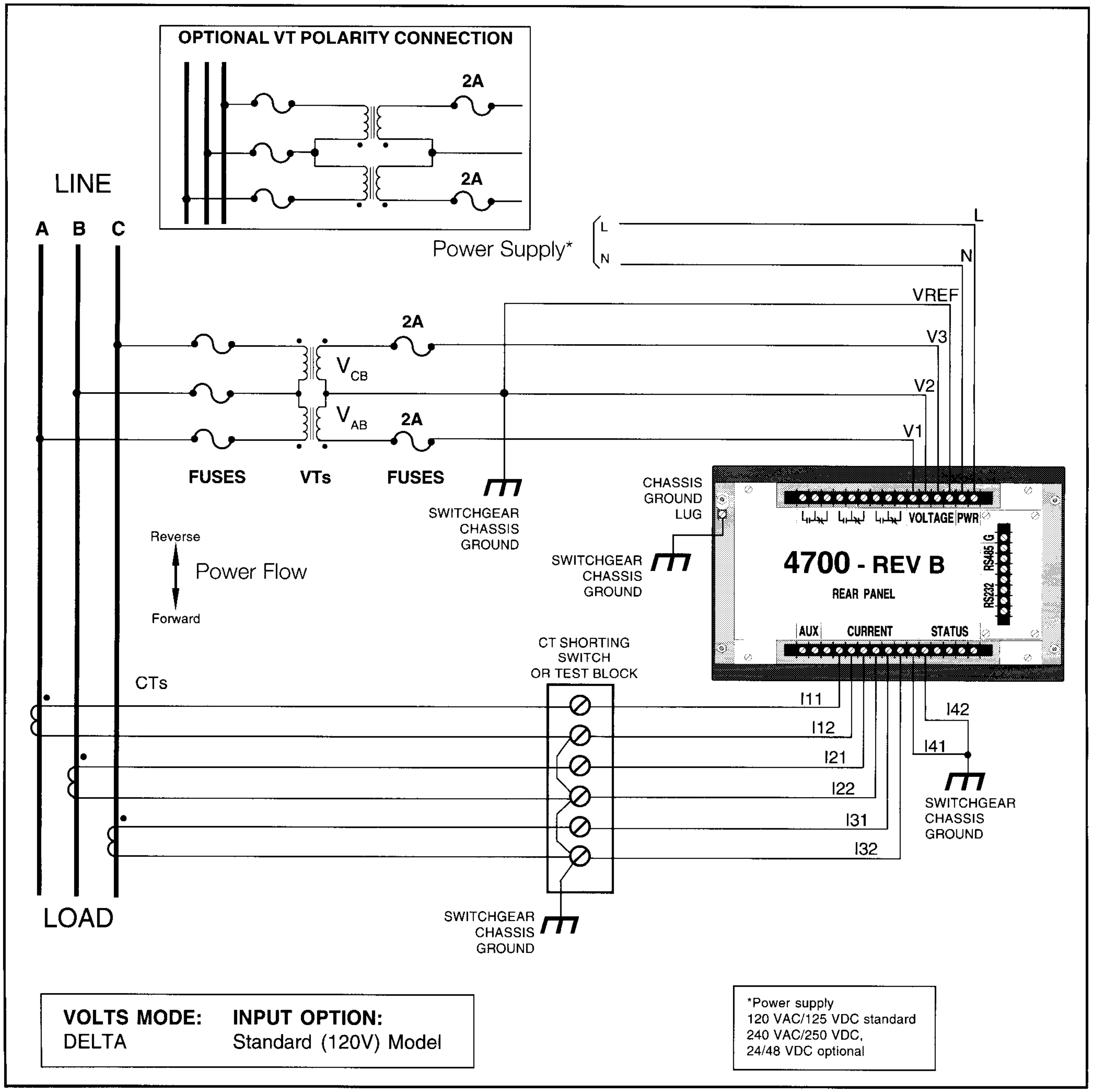
2.6 Connecting to 3-Phase, Delta Systems

2½-Element Connection

For ungrounded (floating) 3-wire Delta systems, the 4700 power meter always requires two VTs and senses the line-to-line voltages between each of the phases.

Connect the 4700 power meter in one of two ways: using 2 or 3 CTs.

Figure 2-4 shows an ungrounded Delta connection using 3 CTs. Set the VOLTS MODE to DELTA.



VOLTS MODE:	**INPUT OPTION:**
DELTA	Standard (120V) Model

*Power supply
120 VAC/125 VDC standard
240 VAC/250 VDC,
24/48 VDC optional

Figure 2-4 3-Wire Delta: 2½-Element Connection Using 2 VTs and 3 CTs

2-Element Connection

Figure 2-5 shows an ungrounded Delta connection using 2 CTs. Set the VOLTS MODE to DELTA.

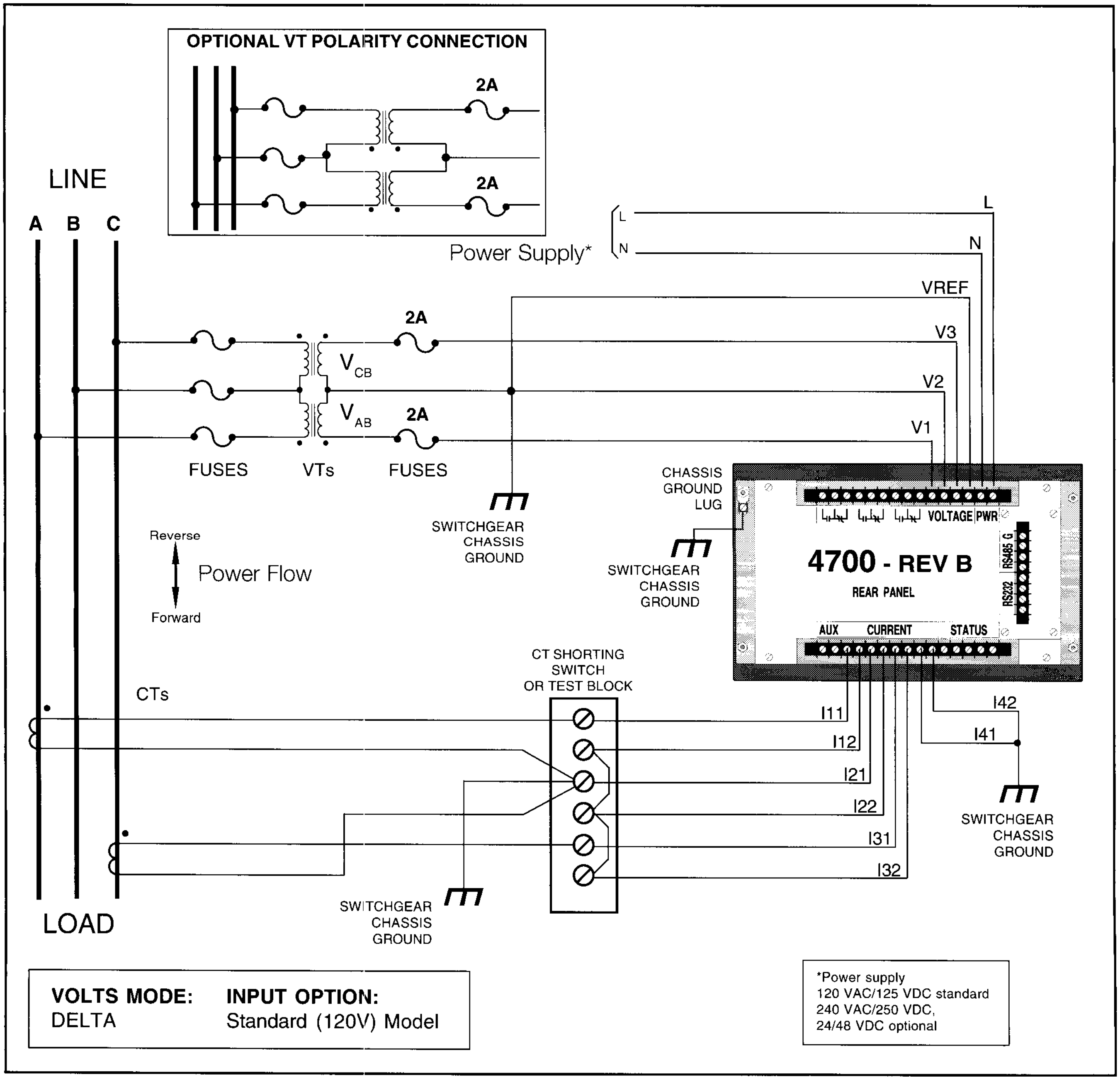


Figure 2-5 3-Wire Delta: 2-Element Connection Using 2 VTs & 2 CTs

2.7 Connecting to Single Phase, 3-Wire Systems

2-Element Connection

For Single Phase systems, connect the two voltage phases (180 degrees respectively) to the V_1 and V_2 inputs of the 4700 power meter. Also, connect the outputs of the two corresponding current transformers to the I1 and I2 input pairs.

The connections are illustrated in Figure 2-6. Note that the V3 input and I3 input pair are unused and grounded. For Single Phase systems, set the VOLTS MODE of the 4700 power meter to SINGLE.

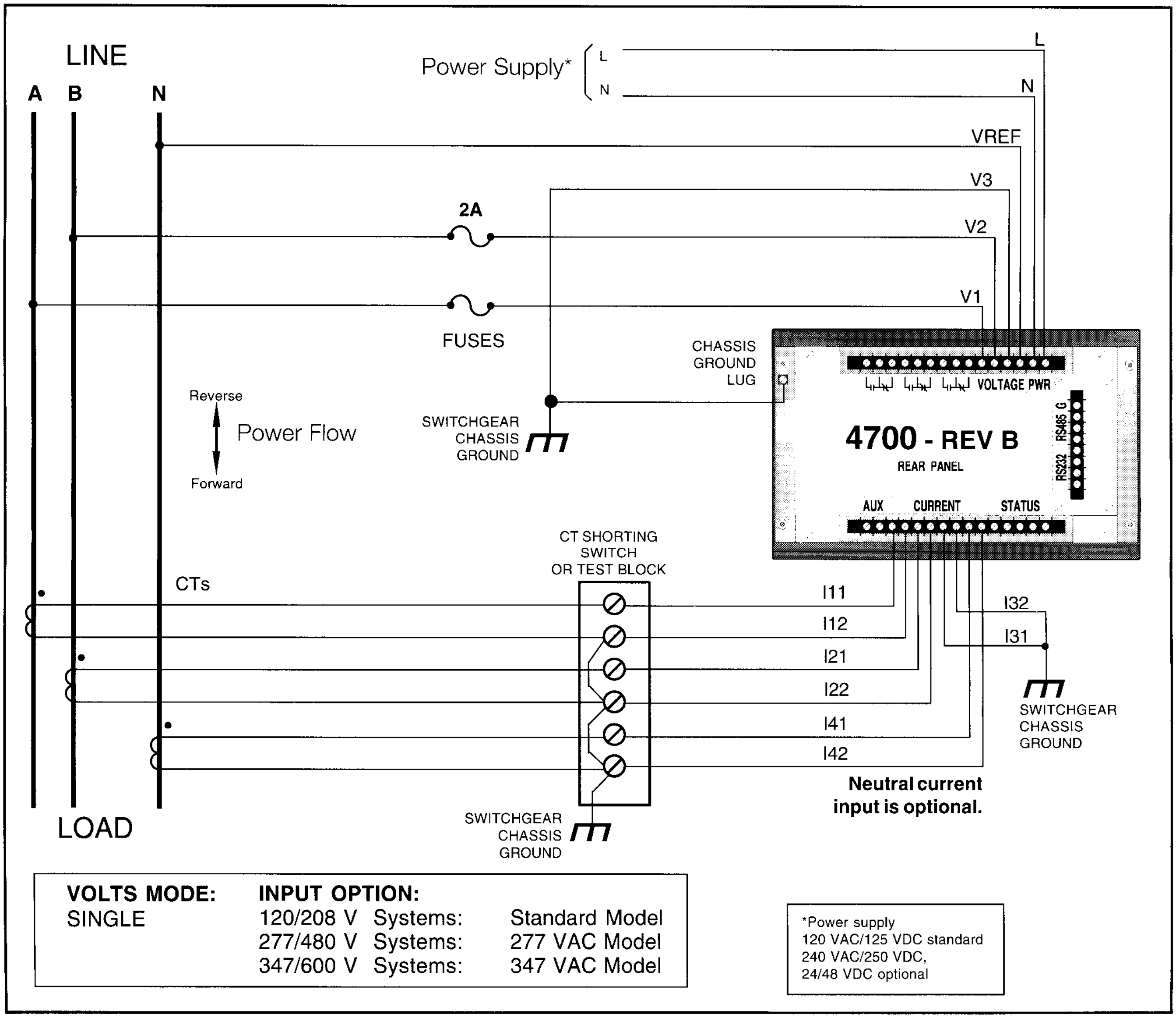


Figure 2-6 3-Wire Single Phase: 2-Element Direct Connection

2.8 Communication Connections

The communications option of the 4700 power meter includes an ISOCOM communications card. The communications card allows the 4700 power meter to transmit using either the RS-232C or RS-485 standards in full isolation for both RS-232C and RS-485 lines. Optical coupling provides isolation between the communications lines and the metering equipment. Internal circuitry protects against common mode voltages or incorrect connection of the optional ISOCOM. All inputs pass the ANSI/IEEE C37-90A-1989 tests for withstanding surge and fast transient.

The following sections describe configuration instructions and wiring requirements for direct connection to a master computer station.

Note: The communications card is shipped with a label affixed to the mounting plate that indicates the communications connection (RS-485 or RS-232C) set at the factory. If the connection is incorrect for your application, refer to the following section.

2.8.1 Configuration of the ISOCOM

This section describes how to change the communications mode. You can select RS-232C or RS-485 lines by switching a jumper block on the card. The presently selected communications mode is viewed on the power meter front panel, or by removing the card and examining the position of the jumper block.

The circuit board of the communications card has a jumper labeled J1. The jumper displays two positions, A and B, which determine the communications connection. Figure 2-7 illustrates the jumper position required for RS-232C or RS-485 lines. First, remove control power from the 4700 power meter, then move the jumper to the position you want.

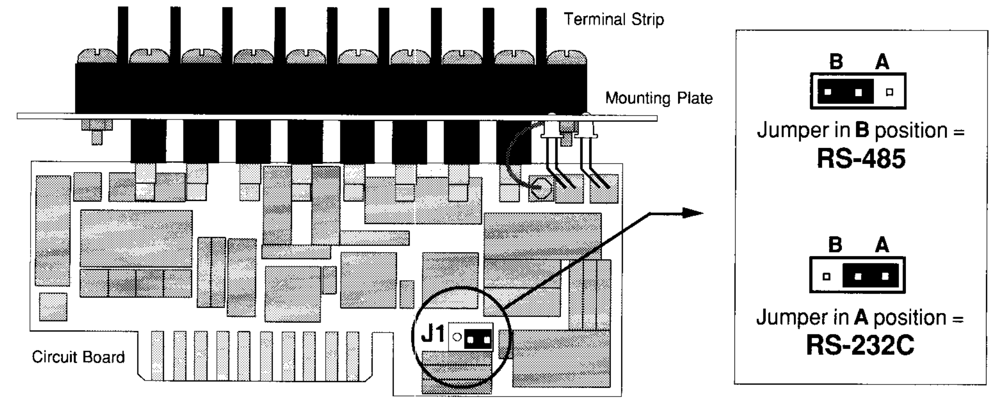
2.8.2 ISOCOM Terminal and LED Indicator Functions

The optional ISOCOM communications card provides a barrier-style terminal strip (see Figure 2-8). Terminal functions include:

Ground	GND	Chassis Ground
RS-485	SHLD	RS-485 Shield (electrically connected to chassis ground)
	-	RS-485 Data Minus
	+	RS-485 Data Plus
RS-232C	RXD	RS-232C Receive Data (i.e. data into device)
	TXD	RS-232C Transmit Data (i.e. data out of device)
	SG	RS-232C Signal Ground
	RTS	RS-232C Request To Send

Two LED indicators, TXD and RXD, show activity on the RS-232C or RS-485 communications line and can also verify correct communications operation. The TXD indicator flashes when data is sent by the device. The RXD indicator flashes when data is received by the device.

The 4700 power meter supports 19.2 Kbaud operation. This applies to both RS-232C and RS-485 standards.



NOTE

The A and B jumper block positions of the optional ISOCOM communications card is the opposite of the previous C01 type communications card. However, the left-right orientation of each comm. mode remains the same (i.e. RS-485 mode = left position, etc.).

Figure 2-7 Optional ISOCOM Card Jumper Configuration

2.8.3 RS-232C Connections

Figure 2-9 illustrates the wiring connection requirements for the RS-232C communications connection. The RS-232C standard allows only one device to exist on the communications connection.

The RS-232C cable is a custom cable. Depending on the mating connector at the computer serial port, the cable must have a 25-pin DB25, or a 9-pin DB9 with a plug (male) or socket (female) connector at one end. Cable length is 50 feet (15.2 m) maximum. Figure 2-11 illustrates RS-232C cable wiring connections.

If connected directly to an IBM PC RS-232C port, you may need to reverse the Tx and Rx leads at the remote device, depending on whether the PC RS-232C port is configured as Data Communication Equipment (DCE) or Data Terminal Equipment (DTE).

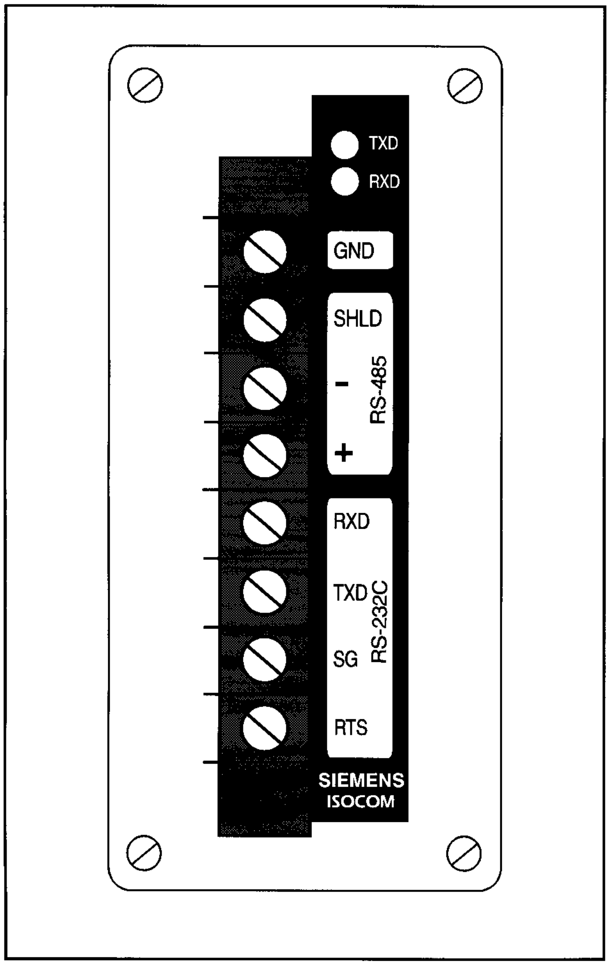
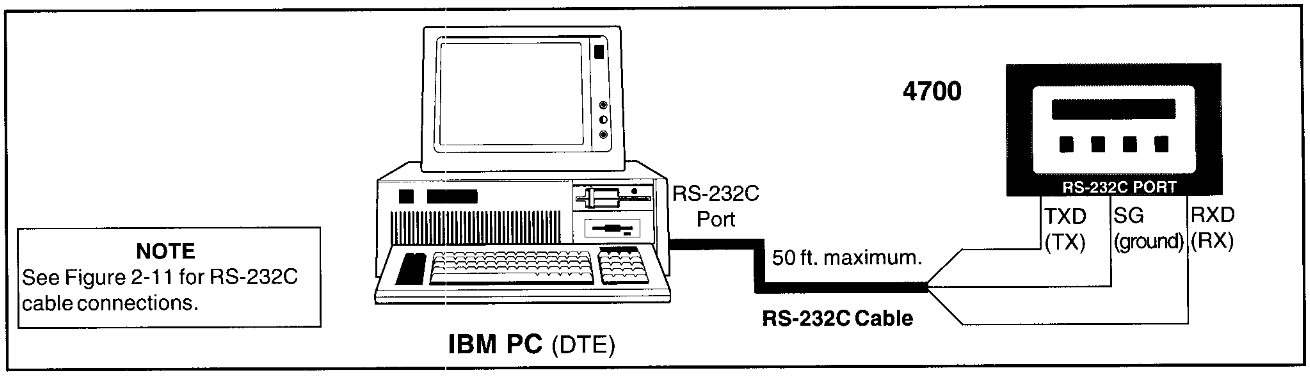


Figure 2-8 ISOCOM Terminal Block

2.8.4 RS-485 Connections

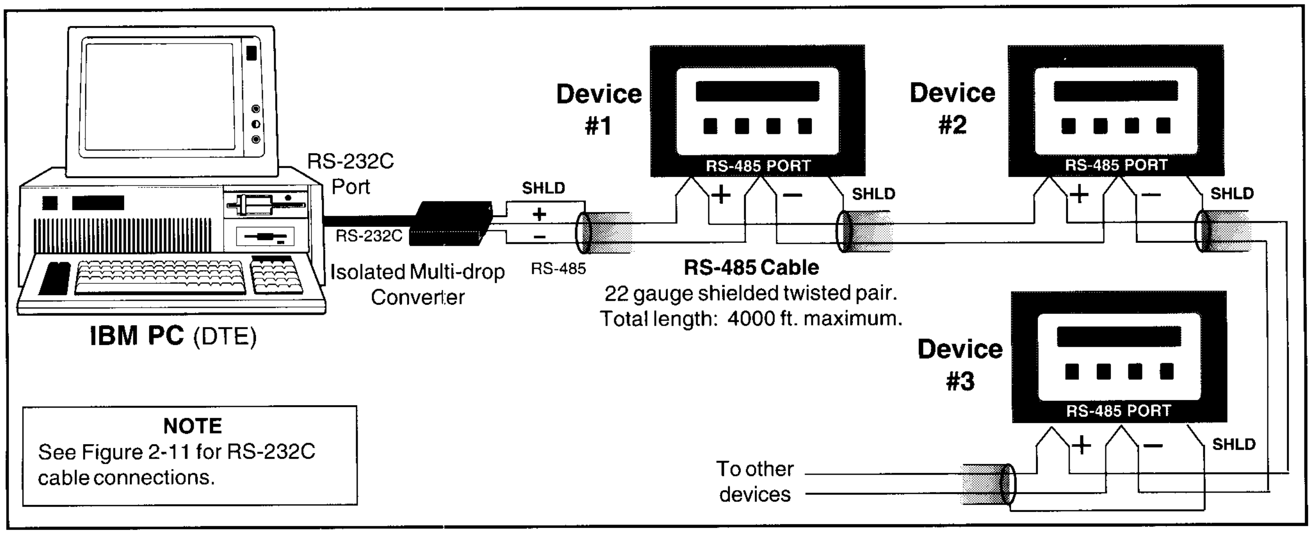
Figure 2-10 illustrates the wiring connection requirements for the RS-485 communications connection. The RS-485 standard allows up to 32 devices on the communications line.

The RS-485 cable is a 22-gauge (0.6 mm diameter) shielded twisted-pair. Cable length is 4000 feet (1219 m) maximum. Ensure that the RS-485 cable shields are each grounded at one end only.



NOTE
See Figure 2-11 for RS-232C cable connections.

Figure 2-9 RS-232C Communications Connections



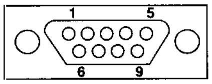
NOTE
See Figure 2-11 for RS-232C cable connections.

Figure 2-10 RS-485 Communications Connections

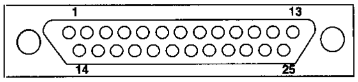
Connector Pinouts

Pin No.	Computer (DTE)	Converter
1	RLSD	RLSD
2	RX	TX
3	TX	RX
4	DTR	DTR
5	Ground	Ground
6	DSR	DSR
7	RTS	RTS
8	CTS	CTS
9	RI	RI
1	Ground	Ground
2	TX	RX
3	RX	TX
4	RTS	RTS
5	CTS	CTS
6	DSR	DSR
7	Ground	Ground
8	RLSD	RLSD
20	DTR	DTR
22	RI	RI

DB9 Type



DB25 Type



Cable Wiring

Computer	Converter
TX	RX
RX	TX
Ground	Ground
RTS	RTS
CTS	CTS
DSR	DSR
DTR	DTR
RLSD	RLSD

Computer	4700 Power Meter RS-232C Port
TX	RX
RX	TX
Ground	SG
RTS	
CTS	
DSR	
DTR	

Figure 2-11 RS-232C Cable Wiring Specifications

2.9 Connecting Additional Components

In addition to current and voltage inputs, the 4700 power meter has connections for status and auxiliary voltage inputs, control relays, and auxiliary current outputs. These additional connections add to the functionality of the meter.

2.9.1 Status Inputs

This section describes and illustrates wiring connection methods and applications for the status inputs.

The 4700 power meter uses a current-sensing technique to monitor the status of an external dry contact or the presence of an external voltage.

Dry (Volts Free) Contact Sensing

Dry contact sensing is performed using external excitation as illustrated in Figure 2-12. External excitation is provided via the SCOM terminal. A 20 to 277 VAC/VDC external power source is required. Various possibilities include:

a) an auxiliary 24 VDC power supply.

b) a 24 to 277 VAC transformer with fused output.

c) direct 120 VAC or 240 VAC fused power.

CAUTION

1. For this application, the SCOM terminal *must* be connected to a suitable supply voltage. Do not leave the SCOM terminal floating.
2. Normally, up to 277 V is present at the S1 to S4 terminals, depending on the external supply voltage.

When the external contact is open, there is no current flow and the status input registers INACTIVE. When the external contact closes, the current flow from the external supply causes the status input to register ACTIVE.

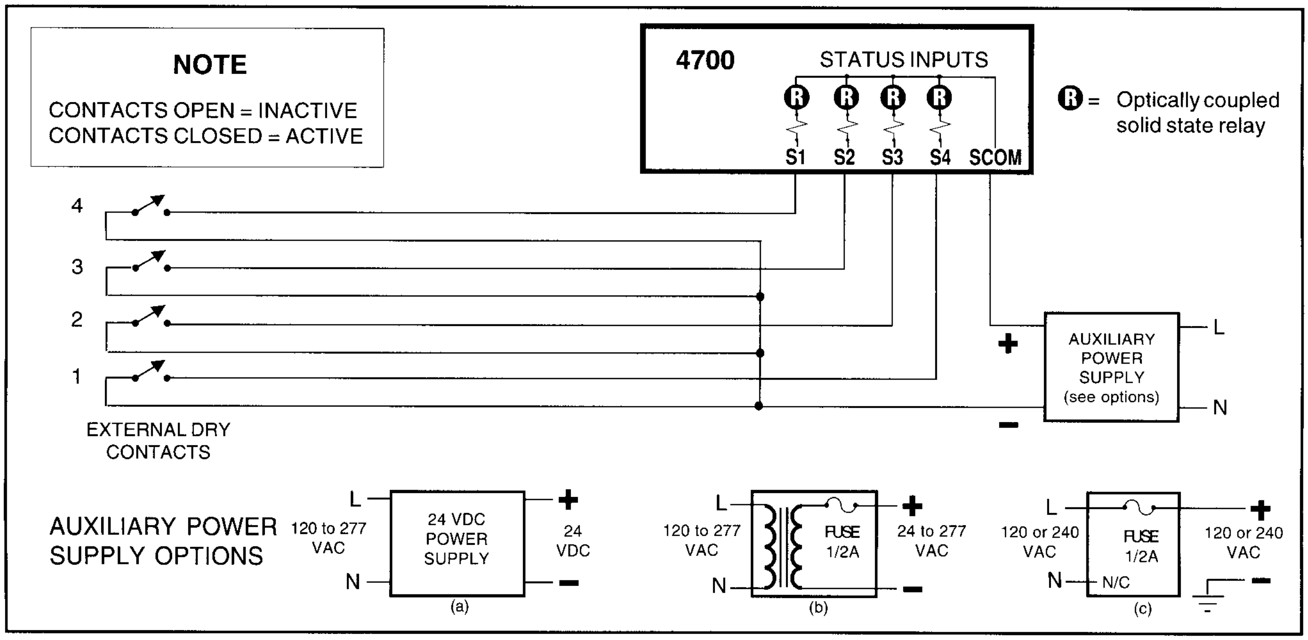


Figure 2-12 Status Input Connections for Dry Contact Sensing

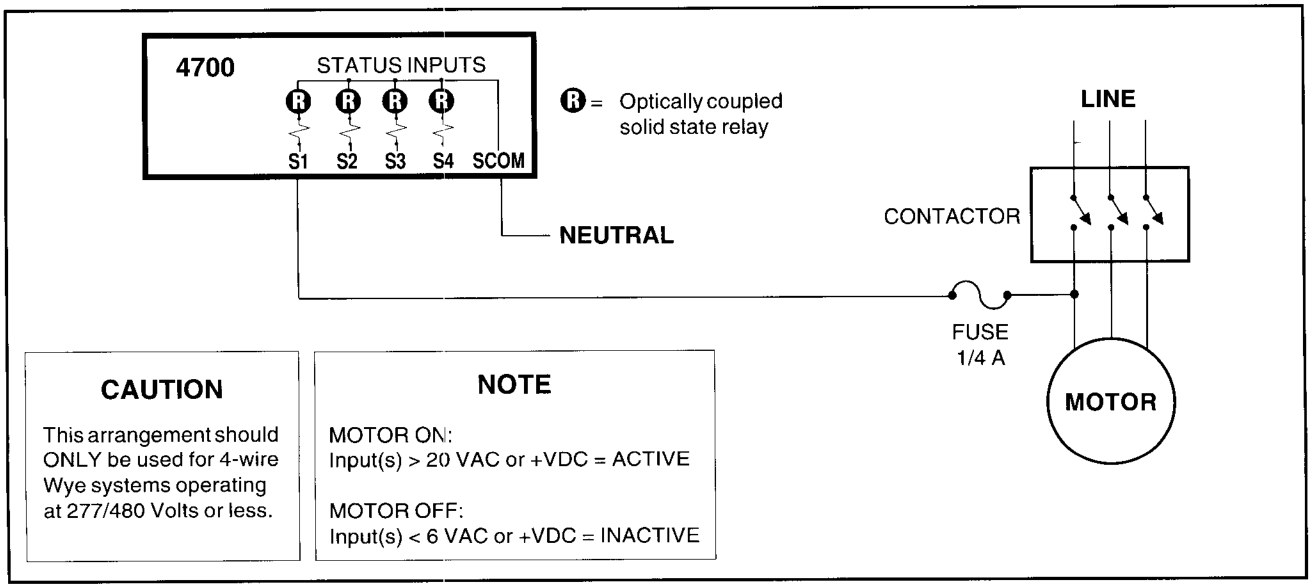
Voltage Sensing

Status inputs can sense the presence or absence of voltage on a power feeder. You can monitor whether a piece of equipment, such as a motor, is energized (see Figure 2-13).

When the motor is on, there is voltage at the sense point, and the status input registers ACTIVE. When the motor is off, there is no voltage at the sense point, and the status input registers INACTIVE.

CAUTION

1. For this application, the SCOM terminal *must* be connected to ground. Do not leave the SCOM terminal floating.
2. Normally, up to 277 V is present at the S1 to S4 terminals, depending on the external voltage.



CAUTION

This arrangement should ONLY be used for 4-wire Wye systems operating at 277/480 Volts or less.

NOTE

MOTOR ON:
Input(s) > 20 VAC or +VDC = ACTIVE

MOTOR OFF:
Input(s) < 6 VAC or +VDC = INACTIVE

Figure 2-13 Status Input Connections for Voltage Sensing

2.9.2 Control Relay Connections

The 4700 power meter provides 3 Form C electromechanical control relays. Figure 2-14 illustrates the wiring connection requirements for the control relays. Refer to Section 3, "Operating the 4700 Power Meter," for more information on operating the relays.

CAUTION

In applications where the relays are used to perform critical control operations (e.g. breaker trip, etc.), the precautions described below should be followed.

1. Connection to the external equipment should be made via an intermediate mechanism that allows relay control to be completely disabled for commissioning and servicing.

   Note: The example shown below forces the normally on load on, and the normally off load off when the relays are disabled.
2. Following initial power up, the 4700 power meter should be programmed (see Section 3.3), including all required setpoints for setpoint controlled relay operations.
3. The relay outputs of the 4700 power meter should be tested to ensure that setpoint or manual control conditions are occurring as expected.
4. Once correct relay operation has been verified, relay control of the external equipment can be enabled.

DANGER

Primary Protection

The relays of the 4700 power meter should not be used for primary protection functions. These include applications where the device would be providing:

a) Overcurrent protection on circuit breakers (I^2t applications).

b) Protection of people from injury. If failure of the device can cause injury or death, the 4700 power meter should not be used.

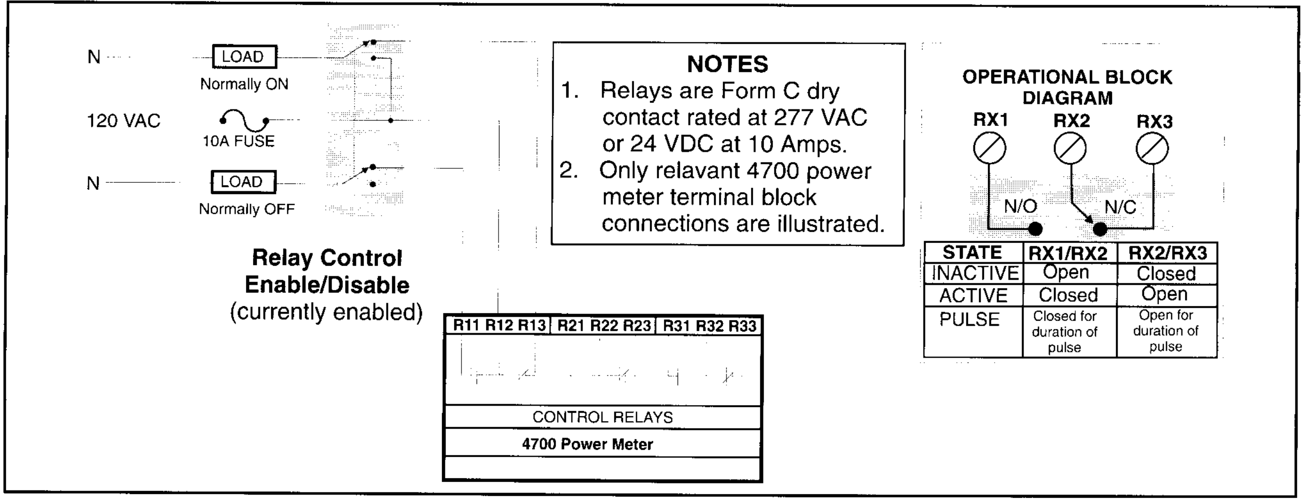
c) Energy limiting. If failure of the device will cause sufficient energy to be released that a fire is likely, the 4700 power meter should not be used. In electrical systems, energy limiting is normally provided by circuit breakers or fuses.

Secondary Protection

The 4700 power meter can be used for secondary protection functions. Secondary protection includes:

a) Situations where the 4700 power meter is backing up a primary protection device (shadow protection), such as an overcurrent relay.

b) Situations where the 4700 power meter is protecting equipment, not people. This typically includes applications such as over/ under voltage, reverse power flow, etc.



NOTES
1. Relays are Form C dry contact rated at 277 VAC or 24 VDC at 10 Amps.
2. Only relavant 4700 power meter terminal block connections are illustrated.

STATE	RX1/RX2	RX2/RX3
INACTIVE	Open	Closed
ACTIVE	Closed	Open
PULSE	Closed for duration of pulse	Open for duration of pulse

Figure 2-14 Control Relay Connections

2.9.3 V_{aux} Auxiliary Voltage Input Connections

Figure 2-15 illustrates two possible wiring connections and applications for the V_{aux} input. Refer to Section 3, "Operating the 4700 Power Meter," for more information on operating the V_{aux} input.

2.9.4 I_{out} Auxiliary Current Output Connections

Figure 2-16 illustrates two possible wiring connections and applications for the I_{out} output. Refer to Section 3, "Operating the 4700 Power Meter," for information on operating the I_{out} output.

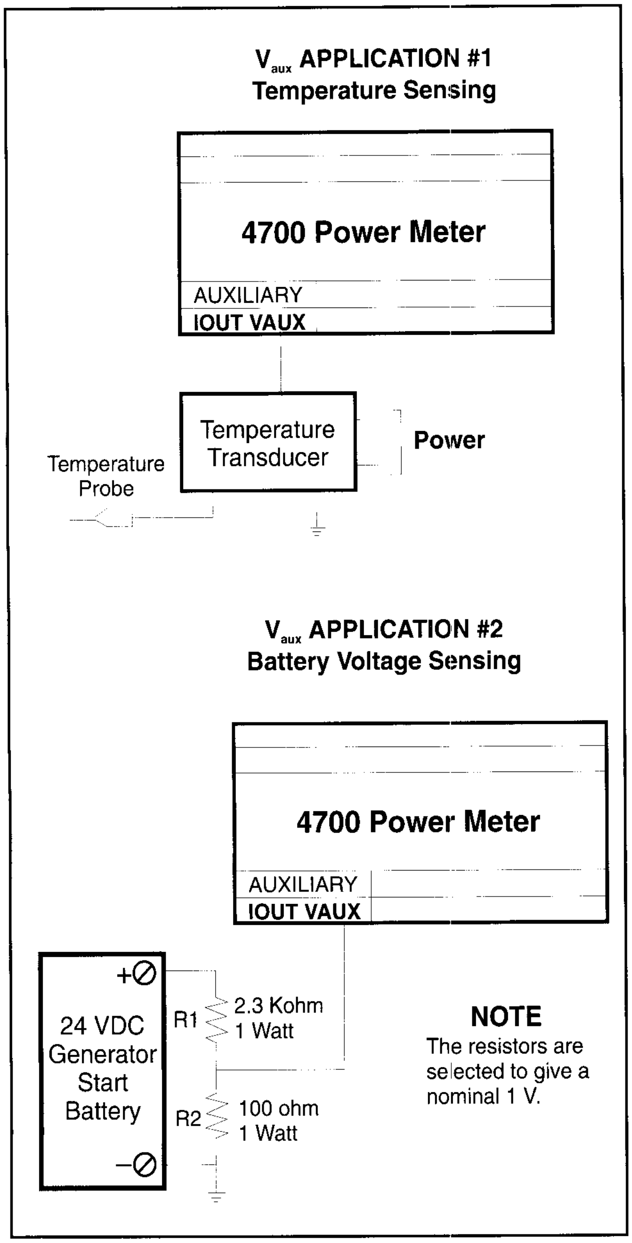


Figure 2-15 Auxiliary Voltage Input Connections

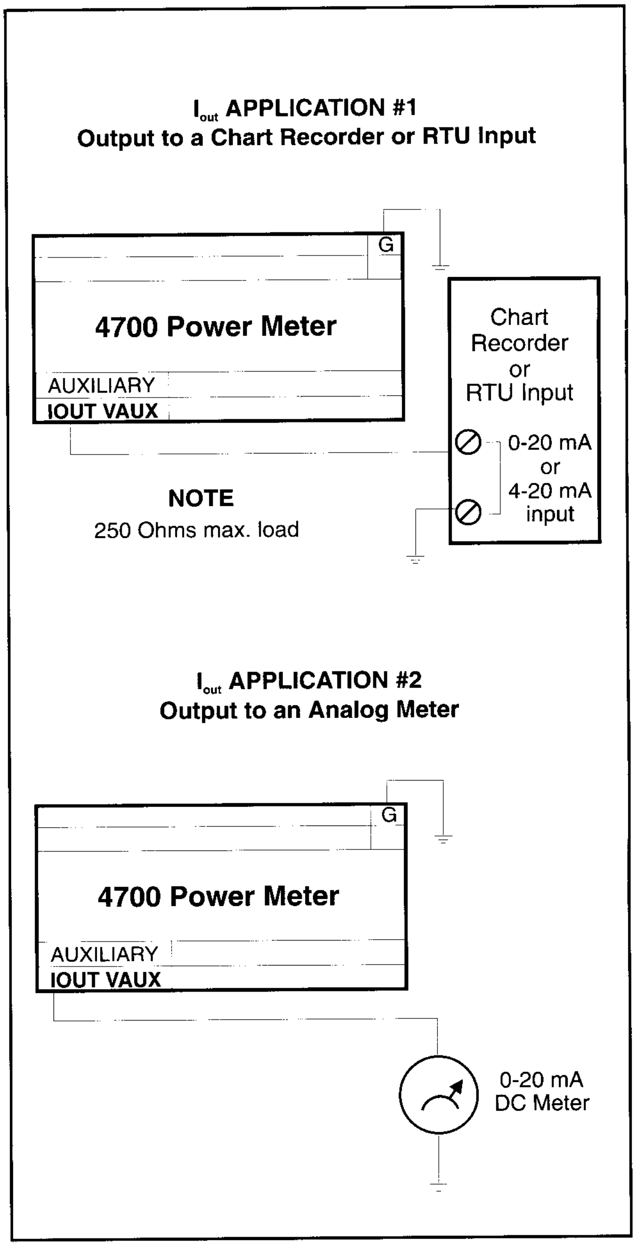


Figure 2-16 Auxiliary Current Output Connections

2.10 Maintenance

The 4700 power meter does not require any regular maintenance with the exception of replacement of the battery.

2.10.1 Replacing the Battery

The 4700 power meter uses nonvolatile memory with a battery backup. The rated life of the battery is 70 years at 50°C, 28 years at 60°C, and 11 years at 70°C.

If the unit operates at less than 50°C for 60% of the time, less than 60° for 90%, or less than 70° for 100%, the expected battery life is 35 years. If the power meter operates in an environment where the temperature regularly exceeds 60°C, then replace the battery every 10 years.

Note: When the battery is replaced, historic data is lost. Setup parameters and calibration of the power meter are *not* affected.

2.10.2 Field Service

In the event of meter failure, it is normally returned for repair. Keep this in mind during initial installation so that removal is convenient.

1. Ensure that a CT shorting block is installed so that the 4700 power meter current inputs can disconnect without open circuiting the CTs. Wire the shorting block so that any CT connection to protective relaying is not affected.
2. Route all wiring to allow easy removal of the connections to the 4700 power meter terminal strips, the rear cover, and to the meter itself.

2.10.3 Calibration

The calibration interval for the 4700 power meter is user-definable, according to your own accuracy requirements. The rated accuracy drift is 0.1% per year. If your 4700 power meter requires recalibration, contact Siemens.

3. Operating the 4700 Power Meter

3.1 Powering Up the 4700 Power Meter

Ensure that all installation wiring is complete before powering up the 4700 power meter. On power up, the meter displays volts, amps, and watts. The initial values displayed are normally incorrect because the unit does not have available information about the installation. The process of supplying the necessary information to the 4700 power meter is known as *field programming*.

3.2 Operating the 4700 Power Meter in Display Mode

The 4700 power meter front panel is set up for ease of operation. Two modes of operation are available: display and programming. In display mode, the meter shows three fields: Volts, Amps, and Power Functions. Four labeled buttons control the information shown on the display. Refer to Figure 3-1.

Phase: The Phase button selects the phase for which the volt and amp values are displayed. The asterisk (*) symbol indicates the average volts and amps values.

In Wye mode (VOLTS MODE = 4W-WYE), the Phase button steps through all line-to-neutral values, the line-to-neutral average, and all line-to-line values. The line-to-line values are displayed with a comma following the phase indicator (ex. A,).

In Delta mode (VOLTS MODE = DELTA), the Phase button steps through all line-to-line values for all the phases, and also gives the average of the three phases.

In Single Phase mode (VOLTS MODE = SINGLE), the Phase button steps through the sequence: A, B, L. An A indicates voltage and current for the A phase. The B indicates voltage and current for the B phase. An L indicates the line-to-line voltage, and also the average of the two line currents.

Function: The Function button selects which power function is displayed. The 4700 power meter displays volts, amps, and watts when first powered up. Press the Function button once to change the KW field to KVA. Press the Function button again to change to KVAR, and so on. The complete sequence is: KW, KVA, KVAR, power factor, frequency, KW demand, Amp demand, V_{aux}, I4, KW hours, and KVAR hours. KW hours (KWhr) and KVAR hours

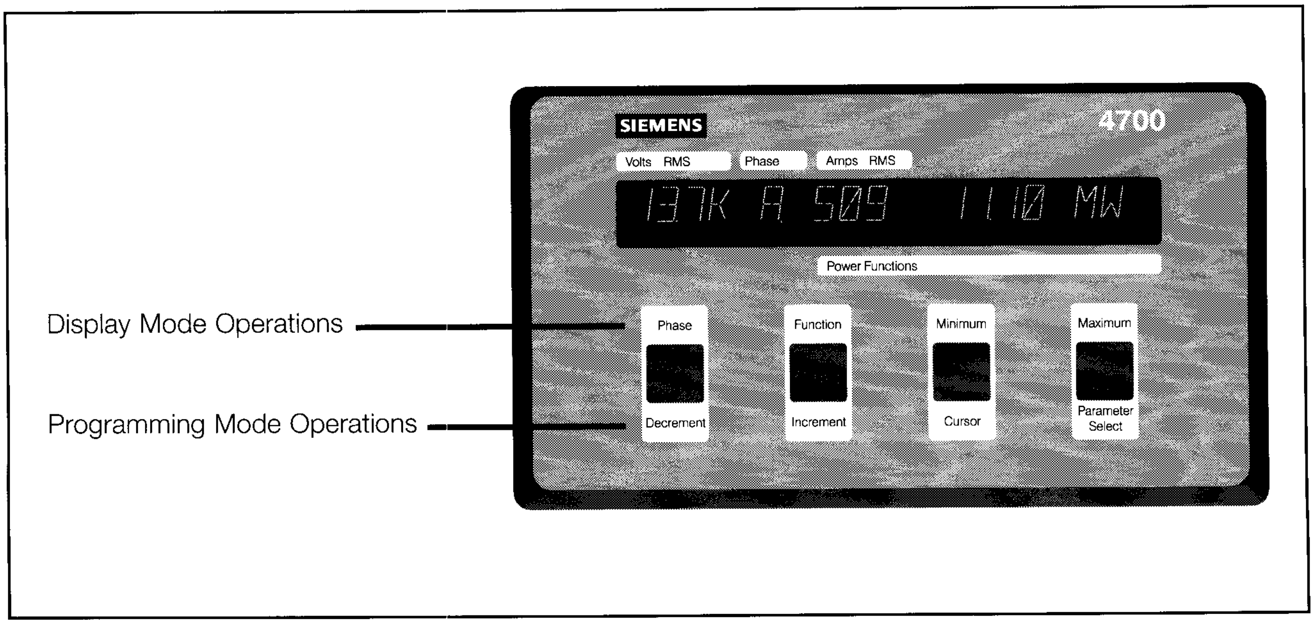


Figure 3-1 Front Panel Display

(KVARhr) (Total) use the entire display to show up to 10 digits of data.

Minimum and Maximum: These buttons display the minimum and maximum values of volts, amps, and power functions. Min/Max values are displayed for three seconds before the real-time display returns. The values displayed are minimums and maximums logged since the last CLEAR MAX/MIN? function (see Table 3-1).

Function	Label
Kilowatts	KW (MW)
Kilovoltamperes	KVA (MVA)
Kilovoltamperes (Reactive)	KQ
Power Factor	PF
Frequency	HZ
Kilowatt Demand	KWD (MWD)
Amp Demand	AMD
V_{aux}	VX
Fourth Current Input	I4
Kilowatt Hours	KWHRS
Kilovoltampere (Reactive) Hours	KVARHRS

3.3 Operating the 4700 Power Meter in Programming Mode

Tables 3-1a and b give brief descriptions of each parameter that is programmable from the front panel display. Detailed descriptions of operating parameters and their applications are provided in the following sections of this manual.

3.3.1 How to Use the Front Panel Buttons in Programming Mode

In programming mode, the front panel buttons assume new programming functions. The label below each button indicates its alternate function. For example, the Maximum button changes to Parameter Select.

The Parameter Select button selects the parameter for display. When displaying available parameters (see Table 3.1), the list *wraps around* to the beginning when the end is reached. If you miss a displayed parameter, press the Parameter Select button until the one you want comes back around. The Cursor and Increment buttons change the value of the displayed parameter.

Press the Cursor button to move the cursor left one digit (cursor wraps around if necessary). Press the Increment button to increase the value of the digit where the cursor resides.

Some parameters accept only Yes or No values. For example, you can answer the CLEAR MAX/MIN? prompt by toggling to Yes or No using the Increment or Decrement button.

Other parameters, such as BAUD RATE, have several values available. Press the Increment or Decrement button to scroll through the values.

3.3.2 Changing to Programming Mode

Press the Function and Minimum buttons at the same time to enter programming mode. The front panel displays PROGRAMMING MODE. Avoid pressing the Function button only, which alters the selected parameter.

You can press the Function and Minimum buttons again to return to display mode.

3.3.3 Entering the Password

At shipping, the 4700 power meter password is 0. In programming mode, press the Parameter Select button until the PASSWORD parameter appears. Enter the password using the Cursor and Increment buttons. You must enter the password to change any parameter values, although you can view them on the front display panel at any time. You can also change the password as described in the next section. If the password is lost or forgotten, contact Siemens customer service.

3.3.4 Changing the Password

To change the password, use the following procedure.

1. Enter programming mode by pressing and holding simultaneously the Function and Minimum buttons.
2. Press Parameter Select until the PASSWORD parameter appears. Enter the current password using the Cursor and Increment buttons.
3. Press Parameter Select repeatedly until the PASSWORD parameter appears again.
4. Enter the new password using the Cursor and Increment buttons.
5. Return to display mode. The new password is now in effect.

3.3.5 Skipping Over the Setpoint Parameters

If the SETPOINT NUM parameter is 00, and the Parameter Select button is pressed, the setpoint parameters are passed over.

3.3.6 Setting the Volt Scale, Amps Scale and Volts Mode

The VOLT and AMP SCALES of the 4700 power meter must correspond with the full scale levels that are to be measured. The scale is the value the meter displays when the input is at full scale.

Volt Scale

In a direct connect configuration, the VOLT SCALE is normally set to 120 for a 120 VAC system, 277 for a 277 VAC system, or 350 for a 350 VAC system. If VTs are used for connection to higher voltage systems (using a 120 VAC model), then set the VOLT SCALE to theprimary rating of the VT. Note that this applies only if the VTs' secondaries are rated at 120 VAC. If not, then the following formula is used to determine the required VOLT SCALE:

$$\text{VOLT SCALE} = \frac{\text{VT Primary Rating x 120 VAC}}{\text{VT Secondary Rating}}$$

Amps Scale

Set the AMPS SCALE to the primary rating of the CTs used. This applies only if the CTs are rated for a 5 Amp full scale output. If not, the following formula is used to determine the required AMP SCALE:

$$\text{AMP SCALE} = \frac{\text{CT Primary Rating x 5 A}}{\text{CT Secondary Rating}}$$

Note: The fourth CT secondary rating must equal the phase CTs.

Volts Mode

Set the VOLTS MODE according to the system connection configuration. Refer to Section 2, "Installing the 4700 Power Meter," and Figures 2-1 through 2-6 for more information.

The VOLTS MODE options are:

4W-WYE, DELTA, SINGLE, DEMO

3.3.7 Setting Additional Component Parameters

V_{aux} Auxiliary Voltage Input Operation

The 4700 power meter uses an auxiliary voltage input that allows measurement and display of an external voltage (1 VAC/VDC nominal, 1.25 VAC/VDC maximum). The VAUX SCALE parameter specifies what the meter displays with a 1.000 VAC_{RMS}/VDC full scale input applied.

Note that this 1 Volt input differs from the 120 Volt input for V1, V2 and V3.

I_{out} Auxiliary Current Output Operation

The 4700 power meter can include an analog current output, which is programmable to deliver a current proportional to any measured parameter. Maximum load on the current output is 250 ohms resistive.

The current output is set in programming mode. You must set the following three parameters:

a) I OUT KEY. This label specifies the measured parameter for which the current output is proportional. Table 3-2 shows the labels for I OUT KEY corresponding to each measured parameter.

b) I OUT SCALE. This value specifies the indicated value for the full scale output of I_{out}.

c) I OUT RANGE. This value indicates whether the output mode is 0 to 20 mA or 4 to 20 mA.

I OUT RANGE = 0	indicates 0 to 20 mA
I OUT RANGE = 1	indicates 4 to 20 mA

Display Format

The front panel display can present numeric information and phase labels in formats that reflect various world standards.

The FORMAT parameter allows the user to select formats for numeric information and phase labels. This parameter is displayed as:

FORMAT= ABC 1,234.5

The three-letter prefix specifies the phase labels. The possible values are ABC (default), XYZ, RBY and RST.

The five-digit integer specifies the display numbers. The formats for possible values are:

a) A comma for the thousands delimiter (radix) and a decimal point for the decimal delimiter. Example: 1,234.5 This is the default.

b) No thousands delimiter and a comma for the decimal delimiter. Example: 1234,5

The Cursor button cycles between the phase label parameter and display number parameter. The Increment or Decrement buttons modify the values for selected parameters.

Field Programmable Operating Parameters

Parameter	Description	Range
FIRMWARE	Displays the software level of the 4700 Power Meter. Not programmable.	V2.xxxB
PASSWORD	Must be entered to change the setup parameters or clear any function. You can also change the password.	0 to 9999
SETPOINT NUM	Selects a setpoint to be programmed. If set to "00", then no setpoint is selected. If no setpoints are programmed, pressing the Parameter Select button will skip directly to RELAY OPERATION. Note: In the parameter names below, "xx" indicates the selected setpoint number.	00 to 17
SPxx TYPE	The type of parameter the selected setpoint is to monitor (e.g. OVER KW, PHASE REVERSAL, etc.).	See Table 4-1
SPxx HI LIMIT	Sets the high limit for the selected setpoint.	0 to 999,999
SPxx LO LIMIT	Sets the low limit for the selected setpoint.	0 to 999,999
SPxx TD OPERATE	Sets the time delay to operate for the selected setpoint.	0 to 32,000 sec.
SPxx TD RELEASE	Sets the time delay to release for the selected setpoint.	0 to 32,000 sec.
SPxx RELAY NUMBER	Selects which one of three control relays the selected setpoint controls. Selecting "0" will select no relay. After setting this parameter, pressing the Parameter Select button will return to SETPOINT NUM.	0 to 32,000 sec.
RELAY OPERATION	Selects one of the three control relays to be programmed. Selecting 0 will exit control relay programming and skip directly to VOLT SCALE. Note: In the parameter names below, "x" indicates the selected control relay number.	0 to 3
Rx MODE	Defines the type of operation the selected relay is to perform.	SETPOINT, KWH PULSE, KVARH PULSE
Rx VALUE	For Rx MODE = SETPOINT: Specifies latch mode or sets pulse duration.	0 = latch mode 1 to 65,535 sec. pulse duration
Rx HRS/PULSE	For Rx MODE = KWH or KVARH PULSE: Defines the number of unit-hours between pulses.	0 to 65,535 unit -hours
VOLT SCALE	Sets full-scale AC input voltage. This parameter should match the VT primary rating on systems using VTs with secondary ratings of 120VAC, or the measured phase voltage rating of the meter on systems connected directly. See Section 3.3.6.	0 to 999,999 Volts
AMPS SCALE	Sets full-scale AC input current. This parameter should match the CT primary rating when the secondary rating is 5 Amps. See Section 3.3.6.	0 to 9,999 Amps
VAUX SCALE	Sets full-scale auxiliary voltage input reading.	0 to 999,999 Volts
I4 SCALE	Sets full-scale I4 input current. This parameter should match the AMPS SCALE parameter.	0 to 9,999 Amps
VOLTS MODE	Sets volts mode.	4W-WYE, DELTA, SINGLE, DEMO

Table 3-1a Field Programmable Operating Parameters, part 1

Field Programmable Operating Parameters

Parameter	Description	Range
UNIT ID	Sets the SEAbus communication address.	1 to 254
BAUD RATE	Sets the communications baud rate.	300, 1200, 2400, 4800, 9600, 19200 Baud
COM MODE	Displays the communications mode: RS-232C or RS-485. This parameter is set by setting a jumper on the optional communications card and cannot be changed in programming mode. See Section 2.8.	N/A
DISPLAY TIMEOUT	Sets the number of minutes before the display turns off after the last button is pressed. The recommended setting is 180 minutes.	0 = display always on 1 to 999 minutes
CLEAR MAX/MIN?	Clears the stored maximum and minimum values. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	N/A
CLEAR KW/KVARHRS?	Clears the stored KWH and KVARH readings. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	N/A
DEMAND PERIOD	Selects Demand Sync mode or the length of each demand period used in calculating demand values. See Section 5.	0 = Demand Sync Mode 1 to 99 minutes
NUM DMD PERIODS	Sets the number of demand periods averaged to calculate demand values.	1 to 15 periods
PHASE ROTATION	Specifies the normal phase sequence. This is used for PF polarity detection in delta mode and for the phase reversal detection setpoint. See Section 4.	ABC, ACB
STNDRD FREQ	Specifies the frequency of the measured power system.	50, 60, or 400
I OUT KEY	Specifies the measured parameter for the current output.	See Table 3.2
I OUT SCALE	Sets the scale of the current output.	0 to 999,999
I OUT RANGE	Indicates 0-20 mA or 4-20 mA proportional current output.	0 = 0 to 20 mA 1 = 4 to 20 mA
FORMAT	Sets phase labels and decimal display formats. The Cursor button cycles between the phase label parameter and decimal display number parameter. The Increment and Decrement buttons modify the values for the selected parameters.	Phase Labels ABC, XYZ, RBY, and RST Decimal Display 1,234.5 or 1234,5

Table 3-1b Field Programmable Operating Parameters, part 2

3.4 Control Relay Operation

The 4700 power meter contains three control relays (R1 to R3), which can be used for a variety of purposes, such as activation of alarms or load control. Each relay can switch AC loads of up to 120 VAC, and DC loads of up to 24 VDC at 10 Amps. Remote operation of each relay is via the communications port.

The relays are also manipulated by setpoints on selected measured parameters. Setpoint operation is described in detail in Section 4, "Setpoint Operation."

Another use for the control relays is for KVAH, KVARH and KWH (relays 1, 2 and 3) pulsed output. See Section 3.4.4, "KVARH and KWH Pulse Operation" for more information.

Section 2, "Installing the 4700 Power Meter," shows wiring requirements for the control relays.

3.4.1 Control Relay Modes

You can assign each of the three relays to setpoint operation in *latch* or *pulse* mode, or to KVARH or KWH pulsing.

3.4.2 Access to Relay Parameters

The RELAY OPERATION parameter accesses the relay parameters, and also allows you to select which relay to program. Selecting a value of 0 (zero) skips all relay parameters when Parameter Select is pressed. Selecting 1, 2, or 3 accesses the programmable parameters for the selected relay.

3.4.3 Relay Setpoint Operation

For setpoint operation, the relays function in latch or pulse mode. In latch mode, the relay operates for the duration that the assigned setpoint is active (normally open contacts are closed). In pulse mode, when the setpoint is active, the relay operates for a specific pulse duration.

Set Rx MODE to SETPOINT for setpoint operation. Set Rx VALUE to latch mode (Rx VALUE = 0), or to pulse duration (in seconds) for pulse mode operation.

CAUTION

While the user is programming from the front panel or via communications, no setpoint-controlled relay operation occurs until after the user exits the programming mode. The meter then assesses the status of each setpoint and performs any required operations.

3.4.4 KVARH and KWH Pulse Operation

When a relay is configured for KVARH or KWH pulse operation, the pulses are based on the total energy imported (forward) and exported (reverse). Set Rx MODE to KVARH PULSE or KWH PULSE. In these modes, use Rx HRS/PULSE to set the number of unit-hours between pulses.

Note: A relay configured for KVARH or KWH pulse operation does not respond to an assigned setpoint that is active.

I OUT KEY	Measured Parameter
VOLTAGE A	Voltage, Phase A (or Vab for Delta)
VOLTAGE B	Voltage, Phase B (or Vbc for Delta)
VOLTAGE C	Voltage, Phase C (or Vca for Delta)
CURRENT A	Current, Phase A
CURRENT B	Current, Phase B
CURRENT C	Current, Phase C
KW A	kW, Phase A
KW B	kW, Phase B
KW C	kW, Phase C
KVA A	kVA, Phase A
KVA B	kVA, Phase B
KVA C	kVA, Phase C
KVAR A	kVAR, Phase A
KVAR B	kVAR, Phase B
KVAR C	kVAR, Phase C
VOLTAGE AV	Voltage, average
CURRENT AV	Current, average
KW TOTAL	kW, total
KVA TOTAL	kVA, total
KVAR TOTAL	kVAR, total
PF	Power Factor, total
KW DEMAND	kW Demand, total
AMP DEMAND	Amps Demand, total
FREQUENCY	Frequency
VAUX	V_{aux}
CURRENT I4	I_4 (neutral or ground current)

Table 3-2 I OUT KEY Parameter Options

3.4.5 Forced Relay Operate/Release

You can *force* operate or release relays by commands via the communications port. Manual forced operate and forced release commands override any present setpoint condition. Forced operate commands made via communications affect only a setpoint relay (Rx MODE = SETPOINT).

If the relay is in *pulse* mode (Rx VALUE > 0), a forced operate command initiates a pulse of length equivalent to the value set by the Rx VALUE parameter for that relay. This operation is recorded in the event log and indicates that the relay was pulsed. A forced release command has no effect.

If the relay is in *latch* mode (Rx VALUE = 0), it behaves normally for forced operate, forced release, and return to normal (return to setpoint control) commands.

See below for manual relay control special cases.

3.4.6 Relay Event Logging

For a relay assigned to setpoint operation (Rx MODE = SETPOINT), the event log records relay operations in one of two ways, depending on whether the relay is set to operate in latch or pulse mode.

a) Pulse mode (Rx VALUE > 0): The event log shows that the relay is pulsed when the setpoint becomes active. When the setpoint returns to its inactive state, the setpoint event is logged but does not indicate the relay is pulsed, since no pulse is generated.

b) Latch mode (Rx VALUE = 0): The event log records that the relay is operated (ON) when the setpoint becomes active, and is released (OFF) when the setpoint returns to an inactive state.

If the relay is configured for KVAH, KVARH, or KWH pulse mode, no relay operations are recorded in the event log.

3.4.7 Manual Relay Command Special Cases

If a manual forced operate command for a selected relay is received while that relay is already in a forced operated state, then the relay command is ignored and is not logged. This is also true for a forced release command sent to a relay already in a forced released state. In addition, manual relay commands sent to relays in KVARH or KWH pulse mode are not logged.

3.4.8 Relay Operation After Power Outages

When the power feed to the 4700 power meter is interrupted, even momentarily, the output relays are released. When power is restored, the meter allows a three-second settling time, then reevaluates setpoint conditions. If appropriate, the relays operate after the programmed time delays.

Any forced operated or forced released relay is released, followed by a resumption of normal setpoint operation.

3.5 Bi-Directional Energy

Energy measurements represent the KWH or KVARH sums for all three phases. Energy parameters provide three measurement modes that indicate bi-directional power flow: *forward, reverse,* and *total.* KWH and KVARH can provide all three modes.

Total energy measurements represent the sum of the absolute values of imported and exported energy. Total energy values are incremented by energy that is imported or exported.

Imported real or reactive energy is displayed with an F suffix (KWH-F, KVARH-F), indicating *forward* flow. Exported energy values are displayed with an R suffix (KWH-R, KVARH-R), indicating *reverse* flow.

Note: Only KWH-F / KWH-R and KVARH-F / KVARH-R measurements are displayed from the front panel. KWH and KVARH total values are read only via communications.

3.6 Status Input Operation

The 4700 power meter provides four optional status inputs (S1 to S4), which are used to sense the state of an external contact. If the input voltage is below 9 VAC or VDC, the input is sensed as inactive. If it is over 20 VAC or VDC, it is sensed as active.

The status of these inputs is viewed using a Power Monitor display and monitoring unit (or other computer running Power Monitor PC, WinPM, or custom software) connected to the communications port.

You can program the Status Input #4 (S4) to initiate KW Demand Synchronization. See Section 5, "Demand," for more information.

The 4700 power meter maintains a counter for the Status Input #1 (S1). The counter accurately follows a maximum frequency of 0.3 Hz. You can reset the counter to zero at any time via the Power Monitor unit or another computer connected to the communications port.

Section 2, "Installing the 4700 Power Meter," shows several wiring diagrams illustrating connections for the status inputs.

3.7 Fourth Current Input Operation

The 4700 power meter includes an optional fourth current input, designated I_4. The input uses connections I41 and I42 on the terminal strip. The AMPS SCALE parameter sets the scaling for all four current inputs. Therefore, the CT primary rating of the I_4 current input must be the same as the CT primary ratings for the three-phase current inputs (5 Amperes nominally).

Normally, this input is used to measure current in the neutral conductor. In installations with nonlinear loads, odd harmonics can fail to cancel, producing significant currents in the neutral conductor.

The I4 reading is viewed from the front panel by pressing the Function button until displayed. It is also viewable remotely.

3.8 Waveform Capture

Digital waveform capture capabilities are used for detailed power quality analysis.

Waveform capture allows the user to perform high-speed sampling of the V1, V2, V3, V_{aux}, I1, I2, I3, or I4 (neutral current) inputs. One full cycle of the signal at a *single* input is sampled at a rate of 128 samples per cycle. All samples are taken in sync with the communications line frequency, and within one input cycle.

Sampled waveform data is stored in on-board memory and is read via the communications port. The high sampling rate produces high-resolution data, which allows analysis of frequency components to the 63rd harmonic.

You can upload captured waveform data to a master computer to display the waveforms and perform Fast Fourier Transforms on them. This provides an indication of total harmonic distortion and a breakdown of individual frequency components.

From the master computer, the operator requests the capture of individually selected 4700 power meter inputs. The computer then uploads the waveform data. Waveform capture is automatically reinitiated when the 4700 power meter on-board memory is read via the communications port.

4. Setpoint Operation

4.1 Introduction

The 4700 power meter can monitor several measured parameters simultaneously and then generate alarms and controlling relays based on the parameter values. The meter uses predefined *setpoints* to activate this functionality. A setpoint is a group of six programmed parameters that tells the unit:

1. which measured parameter to monitor (setpoint type), and activation setting of over or under the value.
2. the high limit.
3. the low limit.
4. the time delay for relay operation.
5. the time delay for relay release.
6. which relay to activate, if any, when appropriate limits are exceeded and time delay conditions are met.

4.2 Applications

The 4700 power meter supports 17 different setpoints simultaneously, numbered 1 to 17. All of the setpoints are programmable from the front panel. Table 4-1 outlines the measured parameters that the setpoints can monitor. You can use the setpoints to operate the following types of control relays:

1. Trip Relay — to shunt trip a breaker
2. Alarm Relay — to activate an alarm buzzer or light
3. Control Relay — to control an external piece of equipment
4. Remote Control Relay — to control an external piece of equipment via the communications port
5. KVARH Pulse Output Relay (relay 2)
6. KWH Pulse Output Relay (relay 3)

CAUTION

The response time of the relays is 1 to 2 seconds, up to 5 seconds after meter power up, and is disabled when in programming mode. Do not use the 4700 power meter for protective functions, which require faster operation. Use separate reliable AC or DC control power when shortest possible reaction times are needed.

You can assign any of the three relays to a single setpoint, or to several setpoints. A relay is activated if any of the setpoints controlling it become active.

In addition, you can use relays 1, 2 and 3 for KVARH and KWH pulsing.

4.3 Over Setpoint

An over setpoint activates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter. When a setpoint becomes active, it operates the assigned relay, if any. The setpoint status change is stored in the event log, and includes the time and parameter value.

An over setpoint deactivates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to Figure 4-1). The setpoint status change is also logged, and includes the time of return-within-limit and the out-of-limit value.

4.4 Under Setpoint

Under setpoints function similarly to over setpoints, except they operate for opposite reasons. An under setpoint activates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to Figure 4-2).

An under setpoint deactivates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter.

4.5 Programming Setpoints

To program setpoints, switch to programming mode and enter your password. Press the Parameter Select button until the SETPOINT NUM parameter appears. Then enter the setpoint number, from 01 to 17, of the parameter you want to program. Program the setpoint by entering new values for all parameters associated with the selected setpoint.

CAUTION

After entering your password in programming mode, no setpoint-controlled relay operations occur until you exit programming mode. The 4700 power meter then assesses the status of each setpoint and performs any required operations.

It is recommended that you use a Setpoint Parameter Form to plan your setpoints, *before* entering programming mode. Table 4-2 is an example Setpoint Parameter Form, containing information about the six parameters as they correspond to each setpoint. Complete a similar form, like the one available in Appendix B, and keep a copy with the meter.

The example Setpoint Parameter Form displays the following attributes:

Relay 1 is used as an trip relay, with over voltage, under voltage, voltage unbalance, and phase reversal trips enabled. The relay is connected to the breaker shunt trip input.

Relay 2 is used as an alarm relay to warn of loads over 70% of the breaker rating. Its output is connected to a buzzer.

Relay 3 is used as a KW demand control relay.

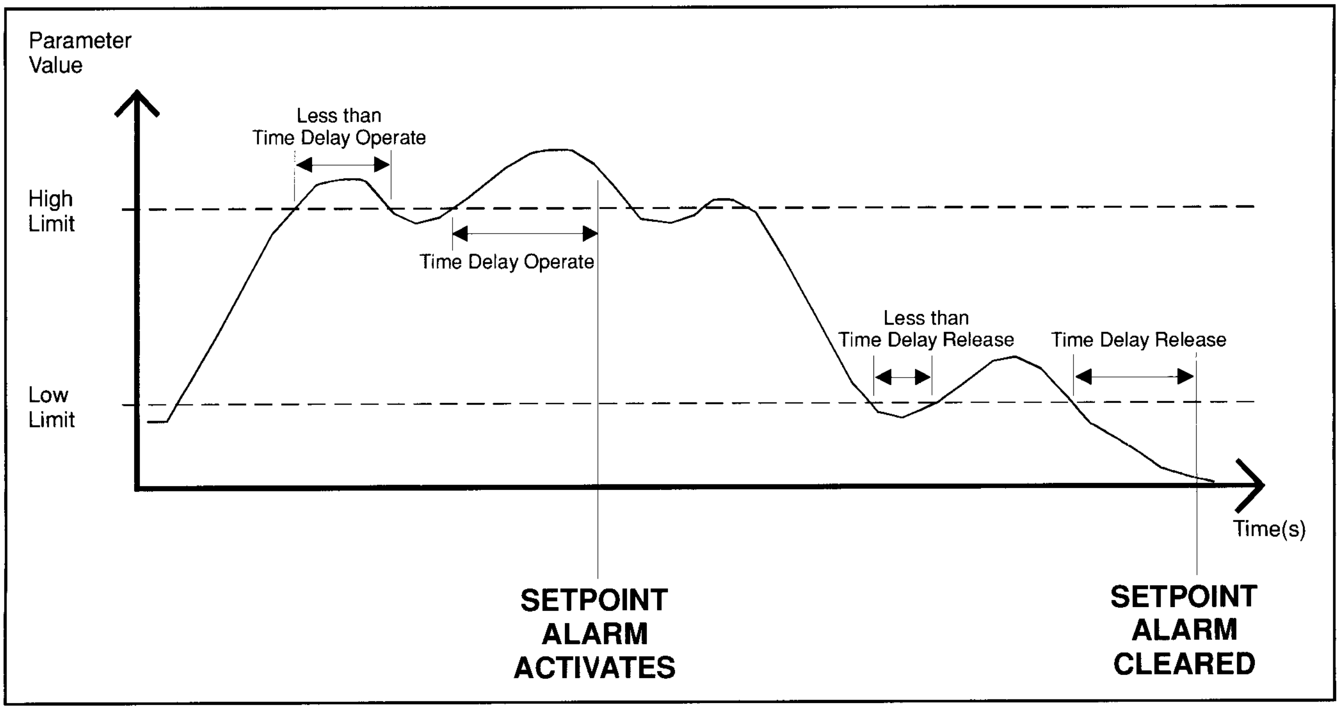


Figure 4-1 Over Setpoint Operation

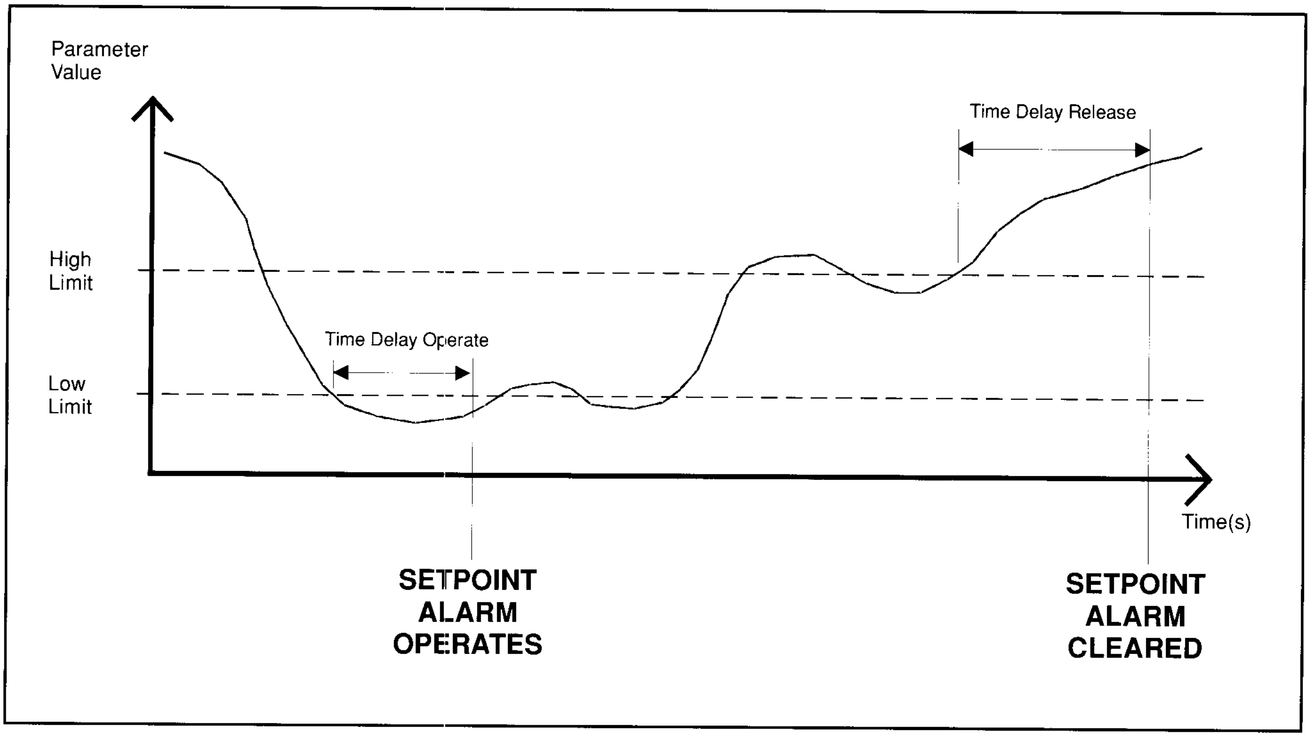


Figure 4-2 Under Setpoint Operation

SETPOINT TYPES

Type	Description
NOT USED	A setpoint not currently in use.
OVER VOLT	Over voltage (highest phase voltage).
UNDER VOLT	Under voltage (lowest phase voltage).
VOLTAGE UNBAL	% difference of most deviant phase voltage from the average.
OVER CURRENT	Over current (highest phase current).
CURRENT UNBAL	% difference of most deviant phase current from the average.
OVER KVA	Over KVA.
OVER KW	Over KW.
OVER KWREV	Over negative KW (feeding power into utility grid).
OVER KVAR FWD	Over KVAR foward (imported) reactive power.
OVER KVAR REV	Over KVAR reverse (exported) reactive power.
OVER KWD	Over KW demand.
OVER AMPD	Over amp demand.
OVER FREQUENCY	Over frequency. (Enter: Frequency x 10 [i.e. 60Hz = 600])
UNDER FREQUENCY	Under frequency. (Enter: Frequency x 10 [i.e. 60Hz = 600])
OVER VAUX	Over auxiliary voltage.
UNDER VAUX	Under auxiliary voltage.
PHASE REVERSAL	Phase reversal. Operates if the phase rotation does not match the programmed normal operation.
UNDER PF LAG	Under power factor lagging.
UNDER PF LEAD	Under power factor leading.
OVER I4	Over I4 current.

Table 4-1 Setpoint Types

Setpoint Parameter Form						
SETPOINT	TYPE	HIGH LIMIT	TD OPERATE	LOW LIMIT	TD RELEASE	RELAY/FUNCTION
1	Over Volts	332	5	290	1	1 Trip
2	Under Volts	270	5	220	1	1 Trip
3	Volts Unbal.	30%	5	10%	1	1 Trip
4	Phase Reversal	-	1	-	1	1 Trip
5	Not Used					
6	Not Used					
7	Over Amps	2100	10	2000	1	2 Alarm
8	Over Volts	300	10	290	1	2 Alarm
9	Under PF Lag	90	10	85	10	2 Alarm
10	Under PF Lead	90	10	85	10	2 Alarm
11	Over KWD	1200	10	900	10	3 Demand Control
12						
13						
14						
15						
16						
17						

Table 4-2 Setpoint Parameter Form

5. Demand

Power utilities generally bill commercial customers based on both their energy consumption (in KWhr) and their peak usage levels, called peak demand (in KW). *Demand* is a measure of average power consumption over a fixed time period, typically 30 minutes. *Peak Demand* is the highest demand level recorded over a specific billing period.

5.1 Demand Measurement Methods

Demand measurement methods, and their intervals, vary according to individual utilities. Some common methods include: thermal averaging, the fixed interval technique, and the sliding window technique.

In thermal averaging, the demand indicator responds to heating of a thermal element in the watt hour meter. The demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes.

The fixed interval technique measures average usage electronically over each period. The highest recorded value is the peak demand.

The sliding window technique, or "rolling interval" method, divides the demand interval into subperiods and the demand is measured electronically, based on the average load level over the most recent set of subperiods. This has the effect of improving the response times, in comparison with the fixed interval method. For example, with a 6x5 minute (30 minute total) sliding window, demand is the average power consumption over the last six five-minute periods.

5.2 Internally Timed Demand Measurement

The 4700 power meter uses the sliding window method to measure demand. You can program both the DEMAND PERIOD (1 to 99 minutes) and NUM DMD PERIODS (1 to 15) for averaging. This allows you to match virtually any utility demand measurement method. Refer to Table 5-1 for more information.

5.3 Demand Synchronization

The 4700 power meter includes the option of starting demand intervals that correspond to an active pulse. Set the DEMAND PERIOD parameter to zero, which initiates the Demand Sync mode. Instead of internally timing the duration of each demand period used in the KW demand calculation, the meter looks for an ACTIVE pulse on Status Input #4 (S4). You can still specify the number of demand periods in this mode, as previously explained.

Utility Method	**4700 Programming**	
	Demand Period (in minutes)	**Number of Demand Periods (must be 15 or less)**
Fixed Interval	Utility Period	1
Fixed Interval Emulation	Utility Period / 15	15
Thermal	Utility Period / 15	15
Sliding Window	Utility Sub Period	Utility # of Sub Periods

Note: With the fixed interval method, the 4700 power meter maximum reading and the utility reading are not necessarily the same, unless the demand periods are time-synchronized. The best way to resolve this problem is to use the sliding window method with the same total demand period as the utility, as shown above. The 4700 power meter maximum demand reading is then always equal to or slightly higher than the utility readings.

Table 5-1 Demand Calculation Chart

6. Communications

6.1 Introduction

The 4700 power meter is optionally equipped with a communications card, allowing data transfer between the unit and other display and monitoring devices such as the PC32F Power Monitor unit. The Power Monitor unit provides complete control of several 4700 power meters, and other ACCESS-compatible field devices, through a common RS-485 communications connection. The 4700 power meter accepts either RS-232C or RS-485 communications connections.

Before communication is possible, the user must program the communication parameters of the 4700 power meter. This is performed on the front panel of the unit or via the communications port. Set the ADDRESS for each meter to a unique value (see "RS-485 Communication" below). The BAUD RATE of the meter must correspond with the baud rate selected for all devices in the network. The COM MODE (communications mode) is set by the jumper position on the communications card, as explained in Section 2.8.1.

6.2 Connecting to the ACCESS System

RS-232C Communication

RS-232C communication is used for direct connection between a single 4700 power meter and a computer (distance less than 50 ft.).

RS-485 Communication

Use an RS-485 communications cable for connecting more than one 4700 power meter to a network. Each meter must have a unique address, allowing monitoring and control from a single Power Monitor unit or other computer.

The total distance limitation for RS-485 connections is 4000 feet, using 22 gauge twisted-pair shielded cable. Refer to Section 2, "Installing the 4700 Power Meter," for connection diagrams.

CAUTION

Ensure that the shield of each leg of the RS-485 cable is grounded at one end only.

7. Troubleshooting the 4700 Power Meter

This section lists some symptoms of improperly functioning meters and explains how to correct them. If your problem persists, or is not listed here, fill out the problem report located in the back of this manual and contact Siemens customer support by phone or fax.

The display does not operate.

1. Check that there is an appropriate voltage available to the power supply (L and N connections on the terminal strip).
2. Confirm that the VREF terminal is connected directly to ground.
3. Press a button on the front panel.

The voltage or current readings are incorrect.

1. Check that the VOLTS MODE is properly set for the given wiring.
2. Check that the voltage and current scales are properly set.
3. Make sure the VREF terminal is properly grounded.
4. Check the quality of the CTs and VTs in use.
5. Make the following voltage tests:
    a) V1, V2, V3 to VREF are 120 VAC (or rated full scale values of 277 or 347 VAC)
    b) VREF to switchgear earth ground is 0 V
    c) L to VREF is 120 VAC or DC (or optional rated control power voltage)
    d) N to VREF is less than 2 VAC
    e) All current inputs are less than 1 VAC with respect to VREF.

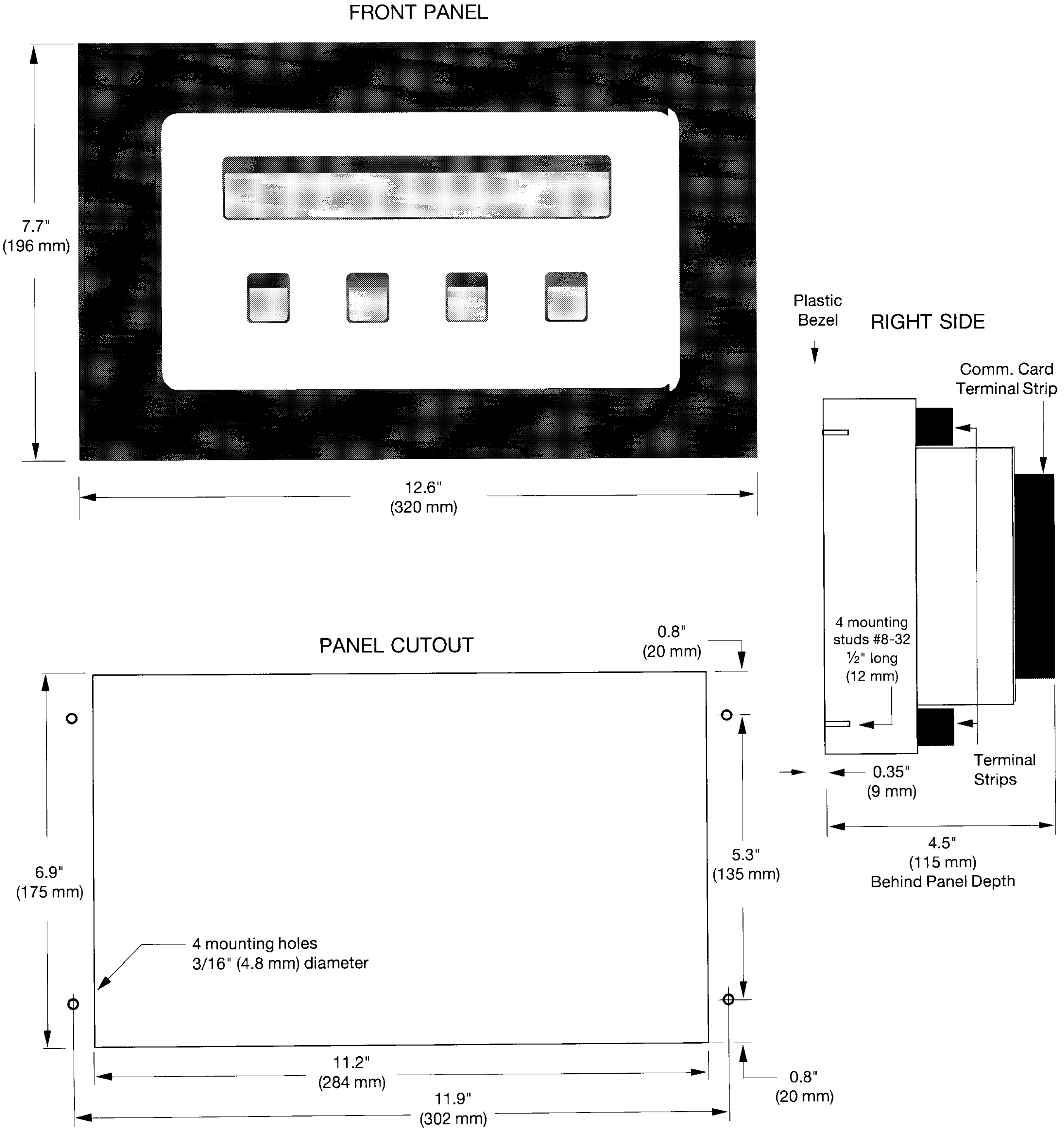
The KW or power factor readings are incorrect but Voltage and Current readings are OK.

1. Make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.

RS-232C or RS-485 communication does not work.

1. Check that the BAUD RATE matches all other ACCESS devices on the network or the personal computer.
2. Check that the communications mode (RS-232C or RS-485) set by the jumper on the communications card matches the given installation. See Section 2.8, "Communication Connections."
3. Check that the ADDRESS of the 4700 power meter matches the configuration of the Power Monitor unit or other computer.

4700 Mechanical Dimensions — Mounting



Appendix B

Setpoint Parameter Form

SETPOINT	TYPE	HIGH LIMIT	TD OPERATE	LOW LIMIT	TD RELEASE	RELAY/FUNCTION
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

4700 Power Meter Software Versions

The following table lists each software version release for the 4700 power meter and the new features or performance enhancements added with each release.

The version number is identified on the label on the rear cover of the 4700 power meter (see Figure 1-1). If yours is currently using a software version older than the most recent version listed in the table below, you can upgrade the software in that unit by contacting your local representative or the manufacturer. Upgrades to the 4700 power meter require a simple replacement of the EPROM (integrated circuit "chip"), which contains the operating software inside the unit. This must be done by a trained electronics serviceman.

Hardware Revision B

From now on, all EPROMs are available for either the A or B hardware. They are not interchangeable. Normally, only the B is released except for an upgrade of an older meter. Revision B meters are easily distinguished from revision A meters by the following:

- Raised black plastic bezel (Rev. A has a flat, white metal bezel)
- Product Rev: B printed on back of meter
- VREF terminal (Rev. A has no VREF terminal).

Software Version	Release Date	Description
2.2.0.2B	January 1, 1992	Exactly the same as Rev. A 2.2.0.2
2.2.0.3B	March 31, 1992	Fixed bug that limited unit ID (address) to 1...99
2.3.0.4B	January, 1993	Fixed bug with KWH/KVARH overflow causing display to blink. Fixed bug that lost password changes if powered down. Adds waveform capture feature. Adds reverse KVARH value. KVARH and KWH changed to return forward not total values. Adds configurable relay pulsing. Adds KW FWD, KVAR FWD, and KVAR REV setpoints. PF display changed to LD/LG. 3-wire Wye mode allows for 2VT/3CT. Demand period is now based on time of day. Added ,/. configuration of display values (European format). RTS line is asserted 10ms before tx in RS-232C mode. PM 3.13 logs diagnostic code 1 type 1 errors with this version.

Appendix D

4700 Power Meter Technical Specifications

Parameter	Accuracy (%)	Resolution (%)	Range
Volts	0.2	0.1	0 to 999,999 (1)
Amps (L & N)	0.2	0.1	0 to 9,999
KVA	0.4	0.1	0 to 999,999 (2)
KW	0.4	0.1	0 to 999,999 (2)
KVAR	0.4	0.1	0 to 999,999 (2)
PF	1	1	1.0 to +/-0.6
FREQUENCY	0.2 Hz	0.1 Hz	40 to 70 Hz
KW DEMAND	0.4	0.1	0 to 999,999
AMPS DEMAND	0.2	0.1	0 to 9,999
KWHR	0.4	1 KWHR	0 to 999,999,999
KVARHR	0.4	1 KVARHR	0 to 999,999,999
Vaux (1 VAC scale)	0.25	0.1	0 to 999,999
Neutral Current	0.2	0.1	0 to 9,999

Notes

(1) Reads in KV for voltages over 9,999

(2) Reads in MVA, MW, MVAR for readings over 9,999

Input Ratings	
Voltage Inputs:	120 VAC, 277 VAC, and 347 VAC nominal full scale input versions
(V1, V2, V3)	Overload withstand: 1500 VAC continuous, 2500 VAC for 1 Sec.
	Input impedance: 2 Megohm
Aux. Voltage Input:	1.0 VAC/VDC nominal full scale input (1.25 VAC/VDC max.)
(Vaux)	Overload withstand: 120 V continuous, 1000 V for 1 Sec.
	Input impedance: 10 Kohm
Current Inputs:	5.000 Amps AC nominal full scale input
(I11, I12, I21, I22	Overload withstand: 15 Amps continuous, 300 Amps for 1 Sec.
I31, I32, I41, I42)	Input impedance: 0.02 ohm, Burden: 0.05 VA
Status Inputs:	>20 VAC/VDC = active, <9 VAC/VDC = inactive
(S1, S2, S3, S4)	(S1, S2, S3, S4) input impedance: 2 Megohm
	Overload withstand: 1500 V continuous, 2500 V for 1 Sec.
Control Relays:	Form C dry contact relays
(R1, R2, R3)	277 VAC or 24 VDC @ 10 Amp maximum load current
Aux Current Output (Iout):	0-20 mA. Maximum load 250 ohms resistive.
Power Supply:	Standard N. American: 85 to 132 VAC/0.2 Amps/47 to 440 Hz or 110 to 170 VDC/0.2 Amps
	European/Optional: 85 to 264 VAC/0.2 Amps/47 to 440 Hz or 110 to 340 VDC/0.2 Amps
	Other Available Options: 24 VDC and 48 VDC
Operating Temperature:	0°C to 50°C (32°F to 122°F) ambient air temperature range

Voltage, Current, Status, Relay and Power inputs all pass the ANSI C37.90A surge withstand and fast transient test.

4700 Power Meter Model/ Ordering Information

Features	Product Designations	
	DR	DRMC3
15 metered parameters	X	X
Min/Max log	X	X
Aux voltage (1VAC/1VDC nominal)	X	X
20 character display	X	X
Four discrete inputs	X	X
Three programmable relay outputs	X	X
One analog ouput (4 to 20mA)	X	X
Communications module installed		X
Event Log		X
Snapshot Log		X
Waveform Capture		X

Table E-1 4700 Power Meter Product Designations

4700 Power Meter Catalog Number Designations

4700B - DR MC3 - 1 2 HN ☐

Options:
MC3 = Optional Communications module (RS-232C & RS-485), Event log, Snapshot log, Waveform Capture

Power Supply Voltage:
1 = 120 VAC/125 VDC
2 = 240 VAC/250 VDC
3 = 24/48 VDC

Measured Phase Voltage (Ref to Neutral):
1 = 120 VAC (50/60Hz)
2 = 277 VAC (50/60Hz)
3 = 347 VAC (50/60Hz)

Additional Options:
F = 400Hz metering application
T = Extended temperature capability (-30° to +70°C)

Examples:

"4700B-DRMC3-11HN" denotes a power meter with an isolated RS-232/RS-485 communications module installed, a 120VAC/125VDC power supply, and 120VAC nominal measured phase voltage inputs.

"4700B-DR-12HNT" denotes a power meter with 120VAC/125VDC power supply, 277VAC nominal measured phase voltage inputs, and extended temperature capability.

Warranty and Registration

Warranty

Company warrants that on the date of shipment to Purchaser the goods will be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

If within one year from date of initial operation, but not more than eighteen months from date of shipment by Company, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such defect by, at Company's option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Company hereunder. Company shall have the right of disposal of items replaced by it. Purchaser shall grant Company access to the goods at all reasonable times in order for Company to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, the Company and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

The Company's responsibility does not extend to any item of the goods which has not been manufactured and sold by Company. Such item shall be covered only by the express warranty, if any, of the manufacturer thereof. The Company and its suppliers shall also have no responsibility if the goods have been improperly stored, handled or installed, if the goods have not been operated or maintained according to their ratings or according to instructions in Company or supplier furnished manuals, or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE), INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE GOODS.

The foregoing states Purchaser's exclusive remedy against Company and its suppliers for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity or any other legal theory, and whether arising out of warranties, representations, instructions, installation or defects from any cause.

Registration

Siemens customer service personnel record your warranty date as the date of energization. This allows Siemens to add you to our mailing list and to keep you up to date on the latest product software releases and new feature offerings.

Your comments and suggestions for product improvement and feature additions are welcome.

Problem Report for ACCESS Systems and Devices

If you have a problem with Siemens ACCESS systems or devices, please make a copy of this two-page form and fill it out. Then contact your Siemens representative to report the problem. (If you have an emergency, call 1-800-241-4453.)

Customer Information

Job-site contact ____________________
Company's name ____________________
Job site or location where equipment is installed
____
Siemens sales order number ____________________
____
Siemens manufacturing order number (from manufacturing drawing) ____________________
Date problem occurred ____________________
Contact's phone number ____________________
Contact's fax number ____________________

Device Information

If you are experiencing a problem with a specific device, please provide the following information from the device's label(s):

Device type ____________________
Model (or catalog number) number ____________________
Part number ____________________
Serial number ____________________
Hardware version ____________________
Software version ____________________
Device options ____________________

Problem-Specific Information

1. Please provide a brief, general description of any performance problems with the system or any devices. ____________________

2. Does the system have any of the following supervisory and monitoring devices? How many?

   - ☐ ACCESS Host PC ____________________
   - ☐ Power Monitor unit ____________________
   - ☐ Power Monitor PC software ____________________
   - ☐ Siemens PLC ____________________
   - ☐ SIEServe software ____________________
   - ☐ WinPM software ____________________
   - ☐ Other (please specify) ____________________

3. How many of the following ACCESS devices are on the system?

   - ☐ 3600 power meter ____________________
   - ☐ 4300 power meter ____________________
   - ☐ 4700 power meter ____________________
   - ☐ Static Trip IIIC trip unit ____________________
   - ☐ Static Trip IIICP trip unit ____________________
   - ☐ SCOR relay ____________________
   - ☐ SB breaker trip unit ____________________
   - ☐ Sensitrip III trip unit ____________________
   - ☐ SAMMS device ____________________
   - ☐ Isolated Multi-Drop converter ____________________
   - ☐ Multiplexer Translator ____________________
   - ☐ Other (please specify) ____________________

4. What type of electrical equipment is the system or device installed on (switchgear, motor control center, switchboard, etc.)? ____________________

5. If the problem is with a specific device, describe its configuration; that is, describe its particular operational settings and parameters. (Attach additional sheet if necessary.) ______________

6. List any error codes, error messages, or targets that have been generated by the system or by individual devices. ______________

7. If the device is installed on an ACCESS system, please provide a summary (or a copy) of any Event Logs and System Diagnostic Logs. ______________

8. Please provide any other information that you think might help Siemens correct the problem (such as information about the wiring, system application, system load, operating environment, or about the physical condition of the system or devices). ______________

To be completed by Siemens personnel

Initial Problem Report completed by ______________

Division or department name ______________

Phone number ______________

Problem report reviewed by ______________

Review date ______________

Sales engineer ______________

Problem referred to ______________

Date problem referred ______________

Problem Report tracking number ______________

Problem classification code ______________

Corrective action taken ______________

Upon completing this form, please forward a copy to:

Siemens Energy & Automation, Inc.
Switchgear and Motor Control Division
Customer Service Department
P. O. Box 29503
Raleigh, North Carolina 27626-0503

Fax Number 919-365-2315

SIEMENS

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SIEMENS

4700 Power Meter

Operator's Manual

Manual No. SG-6018-02

⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

Will cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel.

The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

QUALIFIED PERSON

For the purposes of this manual a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, that person has the following qualifications:

(a)**is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b)**is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, or face shields, flash clothing, etc., in accordance with established safety procedures.

(c)**is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

The contents of the instruction manual shall not become part of or modify any prior or existing aggreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

Table of Contents

1. Introduction

1.1 About the 4700 Power Meter

The 4700 power meter is a microprocessor-based instrumentation package for low, medium or high voltage electrical equipment and substations. It is a state-of-the-art alternative to traditional analog electromechanical metering devices. The unit is economical and is easy to install and operate. It requires no external transducers.

This manual supersedes all previous publication versions on the installation and operation of the 4700 power meter.

1.2 Performance Features

The 4700 power meter offers major improvements in accuracy, communications capability, data logging, control capability, ease of use, and cost, compared to traditional analog components or first generation digital metering systems. The 4700 power meter operates as a stand-alone switchboard, switchgear, motor control center or substation instrument, and serves as a data collection point for Siemens ACCESS™ electrical distribution communication system.

The unit uses a 12 MHz, 16-bit microcontroller chip. This provides very high computational throughput, allowing the sophisticated software to process information in real time. The unit is self-contained and its readings and setup parameters are maintained in nonvolatile memory. Connections to the 4700 power meter are on the rear of the unit, as shown in Figure 1-1.

1.3 Measurement Functions and Displays

You can view readings from the alphanumeric display. Readings are displayed in the following format:

- 4-digit voltage display phase indication
- 4-digit amperage display
- 8-digit power function display

The unit can be configured to operate in Wye (Star), Delta, or single-phase voltage modes. The following measurements are available:

- Current on each phase
- A fourth current input (I4)
- Line-to-line voltages
- Frequency
- Power factor
- KVA
- KW
- KVAR
- KW Demand
- V_{aux} (auxiliary voltage input)
- Total MWhr
- Total MVARhr

Minimum and maximum values for each of the readings are available. You can also set the unit to take snapshots of all readings at specified intervals and maintain them in nonvolatile memory. The snapshot data is read using the serial communications port.

1.4 Other Functions

Logging Capability

The 4700 power meter can record up to three data logs.

- EVENT Log. This log records events such as power up, parameter changes, alarm conditions, relay changes, and status input changes. The 50 most recent events are retrievable from this log using the communications port.
- SNAPSHOT Log. This log contains voltage, current, and all power values recorded at user-defined time intervals. The 100 most recent snapshots are retrievable from this log using the communications port.
- MIN/MAX Log. This log records the extreme values for voltages, currents, power, and other measured parameters. Min/Max data is read using the integral display or the communications port.

All log contents (events, snapshots, and min/max values) are time-stamped to the second.

Control Relays

The 4700 power meter has three control relay options.

- Alarm relays and setpoint relays. These can operate as a function of any measured parameter for demand, power factor, or load control.
- Remote control relays, operated by command via the communications port.
- KVARH, KWH pulse outputs.

Status Inputs

The 4700 power meter also has four status input options available, which can each sense the state of an external contact, active or inactive. The status of these inputs is viewed and logged by a Power Monitor™ display and monitoring unit, or by another computer through the communications port.

Auxiliary Voltage Input

All 4700 power meter models have an auxiliary voltage input that allows monitoring and display of an additional external voltage (1.25 VAC max).

Auxiliary Current Output

You can program an optional analog current output for 0 to 20 mA or 4 to 20 mA, in proportion to any measured parameter.

1.5 Communications and ACCESS Compatibility

The 4700 power meter is equipped with an optically isolated communications port for displaying data on remote supervisory devices. These devices and programs allow the meter to operate in the ACCESS electrical distribution communication system. Examples of supervisory devices include the Power Monitor display and monitoring unit, a standard personal computer running the Power Monitor PC™ communications and supervisory software, and Siemens Microsoft® Windows™-based SIEServe™ or WinPM™ communications software.

1.6 System Applications

The unique features of the 4700 power meter, including measurement, storage, setpoint (load shedding) and display characteristics, make it suitable for use in:

- Utility Installations
- Industrial Buildings
- Office Buildings
- Commercial Buildings
- Hospitals
- Telephone Exchanges
- Factories
- Pulp Mills
- Saw Mills
- Shopping Centers
- Large Stores
- Hotels
- Substation Metering
- Co-generation Systems
- Chemical Process Plants
- Multi-user sites where allocation of electrical cost is desirable
- Any other installation that uses significant amounts of electrical energy
- Any other location where remote monitoring and control is needed.

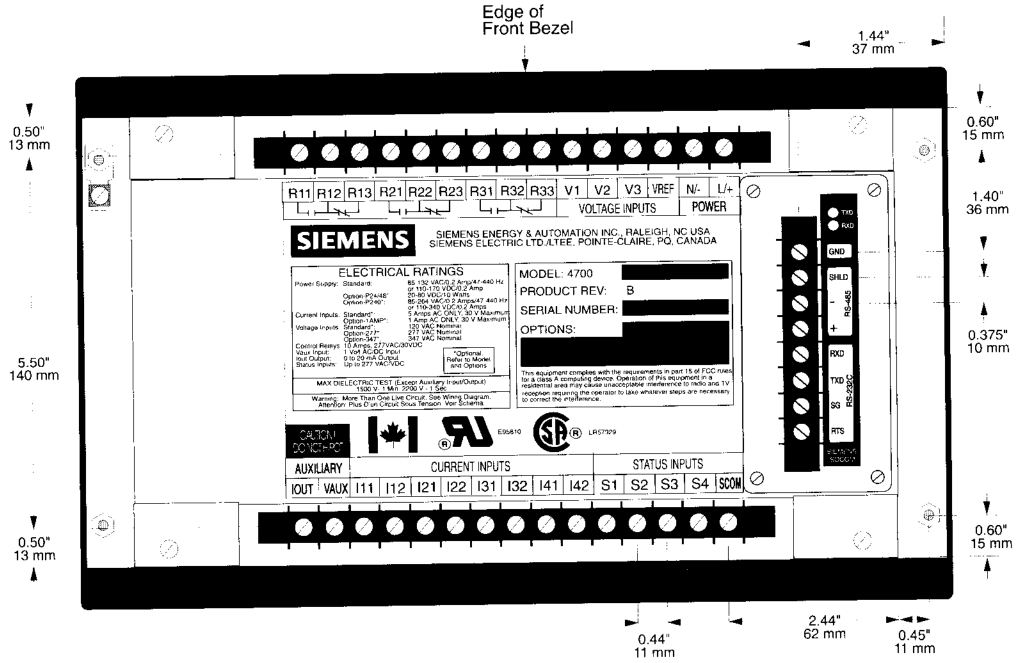


Figure 1-1 4700 Power Meter Rear Terminal Block Dimensions and Functions

2. Installing the 4700 Power Meter

⚠ DANGER

During normal operation of this device hazardous voltages are present, which can cause severe injury or death. These voltages are present on the terminal strips of the device and throughout the connected voltage transformer (VT), current transformer (CT), status input, relay, and control power circuits. It is recommended that installation and servicing is performed by qualified, properly trained personnel only.

2.1 Location and Mounting

Locate the 4700 power meter in a dry, dirt-free environment, away from heat sources and very high electric fields. Temperatures must not exceed 50°C (122°F) or fall below 0°C (32°F).

The 4700 power meter can be panel-mounted for easy access and viewing. The meter has four studs to facilitate panel mounting. Five inches of available depth in the panel are required.

Refer to Appendix A for the mounting dimensions of the 4700 power meter.

2.2 Power Supply

The standard 4700 power meter requires 85 to 132 Volts AC (47 to 440 Hz) or 110 to 170 Volts DC, both at 0.2 Amps. The power can be supplied by a dedicated fused feed, or by the monitored voltage source (120 Volt system). Optional power supplies are available for 24 VDC/48 VDC, and 240 VAC/250 VDC.

2.3 Wiring the 4700 Power Meter

Connections to the 4700 power meter are made to two terminal strips located on the rear of the unit. Refer to Figure 1-1 for the 4700 power meter terminal block dimensions. Ring or spade terminals are recommended for all connections.

The phasing and polarity of AC current and voltage inputs, and their relationship, is critical to the operation of the power meter. Refer to Figures 2-1 through 2-6 for wiring diagrams to ensure correct installation.

2.3.1 Chassis Ground Connection

You must connect the chassis of the 4700 power meter to earth ground. A good, low-impedance chassis ground is essential for the 4700 power meter surge and transient protection circuitry to function effectively. Do not rely on metal door hinges as a ground path.

Connect the ground wire to the chassis of a standard 4700 power meter using the supplied ground lug attached to one of the four mounting studs.

In both cases, ensure that the ground lug screw is tightened securely onto the ground wire, and that the nut is tightened securely onto the lug.

⚠ CAUTION

You must connect the 4700 power meter chassis ground lug to the switchgear earth ground using a dedicated 14-gauge (or larger) wire, so the transient and surge protection circuitry functions correctly. Failure to do so voids the warranty.

2.3.2 Voltage Reference Connection

The voltage reference terminal, VREF, of the 4700 power meter serves as the zero voltage reference for voltage readings. A good, low-impedance VREF connection is essential for accurate measurement. Use a dedicated 14-gauge wire for a connection at a point where there are no voltage errors due to distribution voltage drops.

The connection point for VREF is dependent on the system configuration. Each of the following configurations is illustrated in Figures 2-1 through 2-6:

a) If the system you want to monitor is a 4-wire Wye or Single Phase, then you must connect the VREF to the neutral conductor.

b) If the system is a 3-wire grounded (Delta), then you must connect the VREF to the line transformer neutral.

c) For 3-wire ungrounded (Open Delta) systems, and for systems where VTs are used, you must connect the VREF to the VT common leads.

2.3.3 Fourth Current Input Connections

The 4700 power meter is equipped with a fourth current input, labeled I4. This input is typically used to measure the current flow in the neutral or ground conductor. The use of this input is optional. If not used, connect the I41 and I42 terminals to earth ground.

The secondary rating of the CT connected to the I4 input must match the three phase current inputs. This rating depends on the presently installed input option in the 4700 power meter.

The primary rating for the CT connected to the I4 input can differ from the three phase inputs, since the I4 input scaling is independently programmable.

2.3.4 Waveform Capture Connections

The 4700 power meter waveform capture feature allows digital sampling of signals at each of its voltage (V1, V2, V3, Vaux) inputs and current (I1, I2, I3, I4) inputs. The 4700 power meter uses the V1 input as the triggering reference for waveform capture, and to maintain phase relationships between all sampled signals. You must connect the V1 input for waveform capture to work. No other special wiring considerations are necessary. Waveform capture is accessible only via communications. See Section 3.8, "Waveform Capture," for more information.

2.4 Selecting Voltage and Current Transformers

Selection of correct Current Transformers (CTs) and Voltage Transformers (VTs) is critical to proper monitoring. This section describes how to choose transformers.

2.4.1 Selecting VTs

The requirement and selection of VTs depends on three criteria: the system monitored, the voltage levels monitored, and the model of the 4700 power meter.

For connecting directly to 120/208 Volt systems, the *120 VAC* (full scale) input model is used. It is also used for systems with VTs having a 120 Volt secondary. For connecting directly to a 277/480 Volt system, the *277 VAC* (full scale) input model is used. For connecting a 347/600 Volt system, the *347 VAC* (full scale) input model is used. If system voltages are over 347/600 Volts, then VTs are required.

VTs are used to scale down the system L-N (Wye) or L-L (Delta) voltage to 120 Volts full scale, which is the nominal scale input of the 4700 power meter.

The VTs are selected as follows:

a) Wye (Star): VT primary rating = system L-N voltage or nearest higher standard size. VT secondary rating = 120 volts.

b) Delta: VT primary rating = system L-L voltage. VT secondary rating = 120 volts.

VT quality directly affects system accuracy. Therefore, for valid Volts, KW and PF readings, the VTs must provide good linearity and maintain the proper phase relationship between voltage and current. Instrument Accuracy Class 1 or better is recommended.

2.4.2 Selecting CTs

The 4700 power meter uses CTs to sense the current in each phase of the power feed. The selection of the CTs is important because it directly affects accuracy.

The CT secondary rating is always 5 Amps with a burden capacity greater than 3 VA (burden is the amount of load fed by the CT, measured in Volt-Amps).

Normally, the CT primary rating is selected equal to the Amp rating of the power feed protection device. However, if the anticipated peak load is much less than the rated system capacity, then improved accuracy and resolution is obtained by selecting a lower rated CT. In this case, choose the CT size equal to the maximum anticipated peak current plus 25%, rounded up to the nearest standard CT size available.

Other factors affect CT accuracy. Because long cable runs contribute to inaccuracy, try to minimize the length of the CT cable. Also, the CT burden rating must exceed the combined burden of the 4700 power meter plus cabling and any other connected devices.

VT and CT Considerations

Protect all phase voltage leads with breakers or fuses at their source. In cases where VTs are required and the power rating of the VTs is over 25 Watts, fuse the secondaries.

Connect CTs to the device via a shorting block or test block to facilitate safe connection and disconnection.

Refer questions regarding proper working procedures to qualified personnel.

2.5 Connecting to 3-Phase, Wye (Star) Systems

Without VTs

For a 4-wire Wye system, the 4700 power meter senses both the line-to-neutral (or ground) voltage and the current of each phase. This is the equivalent of a 3-element metering configuration.

If the power system you want to monitor is a 120/208 Volt system, then use the standard 120 VAC input model with direct sensing of each phase, without the need for VTs. If the system is a 277/480 or 347/600 Volt system, then use the 277 VAC or 347 VAC input models connected directly.

Note: Although the 277 VAC and 347 VAC models can be connected directly, VTs may be required to meet local electrical codes when the 4700 is panel mounted.

The wiring diagram for these voltage ranges is shown in Figure 2-1. Set VOLTS MODE to 4W-WYE.

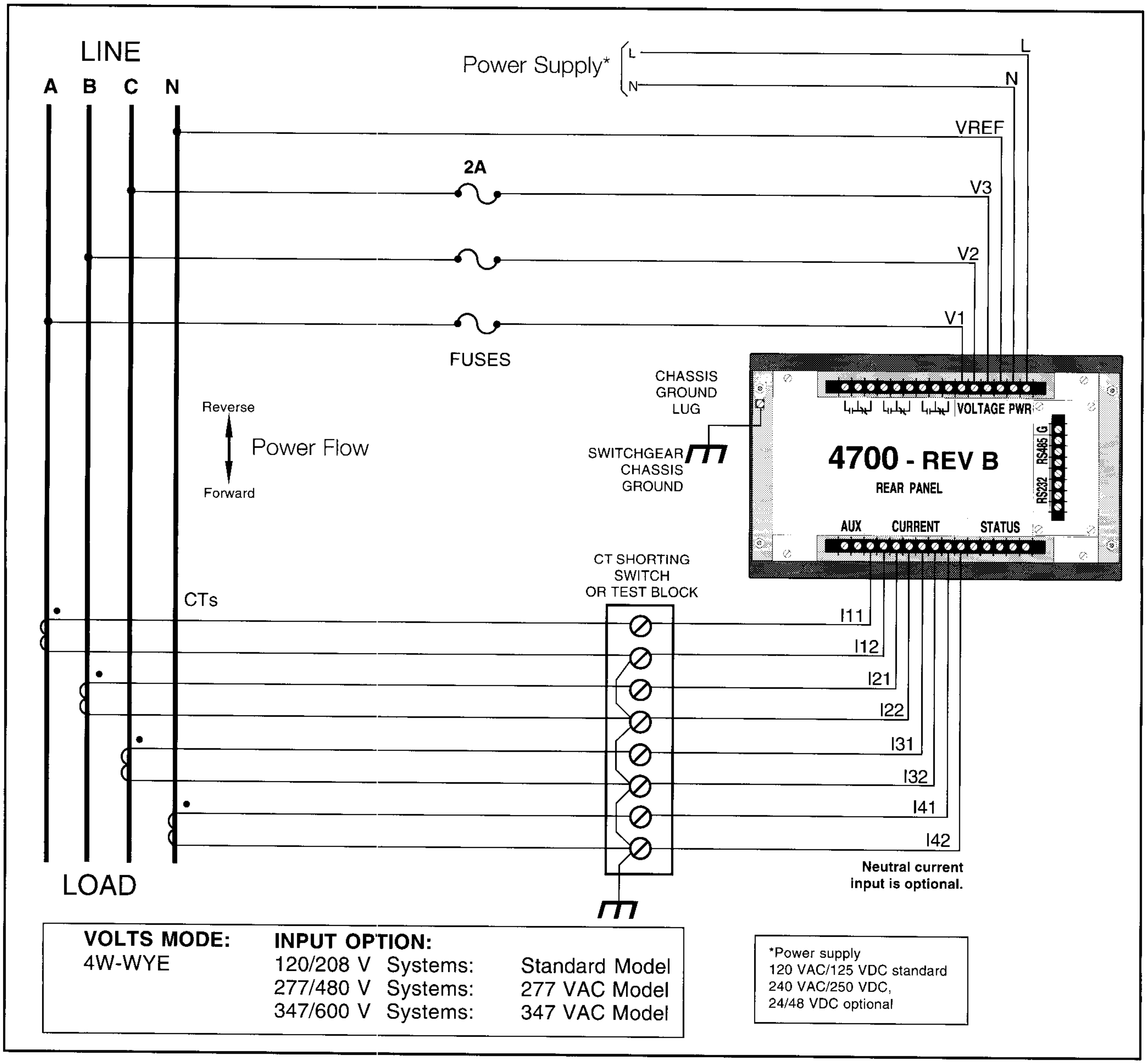


Figure 2-1 4-Wire Wye: 3-Element Direct Connection

With VTs

For Wye system voltages over 347/600 Volts, you must use VTs. Wire both the VT primary and secondary in a Wye (Star), exactly as shown for correct operation.

This configuration is shown in Figure 2-2. Set the VOLTS MODE to 4W-WYE.

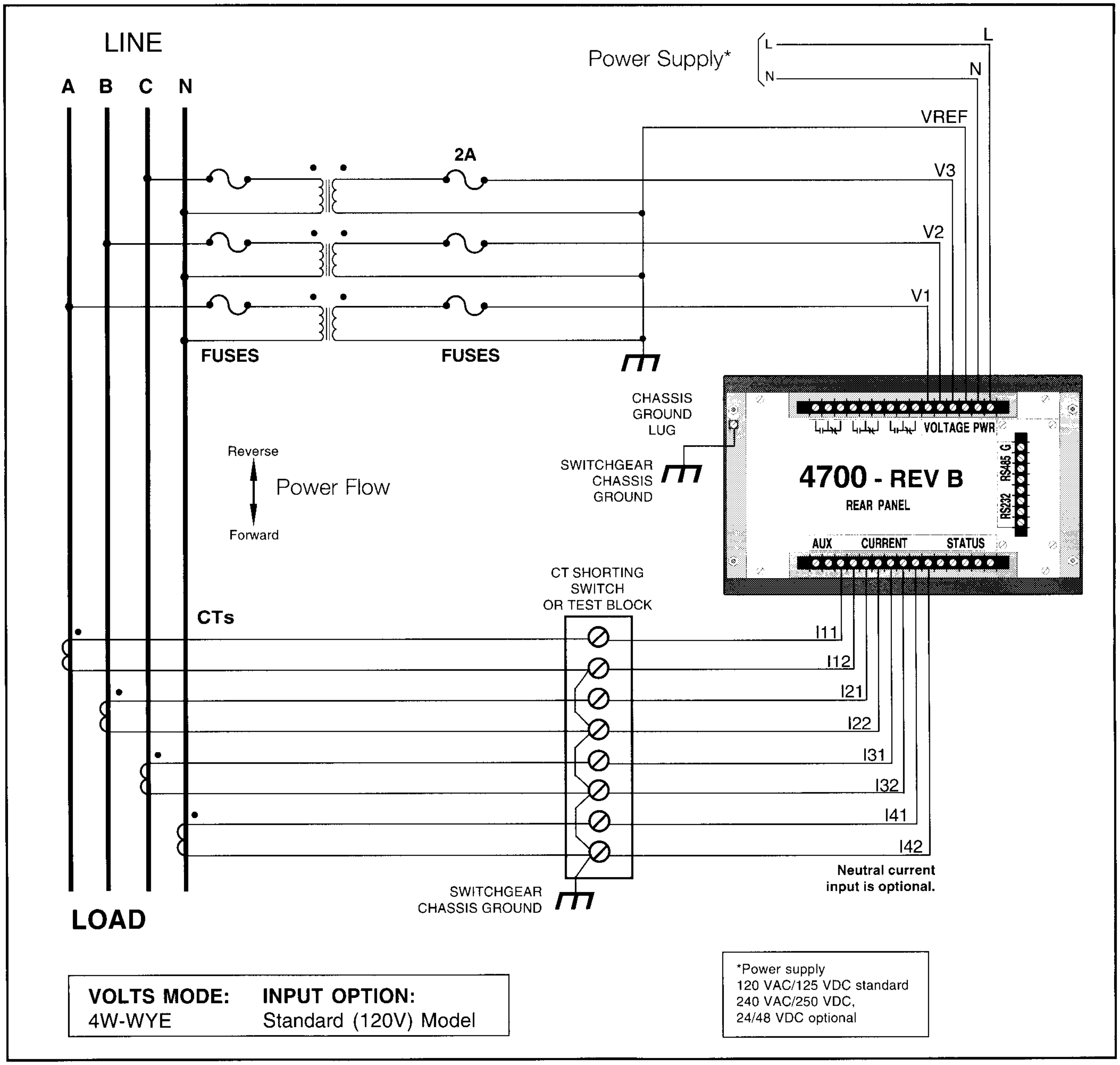
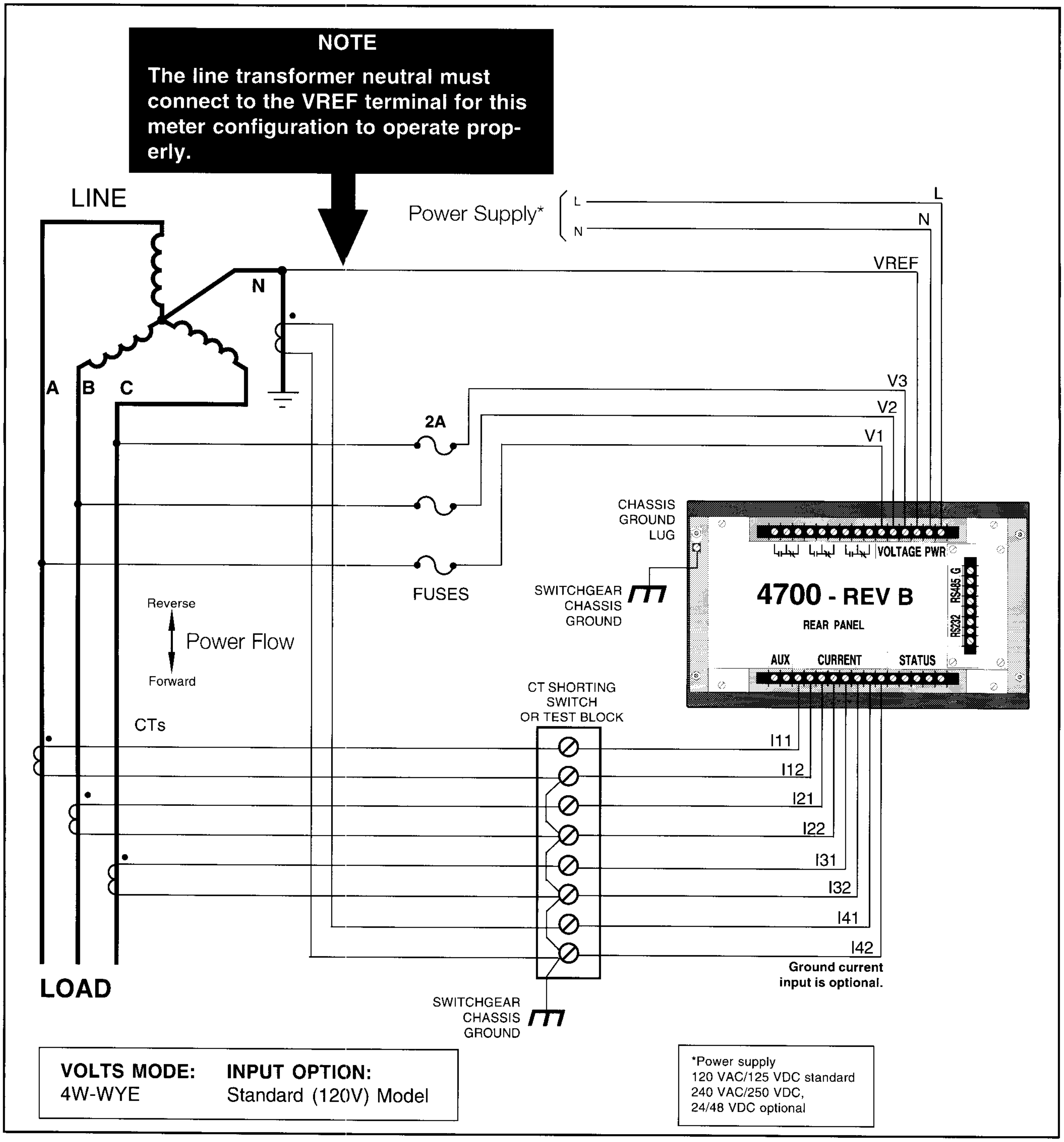


Figure 2-2 4-Wire Wye: 3-Element Using 3 VTs

3-Wire Grounded Wye Without VTs

When the starpoint of a 3-wire Wye system is grounded, then connect the 4700 power meter directly, without the use of VTs. (Ensure that the voltages are within the input range of the unit.)

This configuration is shown in Figure 2-3. Set the VOLTS MODE to 4W-WYE.



NOTE

The line transformer neutral must connect to the VREF terminal for this meter configuration to operate properly.

Ground current input is optional.

VOLTS MODE: 4W-WYE

INPUT OPTION: Standard (120V) Model

*Power supply
120 VAC/125 VDC standard
240 VAC/250 VDC,
24/48 VDC optional

Figure 2-3 3-Wire Grounded Wye: 3-Element Direct Connection

2.6 Connecting to 3-Phase, Delta Systems

2½-Element Connection

For ungrounded (floating) 3-wire Delta systems, the 4700 power meter always requires two VTs and senses the line-to-line voltages between each of the phases.

Connect the 4700 power meter in one of two ways: using 2 or 3 CTs.

Figure 2-4 shows an ungrounded Delta connection using 3 CTs. Set the VOLTS MODE to DELTA.

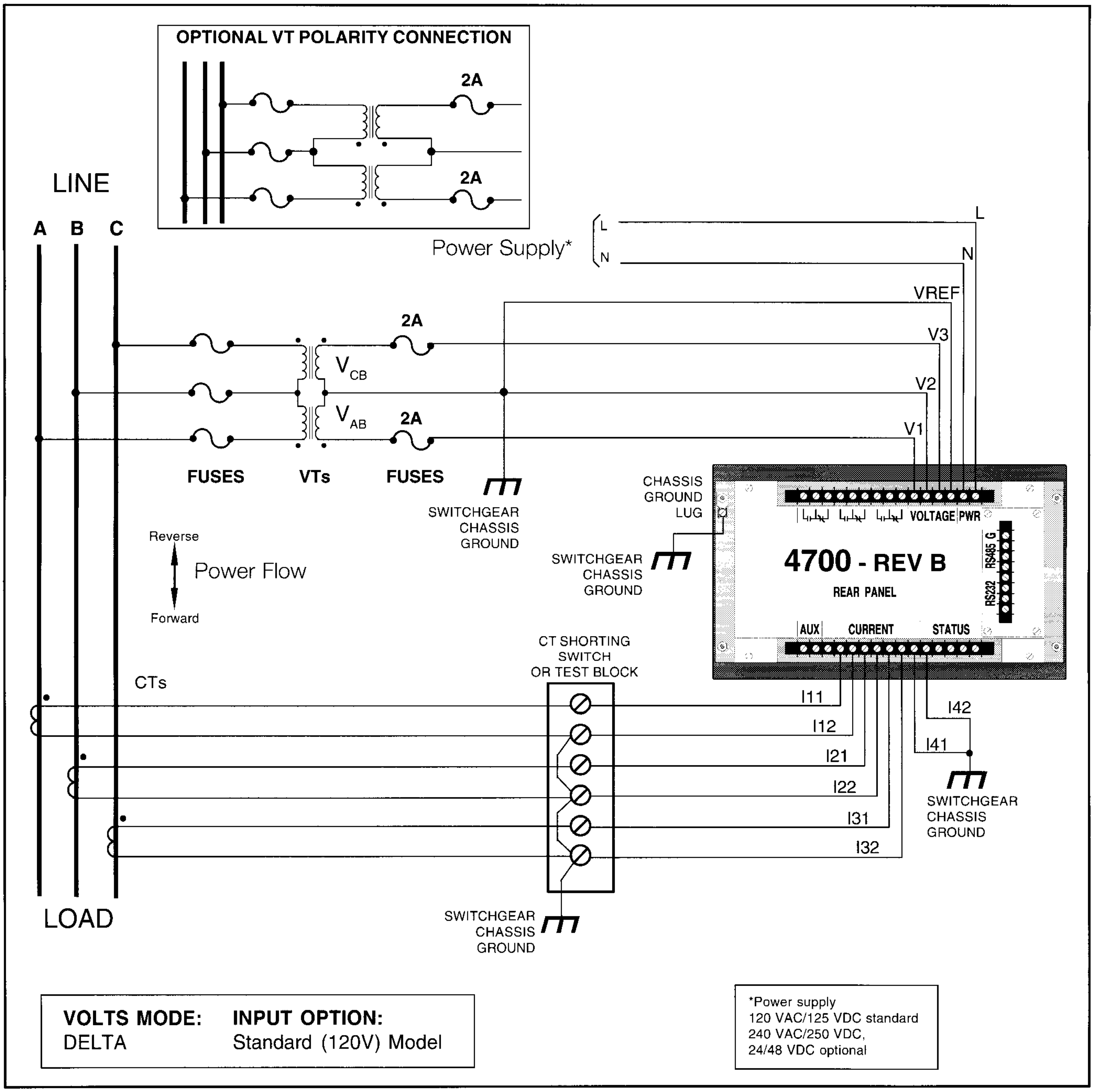


Figure 2-4 3-Wire Delta: 2½-Element Connection Using 2 VTs and 3 CTs

2-Element Connection

Figure 2-5 shows an ungrounded Delta connection using 2 CTs. Set the VOLTS MODE to DELTA.

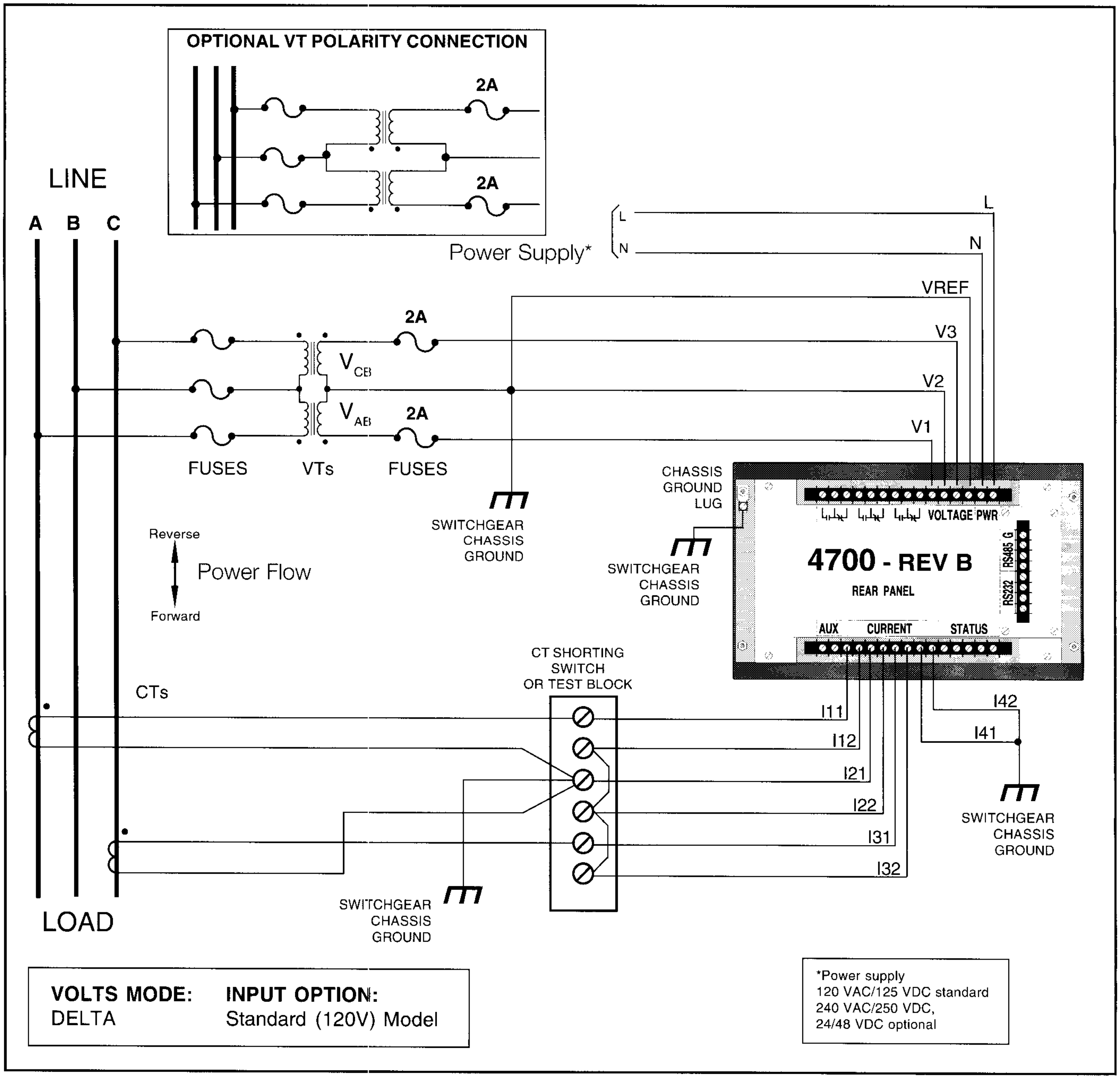


Figure 2-5 3-Wire Delta: 2-Element Connection Using 2 VTs & 2 CTs

2.7 Connecting to Single Phase, 3-Wire Systems

2-Element Connection

For Single Phase systems, connect the two voltage phases (180 degrees respectively) to the V_1 and V_2 inputs of the 4700 power meter. Also, connect the outputs of the two corresponding current transformers to the I1 and I2 input pairs.

The connections are illustrated in Figure 2-6. Note that the V3 input and I3 input pair are unused and grounded. For Single Phase systems, set the VOLTS MODE of the 4700 power meter to SINGLE.

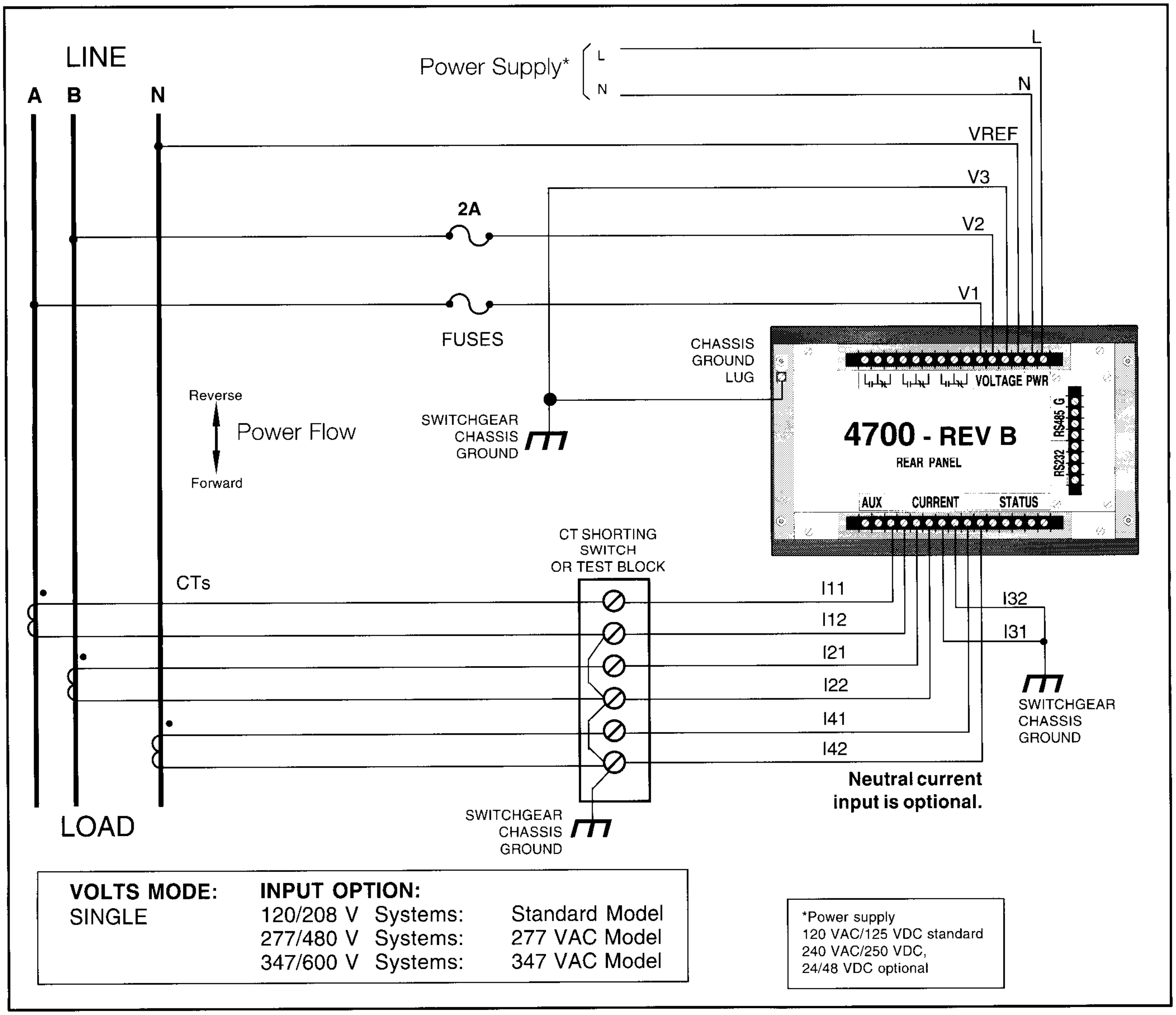


Figure 2-6 3-Wire Single Phase: 2-Element Direct Connection

2.8 Communication Connections

The communications option of the 4700 power meter includes an ISOCOM communications card. The communications card allows the 4700 power meter to transmit using either the RS-232C or RS-485 standards in full isolation for both RS-232C and RS-485 lines. Optical coupling provides isolation between the communications lines and the metering equipment. Internal circuitry protects against common mode voltages or incorrect connection of the optional ISOCOM. All inputs pass the ANSI/IEEE C37-90A-1989 tests for withstanding surge and fast transient.

The following sections describe configuration instructions and wiring requirements for direct connection to a master computer station.

Note: The communications card is shipped with a label affixed to the mounting plate that indicates the communications connection (RS-485 or RS-232C) set at the factory. If the connection is incorrect for your application, refer to the following section.

2.8.1 Configuration of the ISOCOM

This section describes how to change the communications mode. You can select RS-232C or RS-485 lines by switching a jumper block on the card. The presently selected communications mode is viewed on the power meter front panel, or by removing the card and examining the position of the jumper block.

The circuit board of the communications card has a jumper labeled J1. The jumper displays two positions, A and B, which determine the communications connection. Figure 2-7 illustrates the jumper position required for RS-232C or RS-485 lines. First, remove control power from the 4700 power meter, then move the jumper to the position you want.

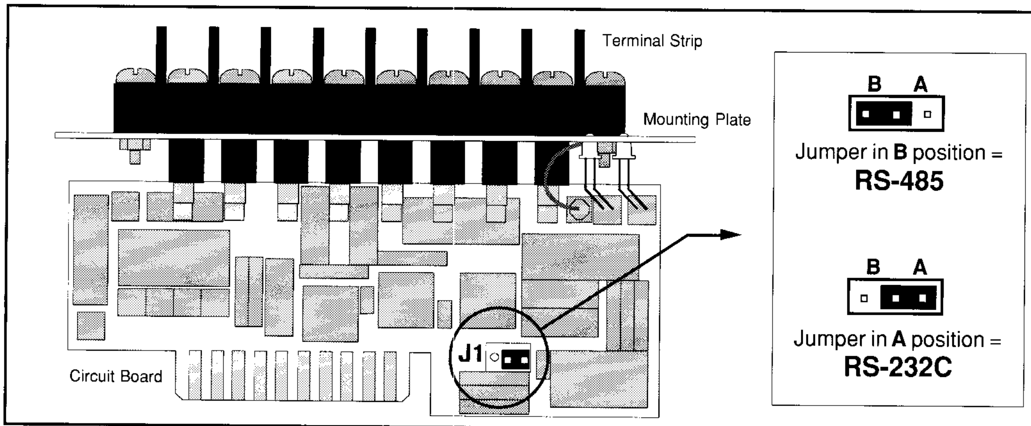
2.8.2 ISOCOM Terminal and LED Indicator Functions

The optional ISOCOM communications card provides a barrier-style terminal strip (see Figure 2-8). Terminal functions include:

Ground	GND	Chassis Ground
RS-485	SHLD	RS-485 Shield (electrically connected to chassis ground)
	-	RS-485 Data Minus
	+	RS-485 Data Plus
RS-232C	RXD	RS-232C Receive Data (i.e. data into device)
	TXD	RS-232C Transmit Data (i.e. data out of device)
	SG	RS-232C Signal Ground
	RTS	RS-232C Request To Send

Two LED indicators, TXD and RXD, show activity on the RS-232C or RS-485 communications line and can also verify correct communications operation. The TXD indicator flashes when data is sent by the device. The RXD indicator flashes when data is received by the device.

The 4700 power meter supports 19.2 Kbaud operation. This applies to both RS-232C and RS-485 standards.



NOTE

The A and B jumper block positions of the optional ISOCOM communications card is the opposite of the previous C01 type communications card. However, the left-right orientation of each comm. mode remains the same (i.e. RS-485 mode = left position, etc.).

Figure 2-7 Optional ISOCOM Card Jumper Configuration

2.8.3 RS-232C Connections

Figure 2-9 illustrates the wiring connection requirements for the RS-232C communications connection. The RS-232C standard allows only one device to exist on the communications connection.

The RS-232C cable is a custom cable. Depending on the mating connector at the computer serial port, the cable must have a 25-pin DB25, or a 9-pin DB9 with a plug (male) or socket (female) connector at one end. Cable length is 50 feet (15.2 m) maximum. Figure 2-11 illustrates RS-232C cable wiring connections.

If connected directly to an IBM PC RS-232C port, you may need to reverse the Tx and Rx leads at the remote device, depending on whether the PC RS-232C port is configured as Data Communication Equipment (DCE) or Data Terminal Equipment (DTE).

2.8.4 RS-485 Connections

Figure 2-10 illustrates the wiring connection requirements for the RS-485 communications connection. The RS-485 standard allows up to 32 devices on the communications line.

The RS-485 cable is a 22-gauge (0.6 mm diameter) shielded twisted-pair. Cable length is 4000 feet (1219 m) maximum. Ensure that the RS-485 cable shields are each grounded at one end only.

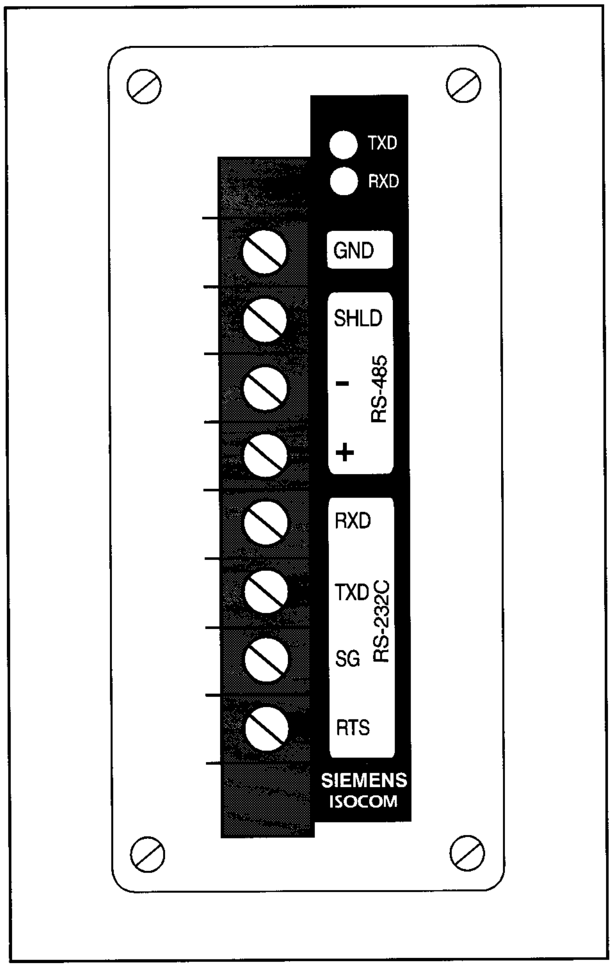
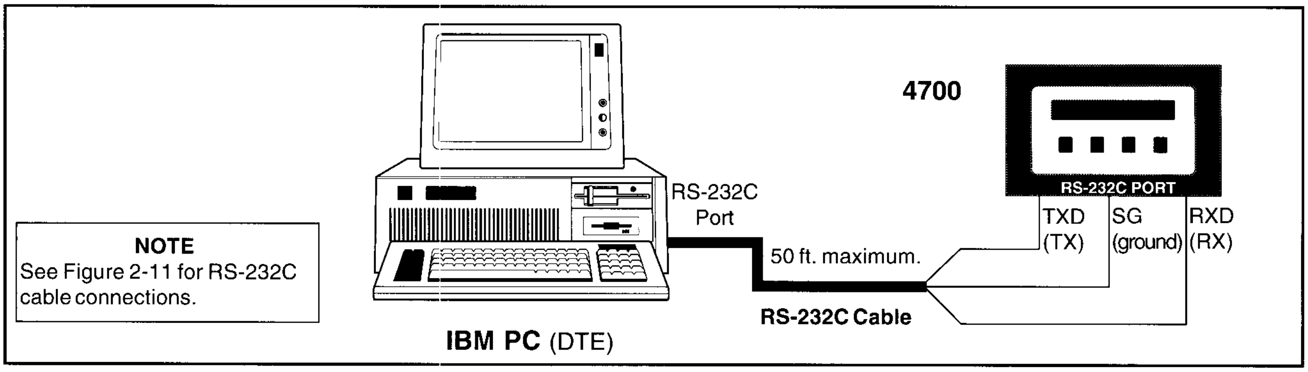
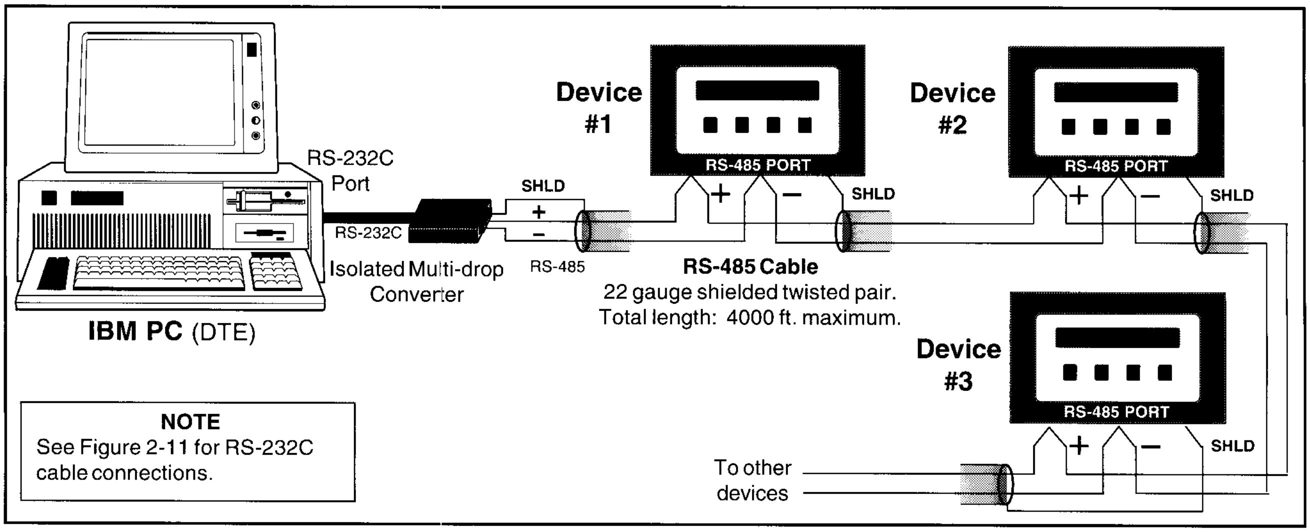


Figure 2-8 ISOCOM Terminal Block



NOTE
See Figure 2-11 for RS-232C cable connections.

Figure 2-9 RS-232C Communications Connections



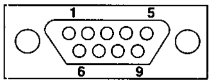
NOTE
See Figure 2-11 for RS-232C cable connections.

Figure 2-10 RS-485 Communications Connections

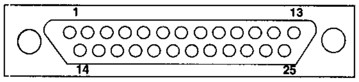
Connector Pinouts

Pin No.	Computer (DTE)	Converter
1	RLSD	RLSD
2	RX	TX
3	TX	RX
4	DTR	DTR
5	Ground	Ground
6	DSR	DSR
7	RTS	RTS
8	CTS	CTS
9	RI	RI
1	Ground	Ground
2	TX	RX
3	RX	TX
4	RTS	RTS
5	CTS	CTS
6	DSR	DSR
7	Ground	Ground
8	RLSD	RLSD
20	DTR	DTR
22	RI	RI

DB9 Type



DB25 Type



Cable Wiring

Computer	Converter
TX	RX
RX	TX
Ground	Ground
RTS	RTS
CTS	CTS
DSR	DSR
DTR	DTR
RLSD	RLSD

Computer	4700 Power Meter RS-232C Port
TX	RX
RX	TX
Ground	SG
RTS	
CTS	
DSR	
DTR	

Figure 2-11 RS-232C Cable Wiring Specifications

2.9 Connecting Additional Components

In addition to current and voltage inputs, the 4700 power meter has connections for status and auxiliary voltage inputs, control relays, and auxiliary current outputs. These additional connections add to the functionality of the meter.

2.9.1 Status Inputs

This section describes and illustrates wiring connection methods and applications for the status inputs.

The 4700 power meter uses a current-sensing technique to monitor the status of an external dry contact or the presence of an external voltage.

Dry (Volts Free) Contact Sensing

Dry contact sensing is performed using external excitation as illustrated in Figure 2-12. External excitation is provided via the SCOM terminal. A 20 to 277 VAC/VDC external power source is required. Various possibilities include:

a) an auxiliary 24 VDC power supply.

b) a 24 to 277 VAC transformer with fused output.

c) direct 120 VAC or 240 VAC fused power.

CAUTION

1. For this application, the SCOM terminal *must* be connected to a suitable supply voltage. Do not leave the SCOM terminal floating.
2. Normally, up to 277 V is present at the S1 to S4 terminals, depending on the external supply voltage.

When the external contact is open, there is no current flow and the status input registers INACTIVE. When the external contact closes, the current flow from the external supply causes the status input to register ACTIVE.

Note: The maximum pulse count for the S1 counter is 65,535 before rollover occurs.

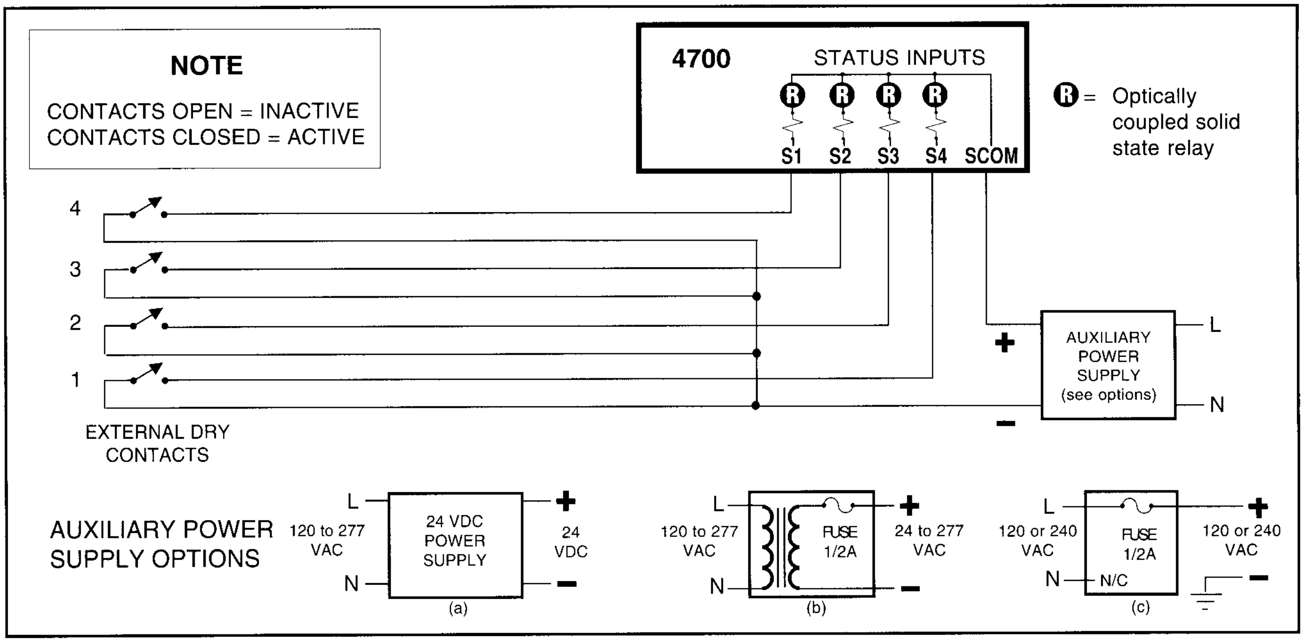


Figure 2-12 Status Input Connections for Dry Contact Sensing

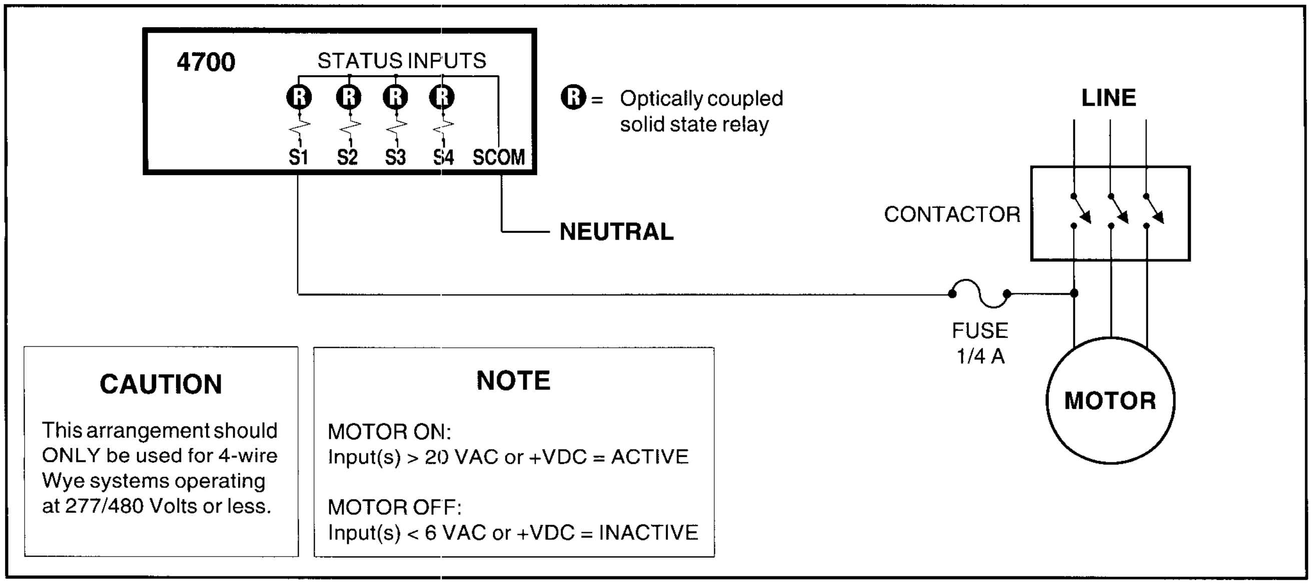
Voltage Sensing

Status inputs can sense the presence or absence of voltage on a power feeder. You can monitor whether a piece of equipment, such as a motor, is energized (see Figure 2-13).

When the motor is on, there is voltage at the sense point, and the status input registers ACTIVE. When the motor is off, there is no voltage at the sense point, and the status input registers INACTIVE.

CAUTION

1. For this application, the SCOM terminal *must* be connected to ground. Do not leave the SCOM terminal floating.
2. Normally, up to 277 V is present at the S1 to S4 terminals, depending on the external voltage.



CAUTION

This arrangement should ONLY be used for 4-wire Wye systems operating at 277/480 Volts or less.

NOTE

MOTOR ON:
Input(s) > 20 VAC or +VDC = ACTIVE

MOTOR OFF:
Input(s) < 6 VAC or +VDC = INACTIVE

Figure 2-13 Status Input Connections for Voltage Sensing

2.9.2 Control Relay Connections

The 4700 power meter provides 3 Form C electromechanical control relays. Figure 2-14 illustrates the wiring connection requirements for the control relays. Refer to Section 3, "Operating the 4700 Power Meter," for more information on operating the relays.

CAUTION

In applications where the relays are used to perform critical control operations (e.g. breaker trip, etc.), the precautions described below should be followed.

1. Connection to the external equipment should be made via an intermediate mechanism that allows relay control to be completely disabled for commissioning and servicing.

   Note: The example shown below forces the normally on load on, and the normally off load off when the relays are disabled.

2. Following initial power up, the 4700 power meter should be programmed (see Section 3.3), including all required setpoints for setpoint controlled relay operations.
3. The relay outputs of the 4700 power meter should be tested to ensure that setpoint or manual control conditions are occurring as expected.
4. Once correct relay operation has been verified, relay control of the external equipment can be enabled.

DANGER

Primary Protection

The relays of the 4700 power meter should not be used for primary protection functions. These include applications where the device would be providing:

a) Overcurrent protection on circuit breakers (I^2t applications).

b) Protection of people from injury. If failure of the device can cause injury or death, the 4700 power meter should not be used.

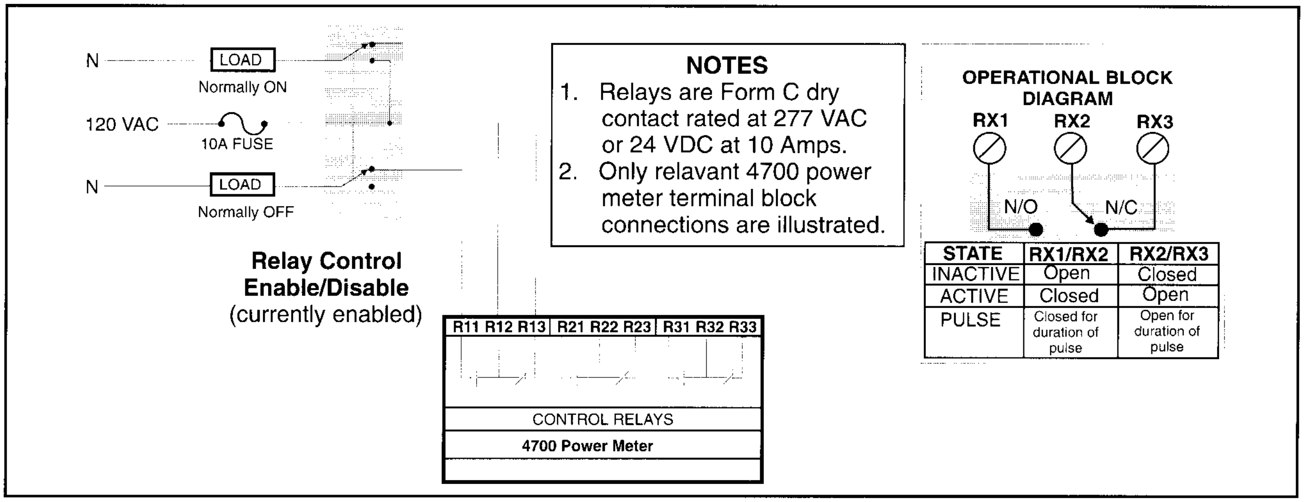
c) Energy limiting. If failure of the device will cause sufficient energy to be released that a fire is likely, the 4700 power meter should not be used. In electrical systems, energy limiting is normally provided by circuit breakers or fuses.

Secondary Protection

The 4700 power meter can be used for secondary protection functions. Secondary protection includes:

a) Situations where the 4700 power meter is backing up a primary protection device (shadow protection), such as an overcurrent relay.

b) Situations where the 4700 power meter is protecting equipment, not people. This typically includes applications such as over/ under voltage, reverse power flow, etc.



NOTES

1. Relays are Form C dry contact rated at 277 VAC or 24 VDC at 10 Amps.
2. Only relavant 4700 power meter terminal block connections are illustrated.

STATE	RX1/RX2	RX2/RX3
INACTIVE	Open	Closed
ACTIVE	Closed	Open
PULSE	Closed for duration of pulse	Open for duration of pulse

Figure 2-14 Control Relay Connections

2.9.3 V_{aux} Auxiliary Voltage Input Connections

Figure 2-15 illustrates two possible wiring connections and applications for the V_{aux} input. Refer to Section 3, "Operating the 4700 Power Meter," for more information on operating the V_{aux} input.

CAUTION

V_{aux} is a non-isolated input. Damage to equipment may result. If full isolation is required, use an intermediate isolation transducer.

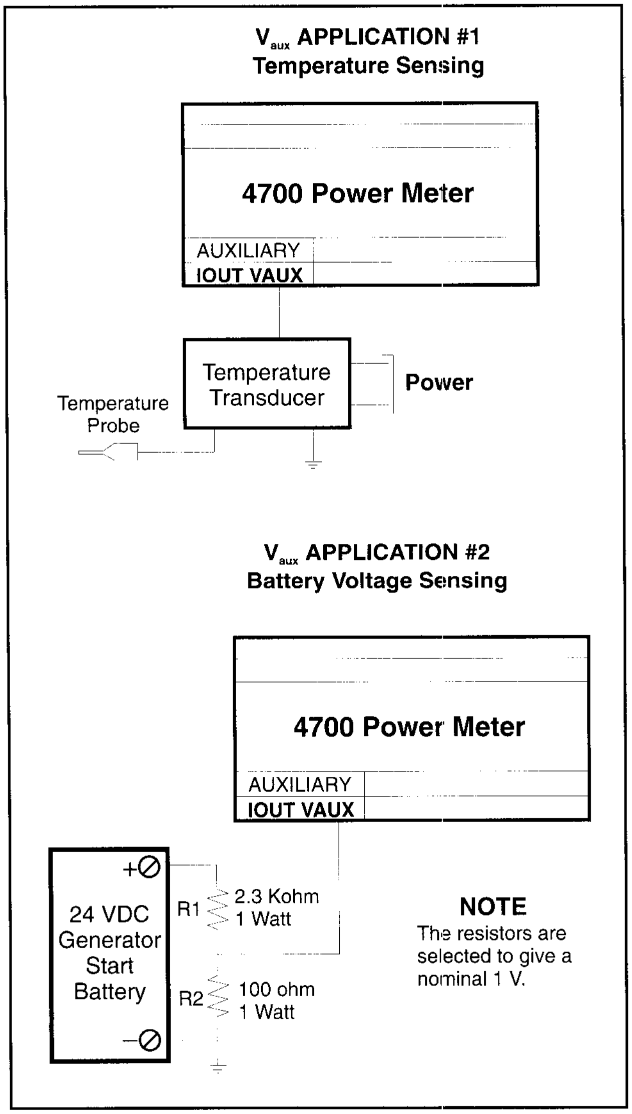


Figure 2-15 Auxiliary Voltage Input Connections

2.9.4 I_{out} Auxiliary Current Output Connections

Figure 2-16 illustrates two possible wiring connections and applications for the I_{out} output. Refer to Section 3, "Operating the 4700 Power Meter," for information on operating the I_{out} output.

CAUTION

I_{aux} is a non-isolated output. Damage to equipment may result. If full isolation is required, use an intermediate isolation transducer.

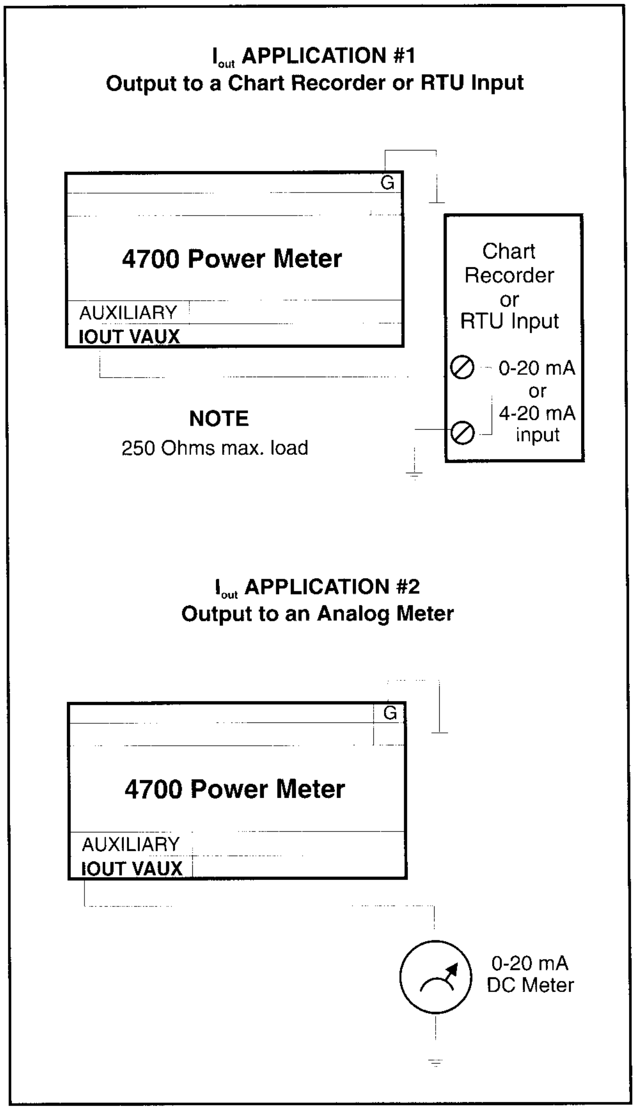


Figure 2-16 Auxiliary Current Output Connections

2.10 Maintenance

The 4700 power meter does not require any regular maintenance with the exception of replacement of the battery.

2.10.1 Replacing the Battery

The 4700 power meter uses nonvolatile memory with a battery backup. The rated life of the battery is 70 years at 50°C, 28 years at 60°C, and 11 years at 70°C.

If the unit operates at less than 50°C for 60% of the time, less than 60° for 90%, or less than 70° for 100%, the expected battery life is 35 years. If the power meter operates in an environment where the temperature regularly exceeds 60°C, then replace the battery every 10 years.

Note: When the battery is replaced, historic data is lost. Setup parameters and calibration of the power meter are *not* affected.

2.10.2 Field Service

In the event of meter failure, it is normally returned for repair. Keep this in mind during initial installation so that removal is convenient.

1. Ensure that a CT shorting block is installed so that the 4700 power meter current inputs can disconnect without open circuiting the CTs. Wire the shorting block so that any CT connection to protective relaying is not affected.
2. Route all wiring to allow easy removal of the connections to the 4700 power meter terminal strips, the rear cover, and to the meter itself.

2.10.3 Calibration

The calibration interval for the 4700 power meter is user-definable, according to your own accuracy requirements. The rated accuracy drift is 0.1% per year. If your 4700 power meter requires recalibration, contact Siemens.

3. Operating the 4700 Power Meter

3.1 Powering Up the 4700 Power Meter

Ensure that all installation wiring is complete before powering up the 4700 power meter. On power up, the meter displays volts, amps, and watts. The initial values displayed are normally incorrect because the unit does not have available information about the installation. The process of supplying the necessary information to the 4700 power meter is known as *field programming*.

3.2 Operating the 4700 Power Meter in Display Mode

The 4700 power meter front panel is set up for ease of operation. Two modes of operation are available: display and programming. In display mode, the meter shows three fields: Volts, Amps, and Power Functions. Four labeled buttons control the information shown on the display. Refer to Figure 3-1.

Phase: The Phase button selects the phase for which the volt and amp values are displayed. The asterisk (*) symbol indicates the average volts and amps values.

In Wye mode (VOLTS MODE = 4W-WYE), the Phase button steps through all line-to-neutral values, the line-to-neutral average, and all line-to-line values. The line-to-line values are displayed with a comma following the phase indicator (for example, A,).

In Delta mode (VOLTS MODE = DELTA), the Phase button steps through all line-to-line values for all the phases, and also gives the average of the three phases.

In Single Phase mode (VOLTS MODE = SINGLE), the Phase button steps through the sequence: A, B, L. An A indicates voltage and current for the A phase. The B indicates voltage and current for the B phase. An L indicates the line-to-line voltage, and also the average of the two line currents.

Function: The Function button selects which power function is displayed. The 4700 power meter displays volts, amps, and watts when first powered up. Press the Function button once to change the KW field to KVA. Press the Function button again to change to KVAR, and so on. The complete sequence is: KW, KVA, KVAR, power factor, frequency, KW demand, Amp demand, V_{aux}, I4, KW hours, and KVAR hours. KW hours (KWhr) and KVAR hours (KVARhr) (Total) use the entire display to show up to 10 digits of data.

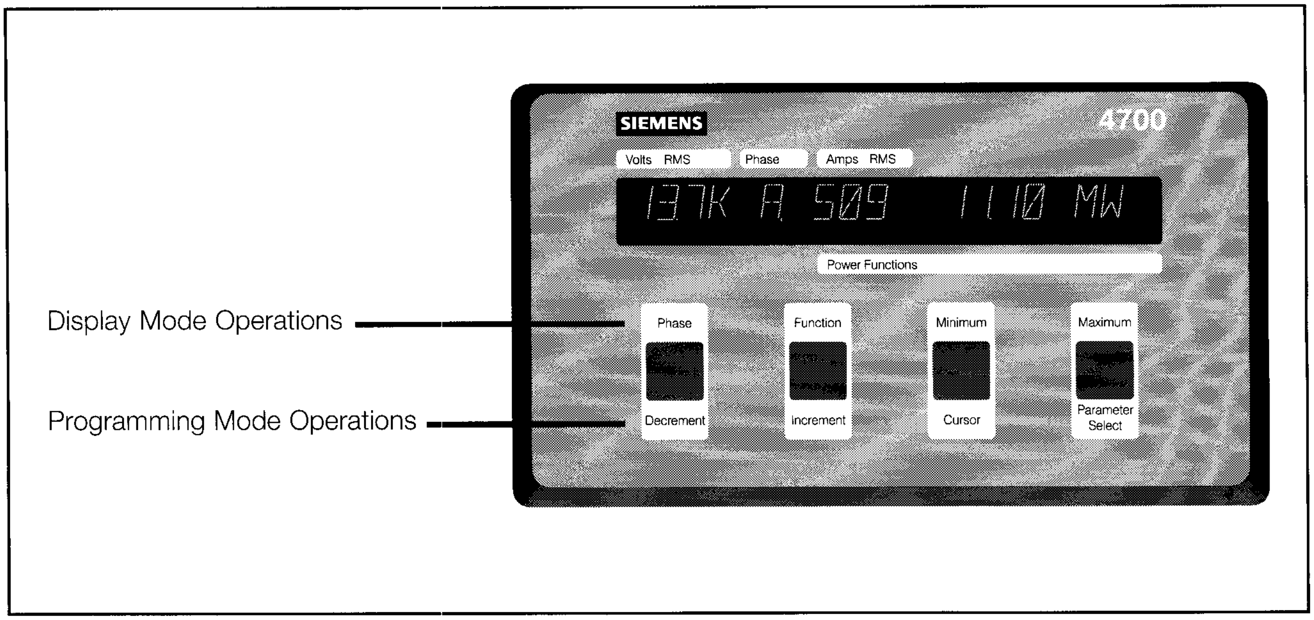


Figure 3-1 Front Panel Display

Minimum and Maximum: These buttons display the minimum and maximum values of volts, amps, and power functions. Min/Max values are displayed for three seconds before the real-time display returns. The values displayed are minimums and maximums logged since the last CLEAR MAX/MIN? function (see Table 3-1).

Function	Label
Kilowatts	KW (MW)
Kilovoltamperes	KVA (MVA)
Kilovoltamperes (Reactive)	KQ
Power Factor	PF
Frequency	HZ
Kilowatt Demand	KWD (MWD)
Amp Demand	AMD
V_{aux}	VX
Fourth Current Input	I4
Kilowatt Hours	KWHRS
Kilovoltampere (Reactive) Hours	KVARHRS

3.3 Operating the 4700 Power Meter in Programming Mode

Tables 3-1a and b give brief descriptions of each parameter that is programmable from the front panel display. Detailed descriptions of operating parameters and their applications are provided in the following sections of this manual.

3.3.1 How to Use the Front Panel Buttons in Programming Mode

In programming mode, the front panel buttons assume new programming functions. The label below each button indicates its alternate function. For example, the Maximum button changes to Parameter Select.

The Parameter Select button selects the parameter for display. When displaying available parameters (see Table 3.1), the list *wraps around* to the beginning when the end is reached. If you miss a displayed parameter, press the Parameter Select button until the one you want comes back around. The Cursor and Increment buttons change the value of the displayed parameter.

Press the Cursor button to move the cursor left one digit (cursor wraps around if necessary). Press the Increment button to increase the value of the digit where the cursor resides.

Some parameters accept only Yes or No values. For example, you can answer the CLEAR MAX/MIN? prompt by toggling to Yes or No using the Increment or Decrement button.

Other parameters, such as BAUD RATE, have several values available. Press the Increment or Decrement button to scroll through the values.

3.3.2 Changing to Programming Mode

Press the Function and Minimum buttons at the same time to enter programming mode. The front panel displays PROGRAMMING MODE. Avoid pressing the Function button only, which alters the selected parameter.

You can press the Function and Minimum buttons again to return to display mode.

3.3.3 Entering the Password

At shipping, the 4700 power meter password is 0. In programming mode, press the Parameter Select button until the PASSWORD parameter appears. Enter the password using the Cursor and Increment buttons. You must enter the password to change any parameter values, although you can view them on the front display panel at any time. You can also change the password as described in the next section. If the password is lost or forgotten, contact Siemens customer service.

3.3.4 Changing the Password

To change the password, use the following procedure.

1. Enter programming mode by pressing and holding simultaneously the Function and Minimum buttons.
2. Press Parameter Select until the PASSWORD parameter appears. Enter the current password using the Cursor and Increment buttons.
3. Press Parameter Select repeatedly until the PASSWORD parameter appears again.
4. Enter the new password using the Cursor and Increment buttons.
5. Return to display mode. The new password is now in effect.

3.3.5 Skipping Over the Setpoint Parameters

If the SETPOINT NUM parameter is 00, and the Parameter Select button is pressed, the setpoint parameters are passed over.

3.3.6 Setting the Volt Scale, Amps Scale and Volts Mode

The VOLT and AMP SCALES of the 4700 power meter must correspond with the full scale levels that are to be measured. The scale is the value the meter displays when the input is at full scale.

Volt Scale

In a direct connect configuration, the VOLT SCALE is normally set to 120 for a 120 VAC system, 277 for a 277 VAC system, or 350 for a 350 VAC system. If VTs are used for connection to higher voltage systems (using a 120 VAC model), then set the VOLT SCALE to the primary rating of the VT. Note that this applies only if the VTs' secondaries are rated at 120 VAC. If not, then the following formula is used to determine the required VOLT SCALE:

$$\text{VOLT SCALE} = \frac{\text{VT Primary Rating x 120 VAC}}{\text{VT Secondary Rating}}$$

Amps Scale

Set the AMPS SCALE to the primary rating of the CTs used. This applies only if the CTs are rated for a 5 Amp full scale output. If not, the following formula is used to determine the required AMP SCALE:

$$\text{AMP SCALE} = \frac{\text{CT Primary Rating x 5 A}}{\text{CT Secondary Rating}}$$

Note: The fourth CT secondary rating must equal the phase CTs.

Volts Mode

Set the VOLTS MODE according to the system connection configuration. Refer to Section 2, "Installing the 4700 Power Meter," and Figures 2-1 through 2-6 for more information.

The VOLTS MODE options are:

4W-WYE, DELTA, SINGLE, DEMO

3.3.7 Setting Additional Component Parameters

V_{aux} Auxiliary Voltage Input Operation

The 4700 power meter uses an auxiliary voltage input that allows measurement and display of an external voltage (1 VAC/VDC nominal, 1.25 VAC/VDC maximum). The VAUX SCALE parameter specifies what the meter displays with a 1.000 VAC_{RMS}/VDC full scale input applied.

Note that this 1 Volt input differs from the 120 Volt input for V1, V2 and V3.

I_{out} Auxiliary Current Output Operation

The 4700 power meter can include an analog current output, which is programmable to deliver a current proportional to any measured parameter. Maximum load on the current output is 250 ohms resistive.

The current output is set in programming mode. You must set the following three parameters:

a) I OUT KEY. This label specifies the measured parameter for which the current output is proportional. Table 3-2 shows the labels for I OUT KEY corresponding to each measured parameter.

b) I OUT SCALE. This value specifies the indicated value for the full scale output of I_{out}.

c) I OUT RANGE. This value indicates whether the output mode is 0 to 20 mA or 4 to 20 mA.

I OUT RANGE = 0	indicates 0 to 20 mA
I OUT RANGE = 1	indicates 4 to 20 mA

Display Format

The front panel display can present numeric information and phase labels in formats that reflect various world standards.

The FORMAT parameter allows the user to select formats for numeric information and phase labels. This parameter is displayed as:

FORMAT= ABC 1,234.5

The three-letter prefix specifies the phase labels. The possible values are ABC (default), XYZ, RBY and RST.

The five-digit integer specifies the display numbers. The formats for possible values are:

a) A comma for the thousands delimiter (radix) and a decimal point for the decimal delimiter. Example: 1,234.5 This is the default.

b) No thousands delimiter and a comma for the decimal delimiter. Example: 1234,5

The Cursor button cycles between the phase label parameter and display number parameter. The Increment or Decrement buttons modify the values for selected parameters.

Field Programmable Operating Parameters

Parameter	Description	Range
FIRMWARE	Displays the software level of the 4700 Power Meter. Not programmable.	V2.xxxB
PASSWORD	Must be entered to change the setup parameters or clear any function. You can also change the password.	0 to 9999
SETPOINT NUM	Selects a setpoint to be programmed. If set to "00", then no setpoint is selected. If no setpoints are programmed, pressing the Parameter Select button will skip directly to RELAY OPERATION. Note: In the parameter names below, "xx" indicates the selected setpoint number.	00 to 17
SPxx TYPE	The type of parameter the selected setpoint is to monitor (e.g. OVER KW, PHASE REVERSAL, etc.).	See Table 4-1
SPxx HI LIMIT	Sets the high limit for the selected setpoint.	0 to 999,999
SPxx LO LIMIT	Sets the low limit for the selected setpoint.	0 to 999,999
SPxx TD OPERATE	Sets the time delay to operate for the selected setpoint.	0 to 32,000 sec.
SPxx TD RELEASE	Sets the time delay to release for the selected setpoint.	0 to 32,000 sec.
SPxx RELAY NUMBER	Selects which one of three control relays the selected setpoint controls. Selecting "0" will select no relay. After setting this parameter, pressing the Parameter Select button will return to SETPOINT NUM.	0 to 3
RELAY OPERATION	Selects one of the three control relays to be programmed. Selecting 0 will exit control relay programming and skip directly to VOLT SCALE. Note: In the parameter names below, "x" indicates the selected control relay number.	0 to 3
Rx MODE	Defines the type of operation the selected relay is to perform.	SETPOINT, KWH PULSE, KVARH PULSE
Rx VALUE	For Rx MODE = SETPOINT: Specifies latch mode or sets pulse duration.	0 = latch mode 1 to 65,535 sec. pulse duration
Rx HRS/PULSE	For Rx MODE = KWH or KVARH PULSE: Defines the number of unit-hours between pulses.	0 to 65,535 unit -hours *
VOLT SCALE	Sets full-scale AC input voltage. This parameter should match the VT primary rating on systems using VTs with secondary ratings of 120VAC, or the measured phase voltage rating of the meter on systems connected directly. See Section 3.3.6.	0 to 999,999 Volts
AMPS SCALE	Sets full-scale AC input current. This parameter should match the CT primary rating when the secondary rating is 5 Amps. See Section 3.3.6.	0 to 9,999 Amps
VAUX SCALE	Sets full-scale auxiliary voltage input reading.	0 to 999,999 Volts
I4 SCALE	Sets full-scale I4 input current. This parameter should match the AMPS SCALE parameter.	0 to 9,999 Amps
VOLTS MODE	Sets volts mode.	4W-WYE, DELTA, SINGLE, DEMO

Table 3-1a Field Programmable Operating Parameters, part 1

* **Note:** For RxMODE = KWHR PULSE or KVARH PULSE, pulse duration is 1 second.

Field Programmable Operating Parameters

Parameter	Description	Range
UNIT ID	Sets the SEAbus communication address.	1 to 254
BAUD RATE	Sets the communications baud rate.	300, 1200, 2400, 4800, 9600, 19200 Baud
COM MODE	Displays the communications mode: RS-232C or RS-485. This parameter is set by setting a jumper on the optional communications card and cannot be changed in programming mode. See Section 2.8.	N/A
DISPLAY TIMEOUT	Sets the number of minutes before the display turns off after the last button is pressed. The recommended setting is 180 minutes.	0 = display always on 1 to 999 minutes
CLEAR MAX/MIN?	Clears the stored maximum and minimum values. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	N/A
CLEAR KW/KVARHRS?	Clears the stored KWH and KVARH readings. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	N/A
DEMAND PERIOD	Selects Demand Sync mode or the length of each demand period used in calculating demand values. See Section 5.	0 = Demand Sync Mode 1 to 99 minutes
NUM DMD PERIODS	Sets the number of demand periods averaged to calculate demand values.	1 to 15 periods
PHASE ROTATION	Specifies the normal phase sequence. This is used for PF polarity detection in delta mode and for the phase reversal detection setpoint. See Section 4.	ABC, ACB
STNDRD FREQ	Specifies the frequency of the measured power system.	50, 60, or 400
I OUT KEY	Specifies the measured parameter for the current output.	See Table 3.2
I OUT SCALE	Sets the scale of the current output.	0 to 999,999
I OUT RANGE	Indicates 0-20 mA or 4-20 mA proportional current output.	0 = 0 to 20 mA 1 = 4 to 20 mA
FORMAT	Sets phase labels and decimal display formats. The Cursor button cycles between the phase label parameter and decimal display number parameter. The Increment and Decrement buttons modify the values for the selected parameters.	Phase Labels ABC, XYZ, RBY, and RST Decimal Display 1,234.5 or 1234,5

Table 3-1b Field Programmable Operating Parameters, part 2

3.4 Control Relay Operation

The 4700 power meter contains three control relays (R1 to R3), which may be used for a variety of purposes, such as activation of alarms or load control. Each relay can switch AC loads of up to 120 VAC, and DC loads of up to 24 VDC at 10 A. Remote operation of each relay is via the communications port.

WARNING

Hazardous voltage and high energy currents.

Can result in death, serious personal injury, or severe property damage.

Do not use power meter for primary (principal) protection device.

The relays in the 4700 power meter should not be used for primary (principal) protection. This includes applications where the device provides:

- Overcurrent protection on circuit breakers
- Protection of people from injury
- Energy limiting

The relays in the 4700 power meter may be used for secondary (backup) protection. This includes applications where the device is:

- Backing up a primary protection device (shadow protection)
- Protecting equipment, not people (over/under voltage, voltage unbalance, phase reversal protection, etc.)

The relays are also manipulated by setpoints on selected measured parameters. Setpoint operation is described in detail in Section 4, "Setpoint Operation."

Another use for the control relays is KVARH and pulsed output. See Section 3.4.4, "KVARH and KWH Pulse Operation" for more information.

Section 2, "Installing the 4700 Power Meter," shows wiring requirements for the control relays.

3.4.1 Control Relay Modes

You can assign each of the three relays to setpoint operation in *latch* or *pulse* mode, or to KVARH or KWH pulsing.

3.4.2 Access to Relay Parameters

The RELAY OPERATION parameter accesses the relay parameters, and also allows you to select which relay to program. Selecting a value of 0 (zero) skips all relay parameters when Parameter Select is pressed. Selecting 1, 2, or 3 accesses the programmable parameters for the selected relay.

3.4.3 Relay Setpoint Operation

For setpoint operation, the relays function in latch or pulse mode. In latch mode, the relay operates for the duration that the assigned setpoint is active (normally open contacts are closed). In pulse mode, when the setpoint is active, the relay operates for a specific pulse duration.

Set Rx MODE to SETPOINT for setpoint operation. Set Rx VALUE to latch mode (Rx VALUE = 0), or to pulse duration (in seconds) for pulse mode operation.

I OUT KEY	Measured Parameter
VOLTAGE A	Voltage, Phase A (or Vab for Delta)
VOLTAGE B	Voltage, Phase B (or Vbc for Delta)
VOLTAGE C	Voltage, Phase C (or Vca for Delta)
CURRENT A	Current, Phase A
CURRENT B	Current, Phase B
CURRENT C	Current, Phase C
KW A	kW, Phase A
KW B	kW, Phase B
KW C	kW, Phase C
KVA A	kVA, Phase A
KVA B	kVA, Phase B
KVA C	kVA, Phase C
KVAR A	kVAR, Phase A
KVAR B	kVAR, Phase B
KVAR C	kVAR, Phase C
VOLTAGE AV	Voltage, average
CURRENT AV	Current, average
KW TOTAL	kW, total
KVA TOTAL	kVA, total
KVAR TOTAL	kVAR, total
PF	Power Factor, total
KW DEMAND	kW Demand, total
AMP DEMAND	Amps Demand, total
FREQUENCY	Frequency
VAUX	V_{aux}
CURRENT I4	I_4 (neutral or ground current)

Table 3-2 I OUT KEY Parameter Options

⚠ CAUTION

While the user is programming from the front panel or via communications, no setpoint-controlled relay operation occurs until after the user exits the programming mode. The meter then assesses the status of each setpoint and performs any required operations.

3.4.4 KVARH and KWH Pulse Operation

When a relay is configured for KVARH or KWH pulse operation, the pulses are based on the total energy imported (forward) and exported (reverse). Set Rx MODE to KVARH PULSE or KWH PULSE. In these modes, use Rx HRS/PULSE to set the number of unit-hours between pulses.

Note: A relay configured for KVARH or KWH pulse operation does not respond to an assigned setpoint that is active.

Note: Maximum pulse rate for the relays is one pulse every two seconds (0.5 Hz).

3.4.5 Forced Relay Operate/Release

You can *force* operate or release relays by commands via the communications port. Manual forced operate and forced release commands override any present setpoint condition. Forced operate commands made via communications affect only a setpoint relay (Rx MODE = SETPOINT).

If the relay is in *pulse* mode (Rx VALUE > 0), a forced operate command initiates a pulse of length equivalent to the value set by the Rx VALUE parameter for that relay. This operation is recorded in the event log and indicates that the relay was pulsed. A forced release command has no effect.

If the relay is in *latch* mode (Rx VALUE = 0), it behaves normally for forced operate, forced release, and return to normal (return to setpoint control) commands.

See below for manual relay control special cases.

3.4.6 Relay Event Logging

For a relay assigned to setpoint operation (Rx MODE = SETPOINT), the event log records relay operations in one of two ways, depending on whether the relay is set to operate in latch or pulse mode.

a) Pulse mode (Rx VALUE > 0): The event log shows that the relay is pulsed when the setpoint becomes active. When the setpoint returns to its inactive state, the setpoint event is logged but does not indicate the relay is pulsed, since no pulse is generated.

b) Latch mode (Rx VALUE = 0): The event log records that the relay is operated (ON) when the setpoint becomes active, and is released (OFF) when the setpoint returns to an inactive state.

If the relay is configured for KVARH, or KWH pulse mode, no relay operations are recorded in the event log.

3.4.7 Manual Relay Command Special Cases

If a manual forced operate command for a selected relay is received while that relay is already in a forced operated state, then the relay command is ignored and is not logged. This is also true for a forced release command sent to a relay already in a forced released state. In addition, manual relay commands sent to relays in KVARH or KWH pulse mode are not logged.

3.4.8 Relay Operation After Power Outages

When the power feed to the 4700 power meter is interrupted, even momentarily, the output relays are released. When power is restored, the meter allows a three-second settling time, then reevaluates setpoint conditions. If appropriate, the relays operate after the programmed time delays.

Any forced operated or forced released relay is released, followed by a resumption of normal setpoint operation.

3.5 Bi-Directional Energy

Energy measurements represent the KWH or KVARH sums for all three phases. Energy parameters provide three measurement modes that indicate bi-directional power flow: *forward, reverse,* and *total.* KWH and KVARH can provide all three modes.

Total energy measurements represent the sum of the absolute values of imported and exported energy. Total energy values are incremented by energy that is imported or exported.

Imported real or reactive energy is displayed with an F suffix (KWH-F, KVARH-F), indicating *forward* flow. Exported energy values are displayed with an R suffix (KWH-R, KVARH-R), indicating *reverse* flow.

Note: Only KWH-F / KWH-R and KVARH-F / KVARH-R measurements are displayed from the front panel. KWH and KVARH total values are read only via communications.

3.6 Status Input Operation

The 4700 power meter provides four optional status inputs (S1 to S4), which are used to sense the state of an external contact. If the input voltage is below 9 VAC or VDC, the input is sensed as inactive. If it is over 20 VAC or VDC, it is sensed as active.

The status of these inputs is viewed by a supervisory device connected to the communications port. This may be a personal computer running WinPM, SIEServe, or other supervisory software or a Power Monitor display and monitoring unit.

You can program the Status Input #4 (S4) to initiate KW Demand Synchronization. See Section 5, "Demand," for more information.

The 4700 power meter maintains a counter for the Status Input #1 (S1). The counter accurately follows a maximum frequency of 0.3 Hz (20 per second). You can reset the counter to zero at any time through a supervisory device connected to the communications port. The minimum duration of a pulse that the 4700 power meter will recognize is 40 ms.

Section 2, "Installing the 4700 Power Meter," shows several wiring diagrams illustrating connections for the status inputs.

3.7 Fourth Current Input Operation

The 4700 power meter includes an optional fourth current input, designated I_4. The input uses connections I41 and I42 on the terminal strip. The AMPS SCALE parameter sets the scaling for all four current inputs. Therefore, the CT primary rating of the I_4 current input must be the same as the CT primary ratings for the three-phase current inputs (5 A nominally).

Normally, this input is used to measure current in the neutral conductor. In installations with nonlinear loads, odd harmonics can fail to cancel, producing significant currents in the neutral conductor.

The I4 reading is viewed from the front panel by pressing the Function button until displayed. It is also viewable remotely.

3.8 Waveform Capture

Digital waveform capture capabilities are used for detailed power quality analysis.

Waveform capture allows the user to perform high-speed sampling of the V1, V2, V3, V_{aux}, I1, I2, I3, or I4 (neutral current) inputs. One full cycle of the signal at a *single* input is sampled at a rate of 128 samples per cycle. All samples are taken in sync with the communications line frequency, and within one input cycle.

Sampled waveform data is stored in on-board memory and is read via the communications port. The high sampling rate produces high-resolution data, which allows analysis of frequency components to the 63rd harmonic.

You can upload captured waveform data to a master computer to display the waveforms and perform Fast Fourier Transforms on them. This provides an indication of total harmonic distortion and a breakdown of individual frequency components.

From the master computer, the operator requests the capture of individually selected 4700 power meter inputs. The computer then uploads the waveform data. Waveform capture is automatically reinitiated when the 4700 power meter on-board memory is read via the communications port.

4. Setpoint Operation

4.1 Introduction

The 4700 power meter can monitor several measured parameters simultaneously and then generate alarms and controlling relays based on the parameter values. The meter uses predefined *setpoints* to activate this functionality. A setpoint is a group of six programmed parameters that tells the unit:

1. which measured parameter to monitor (setpoint type), and activation setting of over or under the value.
2. the high limit.
3. the low limit.
4. the time delay for relay operation.
5. the time delay for relay release.
6. which relay to activate, if any, when appropriate limits are exceeded and time delay conditions are met.

4.2 Applications

The 4700 power meter supports 17 different setpoints simultaneously, numbered 1 to 17. All of the setpoints are programmable from the front panel. Table 4-1 outlines the measured parameters that the setpoints can monitor. You can use the setpoints to operate the following types of control relays:

1. Trip Relay — to shunt trip a breaker
2. Alarm Relay — to activate an alarm buzzer or light
3. Control Relay — to control an external piece of equipment
4. Remote Control Relay — to control an external piece of equipment via the communications port
5. KVARH Pulse Output Relay (relay 2)
6. KWH Pulse Output Relay (relay 3)

> **⚠ CAUTION**
>
> The response time of the relays is 1 to 2 seconds, up to 5 seconds after meter power up, and is disabled when in programming mode. Do not use the 4700 power meter for protective functions, which require faster operation. Use separate reliable AC or DC control power when shortest possible reaction times are needed.

You can assign any of the three relays to a single setpoint, or to several setpoints. A relay is activated if any of the setpoints controlling it become active.

In addition, you can use relays 1, 2 and 3 for KVARH and KWH pulsing.

4.3 Over Setpoint

An over setpoint activates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter. When a setpoint becomes active, it operates the assigned relay, if any. The setpoint status change is stored in the event log, and includes the time and parameter value.

An over setpoint deactivates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to Figure 4-1). The setpoint status change is also logged, and includes the time of return-within-limit and the out-of-limit value.

4.4 Under Setpoint

Under setpoints function similarly to over setpoints, except they operate for opposite reasons. An under setpoint activates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to Figure 4-2).

An under setpoint deactivates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter.

4.5 Programming Setpoints

To program setpoints, switch to programming mode and enter your password. Press the Parameter Select button until the SETPOINT NUM parameter appears. Then enter the setpoint number, from 01 to 17, of the parameter you want to program. Program the setpoint by entering new values for all parameters associated with the selected setpoint.

> **⚠ CAUTION**
>
> After entering your password in programming mode, no setpoint-controlled relay operations occur until you exit programming mode. The 4700 power meter then assesses the status of each setpoint and performs any required operations.

It is recommended that you use a Setpoint Parameter Form to plan your setpoints, *before* entering programming mode. Table 4-2 is an example Setpoint Parameter Form, containing information about the six parameters as they correspond to each setpoint. Complete a similar form, like the one available in Appendix B, and keep a copy with the meter.

The example Setpoint Parameter Form displays the following attributes:

Relay 1 is used as an trip relay, with over voltage, under voltage, voltage unbalance, and phase reversal trips enabled. The relay is connected to the breaker shunt trip input.

Relay 2 is used as an alarm relay to warn of loads over 70% of the breaker rating. Its output is connected to a buzzer.

Relay 3 is used as a KW demand control relay.

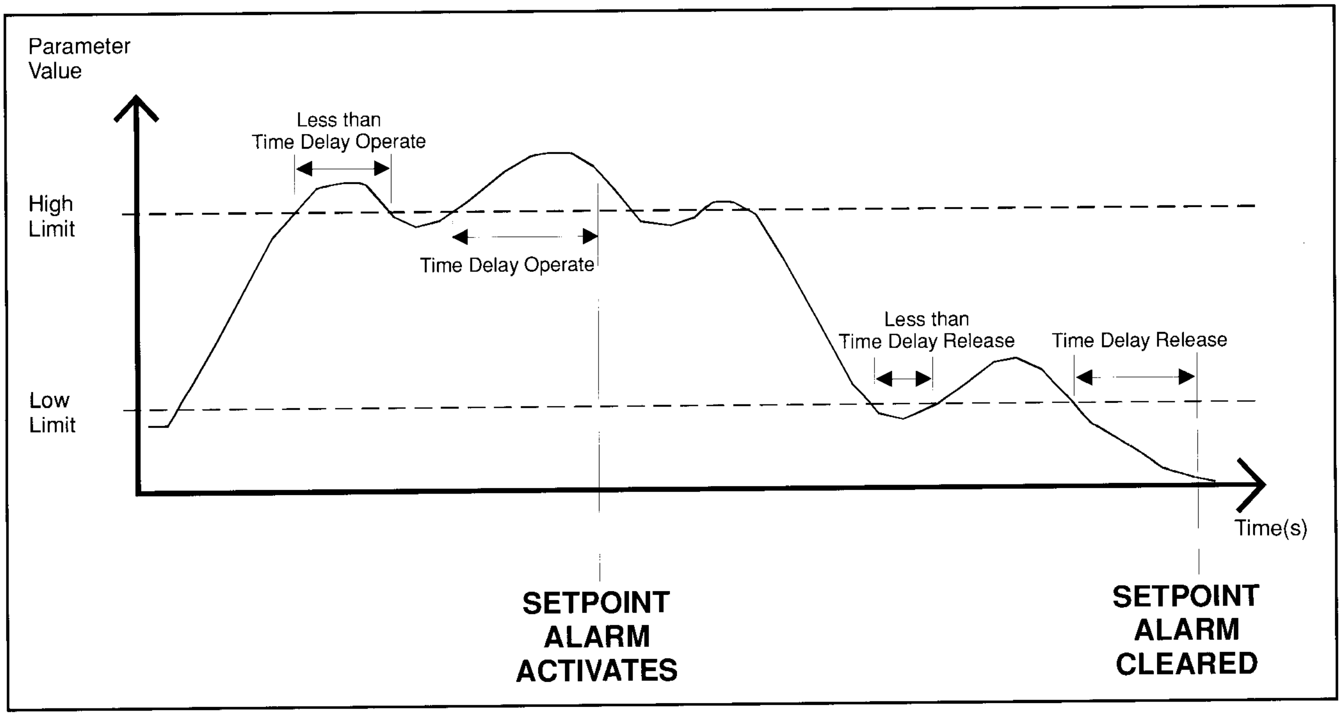


Figure 4-1 Over Setpoint Operation

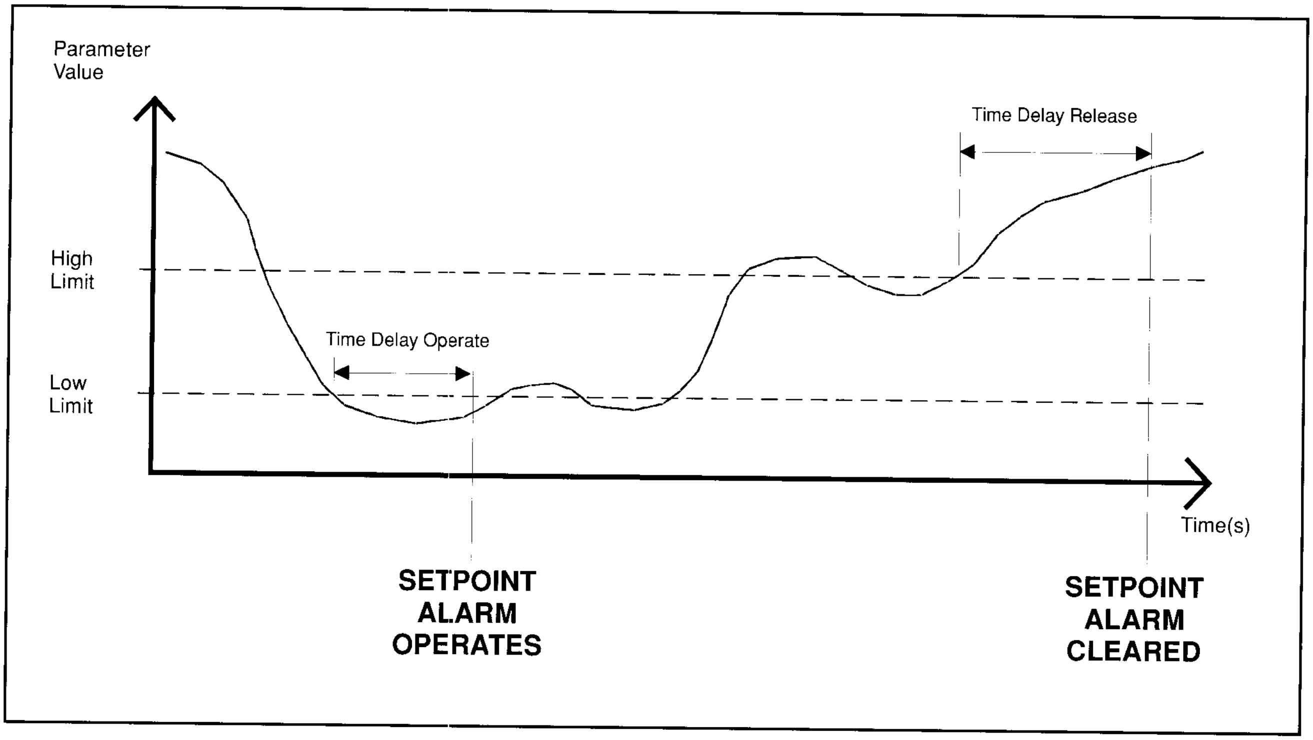


Figure 4-2 Under Setpoint Operation

SETPOINT TYPES

Type	Description
NOT USED	A setpoint not currently in use.
OVER VOLT	Over voltage (highest phase voltage).
UNDER VOLT	Under voltage (lowest phase voltage).
VOLTAGE UNBAL	% difference of most deviant phase voltage from the average.
OVER CURRENT	Over current (highest phase current).
CURRENT UNBAL	% difference of most deviant phase current from the average.
OVER KVA	Over KVA.
OVER KW	Over KW.
OVER KWREV	Over negative KW (feeding power into utility grid).
OVER KVAR FWD	Over KVAR foward (imported) reactive power.
OVER KVAR REV	Over KVAR reverse (exported) reactive power.
OVER KWD	Over KW demand.
OVER AMPD	Over amp demand.
OVER FREQUENCY	Over frequency. (Enter: Frequency x 10 [i.e. 60Hz = 600])
UNDER FREQUENCY	Under frequency. (Enter: Frequency x 10 [i.e. 60Hz = 600])
OVER VAUX	Over auxiliary voltage.
UNDER VAUX	Under auxiliary voltage.
PHASE REVERSAL	Phase reversal. Operates if the phase rotation does not match the programmed normal operation.
UNDER PF LAG	Under power factor lagging.
UNDER PF LEAD	Under power factor leading.
OVER I4	Over I4 current.

Table 4-1 Setpoint Types

Setpoint Parameter Form

SETPOINT	TYPE	HIGH LIMIT	TD OPERATE	LOW LIMIT	TD RELEASE	RELAY/FUNCTION
1	Over Volts	332	5	290	1	1 Trip
2	Under Volts	270	5	220	1	1 Trip
3	Volts Unbal.	30%	5	10%	1	1 Trip
4	Phase Reversal	-	1	-	1	1 Trip
5	Not Used					
6	Not Used					
7	Over Amps	2100	10	2000	1	2 Alarm
8	Over Volts	300	10	290	1	2 Alarm
9	Under PF Lag	90	10	85	10	2 Alarm
10	Under PF Lead	90	10	85	10	2 Alarm
11	Over KWD	1200	10	900	10	3 Demand Control
12						
13						
14						
15						
16						
17						

Table 4-2 Setpoint Parameter Form

5. Demand

Power utilities generally bill commercial customers based on both their energy consumption (in KWhr) and their peak usage levels, called peak demand (in KW). *Demand* is a measure of average power consumption over a fixed time period, typically 30 minutes. *Peak Demand* is the highest demand level recorded over a specific billing period.

5.1 Demand Measurement Methods

Demand measurement methods, and their intervals, vary according to individual utilities. Some common methods include: thermal averaging, the fixed interval technique, and the sliding window technique.

In thermal averaging, the demand indicator responds to heating of a thermal element in the watt hour meter. The demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes.

The fixed interval technique measures average usage electronically over each period. The highest recorded value is the peak demand.

The sliding window technique, or "rolling interval" method, divides the demand interval into subperiods and the demand is measured electronically, based on the average load level over the most recent set of subperiods. This has the effect of improving the response times, in comparison with the fixed interval method. For example, with a 6x5 minute (30 minute total) sliding window, demand is the average power consumption over the last six five-minute periods.

5.2 Internally Timed Demand Measurement

The 4700 power meter uses the sliding window method to measure demand. You can program both the DEMAND PERIOD (1 to 99 minutes) and NUM DMD PERIODS (1 to 15) for averaging. This allows you to match virtually any utility demand measurement method. Refer to Table 5-1 for more information.

5.3 Demand Synchronization

The 4700 power meter includes the option of starting demand intervals that correspond to an active pulse. Set the DEMAND PERIOD parameter to zero, which initiates the Demand Sync mode. Instead of internally timing the duration of each demand period used in the KW demand calculation, the meter looks for an ACTIVE pulse on Status Input #4 (S4). You can still specify the number of demand periods in this mode, as previously explained.

Utility Method	**4700 Programming**	
	Demand Period (in minutes)	**Number of Demand Periods (must be 15 or less)**
Fixed Interval	Utility Period	1
Fixed Interval Emulation	Utility Period / 15	15
Thermal	Utility Period / 15	15
Sliding Window	Utility Sub Period	Utility # of Sub Periods

Note: With the fixed interval method, the 4700 power meter maximum reading and the utility reading are not necessarily the same, unless the demand periods are time-synchronized. The best way to resolve this problem is to use the sliding window method with the same total demand period as the utility, as shown above. The 4700 power meter maximum demand reading is then always equal to or slightly higher than the utility readings.

Table 5-1 Demand Calculation Chart

6. Communications

6.1 Introduction

The 4700 power meter is optionally equipped with a communications card, allowing data transfer between the unit and other display and monitoring devices such as the PC32F Power Monitor unit. The Power Monitor unit provides complete control of several 4700 power meters, and other ACCESS-compatible field devices, through a common RS-485 communications connection. The 4700 power meter accepts either RS-232C or RS-485 communications connections.

Before communication is possible, the user must program the communication parameters of the 4700 power meter. This is performed on the front panel of the unit or via the communications port. Set the ADDRESS for each meter to a unique value (see "RS-485 Communication" below). The BAUD RATE of the meter must correspond with the baud rate selected for all devices in the network. The COM MODE (communications mode) is set by the jumper position on the communications card, as explained in Section 2.8.1.

6.2 Connecting to the ACCESS System

RS-232C Communication

RS-232C communication is used for direct connection between a single 4700 power meter and a computer (distance less than 50 ft.).

RS-485 Communication

Use an RS-485 communications cable for connecting more than one 4700 power meter to a network. Each meter must have a unique address, allowing monitoring and control from a single Power Monitor unit or other computer.

The total distance limitation for RS-485 connections is 4000 feet, using 22 gauge twisted-pair shielded cable. Refer to Section 2, "Installing the 4700 Power Meter," for connection diagrams.

⚠ CAUTION

Ensure that the shield of each leg of the RS-485 cable is grounded at one end only.

7. Troubleshooting the 4700 Power Meter

This section lists some symptoms of improperly functioning meters and explains how to correct them. If your problem persists, or is not listed here, fill out the problem report located in the back of this manual and contact Siemens customer support by phone or fax.

The display does not operate.

1. Check that there is an appropriate voltage available to the power supply (L and N connections on the terminal strip).
2. Confirm that the VREF terminal is connected directly to ground.
3. Press a button on the front panel.

The voltage or current readings are incorrect.

1. Check that the VOLTS MODE is properly set for the given wiring.
2. Check that the voltage and current scales are properly set.
3. Make sure the VREF terminal is properly grounded.
4. Check the quality of the CTs and VTs in use.
5. Make the following voltage tests:
   a) V1, V2, V3 to VREF are 120 VAC (or rated full scale values of 277 or 347 VAC)
   b) VREF to switchgear earth ground is 0 V
   c) L to VREF is 120 VAC or DC (or optional rated control power voltage)
   d) N to VREF is less than 2 VAC
   e) All current inputs are less than 1 VAC with respect to VREF.

The KW or power factor readings are incorrect but Voltage and Current readings are OK.

1. Make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.

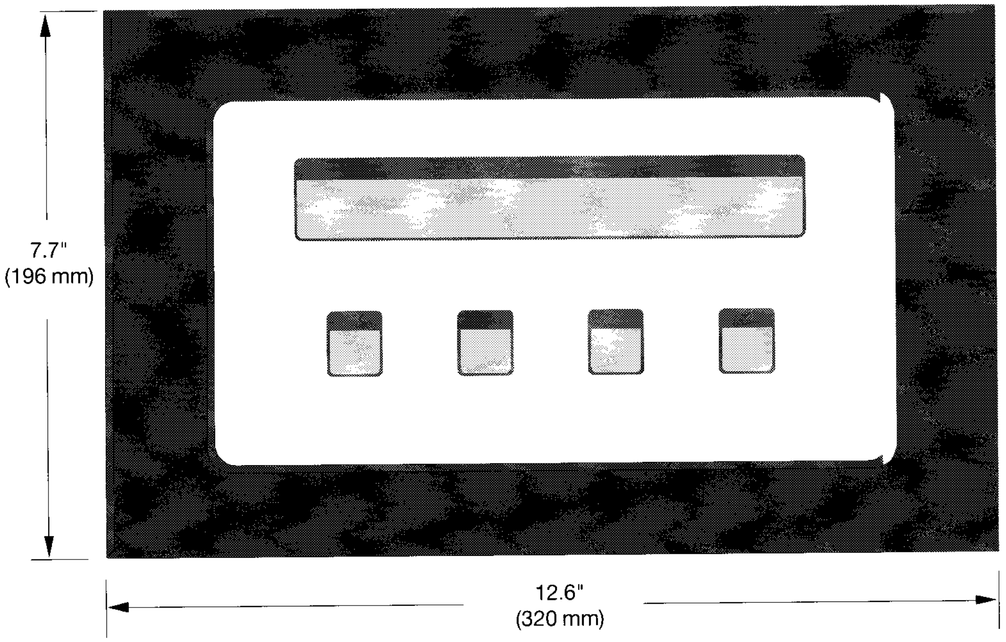
RS-232C or RS-485 communication does not work.

1. Check that the BAUD RATE matches all other ACCESS devices on the network or the personal computer.
2. Check that the communications mode (RS-232C or RS-485) set by the jumper on the communications card matches the given installation. See Section 2.8, "Communication Connections."
3. Check that the ADDRESS of the 4700 power meter matches the configuration of the Power Monitor unit or other computer.

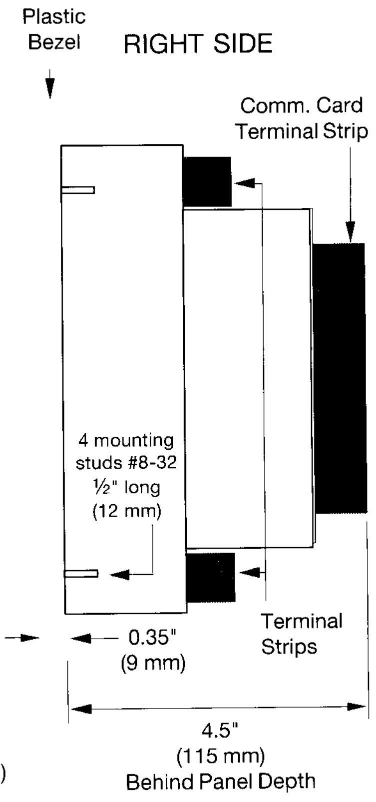
Appendix A

4700 Mechanical Dimensions — Mounting

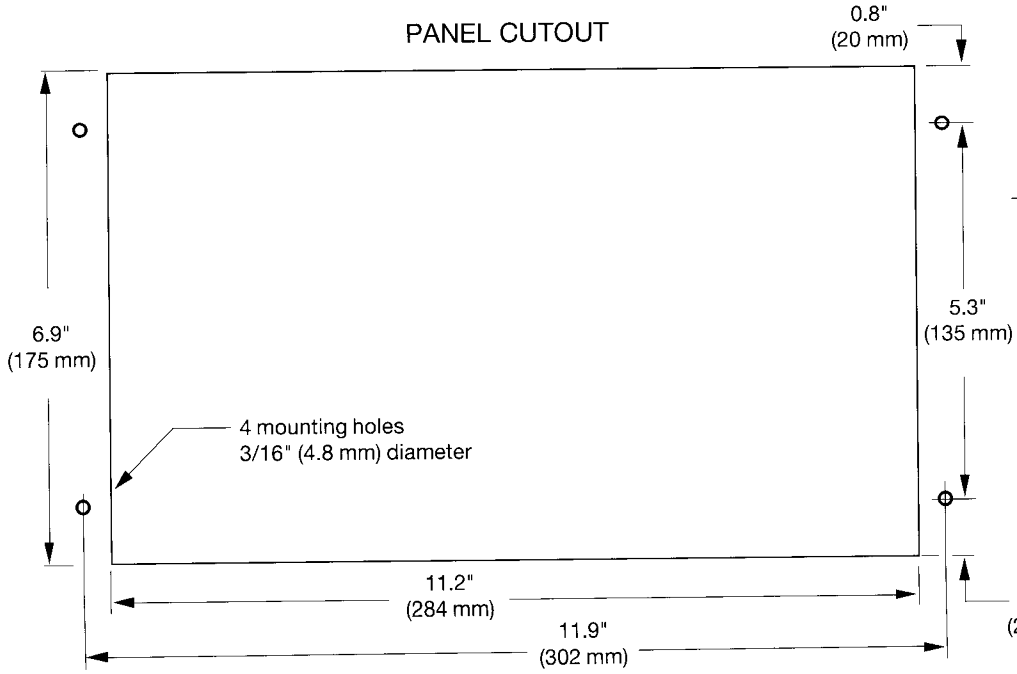
FRONT PANEL



RIGHT SIDE



PANEL CUTOUT



Appendix B

Setpoint Parameter Form

SETPOINT	TYPE	HIGH LIMIT	TD OPERATE	LOW LIMIT	TD RELEASE	RELAY/FUNCTION
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

4700 Power Meter Software Versions

The following table lists each software version release for the 4700 power meter and the new features or performance enhancements added with each release.

The version number is identified on the label on the rear cover of the 4700 power meter (see Figure 1-1). If yours is currently using a software version older than the most recent version listed in the table below, you can upgrade the software in that unit by contacting your local representative or the manufacturer. Upgrades to the 4700 power meter require a simple replacement of the EPROM (integrated circuit "chip"), which contains the operating software inside the unit. This must be done by a trained electronics serviceman.

Hardware Revision B

From now on, all EPROMs are available for either the A or B hardware. They are not interchangeable. Normally, only the B is released except for an upgrade of an older meter. Revision B meters are easily distinguished from revision A meters by the following:

- Raised black plastic bezel (Rev. A has a flat, white metal bezel)
- Product Rev: B printed on back of meter
- VREF terminal (Rev. A has no VREF terminal).

Software Version	Release Date	Description
2.2.0.2B	January 1, 1992	Exactly the same as Rev. A 2.2.0.2
2.2.0.3B	March 31, 1992	Fixed bug that limited unit ID (address) to 1...99
2.3.0.4B	January, 1993	Fixed bug with KWH/KVARH overflow causing display to blink. Fixed bug that lost password changes if powered down. Adds waveform capture feature. Adds reverse KVARH value. KVARH and KWH changed to return forward not total values. Adds configurable relay pulsing. Adds KW FWD, KVAR FWD, and KVAR REV setpoints. PF display changed to LD/LG. 3-wire Wye mode allows for 2VT/3CT. Demand period is now based on time of day. Added ,/. configuration of display values (European format). RTS line is asserted 10ms before tx in RS-232C mode. PM 3.13 logs diagnostic code 1 type 1 errors with this version.

Appendix D

4700 Power Meter Technical Specifications

Parameter	Accuracy (%)	Resolution (%)	Range
Volts	0.2	0.1	0 to 999,999 (1)
Amps (L & N)	0.2	0.1	0 to 9,999
KVA	0.4	0.1	0 to 999,999 (2)
KW	0.4	0.1	0 to 999,999 (2)
KVAR	0.4	0.1	0 to 999,999 (2)
Power Factor	1	1	1.0 to +/-0.6
Frequency	0.2 Hz	0.1 Hz	40 to 70 Hz
KW Demand	0.4	0.1	0 to 999,999
Amps Demand	0.2	0.1	0 to 9,999
KWHr	0.4	1 KWHR	0 to 999,999,999
KVARHr	0.4	1 KVARHR	0 to 999,999,999
Vaux (1 VAC scale)	0.25	0.1	0 to 999,999
Neutral Current	0.2	0.1	0 to 9,999

NOTES:

(1) Power meter reads in kV for voltages over 9,999.

(2) Power meter reads in MVA, MW, MVAR for readings over 9,999k.

(3) For extended temperature option, derate accuracy by 0.01%/°C below 0°C and above 50°C.

Input Ratings	
Voltage Inputs: (V1, V2, V3)	120 VAC, 277 VAC, and 347 VAC nominal full scale input versions Overload withstand: 1500 VAC continuous, 2500 VAC for 1 sec. Input impedance: 2 MOhm
Aux. Voltage Input: (Vaux)	1.0 VAC/VDC nominal full scale input (1.25 VAC/VDC max.) Overload withstand: 120 V continuous, 1000 V for 1 sec. Input impedance: 10 kOhm
Current Inputs: (I11, I12, I21, I22 I31, I32, I41, I42)	5.000 A AC nominal full scale input Overload withstand: 15 A continuous, 300 A for 1 sec. Input impedance: 0.02 Ohm, Burden: 0.05 VA
Status Inputs: (S1, S2, S3, S4)	>20 VAC/VDC = active, <9 VAC/VDC = inactive (S1, S2, S3, S4) input impedance: 2 MOhm Overload withstand: 1500 V continuous, 2500 V for 1 sec.
Control Relays: (R1, R2, R3)	Form-C dry contact relays 277 VAC or 24 VDC @ 10 A maximum load current
Aux. Current Output: (Iout)	0-20 mA. Maximum load 250 Ohms resistive.
Power Supply:	Std. N. American: 85 to 132 VAC, 0.2 A, 47 to 440 Hz or 110 to 170 VDC, 0.2 A European(Optional): 85 to 264 VAC, 0.2 A, 47 to 440 Hz or 110 to 340 VDC, 0.2 A Other Options: 24 VDC and 48 VDC
Operating Temperature:	0°C to +50°C (32°F to 122°F) ambient air
Operating Humidity:	5 to 95%, noncondensing
Storage Temperature:	-30°C to +70°C (-22°F to +158°F) ambient air
Shipping:	Weight: 3.9 kg (8 lbs., 10 oz.) Carton: 38 x 25 x 18 cm (15" x 9.8" x 7.1")

NOTE:
Voltage, Current, Status, Relay, and Power inputs pass the ANSI C37.90A surge withstand and fast transient test.

Appendix E

4700 Power Meter Model/Ordering Information

Features	Product Designations	
	DR	DRMC3
15 Metered Parameters	X	X
Min/Max Log	X	X
Aux. Voltage (1VAC/1VDC Nominal)	X	X
20-Character Display	X	X
4 Discrete Inputs	X	X
3 Programmable Relay Outputs	X	X
1 Analog Ouput (4 to 20mA)	X	X
Communications		X
Event Log		X
Snapshot Log		X
Waveform Capture		X

Table E-1 4700 Power Meter Product Designations

4700 Power Meter Catalog Number Designations

4700B - DR ☐ - ☐☐ H N ☐

Options:
MC3 = Communications, event log, snapshot log, waveform capture

Power Supply:
1 = 120 VAC/125 VDC
2 = 240 VAC/250 VDC
3 = 24/48 VDC

Input Voltage (Ref. to Neutral):
1 = 120 VAC
2 = 277 VAC
3 = 347 VAC

Additional Options:
T = Extended temperature capability -30°C to +70°C (-22°F to +158°F)

Examples:

4700B-DRMC3-11HN

specifies a power meter with an isolated RS-232/RS-485 communications module, a 120VAC/125VDC power supply, and 120VAC nominal measured phase voltage inputs.

4700B-DR-12HNT

specifies a power meter with a 120VAC/125VDC power supply, 277VAC nominal measured phase voltage inputs, and extended temperature capability.

Warranty

Company warrants that on the date of shipment to Purchaser the goods will be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

If within one year from date of initial operation, but not more than eighteen months from date of shipment by Company, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such defect by, at Company's option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Company hereunder. Company shall have the right of disposal of items replaced by it. Purchaser shall grant Company access to the goods at all reasonable times in order for Company to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, the Company and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

The Company's responsibility does not extend to any item of the goods which has not been manufactured and sold by Company. Such item shall be covered only by the express warranty, if any, of the manufacturer thereof. The Company and its suppliers shall also have no responsibility if the goods have been improperly stored, handled or installed, if the goods have not been operated or maintained according to their ratings or according to instructions in Company or supplier furnished manuals, or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE), INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE GOODS.

The foregoing states Purchaser's exclusive remedy against Company and its suppliers for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity or any other legal theory, and whether arising out of warranties, representations, instructions, installation or defects from any cause.

SIEMENS

Siemens Energy
& Automation, Inc.
Switchgear and Motor Control
Business
Customer Service
P.O. Box 29503
Raleigh, NC 27626

ACCESS Systems Problem Report

To report problems with Siemens ACCESS systems and devices, make a copy of this form, complete it with as much information as you can, and contact your Siemens representative. You can also fax this form to Siemens Customer Service at 919-365-2830. For emergency service call 1-800-347-6659.

Customer Information

Job site location and contact: ______________________________

____

____

Phone and fax number: ______________________________

Siemens sales order number: ______________________________

Siemens manufacturing order number (from drawing): ______________________________

System Information

Describe the number and type of devices on your ACCESS system.

Field Devices

Quantity	Device Type	Quantity	Device Type
	4300 power meter		SCOR relay
	4700 power meter		ISGS relay
	4720 power meter		7SA, 7SJ, or 7UT relay
	Static Trip IIIC trip unit		Multiplexer Translator
	Static Trip IIICP trip unit		Isolated Multi-Drop converter
	Sensitrip III trip unit		S7-I/O device
	SB breaker trip unit		PRM pulse reading meter
	SAMMS-LV device		Other:
	SAMMS-MV device		Other:

Supervisory Devices and Software

Quantity	Product	Quantity	Product
	WinPM software		Power Monitor Panel (PMP)
	Host PC software		PC32F power monitor
	Power Monitor PC software		Siemens PLC
	SIEServe software		Other hardware:
	Other software:		Other hardware:

Form: SG-6004-01 1095

Problem Description

Provide the following information on the affected device(s):

Device type: ____________________

Model or catalog number: ____________________

Part number: ____________________ Serial number: ____________________

Hardware version: ____________________ Software version: ____________________

Installed options: ____________________

Configuration information, including operational settings, parameters, wiring, type of system:

On what type of electrical equipment are the devices installed? (switchgear, motor control center, switchboard, etc.): ____________________

Provide a brief description of the problem: ____________________

Indicate what error messages, if any, are generated by the device or supervisory software. Include messages listed in the event log: ____________________

To be completed by Siemens

Received by: ____________________ Date received: ____________________

Reviewed by: ____________________ Date reviewed: ____________________

Sales engineer: ____________________

Problem report tracking number: ____________________

Problem classification code: ____________________

Corrective action: ____________________

SIEMENS

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tel. 1-919-365-2200
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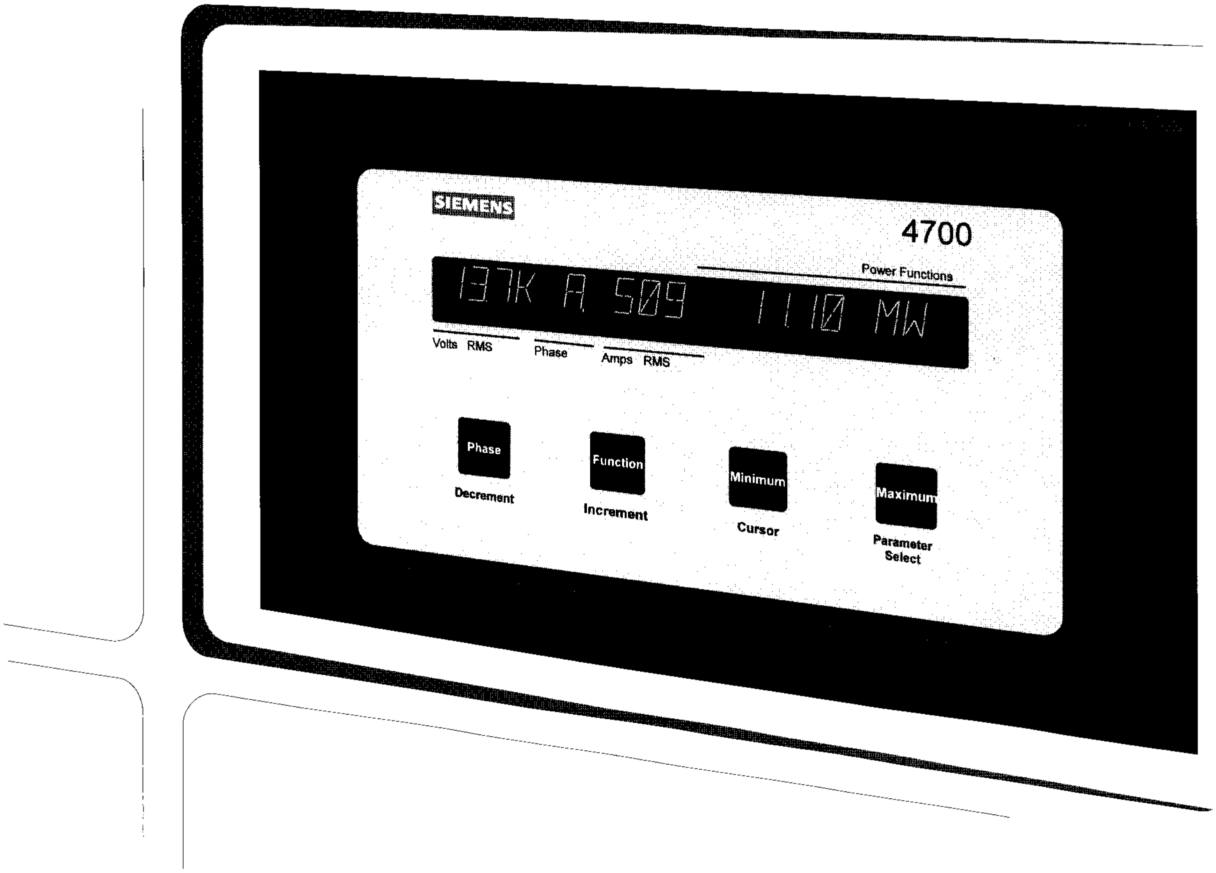
Manual No. SG-6018-02 (Replaces -01) 2MTD1095
Printed in U.S.A.

SIEMENS

4700 Power Meter

Operator's Manual



Manual No. SG6018-03

⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

Will cause death, serious personal injury, or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel.

The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

QUALIFIED PERSON

For the purposes of this manual, a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, that person has the following qualifications:

(a) is **trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) is **trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, or face shields, flash clothing, etc., in accordance with established safety procedures.

(c) is **trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

The contents of the instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

Table of Contents

1 Introduction

1.1 About the 4700 Power Meter

The 4700 power meter is a microprocessor-based instrumentation package for low, medium or high voltage electrical equipment and substations. It is a state-of-the-art alternative to traditional analog electromechanical metering devices. The unit is economical and is easy to install and operate. It requires no external transducers.

This manual supersedes all previous publication versions on the installation and operation of the 4700 power meter.

1.2 Performance Features

The 4700 power meter offers major improvements in accuracy, communications capability, data logging, control capability, ease of use, and cost, compared to traditional analog components or first generation digital metering systems. The 4700 power meter operates as a stand-alone switchboard, switchgear, motor control center or substation instrument, and serves as a data collection point for Siemens ACCESS™ electrical distribution communication system.

The unit uses a 12 MHz, 16-bit microcontroller chip. This provides very high computational throughput, allowing the sophisticated software to process information in real time. The unit is self-contained and its readings and setup parameters are maintained in nonvolatile memory. Connections to the 4700 power meter are on the rear of the unit, as shown in **Figure 1.1**.

1.3 Displays and Measurements

You can view readings from the alphanumeric display. Readings are displayed in the following format:

- 4-digit voltage display phase indication
- 4-digit amperage display
- 8-digit power function display

The unit can be configured to operate in wye (star), delta, or single-phase voltage modes. The following measurements are available:

- Current on each phase
- A fourth current input (I4)
- Line-to-line voltages
- Frequency
- Power factor
- kVA
- kW
- kVAR
- kW Demand
- V_{AUX} (auxiliary voltage input)
- Total MWHr
- Total MVARHr

Minimum and maximum values for each of the readings are available. You can also set the unit to take snapshots of all readings at specified intervals and maintain them in nonvolatile memory. The snapshot data is read using the serial communications port.

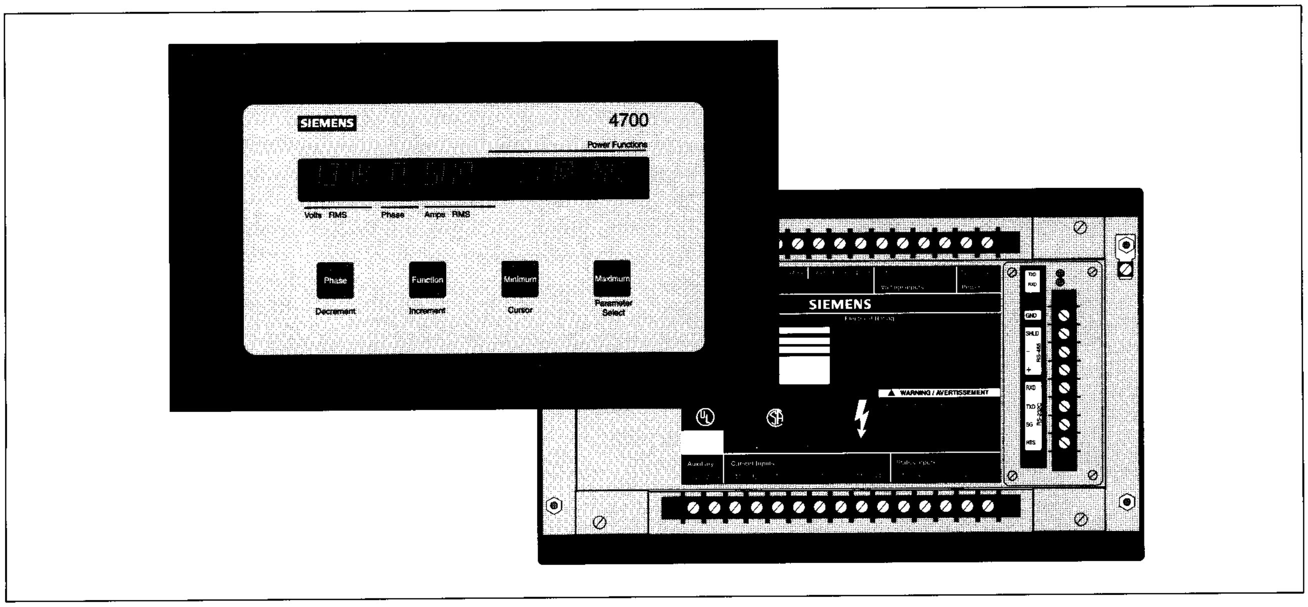


Figure 1.1 Front and Rear Views

1.4 Other Functions

1.4.1 Logging Capability

The 4700 power meter can record up to three data logs.

- EVENT Log. This log records events such as power up, parameter changes, alarm conditions, relay changes, and status input changes. The 50 most recent events are retrievable from this log using the communications port.
- SNAPSHOT Log. This log contains voltage, current, and all power values recorded at user-defined time intervals. The 100 most recent snapshots are retrievable from this log using the communications port.
- MIN/MAX Log. This log records the extreme values for voltages, currents, power, and other measured parameters. Min/Max data is read using the integral display or the communications port.

All log contents (events, snapshots, and min/max values) are time-stamped to the second.

1.4.2 Control Relays

The 4700 power meter has three control relay options.

- Alarm relays and setpoint relays. These can operate as a function of any measured parameter for demand, power factor, or load control.
- Remote control relays, operated by command via the communications port.
- kVARHr, kWHr pulse outputs.

1.4.3 Status Inputs

The 4700 power meter has four status input options available, which can each sense the state of an external contact, active or inactive. The status of these inputs is viewed and logged by a Power Monitor™ display and monitoring unit, or by another computer through the communications port.

1.4.4 Auxiliary Voltage Input

All 4700 power meter models have an auxiliary voltage input that allows monitoring and display of an additional external voltage (1.25 VAC max).

1.4.5 Auxiliary Current Output

You can program an optional analog current output for 0 to 20 mA or 4 to 20 mA, in proportion to any measured parameter.

1.5 Communications and ACCESS Compatibility

The 4700 power meter is equipped with an optically isolated communications port for displaying data on remote supervisory devices. These devices and programs allow the meter to operate in the ACCESS electrical distribution communication system. Examples of supervisory devices include the Power Monitor display and monitoring unit, a standard personal computer running the Power Monitor PC communications and supervisory software, and Siemens Microsoft® Windows™-based SIEServe™ or WinPM™ communications software.

1.6 System Applications

The unique features of the 4700 power meter, including measurement, storage, setpoint (load shedding) and display characteristics, make it suitable for use in:

- Utility Installations
- Industrial Buildings
- Office Buildings
- Commercial Buildings
- Hospitals
- Telephone Exchanges
- Factories
- Pulp Mills
- Saw Mills
- Shopping Centers
- Large Stores
- Hotels
- Substation Metering
- Co-Generation Systems
- Chemical Process Plants
- Multi-User Sites (where allocation of electrical cost is desirable)
- Any other installation that uses significant amounts of electrical energy
- Any other location where remote monitoring and control is needed

2 Installation

⚠ DANGER

Electrical equipment contains hazardous voltages.

Can cause death, serious personal injury, or equipment damage.

Installation and maintenance should be performed only by qualified personnel.

2.1 Location and Mounting

Locate the 4700 power meter in a dry, dirt-free environment, away from heat sources and very high electric fields. To operate properly and effectively, environmental conditions should fall within the guidelines listed in **Appendix A**.

The 4700 power meter can be panel-mounted for easy access and viewing. The meter has four studs to facilitate panel mounting. **Figure** provides the mounting dimensions for the 4700 power meter. A five inch clearance behind the front panel is required for access to wiring.

2.2 Power Supply

The standard 4700 power meter requires 85 to 132 VAC (47 to 440 Hz) or 110 to 170 VDC, both at 0.2 A. The power can be supplied by a dedicated fused feed, or by the monitored voltage source (120 V system). Optional power supplies are available for 24 VDC/48 VDC, and 240 VAC/250 VDC.

2.3 Power Wiring

Connections to the 4700 power meter are made to two terminal strips located on the rear of the unit. **Figure** provides 4700 power meter terminal block dimensions. Ring or spade terminals are recommended for all connections.

The phasing and polarity of AC current and voltage inputs, and their relationship, is critical to the operation of the power meter. Refer to **Figure 2.2** through **Figure 2.7** for wiring diagrams to ensure correct installation.

2.3.1 Chassis Ground Connection

You must connect the chassis of the 4700 power meter to earth ground. A good, low-impedance chassis ground is essential for the 4700 power meter surge and transient protection circuitry to function effectively. Do not rely on metal door hinges as a ground path.

Connect the ground wire to the chassis of a standard 4700 power meter using the supplied ground lug attached to one of the four mounting studs.

In both cases, ensure that the ground lug screw is tightened securely onto the ground wire, and that the nut is tightened securely onto the lug.

Note: For the noise and surge protection circuitry to function correctly, the 4700 power meter chassis ground lug must be connected to the switchgear earth ground using a dedicated 14 AWG (or larger) wire. Failure to do so will void the warranty.

2.3.2 Voltage Reference Connection

The voltage reference terminal, VREF, of the 4700 power meter serves as the zero voltage reference for voltage readings. A good, low-impedance VREF connection is essential for accurate measurement. Use a dedicated 14 AWG wire for a connection at a point where there are no voltage errors due to distribution voltage drops.

The connection point for VREF is dependent on the system configuration. Each of the following configurations is illustrated in **Figure 2.2** through **Figure 2.7**:

- If the system you want to monitor is a four-wire wye or single phase, then you must connect the VREF to the neutral conductor
- If the system is a three-wire grounded (delta), then you must connect the VREF to the line transformer neutral
- For three-wire ungrounded (open delta) systems, and for systems where VTs are used, you must connect the VREF to the VT common leads

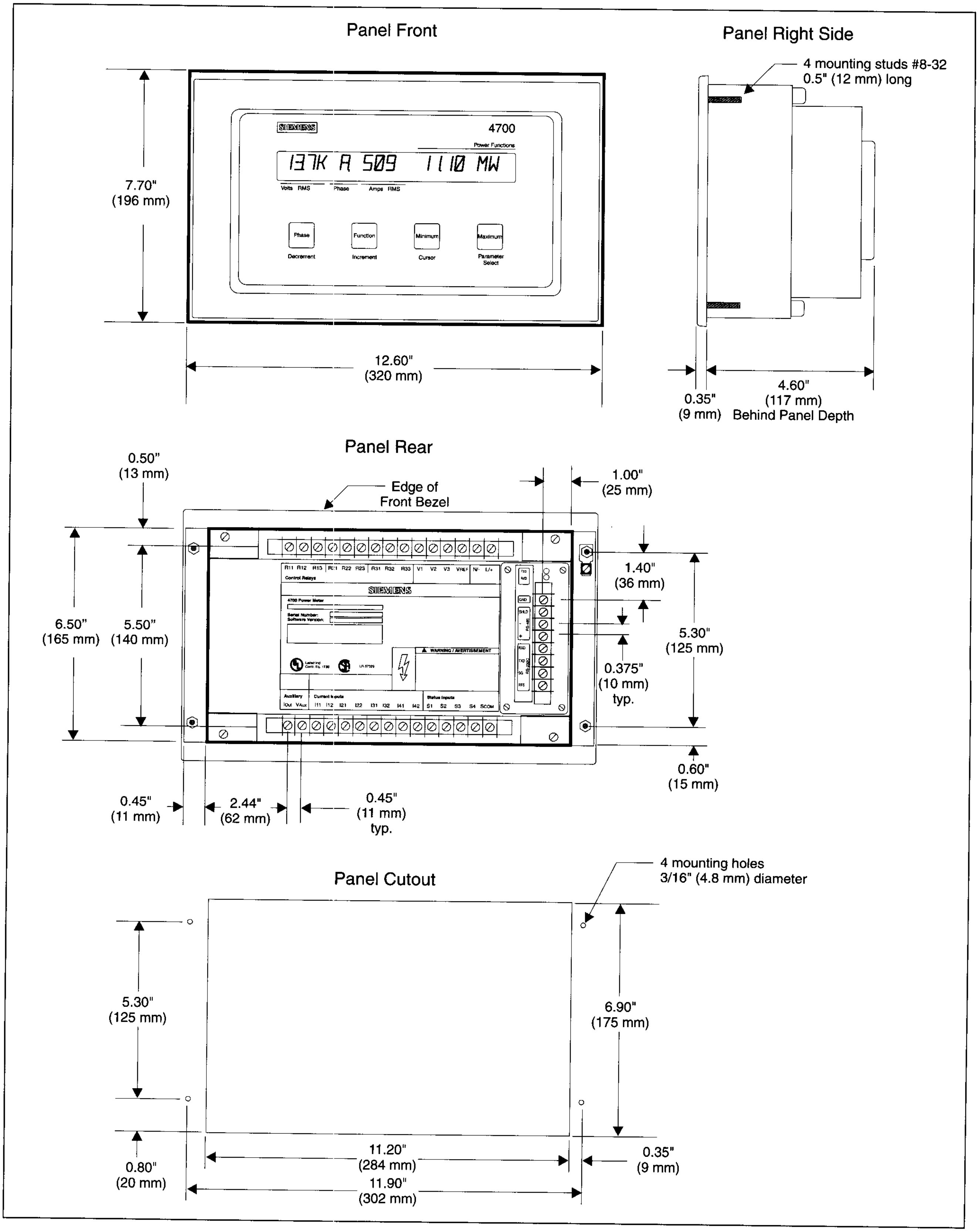


Figure 2.1 Mounting Dimensions

2.3.3 Fourth Current Input Connections

The 4700 power meter is equipped with a fourth current input, labeled I4. This input is typically used to measure the current flow in the neutral or ground conductor. The use of this input is optional. If not used, connect the I41 and I42 terminals to earth ground.

The secondary rating of the CT connected to the I4 input must match the three phase current inputs. This rating depends on the presently installed input option in the 4700 power meter.

The primary rating for the CT connected to the I4 input can differ from the three phase inputs, since the I4 input scaling is independently programmable.

2.3.4 Waveform Capture Connections

The 4700 power meter waveform capture feature allows digital sampling of signals at each of its voltage (V1, V2, V3, Vaux) inputs and current (I1, I2, I3, I4) inputs. The 4700 power meter uses the V1 input as the triggering reference for waveform capture, and to maintain phase relationships between all sampled signals. You must connect the V1 input for waveform capture to work. No other special wiring considerations are necessary. Waveform capture is accessible only via communications. See **section 6.8** in **Chapter 6** for more information about how to use waveform capture.

2.4 Selecting Voltage and Current Transformers

Selection of correct current transformers (CTs) and voltage transformers (VTs) is critical to proper monitoring. This section describes how to choose transformers.

2.4.1 Selecting VTs

The requirement and selection of VTs depends on three criteria: the system monitored, the voltage levels monitored, and the model of the 4700 power meter.

For connecting directly to 120/208 VAC systems, the 120 VAC (full scale) input model is used. It is also used for systems with VTs having a 120 VAC secondary. For connecting directly to a 277/480 VAC system, the 277 VAC (full scale) input model is used. For connecting a 347/600 VAC system, the 347 VAC (full scale) input model is used. If system voltages are over 347/600 VAC, then VTs are required.

VTs are used to scale down the system voltage to 120 VAC full scale. The system voltage is line-to-neutral (L-N) for wye systems or line-to-line (L-L) for delta systems. 120 VAC is the nominal scale input of the 4700 power meter.

The VTs are selected as follows:

a. Wye (star): VT primary rating is the system L-N voltage or nearest higher standard size. VT secondary rating is 120 V.

b. Delta: VT primary rating is the system L-L voltage. VT secondary rating is 120 V.

VT quality directly affects system accuracy. Therefore, for valid Volts, kW and PF readings, the VTs must provide good linearity and maintain the proper phase relationship between voltage and current. Instrument Accuracy Class 1 or better is recommended.

2.4.2 Selecting CTs

The 4700 power meter uses CTs to sense the current in each phase of the power feed. The selection of the CTs is important because it directly affects accuracy.

The CT secondary rating is always 5 A with a burden capacity greater than 3 VA (burden is the amount of load fed by the CT, measured in Volt-Amps).

Normally, the CT primary rating is selected equal to the Amp rating of the power feed protection device. However, if the anticipated peak load is much less than the rated system capacity, then improved accuracy and resolution is obtained by selecting a lower rated CT. In this case, choose the CT size equal to the maximum anticipated peak current plus 25%, rounded up to the nearest standard CT size available.

Other factors affect CT accuracy. Because long cable runs contribute to inaccuracy, try to minimize the length of the CT cable. Also, the CT burden rating must exceed the combined burden of the 4700 power meter plus cabling and any other connected devices.

VT and CT Considerations

Protect all phase voltage leads with breakers or fuses at their source. In cases where VTs are required and the power rating of the VTs is over 25 W, fuse the secondaries.

Connect CTs to the device via a shorting block or test block to facilitate safe connection and disconnection.

Refer questions regarding proper working procedures to qualified personnel.

2.5 Connecting to 3-Phase, Wye (Star) Systems

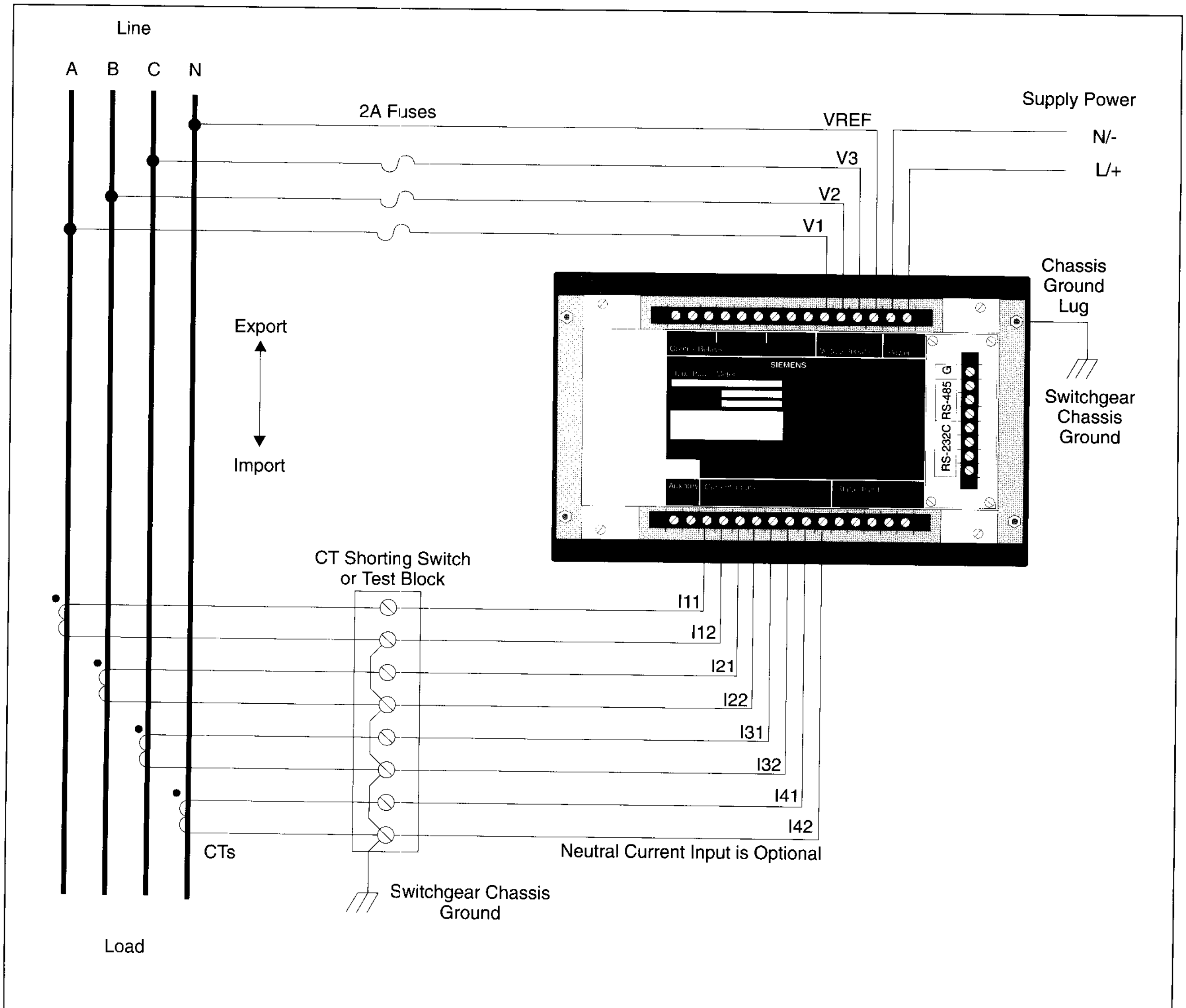
Without VTs

For a four-wire wye system, the 4700 power meter senses both the line-to-neutral (or ground) voltage and the current of each phase. This is the equivalent of a three-element metering configuration.

If the power system you want to monitor is a 120/208 V system, then use the standard 120 VAC input model with direct sensing of each phase, without the need for VTs. If the system is a 277/480 or 347/600 V system, then use the 277 VAC or 347 VAC input models connected directly.

Note: Although the 277 VAC and 347 VAC models can be connected directly, VTs may be required to meet local electrical codes when the 4700 is panel mounted.

The wiring diagram for these voltage ranges is shown in **Figure 2.2**. Set VOLTS MODE to 4W-WYE as described in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTS MODE:** 4W-WYE<0>

Supported Models:

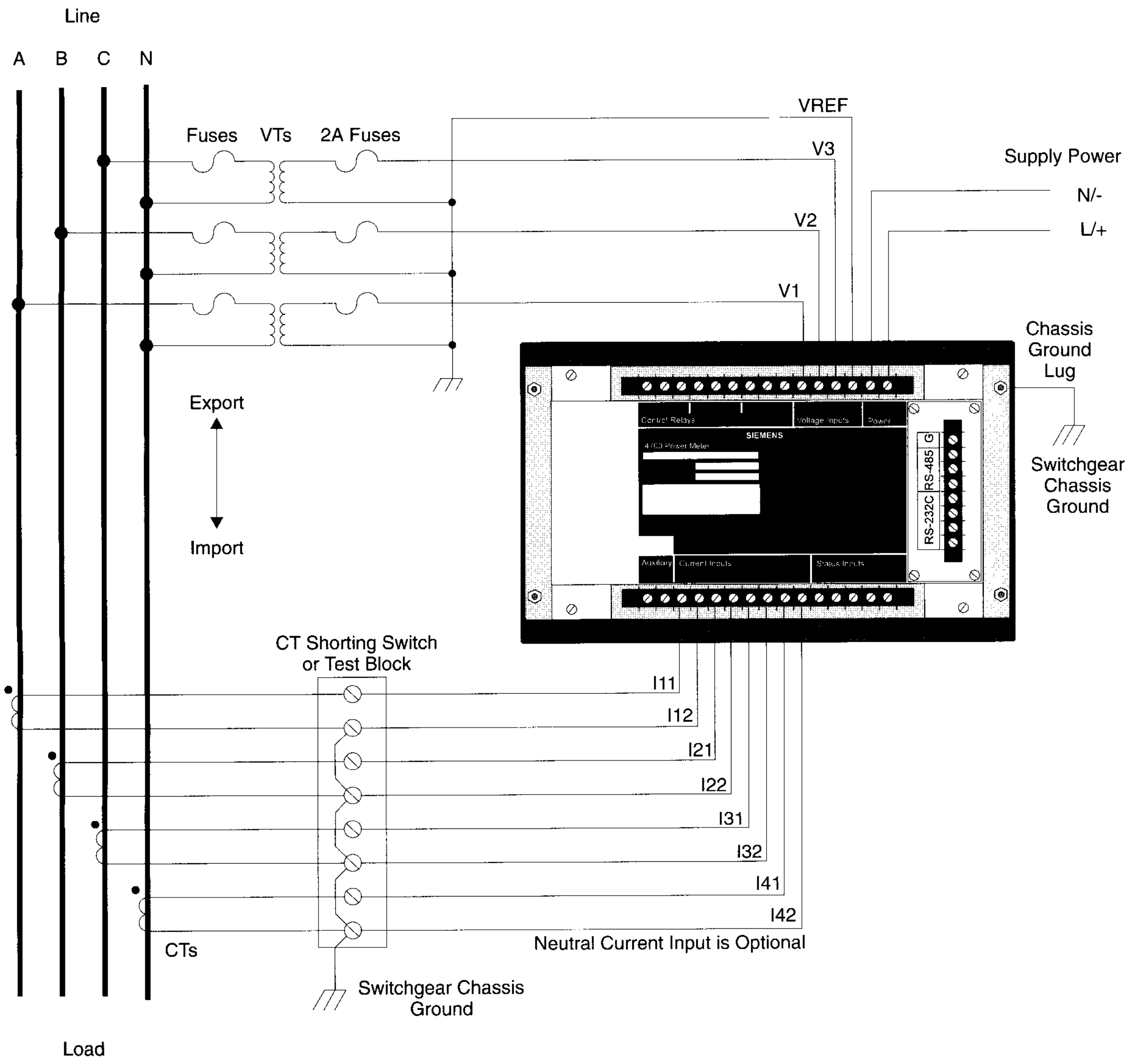
≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.2 Four-Wire Wye: Three-Element Direct Connection

With VTs

For wye system voltages over 347/600 V, you must use VTs. Wire both the VT primary and secondary in a wye (star), exactly as shown for correct operation.

This configuration is shown in **Figure 2.3**. Set the VOLTS MODE to 4W-WYE as described in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTS MODE:** 4W-WYE<0>

Supported Models:

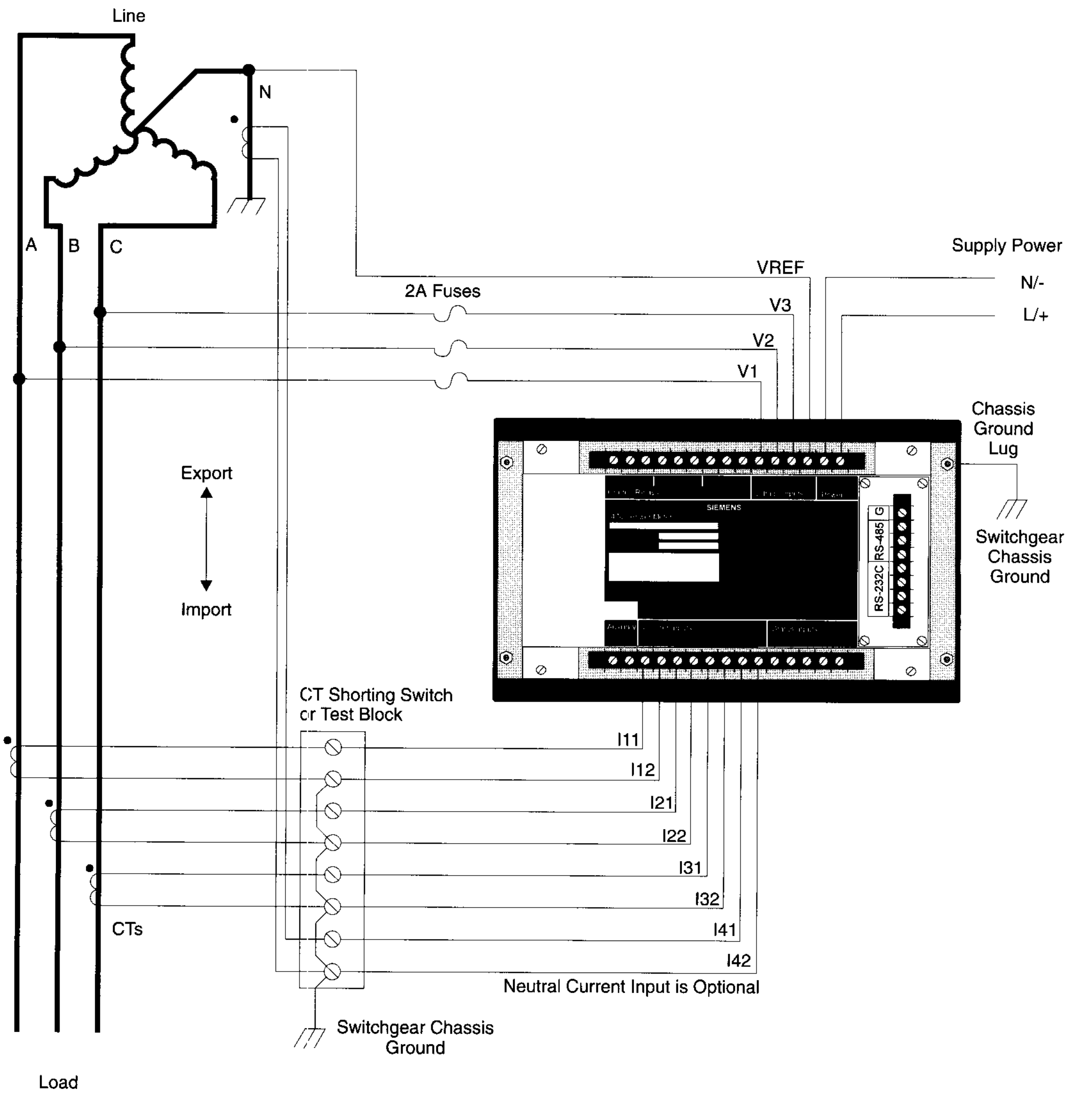
≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.3 Four-Wire Wye: Three-Element Connection Using Three VTs

Three-Wire Grounded Wye Without VTs

When the starpoint of a three-wire wye system is grounded, connect the 4700 power meter directly without the use of VTs. Ensure that the voltages are within the input range of the unit.

This configuration is shown in **Figure 2.4**. Set the VOLTS MODE to 4W-WYE as described in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTS MODE:** 4W-WYE<0>

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.4 Three-Wire Grounded Wye: Three-Element Direct Connection

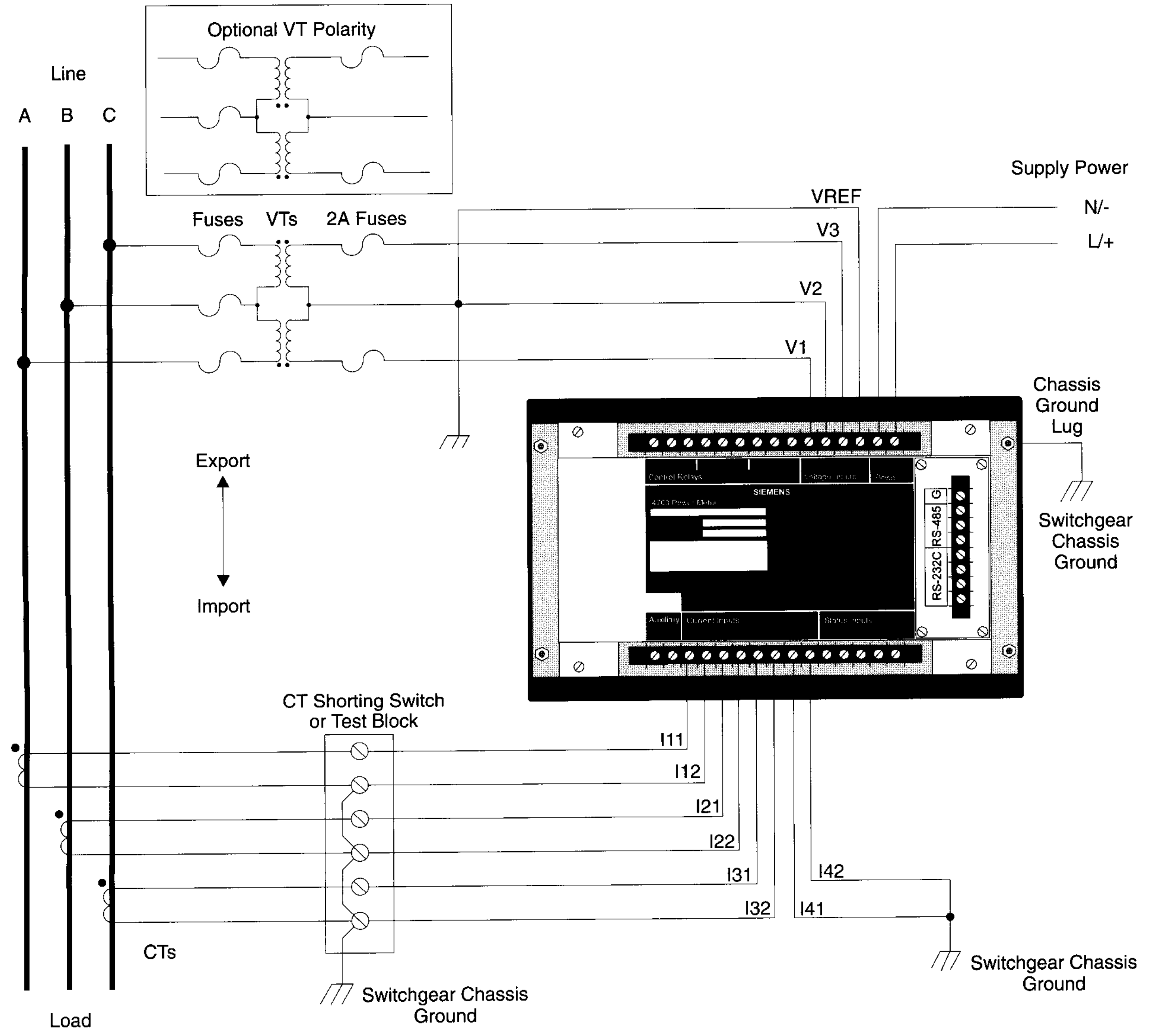
2.6 Connecting to Three-Phase, Delta Systems

2½-Element Connection

For ungrounded (floating) three-wire delta systems, the 4700 power meter always requires two VTs and senses the line-to-line voltages between each of the phases.

Connect the 4700 power meter in one of two ways: using two or three CTs.

Figure 2.5 shows an ungrounded delta connection using three CTs. Set the VOLTS MODE to DELTA as described in **Chapter 6, Programming**.



Volts mode is delta. **VOLTS MODE:** DELTA<1>

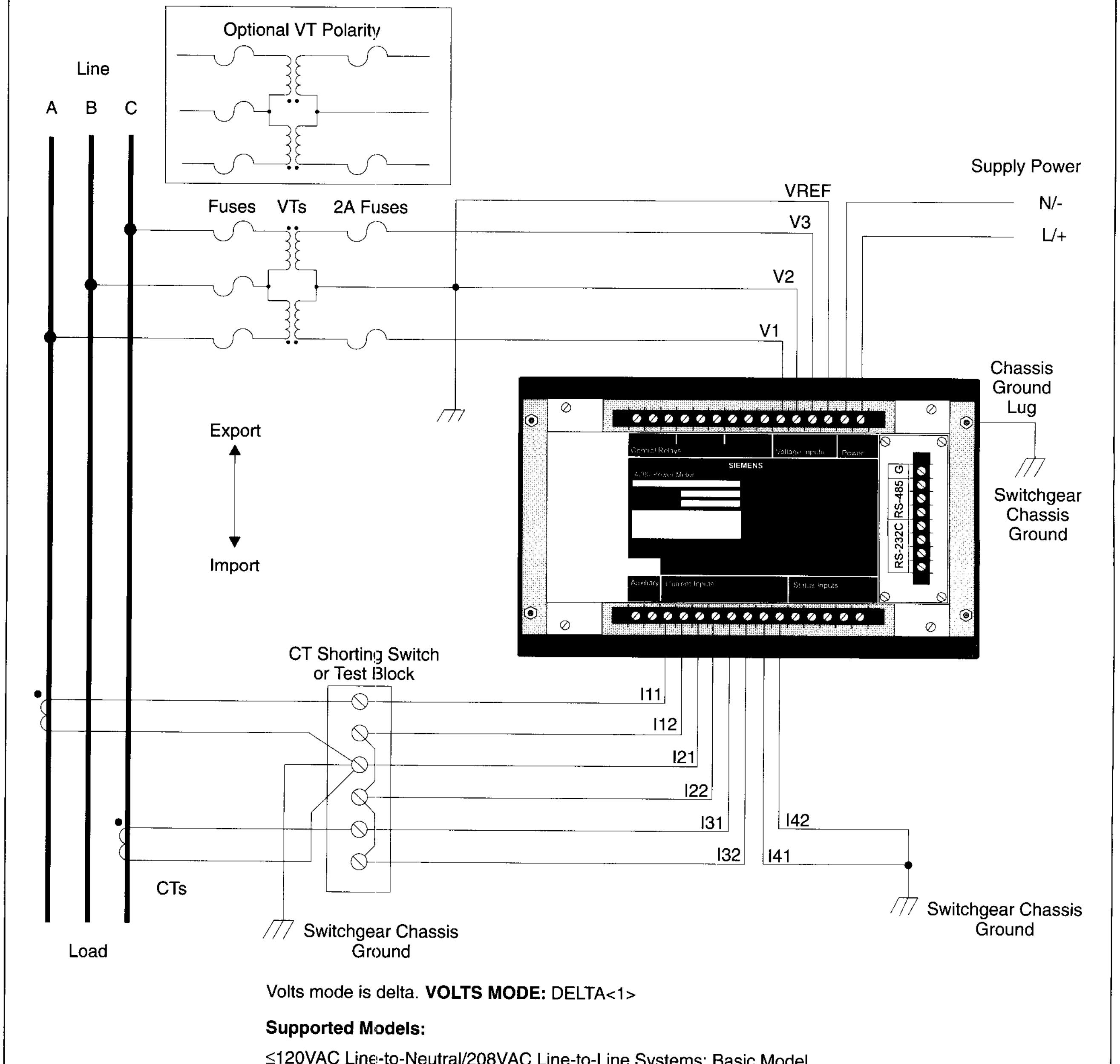
Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.5 Three-Wire Delta: 2½-Element Connection Using Two VTs and Three CTs

Two-Element Connection

Figure 2.6 shows an ungrounded delta connection using two CTs. Set the VOLTS MODE to DELTA as described in **Chapter 6, Programming.**



Volts mode is delta. **VOLTS MODE:** DELTA<1>

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

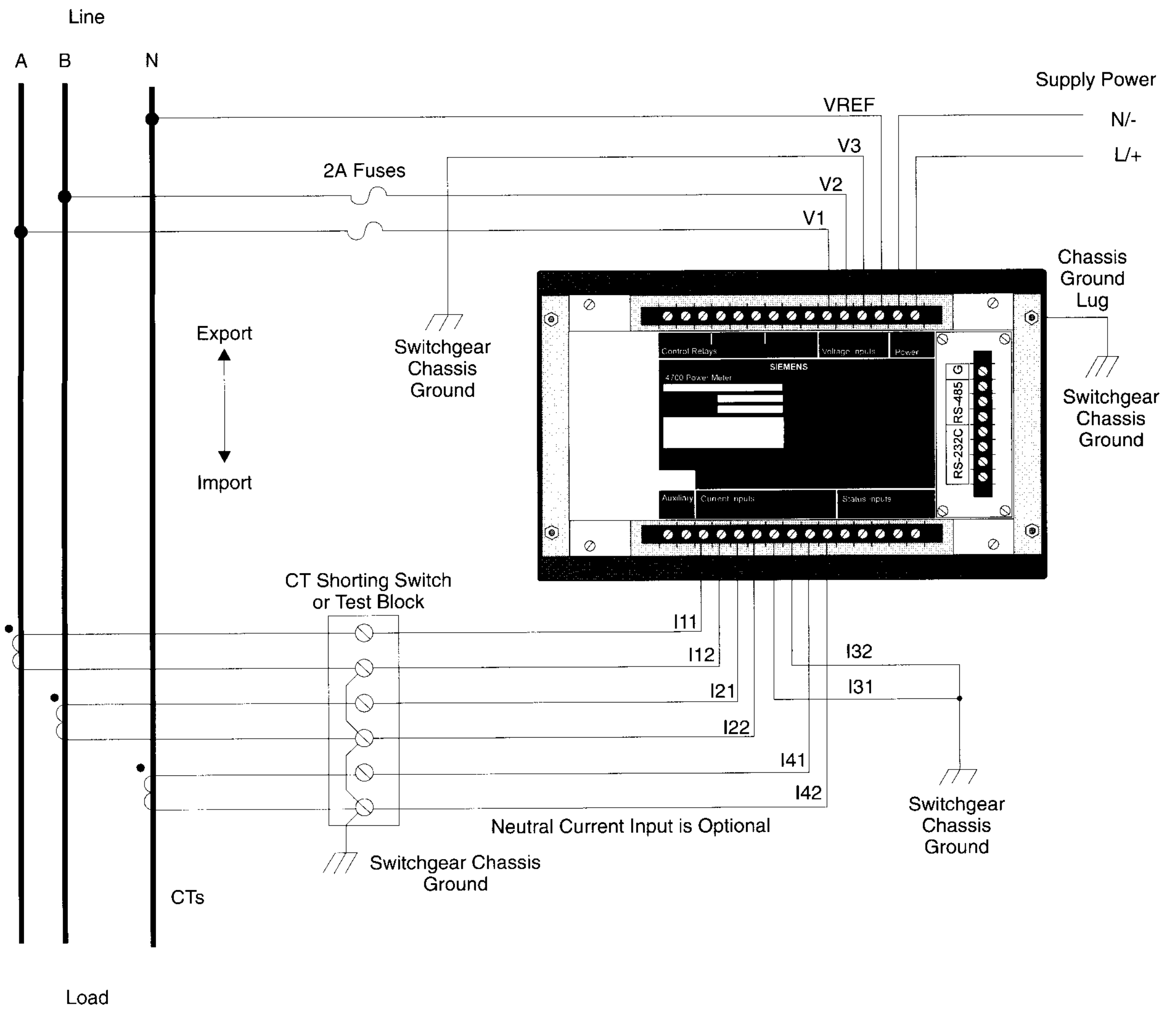
Figure 2.6 Three-Wire Delta: 2-Element Connection Using Two VTs and Two CTs

2.7 Connecting to Single Phase, Three-Wire Systems

Two-Element Connection

For single phase systems, connect the two voltage phases (180 degrees respectively) to the V1 and V2 inputs of the 4700 power meter. Also, connect the outputs of the two corresponding current transformers to the I1 and I2 input pairs.

The connections are illustrated in **Figure 2.7**. Note that the V3 input and I3 input pair are unused and grounded. For single-phase systems, set the VOLTS MODE of the 4700 power meter to SINGLE as described in **Chapter 6, Programming**.



Volts mode is single phase. **VOLTS MODE:** SINGLE<2>

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.7 Three-Wire Single Phase: Two-Element Direct Connection

3 Communications Wiring

The communications option of the 4700 power meter includes a communications card. The card is field configurable to allow the 4700 power meter to communicate using either the EIA/TIA-232 (RS-232) or EIA/TIA-485 (RS-485) standard. Optical coupling provides full isolation between the RS-232 or RS-485 communications lines and the metering equipment. Internal circuitry protects against common mode voltages or incorrect connection of the optional communications card. All inputs pass the ANSI/IEEE C37-90A-1989 tests for withstanding surge and fast transient.

The following sections describe configuration instructions and wiring requirements for direct connection to a master computer station.

The communications card is shipped with a label affixed to the mounting plate indicating the communications mode (RS-485 or RS-232) set at the factory. If the mode is incorrect for your application, refer to the following section for changing the configuration.

3.1 Configuring the Communications Card

This section describes how to change the communications mode of the 4700 communications card. You can select RS-232 or RS-485 lines by switching a jumper block on the card. The presently selected communications mode may be viewed from the power meter front panel, or by removing the card and examining the position of the jumper block. (See **Chapter 5, Operator Interface** for instructions on how to use the power meter front panel to display the communications mode.)

To remove the card for configuration:

1. Turn off the power to the 4700 power meter.
2. Remove the four machine screws holding the rectangular communications card mounting plate to the 4700 power meter case back cover.
3. Carefully pull the plate away from the main chassis to remove the card.

To configure the card:

The circuit board of the communications card has a jumper labelled J1. This jumper has two positions, labelled "RS485" and "RS232," which determine the communications mode. **Figure 3.1** illustrates the jumper position required for RS-485 or RS-232 mode. Move the jumper to the correct position.

To re-install the card:

1. Make sure that the power to the 4700 power meter is off.
2. Insert the communications card into the 4700 power meter, ensuring that the circuit card is oriented such that it will mate properly with the edge connector on the main board inside the 4700 power meter.

   Note: The card is polarized (keyed) to ensure it may only be installed in the correct orientation.

3. Align the holes in the mounting plate of the card with the mounting holes in the rear cover of the main chassis while lowering the card toward its seating. A correct alignment will allow the card edge to mate with the edge connector inside the main chassis.
4. Once the board is resting in proper alignment on the edge connector, carefully press down to plug the card into the edge connector.
5. Install the four mounting screws into the mounting plate to secure the card.

The card is now ready for use.

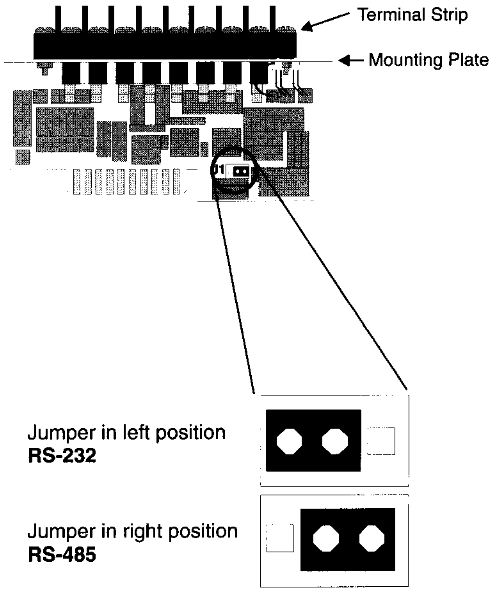


Figure 3.1 Communications Card Jumper Configuration

3.2 Terminal and LED Indicator Functions

The optional communications card provides a barrier-style terminal strip (see **Figure 3.2**). Terminal functions include:

Ground	GND	Chassis Ground
RS-485	SHLD	RS-485 Shield (electrically connected to chassis ground)
	-	RS-485 Data Minus
	+	RS-485 Data Plus
RS-232	RXD	RS-232 Receive Data (that is, receive data into device)
	TXD	RS-232 Transmit Data (that is, transmit data out of device)
	SG	RS-232 Signal Ground
	RTS	RS-232 Request To Send

Two LED indicators, TXD and RXD, show activity on the RS-232 or RS-485 communications lines and can be used to verify correct communications operation. The TXD indicator flashes when data is being sent out by the device. The RXD indicator flashes when data is being received by the device.

The 4700 power meter supports 19.2 Kbaud operation. This applies to both RS-232 and RS-485 standards.

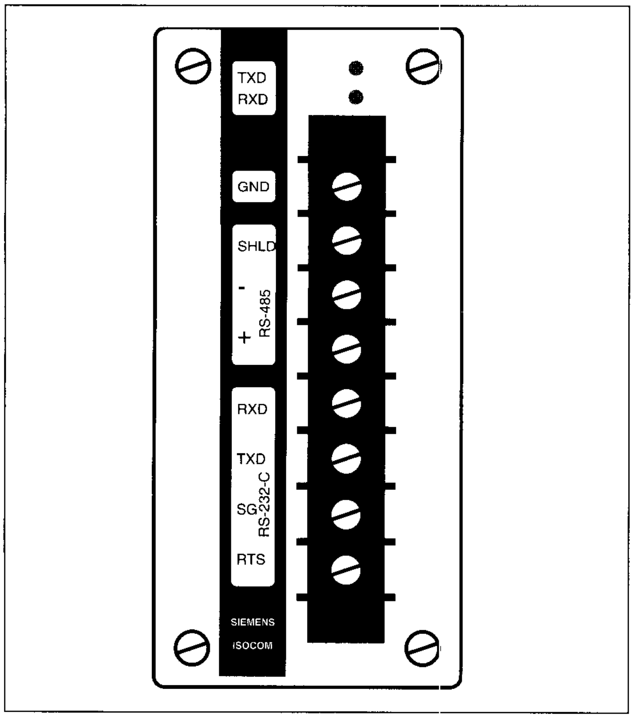


Figure 3.2 Communications Card Terminal Block

3.3 RS-232 Connections

Figure 3.3 illustrates the wiring requirements for connection of the 4700 power meter using RS-232 communications. This can include a local direct connection to a computer or other device, or a remote connection via modem.

Note: For information on remote connections via modem (telephone, fiber optic, radio, and so on), contact Siemens for a detailed application note.

The RS-232 standard allows only a single point-to-point communication connection. Using this method, only one RS-232 equipped device may be connected to the serial port of the computer, modem, or other device.

The cable used between the computer and the modem (if used) is a standard RS-232 communications cable with a maximum length of 50 feet (15.2 meters). Refer to the installation manuals for each device for cable requirements.

The cable used between the computer or modem and the 4700 power meter is a custom RS-232 cable. One end is equipped with a DB-25 or DB-9 plug (male) or socket (female) connector. The connector required depends on the mating computer or modem serial port connector. The other end of the cable consists of discrete wires which connect to the RS-232 terminals of the communications card of the 4700 power meter. Cable length is 50 feet (15.2 meters) maximum.

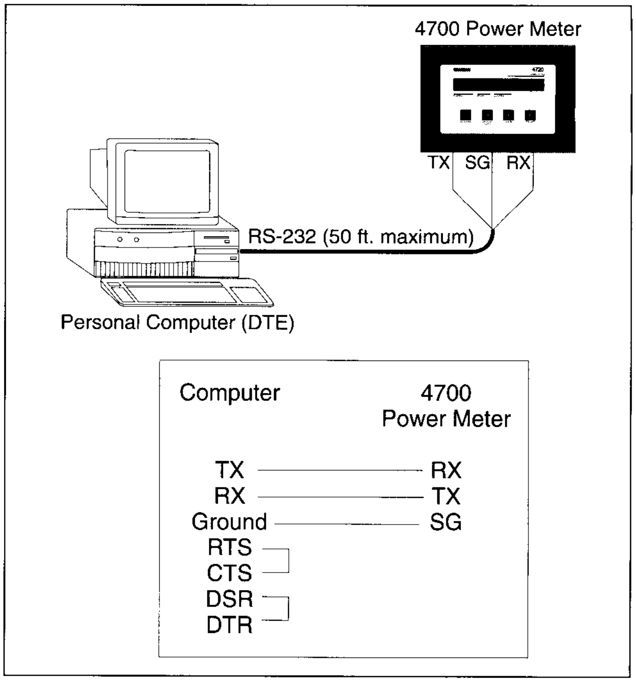
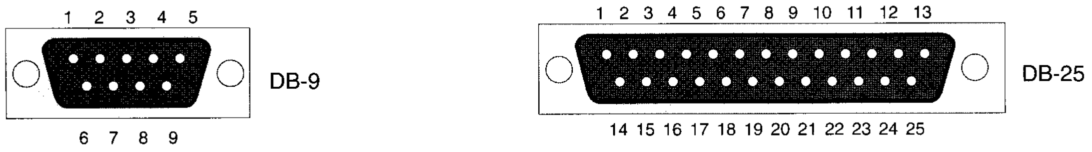


Figure 3.3 RS-232 Communications Connections



(Seen From Computer)

Pin	Computer (DTE)
1	RLSD
2	RX
3	TX
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	RI

(Seen From Computer)

Pin	Computer (DTE)	Isolated Multi-Drop Converter
1	Ground	Ground
2	TX	RX
3	RX	TX
4	RTS	RTS
5	CTS	CTS
6	DSR	DSR
7	Ground	Ground
8	RLSD	RLSD
20	DTR	DTR
22	RI	RI

Figure 3.4 RS-232 Cable Wiring Specifications

Figure 3.3 and **Figure 3.4** illustrate the RS-232 cable configurations and wiring connections.

If connected directly to a computer's RS-232 port, the TXD and RXD leads may need to be reversed at the remote device, depending on whether the PC RS-232 port is configured as DCE or DTE.

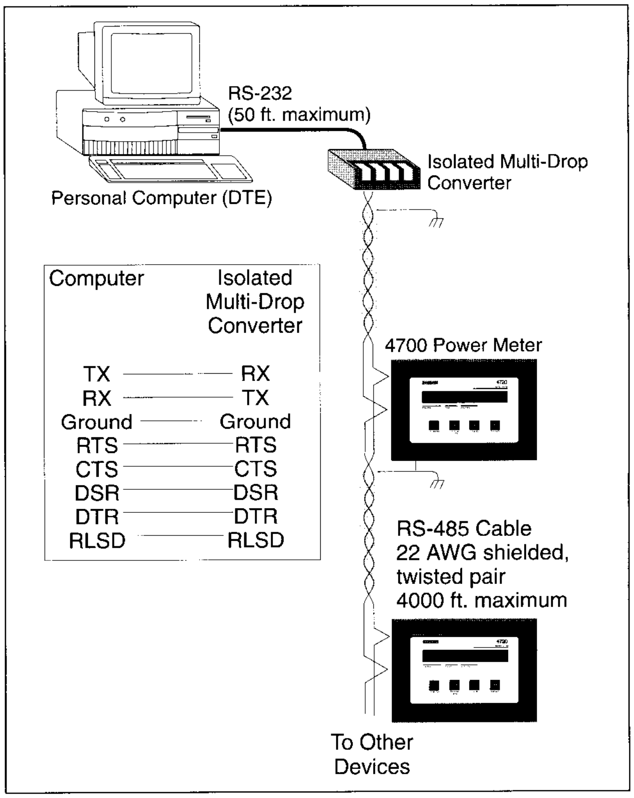
3.4 RS-485 Connections

RS-485 communications allow multiple devices to be connected on the same bus (see **Figure 3.5**). Up to 32 devices can be connected on a single RS-485 bus which consists of a shielded twisted pair cable. The overall length of the RS-485 cable connecting all devices cannot exceed 4000 feet (1220 meters).

To connect an RS-485 communications bus to a computer or other RS-232 equipped device, an RS-232 to RS-485 converter is required, such as the Siemens Isolated Multi-Drop™ converter. The Isolated Multi-Drop converter offers four RS-485 ports that can each support up to 32 devices.

Devices connected on the bus, including the 4700 power meter converter(s), and other instrumentation, must be wired as follows:

1. Use a good quality shielded twisted pair cable for each RS-485 bus. It is recommended that 22 AWG (0.6 mm) or larger conductor size be used.
2. Ensure that the polarity is correct when connecting to the RS-485 port (+) and (-) terminals of each device.



Computer	Isolated Multi-Drop Converter
TX	RX
RX	TX
Ground	Ground
RTS	RTS
CTS	CTS
DSR	DSR
DTR	DTR
RLSD	RLSD

Figure 3.5 RS-485 Communications Connections

3. The shield of each segment of the RS-485 cable must be connected to ground at one end only.

   Note: Do not connect ground to the shield at both ends of a segment. Doing so allows ground loop currents to flow in the shield, inducing noise in the communications cable.

4. It is recommended that an intermediate terminal strip be used to connect each device to the bus. This allows the easy removal of a device for servicing if necessary.

5. Cables should be isolated as much as possible from sources of electrical noise.

Devices on an RS-485 bus are connected in a point-to-point configuration with the (+) and (-) terminals of each device connected to the associated terminals on the next device.

4 Optional Wiring

In addition to current and voltage inputs, the 4700 power meter has connections for status and auxiliary voltage inputs, control relays, and auxiliary current outputs. These additional connections add to the functionality of the meter.

4.1 Status Inputs

This section describes and illustrates wiring connection methods and applications for the status inputs. **Section 6.6** in **Chapter 6** describes the operation of the status inputs.

The 4700 power meter uses a current-sensing technique to monitor the status of an external dry contact or the presence of an external voltage as described in the following sections.

⚠ CAUTION

1. For this application, the SCOM terminal *must* be connected to a suitable supply voltage. Do not leave the SCOM terminal floating.
2. Normally, up to 277 V is present at the S1 to S4 terminals, depending on the external supply voltage.

4.1.1 Dry (Volts Free) Contact Sensing

Dry contact sensing is performed using external excitation as illustrated in **Figure 4.1**. External excitation is provided via the SCOM terminal. A 20 to 277 VAC/VDC external power source is required. Various possibilities include:

a. An auxiliary 24 VDC power supply

b. A 24 to 277 VAC transformer with fused output

c. Direct 120 VAC or 240 VAC fused power

When the external contact is open, there is no current flow and the status input registers INACTIVE. When the external contact closes, the current flow from the external supply causes the status input to register ACTIVE.

Note: The maximum pulse count for the S1 counter is 65,533 before rollover occurs.

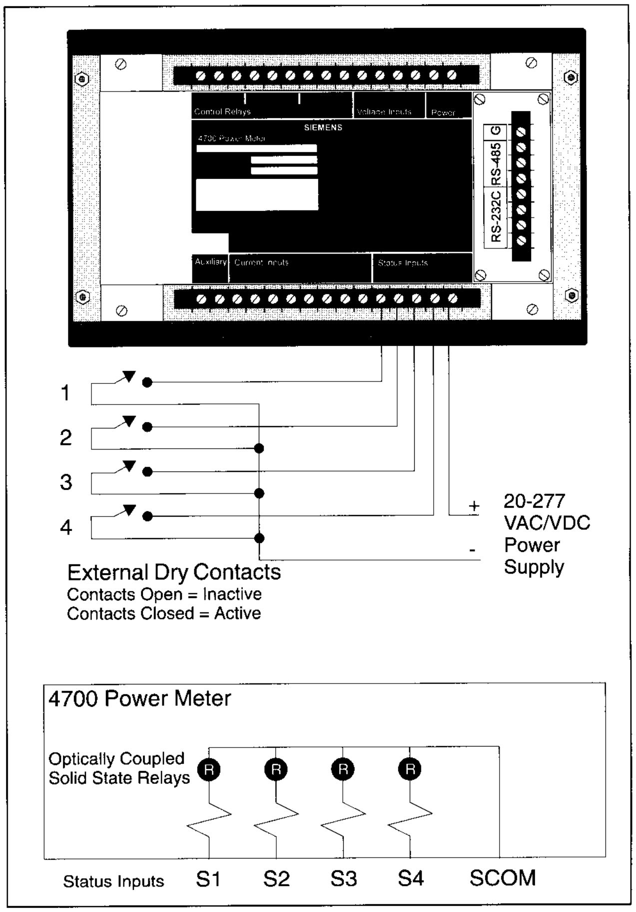


Figure 4.1 Status Input Connections (Dry Contact Sensing)

4.1.2 Voltage Sensing

Status inputs can sense the presence or absence of voltage on a power feeder. You can monitor whether a piece of equipment, such as a motor, is energized (see **Figure 4.2**).

When the motor is on, there is voltage at the sense point, and the status input registers ACTIVE. When the motor is off, there is no voltage at the sense point, and the status input registers INACTIVE.

⚠ CAUTION

In addition to the above precautions, this arrangement should *only* be used for 4-wire wye systems operating at 277/480 V or less.

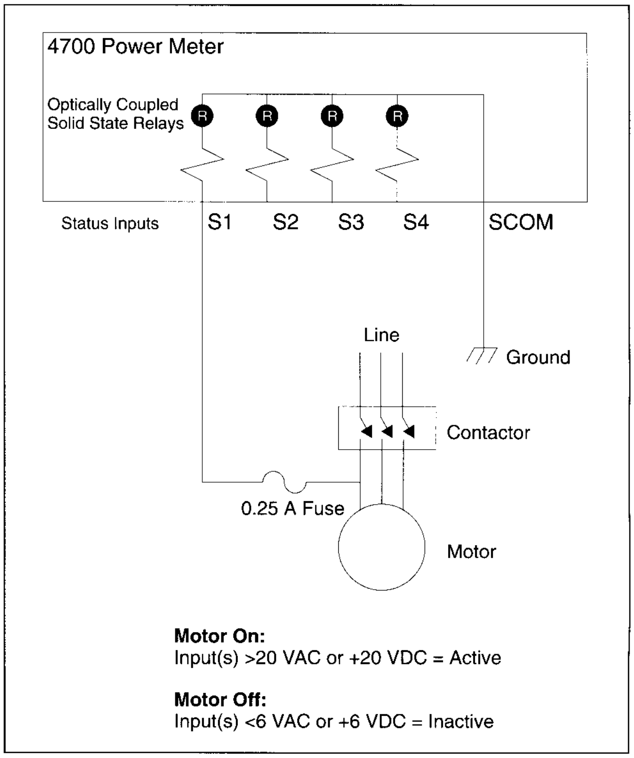


Figure 4.2 Status Input Connections (Voltage Sensing)

4.2 Control Relay Connections

The 4700 power meter provides 3 Form C electromechanical control relays. **Figure 4.3** illustrates the wiring connection requirements for the control relays. Refer to **section 6.4** in **Chapter 6** for more information on operating the relays.

4.2.1 Relay Application Precautions

In applications where the relays are used to perform crirical equipment control operations, such as breaker trip, the important precautions described below should be followed.

6. Connection to the external equipment should be made via an intermediate mechanism that allows relay control to be completely disabled for commissioning and servicing.

   The example shown in **Figure 4.3** forces the normally on load on, and the normally off load off when the relays are disabled.

7. Following initial power up, the 4700 power meter should be programmed (see **Chapter 6**), including all required setpoints for setpoint controlled relay operations (see **Chapter 7**).

8. The relay outputs of the 4700 power meter should be tested to ensure that setpoint or manual control conditions are occurring as expected.

9. Once correct relay operation has been verified, relay control of the external equipment can be enabled.

⚠ WARNING

Hazardous voltages and currents are present.

Can cause death, serious personal injury, or equipment damage.

Do not use the power meter as a primary protection device.

Primary Protection

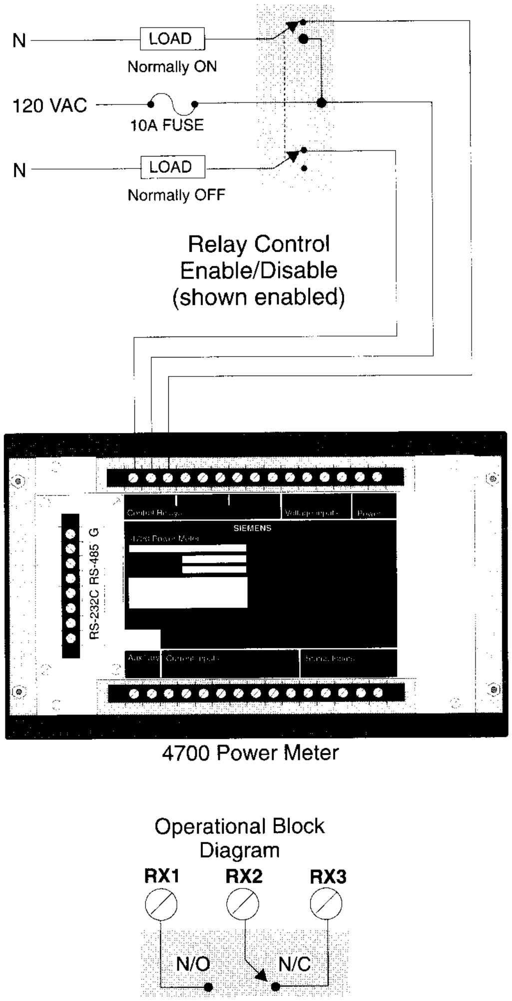
The relays of the 4700 power meter should not be used for primary protection functions. These include applications where the device would be providing:

- Overcurrent protection on circuit breakers.
- Protection of people from injury. If failure of the device can cause injury or death, the 4700 power meter should not be used.
- Energy limiting. If failure of the device will cause sufficient energy to be released that a fire is likely, the 4700 power meter should not be used. In electrical systems, energy limiting is normally provided by circuit breakers or fuses.

Secondary Protection

The 4700 power meter can be used for secondary (that is, backup) protection functions. Secondary protection includes:

- Situations where the 4700 power meter is backing up a primary protection device (shadow protection), such as an overcurrent relay.
- Situations where the 4700 power meter is protecting equipment, not people. This typically includes applications such as over/under voltage, reverse power flow, and so on.



State:	Rx1/Rx2	Rx2/Rx3
Inactive	Open	Closed
Active	Closed	Open
Pulse	Closed for Duration of Pulse	Open for Duration of Pulse

Notes:

1. Relays are Form C dry contact rated at 277 VAC or 24 VDC at 10 Amps.
2. Only relevant 4700 power meter terminal block connections are illustrated.

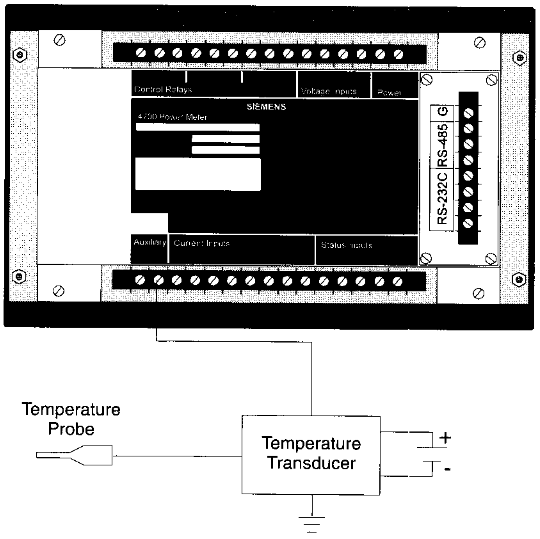
Figure 4.3 Control Relay Connections

4.3 Auxiliary Voltage Input

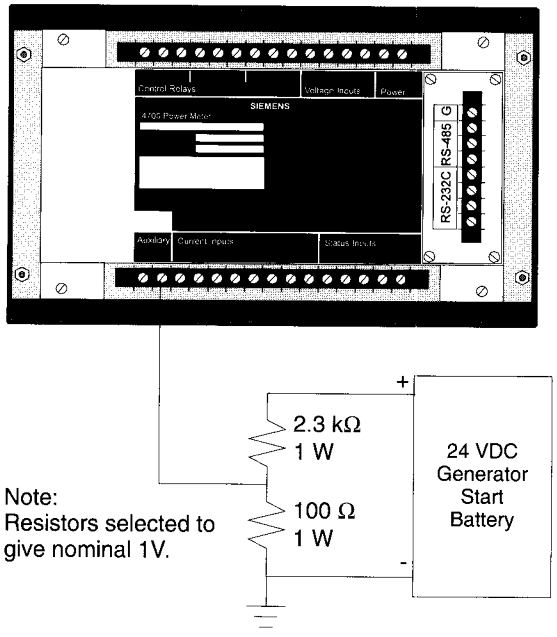
Figure 4.4 illustrates two possible wiring connection methods and applications for the V_{AUX} input. **Section 6.3.1** in **Chapter 6** describes the operation of this input.

Note: V_{AUX} is a non-isolated input. If full isolation is required, use an intermediate isolation transducer.

VAux Application: Temperature Sensing



VAux Application: Battery Voltage Sensing



Note:
Resistors selected to give nominal 1V.

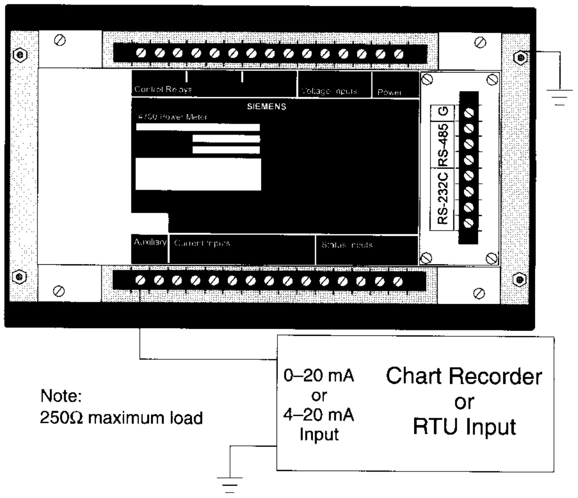
Figure 4.4 Auxiliary Voltage Input Connections

4.4 Auxiliary Current Output

Figure 4.5 illustrates two possible wiring connection methods and applications for the I_{OUT} output. **Section 6.3.2** in **Chapter 6** describes the operation of this input.

Note: I_{OUT} is a non-isolated input. If full isolation is required, use an intermediate isolation transducer.

IOut Application: Chart Recorder or RTU Input



Note:
250Ω maximum load

IOut Application: Analog Meter

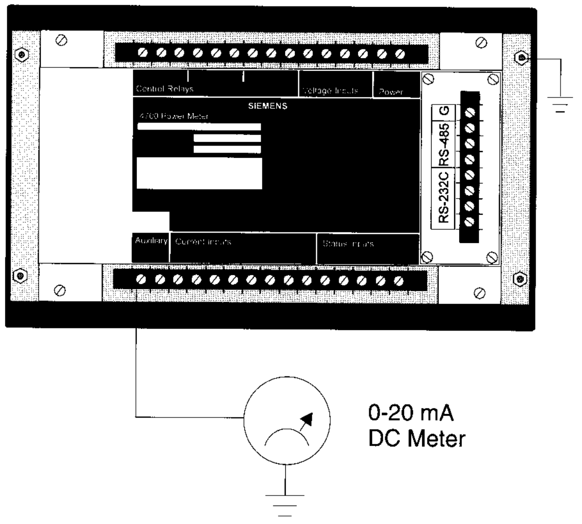


Figure 4.5 Auxiliary Current Output Connections

5 Operator Interface

This chapter describes the following:

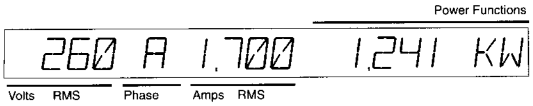
- Power-up procedure
- Front panel operation and display mode

For a description of the 4700 power meter programming mode and instructions on how to program the meter, refer to **Chapter 6, Programming**.

5.1 Start Up

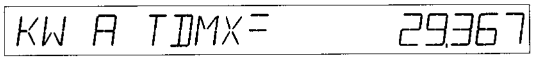
After all installation wiring is complete and has been double checked, the unit may be powered up by applying the appropriate voltage to the power input terminals.

The 4700 power meter first enters its display mode, presenting Volts-Amps-Power Function. The power function displayed on power up is kW average, totalled for all phases (see **Figure 5.1**). The values initially appearing may not be correct, since the unit has not been properly programmed with the correct information. Refer to **Chapter 6, Programming**, for instructions on how to program the meter.



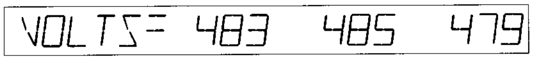
Standard Phase Display

Indicates 260 Volts, 1700 Amps, and 1241 kW for Phase A.



Full Width Display

Indicates 29.4 MW for phase A, thermal demand, maximum.



Three Phase Display

Indicates 483 Volts, phase A, 485 Volts, phase B, and 479 Volts, phase C.

Figure 5.1 Front Panel Display Modes

5.2 Front Panel Operation

The 4700 power meter provides a unique and very flexible user interface. One of its front panel features is the large, high-visibility, 20-character vacuum fluorescent display. The other feature is the row of four long-life, stainless steel membrane buttons for parameter selection and local programming functions. See **Figure 5.2** for an illustration of the front panel of the 4700 power meter.

The display can present a wide variety of information in many different formats. Readings of up to nine digits including any floating point decimals can be displayed. The type of information and formats available are described below.

5.2.1 Standard Phase Display

The front panel display (on power up) presents volts, amps and power function for the selected phase. The Phase button is used to advance through each phase in sequence, while a selection of power functions can be accessed using the Function button. The format of the phase labels and numeric readings can be programmed to conform to international conventions (see **section 6.3.3**).

5.2.2 Full Width Display

Very large measured values (for example, kW hr) and parameters with large display labels are presented using the entire display.

> **Note:** While viewing a full-width display, press the Phase button to return to the standard Volts-Phase-Amps display.

5.2.3 Three-Phase Displays

Concurrent display of readings for all three phase voltages or currents is possible.

5.2.4 Phase Button

The Phase button selects the phase for which the volt and amp values are displayed. The asterisk (*) symbol indicates the average volts and amps values are being displayed.

- If VOLTS MODE = 4W-WYE, the Phase button steps through all line-to-neutral values, the line-to-neutral average, and all line-to-line values. The line-to-line values are displayed with a comma following the phase indicator (for example, A,).
- If VOLTS MODE = DELTA, the Phase button steps through all line-to-line values for all the phases, and also gives the average of the three phases.
- If VOLTS MODE = SINGLE, the Phase button steps through the sequence: A, B, L. An A indicates voltage and current for the A phase. The B indicates voltage and current for the B phase. An L indicates the line-to-line voltage, and also the average of the two line currents.

5.2.5 Function Button

A preset list of useful power function parameters is available via the Function button. Press the Function button to advance through each measured parameter.

For per-phase values displayed using the Function button, the Phase button can be used to advance the display through each phase.

The following is the complete sequence of power function parameters accessible using the Function button:

- kW per phase
- kVAR per phase
- kVA per phase
- Power Factor per phase
- Current I4
- Frequency (phase A)
- kW demand
- Amp demand
- Voltage V_{AUX}
- kW hours
- kVAR hours

5.2.6 Minimum and Maximum Buttons

The Minimum and Maximum buttons display the minimum and maximum values of volts, amps, and power functions as indicated in the list below. Min/Max values are displayed for three seconds before the real-time display returns. The values displayed are minimums and maximums logged since the last CLEAR MAX/MIN? function (see **Table 5.1**).

Table 5.1 Display Labels for Minimum/Maximum Values

Function	**Label**
kilowatts	KW (MW)
kilovolt-amperes	KVA (MVA)
kilovolt-amperes (reactive)	KQ
power factor	PF
frequency	HZ
kilowatt-demand	KWD (MWD)
amperes-demand	AMD
volts (V_{AUX})	VX
fourth current input	I4
kilowatt-hours	KWHRS
kilovolt-ampere (reactive) hours	KVARHRS

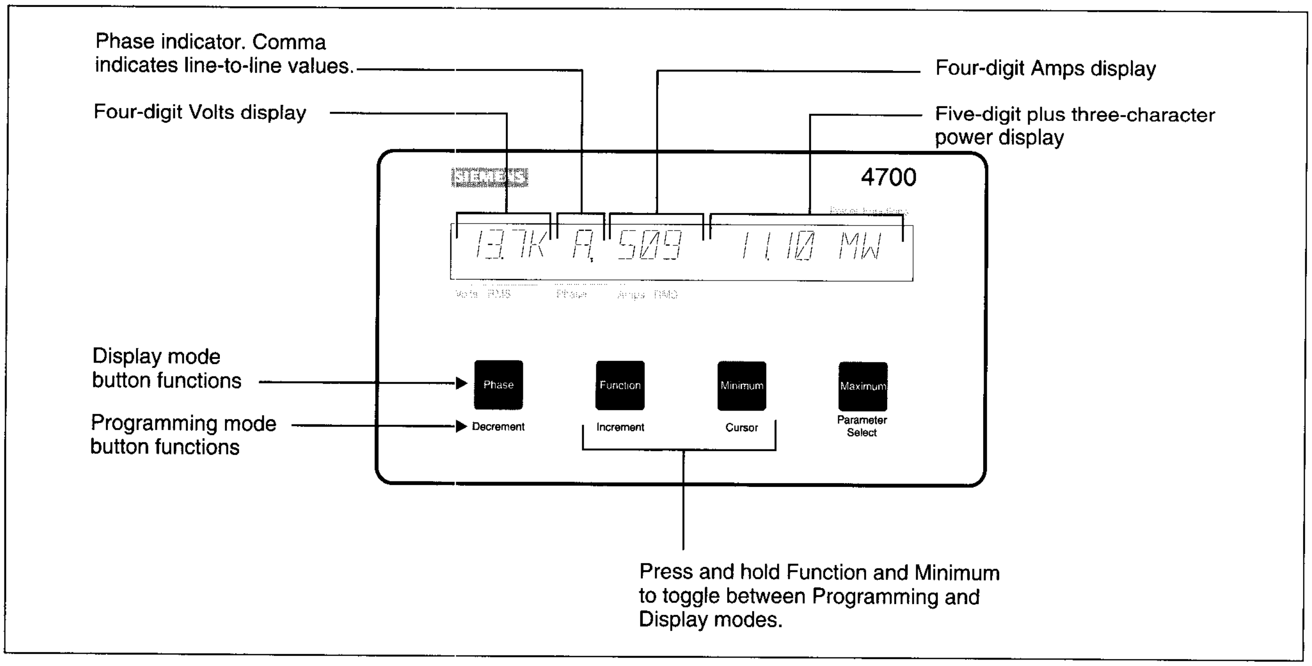


Figure 5.2 Front Panel Buttons

5.3 Power Reading Polarities

Figure 5.3 illustrates how the 4700 power meter interprets and displays signed (positive or negative) values for power, energy import or export indication, and leading or lagging indication of power factor.

The polarity of energy import or export can be reversed by reversing the polarity of the CTs connected to the power meter.

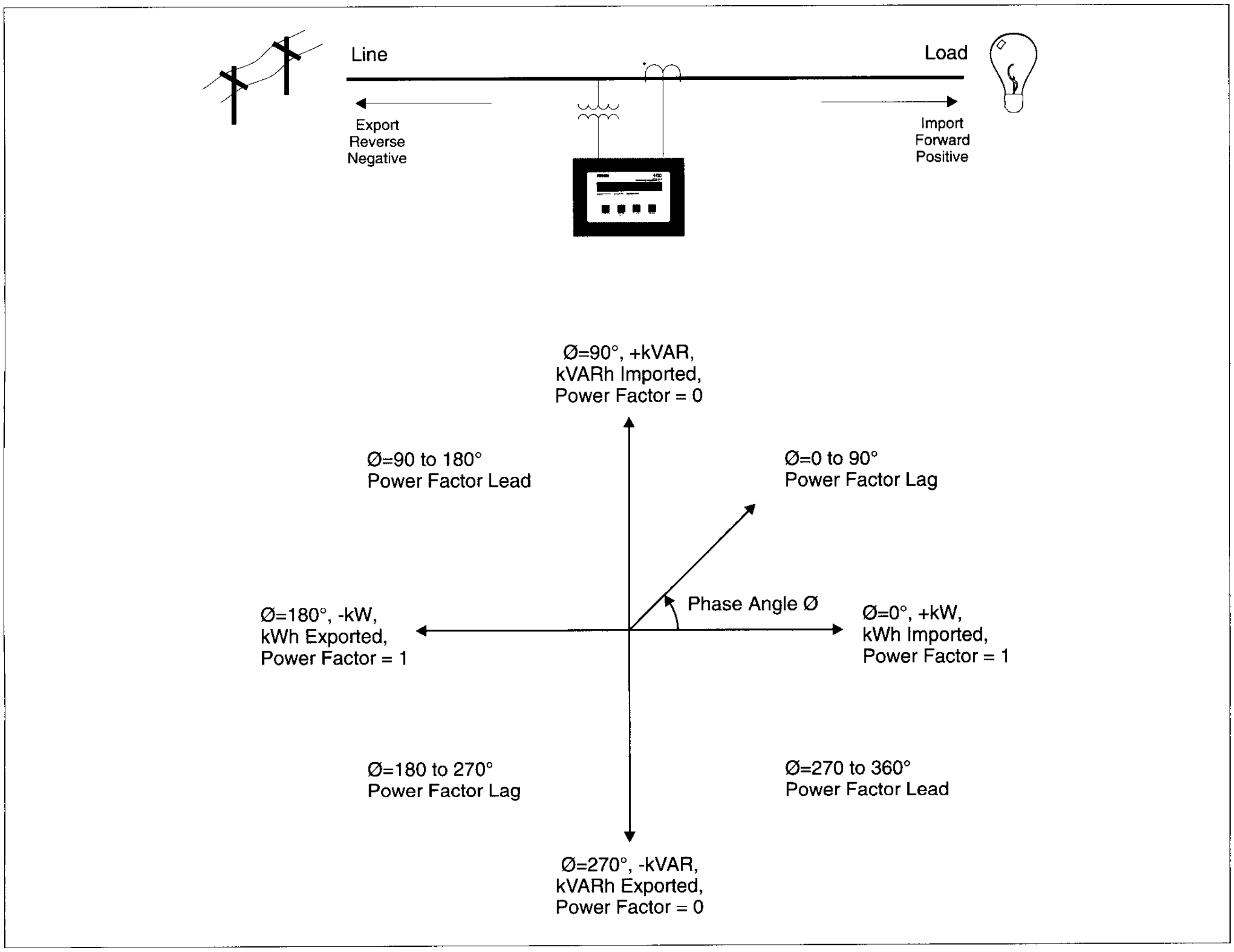


Figure 5.3 Power Reading Polarity Conventions

Notes:

6 Programming

Basic device programming can be performed quickly and easily from the front panel (called *local programming*) or via the communications port using a portable or remotely located computer. Basic setup parameters include scaling factors for the voltage and current inputs, and the voltage mode (wye, delta, and so on). Setup and other critical information are stored in nonvolatile memory and are not lost if power to the unit is turned off. All programming is password protected.

WinPM software fully supports 4700 power meter programming, providing a number of parameter screens which make setup quick and easy. (The open communications protocol of the 4700 power meter also allows free access to all programming parameters using any compatible third-party system.)

A complete list of all programmable setup parameters is provided in **section 6.9**.

This manual describes procedures for programming the 4700 power meter from its front panel only. For information on programming via communications using WinPM software, refer to the documentation for WinPM.

6.1 Programming Mode

To program the setup parameters of the 4700 power meter from the front panel, the meter must be in programming mode. Enter programming mode by pressing the Function and Minimum buttons at the same time (see **Figure 6.1**). The front panel displays "PROGRAMMING MODE." Avoid pressing the Function button by itself because this will alter the selected parameter.

To return to display mode, press the Function and Minimum buttons again.

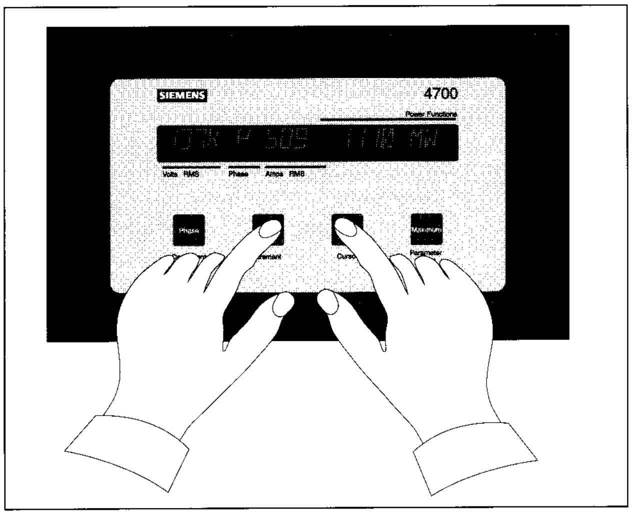


Figure 6.1 Entering Programming Mode

6.1.1 Programming Button Functions

In programming mode, the front panel buttons assume new programming functions. The label below each button indicates its alternate function. For example, the Maximum button used in display mode changes to the Parameter Select button in programming mode.

Parameter Select
: Selects which parameter is displayed. When displaying available parameters, the list wraps around to the beginning when the end is reached. If you miss a displayed parameter, press the Parameter Select button until the one you want comes back around.

Cursor
: Moves the cursor left one digit. The cursor position wraps around to the right of the number if advanced past the left-most digit.

Increment
: Increments the digit at the cursor, advances through a number of preset values, or toggles a yes/no option.

Decrement
: Decrements the digit at the cursor, advances through a number of preset values in reverse order, or toggles a yes/no option.

6.1.2 Entering the Password

At shipping, the 4700 power meter password is set to zero (0). In programming mode, press the Parameter Select button until the PASSWORD parameter appears. Enter the password using the Cursor and Increment buttons. You must enter the password to change any parameter values, although you can view them on the front display panel at any time. You can also change the password as described in the next section. If the password is lost or forgotten, contact Siemens customer service.

6.1.3 Changing the Password

To change the password, use the following procedure.

1. Enter programming mode by pressing and holding simultaneously the Function and Minimum buttons (see **Figure 6.1**).
2. Press Parameter Select until the PASSWORD parameter appears. Enter the current password using the Cursor and Increment buttons.
3. Press Parameter Select repeatedly until the PASSWORD parameter appears again.
4. Enter the new password using the Cursor and Increment buttons.
5. Return to display mode. The new password is now in effect.

6.1.4 Skipping Over the Setpoint Parameters

If the SETPOINT NUM parameter is 00, and the Parameter Select button is pressed, the setpoint parameters are passed over.

6.2 Basic Settings

The VOLT SCALE and AMPS SCALE parameters of the 4700 power meter must correspond with the full scale levels that are to be measured. The scale is the value the meter displays when the input is at full scale.

Figure 6.3 and **Figure 6.4** show a step-by-step example of how to program the operating parameters from the front panel. The example given shows how to set the VOLTS MODE to DELTA, the VOLT SCALE to 277, and the AMPS SCALE to 2000.

6.2.1 Volt Scale

In a direct connect configuration, the VOLT SCALE is normally set to 120 for a 120 VAC system, 277 for a 277 VAC system, or 350 for a 350 VAC system. If VTs are used for connection to higher voltage systems (using a 120 VAC model), then set the VOLT SCALE to the primary rating of the VT. Note that this applies only if the VTs' secondaries are rated at 120 VAC. If not, then the following formula is used to determine the required VOLT SCALE:

$$\text{VOLT SCALE} = \frac{\text{VT Primary Rating x 120 VAC}}{\text{VT Secondary Rating}}$$

6.2.2 Amps Scale

Set the AMPS SCALE to the primary rating of the CTs used. This applies only if the CTs are rated for a 5 A full scale output. If not, the following formula is used to determine the required AMPS SCALE:

$$\text{AMPS SCALE} = \frac{\text{CT Primary Rating x 5A}}{\text{CT Secondary Rating}}$$

Note: The fourth CT secondary rating must equal the phase CTs.

6.2.3 Volts Mode

Set the VOLTS MODE according to the system connection configuration. Refer to **Chapter 2, Installation**, and to **Figure 2.2** through **Figure 2.7** for more information.

The VOLTS MODE options are:

4W-WYE, DELTA, SINGLE, DEMO

6.3 Additional Settings

6.3.1 Auxiliary Voltage Input Operation

The 4700 power meter uses an auxiliary voltage input that allows measurement and display of an external voltage (1 VAC/VDC nominal, 1.25 VAC/VDC maximum). The VAUX SCALE parameter specifies what the meter displays with a 1.000 VAC_{RMS}/VDC full scale input applied.

Note that this 1 V input differs from the 120 V input for V1, V2 and V3.

6.3.2 Auxiliary Current Output Operation

The 4700 power meter can include an analog current output, which is programmable to deliver a current proportional to any measured parameter. Maximum load on the current output is 250Ω resistive. The current output is set in programming mode. You must set the following parameters:

I OUT KEY
This label specifies the measured parameter for which the current output is proportional. **Table 6.2** shows the labels for I OUT KEY corresponding to each measured parameter.

I OUT SCALE
This value specifies the indicated value for the full scale output of I_{OUT}.

I OUT RANGE
This value indicates whether the output mode is 0 to 20 mA or 4 to 20 mA.

I OUT RANGE = 0	indicates 0 to 20 mA
I OUT RANGE = 1	indicates 4 to 20 mA

IOUT POWER FACTOR
Since the scale for Power Factor is essentially two 0.0-1.0 scales (one for leading and one for lagging), the meter must combine these into one scale. To do this, the meter represents the entire Power Factor scale as 0-200, where 0 is 0.0 lagging and 200 is 0.0 leading (see **Figure 6.2**).

The 4700 power meter allows the I_{OUT} scale to be customized so that the top end (20mA) can be programmed to any value on the 0-200 scale, and the bottom end (0mA) is fixed to 0. In **Figure 6.2**, 4mA is set to 50 (which is 0.50 lagging), and 20mA is set to 100 (which is 1.00, or unity).

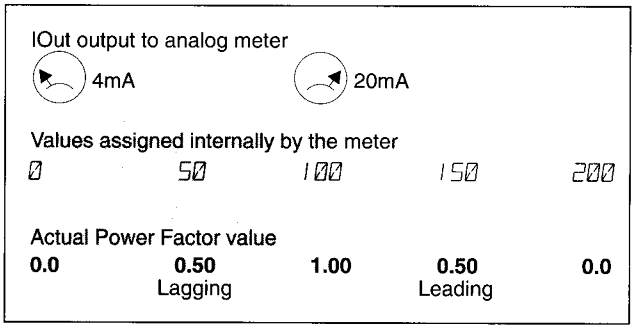
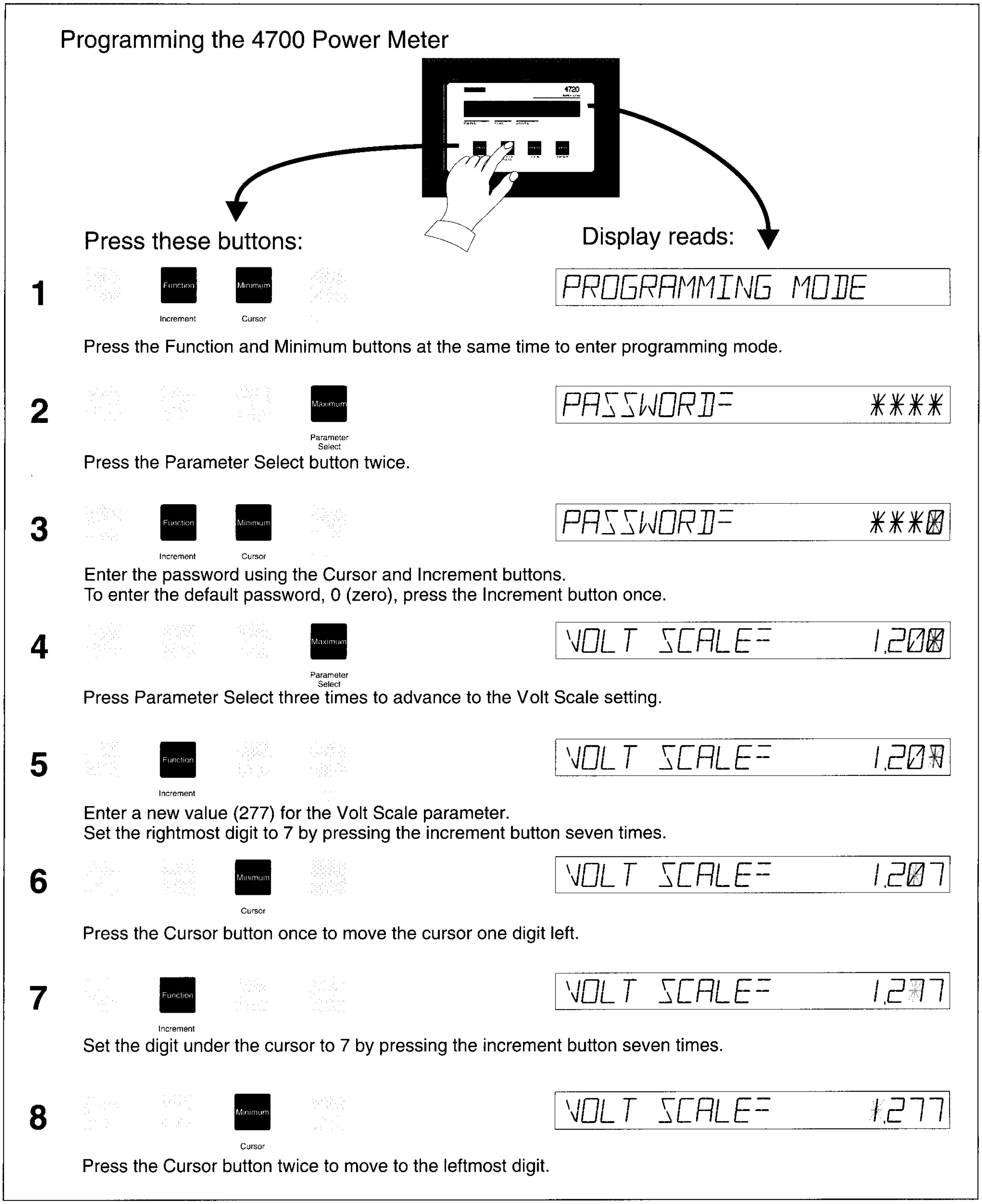


Figure 6.2 Power Factor Scale Representation



Programming the 4700 Power Meter

Press these buttons:

Display reads:

1 Function (Increment), Minimum (Cursor)

`PROGRAMMING MODE`

Press the Function and Minimum buttons at the same time to enter programming mode.

2 Maximum (Parameter Select)

`PASSWORD= ****`

Press the Parameter Select button twice.

3 Function (Increment), Minimum (Cursor)

`PASSWORD= ***0`

Enter the password using the Cursor and Increment buttons.
To enter the default password, 0 (zero), press the Increment button once.

4 Maximum (Parameter Select)

`VOLT SCALE= 1,200`

Press Parameter Select three times to advance to the Volt Scale setting.

5 Function (Increment)

`VOLT SCALE= 1,207`

Enter a new value (277) for the Volt Scale parameter.
Set the rightmost digit to 7 by pressing the increment button seven times.

6 Minimum (Cursor)

`VOLT SCALE= 1,207`

Press the Cursor button once to move the cursor one digit left.

7 Function (Increment)

`VOLT SCALE= 1,277`

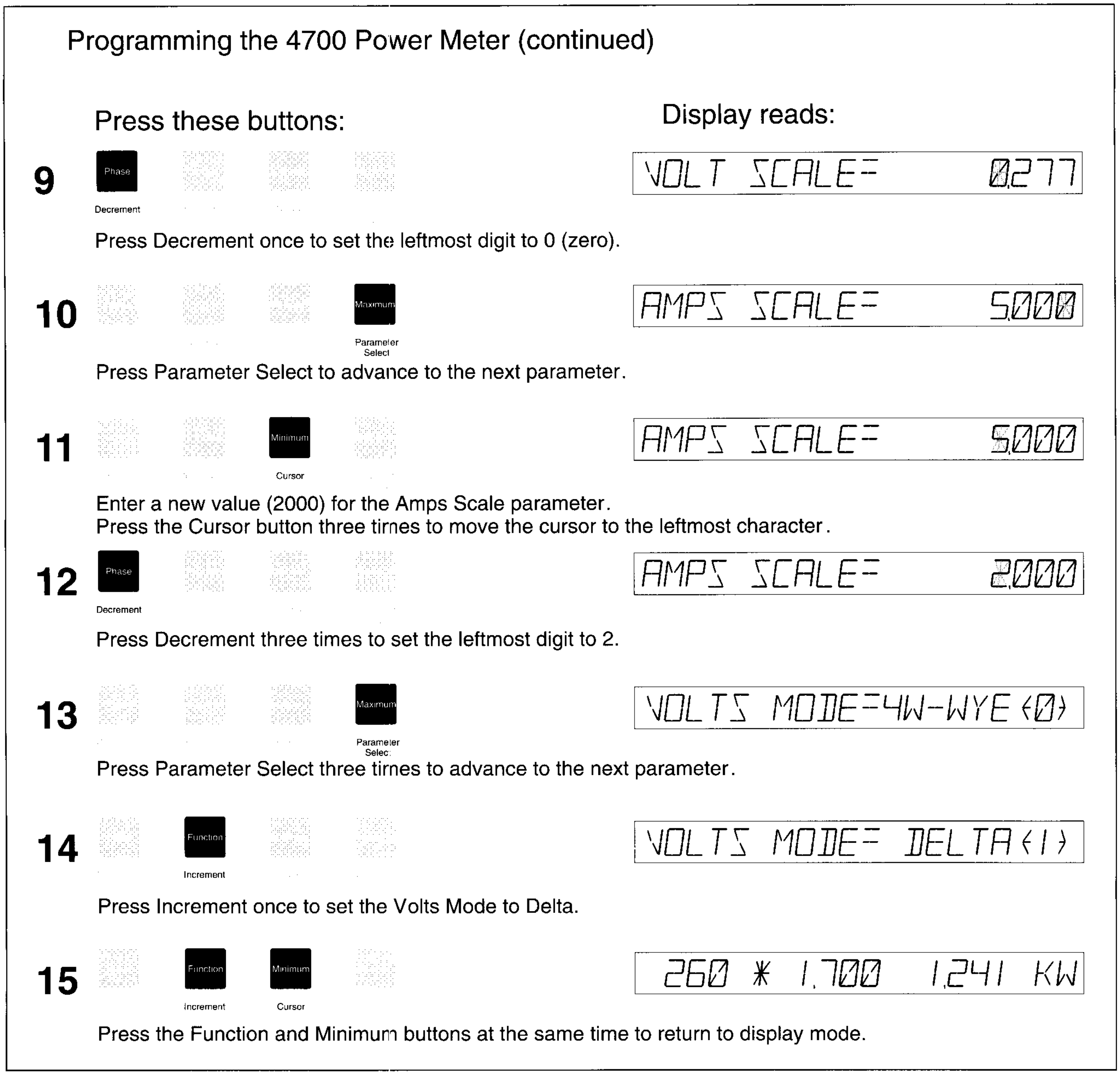
Set the digit under the cursor to 7 by pressing the increment button seven times.

8 Minimum (Cursor)

`VOLT SCALE= 1,277`

Press the Cursor button twice to move to the leftmost digit.

Figure 6.3 Step-by-Step Example Showing How to Program Locally (Steps 1-8)



Programming the 4700 Power Meter (continued)

	Press these buttons:	Display reads:
9	Decrement	VOLT SCALE= 0.277
10	Parameter Select	AMPS SCALE= 5.000
11	Cursor	AMPS SCALE= 5.000
12	Decrement	AMPS SCALE= 2.000
13	Parameter Select	VOLTS MODE=4W-WYE (0)
14	Increment	VOLTS MODE= DELTA (1)
15	Increment, Cursor	260 * 1.700 1.241 KW

9. Press Decrement once to set the leftmost digit to 0 (zero).

10. Press Parameter Select to advance to the next parameter.

11. Enter a new value (2000) for the Amps Scale parameter.
Press the Cursor button three times to move the cursor to the leftmost character.

12. Press Decrement three times to set the leftmost digit to 2.

13. Press Parameter Select three times to advance to the next parameter.

14. Press Increment once to set the Volts Mode to Delta.

15. Press the Function and Minimum buttons at the same time to return to display mode.

Figure 6.4 Step-by-Step Example Showing How to Program Locally (Steps 9-15)

6.3.3 Display Format

The front panel display can present numeric information and phase labels in formats that reflect various world standards.

The FORMAT parameter allows the user to select formats for numeric information and phase labels. This parameter is displayed as:

FORMAT= ABC 1,234.5

The three-letter prefix specifies the phase labels. The possible values are ABC (default), XYZ, RBY and RST.

The five-digit integer specifies the display numbers. The formats for possible values are:

a. A comma for the thousands delimiter (radix) and a decimal point for the decimal delimiter. Example: 1,234.5 This is the default.

b. No thousands delimiter and a comma for the decimal delimiter. Example: 1234,5

The Cursor button cycles between the phase label parameter and display number parameter. The Increment or Decrement buttons modify the values for selected parameters.

6.4 Control Relay Operation

The 4700 power meter contains three control relays (R1 to R3), which can be used for a variety of purposes, such as activation of alarms or load control. Each relay can switch AC loads of up to 120 VAC, and DC loads of up to 24 VDC at 10 A. Remote operation of each relay is via the communications port.

The relays are also manipulated by setpoints on selected measured parameters. Setpoint operation is described in detail in **Chapter 7, Using Setpoints**.

Another use for the control relays is for kVARH and kWH pulsed output. See **section 6.4.4** for more information.

Section 4.2 in **Chapter 4** shows wiring requirements for the control relays.

6.4.1 Control Relay Modes

You can assign each of the three relays to setpoint operation in latch or pulse mode, or to kVARH or kWH pulsing.

6.4.2 Access to Relay Parameters

The RELAY OPERATION parameter accesses the relay parameters, and also allows you to select which relay to program. Selecting a value of 0 (zero) skips all relay parameters when Parameter Select is pressed. Selecting 1, 2, or 3 accesses the programmable parameters for the selected relay.

6.4.3 Setpoint Relay Operation

For setpoint operation, the relays function in latch or pulse mode. In latch mode, the relay operates for the duration that the assigned setpoint is active (normally open contacts are closed). In pulse mode, when the setpoint is active, the relay operates for a specific pulse duration.

Set Rx MODE to SETPOINT for setpoint operation. Set Rx VALUE to latch mode (Rx VALUE = 0), or to pulse duration (in seconds) for pulse mode operation.

Note: While you are programming the 4700 power meter via the front panel or communications, no setpoint-controlled relay operations occur until you complete the programming sequence. The 4700 power meter then assesses the status of each setpoint and performs any required operations.

6.4.4 kVARH and kWH Pulse Operation

When a relay is configured for kVARH or kWH pulse operation, the pulses are based on the total energy imported (forward) and exported (reverse). Set Rx MODE to KVARH PULSE or KWH PULSE. In these modes, use Rx HRS/PULSE to set the number of unit-hours between pulses.

Note: A relay configured for energy pulsing will not respond to an assigned setpoint that becomes active. Maximum pulse rate for the relays is 1 pulse every 2 seconds (0.5 Hz).

6.4.5 Manual Forced Relay Operations

You can force operate or release relays by commands via the communications port. Manual forced operate and forced release commands override any present setpoint condition. Forced operate commands made via communications affect only a setpoint relay (Rx MODE = SETPOINT).

If the relay is in pulse mode (Rx VALUE > 0), a forced operate command initiates a pulse of length equivalent to the value set by the Rx VALUE parameter for that relay. This operation is recorded in the event log and indicates that the relay was pulsed. A forced release command has no effect.

If the relay is in latch mode (Rx VALUE = 0), it behaves normally for forced operate, forced release, and return to normal (return to setpoint control) commands.

See **section 6.4.7** for manual relay control special cases.

6.4.6 Relay Event Logging

For a relay assigned to setpoint operation (Rx MODE = SETPOINT), the event log records relay operations in one of two ways, depending on whether the relay is set to operate in latch or pulse mode.

a. Pulse mode (Rx VALUE > 0): The event log shows that the relay is pulsed when the setpoint becomes active. When the setpoint returns to its inactive state, the setpoint event is logged but does not indicate the relay is pulsed, since no pulse is generated.

b. Latch mode (Rx VALUE = 0): The event log records that the relay is operated (ON) when the setpoint becomes active, and is released (OFF) when the setpoint returns to an inactive state.

If the relay is configured for kVARH or kWH pulse mode, no relay operations are recorded in the event log.

6.4.7 Manual Relay Command Special Cases

If a manual forced operate command for a selected relay is received while that relay is already in a forced operated state, then the relay command is ignored and is not logged. This is also true for a forced release command sent to a relay already in a forced released state. In addition, manual relay commands sent to relays in kVARH or kWH pulse mode are not logged.

6.4.8 Relay Operation After Power Outages

When the power feed to the 4700 power meter is interrupted, even momentarily, the output relays are released. When power is restored, the meter allows a three-second settling time, then reevaluates setpoint conditions. If appropriate, the relays operate after the programmed time delays.

Any forced operated or forced released relay is released, followed by a resumption of normal setpoint operation.

6.5 Bi-Directional Energy

Energy measurements represent the KWH or KVARH sums for all three phases. Energy parameters provide three measurement modes that indicate bi-directional power flow: forward, reverse, and total. KWH and KVARH can provide all three modes.

Total energy measurements represent the sum of the absolute values of imported and exported energy. Total energy values are incremented by energy that is imported or exported.

Imported real or reactive energy is displayed with an F suffix (kWH-F, kVARH-F), indicating forward flow. Exported energy values are displayed with an R suffix (kWH-R, kVARH-R), indicating reverse flow.

Note: Only kWH-F/kWH-R and kVARH-F/kVARH-R measurements are displayed from the front panel. kWH and kVARH total values are read only via communications.

6.6 Status Input Operation

The 4700 power meter provides four optional status inputs (S1 to S4), which are used to sense the state of an external contact. If the input voltage is below 9 VAC or VDC, the input is sensed as inactive. If it is over 20 VAC or VDC, it is sensed as active.

The status of these inputs is viewed using a Power Monitor display and monitoring unit (or a computer running WinPM,SIEServe, or other supervisory software) connected to the communications port.

You can program the Status Input #4 (S4) to initiate kW Demand Synchronization. See **Chapter 8, Demand Calculation**, for more information.

The 4700 power meter maintains a counter for the Status Input #1 (S1). The counter accurately follows a maximum frequency of 0.3 Hz and can be reset to zero via the communications port. A minimum pulse width of 40 milliseconds is required for reliable sensing of status input changes.

Note: The maximum pulse count for the S1 counter is 65,535 before rollover occurs.

Section 4.1 in **Chapter 4** shows several wiring diagrams illustrating connections for the status inputs.

6.7 Fourth Current Input Operation

The 4700 power meter includes an optional fourth current input, designated I4. The input uses connections I41 and I42 on the terminal strip. The AMPS SCALE parameter sets the scaling for all four current inputs. Therefore, the CT primary rating of the I4 current input must be the same as the CT primary ratings for the three-phase current inputs (5 A nominally).

Normally, this input is used to measure current in the neutral conductor. In installations with nonlinear loads, odd harmonics can fail to cancel, producing significant currents in the neutral conductor.

The I4 reading is viewed from the front panel by pressing the Function button until displayed. It is also viewable remotely.

6.8 Waveform Capture

Digital waveform capture capabilities are used for detailed power quality analysis.

Waveform capture allows the user to perform high-speed sampling of the V1, V2, V3, V_{AUX}, I1, I2, I3, or I4 (neutral current) inputs. One full cycle of the signal at a single input is sampled at a rate of 128 samples per cycle. All samples are taken in sync with the communications line frequency, and within one input cycle.

Sampled waveform data is stored in on-board memory and is read via the communications port. The high sampling rate produces high-resolution data, which allows analysis of frequency components to the 63rd harmonic.

You can upload captured waveform data to a master computer to display the waveforms and perform Fast Fourier Transforms on them. This provides an indication of total harmonic distortion and a breakdown of individual frequency components.

From the master computer, the operator requests the capture of individually selected 4700 power meter inputs. The computer then uploads the waveform data. Waveform capture is automatically reinitiated when the 4700 power meter on-board memory is read via the communications port.

6.9 Operating Parameter Descriptions

Table 6.1 and **Table 6.2** provide a brief description of each operating parameter for the 4700 power meter. More detailed descriptions of each operating parameter are provided throughout this manual where operational features are described.

Table 6.1 Programmable Operating Parameters

Parameter	Description	Range/Options
FIRMWARE VER	Displays the software level of the 4700 power meter. *Not programmable.*	V2.xxxB
PASSWORD=	Must be entered to change the setup parameters or clear any function. You can also change the password.	0 to 9999
SETPOINT NUM	Selects a setpoint to be programmed. If set to "00", then no setpoint is selected. If no setpoints are programmed, pressing the Parameter Select button will skip directly to RELAY OPERATION. **Note:** In the parameter names below, "xx" indicates the selected setpoint number.	00 to 17
SPxx TYPE	The type of parameter the selected setpoint is to monitor (for example, OVER KW, PHASE REVERSAL, and so on).	See **Table 7.1** in **Chapter 7**
SPxx HI LIMIT	Sets the high limit for the selected setpoint.	0 to 999,999
SPxx LO LIMIT	Sets the low limit for the selected setpoint.	0 to 999,999
SPxx TD OPERATE	Sets the time delay to operate for the selected setpoint.	0 to 32,000 sec.
SPxx TD RELEASE	Sets the time delay to release for the selected setpoint.	0 to 32,000 sec.
SPxx RELAY NUMBER	Selects which one of three control relays the selected setpoint controls. Selecting "0" will select no relay. After setting this parameter, pressing the Parameter Select button will return to SETPOINT NUM.	0 to 3
RELAY OPERATION	Selects one of the three control relays to be programmed. Selecting 0 will exit control relay programming and skip directly to VOLT SCALE. **Note:** In the parameter names below, "x" indicates the selected control relay number.	0 to 3
Rx MODE	Defines the type of operation the selected relay is to perform.	SETPOINT, KWH PULSE, KVARH PULSE
Rx VALUE	For Rx MODE = SETPOINT: Specifies latch mode or sets pulse duration.	0 = latch mode 1 to 65,535 = pulse duration
Rx HRS/PULSE	For Rx MODE = KWH or KVARH PULSE: Defines the number of unit-hours between pulses.	0 to 65,535 unit-hours*
VOLT SCALE=	Sets full-scale AC input voltage. This parameter should match the VT primary rating on systems using VTs with secondary ratings of 120 VAC, or the measured phase voltage rating of the meter on systems connected directly. See **section 6.2.1**.	0 to 999,999 VAC
AMPS SCALE=	Sets full-scale AC input current. This parameter should match the CT primary rating when the secondary rating is 5 A. See **section 6.2.2**.	0 to 9,999 A

** For Rx MODE = KWHR PULSE or KVARH PULSE, pulse duration is 1 second.*

Table 6.2 Programmable Operating Parameters (continued)

Parameter	Description	Range/Options
VAUX SCALE=	Sets full-scale auxiliary voltage input reading.	0 to 999,999 V
I4 SCALE=	Sets full-scale I4 input current. This parameter should match the AMPS SCALE parameter.	0 to 9,999 A
VOLTS MODE=	Sets volts mode.	4W-WYE, DELTA, SINGLE, DEMO
UNIT ID=	Sets the SEAbus communication address.	1 to 254
BAUD RATE=	Sets the communications baud rate.	300, 1200, 2400, 4800, 9600, 19200 Baud
COM MODE=	Displays the communications mode: RS-232 or RS-485. **Note:** This parameter cannot be changed in programming mode. See **section 3.1** in **Chapter 3** for more information.	RS232, RS485, none
DISPLAY TIMEOUT=	Sets the number of minutes before the display turns off after the last button is pressed. The recommended setting is 180 minutes.	0 = display always on 1 to 999 minutes
CLEAR MAX/MIN?	Clears the stored maximum and minimum values. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	YES, NO
CLEAR KW/KVARHRS?	Clears the stored kWH and kVARH readings. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	YES, NO
DEMAND PERIOD	Selects Demand Sync mode or the length of each demand period used in calculating demand values. See **Chapter 8, Demand Calculation**.	0 = Demand Sync Mode 1 to 99 minutes
NUM DMD PERIODS=	Sets the number of demand periods averaged to calculate demand values.	1 to 15 periods
PHASE ROTATION	Specifies the normal phase sequence. This is used for PF polarity detection in delta mode and for the phase reversal detection setpoint. **Chapter 7, Using Setpoints**.	ABC, ACB
STNDRD FREQ=	Specifies the frequency of the measured power system.	50, 60, or 400
I OUT KEY=	Specifies the measured parameter for the current output.	VOLTAGE A, VOLTAGE B, VOLTAGE C, CURRENT A, CURRENT B, CURRENT C, KW A, KW B, KW C, KVA A, KVA B, KVA C, KVAR A, KVAR B, KVAR C, VOLTAGE AV, CURRENT AV, KW TOTAL, KVA TOTAL, KVAR TOTAL, PF, KW DEMAND, AMP DEMAND, FREQUENCY, VAUX, CURRENT I4,
I OUT SCALE=	Sets the scale of the current output.	0 to 999,999
I OUT RANGE=	Indicates 0-20 mA or 4-20 mA proportional current output.	0 = 0 to 20 mA 1 = 4 to 20 mA
RTS ACTIVE LVL=	Sets the RTS active level, which is used for serial communications.	LOW, HIGH
FORMAT=	Sets phase labels and decimal display formats. The Cursor button cycles between the phase label parameter and decimal display number parameter. The Increment and Decrement buttons modify the values for the selected parameters.	Phase Labels ABC, XYZ, RBY, and RST Decimal Display 1,234.5 or 1234,5

7 Using Setpoints

The 4700 power meter can monitor several measured parameters simultaneously and then generate alarms and controlling relays based on the parameter values. The meter uses predefined setpoints to activate this functionality. A setpoint is a group of six programmed parameters that tells the unit:

1. Which measured parameter to monitor (setpoint type), and activation setting of over or under the value
2. The high limit
3. The low limit
4. The time delay for relay operation
5. The time delay for relay release
6. Which relay to activate, if any, when appropriate limits are exceeded and time delay conditions are met

7.1 Applications

The 4700 power meter supports 17 different setpoints simultaneously, numbered 1 to 17. All of the setpoints are programmable from the front panel. **Table 7.1** outlines the measured parameters that the setpoints can monitor. You can use the setpoints to operate the following types of control relays:

- Trip Relay—to shunt trip a breaker
- Alarm Relay—to activate an alarm buzzer or light
- Control Relay—to control an external piece of equipment
- Remote Control Relay—to control an external piece of equipment via the communications port
- kVARH Pulse Output Relay (relay 2)
- kWH Pulse Output Relay (relay 3)

Note: The response time of the relays is one to two seconds and could be up to five seconds after any meter power-up (for example, initial power or subsequent power-ups following any system power failures). The 4700 power meter should not be used for protective functions that require faster operation. A battery-backed DC power supply should be considered for 4700 power meter devices whose setpoints are being used to perform protective functions in which response time is important.

You can assign any of the three relays to a single setpoint, or to several setpoints. A relay is activated if any of the setpoints controlling it become active.

In addition, you can use relays 1, 2 and 3 for kVARH and kWH pulsing.

7.2 Over Setpoint

An over setpoint activates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter. When a setpoint becomes active, it operates the assigned relay, if any. The setpoint status change is stored in the event log, and includes the time and parameter value.

An over setpoint deactivates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to **Figure 7.1**). The setpoint status change is also logged, and includes the time of return-within-limit and the out-of-limit value.

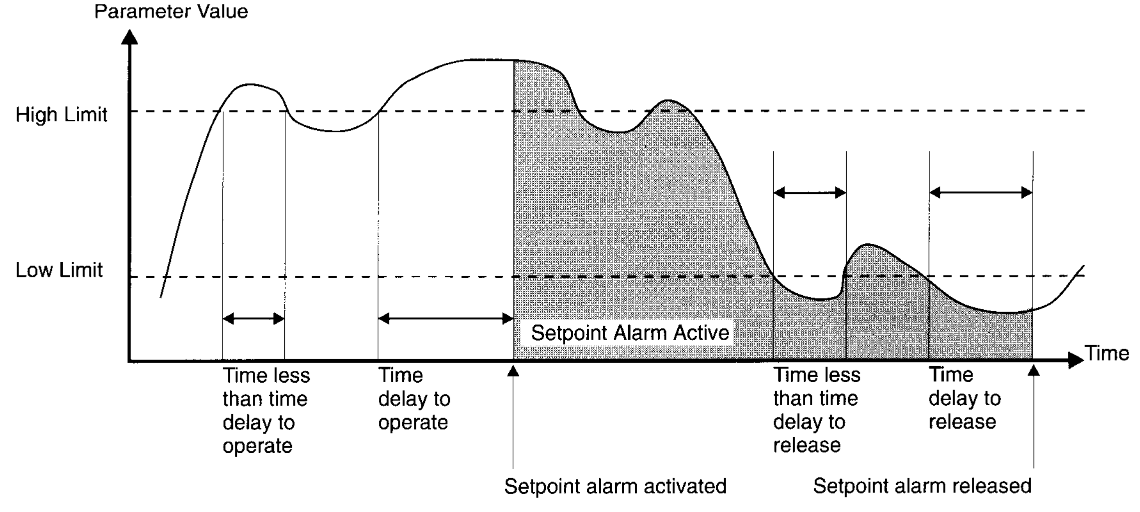


Figure 7.1 Over Setpoint Operation

7.3 Under Setpoint

Under setpoints function similarly to over setpoints, except they operate for opposite reasons. An under setpoint activates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to **Figure 7.2**).

An under setpoint deactivates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter.

7.4 Programming Setpoints

To program setpoints, switch to programming mode and enter your password. Press the Parameter Select button until the SETPOINT NUM parameter appears. Then enter the setpoint number, from 01 to 17, of the parameter you want to program. Program the setpoint by entering new values for all parameters associated with the selected setpoint.

Note: While you are programming the 4700 power meter via the front panel or communications, no setpoint-controlled relay operations occur until you complete the programming sequence. The 4700 power meter then assesses the status of each setpoint and performs any required operations.

It is recommended that you use a Setpoint Parameter Form to plan your setpoints, before entering programming mode. **Figure 7.3** is an example Setpoint Parameter Form, containing information about the six parameters as they correspond to each setpoint. Complete a similar form, like the one available in **Appendix C**, and keep a copy with the meter.

The example Setpoint Parameter Form displays the following attributes:

- Relay 1 is used as an trip relay, with over voltage, under voltage, voltage unbalance, and phase reversal trips enabled. The relay is connected to the breaker shunt trip input.
- Relay 2 is used as an alarm relay to warn of loads over 70% of the breaker rating. Its output is connected to a buzzer.
- After entering your password in programming mode, no setpoint-controlled relay operations occur until you exit programming mode. The 4700 power meter then assesses the status of each setpoint and performs any required operations.
- Relay 3 is used as a kW demand control relay.

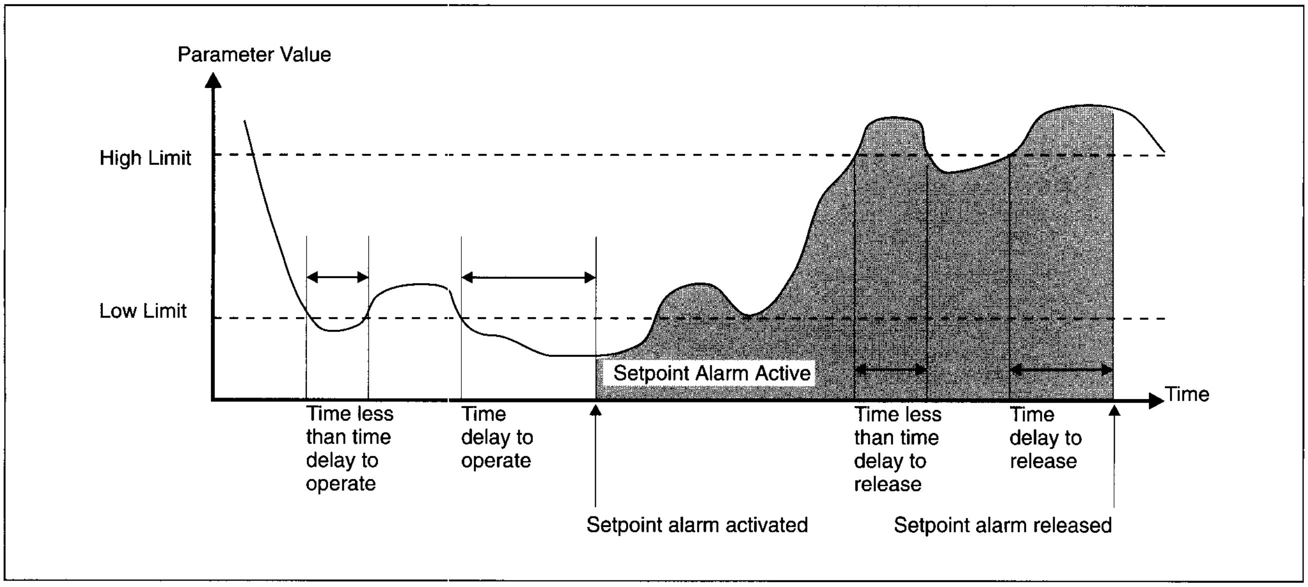


Figure 7.2 Under Setpoint Operation

Table 7.1 Setpoint Types

Type	Description
NOT USED	A setpoint not currently in use.
OVER VOLT	Over voltage (highest phase voltage).
UNDER VOLT	Under voltage (lowest phase voltage).
VOLTAGE UNBAL	Percentage difference of most deviant phase voltage from the average.
OVER CURRENT	Over current (highest phase current).
CURRENT UNBAL	Percentage difference of most deviant phase current from the average.
OVER KVA	Over kVA.
OVER KW	Over kW.
OVER KWREV	Over negative kW (feeding power into utility grid).
OVER KVAR FWD	Over kVAR foward (imported) reactive power.
OVER KVAR REV	Over kVAR reverse (exported) reactive power.
OVER KWD	Over kW demand.
OVER AMPD	Over Amp demand.
OVER FREQUENCY	Over frequency. (Enter: Frequency x 10 [that is, 60Hz = 600])
UNDER FREQUENCY	Under frequency. (Enter: Frequency x 10 [that is, 60Hz = 600])
OVER VAUX	Over auxiliary voltage.
UNDER VAUX	Under auxiliary voltage.
PHASE REVERSAL	Phase reversal. Operates if the phase rotation does not match the programmed normal operation.
UNDER PF LAG	Under power factor lagging.
UNDER PF LEAD	Under power factor leading.
OVER I4	Over I4 current.

Setpoint Parameter Form						
Setpoint	**Type**	**High Limit**	**TD Operate**	**Low Limit**	**TD Release**	**Relay/Function**
1	Over Volts	332	5	290	1	1 Trip
2	Under Volts	270	5	220	1	1 Trip
3	Volts Unbal.	30%	5	10%	1	1 Trip
4	Phase Reversal	-	1	-	1	1 Trip
5	Not Used					
6	Not Used					
7	Over Amps	2100	10	2000	1	2 Alarm
8	Over Volts	300	10	290	1	2 Alarm
9	Under PF Lag	90	10	85	10	2 Alarm
10	Under PF Lead	90	10	85	10	2 Alarm
11	Over KWD	1200	10	900	10	3 Demand Control
12						
13						
14						
15						
16						
17						

Figure 7.3 Example Setpoint Parameter Form

8 Demand Calculation

Power utilities generally bill commercial customers based on both their energy consumption (in kWhr) and their peak usage levels, called peak demand (in kW). *Demand* is a measure of average power consumption over a fixed time period, typically 30 minutes. *Peak demand* is the highest demand level recorded over a specific billing period.

8.1 Demand Measurement Methods

Demand measurement methods, and their intervals, vary according to individual utilities. Some common methods include: thermal averaging, the fixed interval technique, and the sliding window technique.

In thermal averaging, the demand indicator responds to heating of a thermal element in the watt hour meter. The demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes.

The fixed interval technique measures average usage electronically over each period. The highest recorded value is the peak demand.

The sliding window technique, or "rolling interval" method, divides the demand interval into subperiods and the demand is measured electronically, based on the average load level over the most recent set of subperiods. This has the effect of improving the response times, in comparison with the fixed interval method. For example, with a 6x5 minute (30 minute total) sliding window, demand is the average power consumption over the last six five-minute periods.

8.2 Internally Timed Demand Measurement

The 4700 power meter uses the sliding window method to measure demand. You can program both the DEMAND PERIOD (1 to 99 minutes) and NUM DMD PERIODS (1 to 15) for averaging. This allows you to match virtually any utility demand measurement method. Refer to **Table 8.1** for more information.

Table 8.1 Demand Calculation Chart

Utility Method	**4700 Programming**	
	Demand Period (in minutes)	**Number of Demand Periods (must be 15 or less)**
Fixed Interval	Utility Period	1
Fixed Interval Emulation	Utility Period/15	15
Thermal	Utility Period/15	15
Sliding Window	Utility Subperiod	Utility number of subperiods

8.3 Demand Synchronization

The 4700 power meter includes the option of starting demand intervals that correspond to an active pulse. Set the DEMAND PERIOD parameter to zero, which initiates the Demand Sync mode. Instead of internally timing the duration of each demand period used in the kW demand calculation, the meter looks for an ACTIVE pulse on Status Input #4 (S4). You can still specify the number of demand periods in this mode, as previously explained.

Note: With the fixed interval method, the 4700 power meter maximum reading and the utility reading are not necessarily the same, unless the demand periods are time-synchronized. The best way to resolve this problem is to use the sliding window method with the same total demand period as the utility, as shown above. The 4700 power meter maximum demand reading is then always equal to or slightly higher than the utility readings.

Notes:

9 Communications

9.1 General

The 4700 power meter is optionally equipped with a communications card that allows the 4700 power meter to be integrated with large energy monitoring networks. The communications port is optically isolated and transient protected. It is field-configurable for RS-232 or RS-485 standards and can operate at data rates up to 19,200 baud.

The 4700 power meter is fully compatible with Siemens WinPM software. WinPM software can display all measured parameters and status information, waveform data, and data logs provided by the 4700 power meter. WinPM software can also be used to remotely program the setup parameters for all basic and advanced features.

The open communications protocol of the 4700 power meter allows access to all data and setup parameters by third-party systems.

This chapter provides additional information regarding remote communications connections, programming, and general operation.

9.2 RS-232 Communications

RS-232 is commonly used for short distance, point-to-point communications. Connection between a host computer (or PLC) and a single remote device must be less than 50 feet. **Figure 3.3** and **Figure 3.4** in **Chapter 3** provide wiring diagrams for direct RS-232 connection and the required wiring for the RS-232 interconnect cable(s).

Connection using modems via dedicated or dial-up telephone lines is also possible (see **Figure 9.1**).

When using a modem, it is important that the computer-to-modem and modem-to-4700 power meter cable connections illustrated in **Figure 3.4** in **Chapter 3** are used.

The RS-232 port RTS line is operational and can be used if required by any hardware device connected to the 4700 power meter. Siemens WinPM software does not require the use of the RTS line for direct RS-232 connections; however, some types of modems (for example, radio modems) may require its operation.

The RTS signal is asserted before the beginning of a transmission and remains asserted throughout the transmission. The time delay between the assertion of the RTS and the start of the transmission is controlled by the TRANSMIT DELAY parameter, which can be set from the front panel. The range is 0 to 999 milliseconds (with 0 (zero) as default).

The programmable RTS ACTIVE LVL parameter selects whether the RTS line is asserted HIGH or LOW during transmission.

9.3 RS-485 Communications

RS-485 is used when multiple devices are installed at a remote site. RS-485 communications can be used to concurrently connect up to 32 remote devices on a single communications loop. Each device is given a unique unit ID (identification number). In this way, each remote device may be monitored and controlled from one location by a single supervisory device.

The total distance limitation on a single RS-485 communications network is 4000 feet (1220 meters) using 22 AWG twisted pair shielded cable. **Figure 3.5** in **Chapter 3** provides a wiring diagram for RS-485 network connection.

Communication methods between the remote RS-485 site and the supervisory device can include a direct RS-485 connection, telephone lines with modems, fiber-optic and/or radio links. An RS-232 to RS-485 converter, such as the Isolated Multi-Drop converter, is required between the RS-232 port of the computer or modem and the RS-485 network as illustrated in **Figure 3.5** in **Chapter 3**.

9.4 Setting the Unit ID and Baud Rate

Before communication with the host computer/PLC is possible, ensure that the 4700 power meter, and all other connected devices, are configured for the required communications standard (RS-232 or RS-485). Instructions for the 4700 power meter communications card configuration are provided in **Figure 3.1** in **Chapter 3**.

The next step is to program the communication parameters of the 4700 power meter and all other connected devices. The UNIT ID and BAUD RATE parameters of the 4700 power meter can be programmed via the front panel. The unit ID must be set to a unique value between 1 and 254. The baud rate of each device on the network must be set to correspond with the baud rate selected for the computer. Options include 300, 1200, 2400, 4800, 9600 or 19,200 baud.

When using a modem interface between the host computer and any remote device(s), ensure that the host computer is not used to set the BAUD RATE parameter of any selected device outside the working range of the modem. Doing so will cause that meter to cease communicating. Re-establishing communications with that meter is then only possible through the following steps:

1. Reset the baud rate of the remote device from its front panel to a value within the working range of the modem.
2. Set the computer to communicate at the baud rate at which the remote device has been set to communicate.

9.5 Siemens WinPM Software

WinPM Electrical Distribution Communication software operates in the Microsoft® Windows™ 3.1 operating environment on a personal computer (PC). Through communications drivers, WinPM software collects and displays real-time data from Siemens ACCESS field devices, Siemens protective relays, and other field devices. WinPM software displays information and adds the capabilities of programming, monitoring alarms, and logging system events. WinPM software also monitors and displays historical data, minimum and maximum data, and waveform data. In addition, WinPM software can deliver its data to other compatible Windows applications, in real-time, through dynamic data exchange (DDE), a method of sharing information that is supported by Windows applications.

Your computer running WinPM software can be connected to intelligent field devices directly, or through a modem to the ACCESS system's SEAbus communications bus.

9.6 Third-Party System Compatibility

4700 power meter communications uses an advanced object and register based open protocol which supports an efficient exception reporting methodology. This allows the 4700 power meter to be easily adapted to third-party PLC, DCS, EMS, and SCADA systems.

All data and configuration registers are accessible via communications. All configuration and control operations have embedded password protection.

Contact Siemens for complete documentation on the 4700 power meter SEAbus communications protocol or to discuss a specific application.

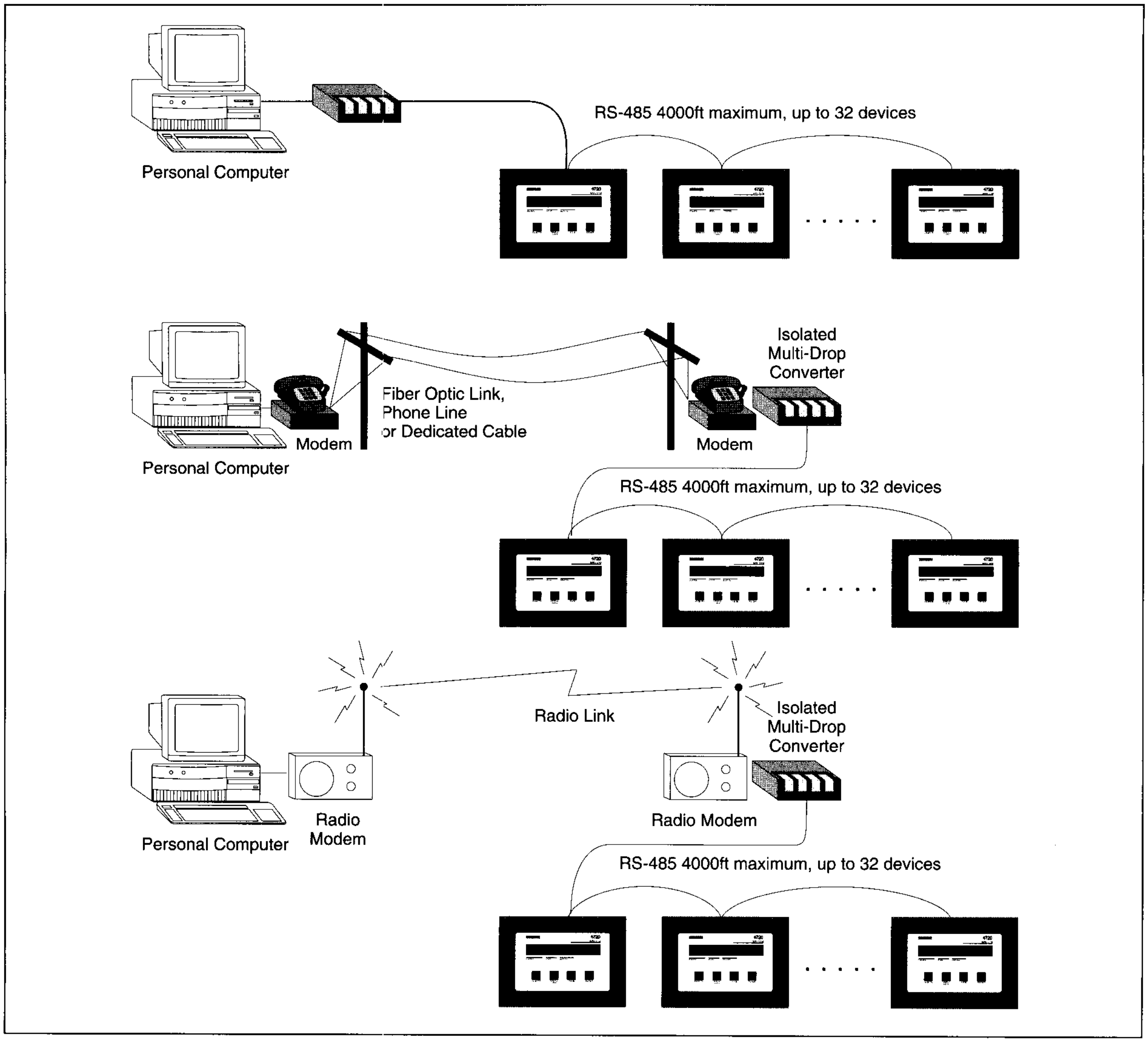


Figure 9.1 Remote Communications Methods

10 Maintenance

The following two circumstances describe the only regular maintenance that the 4700 power meter may require.

10.1 Battery Replacement

The 4700 power meter nonvolatile memory (NVRAM) circuit contains an integrated battery backup system.

The rated life of the NVRAM battery is seventy years at 122°F (50°C), 28 years at 140°F (60°C), and 11 years at 158°F (70°C). If the unit operates at less than 122°F (50°C) for 60% of the time, less than 140°F (60°C) for 90% of the time, and less than 158°F (70°C) for 100% of the time, the expected life of the NVRAM battery is 35 years. If the meter is operating in an environment where the temperatures regularly exceed 140°F (60°C), the NVRAM battery should be replaced every ten years.

Note: When the NVRAM is replaced, historic data may be lost. We recommend backing up critical logged data to the hard drive of a computer prior to servicing. Setup parameters and calibration of the unit are not affected.

10.2 Calibration

The calibration interval for the 4700 power meter depends on your accuracy requirements. The rated accuracy drift is 0.1% per year.

For information regarding the required calibration procedure, contact your local Siemens sales representative.

10.3 Field Service Considerations

In the unlikely event that the 4700 power meter unit should fail, servicing requires disconnection and removal of the unit from its mounting for the purpose of repair, or for exchange with a replacement unit. The initial installation should be done in a way which makes this as convenient as possible:

1. All power to the 4700 power meter should be removed and connections grounded.
2. Current transformer secondary leads should be short-circuited at the CT shorting block. Check to be sure that protective relaying is not affected.
3. All wiring should be routed to allow easy removal of the connections to the 4700 power meter terminal strips, the 4700 power meter rear cover, and the 4700 power meter itself.

11 Troubleshooting

A number of problems can cause the 4700 power meter not to function properly. This section lists possible problems and explains how to correct them.

1. If the display does not operate:

   a. check that there is an appropriate voltage available to the power supply (L and N connections on the terminal strip).

   b. confirm that the VREF terminal is connected directly to ground.

   c. press a button on the front panel.

2. If the voltage or current readings are incorrect:

   a. Check that the VOLTS MODE is properly set for the given wiring.

   b. Check that the voltage and current scales are properly set.

   c. Make sure the VREF terminal is properly grounded.

   d. Check the quality of the CTs and VTs in use.

   e. Make the following voltage tests:

      - V1, V2, V3 to VREF are 120 VAC (or rated full scale values of 277 or 347 VAC).
      - VREF to switchgear earth ground is 0 V.
      - L to VREF is 120 VAC or DC (or optional rated control power voltage).
      - N to VREF is less than 2 VAC.
      - All current inputs are less than 1 VAC with respect to VREF.

3. If the kW or Power Factor readings are incorrect but voltage and current readings are correct:

   make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.

4. If RS-232 or RS-485 communication does not work:

   a. check that the BAUD RATE matches all other ACCESS devices on the network or the personal computer.

   b. check that the communications mode (RS-232 or RS-485) set by the jumper on the communications card is correct for the type of standard being used (see **Chapter 3**, **section 3.1**).

   c. check that the UNIT ID (address) of the 4700 power meter matches the configuration of the Power Monitor unit or other computer.

If your problem persists after performing the specified steps, or if the problem is not listed above, contact Siemens.

A Technical Specifications

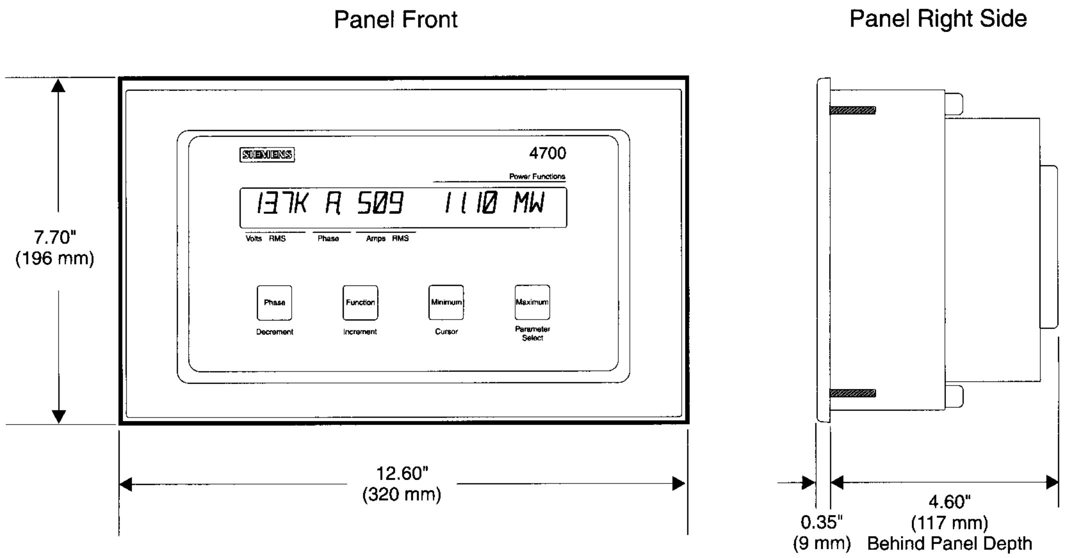
Input and Output Ratings	
Voltage Inputs: (V1, V2, V3)	120 VAC, 277 VAC, and 347 VAC nominal full scale input versions Overload withstand: 1500 VAC continuous, 2500 VAC for 1 second Input impedance: 2 MΩ
Aux. Voltage Input: (V_{AUX})	1.0 VAC/VDC nominal full scale input (1.25 VAC/VDC max.) Overload withstand: 120 V continuous, 1000 V for 1 second Input impedance: 10 KΩ
Current Inputs: (I11, I12, I21, I22 I31, I32, I41, I42)	5.000 A, AC nominal full scale input Overload withstand: 15 A continuous, 300 A for 1 second Input impedance: 0.02Ω, Burden: 0.05 VA
Status Inputs: (S1, S2, S3, S4)	>20 VAC/VDC = active, <9 VAC/VDC = inactive (S1, S2, S3, S4) input impedance: 2 MΩ Overload withstand: 1500 V continuous, 2500 V for 1 second
Control Relays: (R1, R2, R3)	Form C dry contact relays 277 VAC or 24 VDC @ 10 A maximum load current
Aux Current Output (I_{OUT}):	0-20 mA. Maximum load 250Ω resistive
Power Supply:	Standard N. American: 85 to 132 VAC/0.2 A/47 to 440 Hz or 110 to 170 VDC/0.2 A European/Optional: 85 to 264 VAC/0.2 A/47 to 440 Hz or 110 to 340 VDC/0.2 A Other Available Options: 24 VDC and 48 VDC
Operating Temperature:	0°C to 50°C (32°F to 122°F) ambient air temperature range
Storage Temperature:	-30°C to +70°C (-22°F to +158°F)
Humidity:	5 to 95%, non-condensing
Shipping:	Weight: 3.9 kg. (8 lbs, 10 oz.) Carton: 38 x 25 x 18 cm (15" x 9.8" x 7.1")
Voltage, Current,Status, Relay, and Power inputs all pass the ANSI C37.90A surge withstand and fast transient test.	

Technical Specifications

Parameter	Accuracy (%)	Resolution (%)	Range
Volts	0.2	0.1	0 to 999,999 (1)
Amps (L & N)	0.2	0.1	0 to 9,999
KVA	0.4	0.1	0 to 999,999 (2)
KW	0.4	0.1	0 to 999,999 (2)
KVAR	0.4	0.1	0 to 999,999 (2)
PF	1	1	1.0 to +/-0.6
FREQUENCY	0.2 Hz	0.1 Hz	40 to 70 Hz
KW DEMAND	0.4	0.1	0 to 999,999
AMPS DEMAND	0.2	0.1	0 to 9,999
KWHR	0.4	1 KWHR	0 to 999,999,999
KVARHR	0.4	1 KVARHR	0 to 999,999,999
Vaux (1 VAC scale)	0.25	0.1	0 to 999,999
Neutral Current	0.2	0.1	0 to 9,999

(1) Reads in kV for voltages over 9,999
(2) Reads in MVA, MW, MVAR for readings over 9,999

B Dimensions



C Setpoint Parameter Form

Setpoint	Type	High Limit	TD Operate	Low Limit	TD Release	Relay/Function
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

D Firmware Versions

The following table lists each software version release for the 4700 power meter and the new features or performance enhancements added with each release.

The version number is identified on the label on the rear cover of the 4700 power meter (see **Figure 1.1** in **Chapter 1**). If yours is currently using a software version older than the most recent version listed in the table below, you can upgrade the software in that unit by contacting your local representative or the manufacturer. Upgrades to the 4700 power meter require a simple replacement of the EPROM (integrated circuit "chip"), which contains the operating software inside the unit. This replacement procedure must be done by trained electronics service personnel.

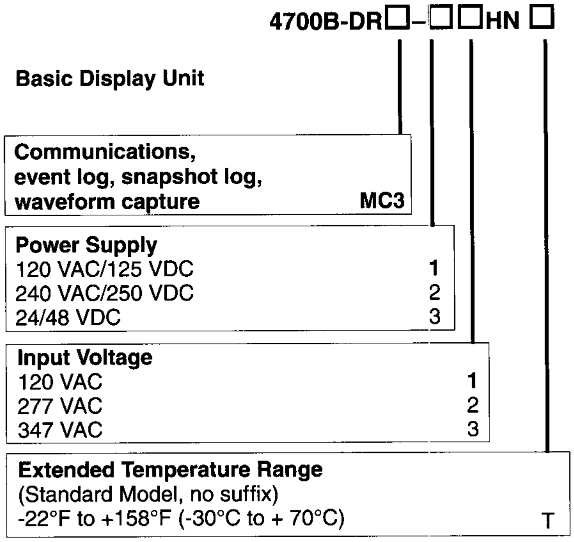
Hardware Revision B

From now on, all EPROMs are available for either the A or B hardware. They are not interchangeable. Normally, only the B is released except for an upgrade of an older meter. Revision B meters are easily distinguished from revision A meters by the following:

- Raised black plastic bezel (Rev. A has a flat, white metal bezel)
- Product Rev: B printed on back of meter
- VREP terminal (Rev. A does not have a VREF terminal)

Software version	**Release Date**	**Description**
2.2.0.2B	January 1, 1992	Exactly the same as Rev. A 2.2.0.2
2.2.0.3B	March 31, 1992	Fixed bug that limited unit ID (address) to 1 thru 99
2.2.0.4B	January, 1993	• Fixed bug with kWH/kVARH overflow causing display to blink • Fixed but that lost password changes if powered down • Adds waveform capture feature • Adds reverse kVARH value; kVARH and kWH changed to return forward, not total values • Adds configurable relay pulsing • Add kW FWD, kVAR FWD, and kVAR REV setpoints • PF display changed to LD/LG • 3-wire WYE mode allows for 2VT/3CT • Demand period is now based on time of day • Added ,/. configuration of display values (European format) • RTS line is asserted 10 msec before TX in RS-232 mode • PM 3.13 logs diagnostic code 1 type 1 errors with this version

E Ordering Information



Examples:

"4700B-DRMC3-11HN" specifies a power meter with an isolated RS-232/RS-485 communications module installed, a 120VAC/125VDC power supply, and 120VAC nominal measured phase voltage inputs.

"4700B-DR-12HNT" specifies a power meter with 120VAC/125VDC power supply, 277VAC nominal measured phase voltage inputs, and extended temperature capability.

4700 Power Meter Product Designations

Features	**Product Designations**	
	DR	DRMC3
15 metered parameters	X	X
Min/Max log	X	X
Aux voltage (1VAC/1VDC nominal)	X	X
20 character display	X	X
Four discrete inputs	X	X
Three programmable relay outputs	X	X
One analog ouput (4 to 20mA)	X	X
Communications module installed		X
Event Log		X
Snapshot Log		X
Waveform Capture		X

SIEMENS

Siemens Energy
& Automation, Inc.
Switchgear and Motor Control
Business
Customer Service
P.O. Box 29503
Raleigh, NC 27626

ACCESS Systems Service Request Form

To report problems with Siemens ACCESS systems and devices, make a copy of this form, complete it with as much information as you can, and contact your Siemens representative. You can also fax this form to Siemens Customer Service at 919-365-2830.
For emergency service call 1-800-347-6659.

Customer Information

Job site location and contact: ______________________________
____
____
Phone and fax number: ______________________________
Siemens sales order number: ______________________________
Siemens manufacturing order number (from drawing): ______________________________

System Information

Describe the number and type of devices on your ACCESS system.

Field Devices

Quantity	Device Type	Quantity	Device Type
	4300 power meter		SCOR relay
	4700 power meter		ISGS relay
	4720 power meter		7SA, 7SJ, or 7UT relay
	Static Trip IIIC trip unit		Multiplexer Translator
	Static Trip IIICP trip unit		Isolated Multi-Drop converter
	Sensitrip III trip unit		S7-I/O device
	SB breaker trip unit		Pulse reading meter
	SAMMS-LV device		Other:
	SAMMS-MV device		Other:

Supervisory Devices and Software

Quantity	Product	Quantity	Product
	WinPM software		Power Monitor Panel (PMP)
	Host PC software		PC32F power monitor
	Power Monitor PC software		Siemens PLC
	SIEServe software		Other hardware:
	Other software:		Other hardware:

Problem Description

Provide the following information on the affected device(s):

Device type: ______________________________

Model or catalog number: ______________________________

Part number: ______________ Serial number: ______________

Hardware version: ______________ Software version: ______________

Installed options: ______________________________

Configuration information, including operational settings, parameters, wiring, type of system:

____

____

____

____

On what type of electrical equipment are the devices installed? (switchgear, motor control center, switchboard, and so on): ______________________________

____

____

Provide a brief description of the problem: ______________________________

____

____

____

____

Indicate what error messages, if any, are generated by the device or supervisory software. Include messages listed in the event log: ______________________________

____

____

____

____

To be completed by Siemens

Received by: ______________ Date received: ______________

Reviewed by: ______________ Date reviewed: ______________

Sales engineer: ______________

Problem report tracking number: ______________________________

Problem classification code: ______________________________

Corrective action: ______________________________

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SIEMENS

Warranty

Company warrants that on the date of shipment to Purchaser the goods will be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

If within one year from date of initial operation, but not more than eighteen months from date of shipment by Company, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such defect by, at Company's option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Company hereunder. Company shall have the right of disposal of items replaced by it. Purchaser shall grant Company access to the goods at all reasonable times in order for Company to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, the Company and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

The Company's responsibility does not extend to any item of the goods which has not been manufactured and sold by Company. Such item shall be covered only by the express warranty, if any, of the manufacturer thereof. The Company and its suppliers shall also have no responsibility if the goods have been improperly stored, handled, or installed; if the goods have not been operated or maintained according to their ratings or according to instructions in Company or supplier furnished manuals; or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE). INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE GOODS.

The foregoing states Purchaser's exclusive remedy against Company and its suppliers for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installation or defects from any cause.

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SIEMENS

Siemens Energy &
Automation, Inc.
Power Apparatus & Conditioning Division
P.O. Box 29503
Raleigh, NC 27626-0503

Manual No. SG6018-03 (Replaces SG-6018-02) 2MTD0696
Printed in U.S.A.

SIEMENS

4700 Power Meter

Operator's Manual

Manual No. SGIM-6018D

⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

Will cause death, serious personal injury, or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel.

The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

QUALIFIED PERSON

For the purposes of this manual, a qualified person is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, that person has the following qualifications:

(a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, or face shields, flash clothing, etc., in accordance with established safety procedures.

(c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

The contents of the instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

Table of Contents

1 Introduction

1.1 About the 4700 Power Meter

The 4700 power meter is a microprocessor-based instrumentation package for low, medium or high voltage electrical equipment and substations. It is a state-of-the-art alternative to traditional analog electromechanical metering devices. The unit is economical and is easy to install and operate. It requires no external transducers.

This manual supersedes all previous publication versions on the installation and operation of the 4700 power meter.

1.2 Performance Features

The 4700 power meter offers major improvements in accuracy, communications capability, data logging, control capability, ease of use, and cost, compared to traditional analog components or first generation digital metering systems. The 4700 power meter operates as a stand-alone switchboard, switchgear, motor control center or substation instrument, and serves as a data collection point for Siemens ACCESS™ electrical distribution communication system.

The unit uses a 12 MHz, 16-bit microcontroller chip. This provides very high computational throughput, allowing the sophisticated software to process information in real time. The unit is self-contained and its readings and setup parameters are maintained in nonvolatile memory. Connections to the 4700 power meter are on the rear of the unit, as shown in **Figure 1.1**.

1.3 Displays and Measurements

You can view readings from the alphanumeric display. Readings are displayed in the following format:

- 4-digit voltage display phase indication
- 4-digit amperage display
- 8-digit power function display

The unit can be configured to operate in wye (star), delta, or single-phase voltage modes. The following measurements are available:

- Current on each phase
- A fourth current input (I4)
- Line-to-line voltages
- Frequency
- Power factor
- kVA
- kW
- kVAR
- kW Demand
- V_{AUX} (auxiliary voltage input)
- Total MWHr
- Total MVARHr

Minimum and maximum values for each of the readings are available. You can also set the unit to take snapshots of all readings at specified intervals and maintain them in nonvolatile memory. The snapshot data is read using the serial communications port.

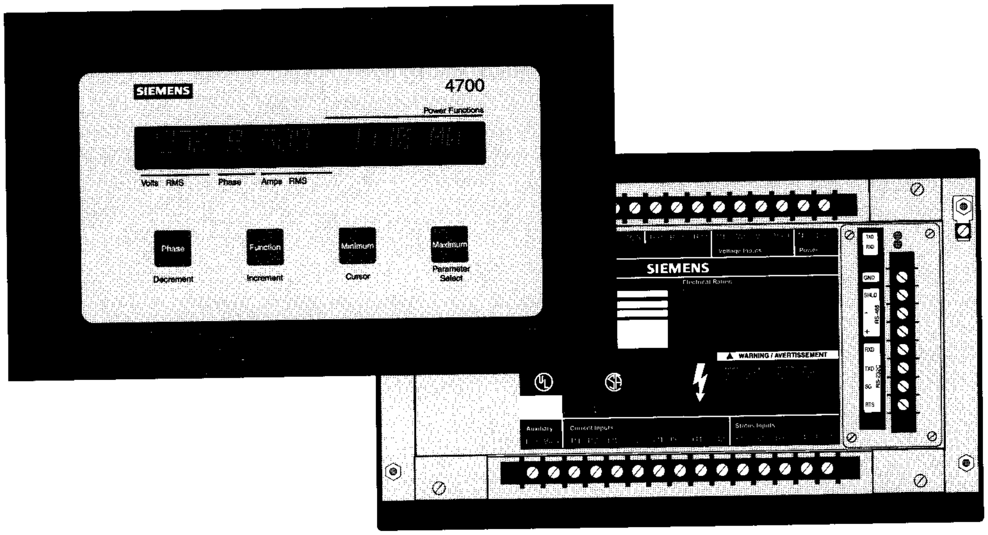


Figure 1.1 Front and Rear Views

1.4 Other Functions

1.4.1 Logging Capability

The 4700 power meter can record up to three data logs.

- EVENT Log. This log records events such as power up, parameter changes, alarm conditions, relay changes, and status input changes. The 50 most recent events are retrievable from this log using the communications port.
- SNAPSHOT Log. This log contains voltage, current, and all power values recorded at user-defined time intervals. The 100 most recent snapshots are retrievable from this log using the communications port.
- MIN/MAX Log. This log records the extreme values for voltages, currents, power, and other measured parameters. Min/Max data is read using the integral display or the communications port.

All log contents (events, snapshots, and min/max values) are time-stamped to the second.

1.4.2 Control Relays

The 4700 power meter has three control relay options.

- Alarm relays and setpoint relays. These can operate as a function of any measured parameter for demand, power factor, or load control.
- Remote control relays, operated by command via the communications port.
- kVARHr, kWHr pulse outputs.

1.4.3 Status Inputs

The 4700 power meter has four status input options available, which can each sense the state of an external contact, active or inactive. The status of these inputs is viewed and logged by a Power Monitor™ display and monitoring unit, or by another computer through the communications port.

1.4.4 Auxiliary Voltage Input

All 4700 power meter models have an auxiliary voltage input that allows monitoring and display of an additional external voltage (1.25 VAC max).

1.4.5 Auxiliary Current Output

You can program an optional analog current output for 0 to 20 mA or 4 to 20 mA, in proportion to any measured parameter.

1.5 Communications and ACCESS Compatibility

The 4700 power meter is equipped with an optically isolated communications port for displaying data on remote supervisory devices. These devices and programs allow the meter to operate in the ACCESS electrical distribution communication system. Examples of supervisory devices include the Power Monitor display and monitoring unit, a standard personal computer running the Power Monitor PC communications and supervisory software, and Siemens Microsoft® Windows™-based SIEServe™ or WinPM™ communications software.

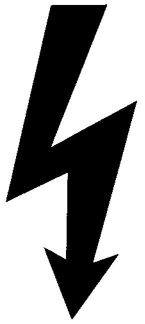
1.6 System Applications

The unique features of the 4700 power meter, including measurement, storage, setpoint (load shedding) and display characteristics, make it suitable for use in:

- Utility Installations
- Industrial Buildings
- Office Buildings
- Commercial Buildings
- Hospitals
- Telephone Exchanges
- Factories
- Pulp Mills
- Saw Mills
- Shopping Centers
- Large Stores
- Hotels
- Substation Metering
- Co-Generation Systems
- Chemical Process Plants
- Multi-User Sites (where allocation of electrical cost is desirable)
- Any other installation that uses significant amounts of electrical energy
- Any other location where remote monitoring and control is needed

2 Installation

⚠ DANGER



Electrical equipment contains hazardous voltages.

Can cause death, serious personal injury, or equipment damage.

Installation and maintenance should be performed only by qualified personnel.

2.1 Location and Mounting

Locate the 4700 power meter in a dry, dirt-free environment, away from heat sources and very high electric fields. To operate properly and effectively, environmental conditions should fall within the guidelines listed in **Appendix A**.

The 4700 power meter can be panel-mounted for easy access and viewing. The meter has four studs to facilitate panel mounting. **Figure** provides the mounting dimensions for the 4700 power meter. A five inch clearance behind the front panel is required for access to wiring.

2.2 Power Supply

The standard 4700 power meter requires 85 to 132 VAC (47 to 440 Hz) or 110 to 170 VDC, both at 0.2 A. The power can be supplied by a dedicated fused feed, or by the monitored voltage source (120 V system). Optional power supplies are available for 24 VDC/48 VDC, and 240 VAC/250 VDC.

2.3 Power Wiring

Connections to the 4700 power meter are made to two terminal strips located on the rear of the unit. **Figure** provides 4700 power meter terminal block dimensions. Ring or spade terminals are recommended for all connections.

The phasing and polarity of AC current and voltage inputs, and their relationship, is critical to the operation of the power meter. Refer to **Figure 2.2** through **Figure 2.7** for wiring diagrams to ensure correct installation.

2.3.1 Chassis Ground Connection

You must connect the chassis of the 4700 power meter to earth ground. A good, low-impedance chassis ground is essential for the 4700 power meter surge and transient protection circuitry to function effectively. Do not rely on metal door hinges as a ground path.

Connect the ground wire to the chassis of a standard 4700 power meter using the supplied ground lug attached to one of the four mounting studs.

In both cases, ensure that the ground lug screw is tightened securely onto the ground wire, and that the nut is tightened securely onto the lug.

Note: For the noise and surge protection circuitry to function correctly, the 4700 power meter chassis ground lug must be connected to the switchgear earth ground using a dedicated 14 AWG (or larger) wire. Failure to do so will void the warranty.

2.3.2 Voltage Reference Connection

The voltage reference terminal, VREF, of the 4700 power meter serves as the zero voltage reference for voltage readings. A good, low-impedance VREF connection is essential for accurate measurement. Use a dedicated 14 AWG wire for a connection at a point where there are no voltage errors due to distribution voltage drops.

The connection point for VREF is dependent on the system configuration. Each of the following configurations is illustrated in **Figure 2.2** through **Figure 2.7**:

- If the system you want to monitor is a four-wire wye or single phase, then you must connect the VREF to the neutral conductor
- If the system is a three-wire grounded (delta), then you must connect the VREF to the line transformer neutral
- For three-wire ungrounded (open delta) systems, and for systems where VTs are used, you must connect the VREF to the VT common leads

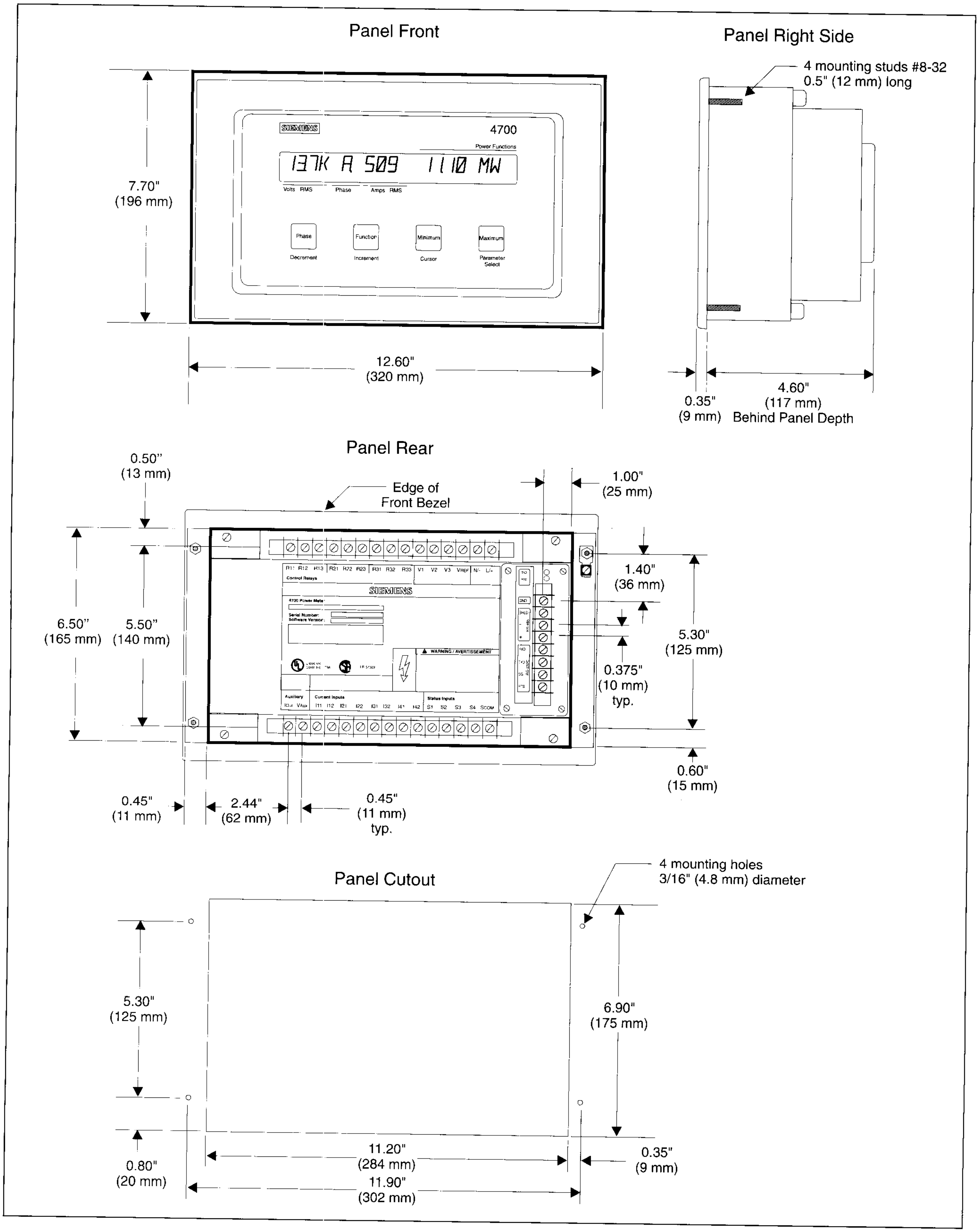


Figure 2.1 Mounting Dimensions

2.3.3 Fourth Current Input Connections

The 4700 power meter is equipped with a fourth current input, labeled I4. This input is typically used to measure the current flow in the neutral or ground conductor. The use of this input is optional. If not used, connect the I41 and I42 terminals to earth ground.

The secondary rating of the CT connected to the I4 input must match the three phase current inputs. This rating depends on the presently installed input option in the 4700 power meter.

The primary rating for the CT connected to the I4 input can differ from the three phase inputs, since the I4 input scaling is independently programmable.

2.3.4 Waveform Capture Connections

The 4700 power meter waveform capture feature allows digital sampling of signals at each of its voltage (V1, V2, V3, Vaux) inputs and current (I1, I2, I3, I4) inputs. The 4700 power meter uses the V1 input as the triggering reference for waveform capture, and to maintain phase relationships between all sampled signals. You must connect the V1 input for waveform capture to work. No other special wiring considerations are necessary. Waveform capture is accessible only via communications. See **section 6.8** in **Chapter 6** for more information about how to use waveform capture.

2.4 Selecting Voltage and Current Transformers

Selection of correct current transformers (CTs) and voltage transformers (VTs) is critical to proper monitoring. This section describes how to choose transformers.

2.4.1 Selecting VTs

The requirement and selection of VTs depends on three criteria: the system monitored, the voltage levels monitored, and the model of the 4700 power meter.

For connecting directly to 120/208 VAC systems, the 120 VAC (full scale) input model is used. It is also used for systems with VTs having a 120 VAC secondary. For connecting directly to a 277/480 VAC system, the 277 VAC (full scale) input model is used. For connecting a 347/600 VAC system, the 347 VAC (full scale) input model is used. If system voltages are over 347/600 VAC, then VTs are required.

VTs are used to scale down the system voltage to 120 VAC full scale. The system voltage is line-to-neutral (L-N) for wye systems or line-to-line (L-L) for delta systems. 120 VAC is the nominal scale input of the 4700 power meter.

The VTs are selected as follows:

a. Wye (star): VT primary rating is the system L-N voltage or nearest higher standard size. VT secondary rating is 120 V.

b. Delta: VT primary rating is the system L-L voltage. VT secondary rating is 120 V.

VT quality directly affects system accuracy. Therefore, for valid Volts, kW and PF readings, the VTs must provide good linearity and maintain the proper phase relationship between voltage and current. Instrument Accuracy Class 1 or better is recommended.

2.4.2 Selecting CTs

The 4700 power meter uses CTs to sense the current in each phase of the power feed. The selection of the CTs is important because it directly affects accuracy.

The CT secondary rating is always 5 A with a burden capacity greater than 3 VA (burden is the amount of load fed by the CT, measured in Volt-Amps).

Normally, the CT primary rating is selected equal to the Amp rating of the power feed protection device. However, if the anticipated peak load is much less than the rated system capacity, then improved accuracy and resolution is obtained by selecting a lower rated CT. In this case, choose the CT size equal to the maximum anticipated peak current plus 25%, rounded up to the nearest standard CT size available.

Other factors affect CT accuracy. Because long cable runs contribute to inaccuracy, try to minimize the length of the CT cable. Also, the CT burden rating must exceed the combined burden of the 4700 power meter plus cabling and any other connected devices.

VT and CT Considerations

Protect all phase voltage leads with breakers or fuses at their source. In cases where VTs are required and the power rating of the VTs is over 25 W, fuse the secondaries.

Connect CTs to the device via a shorting block or test block to facilitate safe connection and disconnection.

Refer questions regarding proper working procedures to qualified personnel.

2.5 Connecting to 3-Phase, Wye (Star) Systems

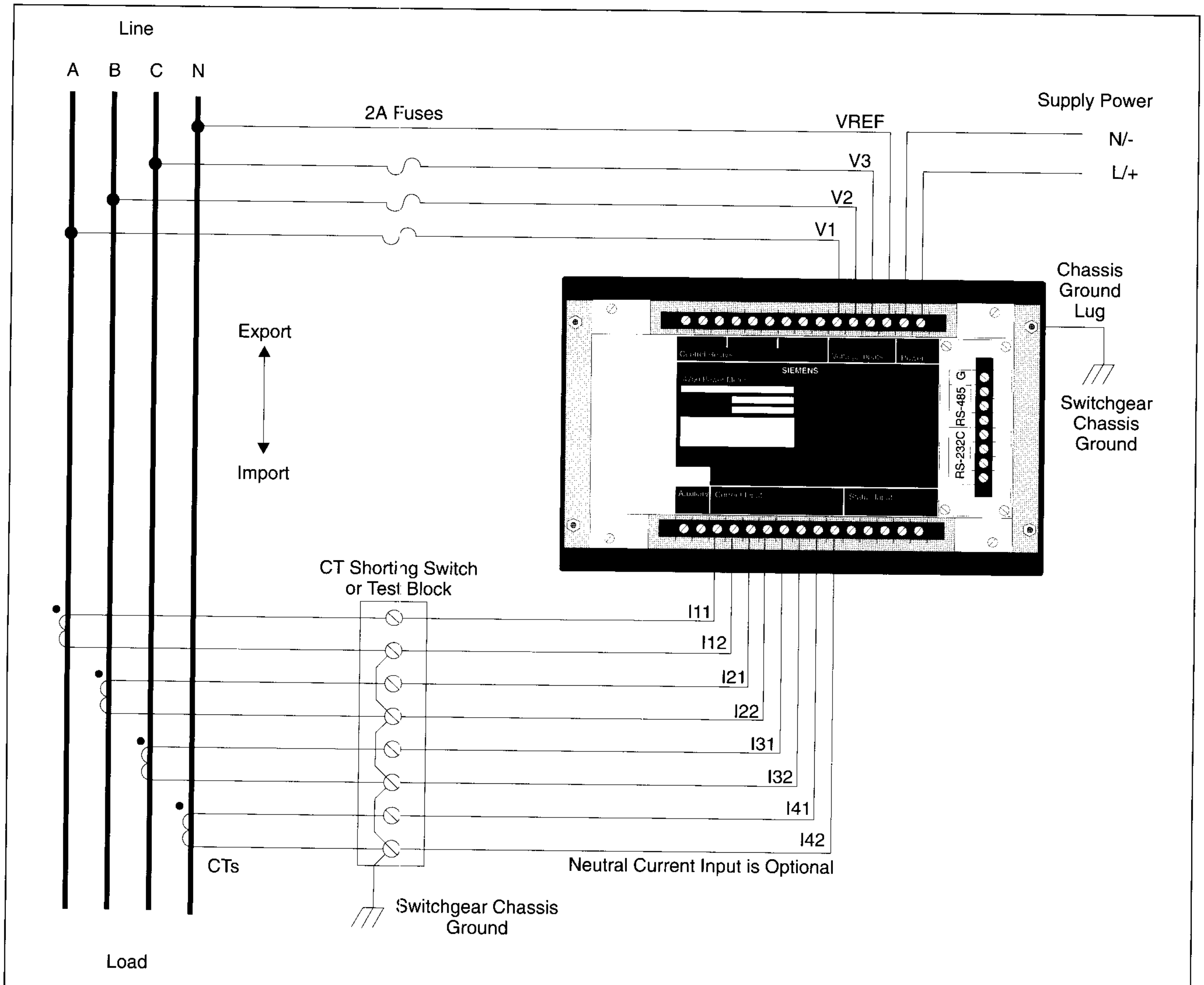
Without VTs

For a four-wire wye system, the 4700 power meter senses both the line-to-neutral (or ground) voltage and the current of each phase. This is the equivalent of a three-element metering configuration.

If the power system you want to monitor is a 120/208 V system, then use the standard 120 VAC input model with direct sensing of each phase, without the need for VTs. If the system is a 277/480 or 347/600 V system, then use the 277 VAC or 347 VAC input models connected directly.

Note: Although the 277 VAC and 347 VAC models can be connected directly, VTs may be required to meet local electrical codes when the 4700 is panel mounted.

The wiring diagram for these voltage ranges is shown in **Figure 2.2**. Set VOLTS MODE to 4W-WYE as described in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTS MODE:** 4W-WYE<0>

Supported Models:

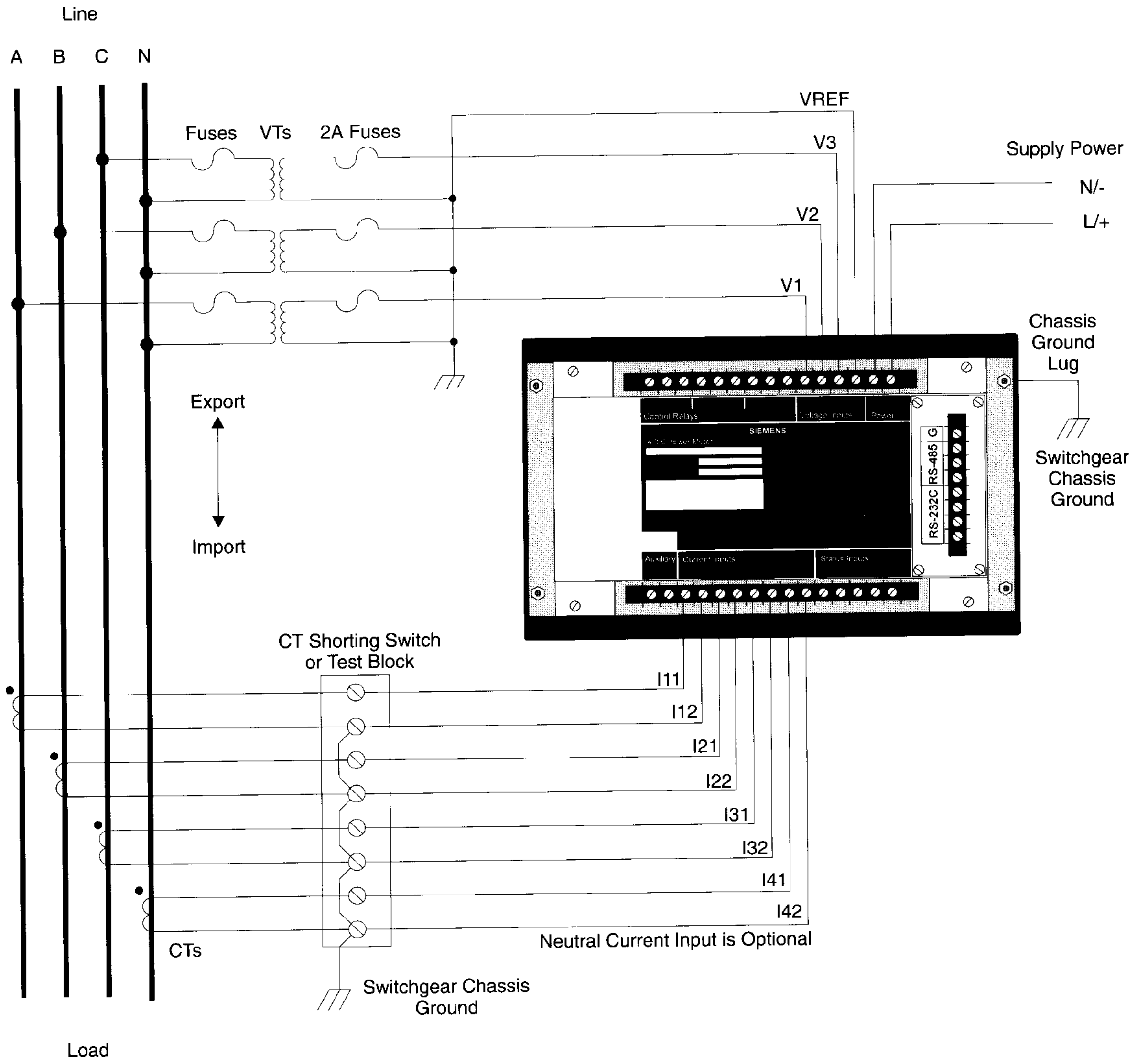
≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.2 Four-Wire Wye: Three-Element Direct Connection

With VTs

For wye system voltages over 347/600 V, you must use VTs. Wire both the VT primary and secondary in a wye (star), exactly as shown for correct operation.

This configuration is shown in **Figure 2.3**. Set the VOLTS MODE to 4W-WYE as described in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTS MODE:** 4W-WYE<0>

Supported Models:

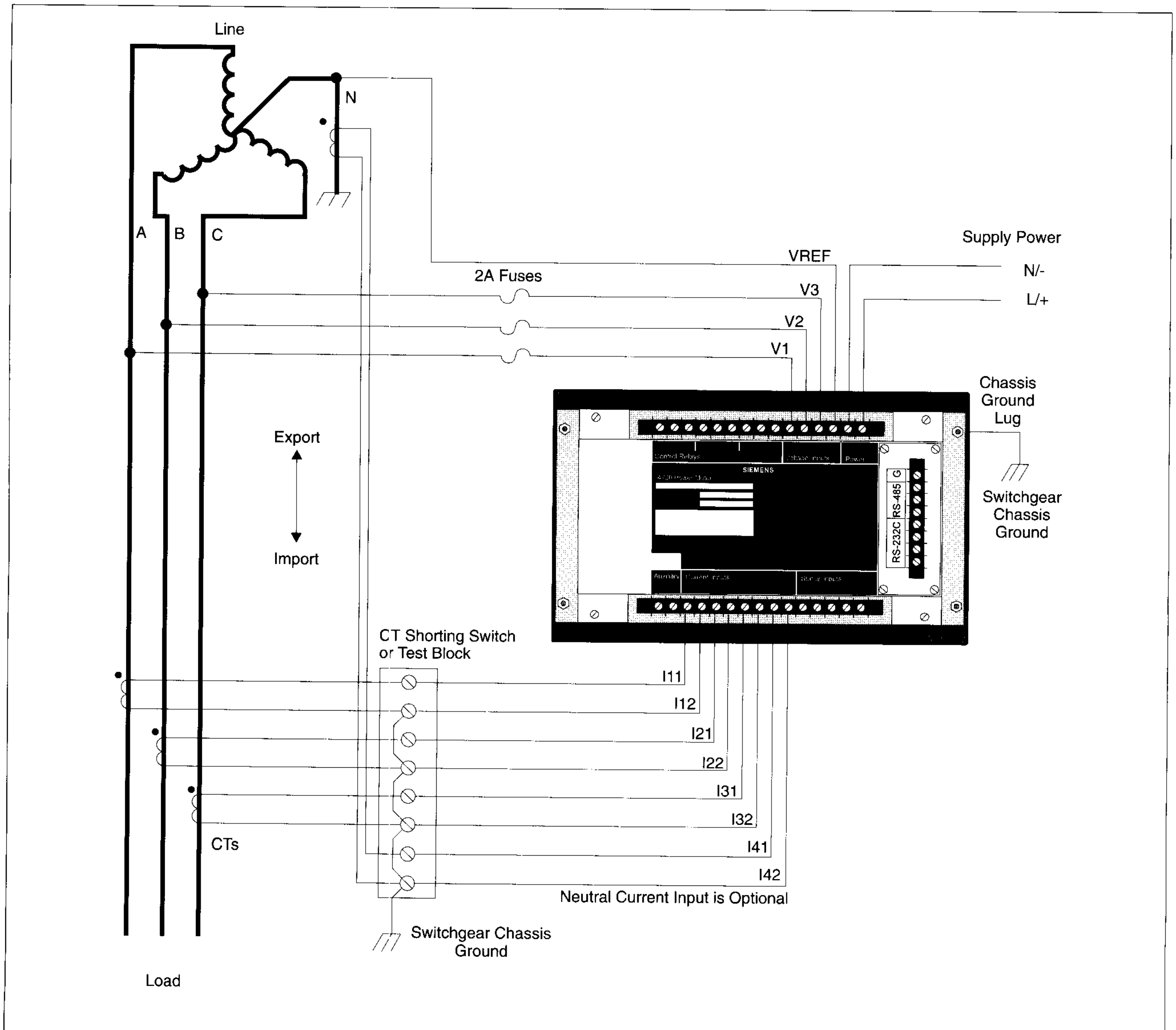
≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.3 Four-Wire Wye: Three-Element Connection Using Three VTs

Three-Wire Grounded Wye Without VTs

When the starpoint of a three-wire wye system is grounded, connect the 4700 power meter directly without the use of VTs. Ensure that the voltages are within the input range of the unit.

This configuration is shown in **Figure 2.4**. Set the VOLTS MODE to 4W-WYE as described in **Chapter 6, Programming**.



Volts mode is four wire wye. **VOLTS MODE:** 4W-WYE<0>

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.4 Three-Wire Grounded Wye: Three-Element Direct Connection

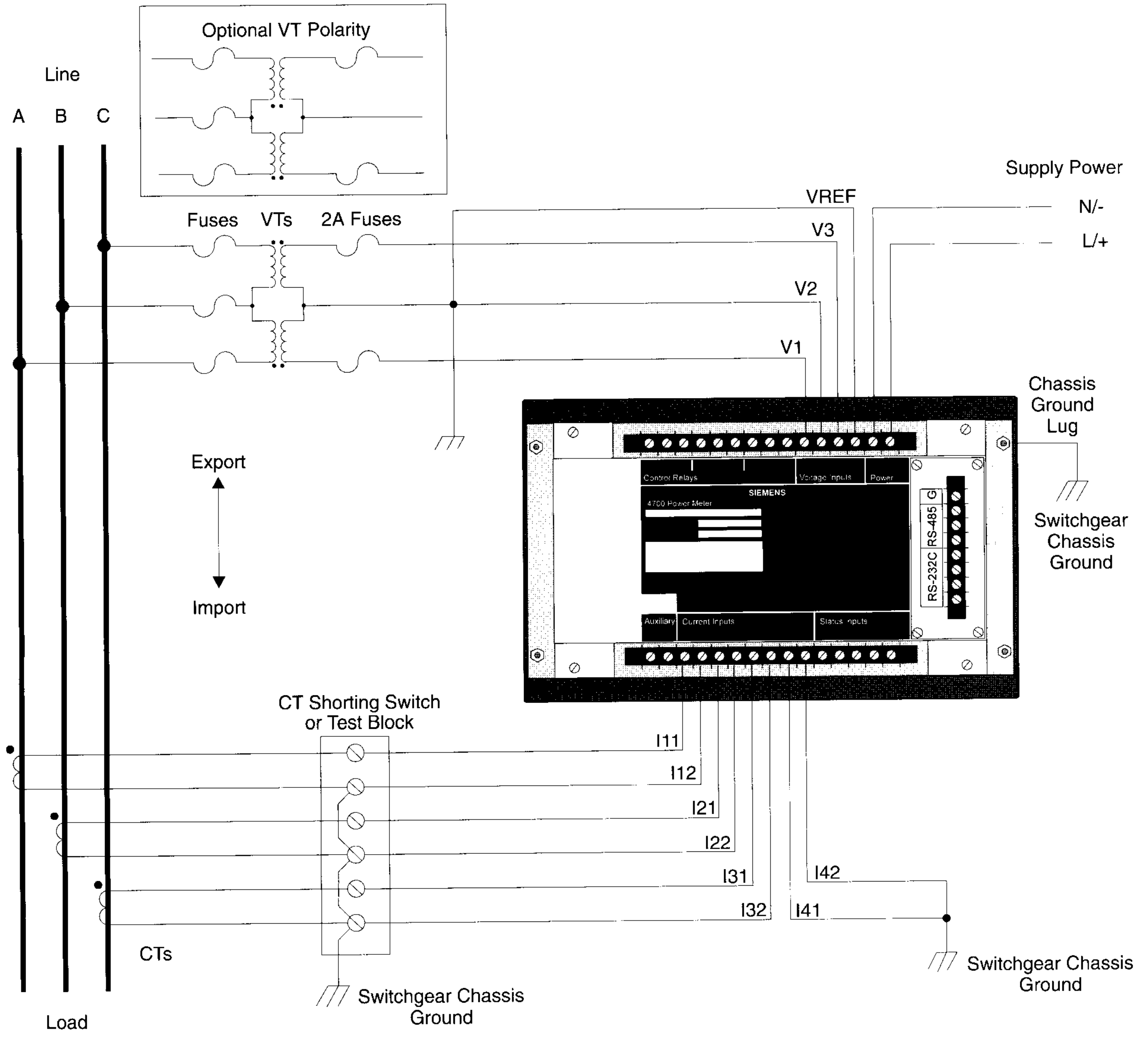
2.6 Connecting to Three-Phase, Delta Systems

2½-Element Connection

For ungrounded (floating) three-wire delta systems, the 4700 power meter always requires two VTs and senses the line-to-line voltages between each of the phases.

Connect the 4700 power meter in one of two ways: using two or three CTs.

Figure 2.5 shows an ungrounded delta connection using three CTs. Set the VOLTS MODE to DELTA as described in **Chapter 6, Programming**.



Volts mode is delta. **VOLTS MODE:** DELTA<1>

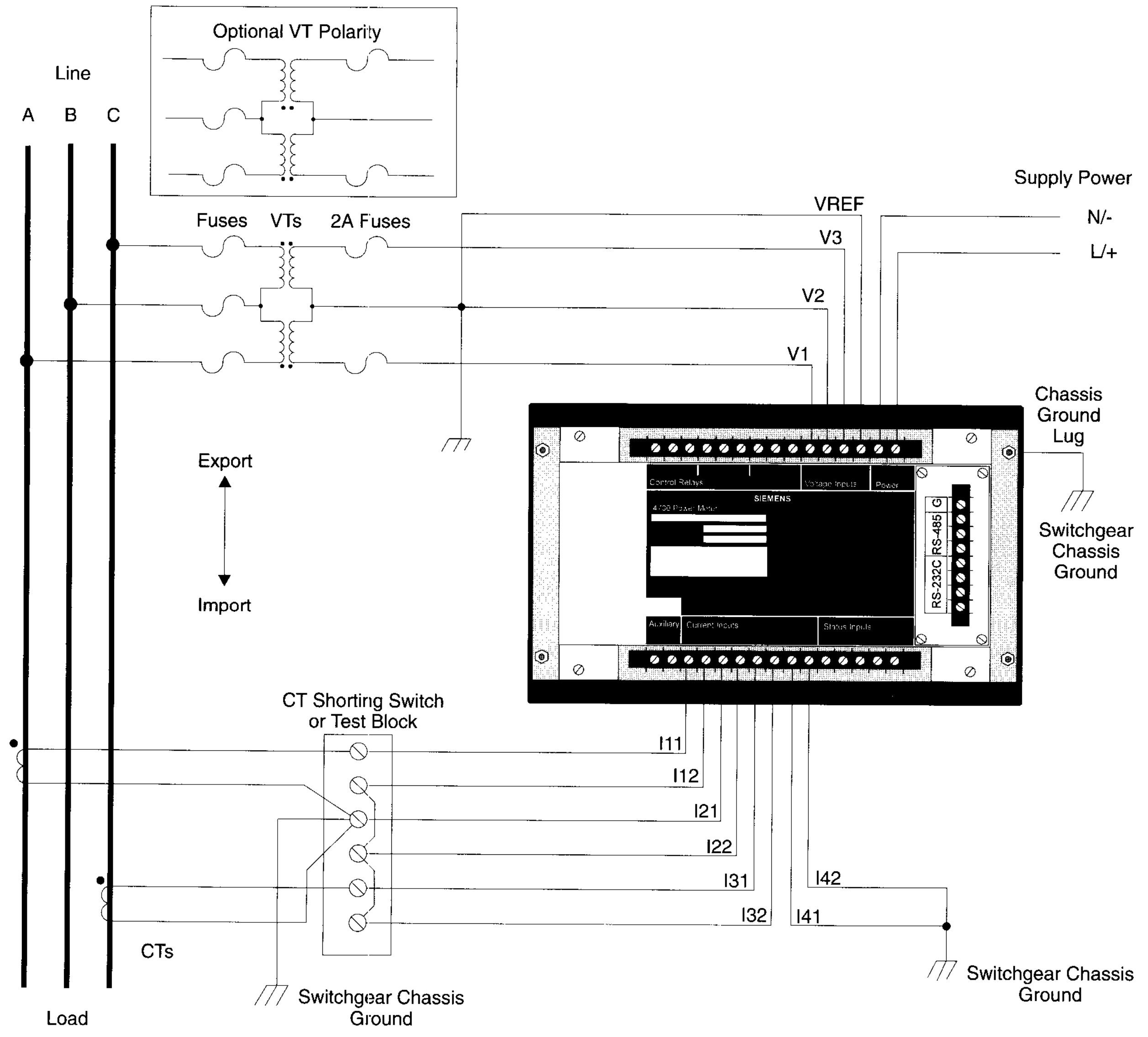
Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

Figure 2.5 Three-Wire Delta: 2½-Element Connection Using Two VTs and Three CTs

Two-Element Connection

Figure 2.6 shows an ungrounded delta connection using two CTs. Set the VOLTS MODE to DELTA as described in **Chapter 6, Programming**.



Volts mode is delta. **VOLTS MODE:** DELTA<1>

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model

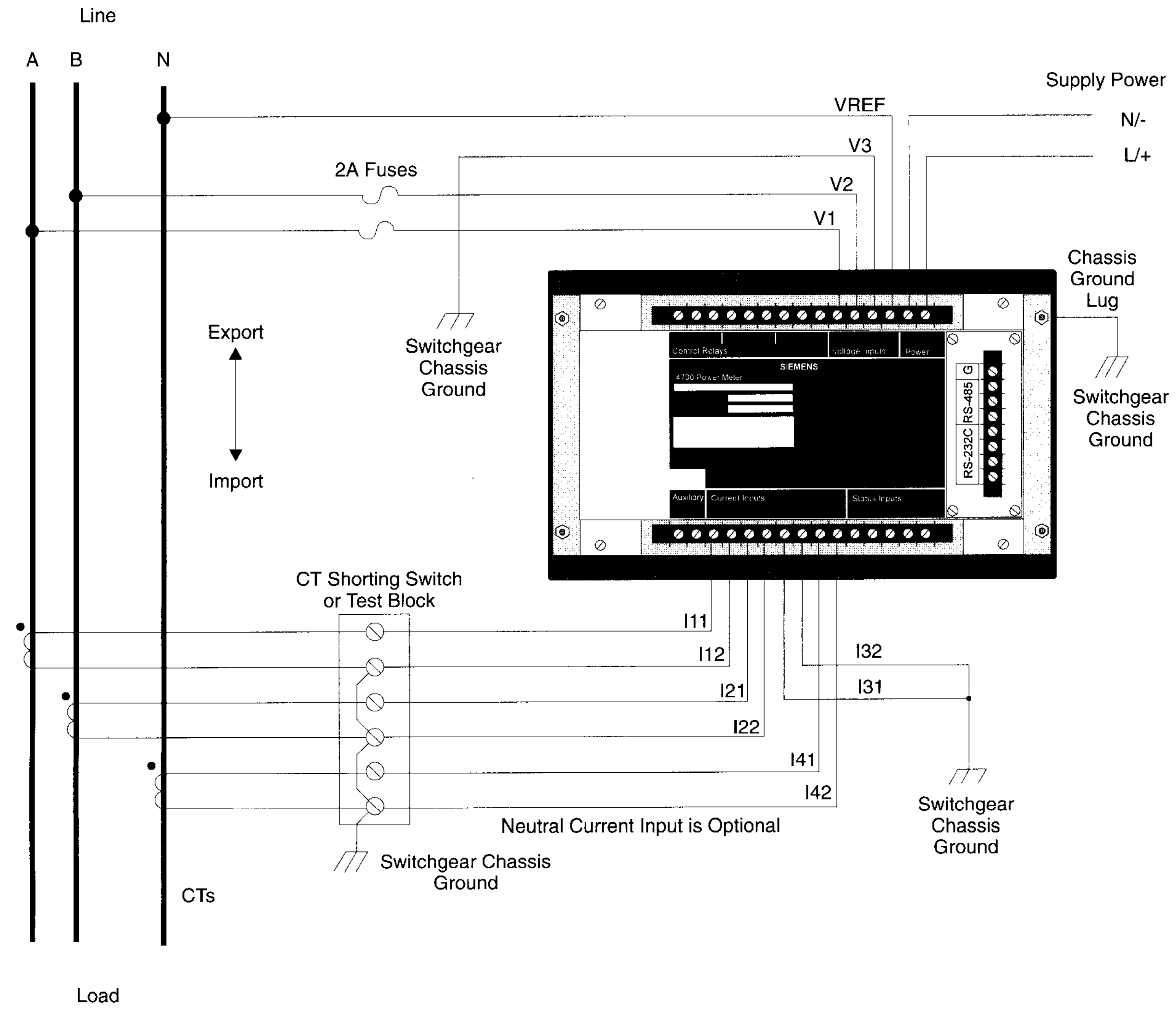
Figure 2.6 Three-Wire Delta: 2-Element Connection Using Two VTs and Two CTs

2.7 Connecting to Single Phase, Three-Wire Systems

Two-Element Connection

For single phase systems, connect the two voltage phases (180 degrees respectively) to the V1 and V2 inputs of the 4700 power meter. Also, connect the outputs of the two corresponding current transformers to the I1 and I2 input pairs.

The connections are illustrated in **Figure 2.7**. Note that the V3 input and I3 input pair are unused and grounded. For single-phase systems, set the VOLTS MODE of the 4700 power meter to SINGLE as described in **Chapter 6, Programming**.



Volts mode is single phase. **VOLTS MODE:** SINGLE<2>

Supported Models:

≤120VAC Line-to-Neutral/208VAC Line-to-Line Systems: Basic Model
≤277VAC Line-to-Neutral/480VAC Line-to-Line Systems: 277 Option
≤347VAC Line-to-Neutral/600VAC Line-to-Line Systems: 347 Option

Figure 2.7 Three-Wire Single Phase: Two-Element Direct Connection

3 Communications Wiring

The communications option of the 4700 power meter includes a communications card. The card is field configurable to allow the 4700 power meter to communicate using either the EIA/TIA-232 (RS-232) or EIA/TIA-485 (RS-485) standard. Optical coupling provides full isolation between the RS-232 or RS-485 communications lines and the metering equipment. Internal circuitry protects against common mode voltages or incorrect connection of the optional communications card. All inputs pass the ANSI/IEEE C37-90A-1989 tests for withstanding surge and fast transient.

The following sections describe configuration instructions and wiring requirements for direct connection to a master computer station.

The communications card is shipped with a label affixed to the mounting plate indicating the communications mode (RS-485 or RS-232) set at the factory. If the mode is incorrect for your application, refer to the following section for changing the configuration.

3.1 Configuring the Communications Card

This section describes how to change the communications mode of the 4700 communications card. You can select RS-232 or RS-485 lines by switching a jumper block on the card. The presently selected communications mode may be viewed from the power meter front panel, or by removing the card and examining the position of the jumper block. (See **Chapter 5, Operator Interface** for instructions on how to use the power meter front panel to display the communications mode.)

To remove the card for configuration:

1. Turn off the power to the 4700 power meter.
2. Remove the four machine screws holding the rectangular communications card mounting plate to the 4700 power meter case back cover.
3. Carefully pull the plate away from the main chassis to remove the card.

To configure the card:

The circuit board of the communications card has a jumper labelled J1. This jumper has two positions, labelled "RS485" and "RS232," which determine the communications mode. **Figure 3.1** illustrates the jumper position required for RS-485 or RS-232 mode. Move the jumper to the correct position.

To re-install the card:

1. Make sure that the power to the 4700 power meter is off.
2. Insert the communications card into the 4700 power meter, ensuring that the circuit card is oriented such that it will mate properly with the edge connector on the main board inside the 4700 power meter.

   Note: The card is polarized (keyed) to ensure it may only be installed in the correct orientation.

3. Align the holes in the mounting plate of the card with the mounting holes in the rear cover of the main chassis while lowering the card toward its seating. A correct alignment will allow the card edge to mate with the edge connector inside the main chassis.
4. Once the board is resting in proper alignment on the edge connector, carefully press down to plug the card into the edge connector.
5. Install the four mounting screws into the mounting plate to secure the card.

The card is now ready for use.

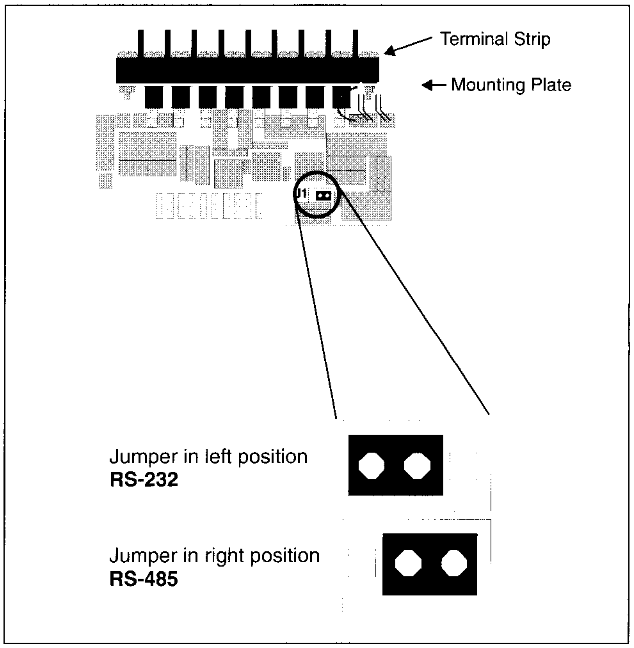


Figure 3.1 Communications Card Jumper Configuration

3.2 Terminal and LED Indicator Functions

The optional communications card provides a barrier-style terminal strip (see **Figure 3.2**). Terminal functions include:

Ground	GND	Chassis Ground
RS-485	SHLD	RS-485 Shield (electrically connected to chassis ground)
	-	RS-485 Data Minus
	+	RS-485 Data Plus
RS-232	RXD	RS-232 Receive Data (that is, receive data into device)
	TXD	RS-232 Transmit Data (that is, transmit data out of device)
	SG	RS-232 Signal Ground
	RTS	RS-232 Request To Send

Two LED indicators, TXD and RXD, show activity on the RS-232 or RS-485 communications lines and can be used to verify correct communications operation. The TXD indicator flashes when data is being sent out by the device. The RXD indicator flashes when data is being received by the device.

The 4700 power meter supports 19.2 Kbaud operation. This applies to both RS-232 and RS-485 standards.

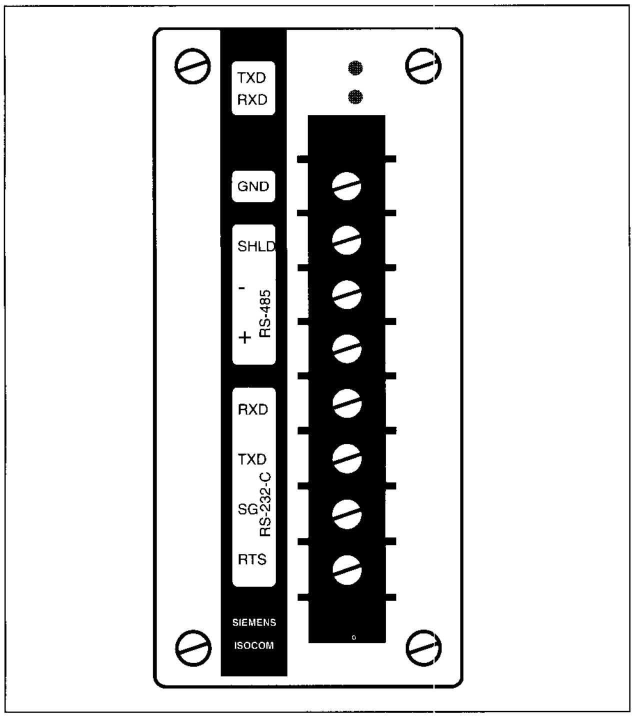


Figure 3.2 Communications Card Terminal Block

3.3 RS-232 Connections

Figure 3.3 illustrates the wiring requirements for connection of the 4700 power meter using RS-232 communications. This can include a local direct connection to a computer or other device, or a remote connection via modem.

> **Note:** For information on remote connections via modem (telephone, fiber optic, radio, and so on), contact Siemens for a detailed application note.

The RS-232 standard allows only a single point-to-point communication connection. Using this method, only one RS-232 equipped device may be connected to the serial port of the computer, modem, or other device.

The cable used between the computer and the modem (if used) is a standard RS-232 communications cable with a maximum length of 50 feet (15.2 meters). Refer to the installation manuals for each device for cable requirements.

The cable used between the computer or modem and the 4700 power meter is a custom RS-232 cable. One end is equipped with a DB-25 or DB-9 plug (male) or socket (female) connector. The connector required depends on the mating computer or modem serial port connector. The other end of the cable consists of discrete wires which connect to the RS-232 terminals of the communications card of the 4700 power meter. Cable length is 50 feet (15.2 meters) maximum.

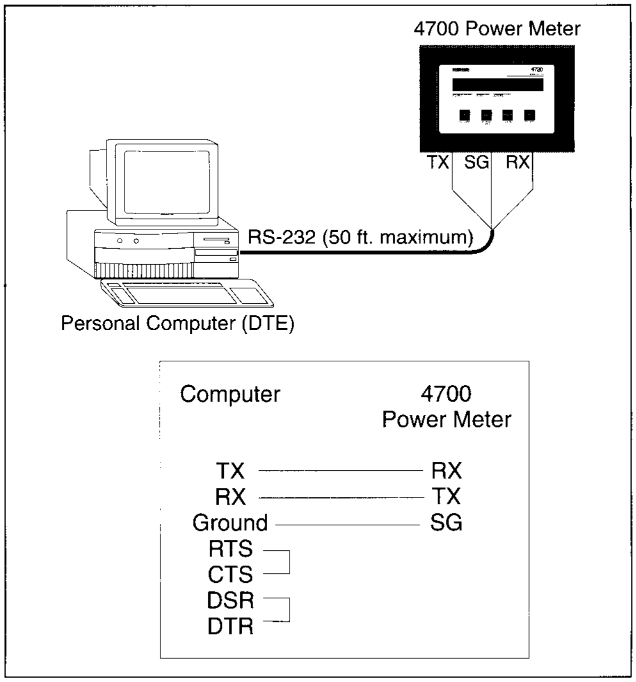
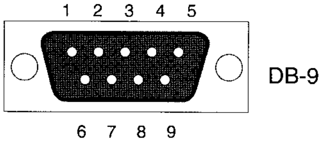
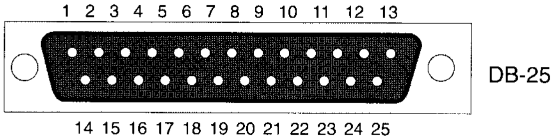


Figure 3.3 RS-232 Communications Connections



(Seen From Computer)

Pin	Computer (DTE)
1	RLSD
2	RX
3	TX
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	RI



(Seen From Computer)

Pin	Computer (DTE)	Isolated Multi-Drop Converter
1	Ground	Ground
2	TX	RX
3	RX	TX
4	RTS	RTS
5	CTS	CTS
6	DSR	DSR
7	Ground	Ground
8	RLSD	RLSD
20	DTR	DTR
22	RI	RI

Figure 3.4 RS-232 Cable Wiring Specifications

Figure 3.3 and **Figure 3.4** illustrate the RS-232 cable configurations and wiring connections.

If connected directly to a computer's RS-232 port, the TXD and RXD leads may need to be reversed at the remote device, depending on whether the PC RS-232 port is configured as DCE or DTE.

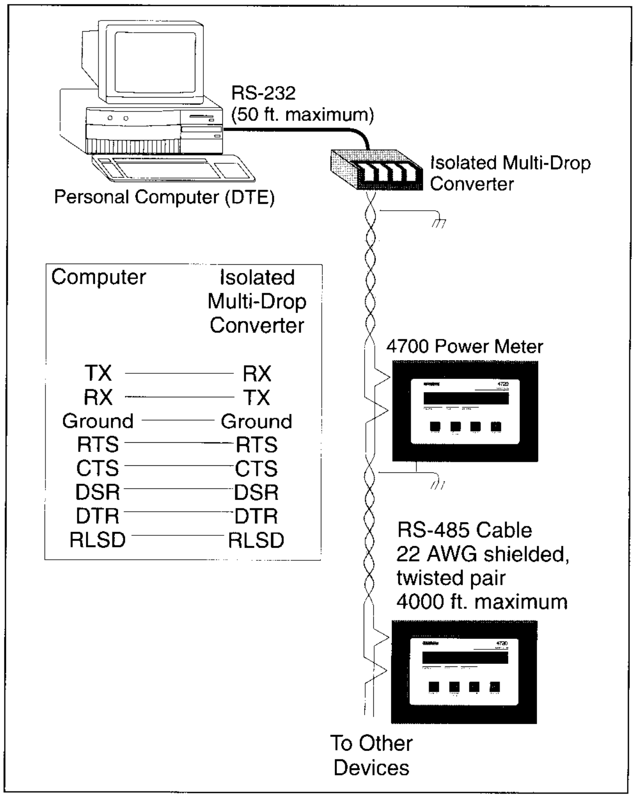
3.4 RS-485 Connections

RS-485 communications allow multiple devices to be connected on the same bus (see **Figure 3.5**). Up to 32 devices can be connected on a single RS-485 bus which consists of a shielded twisted pair cable. The overall length of the RS-485 cable connecting all devices cannot exceed 4000 feet (1220 meters).

To connect an RS-485 communications bus to a computer or other RS-232 equipped device, an RS-232 to RS-485 converter is required, such as the Siemens Isolated Multi-Drop™ converter. The Isolated Multi-Drop converter offers four RS-485 ports that can each support up to 32 devices.

Devices connected on the bus, including the 4700 power meter converter(s), and other instrumentation, must be wired as follows:

1. Use a good quality shielded twisted pair cable for each RS-485 bus. It is recommended that 22 AWG (0.6 mm) or larger conductor size be used.
2. Ensure that the polarity is correct when connecting to the RS-485 port (+) and (-) terminals of each device.



Computer	Isolated Multi-Drop Converter
TX	RX
RX	TX
Ground	Ground
RTS	RTS
CTS	CTS
DSR	DSR
DTR	DTR
RLSD	RLSD

Figure 3.5 RS-485 Communications Connections

3. The shield of each segment of the RS-485 cable must be connected to ground at one end only.

   Note: Do not connect ground to the shield at both ends of a segment. Doing so allows ground loop currents to flow in the shield, inducing noise in the communications cable.

4. It is recommended that an intermediate terminal strip be used to connect each device to the bus. This allows the easy removal of a device for servicing if necessary.

5. Cables should be isolated as much as possible from sources of electrical noise.

Devices on an RS-485 bus are connected in a point-to-point configuration with the (+) and (-) terminals of each device connected to the associated terminals on the next device.

4 Optional Wiring

In addition to current and voltage inputs, the 4700 power meter has connections for status and auxiliary voltage inputs, control relays, and auxiliary current outputs. These additional connections add to the functionality of the meter.

4.1 Status Inputs

This section describes and illustrates wiring connection methods and applications for the status inputs. **Section 6.6** in **Chapter 6** describes the operation of the status inputs.

The 4700 power meter uses a current-sensing technique to monitor the status of an external dry contact or the presence of an external voltage as described in the following sections.

⚠ CAUTION

1. For this application, the SCOM terminal *must* be connected to a suitable supply voltage. Do not leave the SCOM terminal floating.
2. Normally, up to 277 V is present at the S1 to S4 terminals, depending on the external supply voltage.

4.1.1 Dry (Volts Free) Contact Sensing

Dry contact sensing is performed using external excitation as illustrated in **Figure 4.1**. External excitation is provided via the SCOM terminal. A 20 to 277 VAC/VDC external power source is required. Various possibilities include:

a. An auxiliary 24 VDC power supply

b. A 24 to 277 VAC transformer with fused output

c. Direct 120 VAC or 240 VAC fused power

When the external contact is open, there is no current flow and the status input registers INACTIVE. When the external contact closes, the current flow from the external supply causes the status input to register ACTIVE.

Note: The maximum pulse count for the S1 counter is 65,533 before rollover occurs.

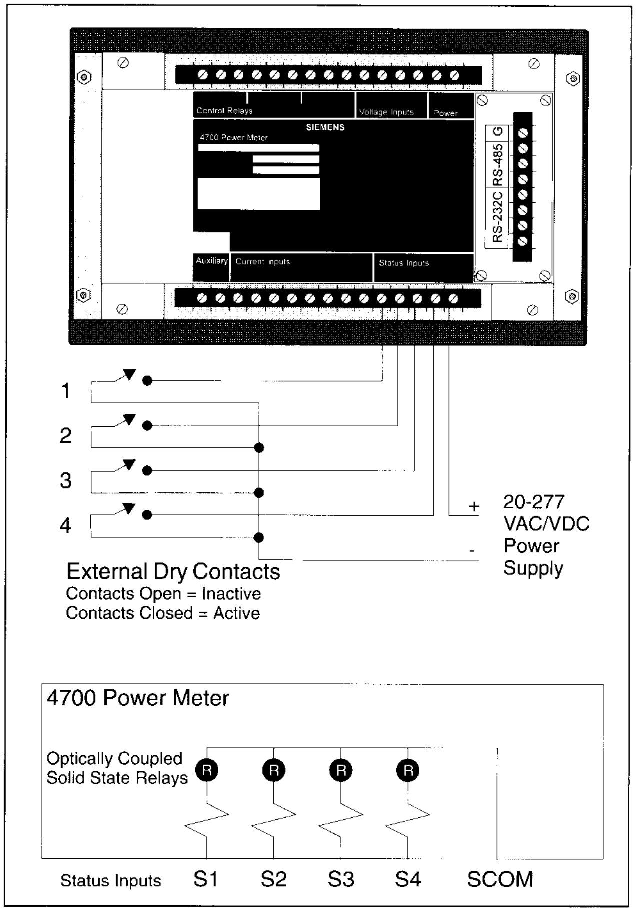


Figure 4.1 Status Input Connections (Dry Contact Sensing)

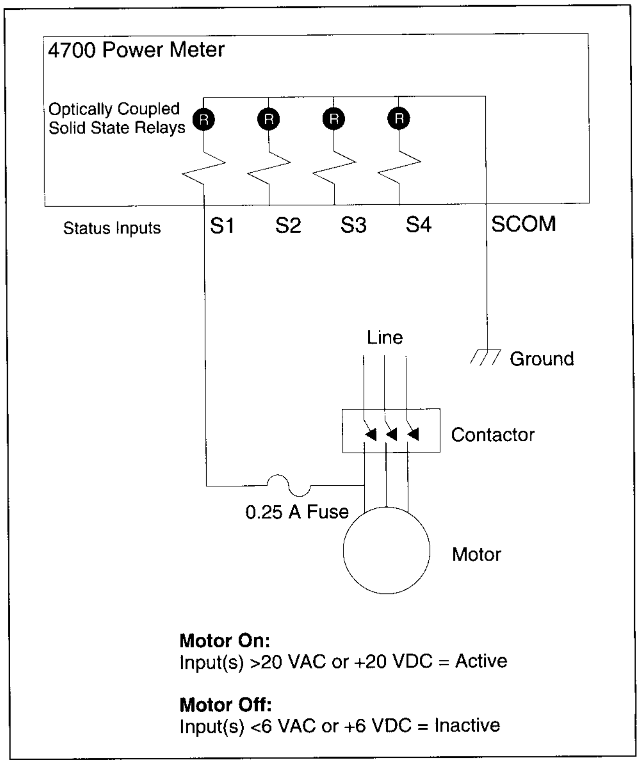
4.1.2 Voltage Sensing

Status inputs can sense the presence or absence of voltage on a power feeder. You can monitor whether a piece of equipment, such as a motor, is energized (see **Figure 4.2**).

When the motor is on, there is voltage at the sense point, and the status input registers ACTIVE. When the motor is off, there is no voltage at the sense point, and the status input registers INACTIVE.

⚠ CAUTION

In addition to the above precautions, this arrangement should *only* be used for 4-wire wye systems operating at 277/480 V or less.



Motor On:
Input(s) >20 VAC or +20 VDC = Active

Motor Off:
Input(s) <6 VAC or +6 VDC = Inactive

Figure 4.2 Status Input Connections (Voltage Sensing)

4.2 Control Relay Connections

The 4700 power meter provides 3 Form C electromechanical control relays. **Figure 4.3** illustrates the wiring connection requirements for the control relays. Refer to **section 6.4** in **Chapter 6** for more information on operating the relays.

4.2.1 Relay Application Precautions

In applications where the relays are used to perform crirical equipment control operations, such as breaker trip, the important precautions described below should be followed.

6. Connection to the external equipment should be made via an intermediate mechanism that allows relay control to be completely disabled for commissioning and servicing.

   The example shown in **Figure 4.3** forces the normally on load on, and the normally off load off when the relays are disabled.

7. Following initial power up, the 4700 power meter should be programmed (see **Chapter 6**), including all required setpoints for setpoint controlled relay operations (see **Chapter 7**).

8. The relay outputs of the 4700 power meter should be tested to ensure that setpoint or manual control conditions are occurring as expected.

9. Once correct relay operation has been verified, relay control of the external equipment can be enabled.

⚠ WARNING

Hazardous voltages and currents are present.

Can cause death, serious personal injury, or equipment damage.

Do not use the power meter as a primary protection device.

Primary Protection

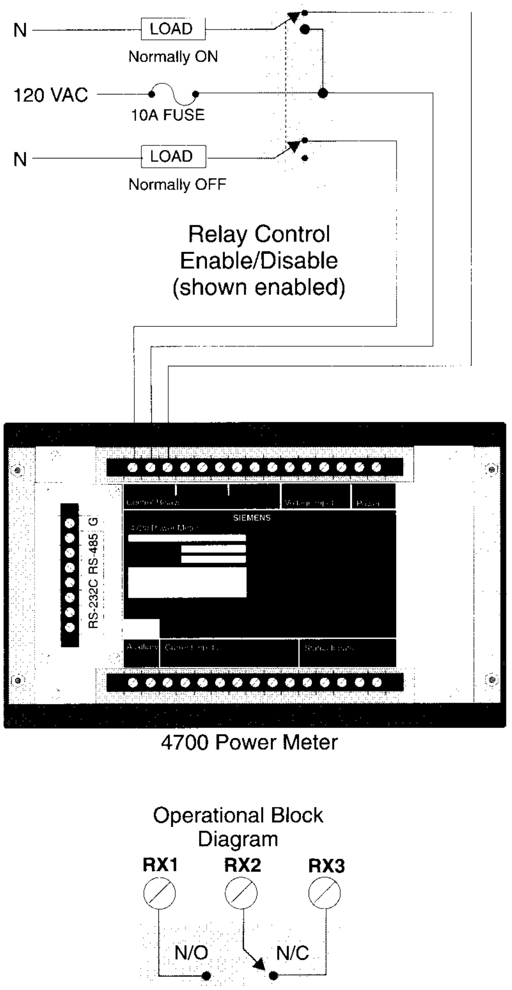
The relays of the 4700 power meter should not be used for primary protection functions. These include applications where the device would be providing:

- Overcurrent protection on circuit breakers.
- Protection of people from injury. If failure of the device can cause injury or death, the 4700 power meter should not be used.
- Energy limiting. If failure of the device will cause sufficient energy to be released that a fire is likely, the 4700 power meter should not be used. In electrical systems, energy limiting is normally provided by circuit breakers or fuses.

Secondary Protection

The 4700 power meter can be used for secondary (that is, backup) protection functions. Secondary protection includes:

- Situations where the 4700 power meter is backing up a primary protection device (shadow protection), such as an overcurrent relay.
- Situations where the 4700 power meter is protecting equipment, not people. This typically includes applications such as over/under voltage, reverse power flow, and so on.



State:	Rx1/Rx2	Rx2/Rx3
Inactive	Open	Closed
Active	Closed	Open
Pulse	Closed for Duration of Pulse	Open for Duration of Pulse

Notes:

1. Relays are Form C dry contact rated at 277 VAC or 24 VDC at 10 Amps.
2. Only relevant 4700 power meter terminal block connections are illustrated.

Figure 4.3 Control Relay Connections

4.3 Auxiliary Voltage Input

Figure 4.4 illustrates two possible wiring connection methods and applications for the V_{AUX} input. **Section 6.3.1** in **Chapter 6** describes the operation of this input.

> **Note:** V_{AUX} is a non-isolated input. If full isolation is required, use an intermediate isolation transducer.

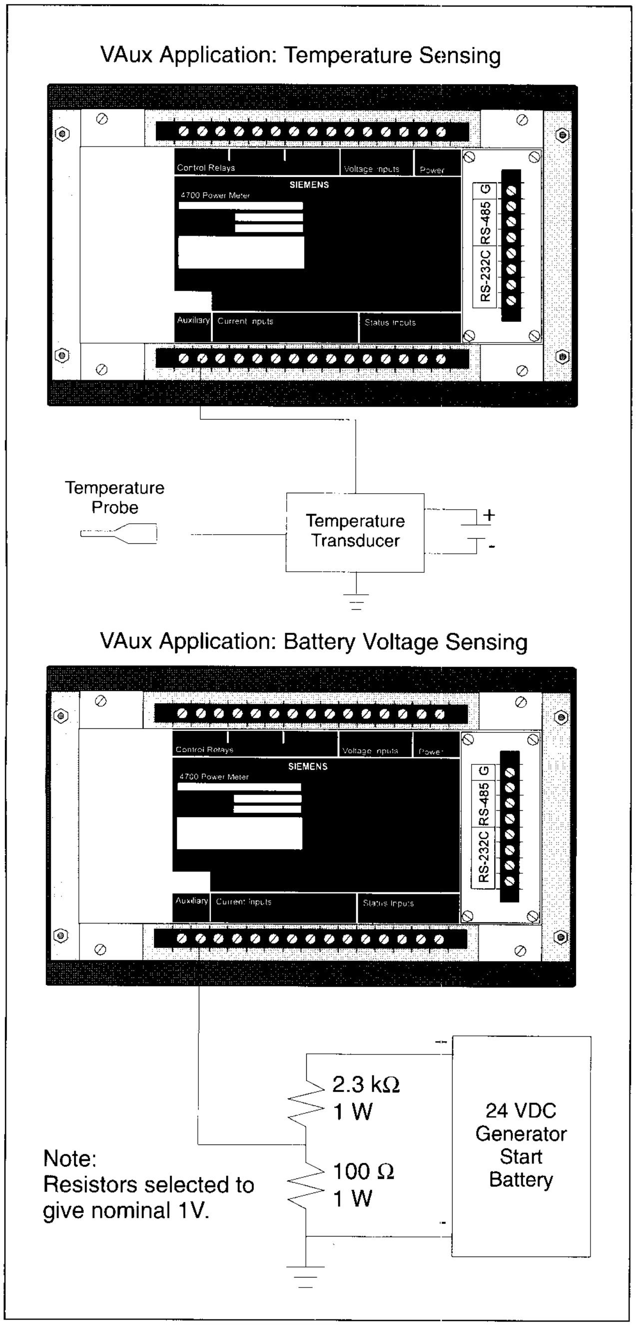


Figure 4.4 Auxiliary Voltage Input Connections

4.4 Auxiliary Current Output

Figure 4.5 illustrates two possible wiring connection methods and applications for the I_{OUT} output. **Section 6.3.2** in **Chapter 6** describes the operation of this input.

> **Note:** I_{OUT} is a non-isolated input. If full isolation is required, use an intermediate isolation transducer.

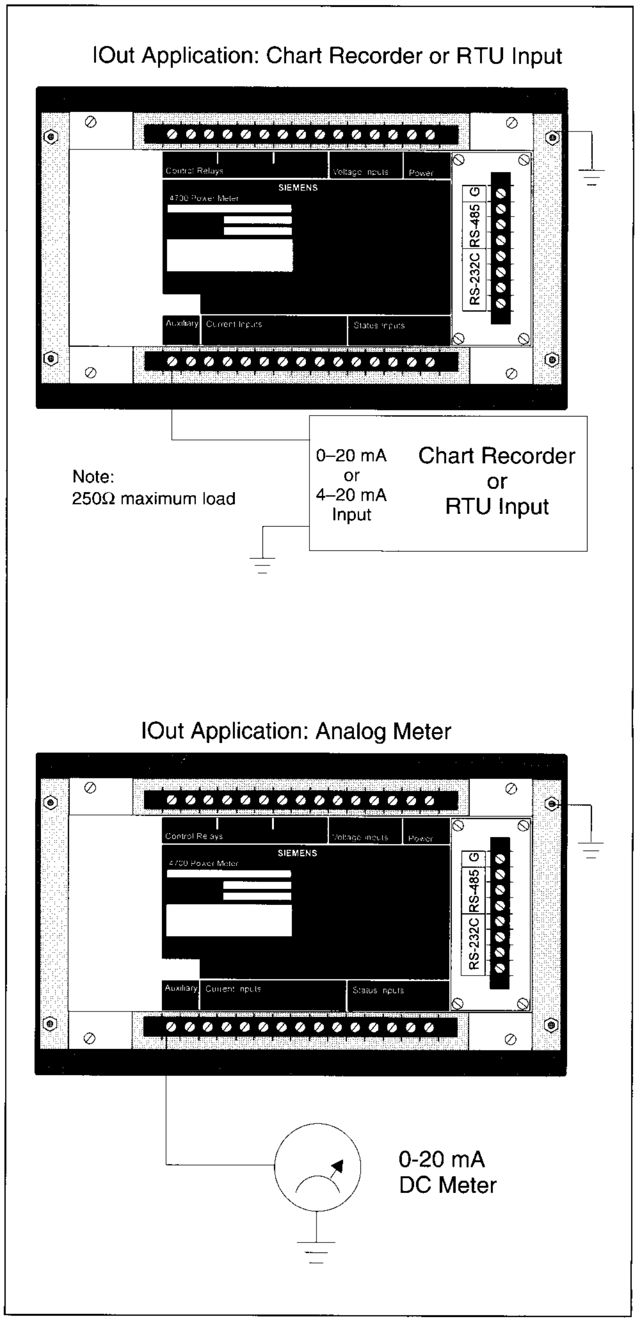


Figure 4.5 Auxiliary Current Output Connections

5 Operator Interface

This chapter describes the following:

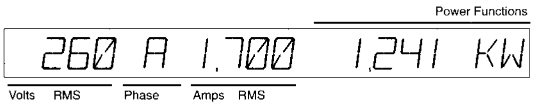
- Power-up procedure
- Front panel operation and display mode

For a description of the 4700 power meter programming mode and instructions on how to program the meter, refer to **Chapter 6, Programming**.

5.1 Start Up

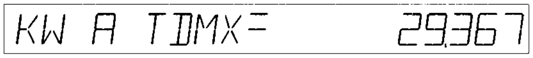
After all installation wiring is complete and has been double checked, the unit may be powered up by applying the appropriate voltage to the power input terminals.

The 4700 power meter first enters its display mode, presenting Volts-Amps-Power Function. The power function displayed on power up is kW average, totalled for all phases (see **Figure 5.1**). The values initially appearing may not be correct, since the unit has not been properly programmed with the correct information. Refer to **Chapter 6, Programming**, for instructions on how to program the meter.



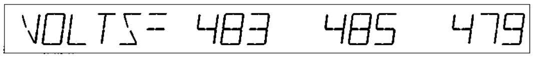
Standard Phase Display

Indicates 260 Volts, 1700 Amps, and 1241 kW for Phase A .



Full Width Display

Indicates 29.4 MW for phase A, thermal demand, maximum.



Three Phase Display

Indicates 483 Volts, phase A, 485 Volts, phase B, and 479 Volts, phase C.

Figure 5.1 Front Panel Display Modes

5.2 Front Panel Operation

The 4700 power meter provides a unique and very flexible user interface. One of its front panel features is the large, high-visibility, 20-character vacuum fluorescent display. The other feature is the row of four long-life, stainless steel membrane buttons for parameter selection and local programming functions. See **Figure 5.2** for an illustration of the front panel of the 4700 power meter.

The display can present a wide variety of information in many different formats. Readings of up to nine digits including any floating point decimals can be displayed. The type of information and formats available are described below.

5.2.1 Standard Phase Display

The front panel display (on power up) presents volts, amps and power function for the selected phase. The Phase button is used to advance through each phase in sequence, while a selection of power functions can be accessed using the Function button. The format of the phase labels and numeric readings can be programmed to conform to international conventions (see **section 6.3.3**).

5.2.2 Full Width Display

Very large measured values (for example, kW hr) and parameters with large display labels are presented using the entire display.

> **Note:** While viewing a full-width display, press the Phase button to return to the standard Volts-Phase-Amps display.

5.2.3 Three-Phase Displays

Concurrent display of readings for all three phase voltages or currents is possible.

5.2.4 Phase Button

The Phase button selects the phase for which the volt and amp values are displayed. The asterisk (*) symbol indicates the average volts and amps values are being displayed.

- If VOLTS MODE = 4W-WYE, the Phase button steps through all line-to-neutral values, the line-to-neutral average, and all line-to-line values. The line-to-line values are displayed with a comma following the phase indicator (for example, A,).
- If VOLTS MODE = DELTA, the Phase button steps through all line-to-line values for all the phases, and also gives the average of the three phases.
- If VOLTS MODE = SINGLE, the Phase button steps through the sequence: A, B, L. An A indicates voltage and current for the A phase. The B indicates voltage and current for the B phase. An L indicates the line-to-line voltage, and also the average of the two line currents.

5.2.5 Function Button

A preset list of useful power function parameters is available via the Function button. Press the Function button to advance through each measured parameter.

For per-phase values displayed using the Function button, the Phase button can be used to advance the display through each phase.

The following is the complete sequence of power function parameters accessible using the Function button:

- kW per phase
- kVAR per phase
- kVA per phase
- Power Factor per phase
- Current I4
- Frequency (phase A)
- kW demand
- Amp demand
- Voltage V_{AUX}
- kW hours
- kVAR hours

5.2.6 Minimum and Maximum Buttons

The Minimum and Maximum buttons display the minimum and maximum values of volts, amps, and power functions as indicated in the list below. Min/Max values are displayed for three seconds before the real-time display returns. The values displayed are minimums and maximums logged since the last CLEAR MAX/MIN? function (see **Table 5.1**).

Table 5.1 Display Labels for Minimum/Maximum Values

Function	Label
kilowatts	KW (MW)
kilovolt-amperes	KVA (MVA)
kilovolt-amperes (reactive)	KQ
power factor	PF
frequency	HZ
kilowatt-demand	KWD (MWD)
amperes-demand	AMD
volts (V_{AUX})	VX
fourth current input	I4
kilowatt-hours	KWHRS
kilovolt-ampere (reactive) hours	KVARHRS

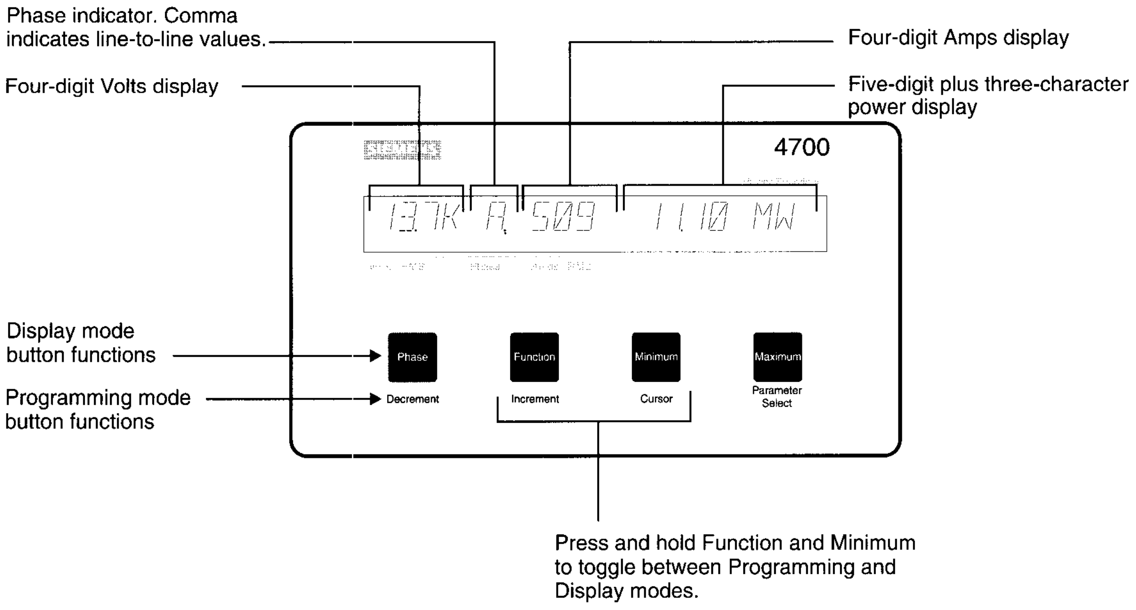


Figure 5.2 Front Panel Buttons

5.3 Power Reading Polarities

Figure 5.3 illustrates how the 4700 power meter interprets and displays signed (positive or negative) values for power, energy import or export indication, and leading or lagging indication of power factor.

The polarity of energy import or export can be reversed by reversing the polarity of the CTs connected to the power meter.

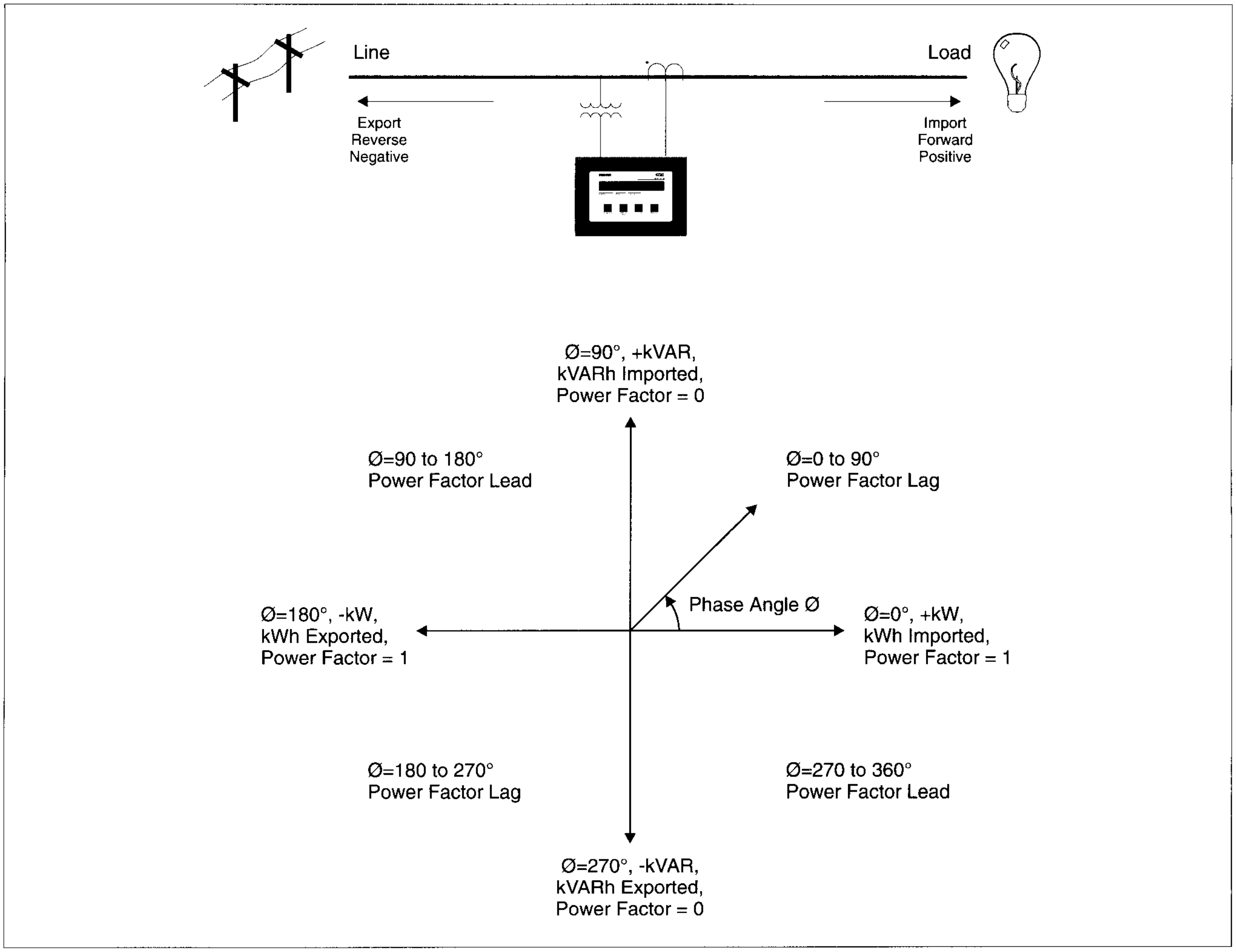


Figure 5.3 Power Reading Polarity Conventions

Notes:

6 Programming

Basic device programming can be performed quickly and easily from the front panel (called *local programming*) or via the communications port using a portable or remotely located computer. Basic setup parameters include scaling factors for the voltage and current inputs, and the voltage mode (wye, delta, and so on). Setup and other critical information are stored in nonvolatile memory and are not lost if power to the unit is turned off. All programming is password protected.

WinPM software fully supports 4700 power meter programming, providing a number of parameter screens which make setup quick and easy. (The open communications protocol of the 4700 power meter also allows free access to all programming parameters using any compatible third-party system.)

A complete list of all programmable setup parameters is provided in **section 6.9**.

This manual describes procedures for programming the 4700 power meter from its front panel only. For information on programming via communications using WinPM software, refer to the documentation for WinPM.

6.1 Programming Mode

To program the setup parameters of the 4700 power meter from the front panel, the meter must be in programming mode. Enter programming mode by pressing the Function and Minimum buttons at the same time (see **Figure 6.1**). The front panel displays "PROGRAMMING MODE." Avoid pressing the Function button by itself because this will alter the selected parameter.

To return to display mode, press the Function and Minimum buttons again.

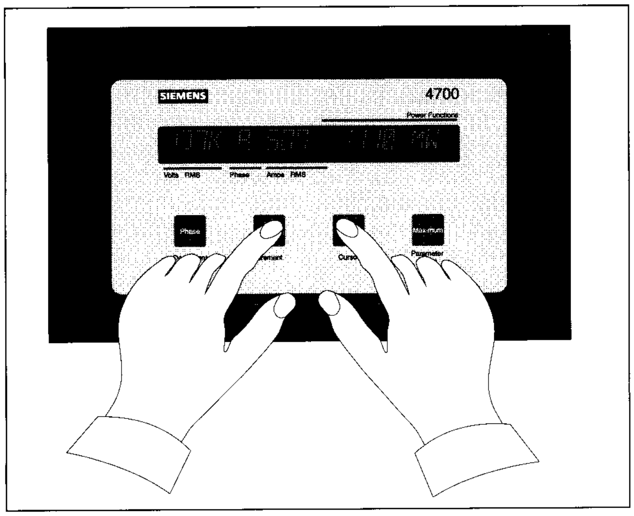


Figure 6.1 Entering Programming Mode

6.1.1 Programming Button Functions

In programming mode, the front panel buttons assume new programming functions. The label below each button indicates its alternate function. For example, the Maximum button used in display mode changes to the Parameter Select button in programming mode.

Parameter Select
: Selects which parameter is displayed. When displaying available parameters, the list wraps around to the beginning when the end is reached. If you miss a displayed parameter, press the Parameter Select button until the one you want comes back around.

Cursor
: Moves the cursor left one digit. The cursor position wraps around to the right of the number if advanced past the left-most digit.

Increment
: Increments the digit at the cursor, advances through a number of preset values, or toggles a yes/no option.

Decrement
: Decrements the digit at the cursor, advances through a number of preset values in reverse order, or toggles a yes/no option.

6.1.2 Entering the Password

At shipping, the 4700 power meter password is set to zero (0). In programming mode, press the Parameter Select button until the PASSWORD parameter appears. Enter the password using the Cursor and Increment buttons. You must enter the password to change any parameter values, although you can view them on the front display panel at any time. You can also change the password as described in the next section. If the password is lost or forgotten, contact Siemens customer service.

6.1.3 Changing the Password

To change the password, use the following procedure.

1. Enter programming mode by pressing and holding simultaneously the Function and Minimum buttons (see **Figure 6.1**).
2. Press Parameter Select until the PASSWORD parameter appears. Enter the current password using the Cursor and Increment buttons.
3. Press Parameter Select repeatedly until the PASSWORD parameter appears again.
4. Enter the new password using the Cursor and Increment buttons.
5. Return to display mode. The new password is now in effect.

6.1.4 Skipping Over the Setpoint Parameters

If the SETPOINT NUM parameter is 00, and the Parameter Select button is pressed, the setpoint parameters are passed over.

6.2 Basic Settings

The VOLT SCALE and AMPS SCALE parameters of the 4700 power meter must correspond with the full scale levels that are to be measured. The scale is the value the meter displays when the input is at full scale.

Figure 6.3 and **Figure 6.4** show a step-by-step example of how to program the operating parameters from the front panel. The example given shows how to set the VOLTS MODE to DELTA, the VOLT SCALE to 277, and the AMPS SCALE to 2000.

6.2.1 Volt Scale

In a direct connect configuration, the VOLT SCALE is normally set to 120 for a 120 VAC system, 277 for a 277 VAC system, or 350 for a 350 VAC system. If VTs are used for connection to higher voltage systems (using a 120 VAC model), then set the VOLT SCALE to the primary rating of the VT. Note that this applies only if the VTs' secondaries are rated at 120 VAC. If not, then the following formula is used to determine the required VOLT SCALE:

$$\text{VOLT SCALE} = \frac{\text{VT Primary Rating x 120 VAC}}{\text{VT Secondary Rating}}$$

6.2.2 Amps Scale

Set the AMPS SCALE to the primary rating of the CTs used. This applies only if the CTs are rated for a 5 A full scale output. If not, the following formula is used to determine the required AMPS SCALE:

$$\text{AMPS SCALE} = \frac{\text{CT Primary Rating x 5A}}{\text{CT Secondary Rating}}$$

Note: The fourth CT secondary rating must equal the phase CTs.

6.2.3 Volts Mode

Set the VOLTS MODE according to the system connection configuration. Refer to **Chapter 2, Installation**, and to **Figure 2.2** through **Figure 2.7** for more information.

The VOLTS MODE options are:

4W-WYE, DELTA, SINGLE, DEMO

6.3 Additional Settings

6.3.1 Auxiliary Voltage Input Operation

The 4700 power meter uses an auxiliary voltage input that allows measurement and display of an external voltage (1 VAC/VDC nominal, 1.25 VAC/VDC maximum). The VAUX SCALE parameter specifies what the meter displays with a 1.000 VAC_{RMS}/VDC full scale input applied.

Note that this 1 V input differs from the 120 V input for V1, V2 and V3.

6.3.2 Auxiliary Current Output Operation

The 4700 power meter can include an analog current output, which is programmable to deliver a current proportional to any measured parameter. Maximum load on the current output is 250Ω resistive. The current output is set in programming mode. You must set the following parameters:

I OUT KEY

This label specifies the measured parameter for which the current output is proportional. **Table 6.2** shows the labels for I OUT KEY corresponding to each measured parameter.

I OUT SCALE

This value specifies the indicated value for the full scale output of I_{OUT}.

I OUT RANGE

This value indicates whether the output mode is 0 to 20 mA or 4 to 20 mA.

I OUT RANGE = 0	indicates 0 to 20 mA
I OUT RANGE = 1	indicates 4 to 20 mA

IOUT POWER FACTOR

Since the scale for Power Factor is essentially two 0.0-1.0 scales (one for leading and one for lagging), the meter must combine these into one scale. To do this, the meter represents the entire Power Factor scale as 0-200, where 0 is 0.0 lagging and 200 is 0.0 leading (see **Figure 6.2**).

The 4700 power meter allows the I_{OUT} scale to be customized so that the top end (20mA) can be programmed to any value on the 0-200 scale, and the bottom end (0mA) is fixed to 0. In **Figure 6.2**, 4mA is set to 50 (which is 0.50 lagging), and 20mA is set to 100 (which is 1.00, or unity).

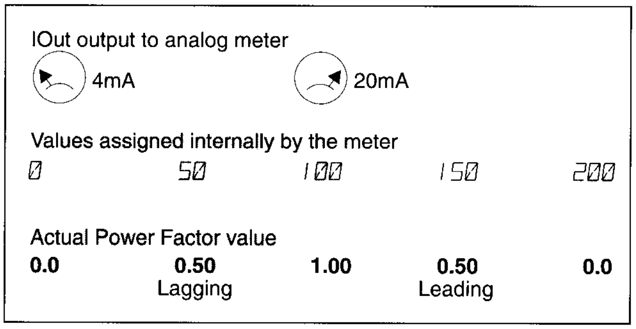
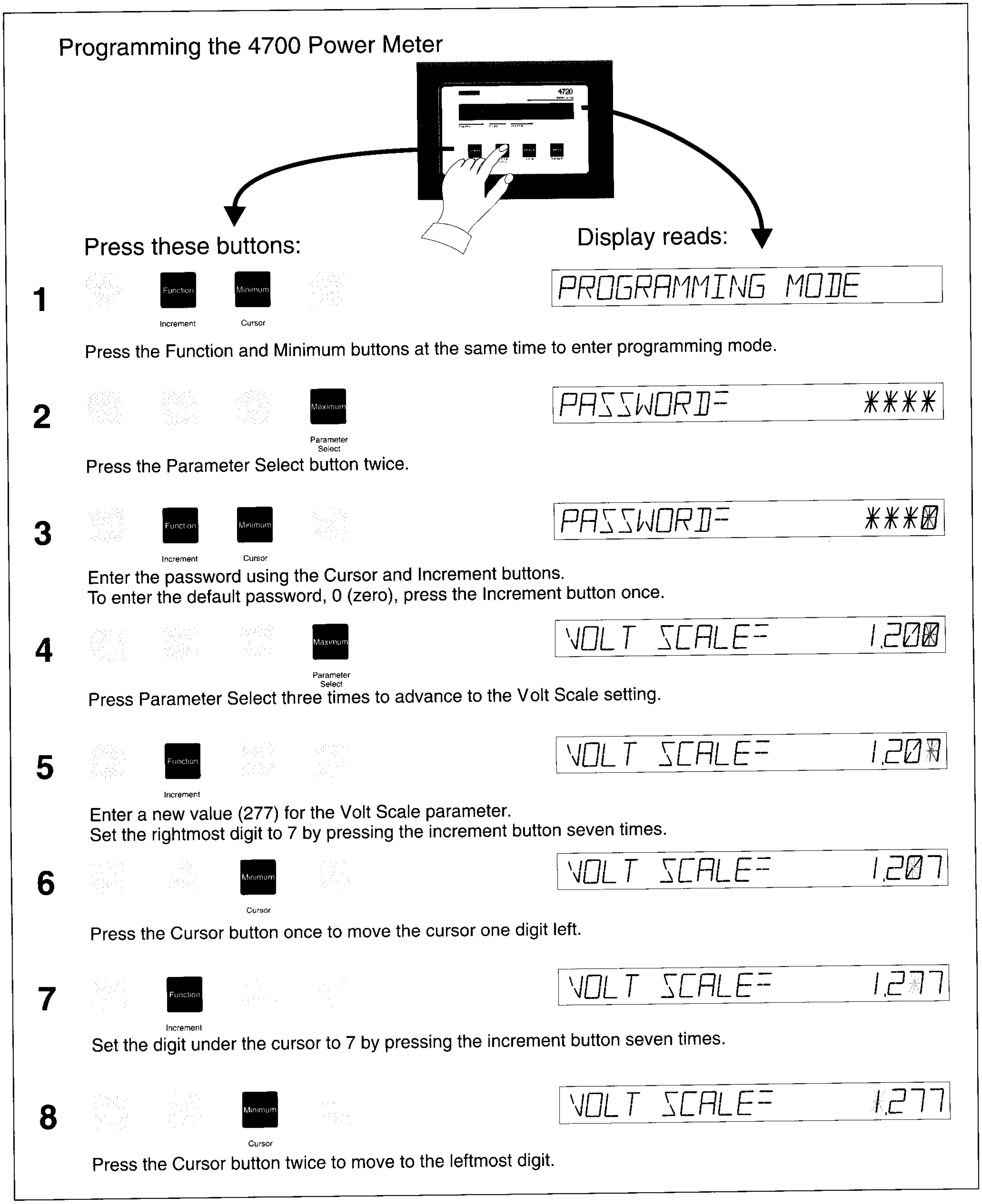


Figure 6.2 Power Factor Scale Representation



Programming the 4700 Power Meter

Press these buttons:

Display reads:

1 Press the Function and Minimum buttons at the same time to enter programming mode.

2 Press the Parameter Select button twice.

3 Enter the password using the Cursor and Increment buttons.
To enter the default password, 0 (zero), press the Increment button once.

4 Press Parameter Select three times to advance to the Volt Scale setting.

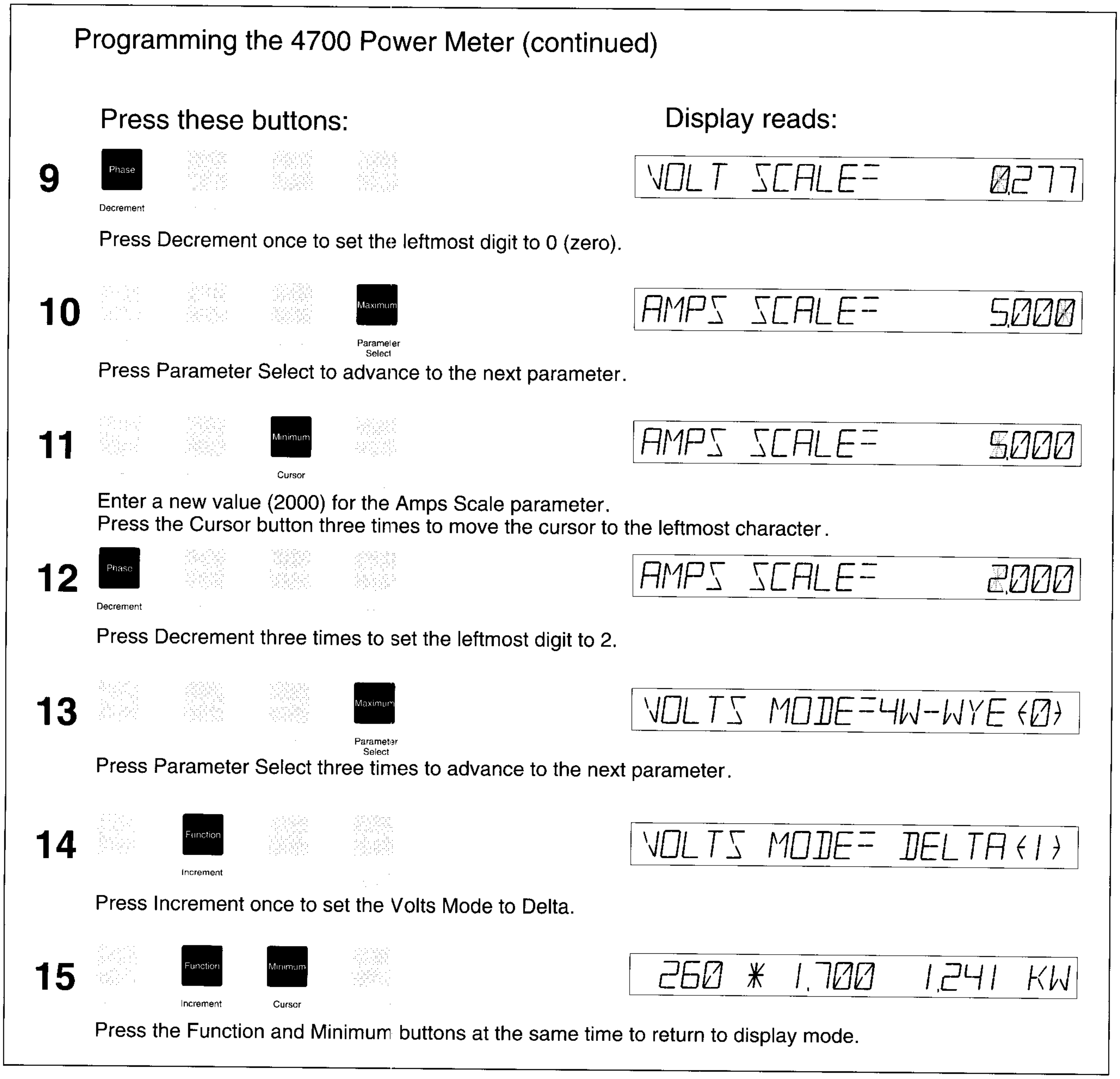
5 Enter a new value (277) for the Volt Scale parameter.
Set the rightmost digit to 7 by pressing the increment button seven times.

6 Press the Cursor button once to move the cursor one digit left.

7 Set the digit under the cursor to 7 by pressing the increment button seven times.

8 Press the Cursor button twice to move to the leftmost digit.

Figure 6.3 Step-by-Step Example Showing How to Program Locally (Steps 1-8)



Programming the 4700 Power Meter (continued)

Press these buttons: / Display reads:

9 Decrement — VOLT SCALE= 0.277

Press Decrement once to set the leftmost digit to 0 (zero).

10 Parameter Select — AMPS SCALE= 5.000

Press Parameter Select to advance to the next parameter.

11 Cursor — AMPS SCALE= 5.000

Enter a new value (2000) for the Amps Scale parameter.
Press the Cursor button three times to move the cursor to the leftmost character.

12 Decrement — AMPS SCALE= 2.000

Press Decrement three times to set the leftmost digit to 2.

13 Parameter Select — VOLTS MODE=4W-WYE (0)

Press Parameter Select three times to advance to the next parameter.

14 Increment — VOLTS MODE= DELTA (1)

Press Increment once to set the Volts Mode to Delta.

15 Increment, Cursor — 260 * 1.700 1.241 KW

Press the Function and Minimum buttons at the same time to return to display mode.

Figure 6.4 Step-by-Step Example Showing How to Program Locally (Steps 9-15)

6.3.3 Display Format

The front panel display can present numeric information and phase labels in formats that reflect various world standards.

The FORMAT parameter allows the user to select formats for numeric information and phase labels. This parameter is displayed as:

FORMAT= ABC 1,234.5

The three-letter prefix specifies the phase labels. The possible values are ABC (default), XYZ, RBY and RST.

The five-digit integer specifies the display numbers. The formats for possible values are:

a. A comma for the thousands delimiter (radix) and a decimal point for the decimal delimiter. Example: 1,234.5 This is the default.

b. No thousands delimiter and a comma for the decimal delimiter. Example: 1234,5

The Cursor button cycles between the phase label parameter and display number parameter. The Increment or Decrement buttons modify the values for selected parameters.

6.4 Control Relay Operation

The 4700 power meter contains three control relays (R1 to R3), which can be used for a variety of purposes, such as activation of alarms or load control. Each relay can switch AC loads of up to 120 VAC, and DC loads of up to 24 VDC at 10 A. Remote operation of each relay is via the communications port.

The relays are also manipulated by setpoints on selected measured parameters. Setpoint operation is described in detail in **Chapter 7, Using Setpoints**.

Another use for the control relays is for kVARH and kWH pulsed output. See **section 6.4.4** for more information.

Section 4.2 in **Chapter 4** shows wiring requirements for the control relays.

6.4.1 Control Relay Modes

You can assign each of the three relays to setpoint operation in latch or pulse mode, or to kVARH or kWH pulsing.

6.4.2 Access to Relay Parameters

The RELAY OPERATION parameter accesses the relay parameters, and also allows you to select which relay to program. Selecting a value of 0 (zero) skips all relay parameters when Parameter Select is pressed. Selecting 1, 2, or 3 accesses the programmable parameters for the selected relay.

6.4.3 Setpoint Relay Operation

For setpoint operation, the relays function in latch or pulse mode. In latch mode, the relay operates for the duration that the assigned setpoint is active (normally open contacts are closed). In pulse mode, when the setpoint is active, the relay operates for a specific pulse duration.

Set Rx MODE to SETPOINT for setpoint operation. Set Rx VALUE to latch mode (Rx VALUE = 0), or to pulse duration (in seconds) for pulse mode operation.

Note: While you are programming the 4700 power meter via the front panel or communications, no setpoint-controlled relay operations occur until you complete the programming sequence. The 4700 power meter then assesses the status of each setpoint and performs any required operations.

6.4.4 kVARH and kWH Pulse Operation

When a relay is configured for kVARH or kWH pulse operation, the pulses are based on the total energy imported (forward) and exported (reverse). Set Rx MODE to KVARH PULSE or KWH PULSE. In these modes, use Rx HRS/PULSE to set the number of unit-hours between pulses.

Note: A relay configured for energy pulsing will not respond to an assigned setpoint that becomes active. Maximum pulse rate for the relays is 1 pulse every 2 seconds (0.5 Hz).

6.4.5 Manual Forced Relay Operations

You can force operate or release relays by commands via the communications port. Manual forced operate and forced release commands override any present setpoint condition. Forced operate commands made via communications affect only a setpoint relay (Rx MODE = SETPOINT).

If the relay is in pulse mode (Rx VALUE > 0), a forced operate command initiates a pulse of length equivalent to the value set by the Rx VALUE parameter for that relay. This operation is recorded in the event log and indicates that the relay was pulsed. A forced release command has no effect.

If the relay is in latch mode (Rx VALUE = 0), it behaves normally for forced operate, forced release, and return to normal (return to setpoint control) commands.

See **section 6.4.7** for manual relay control special cases.

6.4.6 Relay Event Logging

For a relay assigned to setpoint operation (Rx MODE = SETPOINT), the event log records relay operations in one of two ways, depending on whether the relay is set to operate in latch or pulse mode.

a. Pulse mode (Rx VALUE > 0): The event log shows that the relay is pulsed when the setpoint becomes active. When the setpoint returns to its inactive state, the setpoint event is logged but does not indicate the relay is pulsed, since no pulse is generated.

b. Latch mode (Rx VALUE = 0): The event log records that the relay is operated (ON) when the setpoint becomes active, and is released (OFF) when the setpoint returns to an inactive state.

If the relay is configured for kVARH or kWH pulse mode, no relay operations are recorded in the event log.

6.4.7 Manual Relay Command Special Cases

If a manual forced operate command for a selected relay is received while that relay is already in a forced operated state, then the relay command is ignored and is not logged. This is also true for a forced release command sent to a relay already in a forced released state. In addition, manual relay commands sent to relays in kVARH or kWH pulse mode are not logged.

6.4.8 Relay Operation After Power Outages

When the power feed to the 4700 power meter is interrupted, even momentarily, the output relays are released. When power is restored, the meter allows a three-second settling time, then reevaluates setpoint conditions. If appropriate, the relays operate after the programmed time delays.

Any forced operated or forced released relay is released, followed by a resumption of normal setpoint operation.

6.5 Bi-Directional Energy

Energy measurements represent the KWH or KVARH sums for all three phases. Energy parameters provide three measurement modes that indicate bi-directional power flow: forward, reverse, and total. KWH and KVARH can provide all three modes.

Total energy measurements represent the sum of the absolute values of imported and exported energy. Total energy values are incremented by energy that is imported or exported.

Imported real or reactive energy is displayed with an F suffix (kWH-F, kVARH-F), indicating forward flow. Exported energy values are displayed with an R suffix (kWH-R, kVARH-R), indicating reverse flow.

Note: Only kWH-F/kWH-R and kVARH-F/kVARH-R measurements are displayed from the front panel. kWH and kVARH total values are read only via communications.

6.6 Status Input Operation

The 4700 power meter provides four optional status inputs (S1 to S4), which are used to sense the state of an external contact. If the input voltage is below 9 VAC or VDC, the input is sensed as inactive. If it is over 20 VAC or VDC, it is sensed as active.

The status of these inputs is viewed using a Power Monitor display and monitoring unit (or a computer running WinPM,SIEServe, or other supervisory software) connected to the communications port.

You can program the Status Input #4 (S4) to initiate kW Demand Synchronization. See **Chapter 8, Demand Calculation**, for more information.

The 4700 power meter maintains a counter for the Status Input #1 (S1). The counter accurately follows a maximum frequency of 0.3 Hz and can be reset to zero via the communications port. A minimum pulse width of 40 milliseconds is required for reliable sensing of status input changes.

Note: The maximum pulse count for the S1 counter is 65,535 before rollover occurs.

Section 4.1 in **Chapter 4** shows several wiring diagrams illustrating connections for the status inputs.

6.7 Fourth Current Input Operation

The 4700 power meter includes an optional fourth current input, designated I4. The input uses connections I41 and I42 on the terminal strip. The AMPS SCALE parameter sets the scaling for all four current inputs. Therefore, the CT primary rating of the I4 current input must be the same as the CT primary ratings for the three-phase current inputs (5 A nominally).

Normally, this input is used to measure current in the neutral conductor. In installations with nonlinear loads, odd harmonics can fail to cancel, producing significant currents in the neutral conductor.

The I4 reading is viewed from the front panel by pressing the Function button until displayed. It is also viewable remotely.

6.8 Waveform Capture

Digital waveform capture capabilities are used for detailed power quality analysis.

Waveform capture allows the user to perform high-speed sampling of the V1, V2, V3, V_{AUX}, I1, I2, I3, or I4 (neutral current) inputs. One full cycle of the signal at a single input is sampled at a rate of 128 samples per cycle. All samples are taken in sync with the communications line frequency, and within one input cycle.

Sampled waveform data is stored in on-board memory and is read via the communications port. The high sampling rate produces high-resolution data, which allows analysis of frequency components to the 63rd harmonic.

You can upload captured waveform data to a master computer to display the waveforms and perform Fast Fourier Transforms on them. This provides an indication of total harmonic distortion and a breakdown of individual frequency components.

From the master computer, the operator requests the capture of individually selected 4700 power meter inputs. The computer then uploads the waveform data. Waveform capture is automatically reinitiated when the 4700 power meter on-board memory is read via the communications port.

6.9 Operating Parameter Descriptions

Table 6.1 and **Table 6.2** provide a brief description of each operating parameter for the 4700 power meter. More detailed descriptions of each operating parameter are provided throughout this manual where operational features are described.

Table 6.1 Programmable Operating Parameters

Parameter	**Description**	**Range/Options**
FIRMWARE VER	Displays the software level of the 4700 power meter. *Not programmable.*	V2.xxxB
PASSWORD=	Must be entered to change the setup parameters or clear any function. You can also change the password.	0 to 9999
SETPOINT NUM	Selects a setpoint to be programmed. If set to "00", then no setpoint is selected. If no setpoints are programmed, pressing the Parameter Select button will skip directly to RELAY OPERATION. **Note:** In the parameter names below, "xx" indicates the selected setpoint number.	00 to 17
SPxx TYPE	The type of parameter the selected setpoint is to monitor (for example, OVER KW, PHASE REVERSAL, and so on).	See **Table 7.1** in **Chapter 7**
SPxx HI LIMIT	Sets the high limit for the selected setpoint.	0 to 999,999
SPxx LO LIMIT	Sets the low limit for the selected setpoint.	0 to 999,999
SPxx TD OPERATE	Sets the time delay to operate for the selected setpoint.	0 to 32,000 sec.
SPxx TD RELEASE	Sets the time delay to release for the selected setpoint.	0 to 32,000 sec.
SPxx RELAY NUMBER	Selects which one of three control relays the selected setpoint controls. Selecting "0" will select no relay. After setting this parameter, pressing the Parameter Select button will return to SETPOINT NUM.	0 to 3
RELAY OPERATION	Selects one of the three control relays to be programmed. Selecting 0 will exit control relay programming and skip directly to VOLT SCALE. **Note:** In the parameter names below, "x" indicates the selected control relay number.	0 to 3
Rx MODE	Defines the type of operation the selected relay is to perform.	SETPOINT, KWH PULSE, KVARH PULSE
Rx VALUE	For Rx MODE = SETPOINT: Specifies latch mode or sets pulse duration.	0 = latch mode 1 to 65,535 = pulse duration
Rx HRS/PULSE	For Rx MODE = KWH or KVARH PULSE: Defines the number of unit-hours between pulses.	0 to 65,535 unit-hours*
VOLT SCALE=	Sets full-scale AC input voltage. This parameter should match the VT primary rating on systems using VTs with secondary ratings of 120 VAC, or the measured phase voltage rating of the meter on systems connected directly. See **section 6.2.1**.	0 to 999,999 VAC
AMPS SCALE=	Sets full-scale AC input current. This parameter should match the CT primary rating when the secondary rating is 5 A. See **section 6.2.2**.	0 to 9,999 A

* *For Rx MODE = KWHR PULSE or KVARH PULSE, pulse duration is 1 second.*

Table 6.2 Programmable Operating Parameters (continued)

Parameter	Description	Range/Options
VAUX SCALE=	Sets full-scale auxiliary voltage input reading.	0 to 999,999 V
I4 SCALE=	Sets full-scale I4 input current. This parameter should match the AMPS SCALE parameter.	0 to 9,999 A
VOLTS MODE=	Sets volts mode.	4W-WYE, DELTA, SINGLE, DEMO
UNIT ID=	Sets the SEAbus communication address.	1 to 254
BAUD RATE=	Sets the communications baud rate.	300, 1200, 2400, 4800, 9600, 19200 Baud
COM MODE=	Displays the communications mode: RS-232 or RS-485. **Note:** This parameter cannot be changed in programming mode. See **section 3.1** in **Chapter 3** for more information.	RS232, RS485, none
DISPLAY TIMEOUT=	Sets the number of minutes before the display turns off after the last button is pressed. The recommended setting is 180 minutes.	0 = display always on 1 to 999 minutes
CLEAR MAX/MIN?	Clears the stored maximum and minimum values. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	YES, NO
CLEAR KW/KVARHRS?	Clears the stored kWH and kVARH readings. Displays "YES" to indicate the values will be cleared when the Parameter Select button is pressed.	YES, NO
DEMAND PERIOD	Selects Demand Sync mode or the length of each demand period used in calculating demand values. See **Chapter 8, Demand Calculation**.	0 = Demand Sync Mode 1 to 99 minutes
NUM DMD PERIODS=	Sets the number of demand periods averaged to calculate demand values.	1 to 15 periods
PHASE ROTATION	Specifies the normal phase sequence. This is used for PF polarity detection in delta mode and for the phase reversal detection setpoint. **Chapter 7, Using Setpoints**.	ABC, ACB
STNDRD FREQ=	Specifies the frequency of the measured power system.	50, 60, or 400
I OUT KEY=	Specifies the measured parameter for the current output.	VOLTAGE A, VOLTAGE B, VOLTAGE C, CURRENT A, CURRENT B, CURRENT C, KW A, KW B, KW C, KVA A, KVA B, KVA C, KVAR A, KVAR B, KVAR C, VOLTAGE AV, CURRENT AV, KW TOTAL, KVA TOTAL, KVAR TOTAL, PF, KW DEMAND, AMP DEMAND, FREQUENCY, VAUX, CURRENT I4,
I OUT SCALE=	Sets the scale of the current output.	0 to 999,999
I OUT RANGE=	Indicates 0-20 mA or 4-20 mA proportional current output.	0 = 0 to 20 mA 1 = 4 to 20 mA
RTS ACTIVE LVL=	Sets the RTS active level, which is used for serial communications.	LOW, HIGH
FORMAT=	Sets phase labels and decimal display formats. The Cursor button cycles between the phase label parameter and decimal display number parameter. The Increment and Decrement buttons modify the values for the selected parameters.	Phase Labels ABC, XYZ, RBY, and RST Decimal Display 1,234.5 or 1234,5

7 Using Setpoints

The 4700 power meter can monitor several measured parameters simultaneously and then generate alarms and controlling relays based on the parameter values. The meter uses predefined setpoints to activate this functionality. A setpoint is a group of six programmed parameters that tells the unit:

1. Which measured parameter to monitor (setpoint type), and activation setting of over or under the value
2. The high limit
3. The low limit
4. The time delay for relay operation
5. The time delay for relay release
6. Which relay to activate, if any, when appropriate limits are exceeded and time delay conditions are met

7.1 Applications

The 4700 power meter supports 17 different setpoints simultaneously, numbered 1 to 17. All of the setpoints are programmable from the front panel. **Table 7.1** outlines the measured parameters that the setpoints can monitor. You can use the setpoints to operate the following types of control relays:

- Trip Relay—to shunt trip a breaker
- Alarm Relay—to activate an alarm buzzer or light
- Control Relay—to control an external piece of equipment
- Remote Control Relay—to control an external piece of equipment via the communications port
- kVARH Pulse Output Relay (relay 2)
- kWH Pulse Output Relay (relay 3)

Note: The response time of the relays is one to two seconds and could be up to five seconds after any meter power-up (for example, initial power or subsequent power-ups following any system power failures). The 4700 power meter should not be used for protective functions that require faster operation. A battery-backed DC power supply should be considered for 4700 power meter devices whose setpoints are being used to perform protective functions in which response time is important.

You can assign any of the three relays to a single setpoint, or to several setpoints. A relay is activated if any of the setpoints controlling it become active.

In addition, you can use relays 1, 2 and 3 for kVARH and kWH pulsing.

7.2 Over Setpoint

An over setpoint activates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter. When a setpoint becomes active, it operates the assigned relay, if any. The setpoint status change is stored in the event log, and includes the time and parameter value.

An over setpoint deactivates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to **Figure 7.1**). The setpoint status change is also logged, and includes the time of return-within-limit and the out-of-limit value.

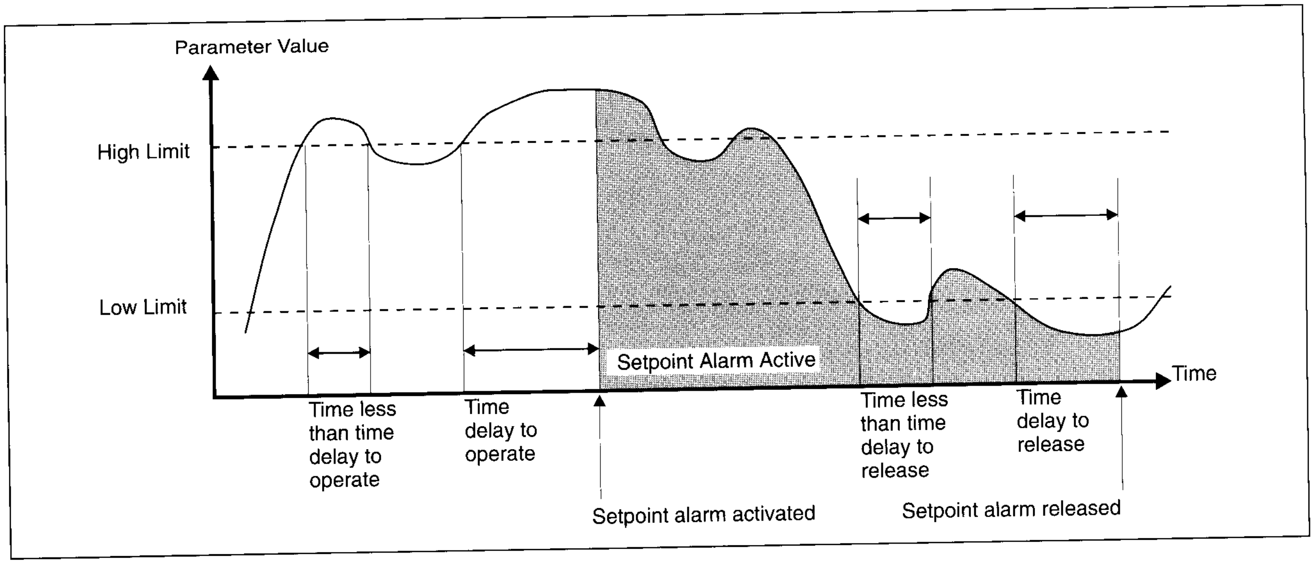


Figure 7.1 Over Setpoint Operation

7.3 Under Setpoint

Under setpoints function similarly to over setpoints, except they operate for opposite reasons. An under setpoint activates when the parameter monitored falls below the low limit for a time period longer than the delay parameter (refer to **Figure 7.2**).

An under setpoint deactivates when the parameter monitored exceeds the high limit for a time period longer than the delay parameter.

7.4 Programming Setpoints

To program setpoints, switch to programming mode and enter your password. Press the Parameter Select button until the SETPOINT NUM parameter appears. Then enter the setpoint number, from 01 to 17, of the parameter you want to program. Program the setpoint by entering new values for all parameters associated with the selected setpoint.

Note: While you are programming the 4700 power meter via the front panel or communications, no setpoint-controlled relay operations occur until you complete the programming sequence. The 4700 power meter then assesses the status of each setpoint and performs any required operations.

It is recommended that you use a Setpoint Parameter Form to plan your setpoints, before entering programming mode. **Figure 7.3** is an example Setpoint Parameter Form, containing information about the six parameters as they correspond to each setpoint. Complete a similar form, like the one available in **Appendix C**, and keep a copy with the meter.

The example Setpoint Parameter Form displays the following attributes:

- Relay 1 is used as an trip relay, with over voltage, under voltage, voltage unbalance, and phase reversal trips enabled. The relay is connected to the breaker shunt trip input.
- Relay 2 is used as an alarm relay to warn of loads over 70% of the breaker rating. Its output is connected to a buzzer.
- After entering your password in programming mode, no setpoint-controlled relay operations occur until you exit programming mode. The 4700 power meter then assesses the status of each setpoint and performs any required operations.
- Relay 3 is used as a kW demand control relay.

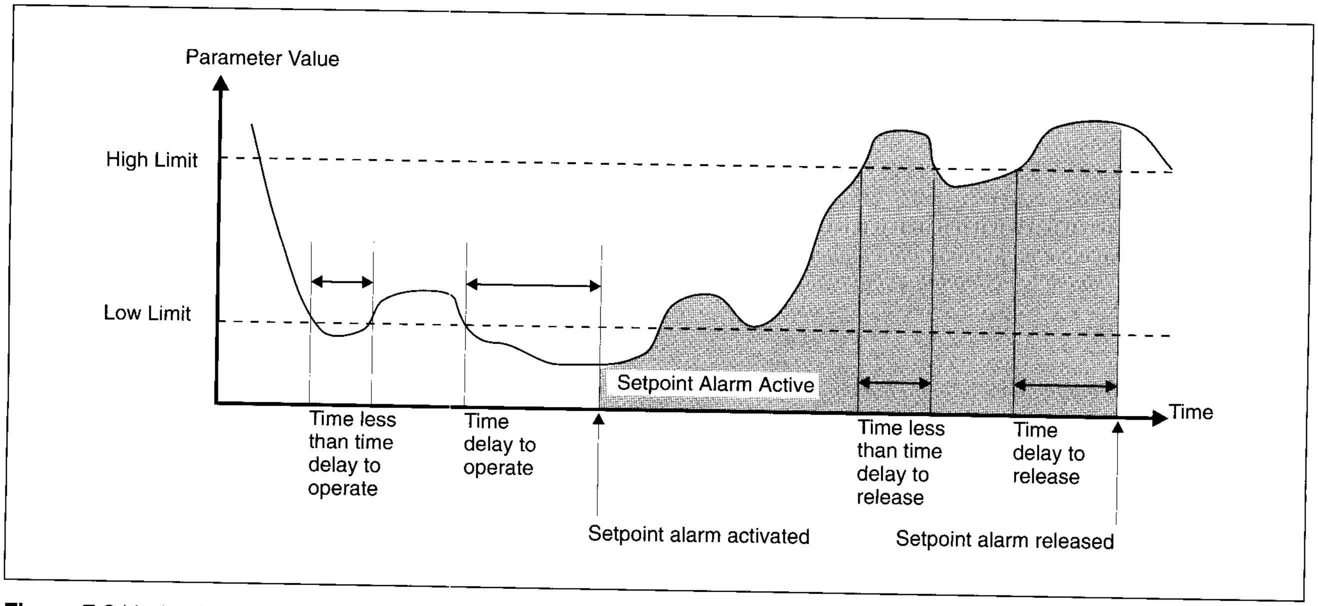


Figure 7.2 Under Setpoint Operation

Table 7.1 Setpoint Types

Type	**Description**
NOT USED	A setpoint not currently in use.
OVER VOLT	Over voltage (highest phase voltage).
UNDER VOLT	Under voltage (lowest phase voltage).
VOLTAGE UNBAL	Percentage difference of most deviant phase voltage from the average.
OVER CURRENT	Over current (highest phase current).
CURRENT UNBAL	Percentage difference of most deviant phase current from the average.
OVER KVA	Over kVA.
OVER KW	Over kW.
OVER KWREV	Over negative kW (feeding power into utility grid).
OVER KVAR FWD	Over kVAR foward (imported) reactive power.
OVER KVAR REV	Over kVAR reverse (exported) reactive power.
OVER KWD	Over kW demand.
OVER AMPD	Over Amp demand.
OVER FREQUENCY	Over frequency. (Enter: Frequency x 10 [that is, 60Hz = 600])
UNDER FREQUENCY	Under frequency. (Enter: Frequency x 10 [that is, 60Hz = 600])
OVER VAUX	Over auxiliary voltage.
UNDER VAUX	Under auxiliary voltage.
PHASE REVERSAL	Phase reversal. Operates if the phase rotation does not match the programmed normal operation.
UNDER PF LAG	Under power factor lagging.
UNDER PF LEAD	Under power factor leading.
OVER I4	Over I4 current.

Setpoint Parameter Form

Setpoint	Type	High Limit	TD Operate	Low Limit	TD Release	Relay/Function
1	Over Volts	332	5	290	1	1 Trip
2	Under Volts	270	5	220	1	1 Trip
3	Volts Unbal.	30%	5	10%	1	1 Trip
4	Phase Reversal	-	1	-	1	1 Trip
5	Not Used					
6	Not Used					
7	Over Amps	2100	10	2000	1	2 Alarm
8	Over Volts	300	10	290	1	2 Alarm
9	Under PF Lag	90	10	85	10	2 Alarm
10	Under PF Lead	90	10	85	10	2 Alarm
11	Over KWD	1200	10	900	10	3 Demand Control
12						
13						
14						
15						
16						
17						

Figure 7.3 Example Setpoint Parameter Form

8 Demand Calculation

Power utilities generally bill commercial customers based on both their energy consumption (in kWhr) and their peak usage levels, called peak demand (in kW). *Demand* is a measure of average power consumption over a fixed time period, typically 30 minutes. *Peak demand* is the highest demand level recorded over a specific billing period.

8.1 Demand Measurement Methods

Demand measurement methods, and their intervals, vary according to individual utilities. Some common methods include: thermal averaging, the fixed interval technique, and the sliding window technique.

In thermal averaging, the demand indicator responds to heating of a thermal element in the watt hour meter. The demand period is determined by the thermal time constant of the element, typically 15 to 30 minutes.

The fixed interval technique measures average usage electronically over each period. The highest recorded value is the peak demand.

The sliding window technique, or "rolling interval" method, divides the demand interval into subperiods and the demand is measured electronically, based on the average load level over the most recent set of subperiods. This has the effect of improving the response times, in comparison with the fixed interval method. For example, with a 6x5 minute (30 minute total) sliding window, demand is the average power consumption over the last six five-minute periods.

8.2 Internally Timed Demand Measurement

The 4700 power meter uses the sliding window method to measure demand. You can program both the DEMAND PERIOD (1 to 99 minutes) and NUM DMD PERIODS (1 to 15) for averaging. This allows you to match virtually any utility demand measurement method. Refer to **Table 8.1** for more information.

Table 8.1 Demand Calculation Chart

Utility Method	**4700 Programming**	
	Demand Period (in minutes)	**Number of Demand Periods (must be 15 or less)**
Fixed Interval	Utility Period	1
Fixed Interval Emulation	Utility Period/15	15
Thermal	Utility Period/15	15
Sliding Window	Utility Subperiod	Utility number of subperiods

8.3 Demand Synchronization

The 4700 power meter includes the option of starting demand intervals that correspond to an active pulse. Set the DEMAND PERIOD parameter to zero, which initiates the Demand Sync mode. Instead of internally timing the duration of each demand period used in the kW demand calculation, the meter looks for an ACTIVE pulse on Status Input #4 (S4). You can still specify the number of demand periods in this mode, as previously explained.

Note: With the fixed interval method, the 4700 power meter maximum reading and the utility reading are not necessarily the same, unless the demand periods are time-synchronized. The best way to resolve this problem is to use the sliding window method with the same total demand period as the utility, as shown above. The 4700 power meter maximum demand reading is then always equal to or slightly higher than the utility readings.

Notes:

9 Communications

9.1 General

The 4700 power meter is optionally equipped with a communications card that allows the 4700 power meter to be integrated with large energy monitoring networks. The communications port is optically isolated and transient protected. It is field-configurable for RS-232 or RS-485 standards and can operate at data rates up to 19,200 baud.

The 4700 power meter is fully compatible with Siemens WinPM software. WinPM software can display all measured parameters and status information, waveform data, and data logs provided by the 4700 power meter. WinPM software can also be used to remotely program the setup parameters for all basic and advanced features.

The open communications protocol of the 4700 power meter allows access to all data and setup parameters by third-party systems.

This chapter provides additional information regarding remote communications connections, programming, and general operation.

9.2 RS-232 Communications

RS-232 is commonly used for short distance, point-to-point communications. Connection between a host computer (or PLC) and a single remote device must be less than 50 feet. **Figure 3.3** and **Figure 3.4** in **Chapter 3** provide wiring diagrams for direct RS-232 connection and the required wiring for the RS-232 interconnect cable(s).

Connection using modems via dedicated or dial-up telephone lines is also possible (see **Figure 9.1**).

When using a modem, it is important that the computer-to-modem and modem-to-4700 power meter cable connections illustrated in **Figure 3.4** in **Chapter 3** are used.

The RS-232 port RTS line is operational and can be used if required by any hardware device connected to the 4700 power meter. Siemens WinPM software does not require the use of the RTS line for direct RS-232 connections; however, some types of modems (for example, radio modems) may require its operation.

The RTS signal is asserted before the beginning of a transmission and remains asserted throughout the transmission. The time delay between the assertion of the RTS and the start of the transmission is controlled by the TRANSMIT DELAY parameter, which can be set from the front panel. The range is 0 to 999 milliseconds (with 0 (zero) as default).

The programmable RTS ACTIVE LVL parameter selects whether the RTS line is asserted HIGH or LOW during transmission.

9.3 RS-485 Communications

RS-485 is used when multiple devices are installed at a remote site. RS-485 communications can be used to concurrently connect up to 32 remote devices on a single communications loop. Each device is given a unique unit ID (identification number). In this way, each remote device may be monitored and controlled from one location by a single supervisory device.

The total distance limitation on a single RS-485 communications network is 4000 feet (1220 meters) using 22 AWG twisted pair shielded cable. **Figure 3.5** in **Chapter 3** provides a wiring diagram for RS-485 network connection.

Communication methods between the remote RS-485 site and the supervisory device can include a direct RS-485 connection, telephone lines with modems, fiber-optic and/or radio links. An RS-232 to RS-485 converter, such as the Isolated Multi-Drop converter, is required between the RS-232 port of the computer or modem and the RS-485 network as illustrated in **Figure 3.5** in **Chapter 3**.

9.4 Setting the Unit ID and Baud Rate

Before communication with the host computer/PLC is possible, ensure that the 4700 power meter, and all other connected devices, are configured for the required communications standard (RS-232 or RS-485). Instructions for the 4700 power meter communications card configuration are provided in **Figure 3.1** in **Chapter 3**.

The next step is to program the communication parameters of the 4700 power meter and all other connected devices. The UNIT ID and BAUD RATE parameters of the 4700 power meter can be programmed via the front panel. The unit ID must be set to a unique value between 1 and 254. The baud rate of each device on the network must be set to correspond with the baud rate selected for the computer. Options include 300, 1200, 2400, 4800, 9600 or 19,200 baud.

When using a modem interface between the host computer and any remote device(s), ensure that the host computer is not used to set the BAUD RATE parameter of any selected device outside the working range of the modem. Doing so will cause that meter to cease communicating. Re-establishing communications with that meter is then only possible through the following steps:

1. Reset the baud rate of the remote device from its front panel to a value within the working range of the modem.
2. Set the computer to communicate at the baud rate at which the remote device has been set to communicate.

9.5 Siemens WinPM Software

WinPM Electrical Distribution Communication software operates in the Microsoft® Windows™ 3.1 operating environment on a personal computer (PC). Through communications drivers, WinPM software collects and displays real-time data from Siemens ACCESS field devices, Siemens protective relays, and other field devices. WinPM software displays information and adds the capabilities of programming, monitoring alarms, and logging system events. WinPM software also monitors and displays historical data, minimum and maximum data, and waveform data. In addition, WinPM software can deliver its data to other compatible Windows applications, in real-time, through dynamic data exchange (DDE), a method of sharing information that is supported by Windows applications.

Your computer running WinPM software can be connected to intelligent field devices directly, or through a modem to the ACCESS system's SEAbus communications bus.

9.6 Third-Party System Compatibility

4700 power meter communications uses an advanced object and register based open protocol which supports an efficient exception reporting methodology. This allows the 4700 power meter to be easily adapted to third-party PLC, DCS, EMS, and SCADA systems.

All data and configuration registers are accessible via communications. All configuration and control operations have embedded password protection.

Contact Siemens for complete documentation on the 4700 power meter SEAbus communications protocol or to discuss a specific application.

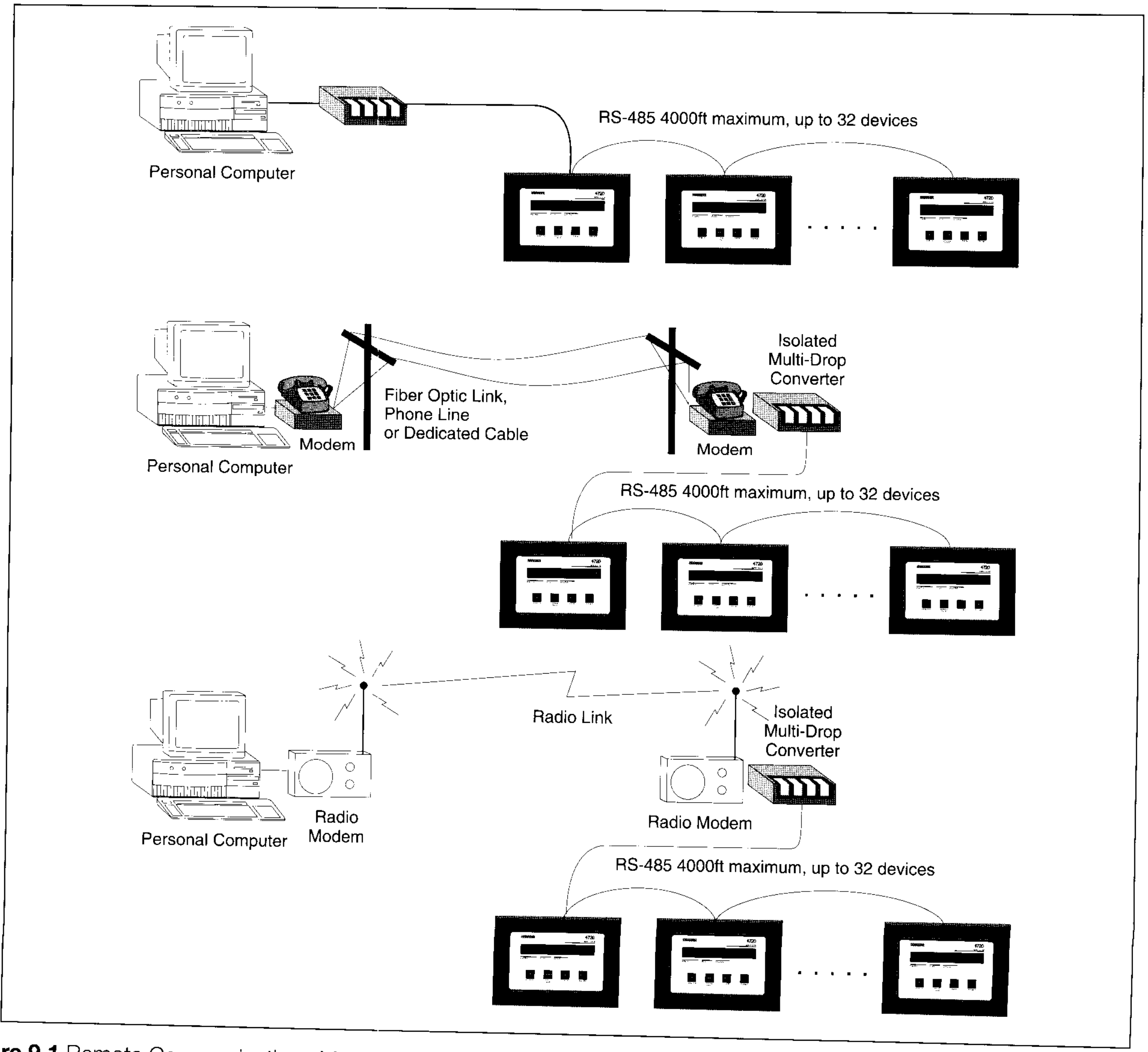


Figure 9.1 Remote Communications Methods

10 Maintenance

The following two circumstances describe the only regular maintenance that the 4700 power meter may require.

10.1 Battery Replacement

The 4700 power meter nonvolatile memory (NVRAM) circuit contains an integrated battery backup system.

The rated life of the NVRAM battery is seventy years at 122°F (50°C), 28 years at 140°F (60°C), and 11 years at 158°F (70°C). If the unit operates at less than 122°F (50°C) for 60% of the time, less than 140°F (60°C) for 90% of the time, and less than 158°F (70°C) for 100% of the time, the expected life of the NVRAM battery is 35 years. If the meter is operating in an environment where the temperatures regularly exceed 140°F (60°C), the NVRAM battery should be replaced every ten years.

Note: When the NVRAM is replaced, historic data may be lost. We recommend backing up critical logged data to the hard drive of a computer prior to servicing. Setup parameters and calibration of the unit are not affected.

10.2 Calibration

The calibration interval for the 4700 power meter depends on your accuracy requirements. The rated accuracy drift is 0.1% per year.

For information regarding the required calibration procedure, contact your local Siemens sales representative.

10.3 Field Service Considerations

In the unlikely event that the 4700 power meter unit should fail, servicing requires disconnection and removal of the unit from its mounting for the purpose of repair, or for exchange with a replacement unit. The initial installation should be done in a way which makes this as convenient as possible:

1. All power to the 4700 power meter should be removed and connections grounded.

2. Current transformer secondary leads should be short-circuited at the CT shorting block. Check to be sure that protective relaying is not affected.

3. All wiring should be routed to allow easy removal of the connections to the 4700 power meter terminal strips, the 4700 power meter rear cover, and the 4700 power meter itself.

11 Troubleshooting

A number of problems can cause the 4700 power meter not to function properly. This section lists possible problems and explains how to correct them.

1. If the display does not operate:
    a. check that there is an appropriate voltage available to the power supply (L and N connections on the terminal strip).
    b. confirm that the VREF terminal is connected directly to ground.
    c. press a button on the front panel.
2. If the voltage or current readings are incorrect:
    a. Check that the VOLTS MODE is properly set for the given wiring.
    b. Check that the voltage and current scales are properly set.
    c. Make sure the VREF terminal is properly grounded.
    d. Check the quality of the CTs and VTs in use.
    e. Make the following voltage tests:
        - V1, V2, V3 to VREF are 120 VAC (or rated full scale values of 277 or 347 VAC).
        - VREF to switchgear earth ground is 0 V.
        - L to VREF is 120 VAC or DC (or optional rated control power voltage).
        - N to VREF is less than 2 VAC.
        - All current inputs are less than 1 VAC with respect to VREF.
3. If the kW or Power Factor readings are incorrect but voltage and current readings are correct:

    make sure that the phase relationship between voltage and current inputs is correct by comparing the wiring with the appropriate wiring diagram.
4. If RS-232 or RS-485 communication does not work:
    a. check that the BAUD RATE matches all other ACCESS devices on the network or the personal computer.
    b. check that the communications mode (RS-232 or RS-485) set by the jumper on the communications card is correct for the type of standard being used (see **Chapter 3**, **section 3.1**).
    c. check that the UNIT ID (address) of the 4700 power meter matches the configuration of the Power Monitor unit or other computer.

If your problem persists after performing the specified steps, or if the problem is not listed above, contact Siemens.

A Technical Specifications

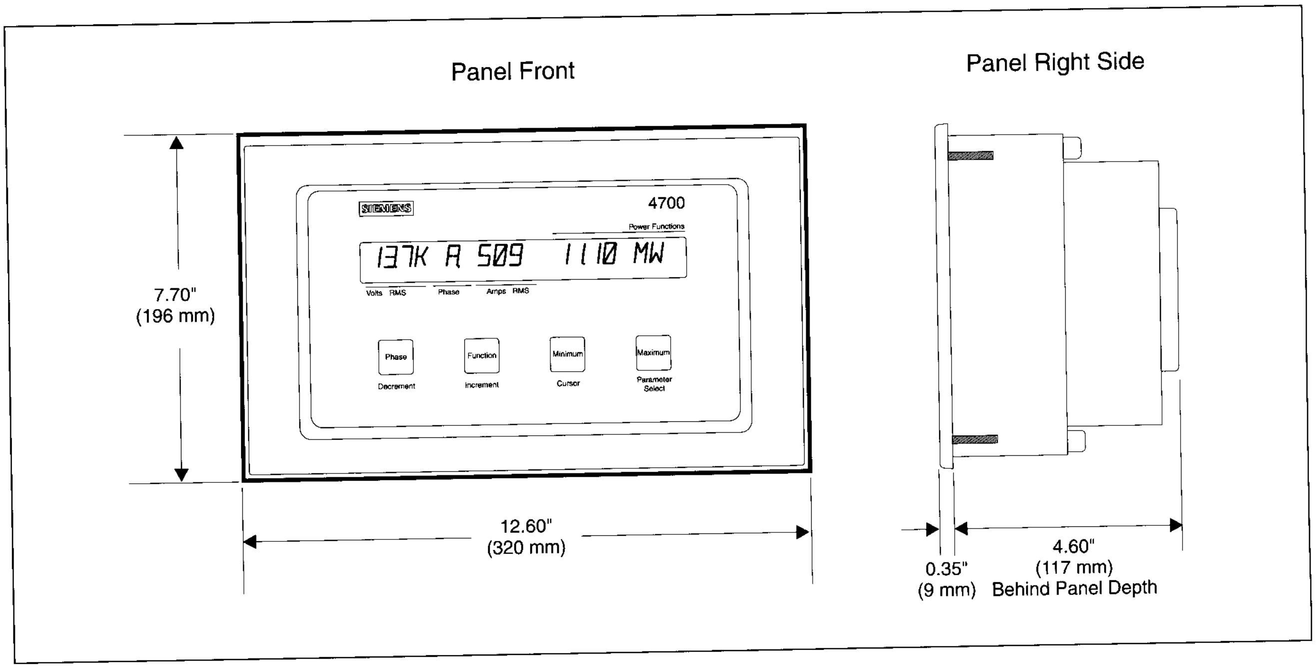
Input and Output Ratings	
Voltage Inputs: (V1, V2, V3)	120 VAC, 277 VAC, and 347 VAC nominal full scale input versions Overload withstand: 1500 VAC continuous, 2500 VAC for 1 second Input impedance: 2 MΩ
Aux. Voltage Input: (V_{AUX})	1.0 VAC/VDC nominal full scale input (1.25 VAC/VDC max.) Overload withstand: 120 V continuous, 1000 V for 1 second Input impedance: 10 KΩ
Current Inputs: (I11, I12, I21, I22 I31, I32, I41, I42)	5.000 A, AC nominal full scale input Overload withstand: 15 A continuous, 300 A for 1 second Input impedance: 0.02Ω, Burden: 0.05 VA
Status Inputs: (S1, S2, S3, S4)	>20 VAC/VDC = active, <9 VAC/VDC = inactive (S1, S2, S3, S4) input impedance: 2 MΩ Overload withstand: 1500 V continuous, 2500 V for 1 second
Control Relays: (R1, R2, R3)	Form C dry contact relays 277 VAC or 24 VDC @ 10 A maximum load current
Aux Current Output (I_{OUT}):	0-20 mA. Maximum load 250Ω resistive
Power Supply:	Standard N. American: 85 to 132 VAC/0.2 A/47 to 440 Hz or 110 to 170 VDC/0.2 A European/Optional: 85 to 264 VAC/0.2 A/47 to 440 Hz or 110 to 340 VDC/0.2 A Other Available Options: 24 VDC and 48 VDC
Operating Temperature:	0°C to 50°C (32°F to 122°F) ambient air temperature range
Storage Temperature:	-30°C to +70°C (-22°F to +158°F)
Humidity:	5 to 95%, non-condensing
Shipping:	Weight: 3.9 kg. (8 lbs, 10 oz.) Carton: 38 x 25 x 18 cm (15" x 9.8" x 7.1")
Voltage, Current,Status, Relay, and Power inputs all pass the ANSI C37.90A surge withstand and fast transient test.	

Technical Specifications

Parameter	Accuracy (%)	Resolution (%)	Range
Volts	0.2	0.1	0 to 999,999 (1)
Amps (L & N)	0.2	0.1	0 to 9,999
KVA	0.4	0.1	0 to 999,999 (2)
KW	0.4	0.1	0 to 999,999 (2)
KVAR	0.4	0.1	0 to 999,999 (2)
PF	1	1	1.0 to +/-0.6
FREQUENCY	0.2 Hz	0.1 Hz	40 to 70 Hz
KW DEMAND	0.4	0.1	0 to 999,999
AMPS DEMAND	0.2	0.1	0 to 9,999
KWHR	0.4	1 KWHR	0 to 999,999,999
KVARHR	0.4	1 KVARHR	0 to 999,999,999
Vaux (1 VAC scale)	0.25	0.1	0 to 999,999
Neutral Current	0.2	0.1	0 to 9,999

(1) Reads in kV for voltages over 9,999
(2) Reads in MVA, MW, MVAR for readings over 9,999

B Dimensions



C Setpoint Parameter Form

Setpoint	Type	High Limit	TD Operate	Low Limit	TD Release	Relay/Function
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

D Firmware Versions

The following table lists each software version release for the 4700 power meter and the new features or performance enhancements added with each release.

The version number is identified on the label on the rear cover of the 4700 power meter (see **Figure 1.1** in **Chapter 1**). If yours is currently using a software version older than the most recent version listed in the table below, you can upgrade the software in that unit by contacting your local representative or the manufacturer. Upgrades to the 4700 power meter require a simple replacement of the EPROM (integrated circuit "chip"), which contains the operating software inside the unit. This replacement procedure must be done by trained electronics service personnel.

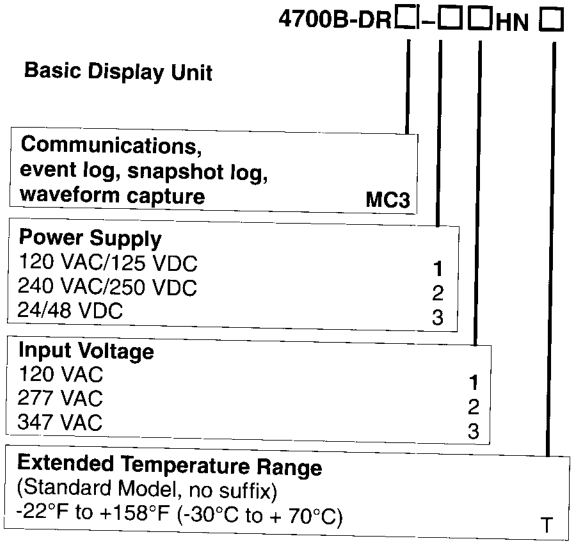
Hardware Revision B

From now on, all EPROMs are available for either the A or B hardware. They are not interchangeable. Normally, only the B is released except for an upgrade of an older meter. Revision B meters are easily distinguished from revision A meters by the following:

- Raised black plastic bezel (Rev. A has a flat, white metal bezel)
- Product Rev: B printed on back of meter
- VREP terminal (Rev. A does not have a VREF terminal)

Software version	Release Date	Description
2.2.0.2B	January 1, 1992	Exactly the same as Rev. A 2.2.0.2
2.2.0.3B	March 31, 1992	Fixed bug that limited unit ID (address) to 1 thru 99
2.2.0.4B	January, 1993	• Fixed bug with kWH/kVARH overflow causing display to blink • Fixed but that lost password changes if powered down • Adds waveform capture feature • Adds reverse kVARH value; kVARH and kWH changed to return forward, not total values • Adds configurable relay pulsing • Add kW FWD, kVAR FWD, and kVAR REV setpoints • PF display changed to LD/LG • 3-wire WYE mode allows for 2VT/3CT • Demand period is now based on time of day • Added ,/. configuration of display values (European format) • RTS line is asserted 10 msec before TX in RS-232 mode • PM 3.13 logs diagnostic code 1 type 1 errors with this version

E Ordering Information



4700B-DR☐-☐☐HN ☐

Basic Display Unit

Communications, event log, snapshot log, waveform capture MC3

Power Supply
120 VAC/125 VDC 1
240 VAC/250 VDC 2
24/48 VDC 3

Input Voltage
120 VAC 1
277 VAC 2
347 VAC 3

Extended Temperature Range
(Standard Model, no suffix)
-22°F to +158°F (-30°C to + 70°C) T

Examples:

"4700B-DRMC3-11HN" specifies a power meter with an isolated RS-232/RS-485 communications module installed, a 120VAC/125VDC power supply, and 120VAC nominal measured phase voltage inputs.

"4700B-DR-12HNT" specifies a power meter with 120VAC/125VDC power supply, 277VAC nominal measured phase voltage inputs, and extended temperature capability.

4700 Power Meter Product Designations

Features	**Product Designations**	
	DR	DRMC3
15 metered parameters	X	X
Min/Max log	X	X
Aux voltage (1VAC/1VDC nominal)	X	X
20 character display	X	X
Four discrete inputs	X	X
Three programmable relay outputs	X	X
One analog ouput (4 to 20mA)	X	X
Communications module installed		X
Event Log		X
Snapshot Log		X
Waveform Capture		X

SIEMENS

Siemens Energy
& Automation, Inc.
Switchgear and Motor Control
Business
Customer Service
P.O. Box 29503
Raleigh, NC 27626

ACCESS Systems Service Request Form

To report problems with Siemens ACCESS systems and devices, make a copy of this form, complete it with as much information as you can, and contact your Siemens representative. You can also fax this form to Siemens Customer Service at 919-365-2830.
For emergency service call 1-800-347-6659.

Customer Information

Job site location and contact:

Phone and fax number:

Siemens sales order number:

Siemens manufacturing order number (from drawing):

System Information

Describe the number and type of devices on your ACCESS system.

Field Devices

Quantity	Device Type	Quantity	Device Type
	4300 power meter		SCOR relay
	4700 power meter		ISGS relay
	4720 power meter		7SA, 7SJ, or 7UT relay
	Static Trip IIIC trip unit		Multiplexer Translator
	Static Trip IIICP trip unit		Isolated Multi-Drop converter
	Sensitrip III trip unit		S7-I/O device
	SB breaker trip unit		Pulse reading meter
	SAMMS-LV device		Other:
	SAMMS-MV device		Other:

Supervisory Devices and Software

Quantity	Product	Quantity	Product
	WinPM software		Power Monitor Panel (PMP)
	Host PC software		PC32F power monitor
	Power Monitor PC software		Siemens PLC
	SIEServe software		Other hardware:
	Other software:		Other hardware:

Problem Description

Provide the following information on the affected device(s):

Device type: ____________________

Model or catalog number: ____________________

Part number: ____________________ Serial number: ____________________

Hardware version: ____________________ Software version: ____________________

Installed options: ____________________

Configuration information, including operational settings, parameters, wiring, type of system:

On what type of electrical equipment are the devices installed? (switchgear, motor control center, switchboard, and so on): ____________________

Provide a brief description of the problem: ____________________

Indicate what error messages, if any, are generated by the device or supervisory software. Include messages listed in the event log: ____________________

To be completed by Siemens

Received by: ____________________ Date received: ____________________

Reviewed by: ____________________ Date reviewed: ____________________

Sales engineer: ____________________

Problem report tracking number: ____________________

Problem classification code: ____________________

Corrective action: ____________________

SIEMENS

Warranty

Company warrants that on the date of shipment to Purchaser the goods will be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

If within one year from date of initial operation, but not more than eighteen months from date of shipment by Company, of any item of the goods, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such defect by, at Company's option, adjustment, repair or replacement of the item and any affected part of the goods. Purchaser shall assume all responsibility and expense for removal, reinstallation and freight in connection with the foregoing remedy. The same obligations and conditions shall extend to replacement items furnished by Company hereunder. Company shall have the right of disposal of items replaced by it. Purchaser shall grant Company access to the goods at all reasonable times in order for Company to determine any defect in the goods. In the event that adjustment, repair or replacement does not remedy the defect, the Company and Purchaser shall negotiate in good faith an equitable adjustment in the contract price.

The Company's responsibility does not extend to any item of the goods which has not been manufactured and sold by Company. Such item shall be covered only by the express warranty, if any, of the manufacturer thereof. The Company and its suppliers shall also have no responsibility if the goods have been improperly stored, handled, or installed; if the goods have not been operated or maintained according to their ratings or according to instructions in Company or supplier furnished manuals; or if unauthorized repairs or modifications have been made to the goods.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES (EXCEPT TITLE). INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE GOODS.

The foregoing states Purchaser's exclusive remedy against Company and its suppliers for any defect in the goods or for failure of the goods to be as warranted, whether Purchaser's remedy is based on contract, warranty, failure of such remedy to achieve its essential purpose, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installation or defects from any cause.

Form: SG6024-00 0296

Siemens Energy & Automation, Inc.

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