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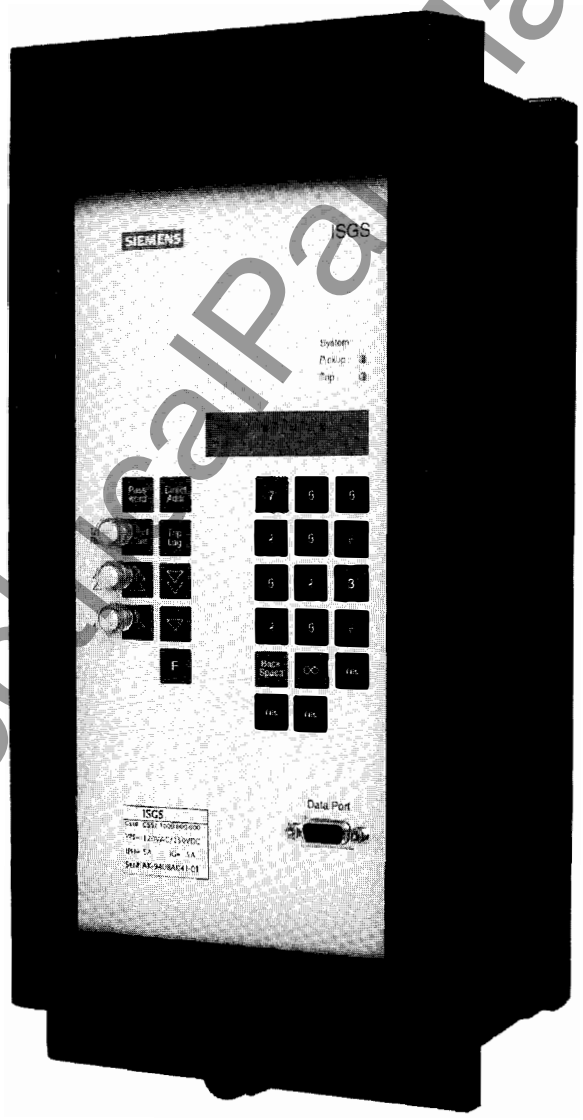
SIEMENS

ISGS™
Intelligent SwitchGear System
Operator's Manual - firmware versions V1 and V2



Manual No. SG-8058-01

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⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

This can cause severe personal injury or equipment damage.

Always de-energize and ground the equipment before performing 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 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, 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 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.

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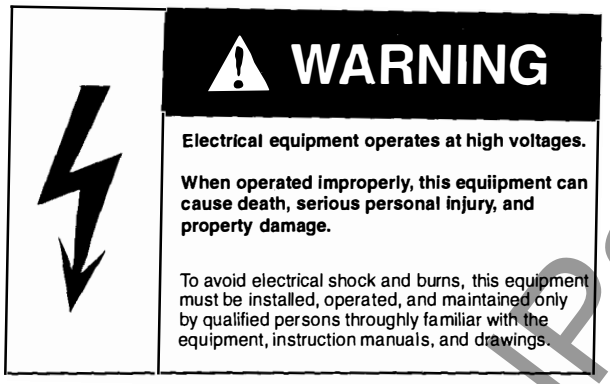
1 Introduction

The ISGS™ relay is designed and manufactured in accordance with the latest provisions of the applicable IEEE, ANSI and NEMA standards. You must thoroughly read and understand this user's manual before you begin any work with the ISGS relay. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the careful design and fabrication by Siemens.

The purpose of this instruction manual is to assist the user in developing safe and efficient procedures for the installation, maintenance, and use of the equipment.

Contact the nearest Siemens representative if any additional information is desired.



Qualified Person
For the purpose of this manual and product labels, a **"Qualified Person"** is one who is familiar with the installation, construction, and operation of this equipment, and the hazards involved. In addition, this person has the following qualifications:

- Training and authorization to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety practices.
- Training in rendering first aid.

Signal Words
The signal words **"Danger," "Warning,"** and **"Caution"** used in this manual indicate the degree of the hazard that may be encountered by the user or operator. These words are defined as follows:

- **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 *could* result in moderate or minor injury.

Required Procedures
In addition to normal safety practices, user personnel must adhere to the following procedures:

1. Always work on de-energized equipment. Always de-energize a breaker, or contactor, and remove it from the equipment before performing any tests, maintenance, or repair.
2. Always perform maintenance on equipment employing springs after the spring-charged mechanisms are discharged.
3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

Field Service Operation
Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair, and maintenance of Siemens equipment, processes, and systems. Contact regional service centers, sales offices, or the factory for details.

1.1 About the Manual

This manual provides the necessary information to install, operate, maintain, and troubleshoot the ISGS relay. The manual is divided into several sections, with each section providing detailed information about different aspects of the ISGS relay, Figure 1.1. Refer to the applicable section to locate detailed information about a specific feature, procedure, or operation. A general overview of the information contained in each section is provided in Table 1.1.

Section 1: Introduction	General information and specifications
Section 2: Installation	Unpacking, mounting, and wiring
Section 3: Operation	Initialization, configuration, password, display, and metering
Section 4: Troubleshooting	Identification and resolution of basic relay and installation problems
Appendix A: Trip Curves	Equations and curves
Appendix B: Metering	Metering accuracy and methods of calculation
Appendix C: Schematics	Connection diagram examples

Table 1.1 Section Overview

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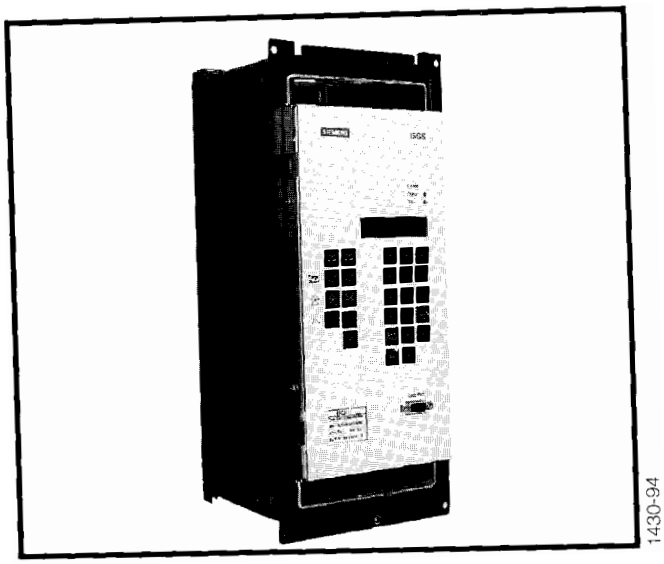

Figure 1.1 ISGS Relay

1.2 General Description

The ISGS relay is a general purpose, multifunction, microprocessor-based protective relay. In its standard configuration, the relay performs protection, metering, and monitoring for three phase CT inputs and one ground CT input, and provides two breaker tripping contacts, plus one relay disabled (alarm) contact. The relay disabled contact is a normally closed contact which remains open when the relay is functioning properly. The standard protection features are: instantaneous and time phase overcurrent, and instantaneous and time ground overcurrent. The standard metering features are: phase and neutral currents, average current, amps demand and min/max logs. The standard monitoring features include logging of: interrupted current on a per-pole basis, a counter for number of breaker operations, and indication of breaker position. For DC trip systems, trip source integrity and coil condition are also monitored.

The ISGS relay includes a 2 line by 16 character liquid crystal display (LCD) for viewing measured data and a 28 button keypad for local access to the data. The keypad also allows the operator to change various parameters and control relay functions. General relay status information is provided by the front panel LED indicators. Password security prevents unintentional changes to the relay parameters. An RS-232 communications port is provided on the front panel for local parameter setup and control via a personal computer.

The ISGS relay is supplied in an M1-size drawout case with dust tight front cover. The case is compatible with XLA connecting plugs that are commonly used to test relays.

1.3 Options

The ISGS relay is a dynamic, feature-rich device that can be used in numerous industrial and utility applications. Available options include voltage inputs, extended protective functions, and an RS-485 communications port (using SEAbus™ protocol).

1.3.1 Voltage Inputs

Installation of the optional voltage input card provides three inputs for the connection of 115 V or 120 V rated VTs. These inputs extend the metering and protection capabilities as follows:

1. Enhanced metering capabilities: kW, kVAR, kVA, PF, kW Demand, kWHR, kVARHR
2. Directional overcurrent protection (67 & 67N)
3. Over and under voltage protection (59/27)
4. Voltage phase sequence protection (47)

1.3.2 SEAbus Communication Interface

Installation of the SEAbus Communication option card adds an RS-485 communication interface on the rear panel for connection to remote monitoring and control systems.

This feature is compatible with the Siemens ACCESS™ System as well as WinPM™ power monitoring and control software, SIEServe™ software, and Wisdom software. This feature allows configuration, measurement, and protection functions to be performed or reviewed from a remote location.

1.4 ISGS Wisdom Software

While it is possible to completely set up and configure the ISGS relay using the keyboard and display on the front panel, this task can also be accomplished remotely through either of the two communication ports (front or rear) described earlier. The available tool for this purpose is the ISGS Wisdom software package provided with the relay.

In addition to setup and configuration, Wisdom software can also retrieve and display fault data stored in the relay. This includes the trip logs and the waveform capture buffers.

Wisdom software can also display real-time relay status and metering data.

Installation and use of the Wisdom program is extremely simple and straight forward. The program runs on a standard IBM™ compatible, personal computer under the Windows™ operating system. An extensive context-sensitive Help function is included. For anyone who might wish to evaluate the software off-line, a demonstration mode is provided that allows all of the program functions to be exercised without actual connection to an ISGS relay. Information on the methods and equipment required to connect the personal computer to the relay are included in the Help function.

In addition to allowing experimentation, the “demo” mode permits the user to create relay configuration files that can be saved and used at a later time to configure an actual relay.

Please refer to the data sheet provided with the software package for further details.

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1.5 Technical Data

1.5.1 Applicable Standards

The relay has been designed in accordance with the following standards:

ANSI / IEEE C37.90-1989	IEEE Standard Relays and Relay Systems Associated With Electric Power Apparatus
IEC 255-4	Single Input Energizing Quantity Measuring Relays With Dependent or Independent Time

1.5.2 General Technical Data

Operating ambient temperature	-20°C - +55°C (-4°F - +131°F)
Storage temperature	-40°C - +75°C (-40°F - +167°F)
Relative humidity	The average relative humidity may be up to 55% outside of enclosure for temperatures up to 40°C, with excursions up to 95% for a maximum of 96 hours, without condensation.
Altitude	< 1500 M
Frequency	50 Hz or 60 Hz, software selectable

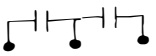
1.5.3 Power Supply

DC power supply	
Rated voltages	48 V (19 - 56 V), 125 V (46 - 144 V), 250 V (92 - 288 V)
Permissible ripple	<10%
AC power supply	
Rated voltage	120 V rms (102 - 132 V, 50 - 60 Hz)
Power consumption	<15 W

1.5.4 Input Circuit Ratings

Rated current (I_n)	1 A or 5 A, independently for phase and ground inputs
Maximum input current	5 x I_n continuous
	10 x I_n for 10 s
	100 x I_n for 1 s
CT burden	<0.1 VA for 1 A CT
	<0.5 VA for 5 A CT
Rated voltage (V_n)	115 V or 120 V
Maximum input voltage	for measurement: 1.25 x V_n MOV protected at: 2.5 x V_n
VT burden	150 kΩ

1.5.5 Output Contacts

Tripping relays	2
Contact configuration (TRIP1 and TRIP2)	N.O. (1 common point) 
Contact rating	IEEE / ANSI C37.90-1989, Section 6.7 (Make and carry 30 A for at least 2000 duty cycles, resistive load, interrupted by independent means. Duty cycle: 200 ms on, 15 s off, 250 V)
Binary output contacts (BO1-BO2)	2 x N.O. (independent, not rated for tripping)
Max. switching voltage	300 VDC, 250 VAC
Max. switching current	8 A
Max. switching capacity (for currents not interrupted by independent means)	DC: voltage dependent: 50 W at V ≥ 70 VDC 100 W at 48 V 270 W at 35 V AC: 2000 VA
Trip source monitor	215 mA for 48 V supply 63 mA for 125 V supply 36 mA for 250 V supply Source quality checked approximately every 4 min

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2.6 RS-232 Interface Connection (Data Port)

The front panel RS-232 data port is intended only for short-term connections to a personal computer. Use this interface to perform initial setup or to read the ISGS relay data logs or waveform buffers.

1. Remove the relay case front cover.
2. Locate the RS-232 connector located on the front panel of the cradle assembly.
3. Connect the personal computer to the front panel RS-232 port using a standard DB-9 serial port connection cable (DB-9 male to DB-9 female or DB-25 female depending on the type of port). This connection does not require the use of special adapters or a null-modem cable.

2.7 Removing and Inserting the Cradle Assembly

Some of the setup and maintenance procedures in this manual require removal of the relay cradle assembly from the drawout case. Use the following instructions for the proper removal and insertion of the cradle assembly.

IMPORTANT: The relay module contains CMOS circuits. Electrostatic discharges into or around the relay cradle or any of its components must be avoided. Use grounding straps or touch a grounded metal surface before handling the relay cradle.

2.7.1 Removing the Cradle Assembly

Use the following procedures to remove the cradle assembly from the case.

1. Remove the front cover.
2. Remove the top and bottom connecting plugs.
3. Loosen the cradle assembly by pulling the top release lever to the left and the bottom release lever to the right until the assembly ejects from the case.
4. Grasp the cradle assembly by the edges of the front panel and pull it out of the drawout case.
5. Place the cradle assembly on an anti-electrostatic surface and perform the desired work.

2.7.2 Inserting the Cradle Assembly

Use these procedures to reinsert the cradle assembly into the drawout case.

1. Insert the cradle assembly until the release levers come in contact with the protrusions on the case.
2. Position the top and bottom release levers until the slots on the levers align with the protrusions on the case.
3. Use the release levers to finish inserting the cradle assembly into the case. Apply pressure to the cradle assembly front panel until the assembly fully seats in the case.
4. Insert the top and bottom connecting plugs.
5. Check for proper insertion of the cradle assembly by installing the front cover and seeing if the expected measured values are observed on the relay display.

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3 Operation

3.1 Overview

This section explains how to operate the ISGS relay. Contained in this section are the keypad explanation, relay menu structure, and the various parameter selections available for system configuration.

To configure the relay the user must be granted access to the protection parameters, which requires the correct password. Access to the parameters will allow the user to change configuration and protective function settings. If the user "saves" the changes, the relay will update its internal parameter database and implement the new parameters.

If the changes involve device configuration or matrixing (address blocks 1000 through 1200, or 6400), rather than just a parameter change, the relay can require up to 30 seconds to re-initialize. This will temporarily leave the circuit unprotected. Therefore, do not change the matrixing (address block 6400) or the device configuration (address blocks 1000 through 1200) while the relay is in service.

3.2 Data Ports

The relay provides both RS-232 and, optionally, RS-485 data interfaces. The RS-232 interface is located on the front panel of the relay and access to this feature is via a DB-9 connector. Connection to the optional RS-485 interface is accomplished via pins 48, 49, and 50 on the rear panel. Use of either of these data interfaces will allow the same level of access to the system as the front panel keypad. This manual covers only keypad operations. If you require more information about the data interfaces, refer to the appropriate software manual (e.g., WinPM software or Wisdom software).

3.3 Controls and Indicators

Operation, parameter selection, and control of the ISGS relay is performed using the front panel keypad and the relay display. Use the following procedures and the appropriate address to obtained desired information, or to change relay parameters.

To access relay information or functions, use the **Arrow** keys to scroll through relay addresses or use the **Direct Addr** key and the specific address number to go directly to the information or function.

Use the **Double Arrow** keys to scroll up or down through the major address blocks (1000, 1100, 1200, etc.). Use the **Single Arrow** keys to scroll up or down within a major block (1101,1102, etc.).

3.3.1 Keypad Description

The ISGS relay keypad contains 26 keys, that are briefly described in Table 3.1. You can use the keypad to display information or change parameters. A password is not necessary to display settings or to view trip or min-max logs. Refer to the applicable instructions in this section for operating procedures for changing parameter or

Key	Name	Function
Pass word	Password	Accesses the password function, which is required for programming relay settings.
Direct Addr	Direct Addr	Allows direct entry of addresses.
Trip Log	Trip Log	Displays the trip log.
Target Reset	Target Reset	Resets the Trip LED.
⏫	Double Arrow	Scrolls through the major address blocks.
▲	Single Arrow	Scrolls through the addresses within a major address block.
F	F	Saves new settings when followed by **Enter**, or assigns a function to an input or output when followed by a valid function number.
9	Numeric	Used to enter an address number after pressing **Direct Addr**, or to enter a numeric setting.
.	Decimal Point	Indicates a decimal point or the separation between month, day, and year, or between hours, minutes, and seconds.
+/-	Plus/Minus	Toggles between positive and negative values.
Back Space	Backspace	Deletes one character to the left.
∞	Infinity	Programs the setting to the highest possible value

Table 3.1 Front Panel Keys

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Major Addr. Block	Function	Required operation steps			Remarks
		1-3	1-9	1-14	
1000	Device configuration		✓		Note 1
1100	CT configuration		✓		Note 1
1200	VT configuration		✓		Note 1
1400	Breaker Statistics	✓			
1500	50 Phase configuration			✓	
1600	50 Neutral or ground configuration			✓	
1700	51 Phase configuration			✓	
1800	51 Neutral or ground configuration			✓	
1900	67 Phase configuration			✓	
2000	67N Neutral or ground configuration			✓	
2200	59 Overvoltage configuration			✓	
2300	27 Undervoltage configuration			✓	
2400	47 Voltage phase sequence configuration			✓	
2800	50 BF Breaker failure configuration			✓	
3100	Demand setpoints configuration		✓		
3200	Power setpoints configuration		✓		
4100	Metering data: Current	✓			
4200	Metering data: Voltage	✓			
4300	Metering data: Power	✓			
4400	Metering data: Frequency	✓			
4600	Min/Max log: Current	✓			
4700	Min/Max log: Voltage	✓			
4800	Min/Max log: Power	✓			
4900	Min/Max log: Frequency	✓			
5100 through 5800	Trip log #1 through Trip log #8	✓			
6400	Matrixing trip contacts				
7000	Operating parameters (LCD display lines)		✓		Note 1. See section 3.11.

Note 1: Do not change configuration while the relay is in service. Changing configuration causes reinitialization time of up to 30 seconds. During reinitialization, the relay does not provide protection.

Table 3.5 Major Address Block Operation Steps

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Major Addr. Block	Function	Required operation steps			Remarks
		1-3	1-9	1-14	
7100	Parameter sets (normal/alternate)		✓		
7200	Communications port configuration		✓		
8100	Time and date setting		✓		Skip step 8. See details for data format. Message at step 7 is "CLOCK ADJUSTED."
8200	Reset (trip log, min/max, energy)		✓		Skip steps 6-7. Messages at step 8 are "IN PROGRESS" and "SUCCESSFUL."
8300	Breaker monitoring configuration		✓		
8400	Waveform capture configuration				
Note 1: Do not change configuration while the relay is in service. Changing configuration causes reinitialization time of up to 30 seconds. During reinitialization, the relay does not provide protection.					

Table 3.5 Major Address Block Operation Steps (Continued)

3.7.1 Device Configuration (Address 1000)

Use this address block to configure the ISGS relay to match the line frequency, phase sequence, and breaker connection settings for your system. The available relay subaddresses are listed in Table 3.6. To make parameter changes, you must first enter the password. If you only want to review the present settings, the password steps 4 and 5 are not necessary. Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4.

Note: Do not change device configuration (Table 3.6) while the relay is in service, as the relay can require up to 30 seconds to reinitialize for this change. During reinitialization, the relay does not provide protection.

Subaddress	Parameter	Selection
1002	Frequency	60 Hz or 50 Hz
1003	Phase Sequence	123 (ABC) or 132 (ACB)
1004	Breaker Connection	Trip 1 or Trip 2

Table 3.6 Device Configuration, Major Block 1000

The breaker connection parameter (1004) defines which output contact (Trip 1 or Trip 2) is connected to open the circuit breaker. This information is used by the breaker failure function, if that function is enabled (see section 3.7.14). Also, refer to the discussion on matrixing in section 3.11.

3.7.2 CT Configuration (Address 1100)

Use this address block to configure the ISGS relay to match the Phase CT Primary Rating and Neutral or Ground CT Primary Rating settings, and the CT input's Norm Power Flow settings to match your system. The available relay subaddresses are listed in Table 3.7.

To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary. Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4.

Note: Do not change CT configuration (Table 3.7) while the relay is in service, as the relay can require up to 30 seconds to reinitialize for this change. During reinitialization, the relay does not provide protection.

Subaddress	Parameter	Selection
1101	Phase CT Primary Rating	5 - 8000 A
1102	Neutral or Ground CT Primary Rating	5 - 8000 A
1104	Normal Power Flow	Normal or Reverse

Table 3.7 CT Configuration, Major Block 1100

The phase (1101) and neutral/ground (1102) CT primary ratings are independently configurable. However, when a residual sensing method is used for ground fault protection, the primary current ratings for the neutral CT and the phase CT must be equal.

Power flow conventions (1104) are defined such that "Normal" power flow is into the phase CT polarity mark, and "Reverse" power flow is out of the phase CT polarity mark. Figure 3.2 illustrates examples of normal and reverse power flow.

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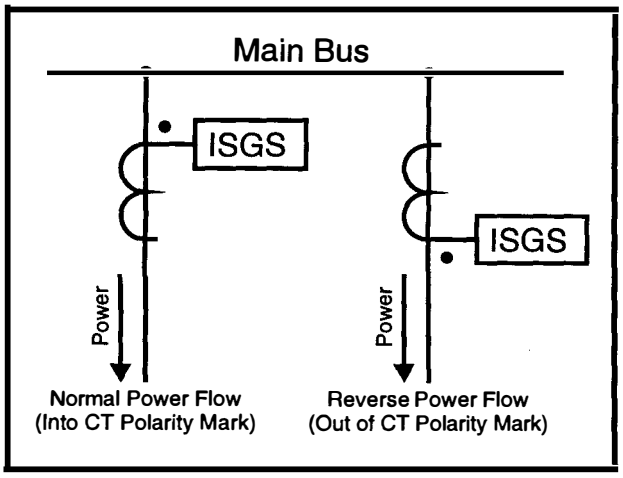

Figure 3.2. Normal/Reverse Power Flow

3.7.3 VT Configuration (Address 1200)

Use this address block to configure the ISGS relay to match the VT primary rating and the VT connection setting for your system. These settings are available only if the voltage input option is installed on the relay. The available relay subaddresses are listed in Table 3.8. To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary. Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4.

Note: Do not change VT configuration (Table 3.8) while the relay is in service, as the relay can require up to 30 seconds to reinitialize for this change. During reinitialization, the relay does not provide protection.

Subaddress	Parameter	Selection
1201	Primary Rating	120 - 138,000 V
1202	VT Connect	Line-To-Line or Line-To-Neutral

Table 3.8 VT Configuration, Major Block 1200

Voltage transformers may be connected in either of two ways:

1. Two VTs connected open delta-open delta, or
2. Three VTs connected wye-wye.

For brevity, the open delta connection is referred to as L-L (line-to-line), while the wye connection is referred to as L-N (line-to-neutral). Wye-delta or delta-wye connection of VTs is not allowed. Figure 3.3 shows the correct VT connections and polarities.

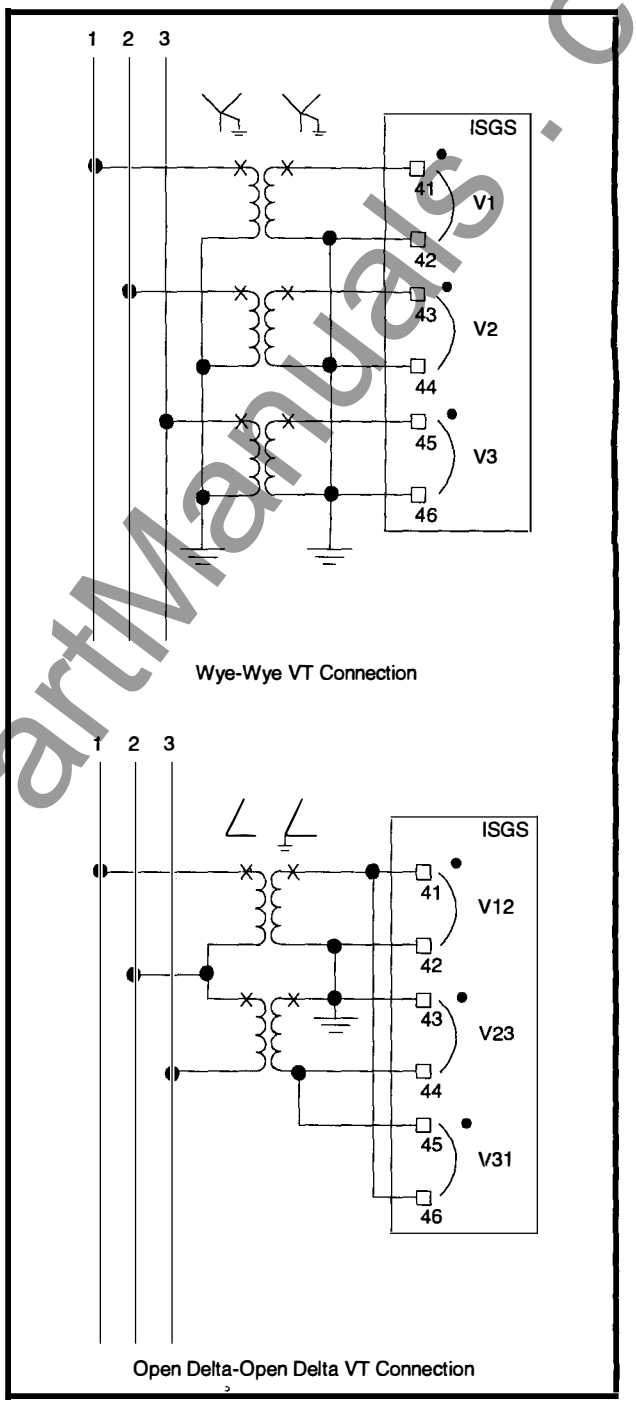

Figure 3.3. Voltage Transformer Connections

Voltage transformers are specified with an input:output voltage ratio (e.g., 12000:120). The secondary voltage rating of the VTs determines the fourth digit of the catalog number. The primary voltage rating of the VTs is configured in subaddress 1201.

Note: See section 3.9.1 for information on the parameters that begin at **Address 1400** (Breaker Statistics).

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3.7.4 Protective Function Configuration

In the following sections, information explaining how to configure the protective functions is provided. For most of the protective functions, some or all of the available parameters can be set in two different parameter sets. Refer to section 3.12.2 for a detailed discussion of these parameter sets.

In brief, there are two parameter sets - the primary set and the alternate set. Either set can be selected as the active set that controls the operation of the relay. When configuring the protective functions, make settings in both the primary and alternate parameter sets, unless a alternate parameter set is not desired. The primary parameter set is denoted by an "A" in front of the address number, and the alternate parameter set is denoted by a "B" in front of the address number. For example, the address displayed for a primary parameter will be "A1500", while the address for an alternate parameter will be "B1500". To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary.

Perform parameter changes using the steps in the standard operation sequence, Table 3.4. Complete steps 1 through 9 if you only desire a primary parameter set. Complete steps 1 through 14 if you desire both a primary and an alternate parameter set.

Note that the settings for parameter sets A and B are entered in the major address block for the protection element that is being configured. However, the parameter set which the ISGS relay is actively using is selected at address block 7100.

Protective functions for which alternate parameter sets are available are indicated in Table 3.3.

3.7.5 Overcurrent Instantaneous Phase 50 (Address 1500)

Use this address block to change the instantaneous phase overcurrent pickup value and time delay. The available relay subaddresses are listed in Table 3.9.

Subaddress	Parameter	Selection
1501	Function	Enable or Disable
1502	Pickup	5 A CTs: 1 - 120 A or 1 A CTs: 0.2 - 24 A
1504	Time Delay	0 - 60 s
1510	Freeze Wfm1	on Pickup, on Trip, or None
1511	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.9 50 Phase Configuration, Major Block 1500

This protection function consists of phase instantaneous overcurrent protection, plus an adjustable delay. The instantaneous function begins timing when any individual phase current exceeds the pickup current setting (1502). The instantaneous overcurrent protection can be enabled or disabled. The time delay is adjustable from 0.0 to 60.0 seconds, in steps of 0.1 seconds.

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (1510 and 1511). For this protection element, the default for buffer 1 is "on Trip" and for buffer 2 it is "None." These settings are not included in the alternate parameter sets.

The settings for phase instantaneous overcurrent (50) are independent of the settings for ground instantaneous overcurrent (50N) and the time overcurrent settings (51 and 51N).

3.7.6 Overcurrent Instantaneous Neutral or Ground 50N (Address 1600)

Use this address block to change the instantaneous neutral/ground overcurrent pickup value and time delay. The available relay subaddresses are listed in Table 3.10.

Subaddress	Parameter	Selection
1601	Function	Enable or Disable
1602	Pickup	5 A CTs: 1 - 120 A or 1 A CTs: 0.2 - 24 A
1604	Time Delay	0 - 60 s
1610	Freeze Wfm1	on Pickup, on Trip, or None
1611	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.10 50N Neutral or Ground Configuration, Major Block 1600

This function is similar to the phase instantaneous overcurrent function described in section 3.7.5, except that the protection responds to current input to the fourth (internal) CT. The form of protection provided depends on the manner in which the external CTs are connected to the ISGS relay. Figure 3.4 shows the correct CT connections and polarities.

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (1510 and 1511). For this protection element, the default for buffer 1 is "on Trip" and for buffer 2 it is "None." These settings are not included in the alternate parameter sets.

The settings for neutral/ground instantaneous overcurrent (50N) are independent of the settings for phase instantaneous overcurrent (50) and the time overcurrent settings (51 and 51N).

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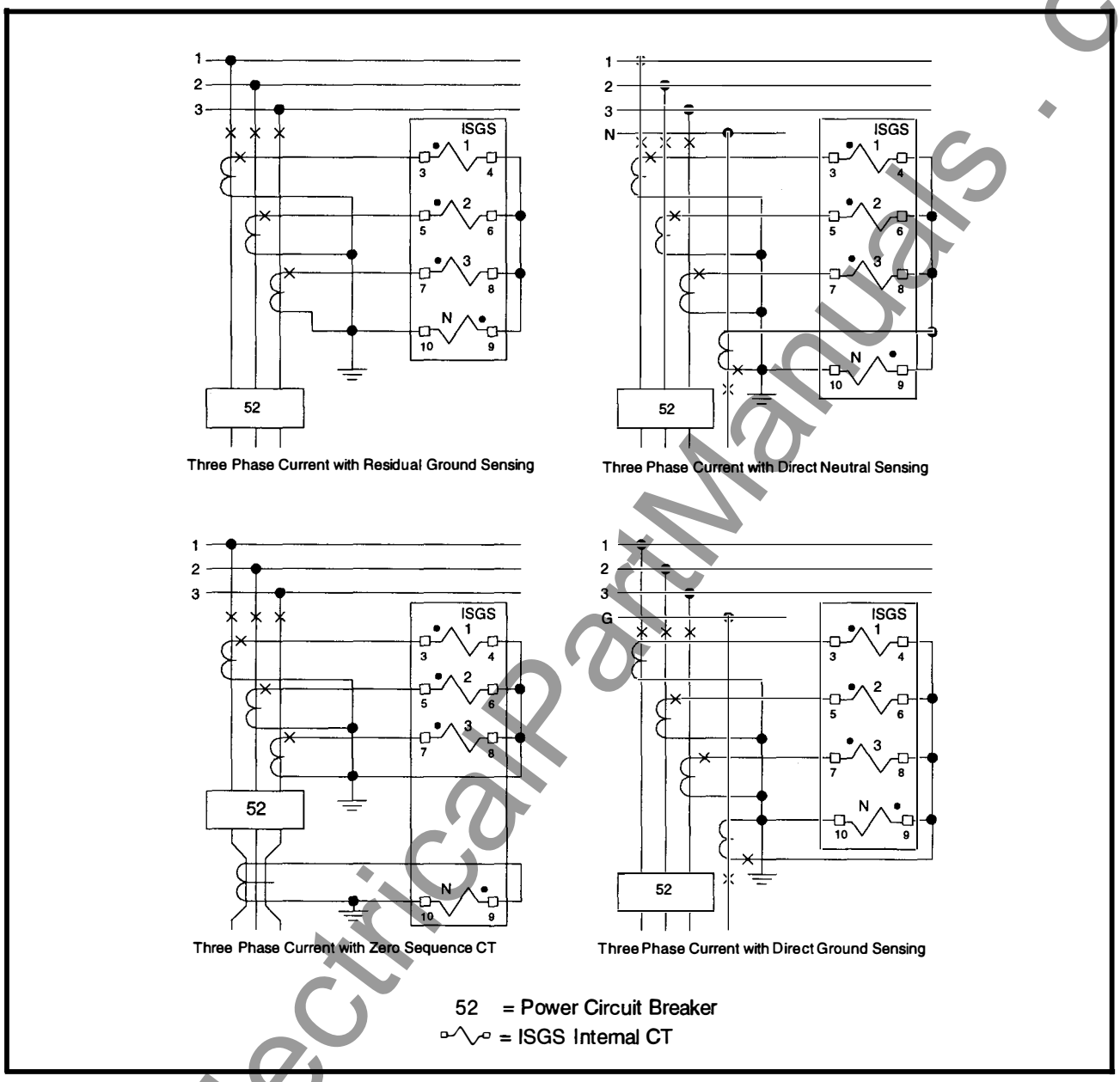

Figure 3.4. Current Transformer Configuration

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3.7.7 Overcurrent Time Phase 51 (Address 1700)

Use this address block to change the time phase overcurrent curve, pickup, time dial, and filter. Refer to Appendix A for detailed trip curve information. The available relay subaddresses are listed in Table 3.11.

Subaddress	Parameter	Selection
1702	Curve	Inverse, Short Inverse, Long Inverse, Moderately Inverse, Custom, Very Inverse, Extremely Inverse, Definite Inverse, Slightly Inverse, I2T w/o Limit
1703	Pickup	5 A CT's: 0.5- 20 A or 1 A CT's: 0.1 - 4 A
1705	Time Dial	0.1 - 9.9
1706	Filter	rms or Fundamental
1710	Freeze Wfm1	on Pickup, on Trip, or None
1711	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.11 51 Phase Configuration, Major Block 1700

The phase time overcurrent protection begins timing when any individual phase current exceeds the pickup current setting (1705). The phase time overcurrent protection cannot be disabled. The time overcurrent characteristic curve (1702) may be selected from one of the curves preprogrammed in the relay, or a custom curve may be programmed. For the preprogrammed curves, the time dial (1705) may be adjusted from 0.1 to 9.9, in steps of 0.1. The function may be configured (1706) to respond on the basis of rms sensing (fundamental plus harmonics), or on the basis of the fundamental current value only (ignores harmonics).

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (1710 and 1711). For this protection element, the default for buffer 1 is "on Trip" and for buffer 2 it is "None." These settings are not included in the alternate parameter sets.

The settings for phase time overcurrent (51) are independent of the settings for ground time overcurrent (51N) and the instantaneous overcurrent settings (50 and 50N).

3.7.8 Overcurrent Time Neutral or Ground 51N (Address 1800)

Use this address block to change the time neutral/ground overcurrent curve, pickup, time dial, and filter. Refer to Appendix A for detailed trip curve information. The available relay subaddresses are listed in Table 3.12.

Subaddress	Parameter	Selection
1801	Function	Enable or Disable
1802	Curve	Inverse, Short Inverse, Long Inverse, Moderately Inverse, Custom, Very Inverse, Extremely Inverse, Definite Inverse, Slightly Inverse, I2T w/o Limit
1803	Pickup	5 A CT's: 0.5 - 20 A or 1 A CT's: 0.1 - 4 A
1805	Time Dial	0.1 - 9.9
1806	Filter	rms or Fundamental
1810	Freeze Wfm1	on Pickup, on Trip, or None
1811	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.12 51N Neutral or Ground Configuration, Major Block 1800

This function is similar to the phase time overcurrent element described in section 3.7.7, except that the protection responds to current input to the fourth (internal) CT, and this protection can be enabled or disabled. The form of protection provided depends on the manner in which the external CT's are connected to the ISGS relay. Figure 3.4 shows the correct CT connections and polarities.

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (1810 and 1811). For this protection element, the default for buffer 1 is "on Trip" and for buffer 2 it is "None." These settings are not included in the alternate parameter sets.

The settings for neutral/ground time overcurrent (51N) are independent of the settings for phase time overcurrent (51) and the instantaneous overcurrent settings (50 and 50N).

3.7.9 Directional Time Overcurrent Phase 67 (Address 1900)

Use this address block to change the *directional* time phase overcurrent curve, pickup, time dial, and filter. In addition, the directional sensitivity relative to normal power flow (forward or reverse), and the angle of the directional characteristic in the complex plane are specified. Refer to Appendix A for detailed trip curve information. This protective function is available only if the voltage input option is installed on the relay. The associated relay subaddresses are listed in Table 3.13.

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Subaddress	Parameter	Selection
1901	Function	Enable or Disable
1902	Curve	Inverse, Short Inverse, Long Inverse, Moderately Inverse, Very Inverse, Extremely Inverse, Definite Inverse, Slightly Inverse, I2T w/o Limit
1903	Pickup	5 A CT's: 0.5 - 20 A or 1 A CT's: 0.1 - 4 A
1905	Time Dial	0.1 - 9.9
1906	Filter	rms or Fundamental
1907	Impedance	0 - 90°
1908	Direction	Forward or Reverse
1910	Freeze Wfm1	on Pickup, on Trip, or None
1911	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.13 67 Directional Phase Configuration, Major Block 1900

The directional phase time overcurrent function begins timing when any individual phase current exceeds the pickup current setting (1903). The time overcurrent characteristic curve (1902) may be selected from one of the curves preprogrammed in the relay. For the preprogrammed curves, the time dial (1905) may be adjusted from 0.1 to 9.9, in steps of 0.1. The protection may be configured (1906) to respond on the basis of rms sensing (fundamental plus harmonics), or on the basis of the fundamental current value only (ignores harmonics).

The directional sensitivity is determined by the setting at address 1908. A setting of "Forward" will allow the directional protection element to pickup on fault current only in the direction of normal power flow. A setting of "Reverse" will allow the directional protection element to pickup on fault current only in the direction opposite to normal power flow. The angle specified at address 1907 (Impedance) sets the angle of the directional characteristic (line) in the complex impedance plane as shown in Figure 3.5. The directional characteristic is always perpendicular to the line impedance vector.

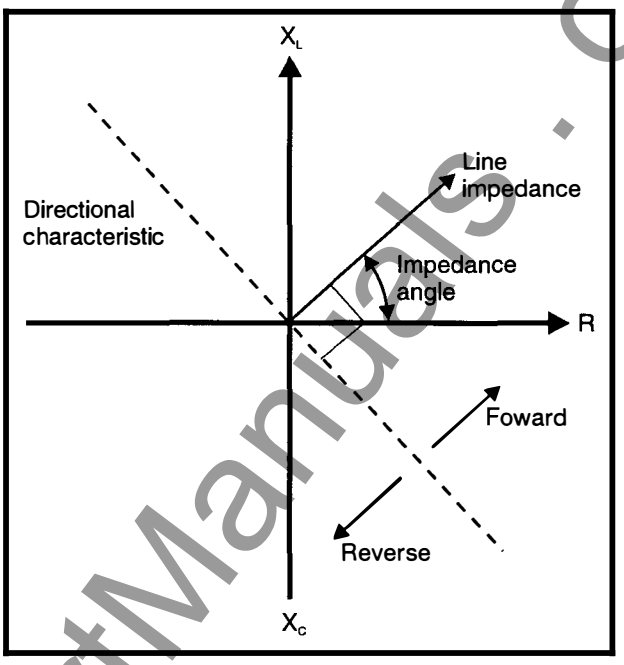

Figure 3.5. Directional Overcurrent Characteristic

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (1910 and 1911). For this protection element, the default for both buffers 1 is "None." These settings are not included in the alternate parameter sets.

The settings for directional phase time overcurrent (67) are independent of the settings for directional neutral/ground time overcurrent (67N) and the nondirectional overcurrent settings (50, 50N, 51, and 51N).

3.7.10 Directional Time Overcurrent Neutral or Ground 67N (Address 2000)

Use this address block to change the *directional* time neutral/ground overcurrent curve, pickup, time dial, and filter. In addition, the directional sensitivity relative to normal power flow (forward or reverse), and the angle of the directional characteristic in the complex plane are specified. Refer to Appendix A for detailed trip curve information. This protective function is available only if the voltage input option is installed on the relay. The associated relay subaddresses are listed in Table 3.14.

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Subaddress	Parameter	Selection
2001	Function	Enable or Disable
2002	Curve	Inverse, Short Inverse, Long Inverse, Moderately Inverse, Very Inverse, Extremely Inverse, Definite Inverse, Slightly Inverse, I2T w/o Limit
2003	Pickup	5 A CT's: 0.5 - 20 A or 1 A CT's: 0.1 - 4 A
2005	Time Dial	0.1 - 9.9
2006	Filter	rms or Fundamental
2007	Impedance	0 - 90°
2008	Direction	Forward or Reverse
2010	Freeze Wfm1	on Pickup, on Trip, or None
2011	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.14 67N Directional Neutral/Ground Configuration, Major Block 2000

This protection function is similar to the directional phase time overcurrent function described in section 3.7.9, except that the protection responds to current input to the fourth (internal) CT. The form of protection provided depends on the manner in which the external CT's are connected to the ISGS relay. Figure 3.4 shows the correct CT connections and polarities.

Application of function 67N requires 3 VTs connected line-to-ground in order to determine direction. The relay uses $3V_0$ as the polarizing quantity.

The settings for directional neutral/ground time overcurrent (67N) are independent of the settings for directional phase time overcurrent (67) and the nondirectional overcurrent settings (50, 50N, 51, and 51N).

3.7.11 Overvoltage 59 (Address 2200)

Use this address block to change the overvoltage protection settings. The voltage type, pickup value, and time characteristic may be specified. Refer to Appendix A for detailed trip curve information. This protection function is available only if the voltage input option is installed on the relay. The associated relay subaddresses are listed in Table 3.15.

Subaddress	Parameter	Selection
2201	Function	Enable or Disable
2202	Curve	Definite Time, Inverse Time
2203	TripOnVolt	Line-to-Neutral, Line-to-Line
2204	Pickup	40 - 260 V
2205	Time Delay (definite time)	0.1 - 60.0 s
2206	Time Dial (inverse time	0.1 - 9.9
2210	Freeze Wfm1	on Pickup, on Trip, or None
2211	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.15 59 Overvoltage Configuration, Major Block 2200

This protection element responds to an overvoltage condition as determined by the protection settings. The element may be disabled or enabled (2201), the voltage type which is monitored is selected (2203), and the voltage value for pickup (2204) is specified.

If the VTs are connected line-to-neutral, the voltage type selected can be either line-to-line or line-to-neutral. If the VTs are connected line-to-line, only the line-to-line voltage type may be selected. In either case, the maximum normal voltage would be 150 volts as measured line-to-line.

The trip delay can be selected as either definite time or inverse time (2202). If definite time is selected, the trip delay is specified in seconds at address 2205. If inverse time is selected, the time dial value is specified in address 2206.

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (2210 and 2211). For this protection element, the default for both buffers is "None." These settings are not included in the alternate parameter sets.

3.7.12 Undervoltage 27 (Address 2300)

Use this address block to change the undervoltage protection settings. The voltage type, pickup value, and time characteristic may be specified. Refer to Appendix A for detailed trip curve information. This protective function is available only if the voltage input option is installed on the relay. The associated relay subaddresses are listed in Table 3.16.

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Subaddress	Parameter	Selection
2301	Function	Enable or Disable
2302	Curve	Definite Time, Inverse Time
2303	TripOnVolt	Line-to-Neutral, Line-to-Line
2304	Pickup	40 - 260 V
2305	Time Delay (definite time)	0.1 - 60.0 s
2306	Time Dial (inverse time	0.1 - 9.9
2310	Freeze Wfm1	on Pickup, on Trip, or None
2311	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.16 27 Undervoltage Configuration, Major Block 2300

This protective function responds to an undervoltage condition as determined by the protection settings. The element may be disabled or enabled (2301), the voltage type which is monitored is selected (2303), and the voltage value for pickup (2304) is specified.

If the VTs are connected line-to-neutral, the voltage type selected can be either line-to-line or line-to-neutral. If the VTs are connected line-to-line, only the line-to-line voltage type may be selected. In either case, the maximum normal voltage would be 150 volts as measured line-to-line.

The trip delay can be selected as either definite time or inverse time (2302). If definite time is selected, the trip delay is specified in seconds at address 2305. If inverse time is selected, the time dial value is specified in address 2306.

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (2310 and 2311). For this protection element, the default for both buffers is "None." These settings are not included in the alternate parameter sets.

3.7.13 Phase Sequence Voltage 47 (Address 2400)

Use this address block to change the phase sequence voltage protection settings. The function may be enabled or disable. This protective function is available only in the voltage input option is installed on the relay. These parameters are not included in the alternate parameter sets. The associated relay subaddresses are listed Table 3.17.

Subaddress	Parameter	Selection
2401	Function	Enable or Disable
2410	Freeze Wfm1	on Pickup, on Trip, or None
2411	Freeze Wfm2	on Pickup, on Trip, or None

Table 3.17 47 Phase Sequence Voltage Configuration, Major Block 2400

This protection element responds to an incorrect voltage phase sequence condition. The correct phase sequence is defined at address 1003 in the device configuration. The element may be disabled or enabled (2401). There is no trip delay. This protection element does not function if the input voltage is less than 40 volts.

Each of the two waveform capture buffers can be independently programmed to freeze the snapshot on pickup, on trip, or not at all (2410 and 2411). For this protection element, the default for both buffers is "None."

3.7.14 Breaker Failure 50BF (Address 2800)

Use this address block to change the breaker failure protection settings. The pickup value and trip delay may be specified. The associated relay subaddresses are listed in Table 3.18. These parameters are not included in the alternate parameter sets.

Subaddress	Parameter	Selection
2801	Function	Enable or Disable
2802	Pickup	5 A CT's: 0.1 - 5 A or 1 A CT's: 0.02 - 1 A
2804	Time Delay	8 - 254 cycles

Table 3.18 50BF Breaker Failure Configuration, Major Block 2800

This protective function responds to a fault condition where current flow is not interrupted after a trip has been issued to the circuit breaker. The element may be disabled or enabled (2801) and the maximum allowable current after a trip is specified (2802). The trip delay (in cycles) is set in address 2804.

In operation, the protective function, when enabled, will begin to monitor the current flow in the circuit following a trip command by the relay. Simultaneously, the protective function starts a timer. If the current flow does not drop below the pickup value specified in address 2803 before the time delay specified in address 2804 has elapsed, a breaker failure is assumed. At this point an another trip command can be issued to a different breaker.

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Breaker failure protection monitors the current flow only following a trip by the contact identified at address 1004 (see section 3.7.1). Normally, this is the contact matrixed to the overcurrent protection (see section 3.11).

3.8 Alarm Setpoints (Address 3000)

Use this address block to set up the alarm reporting thresholds for the relay. To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary. Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4.

3.8.1 Demand Parameters (Address 3100)

Use this address block to select the time periods for the demand calculations performed by the relay. A demand interval can be set for 15, 30, or 60 minutes and can contain one or more subperiods. The minimum number of measurement intervals in a subperiod is 10.

Setpoints for average ampere demand and kilowatt demand are available. For these setpoints the functions may be enabled or disabled and threshold values specified. The available relay subaddresses are listed in Table 3.19.

Subaddress	Parameter	Selection
3101	(Demand) Interval	15, 30, or 60 min
3102	Sync Time	0, 15, 30, or 45 after hour
3103	# Subperiods for demand interval of 60 min	1, 2, 3, 4, 6, or 12
3104	# Subperiods for demand interval of 30 min	1, 2, 3, or 6
3105	# Subperiods for demand interval of 15 min	1 or 3
3106	Over A Demand	Enable or Disable
3107	Over A Demand	0 - 9,999 A
3108	Over kW Demand	Enable or Disable
3109	Over kW Demand	0 - 999,999.99 kW

Table 3.19 Demand Parameter Configuration, Major Block 3100

3.8.2 Power Parameters (Address 3200)

Use this address block to set parameters for the power setpoints. Setpoints for kVAR, kVA, leading power factor, and lagging power factor are available. In each case the setpoints may be enabled or disabled, and have a threshold value and pickup time delay specified. For the power factor setpoints, the sign of the pickup value (leading or lagging) may be specified.

The PFLEAD function will activate when the change in power factor crosses the pickup value while decreasing toward a more *leading* or *negative* power factor. The PFLAG function will activate when the change in power factor crosses the pickup value while increasing toward a more *lagging* or *positive* power factor. See Figure 3.6. By setting thresholds for both PFLEAD and PFLAG, an allowable power factor window can be defined.

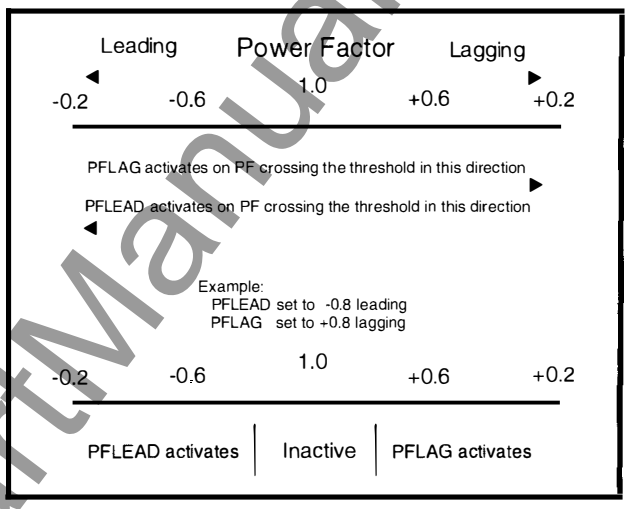

Figure 3.6. Leading and Lagging Power Factor Setpoints

The available relay subaddresses are listed in Table 3.20.

Subaddress	Parameter	Selection
3201	Over kVAR	Enabled or Disabled
3202	Pickup	0 - 999,999.99 kVAR
3203	Time Delay	0 - 3600 s
3204	Over kVA	Enabled or Disabled
3205	Pickup	0 - 999,999.99 kVA
3206	Time Delay	0 - 3600 s
3207	Over PFLEAD	Enabled or Disabled
3208	Pickup	0.2 - 1.0
3209	Sign (of pickup value)	Lead (+) or Lag (-)
3210	Time Delay	0 - 3600 s
3211	Over PFLAG	Enabled or Disabled
3212	Pickup	0.2 - 1.0
3213	Sign (of pickup value)	Lead (+) or Lag (-)
3214	Time Delay	0 - 3600 s

Table 3.20 Power Parameter Configuration, Major block 3200

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3.9 Metering (Addresses 1400 and 4000)

Address block 1400 contains the breaker operation statistics. Address blocks 4100-4900 display metered values. The base relay displays current values and associated logs. If equipped with the voltage input option, the ISGS relay also provides metering for voltage, power, and frequency.

3.9.1 Breaker Statistics (Address 1400)

The breaker statistics that can be displayed beginning at address 1401 include a count of the number of breaker operations, and the accumulated interrupted current for each of the three poles. Table 3.21 identifies each of the available statistics by address.

Subaddress	Data	Range
1401	Breaker Ops	0 - 65535 (count)
1402	Σ Iint Ph1	0.0 kA - 99.9 MA
1403	Σ Iint Ph2	0.0 kA - 99.9 MA
1404	Σ Iint Ph3	0.0 kA - 99.9 MA

Table 3.21 Breaker Statistics, Major Block 1400

3.9.2 Current Metering (Address 4100)

Use this address block to display the metered current and current demand values for the relay. The available monitored current parameters are listed in Table 3.22.

The relay will measure and display the rms values of the current for the three phases and ground/neutral.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Range
4101	Amps Ph A	0 - 250% I_n
4102	Amps Ph B	0 - 250% I_n
4103	Amps Ph C	0 - 250% I_n
4104	Amps Neutral	0 - 250% I_n
4105	Amps Avg	0 - 250% I_n
4106	Amps Dmd A	0 - 250% I_n
4107	Amps Dmd B	0 - 250% I_n
4108	Amps Dmd C	0 - 250% I_n
4109	Amps Dmd Avg	0 - 250% I_n

Table 3.22 Current Metering, Major Block 4100

3.9.3 Voltage Metering (Address 4200)

Use this address block to display the metered voltage values for the relay. The available measured values are listed in Table 3.23. No voltages are measured without the installation of the voltage input option.

The rms voltage measurements for this function will be dependent upon the selected VT connection method, either line-to-ground or line-to-line.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Range
4201	Volts 1-2	10 - 125% V_n
4202	Volts 2-3	10 - 125% V_n
4203	Volts 3-1	10 - 125% V_n
4204	Volt LLavg	10 - 125% V_n
4205	Volts 1-N	10 - 125% V_n
4206	Volts 2-N	10 - 125% V_n
4207	Volts 3-N	10 - 125% V_n
4208	Volt LNavg	10 - 125% V_n

Table 3.23 Voltage Metering, Major Block 4200

3.9.4 Power Metering (Address 4300)

Use this address block to display the power metering function. The available measured values are listed in Table 3.24. No power is metered without the installation of the voltage input option.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Range
4301	kW 3-Phase	0 - 999,999.99 kW
4302	kW hours	0 - 999,999.99 kWHR
4303	kW Demand	0 - 999,999.99 kWD
4304	kVA 3-Phase	0 - 999,999.99 kVA
4305	kVAR 3-Phase	0 - 999,999.99 kVAR
4306	kVAR hours	0 - 999,999.99 kVARH
4307	PF	-1 - 0 - +1

Table 3.24 Power Metering, Major Block 4300

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3.9.5 Frequency Metering (Address 4400)

Use this address block to display the system frequency. The available measured value is listed in Table 3.25.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Range
4401	Frequency	45 - 65 Hz

Table 3.25 Frequency Metering, Major Block 4400

3.9.6 Min/Max Log Amps (Address 4600)

Use this address block to display the minimum and maximum current values measured by the relay. The available measured values are listed in Table 3.26.

This log contains minimum and maximum values measured by the relay while not in pickup. The collected information is compared against previously stored values and the log is updated. All logged values are time stamped and resetting the log (see section 3.13.2, address block 8200) will reset all log values.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Description
4601	I1 min	Phase 1 minimum current
4602	I1 max	Phase 1 maximum current
4603	I2 min	Phase 2 minimum current
4604	I2 max	Phase 2 maximum current
4605	I3 min	Phase 3 minimum current
4606	I3 max	Phase 3 maximum current
4607	IN min	Ground minimum current
4608	IN max	Ground maximum current
4609	Iavmin	Minimum average current
4610	Iavmax	Maximum average current
4611	I1dmin	Minimum demand current on Phase 1
4612	I1dmax	Maximum demand current on Phase 1
4613	I2dmin	Minimum demand current on Phase 2
4614	I2dmax	Maximum demand current on Phase 2
4615	I3dmin	Minimum demand current on Phase 3
4616	I3dmax	Maximum demand current on Phase 3
4617	Iavdmin	Minimum average demand calculated
4618	Iavdmax	Maximum average demand calculated

Table 3.26 Current Min/Max Log, Major Block 4600

3.9.7 Min/Max Log Volts (Address 4700)

Use this address block to display the minimum and maximum voltage values measured by the relay. The available measured values are listed in Table 3.27. No voltages are metered unless the voltage input option is installed.

This log contains minimum and maximum values gathered by the relay while not in pickup. The collected information is compared against previously stored values and the log is updated. All logged values are time stamped and resetting the log (see section 3.13.2, address block 8200) will reset all log values.

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Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Description
4701	V12 min	Minimum phase voltage between phases 1 and 2
4702	V12 max	Maximum phase voltage between phases 1 and 2
4703	V23 min	Minimum phase voltage between phases 2 and 3
4704	V23 max	Maximum phase voltage between phases 2 and 3
4705	V31 min	Minimum phase voltage between phases 3 and 1
4706	V31 max	Maximum phase voltage between phases 3 and 1
4707	V1 min	Minimum voltage value on phase 1
4708	V1 max	Maximum voltage value on phase 1
4709	V2 min	Minimum voltage value on phase 2
4710	V2 max	Maximum voltage value on phase 2
4711	V3 min	Minimum voltage value on phase 3
4712	V3 max	Maximum voltage value on phase 3
4713	Vavmin	Minimum average voltage value
4714	Vavmax	Maximum average voltage value

Table 3.27 Voltage Min/Max Log, Major Block 4700

3.9.8 Min/Max Log Power (Address 4800)

Use this address block to display the minimum and maximum power values monitored by the relay. The available monitored parameters are listed in Table 3.28. No power is metered unless the voltage input option is installed.

This log contains minimum and maximum values gathered by the relay while not in pickup. The collected information is compared against previously stored values and the log is updated. All logged values are time stamped and resetting the log (see section 3.13.2, address block 8200) will reset all log values.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Description
4801	kW min	Minimum power value
4802	kW max	Maximum power value
4803	kWdemin	Minimum active power demand value
4804	kWdemax	Maximum active power demand value
4805	kVAmin	Minimum volt-amps value
4806	kVAmax	Maximum volt-amps value
4807	kVARmin	Minimum volt-amps reactive value
4808	kVARmax	Maximum volt-amps reactive value
4809	PFMax	Maximum power factor value
4810	PFMin	Minimum power factor value

Table 3.28 Power Min/Max Log, Major Block 4800

3.9.9 Min/Max Log Frequency (Address 4900)

Use this address block to display the minimum and maximum frequency values monitored by the relay. The available monitored parameters are listed in Table 3.29.

This log contains minimum and maximum values gathered by the relay while not in pickup. The collected information is compared against previously stored values and the log is updated. All logged values are time stamped and resetting the log (see section 3.13.2, address block 8200) will reset all log values.

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4.

Subaddress	Data	Description
4901	Fmin	Minimum frequency value
4902	Fmax	Maximum frequency value

Table 3.29 Frequency Min/Max Log, Major Block 4900

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3.10 Internal Logs

The ISGS relay has two kinds of internal logs - an Event Log and a set of Trip Logs.

3.10.1 Event Log

The Event Log is a chronological record of the significant events that occur during operation of the relay. These events include operational events such as enabling or disabling protective elements, and fault events such as pickup and trip. Each entry in the log provides a description of the event and its time and date of occurrence.

This log cannot be viewed through the ISGS relay operator panel. It can only be viewed after being retrieved through one of the relay communication ports using either Wisdom (personal computer) or WinPM (ACCESS system) software.

3.10.2 Trip Logs (Addresses 5100 -5800)

Use address blocks 5100 through 5800 to display the trip information. There are eight trip logs, which allows the relay to store the last eight trip events. The trip log addresses are 5100 through 5800. The most recent trip event is stored under address 5100 and the oldest of the eight trip events is stored in address 5800.

The available monitored parameters are listed in Table 3.30. If no data has been recorded in the log, subaddress 001 will display "Table empty."

Access the desired subaddress using steps 1-3 of the standard operation sequence, Table 3.4. An alternative to using the **Direct Addr** key is to use the **Trip Log** key. This displays major address block 5000, from which the eight trip logs can be reached by scrolling with the arrow keys.

Subaddress	Data	Description
001	Trip #	Date and the event record number
002	Pickup Time	Time of the event to the millisecond
003	Pickup	The protection element that picked up
004	Phase	The phase that picked up
005	I1	Current at pickup for phase 1
006	I2	Current at pickup for phase 2
007	I3	Current at pickup for phase 3
008	IN	Ground current at pickup
009	V1	Voltage at pickup phase 1 (1-2*)
010	V2	Voltage at pickup phase 2 (2-3*)
011	V3	Voltage at pickup phase 3 (3-1*)
012	Trip	Protection element that initiated the trip
013	Phase	The phase that caused the trip
014	I1	Current at trip for phase 1
015	I2	Current at trip for phase 2
016	I3	Current at trip for phase 3
017	IN	Ground current at trip
018	V1	Voltage at trip phase 1 (1-2*)
019	V2	Voltage at trip phase 2 (2-3*)
020	V3	Voltage at trip phase 3 (3-1*)
021	TinPU	Total time in pickup
022	End of table	Last entry in this log
* If VTs are connected line-to-line (see address 1202, section 3.7.3), the line-to-line voltage is displayed.		

Table 3.30 Trip Log, Major Blocks 5100-5800

Table 3.30 Trip Log, Major Blocks 5100-5800 (Continued)

3.11 Matrixing (Address 6400)

Matrixing connects a protective element or other function to an output contact. For example, output contact Trip 1 can be matrixed (connected) to protective elements 50 and 50N, while output contact Trip 2 can be matrixed to elements 51 and 51N. In a second example, all overcurrent elements might be matrixed to output contact Trip 1, while output contact Trip 2 is matrixed to respond to a communications command (event), and is connected in the circuit breaker close circuit. In this latter example, the configuration would allow closing of the circuit breaker by a remote signal over the communications channel.

Up to 20 functions can be matrixed to each output contact.

The factory presettings matrix the overcurrent protection to Trip Contact 1 which is also the factory presetting for the Breaker Connection at address 1004. In any case, the overcurrent protection should be matrixed to the same contact as selected at address 1004, since activation of this contact also activates breaker failure (50BF) monitoring (see section 3.7.14).

Note: The process of matrixing includes definition of which protective functions can actuate an output relay (contact), and which output relay (contact) they actuate. Because of

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this, it is extremely important that the physical wiring connections of the protective circuit, including connections to the circuit breaker, match the output connections of the relay. If the matrixing of the ISGS relay is changed, double-check conformance to the wiring of the protective circuit, and always perform a test to assure that operation of a protective function results in tripping of the circuit breaker.

Note: Do not change matrixing of ISGS relay when the associated primary circuit is in service. In order to change matrixing, the ISGS relay must reinitialize. During reinitialization, the ISGS relay does not provide protection.

Use address block 6400 to display or change matrix information for Trip Contact 1 and Trip Contact 2. The available parameters are listed in Figure 3.7.

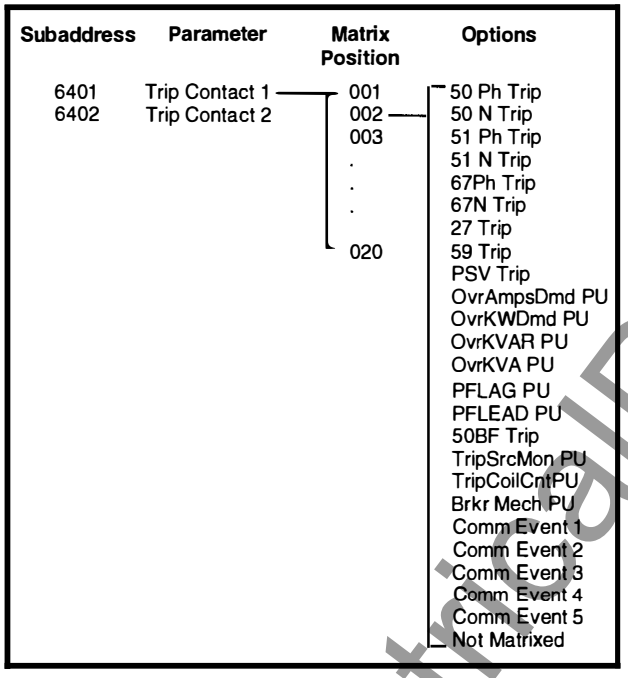

Figure 3.7. Matrix Menu Structure

To configure the matrixing:

1. Ensure power is applied to the relay, the System LED is on, then press the **Direct Addr** key.

2. Enter "6400" using the numeric keypad and press the **Enter** key.

3. Use the **arrow** keys and scroll to the desired subaddress listed in Figure 3.7, or press the **Direct Addr** key and enter the subaddress via the numeric keypad and press the **Enter** key.

4. Press the **F** key and use the **arrow** keys to scroll to the desired matrix position (001-020).

5. Press the **Password** key and enter the password "000000" and press the **Enter** key. The message "PW ACCEPTED" will appear on the display.

6. Press the **Enter** key again and the relay will return to the parameter you wanted to change; observe the blinking display cursor. If the display cursor is not blinking, you will be unable to change a parameter; retry the last step.

7. Press the **No** key until the desired matrixing option appears on the relay display and press the **Enter** key. Scroll to the next matrix position to change additional parameters or proceed to the next step.

8. Press the **F** key and then the **Enter** key. The message "SAVE NEW SETTING" will be displayed.

9. Press the **Yes** key and the ISGS relay will reset to the new parameters.

3.12 Operating Parameters (Address 7000)

3.12.1 Power On Meter Display (Address 7000)

Use this address block to select which metered values will displayed by the Power On Meter Display (see section 3.6.2). Two values may be displayed - one in each of the two lines of the LCD. The available parameters are listed in Table 3.31.

Subaddress	Parameter	Selection
7005	LCD Line 1	Ix (x = 1, 2, 3, or N) Iavg Idmdx (x = 1, 2, or 3) Idmdavg Vx (x = 1-2, 2-3, or 3-1) VLLavg Vx-N (x = 1, 2, or 3) VLNavg W WH Wdmd VA VAR VARH PF f
7006	LCD Line 2	(same as 7005)

Table 3.31 Power On Meter Display Configuration, Major Block 7000

3.12.2 Alternate Parameter Sets

The ISGS relay supports two sets of protection settings, denoted as parameter set A and parameter set B. The relay uses the parameter set designated as the active set in major address block 7100. The parameter sets may be configured as the system needs dictate. For example, parameter set A may be used for protective settings used in the summertime, whereas parameter set B might comprise the settings appropriate to winter, when lower ambient temperatures could allow higher loading than in the summer. Alternatively, parameter set A might be for normal production periods, with parameter set B for construction, periodic shutdowns

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periods, or the like. Use the functions in address block 7100 to switch between primary and alternate relay parameter sets.

Configuration of the front port (RS-232) and SEAbus (rear) port (RS-485) is found under address block 7200.

3.12.3 Parameter Set (Address 7100)

Use this address block to display the active relay parameter set, switch to the alternate set, and copy parameters between parameter set address locations. The displayed parameter set (as indicated by an "A" or "B" next to the parameter block number) is not necessarily the active parameter set. The parameter value can be changed for each parameter, but you must go to the 7101 subaddress location to see which parameter set is active, or subaddress 7103 to change to the desired active parameter set. The available operations are listed in Table 3.32. The flow chart in Figure 3.8 illustrates how to use the operations in Table 3.32. To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary.

Protective functions for which alternate parameter sets are available are indicated in Table 3.3.

Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4. Address 7101 displays the currently active parameter set, and address 7103 is used to change from one parameter set to the other.

Subaddress	Parameter	Description
7101	Active Set	Displays active parameter set (A or B)
7103	Activation	Activates the other parameter set
7104	Copy	Copies the default parameter set to set A
7105	Copy	Copies the default parameter set to set B
7106	Copy	Copies parameter set A to set B
7107	Copy	Copies parameter set B to set A

Table 3.32 Parameter Set Configuration, Major Block 7100

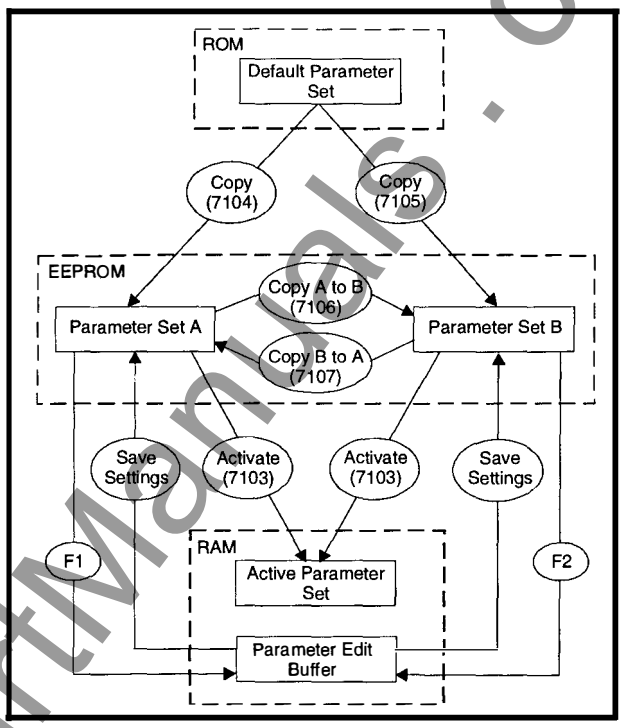

Figure 3.8. Altering and Activating Parameter Sets

3.12.4 Configure Communications Port SEAbus (Address 7200)

Use this address block to set the local and remote port baud rates, allow remote communication event functions, allow remote parameter set changes, and set the relay local address. The available operations and parameters are listed in Table 3.33. To make parameter changes, you must first enter the password. If you only want to review present settings, the password step is not necessary.

Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4.

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Subaddress	Parameter	Description	Selection
7201	Local Port	Set front port baud rate	2400, 4800, 9600, 19200
7202	System	Set rear port baud rate	2400, 4800, 9600, 19200
7203	ParaChange	Allows remote parameter set change	Enable or Disable
7204	Com Events	Allows remote comm event	Enable or Disable
7207	Local Addr	Sets relay SEAbus address	1 - 254

Table 3.33 Communications Port Configuration, Major Block 7200

3.13 Other Settings (Address 8000)

Use these address blocks to set the relay time and date, perform log resets, enable breaker monitoring functions, and specify the amount of prefault data for the waveform capture function.

3.13.1 Time and Date Setting (Address 8100)

Use this address block to set the time and date of the ISGS relay's internal clock. The available operations and parameters are listed in Table 3.34. To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary.

Perform parameter changes using steps 1-7 and 9 of the standard operation sequence, Table 3.4.

To enter the date at address 8102, separate the month, day, and year with a decimal point. Each field must contain two digits with the exception of the year field which will contain four digits (MM.DD.YYYY).

To enter time at address 8103 on a 24 hour basis, separate the hours, minutes, and second fields with a decimal point; each field must contain two digits (HH.MM.SS).

If the ISGS relay is connected to a Siemens ACCESS system, the system will periodically update the time and date in the relay. If not connected to an ACCESS communications network, the time stored in the relay will tend to drift over time.

Subaddress	Parameter	Description
8000	NA	Current Date and Time
8102	Date	Set Date
8103	Time	Set Time

Table 3.34 Time and Date, Major Block 8100

3.13.2 Resets (Address 8200)

Use this address block to reset the trip log, min/max log, and/or energy log. Performing the reset operation for an individual category will reset all values within that category. The available operations and parameters are listed in Table 3.35.

Resetting of logs requires use of the password. Reset logs using steps 1-5 and 8-9 of the standard operation sequence, Table 3.4. At step 8, after the **Yes** key is pressed, the ISGS relay will display the message "IN PROGRESS," followed by the message "SUCCESSFUL."

Subaddress	Parameter	Selection
8201	Reset Trip Log ?	Yes or No
8202	Reset Min/Max Values ?	Yes or No
8203	Reset Energy Log ?	Yes or No
8204	Reset Breaker Ops ?	Yes or No

Table 3.35 Log Reset, Major Block 8200

3.13.3 Breaker Monitoring (Address 8300)

Use this address block to enable or disable Trip Source monitoring, Trip Coil monitoring, and Breaker Mechanism monitoring functions for the relay. The available operations and parameters are listed in Table 3.36. To make parameter changes, you must first enter the password. If you only want to review present settings, the password steps 4 and 5 are not necessary.

Refer to Appendix C for additional details on breaker monitoring.

Perform parameter changes using steps 1-9 of the standard operation sequence, Table 3.4.

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Subaddress	Parameter	Selection
8301	TripSrcImp	Enable or Disable
8302	TripSrcFail	Yes or No
8303	TrpCoil Cont	Enable or Disable
8304	TrpCoilFail	Yes or No
8305	BrkrMech	Enable or Disable

Table 3.36 Breaker Monitoring, Major Block 8300

3.13.4 Waveform Capture (Address 8400)

Use this address block to change the waveform capture settings. The amount of prefault data may specified. The associated relay subaddresses are listed in Table 3.37. None of the waveform capture parameters are included in the alternate parameter sets.

Subaddress	Parameter	Range
8401	Wfm1PreTrip	10 - 900 ms
8402	Wfm2PreTrip	10 - 900 ms

Table 3.37 Waveform Capture Configuration, Major Block 8400

Two waveform capture buffers are provided. Each buffer can contain up to seven waveform records; i.e., four current records and three voltage records. Each record can contain up to 1000 milliseconds of data. The amount of prefault data contained in a "snapshot" can be set individually for each buffer (8401 and 8402). The prefault data setting for each buffer applies to all of the records contained in that buffer.

The waveform records are continuously updated during normal operation. In the event of a fault condition, the buffers can be frozen by selected events. These "snapshots" of the waveforms can then be read out for analysis through the front communications port (using ISGS Wisdom software).

Which event can freeze a buffer is determined by the setting of the Freeze Wfm1 and Freeze Wfm2 parameters provided in each of the protection function parameter blocks (e.g., addresses 1510 and 1511 in the instantaneous overcurrent block). In each case the event that freezes the buffer can be selected to be either pickup or trip. When a buffer is frozen by a particular event, it remains frozen until the next event programmed to freeze the buffer occurs. Then the old waveforms are overwritten with the new snapshots.

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4 Troubleshooting

4.1 Overview

The ISGS relay employs self-checking circuits and software so that calibration and adjustments are not required. Prior to installation, a simple check of functionality, using a commercially available relay test set, should be sufficient under most conditions.

In the event of problem occurrences during acceptance testing or after installation, the general problem determination information provided in this section should be helpful.

4.2 System

The green **System** LED is illuminated at all times when the relay is operating properly. When this LED is on, it indicates that:

1. control power is reaching the relay
2. the relay internal power supply is functioning normally
3. the relay microprocessing system is functioning normally (i.e., internal self-checking has found no problems)

The relay includes a "Relay disabled" contact which is open whenever the relay is operating normally. This contact will close whenever the relay self-checking system detects a internal problem or if power to the relay is removed. The contact can also be closed by the breaker monitoring function (refer to Appendix C).

If the green **System** LED is off or the "Relay disabled" contact is closed, check and ensure that correct power is being supplied to the relay power input terminals. If the relay is receiving correct power, there is likely an internal relay problem. Contact the nearest Siemens sales office for information on returning the relay to the factory for analysis.

4.3 Monitor Mode

To aid in factory testing, the ISGS relay includes software routines used only in the factory. These routines are not for use outside the factory. However, with some unique types of internal failures, this special test mode can be activated. When this happens, the LCD will display the message "Monitor Entry." If this message appears in the LCD, there is an internal relay failure, and the relay is no longer providing protection.

If the message described above appears, take the relay and its associated primary circuits out of service immediately. Then contact the nearest Siemens sales office for information on returning the relay to the factory for analysis.

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Appendix A Trip Curves

Use this section to observe the relationship between trip time and threshold levels. Determine which curve closely follows the requirements of your system and select the applicable curve when performing the settings in address blocks 1700 - 2000 (overcurrent), and 2200 - 2300 (over/undervoltage).

A.1 Standard Inverse Time Overcurrent Equations

Seven of the nine time inverse time overcurrent characteristics supported by the ISGS relay are based on suggested IEEE standards for approximation of electromechanical relays. The following equations describe the curves listed in Table A.1 below.

$$T = \frac{AD}{\left(\frac{i}{i_p}\right)^N - 1.00} + BD + 0.028$$

Where:

T=time to trip, in seconds

$\frac{i}{i_p}$ =multiple of pickup setting

D=time dial setting, 0.1 to 9.9 in steps of 0.1

A, B, and N = constants as follows:.

Curve Type	Designation	A	B	N
Inverse	SEA1	8.9341	0.17966	2.0938
Short Inverse	SEA2	0.2663	0.03393	1.2969
Long Inverse	SEA3	5.6143	2.18592	1.0000
Moderately Inverse	SEA4	0.3022	0.12840	0.5000
Very Inverse	SEA5	5.4678	0.10814	2.0469
Extremely Inverse	SEA6	7.7624	0.02758	2.0938
Slightly Inverse	SEA7	0.4797	0.21359	1.5625

Table A.1 Time-Current Characteristic Curve Constants

A.2 Definite Inverse Equations—SEA8

The ISGS relay provides an emulation of the popular CO-6 Definite Inverse characteristic, as defined by the following equations:

For $\frac{i}{i_p} > 1.5$:

$$T = \left[785 + \frac{671}{\left(\frac{i}{i_p} - 1.19\right)}\right] \times \frac{6.33D + 0.37}{24000} \quad (1)$$

For $1.0 < \frac{i}{i_p} < 1.5$:

$$T = \left[\frac{1475}{\left(\frac{i}{i_p} - 1\right)}\right] \times \frac{6.33D + 0.37}{24000} \quad (2)$$

Where:

T = time to trip, in seconds

$\frac{i}{i_p}$ = multiple of pickup setting

D = time dial setting, 0.1 to 9.9 in steps of 0.1

Equation (1) is valid for values of i/i_p greater than 1.5 and equation (2) is valid for values of i/i_p between 1.0 and 1.5. (Note that the equation is undefined at i/i_p = 1.0).

A.3 I^2t Equation

The ISGS relay provides an I^2t characteristic in addition to standard inverse curves.

$$T = \frac{50.7D + 10.14}{\left(\frac{i}{i_p}\right)^2}$$

Where:

T = time to trip, in seconds

$\frac{i}{i_p}$ = multiple of pickup setting

D = time dial setting, 0.1 to 9.9 in steps of 0.1

A.4 Custom Protective Curve

The custom curve consists of up to 60 current-time pairs corresponding to points on the time-current characteristic curve. Current refers to multiple-of-pickup value (i/i_p) on the horizontal axis, and time refers to time-to-trip values on the vertical axis. Each point consists of two values (i/i_p and *T*), loaded in order from lowest to highest value of i/i_p via the SEAbus or local ports. Siemens ISGS Wisdom software is

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required in order to load a custom curve. Time-to-trip has a range of 0.00 to 655.35 seconds in steps of 0.01 seconds. i/i_p has a range of 1.1 to 20.00 in steps of 0.01. The first point in the data set must be i/i_p =1.1, the last point must be i/i_p = 20. Points in between these two limits can be for any values of I/Ip and t as long as the slope ($\Delta T/(\Delta i/i_p)$) of the curve described by the points is between 0 (horizontal) and -∞ (vertical). For input current in excess of 20 x i_p, the relay will enter a definite time mode and the curve will be considered to be flat (constant time) at the time value associated with i/i_p = 20. Once loaded, a custom curve is not adjustable since there is no time dial adjustment.

A.5 Overvoltage Equations

The ISGS relay provides a moderately inverse overvoltage characteristic that is defined by the following equation:

For $1.01 \le \frac{v}{v_p} \le 1.5$:

$$T = \frac{AD}{\left(\frac{v}{v_p}\right)^N - 1} + BD$$

For $\frac{v}{v_p} > 1.5$:

$$T = \frac{AD}{(1.5)^N - 1} + BD$$

Where:

T=time to trip, in seconds

v = measured input voltage

v_p = pickup value ("tap setting")

$\frac{v}{v_p}$ = multiple of pickup setting

D = time dial setting, 0.1 to 9.9 in steps of 0.1

A, B, and N = constants which, for the moderately inverse curve, are:

A = 0.51
B = -0.45
N = 0.5

A.6 Undervoltage Equations

The ISGS relay provides aa moderately inverse undervoltage characteristic that is defined by the following equation:

For $0.5 \le \frac{v}{v_p} \le 0.99$:

$$T = \frac{AD}{\left(2 - \frac{v}{v_p}\right)^N - 1} + BD$$

For $\frac{v}{v_p} < 0.5$:

$$T = \frac{AD}{(1.5)^N - 1} + BD$$

Where:

T=time to trip, in seconds

v = measured input voltage

v_p = pickup value ("tap setting")

$\frac{v}{v_p}$ = multiple of pickup setting

D = time dial setting, 0.1 to 9.9 in steps of 0.1

A, B, and N = constants which, for the moderately inverse curve, are:

A = 0.51
B = -0.45
N = 0.5

A.7 Time-Current Characteristic Curves

The standard time-current characteristic curves are shown in Figure A.1 through Figure A.9.

A.8 Time-Voltage Characteristic Curves

The standard time-voltage characteristic curves are shown in Figure A.10 and Figure A.11.

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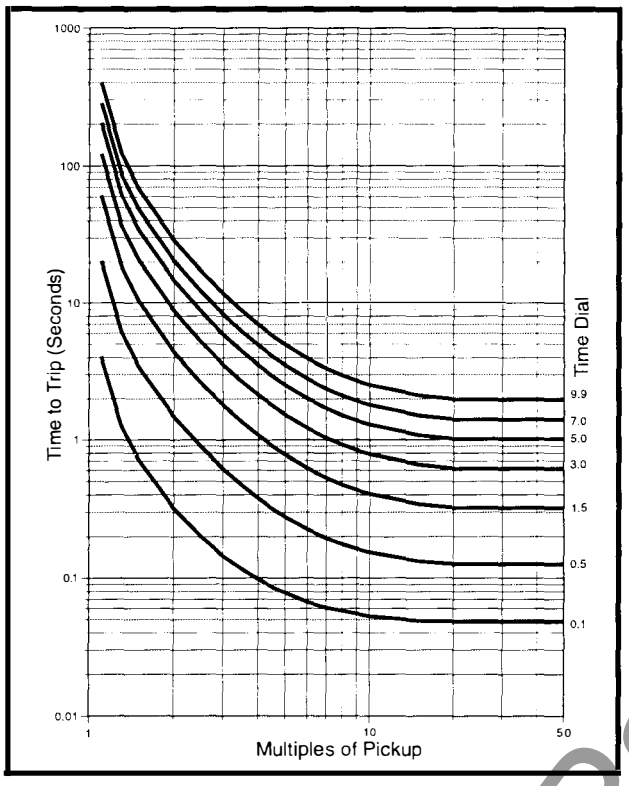

Figure A.1 Inverse (SEA 1)

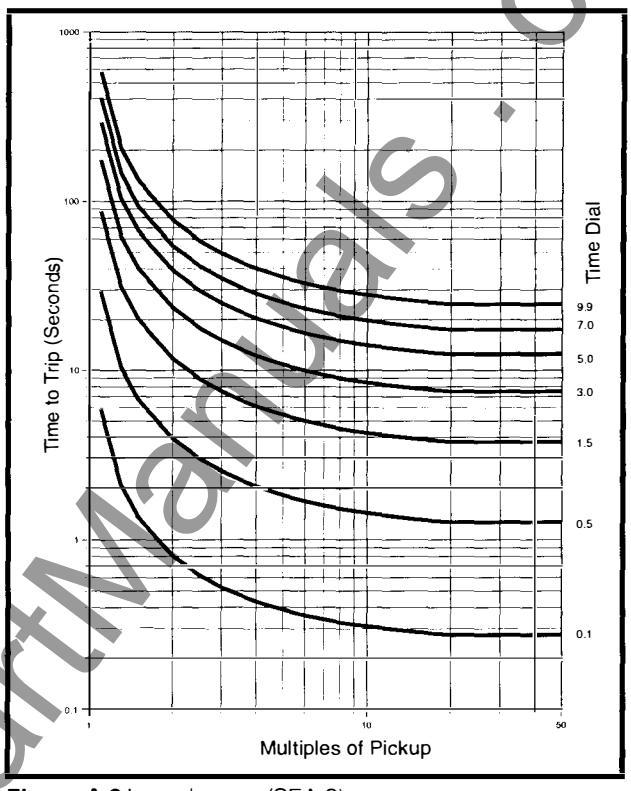

Figure A.3 Long Inverse (SEA 3)

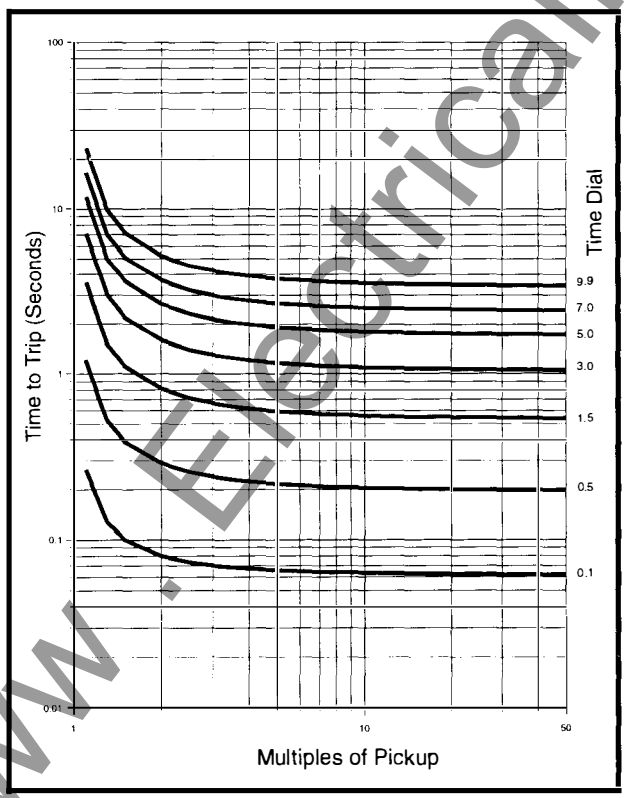

Figure A.2 Short Inverse (SEA 2)

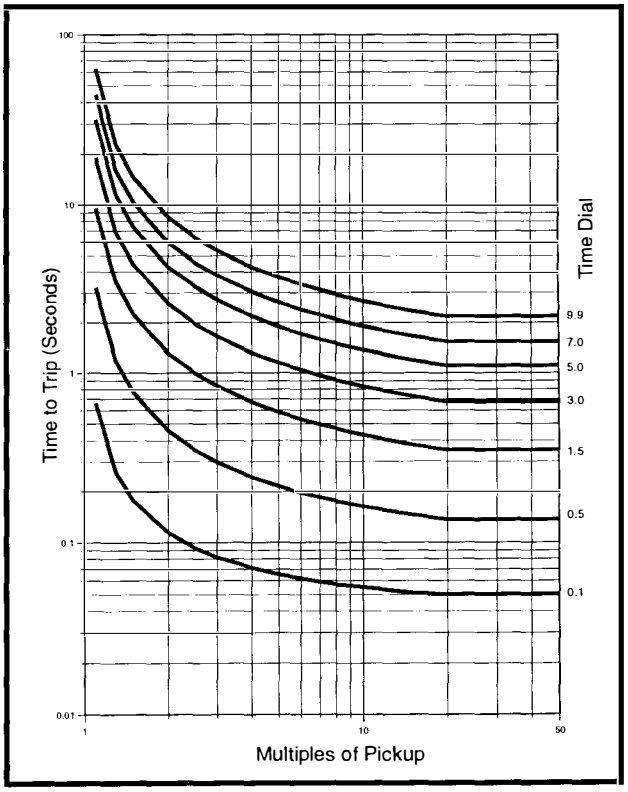

Figure A.4 Moderately Inverse (SEA 4)

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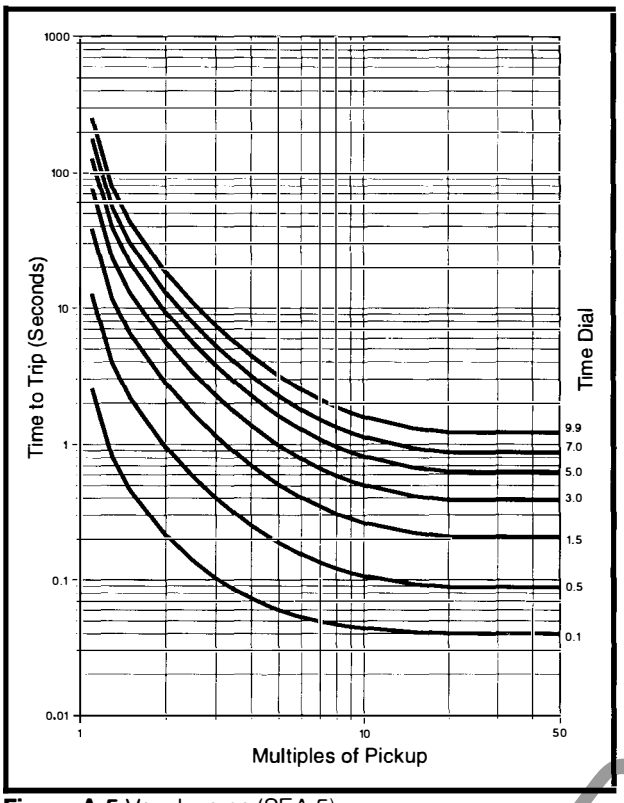

Figure A.5 Very Inverse (SEA 5)

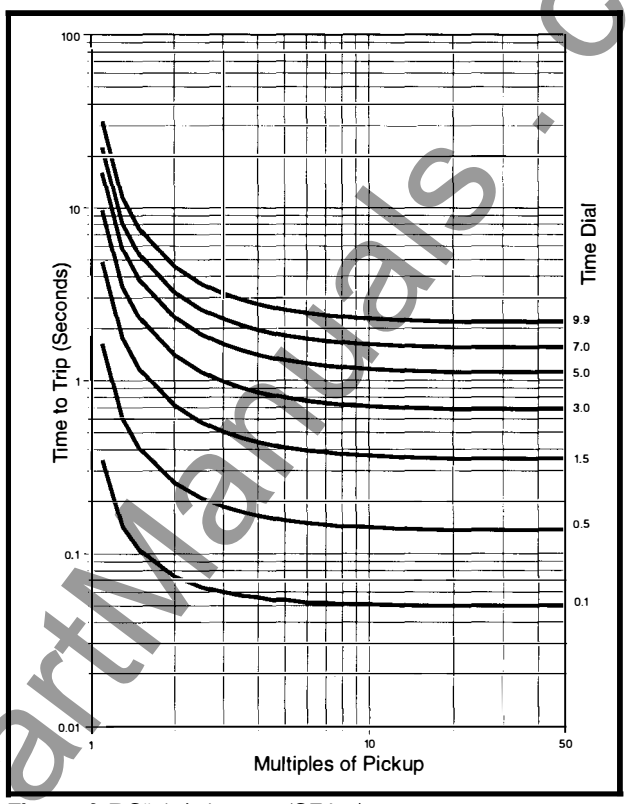

Figure A.7 Slightly Inverse (SEA 7)

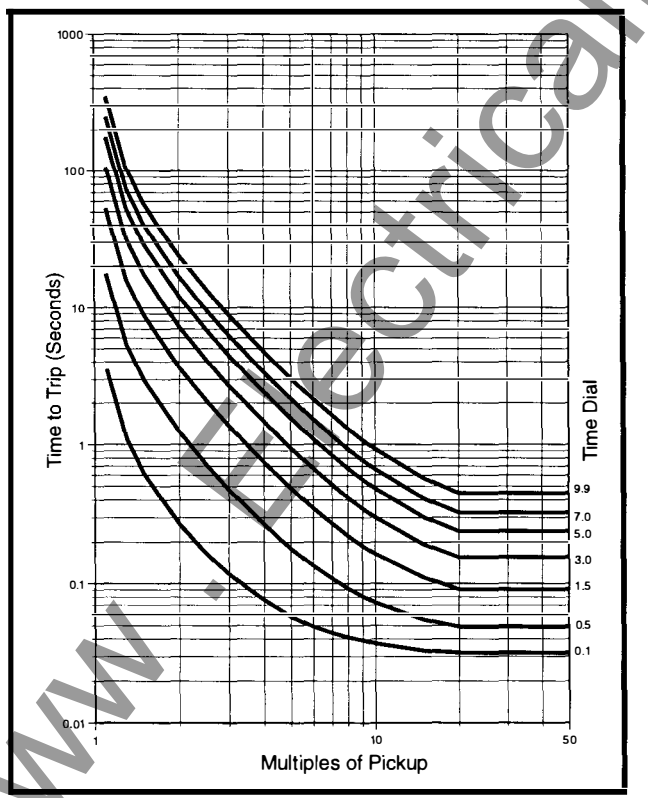

Figure A.6 Extremely Inverse (SEA 6)

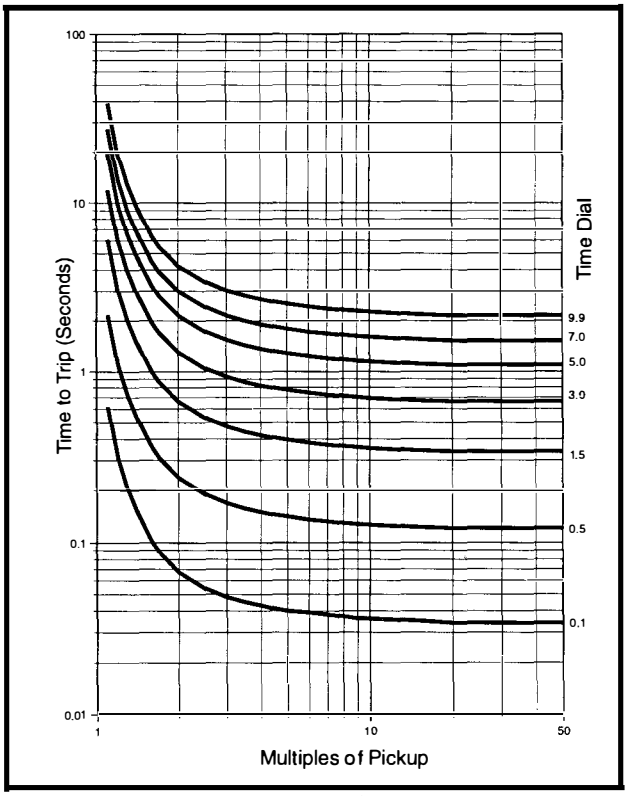

Figure A.8 Definite Inverse (SEA 8)

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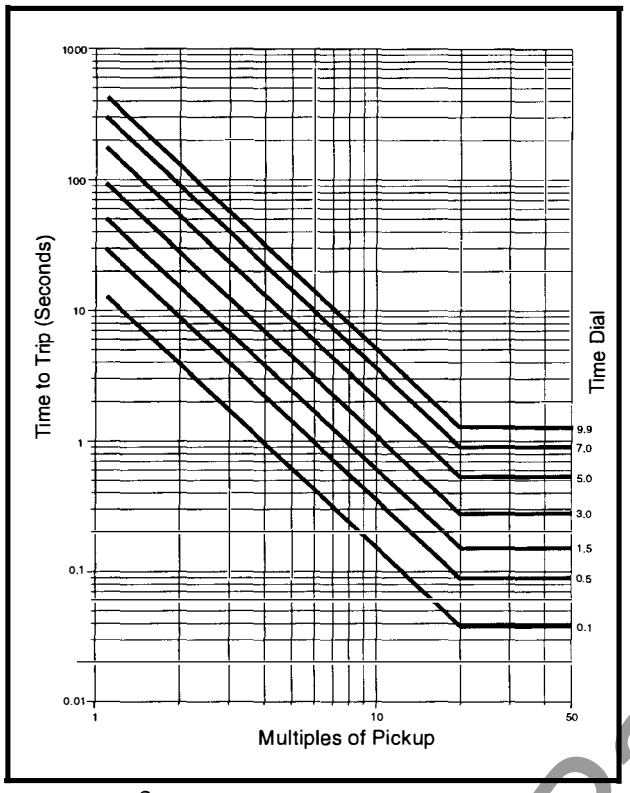

Figure A.9 I^2t Without Limit (SEA 9)

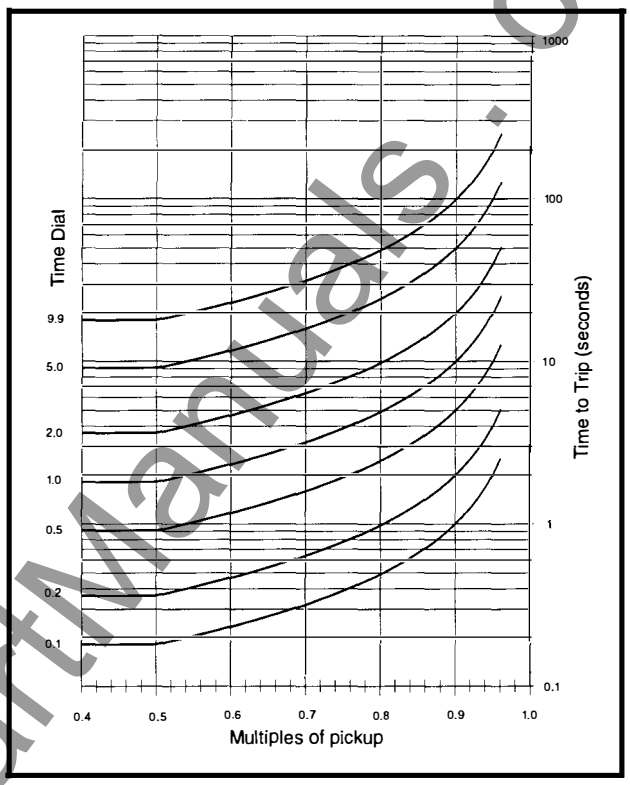

Figure A.11 Moderately Inverse Undervoltage

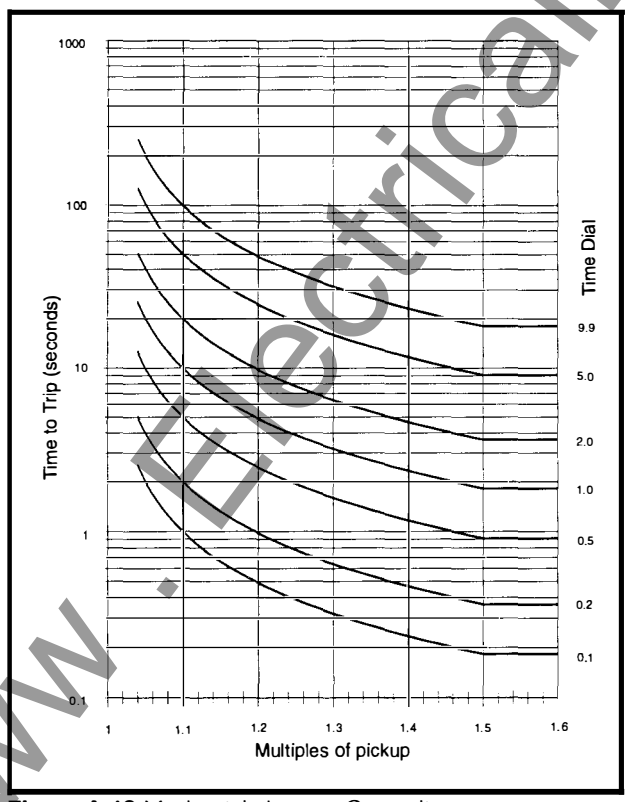

Figure A.10 Moderately Inverse Overvoltage

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Appendix B Metering

B.1 Accuracy

Parameter	Range	Accuracy
rms Current (L & G)	0 - 250% I_n Displayed in Amperes	±1% of measurement from 50 - 125% of I_n ±0.5% of I_n from 10 - 50% of I_n
Average rms Current	0 - 250% I_n Displayed in Amperes	±1% of measurement from 50 - 125% of I_n ±0.5% of I_n from 10 - 50% of I_n
Ampere Demand per Phase	0 - 250% I_n Displayed in Amperes	±1% of measurement from 50 - 125% of I_n ±0.5% of I_n from 10 - 50% of I_n
Average Ampere Demand	0 - 250% I_n Displayed in Amperes	±1% of measurement from 50 - 125% of I_n ±0.5% of I_n from 10 - 50% of I_n
rmsVoltage (L-L & L-N)	10 - 125% V_n Displayed in kV	±1% of measurement from 50 - 125% of V_n ±0.5% of V_n from 10 - 50% of V_n
Average rms Voltage	10 - 125% V_n Displayed in kV	±1% of measurement from 50 - 125% of V_n ±0.5% of V_n from 10 - 50% of V_n
Active Power (kW)	0 - 999,999.99 kW	±2% of measurement from 50 - 125% of P_n ±0.1% of V_n from 10 - 50% of P_n (1) (5)
kW Demand	0 - 999,999.99 kWD	±2% of measurement from 50 - 125% of P_n ±0.1% of V_n from 10 - 50% of P_n (1) (5)
kW Hours	0 - 999,999.99 kWHR	±2% of measurement from 50 - 125% of P_n ±0.1% of V_n from 10 - 50% of P_n (1) (3) (5)
Apparent Power (kVA)	0 - 999,999.99 kVA	±2% of measurement from 50 - 125% of P_n ±0.1% of V_n from 10 - 50% of P_n (1) (5)
Volt-Amperes Reactive (kVAR)	0 - 999,999.99 kVAR	±2% of measurement from 50 - 125% of P_n ±0.1% of V_n from 10 - 50% of P_n (1) (2) (5)
kVAR Hours	0 - 999,999.99 kVARH	±2% of measurement from 50 - 125% of P_n ±0.1% of V_n from 10 - 50% of P_n (1) (2) (3) (5)
Power Factor	-1 - 0 - +1	±0.04 (4)
Frequency	45 - 65 Hz	±0.1% of reading providing voltage is 50% VT primary rating

Notes:

(1) Measured at PF = 1. For |PF| < 1, ±2% + angle error (±2% for |PF| ≥ 0.7)
(2) Measured at PF = 0. For |PF| > 0, ±2% + angle error (±2% for |PF| ≤ 0.7)
(3) Energy is accumulated in either kHR or MHR, selectable (parameter).
(4) For power factor, 1 is considered "perfect," negative is leading and positive is lagging.
(5) $P_n = V_n \times I_n$ where V_n = VT rating and I_n = CT rating.

Note for all values: Stated accuracy applies only when the device is not in pickup. These measurements are valid over a frequency range of 45 to 65 Hz and include fundamental, 2nd harmonic, and all odd harmonics up to the 13th harmonic of the fundamental line frequency.

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B.2 Power Conventions

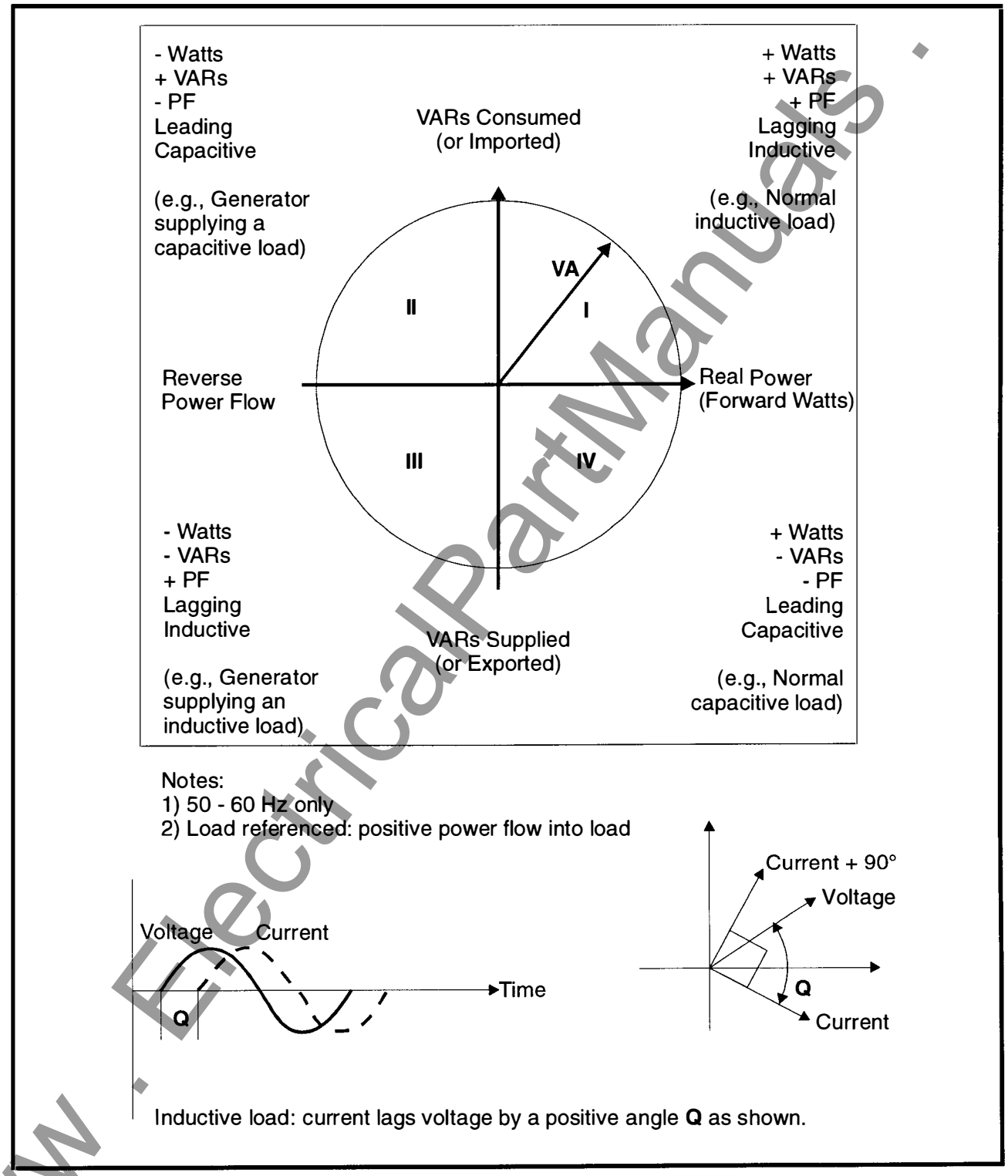

Figure B.1. Complex Power Plane

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Appendix C Schematics

C.1 DC Trip System

The following diagram illustrates a typical connection scheme for the ISGS relay when using a DC trip system.

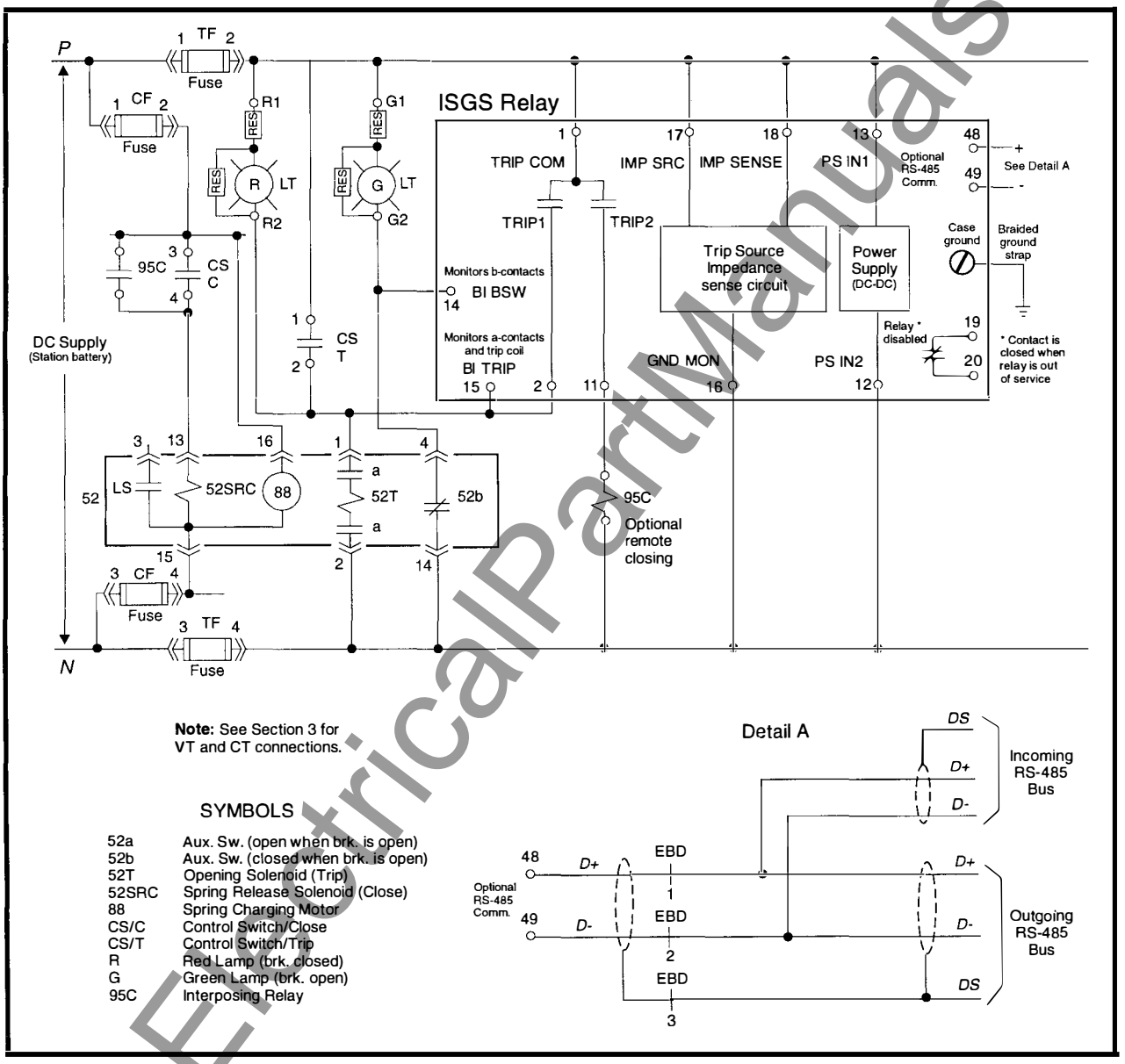

Figure C.1. ISGS Wiring for DC Trip Systems

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C.2 Breaker Monitoring Features

When the circuit breaker is connected to a DC control source (Figure C.1), it is possible to monitor the control source impedance and the trip coil continuity as described in the following sections. These monitoring features are not applicable when the relay is used with an AC control source (Figure C.2).

C.2.1 Trip Coil Continuity Monitoring

Trip coil continuity is checked by monitoring the voltage drop across the 52a contacts and the trip coil as shown in Figure C.1. This voltage drop is caused by the current (approximately 30 mA - 50 mA) flowing through the red "Breaker Closed" lamp. The position of the breaker is determined by sensing the voltage drop across the 52b contacts in series with the green "Breaker Open" lamp.

Note: If very low current LEDs are used as indicators, adjustment of the resistances in parallel with the LEDs may be necessary to prevent them being turned on by the current into the binary input (BI) of the relay.

If trip coil monitoring is enabled (TrpCoil Cont at address 8303) and trip coil failure detection is set to "Yes" (TrpCoilFail at address 8304), a continuity failure will close the "Relay disabled" contact.

C.2.2 Trip Source Impedance Monitoring

The source impedance of the control voltage supply is monitored by periodically drawing a fixed amount of current from the supply and checking for excessive drop in the supply voltage (see the Trip Source Impedance sense circuit in Figure C.1). This sense circuit will also pickup if the supply voltage drops below the ANSI lower limit for trip voltage.

If trip source impedance monitoring is enabled (TrpSrcImp Cont at address 8301) and trip source failure detection is set to "Yes" (TrpSrclFail at address 8302), a trip power source failure will close the "Relay disabled" contact.

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C.3 AC (Capacitor) Trip Systems

The following diagram illustrates a typical connection scheme for the ISGS relay when using an AC trip system.

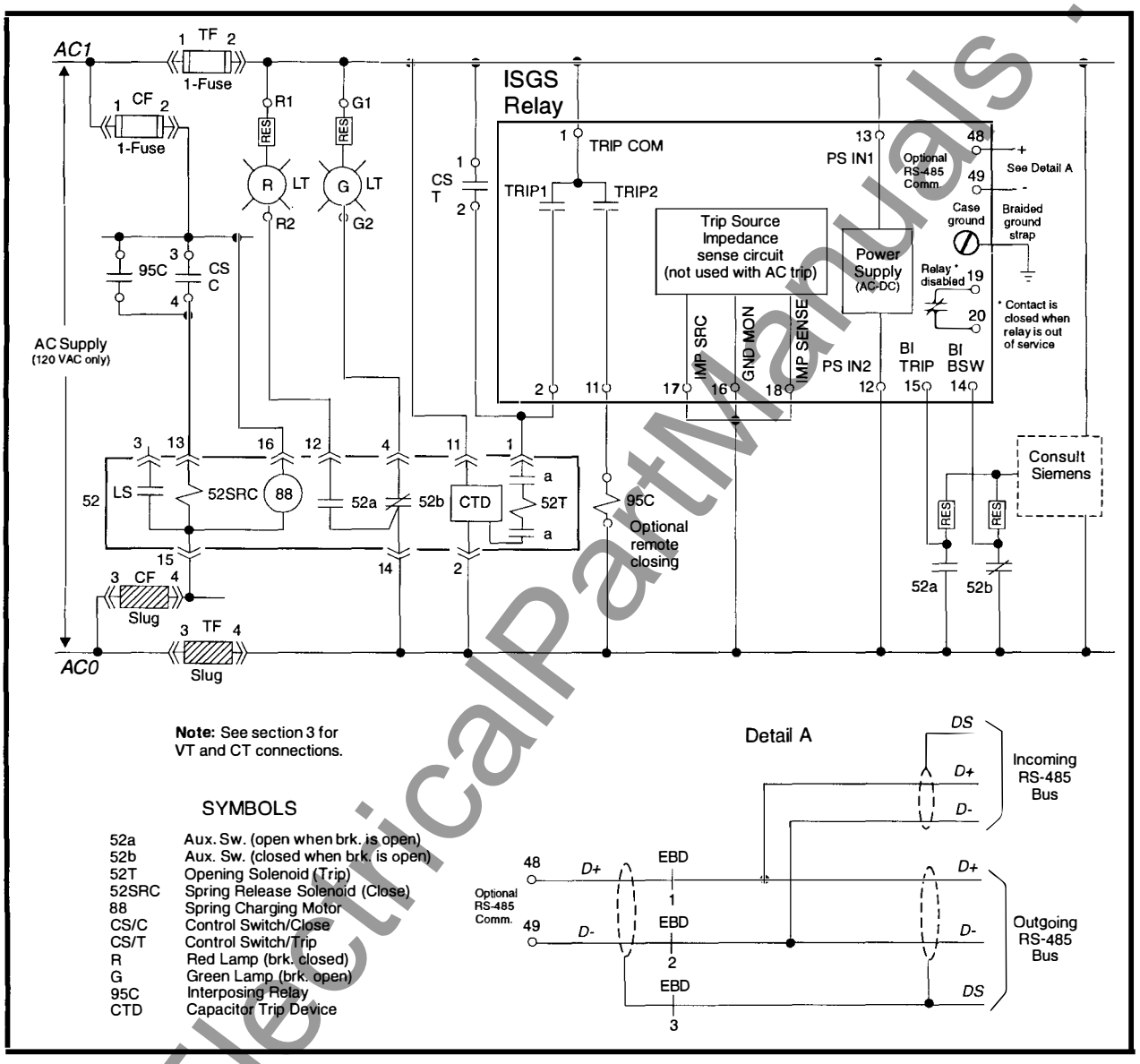

Figure C.2. ISGS Wiring for AC (Capacitor) Trip Systems

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