GE Industrial Systems

469

MOTOR MANAGEMENT RELAY®

Instruction Manual

469 Firmware Revision: 30E29x.000
469PC Software Revision: 2.9x

Manual P/N: 1601-0057-DH (GEK-106289J)

806766A5.CDR

GE Multilin

215 Anderson Avenue, Markham, Ontario

Canada L6E 1B3

Tel: (905) 294-6222 Fax: (905) 294-8512

Internet: http://www.GEindustrial.com/multilin

REGISTERED ISO9001:2000 GE MULTILIN

GE Multilin's Quality Management System is registered to ISO9001:2000

QMI # 005094
UL # A3775

TABLE OF CONTENTS

1.1.1 DESCRIPTION

The 469 Motor Management Relay is a microprocessor based relay designed for the protection and management of medium and large horsepower motors and driven equipment. The 469 is equipped with six output relays for trips, alarms, and start blocks. Motor protection, fault diagnostics, power metering, and RTU functions are integrated into one economical drawout package. The single-line diagram below illustrates the 469 functionality using ANSI (American National Standards Institute) device numbers.

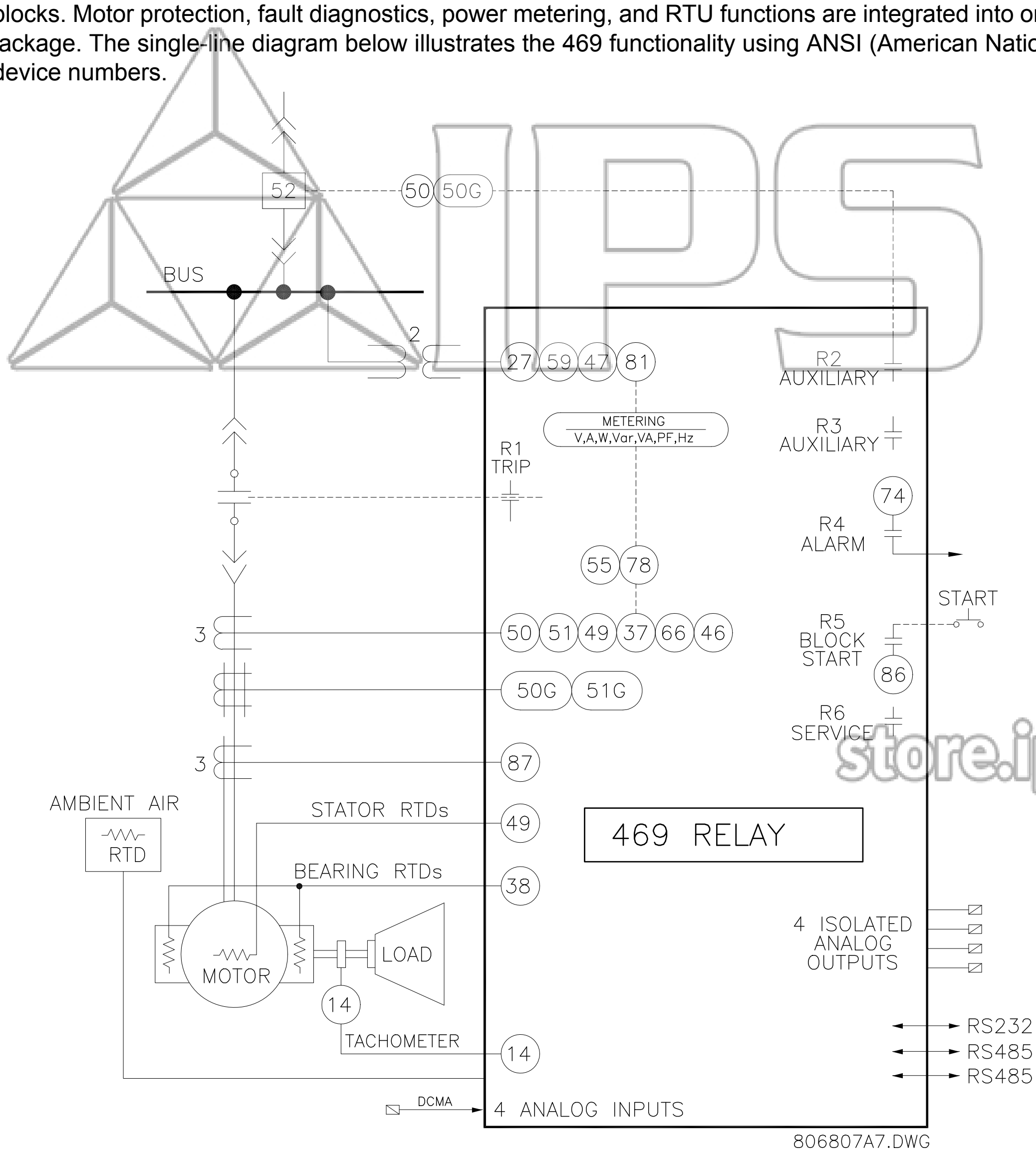


Figure 1–1: SINGLE LINE DIAGRAM

Typical applications include:

- Pumps
- Mills
- Debarkers
- Conveyors
- Blowers
- Fans
- Shredders
- Refiners
- Chillers
- Compressors
- Extruders
- Cranes
- Crushers

Some of the protection highlights are detailed here; a complete list is shown below. Four assignable digital inputs may be configured for a number of different features including tachometer or generic trip and alarm with a programmable name. The thermal model incorporates unbalance biasing, RTD feedback, and exponential cooling. In addition to the 15 standard overload curves, there is a custom curve feature and a curve specifically designed for the starting of high inertia loads, when the acceleration time exceeds the safe stall time. A second overload curve is provided for two-speed motors. Ground faults or earth leakage as low as 0.25 A may be detected using the GE Power Management 50:0.025 Ground CT. CT inputs for phase differential protection are also provided. The 12 RTD inputs provided may be individually field programmed for different RTD types. Voltage transformer inputs allow for numerous protection features based on voltage and power quantities. Four 4 to 20 mA analog inputs may be used for tripping and alarming on any transducer input such as vibration, pressure, flow, etc.

ANSI		Trip	Alarm	Block Start	Control
51	Overload	●	●	●	●
86	Overload Lockout			●	
66	Starts/Hour & Time Between Starts			●	
	Restart Block (Anti-Backspin Timer)			●	
50	Short Circuit & Short Circuit Backup	●		●	
	Mechanical Jam	●		●	●
32	Reverse Power	●	●	●	
37	Undercurrent/Underpower	●	●	●	
46	Current Unbalance	●	●	●	
50G/51G	Ground Fault & Ground Fault Backup	●	●	●	
87	Differential	●		●	
	Acceleration	●		●	
49	Stator RTD	●	●	●	
38	Bearing RTD	●	●	●	
	Other RTD & Ambient RTD	●	●	●	
	Open RTD Alarm		●		
	Short/Low RTD		●		
27/59	Undervoltage/Overvoltage	●	●	●	
47	Phase Reversal	●		●	
81	Frequency	●	●	●	
	Reactive Power	●	●	●	●
55/78	Power Factor	●	●	●	●
	Analog Input	●	●	●	
	Demand Alarm: A kW kvar kVA		●		●
	SR469 Self-Test, Service		●		
	Trip Coil Supervision		●		
	Welded Contactor		●		
	Breaker Failure		●		
	Remote Switch	●	●	●	
14	Speed Switch & Tachometer Trip	●	●	●	
	Load Shed Switch	●		●	
	Pressure Switch	●	●	●	
	Vibration Switch	●	●	●	
19	Reduced Voltage Start				●
48	Incomplete Sequence (Reduced Voltage Start)	●		●	●
	Remote Start/Stop				●
	Over Torque		●		
	Forced Relay Operation				●

PROCTLA5.CDR

Figure 1–2: PROTECTION FEATURES

Fault diagnostics are provided through pretrip data, event record, trace memory, and statistics. Prior to issuing a trip, the 469 takes a snapshot of the measured parameters and stores them with the cause of the trip. This pre-trip data may be viewed using the NEXT key before the trip is reset, or by accessing the **A1 STATUS** ⇨⇩ **LAST TRIP DATA** actual values. The 469 event recorder stores up to 40 time and date stamped events including the pre-trip data. Each time a trip occurs, the 469 stores a trace of 8 cycles pre-trip and 8 cycles post-trip for all measured AC quantities. Trip counters record the number of occurrences of each type of trip. Minimum and maximum values for RTDs and analog inputs are also recorded. These features enable the operator to pinpoint a problem quickly and with certainty.

Power metering included with the 469 as a standard feature. The table below outlines the metered parameters available either through the front panel or communications ports.

The 469 is equipped with 3 fully functional and independent communications ports. The front panel RS232 port may be used for 469 setpoint programming, local interrogation or control, and upgrading of 469 firmware. The Computer RS485 port may be connected to a PLC, DCS, or PC based user interface program. The Auxiliary RS485 port may be used for redundancy or simultaneous interrogation and/or control from a second PLC, DCS, or PC software.

There are also four 4 to 20 mA or 0 to 1 mA (as specified with order) transducer outputs that may be assigned to any measured parameter. The range of these outputs is scalable. Additional features are outlined in the table below.

METERING
Voltage
Current and amps demand
Real power, kW demand, kW power consumption
Apparent power and kVA demand
Reactive power, kvar demand, kvar consumption/generation
Frequency
Power Factor
RTD
Speed in RPM with a key phasor input
User-programmable analog inputs

ADDITIONAL FEATURES
Drawout case (for ease of maintenance/testing)
Reduced voltage starting control for single transition
Trip coil supervision
Flash memory for easy firmware updates

1.1.2 ORDER INFORMATION

All 469 features are standard; there are no options. The phase CT secondaries, control power, and analog output range must be specified at the time of order. The 469 differential CT inputs are field programmable for CTs with 1 A or 5 A secondaries. There are two ground CT inputs, one for the GE Power Management 50:0.025 core balance CT and one for a ground CT with a 1 A or 5 A secondary, also field programmable. The VT inputs will accommodate VTs in either a delta or wye configuration. The output relays are always non-failsafe with the exception of the service relay. The 469PC software is provided with each unit. A metal demo case may be ordered for demonstration or testing purposes.

Table 1–1: 469 ORDER CODES

469	**—**	*****	**—**	*****	**—**	*****	
469		|		|		|	469 Motor Management Relay Base Unit
		P1		|		|	Current Transformer Inputs: 1 A Phase CT Secondaries
		P5		|		|	Current Transformer Inputs: 5 A Phase CT Secondaries
				LO		|	25 to 60 V DC; 20 to 48 V AC at 48 to 62 Hz
				HI		|	90 to 300 V DC; 70 to 265 V AC at 48 to 62 Hz
						A1	0 to 1 mA Analog Outputs
						A20	4 to 20 mA Analog Outputs

For example, the 469-P1-LO-A20 code specifies a 469 Motor Management Relay with 1 A CT Inputs, 25 to 60 V DC or 20 to 48 V AC control voltage, and 4 to 20 mA Analog Outputs. Other accessories are shown below:

- **469PC Software:** Provided free with each relay
- **DEMO:** Metal Carry Case in which 469 unit may be mounted
- **SR 19-1 PANEL:** Single cutout 19" panel; **SR 19-2 PANEL:** Dual cutout 19" panel
- **SCI MODULE:** RS232 to RS485 converter box designed for harsh industrial environments
- **Phase CT:** 50, 75, 100, 150, 200, 250, 300, 350, 400, 500, 600, 750, 1000
- **HGF3, HGF5, HGF8:** For sensitive ground detection on high resistance grounded systems.
- **469 1" Collar:** For shallow switchgear, reduces the depth of the relay by 1 #3/8"
- **469 3" Collar:** For shallow switchgear, reduces the depth of the relay by 3"
- **Optional Mounting Kit:** Additional mounting support 1819-0030

1.2.1 469 SPECIFICATIONS

POWER SUPPLY

Options: LO / HI (must be specified with order)
LO Range: DC: 20 to 60 V DC
AC: 20 to 48 V AC at 48 to 62 Hz
Hi Range: DC: 90 to 300 V DC
AC: 70 to 265 V AC at 48 to 62 Hz
Power: 45 VA (max), 25 VA typical
Proper operation time without supply voltage: 30 ms

FUSE (HI and LO VOLT)

Current rating: 2.50 A
Type: 5 × 20 mm Slow-Blow Littlefuse, High Breaking Capacity
Model Number: 21502.5

NOTE **An external fuse must be used if the supply voltage exceeds 250 V.**

PHASE CURRENT INPUTS

CT Primary: 1 to 5000 A
CT Secondary: 1 A or 5 A (must be specified with order)
Burden: Less than 0.2 VA at rated load
Conversion Range: 0.05 to 20 × CT
Accuracy: at < 2 × CT: ± 0.5% of 2 × CT
at ≥ 2 × CT: ± 1% of 20 × CT
CT Withstand: 1 second at 80 × rated current
2 seconds at 40 × rated current
continuous at 3 × rated current

GROUND CURRENT INPUTS

CT Primary: 1 to 5000 A
CT Secondary: 1 A or 5 A (setpoint)
Burden: < 0.2 VA at rated load for 1 A or 5 A
< 0.25 VA for 50:0.025 at 25 A
Conversion Range: 0.02 to 1 × CT primary Amps
Accuracy: ± 0.5% of 1 × CT for 5 A
± 0.5% of 5 × CT for 1 A
± 0.125 A for 50:0.025
CT Withstand: 1 second at 80 × rated current
2 seconds at 40 × rated current
continuous at 3 × rated current

DIFFERENTIAL PHASE CURRENT INPUTS

CT Primary: 1 to 5000A
CT Secondary: 1 A or 5 A (setpoint)
Burden: Less than 0.2 VA at rated load
Conversion Range: 0.02 to 1 × CT
Accuracy: ±0.5% of 1 × CT for 5 A
±0.5% of 5 × CT for 1 A
CT Withstand: 1 second at 80 × rated current
2 seconds at 40 × rated current
continuous at 3 × rated current

VOLTAGE INPUTS

VT Ratio: 1.00 to 150.00:1 in steps of 0.01
VT Secondary: 273 V AC (full scale)
Conversion Range: 0.05 to 1.00 × full scale
Accuracy: ±0.5% of full scale
Max. Continuous: 280 V AC
Burden: > 500 kΩ

DIGITAL INPUTS

Inputs: 9 opto-isolated inputs
External Switch: dry contact < 400 Ω, or open collector NPN transistor from sensor; 6 mA sinking from internal 4 KΩ pull-up at 24 V DC with Vce < 4 V DC
469 Sensor Supply: +24 V DC at 20 mA maximum

RTD INPUTS

3 wire RTD Types: 100 Ω Platinum (DIN.43760), 100 Ω Nickel, 120 Ω Nickel, 10 Ω Copper
RTD Sensing Current: 5mA
Isolation: 36 Vpk
(isolated with analog inputs and outputs)
Range: –50 to +250°C
Accuracy: ±2°C
Lead Resistance: 25 Ω Max per lead for Pt and Ni type
3 Ω Max per lead for Cu type
No Sensor: >1000 Ω
Short/Low Alarm: < –50°C

TRIP COIL SUPERVISION

Applicable Voltage: 20 to 300 V DC / V AC
Trickle Current: 2 to 5 mA

ANALOG CURRENT INPUTS

Current Inputs: 0 to 1 mA, 0 to 20mA or 4 to 20 mA (setpoint)
Input Impedance: 226 Ω ±10%
Conversion Range: 0 to 21 mA
Accuracy: ±1% of full scale
Type: passive
Analog In Supply: +24 V DC at 100 mA maximum
Response Time: ≤ 100 ms

COMMUNICATIONS PORTS

RS232 Port: 1, Front Panel, non-isolated
RS485 Ports: 2, Isolated together at 36 V_{pk}
Baud Rates: RS485: 300, 1200, 2400, 4800, 9600, 19200
RS232: 9600
Parity: None, Odd, Even
Protocol: Modbus® RTU / half duplex

ANALOG CURRENT OUTPUT

Type: Active
Range: 4 to 20 mA, 0 to 1 mA (must be specified with order)
Accuracy: ±1% of full scale
Maximum Load: 4 to 20 mA input: 1200 Ω
0 to 1 mA input: 10 kΩ
Isolation: 36 V_{pk} (Isolated with RTDs and Analog Inputs)
4 Assignable Outputs: phase A current, phase B current, phase C current, 3 phase average current, ground current, phase AN (AB) voltage, phase BN (BC) voltage, phase CN (CA) voltage, 3 phase average voltage, hottest stator RTD, hottest bearing RTD, hottest other RTD, RTD # 1 to 12, Power factor, 3-phase Real power (kW), 3-phase Apparent power (kVA, 3-phase Reactive power (kvar), Thermal Capacity Used, Relay Lockout Time, Current Demand, kvar Demand, kW Demand, kVA Demand, Motor Load, Torque

OVERLOAD / STALL PROTECTION / THERMAL MODEL

Overload Curves: 15 Standard Overload Curves, Custom Curve, Voltage Dependent Custom Curve for high inertia starting (all curves time out against average phase current)
Curve Biasing: Phase Unbalance
Hot/Cold Curve Ratio
Stator RTD
Running Cool rate
Stopped Cool Rate
Line Voltage
Overload Pickup: 1.01 to 1.25 (for service factor)
Pickup Accuracy: as per Phase Current Inputs
Timing Accuracy: ±100 ms or ±2% of total time
Elements: Trip and Alarm

TERMINALS

Low Voltage (A, B, C, D terminals): 12 AWG max.
High Voltage (E, F, G, H terminals): #8 ring lug, 10 AWG wire std.

PHASE SHORT CIRCUIT

Pickup Level: 4.0 to 20.0 × CT primary in steps of 0.1 of any one phase
Time Delay: 0 to 1000 ms in steps of 10
Pickup Accuracy: as per Phase Current Inputs
Timing Accuracy: +50 ms
Elements: Trip

MECHANICAL JAM

Pickup Level: 1.01 to 3.00 × FLA in steps of 0.01 of any one phase, blocked on start
Time Delay: 1 to 30 s in steps of 1
Pickup Accuracy: as per Phase Current Inputs
Timing Accuracy: ±0.5 s or ±0.5% of total time
Elements: Trip

OUTPUT RELAYS

WARNING

Relay contacts must be considered unsafe to touch when the 469 is energized! If the output relay contacts are required for low voltage accessible applications, it is the customer's responsibility to ensure proper insulation levels.

Configuration: 6 Electromechanical Form C
Contact Material: silver alloy
Operate Time: 10 ms
Max ratings for 100000 operations

VOLTAGE		MAKE/CARRY CONTINUOUS	MAKE/CARRY 0.2S	BREAK	MAX. LOAD
DC RESISTIVE	30 V	10 A	30 A	10 A	300 W
	125 V	10 A	30 A	0.5 A	62.5 W
	250 V	10 A	30 A	0.3 A	75 W
DC INDUCTIVE L/R=40ms	30 V	10 A	30 A	5 A	150 W
	125 V	10 A	30 A	0.25 A	31.3 W
	250 V	10 A	30 A	0.15 A	37.5 W
AC RESISTIVE	120 V	10 A	30 A	10 A	2770 VA
	250 V	10 A	30 A	10 A	2770 VA
AC INDUCTIVE P.F.=0.4	120 V	10 A	30 A	4 A	480 VA
	250 V	10 A	30 A	3 A	750 VA

UNDERCURRENT

Pickup Level: 0.10 to 0.95 × CT primary in steps of 0.01 of any one phase
Time Delay: 1 to 60 s in steps of 1
Block From Start: 0 to 15000 s in steps of 1
Pickup Accuracy: as per Phase Current Inputs
Timing Accuracy: ±0.5 s or ±0.5% of total time
Elements: Trip and Alarm

CURRENT UNBALANCE

Unbalance: I_2 / I_1 if $I_{avg} > FLA$
$I_2 / I_1 \times I_{avg} / FLA$ if $I_{avg} < FLA$
Range: 0 to 100% UB in steps of 1
Pickup Level: 4 to 40% UB in steps of 1
Time Delay: 1 to 60 s in steps of 1
Pickup Accuracy: ±2%
Timing Accuracy: ±0.5 s or ± 0.5% of total time
Elements: Trip and Alarm

GROUND INSTANTANEOUS

Pickup Level: 0.1 to 1.0 × CT primary in steps of 0.01
Time Delay: 0 to 1000 ms in steps of 10
Pickup Accuracy: as per Ground Current Input
Timing Accuracy: +50 ms
Elements: Trip and Alarm

PHASE DIFFERENTIAL INSTANTANEOUS

Pickup Level: 0.05 to 1.0 × CT primary in steps of 0.01 of any one phase
Time Delay: 0 to 1000 ms in steps of 10
Pickup Accuracy: as per Phase Differential Current Inputs
Timing Accuracy: +50 ms
Elements: Trip

ACCELERATION TIMER

Pickup:	transition of no phase current to > overload pickup
Dropout:	when current falls below overload pickup
Time Delay:	1.0 to 250.0 s in steps of 0.1
Timing Accuracy:	±100 ms or ± 0.5% of total time
Elements:	Trip

JOGGING BLOCK

Starts/Hour:	1 to 5 in steps of 1
Time between Starts:	1 to 500 min.
Timing Accuracy:	±0.5 s or ± 0.5% of total time
Elements:	Block

RESTART BLOCK

Time Delay:	1 to 50000 s in steps of 1
Timing Accuracy:	±0.5 s or ± 0.5% of total time
Elements:	Block

RTD

Pickup:	1 to 250°C in steps of 1
Pickup Hysteresis:	2°C
Time Delay:	3 s
Elements:	Trip and Alarm

UNDERVOLTAGE

Pickup Level:	
Motor Starting:	0.60 to 0.99 × Rated in steps of 0.01
Motor Running:	0.60 to 0.99 × Rated in steps of 0.01 of any one phase
Time Delay:	0.1 to 60.0 s in steps of 0.1
Pickup Accuracy:	as per Voltage Inputs
Timing Accuracy:	<100 ms or ±0.5% of total time
Elements:	Trip and Alarm

OVERVOLTAGE

Pickup Level:	1.01 to 1.10 × rated in steps of 0.01 of any one phase
Time Delay:	0.1 to 60.0 s in steps of 0.1
Pickup Accuracy:	as per Voltage Inputs
Timing Accuracy:	±100 ms or ±0.5% of total time
Elements:	Trip and Alarm

VOLTAGE PHASE REVERSAL

Configuration:	ABC or ACB phase rotation
Timing Accuracy:	500 to 700 ms
Elements:	Trip

FREQUENCY

Required Voltage:	> 30% of full scale in Phase A
Overfrequency Pkp:	25.01 to 70.00 in steps of 0.01
Underfrequency Pkp:	20.00 to 60.00 in steps of 0.01
Accuracy:	±0.02 Hz
Time Delay:	0.1 to 60.0 s in steps of 0.1
Timing Accuracy:	<100 ms or ±0.5% of total time
Elements:	Trip and Alarm

REDUCED VOLTAGE START

Transition Level:	25 to 300% FLA in steps of 1
Transition Time:	1 to 250 s in steps of 1
Transition Control:	Current, Timer, Current and Timer

REMOTE SWITCH

Configurable:	Assignable to Digital Inputs1 to 4
Timing Accuracy:	100 ms max.
Elements:	Trip and Alarm

SPEED SWITCH

Configurable:	Assignable to Digital Inputs1 to 4
Time Delay:	1.0 to 250.0 s in steps of 0.1
Timing Accuracy:	100 ms max.
Elements:	Trip

LOAD SHED

Configurable:	Assignable to Digital Inputs1 to 4
Timing Accuracy:	100 ms max.
Elements:	Trip

PRESSURE SWITCH

Configurable:	Assignable to Digital Inputs1 to 4
Time Delay:	0.1 to 100.0 s in steps of 0.1
Block From Start:	0 to 5000 s in steps of 1
Timing Accuracy:	±100 ms or ±0.5% of total time
Elements:	Trip and Alarm

VIBRATION SWITCH

Configurable:	Assignable to Digital Inputs1 to 4
Time Delay:	0.1 to 100.0 s in steps of 0.1
Timing Accuracy:	±100 ms or ±0.5% of total time
Elements:	Trip and Alarm

DIGITAL COUNTER

Configurable:	Assignable to Digital Inputs1 to 4
Count Frequency:	≤ 50 times a second
Range:	0 to 1 000 000 000
Elements:	Alarm

TACHOMETER

Configurable:	Assignable to Digital Inputs1 to 4
RPM Range:	100 to 7200 RPM
Pulse Duty Cycle:	> 10%
Elements:	Trip and Alarm

GENERAL PURPOSE SWITCH

Configurable:	Assignable Digital Inputs1 to 4
Time Delay:	0.1 to 5000.0 s in steps of 0.1
Block From Start:	0 to 5000 s in steps of 1
Timing Accuracy:	±100 ms or ±0.5% of total time
Elements:	Trip and Alarm

POWER FACTOR

Range:	0.01 lead or lag to 1.00
Pickup Level:	0.99 to 0.05 in steps of 0.01, Lead & Lag
Time Delay:	0.2 to 30.0 s in steps of 0.1
Block From Start:	0 to 5000 s in steps of 1
Pickup Accuracy:	±0.02
Timing Accuracy:	±100 ms or ±0.5% of total time
Elements:	Trip and Alarm

3-PHASE REAL POWER

Range: 0 to ±99999 kW
Underpower Pkp: 1 to 25000 kW in steps of 1
Time Delay: 1 to 30 s in steps of 1
Block From Start: 0 to 15000 s in steps of 1
Pickup Accuracy:
at $I_{avg} < 2 \times CT$: ±1% of $\sqrt{3} \times 2 \times CT \times VT \times VT_{full\ scale}$
at $I_{avg} > 2 \times CT$ ±1.5% of $\sqrt{3} \times 20 \times CT \times VT \times VT_{full\ scale}$
Timing Accuracy: ±0.5 s or ±0.5% of total time
Elements: Trip and Alarm

3-PHASE APPARENT POWER

Range: 0 to 65535 kVA
Accuracy:
at $I_{avg} < 2 \times CT$: ±1% of $\sqrt{3} \times 2 \times CT \times VT \times VT_{full\ scale}$
at $I_{avg} > 2 \times CT$: ±1.5% of $\sqrt{3} \times 20 \times CT \times VT \times VT_{full\ scale}$

3-PHASE REACTIVE POWER

Range: 0 to ±99999 kvar
Pickup Level: ±1 to 25000 kvar in steps of 1
Time Delay: 0.2 to 30.0 s in steps of 0.1
Block From Start: 0 to 5000 s in steps of 1
Pickup Accuracy:
at $I_{avg} < 2 \times CT$: ±1% of $\sqrt{3} \times 2 \times CT \times VT \times VT_{full\ scale}$
at $I_{avg} > 2 \times CT$: ±1.5% of $\sqrt{3} \times 20 \times CT \times VT \times VT_{full\ scale}$
Timing Accuracy: ±100ms or ± 0.5% of total time
Elements: Trip and Alarm

OVERTORQUE

Pickup Level: 1.0 to 999999.9 Nm/ft·lb in steps of 0.1; torque unit is selectable under torque setup
Time Delay: 0.2 to 30.0 s in steps of 0.1
Pickup Accuracy: ±2.0%
Time Accuracy: ±100 ms or 0.5% of total time
Elements: Alarm (INDUCTION MOTORS ONLY)

METERED REAL POWER CONSUMPTION

Description: Continuous total real power consumption
Range: 0 to 999999.999 MW·hours.
Timing Accuracy: ±0.5%
Update Rate: 5 seconds

METERED REACTIVE POWER CONSUMPTION

Description: Continuous total reactive power consumption
Range: 0 to 999999.999 Mvar·hours
Timing Accuracy: ±0.5%
Update Rate: 5 seconds

METERED REACTIVE POWER GENERATION

Description: Continuous total reactive power generation
Range: 0 to 2000000.000 Mvar·hours
Timing Accuracy: ±0.5%
Update Rate: 5 seconds

DEMAND

Metered Values: Maximum Phase Current
3 Phase Real Power
3 Phase Apparent Power
3 Phase Reactive Power
Measurement Type: Rolling Demand
Demand Interval: 5 to 90 minutes in steps of 1
Update Rate: 1 minute
Elements: Alarm

OTHER FEATURES

Pre-Trip Data
Event Recorder
Trace Memory
Starter Failure
Fault Simulation
VT Failure

ENVIRONMENT

Ambient Operating Temperature: –40°C to +60°C
Ambient Storage Temperature: –40°C to +80°C
Humidity: Up to 90%, non-condensing.
Altitude: Up to 2000 m
Pollution Degree: 2

NOTE **At temperatures lower than –20°C, the LCD contrast may be impaired.**

LONG-TERM STORAGE

Environment: In addition to the above environmental considerations, the relay should be stored in an environment that is dry, corrosive-free, and not in direct sunlight.
Correct storage: Prevents premature component failures caused by environmental factors such as moisture or corrosive gases. Exposure to high humidity or corrosive environments will prematurely degrade the electronic components in any electronic device regardless of its use or manufacturer, unless specific precautions, such as those mentioned in the Environment section above, are taken

NOTE **It is recommended that all relays be powered up once per year, for one hour continuously, to avoid deterioration of electrolytic capacitors and subsequent relay failure.**

BATTERY BACKUP

Usage: only when there is no control power to relay
Life expectancy: ≥ 10 years with no control power to relay

CASE

Type: Fully drawout (automatic CT shorts)
Seal: Seal provision
Door: Dust tight door
Mounting: Panel or 19" rack mount
IP Class: IP20-X

PRODUCTION TESTS

Thermal Cycling: Operational test at ambient, reducing to –40°C and then increasing to 60°C

Dielectric Strength: 1.9 kV AC for 1 second, or 1.6 kV AC for 1 minute, per UL 508.

WARNING **DO NOT CONNECT FILTER GROUND TO SAFETY GROUND DURING ANY PRODUCTION TESTS!**

TYPE TESTS

Dielectric Strength: Per IEC 255-5 and ANSI/IEEE C37.90 2.0 kV for 1 minute from relays, CTs, VTs, power supply to Safety Ground

Insulation Resistance: IEC255-5 500 V DC, from relays, CTs, VTs, power supply to Safety Ground

WARNING **DO NOT CONNECT FILTER GROUND TO SAFETY GROUND DURING DIELECTRIC STRENGTH OR INSULATION RESISTANCE TESTS!**

Transients: ANSI C37.90.1 Oscillatory (2.5kV/1MHz);
ANSI C37.90.1 Fast Rise (5kV/10ns);
Ontario Hydro A-28M-82; IEC255-4 Impulse/High Frequency Disturbance, Class III Level

Impulse Test: IEC 255-5 0.5 Joule 5 kV

RFI: 50 MHz/15 W Transmitter

EMI: C37.90.2 Electromagnetic Interference at 150 MHz and 450 MHz, 10 V/m

Static: IEC 801-2 Static Discharge

Humidity: 95% non-condensing

Temperature: –40°C to +60°C ambient

Environment: IEC 68-2-38 Temperature/Humidity Cycle

Vibration: Sinusoidal Vibration 8.0 g for 72 hrs.

PACKAGING

Shipping Box: 12" × 11" × 10" (W × H × D)
30.5cm × 27.9cm × 25.4cm

Shipping Weight: 17 lbs Max / 7.7 kg

CERTIFICATION

ISO: Manufactured under an ISO9001 registered system.

UL: UL listed for the USA and Canada

CE: conforms to EN 55011/CISPR 11, EN 50082-2

IEC: conforms to IEC 947-1,1010-1

Specifications are subject to change without notice!

2.1.1 DESCRIPTION

The 469 is packaged in the standard GE Multilin SR series arrangement, which consists of a drawout unit and a companion fixed case. The case provides mechanical protection to the unit and is used to make permanent connections to all external equipment. The only electrical components mounted in the case are those required to connect the unit to the external wiring. Connections in the case are fitted with mechanisms required to allow the safe removal of the relay unit from an energized panel (for example, automatic CT shorting). The unit is mechanically held in the case by pins on the locking handle that cannot be fully lowered to the locked position until the electrical connections are completely mated. Any 469 can be installed in any 469 case, except for custom manufactured units that are clearly identified as such on both case and unit, and are equipped with an index pin keying mechanism to prevent incorrect pairings.

No special ventilation requirements need to be observed during the installation of the unit. The 469 can be cleaned with a damp cloth.

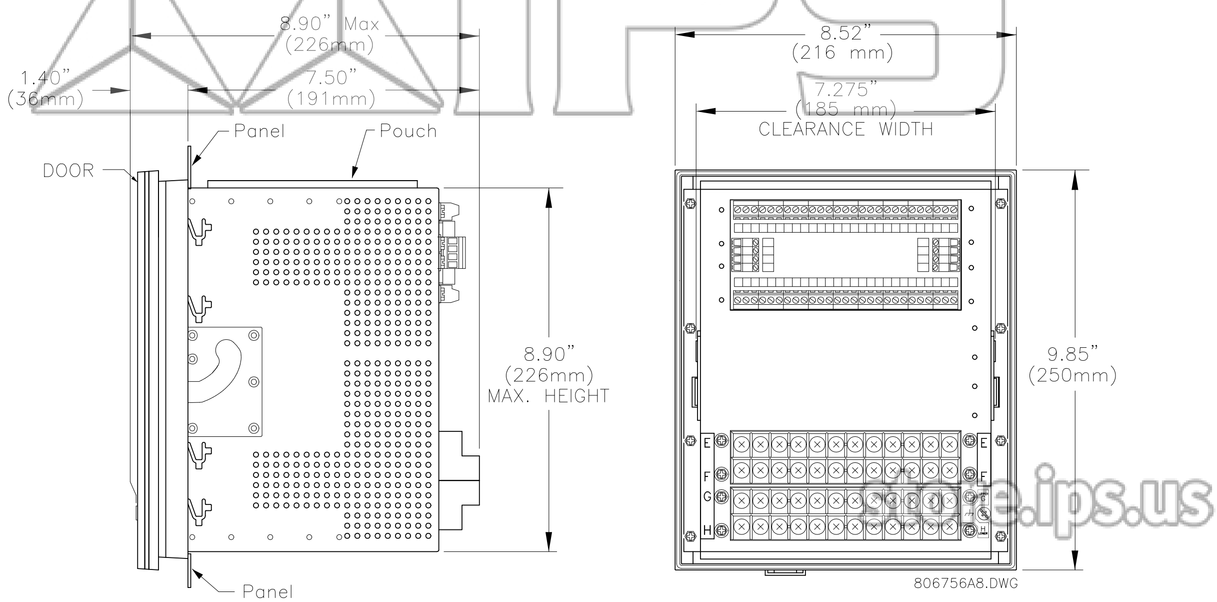


Figure 2–1: DIMENSIONS

To prevent unauthorized removal of the drawout unit, a wire lead seal can be installed in the slot provided on the handle. With this seal in place, the drawout unit cannot be removed. A passcode or setpoint access jumper can be used to prevent entry of setpoints but allow monitoring of actual values. If access to the front panel controls must be restricted, a separate seal can be installed on the cover to prevent it from being opened.

WARNING **Hazard may result if the product is not used for its intended purpose.**

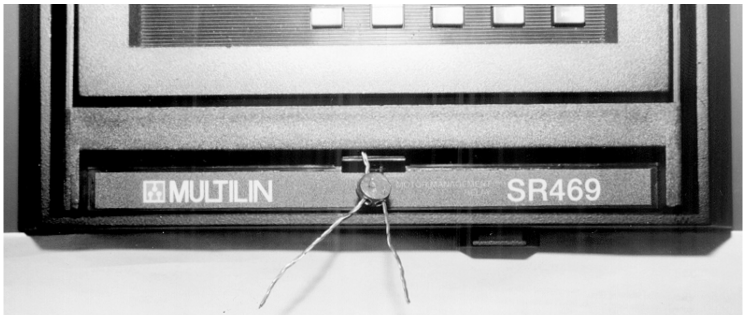


Figure 2–2: SEAL ON DRAWOUT UNIT

2.1.2 PRODUCT IDENTIFICATION

Each 469 unit and case are equipped with a permanent label. This label is installed on the left side (when facing the front of the relay) of both unit and case. The case label details which units can be installed.

The case label details the following information:

- MODEL NUMBER
- MANUFACTURE DATE
- SPECIAL NOTES

The unit label details the following information:

- MODEL NUMBER
- TYPE
- SERIAL NUMBER
- MANUFACTURE DATE
- PHASE CURRENT INPUTS
- SPECIAL NOTES
- OVERVOLTAGE CATEGORY
- INSULATION VOLTAGE
- POLLUTION DEGREE
- CONTROL POWER
- OUTPUT CONTACT RATING

Figure 2–3: CASE AND UNIT IDENTIFICATION LABELS

2.1.3 INSTALLATION

The 469 case, alone or adjacent to another SR series unit, can be installed in the panel of a standard 19-inch rack (see the diagram below for panel cutout dimensions). Provision must be made when mounting for the front door to swing open without interference to, or from, adjacent equipment. Normally the 469 unit is mounted in its case when shipped from the factory, and should be removed before mounting the case in the supporting panel. Unit withdrawal is described in the next section.

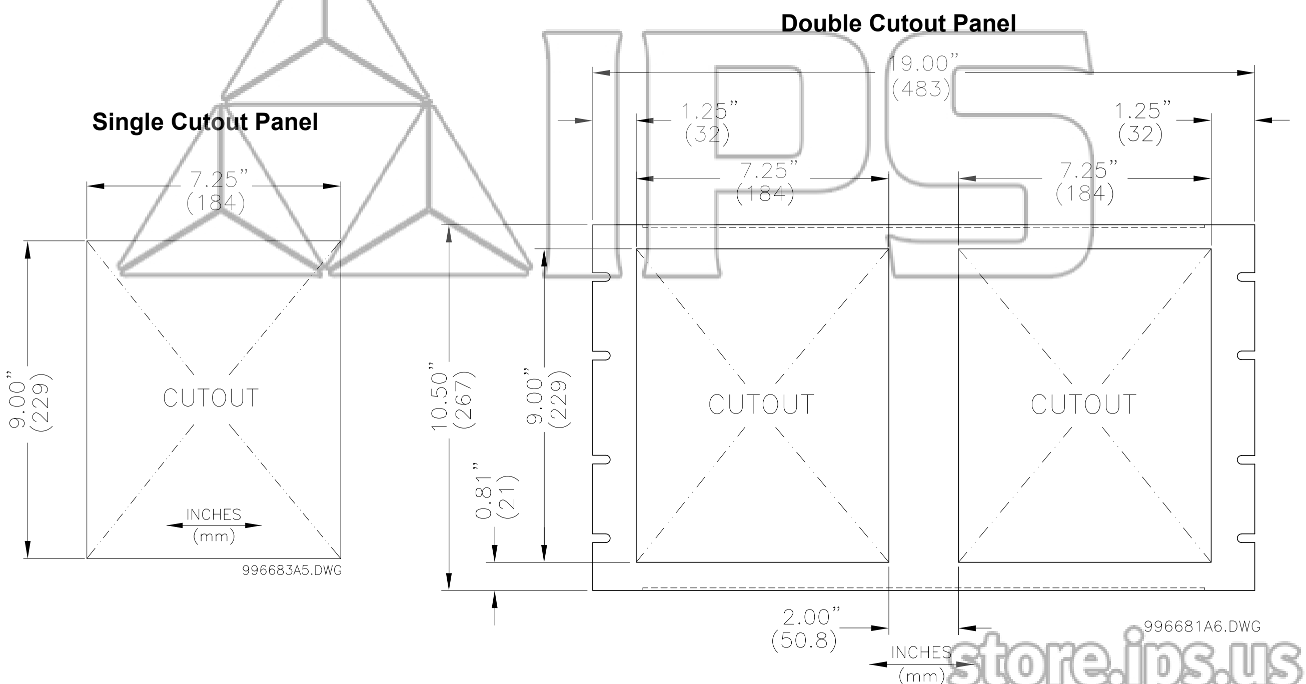


Figure 2–4: SINGLE AND DOUBLE 469 CUTOUT PANELS

After the mounting hole in the panel has been prepared, slide the 469 case into the panel from the front. Applying firm pressure on the front to ensure the front bezel fits snugly against the front of the panel, bend out the pair of retaining tabs (to a horizontal position) from each side of the case as shown below. The case is now securely mounted, ready for panel wiring. If additional support is desired, the SR optional mounting kit may be ordered.

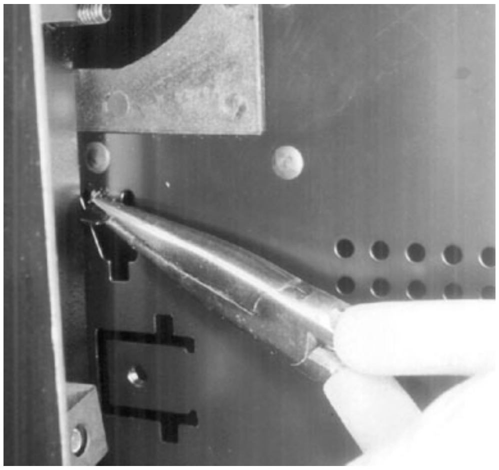


Figure 2–5: BEND UP MOUNTING TABS

2.1.4 UNIT WITHDRAWAL AND INSERTION

CAUTION **TURN OFF CONTROL POWER BEFORE DRAWING OUT OR RE-INSERTING THE RELAY TO PREVENT MAL-OPERATION!**

CAUTION **If an attempt is made to install a unit into a non-matching case, the mechanical key will prevent full insertion of the unit. Do not apply strong force in the following step or damage may result.**

To remove the unit from the case:

1. Open the cover by grasping the center of the right side and then pulling the cover, which will rotate about the hinges on the left.
2. Release the locking latch, located below the locking handle, by pressing upward on the latch with the tip of a screwdriver.

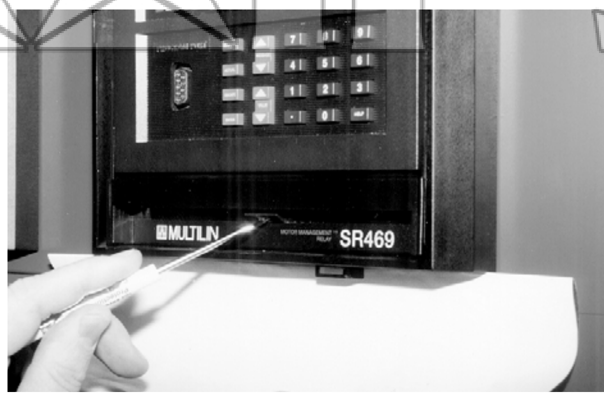


Figure 2–6: PRESS LATCH TO DISENGAGE HANDLE

3. While holding the latch raised, grasp the locking handle in the center and pull firmly, rotating the handle up from the bottom of the unit until movement ceases.

Figure 2–7: ROTATE HANDLE TO STOP POSITION

4. Once the handle is released from the locking mechanism, the unit can freely slide out of the case when pulled by the handle. It may sometimes be necessary to adjust the handle position slightly to free the unit.

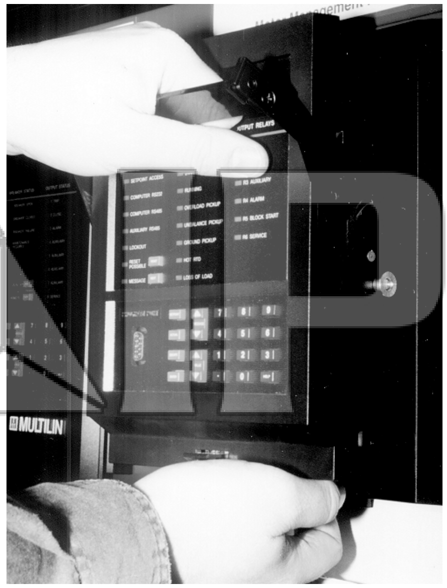


Figure 2–8: SLIDE UNIT OUT OF CASE

To insert the unit into the case:

1. Raise the locking handle to the highest position.
2. Hold the unit immediately in front of the case and align the rolling guide pins (near the hinges of the locking handle) to the guide slots on either side of the case.
3. Slide the unit into the case until the guide pins on the unit have engaged the guide slots on either side of the case.
4. Grasp the locking handle from the center and press down firmly, rotating the handle from the raised position toward the bottom of the unit.
5. When the unit is fully inserted, the latch will be heard to click, locking the handle in the final position.

CAUTION **No special ventilation requirements need to be observed during the installation of the unit. The unit does not require cleaning.**

2.1.5 TERMINAL LOCATIONS

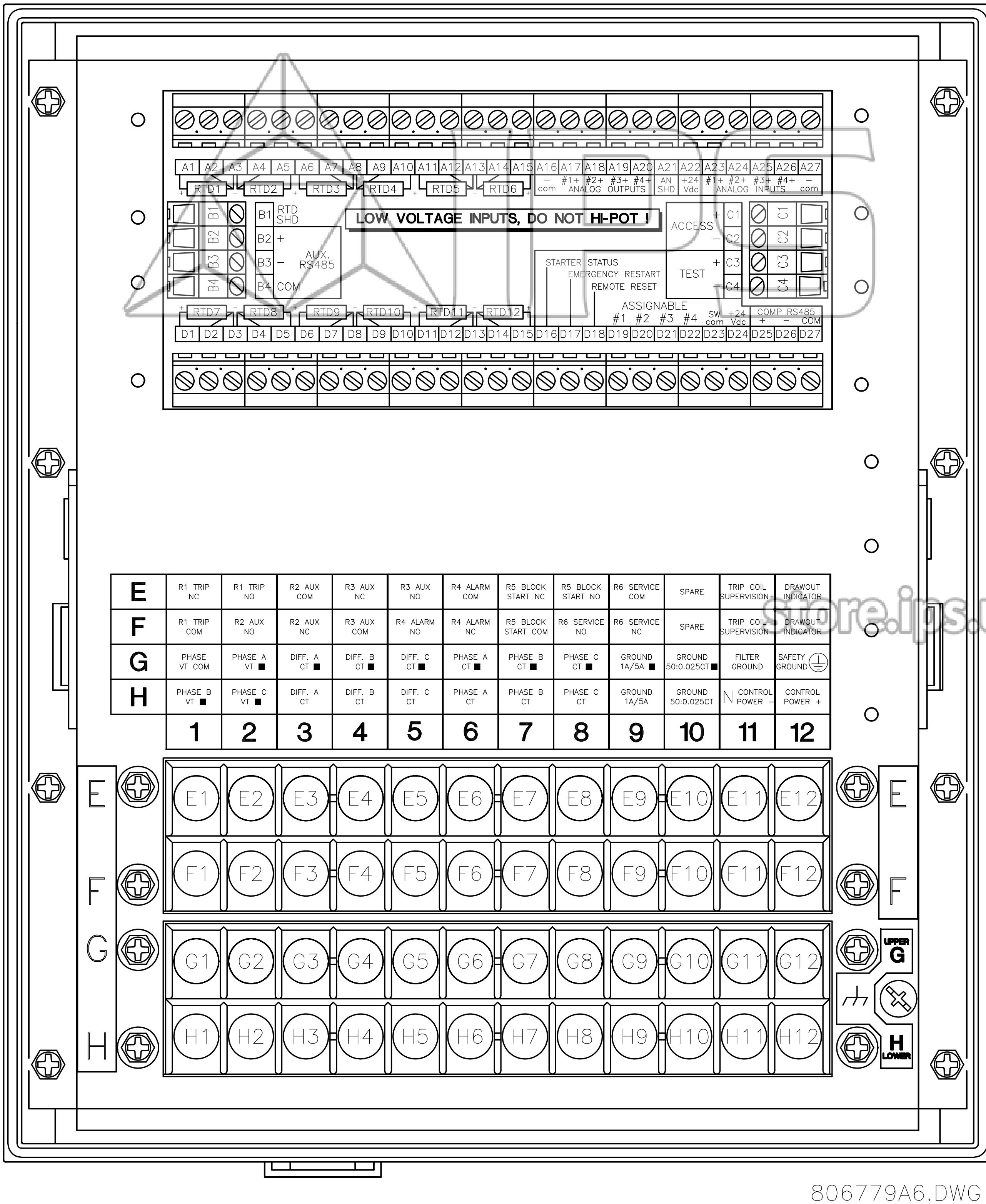


Figure 2–9: TERMINAL LAYOUT

Table 2–1: 469 TERMINAL LIST

TERMINAL	DESCRIPTION
A01	RTD #1 HOT
A02	RTD #1 COMPENSATION
A03	RTD RETURN
A04	RTD #2 COMPENSATION
A05	RTD #2 HOT
A06	RTD #3 HOT
A07	RTD #3 COMPENSATION
A08	RTD RETURN
A09	RTD #4 COMPENSATION
A10	RTD #4 HOT
A11	RTD #5 HOT
A12	RTD #5 COMPENSATION
A13	RTD RETURN
A14	RTD #6 COMPENSATION
A15	RTD #6 HOT
A16	ANALOG OUT COMMON –
A17	ANALOG OUT 1 +
A18	ANALOG OUT 2 +
A19	ANALOG OUT 3 +
A20	ANALOG OUT 4 +
A21	ANALOG SHIELD
A22	ANALOG INPUT 24 V DC POWER SUPPLY +
A23	ANALOG INPUT 1 +
A24	ANALOG INPUT 2 +
A25	ANALOG INPUT 3 +
A26	ANALOG INPUT 4 +
A27	ANALOG INPUT COMMON –
B01	RTD SHIELD
B02	AUXILIARY RS485 +
B03	AUXILIARY RS485 –
B04	AUXILIARY RS485 COMMON
C01	ACCESS +
C02	ACCESS –
C03	469 UNDER TEST +
C04	469 UNDER TEST –
D01	RTD #7 HOT
D02	RTD #7 COMPENSATION
D03	RTD RETURN
D04	RTD #8 COMPENSATION
D05	RTD #8 HOT
D06	RTD #9 HOT
D07	RTD #9 COMPENSATION
D08	RTD RETURN
D09	RTD #10 COMPENSATION
D10	RTD #10 HOT
D11	RTD #11 HOT
D12	RTD #11 COMPENSATION
D13	RTD RETURN
D14	RTD #12 COMPENSATION
D15	RTD #12 HOT
D16	STARTER STATUS
D17	EMERGENCY RESTART
D18	REMOTE RESET
D19	ASSIGNABLE SW. 01
D20	ASSIGNABLE SW. 02

TERMINAL	DESCRIPTION
D21	ASSIGNABLE SW. 03
D22	ASSIGNABLE SW. 04
D23	SWITCH COMMON
D24	SWITCH +24 V DC
D25	COMPUTER RS485 +
D26	COMPUTER RS485 –
D27	COMPUTER RS485 COMMON
E01	R1 TRIP NC
E02	R1 TRIP NO
E03	R2 AUXILIARY COMMON
E04	R3 AUXILIARY NC
E05	R3 AUXILIARY NO
E06	R4 ALARM COMMON
E07	R5 BLOCK START NC
E08	R5 BLOCK START NO
E09	R6 SERVICE COMMON
E10	not used
E11	COIL SUPERVISION +
E12	469 DRAWOUT INDICATOR
F01	R1 TRIP COMMON
F02	R2 AUXILIARY NO
F03	R2 AUXILIARY NC
F04	R3 AUXILIARY COMMON
F05	R4 ALARM NO
F06	R4 ALARM NC
F07	R5 BLOCK START COMMON
F08	R6 SERVICE NO
F09	R6 SERVICE NC
F10	not used
F11	COIL SUPERVISION –
F12	469 DRAWOUT INDICATOR
G01	PHASE VT NEUTRAL
G02	PHASE A VT •
G03	DIFFERENTIAL A CT •
G04	DIFFERENTIAL B CT •
G05	DIFFERENTIAL C CT •
G06	PHASE A CT •
G07	PHASE B CT •
G08	PHASE C CT •
G09	1A/5A GROUND CT •
G10	50:0.025 GROUND CT •
G11	FILTER GROUND
G12	SAFETY GROUND
H01	PHASE B VT •
H02	PHASE C VT •
H03	DIFFERENTIAL A CT
H04	DIFFERENTIAL B CT
H05	DIFFERENTIAL C CT
H06	PHASE A CT
H07	PHASE B CT
H08	PHASE C CT
H09	1A/5A GROUND CT
H10	50:0.025 GROUND CT
H11	CONTROL POWER –
H12	CONTROL POWER +

2.2.1 TYPICAL WIRING DIAGRAM

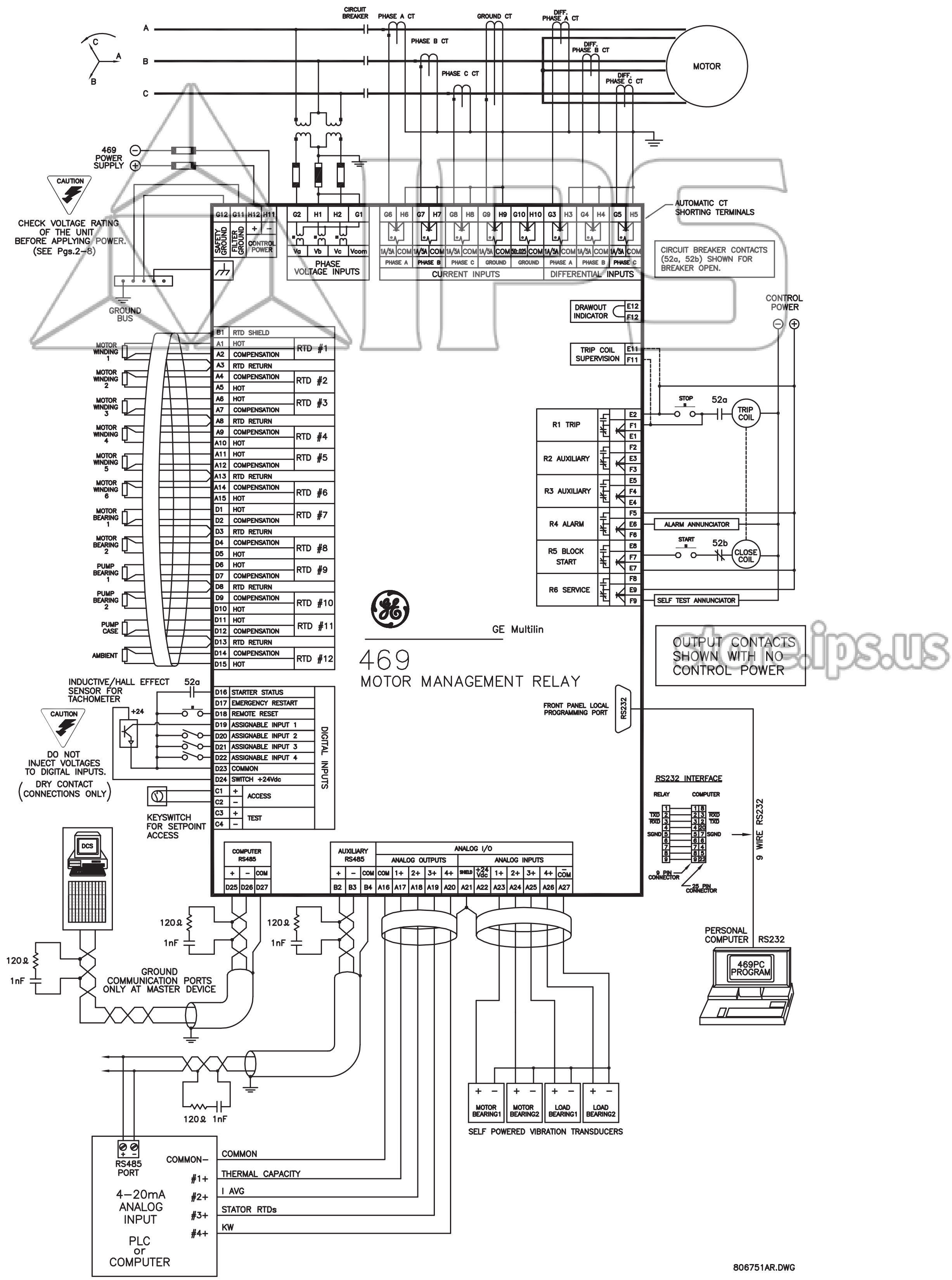


Figure 2–10: TYPICAL WIRING DIAGRAM

A broad range of 469 applications are available. Although it is not possible to present typical connections for all possible schemes, this section will cover the interconnections of instrument transformer inputs, other inputs, outputs, communications, and grounding. See Figure 2–9: Terminal Layout on page 2–6 and Table 2–1: 469 TERMINAL LIST on page 2–7 for terminal arrangement.

2.2.2 CONTROL POWER

CAUTION

The 469 control power must match the installed switching power supply. If the applied voltage does not match, damage to the unit may occur!

The order code from the terminal label on the side of the drawout unit specifies the nominal control voltage as follows:

- LO: 20 to 60 V DC; 20 to 48 V AC, or
- HI: 90 to 300 V DC; 70 to 265 V AC

Ensure applied control voltage and rated voltage on drawout case terminal label match. For example, the HI power supply will work with any DC voltage from 90 to 300 V, or AC voltage from 70 to 265 V. The internal fuse may blow if the applied voltage exceeds this range.

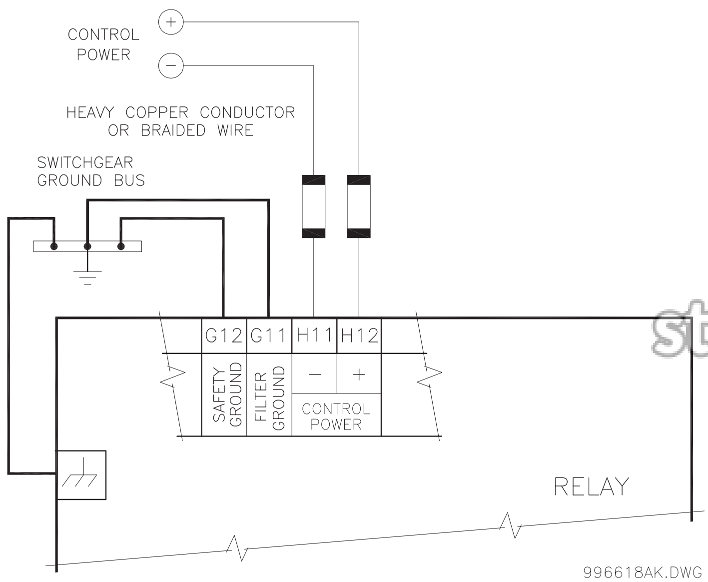


Figure 2–11: CONTROL POWER CONNECTION

Extensive filtering and transient protection are built into the 469 to ensure proper operation in harsh industrial environments. Transient energy must be conducted back to the source through the filter ground terminal. A separate safety ground terminal is provided for hi-pot testing.

WARNING

All grounds MUST be hooked up for normal operation regardless of control power supply type.

2.2.3 CURRENT INPUTS

a) PHASE CURRENT INPUTS

The 469 has three channels for phase current inputs, each with an isolating transformer. There are no internal ground connections on the current inputs. If the unit is withdrawn, each phase CT circuit is shorted by automatic mechanisms on the 469 case. The phase CTs should be chosen so the FLA is no less than 50% of the rated phase CT primary. Ideally, the phase CT primary should be chosen such that the FLA is 100% of the phase CT primary or slightly less, never more. This will ensure maximum accuracy for the current measurements. The maximum phase CT primary current is 5000 A.

The 469 correctly measures up to 20 times the phase current nominal rating. Since the conversion range is large, 1 A or 5 A CT secondaries must be specified at the time of order to ensure the appropriate interposing CT is installed in the unit. The chosen CTs must be capable of driving the 469 phase CT burden (see Section 1.2: Specifications on page 1–4 for ratings).

CAUTION **Verify that the 469 nominal phase current of 1 A or 5 A matches the secondary rating and connections of the connected CTs. Unmatched CTs may result in equipment damage or inadequate protection. Polarity of the phase CTs is critical for Negative Sequence Unbalance calculation, power measurement, and residual ground current detection (if used).**

See Appendix A.1: Two-Phase CT Configuration on page A–1 for 2-phase CT information.

b) GROUND CURRENT INPUT

The 469 has a dual primary isolating transformer for ground CT connection. There are no internal ground connections on the ground current inputs. The ground CT circuits are shorted by automatic mechanisms on the 469 case if the unit is withdrawn. The 1 A / 5 A tap is used either for zero-sequence/core balance applications or residual ground connections where the summation of the three phase current CTs is passed through the ground current input (see the figure below). The maximum ground CT primary current is 5000 A for the 1 A / 5 A tap. Alternatively, the 50:0.025 ground CT input has been designed for sensitive ground current detection on high resistance grounded systems where the GE Multilin 50:0.025 core balance CT is to be used. For example, in mining applications where earth leakage current must be measured for personnel safety, primary ground current as low as 0.25 A may be detected with the GE Multilin 50:0.025 CT. Only one ground CT input tap should be used on a given unit.

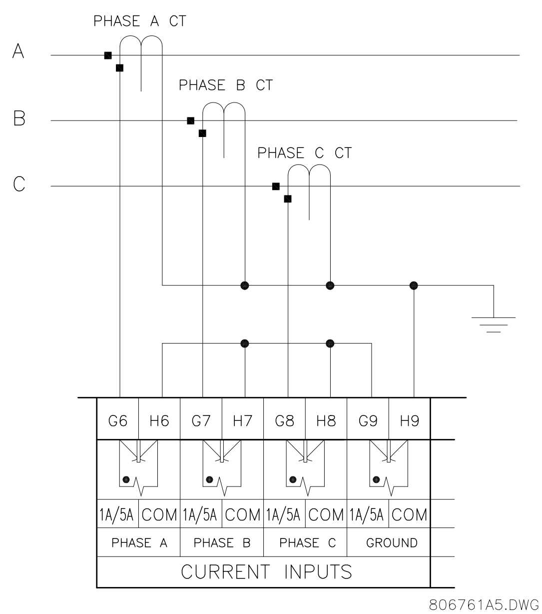


Figure 2–12: RESIDUAL GROUND CT CONNECTION

The 469 measures up to 5 A secondary current if the 1 A / 5 A tap is used. Since the conversion range is relatively small, the 1 A or 5 A option is field programmable. Proper selection of this setpoint ensures proper reading of primary ground current. The 1 A / 5 A ground CT chosen must be capable of driving the 469 ground CT burden (see Section 1.2: Specifications on page 1–4). The 469 measures up to 25 A of primary ground current if this tap is used in conjunction with the GE Multilin core balance CT.

NOTE **The zero-sequence connection is recommended. Unequal saturation of CTs, size and location of motor, resistance of power system and motor core saturation density, etc., may cause false readings in the residually connected GF circuit.**

NOTE **Only one ground input should be wired – the other input should be unconnected.**

The exact placement of a zero-sequence CT to detect only ground fault current is shown below. If the core balance CT is placed over shielded cable, capacitive coupling of phase current into the cable shield during motor starts may be detected as ground current unless the shield wire is also passed through the CT window. Twisted pair cabling on the zero-sequence CT is recommended.

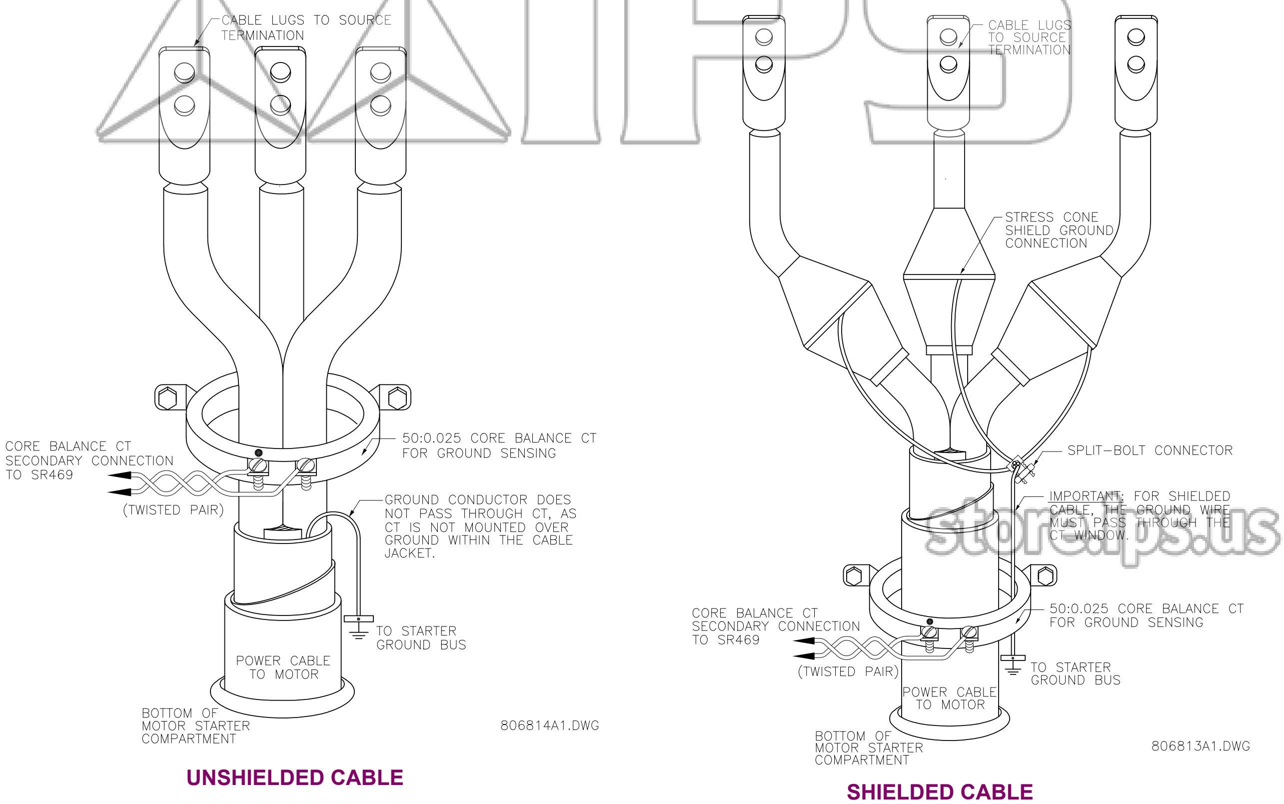


Figure 2–13: CORE BALANCE GROUND CT INSTALLATION

c) DIFFERENTIAL CURRENT INPUTS

The 469 has three channels for differential current inputs, each with an isolating transformer. There are no internal ground connections on the current inputs. Each differential CT circuit is shorted by automatic mechanisms on the 469 case if the unit is withdrawn. The maximum differential CT primary current is 5000 A.

The 469 measures up to 5 A secondary current for the differential CT inputs. Since the conversion range is relatively small, the 1 A or 5 A option is field programmable. Proper selection of this setpoint ensures proper reading of primary phase differential current. The 1 A / 5 A differential CT chosen must be capable of driving the 469 differential CT burden (see Section 1.2: Specifications on page 1–4 for ratings).

The differential CTs may be core balance as shown in the first figure below. Alternatively, the summation of two CTs per phase into the differential input will provide a larger zone of protection. If the summation of two CTs is used, observation of CT polarity is important. The summation method may also be implemented using the phase CTs as shown below. They will have to have the same CT ratio.

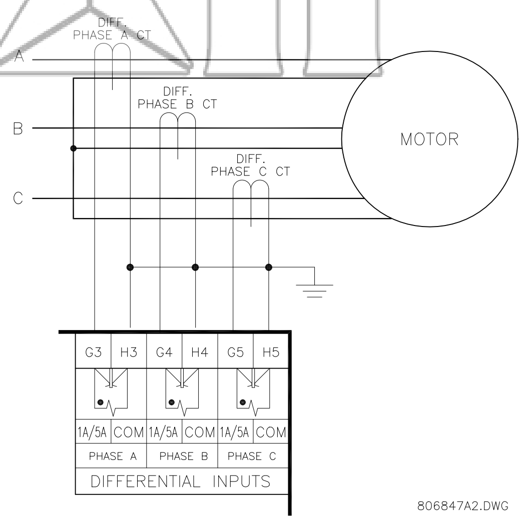
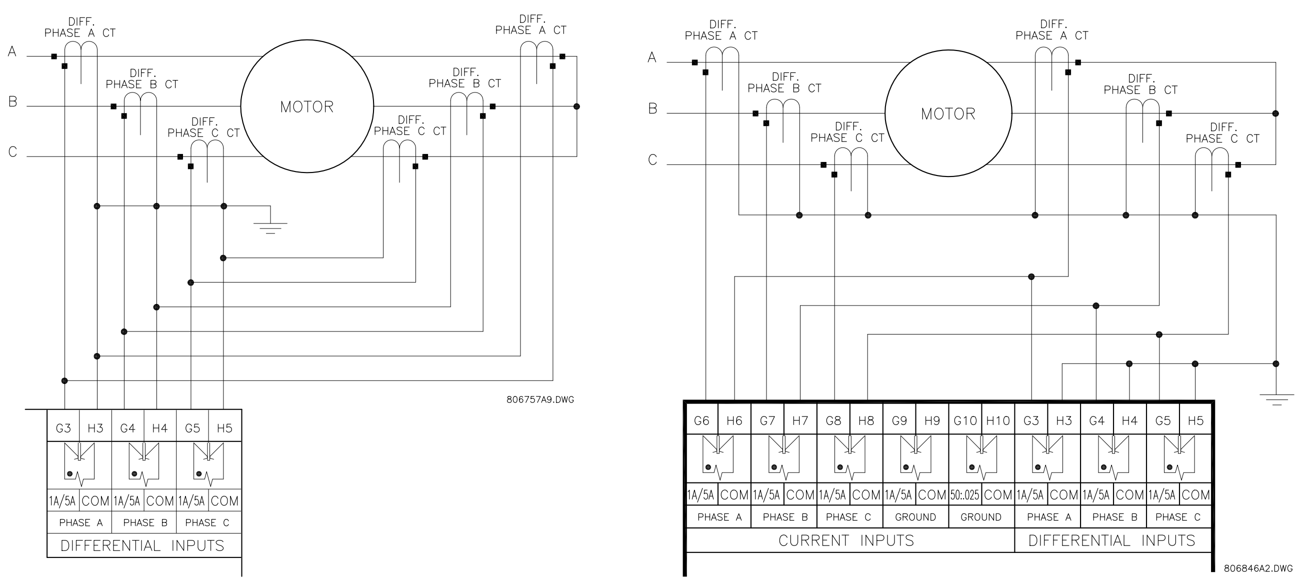


Figure 2–14: CORE BALANCE METHOD



WITHOUT PHASE CTs **WITH PHASE CTs**

Figure 2–15: SUMMATION METHOD

2.2.4 VOLTAGE INPUTS

2

The 469 has three channels for AC voltage inputs, each with an isolating transformer. There are no internal fuses or ground connections on the voltage inputs. The maximum VT ratio is 150.00:1. The two VT connections are open delta (see Figure 2–10: Typical Wiring Diagram on page 2–8) or wye (see below). The voltage channels are connected in wye internally, which means that the jumper shown on the delta-source connection of the TYPICAL WIRING DIAGRAM, between the phase B input and the 469 neutral terminal, must be installed for open delta VTs.

Polarity of the VTs is critical for correct power measurement and voltage phase reversal operation.

A 1 A fuse is typically used to protect the inputs.

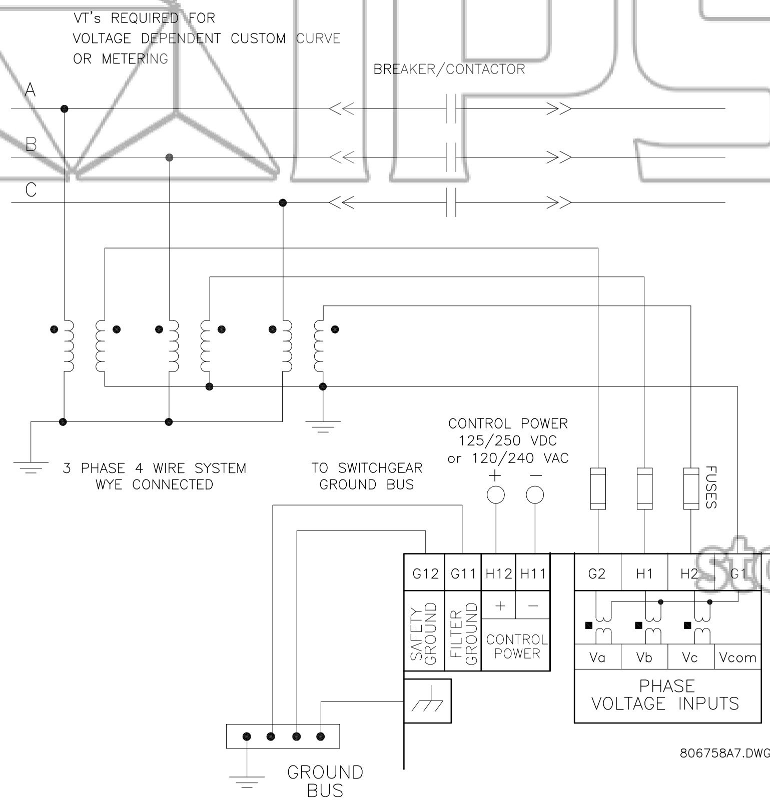


Figure 2–16: WYE VOLTAGE TRANSFORMER CONNECTION

2.2.5 DIGITAL INPUTS

There are 9 digital inputs designed for dry contact connections only. Two of the digital inputs (Access and Test) have their own common terminal; the balance of the digital inputs share one common terminal (see Figure 2–10: Typical Wiring Diagram on page 2–8).

In addition, the +24 V DC switch supply is brought out for control power of an inductive or capacitive proximity probe. The NPN transistor output could be taken to one of the assignable digital inputs configured as a counter or tachometer. Refer to Section 1.2: Specifications on page 1–4 for maximum current draw from the +24 V DC switch supply.

CAUTION **DO NOT INJECT VOLTAGES TO DIGITAL INPUTS. DRY CONTACT CONNECTIONS ONLY.**

NOTE **The digital inputs of the 469 relay are designed for dry contact connection. In the application where the contact inputs need to be connected to the 469 relay digital inputs using long cable, it is recommended to use interposing auxiliary contacts to interface between the 469 relay and long digital input cable. This will**

2

help to prevent relay operating on digital input due to induced voltage on the cables because of the capacitive effect. It is recommended to use shielded twisted pair wires grounded at one end only for digital inputs and avoid locating wire in close proximity to current carrying cables, contactors or other sources of high EMI

2.2.6 ANALOG INPUTS

The 469 provides terminals for four 0 to 1mA, 0 to 20mA, or 4 to 20mA current input signals (field programmable). This current signal can be used to monitor external quantities such as vibration, pressure, or flow. The four inputs share one common return. Polarity of these inputs must be observed for proper operation The analog input circuitry is isolated as a group with the analog output circuitry and the RTD circuitry. Only one ground reference should be used for the three circuits. Transorbs limit this isolation to ±36 V with respect to the 469 safety ground.

In addition, the +24 V DC analog input supply is brought out for control power of loop powered transducers. Refer to Section 1.2: Specifications on page 1–4 for maximum current draw from this supply.

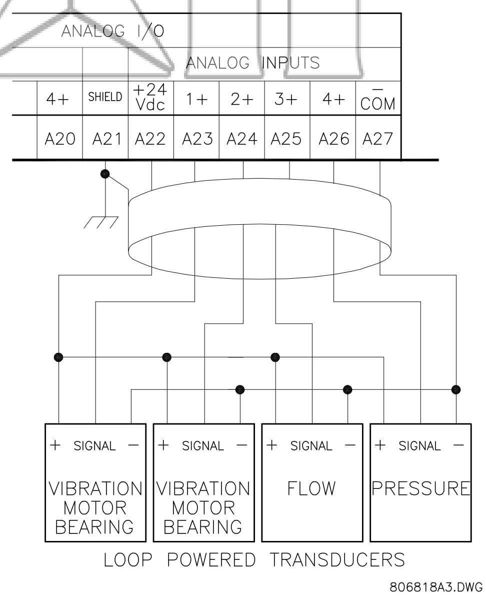


Figure 2–17: LOOP POWERED TRANSDUCER CONNECTION

2.2.7 ANALOG OUTPUTS

The 469 provides 4 analog output channels which may be ordered to provide a full-scale range of either 0 to 1 mA (into a maximum 10 kΩ impedance) or 4 to 20 mA (into a maximum 1200 Ω impedance). Each channel can be configured to provide full-scale output sensitivity for any range of any measured parameter.

As shown in Figure 2–10: Typical Wiring Diagram on page 2–8, these outputs share one common return. Polarity of these outputs must be observed for proper operation. Shielded cable should be used, with only one end of the shield grounded, to minimize noise effects.

The analog output circuitry is isolated as a group with the Analog Input circuitry and the RTD circuitry. Only one ground reference should be used for the three circuits. Transorbs limit this isolation to ±36 V with respect to the 469 safety ground.

If a voltage output is required, a burden resistor must be connected at the input of the SCADA measuring device. Ignoring the input impedance of the input, $R_{load} = V_{full\ scale} / I_{max}$. For 0 to 1 mA, for example, if 5 V full scale is required to correspond to 1 mA, R_{load} = 5 V / 0.001 A = 5000 Ω. For 4 to 20 mA, this resistor would be R_{load} = 5 V / 0.020 A = 250 Ω.

2.2.8 RTD SENSOR CONNECTIONS

a) DESCRIPTION

The 469 monitors up to 12 RTD inputs for Stator, Bearing, Ambient, or Other temperature monitoring. The type of each RTD is field programmable as 100 Ω Platinum (DIN 43760), 100 Ω Nickel, 120 Ω Nickel, or 10 Ω Copper. RTDs must be three wire type. Every two RTDs shares a common return.

The RTD circuitry compensates for lead resistance, provided that each of the three leads is the same length. Lead resistance should not exceed 25 Ω per lead for platinum/nickel RTDs or 3 Ω per lead for copper RTDs. Shielded cable should be used to prevent noise pickup in the industrial environment. RTD cables should be kept close to grounded metal casings and away from areas of high electromagnetic or radio interference. RTD leads should not be run adjacent to or in the same conduit as high current carrying wires.

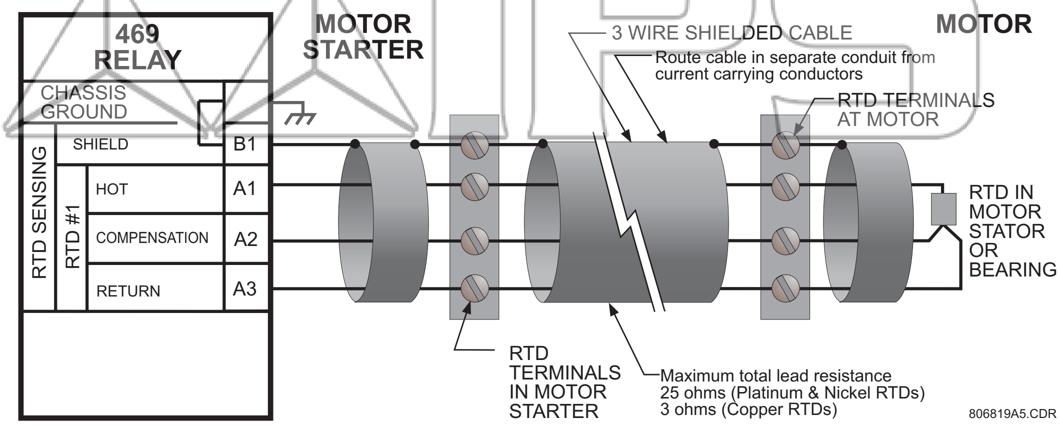


Figure 2–18: RTD WIRING

NOTE

IMPORTANT: The RTD circuitry is isolated as a group with the Analog Input circuitry and the Analog Output circuitry. Only one ground reference should be used for the three circuits. Transorbs limit this isolation to ±36 V with respect to the 469 safety ground.

b) REDUCED RTD LEAD NUMBER APPLICATION

The 469 requires three leads to be brought back from each RTD: Hot, Return and Compensation. This can be quite expensive. It is however possible to reduce the number of leads required to 3 for the first RTD and 1 for each successive RTD. Refer to the figure below for wiring configuration for this application.

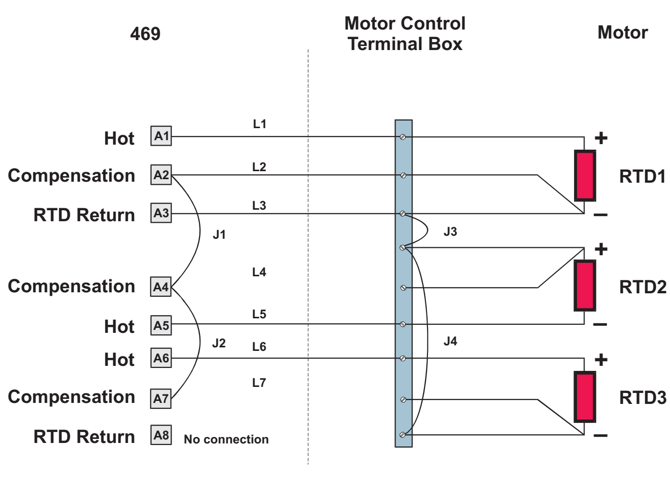


Figure 2–19: REDUCED WIRING RTDS

The Hot line would have to be run as usual for each RTD. The Compensation and Return leads, however, need only be run for the first RTD. At the motor RTD terminal box, the RTD Return leads must be jumpered together with as short as possible jumpers. The Compensation leads must be jumpered together at the 469.

Note that an error is produced on each RTD equal to the voltage drop across the jumper on the RTD return. This error increases with each successive RTD added.

$$V_{RTD1} = V_{RTD1}$$
$$V_{RTD2} = V_{RTD2} + V_{J3}$$
$$V_{RTD3} = V_{RTD3} + V_{J3} + V_{J4}, \text{ etc.}$$

This error is directly dependent on the length and gauge of the wire used for the jumpers and any error introduced by a poor connection. For RTD types other than 10 Ω Copper, the error introduced by the jumpers is negligible. Although this RTD wiring technique reduces the cost of wiring, the following disadvantages must be noted:

1. There will be an error in temperature readings due to lead and connection resistances. This technique is **NOT** recommended for 10 Ω Copper RTDs.
2. If the RTD Return lead to the 469 or any of the jumpers break, all RTDs from the point of the break will read open.
3. If the Compensation lead or any of the jumpers break, all RTDs from the point of the break will function without any lead compensation.

c) TWO-WIRE RTD LEAD COMPENSATION

An example of how to add lead compensation to a two wire RTD may is shown in the figure below.

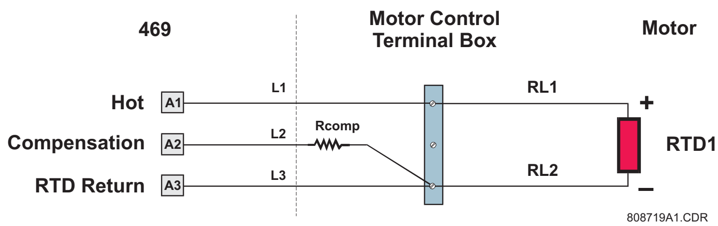


Figure 2–20: 2-WIRE RTD LEAD COMPENSATION

The compensation lead L2 is added to compensate for Hot (L1) and Return (L3), assuming they are all of equal length and gauge. To compensate for leads RL1 and RL2, a resistor equal to the resistance of RL1 or RL2 could be added to the compensation lead, though in many cases this is unnecessary.

d) RTD GROUNDING

Grounding of one lead of the RTDs is done at either the 469 or at the motor. Grounding should **not** be done in both places as it could cause a circulating current. Only RTD Return leads may be grounded. When grounding at the 469, only one Return lead need be grounded as they are hard-wired together internally. No error is introduced into the RTD reading by grounding in this manner.

If the RTD Return leads are tied together and grounded at the motor, only one RTD Return lead can be run back to the 469. See the figure below for a wiring example. Running more than one RTD Return lead to the 469 causes significant errors as two or more parallel paths for the return current have been created. Use of this wiring scheme causes errors in readings equivalent to that in the Reduced RTD Lead Number application described earlier.

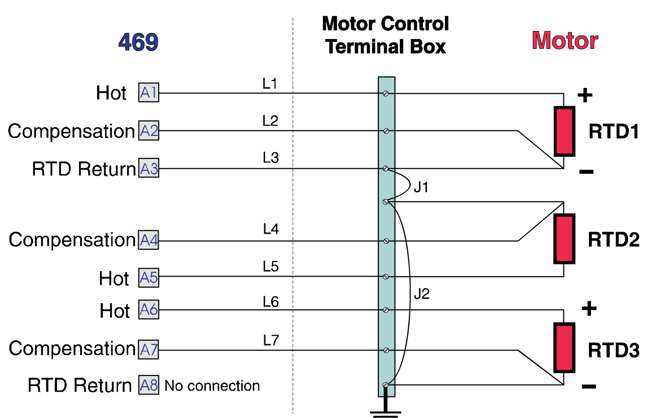


Figure 2–21: RTD ALTERNATE GROUNDING

2.2.9 OUTPUT RELAYS

WARNING **Relay contacts must be considered unsafe to touch when the 469 is energized! If the output relay contacts are required for low voltage accessible applications, it is the customer's responsibility to ensure proper insulation levels.**

There are six (6) Form-C output relays (see Section 1.2: Specifications on page 1–4 for details). Five of the six relays are always non-failsafe; R6 Service is always failsafe. As failsafe, the R6 relay is normally energized and de-energizes when called upon to operate. It also de-energizes when 469 control power is lost and will be in its operated state. All other relays, being non-failsafe, will normally be de-energized and energize when called upon to operate. When the 469 control power is lost, these relays are de-energized and in their non-operated state. Shorting bars in the drawout case ensure that no trip or alarm occurs when the 469 is drawn out. However, the R6 Service output will indicate that the 469 has been drawn out. Each output relay has an LED indicator on the front panel that turns on when the associated relay is in the operated state.

- **R1 TRIP:** The trip relay should be wired to take the motor off line when conditions warrant. For a breaker application, the NO R1 Trip contact should be wired in series with the Breaker trip coil. For contactor applications, the NC R1 Trip contact should be wired in series with the contactor coil.

  Supervision of a breaker trip coil requires that the supervision circuit be in parallel with the R1 TRIP relay output contacts. With this connection made, the supervision input circuits place an impedance across the contacts that draws a 2 mA current (for an external supply voltage from 30 to 250 V DC) through the breaker trip coil. The supervision circuits respond to a loss of this trickle current as a failure condition. Circuit breakers equipped with standard control circuits have a breaker auxiliary contact permitting the trip coil to be energized only when the breaker is closed. When these contacts are open, as detected by the Starter Status Digital Input monitoring breaker auxiliary contacts, trip coil supervision circuit is automatically disabled. This logic allows the trip circuit to be monitored only when the breaker is closed.

- **R2 AUXILIARY, R3 AUXILIARY:** The auxiliary relays may be programmed for trip echo, alarm echo, trip backup, alarm differentiation, control circuitry, and numerous other functions. They should be wired as configuration warrants.
- **R4 ALARM:** The alarm relay should connect to the appropriate annunciator or monitoring device.
- **R5 BLOCK START:** This relay should be wired in series with the start pushbutton in either a breaker or contactor configuration to prevent motor starting. When a trip has not been reset on a breaker, the block start relay prevents a start attempt that would result in an immediate trip. Any lockout functions are also directed to the block start relay.
- **R6 SERVICE:** The service relay operates if any of the 469 diagnostics detect an internal failure or on loss of control power. This output may be monitored with an annunciator, PLC or DCS. If it is deemed that a motor is more important than a process, the service relay NC contact may also be wired in parallel with the trip relay on a breaker application or the NO contact may be wired in series with the trip relay on a contactor application. This will provide failsafe operation of the motor; that is, the motor will be tripped off line in the event that the 469 is not protecting it. If however, the process is critical, annunciation of such a failure will allow the operator or the operation computer to either continue, or do a sequenced shutdown. See the following figure for details.

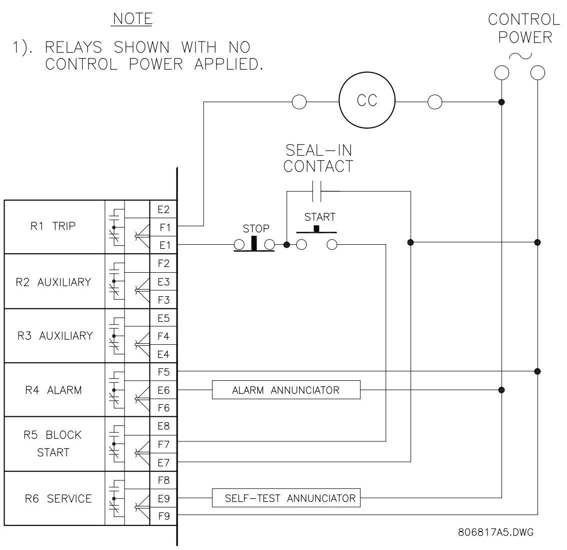


Figure 2–22: ALTERNATE WIRING FOR CONTACTORS

2.2.10 DRAWOUT INDICATOR

The Drawout Indicator is simply a jumper from terminals E12 to F12. When the 469 is withdrawn from the case, terminals E12 and F12 are open. This may be useful for differentiating between loss of control power as indicated by the R6 SERVICE relay and withdrawal of the unit.

2.2.11 RS485 COMMUNICATIONS PORTS

Two independent two-wire RS485 ports are provided. Up to 32 469s can be daisy-chained together on a communication channel without exceeding the driver capability. For larger systems, additional serial channels must be added. Commercially available repeaters can also be used to add more than 32 relays on a single channel. Suitable cable should have a characteristic impedance of 120 Ω (e.g. Belden #9841) and total wire length should not exceed 4000 ft. Commercially available repeaters will allow for transmission distances greater than 4000 ft.

Voltage differences between remote ends of the communication link are not uncommon. For this reason, surge protection devices are internally installed across all RS485 terminals. Internally, an isolated power supply with an optocoupled data interface is used to prevent noise coupling.

NOTE **To ensure that all devices in a daisy-chain are at the same potential, it is imperative that the common terminals of each RS485 port are tied together and grounded only once, at the master. Failure to do so may result in intermittent or failed communications.**

The source computer/PLC/SCADA system should have similar transient protection devices installed, either internally or externally, to ensure maximum reliability. Ground the shield at one point only, as shown in the figure below, to avoid ground loops.

Correct polarity is also essential. The 469s must be wired with all the '+' terminals connected together and all the '–' terminals connected together. Each relay must be daisy-chained to the next one. Avoid star or stub connected configurations. The last device at each end of the daisy chain should be terminated with a 120 Ω ¼-watt resistor in series with a 1 nF capacitor across the '+' and '–' terminals. Observing these guidelines provides a reliable communication system immune to system transients.

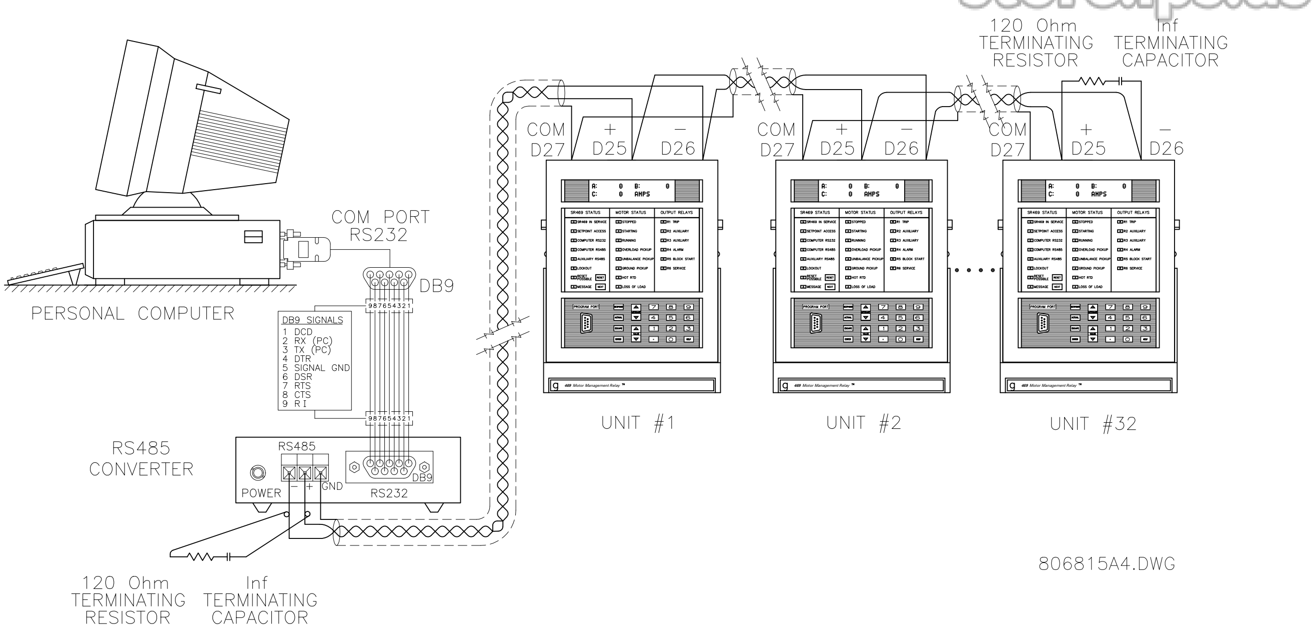


Figure 2–23: RS485 COMMUNICATIONS INTERFACE

2.2.12 DIELECTRIC STRENGTH

It may be required to test a complete motor starter for dielectric strength ("flash" or "hipot") with the 469 installed. The 469 is rated for 1.9 kV AC for 1 second or 1.6 kV AC for 1 minute (per UL 508) isolation between relay contacts, CT inputs, VT inputs, trip coil supervision, and the safety ground terminal G12. Some precautions are required to prevent damage to the 469 during these tests.

Filter networks and transient protection clamps are used between control power, trip coil supervision, and the filter ground terminal G11. This is intended to filter out high voltage transients, radio frequency interference (RFI), and electromagnetic interference (EMI). The filter capacitors and transient suppressors may be damaged by continuous high voltage. Disconnect the filter ground terminal G11 during testing of control power and trip coil supervision. The CT inputs, VT inputs, and output relays do not require any special precautions. Low voltage inputs (less than 30 V), RTDs, analog inputs, analog outputs, digital inputs, and RS485 communication ports are not to be tested for dielectric strength under any circumstance (see below).

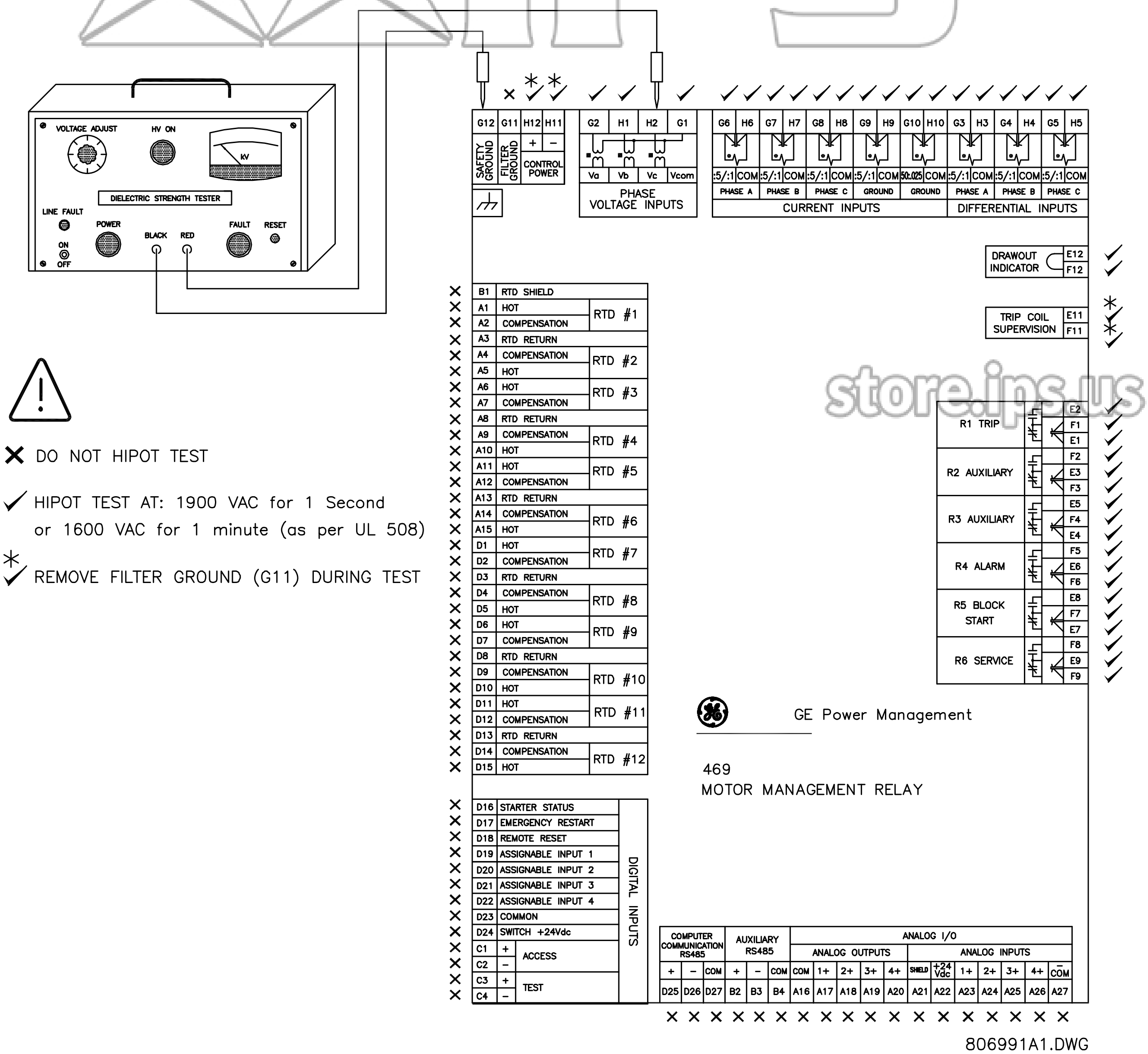
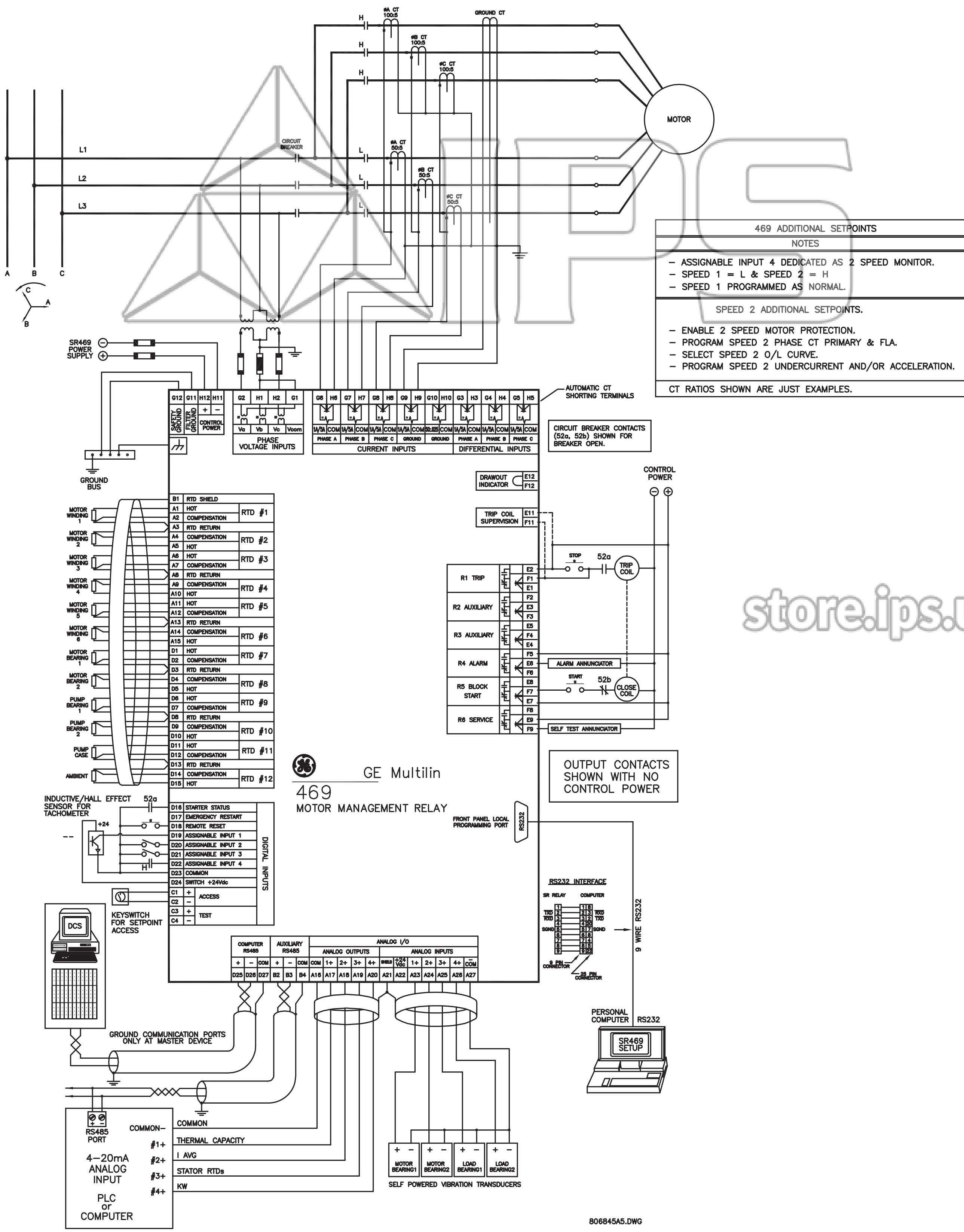


Figure 2–24: TESTING FOR DIELECTRIC STRENGTH

2.2.13 TWO-SPEED MOTOR WIRING



3.1.1 DISPLAY

All messages are displayed on a 40-character liquid crystal display that is backlit for visibility under poor lighting conditions. Messages are displayed in plain English and do not require an instruction manual to decipher. When the keypad and display are not being used, the display defaults to the user-defined status messages. Any trip, alarm, or start block is displayed immediately, automatically overriding the default messages.

3.1.2 LED INDICATORS

There are three groups of LED indicators. They are 469 Status, Motor Status, and Output Relays.

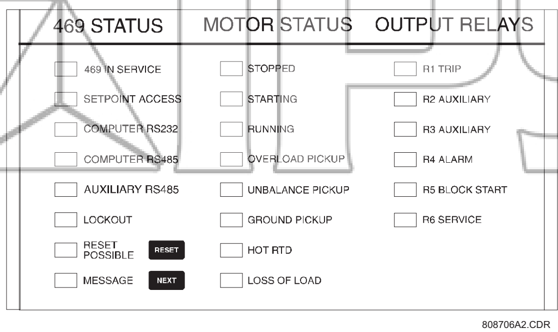


Figure 3–1: 469 LED INDICATORS

a) 469 STATUS LED INDICATORS

- **469 IN SERVICE:** This LED indicates that control power is applied, all monitored inputs/outputs and internal systems are OK, the 469 has been programmed, and the 469 is in protection mode, not simulation mode. This LED flashes when the 469 is in simulation or testing mode.
- **SETPOINT ACCESS:** This LED indicates that the access jumper is installed and passcode protection has been satisfied; setpoints may be altered and stored.
- **COMPUTER RS232:** This LED flashes when there is any activity on the communication port. The LED remains on solid if incoming data is valid.
- **COMPUTER RS485:** Flashes when there is any activity on the communication port. Remains on solid if incoming data is valid and intended for the slave address programmed in the relay.
- **AUXILIARY RS485:** Flashes when there is any activity on the communication port. Remains on solid if incoming data is valid and intended for the slave address programmed in the relay.
- **LOCKOUT:** Indicates start attempts will be blocked either by a programmed lockout time or a condition that is still present.
- **RESET POSSIBLE:** A trip or latched alarm may be reset. Press the RESET key to clear the trip or alarm.
- **MESSAGE:** Flashes when a trip, alarm, or start block occurs. Pressing the NEXT key scrolls through diagnostic messages. This LED remains solid when setpoint and actual value messages are being viewed. Pressing the NEXT key returns the display to the default messages.

b) MOTOR STATUS LED INDICATORS

- **STOPPED:** The motor is stopped based on zero phase current and starter status auxiliary contact feedback.
- **STARTING:** Motor is starting.
- **RUNNING:** Motor is running normally below overload pickup level.
- **OVERLOAD:** Motor is running above overload pickup.
- **UNBALANCE PICKUP:** Level of current unbalance has exceeded the unbalance alarm or trip level.
- **GROUND PICKUP:** Level of ground current has exceeded the ground fault alarm or trip level.
- **HOT RTD:** One of the RTD measurements has exceeded its RTD alarm or trip level.

- **LOSS OF LOAD:** Average motor current has fallen below the undercurrent alarm or trip level; *or* power consumption has fallen below the underpower alarm or trip level.

c) OUTPUT RELAY LED INDICATORS

- **R1 TRIP:** R1 Trip relay has operated (energized).
- **R2 AUXILIARY:** R2 Auxiliary relay has operated (energized).
- **R3 AUXILIARY:** R3 Auxiliary relay has operated (energized).
- **R4 ALARM:** R4 Alarm relay has operated (energized).
- **R5 BLOCK START:** R5 Block Start relay has operated (energized).
- **R6 SERVICE:** R6 Service relay has operated (de-energized, R6 is failsafe, normally energized).

3.1.3 RS232 PROGRAM PORT

This port is intended for connection to a portable PC. Setpoint files may be created at any location and downloaded through this port with the 469PC software. Local interrogation of setpoints and actual values is also possible. New firmware may also be downloaded to the 469 flash memory through this port. Upgrading of the relay firmware does not require a hardware EPROM change.

3.1.4 KEYPAD

a) DESCRIPTION

469 messages are organized into pages under the headings Setpoints and Actual Values. The SETPOINT key navigates through the programmable parameters page headers. The ACTUAL key navigates through the measured parameters page headers.

Each page is broken down further into logical subgroups of messages. The MESSAGE ▼ and MESSAGE ▲ keys may be used to navigate through the subgroups.

The ENTER key is dual purpose. It is used to enter the subgroups or store altered setpoint values.

The ESCAPE key is also dual purpose. It may be used to exit the subgroups or to return an altered setpoint to its original value before it has been stored.

The VALUE ▼ and VALUE ▲ keys scroll through variables in the setpoint programming mode and increment/decrement numerical setpoint values. Alternately, these values may be entered with the numeric keypad.

The HELP key may be pressed at any time to display context sensitive help messages.

b) ENTERING ALPHANUMERIC TEXT

To customize the 469 for specific applications, custom text messages may be programmed in several places. One example is the Message Scratchpad. To enter alphanumeric text messages, the following procedure should be followed:

For example, to enter the text "Check Fluid Levels":

1. Press the decimal key [.] to enter text editing mode.
2. Press the VALUE ▼ or VALUE ▲ keys until **C** appears, then press the decimal key [.] to advance the cursor.
3. Repeat step 2 for the remaining characters: **h**,**e**,**c**,**k**, ,**F**,**l**,**u**,**i**,**d**, ,**L**,**e**,**v**,**e**,**l**,**s**.
4. Press ENTER to store the text message.

c) ENTERING +/– SIGNS

The 469 does not have '+' or '–' keys. Negative numbers may be entered in one of two manners.

- Immediately pressing the VALUE ▼ / VALUE ▲ keys causes the setpoint to scroll through its range including any negative numbers.
- After entering at least one digit of a numeric setpoint value, pressing the VALUE ▼ or VALUE ▲ keys changes the sign of the value where applicable.

3.1.5 SETPOINT ENTRY

To store any setpoints, terminals C1 and C2 (access terminals) must be shorted (a keyswitch may be used for security). There is also a setpoint passcode feature that restricts access to setpoints. The passcode must be entered to allow the changing of setpoint values. A passcode of 0 effectively turns off the passcode feature – in this case only the access jumper is required for changing setpoints. If no key is pressed for 5 minutes, access to setpoint values will be restricted until the passcode is entered again. To prevent setpoint access before the 5 minutes expires, the unit may be turned off and back on, the access jumper may be removed, or the **SETPOINT ACCESS** setpoint may be changed to "Restricted". The passcode cannot be entered until terminals C1 and C2 (access terminals) are shorted. When setpoint access is allowed, the Setpoint Access LED indicator on the front of the 469 will be lit.

Setpoint changes take effect immediately, even when motor is running. However, changing setpoints while the motor is running is not recommended as any mistake may cause a nuisance trip.

The following procedure may be used to access and alter setpoints. This specific example refers to entering a valid passcode to allow access to setpoints if the passcode was "469".

1. The 469 programming is broken down into pages by logical groups. Press SETPOINT to cycle through the setpoint pages until the desired page appears on the screen. Press MESSAGE ▼ to enter a page.

```
■■ SETPOINTS
■■ S1 469 SETUP
```

2. Each page is broken further into subgroups. Press MESSAGE ▼ and MESSAGE ▲ to cycle through subgroups until the desired subgroup appears on the screen. Press ENTER to enter a subgroup.

```
■ PASSCODE
■ [ENTER] for more
```

3. Each sub-group has one or more associated setpoint messages. Press MESSAGE ▼ and MESSAGE ▲ to cycle through setpoint messages until the desired setpoint message appears.

```
ENTER PASSCODE FOR
ACCESS:
```

4. The majority of setpoint messages may be altered by pressing VALUE ▼ or VALUE ▲ until the desired value appears and pressing ENTER. Numeric setpoints may also be entered through the numeric keys (including decimals) and pressing ENTER. If the entered setpoint is out of range, the original setpoint value reappears. If the entered setpoint is out of step, an adjusted value will be stored (e.g. 101 for a setpoint that steps 95, 100, 105 is stored as 100). If a mistake is made entering the new value, pressing ESCAPE returns the setpoint to its original value. Text editing is a special case described in detail in Section b): Entering Alphanumeric Text on page 3–2. Each time a new setpoint is successfully stored, a message will flash on the display stating "NEW SETPOINT HAS BEEN STORED".

5. Press the 4, 6, and 9 keys, then press ENTER. The following flash message is displayed:

```
NEW SETPOINT
HASE BEEN STORED
```

and the display returns to

```
SETPOINT ACCESS:
PERMITTED
```

6. Press ESCAPE to exit the subgroup. Pressing ESCAPE numerous times will always returns the cursor to the top of the page.

3

3.2.1 REQUIREMENTS

This chapter provides the necessary information to install and/or upgrade a previous installation of the 469PC software, upgrade the relay firmware, and write/edit setpoint files. It should be noted that the 469PC software should only be used with firmware versions 30D220A4.000, 30D220A8.000, 30D251A8.000 or later releases.

469PC is *not* compatible with Mods or any firmware versions prior to 220, and may cause errors if setpoints are edited. It can be used to upgrade older versions of relay firmware, but all previously programmed setpoints will be erased. Ensure that all setpoints are saved to a file before reprogramming the 469 firmware.

The following minimum requirements must be met for the 469PC software to properly operate on a computer.

- Processor: minimum 486, Pentium or higher recommended
- Memory: minimum 4 MB, 16 MB recommended
  minimum 540 K of conventional memory
- Hard Drive: 20 MB free space required before installation of software.
- O/S: Windows 3.1, Windows 3.11 for Workgroups, Windows NT, or Windows 95/98.

NOTE: Windows 3.1 Users must ensure that **SHARE.EXE** is installed.

469PC can be installed from either the GE Multilin Products CD or from the GE Multilin website at http://www.GEindustrial.com/multilin. If you are using legacy equipment without web access or a CD, 3.5” floppy disks can be ordered from the factory.

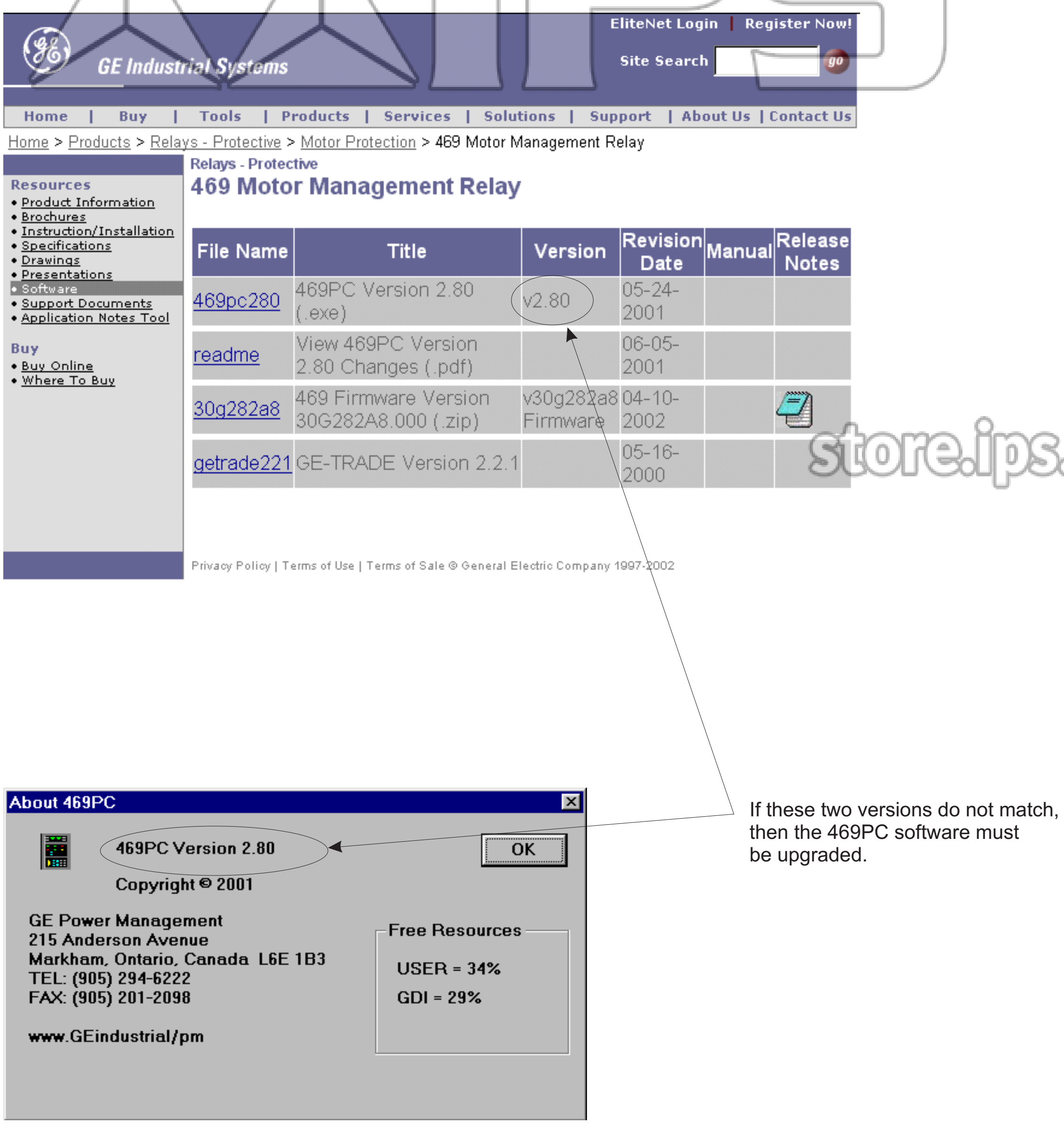
3.2.2 INSTALLATION/UPGRADE

a) PREPARATION

If 469PC is already installed, run the program and check if it needs upgrading as follows:

1. While 469PC is running, insert the GE Multilin Products CD and allow it to autostart (alternately, load the D:\index.htm file into your default web browser, **OR**

   Go to the GE Multilin website at http://www.GEindustrial.com/multilin (preferred method).
2. Click the “Software” menu item and select “469 Motor Management Relay” from the product list.
3. Verify that the version shown on this page is identical to the installed version as shown below. Select the **Help > About 469PC** menu item to determine which version is running on the local PC.



806972A1.CDR

b) INSTALLING/UPGRADING 469PC

Installation/upgrade of the 469PC software is accomplished as follows:

1. Ensure that Windows is running on the local PC
2. Insert the GE Multilin Products CD into your CD-ROM drive or point your web browser to the GE Multilin website at http://www.GEindustrial.com/multilin. With Windows 95/98 or higher, the Products CD will launch the welcome screen automatically; with Windows 3.1, open the Products CD by launching the `index.htm` file in the CD root directory.

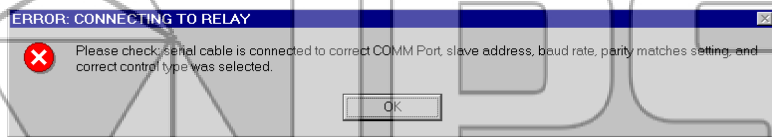
   The Products CD is essentially a “snapshot” of the GE Multilin website at the date printed on the CD. As such, the procedures for installation from the CD and the web are identical; however, to ensure that the newest version of 469PC is installed, installation from the web is preferred.

Figure 3–2: GE MULTILIN WELCOME SCREEN

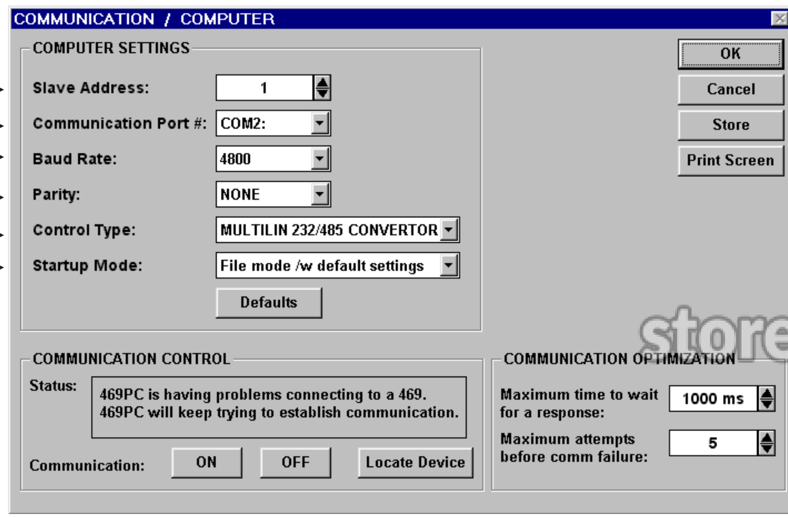
3. Click the Index by Product Name item from the main page and select 469 Motor Management Relay from the product list to open the 469 product page.
4. Click the Software item from the Product Resources list to go to the 469 software page.
5. The latest version of the 469PC software will be shown. Click on the 469PC Program item to download the installation program to your local PC. Run the installation program and follow the prompts to install to the desired directory. When complete, a new GE Multilin group window will appear containing the 469PC icon.

3.2.3 STARTUP AND COMMUNICATIONS CONFIGURATION

1. Connect the computer running the 469PC software to the relay via one of the RS485 ports (see Section 2.2.11: RS485 Communications Ports on page 2–18 for details and wiring) or directly via the RS232 front port.
2. Start 469PC. When starting, the software attempts to communicate with the relay. If communications are successfully established, the relay shown on the screen will display the same information seen on the actual relay The LED Status shown will also match the actual relay when communications is established.
3. If 469PC cannot establish communications with the relay, this message will appear.



4. Click **OK** to edit the communications settings (or alternately, select the Communications > Computer menu item at any time). The Communications/Computer dialog box will appear containing the various communications settings for the local PC. The settings should be modified as shown below.



Set the **Startup Mode** based on user preference. In “Communicate with Relay” mode, 469PC will attempt to establish communications immediately upon startup. While in the “File mode /w default settings”, 469PC waits for the user to click the ON button before attempting communications – this mode is preferred when the 469PC is being used without an attached 469 relay.

Set **Control Type** to match the type of RS232/RS485 converter. If connected through the 469 front panel RS232 port, select “No Control Type”. If connected through a GE Multilin F485 converter unit, select “MULTILIN RS232/RS485 CONVERTOR”. If connected through a modem, select “Modem”. If a third-party RS232/RS485 converter is being used, select the appropriate control type from the available list based on the manufacturer’s specifications.

Set **Parity** to match the 469 PARITY setpoint (see S1 469 SETUP). If connected through the 469 front panel RS232 port, set to “None”.

Set **Baud Rate** to match the 469 BAUD RATE setpoint (see S1 469 SETUP).

Set **Communcation Port #** to ***the COM port on your local PC*** where the 469 relay is connected (e.g. COM1 or COM2). On most computers, COM1 is used by the mouse device and as such COM2 is usually available for communications.

Set **Slave Address** to match the 469 SLAVE ADDRESS setpoint (see S1 469 SETUP).

Figure 3–3: COMMUNICATION/COMPUTER DIALOG BOX

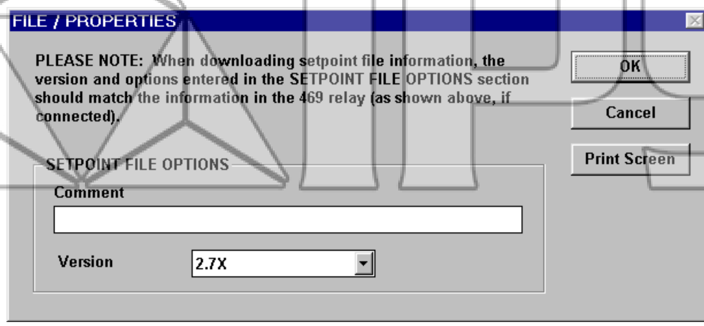
5. To begin communications, click the **ON** button in the **Communication** section of the dialog box. The status section indicates the communications status. If communications are established, the message “469PC is now talking to a 469” is displayed. As well, the status at the bottom right hand corner of the screen indicates “Communicating”.

3.2.4 USING 469PC

a) SAVING SETPOINTS TO A FILE

Setpoints must be saved to a file on the local PC before performing any firmware upgrades. Saving setpoints is also highly recommended before making any setpoint changes or creating new setpoint files. To save setpoints to a file on the local PC, follow the procedure below.

1. Select the **File > Properties** menu item. The dialog box below appears, allowing for the configuration of the 469PC software for the correct firmware version. 469PC needs to know the correct version when creating a setpoint file so that setpoints not available in a particular version are not downloaded into the relay.



2. When the correct firmware version is chosen, select the **File > Save As** menu item. This launches the following dialog box. Enter the filename under which the setpoints are saved in the **File Name** box or select any displayed file names to update them. All 469 setpoint files should have the extension `469` (for example, `motor1.469`). Click **OK** to proceed.
3. The software reads all the relay setpoint values and stores them to the selected file.

b) 469 FIRMWARE UPGRADES

Prior to downloading new firmware to the 469, it is necessary to save the 469 setpoints to a file (see the previous section). Loading new firmware into the 469 flash memory is accomplished as follows:

1. Ensure the local PC is connected to the 469 *via the front RS232 port* and that communications are established. Save the current setpoints to a file using the procedure outlined in the previous section.
2. Select the **Communications > Upgrade Firmware** menu item.
3. A warning message will appear (remember that all previously programmed setpoints will be erased). Click **Yes** to proceed or **No** to exit.
4. Next, 469PC will request the name of the new firmware file. Locate the appropriate file by changing drives and/or directories until a list of file names appears in the list box. File names for released 469 firmware have the following format:

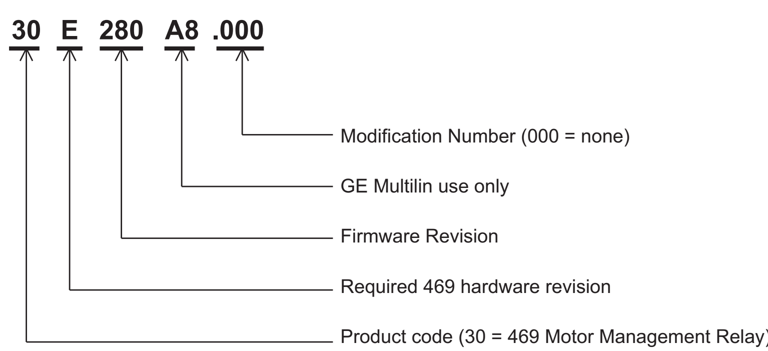
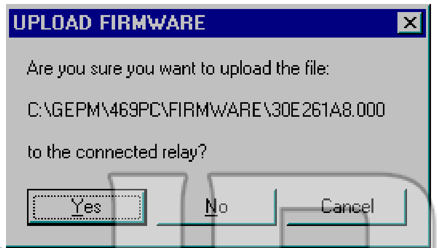


Figure 3–4: 469 FIRMWARE FILE FORMAT

5. The 469PC software automatically lists all filenames beginning with **30**. Select the appropriate file and click **OK** to continue.

6. 469PC will prompt with the following dialog box. This will be the last chance to cancel the firmware upgrade before the flash memory is erased. Click **Yes** to continue or **No** to cancel the upgrade.



7. The software automatically puts the relay into “upload mode” and then begins loading the selected file. Upon completion, the relay is placed back into “normal mode”.
8. Upon successful updating of the 469 firmware, the relay will not be in service and will require programming. To communicate with the relay via the RS485 ports, the **Slave Address**, **Baud Rate**, and **Parity** will have to be manually programmed. When communications is established, the saved setpoints will have to be reloaded back into the 469. See the next section for details.

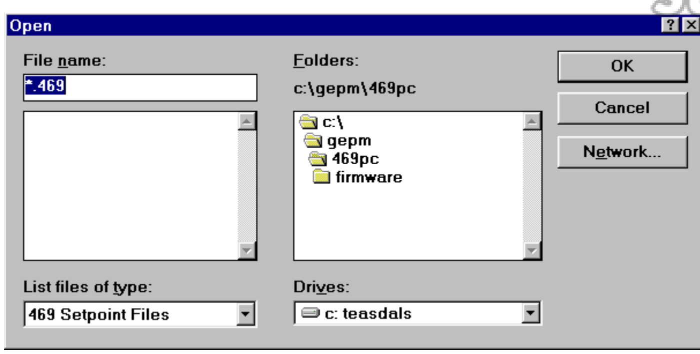
c) LOADING SETPOINTS FROM A FILE

NOTE

An error message will occur when attempting to download a setpoint file with a revision number that does not match the relay firmware. If the firmware has been upgraded since saving the setpoint file, see Section e) Upgrading Setpoint Files to a New Revision on page 3–11 for instructions on changing the revision number of the setpoint file.

Loading the 469 with setpoints from a file is accomplished as follows:

1. Select the **File > Open** menu item.
2. 469PC will launch the Open dialog box listing all filenames in the 469 default directory with the `469` extension. Select the setpoint file to download and click **OK** to continue.



3. Select the **File > Send Info to Relay** menu item. 469PC will prompt to confirm or cancel the setpoint file load. Click **Yes** to update the 469 setpoints.

d) ENTERING SETPOINTS

The following example illustrates how setpoints are entered and edited from the 469PC software.

1. Select the **Setpoint > Digital Inputs** menu item.
2. Click the **Input 1** tab to configure Digital Input 1 and select **DIGITAL Counter** from the Function menu.
3. 469PC displays the following dialog box showing the Digital Counter setpoint information.

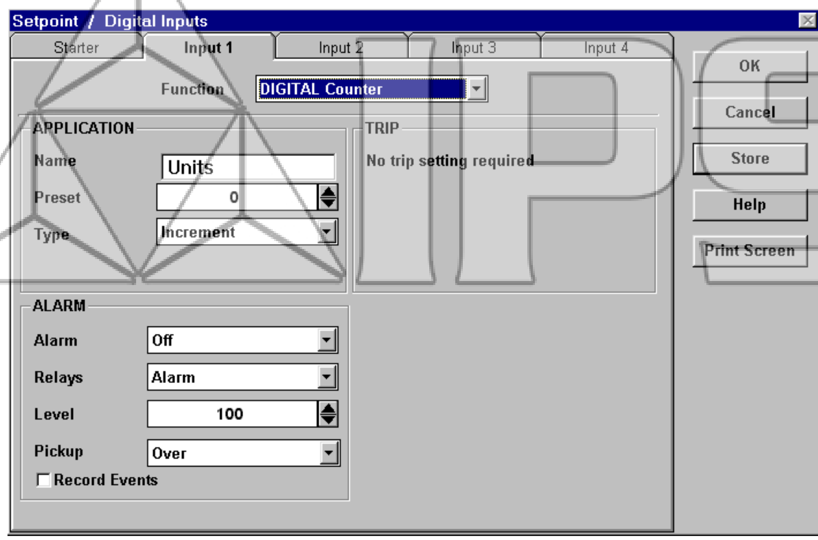
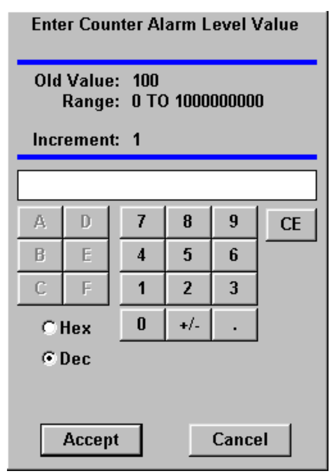


Figure 3–5: DIGITAL INPUT 1 – DIGITAL COUNTER SETPOINTS

4. For setpoints requiring numerical values (e.g. **ALARM LEVEL**), clicking anywhere within the setpoint value box launches a numerical keypad showing the old value, range, and increment of the setpoint value.



5. Numerical setpoint values may also be chosen by scrolling with the up/down arrows at the end of the setpoint value box. The values increment and decrement accordingly.
6. For setpoints requiring non-numerical pre-set values (e.g. **DIGITAL COUNTER TYPE**), clicking anywhere within the setpoint value box displays a drop-down selection menu.
7. For setpoints requiring an alphanumeric text string (e.g. **DIGITAL COUNTER NAME**), enter the value directly into the setpoint value box.

e) UPGRADING SETPOINT FILES TO A NEW REVISION

It may be necessary to upgrade the revision code for a previously saved setpoint file after the 469 firmware has been upgraded.

1. Establish communications with the relay.
2. Select the **Actual > Product Information** menu item and record the Main Revision identifier of the relay firmware; for example, 30D**270**A8.000, where **270** is the Main Revision identifier and refers to firmware version 2.70.
3. Select the **File > Open** menu item and enter the location and file name of the saved setpoint file to be downloaded to the connected relay. When the file is open, the 469PC software will be in “File Editing” mode and “Not Communicating”.
4. Select the **File > Properties** menu item and note the version code of the setpoint file. If the version code of the setpoint file (e.g. **2.6X**) is different than the Main Revision code of the firmware (as noted in Step 1, as **270**), use the pull-down tab to expose the available revision codes and select the one which matches the firmware.

   For example: Firmware revision: 30D**270**A8.000
   current setpoint file version: **2.6X**
   change setpoint file version to: **2.7X**

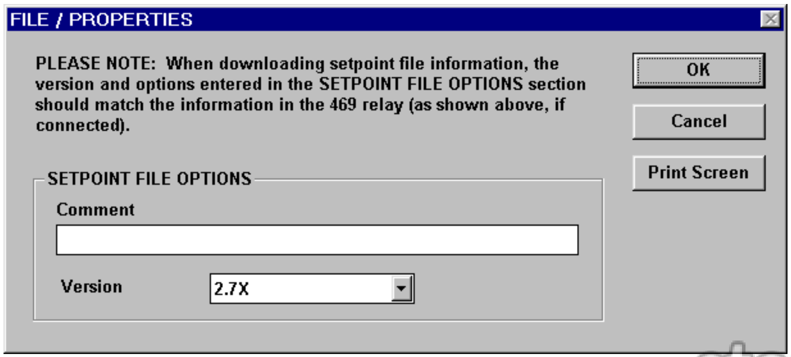


Figure 3–6: SETPOINT FILE VERSION

5. Select the **File > Save** menu item to save the setpoint file in the new format.
6. See Section c): Loading Setpoints from a File for instructions on downloading this setpoint file to the 469.

f) PRINTING SETPOINTS AND ACTUAL VALUES

Use the following procedure to print a list of setpoints:

1. Select the **File > Open** menu item and open a previously saved setpoint file,

   OR establish communications with the 469.
2. Select the **File > Print Setup** menu item, select either **Setpoints (All)** or **Setpoints (Enabled Features)** and click **OK**.
3. Select the **File > Print** menu item to send the setpoint file to a printer.

Use the following procedure to print a list of actual values:

1. Establish communications with the 469.
2. Select the **File > Print Setup** menu item, select **Actual Values** and click **OK**.
3. Select the **File > Print** menu item to send the actual values file to a printer.

3.2.5 TRENDING

Trending from the 469 can be accomplished via the 469PC software. Many different parameters can be trended and graphed at sampling periods ranging from 1 second up to 1 hour.

The parameters which can be **Trended** by the 469PC software are:

Currents/Voltages:	Phase Currents A, B, and C Motor Load Ground Current System Frequency	Average Phase Current Current Unbalance Differential Currents A, B, and C Voltages Vab, Vbc, Vca Van, Vbn & Vcn
Power:	Power Factor Reactive Power (kvar) Positive Watthours Negative Varhours	Real Power (kW) Apparent Power (kVA) Positive Varhours
Temperature:	Hottest Stator RTD RTDs 1 through 12	Thermal Capacity Used
Demands:	Current Reactive Power Apparent Power	Peak Current Peak Reactive Power, Peak Apparent Power
Others:	Analog Inputs 1, 2, 3, and 4	Tachometer

1. With 469PC running and communications established, select the **Actual > Trending** menu item to open the trending window.
2. Click **Setup** to enter the **Graph Attribute** page.
3. Select the graphs to be displayed through the pull-down menu beside each **Description**. Change the **Color**, **Style**, **Width**, **Group#**, and **Spline** selection as desired. Select the same **Group#** for all parameters to be scaled together.
4. Click **Save** to store the graph attributes and **OK** to close the window.

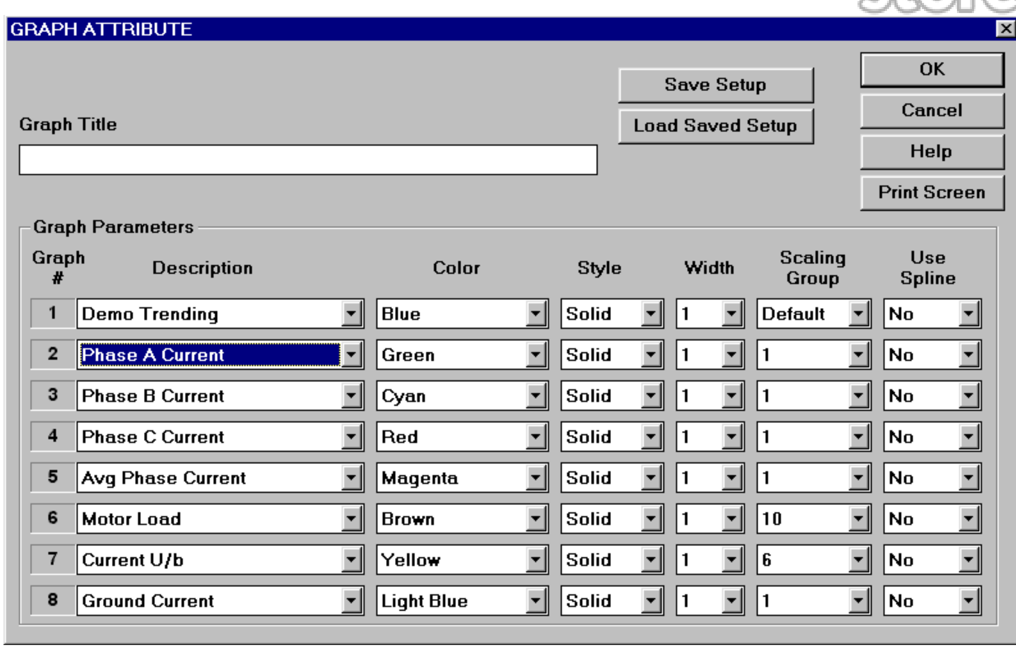


Figure 3–7: GRAPH ATTRIBUTE PAGE

5. Select the **Sample Rate** through the pull-down menu, click the checkboxes of the graphs to be displayed, and select **RUN** to begin the trending sampling.

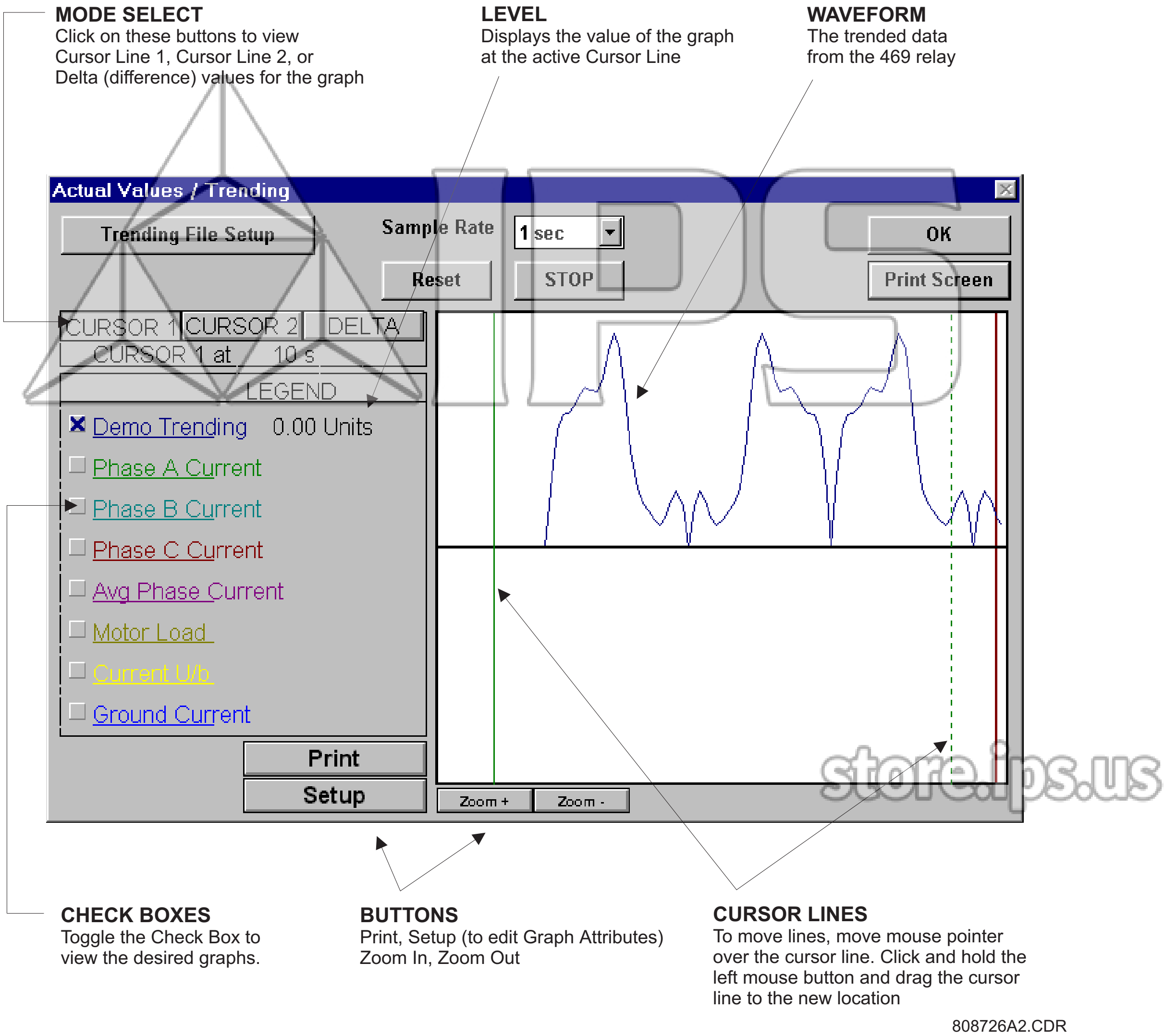


Figure 3–8: TRENDING

6. The Trending File Setup button can be used to write graph data to a standard spreadsheet format. Ensure that the **Write trended data to the above file** checkbox is checked and that the **Sample Rate** is a minimum of 5 seconds.

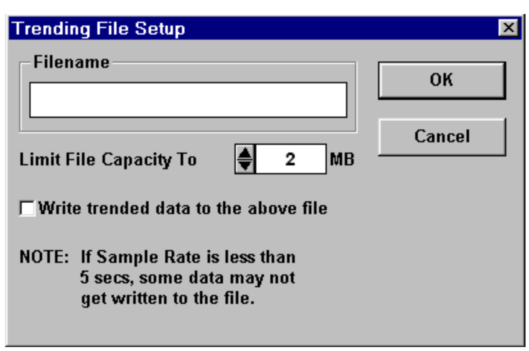


Figure 3–9: TRENDING FILE SETUP

3.2.6 WAVEFORM CAPTURE

The 469PC software can be used to capture waveforms from the 469 at the instant of a trip. A maximum of 64 cycles can be captured and the trigger point can be adjusted to anywhere within the set cycles. A maximum of 16 waveforms can be buffered (stored) with the buffer/cycle trade-off.

The waveforms captured are: Phase Currents A, B, and C; Differential Currents A, B, and C; Ground Current; Phase Voltages A-N, B-N, and C-N.

1. With 469PC running and communications established, select the **Actual > Waveform Capture** menu item to open the **Waveform Capture** window.
2. The waveform of Phase A current of the last 469 trip will appear. The date and time of this trip is displayed on the top of the window. The RED vertical line indicates the trigger point of the relay.
3. Press the **Setup** button to enter the **Graph Attribute** page. Program the graphs to be displayed by selecting the pull down menu beside each **Graph Description**. Change the **Color**, **Style**, **Width**, **Group#**, and **Spline** selection as desired. Select the same **Group#** for all parameters to be scaled together.
4. Click **Save** to store these graph attributes then **OK** to close this window.
5. Select the graphs to display by checking the appropriate checkboxes.
6. The **Save** button can be used to store the current image on the screen, and **Open** can be used to recall a saved image. **Print** will copy the window to the system printer.

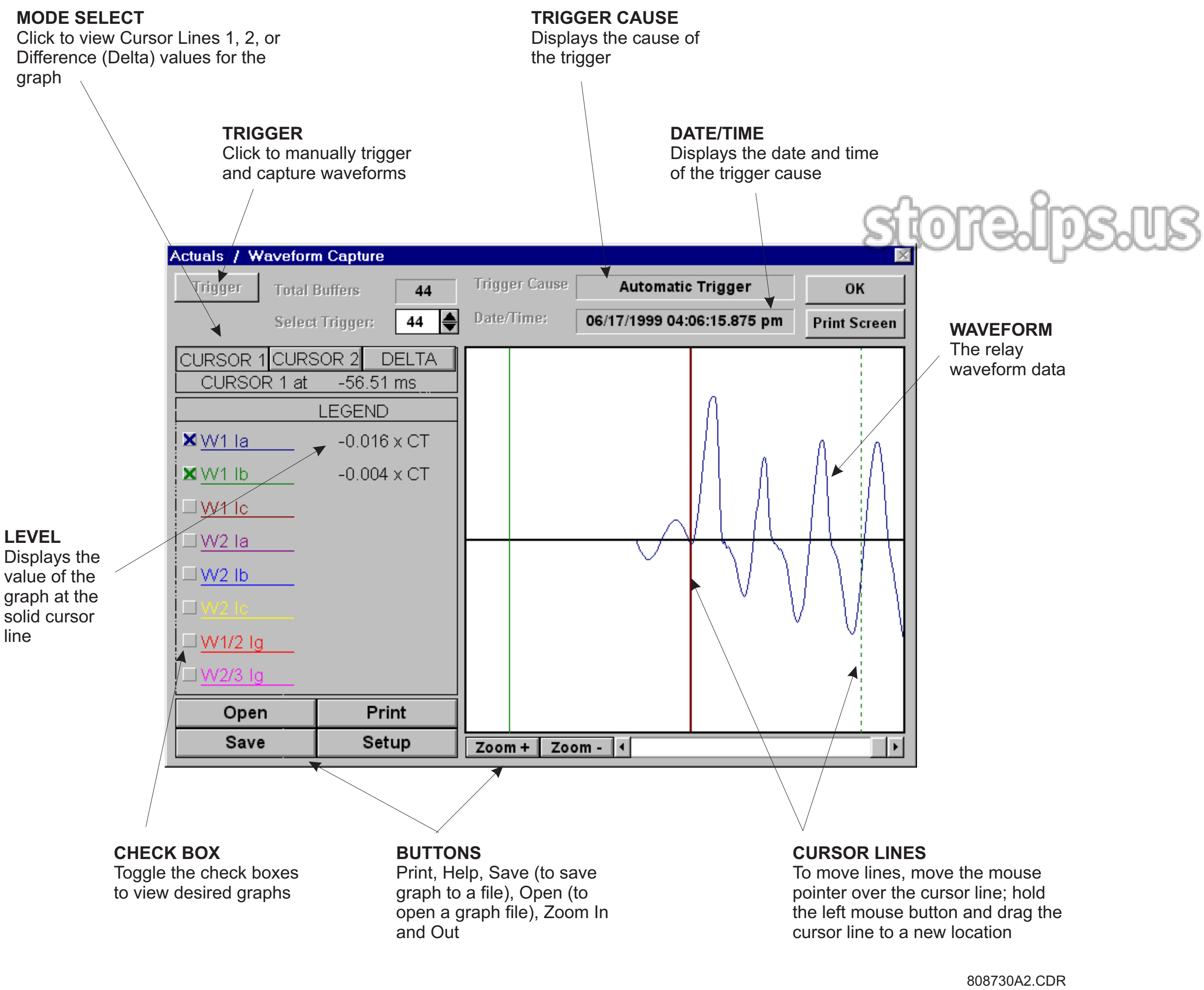


Figure 3–10: WAVEFORM CAPTURE

3.2.7 PHASORS

The 469PC software can be used to view the phasor diagram of three phase currents and voltages. The phasors are for: Phase Voltages A, B, and C; Phase Currents A, B, and C.

1. With 469PC running and the communications established, open the Metering Data window by selecting the **Actual > Metering Data** menu item then clicking the **Phasors** tab. The phasor diagram and the values of voltage phasors, and current phasors are displayed.

NOTE **Longer arrows are the voltage phasors, shorter arrows are the current phasors.**

2. Va and Ia are the references (i.e. zero degree phase). The lagging angle is clockwise.

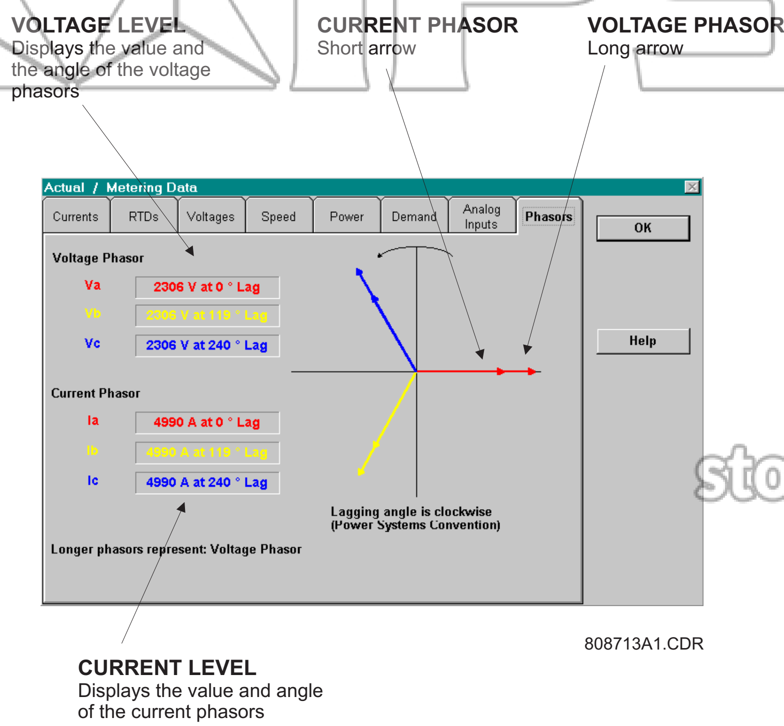


Figure 3–11: PHASORS

3.2.8 EVENT RECORDS

The 469 event recorder can be viewed with the 469PC software. The event recorder stores motor and system information each time an event occurs (e.g. motor trip). Up to 40 events can be stored, where EVENT01 is the most recent and EVENT40 is the oldest. EVENT40 is overwritten whenever a new event occurs.

1. With 469PC running and communications established, select the Actual > Event Recording menu item to open the **Event Recording** window. This window displays the list of events with the most current event displayed on top (see the figure below).
2. Press the **View Data** button to view the details of selected events.
3. The **Event Record Selector** at the top of the **View Data** Window allows the user to scroll through different events.
4. Select **Save** to store the details of the selected events to a file.
5. Select **Print** to send the events to the system printer, and **OK** to close the window.

More information for the event recorder can be found under **Help**.

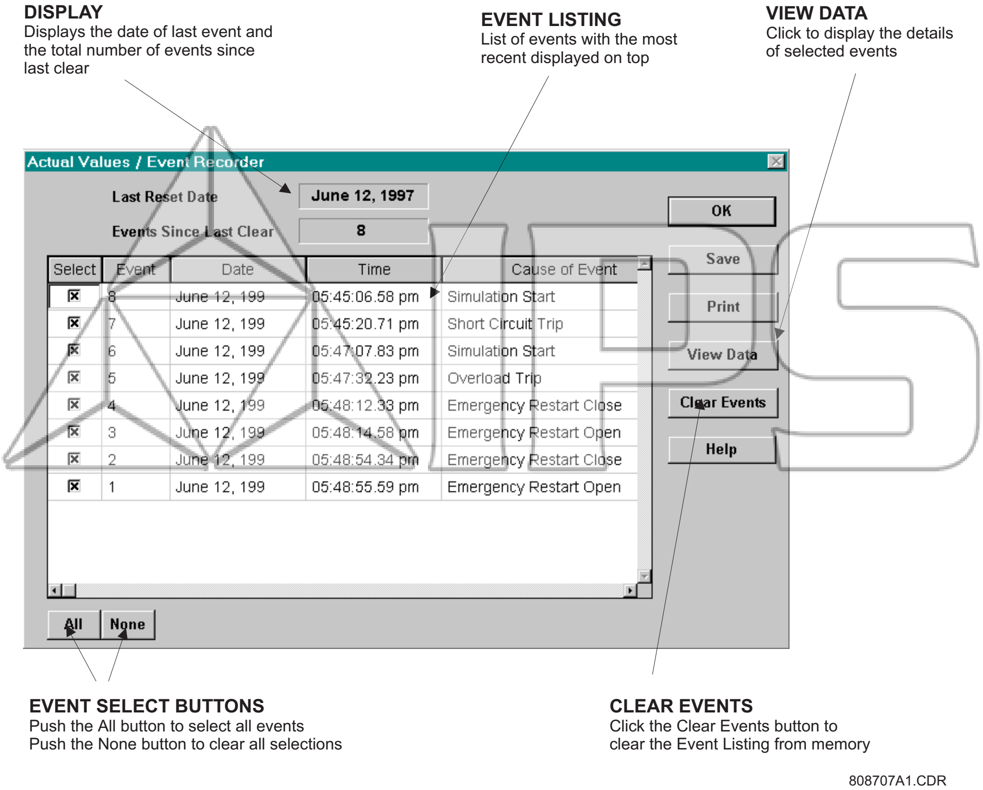


Figure 3–12: 469PC EVENT RECORDER

3.2.9 TROUBLESHOOTING

This section provides some procedures for troubleshooting the 469PC when troubles are encountered within the Windows environment (for example, **General Protection Fault (GPF)**, **Missing Window**, **Problems in Opening/Saving Files**, **and Application Error** messages).

If the 469PC software causes Windows system errors:

1. Check system resources:

   •In Windows 95/98, right-click on the **My Computer** icon and click on the **Performance** tab.

   •In Windows 3.1/3.11, select the **Help > About Program Manager** menu item from the Program Manager window.

   Verify that the available system resources are 60% or higher. If they are lower, close any other programs that are not being used.

2. The `threed.vbx` file in the Windows directory structure is used by the 469PC software (and possibly other Windows™ programs). Some older versions of this file are not compatible with 469PC; therefore it may be necessary to update this file with the latest version included with 469PC. After installation of the 469PC software, this file will be located in `\GEPM\469PC\threed.vbx`.
3. To update the `threed.vbx` file, locate the currently used file and make a backup of it, e.g. `threed.bak`.
4. A search should be conducted to locate any `threed.vbx` files on the local PC hard drive. The file which needs replacing is the one located in the `\windows` or the `\windows\system` directory.
5. Replace the original `threed.vbx` with `\GEPM\469PC\threed.vbx`. Ensure that the new file is copied to the same directory where the original one was.
6. If Windows™ prevents the replacing of this file, restart the PC and replace the file before any programs are opened.
7. Restart Windows™ for these changes to take full effect.

4.1.1 SETPOINT MESSAGE MAP

■■ S1 SETPOINTS ■■ 469 SETUP	■ PASSCODE ■ [ENTER] for more	See page 4–6.
	■ PREFERENCES ■ [ENTER] for more	See page 4–7.
	■ SERIAL PORTS ■ [ENTER] for more	See page 4–8.
	■ REAL TIME CLOCK ■ [ENTER] for more	See page 4–8.
	■ DEFAULT MESSAGES ■ [ENTER] for more	See page 4–9.
	■ MESSAGE SCRATCHPAD ■ [ENTER] for more	See page 4–10.
	■ CLEAR DATA ■ [ENTER] for more	See page 4–10.
	■ INSTALLATION ■ [ENTER] for more	See page 4–11.

■■ S2 SETPOINTS ■■ SYSTEM SETUP	■ CURRENT SENSING ■ [ENTER] for more	See page 4–12.
	■ VOLTAGE SENSING ■ [ENTER] for more	See page 4–13.
	■ POWER SYSTEM ■ [ENTER] for more	See page 4–14.
	■ SERIAL COM. CONTROL ■ [ENTER] for more	See page 4–14.
	■ REDUCED VOLTAGE ■ [ENTER] for more	See page 4–15.

■■ S3 SETPOINTS ■■ DIGITAL INPUTS	■ STARTER STATUS ■ [ENTER] for more	See page 4–17.
	■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	See page 4–18.
	■ ASSIGNABLE INPUT 2 ■ [ENTER] for more	
	■ ASSIGNABLE INPUT 3 ■ [ENTER] for more	
	■ ASSIGNABLE INPUT 4 ■ [ENTER] for more	

4

■■ S4 SETPOINTS ■■ OUTPUT RELAYS	■ RELAY RESET MODE ■ [ENTER] for more	See page 4-26.
	■ FORCE OUTPUT RELAY ■ [ENTER] for more	See page 4-27.
■■ S5 SETPOINTS ■■ THERMAL MODEL	■ THERMAL MODEL ■ [ENTER] for more	See page 4-29.
	■ O/L CURVE SETUP ■ [ENTER] for more	See page 4-30.
■■ S6 SETPOINTS ■■ CURRENT ELEMENTS	■ SHORT CIRCUIT TRIP ■ [ENTER] for more	See page 4-42.
	■ OVERLOAD ALARM ■ [ENTER] for more	See page 4-43.
	■ MECHANICAL JAM ■ [ENTER] for more	See page 4-43.
	■ UNDERCURRENT ■ [ENTER] for more	See page 4-44.
	■ CURRENT UNBALANCE ■ [ENTER] for more	See page 4-45.
	■ GROUND FAULT ■ [ENTER] for more	See page 4-46.
	■ PHASE DIFFERENTIAL ■ [ENTER] for more	See page 4-47.
■■ S7 SETPOINTS ■■ MOTOR STARTING	■ ACCELERATION TIMER ■ [ENTER] for more	See page 4-48.
	■ START INHIBIT ■ [ENTER] for more	See page 4-48.
	■ JOGGING BLOCK ■ [ENTER] for more	See page 4-49.
	■ RESTART BLOCK ■ [ENTER] for more	See page 4-50.
■■ S8 SETPOINTS ■■ RTD TEMPERATURE	■ RTD TYPES ■ [ENTER] for more	See page 4-51.
	■ RTD #1 ■ [ENTER] for more	See page 4-52.

↓

■ RTD #12
■ [ENTER] for more

■ OPEN RTD SENSOR
■ [ENTER] for more
See page 4–56.

■ RTD SHORT/LOW TEMP
■ [ENTER] for more
See page 4–56.

■■ S9 SETPOINTS
■■ VOLTAGE ELEMENTS

■ UNDERVOLTAGE
■ [ENTER] for more
See page 4–57.

■ OVERVOLTAGE
■ [ENTER] for more
See page 4–59.

■ PHASE REVERSAL
■ [ENTER] for more
See page 4–59.

■ FREQUENCY
■ [ENTER] for more
See page 4–60.

■■ S10 SETPOINTS
■■ POWER ELEMENTS

■ POWER FACTOR
■ [ENTER] for more
See page 4–62.

■ REACTIVE POWER
■ [ENTER] for more
See page 4–63.

■ UNDERPOWER
■ [ENTER] for more
See page 4–64.

■ REVERSE POWER
■ [ENTER] for more
See page 4–65.

■ TORQUE SETUP
■ [ENTER] for more
See page 4–66.

■ OVERTORQUE SETUP
■ [ENTER] for more
See page 4–66.

■■ S11 SETPOINTS
■■ MONITORING

■ TRIP COUNTER
■ [ENTER] for more
See page 4–67.

■ STARTER FAILURE
■ [ENTER] for more
See page 4–68.

■ CURRENT DEMAND
■ [ENTER] for more
See page 4–69.

■ kW DEMAND
■ [ENTER] for more
See page 4–69.

■ kvar DEMAND
■ [ENTER] for more
See page 4–69.

■ kVA DEMAND
■ [ENTER] for more
See page 4–69.

■ PULSE OUTPUT
■ [ENTER] for more
See page 4-70.

■■ S12 SETPOINTS
■■ ANALOG I/O

■ ANALOG OUTPUT 1
■ [ENTER] for more
See page 4-72.

↓

■ ANALOG OUTPUT 4
■ [ENTER] for more

■ ANALOG INPUT 1
■ [ENTER] for more
See page 4-74.

↓

■ ANALOG INPUT 4
■ [ENTER] for more

■ ANALOG IN DIFF 1-2
■ [ENTER] for more
See page 4-76.

■ ANALOG IN DIFF 3-4
■ [ENTER] for more
See page 4-77.

■■ S13 SETPOINTS
■■ 469 TESTING

■ SIMULATION MODE
■ [ENTER] for more
See page 4-78.

■ PRE-FAULT SETUP
■ [ENTER] for more
See page 4-79.

■ FAULT SETUP
■ [ENTER] for more
See page 4-80.

■ TEST OUTPUT RELAYS
■ [ENTER] for more
See page 4-81.

■ TEST ANALOG OUTPUT
■ [ENTER] for more
See page 4-81.

■ COMM PORT MONITOR
■ [ENTER] for more
See page 4-82.

■ GEPM USE ONLY
■ [ENTER] for more
See page 4-82.

■■ S14 SETPOINTS
■■ TWO-SPEED MOTOR

■ SPEED2 O/L SETUP
■ [ENTER] for more
See page 4-83.

■ SPEED2 U/C
■ [ENTER] for more
See page 4-85.

■ SPEED2 ACCELERATION
■ [ENTER] for more
See page 4-85.

4.1.2 TRIPS, ALARMS, AND BLOCKS

The 469 has three basic categories of protection elements. They are *trips*, *alarms*, and *blocks*.

- **TRIPS:** A 469 trip feature may be assigned to any combination of the two Auxiliary relays, R2 and R3, in addition to the R1 Trip Relay. If a Trip becomes active, the appropriate LED (indicator) on the 469 faceplate will illuminate to show which of the output relays has operated. In addition to the Trip relay(s), a trip will always operate the Block Start relay. Trip features are may be programmed as latched or unlatched. Once a relay has been operated by a latched trip, a reset must be performed to clear the trip when the condition is no longer present. If there is a lockout time, the Block Start relay will not reset until the lockout time has expired. If an unlatched trip feature becomes active, that trip will reset itself (and associated output relays) as soon as the condition that caused the trip ceases. Immediately prior to issuing a trip, the 469 takes a snapshot of motor parameters and stores them as pre-trip values which will allow for troubleshooting after the trip occurs. The cause of last trip message is updated with the current trip and the 469 display defaults to that message. All trip features are automatically logged and date and time stamped as they occur. In addition, all trips are counted and logged as statistics such that any long term trends may be identified.
- **ALARMS:** A 469 alarm feature may be assigned to operate any combination of three output relays, R4 Alarm, R3 Auxiliary, and R2 Auxiliary. When an Alarm becomes active, the appropriate LED (indicator) on the 469 faceplate will illuminate when an output relay(s) has operated. Each alarm feature may be programmed as latched or unlatched. Once a latched alarm feature becomes active, the reset key must be pressed to reset that alarm. If the condition that has caused the alarm is still present (e.g. hot RTD) the Alarm relay(s) will not reset until the condition is no longer present. If on the other hand, an unlatched alarm feature becomes active, that alarm will reset itself (and associated output relay(s)) as soon as the condition that caused the alarm ceases. As soon as an alarm occurs, the alarms messages are updated to reflect the alarm and the 469 display defaults to that message. Since it may not be desirable to log all alarms as events, each alarm feature may be programmed to log as an event or not. If an alarm is programmed to log as an event, when it becomes active, it is automatically logged as a date and time stamped event.
- **BLOCK START:** A 469 Block Start prevents or inhibits the start of the motor based on some logic or algorithm. The Block Start feature is always assigned to the Block Start relay. In addition to the Trip relay(s), a trip always operates the Block Start relay. If the condition that has caused the trip is still present (e.g. hot RTD), or there is a lockout time when the RESET key is pressed, the Block Start relay will not reset until the condition is no longer present or the lockout time has expired. Blocking features are always unlatched and reset immediately when conditions that caused the block cease. In addition to becoming active in conjunction with trips, a block may become active once the motor stops. There are several features that operate as such: Starts/Hour, Time Between Starts, Start Inhibit, Restart Block, and 469 Not Programmed. Block messages are updated to reflect the block when it becomes active (complete with lockout time if required) and the screen defaults to that message. Blocks are normally not logged as events. If however, a motor start or start attempt is detected when a block is active, it is automatically logged as a date and time stamped event. This scenario might occur if someone shorts across the block terminals and overrides the 469 protection to start the motor.

4.1.3 RELAY ASSIGNMENT PRACTICES

There are six output relays. Five of the relays are always non-failsafe, the other (Service) is failsafe and dedicated to enunciate internal 469 faults (these faults include Setpoint Corruption, failed hardware components, loss of control power, etc.). One of the output relays is dedicated as the Block Start relay; it is dedicated to features that are intended to block motor starting. The four remaining relays may be programmed for different types of features depending on what is required. One of the relays, R1 Trip, is intended to be used as the main trip relay. Another relay, R4 Alarm, is intended to be used as the main alarm relay. The two relays that are left, R2 Auxiliary and R3 Auxiliary, are intended for special requirements.

When assigning features to R2 and R3, it is a good idea to decide early on what is required since features that may be assigned may conflict. For example, if R2 Auxiliary is to be used for upstream trips, it cannot also be used for the control of a Reduced Voltage Start. Similarly, if R3 is to be dedicated as a relay to echo all alarm conditions to a PLC, it cannot also be used strictly to enunciate a specific alarm such as Undercurrent.

In order to ensure that conflicts in relay assignment do not occur, several precautions have been taken. All trips with the exception of the Short Circuit Backup Trip default to R1 Trip output relay. All alarms default to the R4 Alarm relay. Only special control functions are defaulted to the R2 and R3 Auxiliary relays. It is recommended that these assignments be reviewed once all the setpoints have been programmed.

4.2.1 PASSCODE

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨ PASSCODE

			Range
■ PASSCODE ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	ENTER PASSCODE FOR ACCESS:	*Range: 1 to 8 numeric digits. Seen only if passcode is not "0" and* **SETPOINT ACCESS** *is "Restricted".*
	ESCAPE MESSAGE ⇕	SETPOINT ACCESS: Permitted	*Range: Permitted, Restricted. Seen only if the passcode is "0" or* **SETPOINT ACCESS** *is "Permitted".*
	ESCAPE MESSAGE ⇧	CHANGE PASSWORD: No	*Range: No, Yes. Seen only if the passcode is "0" or* **SETPOINT ACCESS** *is "Permitted".*

A passcode access security feature is provided in addition to the setpoint access jumper. When shipped from the factory, the passcode is defaulted to 0. Passcode protection is ignored when the passcode is 0. In this case, only the setpoint access jumper is required for changing setpoints from the front panel. Passcodes are also ignored when programming setpoints via the RS485 port. However when programming setpoints using the front RS232 port and the 469PC software, a passcode is required (if enabled).

To enable passcode protection on a new relay, follow the procedure below:

1. Press ENTER then MESSAGE ▼ until the **CHANGE PASSCODE?** message is displayed.
2. Select "Yes" and follow the directions to enter a new passcode 1 to 8 digits in length.
3. Once a passcode (other than "0") is programmed, it must be entered each time setpoint access is restricted. If a non-zero passcode has been programmed and setpoint access is restricted, then the **ENTER PASSCODE FOR ACCESS** message appears when entering the **S1 469 SETUP ⇨ PASSCODE** subgroup.
4. Enter the correct passcode. A flash message will advise if the code is incorrect and allows a retry. If the passcode is correct and the setpoint access jumper is installed, the **SETPOINT ACCESS: Permitted** message appears.
5. Setpoints can now be entered. Press ESCAPE to exit the **S1 469 SETUP ⇨ PASSCODE** group and program the appropriate setpoints. If no keys are pressed for 5 minutes, programming access will no longer be allowed and the passcode must be re-entered. Removing the setpoint access jumper or setting the **SETPOINT ACCESS** setpoint to "Restricted" will also immediately disable setpoint access.

If a new passcode is required, gain setpoint access by entering the valid passcode as described above, then press MESSAGE ▼ to display the **CHANGE PASSCODE** message and follow directions. If an invalid passcode is entered, an encrypted passcode may be viewed by pressing the HELP key. Consult the factory service department with this number if the currently programmed passcode is unknown. Using a deciphering program, the passcode can be determined.

4.2.2 PREFERENCES

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ PREFERENCES

■ PREFERENCES ■ [ENTER] for more	
DEFAULT MESSAGE CYCLE TIME: 2.0 s	*Range: 0.5 to 10.0 s in steps of 1*
DEFAULT MESSAGE TIMEOUT: 300 s	*Range: 10 to 900 s in steps of 1*
AVERAGE MOTOR LOAD CALC. PERIOD: 15 min.	*Range: 1 to 90 min in steps of 1*
TEMPERATURE DISPLAY: Celsius	*Range: Celsius, Fahrenheit*
TRACE MEMORY TRIGGER POSITION: 25%	*Range: 1 to 100% in steps of 1*
TRACE MEMORY BUFFERS 8x14 CYCLES	*Range: 1x64, 2x42, 3x32, 4x35, 5x21, 6x18, 7x16, 8x14, 9x12, 10x11, 11x10, 12x9, 13x9, 14x8, 15x8, 16x7 cycles.*
DISPLAY UPDATE INTERVAL: 0.4 s	*Range: 0.1 to 60 s in steps of 0.1*
MOTOR LOAD FILTER INTERVAL: 0 cycles	*Range: 0 to 32 cycles (0 = OFF) in steps of 1. Not seen if* **NOMINAL SYSTEM FREQUENCY** *is "Variable"*

Some characteristics can be modified for different situations. Normally this subgroup will not require changes.

- **DEFAULT MESSAGE CYCLE TIME:** If multiple default messages are chosen, the display automatically cycles through those messages. The display time can be changed to accommodate different user preferences.
- **DEFAULT MESSAGE TIMEOUT:** If no keys are pressed for a period of time then the relay will automatically scan a programmed set of default messages. This time can be modified to ensure messages remain on the screen long enough during programming or reading actual values. Once default scanning starts, pressing any key will return the last message viewed to the screen.
- **AVERAGE MOTOR LOAD CALCULATION PERIOD:** This setpoint adjusts the period of time over which the average motor load is calculated. The calculation is a sliding window and is ignored during motor starting.
- **TEMPERATURE DISPLAY:** Temperature measurements may be displayed in either Celsius or Fahrenheit. Each temperature value is displayed as °C or °F. RTD setpoints are always displayed in degrees Celsius.
- **TRACE MEMORY TRIGGER POSITION:** Sets the trigger position for waveform capture. This value represents the percentage of cycles captured and recorded in the trace memory buffer prior to the trigger (trip).
- **TRACE MEMORY BUFFERS:** Sets the number of traces to capture and the number of cycles for each of the 10 waveforms captured. Note: 10 waveforms are captured for each trace, showing all currents and voltages.
- **DISPLAY UPDATE INTERVAL:** Sets the duration for which the metered current and voltage readings are averaged before being displayed. It does not affect relay protection or function timing in any way. It can be used to steady the display when readings are bouncing.
- **MOTOR LOAD FILTER INTERVAL:** This value (when non-zero) averages current and power factor for the programmed number of cycles using a running average technique. This setpoint is intended for use on synchronous motors running at low RPM and driving reciprocating loads. The number of cycles to average can be determined by using current waveform capture. The number of cycles to complete one stroke can be determined from this waveform. This value can be used as the starting point for the motor load filter interval. Additional fine tuning may be required.

WARNING **This averaging may increase trip/alarm times by 16.7 ms for every cycle averaged.**

4

4.2.3 SERIAL PORTS

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ SERIAL PORTS

■ SERIAL PORTS ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	SLAVE ADDRESS: 254	Range: 1 to 254 in steps of 1
	ESCAPE / MESSAGE ⇳	COMPUTER RS485 BAUD RATE: 9600	Range: 300, 1200, 2400, 4800, 9600, 19200
	ESCAPE / MESSAGE ⇳	COMPUTER RS485 PARITY: None	Range: None, Odd, Even
	ESCAPE / MESSAGE ⇳	AUXILIARY RS485 BAUD RATE: 9600	Range: 300, 1200, 2400, 4800, 9600, 19200
	ESCAPE / MESSAGE ⇧	AUXILIARY RS485 PARITY: None	Range: None, Odd, Even

4

The 469 has three (3) serial communications ports supporting a subset of the Modbus protocol. The front panel RS232 has a fixed baud rate of 9600, a fixed data frame of 1 start, 8 data, and 1 stop bits with no parity. The front port is for local use only and responds regardless of the slave address programmed. This port may be connected to a personal computer running 469PC. The software can download and upload setpoint files as well as upgrade the 469 firmware.

For RS485 communications, each 469 must have a unique address from 1 to 254. Address 0 is the broadcast address detected by all relays. Addresses do not have to be sequential but no two units can have the same address or errors will occur. Generally, each unit added to the link uses the next higher address starting at 1. Baud rates can be selected as 300, 1200, 2400, 4800, 9600, or 19200. The data frame is fixed at 1 start, 8 data, and 1 stop bits, while parity is optional. The computer RS485 port is a general purpose port for connection to a DCS, PLC, or PC. The auxiliary RS485 port may be used for redundancy or, it may be used to talk to auxiliary GE Multilin devices.

4.2.4 REAL TIME CLOCK

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ REAL TIME CLOCK

■ REAL TIME CLOCK ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	DATE (MM.DD.YYYY) 01/01/1994	Range: 01 to 12 / 01 to 31 / 1995 to 2094
	ESCAPE / MESSAGE ⇧	TIME (HH.MM.SS): 12:00:00	Range: 00 to 23 hrs / 00 to 59 mins. / 00 to 59 sec.

The correct time and date must be entered for event recorder events to be correctly time/date stamped. A battery backed internal clock runs continuously even when power is off. It has an accuracy of approximately ±1 minute per month. It must be periodically corrected manually through the front panel or via the RS485 serial link clock update command. If the approximate time an event occurred without synchronization to other relays is sufficient, then entry of time/date from the front panel keys is adequate.

If the RS485 serial communication link is used, then all the relays can keep synchronized time. A new clock time is pre-loaded into the 469 memory via the RS485 port by a remote computer to each relay connected on the communications channel. After the computer broadcasts (address 0) a "set clock" command, all relays in the system begin timing at the same instant. There can be up to 100 ms of delay in receiving serial commands so the clock time in each relay is ±100 ms, ± the absolute clock accuracy in the PLC or PC. See Chapter 6: COMMUNICATIONS for information on programming the time preload and synchronizing commands.

4.2.5 DEFAULT MESSAGES

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ DEFAULT MESSAGES

■ DEFAULT MESSAGES ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	MOTOR STATUS: Stopped	Range: N/A
	ESCAPE MESSAGE ⇳	A: 0 B: 0	Range: N/A
	ESCAPE MESSAGE ⇳	MOTOR LOAD: 0.00 x FLA	Range: N/A
	ESCAPE MESSAGE ⇳	CURRENT UNBALANCE: 0%	Range: N/A
	ESCAPE MESSAGE ⇳	DATE: 01/01/1995 TIME: 12:00:00	Range: N/A
	ESCAPE MESSAGE ⇧	MULTILIN 469 Motor Management Relay	Range: N/A

After a period of inactivity, the 469 displays default messages. Between 1 and 20 default messages can be selected. Multiple default messages automatically scan in sequence at a rate determined by the **S1 469 SETUP ⇨⇩ PREFERENCES ⇨ DEFAULT MESSAGE CYCLE TIME** setpoint. Any actual value can be selected for default display; in addition, up to five user programmable messages can be created and displayed (Message Scratchpad). For example, the relay can alternately scan a motor identification message, the current in each phase, and the hottest stator RTD. Default messages are shown in the **S1 469 SETUP ⇨⇩ DEFAULT MESSAGES** subgroup.

Use the following procedure to add default messages:

1. Enter the correct passcode for the **S1 469 SETUP ⇨ PASSCODE ⇨ ENTER PASSCODE FOR ACCESS** setpoint (unless the passcode has already been entered or the passcode is "0", defeating the passcode security feature).
2. Move to the message to be added to the default message list using the MESSAGE ▼ and MESSAGE ▲ keys. The selected message can be any actual value or Message Scratchpad message.
3. Press ENTER. The message **PRESS [ENTER] TO ADD DEFAULT MESSAGES** will be displayed for 5 seconds.
4. Press ENTER again while displayed to add the current message to the default message list.
5. If the procedure was followed correctly, the following flash message will be displayed:

```
DEFAULT MESSAGE
HAS BEEN ADDED
```

6. To verify that the message was added, view the last message in the **S1 469 SETUP ⇨⇩ DEFAULT MESSAGES** subgroup.

Use the following procedure to remove default messages:

1. Enter the correct passcode for the **S1 469 SETUP ⇨ PASSCODE ⇨ ENTER PASSCODE FOR ACCESS** setpoint (unless the passcode has already been entered or unless the passcode is "0", defeating the passcode security feature).
2. Select the message to remove under the **S1 469 SETUP ⇨⇩ DEFAULT MESSAGES** subgroup.
3. When the default message to be removed is shown, press ENTER. The relay displays the **PRESS [ENTER] TO REMOVE DEFAULT MESSAGE** message.
4. Press ENTER to remove the current message from the default message list.
5. If the procedure was followed correctly, the following flash message will be displayed:

```
DEFAULT MESSAGE
HAS BEEN REMOVED
```

4.2.6 MESSAGE SCRATCHPAD

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ MESSAGE SCRACTHPAD

■ MESSAGE SCRATCHPAD ■ [ENTER] for more	
TEXT 1	Range: 40 alphanumeric characters
TEXT 2	Range: 40 alphanumeric characters
TEXT 3	Range: 40 alphanumeric characters
TEXT 4	Range: 40 alphanumeric characters
MULTILIN 469 MOTOR MANAGEMENT RELAY	Range: 40 alphanumeric characters

Up to five (5) message screens can be programmed under the Message Scratchpad area. These messages may be notes that pertain to the installation or the motor or any other information deemed pertinent by the user. In addition, these messages may be selected for scanning during default message display. This might be useful for reminding operators to perform certain tasks. The messages may be entered from the communications ports or through the keypad. The following procedure demonstrates the use of the message scratchpad:

1. Select the user message to be changed.
2. Press the decimal [.] key to enter text mode. An underline cursor will appear under the first character.
3. Use the VALUE ▽ / VALUE △ keys to display the desired character. A space is selected like a character.
4. Press the decimal [.] key to advance to the next character. To skip over a character press the decimal key. If an incorrect character is accidentally stored, press the decimal key enough times to scroll the cursor around to the character.
5. When the desired message is displayed press ENTER to store or ESCAPE to quit. The message is now permanently stored. Press ESCAPE to cancel the altered message.

4.2.7 CLEAR DATA

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ CLEAR DATA

■ CLEAR DATA ■ [ENTER] for more	
CLEAR LAST TRIP DATA: No	Range: No, Yes
RESET MWh and Mvarh METERS: No	Range: No, Yes
CLEAR PEAK DEMAND DATA: No	Range: No, Yes
CLEAR RTD MAXIMUMS: No	Range: No, Yes
CLEAR ANALOG I/P MIN/MAX: No	Range: No, Yes
CLEAR TRIP COUNTERS: No	Range: No, Yes
PRESET DIGITAL COUNTER: No	Range: No, Yes
CLEAR EVENT RECORDER: No	Range: No, Yes

These commands may be used to clear various historical data.

- **CLEAR LAST TRIP DATA:** Clears the last trip data.
- **RESET MWh and Mvarh METERS:** Resets the MWh and Mvarh metering to zero.
- **CLEAR PEAK DEMAND DATA:** Clears the peak demand values.
- **CLEAR RTD MAXIMUMS:** All maximum RTD temperature measurements are stored and updated each time a new maximum temperature is established. This command clears the maximum values.
- **CLEAR ANALOG I/P MIN/MAX:** The minimum and maximum analog input values are stored for each analog input. These minimum and maximum values may be cleared at any time.
- **CLEAR TRIP COUNTERS:** There are counters for each possible type of trip. This command clears these counters.
- **PRESET DIGITAL COUNTER:** When one of the assignable Digital Inputs is configured as “Counter”, this command presets the counter. If the counter is an incrementing type, setting the preset value to “0” effectively resets the counter.
- **CLEAR EVENT RECORD:** The event recorder saves the last 40 events, automatically overwriting the oldest event. If desired, this command can clear all events to prevent confusion with old information.

4.2.8 INSTALLATION

PATH: SETPOINTS ⇨ S1 469 SETUP ⇨⇩ INSTALLATION

```
■ INSTALLATION          ENTER ⇨   RESET MOTOR              Range: No, Yes
■ [ENTER] for more    ⇦ ESCAPE    INFORMATION: No

                      ⇖ ESCAPE    RESET STARTER            Range: No, Yes
                        MESSAGE ⇧ INFORMATION: No
```

These commands clear various informative and historical data when the 469 is first applied on a new installation.

- **RESET MOTOR INFORMATION:** Counters for number of motor starts and emergency restarts can be viewed in actual values. The 469 also learns various motor characteristics through motor operation. These learned parameters include acceleration time, starting current, and starting thermal capacity. Total motor running hours may also be viewed in actual values. On a new installation or if new equipment is installed, all this information can be reset with this setpoint.
- **RESET STARTER INFORMATION:** The total number of starter operations can be viewed in actual values. Use this setpoint to clear this counter on a new installation or if maintenance work is done on the breaker or contactor.

4.3.1 CURRENT SENSING

PATH: SETPOINTS ⇨⇩ S2 SYSTEM SETUP ⇨ CURRENT SENSING

■ CURRENT SENSING ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	PHASE CT PRIMARY: Not Programmed	Range: 1 to 5000 A in steps of 1, Not Programmed
	ESCAPE / MESSAGE ⇳	MOTOR FULL LOAD AMPS FLA: Not Programmed	Range: 1 to 5000 A in steps of 1, Not Programmed
	ESCAPE / MESSAGE ⇳	GROUND CT: Multilin 50:0.025	Range: None, 1A Secondary, 5A Secondary, Multilin 50:0.025
	ESCAPE / MESSAGE ⇳	GROUND CT PRIMARY: 100 A	Range: 1 to 5000 A in steps of 1. Seen only if GROUND CT is "1A Secondary" or "5A Secondary"
	ESCAPE / MESSAGE ⇳	PHASE DIFFERENTIAL CT: None	Range: None, 1A Secondary, 5A Secondary
	ESCAPE / MESSAGE ⇳	PHASE DIFFERENTIAL CT PRIMARY: 100 A	Range: 1 to 5000 in steps of 1. Seen only if GROUND CT is "1A Secondary" or "5A Secondary"
	ESCAPE / MESSAGE ⇳	ENABLE 2-SPEED MOTOR PROTECTION: No	Range: No, Yes
	ESCAPE / MESSAGE ⇳	SPEED2 PHASE CT PRIMARY: 100 A	Range: 1 to 5000 A in steps of 1. Seen only if 2-Speed motor protection is enabled.
	ESCAPE / MESSAGE ⇧	SPEED2 MOTOR FLA: 1 A	Range: 1 to 5000 A in steps of 1. Seen only if 2-Speed motor protection is enabled.

As a safeguard, **PHASE CT PRIMARY** and **MOTOR FULL LOAD AMPS** are defaulted to "Not Programmed" when shipped. A block start indicates the 469 was never programmed. Once **PHASE CT PRIMARY** and **MOTOR FULL LOAD AMPS** are entered, the alarm resets itself. The phase CT should be chosen so the FLA is no less than 50% of the rated phase CT primary. Ideally, the phase CT primary should be chosen so the FLA is 100% of the phase CT primary or slightly less, never more. The secondary value of 1 or 5 A *must* be specified at the time of order so that the proper hardware is installed. A value for **MOTOR FULL LOAD AMPS** (FLA) must also be entered. The value may be taken from the motor nameplate data sheets. The Service Factor may be entered as Overload Pickup (see Section 4.6: S5 THERMAL MODEL on page 4–28).

For high resistance grounded systems, sensitive ground current detection is possible if the 50:0.025 ground CT input is used. To use the 50:0.025 input, select "Multilin 50:0.025" for the **GROUND CT** setpoint. No additional ground CT messages will appear. On solidly grounded systems where fault currents may be quite large, the 469 1A or 5A secondary ground CT input should be used for either zero-sequence or residual ground sensing. If the connection is residual, the Ground CT secondary and primary values should be the same as the phase CT. If however, the connection is zero-sequence, the Ground CT secondary and primary values must be entered. The Ground CT primary should be selected such that potential fault current does not exceed 20 times the primary rating. When relaying class CTs are purchased, this precaution will ensure that the Ground CT does not saturate under fault conditions.

The **PHASE DIFFERENTIAL CT PRIMARY** setpoint must be entered if the differential feature is to be used. If two CTs are used per phase in a vectorial summation configuration, the CTs should be chosen to ensure there is no saturation during motor starting. If however, a core balance CT is used for the differential protection in each phase, a low CT rating of 50 or 100 A allows for very sensitive differential protection.

When the two-speed motor feature is used, a value for a second set of Phase CTs and motor FLA must be entered here for Speed 2. If the Phase CTs are the same as the speed 1 phase CTs, simply enter the same value here as well.

Example 1:

Consider a 469 with a 5 A Phase CT secondary and Ground Fault Detection set to Residual and a motor with the following specifications:

Motor Nameplate FLA: 87 A; Low Resistance Grounded; Maximum Fault: 400 A

The following settings are required:

PHASE CT PRIMARY: "100"
MOTOR FULL LOAD AMPS: "87"
GROUND CT: "5 A Secondary"
GROUND CT PRIMARY: "100"

Example 2:

Consider a 469 with a 5 A Phase CT secondary and Ground Fault Detection set to Residual and a motor with the following specifications:

Motor Nameplate FLA: 255 A; Solidly Grounded; Maximum Fault: 10000 A;
Zero Sequence Ground CT: (10000/20) 500:1

The following settings are required:

PHASE CT PRIMARY: "300"
MOTOR FULL LOAD AMPS: "255"
GROUND CT: "5 A Secondary"
GROUND CT PRIMARY: "500"

Example 3:

Again, consider a 469 with a 5 A Phase CT secondary and Ground Fault Detection set to Residual and a motor with the following specifications:

Motor Nameplate FLA: 330 A; High Resistance Grounded; Maximum Fault: 5 A

The following settings are required:

PHASE CT PRIMARY: "350"
MOTOR FULL LOAD AMPS: "330"
GROUND CT: "Multilin 50:0.025"

4.3.2 VOLTAGE SENSING

PATH: SETPOINTS ⇨⇩ S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING

```
■ VOLTAGE SENSING
■ [ENTER] for more
```

	Range
VT CONNECTION TYPE: None	Range: Open Delta, Wye, None
ENABLE SINGLE VT OPERATION: OFF	Range: AN, BN, CN, OFF or AB, CB, OFF. Seen only if VT Connection Type is Wye or Open Delta
VOLTAGE TRANSFORMER RATIO: 35.00:1	Range: 1.00:1 to 300.00:1 in steps of 0.01
MOTOR NAMEPLATE VOLTAGE: 4000 V	Range: 100 to 36000 V in steps of 1

The manner in which the voltage transformers are connected must be entered here. A value of "None" indicates that no voltage measurement is required. Note that phase reversal is disabled for single VT operation. All voltages are assumed balanced. Also, frequency is only available for AN or AB connections.

If voltage measurements are to be made, the turns ratio of the voltage transformers must be entered. The **VOLTAGE TRANSFORMER RATIO** must be chosen such that the secondary voltage of the VTs is between 40 and 240 V when the primary is at **MOTOR NAMEPLATE VOLTAGE**. All voltage protection features that require a level setpoint are programmed as a percent of the **MOTOR NAMEPLATE VOLTAGE** or rated voltage, where **MOTOR NAMEPLATE VOLTAGE** represents the rated design voltage line to line.

For example, given the following specifications: the Motor Nameplate Voltage is 4160 V, the VTs are 4160/120 Open Delta. Set the Voltage Sensing setpoints as follows:

VT CONNECTION TYPE: "Open Delta"
VT RATIO: "34.67:1"
MOTOR NAMEPLATE VOLTAGE: "4160"

4.3.3 POWER SYSTEM

PATH: SETPOINTS ⇨⇩ S2 SYSTEM SETUP ⇨⇩ POWER SYSTEM

■ POWER SYSTEM ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	NOMINAL SYSTEM FREQUENCY: 60 Hz	*Range: 50 Hz, 60 Hz, Variable*
	ESCAPE MESSAGE ⇳	SYSTEM PHASE SEQUENCE: ABC	*Range: ABC, ACB*
	ESCAPE MESSAGE ⇧	SPEED2 PHASE SEQUENCE: ABC	*Range: ABC, ACB* *Seen only if 2-Speed Motor Protection is enabled*

Enter the nominal system frequency here. These setpoints allow the 469 to determine the internal sampling rate for maximum accuracy.

The 469 may be used on variable frequency drives when the **NOMINAL SYSTEM FREQUENCY** is set to "Variable". All of the elements function in the same manner with the following exceptions: the ratio of negative to positive sequence current is calculated from 0 to 30%, not 40%, and the voltage and power elements will work properly if the voltage waveform is approximately sinusoidal. An unfiltered voltage waveform from a pulse width modulated drive cannot be measured accurately; however, the current waveform is approximately sinusoidal and can be measured accurately. All current elements will function properly. Note, however, that undervoltage and underfrequency elements will not work instantaneously using variable frequency. If "Variable" is chosen, the filtering algorithm increases the trip and alarm times by up to 270 ms when the level is close to the threshold. If the level exceeds the threshold by a significant amount, trip and alarm times will decrease until they match the programmed delay. The exceptions to this increased time are the short circuit, ground fault, and differential elements which will trip as per specification.

If the sequence of phase rotation for a given plant is ACB rather than the standard ABC, the **SYSTEM PHASE SEQUENCE** setpoint may be used to accommodate this. This setpoint allows the 469 to properly calculate phase reversal, negative sequence, and power quantities. The **SPEED2 PHASE SEQUENCE** can be programmed to accommodate the reversed motor rotation at Speed2.

4.3.4 SERIAL COMMUNICATION CONTROL

PATH: SETPOINTS ⇨⇩ S2 SYSTEM SETUP ⇨⇩ SERIAL COM. CONTROL

■ SERIAL COM. CONTROL ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	SERIAL COMMUNICATION CONTROL: Off	*Range: On, Off*
	ESCAPE MESSAGE ⇧	ASSIGN START CONTROL RELAYS: Auxiliary2	*Range: Auxiliary2, Aux2 & Aux3, Auxiliary3*

If enabled, motor starting and stopping is possible via any of the three 469 communication ports. Refer to Chapter 6: COMMUNICATIONS for command formats. When a stop command is issued, the R1 Trip relay is activated for 1 second to complete the trip coil circuit for a breaker application or break the contact coil circuit for a contactor application. When a start command is issued, the auxiliary relay assigned for starting control is activated for 1 second to complete the close coil circuit for a breaker application or complete the start control circuit for a contactor application. A contactor sealing contact would be used to maintain the circuit.

Foir details on issuing a start or stop command via communications, see Section 6.2.4: Function Code 05: Execute Operation on page 6–6.

4.3.5 REDUCED VOLTAGE

PATH: SETPOINTS ⇨⇩ S2 SYSTEM SETUP ⇨⇩ REDUCED VOLTAGE

■ REDUCED VOLTAGE ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	REDUCED VOLTAGE STARTING: Off	*Range: On, Off*
	ESCAPE MESSAGE ⇳	ASSIGN CONTROL RELAYS: Auxiliary3	*Range: Auxilary2, Aux2 & Aux3, Auxiliary3*
	ESCAPE MESSAGE ⇳	TRANSITION ON: Current Only	*Range: Current Only, Current or Timer, Current and Timer*
	ESCAPE MESSAGE ⇳	ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Aux2, Trip & Aux2 & Aux3, Trip & Aux3*
	ESCAPE MESSAGE ⇳	REDUCED VOLTAGE START LEVEL: 100% FLA	*Range: 25 to 300% in steps of 1*
	ESCAPE MESSAGE ⇧	REDUCED VOLTAGE START TIMER: 200 s	*Range: 1 to 600 s in steps of 1*

The 469 can control the transition of a reduced voltage starter from reduced to full voltage. That transition may be based on "Current Only", "Current and Timer", or "Current or Timer" (whichever comes first). When the 469 measures the transition of no motor current to some value of motor current, a 'Start' is assumed to be occurring (typically current will rise quickly to a value in excess of FLA, e.g. 3 × FLA). At this point, the **REDUCED VOLTAGE START TIMER** is initialized with the programmed value in seconds.

- If "Current Only" is selected, when the motor current falls below the user's programmed Transition Level, transition will be initiated by activating the assigned output relay for 1 second. If the timer expires before that transition is initiated, an Incomplete Sequence Trip will occur activating the assigned trip relay(s).
- If "Current or Timer" is selected, when the motor current falls below the user's programmed Transition Level, transition will be initiated by activating the assigned output relay for 1 second. If the timer expires before that transition is initiated, the transition will be initiated regardless.
- If "Current and Timer" is selected, when the motor current falls below the user's programmed Transition Level and the timer expires, transition will be initiated by activating the assigned output relay for 1 second. If the timer expires before current falls below the Transition Level, an Incomplete Sequence Trip will occur activating the assigned trip relay(s).

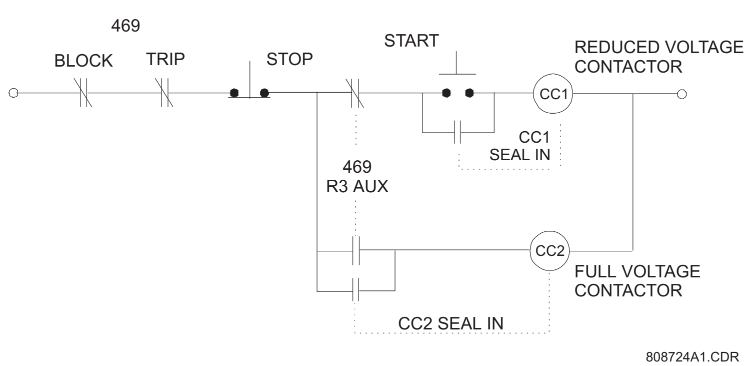


Figure 4–1: REDUCED VOLTAGE START CONTACTOR CONTROL CIRCUIT

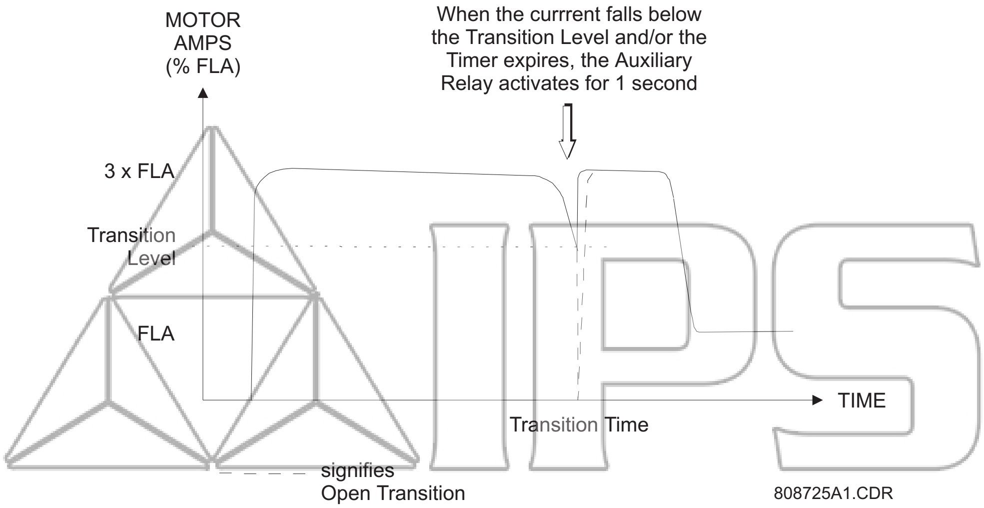


Figure 4–2: REDUCED VOLTAGE STARTING CURRENT CHARACTERISTIC

NOTE

If this feature is used, the Starter Status Switch input must be either from a common control contact or a parallel combination of Auxiliary 'a' contacts or a series combination of Auxiliary 'b' contacts from the reduced voltage contactor and the full voltage contactor. Once transition is initiated, the 469 assumes the motor is still running for at least 2 seconds. This prevents the 469 from recognizing an additional start if motor current goes to zero during an open transition.

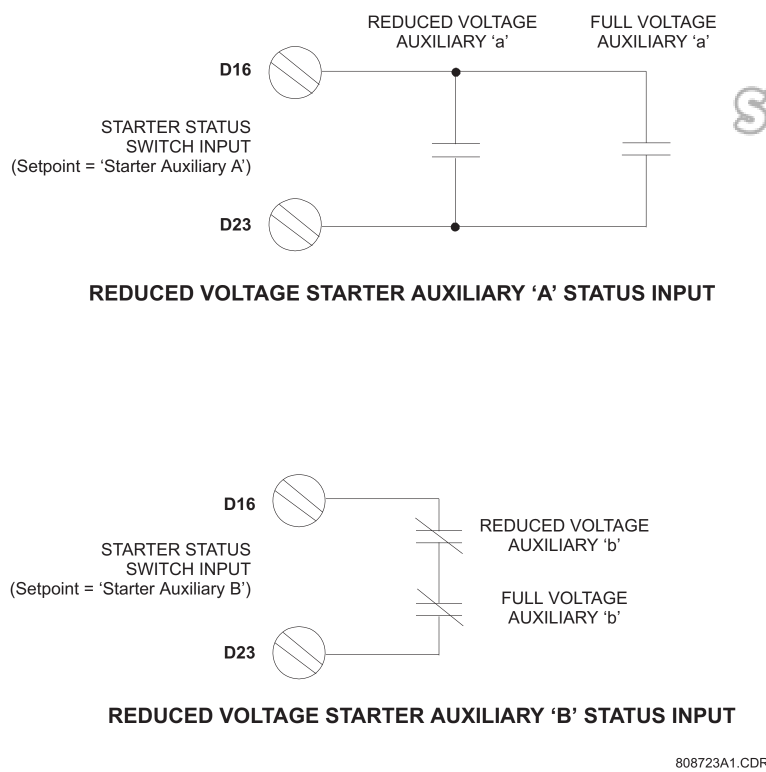


Figure 4–3: REDUCED VOLTAGE STARTER INPUTS

4.4.1 DESCRIPTION

The 469 relay has nine (9) digital inputs. Five of the digital inputs have been pre-assigned as switches having a specific function. Four of the five pre-assigned digital inputs are always functional and do not have any setpoint messages associated with them. The fifth, Starter Status, may be configured for either an 'a' or 'b' auxiliary contact. The remaining four digital inputs are assignable; that is to say, the function that the input is used for may be chosen from one of a number of different functions. Some of those functions are very specific, others may be programmed to adapt to the user requirements. If the Two-Speed Motor feature is enabled, Assignable Input 4 will be dedicated as the Two-Speed Motor Monitor.

a) ACCESS SWITCH

Terminals C1 and C2 ***must*** be shorted to allow changing of any setpoint values. This safeguard is in addition to the setpoint passcode feature, which functions independently (see Section 4.2.1: Passcode on page 4–6).

b) TEST SWITCH

Once the 469 is in service, it may be tested from time to time as part of a regular maintenance schedule. The relay will have accumulated statistical information relating historically to starter and motor operation. This information includes: last trip data, demand data (if the metering features are in use), MWh and Mvarh metering, RTD maximums, the event record, analog input minimums and maximums, number of motor trips, number of trips by type, total motor running hours, learned parameters, number of starter operations, number of motor starts, number of emergency restarts, and the digital counter. Shorting the 469 Test input (terminals C3 and C4) prevents all of this data from being corrupted or updated when the relay is under test. The In Service LED will flash while the test terminals are shorted.

c) EMERGENCY RESTART

Shorting terminals D17 and D23 discharges the thermal capacity used to zero, sets any Starts/Hour Block lockout to zero, sets any Time Between Starts Block lockout to zero, and reset all Trips and Alarms so that a hot motor may be restarted. However, a Restart Block lockout will remain active (it may be used as a backspin timer) and any trip condition that remains (such as a hot RTD) will still cause a trip. Therefore, while the terminals are shorted, the Trip and Block output relays will remain in their normal non-operated state. In the event of a real emergency, the Emergency Restart terminals should remain shorted until the emergency is over. Also, while the Emergency Restart terminals are shorted, a Service Alarm message indicates any trips or blocks that are active. As the name implies, this feature should only be used in an emergency – using it otherwise defeats the purpose of the relay, namely, protecting the motor. Any Emergency Restart input transition from open to closed or closed to open is logged as an event.

d) REMOTE RESET

Shorting terminals D18 and D23 resets any trips or latched alarms provided that the condition that caused the alarm or trip is no longer present. If there is a lockout time the Block Start relay will not reset until the lockout time has expired.

4.4.2 STARTER STATUS

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨ STARTER STATUS

```
■ STARTER STATUS          ENTER ⇨   STARTER STATUS SW:
■ [ENTER] for more      ⇦ ESCAPE    Starter Auxiliary A
```

Range: Starter Auxiliary A, Starter Auxiliary B

This input is *necessary* for all motors. The 469 determines that a motor has stopped when the phase current falls below the level that the relay can measure (5% of CT primary). Monitoring an auxiliary contact from the breaker or contactor prevents the relay from detecting additional starts when an unloaded motor is loaded, or issuing a block start after an unloaded motor is started and running at less than 5% CT rated primary current.

If "Starter Auxiliary A" is chosen, terminals D16 and D23 are monitored to detect the breaker or contactor state, open signifying the breaker or contactor is open and shorted signifying closed. The 469 will then determine that a motor has made the transition from 'running' to 'stopped' only when the measured current is less than 5% CT ratio **and** the 'a' contact is open.

If "Starter Auxiliary B" is chosen, terminals D16 and D23 are monitored to detect the breaker or contactor state, open signifying the breaker or contactor is closed and shorted signifying open. The 469 then determines that a motor has made the transition from 'running' to 'stopped' only when the measured current is less than 5% CT ratio **and** the 'b' contact is closed.

4.4.3 ASSIGNABLE INPUTS 1 TO 4

a) MAIN MENU

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

			Range
■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Off	Range: *Off, Remote Alarm, Remote Trip, Speed Switch Trip, Load Shed Trip, Pressure Sw Alarm, Pressure Switch Trip, Vibration Sw Alarm, Vibration Sw Trip, Digital Counter, Tachometer, General Sw A, General Sw B, General Sw C, General Sw D, Capture Trace, Simulate Pre-Fault, Simulate Fault, Simulate Pre Fault... Fault*
■ ASSIGNABLE INPUT 2 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 2 FUNCTION: Off	Range: *As above for INPUT 1 FUNCTION*
■ ASSIGNABLE INPUT 3 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 3 FUNCTION: Off	Range: *As above for INPUT 1 FUNCTION*
■ ASSIGNABLE INPUT 4 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 4 FUNCTION: Off	Range: *As above for INPUT 1 FUNCTION*

4

There are four user assignable digital inputs configurable to a number of different functions, or turned Off. Once a function is chosen, any messages that follow may be used to set pertinent parameters for operation. Each function may only be chosen once. Assignable Inputs 1 to 4 are activated by shorting D19 to D22 (respectively) with D23.

```
INPUT 4 FUNCTION IS
TWO-SPEED MOTOR
```

Two-speed motor protection is enabled with the **S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ ENABLE 2-SPEED MOTOR PROTECTION** setpoint. If the Two-Speed Motor feature is enabled, Assignable Input 4 is dedicated as the Two-Speed Motor Monitor and terminals D22 and D23 are monitored for a contact closure. Closure of the contact signifies that the motor is in Speed 2 or High Speed. If the input is open, it signifies that the motor is in Speed 1. This allows the 469 to determine which setpoints should be active at any given point in time.

b) REMOTE ALARM

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

			Range
■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Remote Alarm	Range: *See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Remote Alarm"
	ESCAPE / MESSAGE ⇳	REMOTE ALARM NAME: Remote Alarm	Range: *20 alphanumeric characters. Only seen if* **INPUT 1(4) FUNCTION** *is* "Remote Alarm"
	ESCAPE / MESSAGE ⇳	REMOTE ALARM: Unlatched	Range: *Latched, Unlatched. Only seen if* **INPUT 1(4) FUNCTION** *is* "Remote Alarm"
	ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2. Only seen if* **INPUT 1(4) FUNCTION** *is* "Remote Alarm"
	ESCAPE / MESSAGE ⇧	REMOTE ALARM EVENTS: Off	Range: *On, Off. Only seen if* **INPUT 1(4) FUNCTION** *is* "Remote Alarm"

Once the Remote Alarm function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. An alarm relay may be selected and the name of the alarm may be altered. A contact closure on the digital input assigned as Remote Alarm will cause an alarm within 100 ms with the name that has been chosen. Multiple sources may be used to trigger a remote alarm by paralleling inputs (see Figure 4–4: Remote Alarm/Trip from Multiple Sources on page 4–19).

c) REMOTE TRIP

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1
■ [ENTER] for more
```

[ENTER] ⇨ / ⇦ [ESCAPE]

```
INPUT 1 FUNCTION:
Remote Trip
```

Range: See above. The following setpoints apply only if **INPUT 1(4) FUNCTION** *is* "Remote Trip"

[ESCAPE] [MESSAGE] ⇳

```
REMOTE TRIP NAME:
Remote Trip
```

Range: 20 character alphanumeric. Only seen if **INPUT 1(4) FUNCTION** *is* "Remote Trip"

[ESCAPE] [MESSAGE] ⇧

```
ASSIGN TRIP RELAYS:
Trip
```

Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if **INPUT 1(4) FUNCTION** *is* "Remote Trip"

Once the Remote Trip function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. A trip relay may be selected and the name of the trip may be altered. A contact closure on the digital input assigned as Remote Trip will cause a trip within 100 ms with the name that has been chosen. Multiple sources may be used to trigger a remote trip by paralleling inputs.

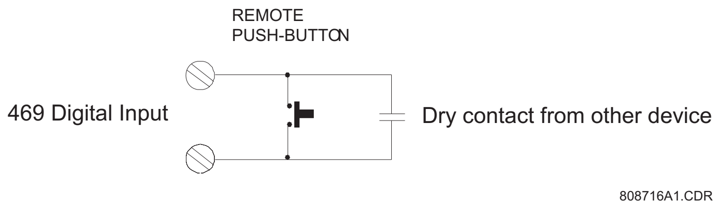


Figure 4–4: REMOTE ALARM/TRIP FROM MULTIPLE SOURCES

d) SPEED SWITCH TRIP

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1
■ [ENTER] for more
```

[ENTER] ⇨ / ⇦ [ESCAPE]

```
INPUT 1 FUNCTION:
Speed Switch Trip
```

Range: See above. The following setpoints apply only if **INPUT 1(4) FUNCTION** *is* "Speed Switch Trip"

[ESCAPE] [MESSAGE] ⇳

```
ASSIGN TRIP RELAYS:
Trip
```

Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if **INPUT 1(4) FUNCTION** *is* "Speed Switch Trip"

[ESCAPE] [MESSAGE] ⇧

```
SPEED SWITCH TRIP
TIME DELAY: 5.0 s
```

Range: 1.0 to 250.0 s in steps of 0.1. Only seen if **INPUT 1(4) FUNCTION** *is* "Speed Switch Trip"

When this function is assigned to a digital input, the following will occur. When a transition from stopped to start is detected a timer will be loaded with the delay programmed. If that delay expires before a contact closure is detected, a trip will occur. Once the motor is stopped, the scheme is reset.

e) LOAD SHED TRIP

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1
■ [ENTER] for more
```

[ENTER] ⇨ / ⇦ [ESCAPE]

```
INPUT 1 FUNCTION:
Load Shed Trip
```

Range: See above. The following setpoints apply only if **INPUT 1(4) FUNCTION** *is* "Load Shed Trip"

[ESCAPE] [MESSAGE] ⇧

```
ASSIGN TRIP RELAYS:
Trip
```

Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if **INPUT 1(4) FUNCTION** *is* "Load Shed Trip"

Once the Load Shed Trip function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. A trip relay may be selected. A contact closure on the switch input assigned as Load Shed Trip will cause a trip within 100 ms.

f) PRESSURE SWITCH ALARM

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1
■ [ENTER] for more
```

INPUT 1 FUNCTION: Pressure Sw Alarm	*Range: See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Pressure Sw Alarm"
BLOCK PRES. SW. ALARM FROM START: 0 s	*Range: 0 to 5000 s in steps of 1 (0 indicates feature is active while motor is stopped as well as running). Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Sw Alarm"
PRESSURE SWITCH ALARM: Unlatched	*Range: Latched, Unlatched. Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Sw Alarm"
ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Sw Alarm"
PRESSURE SW. ALARM DELAY: 5.0 s	*Range: 0.1 to 100.0 sec., step: 0.1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Sw Alarm"
PRESSURE SW. ALARM EVENTS: Off	*Range: On, Off. Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Sw Alarm"

Once the Pressure Switch Alarm function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. The Pressure Switch alarm feature may be blocked for a specified period of time from a motor start. A value of zero for the block time indicates that the feature is always active, when the motor is stopped or running. After the block delay has expired, the digital input will be monitored. If a closure occurs, after the specified delay, an alarm will occur.

g) PRESSURE SWITCH TRIP

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)


```
■ ASSIGNABLE INPUT 1
■ [ENTER] for more
```

INPUT 1 FUNCTION: Pressure Switch Trip	*Range: See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Pressure Switch Trip"
BLOCK PRES. SW. TRIP FROM START: 0 s	*Range: 0 to 5000 sec.; step: 1 (0 indicates feature is active while motor is stopped as well as running). Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Switch Trip"
ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Switch Trip"
PRESSURE SW. TRIP DELAY: 5.0 s	*Range: 0.1 to 100.0 s in steps of 0.1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Pressure Switch Trip"

Once the Pressure Switch Trip function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. The Pressure Switch trip feature may be blocked for a specified period of time from a motor start. A value of zero for the Block time indicates that the feature is always active, when the motor is stopped or running. After the block delay has expired, the digital input will be monitored. If a closure occurs, after the specified delay, a trip will occur.

h) VIBRATION SWITCH ALARM

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Vibration Sw Alarm	*Range: See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Alarm".
	ESCAPE / MESSAGE ⇳	VIBRATION SWITCH ALARM: Unlatched	*Range: Latched, Unlatched. Only seen if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Alarm"
	ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Alarm"
	ESCAPE / MESSAGE ⇳	VIBRATION SW. ALARM DELAY: 5.0 s	*Range: 0.1 to 100.0 s in steps of 0.1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Alarm"
	ESCAPE / MESSAGE ⇧	VIBRATION SW. ALARM EVENTS: Off	*Range: On, Off. Only seen if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Alarm"

Once the Vibration Switch Alarm function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. When the motor is stopped or running, the digital input will be monitored. If a closure occurs, after the specified delay, an alarm will occur.

i) VIBRATION SWITCH TRIP

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Vibration Sw Trip	*Range: See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Trip".
	ESCAPE / MESSAGE ⇳	ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Trip"
	ESCAPE / MESSAGE ⇧	VIBRATION SW. TRIP DELAY: 5.0 s	*Range: 0.1 to 100.0 s in steps of 0.1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Vibration Sw Trip"

Once the Vibration Switch Trip function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. When the motor is stopped or running, the digital input will be monitored. If a closure occurs, after the specified delay, a trip will occur.

j) DIGITAL COUNTER

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Digital Counter	Range: *See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Digital Counter".
ESCAPE / MESSAGE ⇳	COUNTER UNITS: Units	Range: *6 alphanumeric characters. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇳	COUNTER PRESET VALUE: 0	Range: *0 to 1000000000 in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇳	COUNTER TYPE: Increment	Range: *Increment, Decrement. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇳	COUNTER ALARM: Off	Range: *Off, Latched, Unlatched. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇳	COUNTER ALARM LEVEL: 100	Range: *0 to 1000000000 in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇳	COUNTER ALARM PICKUP: Over	Range: *Over, Under. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"
ESCAPE / MESSAGE ⇧	COUNTER ALARM EVENTS: Off	Range: *On, Off. Only seen if* **INPUT 1(4) FUNCTION** *is* "Digital Counter"

Once the Digital Counter function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. Each closure of the switch will be counted, by either adding or decrementing the counter value. An alarm may be configured when a certain count is reached. The counter value may be viewed in the **A4 MAINTENANCE ⇨⇩ GENERAL COUNTERS ⇨⇩ DIGITAL COUNTER** actual value.

To initialize the counter, program the counter value here and then change the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ PRESET DIGITAL COUNTER** setpoint to "Yes".

For example, a capacitive proximity probe may be used to sense non-magnetic units that are passing by on a conveyor, glass bottles for instance. The probe could be powered from the +24 V from the input switch power supply. The NPN transistor output could be taken to one of the assignable digital inputs configured as a counter.

k) TACHOMETER

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

	■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	
ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Tachometer	Range: *See above. The following setpoints apply only if* **INPUT 1(4) FUNCTION** *is* "Tachometer".
ESCAPE / MESSAGE ⇳	RATED SPEED: 3600 RPM	Range: *100 to 7200 RPM in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	TACHOMETER ALARM: Off	Range: *Off, Latched, Unlatched. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	TACHOMETER ALARM SPEED: 10% Rated	Range: *5 to 100% in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	TACHOMETER ALARM DELAY: 1 s	Range: *1 to 250 s in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	TACHOMETER ALARM EVENTS: Off	Range: *On, Off. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	TACHOMETER TRIP: Off	Range: *Off, Latched, Unlatched. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	ASSIGN TRIP RELAYS: Trip	Range: *Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇳	TACHOMETER TRIP SPEED: 10% Rated	Range: *5 to 95% in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"
ESCAPE / MESSAGE ⇧	TACHOMETER TRIP DELAY: 1 s	Range: *1 to 250 s in steps of 1. Only seen if* **INPUT 1(4) FUNCTION** *is* "Tachometer"

Once the tachometer function is chosen for one of the assignable digital inputs, the setpoint messages shown here will follow the assignment message. The period of time between each switch closure measured and converted to an RPM value based on one closure per revolution. A trip and alarm may be configured such that the motor or load must be at a certain speed within a set period of time from the initiation of motor starting. The tachometer trip and alarm are ignored while the motor is stopped. The RPM value may be viewed with the **A2 METERING ⇨⇩ SPEED ⇨ TACHOMETER** actual value.

For example, an inductive proximity probe or hall effect gear tooth sensor may be used to sense the key on the motor. The probe could be powered from the +24 V from the input switch power supply. The NPN transistor output could be taken to one of the assignable switch inputs configured as a tachometer.

l) GENERAL SWITCH A to D

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: General Sw. A	Range: See above. The following setpoints apply only if **INPUT 1(4) FUNCTION** is "General Sw. A".
	ESCAPE / MESSAGE ⇳	SWITCH NAME: General Sw. A	Range: 12 alphanumeric characters. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	GENERAL SWITCH A: Normally Open	Range: Normally Open, Normally Closed. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	BLOCK INPUT FROM START: 0 s	Range: 0 to 5000 s in steps of 1 (0 indicates that feature is active while motor is stopped as well as running). Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	GENERAL SWITCH A ALARM: Off	Range: Off, Latched, Unlatched. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	GENERAL SWITCH A ALARM DELAY: 5.0 s	Range: 0.1 to 5000.0 s in steps of 0.1. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	GENERAL SWITCH A EVENTS: Off	Range: On, Off. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	GENERAL SWITCH A TRIP: Off	Range: Off, Latched, Unlatched. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇳	ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"
	ESCAPE / MESSAGE ⇧	GENERAL SWITCH A TRIP DELAY: 5.0 s	Range: 0.1 to 5000.0 s in steps of 0.1. Only seen if **INPUT 1(4) FUNCTION** is "General Sw. A"

There are four General Switch functions assignable to any of the four assignable digital inputs. Once a General Switch function is chosen for one of the digital inputs, the setpoint messages shown here follow the assignment message. An alarm and/or trip may then be configured for that input. The alarm and/or trip may be assigned a common name and a common block time from motor start if required (if the alarm is to be disabled until some period of time after he motor has been started). A value of "0" for the **BLOCK TIME** setpoint indicates that the feature is always active, when the motor is stopped or running. The switch may also be defined as normally open or normally closed. After the block delay has expired, the digital input will be monitored. If the switch is not in its normal state after the specified delay, an alarm or trip will occur.

m) CAPTURE TRACE

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

■ ASSIGNABLE INPUT 1 ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	INPUT 1 FUNCTION: Capture Trace	Range: See above.

Setting the **INPUT 1(4) FUNCTION** to "Capture Trace" allows the user to capture a trace upon command via a switch input. The captured waveforms can then be displayed with 469PC. There are no additional Digital Input setpoints associated with this value.

4

n) SIMULATE PRE-FAULT

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1     ENTER ⇨   INPUT 1 FUNCTION:        Range: See above.
■ [ENTER] for more     ⇦ ESCAPE    Simulate Pre-Fault
```

Setting the **INPUT 1(4) FUNCTION** to "Simulate Pre-Fault" allows the user to start the Simulate Pre-Fault mode as per the **S13 469 TESTING ⇨ SIMULATION MODE ⇨ SIMULATION MODE** setting via a switch input. This is typically used for relay or system testing. There are no additional Digital Input setpoints associated with this value.

o) SIMULATE FAULT

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1     ENTER ⇨   INPUT 1 FUNCTION:        Range: See above.
■ [ENTER] for more     ⇦ ESCAPE    Simulate Fault
```

Setting the **INPUT 1(4) FUNCTION** to "Simulate Fault" allows the user to start the Simulate Fault mode as per the **S13 469 TESTING ⇨ SIMULATION MODE ⇨ SIMULATION MODE** setting via a switch input. This is typically used for relay or system testing. There are no additional Digital Input setpoints associated with this value.

4

p) SIMULATE PRE-FAULT … FAULT

PATH: SETPOINTS ⇨⇩ S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT 1(4)

```
■ ASSIGNABLE INPUT 1     ENTER ⇨   INPUT 1 FUNCTION:        Range: See above.
■ [ENTER] for more     ⇦ ESCAPE    Sim Pre-Fault.Fault
```

Setting the **INPUT 1(4) FUNCTION** to "Sim Pre-Fault.Fault" allows the user to start the Simulate Pre-Fault to Fault mode as per the **S13 469 TESTING ⇨ SIMULATION MODE ⇨ SIMULATION MODE** setting via a switch input. This is typically used for relay or system testing. There are no additional Digital Input setpoints associated with this value.

4.5.1 DESCRIPTION

Five of the six output relays are always non-failsafe, R6 Service is always failsafe. As failsafe, R6 relay will be energized normally and de-energize when called upon to operate. It will also de-energize when control power to the 469 is lost and therefore, be in its operated state. All other relays, being non-failsafe, will be de-energized normally and energize when called upon to operate. Obviously, when control power is lost to the 469, the output relays must be de-energized and therefore, they will be in their non-operated state. Shorting bars in the drawout case ensure that when the 469 is drawn out, no trip or alarm occurs. The R6 Service output will however indicate that the 469 has been drawn out.

4.5.2 RELAY RESET MODE

PATH: SETPOINTS ⇨⇩ S4 OUTPUT RELAYS ⇨ RELAY RESET MODE

```
■ RELAY RESET MODE
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

	Range
R1 TRIP: All Resets	*Range: All Resets, Remote Reset Only, Keypad Reset Only*
R2 AUXILIARY: All Resets	*Range: All Resets, Remote Reset Only, Keypad Reset Only*
R3 AUXILIARY: All Resets	*Range: All Resets, Remote Reset Only, Keypad Reset Only*
R4 ALARM: All Resets	*Range: All Resets, Remote Reset Only, Keypad Reset Only*
R5 BLOCK START: Auto-Reset	*Range: N/A*
R6 SERVICE: All Resets	*Range: All Resets, Remote Reset Only, Keypad Reset Only*

A latched trip or alarm may be reset at any time, providing that the condition that caused the trip or alarm is no longer present. Unlatched trips and alarms will reset automatically once the condition is no longer present. If any condition may be reset, the Reset Possible LED will be lit. All Block Start features reset automatically when the lockout time has expired and the trip has been reset.

The other relays may be programmed to All Resets which allows reset from the front keypad or the remote reset switch input or the communications port. Optionally, relays 1 through 6 may be programmed to reset by the "Remote Reset Only" (by the remote reset switch input or the communications port) or "Keypad Reset Only" (reset only by relay keypad).

WARNING

NO **trip or alarm element must *EVER* be assigned to two output relays where one is Remote Reset Only and the other is Keypad Reset Only. The trip or alarm will be unresettable if this occurs.**

For example, serious trips such as Short Circuit and Ground Fault may be assigned to the R2 Auxiliary relay so that they can only be reset via the remote reset terminals (D18 and D23) or the communication port. The remote reset terminals should be connected to a keyswitch so that only authorized personnel could reset such a critical trip.

- Assign only Short Circuit and Ground Fault to the R2 Auxiliary relay
- Program **R2 AUXILIARY** to "Remote Reset Only"

4.5.3 FORCE OUTPUT RELAY

PATH: SETPOINTS ⇨⇩ S4 OUTPUT RELAYS ⇨⇩ FORCE OUTPUT RELAY

■ FORCE OUTPUT RELAY ■ [ENTER] for more	
FORCE TRIP (R1) RELAY: Disabled	Range: Disabled, Enabled
FORCE TRIP RELAY DURATION: Static	Range: Static, 1 to 300 s in steps of 1
FORCE AUX1 (R2) RELAY: Disabled	Range: Disabled, Enabled
FORCE AUX1 RELAY DURATION: Static	Range: Static, 1 to 300 s in steps of 1
FORCE AUX2 (R3) RELAY: Disabled	Range: Disabled, Enabled
FORCE AUX2 RELAY DURATION: Static	Range: Static, 1 to 300 s in steps of 1
FORCE ALARM (R4) RELAY: Disabled	Range: Disabled, Enabled
FORCE ALARM RELAY DURATION: Static	Range: Static, 1 to 300 s in steps of 1
FORCE BLOCK (R5) RELAY: Disabled	Range: Disabled, Enabled
FORCE BLOCK RELAY OPERATION: Static	Range: Static, 1 to 300 s in steps of 1

The output relays can be independently forced in static or dynamic mode. In static mode the selected relay will operate as long as it is in the "Enabled" state. Only when the user enters "Disabled" will the selected relay reset. In dynamic mode the user specifies the operate time (1 to 300 seconds) and the selected relay will operate for the specified duration.

The **FORCE OUTPUT RELAY** option is NOT allowed when the selected relay output is already active due to trip or alarm condition, when the 469 is in start block condition, or when the 469 is not in service.

NOTE

IMPORTANT NOTE:

The forced relay will override any trip or alarm conditions. (i.e. when the relay is forced and trip occurs, the relay will still be enabled when the trip condition is reset).

Control power loss in the 469 will **reset** all forced relays.

4.6.1 MOTOR THERMAL LIMITS

One of the principle enemies of motor life is heat. When a motor is specified, the purchaser communicates to the manufacturer what the loading conditions and duty cycle will be, as well as, environment and other pertinent information about the driven load such as starting torque, etc. The manufacturer then provides a stock motor or builds a motor that should have a reasonable life under those conditions.

Motor thermal limits are dictated by the design of both the stator and the rotor. Motors have three modes of operation: locked rotor or stall (when the rotor is not turning), acceleration (when the rotor is coming up to speed), and running (when the rotor turns at near synchronous speed). Heating occurs in the motor during each of these conditions in very distinct ways. Typically, during motor starting, locked rotor and acceleration conditions, the motor is rotor limited. That is to say that the rotor will approach its thermal limit before the stator. Under locked rotor conditions, voltage is induced in the rotor at line frequency, 50 or 60 Hz. This voltage causes a current to flow in the rotor, also at line frequency, and the heat generated (I^2R) is a function of the effective rotor resistance. At 50 or 60 Hz, the reactance of the rotor cage causes the current to flow at the outer edges of the rotor bars. The effective resistance of the rotor is therefore at a maximum during a locked rotor condition as is rotor heating. When the motor is running at rated speed, the voltage induced in the rotor is at a low frequency (approximately 1 Hz) and therefore, the effective resistance of the rotor is reduced quite dramatically. During running overloads, the motor thermal limit is typically dictated by stator parameters. Some special motors might be all stator or all rotor limited. During acceleration, the dynamic nature of the motor slip dictates that rotor impedance is also dynamic, and a third overload thermal limit characteristic is necessary.

4

The figure below illustrates typical thermal limit curves. The motor starting characteristic is shown for a high inertia load at 80% voltage. If the motor started quicker, the distinct characteristics of the thermal limit curves would not be required and the running overload curve would be joined with locked rotor safe stall times to produce a single overload curve.

The motor manufacturer should provide a safe stall time or thermal limit curves for any motor they sell. To program the 469 for maximum protection, it is necessary to ask for these items when the motor is out for bid. These thermal limits are intended to be used as guidelines and their definition is not always precise. When operation of the motor exceeds the thermal limit, the motor insulation does not immediately melt. Rather, the rate of insulation degradation has reached a point that motor life will be significantly reduced if it is run any longer in that condition.

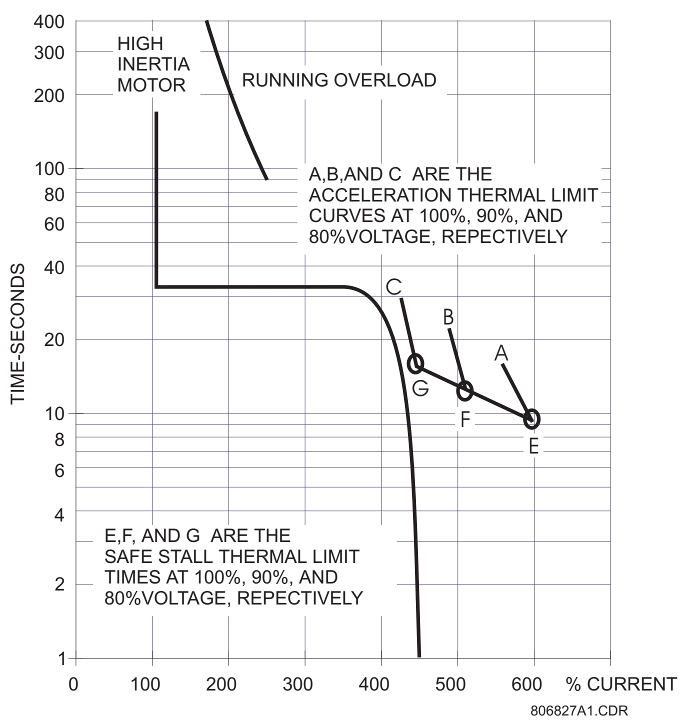


Figure 4–5: TYPICAL TIME-CURRENT AND THERMAL LIMIT CURVES (ANSI/IEEE C37.96)

4.6.2 THERMAL MODEL

PATH: SETPOINTS ⇨⇩ S5 THERMAL MODEL ⇨ THERMAL MODEL

■ THERMAL MODEL ■ [ENTER] for more	
SELECT CURVE STYLE: Standard	Range: Standard, Custom, Voltage Dependent
OVERLOAD PICKUP LEVEL: 1.01 x FLA	Range: 1.01 to 1.25 in steps of 0.01
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Aux2, Trip & Aux2 & Aux3, Trip & Aux3
UNBALANCE BIAS K FACTOR: 0	Range: 0 to 19 in steps of 1. (0 defeats this feature)
COOL TIME CONSTANT RUNNING: 15 min.	Range: 1 to 1000 min. in steps of 1
COOL TIME CONSTANT STOPPED: 30 min.	Range: 1 to 1000 min. in steps of 1
HOT/COLD SAFE STALL RATIO: 1.00	Range: 0.01 to 1.00 in steps of 0.01
ENABLE RTD BIASING: No	Range: Yes, No
RTD BIAS MINIMUM: 40°C	Range: 0°C to **RTD BIAS CENTER** value in steps of 1
RTD BIAS CENTER POINT: 130°C	Range: **RTD BIAS MINIMUM** value to **RTD BIAS MAXMIMUM** value in steps of 1
RTD BIAS MAXIMUM: 155°C	Range: **RTD BIAS CENTER** value to 250°C in steps of 1
THERMAL CAPACITY ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
THERMAL CAP. ALARM LEVEL: 75% USED	Range: 10 to 100% in steps of 1
THERMAL CAPACITY ALARM EVENTS: Off	Range: On, Off

The primary protective function of the 469 is the thermal model. It consists of five key elements: the overload curve and overload pickup level, the unbalance biasing of the motor current while the motor is running, the motor cooling time constants, and the biasing of the thermal model based on Hot/Cold motor information and measured stator temperature. Each of these elements are described in detail in the sections that follow.

The 469 integrates stator and rotor heating into one model. Motor heating is reflected in the **A1 STATUS ⇨ MOTOR STATUS ⇨⇩ MOTOR THERMAL CAPACITY USED** actual value register. If the motor has been stopped for a long period of time, it will be at ambient temperature and the **MOTOR THERMAL CAPACITY USED** should be zero. If the motor is in overload, once the thermal capacity used reaches 100%, a trip will occur. The **THERMAL CAPACITY ALARM** may be used as a warning indication of an impending overload trip.

4.6.3 OVERLOAD CURVE SETUP

PATH: SETPOINTS ⇨⇩ S5 THERMAL MODEL ⇨⇩ O/L CURVE SETUP

■ O/L CURVE SETUP
■ [ENTER] for more

STANDARD OVERLOAD CURVE NUMBER: 4	*Range: 1 to 15 in steps of 1. Seen only if Standard Curve Style is selected.*
TIME TO TRIP AT 1.01 x FLA: 17414.5 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.05 x FLA: 3414.9 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.10 x FLA: 1666.7 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.20 x FLA: 795.4 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.30 x FLA: 507.2 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.40 x FLA: 364.6 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.50 x FLA: 280.0 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 1.75 x FLA: 169.7 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 2.00 x FLA: 116.6 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 2.25 x FLA: 86.1 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 2.50 x FLA: 66.6 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 2.75 x FLA: 53.3 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 3.00 x FLA: 43.7 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 3.25 x FLA: 36.6 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 3.50 x FLA: 31.1 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 3.75 x FLA: 26.8 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 4.00 x FLA: 23.3 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 4.25 x FLA: 20.5 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*
TIME TO TRIP AT 4.50 x FLA: 18.2 s	*Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if* **SELECT CURVE STYLE** *is "Standard".*

	Range
TIME TO TRIP AT 4.75 x FLA: 16.2 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 5.00 x FLA: 14.6 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 5.50 x FLA: 12.0 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 6.00 x FLA: 10.0 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 6.50 x FLA: 8.5 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 7.00 x FLA: 7.3 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 7.50 x FLA: 6.3 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 8.00 x FLA: 5.6 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 10.0 x FLA: 5.6 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 15.0 x FLA: 5.6 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
TIME TO TRIP AT 20.0 x FLA: 5.6 s	Range: 0.5 to 99999.9 s in steps of 0.1. Cannot be altered if **SELECT CURVE STYLE** is "Standard".
MINIMUM ALLOWABLE LINE VOLTAGE: 80%	Range: 70 to 95% in steps of 1. Seen only if **SELECT CURVE STYLE** is "Voltage Dependent".
STALL CURRENT @ MIN Vline: 4.80 x FLA	Range: 2.00 to 15.00 x FLA in steps of 0.01. Seen only if **SELECT CURVE STYLE** is Voltage Dependent.
SAFE STALL TIME @ MIN Vline: 20.0 s	Range: 0.5 to 999.9 s in steps of 0.1. Seen only if **SELECT CURVE STYLE** is Voltage Dependent.
ACCEL. INTERSECT @ MIN Vline: 3.80 x FLA	Range: 2.00 to **STALL CURRENT @ MIN Vline** value in steps of 0.01. Seen only if **SELECT CURVE STYLE** is "Voltage Dependent"
STALL CURRENT @ 100% Vline: 6.00 x FLA	Range: 2.00 to 15.00 x FLA in steps of 0.01. Seen only if **SELECT CURVE STYLE** is Voltage Dependent.
SAFE STALL TIME @ 100% Vline: 10.0 s	Range: 0.5 to 999.9 s in steps of 0.1. Seen only if **SELECT CURVE STYLE** is Voltage Dependent.
ACCEL. INTERSECT @ 100% Vline: 5.00 x FLA	Range: 2.00 to **STALL CURRENT @ MIN Vline** value in steps of 0.01. Seen only if **SELECT CURVE STYLE** is "Voltage Dependent"

The overload curve accounts for motor heating during stall, acceleration, and running in both the stator and the rotor. The **OVERLOAD PICKUP LEVEL** setpoint dictates where the running overload curve begins as the motor enters an overload condition. This is useful for service factor motors as it allows the pickup level to be defined. The curve is effectively cut off at current values below this pickup.

Motor thermal limits consist of three distinct parts based on the three conditions of operation: locked rotor or stall, acceleration, and running overload. Each of these curves may be provided for a hot and a cold motor. A hot motor is defined as one that has been running for a period of time at full load such that the stator and rotor temperatures have settled at their rated temperature. A cold motor is a motor that has been stopped for a period of time such that the stator and rotor temperatures have settled at ambient temperature. For most motors, the distinct characteristics of the motor thermal limits are formed into a smooth homogeneous curve. Sometimes only a safe stall time is provided. This is acceptable if the motor has been designed conservatively and can easily perform its required duty without infringing on the thermal limit. In this case, the protection can be conservative and process integrity is not compromised. If a motor has been designed very close to its thermal limits when operated as required, then the distinct characteristics of the thermal limits become important.

The 469 overload curve can take one of three formats: Standard, Custom Curve, or Voltage Dependent. Regardless of the selected curve style, thermal memory is retained in the **A1 STATUS ⇨ MOTOR STATUS ⇨⇩ MOTOR THERMAL CAPACITY USED** register. This register is updated every 100 ms using the following equation:

$$TC_{used\ t} = TC_{used\ t-100ms} + \frac{100\text{ ms}}{\text{time to trip}} \times 100\% \quad \textbf{(EQ 4.1)}$$

where: time_to_trip = time taken from the overload curve at I_{eq} as a function of FLA. The overload protection curve should always be set slightly lower than the thermal limits provided by the manufacturer. this will ensure that the motor is tripped before the thermal limit is reached.

a) STANDARD OVERLOAD CURVES

If the motor starting times are well within the safe stall times, it is recommended that the 469 Standard Overload Curve be used. The standard overload curves are a series of 15 curves with a common curve shape based on typical motor thermal limit curves (see the figure and table below).

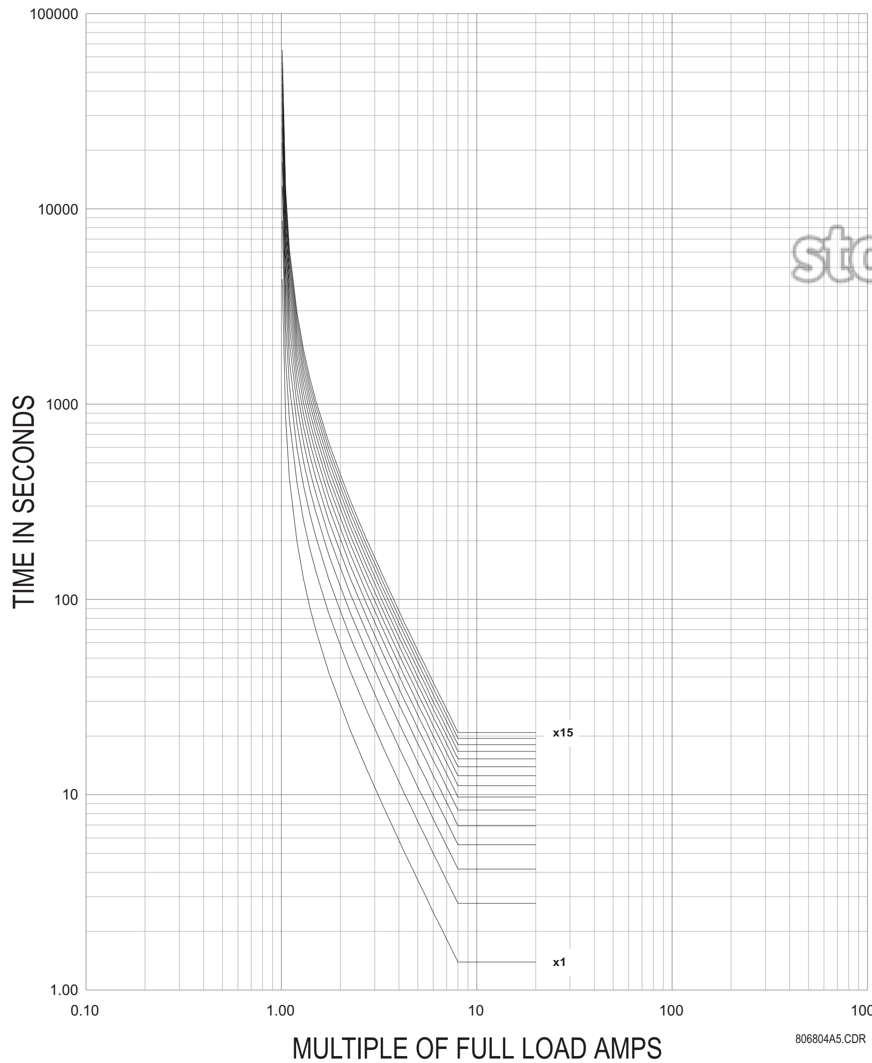


Figure 4–6: 469 STANDARD OVERLOAD CURVES

Table 4–1: 469 STANDARD OVERLOAD CURVE MULTIPLIERS

PICKUP LEVEL	STANDARD CURVE MULTIPLIERS														
	× 1	× 2	× 3	× 4	× 5	× 6	× 7	× 8	× 9	× 10	× 11	× 12	× 13	× 14	× 15
1.01	4353.6	8707.2	13061	17414	21768	26122	30475	34829	39183	43536	47890	52243	56597	60951	65304
1.05	853.71	1707.4	2561.1	3414.9	4268.6	5122.3	5976.0	6829.7	7683.4	8537.1	9390.8	10245	11098	11952	12806
1.10	416.68	833.36	1250.0	1666.7	2083.4	2500.1	2916.8	3333.5	3750.1	4166.8	4583.5	5000.2	5416.9	5833.6	6250.2
1.20	198.86	397.72	596.58	795.44	994.30	1193.2	1392.0	1590.9	1789.7	1988.6	2187.5	2386.3	2585.2	2784.1	2982.9
1.30	126.80	253.61	380.41	507.22	634.02	760.82	887.63	1014.4	1141.2	1268.0	1394.8	1521.6	1648.5	1775.3	1902.1
1.40	91.14	182.27	273.41	364.55	455.68	546.82	637.96	729.09	820.23	911.37	1002.5	1093.6	1184.8	1275.9	1367.0
1.50	69.99	139.98	209.97	279.96	349.95	419.94	489.93	559.92	629.91	699.90	769.89	839.88	909.87	979.86	1049.9
1.75	42.41	84.83	127.24	169.66	212.07	254.49	296.90	339.32	381.73	424.15	466.56	508.98	551.39	593.81	636.22
2.00	29.16	58.32	87.47	116.63	145.79	174.95	204.11	233.26	262.42	291.58	320.74	349.90	379.05	408.21	437.37
2.25	21.53	43.06	64.59	86.12	107.65	129.18	150.72	172.25	193.78	215.31	236.84	258.37	279.90	301.43	322.96
2.50	16.66	33.32	49.98	66.64	83.30	99.96	116.62	133.28	149.94	166.60	183.26	199.92	216.58	233.24	249.90
2.75	13.33	26.65	39.98	53.31	66.64	79.96	93.29	106.62	119.95	133.27	146.60	159.93	173.25	186.58	199.91
3.00	10.93	21.86	32.80	43.73	54.66	65.59	76.52	87.46	98.39	109.32	120.25	131.19	142.12	153.05	163.98
3.25	9.15	18.29	27.44	36.58	45.73	54.87	64.02	73.16	82.31	91.46	100.60	109.75	118.89	128.04	137.18
3.50	7.77	15.55	23.32	31.09	38.87	46.64	54.41	62.19	69.96	77.73	85.51	93.28	101.05	108.83	116.60
3.75	6.69	13.39	20.08	26.78	33.47	40.17	46.86	53.56	60.25	66.95	73.64	80.34	87.03	93.73	100.42
4.00	5.83	11.66	17.49	23.32	29.15	34.98	40.81	46.64	52.47	58.30	64.13	69.96	75.79	81.62	87.45
4.25	5.12	10.25	15.37	20.50	25.62	30.75	35.87	41.00	46.12	51.25	56.37	61.50	66.62	71.75	76.87
4.50	4.54	9.08	13.63	18.17	22.71	27.25	31.80	36.34	40.88	45.42	49.97	54.51	59.05	63.59	68.14
4.75	4.06	8.11	12.17	16.22	20.28	24.33	28.39	32.44	36.50	40.55	44.61	48.66	52.72	56.77	60.83
5.00	3.64	7.29	10.93	14.57	18.22	21.86	25.50	29.15	32.79	36.43	40.08	43.72	47.36	51.01	54.65
5.50	2.99	5.98	8.97	11.96	14.95	17.94	20.93	23.91	26.90	29.89	32.88	35.87	38.86	41.85	44.84
6.00	2.50	5.00	7.49	9.99	12.49	14.99	17.49	19.99	22.48	24.98	27.48	29.98	32.48	34.97	37.47
6.50	2.12	4.24	6.36	8.48	10.60	12.72	14.84	16.96	19.08	21.20	23.32	25.44	27.55	29.67	31.79
7.00	1.82	3.64	5.46	7.29	9.11	10.93	12.75	14.57	16.39	18.21	20.04	21.86	23.68	25.50	27.32
7.50	1.58	3.16	4.75	6.33	7.91	9.49	11.08	12.66	14.24	15.82	17.41	18.99	20.57	22.15	23.74
8.00	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.10	12.49	13.88	15.27	16.65	18.04	19.43	20.82
10.00	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.10	12.49	13.88	15.27	16.65	18.04	19.43	20.82
15.00	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.10	12.49	13.88	15.27	16.65	18.04	19.43	20.82
20.00	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.10	12.49	13.88	15.27	16.65	18.04	19.43	20.82

NOTE

Above 8.0 x Pickup, the trip time for 8.0 is used. This prevents the overload curve from acting as an instantaneous element.

The standard overload curves equation is:

$$\text{Time to Trip} = \frac{\text{Curve\_Multiplier} \times 2.2116623}{0.02530337 \times (\text{Pickup} - 1)^2 + 0.05054758 \times (\text{Pickup} - 1)} \qquad \textbf{(EQ 4.2)}$$

b) CUSTOM OVERLOAD CURVE

If the motor starting current begins to infringe on the thermal damage curves, it may become necessary to use a custom curve to tailor the motor protection so that successful starting may occur without compromising protection. Furthermore, the characteristics of the starting thermal damage curve (locked rotor and acceleration) and the running thermal damage curves may not fit together very smoothly. In this instance, a custom curve may be necessary to tailor motor protection to the motor thermal limits so it may be started successfully and be utilized to its full potential without compromising protection. The distinct parts of the thermal limit curves now become more critical. For these conditions, it is recommended that the 469 custom curve thermal model be used. The custom overload curve feature allows the user to program their own curve by entering trip times for 30 pre-determined current levels.

As seen in the figure below, if the running overload thermal limit curve were smoothed into one curve with the locked rotor overload curve, the motor could not start at 80% line voltage. A custom curve is required.

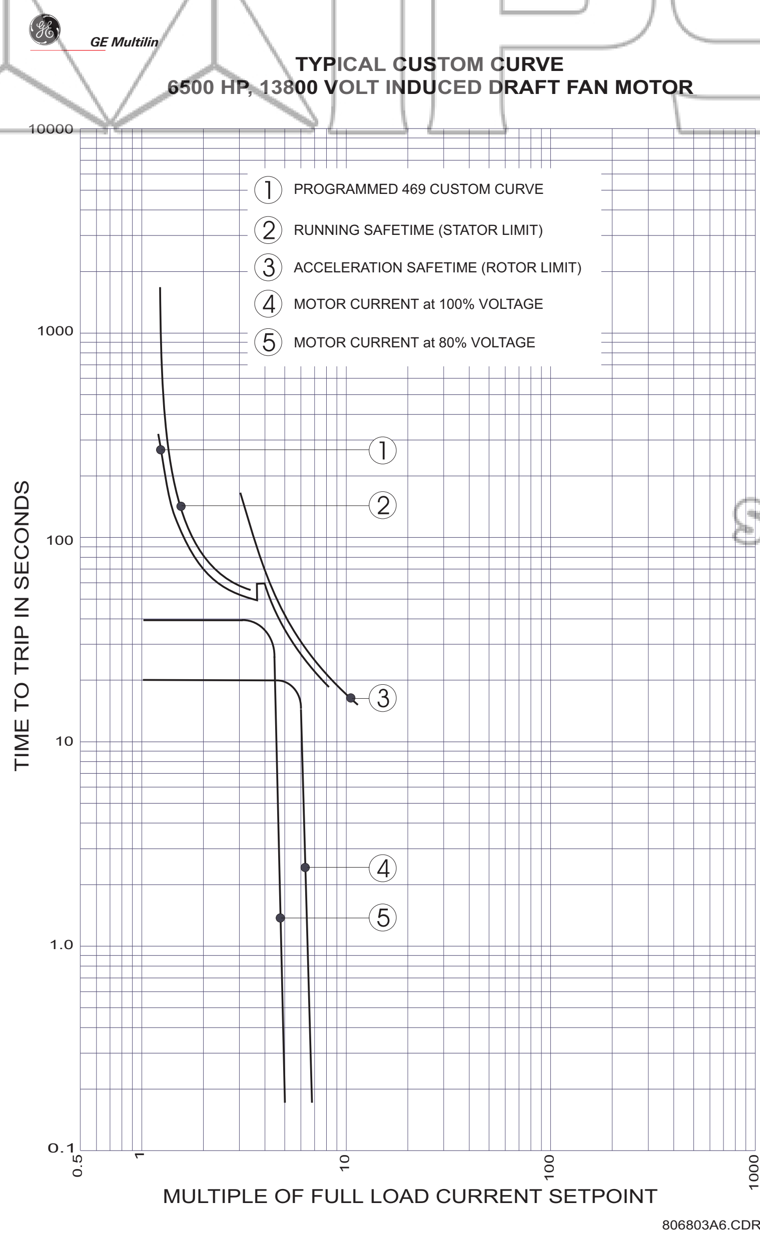


Figure 4–7: CUSTOM CURVE EXAMPLE

NOTE

During the interval of discontinuity, the longer of the two trip times is used to reduce the chance of nuisance tripping during motor starts.

c) VOLTAGE DEPENDENT OVERLOAD CURVE

If the motor is called upon to drive a high inertia load, it is quite possible and acceptable that the acceleration time exceeds the safe stall time (bearing in mind that a locked rotor condition is different than an acceleration condition). In this instance, each distinct portion of the thermal limit curve must be known and protection must be coordinated against that curve. The relay that is protecting the motor must be able to distinguish between a locked rotor condition, an accelerating condition and a running condition. The 469 Voltage Dependent Overload Curve feature is tailored to protect these types of motors. Voltage is continually monitored during motor starting and the acceleration thermal limit curve is adjusted accordingly.

The Voltage Dependent Overload Curve is comprised of the three characteristic shapes of thermal limit curves as determined by the stall or locked rotor condition, acceleration, and running overload. The curve is constructed by entering a custom curve shape for the running overload protection curve. Next, a point must be entered for the acceleration protection curve at the point of intersection with the custom curve, based on the minimum allowable starting voltage as defined by the minimum allowable line voltage. The locked rotor current and safe stall time must also be entered for that voltage. A second point of intersection must be entered for 100% line voltage. Once again, the locked rotor current and the safe stall time must be entered, this time for 100% line voltage. The protection curve created from the safe stall time and intersection point will be dynamic based on the measured line voltage between the minimum allowable line voltage and the 100% line voltage. This method of protection inherently accounts for the change in motor speed as an impedance relay would. The change in impedance is reflected by motor terminal voltage and line current. For any given speed at any given line voltage, there is only one value of line current.

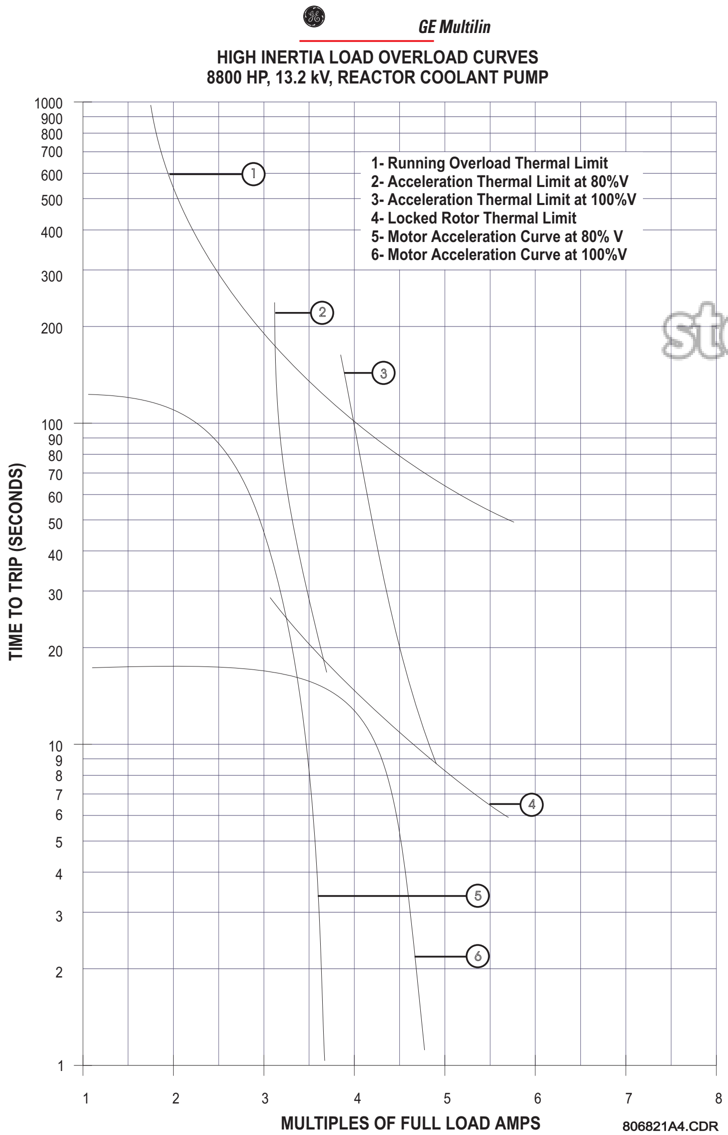


Figure 4–8: THERMAL LIMITS FOR HIGH INERTIAL LOAD

To illustrate the Voltage Dependent Overload Curve feature, the thermal limits of Figure 4–8: Thermal Limits for High Inertial Load will be used.

1. Construct a custom curve for the running overload thermal limit. If the curve does not extend to the acceleration thermal limits, extend it such that the curve intersects the acceleration thermal limit curves (see the Custom Curve below).
2. Enter the per unit current value for the acceleration overload curve intersect with the custom curve for 80% line voltage. Also enter the per unit current and safe stall protection time for 80% line voltage (see the Acceleration Curve below).
3. Enter the per unit current value for the acceleration overload curve intersect with the custom curve for 100% line voltage. Also enter the per unit current and safe stall protection time for 100% line voltage (see the Acceleration Curve below).

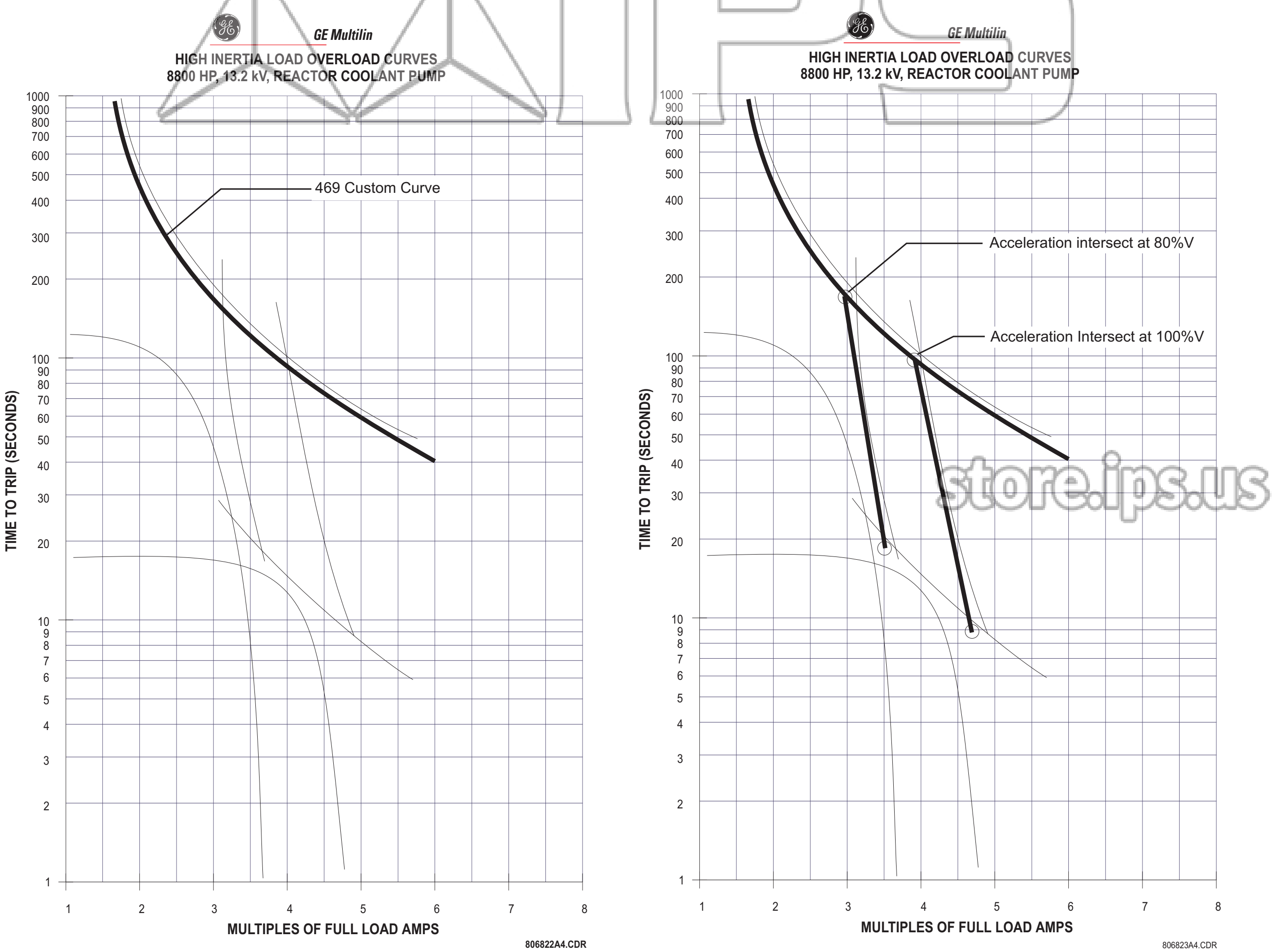


Figure 4–9: VOLTAGE DEPENDENT OVERLOAD CURVES

The 469 takes the information provided and create protection curves for any voltage between the minimum and 100%. For values above the voltage in question, the 469 extrapolates the safe stall protection curve to 110% voltage. This current level is calculated by taking the locked rotor current at 100% voltage and multiplying by 1.10. For trip times above the 110% current level, the trip time of 110% will be used. (see figure below).

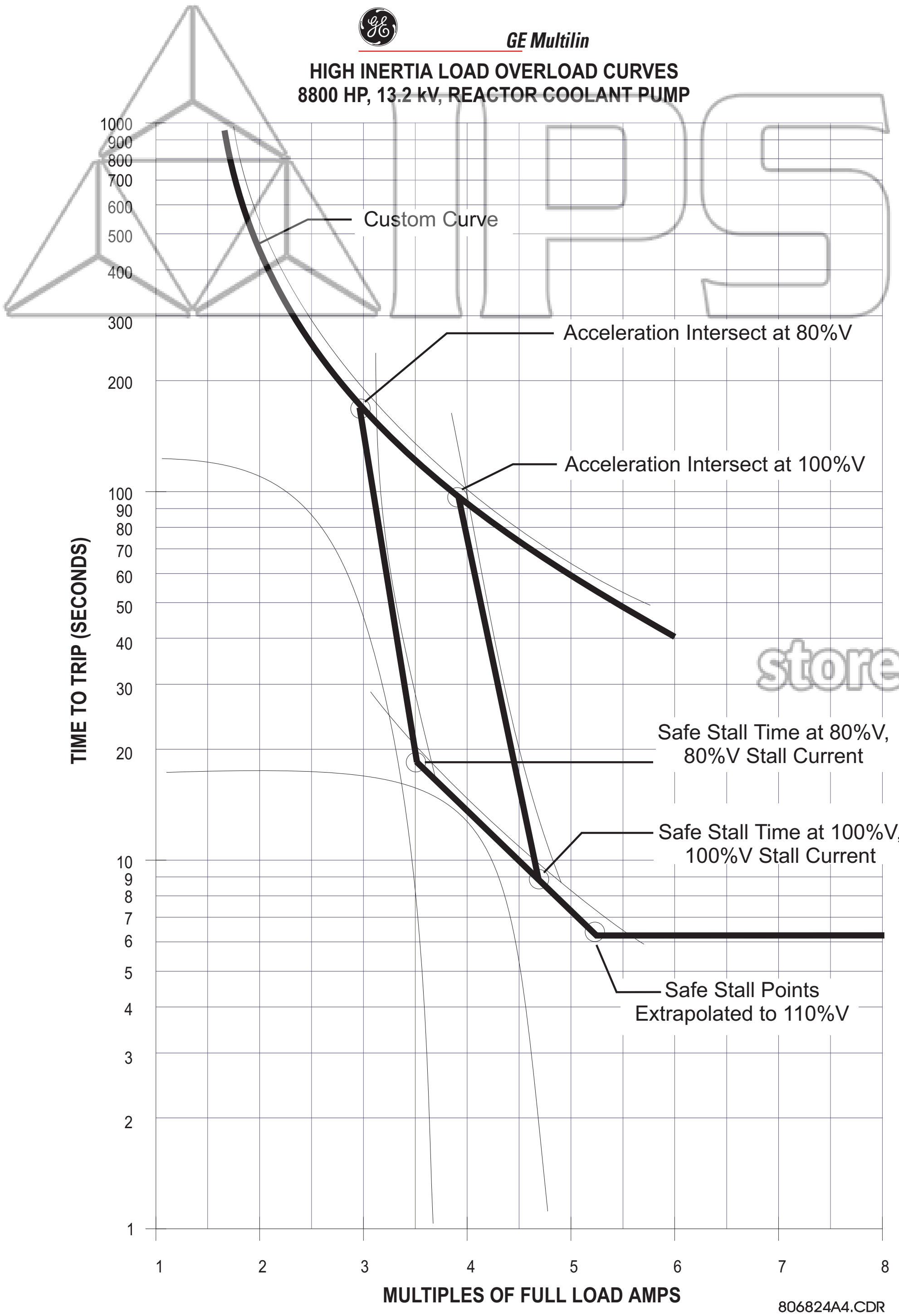


Figure 4–10: VOLTAGE DEPENDENT OVERLOAD PROTECTION CURVES

NOTE

The safe stall curve is in reality a series of safe stall points for different voltages. For a given voltage, there can only be one value of stall current and therefore, only one safe stall time.

The following two figures illustrate the resultant overload protection curves for 80% and 100% line voltage, respectively. For voltages in between, the 469 will shift the acceleration curve linearly and constantly based on measured line voltage during a motor start.

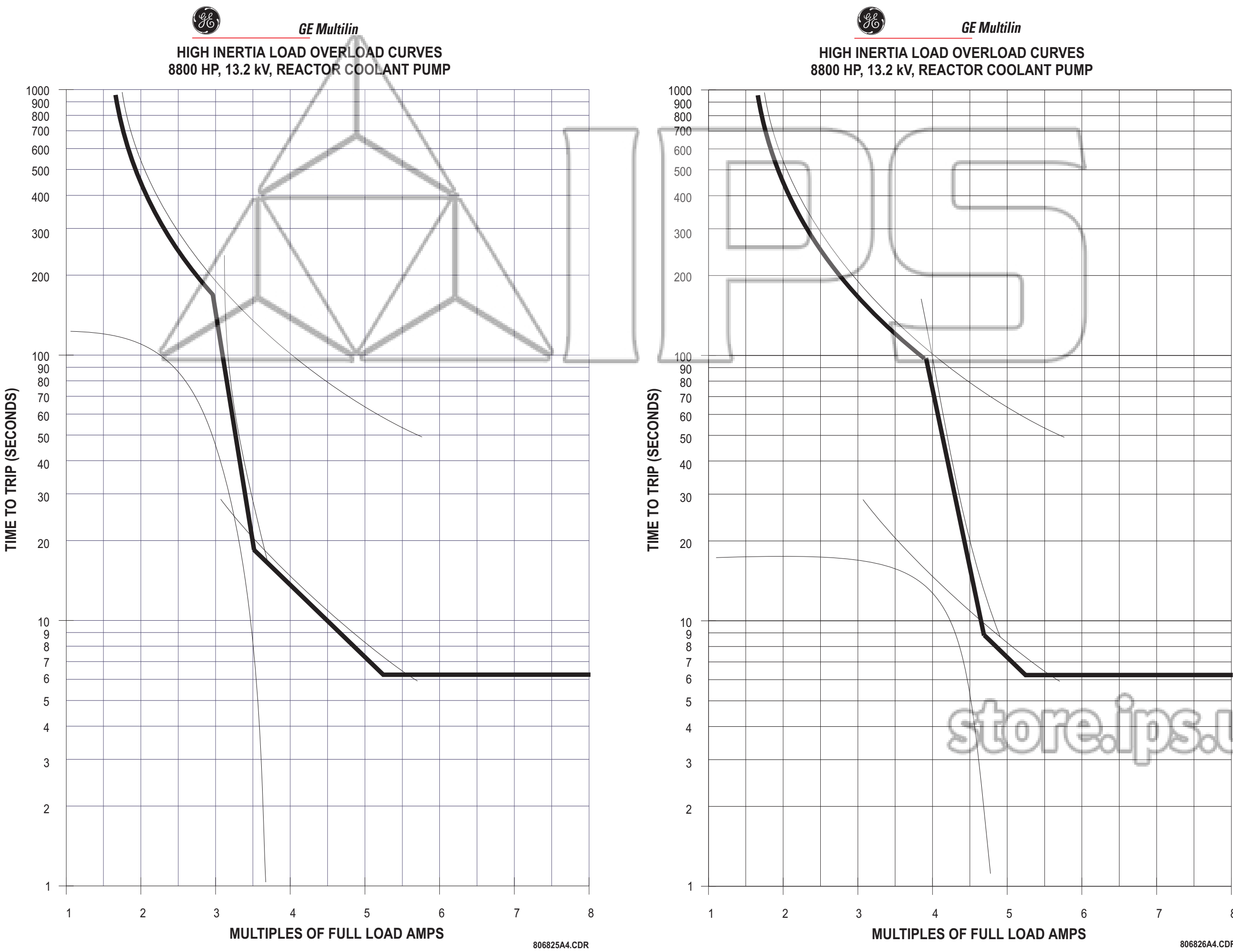


Figure 4–11: VOLTAGE DEPENDENT OVERLOAD PROTECTION AT 80% AND 100% VOLTAGE

d) UNBALANCE BIAS

Unbalanced phase currents also cause additional rotor heating not accounted for by electromechanical relays and also not accounted for in some electronic protective relays. When the motor is running, the rotor rotates in the direction of the positive-sequence current at near synchronous speed. Negative-sequence current, with a phase rotation opposite to positive-sequence current (and hence, opposite to the rotor rotation), generates a rotor voltage that produces a substantial rotor current. This induced current has a frequency approximately 2 times the line frequency: 100 Hz for a 50 Hz system or 120 Hz for a 60 Hz system. The skin effect in the rotor bars at this frequency causes a significant increase in rotor resistance and therefore a significant increase in rotor heating. This extra heating is not accounted for in the thermal limit curves supplied by the motor manufacturer, as these curves assume only positive-sequence currents from a perfectly balanced supply and motor design.

The 469 measures the ratio of negative to positive-sequence current. The thermal model may be biased to reflect the additional heating that is caused by negative sequence current when the motor is running. This biasing is accomplished by creating an equivalent motor heating current rather than simply using average current (I_{per_unit}). This equivalent current is calculated using the equation shown below.

$$I_{eq} = \sqrt{I^2{}_{per\_unit} \cdot \left(1 + k \cdot \left(\frac{I_2}{I_1}\right)^2\right)} \quad \textbf{(EQ 4.3)}$$

where: I_{eq} = equivalent motor heating current
I_{per_unit} = per unit current based on FLA
I_2= negative sequence current
I_1= positive sequence current
k = constant

The figure below shows recommended motor derating as a function of voltage unbalance recommended by NEMA (the National Electrical Manufacturers Association). Assuming a typical induction motor with an inrush of 6 x FLA and a negative sequence impedance of 0.167, voltage unbalances of 1, 2, 3, 4, and 5% equal current unbalances of 6, 12, 18, 24, and 30% respectively. Based on this assumption, the GE Multilin curve illustrates the motor derating for different values of *k* entered for the **UNBALANCE BIAS K FACTOR** setpoint. Note that the curve created when k = 8 is almost identical to the NEMA derating curve.

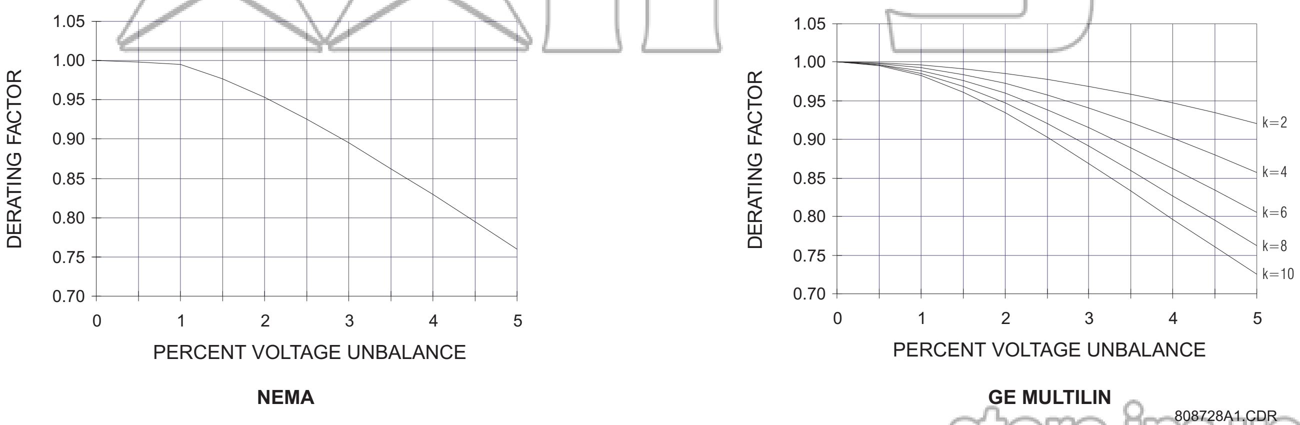


Figure 4–12: MEDIUM MOTOR DERATING FACTOR DUE TO UNBALANCED VOLTAGE

If a *k* value of 0 is entered, the unbalance biasing is defeated and the overload curve will time out against the measured per unit motor current. k may be calculated conservatively as:

$$k = \frac{175}{I_{LR}^2} \text{ (typical estimate); } \quad k = \frac{230}{I_{LR}^2} \text{ (conservative estimate), where } I_{LR} \text{ is the per unit locked rotor current} \quad \textbf{(EQ 4.4)}$$

e) MOTOR COOLING

The thermal capacity used value decreases exponentially when the motor current is less than the **OVERLOAD PICKUP** set-point. This reduction simulates motor cooling. The motor cooling time constants should be entered for both stopped and running cases. Since cooling is exponential, the time constants are one-fifth of the total time from 100% thermal capacity used to 0%. A stopped motor normally cools significantly slower than a running motor. Motor cooling is calculated as:

$$TC_{used} = (TC_{used\_start} - TC_{used\_end})(e^{-t/\tau}) + TC_{used\_end} \quad \textbf{(EQ 4.5)}$$

$$TC_{used\_end} = \left(\frac{I_{eq}}{overload\_pickup}\right)\left(1 - \frac{hot}{cold}\right) \times 100\% \quad \textbf{(EQ 4.6)}$$

where: TC_{used} = thermal capacity used
TC_{used_start} = TC_{used} value caused by overload condition
TC_{used_end} = TC_{used} value dictated by the hot/cold curve ratio when the motor is running (= 0 when the motor is stopped)
t = time in minutes
τ = Cool Time Constant (running or stopped)
I_{eq} = equivalent motor heating current
overload_pickup= overload pickup setpoint as a multiple of FLA
hot / cold = hot/cold curve ratio

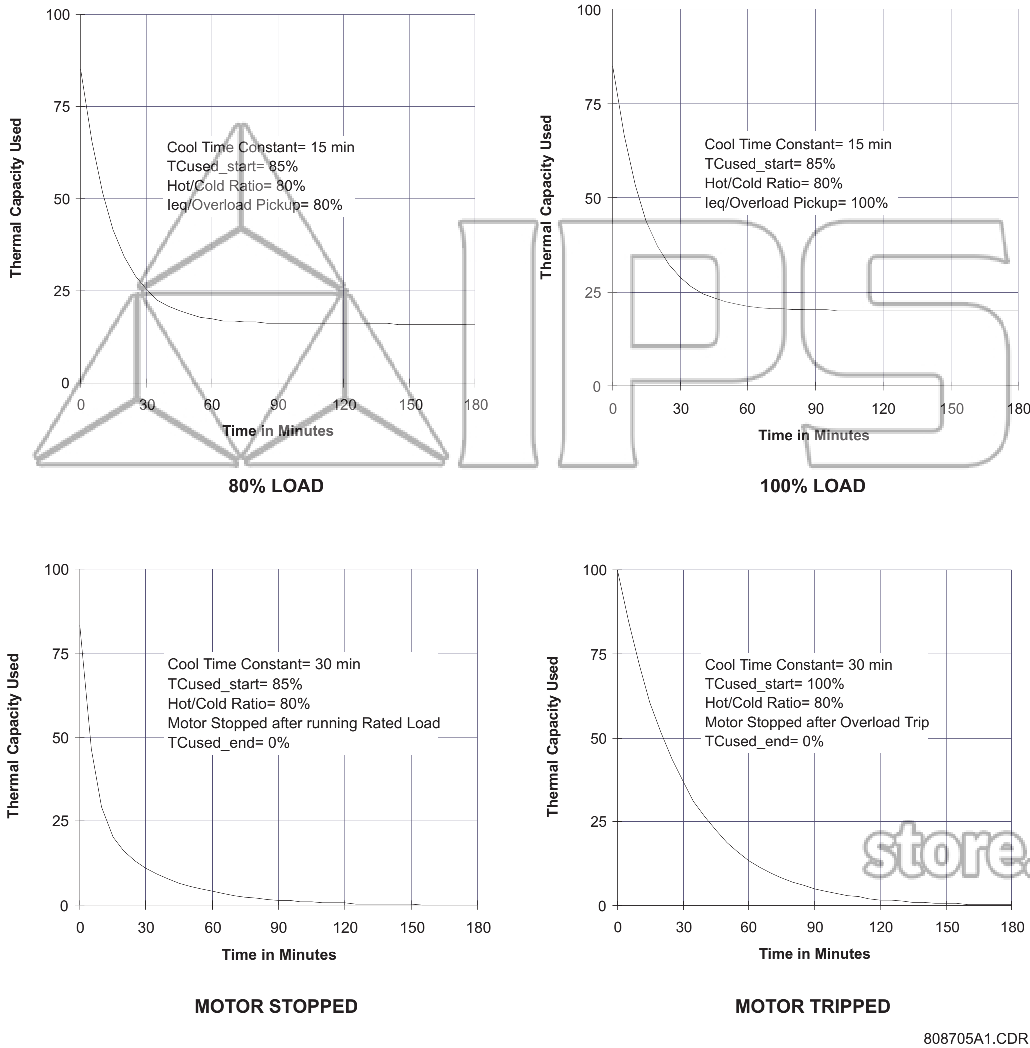


Figure 4–13: THERMAL MODEL COOLING

f) HOT/COLD CURVE RATIO

The motor manufacturer may provide thermal limit information for a hot/cold motor. The 469 thermal model adapts for these conditions if the **HOT/COLD CURVE RATIO** setpoint is programmed. This setpoint value dictates the level of thermal capacity used the relay will settle at for current levels below the **OVERLOAD PICKUP LEVEL**. When the motor is running at a level that is below the **OVERLOAD PICKUP LEVEL**, the **THERMAL CAPACITY USED** register will rise or fall to a value based on the average phase current and the **HOT/COLD CURVE RATIO** setpoint. The **THERMAL CAPACITY USED** will either rise at a fixed rate of 5% per minute or fall as dictated by the running cool time constant.

$$TC_{used\_end} = I_{eq} \times \left(1 - \frac{hot}{cold}\right) \times 100\% \qquad \textbf{(EQ 4.7)}$$

where: TC_{used_end} = **THERMAL CAPACITY USED** if I_{per_unit} remains steady state
I_{eq} = equivalent motor heating current
hot / cold = **HOT/COLD CURVE RATIO** setpoint

The **HOT/COLD CURVE RATIO** may be determined from the thermal limit curves if provided or the hot and cold safe stall times. Simply divide the hot safe stall time by the cold safe stall time. If hot and cold times are not provided, there can be no differentiation and the **HOT/COLD CURVE RATIO** should be entered as "1.00".

g) RTD BIAS

The 469 thermal replica operates as a complete and independent model. The thermal overload curves however, are based solely on measured current, assuming a normal 40°C ambient and normal motor cooling. If the ambient temperature is unusually high, or if motor cooling is blocked, the motor temperature will increase. If the motor stator has embedded RTDs, the 469 RTD bias feature should be used to correct the thermal model.

The RTD bias feature is a two-part curve, constructed using 3 points. If the maximum stator RTD temperature is below the **RTD BIAS MINIMUM** setpoint (typically 40°C), no biasing occurs. If the maximum stator RTD temperature is above the **RTD BIAS MAXIMUM** setpoint (typically at the stator insulation rating or slightly higher), then the thermal memory is fully biased and **THERMAL CAPACITY USED** is forced to "100%". At values between the maximum and minimum, the **THERMAL CAPACITY USED** created by the overload curve and the thermal model is compared to the RTD Bias thermal capacity used from the RTD Bias curve. If the RTD Bias thermal capacity used value is higher, then that value is used from that point onward. The **RTD BIAS CENTER POINT** should be set at the rated motor running temperature. The 469 automatically determines the **THERMAL CAPACITY USED** value for the center point using the **HOT/COLD SAFE STALL RATIO** setpoint.

$$TC_{used} \text{ @ RTD\_Bias\_Center} = \left(1 - \frac{hot}{cold}\right) \times 100\% \qquad \textbf{(EQ 4.8)}$$

At < RTD_Bias_Center temperature,

$$\text{RTD\_Bias\_TC}_{used} = \frac{Temp_{actual} - Temp_{min}}{Temp_{center} - Temp_{min}} \times (100 - TC_{used} \text{ @ RTD\_Bias\_Center}) + TC_{used} \text{ @ RTD\_Bias\_Center} \qquad \textbf{(EQ 4.9)}$$

At > RTD_Bias_Center temperature,

$$\text{RTD\_Bias\_TC}_{used} = \frac{Temp_{actual} - Temp_{center}}{Temp_{max} - Temp_{center}} \times (100 - TC_{used} \text{ @ RTD\_Bias\_Center}) + TC_{used} \text{ @ RTD\_Bias\_Center} \qquad \textbf{(EQ 4.10)}$$

where: RTD_Bias_TCused = TC used due to hottest stator RTD
$Temp_{acutal}$ = current temperature of the hottest stator RTD
$Temp_{min}$ = RTD Bias minimum setpoint
$Temp_{center}$ = RTD Bias center setpoint
$Temp_{max}$ = RTD Bias maximum setpoint
TCused @ RTD_Bias_Center = TC used defined by the **HOT/COLD SAFE STALL RATIO** setpoint

In simple terms, the RTD bias feature is real feedback of the measured stator temperature. This feedback acts as correction of the thermal model for unforeseen situations. Since RTDs are relatively slow to respond, RTD biasing is good for correction and slow motor heating. The rest of the thermal model is required during starting and heavy overload conditions when motor heating is relatively fast.

It should be noted that the RTD bias feature alone cannot create a trip. If the RTD bias feature forces the thermal capacity used to 100%, the motor current must be above the overload pickup before an overload trip occurs. Presumably, the motor would trip on stator RTD temperature at that time.

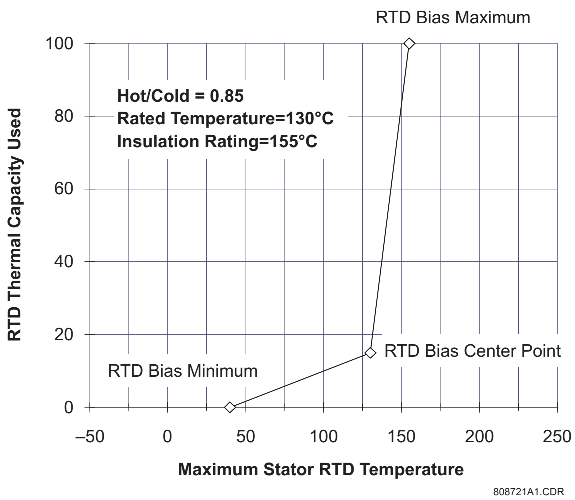


Figure 4–14: RTD BIAS CURVE

4.7.1 SHORT CIRCUIT TRIP

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨ SHORT CIRCUIT TRIP

	Range
■ SHORT CIRCUIT TRIP ■ [ENTER] for more	
SHORT CIRCUIT TRIP: Off	*Range: Off, Latched, Unlatched*
SHORT CIRCUIT TRIP OVERREACH FILTER: Off	*Range: On, Off*
ASSIGN TRIP RELAYS: Trip	*Range: Alarm, Auxiliary2, Auxiliary3, Alarm & Aux2, Alarm & Aux3, Aux2 & Aux3, Alarm & Aux2 & Aux3*
SHORT CIRCUIT TRIP PICKUP: 2.0 x CT	*Range: 2.0 to 20.0 x CT in steps of 0.1*
INTENTIONAL S/C TRIP DELAY: 0 ms	*Range: 0 to 1000 ms in steps of 10*
SHORT CIRCUIT TRIP BACKUP: Off	*Range: On, Off*
ASSIGN BACKUP RELAYS: Auxiliary2	*Range: Auxiliary2, Aux2 & Aux3, Auxiliary3*
SHORT CIRCUIT TRIP BACKUP DELAY: 200 ms	*Range: 10 to 2000 ms in steps of 10*

WARNING

Care must be taken when turning On this feature. If the interrupting device (contactor or circuit breaker) is not rated to break the fault current, this feature should be disabled. Alternatively, this feature may be assigned to an auxiliary relay and connected such that it trips an upstream device that is capable of breaking the fault current.

If turned on, the Short Circuit element functions as follows.

A trip occurs once the magnitude of either Ia, Ib, or Ic exceeds the Pickup Level × Phase CT Primary for a period of time specified by **INTENTIONAL S/C TRIP DELAY**. A backup trip feature may also be enabled. The **SHORT CIRCUIT TRIP BACKUP DELAY** should be greater than the **INTENTIONAL S/C TRIP DELAY** plus the breaker clearing time. If the **SHORT CIRCUIT TRIP BACKUP** is "On", and a Short Circuit trip has initiated, a second trip occurs if the motor phase current persists for a period of time exceeding the **SHORT CIRCUIT TRIP BACKUP DELAY**. It is intended that this second trip be assigned to R2 or R3 which would be dedicated as an upstream breaker trip relay.

Various situations (e.g. charging a long line to the motor or power factor correction capacitors) may cause transient inrush currents during motor starting that may exceed the **SHORT CIRCUIT TRIP PICKUP** level for a very short period of time. The **INTENTIONAL S/C TRIP DELAY** is adjustable in 10 ms increments. This delay can be fine tuned to an application so it still responds very fast but rides through normal operational disturbances. Normally, the **INTENTIONAL S/C TRIP DELAY** is set as quick as possible, 0 ms. This time may be increased if nuisance tripping occurs.

When a motor starts, the starting current (typically 6 × FLA for an induction motor) has an asymmetrical component. This asymmetrical current may cause one phase to see as much as 1.6 times the normal RMS starting current. If the **SHORT CIRCUIT TRIP PICKUP** was set at 1.25 times the symmetrical starting current, it is probable that there would be nuisance trips during motor starting. A rule of thumb has been developed over time that short circuit protection at least 1.6 times the symmetrical starting current value. This allows the motor to start without nuisance tripping.

The overreach filter removes the DC component from the asymmetrical current present at the moment a fault occurs. This results in no overreach whatsoever, however, the response time slows slightly (10 to 15 ms) but times still remain within specifications.

4.7.2 OVERLOAD ALARM

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨⇩ OVERLOAD ALARM

```
■ OVERLOAD ALARM
■ [ENTER] for more
```

OVERLOAD ALARM: Off	Range: *Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Auxiliary2, Auxiliary3, Alarm & Aux2, Alarm & Aux3, Aux2 & Aux3, Alarm & Aux2 & Aux3*
OVERLOAD ALARM DELAY: 0.1 s	Range: *0.1 to 60 s in steps of 0.1*
OVERLOAD ALARM EVENTS: Off	Range: *On, Off*

If enabled as "Latched" or "Unlatched", the Overload Alarm functions as follows. After a motor start, when the equivalent motor heating current exceeds the **OVERLOAD PICKUP LEVEL**, an alarm will occur. If programmed as Unlatched, the overload alarm resets itself when the motor is no longer in overload. If programmed as "Latched", the **RESET** key must be pressed to reset the alarm once the overload condition is gone. Event recording for all alarm features is optional.

For example, it may be desirable to have an unlatched alarm connected to a PLC that is controlling the load on a motor.

4

4.7.3 MECHANICAL JAM

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨⇩ MECHANICAL JAM

```
■ MECHANICAL JAM
n [ENTER] for more
```

MECHANICAL JAM TRIP: Off	Range: *Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	Range: *Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3; Trip & Auxiliary3*
MECHANICAL JAM PICKUP: 1.50 x FLA	Range: *1.01 to 3.00 x FLA in steps of 0.01*
MECHANICAL JAM DELAY: 1 s	Range: *1 to 30 s in steps of 1*

If turned On, the Mechanical Jam element function as follows. After a motor start, a Trip occurs once the magnitude of Ia, Ib, or Ic exceeds the Pickup Level × FLA for a period of time specified by the **MECHANICAL JAM DELAY** setpoint. This feature may be used to indicate a stall condition when running. Not only does it protect the motor by taking it off-line quicker than the thermal model (overload curve), it may also prevent or limit damage to the driven equipment if motor starting torque persists on jammed or broken equipment.

The **MECHANICAL JAM PICKUP** level should be set higher than motor loading during normal operation, but lower than the motor stall level. Normally the delay is set to the minimum time delay or set so that no nuisance trips occur due to momentary load fluctuations.

4.7.4 UNDERCURRENT

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨⇩ UNDERCURRENT

■ UNDERCURRENT
■ [ENTER] for more

BLOCK UNDERCURRENT FROM START: 0 s	Range: 0 to 15000 s in steps of 1
UNDERCURRENT ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Auxiliary2, Aux2 & Aux3, Auxiliary3
UNDERCURRENT ALARM PICKUP: 0.70 x FLA	Range: 0.10 to 0.95 x FLA in steps of 0.01
UNDERCURRENT ALARM DELAY: 1 s	Range: 1 to 60 s in steps of 1
UNDERCURRENT ALARM EVENTS: Off	Range: On, Off
UNDERCURRENT TRIP: Off	Range: Off, Latched, Unlatched
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3
UNDERCURRENT TRIP PICKUP: 0.70 x FLA	Range: 0.10 to 0.99 x FLA in steps of 0.01
UNDERCURRENT TRIP DELAY: 1 s	Range: 1 to 60 s in steps of 1

A trip or alarm will occurs once the magnitude Ia, Ib, or Ic falls below the pickup level × FLA for the time specified by the **UNDERCURRENT ALARM DELAY**. The Undercurrent element is active only when the motor is running. It is blocked upon the initiation of a motor start for the time defined by the **U/C BLOCK FROM START** setpoint (e.g. this block may be used to allow pumps to build up head before the undercurrent element trips). A value of "0" means the feature is not blocked from start. If a value other than "0" is entered, the feature is disabled when the motor is stopped and also from the time a start is detected until the time entered expires. The **UNDERCURRENT ALARM PICKUP** level should be set lower than motor loading during normal operations.

For example, if a pump is cooled by the liquid it pumps, loss of load may mean that the pump overheats. In this case, enable the undercurrent feature. If the motor loading should never fall below 0.75 × FLA, even for short durations, the **UNDERCURRENT TRIP PICKUP** could be set to "0.70" and the **UNDERCURRENT ALARM PICKUP** to "0.75". If the pump is always started loaded, the **BLOCK UNDERCURRENT FROM START** setpoint should be disabled (programmed as 0).

- the **UNDERCURRENT ALARM DELAY** / **UNDERCURRENT TRIP DELAY** is typically set as quick as possible, i.e. 1 s.

4.7.5 CURRENT UNBALANCE

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨⇩ CURRENT UNBALANCE

■ CURRENT UNBALANCE ■ [ENTER] for more	
CURRENT UNBALANCE ALARM: Off	Range: *Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
CURRENT UNBALANCE ALARM PICKUP: 15%	Range: *4 to 40% in steps of 1*
CURRENT UNBALANCE ALARM DELAY: 1 s	Range: *1 to 60 s in steps of 1*
CURRENT UNBALANCE ALARM EVENTS: Off	Range: *On, Off*
CURRENT UNBALANCE TRIP: Off	Range: *Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	Range: *Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
CURRENT UNBALANCE TRIP PICKUP: 20%	Range: *4 to 40% in steps of 1*
CURRENT UNBALANCE TRIP DELAY: 1 s	Range: *1 to 60 s in steps of 1*

469 unbalance is defined as the ratio of negative-sequence to positive-sequence current, I_2 / I_1, if the motor is operating at a load (I_{avg}) greater than FLA. If the motor I_{avg} is less than FLA, unbalance is defined as $I_2 / I_1 \times I_{avg}$ / FLA. This derating is necessary to prevent nuisance alarms when a motor is lightly loaded. If enabled, a trip and/or alarm occurs once the unbalance magnitude exceeds the **CURRENT UNBALANCE ALARM**/**TRIP PICKUP** for a period of time specified by the **CURRENT UNBALANCE ALARM**/**TRIP DELAY**. If the unbalance level exceeds 40%, or when I_{avg} > 25% FLA and current in any one phase is zero, the motor is considered single phasing and a trip occurs within 2 seconds. Single phasing protection is disabled if the unbalance feature is turned "Off".

When setting the **CURRENT UNBALANCE ALARM**/**TRIP PICKUP** level, note that a 1% voltage unbalance typically translates into a 6% current unbalance. Therefore, to prevent nuisance trips or alarms, the pickup level should not be set too low. Also, since short term unbalances are common, a reasonable delay should be set to avoid nuisance trips or alarms. The unbalance bias feature is recommended to bias the thermal model for motor heating caused by cyclic short term unbalances (see Section d): Unbalance Bias on page 4–38).

NOTE

Unusually high unbalance levels may be caused by incorrect phase CT wiring.

For example, fluctuations of current unbalance levels are typically caused by the supply voltage. It may be desirable to have a latched alarm to capture any such fluctuations that go beyond the Unbalance Alarm parameters. Also, a trip is recommended.

If the supply voltage is normally unbalanced up to 2%, the current unbalance seen by a typical motor is 2 × 6 = 12%. In this case, set the **CURRENT UNBALANCE ALARM PICKUP** to "15" and the **CURRENT UNBALANCE TRIP PICKUP** to "20" to prevent nuisance tripping; 5 or 10 seconds is a reasonable delay.

4.7.6 GROUND FAULT

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨⇩ GROUND FAULT

■ GROUND FAULT ■ [ENTER] for more → GROUND FAULT OVERREACH FILTER: Off	Range: On, Off
GROUND FAULT ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Auxiliary2, Aux2 & Aux3, Auxiliary3
GROUND FAULT ALARM PICKUP: 0.10 x CT	Range: 0.10 to 1.00 x CT, step: 0.01. Seen only if Ground CT is programmed as 1A or 5A Secondary
GROUND FAULT ALARM PICKUP: 1.00 A	Range: 0.25 to 25.00 A, step: 0.01. Seen only if Ground CT is programmed as Multilin 50:0.025
INTENTIONAL GF ALARM DELAY: 0 ms	Range: 0 to 1000 ms in steps of 1
GROUND FAULT ALARM EVENTS: Off	Range: On, Off
GROUND FAULT TRIP: Off	Range: Off, Latched, Unlatched
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
GROUND FAULT TRIP PICKUP: 0.20 x CT	Range: 0.10 to 1.00 x CT, step: 0.01. Seen only if Ground CT is programmed as 1A or 5A Secondary
GROUND FAULT TRIP PICKUP: 1.00 A	Range: 0.25 to 25.00 A; step: 0.01. Seen only if Ground CT is programmed as Multilin 50:0.025
INTENTIONAL GF TRIP DELAY: 0 ms	Range: 0 to 1000 ms in steps of 1
GROUND FAULT TRIP BACKUP: Off	Range: On, Off
ASSIGN BACKUP RELAYS: Auxiliary2	Range: Auxiliary2, Aux2 & Aux3, Auxiliary3
GROUND FAULT TRIP BACKUP DELAY: 200 ms	Range: 10 to 2000 ms in steps of 10

The Ground Fault element functions as follows. Once the ground current magnitude exceeds the Pickup Level × **GROUND CT PRIMARY** (see Section 4.3.1: Current Sensing on page 4–12) for the time specified by the delay, a trip and/or alarm will occur. There is also a backup trip feature that can be enabled. If the **GROUND FAULT TRIP BACKUP** is "On", and a Ground Fault trip has initiated, a second trip will occur if the ground current persists longer than the **GROUND FAULT TRIP BACKUP DELAY**. It is intended that this second trip be assigned to R2 or R3, which would be dedicated as an upstream breaker trip relay. The **GROUND FAULT TRIP BACKUP DELAY** must be set to a time longer than the breaker clearing time.

NOTE

Care must be taken when turning On this feature. If the interrupting device (contactor or circuit breaker) is not rated to break ground fault current (low resistance or solidly grounded systems), the feature should be disabled. Alternately, the feature may be assigned to an auxiliary relay and connected such that it trips an upstream device that is capable of breaking the fault current.

Various situations (e.g. contactor bounce) may cause transient ground currents during motor starting that may exceed the Ground Fault pickup levels for a very short period of time. The Ground Fault time delays are adjustable in 10 ms increments. The delay can be fine tuned to an application such that it still responds very fast, but rides through normal operational disturbances. Normally, the Ground Fault time delays are set as quick as possible, that is, 0 ms. Time may have to be increased if nuisance tripping occurs.

Special care must be taken when the ground input is wired to the phase CTs in a residual connection. When a motor starts, the starting current (typically 6 × FLA for an induction motor) has an asymmetrical component. This asymmetrical current may cause one phase to see as much as 1.6 times the normal RMS starting current. This momentary DC component will cause each of the phase CTs to react differently and the net current into the ground input of the 469 will not be negligible. A 20 ms block of the ground fault elements when the motor starts enables the 469 to ride through this momentary ground current signal.

The overreach filter removed the DC component from the asymmetrical current present at the moment a fault occurs. This results in no overreach whatsoever, however, the response time slows slightly (10 to 15 ms) but times still remain within specifications.

4.7.7 PHASE DIFFERENTIAL

PATH: SETPOINTS ⇨⇩ S6 CURRENT ELEMENTS ⇨⇩ PHASE DIFFERENTIAL

■ PHASE DIFFERENTIAL
■ [ENTER] for more

	Range
PHASE DIFFERENTIAL TRIP: Off	Range: Off, Latched, Unlatched
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Auxiliary2, Aux2 & Aux3, Auxiliary3
STARTING DIFF. TRIP PICKUP: 0.10 x CT	Range: 0.05 to 1.00 x CT in steps of 0.01
STARTING DIFF. TRIP DELAY: 0 ms	Range: 0 to 60000 ms in steps of 1
RUNNING DIFF. TRIP PICKUP: 0.10 x CT	Range: 0.05 to 1.00 x CT in steps of 0.01
RUNNING DIFF. TRIP DELAY: 0 ms	Range: 0 to 1000 ms in steps of 1

These setpoints program the differential element when the differential feature is in use. This feature consists of three instantaneous overcurrent elements for phase differential protection. Differential protection may be considered first line protection for phase to phase or phase to ground faults. In the event of such a fault, differential protection may limit the damage that may occur.

NOTE

Care must be taken when enabling this feature. If the interrupting device (contactor or circuit breaker) is not rated to break potential faults, the feature should be disabled. Alternately, the feature may be assigned to an auxiliary relay and connected such that it trips an upstream device that is capable of breaking the fault current. A low level differential fault can develop into a short circuit in an instant.

A trip occurs once the magnitude of either I_{aIN}-I_{aOUT}, I_{bIN}-I_{bOUT}, or I_{cIN}-I_{cOUT} (phase differential) exceeds the Pickup Level × Differential CT Primary for a period of time specified by the delay. Separate pickup levels and delays are provided for motor starting and running conditions.

The Differential trip element is programmable as a fraction of the rated CT. The level may be set more sensitive if the Differential CTs are connected in a flux balancing configuration (3 CTs). If 6 CTs are used in a summing configuration, the values from the two CTs on each phase during motor starting may not be equal since the CTs are not perfectly identical (asymmetrical currents may cause the CTs on each phase to have different outputs). To prevent nuisance tripping in this configuration, the STARTING DIFF. TRIP PICKUP level may have to be set less sensitive, or the STARTING DIFF. TRIP DELAY may have to be extended to ride through the problem period during start. The running differential delay can then be fine tuned to an application such that it responds very fast to sensitive (low) differential current levels.

4.8.1 ACCELERATION TIMER

PATH: SETPOINTS ⇨⇩ S7 MOTOR STARTING ⇨ ACCELERATION TIMER

■ ACCELERATION TIMER ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	ACCELERATION TIMER TRIP: Off	Range: Off, Latched, Unlatched
	ESCAPE MESSAGE ⇳	ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3
	ESCAPE MESSAGE ⇧	ACCELERATION TIMER FROM START: 10.0 s	Range: 1.0 to 250.0 s in steps of 0.1

The thermal model protects the motor under both starting and overload conditions. The acceleration timer trip may be used to complement this protection. For example, if the motor always starts in 2 seconds, but the safe stall time is 8 seconds, there is no point letting the motor remain in a stall condition for 7 or 8 seconds when the thermal model would take it off line. Furthermore, the starting torque applied to the driven equipment for that period of time could cause severe damage.

4

If enabled, the Acceleration Timer functions as follows. A motor start is assumed to be occurring when the 469 measures the transition of no motor current to some value of motor current. Typically current rises quickly to a value in excess of FLA (e.g. 6 x FLA). At this point, the Acceleration Timer will be initialized with the **ACCELERATION TIMER FROM START** value in seconds. If the current does not fall below the overload curve pickup level before the timer expires, an acceleration trip will occur. If the acceleration time of the motor is variable, this feature should be set just beyond the longest acceleration time.

Some motor softstarters allow current to ramp up slowly while others limit current to less than FLA throughout the start. Since the 469 is a generic motor relay, it cannot differentiate between a motor with a slow ramp up time and one that has completed a start and gone into overload. Therefore, if the motor current does not rise to greater than full load within 1 second on start, the acceleration timer feature is ignored. In any case, the motor is still protected by the overload curve.

4.8.2 START INHIBIT

PATH: SETPOINTS ⇨⇩ S7 MOTOR STARTING ⇨⇩ START INHIBIT

■ START INHIBIT ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	START INHIBIT BLOCK: Off	Range: On, Off
	ESCAPE MESSAGE ⇧	TC USED MARGIN: 25%	Range: 0 to 25% in steps of 1

The Start Inhibit feature prevents motor tripping during start if there is insufficient thermal capacity. The largest **THERMAL CAPACITY USED** value from the last five successful starts is multiplied by (1 + **TC USED MARGIN**) and stored as the **LEARNED STARTING CAPACITY**. This thermal capacity margin ensures a successful motor start. If the number is greater than 100%, 100% is stored as **LEARNED STARTING CAPACITY**. A successful motor start is one in which phase current rises from 0 to greater than overload pickup and then, after acceleration, falls below the overload curve pickup level. If the Start Inhibit feature is enabled, the amount of thermal capacity available (100% – **THERMAL CAPACITY USED**) is compared to the **LEARNED STARTING CAPACITY** each time the motor is stopped. If the thermal capacity available does not exceed the **LEARNED STARTING CAPACITY**, or is not equal to 100%, the Start Inhibit Block is activated until there is sufficient thermal capacity. When a block occurs, the lockout time will be equal to the time required for the motor to cool to an acceptable start temperature. This time is a function of the **S5 THERMAL MODEL ⇨ THERMAL MODEL ⇨⇩ COOL TIME CONSTANT STOPPED** setpoint.

If this feature is turned "Off", the **THERMAL CAPACITY USED** must reduce to 15% before an overload lockout resets. This feature should be turned off if the load varies for different starts.

For example, if the **THERMAL CAPACITY USED** for the last 5 starts is 24, 23, 27, 25, and 21% respectively, the **LEARNED STARTING CAPACITY** is 27% × 1.25 = 33.75% used. If the motor stops with 90% thermal capacity used, a start block will be issued. When the motor has cooled and the level of thermal capacity used has fallen to 66%, a start will be permitted. If the **COOL TIME CONSTANT STOPPED** setpoint is programmed for 30 minutes, the lockout time will be equal to:

$$TC_{used} = TC_{used\_start} \times e^{-t/\tau} \Rightarrow 66\% = 90\% \times e^{-t/30}$$
$$\Rightarrow t = \ln\frac{66}{90} \times -30 = 9.3 \text{ minutes} \quad \textbf{(EQ 4.11)}$$

4.8.3 JOGGING BLOCK

PATH: SETPOINTS ⇨⇩ S7 MOTOR STARTING ⇨⇩ JOGGING BLOCK

```
■ JOGGING BLOCK
■ [ENTER] for more
```

[ENTER] ⇨ / ⇦ [ESCAPE]

```
JOGGING BLOCK:
Off
```

Range: On, Off

[ESCAPE] / [MESSAGE] ⇳

```
MAX. STARTS/HOUR
PERMISSIBLE: 3
```

Range: 1 to 5 in steps of 1

[ESCAPE] / [MESSAGE] ⇧

```
TIME BETWEEN STARTS
PERMISSIBLE: 10 min.
```

Range: 0 to 500 min. in steps of 1

The Jogging Block feature may be used to prevent operators from jogging the motor (multiple starts and stops performed in rapid succession). It consists of two distinct elements: Starts/Hour and Time Between Starts.

The Starts/Hour feature does not guarantee that a certain number of starts or start attempts will be allowed within an hour; rather, it ensures that a certain number of start attempts will not be exceeded within an hour. Similarly, the Time Between Starts feature does not guarantee another start will be permitted if the **TIME BETWEEN STARTS PERMISSIBLE** elapses after the most recent start. Rather, it ensures a minimum time between starts. If however, the first start attempt from cold is unsuccessful due to a jam or it takes long because the process is overloaded, the Thermal Model might reduce the number of starts that can be attempted within an hour. It may also cause a lockout time that exceeds a Time Between Starts lockout that may have been active. Such a thermal lockout will remain until the motor has cooled to an acceptable temperature for a start.

4

Starts / Hour:

A motor start is assumed to be occurring when the 469 measures the transition of no motor current to some value of motor current. At this point, one of the Starts/Hour timers is loaded with 60 minutes. Even unsuccessful start attempts will be logged as starts for this feature. Once the motor is stopped, the number of starts within the past hour is compared to the number of starts allowable. If the two numbers are the same, a block will occur. If a block occurs, the lockout time will be equal to the longest time elapsed since a start within the past hour, subtracted from one hour.

For example, if **MAX. STARTS/HOUR PERMISSIBLE** is programmed at "2",

- one start occurs at T = 0 minutes,
- a second start occurs at T = 17 minutes,
- the motor is stopped at T = 33 minutes,
- a block occurs,
- the lockout time would be 1 hour – 33 minutes = 27 minutes.

Time Between Starts

A motor start is assumed to be occurring when the 469 measures the transition of no motor current to some value of motor current. At this point, the Time Between Starts timer is loaded with the entered time. Even unsuccessful start attempts will be logged as starts for this feature. Once the motor is stopped, if the time elapsed since the most recent start is less than the **TIME BETWEEN STARTS PERMISSIBLE** setpoint, a block will occur. If a block occurs, the lockout time will be equal to the time elapsed since the most recent start subtracted from the **TIME BETWEEN STARTS PERMISSIBLE**. A value of "0" effectively disables this element.

For example, if **TIME BETWEEN STARTS PERMISSIBLE** is programmed = 25 min.

- a start occurs at T = 0 minutes,
- the motor is stopped at T = 12 minutes,
- a block occurs,
- the lockout time would be 25 minutes – 12 minutes = 13 minutes

4.8.4 RESTART BLOCK

PATH: SETPOINTS ⇨⇩ S7 MOTOR STARTING ⇨⇩ RESTART BLOCK

```
■ RESTART BLOCK
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

```
RESTART BLOCK:
Off
```

Range: *On, Off*

ESCAPE / MESSAGE ⇧

```
RESTART BLOCK
TIME: 1 s
```

Range: *1 to 50000 s in steps of 1*

The Restart Block feature may be used to ensure that a certain amount of time passes between stopping a motor and restarting that motor. This timer feature may be very useful for some process applications or motor considerations. If a motor is on a down-hole pump, after the motor stops, the liquid may fall back down the pipe and spin the rotor backwards. It would be very undesirable to start the motor at this time. In another scenario, a motor may be driving a very high inertia load. Once the supply to the motor is disconnected, the rotor may continue to turn for a long period of time as it decelerates. The motor has now become a generator and applying supply voltage out of phase may result in catastrophic failure.

NOTE

The Restart Block feature is strictly a timer. The 469 does not sense rotor rotation.

4

4.9.1 RTD TYPES

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨ RTD TYPES

```
■ RTD TYPES
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

```
STATOR RTD TYPE:
100 Ohm Platinum
```

Range: 100 Ohm Platinum, 120 Ohm Nickel, 100 Ohm Nickel, 10 Ohm Copper

ESCAPE / MESSAGE

```
BEARING RTD TYPE:
100 Ohm Platinum
```

Range: 100 Ohm Platinum, 120 Ohm Nickel, 100 Ohm Nickel, 10 Ohm Copper

ESCAPE / MESSAGE

```
AMBIENT RTD TYPE:
100 Ohm Platinum
```

Range: 100 Ohm Platinum, 120 Ohm Nickel, 100 Ohm Nickel, 10 Ohm Copper

ESCAPE / MESSAGE

```
OTHER RTD TYPE:
100 Ohm Platinum
```

Range: 100 Ohm Platinum, 120 Ohm Nickel, 100 Ohm Nickel, 10 Ohm Copper

Each of the twelve RTDs may be configured as "None" or any one of four application types: "Stator", "Bearing", "Ambient", or "Other". Each of these types may in turn be any one of four different RTD types: "100 Ohm Platinum", "120 Ohm Nickel", "100 Ohm Nickel", or "10 Ohm Copper". The table below lists RTD resistance versus temperature.

TEMP °C	TEMP °F	100 Ω PT (DIN 43760)	120 Ω NI	100 Ω NI	10 Ω CU
–50	–58	80.31	86.17	74.26	7.10
–40	–40	84.27	92.76	79.13	7.49
–30	–22	88.22	99.41	84.15	7.88
–20	–4	92.16	106.15	89.23	8.26
–10	14	96.09	113.00	94.58	8.65
0	32	100.00	120.00	100.00	9.04
10	50	103.90	127.17	105.55	9.42
20	68	107.79	134.52	111.24	9.81
30	86	111.67	142.06	117.06	10.19
40	104	115.54	149.79	123.01	10.58
50	122	119.39	157.74	129.11	10.97
60	140	123.24	165.90	135.34	11.35
70	158	127.07	174.25	141.72	11.74
80	176	130.89	182.84	148.25	12.12
90	194	134.70	191.64	154.94	12.51
100	212	138.50	200.64	161.78	12.90
110	230	142.29	209.85	168.79	13.28
120	248	146.06	219.29	175.98	13.67
130	266	149.82	228.96	183.35	14.06
140	284	153.58	238.85	190.90	14.44
150	302	157.32	248.95	198.66	14.83
160	320	161.04	259.30	206.62	15.22
170	338	164.76	269.91	214.81	15.61
180	356	168.47	280.77	223.22	16.00
190	374	172.46	291.96		16.39
200	392	175.84	303.46		16.78
210	410	179.51	315.31		17.17
220	428	183.17	327.54		17.56
230	446	186.82	340.14		17.95
240	464	190.45	353.14		18.34
250	482	194.08	366.53		18.73

4.9.2 RTDS 1 TO 6

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨⇩ RTD #1(6)

```
■ RTD #1
■ [ENTER] for more
```

RTD #1 APPLICATION: Stator	Range: Stator, Bearing, Ambient, Other, None
RTD #1 NAME:	Range: 8 alphanumeric characters
RTD #1 ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
RTD #1 ALARM TEMPERATURE: 130°C	Range: 1 to 250°C in steps of 1
RTD #1 HIGH ALARM: Off	Range: Off, Latched, Unlatched
HIGH ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
RTD #1 HIGH ALARM TEMPERATURE: 130°C	Range: 1 to 250 in steps of 1
RTD #1 ALARM EVENTS: Off	Range: On, Off
RTD #1 TRIP: Off	Range: Off, Latched, Unlatched
RTD #1 TRIP VOTING: RTD #1	Range: RTD #1 to RTD #12
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3
RTD #1 TRIP TEMPERATURE: 155°C	Range: 1 to 250°C in steps of 1

RTDs 1 through 6 default to "Stator" RTD type. There are individual alarm and trip configurations for each RTD. This allows one of the RTDs to be turned off if it malfunctions. The alarm level is normally set slightly above the normal running temperature. The high alarm is usually set as a warning of a trip or to initiate an orderly shutdown before tripping occurs. The trip level is normally set at the insulation rating. Trip voting has been added for extra reliability in the event of RTD malfunction. If enabled, a second RTD must also exceed the trip temperature of the RTD being checked before a trip will be issued. If the RTD is chosen to vote with itself, the voting feature is disabled. Each RTD name may be changed if desired.

4.9.3 RTDS 7 TO 10

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨⇩ RTD #7(10)

```
■ RTD #7
■ [ENTER] for more
```

RTD #7 APPLICATION: Bearing	Range: Stator, Bearing, Ambient, Other, None
RTD #7 NAME:	Range: 8 alphanumeric characters
RTD #7 ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
RTD #7 ALARM TEMPERATURE: 80°C	Range: 1 to 250°C in steps of 1
RTD #7 HIGH ALARM: Off	Range: Off, Latched, Unlatched
HIGH ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
RTD #7 HIGH ALARM TEMPERATURE: 80°C	Range: 1 to 250°C in steps of 1
RTD #7 ALARM EVENTS: Off	Range: On, Off
RTD #7 TRIP: Off	Range: Off, Latched, Unlatched
RTD #7 TRIP VOTING: RTD #7	Range: RTD #1 to RTD #12
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3
RTD #7 TRIP TEMPERATURE: 90°C	Range: 1 to 250°C in steps of 1

RTDs 7 through 10 default to "Bearing" RTD type. There are individual alarm and trip configurations for each RTD. This allows one of the RTDs to be turned off if it malfunctions. The alarm level, high alarm level and the trip level are normally set slightly above the normal running temperature, but below the bearing temperature rating. Trip voting has been added for extra reliability in the event of RTD malfunction. If enabled, a second RTD must also exceed the trip temperature of the RTD being checked before a trip will be issued. If the RTD is chosen to vote with itself, the voting feature is disabled. Each RTD name may be changed if desired.

4

4.9.4 RTD 11

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨⇩ RTD #11

```
■ RTD #11
■ [ENTER] for more
```

RTD #11 APPLICATION: Other	Range: Stator, Bearing, Ambient, Other, None
RTD #11 NAME:	Range: 8 alphanumeric characters
RTD #11 ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
RTD #11 ALARM TEMPERATURE: 80°C	Range: 1 to 250°C in steps of 1
RTD #7 HIGH ALARM: Off	Range: Off, Latched, Unlatched
HIGH ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
RTD #11 HIGH ALARM TEMPERATURE: 80°C	Range: 1 to 250°C in steps of 1
RTD #11 ALARM EVENTS: Off	Range: On, Off
RTD #11 TRIP: Off	Range: Off, Latched, Unlatched
RTD #11 TRIP VOTING: RTD #11	Range: RTD #1 to RTD #12
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3
RTD #11 TRIP TEMPERATURE: 90°C	Range: 1 to 250°C in steps of 1

RTD 11 defaults to "Other" RTD type. The Other selection allows the RTD to be used to monitor any temperature that might be required, either for a process or additional bearings or other. There are individual alarm, high alarm and trip configurations for this RTD. Trip voting has been added for extra reliability in the event of RTD malfunction. If enabled, a second RTD must also exceed the trip temperature of the RTD being checked before a trip will be issued. If the RTD is chosen to vote with itself, the voting feature is disabled. The RTD name may be changed if desired.

4.9.5 RTD 12

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨⇩ RTD 12

■ RTD #12
■ [ENTER] for more

	Range
RTD #12 APPLICATION: Ambient	Range: *Stator, Bearing, Ambient, Other, None*
RTD #12 NAME:	Range: *8 alphanumeric characters*
RTD #12 ALARM: Off	Range: *Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
RTD #12 ALARM TEMPERATURE: 60°C	Range: *1 to 250°C in steps of 1*
RTD #12 HIGH ALARM: Off	Range: *Off, Latched, Unlatched*
HIGH ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
RTD #12 HIGH ALARM TEMPERATURE: 60°C	Range: *1 to 250°C in steps of 1*
RTD #12 ALARM EVENTS: Off	Range: *On, Off*
RTD #12 TRIP: Off	Range: *Off, Latched, Unlatched*
RTD #12 TRIP VOTING: RTD #12	Range: *RTD #1 to RTD #12*
ASSIGN TRIP RELAYS: Trip	Range: *Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
RTD #12 TRIP TEMPERATURE: 80°C	Range: *1 to 250°C in steps of 1*

RTDs 12 defaults to "Ambient" RTD type. The Ambient selection allows the RTD to be used to monitor ambient temperature for input into the thermal model. This sensor is required for the Learned Cooling feature of the thermal model (see Section 4.6: S5 THERMAL MODEL on page 4–28). There are individual alarm, high alarm and trip configurations for this RTD. Trip voting has been added for extra reliability in the event of RTD malfunction. If enabled, a second RTD must also exceed the trip temperature of the RTD being checked before a trip will be issued. If the RTD is chosen to vote with itself, the voting feature is disabled. The RTD name may be changed if desired.

4.9.6 OPEN RTD SENSOR

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨⇩ OPEN RTD SENSOR

■ OPEN RTD SENSOR ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	OPEN RTD SENSOR: Off	Range: Off, Latched, Unlatched
	ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	ESCAPE / MESSAGE ⇧	OPEN RTD SENSOR ALARM EVENTS: Off	Range: On, Off

The 469 has an Open RTD Sensor alarm. This alarm will look at all RTDs that have either an alarm or trip programmed and determine if an RTD connection has been broken. Any RTDs that do not have a trip or alarm associated with them will be ignored for this feature. When a broken sensor is detected, the assigned output relay will operate and a message will appear on the display identifying the RTD that is broken. It is recommended that if this feature is used, the alarm be programmed as latched so that intermittent RTDs are detected and corrective action may be taken.

4

4.9.7 RTD SHORT/LOW TEMP

PATH: SETPOINTS ⇨⇩ S8 RTD TEMPERATURE ⇨⇩ RTD SHORT/LOW TEMP

■ RTD SHORT/LOW TEMP ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	RTD SHORT/LOW TEMP ALARM: Off	Range: Off, Latched, Unlatched
	ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	ESCAPE / MESSAGE ⇧	RTD SHORT/LOW TEMP ALARM EVENTS: Off	Range: On, Off

The 469 has an RTD Short/Low Temperature alarm. This alarm will look at all RTDs that have either an alarm or trip programmed and determine if an RTD has either a short or a very low temperature (less than –50°C). Any RTDs that do not have a trip or alarm associated with them will be ignored for this feature. When a short/low temperature is detected, the assigned output relay will operate and a message will appear on the display identifying the RTD that caused the alarm. It is recommended that if this feature is used, the alarm be programmed as latched so that intermittent RTDs are detected and corrective action may be taken.

4.10.1 UNDERVOLTAGE

PATH: SETPOINTS ⇨⇩ S9 VOLTAGE ELEMENTS ⇨ UNDERVOLTAGE

```
■ UNDERVOLTAGE
■ [ENTER] for more
```

U/V ACTIVE ONLY IF BUS ENERGIZED: No	Range: *No, Yes*
UNDERVOLTAGE ALARM: Off	Range: *Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	Range: *Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
UNDERVOLTAGE ALARM PICKUP: 0.85 x RATED	Range: *0.60 to 0.99 x RATED in steps of 0.01*
STARTING U/V ALARM PICKUP: 0.85 x RATED	Range: *Off, 0.60 to 0.99 x RATED in steps of 0.01*
UNDERVOLTAGE ALARM DELAY: 3.0 s	Range: *0.0 to 60.0 s in steps of 0.1*
UNDERVOLTAGE ALARM EVENTS: Off	Range: *On, Off*
UNDERVOLTAGE TRIP: Off	Range: *Off, Latched, Unlatched*
UNDERVOLTAGE TRIP MODE: 1-Phase	Range: *1-Phase, 3-Phase*
ASSIGN TRIP RELAYS: Trip	Range: *Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
UNDERVOLTAGE TRIP PICKUP: 0.80 x RATED	Range: *0.60 to 0.99 x RATED in steps of 0.01*
STARTING U/V TRIP PICKUP: 0.80 x RATED	Range: *0.60 to 0.99 x RATED in steps of 0.01*
UNDERVOLTAGE TRIP DELAY: 3.0 s	Range: *0.0 to 60.0 s in steps of 0.1*

The **U/V ACTIVE ONLY IF BUS ENERGIZED** setpoint may be used to prevent nuisance alarms or trips when the bus is not energized. If this setpoint is programmed to “Yes”, at least one voltage must be greater than 20% of the nominal nameplate voltage rating for any alarm/trip. If the load is high inertia, it may be desirable to trip the motor off-line or prevent it from starting in the event of a total loss of line voltage. Programming “No” for this setpoint ensures that the motor is tripped and may be restarted only after the bus is re-energized.

If the undervoltage alarm feature is enabled, an alarm will occur once the magnitude of either Vab, Vbc, or Vca falls below the pickup level while running or starting for a period of time specified by the delay (note that pickup levels are multiples of motor nameplate voltage). The running pickup level also applies when the motor is stopped and the **U/V ACTIVE ONLY IF BUS ENERGIZED** setpoint is programmed to “No”.

Undervoltage trips can be set for single-phase or three-phase conditions. If undervoltage tripping is enabled, and the **UNDERVOLTAGE TRIP MODE** is set for “3-Phase”, a trip will occur only when the magnitude of all three phases falls below the pickup level while running or starting for a period of time specified by the time delay. On the other hand, if undervoltage trip is enabled, and the **UNDERVOLTAGE TRIP MODE** is set for “1-Phase”, a trip will occur once the magnitude of either Vab, Vbc, or Vca falls below the pickup level while running or starting for a period of time specified by the time delay. Note that pickup levels are multiples of motor nameplate voltage. The running pickup level also applies when the motor is stopped, and the **U/V ACTIVE ONLY IF BUS ENERGIZED** setpoint is programmed to “No”.

An undervoltage on a running motor with a constant load results in increased current. The relay thermal model typically picks up this condition and provides adequate protection. However, this setpoint may be used in conjunction with the time delay to provide additional protection that may be programmed for advance warning by tripping.

Attempting to start a large motor when the supply voltage is down may also be undesirable. An undervoltage of significant proportion that persists while starting a motor may prevent the motor from reaching rated speed. This may be especially critical for a synchronous motor. As such, this feature may be used in with a time delay to provide protection for undervoltage conditions before and during starting.

In the event of system problems causing asymmetrical voltage conditions where at least one voltage remains above pickup, an Alarm condition will occur, indicating that the voltage on at least one phase is below acceptable levels. The trip relay will not be energized unless the **UNDERVOLTAGE TRIP MODE** is set to “1-Phase”. The factory default setting for **UNDERVOLTAGE TRIP MODE** is “1-Phase”.

To prevent for nuisance undervoltage trips due to VT Fuse Failure, set the **UNDERVOLTAGE TRIP MODE** to “3-Phase”. The alarm relay will be energized in the event of a single-phase undervoltage, which can also be an indication of a potential VT fuse failure. Typically a fuse failure is detected when there are significant levels of negative-sequence voltage, indicating voltage unbalance due to the loss of one phase, without correspondingly significant levels of negative-sequence current, indicating current unbalance, measured at the output CTs.

4

If the conditions for Fuse Failure exist, an alarm will occur after a time delay due to an undervoltage condition in at least one phase. If the motor is running, the voltage in the faulted phase will be zero, and the measured load current should not indicate a significant amount of negative or unbalance currents. Therefore the motor can be kept in service until the opportunity to replace the faulty fuse is available.

If the alarm is caused by an abnormal system conditions, a significant amount of unbalance current will be present. If the condition is not detected on time, the unbalance function or the underpower element will trip the motor.

NOTE

Set **UNDERVOLTAGE TRIP MODE** to “3-Phase”, when the setpoint **S2 SYSTEM SETUP** ⇨⇩ **VOLTAGE SENSING** ⇨⇩ **ENABLE SINGLE VT OPERATION** is set to “On”. The relay assumes a balanced three phase system when fed from a single VT.

4.10.2 OVERVOLTAGE

PATH: SETPOINTS ⇨⇩ S9 VOLTAGE ELEMENTS ⇨⇩ OVERVOLTAGE

	Range
■ OVERVOLTAGE ■ [ENTER] for more	
OVERVOLTAGE ALARM: Off	*Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	*Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
OVERVOLTAGE ALARM PICKUP: 1.05 x RATED	*1.01 to 1.10 x RATED in steps of 0.01*
OVERVOLTAGE ALARM DELAY: 3.0 s	*0.5 to 60.0 s in steps of 0.1*
OVERVOLTAGE ALARM EVENTS: Off	*On, Off*
OVERVOLTAGE TRIP: Off	*Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	*Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
OVERVOLTAGE TRIP PICKUP: 1.10 x RATED	*1.01 to 1.10 x RATED in steps of 0.01*
OVERVOLTAGE TRIP DELAY: 3.0 s	*0.5 to 60.0 s in steps of 0.1*

If enabled, once the magnitude of either Va, Vb, or Vc rises above the pickup level for a period of time specified by the delay, a trip or alarm will occur (pickup levels are multiples of motor nameplate voltage).

An overvoltage on running motor with a constant load results in decreased current. However, iron and copper losses increase, causing an increase in motor temperature. The current overload relay will not pickup this condition and provide adequate protection. Therefore, the overvoltage element may be useful for protecting the motor in the event of a sustained overvoltage condition.

4.10.3 PHASE REVERSAL

PATH: SETPOINTS ⇨⇩ S9 VOLTAGE ELEMENTS ⇨⇩ PHASE REVERSAL

	Range
■ PHASE REVERSAL ■ [ENTER] for more	
PHASE REVERSAL TRIP: Off	*Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	*Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*

The 469 can detect the phase rotation of the three phase voltage. If the Phase Reversal feature is turned on when all 3 phase voltages are greater than 50% motor nameplate voltage, and the phase rotation of the three phase voltages is not the same as the setpoint, a trip and block start will occur in 500 to 700 ms.

NOTE: This feature does not work when single VT operation is enabled.

4.10.4 FREQUENCY

PATH: SETPOINTS ⇨⇩ S9 VOLTAGE ELEMENTS ⇨⇩ FREQUENCY

```
■ FREQUENCY
■ [ENTER] for more
```

	Range
FREQUENCY ALARM: Off	*Range: Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
OVER FREQUENCY ALARM LEVEL: 60.50 Hz	*Range: 25.01 to 70.00 Hz in steps of 0.01*
UNDER FREQUENCY ALARM LEVEL: 59.50 Hz	*Range: 20.00 to 60.00 Hz in steps of 0.01*
FREQUENCY ALARM DELAY: 1.0 s	*Range: 0.0 to 60.0 s in steps of 0.1*
FREQUENCY ALARM EVENTS: Off	*Range: On, Off*
FREQUENCY TRIP: Off	*Range: Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
OVER FREQUENCY TRIP LEVEL: 60.50 Hz	*Range: 25.01 to 70.00 Hz in steps of 0.01*
UNDER FREQUENCY TRIP LEVEL: 59.50 Hz	*Range: 20.00 to 60.00 Hz in steps of 0.01*
FREQUENCY TRIP DELAY: 1.0 s	*Range: 0.0 to 60.0 s in steps of 0.1*

Once the frequency of the phase AN or AB voltage (depending on wye or delta connection) is out of range of the overfrequency and underfrequency setpoints, a trip or alarm will occur.

This feature may be useful for load shedding applications on large motors. It could also be used to load shed an entire feeder if the trip was assigned to an upstream breaker.

4.11.1 POWER MEASUREMENT CONVENTIONS

By convention, an induction motor consumes Watts and vars. This condition is displayed on the 469 as +Watts and +vars. A synchronous motor can consume Watts and vars or consume Watts and generate vars. These conditions are displayed on the 469 as +Watts, +vars, and +Watts, –vars respectively (see the figure below).

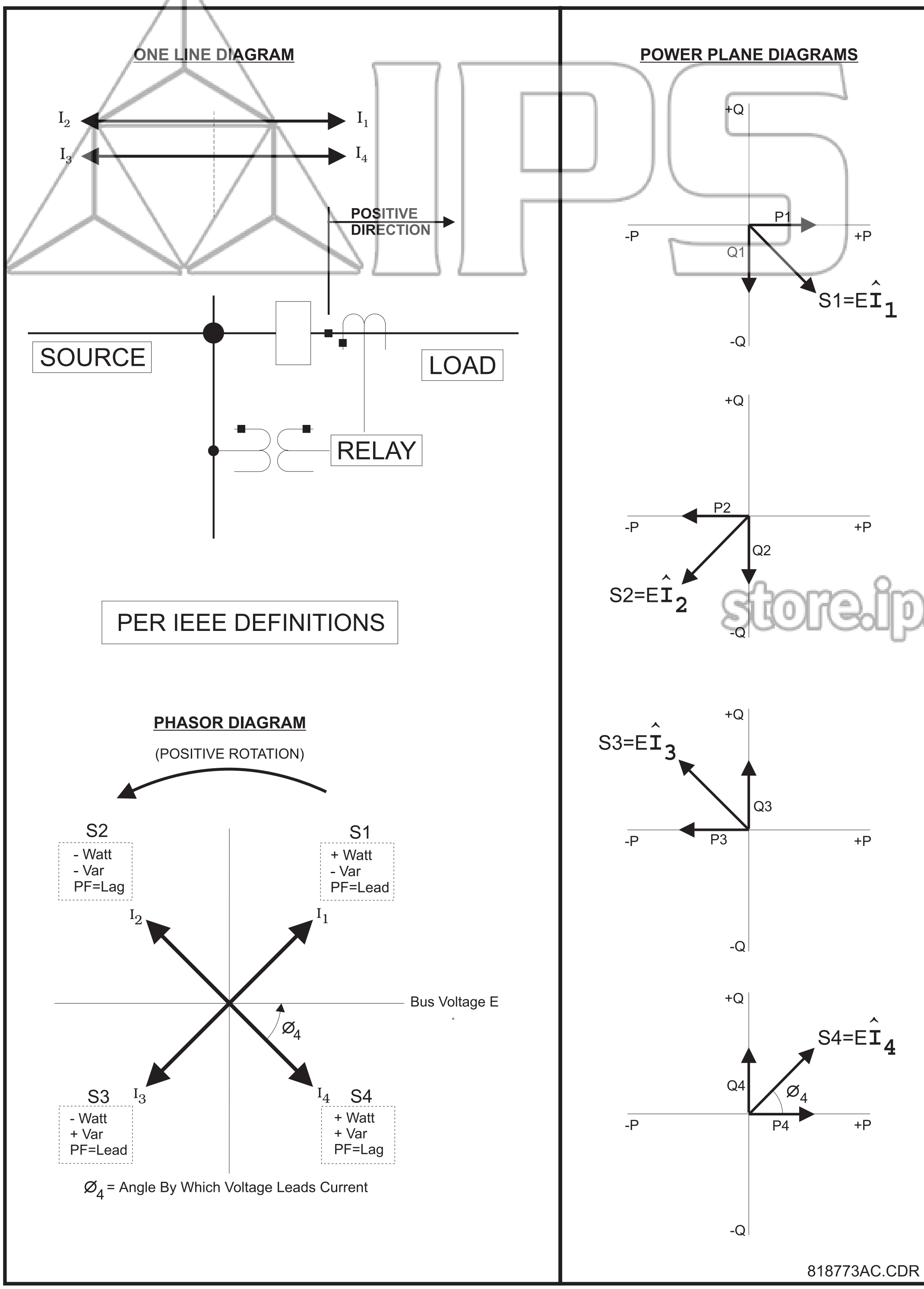


Figure 4–15: POWER MEASUREMENT CONVENTIONS

4.11.2 POWER FACTOR

PATH: SETPOINTS ⇨⇩ S10 POWER ELEMENTS ⇨ POWER FACTOR

■ POWER FACTOR
■ [ENTER] for more

BLOCK PF ELEMENT FROM START: 1 s	*Range: 0 to 5000 s in steps of 1*
POWER FACTOR ALARM: Off	*Range: Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
POWER FACTOR LEAD ALARM LEVEL: Off	*Range: Off, 0.05 to 0.99 in steps of 0.01*
POWER FACTOR LAG ALARM LEVEL: Off	*Range: Off, 0.05 to 0.99 in steps of 0.01*
POWER FACTOR ALARM DELAY: 1.0 s	*Range: 0.2 to 30.0 s in steps of 0.1*
POWER FACTOR ALARM EVENTS: Off	*Range: On, Off*
POWER FACTOR TRIP: Off	*Range: Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
POWER FACTOR LEAD TRIP LEVEL: Off	*Range: Off, 0.05 to 0.99 in steps of 0.01*
POWER FACTOR LAG TRIP LEVEL: Off	*Range: Off, 0.05 to 0.99 in steps of 0.01*
POWER FACTOR TRIP DELAY: 1.0 s	*Range: 0.2 to 30.0 s in steps of 0.1*

If the 469 is applied on a synchronous motor, it is desirable not to trip or alarm on power factor until the field has been applied. Therefore, this feature can be blocked until the motor comes up to speed and the field is applied. From that point forward, the power factor trip and alarm elements will be active. Once the power factor is less than either the Lead or Lag level, for the specified delay, a trip or alarm will occur indicating a Lead or Lag condition. The power factor alarm can be used to detect loss of excitation and out of step.

4.11.3 REACTIVE POWER

PATH: SETPOINTS ⇨⇩ S10 POWER ELEMENTS ⇨⇩ REACTIVE POWER

■ REACTIVE POWER
■ [ENTER] for more

BLOCK kvar ELEMENT FROM START: 1 s	Range: 0 to 5000 s in steps of 1
REACTIVE POWER ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
POSITIVE kvar ALARM LEVEL: 10 kvar	Range: 1 to 25000 kvar in steps of 1
NEGATIVE kvar ALARM LEVEL: 10 kvar	Range: 1 to 25000 kvar in steps of 1
REACTIVE POWER ALARM DELAY: 1.0 s	Range: 0.2 to 30.0 s in steps of 0.1
REACTIVE POWER ALARM EVENTS: Off	Range: On, Off
REACTIVE POWER TRIP: Off	Range: Off, Latched, Unlatched
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3
POSITIVE kvar TRIP LEVEL: 25 kvar	Range: 1 to 25000 kvar in steps of 1
NEGATIVE kvar TRIP LEVEL: 25 kvar	Range: 1 to 25000 kvar in steps of 1
REACTIVE POWER TRIP DELAY: 1.0 s	Range: 0.2 to 30.0 s in steps of 0.1

If the 469 is applied on a synchronous motor, it is desirable not to trip or alarm on kvar until the field has been applied. Therefore, this feature can be blocked until the motor comes up to speed and the field is applied. From that point forward, the kvar trip and alarm elements will be active. Once the kvar level exceeds either the positive or negative level, for the specified delay, a trip or alarm will occur indicating a positive or negative kvar condition. The reactive power alarm can be used to detect loss of excitation and out of step.

4.11.4 UNDERPOWER

PATH: SETPOINTS ⇨⇩ S10 POWER ELEMENTS ⇨⇩ UNDERPOWER

```
■ UNDERPOWER
■ [ENTER] for more
```

BLOCK UNDERPOWER FROM START: 0 s	*Range: 0 to 15000 s in steps of 1*
UNDERPOWER ALARM: Off	*Range: Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
UNDERPOWER ALARM LEVEL: 2 kW	*Range: 1 to 25000 kW in steps of 1*
UNDERPOWER ALARM DELAY: 1 s	*Range: 1 to 30 s in steps of 1*
UNDERPOWER ALARM EVENTS: Off	*Range: On, Off*
UNDERPOWER TRIP: Off	*Range: Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
UNDERPOWER TRIP LEVEL: 1 kW	*Range: 1 to 25000 kW in steps of 1*
UNDERPOWER TRIP DELAY: 1 s	*Range: 1 to 30 s in steps of 1*

If enabled, once the magnitude of 3Φ total power falls below the Pickup Level for a period of time specified by the Delay, a trip or alarm will occur. The Underpower element is active only when the motor is running and will be blocked upon the initiation of a motor start for a period of time defined by the **BLOCK ELEMENT FROM START** setpoint (e.g. this block may be used to allow pumps to build up head before the underpower element trips or alarms). A value of 0 means the feature is not blocked from start. If a value other than 0 is entered, the feature will be disabled when the motor is stopped and also from the time a start is detected until the time entered expires. The pickup level should be set lower than motor loading during normal operations.

For example, underpower may be used to detect loss of load conditions. Loss of load conditions will not always cause a significant loss of current. Power is a more accurate representation of loading and may be used for more sensitive detection of load loss or pump cavitation. This may be especially useful for detecting process related problems.

4.11.5 REVERSE POWER

PATH: SETPOINTS ⇨⇩ S10 POWER ELEMENTS ⇨⇩ REVERSE POWER

```
■ REVERSE POWER
■ [ENTER] for more
```

BLOCK REVERSE POWER FROM START: 0 s	*Range: 0 to 50000 s in steps of 1*
REVERSE POWER ALARM: Off	*Range: Off, Latched, Unlatched*
ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
REVERSE POWER ALARM LEVEL: 2 kW	*Range: 1 to 25000 kW in steps of 1*
REVERSE POWER ALARM DELAY: 1 s	*Range: 0.2 to 30.0 s in steps of 0.1*
REVERSE POWER ALARM EVENTS: Off	*Range: On, Off*
REVERSE POWER TRIP: Off	*Range: Off, Latched, Unlatched*
ASSIGN TRIP RELAYS: Trip	*Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3*
REVERSE POWER TRIP LEVEL: 1 kW	*Range: 1 to 25000 kW in steps of 1*
REVERSE POWER TRIP DELAY: 1 s	*Range: 0.2 to 30.0 s in steps of 1*

If enabled, once the magnitude of 3-phase total power exceeds the Pickup Level in the reverse direction (negative kW) for a period of time specified by the Delay, a trip or alarm will occur.

NOTE: The minimum magnitude of power measurement is determined by the phase CT minimum of 5% rated CT primary. If the level for reverse power is set below that level, a trip or alarm will only occur once the phase current exceeds the 5% cutoff.

4.11.6 TORQUE SETUP

PATH: SETPOINTS ⇨⇩ S10 POWER ELEMENTS ⇨⇩ TORQUE SETUP

■ TORQUE SETUP ■ [ENTER] for more	TORQUE METERING Disabled	Range: Disabled, Enabled
	STATOR RESISTANCE: 0.004 mΩ	Range: 0.001 to 50.00 mΩ in steps of 0.001
	POLE PAIRS: 2	Range: 2 to 128 in steps of 1
	TORQUE UNIT: Newton-meter	Range: Newton-meter, Foot-pound

Before torque can be determined, the motor stator resistance and number of pole pairs must be entered here. The base stator resistance can be determined from the motor's rated voltage and current. Torque metering is intended for induction motors only, and only positive torque is calculated. Please consult the motor specifications for the stator resistance and the pole pairs.

The default unit for torque is the SI unit of Newton-meter (Nm). The torque unit is selectable to either Newton-meter or foot-pound.

NOTE: 1 Nm = 0.738 ft·lb.

4.11.7 OVERTORQUE SETUP

PATH: SETPOINTS ⇨⇩ S10 POWER ELEMENTS ⇨⇩ OVERTORQUE SETUP

■ OVERTORQUE ■ [ENTER] for more	OVERTORQUE ALARM: Off	Range: Off, Latched, Unlatched
	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	TORQUE ALARM LEVEL: 4000.0 Nm	Range: 1.0 to 999999.9 Nm (or ft·lb) in steps of 0.1
	TORQUE ALARM DELAY: 1.0 s	Range: 0.2 to 30 s in steps of 0.1
	TORQUE ALARM EVENTS: Off	Range: On, Off

Detection of a motor overtorque condition, usually done to protect devices driven by the motor, can be set up here. The assigned relay activates when the torque measured exceeds the specified level for the specified time duration.

4.12.1 TRIP COUNTER

PATH: SETPOINTS ⇨⇩ S11 MONITORING ⇨ TRIP COUNTER

■ TRIP COUNTER ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	TRIP COUNTER ALARM: Off	Range: Off, Latched, Unlatched
	ESCAPE / MESSAGE ⇳	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	ESCAPE / MESSAGE ⇳	TRIP COUNTER ALARM LEVEL: 25 Trips	Range: 1 to 50000 Trips in steps of 1
	ESCAPE / MESSAGE ⇧	TRIP COUNTER ALARM EVENTS: Off	Range: On, Off

When the Trip Counter Limit is reached, an alarm will occur. The trip counter must be cleared or the alarm level raised and the reset key must be pressed (if the alarm was latched) to reset the alarm.

For example, it might be useful to set a Trip Counter alarm at 100 so that if 100 trips occur, the resulting alarm prompts the operator or supervisor to investigate the type of trips that occurred. A breakdown of trips by type may be found on **A3 MAINTENANCE\TRIP COUNTERS**. If a trend is detected, it would warrant further investigation.

4

4.12.2 STARTER FAILURE

PATH: SETPOINTS ⇨⇩ S11 MONITORING ELEMENTS ⇨⇩ STARTER FAILURE

```
■ STARTER FAILURE
■ [ENTER] for more
```

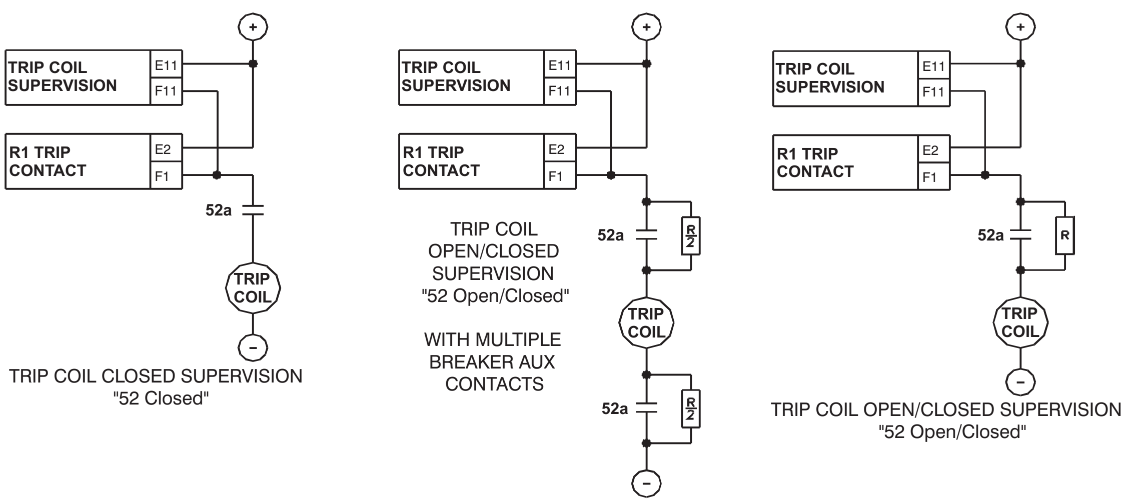
ENTER / ESCAPE

STARTER FAILURE ALARM: Off	*Range: Off, Latched, Unlatched*
STARTER TYPE: Breaker	*Range: Breaker, Contactor*
ASSIGN ALARM RELAYS: Alarm	*Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3*
STARTER FAILURE DELAY: 100 ms	*Range: 10 to 1000 ms in steps of 10*
SUPERVISION OF TRIP COIL: Disabled	*Range: Disabled, 52 Closed, 52 Open/Closed Seen only if* **STARTER TYPE** *is "Breaker"*
STARTER FAILURE ALARM EVENTS: Off	*Range: On, Off*

If the **STARTER FAILURE ALARM** is set to "Latched" or "Unlatched", then the Starter Status input and motor current are monitored when the 469 initiates a trip. If the starter status contacts do not change state or motor current does not drop to zero after the programmed time delay, an alarm occurs. The time delay should be slightly longer than the breaker or contactor operating time. If an alarm occurs and "Breaker" was chosen as the starter type, the alarm will be Breaker Failure. If "Contactor" was chosen for starter type, the alarm will be Welded Contactor. Also, if the starter type chosen is "Breaker", Trip Coil Supervision may be enabled.

- If "52 Closed" is selected, the trip coil supervision circuitry monitors the trip coil circuit for continuity any time the starter status input indicates that the breaker is closed or motor current is detected. If that continuity is broken, a Starter Failure alarm will indicate Trip Coil Supervision.

- If "52 Open/Closed" is selected, the trip coil supervision circuitry monitors the trip coil circuit for continuity at all times, regardless of breaker state. This requires an alternate path around the 52a contacts in series with the trip coil when the breaker is open. See the following figure for modifications to the wiring and proper resistor selection. If that continuity is broken, a Starter Failure alarm will indicate Trip Coil Supervision.



VALUE OF RESISTOR 'R'

SUPPLY	OHMS	WATTS
48 VDC	10 K	2
125 VDC	25 K	5
250 VDC	50 K	5

808727A1.CDR

Figure 4–16: TRIP COIL SUPERVISION

4.12.3 CURRENT, KW, KVAR, AND KVA DEMAND

PATH: SETPOINTS ⇨⇩ S11 MONITORING ⇨⇩ CURRENT DEMAND

■ CURRENT DEMAND ■ [ENTER] for more	CURRENT DEMAND PERIOD: 15 min.	Range: 5 to 90 min. in steps of 1
	CURRENT DEMAND ALARM: Off	Range: Off, Latched, Unlatched
	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	CURRENT DEMAND LIMIT: 100 A	Range: 10 to 100000 A in steps of 1
	CURRENT DEMAND ALARM EVENTS: Off	Range: On, Off
■ kW DEMAND ■ [ENTER] for more	kW DEMAND PERIOD: 15 min.	Range: 5 to 90 min. in steps of 1
	kW DEMAND ALARM: Off	Range: Off, Latched, Unlatched
	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	kW DEMAND LIMIT: 100 kW	Range: 1 to 50000 kW in steps of 1
	kW DEMAND ALARM EVENTS: Off	Range: On, Off
■ kvar DEMAND ■ [ENTER] for more	kvar DEMAND PERIOD: 15 min.	Range: 5 to 90 min in steps of 1
	kvar DEMAND ALARM: Off	Range: Off, Latched, Unlatched
	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	kvar DEMAND LIMIT: 100 kvar	Range: 1 to 50000 kvar, step 1
	kvar DEMAND ALARM EVENTS: Off	Range: On, Off
■ kVA DEMAND ■ [ENTER] for more	kVA DEMAND PERIOD: 15 min.	Range: 5 to 90 min. in steps of 1
	kVA DEMAND ALARM: Off	Range: Off, Latched, Unlatched
	ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
	kVA DEMAND LIMIT: 100 kVA	Range: 1 to 50000 kVA, step: 1
	kVA DEMAND ALARM EVENTS: Off	Range: On, Off

4

The 469 measures motor demand for several parameters (current, kW, kvar, and kVA). These values may be of interest for energy management programs where processes may be altered or scheduled to reduce overall demand on a feeder.

Demand is calculated as follows. Every minute, an average magnitude is calculated for current, +kW, +kvar, and kVA based on samples taken every 5 seconds. These values are stored in a FIFO (first in, first out) buffer. The buffer size is dictated by the setpoint demand period. The average value of the buffer is calculated and stored as the new demand value every minute. Demand for real and reactive power is only positive quantities (+kW and +kvar).

$$\text{Demand} = \frac{1}{N}\sum_{n=1}^{N}\left|\text{Average}_N\right| \qquad \textbf{(EQ 4.12)}$$

where: N = programmed demand period in minutes, n = time in minutes.

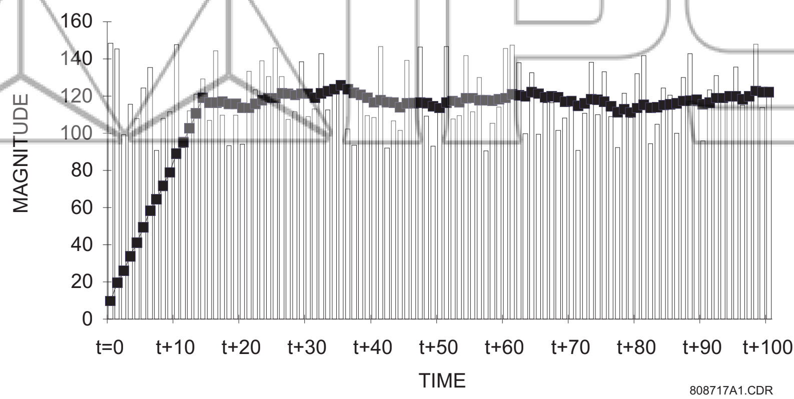


Figure 4–17: ROLLING DEMAND (15 MINUTE WINDOW)

4.12.4 PULSE OUTPUT

PATH: SETPOINTS ⇨⇩ S11 MONITORING ⇨⇩ PULSE OUTPUT

■ PULSE OUTPUT ■ [ENTER] for more	ENTER / ESCAPE	POS kWh PULSE OUTPUT RELAY: Off	Range: *Off, Alarm, Auxiliary2, Auxiliary3*
	ESCAPE / MESSAGE	POS kWh PULSE OUTPUT INTERVAL: 1 kWh	Range: *1 to 50000 kWh in steps of 1*
	ESCAPE / MESSAGE	POS kvarh PULSE OUT RELAY: Off	Range: *Off, Alarm, Auxiliary2, Auxiliary3*
	ESCAPE / MESSAGE	POS kvarh PULSE OUT INTERVAL: 1 kvarh	Range: *1 to 50000 kvarh in steps of 1*
	ESCAPE / MESSAGE	NEG kvarh PULSE OUT RELAY: Off	Range: *Off, Alarm, Auxiliary2, Auxiliary3*
	ESCAPE / MESSAGE	NEG kvarh PULSE OUT INTERVAL: 1 kvarh	Range: *1 to 50000 kvarh in steps of 1*
	ESCAPE / MESSAGE	RUNNING TIME PULSE RELAY: Off	Range: *Off, Alarm, Auxiliary2, Auxiliary3*
	ESCAPE / MESSAGE	RUNNING TIME PULSE INTERVAL: 0 s	Range: *1 to 50000 s in steps of 1*

This feature configures one or more of the output relays as a pulsed output. When the programmed interval has transpired the assigned relay will be activated for 1 second.

NOTE

This feature should be programmed such that no more than one pulse per second will be required or the pulsing will lag behind the interval activation.

4.13.1 ANALOG OUTPUTS 1 TO 4

PATH: SETPOINTS ⇨⇩ S12 ANALOG I/O ⇨ ANALOG OUTPUT 1(4)

■ ANALOG OUTPUT 1 ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	ANALOG OUTPUT 1: Therm. Capacity Used	Range: See Table 4–2: Analog Output Parameter Selection Table.
	ESCAPE MESSAGE ⇳	THERM. CAPACITY USED MIN: 0%	Range: 0 to 100% in steps of 1
	ESCAPE MESSAGE ⇧	THERM. CAPACITY USED MAX: 100%	Range: 0 to 100% in steps of 1
■ ANALOG OUTPUT 2 ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	ANALOG OUTPUT 2: Motor Load	Range: See Table 4–2: Analog Output Parameter Selection Table.
	ESCAPE MESSAGE ⇳	MOTOR LOAD MIN: 0.00 x FLA	Range: 0.00 to 20.00 x FLA in steps of 0.01
	ESCAPE MESSAGE ⇧	MOTOR LOAD MAX: 1.50 x FLA	Range: 0.00 to 20.00 x FLA in steps of 0.01
■ ANALOG OUTPUT 3 ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	ANALOG OUTPUT 3: Hottest Stator RTD	Range: See Table 4–2: Analog Output Parameter Selection Table.
	ESCAPE MESSAGE ⇳	HOTTEST STATOR RTD MIN: 0°C	Range: –50 to 250°C (or –58 to 482°F) in steps of 1
	ESCAPE MESSAGE ⇧	HOTTEST STATOR RTD MAX: 250°C	Range: –50 to 250°C (or –58 to 482°F) in steps of 1
■ ANALOG OUTPUT 4 ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	ANALOG OUTPUT 4: Real Power (kW)	Range: See Table 4–2: Analog Output Parameter Selection Table.
	ESCAPE MESSAGE ⇳	REAL POWER (kW) MIN: 0 kW	Range: –50000 to 50000 kW in steps of 1
	ESCAPE MESSAGE ⇧	REAL POWER (kW) MAX: 100 kW	Range: –50000 to 50000 kW in steps of 1

The 469 has four analog output channels (4 to 20 mA or 0 to 1 mA as ordered). Each channel may be individually configured to represent a number of different measured parameters as shown in the table below. The minimum value programmed represents the 4 mA output. The maximum value programmed represents the 20 mA output. If the maximum is programmed lower than the minimum, the output will function in reverse. All four of the outputs are updated once every 50 ms. Each parameter may only be used once.

For example, the analog output parameter may be chosen as "Hottest Stator RTD" for a 4 to 20 mA output. If the minimum is set for "0°C" and the maximum is set for "250°C", the analog output channel will output 4 mA when the Hottest Stator RTD temperature is at 0°C, 12 mA when it is 125°C, and 20 mA when it is 250°C.

Table 4–2: ANALOG OUTPUT PARAMETER SELECTION TABLE

PARAMETER NAME	RANGE / UNITS	STEP	DEFAULT	
			MIN.	MAX
Phase A Current	0 to 100000 A	1	0	100
Phase B Current	0 to 100000 A	1	0	100
Phase C Current	0 to 100000 A	1	0	100
Avg. Phase Current	0 to 100000 A	1	0	100
AB Line Voltage	50 to 20000 V	1	3200	4500
BC Line Voltage	50 to 20000 V	1	3200	4500
CA Line Voltage	50 to 20000 V	1	3200	4500
Avg. Line Voltage	50 to 20000 V	1	3200	4500
Phase AN Voltage	50 to 20000 V	1	1900	2500
Phase BN Voltage	50 to 20000 V	1	1900	2500
Phase CN Voltage	50 to 20000 V	1	1900	2500
Avg. Phase Voltage	50 to 20000 V	1	1900	2500
Hottest Stator RTD	–50 to +250°C or –58 to +482°F	1	0	200
Hottest Bearing RTD	–50 to +250°C or –58 to +482°F	1	0	200
Ambient RTD	–50 to +250°C or –58 to +482°F	1	-50	60
RTD #1 to 12	–50 to +250°C or –58 to +482°F	1	-50	250
Power Factor	0.01 to 1.00 lead/lag	0.01	0.8 lag	0.8 lead
Reactive Power	-50000 to 50000 kvar	1	0	750
Real Power	-50000 to 50000 kW	1	0	1000
Apparent Power	0 to 50000 kVA	1	0	1250
Thermal Capacity Used	0 to 100%	1	0	100
Relay Lockout Time	0 to 500 min.	1	0	150
Current Demand	0 to 100000 A	1	0	700
kvar Demand	0 to 50000 kvar	1	0	1000
kW Demand	0 to 50000 kW	1	0	1250
kVA Demand	0 to 50000 kVA	1	0	1500
Motor Load	0.00 to 20.00 x FLA	0.01	0.00	1.25
Analog Inputs 1-4	–50000 to +50000	1	0	+50000
Tachometer	100 to 7200 RPM	1	3500	3700
MWhrs	0.000 to 999999.999 MWhrs	0.001	50.000	100.000
Analog In Diff 1-2	–50000 to +50000	1	0	100
Analog In Diff 3-4	–50000 to +50000	1	0	100
Torque	0 to 999999.9	0.1	0	100

4.13.2 ANALOG INPUTS 1 TO 4

PATH: SETPOINTS ⇨⇩ S12 ANALOG I/O ⇨⇩ ANALOG INPUT 1(4)

■ ANALOG INPUT 1 ■ [ENTER] for more	
ANALOG INPUT 1: Disabled	Range: Disabled, 4-20 mA, 0-20 mA, 0-1 mA
ANALOG INPUT 1 NAME: Analog I/P 1	Range: 12 alphanumeric characters
ANALOG INPUT 1 UNITS: Units	Range: 6 alphanumeric characters
ANALOG INPUT 1 MINIMUM: 0	Range: –50000 to 50000 in steps of 1
ANALOG INPUT 1 MAXIMUM: 100	Range: –50000 to 50000 in steps of 1
ANALOG INPUT 1 BLOCK FROM START: 0 s	Range: 0 to 5000 s in steps of 1
ANALOG INPUT 1 ALARM: Off	Range: Off, Latched, Unlatched
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
ANALOG INPUT 1 ALARM LEVEL: 10 Units	Range: –50000 to 50000 in steps of 1 Units reflect **ANALOG INPUT 1 UNITS** above
ANALOG INPUT 1 ALARM PICKUP: Over	Range: Over, Under
ANALOG INPUT 1 ALARM DELAY: 0.1 s	Range: 0.1 to 300.0 s in steps of 0.1
ANALOG INPUT 1 ALARM EVENTS: Off	Range: On, Off
ANALOG INPUT 1 TRIP: Off	Range: Off, Latched, Unlatched
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3 Trip & Auxiliary3
ANALOG INPUT 1 TRIP LEVEL: 20 Units	Range: –50000 to 50000 in steps of 1 Units reflect **ANALOG INPUT 1 UNITS** above
ANALOG INPUT 1 TRIP PICKUP: Over	Range: Over, Under
ANALOG INPUT 1 TRIP DELAY: 0.1 s	Range: 0.1 to 300.0 s in steps of 0.1

There are 4 analog inputs, 4 to 20 mA, 0 to 20 mA, or 0 to 1 mA as selected. These inputs may be used to monitor transducers such as vibration monitors, tachometers, pressure transducers, etc. These inputs may be used for alarm and tripping purposes. The inputs are sampled every 50 ms. The level of the analog input is also available over the communications port.

Before the input may be used, it must be configured. A name may be assigned for the input, units may be assigned, and a minimum and maximum value may be assigned. Also, the trip and alarm features may be blocked from start for a specified time delay. If the block time is 0, there is no block and the trip and alarm features will be active when the motor is stopped or running. If a time is programmed other than 0, the feature will be disabled when the motor is stopped and also from the time a start is detected until the time entered expires. Once the input is setup, both the trip and alarm features may be configured. In addition to programming a level and time delay, the pickup setpoint may be used to dictate whether the feature picks up when the measured value is over or under the level.

For example, if a pressure transducer is to be used for a pump application, program the following setpoints:

ANALOG INPUT 1/2/3/4 NAME: Pressure
ANALOG INPUT 1/2/3/4 UNITS: PSI
ANALOG INPUT 1/2/3/4 MINIMUM: 0
ANALOG INPUT 1/2/3/4 MAXIMUM: 500

If there is no pressure until the pump is up and running for 5 minutes and pressure builds up, program the **ANALOG INPUT 1 BLOCK FROM START** as 6 minutes ("360 s"). The alarm may be fed back to a PLC for when pressure is under 300 PSI. Program a reasonable delay (e.g **ANALOG INPUT ALARM 1 DELAY** = "3 s") and **ANALOG INPUT ALARM 1 PICKUP** as "Under".

If a vibration transducer is to be used for a pump application, program the following setpoints:

ANALOG INPUT 1/2/3/4 NAME: Vibration
ANALOG INPUT 1/2/3/4 UNITS: mm/s
ANALOG INPUT 1/2/3/4 MINIMUM: 0
ANALOG INPUT 1/2/3/4 MAXIMUM: 25

Program **ANALOG INPUT 1/2/3/4 BLOCK FROM START** as "0" minutes. Set the alarm for a reasonable level slightly higher than the normal vibration level. Program a delay of "3 s" and a pickup value of "Over".

4.13.3 ANALOG IN DIFF 1-2

PATH: SETPOINTS ⇨⇩ S12 ANALOG I/O ⇨⇩ ANALOG IN DIFF 1–2

■ ANALOG IN DIFF 1-2 ■ [ENTER] for more	
ANALOG IN DIFF 1-2: Disabled	Range: Disabled, Enabled Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 NAME: Analog 1-2	Range: 12 alphanumeric characters Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 COMPARISON: % Diff	Range: % Diff, Abs. Diff Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 LOGIC: 1<>2	Range: 1<>2, 1>2, 2>1 Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 ACTIVE: Always	Range: Always, Start/Run Seen only if Analog Inputs 1 and 2 are enabled.
A/I DIFF 1-2 BLOCK FROM START: 0 s	Range: 0 to 5000 s in steps of 1 Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 ALARM: Off	Range: Off, Latched, Unlatched Seen only if Analog Inputs 1 and 2 are enabled.
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
ANALOG IN DIFF 1-2 ALARM LEVEL: 10%	Range: 0 to 500% in steps of 1. Seen only if Analog Inputs 1 / 2 are enabled and %Diff is set.
A/I DIFF 1-2 ALARM LEVEL: 10 Units	Range: 0 to 50000 Units in steps of 1. Seen only if Analog Inputs 1 / 2 enabled and Abs Diff is set.
ANALOG IN DIFF 1-2 ALARM DELAY: 0.1 s	Range: 0.1 to 300.0 s in steps of 0.1 Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 EVENTS: Off	Range: On, Off Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 1-2 TRIP: Off	Range: Off, Latched, Unlatched Seen only if Analog Inputs 1 and 2 are enabled.
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3 Trip & Auxiliary3
ANALOG IN DIFF 1-2 TRIP LEVEL: 10%s	Range: 0 to 500% in steps of 1. Seen only if Analog Inputs 1 / 2 are enabled and %Diff is set.
ANALOG IN DIFF 1-2 TRIP LEVEL: 10 Units	Range: 0 to 50000 in steps of 1. Seen only if Analog Inputs 1 / 2 enabled and Abs Diff is set.
ANALOG IN DIFF 1-2 TRIP DELAY: 0.1 s	Range: 0.1 to 300.0 s in steps of 0.1 Seen only if Analog Inputs 1 and 2 are enabled.

This feature compares two analog inputs and activate alarms or trips based on their difference, which can be an absolute difference in units or a percentage difference. The second analog input (2 for 1-2) is used as the reference value for percentage calculations. The comparison logic can also be selected as one input greater than the other ("1>2") or vice versa ("2>1") or as absolute difference ("1<>2"). The compared analog inputs must be programmed with the same units type prior to programming this feature.

For example, two motors on a dual motor drive are each protected a 469. The motors should be at the same power level (kW). Connect the analog outputs (programmed for kW) from both relays to the analog inputs of one relay. Program the analog input differential to monitor the two motors kW and trip at a predetermined level.

4.13.4 ANALOG IN DIFF 3-4

PATH: SETPOINTS ⇨⇩ S12 ANALOG I/O ⇨⇩ ANALOG DIFF 3–4

■ ANALOG IN DIFF 3-4 ■ [ENTER] for more	
ANALOG IN DIFF 3-4: Disabled	Range: Disabled, Enabled Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 NAME: Analog 3-4	Range: 12 alphanumeric characters Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 COMPARISON: % Diff	Range: % Diff, Abs. Diff Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 LOGIC: 3<>4	Range: 1<>2, 1>2, 2>1 Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 ACTIVE: Always	Range: Always, Start/Run Seen only if Analog Inputs 1 and 2 are enabled.
A/I DIFF 3-4 BLOCK FROM START: 0 s	Range: 0 to 5000 s in steps of 1 Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 ALARM: Off	Range: Off, Latched, Unlatched Seen only if Analog Inputs 1 and 2 are enabled.
ASSIGN ALARM RELAYS: Alarm	Range: Alarm, Alarm & Auxiliary2, Alarm & Aux2 & Aux3, Alarm & Auxiliary3, Auxiliary2, Aux2 & Aux3, Auxiliary3
ANALOG IN DIFF 3-4 ALARM LEVEL: 10%	Range: 0 to 500% in steps of 1. Seen only if Analog Inputs 1 and 2 are enabled and % Diff is Set
A/I DIFF 3-4 ALARM LEVEL: 10 Units	Range: 0 to 50000 in steps of 1. Seen only if Analog Inputs 1 and 2 are enabled and Abs Diff is Set
ANALOG IN DIFF 3-4 ALARM DELAY: 0.1 s	Range: 0.1 to 300.0 s in steps of 0.1 Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 EVENTS: Off	Range: On, Off Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 TRIP: Off	Range: Off, Latched, Unlatched Seen only if Analog Inputs 1 and 2 are enabled.
ASSIGN TRIP RELAYS: Trip	Range: Trip, Trip & Auxiliary2, Trip & Aux2 & Aux3, Trip & Auxiliary3. Seen only if Analog Inputs 1 and 2 are enabled.
ANALOG IN DIFF 3-4 TRIP LEVEL: 10%	Range: 0 to 500% in steps of 1. Seen only if Analog Inputs 1 and 2 are enabled and % Diff is set.
ANALOG IN DIFF 3-4 TRIP LEVEL: 10 Units	Range: 0 to 50000 in steps of 1. Seen only if Analog Inputs 1 and 2 are enabled and Abs Diff is Set
ANALOG IN DIFF 3-4 TRIP DELAY: 0.1 s	Range: 0.1 to 300.0 s in steps of 0.1 Seen only if Analog Inputs 1 and 2 are enabled.

This feature compares two of the analog inputs and activate alarms or trips based on the difference between them. The difference can be of an absolute difference in units or a percentage difference. The second analog input (4 for 3-4) is used as the reference value for percentage calculations. The comparison logic can also be selected as one input greater than the other ("3>4") or vice versa ("4>3") or as absolute difference ("3<>4"). Note that the compared analog inputs must be programmed with the same unit type prior to using this feature.

4.14.1 SIMULATION MODE

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨ SIMULATION MODE

■ SIMULATION MODE ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	SIMULATION MODE: Off	*Range: Off, Simulate Pre-Fault, Simulate Fault, Pre-Fault to Fault*
	ESCAPE MESSAGE ⇧	PRE-FAULT TO FAULT TIME DELAY: 15 s	*Range: 0 to 300 s in steps of 1*

The 469 may be placed in several simulation modes. This simulation may be useful for several purposes.

- First, it may be used to understand the operation of the 469 for learning or training purposes.
- Second, simulation may be used during startup to verify that control circuitry operates as it should in the event of a trip, alarm, or block start.
- In addition, simulation may be used to verify that setpoints had been set properly in the event of fault conditions.

Simulation mode may be entered only if the motor is stopped and there are no trips, alarms, or block starts active. The values entered as Pre-Fault Values will be substituted for the measured values in the 469 when the simulation mode is "Simulate Pre-Fault". The values entered as Fault Values will be substituted for the measured values in the 469 when the simulation mode is "Simulate Fault". If the simulation mode: Pre-Fault to Fault is selected, the Pre-Fault values will be substituted for the period of time specified by the delay, followed by the Fault values. If a trip occurs, simulation mode will revert to Off. Selecting "Off" for the simulation mode will place the 469 back in service. If the 469 measures phase current or control power is cycled, simulation mode will automatically revert to Off.

If the 469 is to be used for training, it might be desirable to allow all learned parameters, statistical information, and event recording to update when operating in simulation mode. If however, the 469 has been installed and will remain installed on a specific motor, it might be desirable to short the 469 Test input (C3 and C4) to prevent all of this data from being corrupted or updated. In any case, when in simulation mode, the 469 in Service LED (indicator) will flash, indicating that the 469 is not in protection mode.

4.14.2 PRE-FAULT SETUP

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨⇩ PRE-FAULT SETUP

```
■ PRE-FAULT SETUP
■ [ENTER] for more
```

PRE-FAULT CURRENT PHASE A: 0.00 x CT	Range: 0.00 to 20.00 x CT in steps of 0.01
PRE-FAULT CURRENT PHASE B: 0.00 x CT	Range: 0.00 to 20.00 x CT in steps of 0.01
PRE-FAULT CURRENT PHASE C: 0.00 x CT	Range: 0.00 to 20.00 x CT in steps of 0.01
PRE-FAULT GROUND CURRENT: 0.0 A	Range: 0.0 to 5000.0 A in steps of 0.1
PRE-FAULT VOLTAGES VLINE: 1.00 x RATED	Range: 0.00 to 1.10 x RATED in steps of 0.01
PRE-FAULT CURRENT LAGS VOLTAGE: 0°	Range: 0 to 359° in steps of 1
PRE-FAULT DIFF AMPS IDIFF: 0.00 x CT	Range: 0.00 to 1.10 x RATED in steps of 0.01
PRE-FAULT STATOR RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
PRE-FAULT BEARING RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
PRE-FAULT OTHER RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
PRE-FAULT AMBIENT RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
PRE-FAULT SYSTEM FREQUENCY: 60.0 Hz	Range: 45.0 to 70.0 Hz in steps of 0.1
PRE-FAULT ANALOG INPUT 1: 0%	Range: 0 to 100% in steps of 1
PRE-FAULT ANALOG INPUT 2: 0%	Range: 0 to 100% in steps of 1
PRE-FAULT ANALOG INPUT 3: 0%	Range: 0 to 100% in steps of 1
PRE-FAULT ANALOG INPUT 4: 0%	Range: 0 to 100% in steps of 1

The values entered under Pre-Fault Values will be substituted for the measured values in the 469 when the simulation mode is "Simulate Pre-Fault".

4.14.3 FAULT SETUP

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨⇩ FAULT SETUP

■ FAULT SETUP
■ [ENTER] for more

FAULT CURRENT PHASE A: 0.00 x CT	Range: 0.00 to 20.00 x CT in steps of 0.01
FAULT CURRENT PHASE B: 0.00 x CT	Range: 0.00 to 20.00 x CT in steps of 0.01
FAULT CURRENT PHASE C: 0.00 x CT	Range: 0.00 to 20.00 x CT in steps of 0.01
FAULT GROUND CURRENT: 0.0 A	Range: 0.0 to 5000.0 A in steps of 0.1
FAULT VOLTAGES VLINE: 1.00 x RATED	Range: 0.00 to 1.10 x RATED in steps of 0.01
FAULT CURRENT LAGS VOLTAGE: 0°	Range: 0 to 359° in steps of 1
FAULT DIFF AMPS IDIFF: 0.00 x CT	Range: 0.00 to 1.10 x RATED in steps of 0.01
FAULT STATOR RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
FAULT BEARING RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
FAULT OTHER RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
FAULT AMBIENT RTD TEMP: 40°C	Range: –50 to 250°C in steps of 1
FAULT SYSTEM FREQUENCY: 60.0 Hz	Range: 45.0 to 70.0 Hz in steps of 0.1
FAULT ANALOG INPUT 1: 0%	Range: 0 to 100% in steps of 1
FAULT ANALOG INPUT 2: 0%	Range: 0 to 100% in steps of 1
FAULT ANALOG INPUT 3: 0%	Range: 0 to 100% in steps of 1
FAULT ANALOG INPUT 4: 0%	Range: 0 to 100% in steps of 1

The values entered under Fault Values will be substituted for the measured values in the 469 when the simulation mode is "Simulate Fault".

4.14.4 TEST OUTPUT RELAYS

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨⇩ TEST OUTPUT RELAYS

			Range
■ TEST OUTPUT RELAYS ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	FORCE OPERATION OF RELAYS: Disabled	Range: Disabled, R1 Trip, R2 Auxiliary, R3 Auxiliary, R4 Alarm, R5 Block, R6 Service, All Relays, No Relays

In addition to the simulation modes, the **TEST OUTPUT RELAYS** setpoint group may be used during startup or testing to verify that the output relays are functioning correctly.

The output relays can only be forced to operate only if the motor is stopped and there are no trips, alarms, or start blocks active. If any relay is forced to operate, the relay will toggle from its normal state when there are no trips, alarms, or blocks to its active state. The appropriate relay indicator will illuminate at that time. Selecting "Disabled" places the output relays back in service. If the 469 measures phase current or control power is cycled, the **FORCE OPERATION OF RELAYS** setpoint will automatically become disabled and the output relays will revert back to their normal states.

If any relay is forced, the 469 In Service LED will flash, indicating that the 469 is not in protection mode.

4.14.5 TEST ANALOG OUTPUT

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨⇩ TEST ANALOG OUTPUT

			Range
■ TEST ANALOG OUTPUT ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	FORCE ANALOG OUTPUTS FUNCTION: Disabled	Range: Enabled, Disabled
	ESCAPE MESSAGE ⇳	ANALOG OUTPUT 1 FORCED VALUE: 0%	Range: 0 to 100%, step 1
	ESCAPE MESSAGE ⇳	ANALOG OUTPUT 2 FORCED VALUE: 0%	Range: 0 to 100%, step 1
	ESCAPE MESSAGE ⇳	ANALOG OUTPUT 3 FORCED VALUE: 0%	Range: 0 to 100%, step 1
	ESCAPE MESSAGE ⇧	ANALOG OUTPUT 4 FORCED VALUE: 0%	Range: 0 to 100%, step 1

In addition to the simulation modes, the **TEST ANALOG OUTPUT** setpoint group may be used during startup or testing to verify that the analog outputs are functioning correctly.

The analog outputs can only be forced if the motor is stopped and there are no trips, alarms, or start blocks active. When the **FORCE ANALOG OUTPUTS FUNCTION** is "Enabled", the output reflects the forced value as a percentage of the 4 to 20 mA or 0 to 1 mA range. Selecting "Disabled" places all four analog output channels back in service, reflecting the parameters programmed to each. If the 469 measures phase current or control power is cycled, the **FORCE ANALOG OUTPUTS FUNCTION** is automatically disabled and all analog outputs revert back to their normal state.

Any time the analog outputs are forced, the 469 In Service LED will flash, indicating that the 469 is not in protection mode.

4.14.6 COMM PORT MONITOR

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨⇩ COMM PORT MONITOR

■ COMM PORT MONITOR ■ [ENTER] for more	ENTER / ESCAPE	MONITOR COMM. PORT: Computer RS485	Range: Computer RS485, Auxiliary RS485, Front Panel RS232
	ESCAPE / MESSAGE	CLEAR COMM. BUFFERS: No	Range: No, Yes
	ESCAPE / MESSAGE	LAST Rx BUFFER: Received OK	Range: Buffer Cleared, Received OK, Wrong Slave Addr., Illegal Function, Illegal Count, Illegal Reg. Addr., CRC Error, Illegal Data
	ESCAPE / MESSAGE	Rx1: 02,03,00,67,00, 03,B4,27,//----------	Range: received data in HEX
	ESCAPE / MESSAGE	Rx2: ---------------- ----------------------	Range: received data in HEX
	ESCAPE / MESSAGE	Tx1: 02,03,06,00,64, 00,0A,00,0F//---------	Range: received data in HEX
	ESCAPE / MESSAGE	Tx2: ---------------- ----------------------	Range: received data in HEX

During the course of troubleshooting communications problems, it can be very useful to see the data that is first being transmitted to the 469 from some master device, and then see the data that the 469 transmits back to that master device. The messages shown here should make it possible to view that data. Any of the three communications ports may be monitored. After the communication buffers have been cleared, any data received from the communications port being monitored will be stored in the Rx1 and Rx2 buffers with '//' acting as a character break between messages. If the 469 transmits a message, it will appear in the Tx1 and Tx2 buffers. In addition to these buffers, there is a message that will indicate the status of the last received message.

4.14.7 GEPM USE ONLY

PATH: SETPOINTS ⇨⇩ S13 469 TESTING ⇨⇩ GEPM USE ONLY

■ GEPM USE ONLY ■ [ENTER] for more	ENTER / ESCAPE	GEPM USE ONLY CODE: 0	Range: N/A

This section is for use by GE Multilin personnel for testing and calibration purposes.

4.15.1 DESCRIPTION

The two-speed motor feature provides proper protection for a two-speed motor where there will be two different full load values. The algorithm integrates the heating at each speed into one thermal model using a common thermal capacity used register value for both speeds.

If the two-speed motor feature is used, Assignable Input 4 is dedicated as the two-speed motor monitor and terminals D22 and D23 are monitored for a contact closure. Contact closure signifies that the motor is in Speed 2; if the input is open, it signifies that the motor is in Speed 1. This allows the 469 to determine which setpoints should be active at any given point in time. Two-speed motor protection is enabled with the **S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ ENABLE 2-SPEED MOTOR PROTECTION** setpoint.

4.15.2 SPEED 2 O/L SETUP

PATH: SETPOINTS ⇨⇩ S14 TWO-SPEED MOTOR ⇨ SPEED 2 O/L SETUP

■ SPEED 2 O/L SETUP ■ [ENTER] for more	
SPEED2 STANDARD CURVE NUMBER: 4	*Range: 1 to 15 in steps of 1. Seen only if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.01 x FLA: 17414.5 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.05 x FLA: 3414.9 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.10 x FLA: 1666.7 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.20 x FLA: 795.4 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.30 x FLA: 507.2 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.40 x FLA: 364.6 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.50 x FLA: 280.0 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 1.75 x FLA: 169.7 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 2.00 x FLA: 116.6 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 2.25 x FLA: 86.1 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 2.50 x FLA: 66.6 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 2.75 x FLA: 53.3 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 3.00 x FLA: 43.7 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 3.25 x FLA: 36.6 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*
SPEED2 TRIP AT 3.50 x FLA: 31.1 s	*Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.*

SPEED2 TRIP AT 3.75 x FLA: 26.8 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 4.00 x FLA: 23.2 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 4.25 x FLA: 20.5 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 4.50 x FLA: 18.2 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 4.75 x FLA: 16.2 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 5.00 x FLA: 14.6 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 5.50 x FLA: 12.0 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 6.00 x FLA: 10.0 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 6.50 x FLA: 8.5 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 7.00 x FLA: 7.3 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 10.0 x FLA: 5.6 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 15.0 x FLA: 5.6 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 TRIP AT 20.0 x FLA: 5.6 s	Range: 0.5 to 99999.9 in steps of 0.1. Cannot be altered if Standard Curve Style is selected.
SPEED2 MIN ALLOWABLE LINE VOLTAGE: 80%	Range: 70 to 95% in steps of 1. Seen only if Voltage Dependent Curve Style is selected
SPEED2 ISTALL @ MIN Vline: 4.80 x FLA	Range: 2.00 to 15.00 x FLA in steps of 0.01. Seen only if Voltage Dependent Curve Style is selected
SPEED2 SAFE STALL @ MIN Vline: 20.0 s	Range: 0.5 to 999.9 s in steps of 0.1. Seen only if Voltage Dependent Curve Style is selected
SPEED2 ACL INTERSECT @ MIN Vline: 3.80 x FLA	Range: 2.00 to **ISTALL@MIN_VLINE** x FLA in steps of 0.01. Seen only if Voltage Dependent Curve Style is selected
SPEED2 ISTALL @ 100% Vline: 6.00 x FLA	Range: 2.00 to 15.00 x FLA in steps of 0.01. Seen only if Voltage Dependent Curve Style is selected
SPEED2 SAFE STALL @ 100% Vline: 10.0 s	Range: 0.5 to 999.9 s in steps of 0.1. Seen only if Voltage Dependent Curve Style is selected
SPEED 2 ACL INTERSECT @100% Vlin: 5.00 x FLA	Range: 2.00 to **ISTALL@MIN_VLINE** x FLA in steps of 0.01. Seen only if Voltage Dependent Curve Style is selected

All the Thermal Model parameters set for Speed 1 will be identical for Speed 2. A second overload curve setup may be programmed here for Speed 2, High Speed.

4.15.3 SPEED 2 UNDERCURRENT

PATH: SETPOINTS ⇨⇩ S14 TWO-SPEED MOTOR ⇨⇩ SPEED2 U/C

■ SPEED2 U/C ■ [ENTER] for more	
BLOCK SPEED2 U/C FROM START: 0 s	Range: 0 to 15000 s in steps of 1
SPEED2 U/C ALARM: Off	Range: Off, Latched, Unlatched
SPEED2 U/C ALARM PICKUP: 0.70 x FLA	Range: 0.10 to 0.95 x FLA in steps of 0.01
SPEED2 U/C ALARM DELAY: 1 s	Range: 1 to 60 s in steps of 1
SPEED2 U/C ALARM EVENTS: Off	Range: On, Off
SPEED2 U/C TRIP: Off	Range: Off, Latched, Unlatched
SPEED2 U/C TRIP PICKUP: 0.70 x FLA	Range: 0.10 to 0.99 x FLA in steps of 0.01
SPEED2 U/C TRIP DELAY: 1 s	Range: 1 to 60 s in steps of 1

The addition of a second Undercurrent trip or alarm level may be useful as it will indicate if the wrong setpoints are being used for the wrong speed i.e. normal running current for Speed 2 may be undercurrent for Speed 1.

4.15.4 SPEED 2 ACCELERATION

PATH: SETPOINTS ⇨⇩ S14 TWO-SPEED MOTOR ⇨⇩ SPEED2 ACCEL.

■ SPEED2 ACCEL. ■ [ENTER] for more	
SPEED2 ACCEL. TIMER FROM START: 10.0 s	Range: 1.0 to 250.0 s in steps of 0.1
ACCEL. TIMER FROM SPEED1-2: 10.0 s	Range: 1.0 to 250.0 s in steps of 0.1
SPEED SWITCH TRIP SPEED2 DELAY: 5.0 s	Range: 1.0 to 250.0 s in steps of 0.1. Seen only if one of the digital inputs is assigned as Speed Switch
SPEED2 RATED SPEED: 3600 RPM	Range: 100 to 7200 RPM in steps of 0.1. Seen only if one of the digital inputs is assigned as Tachometer.

Two additional acceleration timers are provided for the two speed motor feature. One timer is for a start in Speed 2 from a stopped condition. The other is an acceleration timer for the transition from Speed 1 to Speed 2. Also, while the motor is running, the 469 will ignore Mechanical Jam protection during the acceleration from Speed 1 to Speed 2 until the motor current has dropped below Speed 2 FLA × Overload Pickup value, or the Speed 1-2 acceleration time has expired. At that point in time, the Mechanical Jam feature will be enabled with the Speed 2 FLA

5.1.1 ACTUAL VALUES MESSAGE MAP

■■ A1 ACTUAL VALUES ■■ STATUS	■ MOTOR STATUS ■ [ENTER] for more	See page 5-3.
	■ LAST TRIP DATA ■ [ENTER] for more	See page 5-3.
	■ ALARM STATUS ■ [ENTER] for more	See page 5-5.
	■ START BLOCKS ■ [ENTER] for more	See page 5-7.
	■ DIGITAL INPUTS ■ [ENTER] for more	See page 5-8.
	■ REAL TIME CLOCK ■ [ENTER] for more	See page 5-8.

■■ A2 ACTUAL VALUES ■■ METERING DATA	■ CURRENT METERING ■ [ENTER] for more	See page 5-9.
	■ TEMPERATURE ■ [ENTER] for more	See page 5-10.
	■ VOLTAGE METERING ■ [ENTER] for more	See page 5-11.
	■ SPEED ■ [ENTER] for more	See page 5-11.
	■ POWER METERING ■ [ENTER] for more	See page 5-12.
	■ DEMAND METERING ■ [ENTER] for more	See page 5-13.
	■ ANALOG INPUTS ■ [ENTER] for more	See page 5-13.
	■ PHASORS ■ [ENTER] for more	See page 5-14.

■■ A3 ACTUAL VALUES ■■ LEARNED DATA	■ MOTOR STARTING ■ [ENTER] for more	See page 5-16.
	■ AVERAGE MOTOR LOAD ■ [ENTER] for more	See page 5-16.
	■ RTD MAXIMUMS ■ [ENTER] for more	See page 5-17.
	■ ANALOG IN MIN/MAX ■ [ENTER] for more	See page 5-18.

5

```
■■ A4 ACTUAL VALUES        ENTER / ESCAPE     ■ TRIP COUNTERS          See page 5-19.
■■ MAINTENANCE                                ■ [ENTER] for more

                           ESCAPE / MESSAGE   ■ GENERAL COUNTERS       See page 5-20.
                                              ■ [ENTER] for more

                           ESCAPE / MESSAGE   ■ TIMERS                 See page 5-21.
                                              ■ [ENTER] for more

        ESCAPE / MESSAGE

■■ A5 ACTUAL VALUES        ENTER / ESCAPE     ■ [ENTER] EVENT 01       See page 5-22.
■■ EVENT RECORD                               ■ [ENTER] for more

                           ESCAPE / MESSAGE   ■ [ENTER] EVENT 02
                                              ■ [ENTER] for more
                                                      ↓
                           ESCAPE / MESSAGE   ■ [ENTER] EVENT 40
                                              ■ [ENTER] for more

        ESCAPE / MESSAGE

■■ A6 ACTUAL VALUES        ENTER / ESCAPE     ■ 469 MODEL INFO.        See page 5-24.
■■ PRODUCT INFO                               ■ [ENTER] for more

                           ESCAPE / MESSAGE   ■ CALIBRATION INFO.      See page 5-24.
                                              ■ [ENTER] for more
```


5.1.2 DESCRIPTION

Measured values, maintenance and fault analysis information are accessed in Actual Value mode. Actual values may be accessed via one of the following methods:

1. The front panel, using the keys and display.
2. The front program port and a portable computer running the 469PC software supplied with the relay.
3. The rear terminal RS485 port and a PLC/SCADA system running user-written software.

Any of these methods can be used to view the same information. A computer makes viewing much more convenient, since many variables may be viewed at the same time. Actual value messages are organized into logical groups, or pages, for easy reference. All actual value messages are illustrated and described in blocks throughout this chapter. All values shown in these message illustrations assume that no inputs (besides control power) are connected to the 469.

In addition to the actual value messages, there are also diagnostic messages and flash messages that appear when certain conditions occur. Diagnostic messages are described in Section 5.8.1: Diagnostic Messages on page 5–25. Flash messages are described in Section 5.8.2: Flash Messages on page 5–26.

5.2.1 MOTOR STATUS

PATH: ACTUAL VALUES ⇨ A1 STATUS ⇨ MOTOR STATUS

```
■ MOTOR STATUS
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

```
MOTOR STATUS:
Stopped
```

Range: Tripped, Stopped, Starting, Running, Overload

ESCAPE / MESSAGE ⇕

```
MOTOR THERMAL
CAPACITY USED: 0%
```

Range: 0 to 100%

ESCAPE / MESSAGE ⇕

```
ESTIMATED TRIP TIME
ON OVERLOAD: Never
```

Range: 0 to 10000 sec., Never

ESCAPE / MESSAGE ⇑

```
MOTOR SPEED:
Low Speed
```

Range: HIgh Speed, Low Speed
Seen only if Two Speed Motor feature is enabled

These messages describe the motor status at any given point in time. If the motor has been tripped and the 469 has not yet been reset, the **MOTOR STATUS** value will be "Tripped". The **MOTOR THERMAL CAPACITY USED** reflects an integrated value of both the Stator and Rotor Thermal Capacity Used. The values for **ESTIMATED TRIP TIME ON OVERLOAD** appear whenever the 469 picks up on the overload curve.

5.2.2 LAST TRIP DATA

PATH: ACTUAL VALUES ⇨ A1 STATUS ⇨⇩ LAST TRIP DATA

```
■ LAST TRIP DATA
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

```
CAUSE OF LAST TRIP:
No Trip to Date
```

Range: No Trip to Date, Incomplete Sequence, Remote Trip, Speed Switch, Load Shed, Pressure Switch, Vibration Switch, General Sw, Overload, Short Circuit, Mechanical Jam, Undercurrent, Current Unbalance, Ground Fault, Phase Differential, Acceleration, Tachometer, RTD #1 to #12, Undercurrent, Overvoltage, Phase Reversal, Frequency, Reactive Power, Power Factor, Underpower, Analog Inputs 1 to 4

ESCAPE / MESSAGE ⇕

```
TIME OF LAST TRIP:
09:00:00.00
```

Range: hour:min:sec

ESCAPE / MESSAGE ⇕

```
DATE OF LAST TRIP:
Jan 01 1995
```

Range: Month Day Year

ESCAPE / MESSAGE ⇕

```
MOTOR SPEED DURING
TRIP: Low Speed
```

Range: High Speed, Low Speed
Seen only if Two-Speed Motor is enabled

ESCAPE / MESSAGE ⇕

```
TACHOMETER
PRETRIP: 3600 RPM
```

Range: 0 to 3600 RPM. Seen only if an Assignable Digital Input is programmed as Tachometer.

ESCAPE / MESSAGE ⇕

```
A:         0   B:         0
C:         0  A PreTrip
```

Range: 0 to 100000 A

ESCAPE / MESSAGE ⇕

```
MOTOR LOAD:
0.00 x FLA PreTrip
```

Range: 0.00 to 20.00 x FLA

ESCAPE / MESSAGE ⇕

```
CURRENT UNBALANCE
PRETRIP: 0%
```

Range: 0 to 100%

ESCAPE / MESSAGE ⇕

```
GROUND CURRENT
PRETRIP: 0.00 Amps
```

Range: 0.0 to 5000.0 A

ESCAPE / MESSAGE ⇕

```
A:     0   B:     0
C:     0  A Diff.PreTrip
```

Range: 0 to 5000 A. Not seen if Differential CT is programmed as None

5

HOTTEST STATOR RTD RTD #1: 0°C PreTrip	Range: –50 to 250°C. Seen only if at least 1 RTD programmed as Stator
HOTTEST STATOR RTD RTD #7: 0°C PreTrip	Range: –50 to 250°C. Seen only if at least 1 RTD programmed as Bearing
HOTTEST STATOR RTD RTD #11: 0°C PreTrip	Range: –50 to 250°C. Seen only if at least 1 RTD programmed as Other
AMBIENT RTD RTD#12: 0°C PreTrip	Range: –50 to 250°C. Seen only if at least 1 RTD programmed as Ambient
Vab: 0 Vbc: 0 Vca: 0 V PreTrip	Range: 0 to 20000 V. Not seen if VT Connection is programmed as None
Van: 0 Vbn: 0 Vcn: 0 V PreTrip	Range: 0 to 20000 V. Not seen if VT Connection is programmed as Wye
PRETRIP SYSTEM FREQUENCY: 0.00 Hz	Range: 0.00, 20.00 to 120.00 Hz. Not seen if VT Connection is programmed as None
0 kW 0 kVA 0 kvar PreTrip	Range: –50000 to 50000 kVA. Not seen if VT Connection is programmed as None
POWER FACTOR PreTrip: 0.00	Range: 0.01 to 0.99 Lead or Lag, 0.00, 1.00. Not seen if VT Connection is programmed as None
ANALOG INPUT 1 PreTrip: 0 Units	Range: –50000 to 50000. Not seen if VT Connection is programmed as None
ANALOG INPUT 2 PreTrip: 0 Units	Range: –50000 to 50000. Not seen if VT Connection is programmed as None
ANALOG INPUT 3 PreTrip: 0 Units	Range: –50000 to 50000. Not seen if VT Connection is programmed as None
ANALOG INPUT 4 PreTrip: 0 Units	Range: –50000 to 50000. Not seen if VT Connection is programmed as None

Immediately prior to issuing a trip, the 469 takes a snapshot of motor parameters and stores them as pre-trip values that allow for troubleshooting after the trip occurs. The **CAUSE OF LAST TRIP** message is updated with the current trip and the screen defaults to that message. All trip features are automatically logged as date and time stamped events as they occur. This information may include motor speed (2-Speed feature or Assignable Digital Input), phase and ground currents, RTD temperatures, voltages, frequency, power quantities, and analog inputs. This information can be cleared using the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ CLEAR TRIP COUNTERS** setpoint.

NOTE Phase, differential, and ground currents are recorded 1 cycle prior to the trip. All other pre-trip data is recorded 50 ms prior to the trip. Thus some values will not be recorded upon instantaneous trips during a start if the trip is less than 50 ms.

5.2.3 ALARM STATUS

PATH: ACTUAL VALUES ⇨ A1 STATUS ⇨⇩ ALARM STATUS

■ ALARM STATUS ■ [ENTER] for more	
NO ALARMS	Range: N/A Message seen when no alarms are active
REMOTE ALARM STATUS: Active	Range: Active, Latched. The first line of this message reflects the Switch Name as programmed. The status is Active if the condition that caused the alarm is still present
PRESSURE SWITCH ALARM STATUS: Active	Range: Active, Latched. Status is Active if condition causing the Alarm still present
VIBRATION SWITCH ALARM STATUS: Active	Range: Active, Latched. Status is Active if condition causing the Alarm still present
DIG. COUNTER ALARM: 1 000 000 000 Units	Range: 1 to 9999999999 Displays current value of digital counter
TACHOMETER ALARM: 3000 RPM	Range: 0 to 3600 RPM Displays current Tachometer Digital Input value
GENERAL SW. A ALARM STATUS: Active	Range: Active, Latched. The first line of this message reflects the Switch Name as programmed. The status is Active if the condition that caused the alarm is still present
THERMAL CAPACITY ALARM: 100% USED	Range: 1 to 100 Thermal Capacity Used value is shown here
XX.XX x FLA OVERLOAD TIME TO TRIP: XXXXX s	Range: 0 to 99999 sec. Displays overload level and estimated time to trip
UNDERCURRENT ALARM Ia = 85 A 85% FLA	Range: 1 to 5000 A; 5 to 99% FLA Value of lowest phase current is shown here
CURRENT UNBALANCE ALARM: 15%	Range: 0 to 100% Reflects the present unbalance level
GROUND FAULT ALARM: 25.3 A	Range: 0.1 to 5000 A Reflects the present ground current level
STATOR RTD #1 ALARM: 135°C	Range: –50 to 250°C. The first line of this alarm message reflects the RTD Name as programmed. Reflects present RTD temperature
OPEN SENSOR ALARM: RTD # 1 2 3 4 5 6...	Range: the RTD number with the open sensor as programmed for RTDs 1 to 12
SHORT/LOW TEMP ALARM RTD # 7 8 9 10 11...	Range: 1 to 12 Shows RTD with the short/low temperature alarm
UNDERVOLTAGE ALARM Vab= 3245 V 78% Rated	Range: 0 to 20000 V; 50 to 99% of Rated Value of lowest line-to-line voltage is shown here
OVERVOLTAGE ALARM Vab= 4992 V 120%	Range: 0 to 20000 V; 101 to 150% of Rated Value of lowest line-to-line voltage is shown here
SYSTEM FREQUENCY ALARM: 59.4 Hz	Range: 0.00, 20.00 to 120.00 Hz System voltage frequency value is shown here
POWER FACTOR ALARM PF: 0.00	Range: 0.00 to 0.99 Lead or Lag, 0.00, 1.00 Current Power Factor is shown here

5

REACTIVE POWER ALARM: +2000 kvar	*Range: –50000 to +50000 kvar Current kvar value is shown here*
UNDERPOWER ALARM: 200 kW	*Range: –50000 to +50000 kW Current kW value is shown here*
TRIP COUNTER ALARM: 25 Trips	*Range: 1 to 10000 Trips Total number of motor trips is displayed here*
STARTER FAILURE: Trip Coil Super	*Range: Trip Coil Super, Welded Contactor, Breaker Failure. The type of failure is displayed here*
CURRENT DEMAND ALARM: 1053 A	*Range: 1 to 10000 A Displays the current Running Current Demand*
kW DEMAND ALARM: 505 kW	*Range: –50000 to +50000 kW Current Running kW Demand is shown here*
kvar DEMAND ALARM: -2000 kvar	*Range: –50000 to +50000 kvar Current Running kvar Demand is shown here*
kVA DEMAND ALARM: 2062 kVA	*Range: 0 to 50000 kVA Current Running kVA Demand is shown here*
ANALOG I/P 1 ALARM: 201 Units	*Range: –50000 to +50000. Reflects the Analog Input Name as programmed. The Analog Input level is shown here.*
EMERGENCY RESTART: Trip Still Present	*Range: Trip Still Present, Block Still Present, No Trips & No Blocks*
ALARM, 469 NOT INSERTED PROPERLY	*Range: If the 469 chassis is only partially engaged with the case, this service alarm appears after 1 sec. Secure the chassis handle to ensure that all contacts mate properly*
469 NOT IN SERVICE Not Programmed	*Range: Not Programmed, Output Relays Forced, Analog Output Forced, Test Switch Shorted*
RTD #1 HI ALARM: 135°C	*Range: 1 to 250°C. Similar Hi Alarms will occur for other RTDs. The message reflects the Alarm Name as programmed*
ANALOG 1-2 ALARM: 50%	*Range: 0 to 999 (% Diff) or 0 to 99999 (Abs Diff) The alarm message reflects the Alarm Name as programmed*
ANALOG 3-4 ALARM: 50%	*Range: 0 to 999 (% Diff) or 0 to 99999 (Abs Diff) The alarm message reflects the Alarm Name as programmed*
OVERTORQUE ALARM: 0.00	*Range: 0.00 to 999999.9 Nm*

Any active alarms may be viewed here.

5

5.2.4 START BLOCKS

PATH: ACTUAL VALUES ⇨ A1 STATUS ⇨⇩ START BLOCKS

■ START BLOCKS
■ [ENTER] for more

NO START BLOCKS ACTIVE	*Range: N/A Message seen when no start blocks are active*
OVERLOAD LOCKOUT BLOCK: 25 min.	*Range: 0 to 500 min. Message seen only after an overload trip*
START INHIBIT BLOCK LOCKOUT TIME: 20 min.	*Range: 0 to 500 min.*
STARTS/HOUR BLOCK LOCKOUT TIME: 20 min.	*Range: 0 to 60 min.*
TIME BETWEEN STARTS LOCKOUT TIME: 20 min.	*Range: 0 to 500 min.*
RESTART BLOCK LOCKOUT: 1200 s	*Range: 0 to 50000 sec.*
WARNING 469 NOT PROGRAMMED	*Range: N/A. Seen only if Phase CT Primary and Motor FLA not programmed*

Any active blocking functions may be viewed here.

5.2.5 DIGITAL INPUTS

PATH: ACTUAL VALUES ⇨ A1 STATUS ⇨⇩ DIGITAL INPUTS

■ DIGITAL INPUTS ■ [ENTER] for more	
ACCESS SWITCH STATE: Open	*Range: Open, Shorted*
TEST SWITCH STATE: Open	*Range: Open, Shorted*
STARTER STATUS SWITCH STATE: Open	*Range: Open, Shorted*
EMERGENCY RESTART SWITCH STATE: Open	*Range: Open, Shorted*
REMOTE RESET SWITCH STATE: Open	*Range: Open, Shorted*
ASSIGNABLE DIGITAL INPUT1 STATE: Open	*Range: Open, Shorted*
ASSIGNABLE DIGITAL INPUT2 STATE: Open	*Range: Open, Shorted*
ASSIGNABLE DIGITAL INPUT3 STATE: Open	*Range: Open, Shorted*
ASSIGNABLE DIGITAL INPUT4 STATE: Open	*Range: Open, Shorted*
TRIP COIL SUPERVISION: No Coil	*Range: Coil, No Coil*

The messages shown here may be used to monitor Digital Input status. This may be useful during relay testing or during installation.

NOTE: Digital Input states will read as shorted if assigned as a tachometer.

5.2.6 REAL TIME CLOCK

PATH: ACTUAL VALUES ⇨ A1 STATUS ⇨⇩ REAL TIME CLOCK

■ REAL TIME CLOCK ■ [ENTER] for more	
DATE: 01/01/1994 TIME: 12:00:00	*Range: 01 to 12 / 01 to 31 / 1995 to 2094*

The time and date from the 469 real time clock may be viewed here.

5.3.1 CURRENT METERING

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨ CURRENT METERING

```
■ CURRENT METERING
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

A: 0 B: 0 C: 0 Amps	Range: 0 to 100000 A
AVERAGE PHASE CURRENT: 0 Amps	Range: 0 to 100000 A
MOTOR LOAD: 0.00 x FLA	Range: 0.00 to 20.00 x FLA
CURRENT UNBALANCE: 0%	Range: 0 to 99.99%
U/B BIASED MOTOR LOAD: 0.00 x FLA	Range: 0.00 to 20.00 x FLA
GROUND CURRENT: 0.0 Amps	Range: 0.0 to 5000.0 A Seen only if Ground CT has 1 A or 5 A secondary
GROUND CURRENT: 0.00 Amps	Range: 0.00 to 25.00 A Seen only if Ground CT is 50:0.025
A: 0 B: 0 C: 0 Amps Diff.	Range: 0 to 5000 A

All measured current values are displayed here. The **CURRENT UNBALANCE** is defined as the ratio of negative-sequence to positive-sequence current, I_2 / I_1 when the motor is operating at a load (I_{avg}) greater than FLA. If the motor I_{avg} is less than FLA, unbalance is defined as $I_2 / I_1 \times I_{avg} / \text{FLA}$. This derating is necessary to prevent nuisance alarms and trips when a motor is lightly loaded. The **U/B BIASED MOTOR LOAD** value shows the equivalent motor heating current caused by the unbalance k factor.

5

5.3.2 TEMPERATURE

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ TEMPERATURE

```
■ TEMPERATURE
■ [ENTER] for more
```

HOTTEST STATOR RTD RTD#1: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Only seen if at least 1 RTD is set as Stator*
RTD #1 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #2 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #3 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted) Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #4 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #5 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #6 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted) Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #7 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #8 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #9 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted) Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #10 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #11 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*
RTD #12 TEMPERATURE: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set as None; reflects RTD Name as programmed*

The current level of the 12 RTDs is displayed here. If the RTD is not connected, the value will be "No RTD".

If no RTDs are programmed in **S8 RTD TEMPERATURE**, the following flash message will appear when an attempt is made to enter this group of messages.

```
THIS FEATURE NOT
PROGRAMMED
```

5.3.3 VOLTAGE METERING

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ VOLTAGE METERING

■ VOLTAGE METERING ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	Vab: 0 Vbc: 0 Vca: 0 Volts	Range: 0 to 20000 V. Not seen if VT Connection is programmed as None
	ESCAPE / MESSAGE	AVERAGE LINE VOLTAGE: 0 Volts	Range: 0 to 20000 V. Not seen if VT Connection is programmed as None
	ESCAPE / MESSAGE	Van: 0 Vbn: 0 Vcn: 0 Volts	Range: 0 to 20000 V. Seen only if VT Connection is programmed as Wye
	ESCAPE / MESSAGE	AVERAGE PHASE VOLTAGE: 0 Volts	Range: 0 to 20000 V. Seen only if VT Connection is programmed as Wye
	ESCAPE / MESSAGE	SYSTEM FREQUENCY: 0.00 Hz	Range: 0.00, 20.00 to 120.00 Hz

Measured voltage parameters will be displayed here.

If no VT connection type is programmed for the S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨⇩ VT CONNECTION TYPE setpoint, the following flash message will appear when an attempt is made to enter this group of messages.

```
THIS FEATURE NOT
PROGRAMMED
```

5.3.4 SPEED

5

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ SPEED

■ SPEED ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	TACHOMETER: 0 RPM	Range: 0 to 3600 RPM Seen only if a Digital Input is configured as Tachometer

If the Tachometer function is assigned to one of the digital inputs, the tachometer readout may be viewed here.

If no digital input is configured as tachometer in S3 DIGITAL INPUTS ⇨⇩ ASSIGNABLE INPUT1(4), the following flash message will appear when an attempt is made to enter this group of messages.

```
THIS FEATURE NOT
PROGRAMMED
```

5.3.5 POWER METERING

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ POWER METERING

```
■ POWER METERING
■ [ENTER] for more
```

ENTER / ESCAPE / MESSAGE	
POWER FACTOR: 0.00	Range: 0.01 to 0.99 Lead or Lag, 0.00, 1.00
REAL POWER: 0 kW	Range: 0 to ±99999 kW
REAL POWER: 0 hp	Range: 0 to 65535 hp
REACTIVE POWER: 0 kvar	Range: 0 to ±99999 kvar
APPARENT POWER: 0 kVA	Range: 0 to 65535 kVA
POSITIVE WATTHOURS: 0.000 MWh	Range: 0.000 to 999999.999 MWh
POSITIVE VARHOURS: 0.000 Mvarh	Range: 0.000 to 999999.999 Mvarh
NEGATIVE VARHOURS: 0.000 Mvarh	Range: 0.000 to 999999.999 Mvarh
TORQUE: 000.0 Nm	Range: 0.00 to 999999.9 Nm Seen only if Torque Metering is enabled

The values for power metering and 3-phase total power quantities are displayed here. Watthours and varhours can also be seen here.

NOTE

An induction motor by convention consumes Watts and vars (+Watts and +vars). A synchronous motor can generate vars (–vars) and feed them back to the power system.

If the S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨⇩ VOLTAGE TRANSFORMER RATIO setpoint is not programmed, the following flash message appears when an attempt is made to enter this group of messages.

```
THIS FEATURE NOT
PROGRAMMED
```

NOTE

Real Power (hp) is converted directly from Real Power (kW). This display-only value is not used for protection functions. This message will not display more than 65535 hp regardless of the actual kW that are being metered.

5.3.6 DEMAND METERING

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ DEMAND METERING

■ DEMAND METERING ■ [ENTER] for more	
CURRENT DEMAND: 0 Amps	*Range: 0 to 100000 A*
REAL POWER DEMAND: 0 kW	*Range: 0 to 50000 kW* *Not seen if VT Ratio is programmed as None*
REACTIVE POWER DEMAND: 0 kvar	*Range: 0 to 50000 kvar* *Not seen if VT Ratio is programmed as None*
APPARENT POWER DEMAND: 0 kVA	*Range: 0 to 50000 kVA* *Not seen if VT Ratio is programmed as None*
PEAK CURRENT DEMAND: 0 Amps	*Range: 0 to 100000 A* *Not seen if VT Ratio is programmed as None*
PEAK REAL POWER DEMAND: 0 kW	*Range: 0 to 50000 kW* *Mot seen if VT Ratio is programmed as None*
PEAK REACTIVE POWER DEMAND: 0 kvar	*Range: 0 to 50000 kvar* *Not seen if VT Ratio is programmed as None*
PEAK APPARENT POWER DEMAND: 0 kVA	*Range: 0 to 50000 kVA* *Not seen if VT Ratio is programmed as None*

The values for current and power demand are shown. Peak Demand information is cleared with the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ CLEAR PEAK DEMAND DATA** setpoint. Demand is shown only for positive real and positive reactive power.

5.3.7 ANALOG INPUTS

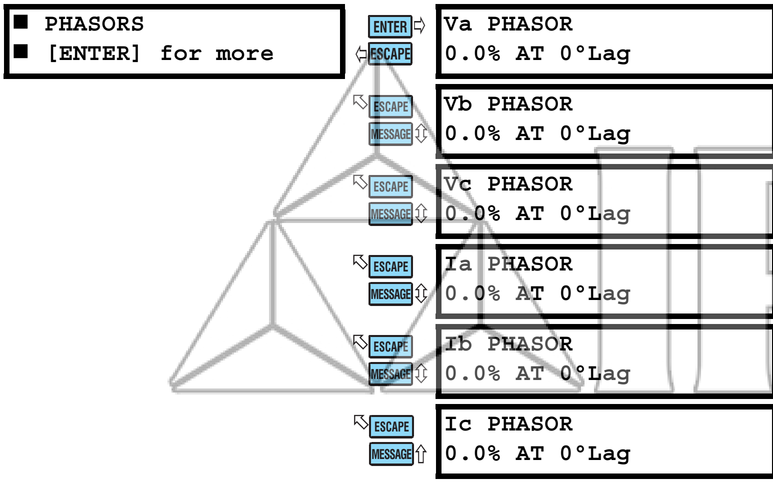
PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ ANALOG INPUTS

■ ANALOG INPUTS ■ [ENTER] for more	
ANALOG I/P 1 0 Units	*Range: –50000 to 50000* *Seen only if Analog Input is programmed.* *Reflects Analog Input Name as programmed*
ANALOG I/P 2 0 Units	*Range: –50000 to 50000* *Seen only if Analog Input is programmed.* *Reflects Analog Input Name as programmed*
ANALOG I/P 3 0 Units	*Range: –50000 to 50000* *Seen only if Analog Input is programmed.* *Reflects Analog Input Name as programmed*
ANALOG I/P 4 0 Units	*Range: –50000 to 50000* *Seen only if Analog Input is programmed.* *Reflects Analog Input Name as programmed*
ANALOG 1-2 0 Percent	*Range: –5100 to 4900%* *Seen only if Analog In Diff 1-2 set to %Diff* *Reflects Analog Input Name as programmed*
ANALOG 1-2 0 Units	*Range: –100000 to 100000* *Seen only if Analog In Diff 1-2 set to Abs Diff* *Reflects Analog Input Name as programmed*
ANALOG 3-4 0 Percent	*Range: –5100 to 4900%* *Seen only if Analog In Diff 3-4 set to %Diff* *Reflects Analog Input Name as programmed*
ANALOG 3-4 0 Units	*Range: –100000 to 100000* *Seen only if Analog In Diff 3-4 set to Abs Diff* *Reflects Analog Input Name as programmed*

The values for analog inputs are shown here. The name of the input and the units will reflect those programmed for each input. If no analog inputs are programmed in **S12 ANALOG I/O ⇨ ANALOG INPUT 1(4)**, the **THIS FEATURE NOT PROGRAMMED** flash message will appear when an attempt is made to enter this group of messages.

5.3.8 PHASORS

PATH: ACTUAL VALUES ⇨⇩ A2 METERING DATA ⇨⇩ PHASORS



To aid in wiring, the tables on the following page can be used to determine if VTs and CTs are on the correct phases and that their polarity is correct. Problems arising from incorrect wiring are extremely high unbalance levels (CTs) or erroneous power readings (CTs and VTs) or phase reversal trips (VTs).

5

To correct wiring, simply start the motor and record the phasors. Using the tables below along with recorded phasors, system rotation, VT connection type, and motor power factor the correct phasors can be determined. Note that the phase angle for Va (Vab if delta) is always assumed to be 0° and is the reference for all angle measurements.

Common problems include: Phase currents 180° from proper location (CT polarity reversed)
Phase currents or voltages 120 or 240° out (CT/VT on wrong phase)

Table 5–1: THREE-PHASE WYE VT CONNECTION

ABC Rotation	72.5° = 0.3 pf lag	45° = 0.7 pf lag	0° = 1.00 pf	–45° = 0.7 pf lead	–72.5° = 0.2 pf lead
Va	0	0° lag	0° lag	0° lag	0
Vb	120	120	120	120	120
Vc	240	240	240	240	240
Ia	75	45	0	315	285
Ib	195	165	120	75	45
Ic	315	285	240	195	165
kW	+	+	+	+	+
kVAR	+	+	0	–	–
kVA	+	+	+ (= kW)	+	+
ACB Rotation	**72.5° = 0.3 pf lag**	**45° = 0.7 pf lag**	**0° = 1.00 pf**	**–45° = 0.7 pf lead**	**–72.5° = 0.2 pf lead**
Va	0	0° lag	0° lag	0° lag	0
Vb	240	240	240	240	240
Vc	120	120	120	120	120
Ia	75	45	0	315	285
Ib	315	285	240	195	165
Ic	195	165	120	75	45
kW	+	+	+	+	+
kVAR	+	+	0	–	–
kVA	+	+	+ (=kW)	+	+

Table 5–2: THREE-PHASE OPEN DELTA VT CONNECTION

ABC Rotation	72.5° = 0.3 pf lag	45° = 0.7 pf lag	0° = 1.00 pf	–45° = 0.7 pf lead	–72.5° = 0.2 pf lead
Va	0	0°	0°	0°	0
Vb	----	----	----	----	----
Vc	300	300	300	300	300
Ia	100	75	30	345	320
Ib	220	195	150	105	80
Ic	340	315	270	225	200
kW	+	+	+	+	+
kVAR	+	+	0	–	–
kVA	+	+	+ (=kW)	+	+
ABC Rotation	**72.5° = 0.3 pf lag**	**45° = 0.7 pf lag**	**0° = 1.00 pf**	**–45° = 0.7 pf lead**	**–72.5° = 0.2 pf lead**
Va	0	0°	0°	0°	0
Vb	----	----	----	----	----
Vc	60	60	60	60	60
Ia	45	15	330	285	260
Ib	285	255	210	165	140
Ic	165	135	90	45	20
kW	+	+	+	+	+
kVAR	+	+	0	–	–
kVA	+	+	+ (=kW)	+	+

5.4.1 MOTOR STARTING

PATH: ACTUAL VALUES ⇨⇩ A3 LEARNED DATA ⇨ MOTOR STARTING

■ MOTOR STARTING ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	LEARNED ACCELERATION TIME: 0.0 s	Range: 0.0 to 200.0 sec.
	ESCAPE MESSAGE ⇳	LEARNED STARTING CURRENT: 0 A	Range: 0 to 50000 A
	ESCAPE MESSAGE ⇳	LEARNED STARTING CAPACITY: 0% used	Range: 0 to 100%
	ESCAPE MESSAGE ⇳	LAST ACCELERATION TIME: 0.0 s	Range: 0.0 to 200.0 sec.
	ESCAPE MESSAGE ⇳	LAST STARTING CURRENT: 0 A	Range: 0 to 50000 A
	ESCAPE MESSAGE ⇧	LAST STARTING CAPACITY: 0% used	Range: 0 to 100%

The 469 learns the acceleration time, the starting current, as well as, the thermal capacity required during motor starts. This data is accumulated based on the last five starts. The 469 also keeps statistics for last acceleration time, last starting current, and last starting capacity. This information can be reset to default using the **S1 469 SETUP ⇨⇩ INSTALLATION ⇨⇩ RESET MOTOR INFORMATION** setpoint.

5

If motor load during starting is relatively consistent, the **LEARNED ACCELERATION TIME** may be used to fine tune the acceleration protection. Learned acceleration time will be the longest time of the last five successful starts. The time is measured from the transition of motor current from zero to greater than overload pickup, until line current falls below the overload pickup level.

LEARNED STARTING CURRENT is measured 200 ms after the transition of motor current from zero to greater than overload pickup. This should ensure that the measured current is symmetrical. The value displayed is the average of the last 5 successful starts. If there are less than 5 starts, 0s will be averaged in for the full 5 starts.

The **LEARNED STARTING CAPACITY** is used to determine if there is enough thermal capacity to permit a start (refer to Section 4.8.2: Start Inhibit on page 4–48 for more information on start inhibit). If there is not enough thermal capacity for a start, a start inhibit will be issued. Starting will be blocked until there is sufficient thermal capacity.

5.4.2 AVERAGE MOTOR LOAD

PATH: ACTUAL VALUES ⇨⇩ A3 LEARNED DATA ⇨⇩ AVERAGE MOTOR LOAD

■ AVERAGE MOTOR LOAD ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	AVERAGE MOTOR LOAD LEARNED: 0.00 x FLA	Range: 0.00 to 20.00

The 469 can learn the average motor load over a period of time. This time is specified by the **S1 469 SETUP ⇨⇩ PREFERENCES ⇨⇩ AVERAGE MOTOR LOAD CALC. PERIOD** setpoint (default 15 minutes). The calculation is a sliding window and is ignored during motor starting.

5.4.3 RTD MAXIMUMS

PATH: ACTUAL VALUES ⇨⇩ A3 LEARNED DATA ⇨⇩ RTD MAXIMUMS

■ RTD MAXIMUMS ■ [ENTER] for more	ENTER ⇨ ⇦ ESCAPE	RTD #1 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Seen only if at least 1 RTD is set as Stator*
	ESCAPE MESSAGE ⇳	RTD #2 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #3 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #4 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #5 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #6 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #7 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #8 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #9 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #10 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇳	RTD #11 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*
	ESCAPE MESSAGE ⇧	RTD #12 MAX. TEMP.: 40°C	*Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed*

The 469 will learn the maximum temperature for each RTD. This information can be cleared using the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ CLEAR RTD MAXIMUMS** setpoint.

If no RTDs are programmed in **S8 RTD TEMPERATURE**, the following flash message will appear when an attempt is made to enter this group of messages.

```
THIS FEATURE NOT
PROGRAMMED
```

5.4.4 ANALOG IN MIN/MAX

PATH: ACTUAL VALUES ⇨⇩ A3 LEARNED DATA ⇨⇩ ANALOG IN MIN/MAX

```
■ ANALOG IN MIN/MAX
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE	ANALOG I/P 1 MIN: 0 Units	Range: –50000 to 50000. Not seen if Analog Input is set as None. Reflects the Analog Input Name as programmed
ESCAPE / MESSAGE ⇳	ANALOG I/P 1 MAX: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed
ESCAPE / MESSAGE ⇳	ANALOG I/P 2 MIN: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed
ESCAPE / MESSAGE ⇳	ANALOG I/P 2 MAX: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed
ESCAPE / MESSAGE ⇳	ANALOG I/P 3 MIN: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed
ESCAPE / MESSAGE ⇳	ANALOG I/P 3 MAX: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed
ESCAPE / MESSAGE ⇳	ANALOG I/P 4 MIN: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed
ESCAPE / MESSAGE ⇧	ANALOG I/P 4 MAX: 0 Units	Range: –50 to 250°C, No RTD (open), ---- (shorted). Not seen if RTD set to None; reflects RTD Name as programmed

The 469 will learn the minimum and maximum values of the analog inputs since they were last cleared. This information can be cleared with the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ CLEAR ANALOG I/P MIN/MAX** setpoint. When the data is cleared, the present value of each analog input will be loaded as a starting point for both minimum and maximum. The name of the input and the units will reflect those programmed for each input.

If no Analog Inputs are programmed in **S12 ANALOG I/O**, the following flash message will appear when an attempt is made to enter this group of messages.

```
THIS FEATURE NOT
PROGRAMMED
```

5.5.1 TRIP COUNTERS

PATH: ACTUAL VALUES ⇨ ⇩ A4 MAINTENANCE ⇨ TRIP COUNTERS

■ TRIP COUNTERS ■ [ENTER] for more	
TOTAL NUMBER OF TRIPS: 0	Range: 0 to 50000
INCOMPLETE SEQUENCE TRIPS: 0	Range: 0 to 50000 Caused by the Reduced Voltage Start feature
INPUT SWITCH TRIPS: 0	Range: 0 to 50000 Caused by Remote, Speed, Load Shed, Pressure, Vibration, or General Purpose Switch Trip features
TACHOMETER TRIPS: 0	Range: 0 to 50000. Caused by Digital Input programmed as Tachometer
OVERLOAD TRIPS: 0	Range: 0 to 50000
SHORT CIRCUIT TRIPS: 0	Range: 0 to 50000
MECHANICAL JAM TRIPS: 0	Range: 0 to 50000
UNDERCURRENT TRIPS: 0	Range: 0 to 50000
CURRENT UNBALANCE TRIPS: 0	Range: 0 to 50000
GROUND FAULT TRIPS: 0	Range: 0 to 50000
PHASE DIFFERENTIAL TRIPS: 0	Range: 0 to 50000
ACCELERATION TIMER TRIPS: 0	Range: 0 to 50000
STATOR RTD TRIPS: 0	Range: 0 to 50000
BEARING RTD TRIPS: 0	Range: 0 to 50000
OTHER RTD TRIPS: 0	Range: 0 to 50000
AMBIENT RTD TRIPS: 0	Range: 0 to 50000
UNDERVOLTAGE TRIPS: 0	Range: 0 to 50000
OVERVOLTAGE TRIPS: 0	Range: 0 to 50000
PHASE REVERSAL TRIPS: 0	Range: 0 to 50000
VOLTAGE FREQUENCY TRIPS: 0	Range: 0 to 50000

POWER FACTOR TRIPS: 0	Range: 0 to 50000
REACTIVE POWER TRIPS: 0	Range: 0 to 50000
REVERSE POWER TRIPS: 0	Range: 0 to 50000
UNDERPOWER TRIPS: 0	Range: 0 to 50000
ANALOG I/P 1 TRIPS: 0	Range: 0 to 50000. Message reflects Analog Input Name/units as programmed
ANALOG I/P 2 TRIPS: 0	Range: 0 to 50000. Message reflects Analog Input Name/units as programmed
ANALOG I/P 3 TRIPS: 0	Range: 0 to 50000. Message reflects Analog Input Name/units as programmed
ANALOG I/P 4 TRIPS: 0	Range: 0 to 50000. Message reflects Analog Input Name/units as programmed
ANALOG 1-2 TRIPS: 0	Range: 0 to 50000. Message reflects Analog Input Name/units as programmed
ANALOG 3-4 TRIPS: 0	Range: 0 to 50000. Message reflects Analog Input Name/units as programmed

A breakdown of number of trips by type is displayed here. When the Total reaches 50000, all counters reset. This information can be cleared using the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ CLEAR TRIP COUNTERS** setpoint.

5.5.2 GENERAL COUNTERS

PATH: ACTUAL VALUES ⇨⇩ A4 MAINTENANCE ⇨⇩ GENERAL COUNTERS

■ GENERAL COUNTERS
■ [ENTER] for more

NUMBER OF MOTOR STARTS: 0	Range: 0 to 50000
NUMBER OF EMERGENCY RESTARTS: 0	Range: 0 to 50000
NUMBER OF STARTER OPERATIONS: 0	Range: 0 to 50000
DIGITAL COUNTER 0 Units	Range: 0 to 1 000 000 000. Seen only if an Assignable Digital Input programmed as Digital Counter.

Two of the 469 general counters count the number of motor starts or start attempts and the number of Emergency Restarts performed to start a given motor over time. This may be useful information when troubleshooting a motor failure. When either of these counters reaches 50000, that counter will reset to 0. This information can be cleared with the **S1 469 SETUP ⇨⇩ INSTALLATION ⇨⇩ RESET MOTOR INFORMATION** setpoint. Another of the 469 General counters will count the number of starter operations performed over time. This counter is incremented any time the motor is stopped, either by a trip or normal stop. This may be useful information for starter maintenance. When the counter reaches 50000, that counter will reset to 0. This information may be cleared with the **S1 469 SETUP ⇨⇩ INSTALLATION ⇨⇩ RESET STARTER INFORMATION** setpoint. If one of the assignable digital inputs is programmed as Digital Counter, that counter measurement will appear here. The counter can be reset to zero if the counter is of the incrementing type or pre-set to a predetermined value using the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ PRESET DIGITAL COUNTER** setpoint.

5.5.3 TIMERS

PATH: ACTUAL VALUES ⇨⇩ A4 MAINTENANCE ⇨⇩ TIMERS

```
■ TIMERS
■ [ENTER] for more
```

ENTER ⇨ / ⇦ ESCAPE

```
MOTOR RUNNING HOURS:
 0 hr
```

Range: 0 to 100000 hrs.

ESCAPE / MESSAGE ⇳

```
TIME BETWEEN STARTS
TIMER: 0 min
```

Range: 0 to 500 min.

ESCAPE / MESSAGE ⇧

```
STARTS/HOUR TIMERS
0    0    0    0    0 min
```

Range: 0 to 60 min.

One of the 469 timers accumulates the total running time for the Motor. This may be useful for scheduling routine maintenance. When this timer reaches 100000, it will reset to 0. This timer can be cleared using the **S1 469 SETUP ⇨⇩ INSTALLATION ⇨⇩ RESET MOTOR INFORMATION** setpoint.

The **TIME BETWEEN STARTS TIMER** value may be viewed here. This value might be useful for planning a motor shutdown. The **STARTS/HOUR TIMER** value is also viewable here.

5.6.1 EVENT 01 TO EVENT 40

PATH: ACTUAL VALUES ⇨⇩ A5 EVENT RECORDER ⇨ [ENTER] EVENT 01(40)

```
■ [ENTER] EVENT 01
No Event
```

	Range
TIME OF EVENT 01: 00:00:00.0	Range: *hour:minutes:seconds*
DATE OF EVENT 01: Jan. 01, 1992	Range: *month day, year*
MOTOR SPEED DURING EVENT01: Low Speed	Range: *High Speed, Low Speed* *Seen only if the Two-Speed feature is enabled*
TACHOMETER DURING EVENT01: 0 RPM	Range: *0 to 3600 RPM. Seen only if a Digital Input is programmed as Tachometer*
A: 0 B: 0 C: 0 A EVENT01	Range: *0 to 100000 A*
MOTOR LOAD EVENT01: 0.00 x FLA	Range: *0.00 to 20.00 x FLA*
CURRENT UNBALANCE EVENT01: 0%	Range: *0 to 100%*
GROUND CURRENT EVENT01: 0.00 A	Range: *0.00 to 5000.0 A*
A: 0 B: 0 C: 0 A Diff. EV01	Range: *0 to 5000 A.* *Seen only if Phase Differential CT is set*
HOTTEST STATOR RTD: 0°C EVENT01	Range: *–50 to 250°C, ---- (no RTD).* *Seen only if at least one RTD is set as Stator*
HOTTEST BEARING RTD: 0°C EVENT01	Range: *–50 to 250°C, ---- (no RTD).* *Seen only if at least one RTD is set as Bearing*
HOTTEST OTHER RTD: 0°C EVENT01	Range: *–50 to 250°C, ---- (no RTD).* *Seen only if at least one RTD is set as Other*
AMBIENT RTD: 0°C EVENT01	Range: *–50 to 250°C, ---- (no RTD).* *Seen only if at least one RTD is set as Ambient*
Vab: 0 Vbc: 0 Vca: 0 A EVENT01	Range: *0 to 20000 A.* *Seen only if VT Connection set as None*
Van: 0 Vbn: 0 Vcn: 0 A EVENT01	Range: *0 to 20000 A.* *Seen only if VT Connection programmed as Wye*
SYSTEM FREQUENCY EVENT01: 0.00 Hz	Range: *0.00, 20.00 to 120.00 Hz*
0 kW 0 kVA 0 kvar EVENT01	Range: *–50000 to 50000 kVA.* *Seen only if VT Connection is set as None*
POWER FACTOR EVENT01: 0.00	Range: *0.01 to 0.99 Lead or Lag, 0.00, 1.00* *Seen only if VT Connection is set as None*
TORQUE EVENT01: 0.0 Nm	Range: *0 to 999999.9.* *Seen only if Torque Metering is Enabled*
ANALOG I/P 1 EVENT01: 0 Units	Range: *–50000 to 50000*

ESCAPE MESSAGE
```
ANALOG I/P 2
EVENT01: 0 Units
```
Range: –50000 to 50000

ESCAPE MESSAGE
```
ANALOG I/P 3
EVENT01: 0 Units
```
Range: –50000 to 50000

ESCAPE MESSAGE
```
ANALOG I/P 4
EVENT01: 0 Units
```
Range: –50000 to 50000

The event recorder stores motor and system information each time an event occurs. An event description is stored along with a time and date stamp for troubleshooting purposes. Events include all trips, any alarm optionally (except Service Alarm, and 469 Not Inserted Alarm, which always records as events), loss of control power, application of control power, emergency restarts, and motor starts when a blocking function is active. The latter event could occur if the block start contacts were shorted out to bypass the 469 and start the motor.

EVENT 01 is the most recent event and **EVENT 40** is the oldest event. Each new event bumps the other event records up one until **EVENT 40** is reached. The event record in **EVENT 40** is lost when a new event occurs. This information can be cleared using the **S1 469 SETUP ⇨⇩ CLEAR DATA ⇨⇩ CLEAR EVENT RECORD** setpoint.

Table 5–3: CAUSE OF EVENTS

TRIPS

Acceleration Trip	Ambient RTD12 Trip	Analog I/P 1 to 4 Trip	Bearing RTD 7 Trip
Bearing RTD 8 Trip	Bearing RTD 9 Trip	Bearing RTD 10 Trip	Current U/B Trip
Differential Trip	General Sw.A Trip	General Sw.B Trip	General Sw.C Trip
General Sw.D Trip	Ground Fault Backup	Ground Fault Trip	Incomplete Seq Trip
Load Shed Trip	Mechanical Jam Trip	Overload Trip	Overvoltage Trip
Phase Reversal Trip	Power Factor Trip	Pressure Sw. Trip	Reactive Power Trip
Remote Trip	RTD11 Trip	Short Circuit Backup	Short Circuit Trip
Single Phasing (Unbalanced)	Speed Switch Trip	Stator RTD 1 Trip	Stator RTD 2 Trip
Stator RTD 3 Trip	Stator RTD 4 Trip	Stator RTD 5 Trip	Stator RTD 6 Trip
Tachometer Trip	Undercurrent Trip	Underpower Trip	Undervoltage Trip
Vibration Sw.Trip	Volt. Frequency Trip		

ALARMS (OPTIONAL EVENTS)

Ambient RTD12 Alarm	Analog I/P 1 to 4 Alarm	Bearing RTD 7 Alarm	Bearing RTD 8 Alarm
Bearing RTD 9 Alarm	Bearing RTD 10 Alarm	Breaker Failure	Counter Alarm
Current Demand Alarm	Current U/B Alarm	General Sw.A Alarm	General Sw.B Alarm
General Sw.C Alarm	General Sw.D Alarm	Ground Fault Alarm	kVA Demand Alarm
kvar Demand Alarm	kW Demand Alarm	Open RTD Alarm	Overload Alarm
Overtorque	Overvoltage Alarm	Pressure Sw. Alarm	Reactive Power Alarm
Remote Alarm	RTD11 Alarm	Short/Low RTD Alarm	Stator RTD 1 Alarm
Stator RTD 2 Alarm	Stator RTD 3 Alarm	Stator RTD 4 Alarm	Stator RTD 5 Alarm
Stator RTD 6 Alarm	Tachometer Alarm	Thermal Model Alarm	Trip Coil Super
Trip Counter Alarm	Undercurrent Alarm	Underpower Alarm	Undervoltage Alarm
Vibration Sw. Alarm	Volt. Frequency Alarm	Welded Contactor	

OTHER

469 Not Inserted	Control Power Applied	Control Power Lost	Emergency Rst. Close
Emergency Rst. Open	Forced Relay	Service Alarm	Simulation Started
Simulation Stopped	Start While Blocked		

5.7.1 469 MODEL INFORMATION

PATH: ACTUAL VALUES ⇨⇩ A6 PRODUCT INFO ⇨ 469 MODEL INFO

■ 469 MODEL INFO ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	ORDER CODE: 469-P5-HI-A20	*Range: 469-P5/P1-HI/LO-A20/A1*
	ESCAPE / MESSAGE ⇳	469 SERIAL NO: A3050001	*Range: A3050001 to A3099999*
	ESCAPE / MESSAGE ⇳	469 REVISION: 30C100A4.000	*Range: 30A100A4.000 to 30Z999A4.999*
	ESCAPE / MESSAGE ⇧	469 BOOT REVISION: 30C100A4.000	*Range 30A100A4.000 to 30Z999A4.999*

All of the 469 model information may be viewed here when the unit is powered up. In the event of a product software upgrade or service question, the information shown here should be jotted down prior to any inquiry.

5.7.2 CALIBRATION INFORMATION

PATH: ACTUAL VALUES ⇨⇩ A6 PRODUCT INFO ⇨⇩ CALIBRATION INFO

■ CALIBRATION INFO ■ [ENTER] for more	ENTER ⇨ / ⇦ ESCAPE	ORIGINAL CALIBRATION DATE: Jan 01 1995	*Range: month day year*
	ESCAPE / MESSAGE ⇧	LAST CALIBRATION DATE: Jan 01 1995	*Range: month day year*

The date of the original calibration and last calibration may be viewed here.

5.8.1 DIAGNOSTIC MESSAGES

Some actual value messages are helpful in diagnosing the cause of Trips, Alarms, or Start Blocks. The 469 automatically defaults to the most important message. The hierarchy is Trip and PreTrip messages, Alarm, and lastly, Start Block Lockout. To simplify things, the Message LED (indicator) will flash, prompting the operator to press the NEXT key. When NEXT is pressed, the next relevant message is automatically displayed. The 469 cycles through the messages with each keypress. When all of these conditions have cleared, the 469 reverts back to the normal default messages.

Any time the 469 is not displaying the default messages because other Actual Value or Setpoint messages are being viewed and there are no trips, alarms, or blocks, the Message LED (indicator) will be on solid. From any point in the message structure, pressing the NEXT key will cause the 469 to revert back to the normal default messages. When normal default messages are being displayed, pressing NEXT displays the next default message immediately.

Example:

When an overload trip occurs, an RTD alarm may also occur as a result of the overload and a lockout time associated with the trip. The 469 automatically defaults to the **A1 STATUS ⇨⇩ LAST TRIP DATA ⇨ CAUSE OF LAST TRIP** actual value message and the Message LED flashes. Pressing the NEXT key cycles through the time and date stamp information as well as all of the pre-trip data. When the bottom of this queue is reached, pressing NEXT again normally returns to the top of the queue. However, because an alarm is active, the display skips to the alarm message at the top of the **A1 STATUS ⇨⇩ ALARM STATUS** queue. Similarly, pressing NEXT again skips to the **A1 STATUS ⇨⇩ START BLOCK ⇨⇩ RESTART BLOCK LOCKOUT** message. Pressing NEXT once final time returns to the original **CAUSE OF LAST TRIP** message, and the cycle could be repeated.

LAST TRIP DATA:

```
CAUSE OF LAST TRIP:
Overload
```

```
TIME OF LAST TRIP:
12:00:00.0
```

```
DATE OF LAST TRIP
Jan 01 1992
```

↓
↓
↓

```
ANALOG INPUT 4
PreTrip: 0 Units
```

ACTIVE ALARMS:

```
STATOR RTD #1
ALARM: 135°C
```

START BLOCK LOCKOUTS:

```
OVERLOAD LOCKOUT
BLOCK: 25 min
```

When the RESET has been pressed, the hot RTD condition is no longer present, and the lockout time has expired, the display will revert back to the normal Default Messages.

5.8.2 FLASH MESSAGES

Flash messages are warning, error, or general information messages that are temporarily displayed in response to certain key presses. These messages are intended to assist with navigation of the 469 messages by explaining what has happened or by prompting the user to perform certain actions.

NEW SETPOINT HAS BEEN STORED	ROUNDED SETPOINT HAS BEEN STORED	OUT OF RANGE! ENTER: ####-##### by #	ACCESS DENIED, SHORT ACCESS SWITCH	ACCESS DENIED, ENTER PASSCODE
INVALID PASSCODE ENTERED!	NEW PASSCODE HAS BEEN ACCEPTED	ENTER NEW PASSCODE FOR ACCESS	SETPOINT ACCESS IS NOW PERMITTED	SETPOINT ACCESS IS NOW RESTRICTED
DATE ENTRY WAS NOT COMPLETE	DATE ENTRY OUT OF RANGE	TIME ENTRY WAS NOT COMPLETE	TIME ENTRY OUT OF RANGE	NO TRIPS OR ALARMS TO RESET
RESET PERFORMED SUCCESSFULLY	ALL POSSIBLE RESETS HAVE BEEN PERFORMED	ARE YOU SURE? PRESS [ENTER] TO VERIFY	PRESS [ENTER] TO ADD DEFAULT MESSAGE	DEFAULT MESSAGE HAS BEEN ADDED
DEFAULT MESSAGE LIST IS FULL	PRESS [ENTER] TO REMOVE MESSAGE	DEFAULT MESSAGE HAS BEEN REMOVED	DEFAULT MESSAGES 6 TO 20 ARE ASSIGNED	INPUT FUNCTION ALREADY ASSIGNED
INVALID SERVICE CODE ENTERED	KEY PRESSED IS INVALID HERE	DATA CLEARED SUCCESSFULLY	TOP OF PAGE	END OF PAGE
TOP OF LIST	END OF LIST	MOTOR STARTING ▌▌1▌▌2▌▌3▌▌4▌▌5▌▌6▌▌	[.] KEY IS USED TO ADVANCE THE CURSOR	NO ALARMS
NO START BLOCKS ACTIVE	THIS FEATURE NOT PROGRAMMED			

5

- **NEW SETPOINT HAS BEEN STORED:** This message appear each time a setpoint has been altered and stored as shown on the display.
- **ROUNDED SETPOINT HAS BEEN STORED:** A setpoint value entered with the numeric keypad may be between valid setpoint values. The 469 detects this condition and stores a value that has been rounded to the nearest valid setpoint value. To find the valid range and step for a given setpoint, simply press HELP while the setpoint is being displayed.
- **OUT OF RANGE! ENTER: #### - ##### by #:** If an entered setpoint value that is outside of the acceptable range of values, the 469 displays this message, substituting the proper values for that setpoint. An appropriate value may then be entered.
- **ACCESS DENIED, SHORT ACCESS SWITCH:** In order to store any setpoint values, the access switch must be shorted. If this message appears and it is necessary to change a setpoint, short access terminals C1 and C2.
- **ACCESS DENIED, ENTER PASSCODE:** The 469 has a passcode security feature. If that feature has been enabled, not only do the access switch terminals have to be shorted, but the passcode must also be entered. If the correct passcode has been lost or forgotten, contact the factory with the encrypted access code. See Section 4.2.1: Passcode on page 4–6 for passcode features.
- **INVALID PASSCODE ENTERED:** If an invalid passcode is entered for passcode security feature, this message will flash on the display.
- **NEW PASSCODE HAS BEEN ACCEPTED:** This message will appear as an acknowledge that the new passcode has been accepted when changing the passcode for the passcode security feature.
- **ENTER NEW PASSCODE FOR ACCESS:** If the passcode is zero, the passcode security feature is disabled. If the Change Passcode Setpoint is entered as yes, this flash message will appear prompting the user to enter a non-zero passcode which in turn will enable the feature.
- **SETPOINT ACCESS IS NOW PERMITTED:** This flash message notifies the user that setpoints may now be altered and stored any time the passcode security feature is enabled and a valid passcode is entered.
- **SETPOINT ACCESS IS NOW RESTRICTED:** This message appears if the passcode security feature is enabled, a valid passcode has been entered, and the S1 469 SETUP ⇨ PASSCODE ⇨ SETPOINT ACCESS setpoint value is Restricted. This message also appears anytime that setpoint access is permitted and the access jumper is removed.

- **DATE ENTRY WAS NOT COMPLETE:** Since the **DATE** setpoint has a special format (MM/DD/YYYY), if ENTER is pressed before the complete value is entered, this message appears and the new value is not stored. Another attempt will have to be made with the complete information.
- **DATE ENTRY WAS OUT OF RANGE:** This message appears if and invalid entry is made for the **DATE** (e.g. 15 entered for month).
- **TIME ENTRY WAS NOT COMPLETE:** Since the **TIME** setpoint has a special format (HH/MM/SS.S), if ENTER is pressed before the complete value entered, this message appears and the new value is not stored. Another attempt will have to be made with the complete information.
- **TIME ENTRY WAS OUT OF RANGE:** If and invalid entry is made for the time (e.g. 35 entered for hour), this message will appear.
- **NO TRIPS OR ALARMS TO RESET:** If RESET is pressed when there are no trips or alarms present, this message will appear.
- **RESET PERFORMED SUCCESSFULLY:** If all trip and alarm features that are active can be cleared (i.e. the conditions that caused these trips and/or alarms are no longer present), then this message will appear when a RESET is performed, indicating that all trips and alarms have been cleared.
- **ALL POSSIBLE RESETS HAVE BEEN PERFORMED:** If only some of the trip and alarm features that are active can be cleared (i.e. the conditions that caused some of these trips and/or alarms are still present), then this message will appear when a RESET is performed, indicating that only trips and alarms that could be reset have been reset.
- **ARE YOU SURE? PRESS [ENTER] TO VERIFY:** If the RESET key is pressed and resetting of any trip or alarm feature is possible, this message will appear to ask for verification of the operation. If RESET is pressed again while the message is still on the display, the reset will be performed.
- **PRESS [ENTER] TO ADD DEFAULT MESSAGE:** If the ENTER key is pressed anywhere in the 469 actual value messages, this message prompts the user to press ENTER again to add a new default message. To add a new default message, ENTER must be pressed while this message is being displayed.
- **DEFAULT MESSAGE HAS BEEN ADDED:** Any time a new default message is added to the default message list, this message will appear as verification.
- **DEFAULT MESSAGE LIST IS FULL:** If an attempt is made to add a new default message to the default message list when 20 messages are already assigned, this message will appear. In order to add a message, one of the existing messages must be removed.
- **PRESS [ENTER] TO REMOVE MESSAGE:** If the decimal key is pressed in the **S1 469 SETUP ⇨⇩ DEFAULT MESSAGES** setpoint group, immediately followed by the ENTER key, this message prompts the user to press ENTER to remove a default message. To remove the default message, ENTER must be pressed while this message is being displayed.
- **DEFAULT MESSAGE HAS BEEN REMOVED:** Any time a default message is removed from the default message list, this message will appear as verification.
- **DEFAULT MESSAGES 6 of 20 ARE ASSIGNED:** This message appears each time the **S1 469 SETUP ⇨⇩ DEFAULT MESSAGES** setpoint group is entered. It notifies the user of the number of assigned default messages.
- **INPUT FUNCTION IS ALREADY ASSIGNED:** The Assignable Digital Input functions may only be used once. If an attempt is made to assign the same function to two different switches, this message will appear.
- **INVALID SERVICE CODE ENTERED:** This message appears if an invalid code is entered in **S13 469 TESTING ⇨⇩ MULTILIN USE ONLY**.
- **KEY PRESSED HERE IS INVALID:** Under certain situations, certain keys have no function (e.g. any number key while viewing Actual Values). If a key is pressed where it should have no function, this message will appear.
- **DATA CLEARED SUCCESSFULLY:** This message confirms that data has been cleared or reset in the **S1 469 SETUP ⇨⇩ CLEAR DATA** or **S1 469 SETUP ⇨⇩ INSTALLATION** setpoint groups.
- **TOP OF PAGE:** This message will indicate when the top of a page has been reached.
- **BOTTOM OF PAGE:** This message will indicate when the bottom of a page has been reached.
- **TOP OF LIST:** This message will indicate when the top of subgroup has been reached.
- **BOTTOM OF LIST:** This message will indicate when the bottom of a subgroup has been reached.

5

- **[.] KEY IS USED TO ADVANCE THE CURSOR:** Any time a setpoint that requires text editing is viewed, this message will appear immediately to prompt the user to use the decimal key for cursor control. If the setpoint is not altered for one (1) minute, the message will flash again.
- **NO ALARMS:** This message appears if an attempt is made to enter the **A1 STATUS ⇨ ALARM STATUS** subgroup when there are no active alarms.
- **NO START BLOCKS ACTIVE:** This message appears if an attempt is made to enter the **A1 STATUS ⇨⇩ START BLOCKS** subgroup when there are no active Start Blocks.
- **THIS FEATURE NOT PROGRAMMED:** If an attempt is made to enter an actual value message subgroup, when the setpoints are not configured for that feature, this message will appear.

6.1.1 ELECTRICAL INTERFACE

The hardware or electrical interface is one of the following: one of two 2-wire RS485 ports from the rear terminal connector or the RS232 from the front panel connector. In a 2-wire RS485 link, data flow is bidirectional. Data flow is half duplex for both the RS485 and the RS232 ports. That is, data is never transmitted and received at the same time. RS485 lines should be connected in a daisy chain configuration (avoid star connections) with a terminating network installed at each end of the link, i.e. at the master end and at the slave farthest from the master. The terminating network should consist of a 120 Ω resistor in series with a 1 nF ceramic capacitor when used with Belden 9841 RS485 wire. The value of the terminating resistors should be equal to the characteristic impedance of the line. This is approximately 120 Ω for standard #22 AWG twisted pair wire. Shielded wire should always be used to minimize noise. Polarity is important in RS485 communications. Each '+' terminal of every 469 must be connected together for the system to operate. See Section 2.2.11: RS485 Communications Ports on page 2–18 for details on correct serial port wiring.

6.1.2 MODBUS RTU PROTOCOL

The 469 implements a subset of the AEG Modicon Modbus RTU serial communication standard. Many popular programmable controllers support this protocol directly with a suitable interface card allowing direct connection of relays. Although the Modbus protocol is hardware independent, the 469 interfaces include two 2-wire RS485 ports and one RS232 port. Modbus is a single master, multiple slave protocol suitable for a multi-drop configuration as provided by RS485 hardware. In this configuration up to 32 slaves can be daisy-chained together on a single communication channel.

The 469 is always a slave. It cannot be programmed as a master. Computers or PLCs are commonly programmed as masters. The Modbus protocol exists in two versions: Remote Terminal Unit (RTU, binary) and ASCII. Only the RTU version is supported by the 469. Monitoring, programming and control functions are possible using read and write register commands.

6.1.3 DATA FRAME FORMAT AND DATA RATE

One data frame of an asynchronous transmission to or from an 469 is default to 1 start bit, 8 data bits, and 1 stop bit. This produces a 10 bit data frame. This is important for transmission through modems at high bit rates (11-bit data frames are not supported by Hayes modems at bit rates of greater than 300 bps). The parity bit is optional as odd or even. If it is programmed as odd or even, the data frame consists of 1 start bit, 8 data bits, 1 parity bit, and 1 stop bit.

Modbus protocol can be implemented at any standard communication speed. The 469 RS485 ports support operation at 1200, 2400, 4800, 9600, and 19200 baud. The front panel RS232 baud rate is fixed at 9600 baud.

6.1.4 DATA PACKET FORMAT

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

MASTER QUERY MESSAGE:	
SLAVE ADDRESS:	(1 byte)
FUNCTION CODE:	(1 byte)
DATA:	(variable number of bytes depending on FUNCTION CODE)
CRC:	(2 bytes)
SLAVE RESPONSE MESSAGE:	
SLAVE ADDRESS:	(1 byte)
FUNCTION CODE:	(1 byte)
DATA:	(variable number of bytes depending on FUNCTION CODE)
CRC:	(2 bytes)

- **SLAVE ADDRESS**: This is the first byte of every transmission. This byte represents the user-assigned address of the slave device that receives the message sent by the master. Each slave device must be assigned a unique address and only the addressed slave responds to a transmission that starts with its address. In a master request transmission the Slave Address represents the address of the slave to which the request is being sent. In a slave response transmission the Slave Address represents the address of the slave that is sending the response. Note that a master transmission with a Slave Address of 0 indicates a broadcast command. Broadcast commands can be used for specific functions.

- **FUNCTION CODE**: This is the second byte of every transmission. Modbus defines function codes of 1 to 127. The 469 implements some of these functions. In a master request transmission the Function Code tells the slave what action to perform. In a slave response transmission if the Function Code sent from the slave is the same as the Function Code sent from the master indicating the slave performed the function as requested. If the high order bit of the Function Code sent from the slave is a 1 (i.e. if the Function Code is > 127) then the slave did not perform the function as requested and is sending an error or exception response.
- **DATA**: A variable number of bytes depending on the Function Code. This may be actual values, setpoints, or addresses sent by the master to the slave or *vice versa*. Data is sent MSByte first followed by the LSByte.
- **CRC**: This is a two byte error checking code. CRC is sent LSByte first followed by the MSByte. The RTU version of Modbus includes a two byte CRC-16 (16-bit cyclic redundancy check) with every transmission. The CRC-16 algorithm essentially treats the entire data stream (data bits only; start, stop and parity ignored) as one continuous binary number. This number is first shifted left 16 bits and then divided by a characteristic polynomial (11000000000000101B). The 16-bit remainder of the division is appended to the end of the transmission, LSByte first. The resulting message including CRC, when divided by the same polynomial at the receiver will give a zero remainder if no transmission errors have occurred.

  If an 469 Modbus slave device receives a transmission in which an error is indicated by the CRC-16 calculation, the slave device will not respond to the transmission. A CRC-16 error indicates than one or more bytes of the transmission were received incorrectly and thus the entire transmission should be ignored in order to avoid the 469 performing any incorrect operation. The CRC-16 calculation is an industry standard method used for error detection. An algorithm is included here to assist programmers in situations where no standard CRC-16 calculation routines are available.

6.1.5 CRC-16 ALGORITHM

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

Symbols:

-->	data transfer
A; **A_{low}**; **A_{high}**	16-bit working register; low and high order bytes of A (the 16-bit working register)
CRC	16 bit CRC-16 result
i, j	loop counters
(+)	logical EXCLUSIVE-OR operator
N	total number of data bytes
D_i	i-th data byte (i = 0 to N – 1)
G	16 bit characteristic polynomial = 1010000000000001 (binary) with MSbit dropped and bit order reversed
shr (x)	right shift operator (the LSbit of x is shifted into a carry flag, a '0' is shifted into the MSbit of x, all other bits are shifted right one location)

Algorithm:

```
1.     FFFF (hex) --> A
2.     0 --> i
3.     0 --> j
4.     Di (+) Alow --> Alow
5.     j + 1 --> j
6.     shr (A)
7.     Is there a carry?   No: go to step 8.
                           Yes: G (+) A --> A and continue.
8.     Is j = 8?     No: go to 5.; Yes: continue.
9.     i + 1 --> i
10.    Is i = N?     No: go to 3.; Yes: continue.
11.    A --> CRC
```

6.1.6 TIMING

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

6.2.1 SUPPORTED FUNCTIONS

The following functions are supported by the 469:

Modbus Function Code 01: Read Relay Coil
Modbus Function Code 02: Read Digital Input Status
Modbus Function Code 03: Read Setpoints and Actual Values
Modbus Function Code 04: Read Setpoints and Actual Values
Modbus Function Code 05: Execute Operation
Modbus Function Code 06: Store Single Setpoint
Modbus Function Code 07: Read Device Status
Modbus Function Code 08: Loopback Test
Modbus Function Code 16: Store Multiple Setpoints

6.2.2 FUNCTION CODES 01/02: READ RELAY COIL / DIGITAL INPUT STATUS

Modbus implementation: Read Coil and Input Status
469 Implementation: Read Relay Coil and Digital Input Status

For the 469 implementation of Modbus, these commands can be used to read Relay Coil Status or Digital Input Status.

MESSAGE FORMAT AND EXAMPLE, FUNCTION 01:

The standard implementation requires the following: slave address (one byte), function code (one byte), starting relay coil (two bytes), number of coils to read (two bytes), and CRC (two bytes). The slave response is the slave address (one byte), function code (one byte), relay coil mask byte count (one byte; always 01 since only six relay coils), bit mask indicating the status of requested relay coils (one byte), and CRC (two bytes).

Request slave 11 to respond with status of relay coil 3 to 5:

Relay	***Status***
R1	*Energized*
R2	*De-energized*
R3	*De-energized*
R4	*De-energized*
R5	*Energized*
R6	*Energized*
Bit Mask	*0011 0001 (0 x 31)*

MASTER TRANSMISSION:	**BYTES**	**EXAMPLE / DESCRIPTION**	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	01	read relay coil status
STARTING RELAY COIL	2	00 03	starting relay coil 3
NUMBER OF RELYAS	2	00 03	3 relays coils (i.e. R3, R4, R5)
CRC	2	8C A1	CRC calculated by the master

SLAVE RESPONSE:	**BYTES**	**EXAMPLE / DESCRIPTION**	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	01	read relay coil status
BYTE COUNT	1	01	1 byte bit mask
BIT MASK	1	10	bit mask of requested relay (0001 0000)
CRC	2	53 93	CRC calculated by the slave

NOTE

If a Starting Relay Coil (Starting Digital Input) of Zero is entered, the 469 will default it to One. If the Number of Relays (Number of Digital Inputs) requested exceeds the number of relays available, the user is prompted with a **ILLEGAL DATA** message.

MESSAGE FORMAT AND EXAMPLE, FUNCTION 02:

The standard implementation requires the following: slave address (one byte), function code (one byte), starting digital input (two byte), number of digital inputs to read (two bytes), and CRC (two bytes). The slave response is the slave address (one byte), function code (one byte), byte count of digital input mask (one byte), bit mask indicating the status of requested digital inputs (one or two bytes), and CRC (two bytes).

Note: the CRC is sent as a two byte number with the low order byte sent first.

Example 1: Request slave 11 to respond with status of digital inputs 5 to 9:

Digital Input	*Status*
D1: Access	*Closed*
D2: Test	*Open*
D3: Starter Status	*Open*
D4: Emergency Restart	*Open*
D5: Remote Reset	*Closed*
D6: Assignable Input 1	*Closed*

Digital Input	*Status*
D7: Assignable Input 2	*Closed*
D8: Assignable Input 3	*Closed*
D9: Assignable Input 4	*Closed*
Bit Mask (LSB)	*0111 0001*
Bit Mask (MSB)	*0000 0001*

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	02	read digital input status
STARTING DIGITAL INPUT	2	00 05	starting at digital input 5
NUMBER OF DIGITAL INPUTS	2	00 05	5 digital inputs (i.e. D5, D6, D7, D8, D9)
CRC	2	A8 A2	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	02	read relay coil status
BYTE COUNT	1	02	2 byte bit mask
BIT MASK	2	71 01	bit mask of requested digital input
CRC	2	C5 B9	CRC calculated by the slave

6

Example 2: Request slave 11 to respond with status of digital inputs 1 to 4:

Digital Input	*Status*
D1: Access	*Closed*
D2: Test	*Open*
D3: Starter Status	*Open*
D4: Emergency Restart	*Open*
D5: Remote Reset	*Closed*

Digital Input	*Status*
D6: Assignable Input 1	*Closed*
D7: Assignable Input 2	*Closed*
D8: Assignable Input 3	*Open*
D9: Assignable Input 4	*Closed*
Bit Mask (LSB)	*0111 0001*

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	02	read digital input status
STARTING DIGITAL INPUT	2	00 01	starting at digital input 1
NUMBER OF DIGITAL INPUTS	2	00 04	4 digital inputs (i.e. D1, D2, D3, D4)
CRC	2	28 A3	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	02	read relay coil status
BYTE COUNT	1	01	2 byte bit mask
BIT MASK	2	01	bit mask of requested digital input
CRC	2	63 90	CRC calculated by the slave

6.2.3 FUNCTION CODES 03/04: READ SETPOINTS / ACTUAL VALUES

Modbus implementation: Read Input and Holding Registers
469 Implementation: Read Setpoints and Actual Values

For the 469 implementation of Modbus, these commands can be used to read any Setpoint ("holding registers") or Actual Value ("input registers"). Holding and input registers are 16 bit (two byte) values transmitted high order byte first. Thus all 469 Setpoints and Actual Values are sent as two bytes. The maximum number of registers that can be read in one transmission is 125. Function codes 03 and 04 are configured to read setpoints or actual values interchangeably because some PLCs do not support both function codes.

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

MESSAGE FORMAT AND EXAMPLE:

Request slave 11 to respond with 2 registers starting at address 0308. For this example the register data in these addresses is:

Address	***Data***
0308	*0064*
0309	*000A*

MASTER TRANSMISSION:	**BYTES**	**EXAMPLE / DESCRIPTION**	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	03	read registers
DATA STARTING ADDRESS	2	03 08	data starting at 0308
NUMBER OF SETPOINTS	2	00 02	2 registers (4 bytes total)
CRC	2	45 27	CRC calculated by the master

SLAVE RESPONSE:	**BYTES**	**EXAMPLE / DESCRIPTION**	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	03	read registers
BYTE COUNT	1	04	2 registers = 4 bytes
DATA 1	2	00 64	value in address 0308
DATA 2	2	00 0A	value in address 0309
CRC	2	EB 91	CRC calculated by the slave

6

6.2.4 FUNCTION CODE 05: EXECUTE OPERATION

Modbus Implementation: Force Single Coil
469 Implementation: Execute Operation

This function code allows the master to request an 469 to perform specific command operations. The command numbers listed in the Commands area of the memory map correspond to operation code for function code 05. The operation commands can also be initiated by writing to the Commands area of the memory map using function code 16. Refer to Section 6.2.8: Function Code 16: Store Multiple Setpoints on page 6–8 for complete details.

Supported Operations: Reset 469 (operation code 1); Motor Start (operation code 2)
Motor Stop (operation code 3); Waveform Trigger (operation code 4)

MESSAGE FORMAT AND EXAMPLE:

Reset 469 (operation code 1).

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	05	execute operation
OPERATION CODE	2	00 01	reset command (operation code 1)
CODE VALUE	2	FF 00	perform function
CRC	2	DD 50	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	05	execute operation
OPERATION CODE	2	00 01	reset command (operation code 1)
CODE VALUE	2	FF 00	perform function
CRC	2	DD 50	CRC calculated by the slave

6.2.5 FUNCTION CODE 06: STORE SINGLE SETPOINT

Modbus Implementation: Preset Single Register
469 Implementation: Store Single Setpoint

This command allows the master to store a single setpoint into the memory of an 469. The slave response to this function code is to echo the entire master transmission.

MESSAGE FORMAT AND EXAMPLE:

Request slave 11 to store the value 01F4 in Setpoint address 1180. After the transmission in this example is complete, setpoints address 1180 will contain the value 01F4.

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	06	store single setpoint
DATA STARTING ADDRESS	2	11 80	setpoint address 1180
DATA	2	01 F4	data for address 1180
CRC	2	8D A3	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	06	store single setpoint
DATA STARTING ADDRESS	2	11 80	setpoint address 1180
DATA	2	01 F4	data for address 1180
CRC	2	8D A3	CRC calculated by the slave

6.2.6 FUNCTION CODE 07: READ DEVICE STATUS

Modbus Implementation: Read Exception Status
469 Implementation: Read Device Status

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

469 General Status Byte:

Bit No.	Description	Bit No.	Description
B0	R1 Trip relay operated = 1	B4	R5 Block start relay operated = 1
B1	R2 Auxiliary relay operated = 1	B5	R6 Service relay operated = 1
B2	R3 Auxiliary relay operated = 1	B6	Stopped = 1
B3	R4 Alarm relay operated = 1	B7	Running = 1

If status is neither stopped or running, the motor is starting.

MESSAGE FORMAT AND EXAMPLE:

Request status from slave 11.

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	07	read device status
CRC	2	47 42	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	07	read device status
DEVICE STATUS	1	59	status = 01011001 in binary
CRC	2	C2 08	CRC calculated by the slave

6.2.7 FUNCTION CODE 08: LOOPBACK TEST

Modbus Implementation: Loopback Test
469 Implementation: Loopback Test

This function is used to test the integrity of the communication link. The 469 will echo the request.

MESSAGE FORMAT AND EXAMPLE:

Loopback test from slave 11.

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	08	loopback test
DIAG CODE	2	00 00	must be 00 00
DATA	2	00 00	must be 00 00
CRC	2	E0 A1	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	08	loopback test
DIAG CODE	2	00 00	must be 00 00
DATA	2	00 00	must be 00 00
CRC	2	E0 A1	CRC calculated by the slave

6.2.8 FUNCTION CODE 16: STORE MULTIPLE SETPOINTS

Modbus Implementation: *Preset Multiple Registers*
469 Implementation: *Store Multiple Setpoints*

This function code allows multiple setpoints to be stored into the 469 memory. Modbus "registers" are 16-bit (two byte) values transmitted high order byte first. Thus all 469 setpoints are sent as two byte values. The maximum number of setpoints that can be stored in one transmission is dependent on the slave device. Modbus allows up to a maximum of 60 holding registers to be stored. The 469 response to this function code is to echo the slave address, function code, starting address, the number of Setpoints stored, and the CRC.

MESSAGE FORMAT AND EXAMPLE:

Request slave 11 to store the value 01F4 to Setpoint address 1180 and the value 01DE to setpoint address 1181. After the transmission in this example is complete, 469 slave 11 will have the following Setpoints information stored:

Address	***Data***
1180	*01F4*
1181	*01DE*

MASTER TRANSMISSION:	**BYTES**	**EXAMPLE / DESCRIPTION**	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	10	store setpoints
DATA STARTING ADDRESS	2	11 80	setpoint address 1180
NUMBER OF SETPOINTS	2	00 02	2 setpoints (4 bytes total)
BYTE COUNT	1	04	4 bytes of data
DATA 1	2	01 F4	data for address 1180
DATA 2	2	01 DE	data for address 1181
CRC	2	DB B1	CRC calculated by the master

SLAVE RESPONSE:	**BYTES**	**EXAMPLE / DESCRIPTION**	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	10	store setpoints
DATA STARTING ADDRESS	2	11 80	setpoint address 1180
NUMBER OF SETPOINTS	2	00 02	2 setpoints
CRC	2	45 B6	CRC calculated by the slave

6.2.9 FUNCTION CODE 16: PERFORMING COMMANDS

Some PLCs may not support execution of commands using function code 5 but do support storing multiple setpoints using function code 16. To perform this operation using function code 16 (10H), a certain sequence of commands must be written at the same time to the 469. The sequence consists of: command function register, command operation register and command data (if required). The command function register must be written with the value of 5 indicating an execute operation is requested. The command operation register must then be written with a valid command operation number from the list of commands shown in the memory map. The command data registers must be written with valid data if the command operation requires data. The selected command will execute immediately upon receipt of a valid transmission.

MESSAGE FORMAT AND EXAMPLE:

Perform a reset on 469 (operation code 1)

MASTER TRANSMISSION:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	message for slave 11
FUNCTION CODE	1	10	store setpoints
DATA STARTING ADDRESS	2	00 80	setpoint address 0080
NUMBER OF SETPOINTS	2	00 02	2 setpoints (4 bytes total)
BYTE COUNT	1	04	2 registers = 4 bytes
COMMAND FUNCTION	2	00 05	data for address 0080
COMMAND OPERATION	2	00 01	data for address 0081
CRC	2	0B D6	CRC calculated by the master

SLAVE RESPONSE:	BYTES	EXAMPLE / DESCRIPTION	
SLAVE ADDRESS	1	0B	response message from slave 11
FUNCTION CODE	1	10	store setpoints
DATA STARTING ADDRESS	2	00 80	setpoint address 0080
NUMBER OF SETPOINTS	2	00 02	2 setpoints (4 bytes total)
CRC	2	40 8A	CRC calculated by the slave

6.2.10 ERROR RESPONSES

When an 469 detects an error other than a CRC error, a response will be sent to the master. The MSbit of the Function Code byte will be set to 1 (i.e. the function code sent from the slave will be equal to the function code sent from the master plus 128). The following byte will be an exception code indicating the type of error that occurred.

Transmissions received from the master with CRC errors will be ignored by the 469.

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

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

The 469 implements the following exception response codes.

01: ILLEGAL FUNCTION

The function code transmitted is not one of the functions supported by the 469.

02: ILLEGAL DATA ADDRESS

The address referenced in the data field transmitted by the master is not an allowable address for the 469.

03: ILLEGAL DATA VALUE

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

6.3.1 MEMORY MAP INFORMATION

The data stored in the 469 is grouped as Setpoints and Actual Values. Setpoints can be read and written by a master computer. Actual Values are read only. All Setpoints and Actual Values are stored as two-byte values. That is, each register address is the address of a two-byte value. Addresses are listed in hexadecimal. Data values (setpoint ranges, increments, factory values) are in decimal.

NOTE

Many Modbus communications drivers add 40001d to the actual address of the register addresses. For example: if address 0h was to be read, 40001d would be the address required by the Modbus communications driver; if address 320h (800d) was to be read, 40801d would be the address required by the Modbus communications driver.

6.3.2 USER-DEFINABLE MEMORY MAP AREA

The 469 has a powerful feature, called the User Definable Memory Map, which allows a computer to read up to 124 non-consecutive data registers (setpoints or actual values) by using one Modbus packet. It is often necessary for a master computer to continuously poll various values in each of the connected slave relays. If these values are scattered throughout the memory map, reading them would require numerous transmissions and would burden the communication link. The User Definable Memory Map can be programmed to join any memory map address to one in the block of consecutive User Map locations, so that they can be accessed by reading these consecutive locations.

The User Definable area has two sections:

1. A register index area (memory map addresses 0180h to 01FCh) that contains 125 actual values or setpoints register addresses.
2. A register area (memory map addresses 0100h to 017Ch) that contains the data at the addresses in the register index.

Register data that is separated in the rest of the memory map may be remapped to adjacent register addresses in the User Definable Registers area. This is accomplished by writing to register addresses in the User Definable Register Index area. This allows for improved through-put of data and can eliminate the need for multiple read command sequences.

For example, if the values of Average Phase Current (register address 0306h) and Hottest Stator RTD Temperature (register address 0320h) are required to be read from an 469, their addresses may be remapped as follows:

1. Write 0306h to address 0180h (User Definable Register Index 0000) using function code 06 or 16.
2. Write 0307h to address 0181h (User Definable Register Index 0001) using function code 06 or 16. (Average Phase Current is a double register number)
3. Write 0320h to address 0182h (User Definable Register Index 0001) using function code 06 or 16.

A read (function code 03 or 04) of registers 0100h (User Definable Register 0000) and 0101h (User Definable Register 0001) will return the Phase A Current and register 0102h (User Definable Register 0002) will return Hottest Stator RTD Temperature.

6.3.3 EVENT RECORDER

The 469 event recorder data starts at address 3000h. Address 3003h is a pointer to the event of interest (1 representing the latest event and 40 representing the oldest event). To retrieve Event 1, write ‘1’ to the Event Record Selector (3003h) and read the data from 3004h to 3022h. To retrieve Event 2, write ‘2’ to the Event Record Selector (3003h) and read the data from 3004h to 3022h. All 40 events may be retrieved in this manner. The time and date stamp of each event may be used to ensure that all events have been retrieved in order without new events corrupting the sequence of events (Event 1 should be more recent than Event 2, Event 2 should be more recent than Event 3, etc.).

6.3.4 WAVEFORM CAPTURE

The 469 stores a number of cycles of A/D samples each time a trip occurs in a trace buffer. The trace buffer is partitioned according to the **S1 PREFERENCES ⇨⇩ TRACE MEMORY BUFFERS** setpoint. The Trace Memory Trigger is set up with the **S1 PREFERENCES ⇨⇩ TRACE MEMORY TRIGGER** setpoint and this determines how many pre-trip and post-trip cycles are stored. The trace buffer is time and date stamped and may be correlated to a trip in the event record. 10 waveforms are captured this way when a trip occurs. These are the 3 phase currents, 3 differential currents, ground current and 3 voltage waveforms. This information is stored in volatile memory and will be lost if power is cycled to the relay.

To access the captured waveforms, select the waveform of interest by writing its trace memory channel (see following table) to the Trace Memory Channel Selector (address 30F1h). Then read the trace memory data from address 3100h to 3400h. There are 12 samples per cycle for each of the cycles. The values read are in actual amperes or volts.

TRACE MEMORY CHANNEL	WAVEFORM
0	Phase A current
1	Phase B current
2	Phase C current
3	Differential phase A current
4	Differential phase B current
5	Differential phase C current
6	Ground current
7	Phase A voltage
8	Phase B voltage
9	Phase C voltage

Address 30F8h shows the number of traces taken. To access the latest use the value at address 30F0h. To access more than 1 trace, reduce this value to access the older traces.

6.3.5 469 MEMORY MAP

Table 6–1: 469 MEMORY MAP (Sheet 1 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
Product ID (Addresses 0000 to 007F)								
PRODUCT ID	0000	Product Device Code	N/A	N/A	N/A	N/A	F1	30
	0001	Product Hardware Revision	1	26	1	N/A	F15	N/A
	0002	Product Software Revision	N/A	N/A	N/A	N/A	F16	N/A
	0003	Product Modification Number	0	999	1	N/A	F1	N/A
	0004	Reserved						
	...	...						
	000F	Reserved						
	0010	Boot Program Revision	N/A	N/A	N/A	N/A	F16	N/A
	0011	Boot Program Modification Number	0	999	1	N/A	F1	N/A
	0012	Reserved						
	...	...						
	007F	Reserved						
Commands (Addresses 0080 -00FF)								
COMMANDS	0080	Command Function Code						
	0081	Reserved						
	0088	Communications Port Passcode	0	99999999	1	N/A	F12	0
	00F0	Time (Broadcast)	N/A	N/A	N/A	N/A	F24	N/A
	00F2	Date (Broadcast)	N/A	N/A	N/A	N/A	F18	N/A
	...	...						
	00FF	Reserved						
User Map (Addresses 0100 to 017F)								
USER MAP VALUES	0100	User Map Value # 1	---	---	---	---	---	---
	0101	User Map Value # 2	---	---	---	---	---	---
	...	...						
	017C	User Map Value # 125	---	---	---	---	---	---
	017D	Reserved						
	...	...						
	17FF	Reserved						
USER MAP ADDRESSES	0180	User Map Address # 1	0	3FFF	1	hex	F1	0
	0181	User Map Address # 2	0	3FFF	1	hex	F1	0
	...	...						
	01FC	User Map Address # 125	0	3FFF	1	hex	F1	0
	01FD	Reserved						
	...	...						
	01FF	Reserved						
Actual Values (Addresses 0200 -0FFF)								
MOTOR STATUS	0200	Motor Status	0	4	1	-	FC133	0
	0201	Motor Thermal Capacity Used	0	100	1	%	F1	0
	0202	Estimated Time to Trip on Overload	–1	99999	1	s	F20	–1
	0204	Motor Speed	0	1	1	-	FC135	0
	0205	Communication Setpoint Access	0	1	N/A	N/A	F126	N/A
	0206	Reserved						
	...	...						
	020F	Reserved						
SYSTEM STATUS	0210	General Status	0	65535	1	-	FC140	0
	0211	Output Relay Status	0	63	1	-	FC141	0
	0212	Reserved						
	...							
	021F	Reserved						

Table 6–1: 469 MEMORY MAP (Sheet 2 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
LAST TRIP DATA ALARM	0220	Cause of Last Trip	0	45	1	-	FC134	0
	0221	Time of Last Trip (2 words)	N/A	N/A	N/A	N/A	F19	N/A
	0223	Date of Last Trip (2 words)	N/A	N/A	N/A	N/A	F18	N/A
	0225	Motor Speed During Trip	0	1	1	-	FC135	0
	0226	Pre-Trip Tachometer RPM	0	3600	1	RPM	F1	0
	0227	Phase A Pre-Trip Current	0	100000	1	A	F9	0
	0229	Phase B Pre-Trip Current	0	100000	1	A	F9	0
	022B	Phase C Pre-Trip Current	0	100000	1	A	F9	0
	022D	Pre-Trip Motor Load	0	2000	1	FLA	F3	0
	022E	Pre-Trip Current Unbalance	0	100	1	%	F1	0
	022F	Pre-Trip Ground Current	0	500000	1	A	F11	0
	0231	Phase A Pre-Trip Differential Current	0	5000	1	A	F1	0
	0232	Phase B Pre-Trip Differential Current	0	5000	1	A	F1	0
	0233	Phase C Pre-Trip Differential Current	0	5000	1	A	F1	0
	0234	Hottest Stator RTD During Trip	0	12	1	-	F1	0
	0235	Pre-Trip Temperature of Hottest Stator RTD	–50	250	1	°C	F4	0
	0236	Hottest Bearing RTD During Trip	0	12	1	-	F1	0
	0237	Pre-Trip Temperature of Hottest Bearing RTD	–50	250	1	°C	F4	0
	0238	Hottest Other RTD During Trip	0	12	1	-	F1	0
	0239	Pre-Trip Temperature of Hottest Other RTD	–50	250	1	°C	F4	0
	023A	Hottest Ambient RTD During Trip	0	12	1	-	F1	0
	023B	Pre-Trip Ambient RTD Temperature	–50	250	1	°C	F4	0
	023C	Pre-Trip Voltage Vab	0	20000	1	V	F1	0
	023D	Pre-Trip Voltage Vbc	0	20000	1	V	F1	0
	023E	Pre-Trip Voltage Vca	0	20000	1	V	F1	0
	023F	Pre-Trip Voltage Van	0	20000	1	V	F1	0
	0240	Pre-Trip Voltage Vbn	0	20000	1	V	F1	0
	0241	Pre-Trip Voltage Vcn	0	20000	1	V	F1	0
	0242	Pre-Trip System Frequency	0	12000	1	Hz	F3	0
	0243	Pre-Trip Real Power	–50000	50000	1	kW	F12	0
	0245	Pre-Trip Reactive Power	–50000	50000	1	kvar	F12	0
	0247	Pre-Trip Apparent Power	0	50000	1	kVA	F1	0
	0248	Pre-Trip Power Factor	–99	100	1	-	F21	0
	0249	Analog Input #1 Pre-Trip	–50000	50000	1	-	F12	0
	024B	Analog Input #2 Pre-Trip	–50000	50000	1	-	F12	0
	024D	Analog Input #3 Pre-Trip	–50000	50000	1	-	F12	0
	024F	Analog Input #4 Pre-Trip	–50000	50000	1	-	F12	0
	0251	Reserved						
	...							
	025B	Reserved						
	025C	Pre-Trip Temp. of Hottest Stator RTD (°F)	–58	482	1	°F	F4	32
	025D	Pre-Trip Temp. of Hottest Bearing RTD (°F)	–58	482	1	°F	F4	32
	025E	Pre-Trip Temp. of Hottest Other RTD (°F)	–58	482	1	°F	F4	32
	025F	Pre-Trip Temp. of Hottest Ambient RTD (°F)	–58	482	1	°F	F4	32
	0260	Reserved						
	...	...						
	0264	Reserved						
	0265	Remote Alarm Status	0	4	1	-	FC123	0
STATUS	0266	Pressure Switch Alarm Status	0	4	1	-	FC123	0
	0267	Vibration Switch Alarm Status	0	4	1	-	FC123	0
	0268	Digital Counter Alarm Status	0	4	1	-	FC123	0
	0269	Tachometer Alarm Status	0	4	1	-	FC123	0
	026A	General Switch A Alarm Status	0	4	1	-	FC123	0

Table 6–1: 469 MEMORY MAP (Sheet 3 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
STATUS continued	026B	General Switch B Alarm Status	0	4	1	-	FC123	0
	026C	General Switch C Alarm Status	0	4	1	-	FC123	0
	026D	General Switch D Alarm Status	0	4	1	-	FC123	0
	026E	Thermal Capacity Alarm	0	4	1	-	FC123	0
	026F	Overload Alarm Status	0	4	1	-	FC123	0
	0270	Undercurrent Alarm Status	0	4	1	-	FC123	0
	0271	Current Unbalance Alarm Status	0	4	1	-	FC123	0
	0272	Ground Fault Alarm Status	0	4	1	-	FC123	0
	0273	RTD #1 Alarm Status	0	4	1	-	FC123	0
	0274	RTD #2 Alarm Status	0	4	1	-	FC123	0
	0275	RTD #3 Alarm Status	0	4	1	-	FC123	0
	0276	RTD #4 Alarm Status	0	4	1	-	FC123	0
	0277	RTD #5 Alarm Status	0	4	1	-	FC123	0
	0278	RTD #6 Alarm Status	0	4	1	-	FC123	0
	0279	RTD #7 Alarm Status	0	4	1	-	FC123	0
	027A	RTD #8 Alarm Status	0	4	1	-	FC123	0
	027B	RTD #9 Alarm Status	0	4	1	-	FC123	0
	027C	RTD #10 Alarm Status	0	4	1	-	FC123	0
	027D	RTD #11 Alarm Status	0	4	1	-	FC123	0
	027E	RTD #12 Alarm Status	0	4	1	-	FC123	0
	027F	Open RTD Sensor Alarm Status	0	4	1	-	FC123	0
	0280	Short Sensor/Low Temp Alarm Status	0	4	1	-	FC123	0
	0281	Undervoltage Alarm Status	0	4	1	-	FC123	0
	0282	Overvoltage Alarm Status	0	4	1	-	FC123	0
	0283	System Frequency Alarm Status	0	4	1	-	FC123	0
	0284	Power Factor Alarm Status	0	4	1	-	FC123	0
	0285	Reactive Power Alarm Status	0	4	1	-	FC123	0
	0286	Underpower Alarm Status	0	4	1	-	FC123	0
	0287	Trip Counter Alarm Status	0	4	1	-	FC123	0
	0288	Starter Failure Alarm	0	4	1	-	FC123	0
	0289	Current Demand Alarm Status	0	4	1	-	FC123	0
	028A	kW Demand Alarm Status	0	4	1	-	FC123	0
	028B	kvar Demand Alarm Status	0	4	1	-	FC123	0
	028C	kVA Demand Alarm Status	0	4	1	-	FC123	0
	028D	Analog Input 1 Alarm Status	0	4	1	-	FC123	0
	028E	Analog Input 2 Alarm Status	0	4	1	-	FC123	0
	028F	Analog Input 3 Alarm Status	0	4	1	-	FC123	0
	0290	Analog Input 4 Alarm Status	0	4	1	-	FC123	0
	0291	Reverse Power Alarm Status	0	4	1	-	FC123	0
	0292	RTD #1 High Alarm Status	0	4	1	-	FC123	0
	0293	RTD #2 High Alarm Status	0	4	1	-	FC123	0
	0294	RTD #3 High Alarm Status	0	4	1	-	FC123	0
	0295	RTD #4 High Alarm Status	0	4	1	-	FC123	0
	0296	RTD #5 High Alarm Status	0	4	1	-	FC123	0
	0297	RTD #6 High Alarm Status	0	4	1	-	FC123	0
	0298	RTD #7 High Alarm Status	0	4	1	-	FC123	0
	0299	RTD #8 High Alarm Status	0	4	1	-	FC123	0
	029A	RTD #9 High Alarm Status	0	4	1	-	FC123	0
	029B	RTD #10 High Alarm Status	0	4	1	-	FC123	0
	029C	RTD #11 High Alarm Status	0	4	1	-	FC123	0
	029D	RTD #12 High Alarm Status	0	4	1	-	FC123	0
	029E	Analog Diff 1-2 Alarm Status	0	4	1	-	FC123	0
	029F	Analog Diff 3-4 Alarm Status	0	4	1	-	FC123	0

Table 6–1: 469 MEMORY MAP (Sheet 4 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
STATUS continued	02A0	Over Torque Alarm Status	0	4	1	-	FC123	0
	02A1	Lo-set Overcurrent Alarm Status	0	4	1	-	FC123	0
	02A2	Reserved						
		...						
	02AE	Reserved						
	02AF	Self Test Alarm	0	FFFF	1	-		0
START BLOCKS	02B0	Overload Lockout Block	0	500	1	min	F1	0
	02B1	Start Inhibit Block Lockout Time	0	500	1	min	F1	0
	02B2	Starts/Hour Block Lockout Time	0	60	1	min	F1	0
	02B3	Time Between Starts Lockout Time	0	500	1	min	F1	0
	02B4	Restart Block Lockout	0	50000	1	s	F1	0
	02B5	Reserved						
	...	...						
	02CF	Reserved						
DIGITAL INPUTS	02D0	Access Switch Status	0	1	1	-	FC131	0
	02D1	Test Switch Status	0	1	1	-	FC131	0
	02D2	Starter Switch Status	0	1	1	-	FC131	0
	02D3	Emergency Restart Switch Status	0	1	1	-	FC131	0
	02D4	Remote Reset Switch Status	0	1	1	-	FC131	0
	02D5	Assignable Switch #1 Status	0	1	1	-	FC131	0
	02D6	Assignable Switch #2 Status	0	1	1	-	FC131	0
	02D7	Assignable Switch #3 Status	0	1	1	-	FC131	0
	02D8	Assignable Switch #4 Status	0	1	1	-	FC131	0
	02D9	Trip Coil Supervision	0	1	1	-	FC132	0
	02DA	Reserved						
	...	...						
	02FB	Reserved						
REAL TIME CLOCK	02FC	Date (Read Only)	N/A	N/A	N/A	N/A	F18	N/A
	02FE	Time (Read Only)	N/A	N/A	N/A	N/A	F19	N/A
CURRENT METERING	0300	Phase A Current	0	100000	1	A	F9	0
	0302	Phase B Current	0	100000	1	A	F9	0
	0304	Phase C Current	0	100000	1	A	F9	0
	0306	Average Phase Current	0	100000	1	A	F9	0
	0308	Motor Load	0	2000	1	FLA	F3	0
	0309	Current Unbalance	0	100	1	%	F1	0
	030A	Equivalent Motor Load	0	2000	1	FLA	F3	0
	030B	Ground Current	0	500000	1	A	F11	0
	030D	Phase A Differential Current	0	5000	1	A	F1	0
	030E	Phase B Differential Current	0	5000	1	A	F1	0
	030F	Phase C Differential Current	0	5000	1	A	F1	0
	0310	Reserved						
	...	...						
	031F	Reserved						
TEMPERA-TURE	0320	Hottest Stator RTD	–50	250	1	°C	F4	0
	0321	RTD #1 Temperature	–50	250	1	°C	F4	0
	0322	RTD #2 Temperature	–50	250	1	°C	F4	0
	0323	RTD #3 Temperature	–50	250	1	°C	F4	0
	0324	RTD #4 Temperature	–50	250	1	°C	F4	0
	0325	RTD #5 Temperature	–50	250	1	°C	F4	0
	0326	RTD #6 Temperature	–50	250	1	°C	F4	0
	0327	RTD #7 Temperature	–50	250	1	°C	F4	0
	0328	RTD #8 Temperature	–50	250	1	°C	F4	0
	0329	RTD #9 Temperature	–50	250	1	°C	F4	0

Table 6–1: 469 MEMORY MAP (Sheet 5 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
TEMPERA-TURE continued	032A	RTD #10 Temperature	–50	250	1	°C	F4	0
	032B	RTD #11 Temperature	–50	250	1	°C	F4	0
	032C	RTD #12 Temperature	–50	250	1	°C	F4	0
	032D	Reserved						
	032E	Reserved						
	032F	Reserved						
	0330	Hottest Stator RTD (in Fahrenheit)	–58	482	1	°F	F4	32
	0331	RTD #1 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0332	RTD #2 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0333	RTD #3 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0334	RTD #4 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0335	RTD #5 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0336	RTD #6 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0337	RTD #7 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0338	RTD #8 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	0339	RTD #9 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	033A	RTD #10 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	033B	RTD #11 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	033C	RTD #12 Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	033D	Reserved						
	033E	Reserved						
	033F	Reserved						
VOLTAGE METERING	0340	Vab	0	20000	1	V	F1	0
	0341	Vbc	0	20000	1	V	F1	0
	0342	Vca	0	20000	1	V	F1	0
	0343	Average Line Voltage	0	20000	1	V	F1	0
	0344	Van	0	20000	1	V	F1	0
	0345	Vbn	0	20000	1	V	F1	0
	0346	Vcn	0	20000	1	V	F1	0
	0347	Average_Phase_Voltage	0	20000	1	V	F1	0
	0348	System Frequency	0	12000	1	Hz	F3	0
	0349	Reserved						
	...	...						
	035F	Reserved						
SPEED	0360	Tachometer RPM	0	3600	1	RPM	F1	0
	0361	Reserved						
	...	...						
	036F	Reserved						
POWER METERING	0370	Power Factor	–99	100	1	-	F21	0
	0371	Real Power	–99999	99999	1	kW	F12	0
	0373	Real Power (HP)	0	65535	1	hp	F1	0
	0374	Reactive Power	–99999	99999	1	kvar	F12	0
	0376	Apparent Power	0	65535	1	kVA	F1	0
	0377	MWh Consumption	0	999999999	1	MWh	F17	0
	0379	Mvarh Consumption	0	999999999	1	Mvarh	F17	0
	037B	Mvarh Generation	0	999999999	1	Mvarh	F17	0
	037D	Torque	0	9999999	1	Nm/ftlb	F10	0
	037F	Reserved						
	...	...						
	038F	Reserved						
DEMAND METERING	0390	Current Demand	0	100000	1	A	F9	0
	0392	Real Power Demand	–50000	50000	1	kW	F12	0
	0394	Reactive Power Demand	–50000	50000	1	kvar	F12	0

Table 6–1: 469 MEMORY MAP (Sheet 6 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
DEMAND METERING continued	0396	Apparent Power Demand	0	50000	1	kVA	F1	0
	0397	Peak Current Demand	0	100000	1	A	F9	0
	0399	Peak Real Power Demand	–50000	50000	1	kW	F12	0
	039B	Peak Reactive Power Demand	–50000	50000	1	kvar	F12	0
	039D	Peak Apparent Power Demand	0	50000	1	kVA	F1	0
	039E	Reserved						
	...							
	03AF	Reserved						
ANALOG INPUTS	03B0	Analog I/P 1	–50000	50000	1	-	F12	0
	03B2	Analog I/P 2	–50000	50000	1	-	F12	0
	03B4	Analog I/P 3	–50000	50000	1	-	F12	0
	03B6	Analog I/P 4	–50000	50000	1	-	F12	0
	03B8	Analog Diff 1-2 Absolute	–100000	100000	1	-	F12	0
	03BA	Analog Diff 3-4 Absolute	–100000	100000	1	-	F12	0
	03BC	Reserved						
	...	...						
	03BF	Reserved						
MOTOR STARTING	03C0	Learned Acceleration Time	0	2000	1	s	F2	0
	03C1	Learned Starting Current	0	50000	1	A	F9	0
	03C3	Learned Starting Capacity	0	100	1	%	F1	0
	03C4	Last Acceleration Time	0	2000	1	s	F2	0
	03C5	Last Starting Current	0	50000	1	A	F9	0
	03C7	Last Starting Capacity	0	100	1	%	F1	0
	03C8	Reserved						
	...	...						
	03CF	Reserved						
AVERAGE MOTOR LOAD	03D0	Average Motor Load Learned	0	2000	1	¥ FLA	F3	5
	03D1	Reserved						
	...	...						
	03DF	Reserved						
RTD MAXIMUMS	03E0	RTD # 1 Max. Temperature	–50	250	1	°C	F4	0
	03E1	RTD # 2 Max. Temperature	–50	250	1	°C	F4	0
	03E2	RTD # 3 Max. Temperature	–50	250	1	°C	F4	0
	03E3	RTD # 4 Max. Temperature	–50	250	1	°C	F4	0
	03E4	RTD # 5 Max. Temperature	–50	250	1	°C	F4	0
	03E5	RTD # 6 Max. Temperature	–50	250	1	°C	F4	0
	03E6	RTD # 7 Max. Temperature	–50	250	1	°C	F4	0
	03E7	RTD # 8 Max. Temperature	–50	250	1	°C	F4	0
	03E8	RTD # 9 Max. Temperature	–50	250	1	°C	F4	0
	03E9	RTD # 10 Max. Temperature	–50	250	1	°C	F4	0
	03EA	RTD # 11 Max. Temperature	–50	250	1	°C	F4	0
	03EB	RTD # 12 Max. Temperature	–50	250	1	°C	F4	0
	03EC	Reserved						
	...	...						
	03EF	Reserved						
	03F0	RTD # 1 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F1	RTD # 2 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F2	RTD # 3 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F3	RTD # 4 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F4	RTD # 5 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F5	RTD # 6 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F6	RTD # 7 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F7	RTD # 8 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32

Table 6–1: 469 MEMORY MAP (Sheet 7 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RTD MAXIMUMS continued	03F8	RTD # 9 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03F9	RTD # 10 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03FA	RTD # 11 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03FB	RTD # 12 Max. Temperature (in Fahrenheit)	–58	482	1	°F	F4	32
	03FC	Reserved						
	...	...						
	03FF	Reserved						
ANALOG INPUTS MIN / MAX	0400	Analog I/P 1 Minimum	–50000	50000	1	-	F12	0
	0402	Analog I/P 1 Maximum	–50000	50000	1	-	F12	0
	0404	Analog I/P 2 Minimum	–50000	50000	1	-	F12	0
	0406	Analog I/P 2 Maximum	–50000	50000	1	-	F12	0
	0408	Analog I/P 3 Minimum	–50000	50000	1	-	F12	0
	040A	Analog I/P 3 Maximum	–50000	50000	1	-	F12	0
	040C	Analog I/P 4 Minimum	–50000	50000	1	-	F12	0
	040E	Analog I/P 4 Maximum	–50000	50000	1	-	F12	0
	0410	Reserved						
	...							
	041F	Reserved						
	0420	Original Calibration Date	N/A	N/A	N/A	N/A	F18	N/A
	0422	Last Calibration Date	N/A	N/A	N/A	N/A	F18	N/A
	0424	Reserved						
	...	...						
	042F	Reserved						
TRIP COUNTERS	0430	Total Number of Trips	0	50000	1	-	F1	0
	0431	Incomplete Sequence Trips	0	50000	1	-	F1	0
	0432	Input Switch Trips	0	50000	1	-	F1	0
	0433	Tachometer Trips	0	50000	1	-	F1	0
	0434	Overload Trips	0	50000	1	-	F1	0
	0435	Short Circuit Trips	0	50000	1	-	F1	0
	0436	Mechanical Jam Trips	0	50000	1	-	F1	0
	0437	Undercurrent Trips	0	50000	1	-	F1	0
	0438	Current Unbalance Trips	0	50000	1	-	F1	0
	0439	Ground Fault Trips	0	50000	1	-	F1	0
	043A	Phase Differential Trips	0	50000	1	-	F1	0
	043B	Motor Acceleration Trips	0	50000	1	-	F1	0
	043C	Stator RTD Trips	0	50000	1	-	F1	0
	043D	Bearing RTD Trips	0	50000	1	-	F1	0
	043E	Other RTD Trips	0	50000	1	-	F1	0
	043F	Ambient RTD Trips	0	50000	1	-	F1	0
	0440	Undervoltage Trips	0	50000	1	-	F1	0
	0441	Overvoltage Trips	0	50000	1	-	F1	0
	0442	Voltage Phase Reversal Trips	0	50000	1	-	F1	0
	0443	Voltage Frequency Trips	0	50000	1	-	F1	0
	0444	Power Factor Trips	0	50000	1	-	F1	0
	0445	Reactive Power Trips	0	50000	1	-	F1	0
	0446	Underpower Trips	0	50000	1	-	F1	0
	0447	Analog I/P 1 Trips	0	50000	1	-	F1	0
	0448	Analog I/P 2 Trips	0	50000	1	-	F1	0
	0449	Analog I/P 3 Trips	0	50000	1	-	F1	0
	044A	Analog I/P 4 Trips	0	50000	1	-	F1	0
	044B	Reverse Power Trips	0	50000	1	-	F1	0
	044C	Analog Diff 1-2 Trips	0	50000	1	-	F1	0
	044D	Analog Diff 3-4 Trips	0	50000	1	-	F1	0

Table 6–1: 469 MEMORY MAP (Sheet 8 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
TRIP COUNTERS continued	044E	Lo-set Overcurrent Trip	0	50000	1	-	F1	0
	044F	Reserved						
	...	...						
	046F	Reserved						
GENERAL COUNTERS	0470	Number of Motor Starts	0	50000	1	-	F1	0
	0471	Number of Emergency Restarts	0	50000	1	-	F1	0
	0472	Number of Starter Operations	0	50000	1	-	F1	0
	0473	Digital Counter	0	1000000000	1	-	F9	0
	0475	Reserved						
	...	...						
	049F	Reserved						
TIMERS	04A0	Motor Running Hours	1	100000	1	hr	F9	0
	04A2	Time Between Starts Timer	0	500	1	min	F1	0
	04A3	Start Timer 1	0	60	1	min	F1	0
	04A4	Start Timer 2	0	60	1	min	F1	0
	04A5	Start Timer 3	0	60	1	min	F1	0
	04A6	Start Timer 4	0	60	1	min	F1	0
	04A7	Start Timer 5	0	60	1	min	F1	0
	04A8	Reserved						
	...	...						
	04BF	Reserved						
469 MODEL INFO.	04C0	Order Code	0	65535	1	N/A	FC136	N/A
	04C1	Relay Serial Number	3050001	N/A	1	-	F9	N/A
	04C3	Reserved						
	...	...						
	04DF	Reserved						
CALIBRATION INFO.	04E0	Original Calibration Date	N/A	N/A	N/A	N/A	F18	N/A
	04E2	Last Calibration Date	N/A	N/A	N/A	N/A	F19	N/A
	04E4	Reserved						
	...	...						
	04FF	Reserved						
PHASORS	0500	Va Angle	0	359	1	°	F1	N/A
	0501	Vb Angle	0	359	1	°	F1	N/A
	0502	Vc Angle	0	359	1	°	F1	N/A
	0503	Ia Angle	0	359	1	°	F1	N/A
	0504	Ib Angle	0	359	1	°	F1	N/A
	0505	Ic Angle	0	359	1	°	F1	N/A
	0506	Reserved						
	...	...						
	0FFF	Reserved						
Setpoints (Addresses 1000 to 1FFF)								
PREFER-ENCES	1000	Default Message Cycle Time	5	100	5	s	F2	20
	1001	Default Message Timeout	10	900	1	s	F1	300
	1002	Reserved						
	1003	Average Motor Load Calculation Period	1	90	1	min	F1	15
	1004	Temperature Display Units	0	1	1	-	FC100	0
	1005	Trace Memory Trigger Position	1	100	1	%	F1	25
	1006	Trace Memory Buffers	1	16	1	cycles	F1	8
	1007	Display Update Interval	1	60	1	s	F2	4
	1008	Cyclic Load Filter Interval	0	32	1	cycles	F1	0
	1009	Passcode (Write Only)	0	99999999	1	N/A	F12	0
	100B	Encrypted Passcode (Read Only)	N/A	N/A	N/A	N/A	F12	N/A
	100C	Reserved						

6

Table 6–1: 469 MEMORY MAP (Sheet 9 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
PREFER-ENCES ctd	...							
	100F	Reserved						
RS485 SERIAL PORTS	1010	Slave Address	1	254	1	-	F1	254
	1011	Computer RS485 Baud Rate	0	5	1	-	FC101	4
	1012	Computer RS485 Parity	0	2	1	-	FC102	0
	1013	Auxiliary RS485 Baud Rate	0	5	1	-	FC101	4
	1014	Auxiliary RS485 Parity	0	2	1	-	FC102	0
	1015	Reserved						
	...							
	102F	Reserved						
REAL TIME CLOCK	1030	Date	N/A	N/A	N/A	N/A	F18	N/A
	1032	Time	N/A	N/A	N/A	N/A	F19	N/A
	1034	Reserved						
	...							
	103F	Reserved						
DEFAULT MESSAGES	1040	Reserved						
	...							
	105F	Reserved						
MESSAGE SCRATCHPAD	1060	1st & 2nd Char of First Scratchpad Message	32	127	1	-	F1	'Te'
	1061	3rd & 4th Char of First Scratchpad Message	32	127	1	-	F1	'xt'
	...							
	1073	39th & 40th Char of First Scratchpad Message	32	127	1	-	F1	' '
	1074	Reserved						
	...							
	107F	Reserved						
	1080	1st & 2nd Char of Second Scratchpad Msg	32	127	1	-	F1	'Te'
	1081	3rd & 4th Char of Second Scratchpad Msg	32	127	1	-	F1	'xt'
	...							
	1093	39th & 40th Char of Second Scratchpad Msg	32	127	1	-	F1	' '
	1094	Reserved						
	...							
	109F	Reserved						
	10A0	1st & 2nd Char of 3rd Scratchpad Message	32	127	1	-	F1	'Te'
	10A1	3rd & 4th Char of 3rd Scratchpad Message	32	127	1	-	F1	'xt'
	...							
	10B3	39th & 40th Char of 3rd Scratchpad Message	32	127	1	-	F1	' '
	10B4	Reserved						
	...							
	10BF	Reserved						
	10C0	1st & 2nd Char of 4th Scratchpad Message	32	127	1	-	F1	'Te'
	10C1	3rd & 4th Char of 4th Scratchpad Message	32	127	1	-	F1	'xt'
	...							
	10D3	39th & 40th Char of 4th Scratchpad Message	32	127	1	-	F1	' '
	10D4	Reserved						
	...							
	10DF	Reserved						
	10E0	1st & 2nd Char of 5th Scratchpad Message	32	127	1	-	F1	'Mu'
	10E1	3rd & 4th Char of 5th Scratchpad Message	32	127	1	-	F1	'lt'
	...							
	10F3	39th & 40th Char of 5th Scratchpad Message	32	127	1	-	F1	' '
	10F4	Reserved						
	...							
	112F	Reserved						

Table 6–1: 469 MEMORY MAP (Sheet 10 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
CLEAR DATA	1130	Clear Last Trip Data Prompt	0	1	1	-	FC103	0
	1131	Reset MWh and Mvarh Meters	0	1	1	-	FC103	0
	1132	Clear Peak Demand Data	0	1	1	-	FC103	0
	1133	Clear RTD Maximums	0	1	1	-	FC103	0
	1134	Clear Analog Input Min/Max Data	0	1	1	-	FC103	0
	1135	Clear Trip Counters	0	1	1	-	FC103	0
	1136	Preset Digital Counter	0	1	1	-	FC103	0
	1137	Clear Event Records	0	1	1	-	FC103	0
	1138	Reserved						
	...							
	113F	Reserved						
INSTALLATION	1140	Reset Motor Information	0	1	1	-	FC103	0
	1141	Reset Starter Information	0	1	1	-	FC103	0
	1142	Reserved						
	...							
	117F	Reserved						
CURRENT SENSING	1180	Phase CT Primary	1	5001	1	A	F1	5001
	1181	Motor Full Load Amps	1	5001	1	A	F1	5001
	1182	Ground CT Type	0	3	1	-	FC104	3
	1183	Ground CT Primary	1	5000	1	A	F1	100
	1184	Phase Differential CT Type	0	2	1	-	FC105	0
	1185	Phase Differential CT Primary	1	5000	1	A	F1	100
	1186	Enable Two Speed Motor Option	0	1	1	-	FC103	0
	1187	Speed Two Phase CT Primary	1	5000	1	A	F1	100
	1188	Speed Two Motor Full Load Amps	1	5000	1	A	F1	1
	1189	Reserved						
	...							
	119F	Reserved						
VOLTAGE SENSING	11A0	Voltage Transformer Connection Type	0	2	1	-	FC106	0
	11A1	Voltage Transformer Ratio	100	30000	1	-	F3	3500
	11A2	Motor Nameplate Voltage	100	36000	1	V	F1	4000
	11A3	Enable Single VT Connection	0	1	1	-	FC143	0
	11A4	Reserved						
	...							
	11BF	Reserved						
POWER SYSTEM	11C0	Nominal System Frequency	0	1	1	-	FC107	0
	11C1	System Phase Sequence	0	1	1	-	FC124	0
	11C2	Speed2 Phase Sequence	0	1	1	-	FC124	0
	11C3	Reserved						
	...							
	11C7	Reserved						
SERIAL COM. CONTROL	11C8	Serial Communication Control	0	1	1	-	FC103	0
	11C9	Assign Start Control Relays	0	2	1	-	FC137	0
	11CA	Reserved						
	...							
	11CF	Reserved						
REDUCED VOLTAGE	11D0	Reduced Voltage Starting	0	1	1	-	FC103	0
	11D1	Control Relays for Reduced Voltage Starting	0	2	1	-	FC137	2
	11D2	Transition On	0	2	1	-	FC108	0
	11D3	Reduced Voltage Start Level	25	300	1	%FLA	F1	100
	11D4	Reduced Voltage Start Timer	1	600	1	s	F1	200
	11D5	Incomplete Sequence Trip Relays	0	3	1	-	FC111	0
	11D6	Reserved						

Table 6–1: 469 MEMORY MAP (Sheet 11 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
REDUCED VOLTAGE ctd	...							
	122F	Reserved						
STARTER STATUS	1230	Starter Status Switch	0	1	1	-	FC109	0
	1231	Reserved						
	...							
	123F	Reserved						
ASSIGNABLE INPUTS	1240	Assignable Input 1 Function	0	18	1	-	FC110	0
	1241	Assignable Input 2 Function	0	18	1	-	FC110	0
	1242	Assignable Input 3 Function	0	18	1	-	FC110	0
	1243	Assignable Input 4 Function	0	18	1	-	FC110	0
	1244	Reserved						
	...							
	1259	Reserved						
REMOTE ALARM	125A	1st and 2nd char. of Remote Alarm Name	0	65535	1	-	F22	'Re'
	125B	3rd and 4th char. of Remote Alarm Name	0	65535	1	-	F22	'mo'
	...							
	1263	19th and 20th char. of Remote Alarm Name	0	65535	1	-	F22	' '
	1264	Remote Alarm Function	1	2	1	-	FC115	2
	1265	Remote Alarm Relays	0	6	1	-	FC113	0
	1266	Remote Alarm Events	0	1	1	-	FC103	0
	1267	Reserved						
	...	...						
	1279	Reserved						
REMOTE TRIP	127A	1st and 2nd char. of Remote Trip Name	0	65535	1	-	F22	'Re'
	127B	3rd and 4th char. of Remote Trip Name	0	65535	1	-	F22	'e'
	...							
	1283	19th and 20th char. of Remote Trip Name	0	65535	1	-	F22	' '
	1284	Remote Trip Relays	0	3	1	-	FC111	0
	1285	Reserved						
	...							
	128F	Reserved						
SPEED SWITCH TRIP	1290	Speed Switch Trip Relays	0	3	1	-	FC111	0
	1291	Speed Switch Trip Delay	10	2500	1	s	F2	50
	1292	Reserved						
	...	...						
	129F	Reserved						
LOAD SHED TRIP	12A0	Load Shed Trip Relays	0	3	1	-	FC111	0
	12A1	Reserved						
	...	...						
	12AF	Reserved						
PRESSURE SWITCH ALARM	12B0	Block Pressure Switch Alarm from Start	0	5000	1	s	F1	0
	12B1	Pressure Switch Alarm Function	1	2	1	-	FC115	2
	12B2	Pressure Switch Alarm Relays	0	6	1	-	FC113	0
	12B3	Pressure Switch Alarm Delay	1	1000	1	s	F2	50
	12B4	Pressure Switch Alarm Events	0	1	1	-	FC103	0
	12B5	Reserved						
	...							
	12BF	Reserved						
PRESSURE SWITCH TRIP	12C0	Block Pressure Switch Trip from Start	0	5000	1	s	F1	0
	12C1	Pressure Switch Trip Relays	0	3	1	-	FC111	0
	12C2	Pressure Switch Trip Delay	1	1000	1	s	F2	50
	12C3	Reserved						
	...							

Table 6–1: 469 MEMORY MAP (Sheet 12 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
VIBRATION SWITCH ALARM	12CF	Reserved						
	12D0	Vibration Switch Alarm Function	1	2	1	-	FC115	2
	12D1	Vibration Switch Alarm Relays	0	6	1	-	FC113	0
	12D2	Vibration Switch Alarm Delay	1	1000	1	s	F2	50
	12D3	Vibration Switch Alarm Events	0	1	1	-	FC103	0
	12D4	Reserved						
	...							
	12DF	Reserved						
VIBRATION SWITCH TRIP	12E0	Vibration Switch Trip Relays	0	3	1	-	FC111	0
	12E1	Vibration Switch Trip Delay	1	1000	1	s	F2	50
	12E2	Reserved						
	...							
	12F2	Reserved						
DIGITAL COUNTERS	12F3	1st and 2nd char. of Counter Units Name	0	65535	1	-	F22	‘Un’
	12F4	3rd and 4th char. of Counter Units Name	0	65535	1	-	F22	‘it’
	12F5	5th and 6th char. of Counter Units Name	0	65535	1	-	F22	‘s ‘
	12F6	Counter Preset Value	0	1000000000	1	-	F9	0
	12F8	Counter Type	0	1	1	-	FC114	0
	12F9	Counter Alarm	0	2	1	-	FC115	0
	12FA	Counter Alarm Relays	0	6	1	-	FC113	0
	12FB	Counter Alarm Level	0	1000000000	1	-	F9	100
	12FD	Counter Alarm Pickup	0	1	1	-	FC130	0
	12FE	Counter Alarm Events	0	1	1	-	FC103	0
	12FF	Reserved						
	...	...						
	130F	Reserved						
TACHOMETER	1310	Rated Speed	100	7200	1	RPM	F1	3600
	1311	Tachometer Alarm	0	2	1	-	FC115	0
	1312	Tachometer Alarm Relays	0	6	1	-	FC113	0
	1313	Tachometer Alarm Speed	5	100	1	%Rated	F1	10
	1314	Tachometer Alarm Delay	1	250	1	s	F1	1
	1315	Tachometer Alarm Events	0	1	1	-	FC103	0
	1316	Tachometer Trip	0	2	1	-	FC115	0
	1317	Tachometer Trip Relays	0	3	1	-	FC111	0
	1318	Tachometer Trip Speed	5	95	1	%Rated	F1	10
	1319	Tachometer Trip Delay	1	250	1	s	F1	1
	131A	Reserved						
	...							
	1335	Reserved						
GENERAL SWITCH A	1336	1st and 2nd char. of General Switch A Name	0	65535	1	-	F22	‘Ge’
	1337	3rd and 4th char. of General Switch A Name	0	65535	1	-	F22	‘ne’
	...							
	133B	11th and 12th char. of General Switch A Name	0	65535	1	-	F22	‘ ‘
	133C	General Switch A Normal State	0	1	1	-	FC116	0
	133D	General Switch A Block Input From Start	0	5000	1	s	F1	0
	133E	General Switch A Alarm	0	2	1	-	FC115	0
	133F	General Switch A Alarm Relays	0	6	1	-	FC113	0
	1340	General Switch A Alarm Delay	1	50000	1	s	F2	50
	1341	General Switch A Alarm Events	0	1	1	-	FC103	0
	1342	General Switch A Trip	0	2	1	-	FC115	0
	1343	General Switch A Trip Relays	0	3	1	-	FC111	0
	1344	General Switch A Trip Delay	1	50000	1	s	F2	50
	1345	Reserved						

6

Table 6–1: 469 MEMORY MAP (Sheet 13 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
GENERAL SWITCH A ctd	...							
	1365	Reserved						
GENERAL SWITCH B	1366	1st and 2nd char. of General Switch B Name	0	65535	1	-	F22	‘Ge’
	1367	3rd and 4th char. of General Switch B Name	0	65535	1	-	F22	‘ne’
	...							
	136B	11th and 12th char. of General Switch B Name	0	65535	1	-	F22	‘ ‘
	136C	General Switch B Normal State	0	1	1	-	FC116	0
	136D	General Switch B Block Input From Start	0	5000	1	s	F1	0
	136E	General Switch B Alarm	0	2	1	-	FC115	0
	136F	General Switch B Alarm Relays	0	6	1	-	FC113	0
	1370	General Switch B Alarm Delay	1	50000	1	s	F2	50
	1371	General Switch B Alarm Events	0	1	1	-	FC103	0
	1372	General Switch B Trip	0	2	1	-	FC115	0
	1373	General Switch B Trip Relays	0	3	1	-	FC111	0
	1374	General Switch B Trip Delay	1	50000	1	s	F2	50
	1375	Reserved						
	...							
	1395	Reserved						
GENERAL SWITCH C	1396	1st and 2nd char. of General Switch C Name	0	65535	1	-	F22	‘Ge’
	1397	3rd and 4th char. of General Switch C Name	0	65535	1	-	F22	‘ne’
	...							
	139B	11th and 12th char. of General Switch C Name	0	65535	1	-	F22	‘ ‘
	139C	General Switch C Normal State	0	1	1	-	FC116	0
	139D	General Switch C Block Input From Start	0	5000	1	s	F1	0
	139E	General Switch C Alarm	0	2	1	-	FC115	0
	139F	General Switch C Alarm Relays	0	6	1	-	FC113	0
	13A0	General Switch C Alarm Delay	1	50000	1	s	F2	50
	13A1	General Switch C Alarm Events	0	1	1	-	FC103	0
	13A2	General Switch C Trip	0	2	1	-	FC115	0
	13A3	General Switch C Trip Relays	0	3	1	-	FC111	0
	13A4	General Switch C Trip Delay	1	50000	1	s	F2	50
	13A5	Reserved						
	...							
	13C5	Reserved						
GENERAL SWITCH D	13C6	1st and 2nd char. of General Switch D Name	0	65535	1	-	F22	‘Ge’
	13C7	3rd and 4th char. of General Switch D Name	0	65535	1	-	F22	‘ne’
	...							
	13CB	11th and 12th char. of General Switch D Name	0	65535	1	-	F22	‘ ‘
	13CC	General Switch D Normal State	0	1	1	-	FC116	0
	13CD	General Switch D Block Input From Start	0	5000	1	s	F1	0
	13CE	General Switch D Alarm	0	2	1	-	FC115	0
	13CF	General Switch D Alarm Relays	0	6	1	-	FC113	0
	13D0	General Switch D Alarm Delay	1	50000	1	s	F2	50
	13D1	General Switch D Alarm Events	0	1	1	-	FC103	0
	13D2	General Switch D Trip	0	2	1	-	FC115	0
	13D3	General Switch D Trip Relays	0	3	1	-	FC111	0
	13D4	General Switch D Trip Delay	1	50000	1	s	F2	50
	13D5	Reserved						
	...							
	14FF	Reserved						
RELAY RESET MODE	1500	Reset Mode R1 TRIP	0	2	1	-	FC117	0
	1501	Reset Mode R2 AUXILIARY	0	2	1	-	FC117	0
	1502	Reset Mode R3 AUXILIARY	0	2	1	-	FC117	0

Table 6–1: 469 MEMORY MAP (Sheet 14 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RELAY RESET MODE continued	1503	Reset Mode R4 ALARM	0	2	1	-	FC117	0
	1504	Reserved						
	1505	Reset Mode R6 SERVICE	0	2	1	-	FC117	0
FORCE OUTPUT RELAY	1506	Force Trip (R1) Relay	0	1	1	-	FC126	0
	1507	Force Trip Relay Duration	0	300	1	s	F1	0
	1508	Force Aux1 (R2) Relay	0	1	1	-	FC126	0
	1509	Force Aux1 Relay Duration	0	300	1	s	F1	0
	150A	Force Aux2 (R3) Relay	0	1	1	-	FC126	0
	150B	Force Aux2 Relay Duration	0	300	1	s	F1	0
	150C	Force Alarm (R4) Relay	0	1	1	-	FC126	0
	150D	Force Alarm Relay Duration	0	300	1	s	F1	0
	150E	Force Block (R5) Relay	0	1	1	-	FC126	0
	150F	Force Block Relay Duration	0	300	1	s	F1	0
	1510	Reserved						
	...							
	157F	Reserved						
THERMAL MODEL	1580	Curve Style	0	2	1	-	FC128	0
	1581	Overload Pickup Level	101	125	1	¥ FLA	F3	101
	1582	Unbalance k Factor	0	12	1	-	F1	0
	1582	Unbalance k Factor	0	12	1	-	F1	0
	1583	Cool Time Constant Running	1	1000	1	min	F1	15
	1584	Cool Time Constant Stopped	1	1000	1	min	F1	30
	1585	Hot/Cold Safe Stall Ratio	1	100	1	-	F3	100
	1586	RTD Biasing	0	1	1	-	FC103	0
	1587	RTD Bias Minimum	0	250	1	°C	F1	40
	1588	RTD Bias Center Point	0	250	1	°C	F1	130
	1589	RTD Bias Maximum	0	250	1	°C	F1	155
	158A	Thermal Capacity Alarm	0	2	1	-	FC115	0
	158B	Thermal Capacity Alarm Relays	0	6	1	-	FC113	0
	158C	Thermal Capacity Alarm Level	10	100	1	%used	F1	75
	158D	Thermal Capacity Alarm Events	0	1	1	-	FC103	0
	158E	Overload Trip Relays	0	3	1	-	FC111	0
	158F	Reserved						
	...							
	15AE	Reserved						
O/L CURVE SETUP	15AF	Standard Overload Curve Number	1	15	1	-	F1	4
	15B0	Time to Trip at 1.01 x FLA	5	999999	1	s	F10	174145
	15B2	Time to Trip at 1.05 x FLA	5	999999	1	s	F10	34149
	15B4	Time to Trip at 1.10 x FLA	5	999999	1	s	F10	16667
	15B6	Time to Trip at 1.20 x FLA	5	999999	1	s	F10	7954
	15B8	Time to Trip at 1.30 x FLA	5	999999	1	s	F10	5072
	15BA	Time to Trip at 1.40 x FLA	5	999999	1	s	F10	3646
	15BC	Time to Trip at 1.50 x FLA	5	999999	1	s	F10	2800
	15BE	Time to Trip at 1.75 x FLA	5	999999	1	s	F10	1697
	15C0	Time to Trip at 2.00 x FLA	5	999999	1	s	F10	1166
	15C2	Time to Trip at 2.25 x FLA	5	999999	1	s	F10	861
	15C4	Time to Trip at 2.50 x FLA	5	999999	1	s	F10	666
	15C6	Time to Trip at 2.75 x FLA	5	999999	1	s	F10	533
	15C8	Time to Trip at 3.00 x FLA	5	999999	1	s	F10	437
	15CA	Time to Trip at 3.25 x FLA	5	999999	1	s	F10	366
	15CC	Time to Trip at 3.50 x FLA	5	999999	1	s	F10	311
	15CE	Time to Trip at 3.75 x FLA	5	999999	1	s	F10	268
	15D0	Time to Trip at 4.00 x FLA	5	999999	1	s	F10	233

Table 6–1: 469 MEMORY MAP (Sheet 15 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
O/L CURVE SETUP continued	15D2	Time to Trip at 4.25 x FLA	5	999999	1	s	F10	205
	15D4	Time to Trip at 4.50 x FLA	5	999999	1	s	F10	182
	15D6	Time to Trip at 4.75 x FLA	5	999999	1	s	F10	162
	15D8	Time to Trip at 5.00 x FLA	5	999999	1	s	F10	146
	15DA	Time to Trip at 5.50 x FLA	5	999999	1	s	F10	120
	15DC	Time to Trip at 6.00 x FLA	5	999999	1	s	F10	100
	15DE	Time to Trip at 6.50 x FLA	5	999999	1	s	F10	85
	15E0	Time to Trip at 7.00 x FLA	5	999999	1	s	F10	73
	15E2	Time to Trip at 7.50 x FLA	5	999999	1	s	F10	63
	15E4	Time to Trip at 8.00 x FLA	5	999999	1	s	F10	56
	15E6	Time to Trip at 10.0 x FLA	5	999999	1	s	F10	56
	15E8	Time to Trip at 15.0 x FLA	5	999999	1	s	F10	56
	15EA	Time to Trip at 20.0 x FLA	5	999999	1	s	F10	56
	15EC	Reserved						
	...							
	15FF	Reserved						
	1600	Minimum Allowable Line Voltage	70	95	1	%Rated	F1	80
	1601	Stall Current at Min Vline	200	1500	1	¥ FLA	F3	480
	1602	Safe Stall Time at Min Vline	5	9999	1	s	F2	200
	1603	Accel. Intersect at Min Vline	200	1500	1	¥ FLA	F3	380
	1604	Stall Current at 100% Vline	200	1500	1	¥ FLA	F3	600
	1605	Safe Stall Time at 100% Vline	5	9999	1	s	F2	100
	1606	Accel. Intersect at 100% Vline	200	1500	1	¥ FLA	F3	500
	1607	Reserved						
	...							
	163F	Reserved						
SHORT CIRCUIT TRIP	1640	Short Circuit Trip	0	2	1	-	FC115	0
	1641	Overreach Filter	0	1	1	-	FC103	0
	1642	Short Circuit Trip Relays	0	6	1	-	FC118	0
	1643	Short Circuit Trip Pickup	20	200	1	¥ CT	F2	100
	1644	Intentional Short Circuit Trip Delay	0	1000	10	ms	F1	0
	1645	Short Circuit Trip Backup	0	1	1	-	FC103	0
	1646	Short Circuit Backup Relays	0	2	1	-	FC119	0
	1647	Short Circuit Trip Backup Delay	10	2000	10	ms	F1	200
	1648	Reserved						

	164F	Reserved						
OVERLOAD ALARM	1650	Overload Alarm	0	2	1	-	FC115	0
	1651	Overload Alarm Relays	0	6	1	-	FC113	0
	1652	Overload Alarm Events	0	1	1	-	FC103	0
	1653	Overload Alarm Delay	1	600	1	s	F2	0
	1654	Reserved						
	...							
	165F	Reserved						
MECHANICAL JAM	1660	Mechanical Jam Trip	0	2	1	-	FC115	0
	1661	Mechanical Jam Trip Relays	0	3	1	-	FC111	0
	1662	Mechanical Jam Pickup	101	300	1	¥ FLA	F3	150
	1663	Mechanical Jam Delay	1	30	1	s	F1	1
	1664	Reserved						
	...							
	166F	Reserved						
UNDERCURRENT	1670	Block Undercurrent from Start	0	15000	1	s	F1	0
	1671	Undercurrent Alarm	0	2	1	-	FC115	0

Table 6–1: 469 MEMORY MAP (Sheet 16 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
UNDERCURRENT continued	1672	Undercurrent Alarm Relays	0	6	1	-	FC113	0
	1673	Undercurrent Alarm Pickup	10	95	1	¥ FLA	F3	70
	1674	Undercurrent Alarm Delay	1	60	1	s	F1	1
	1675	Undercurrent Alarm Events	0	1	1	-	FC103	0
	1676	Undercurrent Trip	0	2	1	-	FC115	0
	1677	Undercurrent Trip Relays	0	3	1	-	FC111	0
	1678	Undercurrent Trip Pickup	10	99	1	¥ FLA	F3	70
	1679	Undercurrent Trip Delay	1	60	1	s	F1	1
	167A	Reserved						
	...							
	167F	Reserved						
CURRENT UNBALANCE	1680	Current Unbalance Alarm	0	2	1	-	FC115	0
	1681	Current Unbalance Alarm Relays	0	6	1	-	FC113	0
	1682	Current Unbalance Alarm Pickup	4	40	1	%	F1	15
	1683	Current Unbalance Alarm Delay	1	60	1	s	F1	1
	1684	Current Unbalance Alarm Events	0	1	1	-	FC103	0
	1685	Current Unbalance Trip	0	2	1	-	FC115	0
	1686	Current Unbalance Trip Relays	0	3	1	-	FC111	0
	1687	Current Unbalance Trip Pickup	4	40	1	%	F1	20
	1688	Current Unbalance Trip Delay	1	60	1	s	F1	1
	1689	Reserved						
	...							
	169F	Reserved						
GROUND FAULT	16A0	Reserved						
	16A1	Ground Fault Alarm	0	2	1	-	FC115	0
	16A2	Ground Fault Alarm Relays	0	6	1	-	FC113	0
	16A3	Ground Fault Alarm Pickup	10	100	1	¥ CT	F3	10
	16A4	Alarm Pickup for 50/0.025 CT	25	2500	1	A	F3	100
	16A5	Intentional GF Alarm Delay	0	1000	10	ms	F1	0
	16A6	Ground Fault Alarm Events	0	1	1	-	FC103	0
	16A7	Ground Fault Trip	0	2	1	-	FC115	0
	16A8	Ground Fault Trip Relays	0	6	1	-	FC118	0
	16A9	Ground Fault Trip Pickup	10	100	1	¥ CT	F3	20
	16AA	Trip Pickup for 50/0.025 CT	25	2500	1	A	F3	100
	16AB	Intentional GF Trip Delay	0	1000	10	ms	F1	0
	16AC	Ground Fault Trip Backup	0	1	1	-	FC103	0
	16AD	Ground Fault Trip Backup Relays	0	2	1	-	FC119	0
	16AE	Ground Fault Trip Backup Delay	10	2000	10	ms	F1	200
	...	Reserved						
	16BF	Reserved						
PHASE DIFFERENTIAL	16C0	Phase Differential Trip	0	2	1	-	FC115	0
	16C1	Phase Differential Trip Relays	0	6	1	-	FC118	0
	16C2	Differential Trip Pickup While Starting	5	100	1	¥ CT	F3	10
	16C3	Differential Trip Delay While Starting	0	60000	10	ms	F1	0
	16C4	Differential Trip Pickup While Running	5	100	1	¥ CT	F3	10
	16C5	Differential Trip Delay While Running	0	1000	10	ms	F1	0
	16C4	Reserved						
	...							
	16CF	Reserved						
ACCELER-ATION TIMER	16D0	Acceleration Timer Trip	0	2	1	-	FC115	0
	16D1	Acceleration Timer Trip Relays	0	3	1	-	FC111	0
	16D2	Acceleration Timer from Start	10	2500	1	s	F2	100

Table 6–1: 469 MEMORY MAP (Sheet 17 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ACCELER-ATION TIMER continued	16D3	Reserved						
	...							
	16DF	Reserved						
START INHIBIT	16E0	Start Inhibit Block	0	1	1	-	FC103	0
	16E1	Thermal Capacity Used Margin	0	25	1	%	F1	25
	16E2	Reserved						
	...							
	16EF	Reserved						
JOGGING BLOCK	16F0	Jogging Block	0	1	1	-	FC103	0
	16F1	Maximum Starts/Hour Permissible	1	5	1	-	F1	3
	16F2	Time Between Starts	0	500	1	min	F1	10
	16F3	Reserved						
	...							
	16FF	Reserved						
RESTART BLOCK	1700	Restart Block	0	1	1	-	FC103	0
	1701	Restart Block Time	1	50000	1	s	F1	1
	1702	Reserved						
	...							
	177F	Reserved						
RTD TYPES	1780	Stator RTD Type	0	3	1	-	FC120	0
	1781	Bearing RTD Type	0	3	1	-	FC120	0
	1782	Ambient RTD Type	0	3	1	-	FC120	0
	1783	Other RTD Type	0	3	1	-	FC120	0
	1784	Reserved						
	...							
	178F	Reserved						
RTD #1	1790	RTD #1 Application	0	4	1	-	FC121	1
	1791	RTD #1 Alarm	0	2	1	-	FC115	0
	1792	RTD #1 Alarm Relays	0	6	1	-	FC113	0
	1793	RTD #1 Alarm Temperature	1	250	1	°C	F1	130
	1794	RTD #1 Alarm Events	0	1	1	-	FC103	0
	1795	RTD #1 Trip	0	2	1	-	FC115	0
	1796	RTD #1 Trip Voting	1	12	1	-	FC122	1
	1797	RTD #1 Trip Relays	0	3	1	-	FC111	0
	1798	RTD #1 Trip Temperature	1	250	1	°C	F1	155
	1799	1st and 2nd char. of RTD #1 Name	0	65535	1	-	F22	‘ ‘
	...							
	179C	7th and 8th char. of RTD #1 Name	0	65535	1	-	F22	‘ ‘
	179D	Reserved						
	...							
	17AD	Reserved						
	17AE	RTD #1 Alarm Temperature (in Fahrenheit)	34	482	1	°C	F1	266
	17AF	RTD #1 Trip Temperature (in Fahrenheit)	34	482	1	°C	F1	311
RTD #2	17B0	RTD #2 Application	0	4	1	-	FC121	1
	17B1	RTD #2 Alarm	0	2	1	-	FC115	0
	17B2	RTD #2 Alarm Relays	0	6	1	-	FC113	0
	17B3	RTD #2 Alarm Temperature	1	250	1	°C	F1	130
	17B4	RTD #2 Alarm Events	0	1	1	-	FC103	0
	17B5	RTD #2 Trip	0	2	1	-	FC115	0
	17B6	RTD #2 Trip Voting	1	12	1	-	FC122	2
	17B7	RTD #2 Trip Relays	0	3	1	-	FC111	0
	17B8	RTD #2 Trip Temperature	1	250	1	°C	F1	155
	17B9	1st and 2nd char. of RTD #2 Name	0	65535	1	-	F22	‘ ‘

Table 6–1: 469 MEMORY MAP (Sheet 18 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RTD #2 continued	...							
	17BC	7th and 8th char. of RTD #2 Name	0	65535	1	-	F22	‘ ‘
	17BD	Reserved						
	...							
	17CD	Reserved						
	17CE	RTD #2 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	266
	17CF	RTD #2 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	311
RTD #3	17D0	RTD #3 Application	0	4	1	-	FC121	1
	17D1	RTD #3 Alarm	0	2	1	-	FC115	0
	17D2	RTD #3 Alarm Relays	0	6	1	-	FC113	0
	17D3	RTD #3 Alarm Temperature	1	250	1	°C	F1	130
	17D4	RTD #3 Alarm Events	0	1	1	-	FC103	0
	17D5	RTD #3 Trip	0	2	1	-	FC115	0
	17D6	RTD #3 Trip Voting	1	12	1	-	FC122	3
	17D7	RTD #3 Trip Relays	0	3	1	-	FC111	0
	17D8	RTD #3 Trip Temperature	1	250	1	°C	F1	155
	17D9	1st and 2nd char. of RTD #3 Name	0	65535	1	-	F22	‘ ‘
	...							
	17DC	7th and 8th char. of RTD #3 Name	0	65535	1	-	F22	‘ ‘
	17DD	Reserved						
	...							
	17ED	Reserved						
	17EE	RTD #3 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	266
	17EF	RTD #3 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	311
RTD #4	17F0	RTD #4 Application	0	4	1	-	FC121	1
	17F1	RTD #4 Alarm	0	2	1	-	FC115	0
	17F2	RTD #4 Alarm Relays	0	6	1	-	FC113	0
	17F3	RTD #4 Alarm Temperature	1	250	1	°C	F1	130
	17F4	RTD #4 Alarm Events	0	1	1	-	FC103	0
	17F5	RTD #4 Trip	0	2	1	-	FC115	0
	17F6	RTD #4 Trip Voting	1	12	1	-	FC122	4
	17F7	RTD #4 Trip Relays	0	3	1	-	FC111	0
	17F8	RTD #4 Trip Temperature	1	250	1	°C	F1	155
	17F9	1st and 2nd char. of RTD #4 Name	0	65535	1	-	F22	‘ ‘
	...							
	17FC	7th and 8th char. of RTD #4 Name	0	65535	1	-	F22	‘ ‘
	17FD	Reserved						
	...							
	180D	Reserved						
	180E	RTD #4 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	266
	180F	RTD #4 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	311
RTD #5	1810	RTD #5 Application	0	4	1	-	FC121	1
	1811	RTD #5 Alarm	0	2	1	-	FC115	0
	1812	RTD #5 Alarm Relays	0	6	1	-	FC113	0
	1813	RTD #5 Alarm Temperature	1	250	1	°C	F1	130
	1814	RTD #5 Alarm Events	0	1	1	-	FC103	0
	1815	RTD #5 Trip	0	2	1	-	FC115	0
	1816	RTD #5 Trip Voting	1	12	1	-	FC122	5
	1817	RTD #5 Trip Relays	0	3	1	-	FC111	0
	1818	RTD #5 Trip Temperature	1	250	1	°F	F1	155
	1819	1st and 2nd char. of RTD #5 Name	0	65535	1	-	F22	‘ ‘
	...							
	181C	7th and 8th char. of RTD #5 Name	0	65535	1	-	F22	‘ ‘

Table 6–1: 469 MEMORY MAP (Sheet 19 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RTD #5 continued	181D	Reserved						
	...							
	182D	Reserved						
	182E	RTD #5 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	266
	182F	RTD #5 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	311
RTD #6	1830	RTD #6 Application	0	4	1	-	FC121	1
	1831	RTD #6 Alarm	0	2	1	-	FC115	0
	1832	RTD #6 Alarm Relays	0	6	1	-	FC113	0
	1833	RTD #6 Alarm Temperature	1	250	1	°C	F1	130
	1834	RTD #6 Alarm Events	0	1	1	-	FC103	0
	1835	RTD #6 Trip	0	2	1	-	FC115	0
	1836	RTD #6 Trip Voting	1	12	1	-	FC122	6
	1837	RTD #6 Trip Relays	0	3	1	-	FC111	0
	1838	RTD #6 Trip Temperature	1	250	1	°C	F1	155
	1839	1st and 2nd char. of RTD #6 Name	0	65535	1	-	F22	‘ ‘
	...							
	183C	7th and 8th char. of RTD #6 Name	0	65535	1	-	F22	‘ ‘
	183D	Reserved						
	...							
	184D	Reserved						
	184E	RTD #6 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	266
	184F	RTD #6 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	311
RTD #7	1850	RTD #7 Application	0	4	1	-	FC121	2
	1851	RTD #7 Alarm	0	2	1	-	FC115	0
	1852	RTD #7 Alarm Relays	0	6	1	-	FC113	0
	1853	RTD #7 Alarm Temperature	1	250	1	°C	F1	80
	1854	RTD #7 Alarm Events	0	1	1	-	FC103	0
	1855	RTD #7 Trip	0	2	1	-	FC115	0
	1856	RTD #7 Trip Voting	1	12	1	-	FC122	7
	1857	RTD #7 Trip Relays	0	3	1	-	FC111	0
	1858	RTD #7 Trip Temperature	1	250	1	°C	F1	90
	1859	1st and 2nd char. of RTD #7 Name	0	65535	1	-	F22	‘ ‘
	...							
	185C	7th and 8th char. of RTD #7 Name	0	65535	1	-	F22	‘ ‘
	185D	Reserved						
	...							
	186D	Reserved						
	186E	RTD #7 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	176
	186F	RTD #7 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	194
RTD #8	1870	RTD #8 Application	0	4	1	-	FC121	2
	1871	RTD #8 Alarm	0	2	1	-	FC115	0
	1872	RTD #8 Alarm Relays	0	6	1	-	FC113	0
	1873	RTD #8 Alarm Temperature	1	250	1	°C	F1	80
	1874	RTD #8 Alarm Events	0	1	1	-	FC103	0
	1875	RTD #8 Trip	0	2	1	-	FC115	0
	1876	RTD #8 Trip Voting	1	12	1	-	FC122	8
	1877	RTD #8 Trip Relays	0	3	1	-	FC111	0
	1878	RTD #8 Trip Temperature	1	250	1	°C	F1	90
	1879	1st and 2nd char. of RTD #8 Name	0	65535	1	-	F22	‘ ‘
	...							
	187C	7th and 8th char. of RTD #8 Name	0	65535	1	-	F22	‘ ‘
	187D	Reserved						
	...							

Table 6–1: 469 MEMORY MAP (Sheet 20 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RTD #8 continued	188D	Reserved						
	188E	RTD #8 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	176
	188F	RTD #8 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	194
RTD #9	1890	RTD #9 Application	0	4	1	-	FC121	2
	1891	RTD #9 Alarm	0	2	1	-	FC115	0
	1892	RTD #9 Alarm Relays	0	6	1	-	FC113	0
	1893	RTD #9 Alarm Temperature	1	250	1	°C	F1	80
	1894	RTD #9 Alarm Events	0	1	1	-	FC103	0
	1895	RTD #9 Trip	0	2	1	-	FC115	0
	1896	RTD #9 Trip Voting	1	12	1	-	FC122	9
	1897	RTD #9 Trip Relays	0	3	1	-	FC111	0
	1898	RTD #9 Trip Temperature	1	250	1	°C	F1	90
	1899	1st and 2nd char. of RTD #9 Name	0	65535	1	-	F22	‘ ‘
	...							
	189C	7th and 8th char. of RTD #9 Name	0	65535	1	-	F22	‘ ‘
	189D	Reserved						
	...							
	18AD	Reserved						
	18AE	RTD #9 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	176
	18AF	RTD #9 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	194
RTD #10	18B0	RTD #10 Application	0	4	1	-	FC121	2
	18B1	RTD #10 Alarm	0	2	1	-	FC115	0
	18B2	RTD #10 Alarm Relays	0	6	1	-	FC113	0
	18B3	RTD #10 Alarm Temperature	1	250	1	°C	F1	80
	18B4	RTD #10 Alarm Events	0	1	1	-	FC103	0
	18B5	RTD #10 Trip	0	2	1	-	FC115	0
	18B6	RTD #10 Trip Voting	1	12	1	-	FC122	10
	18B7	RTD #10 Trip Relays	0	3	1	-	FC111	0
	18B8	RTD #10 Trip Temperature	1	250	1	°C	F1	90
	18B9	1st and 2nd char. of RTD #10 Name	0	65535	1	-	F22	‘ ‘
	...							
	18BC	7th and 8th char. of RTD #10 Name	0	65535	1	-	F22	‘ ‘
	18BD	Reserved						
	...							
	18CD	Reserved						
	18CE	RTD #10 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	176
	18CF	RTD #10 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	194
RTD #11	18D0	RTD #11 Application	0	4	1	-	FC121	4
	18D1	RTD #11 Alarm	0	2	1	-	FC115	0
	18D2	RTD #11 Alarm Relays	0	6	1	-	FC113	0
	18D3	RTD #11 Alarm Temperature	1	250	1	°C	F1	80
	18D4	RTD #11 Alarm Events	0	1	1	-	FC103	0
	18D5	RTD #11 Trip	0	2	1	-	FC115	0
	18D6	RTD #11 Trip Voting	1	12	1	-	FC122	11
	18D7	RTD #11 Trip Relays	0	3	1	-	FC111	0
	18D8	RTD #11 Trip Temperature	1	250	1	°C	F1	90
	18D9	1st and 2nd char. of RTD #11 Name	0	65535	1	-	F22	‘ ‘
	...							
	18DC	7th and 8th char. of RTD #11 Name	0	65535	1	-	F22	‘ ‘
	18DD	Reserved						
	...							
	18ED	Reserved						
	18EE	RTD #11 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	176

6

Table 6–1: 469 MEMORY MAP (Sheet 21 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RTD #11 ctd	18EF	RTD #11 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	194
RTD #12	18F0	RTD #12 Application	0	4	1	-	FC121	3
	18F1	RTD #12 Alarm	0	2	1	-	FC115	0
	18F2	RTD #12 Alarm Relays	0	6	1	-	FC113	0
	18F3	RTD #12 Alarm Temperature	1	250	1	°C	F1	60
	18F4	RTD #12 Alarm Events	0	1	1	-	FC103	0
	18F5	RTD #12 Trip	0	2	1	-	FC115	0
	18F6	RTD #12 Trip Voting	1	12	1	-	FC122	12
	18F7	RTD #12 Trip Relays	0	3	1	-	FC111	0
	18F8	RTD #12 Trip Temperature	1	250	1	°C	F1	80
	18F9	1st and 2nd char. of RTD #12 Name	0	65535	1	-	F22	‘ ‘
	...							
	18FC	7th and 8th char. of RTD #12 Name	0	65535	1	-	F22	‘ ‘
	18FD	Reserved						
	...							
	190D	Reserved						
	190E	RTD #12 Alarm Temperature (in Fahrenheit)	34	482	1	°F	F1	140
	190F	RTD #12 Trip Temperature (in Fahrenheit)	34	482	1	°F	F1	176
OPEN RTD SENSOR	1910	Open RTD Sensor Alarm	0	2	1	-	FC115	0
	1911	Open RTD Sensor Alarm Relays	0	6	1	-	FC113	0
	1912	Open RTD Sensor Alarm Events	0	1	1	-	FC103	0
	1913	Reserved						
	...							
	191F	Reserved						
RTD SHORT/ LOW TEMP	1920	RTD Short / Low Temp Alarm	0	2	1	-	FC115	0
	1921	RTD Short / Low Temp Alarm Relays	0	6	1	-	FC113	0
	1922	RTD Short / Low Temp Alarm Events	0	1	1	-	FC103	0
	1923	Reserved						
	...	...						
	192F	Reserved						
RTD HIGH ALARMS	1930	RTD #1 Hi Alarm	0	2	1	-	FC115	0
	1931	RTD #1 Hi Alarm Relays	0	6	1	-	FC113	0
	1932	RTD #1 Hi Alarm Level	1	250	1	°C	F1	130
	1933	Reserved						
	1934	RTD #2 Hi Alarm	0	2	1	-	FC115	0
	1935	RTD #2 Hi Alarm Relays	0	6	1	-	FC113	0
	1936	RTD #2 Hi Alarm Level	1	250	1	°C	F1	130
	1937	Reserved						
	1938	RTD #3 Hi Alarm	0	2	1	-	FC115	0
	1939	RTD #3 Hi Alarm Relays	0	6	1	-	FC113	0
	193A	RTD #3 Hi Alarm Level	1	250	1	°C	F1	130
	193B	Reserved						
	193C	RTD #4 Hi Alarm	0	2	1	-	FC115	0
	193D	RTD #4 Hi Alarm Relays	0	6	1	-	FC113	0
	193E	RTD #4 Hi Alarm Level	1	250	1	°C	F1	130
	193F	Reserved						
	1940	RTD #5 Hi Alarm	0	2	1	-	FC115	0
	1941	RTD #5 Hi Alarm Relays	0	6	1	-	FC113	0
	1942	RTD #5 Hi Alarm Level	1	250	1	°C	F1	130
	1943	Reserved						
	1944	RTD #6 Hi Alarm	0	2	1	-	FC115	0
	1945	RTD #6 Hi Alarm Relays	0	6	1	-	FC113	0
	1946	RTD #6 Hi Alarm Level	1	250	1	°C	F1	130

Table 6–1: 469 MEMORY MAP (Sheet 22 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
RTD HIGH ALARMS continued	1947	Reserved						
	1948	RTD #7 Hi Alarm	0	2	1	-	FC115	0
	1949	RTD #7 Hi Alarm Relays	0	6	1	-	FC113	0
	194A	RTD #7 Hi Alarm Level	1	250	1	°C	F1	80
	194B	Reserved						
	194C	RTD #8 Hi Alarm	0	2	1	-	FC115	0
	194D	RTD #8 Hi Alarm Relays	0	6	1	-	FC113	0
	194E	RTD #8 Hi Alarm Level	1	250	1	°C	F1	80
	194F	Reserved						
	1950	RTD #9 Hi Alarm	0	2	1	-	FC115	0
	1951	RTD #9 Hi Alarm Relays	0	6	1	-	FC113	0
	1952	RTD #9 Hi Alarm Level	1	250	1	°C	F1	80
	1953	Reserved						
	1954	RTD #10 Hi Alarm	0	2	1	-	FC115	0
	1955	RTD #10 Hi Alarm Relays	0	6	1	-	FC113	0
	1956	RTD #10 Hi Alarm Level	1	250	1	°C	F1	80
	1957	Reserved						
	1958	RTD #11 Hi Alarm	0	2	1	-	FC115	0
	1959	RTD #11 Hi Alarm Relays	0	6	1	-	FC113	0
	195A	RTD #11 Hi Alarm Level	1	250	1	°C	F1	80
	195B	Reserved						
	195C	RTD #12 Hi Alarm	0	2	1	-	FC115	0
	195D	RTD #12 Hi Alarm Relays	0	6	1	-	FC113	0
	195E	RTD #12 Hi Alarm Level	1	250	1	°C	F1	60
	195F	Reserved						
UNDER VOLTAGE	1960	Undervoltage Active Only If Bus Energized	0	1	1	-	FC103	0
	1961	Undervoltage Alarm	0	2	1	-	FC115	0
	1962	Undervoltage Alarm Relays	0	6	1	-	FC113	0
	1963	Undervoltage Alarm Pickup	60	99	1	¥ Rated	F3	85
	1964	Starting Undervoltage Alarm Pickup	60	100[1]	1	¥ Rated	F3	85
	1965	Undervoltage Alarm Delay	0	600	1	s	F2	30
	1966	Undervoltage Alarm Events	0	1	1	-	FC103	0
	1967	Undervoltage Trip	0	2	1	-	FC115	0
	1968	Undervoltage Trip Relays	0	3	1	-	FC111	0
	1969	Undervoltage Trip Pickup	60	99	1	¥ Rated	F3	80
	196A	Starting Undervoltage Trip Pickup	60	100[1]	1	¥ Rated	F3	80
	196B	Undervoltage Trip Delay	0	600	1	s	F2	30
	196C	Undervoltage Trip Mode	0	1	1	-	FC149	0
	196D	Reserved						
	...							
	197F	Reserved						
OVER VOLTAGE	1980	Overvoltage Alarm	0	2	1	-	FC115	0
	1981	Overvoltage Relays	0	6	1	-	FC113	0
	1982	Overvoltage Alarm Pickup	101	120	1	¥ Rated	F3	105
	1983	Overvoltage Alarm Delay	5	600	1	s	F2	30
	1984	Overvoltage Alarm Events	0	1	1	-	FC103	0
	1985	Overvoltage Trip	0	2	1	-	FC115	0
	1986	Overvoltage Trip Relays	0	3	1	-	FC111	0
	1987	Overvoltage Trip Pickup	101	120	1	¥ Rated	F3	110
	1988	Overvoltage Trip Delay	5	600	1	s	F2	30
	1989	Reserved						
	...							
	199F	Reserved						

Table 6–1: 469 MEMORY MAP (Sheet 23 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
PHASE REVERSAL	19A0	Voltage Phase Reversal Trip	0	2	1	-	FC115	0
	19A1	Voltage Phase Reversal Trip Relays	0	3	1	-	FC111	0
	19A2	Reserved						
	...							
	19AF	Reserved						
VOLTAGE FREQUENCY	19B0	Voltage Frequency Alarm	0	2	1	-	FC115	0
	19B1	Voltage Frequency Alarm Relays	0	6	1	-	FC113	0
	19B2	Overfrequency Alarm Level	2501	7000	1	Hz	F3	6050
	19B3	Underfrequency Alarm Level	2000	6000	1	Hz	F3	5950
	19B4	Voltage Frequency Alarm Delay	0	600	1	s	F2	10
	19B5	Voltage Frequency Alarm Events	0	1	1	-	FC103	0
	19B6	Voltage Frequency Trip	0	2	1	-	FC115	0
	19B7	Voltage Frequency Trip Relays	0	3	1	-	FC111	0
	19B8	Overfrequency Trip Level	2501	7000	1	Hz	F3	6050
	19B9	Underfrequency Trip Level	2000	6000	1	Hz	F3	5950
	19BA	Voltage Frequency Trip Delay	0	600	1	s	F2	10
	19BB	Reserved						
	...							
	19CF	Reserved						
POWER FACTOR	19D0	Block Power Factor Element from Start	0	5000	1	s	F1	1
	19D1	Power Factor Alarm	0	2	1	-	FC115	0
	19D2	Power Factor Alarm Relays	0	6	1	-	FC113	0
	19D3	Power Factor Lead Alarm Level	5	100	1	-	F3	100
	19D4	Power Factor Lag Alarm Level	5	100	1	-	F3	100
	19D5	Power Factor Alarm Delay	2	300	1	s	F1	10
	19D6	Power Factor Alarm Events	0	1	1	-	FC103	0
	19D7	Power Factor Trip	0	2	1	-	FC115	0
	19D8	Power Factor Trip Relays	0	3	1	-	FC111	0
	19D9	Power Factor Lead Trip Level	5	100	1	-	F3	100
	19DA	Power Factor Lag Trip Level	5	100	1	-	F3	100
	19DB	Power Factor Trip Delay	2	300	1	s	F1	10
	19DC	Reserved						
	...							
	19EF	Reserved						
REACTIVE POWER	19F0	Block kvar Element from Start	0	5000	1	s	F1	1
	19F1	Reactive Power Alarm	0	2	1	-	FC115	0
	19F2	Reactive Power Alarm Relays	0	6	1	-	FC113	0
	19F3	Positive Reactive Power Alarm Level	1	25000	1	kvar	F1	10
	19F4	Negative Reactive Power Alarm Level	1	25000	1	kvar	F1	10
	19F5	Reactive Power Alarm Delay	2	300	1	s	F2	10
	19F6	Reactive Power Alarm Events	0	1	1	-	FC103	0
	19F7	Reactive Power Trip	0	2	1	-	FC115	0
	19F8	Reactive Power Trip Relays	0	3	1	-	FC111	0
	19F9	Positive Reactive Power Trip Level	1	25000	1	kvar	F1	25
	19FA	Negative Reactive Power Trip Level	1	25000	1	kvar	F1	25
	19FB	Reactive Power Trip Delay	2	300	1	s	F2	10
	19FC	Reserved						
	...							
	1A0F	Reserved						
UNDER-POWER	1A10	Block Underpower From Start	0	15000	1	s	F1	0
	1A11	Underpower Alarm	0	2	1	-	FC115	0
	1A12	Underpower Alarm Relays	0	6	1	-	FC113	0
	1A13	Underpower Alarm Level	1	25000	1	kW	F1	2

Table 6–1: 469 MEMORY MAP (Sheet 24 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
UNDER-POWER continued	1A14	Underpower Alarm Delay	1	30	1	s	F1	1
	1A15	Underpower Alarm Events	0	1	1	-	FC103	0
	1A16	Underpower Trip	0	2	1	-	FC115	0
	1A17	Underpower Trip Relays	0	3	1	-	FC111	0
	1A18	Underpower Trip Level	1	25000	1	kW	F1	1
	1A19	Underpower Trip Delay	1	30	1	s	F1	1
	1A1A	Reserved						
	...							
	1A1F	Reserved						
REVERSE POWER	1A20	Block Reverse Power From Start	0	5000	1	s	F1	0
	1A21	Reverse Power Alarm	0	2	1	-	FC115	0
	1A22	Reverse Power Alarm Relays	0	6	1	-	FC113	0
	1A23	Reverse Power Alarm Level	1	25000	1	kW	F1	1
	1A24	Reverse Power Alarm Delay	2	300	1	s	F1	10
	1A25	Reverse Power Alarm Events	0	1	1	-	FC103	0
	1A26	Reverse Power Trip	0	2	1	-	FC115	0
	1A27	Reverse Power Trip Relays	0	3	1	-	FC111	0
	1A28	Reverse Power Trip Level	1	25000	1	kW	F1	1
	1A29	Reverse Power Trip Delay	2	300	1	s	F1	10
	1A2A	Reserved						
	...							
	1A2F	Reserved						
TORQUE SETUP	1A30	Torque Metering	0	1	1	N/A	FC126	0
	1A31	Stator Resistance	1	50000	1	mΩ	F26	4
	1A32	Pole Pairs	2	128	2	-	F1	2
	1A33	Torque Unit	0	1	1	-	FC148	0
	1A34	Reserved						
	...							
	1A3F	Reserved						
OVER-TORQUE SETUP	1A40	Overtorque Alarm	0	2	1	-	FC115	0
	1A41	Overtorque Alarm Relays	0	6	1	-	FC113	0
	1A42	Torque Alarm Level	10	9999999	1	Nm/ftlb	F10	40000
	1A44	Torque Alarm Delay	2	300	1	s	F2	10
	1A45	Torque Alarm Events	0	1	1	-	FC103	0
	1A46	Reserved						
	...							
	1A7F	Reserved						
TRIP COUNTER	1A80	Trip Counter Alarm	0	2	1	-	FC115	0
	1A81	Trip Counter Alarm Relays	0	6	1	-	FC113	0
	1A82	Trip Counter Alarm Level	1	50000	1	-	F1	25
	1A83	Trip Counter Alarm Events	0	1	1	-	FC103	0
	1A84	Reserved						
	...							
	1A8F	Reserved						
STARTER FAILURE	1A90	Starter Failure Alarm	0	2	1	-	FC115	0
	1A91	Starter Type	0	1	1	-	FC125	0
	1A92	Starter Failure Alarm Relays	0	6	1	-	FC113	0
	1A93	Starter Failure Alarm Delay	10	1000	10	ms	F1	100
	1A94	Supervision of Trip Coil	0	2	1	-	FC142	0
	1A95	Starter Failure Alarm Events	0	1	1	-	FC103	0
	1A96	Reserved						
	...							
	1ACF	Reserved						

6

Table 6–1: 469 MEMORY MAP (Sheet 25 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
CURRENT DEMAND	1AD0	Current Demand Period	5	90	1	min	F1	15
	1AD1	Current Demand Alarm	0	2	1	-	FC115	0
	1AD2	Current Demand Alarm Relays	0	6	1	-	FC113	0
	1AD3	Current Demand Alarm Level	10	100000	1	A	F9	100
	1AD5	Current Demand Alarm Events	0	1	1	-	FC103	0
	1AD6	Reserved						
	...							
	1ADF	Reserved						
kW DEMAND	1AE0	kW Demand Period	5	90	1	min	F1	15
	1AE1	kW Demand Alarm	0	2	1	-	FC115	0
	1AE2	kW Demand Alarm Relays	0	6	1	-	FC113	0
	1AE3	kW Demand Alarm Level	1	50000	1	kW	F1	100
	1AE4	kW Demand Alarm Events	0	1	1	-	FC103	0
	1AE5	Reserved						
	...							
	1AEF	Reserved						
kvar DEMAND	1AF0	kvar Demand Period	5	90	1	min	F1	15
	1AF1	kvar Demand Alarm	0	2	1	-	FC115	0
	1AF2	kvar Demand Alarm Relays	0	6	1	-	FC113	0
	1AF3	kvar Demand Alarm Level	1	50000	1	kvar	F1	100
	1AF4	kvar Demand Alarm Events	0	1	1	-	FC103	0
	1AF5	Reserved						
	...							
	1AFF	Reserved						
kVA DEMAND	1B00	kVA Demand Period	5	90	1	min	F1	15
	1B01	kVA Demand Alarm	0	2	1	-	FC115	0
	1B02	kVA Demand Alarm Relays	0	6	1	-	FC113	0
	1B03	kVA Demand Alarm Level	1	50000	1	kVA	F1	100
	1B04	kVA Demand Alarm Events	0	1	1	-	FC103	0
	1B05	Reserved						
	...	...						
	1B0F	Reserved						
PULSE OUTPUT	1B10	Positive kWh Pulse Output Relay	0	3	1	-	FC144	0
	1B11	Positive kWh Pulse Output Interval	1	50000	1	kWh	F1	1
	1B12	Positive kvarh Pulse Output Relay	0	3	1	-	FC144	0
	1B13	Positive kvarh Pulse Output Interval	1	50000	1	kvarh	F1	1
	1B14	Negative kvarh Pulse Output Relay	0	3	1	-	FC144	0
	1B15	Negative kvarh Pulse Output Interval	1	50000	1	kvarh	F1	1
	1B16	Running Time Pulse Relay	0	3	1	-	FC144	0
	1B17	Running Time Pulse Interval	1	50000	1	sec	F1	0
	1B18	Reserved						
	...							
	1B3F	Reserved						
ANALOG OUTPUTS	1B40	Analog Output 1 Selection	0	46	1	-	FC127	0
	1B41	Analog Output 2 Selection	0	46	1	-	FC127	0
	1B42	Analog Output 3 Selection	0	46	1	-	FC127	0
	1B43	Analog Output 4 Selection	0	46	1	-	FC127	0
	1B44	Phase A Current Minimum	0	100000	1	A	F9	0
	1B46	Phase A Current Maximum	0	100000	1	A	F9	100
	1B48	Phase B Current Minimum	0	100000	1	A	F9	0
	1B4A	Phase B Current Maximum	0	100000	1	A	F9	100
	1B4C	Phase C Current Minimum	0	100000	1	A	F9	0
	1B4E	Phase C Current Maximum	0	100000	1	A	F9	100

6

Table 6–1: 469 MEMORY MAP (Sheet 26 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ANALOG OUTPUTS continued	1B50	Average Phase Current Minimum	0	100000	1	A	F9	0
	1B52	Average Phase Current Maximum	0	100000	1	A	F9	100
	1B54	AB Line Voltage Minimum	50	20000	1	V	F1	3200
	1B55	AB Line Voltage Maximum	50	20000	1	V	F1	4500
	1B56	BC Line Voltage Minimum	50	20000	1	V	F1	3200
	1B57	BC Line Voltage Maximum	50	20000	1	V	F1	4500
	1B58	CA Line Voltage Minimum	50	20000	1	V	F1	3200
	1B59	CA Line Voltage Maximum	50	20000	1	V	F1	4500
	1B5A	Average Line Voltage Minimum	50	20000	1	V	F1	3200
	1B5B	Average Line Voltage Maximum	50	20000	1	V	F1	4500
	1B5C	Phase AN Voltage Minimum	50	20000	1	V	F1	1900
	1B5D	Phase AN Voltage Maximum	50	20000	1	V	F1	2500
	1B5E	Phase BN Voltage Minimum	50	20000	1	V	F1	1900
	1B5F	Phase BN Voltage Maximum	50	20000	1	V	F1	2500
	1B60	Phase CN Voltage Minimum	50	20000	1	V	F1	1900
	1B61	Phase CN Voltage Maximum	50	20000	1	V	F1	2500
	1B62	Average Phase Voltage Minimum	50	20000	1	V	F1	1900
	1B63	Average Phase Voltage Maximum	50	20000	1	V	F1	2500
	1B64	Hottest Stator RTD Minimum	–50	250	1	°C	F4	0
	1B65	Hottest Stator RTD Maximum	–50	250	1	°C	F4	200
	1B66	Hottest Bearing RTD Minimum	–50	250	1	°C	F4	0
	1B67	Hottest Bearing RTD Maximum	–50	250	1	°C	F4	200
	1B68	Hottest Ambient RTD Minimum	–50	250	1	°C	F4	–50
	1B69	Hottest Ambient RTD Maximum	–50	250	1	°C	F4	60
	1B6A	RTD #1 Minimum	–50	250	1	°C	F4	–50
	1B6B	RTD #1 Maximum	–50	250	1	°C	F4	250
	1B6C	RTD #2 Minimum	–50	250	1	°C	F4	–50
	1B6D	RTD #2 Maximum	–50	250	1	°C	F4	250
	1B6E	RTD #3 Minimum	–50	250	1	°C	F4	–50
	1B6F	RTD #3 Maximum	–50	250	1	°C	F4	250
	1B70	RTD #4 Minimum	–50	250	1	°C	F4	–50
	1B71	RTD #4 Maximum	–50	250	1	°C	F4	250
	1B72	RTD #5 Minimum	–50	250	1	°C	F4	–50
	1B73	RTD #5 Maximum	–50	250	1	°C	F4	250
	1B74	RTD #6 Minimum	–50	250	1	°C	F4	–50
	1B75	RTD #6 Maximum	–50	250	1	°C	F4	250
	1B76	RTD #7 Minimum	–50	250	1	°C	F4	–50
	1B77	RTD #7 Maximum	–50	250	1	°C	F4	250
	1B78	RTD #8 Minimum	–50	250	1	°C	F4	–50
	1B79	RTD #8 Maximum	–50	250	1	°C	F4	250
	1B7A	RTD #9 Minimum	–50	250	1	°C	F4	–50
	1B7B	RTD #9 Maximum	–50	250	1	°C	F4	250
	1B7C	RTD #10 Minimum	–50	250	1	°C	F4	–50
	1B7D	RTD #10 Maximum	–50	250	1	°C	F4	250
	1B7E	RTD #11 Minimum	–50	250	1	°C	F4	–50
	1B7F	RTD #11 Maximum	–50	250	1	°C	F4	250
	1B80	RTD #12 Minimum	–50	250	1	°C	F4	–50
	1B81	RTD #12 Maximum	–50	250	1	°C	F4	250
	1B82	Power Factor Minimum	–99	100	1	lead/lag	F21	0.8 lag
	1B83	Power Factor Maximum	–99	100	1	lead/lag	F21	0.8lead
	1B84	Reactive Power Minimum	–50000	50000	1	kvar	F12	0
	1B86	Reactive Power Maximum	–50000	50000	1	kvar	F12	750
	1B88	Real Power Minimum	–50000	50000	1	kW	F12	0

6

Table 6–1: 469 MEMORY MAP (Sheet 27 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ANALOG OUTPUTS continued	1B8A	Real Power Maximum	–50000	50000	1	kW	F12	1000
	1B8C	Apparent Power Minimum	0	50000	1	kVA	F1	0
	1B8D	Apparent Power Maximum	0	50000	1	kVA	F1	1250
	1B8E	Thermal Capacity Used Minimum	0	100	1	%used	F1	0
	1B8F	Thermal Capacity Used Maximum	0	100	1	%used	F1	100
	1B90	Relay Lockout Time Minimum	0	500	1	min	F1	0
	1B91	Relay Lockout Time Maximum	0	500	1	min	F1	150
	1B92	Current Demand Minimum	0	100000	1	A	F9	0
	1B94	Current Demand Maximum	0	100000	1	A	F9	700
	1B96	kvar Demand Minimum	0	50000	1	kvar	F1	0
	1B97	kvar Demand Maximum	0	50000	1	kvar	F1	1000
	1B98	kW Demand Minimum	0	50000	1	kW	F1	0
	1B99	kW Demand Maximum	0	50000	1	kW	F1	1250
	1B9A	kVA Demand Minimum	0	50000	1	kVA	F1	0
	1B9B	kVA Demand Maximum	0	50000	1	kVA	F1	1500
	1B9C	Motor Load Minimum	0	2000	1	¥ FLA	F3	0
	1B9D	Motor Load Maximum	0	2000	1	¥ FLA	F3	125
	1B9E	Analog Input 1 Minimum	–50000	50000	1	-	F12	0
	1BA0	Analog Input 1 Maximum	–50000	50000	1	-	F12	50000
	1BA2	Analog Input 2 Minimum	–50000	50000	1	-	F12	0
	1BA4	Analog Input 2 Maximum	–50000	50000	1	-	F12	50000
	1BA6	Analog Input 3 Minimum	–50000	50000	1	-	F12	0
	1BA8	Analog Input 3 Maximum	–50000	50000	1	-	F12	50000
	1BAA	Analog Input 4 Minimum	–50000	50000	1	-	F12	0
	1BAC	Analog Input 4 Maximum	–50000	50000	1	-	F12	50000
	1BAE	Tachometer Min	100	7200	1	RPM	F1	3500
	1BAF	Tachometer Max	100	7200	1	RPM	F1	3700
	1BB0	MWh Minimum	0	999999999	1	MWh	F17	50000
	1BB2	MWh Maximum	0	999999999	1	MWh	F17	100000
	1BB4	Reserved						
	...	...						
	1BBF	Reserved						
	1BC0	Torque Minimum	0	9999999	1	Nm/ftlb	F10	0
	1BC2	Torque Maximum	0	9999999	1	Nm/ftlb	F10	0
	1BC4	Reserved						
	...							
	1BD3	Reserved						
	1BD4	Hottest Stator RTD Minimum (in Fahrenheit)	–58	482	1	°F	F4	32
	1BD5	Hottest Stator RTD Maximum (in Fahrenheit)	–58	482	1	°F	F4	392
	1BD6	Hottest Bearing RTD Minimum (in Fahrenheit)	–58	482	1	°F	F4	32
	1BC7	Hottest Bearing RTD Maximum (in Fahrenheit)	–58	482	1	°F	F4	392
	1BD8	Hottest Ambient RTD Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BD9	Hottest Ambient RTD Maximum (in Fahrenheit)	–58	482	1	°F	F4	140
	1BDA	RTD #1 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BDB	RTD #1 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BDC	RTD #2 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BDD	RTD #2 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BDE	RTD #3 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BDF	RTD #3 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BE0	RTD #4 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BE1	RTD #4 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BE2	RTD #5 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BE3	RTD #5 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482

Table 6–1: 469 MEMORY MAP (Sheet 28 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ANALOG OUTPUTS continued	1BE4	RTD #6 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BE5	RTD #6 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BE6	RTD #7 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BE7	RTD #7 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BE8	RTD #8 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BE9	RTD #8 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BEA	RTD #9 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BEB	RTD #9 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BEC	RTD #10 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BED	RTD #10 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BEE	RTD #11 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BEF	RTD #11 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BF0	RTD #12 Minimum (in Fahrenheit)	–58	482	1	°F	F4	–57
	1BF1	RTD #12 Maximum (in Fahrenheit)	–58	482	1	°F	F4	482
	1BF2	Reserved						
	...	...						
	1BF7	Reserved						
	1BF8	Analog Input Diff 1-2 Minimum	–50000	50000	1	-	F12	0
	1BFA	Analog Input Diff 1-2 Maximum	–50000	50000	1	-	F12	100
	1BFC	Analog Input Diff 3-4 Minimum	–50000	50000	1	-	F12	0
	1BFE	Analog Input Diff 3-4 Maximum	–50000	50000	1	-	F12	100
	1C00	Reserved						
	...							
	1C0A	Reserved						
ANALOG INPUT 1	1C0B	Analog Input 1 Setup	0	3	1	-	FC129	0
	1C0C	Reserved						
	...							
	1C0F	Reserved						
	1C10	1st and 2nd char. of Analog Input 1 Units	0	65535	1	-	F22	‘Un’
	...							
	1C12	5th and 6th char. of Analog Input 1 Units	0	65535	1	-	F22	‘ ‘
	1C13	Analog Input 1 Minimum	–50000	50000	1	-	F12	0
	1C15	Analog Input 1 Maximum	–50000	50000	1	-	F12	100
	1C17	Block Analog Input 1 From Start	0	5000	1	s	F1	0
	1C18	Analog Input 1 Alarm	0	2	1	-	FC115	0
	1C19	Analog Input 1 Alarm Relays	0	6	1	-	FC113	0
	1C1A	Analog Input 1 Alarm Level	–50000	50000	1	-	F12	10
	1C1C	Analog Input 1 Alarm Pickup	0	1	1	-	FC130	0
	1C1D	Analog Input 1 Alarm Delay	1	3000	1	s	F2	1
	1C1E	Analog Input 1 Alarm Events	0	1	1	-	FC103	0
	1C1F	Analog Input 1 Trip	0	2	1	-	FC115	0
	1C20	Analog Input 1 Trip Relays	0	3	1	-	FC111	0
	1C21	Analog Input 1 Trip Level	–50000	50000	1	-	F12	20
	1C23	Analog Input 1 Trip Pickup	0	1	1	-	FC130	0
	1C24	Analog Input 1 Trip Delay	1	3000	1	s	F2	1
	1C25	1st and 2nd char. of Analog Input 1 Name	0	65535	1	-	F22	‘An’
	...							
	1C2A	11th and 12th char. of Analog Input 1 Name	0	65535	1	-	F22	‘ ‘
	1C2B	Reserved						
	...							
	1C4A	Reserved						
ANALOG INPUT 2	1C4B	Analog Input 2 Setup	0	3	1	-	FC129	0
	1C4C	Reserved						

6

Table 6–1: 469 MEMORY MAP (Sheet 29 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ANALOG INPUT 2 continued	...							
	1C4F	Reserved						
	1C50	1st and 2nd char. of Analog Input 2 Units	0	65535	1	-	F22	'Un'
	...							
	1C52	5th and 6th char. of Analog Input 2 Units	0	65535	1	-	F22	' '
	1C53	Analog Input 2 Minimum	–50000	50000	1	-	F12	0
	1C55	Analog Input 2 Maximum	–50000	50000	1	-	F12	100
	1C57	Block Analog Input 2 From Start	0	5000	1	s	F1	0
	1C58	Analog Input 2 Alarm	0	2	1	-	FC115	0
	1C59	Analog Input 2 Alarm Relays	0	6	1	-	FC113	0
	1C5A	Analog Input 2 Alarm Level	–50000	50000	1	-	F12	10
	1C5C	Analog Input 2 Alarm Pickup	0	1	1	-	FC130	0
	1C5D	Analog Input 2 Alarm Delay	1	3000	1	s	F2	1
	1C5E	Analog Input 2 Alarm Events	0	1	1	-	FC103	0
	1C5F	Analog Input 2 Trip	0	2	1	-	FC115	0
	1C60	Analog Input 2 Trip Relays	0	3	1	-	FC111	0
	1C61	Analog Input 2 Trip Level	–50000	50000	1	-	F12	20
	1C63	Analog Input 2 Trip Pickup	0	1	1	-	FC130	0
	1C64	Analog Input 2 Trip Delay	1	3000	1	s	F2	1
	1C65	1st and 2nd char. of Analog Input 2 Name	0	65535	1	-	F22	'An'
	...							
	1C6A	11th and 12th char. of Analog Input 2 Name	0	65535	1	-	F22	' '
	1C6B	Reserved						
	...							
	1C8A	Reserved						
ANALOG INPUT 3	1C8B	Analog Input 3 Setup	0	3	1	-	FC129	0
	1C8C	Reserved						
	...							
	1C8F	Reserved						
	1C90	1st and 2nd char. of Analog Input 3 Units	0	65535	1	-	F22	'Un'
	...							
	1C92	5th and 6th char. of Analog Input 3 Units	0	65535	1	-	F22	' '
	1C93	Analog Input 3 Minimum	–50000	50000	1	-	F12	0
	1C95	Analog Input 3 Maximum	–50000	50000	1	-	F12	100
	1C97	Block Analog Input 3 From Start	0	5000	1	s	F1	0
	1C98	Analog Input 3 Alarm	0	2	1	-	FC115	0
	1C99	Analog Input 3 Alarm Relays	0	6	1	-	FC113	0
	1C9A	Analog Input 3 Alarm Level	–50000	50000	1	-	F12	10
	1C9C	Analog Input 3 Alarm Pickup	0	1	1	-	FC130	0
	1C9D	Analog Input 3 Alarm Delay	1	3000	1	s	F2	1
	1C9E	Analog Input 3 Alarm Events	0	1	1	-	FC103	0
	1C9F	Analog Input 3 Trip	0	2	1	-	FC115	0
	1CA0	Analog Input 3 Trip Relays	0	3	1	-	FC111	0
	1CA1	Analog Input 3 Trip Level	–50000	50000	1	-	F12	20
	1CA3	Analog Input 3 Trip Pickup	0	1	1	-	FC130	0
	1CA4	Analog Input 3 Trip Delay	1	3000	1	s	F2	1
	1CA5	1st and 2nd char. of Analog Input 3 Name	0	65535	1	-	F22	'An'
	...							
	1CAA	11th and 12th char. of Analog Input 3 Name	0	65535	1	-	F22	' '
	1CAB	Reserved						
	...							
	1CCA	Reserved						

Table 6–1: 469 MEMORY MAP (Sheet 30 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ANALOG INPUT 4	1CCB	Analog Input 4 Setup	0	3	1	-	FC129	0
	1CCC	Reserved						
	...							
	1CCF	Reserved						
	1CD0	1st and 2nd char. of Analog Input 4 Units	0	65535	1	-	F22	‘Un’
	...							
	1CD2	5th and 6th char. of Analog Input 4 Units	0	65535	1	-	F22	‘ ‘
	1CD3	Analog Input 4 Minimum	–50000	50000	1	-	F12	0
	1CD5	Analog Input 4 Maximum	–50000	50000	1	-	F12	100
	1CD7	Block Analog Input 4 From Start	0	5000	1	s	F1	0
	1CD8	Analog Input 4 Alarm	0	2	1	-	FC115	0
	1CD9	Analog Input 4 Alarm Relays	0	6	1	-	FC113	0
	1CDA	Analog Input 4 Alarm Level	–50000	50000	1	-	F12	10
	1CDC	Analog Input 4 Alarm Pickup	0	1	1	-	FC130	0
	1CDD	Analog Input 4 Alarm Delay	1	3000	1	s	F2	1
	1CDE	Analog Input 4 Alarm Events	0	1	1	-	FC103	0
	1CDF	Analog Input 4 Trip	0	2	1	-	FC115	0
	1CE0	Analog Input 4 Trip Relays	0	3	1	-	FC111	0
	1CE1	Analog Input 4 Trip Level	–50000	50000	1	-	F12	20
	1CE3	Analog Input 4 Trip Pickup	0	1	1	-	FC130	0
	1CE4	Analog Input 4 Trip Delay	1	3000	1	s	F2	1
	1CE5	1st and 2nd char. of Analog Input 4 Name	0	65535	1	-	F22	‘An’
	...							
	1CEA	11th and 12th char. of Analog Input 4 Name	0	65535	1	-	F22	‘ ‘
	1CEB	Reserved						
	...	...						
	1CFF	Reserved						
SIMULATION MODE	1D00	Simulation Mode	0	3	1	-	FC138	0
	1D01	Pre-Fault to Fault Time Delay	0	300	1	s	F1	15
		Reserved						
	...							
	1D0F	Reserved						
PRE-FAULT VALUES	1D10	Pre-Fault Current Phase A	0	2000	1	¥ CT	F3	0
	1D11	Pre-Fault Current Phase B	0	2000	1	¥ CT	F3	0
	1D12	Pre-Fault Current Phase C	0	2000	1	¥ CT	F3	0
	1D13	Pre-Fault Ground Current	0	50000	1	A	F2	0
	1D14	Pre-Fault Line Voltages	0	110	1	¥ Rated	F3	100
	1D15	Pre-Fault Current Lags Voltage	0	359	1	0	F1	0
	1D16	Stator RTD Pre-Fault Temperature	–50	250	1	°C	F4	40
	1D17	Bearing RTD Pre-Fault Temperature	–50	250	1	°C	F4	40
	1D18	Other RTD Pre-Fault Temperature	–50	250	1	°C	F4	40
	1D19	Ambient RTD Pre-Fault Temperature	–50	250	1	°C	F4	40
	1D1A	Pre-Fault System Frequency	450	700	1	Hz	F2	600
	1D1B	Pre-Fault Analog Input 1	0	100	1	%range	F1	0
	1D1C	Pre-Fault Analog Input 2	0	100	1	%range	F1	0
	1D1D	Pre-Fault Analog Input 3	0	100	1	%range	F1	0
	1D1E	Pre-Fault Analog Input 4	0	100	1	%range	F1	0
	1D1F	Pre-Fault Differential Current	0	110	1	¥ CT	F3	0
	1D20	Reserved						
	...							
	1D3B	Reserved						
	1D3C	Pre-Fault Stator RTD Temperature (in Fahr.)	–58	482	1	°F	F4	104
	1D3D	Pre-Fault Bearing RTD Temperature (in Fahr.)	–58	482	1	°F	F4	104

Table 6–1: 469 MEMORY MAP (Sheet 31 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
PRE-FAULT VALUES ctd	1D3E	Pre-Fault Other RTD Temperature (in Fahr.)	–58	482	1	°F	F4	104
	1D3F	Pre-Fault Ambient RTD Temperature (in Fahr.)	–58	482	1	°F	F4	104
FAULT VALUES	1D40	Fault Current Phase A	0	2000	1	¥ CT	F3	0
	1D41	Fault Current Phase B	0	2000	1	¥ CT	F3	0
	1D42	Fault Current Phase C	0	2000	1	¥ CT	F3	0
	1D43	Fault Ground Current	0	50000	1	A	F2	0
	1D44	Fault Line Voltages	0	110	1	¥ Rated	F3	100
	1D45	Fault Current Lags Voltage	0	120	30	0	F1	0
	1D46	Stator RTD Fault Temperature	–50	250	1	°C	F4	40
	1D47	Bearing RTD Fault Temperature	–50	250	1	°C	F4	40
	1D48	Other RTD Fault Temperature	–50	250	1	°C	F4	40
	1D49	Ambient RTD Fault Temperature	–50	250	1	°C	F4	40
	1D4A	Fault System Frequency	450	700	1	Hz	F2	600
	1D4B	Fault Analog Input 1	0	100	1	%range	F1	0
	1D4C	Fault Analog Input 2	0	100	1	%range	F1	0
	1D4D	Fault Analog Input 3	0	100	1	%range	F1	0
	1D4E	Fault Analog Input 4	0	100	1	%range	F1	0
	1D4F	Fault Differential Current	0	110	1	¥ CT	F3	0
	1D50	Reserved						
	...							
	1D7B	Reserved						
	1D7C	Fault Stator RTD Temperature (in Fahrenheit)	–58	482	1	°F	F4	104
	1D7D	Fault Bearing RTD Temperature (in Fahrenheit)	–58	482	1	°F	F4	104
	1D7E	Fault Other RTD Temperature (in Fahrenheit)	–58	482	1	°F	F4	104
	1D7F	Fault Ambient RTD Temperature (in Fahrenheit)	–58	482	1	°F	F4	104
TEST OUTPUT RELAYS	1D80	Force Operation of Relays	0	8	1	-	FC139	0
	1D81	Reserved						
	...							
	1D8F	Reserved						
TEST ANALOG OUT-PUTS	1D90	Force Analog Outputs	0	1	1	-	FC126	0
	1D91	Analog Output 1 Forced Value	0	100	1	%range	F1	0
	1D92	Analog Output 2 Forced Value	0	100	1	%range	F1	0
	1D93	Analog Output 3 Forced Value	0	100	1	%range	F1	0
	1D94	Analog Output 4 Forced Value	0	100	1	%range	F1	0
	1D95	Reserved						
	...							
	1DFE	Reserved						
SPEED2 O/L SETUP	1DFF	Speed2 Standard Overload Curve Number	1	15	1	-	F1	4
	1E00	Speed2 Time to Trip at 1.01 x FLA	5	999999	1	s	F10	174145
	1E02	Speed2 Time to Trip at 1.05 x FLA	5	999999	1	s	F10	34149
	1E04	Speed2 Time to Trip at 1.10 x FLA	5	999999	1	s	F10	16667
	1E06	Speed2 Time to Trip at 1.20 x FLA	5	999999	1	s	F10	7954
	1E08	Speed2 Time to Trip at 1.30 x FLA	5	999999	1	s	F10	5072
	1E0A	Speed2 Time to Trip at 1.40 x FLA	5	999999	1	s	F10	3646
	1E0C	Speed2 Time to Trip at 1.50 x FLA	5	999999	1	s	F10	2800
	1E0E	Speed2 Time to Trip at 1.75 x FLA	5	999999	1	s	F10	1697
	1E10	Speed2 Time to Trip at 2.00 x FLA	5	999999	1	s	F10	1166
	1E12	Speed2 Time to Trip at 2.25 x FLA	5	999999	1	s	F10	861
	1E14	Speed2 Time to Trip at 2.50 x FLA	5	999999	1	s	F10	666
	1E16	Speed2 Time to Trip at 2.75 x FLA	5	999999	1	s	F10	533
	1E18	Speed2 Time to Trip at 3.00 x FLA	5	999999	1	s	F10	437
	1E1A	Speed2 Time to Trip at 3.25 x FLA	5	999999	1	s	F10	366
	1E1C	Speed2 Time to Trip at 3.50 x FLA	5	999999	1	s	F10	311

Table 6–1: 469 MEMORY MAP (Sheet 32 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
SPEED2 O/L SETUP continued	1E1E	Speed2 Time to Trip at 3.75 x FLA	5	999999	1	s	F10	268
	1E20	Speed2 Time to Trip at 4.00 x FLA	5	999999	1	s	F10	233
	1E22	Speed2 Time to Trip at 4.25 x FLA	5	999999	1	s	F10	205
	1E24	Speed2 Time to Trip at 4.50 x FLA	5	999999	1	s	F10	182
	1E26	Speed2 Time to Trip at 4.75 x FLA	5	999999	1	s	F10	162
	1E28	Speed2 Time to Trip at 5.00 x FLA	5	999999	1	s	F10	146
	1E2A	Speed2 Time to Trip at 5.50 x FLA	5	999999	1	s	F10	120
	1E2C	Speed2 Time to Trip at 6.00 x FLA	5	999999	1	s	F10	100
	1E2E	Speed2 Time to Trip at 6.50 x FLA	5	999999	1	s	F10	85
	1E30	Speed2 Time to Trip at 7.00 x FLA	5	999999	1	s	F10	73
	1E32	Speed2 Time to Trip at 7.50 x FLA	5	999999	1	s	F10	63
	1E34	Speed2 Time to Trip at 8.00 x FLA	5	999999	1	s	F10	56
	1E36	Speed2 Time to Trip at 10.0 x FLA	5	999999	1	s	F10	56
	1E38	Speed2 Time to Trip at 15.0 x FLA	5	999999	1	s	F10	56
	1E3A	Speed2 Time to Trip at 20.0 x FLA	5	999999	1	s	F10	56
	1E3C	Reserved						
	...							
	1E4F	Reserved						
	1E50	Speed2 Minimum Allowable Line Voltage	70	95	1	%Rated	F1	80
	1E51	Speed2 Stall Current at Min Vline	200	1500	1	¥ FLA	F3	480
	1E52	Speed2 Safe Stall Time at Min Vline	5	9999	1	s	F2	200
	1E53	Speed2 Accel. Intersect at Min Vline	200	1500	1	¥ FLA	F3	380
	1E54	Speed2 Stall Current at 100% Vline	200	1500	1	¥ FLA	F3	600
	1E55	Speed2 Safe Stall Time at 100% Vline	5	9999	1	s	F2	100
	1E56	Speed2 Accel. Intersect at 100% Vline	200	1500	1	¥ FLA	F3	500
	1E57	Reserved						
	...							
	1E8F	Reserved						
SPEED2 UNDER CURRENT	1E90	Block Speed2 Undercurrent from Start	0	15000	1	s	F1	0
	1E91	Speed2 Undercurrent Alarm	0	2	1	-	FC115	0
	1E92	Reserved						
	1E93	Speed2 Undercurrent Alarm Pickup	10	95	1	¥ FLA	F3	70
	1E94	Speed2 Undercurrent Alarm Delay	1	60	1	s	F1	1
	1E95	Speed2 Undercurrent Alarm Events	0	1	1	-	FC103	0
	1E96	Speed2 Undercurrent Trip	0	2	1	-	FC115	0
	1E97	Reserved						
	1E98	Speed2 Undercurrent Trip Pickup	10	99	1	¥ FLA	F3	70
	1E99	Speed2 Undercurrent Trip Delay	1	60	1	s	F1	1
	1E9A	Reserved						
	...							
	1EAF	Reserved						
SPEED2 ACCELERA-TION	1EB0	Speed2 Acceleration Timer From Start	10	2500	1	s	F2	100
	1EB1	Acceleration Timer From Speed One to Two	10	2500	1	s	F2	100
	1EB2	Speed Switch Trip Speed2 Delay	10	2500	1	s	F2	50
	1EB3	Speed2 Rated Speed	100	7200	1	RPM	F1	3600
	1EB4	Reserved						
	...							
	1EFF	Reserved						
ANALOG INPUT 1-2 DIFF.	1F00	Analog In Differential 1-2 Enable	0	1	1	-	FC126	0
	1F01	1st and 2nd char of Analog In Diff 1-2 Name	0	65535	1	-	F22	‘An’
	...							
	1F06	11th and 12th char of Analog In Diff 1-2 Name	0	65535	1	-	F22	‘ ‘
	1F07	Analog In Differential 1-2 Comparison	0	1	1	-	FC145	0

6

Table 6–1: 469 MEMORY MAP (Sheet 33 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
ANALOG IN 1-2 DIFF continued	1F08	Analog In Differential 1-2 Logic	0	2	1	-	FC146	0
	1F09	Analog In Differential 1-2 Active When	0	1	1	-	FC147	0
	1F0A	Analog In Differential 1-2 Block from Start	0	5000	1	s	F1	0
	1F0B	Analog In Differential 1-2 Alarm	0	2	1	-	FC115	0
	1F0C	Analog In Differential 1-2 Alarm Relays	0	6	1	-	FC113	0
	1F0D	Analog In Differential 1-2 Percent Alarm	0	500	1	%	F1	10
	1F0E	Analog In Differential 1-2 Absolute Alarm	0	50000	1	Units	F1	10
	1F0F	Analog In Differential 1-2 Alarm Delay	1	3000	1	s	F2	1
	1F10	Analog In Differential 1-2 Alarm Events	0	1	1	-	FC103	0
	1F11	Analog In Differential 1-2 Trip	0	2	1	-	FC115	0
	1F12	Analog In Differential 1-2 Trip Relays	0	6	1	-	FC111	0
	1F13	Analog In Differential 1-2 Percent Trip	0	500	1	%	F1	10
	1F14	Analog In Differential 1-2 Absolute Trip	0	50000	1	Units	F1	10
	1F15	Analog In Differential 1-2 Trip Delay	1	3000	1	s	F2	1
	1F16	Reserved						
	...	...						
	1F1F	Reserved						
ANALOG INPUT 3-4 DIFF.	1F20	Analog In Differential 3-4 Enable	0	1	1	-	FC126	0
	1F21	1st and 2nd char of Analog In Diff. 3-4 Name	0	65535	1	-	F22	‘An’
	...							
	1F26	11th and 12th char of Analog In Diff 3-4 Name	0	65535	1	-	F22	‘ ‘
	1F27	Analog In Differential 3-4 Comparison	0	1	1	-	FC145	0
	1F28	Analog In Differential 3-4 Logic	0	2	1	-	FC146	0
	1F29	Analog In Differential 3-4 Active When	0	1	1	-	FC147	0
	1F2A	Analog In Differential 3-4 Block from Start	0	5000	1	s	F1	0
	1F2B	Analog In Differential 3-4 Alarm	0	2	1	-	FC115	0
	1F2C	Analog In Differential 3-4 Alarm Relays	0	6	1	-	FC113	0
	1F2D	Analog In Differential 3-4 Percent Alarm	0	500	1	%	F1	10
	1F2E	Analog In Differential 3-4 Absolute Alarm	0	50000	1	Units	F1	10
	1F2F	Analog In Differential 3-4 Alarm Delay	1	3000	1	s	F2	1
	1F30	Analog In Differential 3-4 Alarm Events	0	1	1	-	FC103	0
	1F31	Analog In Differential 3-4 Trip	0	2	1	-	FC115	0
	1F32	Analog In Differential 3-4 Trip Relays	0	3	1	-	FC111	0
	1F33	Analog In Differential 3-4 Percent Trip	0	500	1	%	F1	10
	1F34	Analog In Differential 3-4 Absolute Trip	0	50000	1	Units	F1	10
	1F35	Analog In Differential 3-4 Trip Delay	1	3000	1	s	F2	1
	1F36	Reserved						
	...	...						
	2FFF	Reserved						
Event Recorder / Trace Memory (Addresses 3000 -3FFF)								
EVENT RECORDER	3000	Event Recorder Last Reset (2 words)	N/A	N/A	N/A	N/A	F18	N/A
	3002	Total Number of Events Since Last Clear	0	65535	1	N/A	F1	0
	3003	Event Record Selector (1=newest, 40=oldest)	1	40	1	N/A	F1	1
	3004	Cause of Event	0	131	1	-	FC134	0
	3005	Time of Event (2 words)	N/A	N/A	N/A	N/A	F19	N/A
	3007	Date of Event (2 words)	N/A	N/A	N/A	N/A	F18	N/A
	3009	Motor Speed During Event	0	1	1	-	FC135	0
	300A	Event Tachometer RPM	0	3600	1	RPM	F1	0
	300B	Event Phase A Current	0	100000	1	A	F9	0
	300D	Event Phase B Current	0	100000	1	A	F9	0
	300F	Event Phase C Current	0	100000	1	A	F9	0
	3011	Event Motor Load	0	2000	1	FLA	F3	0
	3012	Event Current Unbalance	0	100	1	%	F1	0

Table 6–1: 469 MEMORY MAP (Sheet 34 of 34)

GROUP	ADDR (HEX)	DESCRIPTION	MIN.	MAX.	STEP VALUE	UNITS	FORMAT CODE	DEFAULT
EVENT RECORDER continued	3013	Event Ground Current	0	500000	1	A	F11	0
	3015	Event Phase A Differential Current	0	5000	1	A	F1	0
	3016	Event Phase B Differential Current	0	5000	1	A	F1	0
	3017	Event Phase C Differential Current	0	5000	1	A	F1	0
	3018	Event Hottest Stator RTD	0	12	1	-	F1	0
	3019	Event Temperature of Hottest Stator RTD	–50	250	1	°C	F4	0
	301A	Event Hottest Bearing RTD	0	12	1	-	F1	0
	301B	Event Temperature of Hottest Bearing RTD	–50	250	1	°C	F4	0
	301C	Event Hottest Other RTD	0	12	1	-	F1	0
	301D	Event Temperature of Hottest Other RTD	–50	250	1	°C	F4	0
	301E	Event Hottest Ambient RTD	0	12	1	-	F1	0
	301F	Event Ambient RTD Temperature	–50	250	1	°C	F4	0
	3020	Event Voltage Vab	0	20000	1	V	F1	0
	3021	Event Voltage Vbc	0	20000	1	V	F1	0
	3022	Event Voltage Vca	0	20000	1	V	F1	0
	3023	Event Voltage Van	0	20000	1	V	F1	0
	3024	Event Voltage Vbn	0	20000	1	V	F1	0
	3025	Event Voltage Vcn	0	20000	1	V	F1	0
	3026	Event System Frequency	0	12000	1	Hz	F3	0
	3027	Event Real Power	–50000	50000	1	kW	F12	0
	3029	Event Reactive Power	–50000	50000	1	kvar	F12	0
	302B	Event Apparent Power	0	50000	1	kVA	F1	0
	302C	Event Power Factor	–99	100	1	-	F21	0
	302D	Event Analog Input #1	–50000	50000	1	-	F12	0
	302F	Event Analog Input #2	–50000	50000	1	-	F12	0
	3031	Event Analog Input #3	–50000	50000	1	-	F12	0
	3033	Event Analog Input #4	–50000	50000	1	-	F12	0
	3035	Event Torque	0	9999999	1	Nm/ftlb	F2	0
	3037	Reserved						
	...							
	30E0	Event Temp. of Hottest Stator RTD (in Fahr.)	–58	482	1	°F	F4	32
	30E1	Event Temp. of Hottest Bearing RTD (in Fahr.)	–58	482	1	°F	F4	32
	30E2	Event Temp. of Hottest Other RTD (in Fahr.)	–58	482	1	°F	F4	32
	30E3	Event Ambient RTD Temperature (in Fahr.)	–58	482	1	°F	F4	32
	30E4	Reserved						
		...						
	30EF	Reserved						
TRACE MEMORY	30F0	Trace Number Selector	1	65535	1	-	F1	0
	30F1	Trace Memory Channel Selector	0	9	1	-	F1	0
	30F2	Trace Memory Date	N/A	N/A	N/A	N/A	F18	N/A
	30F4	Trace Memory Time	N/A	N/A	N/A	N/A	F19	N/A
	30F6	Trace Trigger Cause	0	131	1	-	FC134	N/A
	30F7	Number of Samples per Trace	1	768	1	-	F1	N/A
	30F8	Number of Traces Taken	0	65535	1	-	F1	N/A
	30F9	Reserved						
	30FF	Reserved						
	3100	First Trace Memory Sample	–32767	32767	1	-	F4	0
	...	...						
	3400	Last Trace Memory Sample	–32767	32767	1	-	F4	0
	3401	Reserved						
	...	...						
	3FFF	Reserved						

6

6.3.6 MEMORY MAP FORMAT CODES

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 1 of 12)

FORMAT CODE	TYPE	DEFINITION
F1	16 bits	UNSIGNED VALUE
Example: 1234 stored as 1234		
F2	16 bits	UNSIGNED VALUE, 1 DECIMAL PLACE
Example: 123.4 stored as 1234		
F3	16 bits	UNSIGNED VALUE, 2 DECIMAL PLACES
Example: 12.34 stored as 1234		
F4	16 bits	2's COMPLEMENT SIGNED VALUE
Example: -1234 stored as -1234 (i.e. 64302)		
F5	16 bits	2's COMPLEMENT SIGNED VALUE 1 DECIMAL PLACES
Example: -123.4 stored as -1234 (i.e. 64302)		
F6	16 bits	2's COMPLEMENT SIGNED VALUE 2 DECIMAL PLACES
Example: -12.34 stored as -1234 (i.e. 64302)		
F7	16 bits	2's COMPLEMENT SIGNED VALUE 3 DECIMAL PLACES
Example: -1.234 stored as -1234 (i.e. 64302)		
F8	16 bits	2's COMPLEMENT SIGNED VALUE 4 DECIMAL PLACES
Example: -0.1234 stored as -1234 (i.e. 64302)		
F9	32 bits	UNSIGNED LONG VALUE
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: 123456 stored as 123456 (i.e. 1st word: 0001 hex, 2nd word: E240 hex)		
F10	32 bits	UNSIGNED LONG VALUE 1 DECIMAL PLACE
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: 12345.6 stored as 123456 (i.e. 1st word: 0001 hex, 2nd word: E240 hex)		
F11	32 bits	UNSIGNED LONG VALUE 2 DECIMAL PLACES
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: 1234.56 stored as 123456 (i.e. 1st word: 0001 hex, 2nd word: E240 hex)		
F12	32 bits	2's COMPLEMENT SIGNED LONG VALUE
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: -123456 stored as -123456 (i.e. 1st word: FFFE hex, 2nd word: 1DC0 hex)		
F13	32 bits	2's COMPLEMENT SIGNED LONG VALUE, 1 DECIMAL PLACE
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: -12345.6 stored as -123456 (i.e. 1st word: FFFE hex, 2nd word: 1DC0 hex)		
F14	32 bits	2's COMPLEMENT SIGNED LONG VALUE, 2 DECIMAL PLACES
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: -1234.56 stored as -123456 (i.e. 1st word: FFFE hex, 2nd word: 1DC0 hex)		

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 2 of 12)

FORMAT CODE	TYPE	DEFINITION
F15	16 bits	HARDWARE REVISION
0000 0000 0000 0001		1 = A
0000 0000 0000 0010		2 = B
...		...
0000 0000 0001 1010		26 = Z
F16	16 bits	SOFTWARE REVISION
1111 1111 xxxx xxxx		Major Revision Number 0 to 9 in steps of 1
xxxx xxxx 1111 1111		Minor Revision Number (two BCD digits) 00 to 99 in steps of 1
Example: Revision 2.30 stored as 0230 hex		
F17	32 bits	UNSIGNED LONG VALUE 3 DECIMAL PLACES
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Example: 123.456 stored as 123456 (i.e. 1st word: 0001 hex, 2nd word: E240 hex)		
F18	32 bits	DATE (MM/DD/YYYY)
1st byte		Month (1 to 12)
2nd byte		Day (1 to 31)
3rd & 4th byte		Year (1995 to 2094)
Example: Feb 20, 1995 stored as 34867142 (i.e. 1st word: 0214, 2nd word 07C6)		
F19	32 bits	TIME (HH:MM:SS:hh)
1st byte		Hours (0 to 23)
2nd byte		Minutes (0 to 59)
3rd byte		Seconds (0 to 59)
4th byte		Hundreds of seconds (0 to 99)
Example: 2:05pm stored as 235208704 (i.e. 1st word: 0E05, 2nd word 0000)		
F20	32 bits	2's COMPLEMENT SIGNED LONG VALUE
1st 16 bits		High Order Word of Long Value
2nd 16 bits		Low Order Word of Long Value
Note: -1 means "Never"		
F21	16 bits	2's COMPLEMENT SIGNED VALUE 2 DECIMAL PLACES (Power Factor)
< 0		Leading Power Factor - Negative
> 0		Lagging Power Factor - Positive
Example: Power Factor of 0.87 lag is used as 87 (i.e. 0057)		
F22	16 bits	TWO 8-BIT CHARACTERS PACKED INTO 16-BIT UNSIGNED
MSB		First Character
LSB		Second Character
Example: String 'AB' stored as 4142 hex.		
F24	32 bits	TIME FORMAT FOR BROADCAST
1st byte		Hours (0 to 23)
2nd byte		Minutes (0 to 59)
3rd & 4th bytes		Milliseconds (0 to 59999) Note: Clock resolution limited to 0.01 sec
Example: 1:15:48:572 stored as 17808828 (i.e., 1st word 010F, 2nd word BDBC)		
F25	16 bits	UNSIGNED VALUE, 4 DECIMAL PLACES
Example: 0.1234 stored as 1234		

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 3 of 12)

FORMAT CODE	TYPE	DEFINITION
F26	16 bits	UNSIGNED VALUE, 3 DECIMAL PLACES
Example: 1.234 stored as 1234		
FC100	Unsigned 16 bit integer	TEMPEATURE DISPLAY UNITS
0		Celsius
1		Fahrenheit
FC101	Unsigned 16 bit integer	RS 485 BAUD RATE
0		300 baud
1		1200 baud
2		2400 baud
3		4800 baud
4		9600 baud
5		19200 baud
FC102	Unsigned 16 bit integer	RS 485 PARITY
0		None
1		Odd
2		Even
FC103	Unsigned 16 bit integer	OFF / ON or NO/YES SELECTION
0		Off / No
1		On / Yes
FC104	Unsigned 16 bit integer	GROUND CT TYPE
0		None
1		1 A Secondary
2		5 A Secondary
3		50/0.025 CT
FC105	Unsigned 16 bit integer	DIFFERENTIAL CT TYPE
0		None
1		1 A Secondary
2		5 A Secondary
FC106	Unsigned 16 bit integer	VOLTAGE TRANSFORMER CONNECTION TYPE
0		None
1		Open Delta
2		Wye
FC107	Unsigned 16 bit integer	NOMINAL FREQUENCY
0		60 Hz
1		50 Hz
2		Variable
FC108	Unsigned 16 bit integer	REDUCED VOLTAGE STARTING TRANSITION ON
0		Current Only
1		Current or Timer
2		Current and Timer
FC109	Unsigned 16 bit integer	STARTER STATUS SWITCH
0		Starter Aux a
1		Starter Aux b
FC110	Unsigned 16 bit integer	ASSIGNABLE INPUT FUNCTION
0		Off

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 4 of 12)

FORMAT CODE	TYPE	DEFINITION
1		Remote Alarm
2		Remote Trip
3		Speed Switch Trip
4		Load Shed Trip
5		Pressure Sw. Alarm
6		Pressure Switch Trip
7		Vibration Sw. Alarm
8		Vibration Sw. Trip
9		Digital Counter
10		Tachometer
11		General Sw. A
12		General Sw. B
13		General Sw. C
14		General Sw. D
15		Capture Trace
16		Simulate Pre-Fault
17		Simulate Fault
18		Simulate Pre-Fault...Fault
FC111	Unsigned 16 bit integer	TRIP RELAYS
0		Trip
1		Trip & Aux2
2		Trip & Aux2 & Aux3
3		Trip & Aux3
FC112	Unsigned 16 bit integer	NOT DEFINED
0		
1		
FC113	Unsigned 16 bit integer	ALARM RELAYS
0		Alarm
1		Alarm & Aux2
2		Alarm & Aux2 & Aux3
3		Alarm & Aux3
4		Aux2
5		Aux2 & Aux3
6		Aux3
FC114	Unsigned 16 bit integer	COUNTER TYPE
0		Increment
1		Decrement
FC115	Unsigned 16 bit integer	ALARM / TRIP TYPE SELECTION
0		Off
1		Latched
2		Unlatched
FC116	Unsigned 16 bit integer	SWITCH TYPE
0		Normally Open
1		Normally Closed
FC117	Unsigned 16 bit integer	RESET MODE
0		All Resets
1		Remote Reset Only
2		Keypad Reset Only

6

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 5 of 12)

FORMAT CODE	TYPE	DEFINITION
FC118	Unsigned 16 bit integer	SHORT CIRCUIT RELAYS
0		Trip
1		Trip & Aux2
2		Trip & Aux2 & Aux3
3		Trip & Aux3
4		Aux2
5		Aux2 & Aux3
6		Aux3
FC119	Unsigned 16 bit integer	BACKUP RELAYS
0		Aux2
1		Aux2 & Aux3
2		Aux3
FC120	Unsigned 16 bit integer	RTD TYPE
0		100 Ohm Platinum
1		120 Ohm Nickel
2		100 Ohm Nickel
3		10 Ohm Copper
FC121	Unsigned 16 bit integer	RTD APPLICATION
0		None
1		Stator
2		Bearing
3		Ambient
4		Other
FC122	Unsigned 16 bit integer	RTD VOTING SELECTION
1		RTD #1
2		RTD #2
3		RTD #3
4		RTD #4
5		RTD #5
6		RTD #6
7		RTD #7
8		RTD #8
9		RTD #9
10		RTD #10
11		RTD #11
12		RTD #12
FC123	Unsigned 16 bit integer	ALARM STATUS
0		Off
1		Not Active
2		Timing Out
3		Active
4		Latched
FC124	Unsigned 16 bit integer	PHASE ROTATION AT MOTOR TERMINALS
0		ABC
1		BAC
FC125	Unsigned 16 bit integer	STARTER TYPE
0		Breaker

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 6 of 12)

FORMAT CODE	TYPE	DEFINITION
1		Contactor
FC126	Unsigned 16 bit integer	DISABLED / ENABLED SELECTION
0		Disabled
1		Enabled
FC127	Unsigned 16 bit integer	ANALOG OUTPUT PARAMETER SELECTION
0		None
1		Phase A Current
2		Phase B Current
3		Phase C Current
4		Average Phase Current
5		AB Line Voltage
6		BC Line Voltage
7		CA Line Voltage
8		Average Line Voltage
9		Phase AN Voltage
10		Phase BN Voltage
11		Phase CN Voltage
12		Average Phase Voltage
13		Hottest Stator RTD
14		Hottest Bearing RTD
15		Ambient RTD
16		RTD #1
17		RTD #2
18		RTD #3
19		RTD #4
20		RTD #5
21		RTD #6
22		RTD #7
23		RTD #8
24		RTD #9
25		RTD #10
26		RTD #11
27		RTD #12
28		Power Factor
29		Reactive Power
30		Real Power (kW)
31		Apparent Power
32		Thermal Capacity Used
33		Relay Lockout Time
34		Current Demand
35		kvar Demand
36		kW Demand
37		kVA Demand
38		Motor Load
39		Analog Input 1
40		Analog Input 2
41		Analog Input 3
42		Analog Input 4
43		Tachometer
44		MWhrs
45		Analog In Diff 1-2
46		Analog In Diff 3-4

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 7 of 12)

FORMAT CODE	TYPE	DEFINITION
FC128	Unsigned 16 bit integer	PROTECTION CURVE STYLE SELECTION
0		Standard
1		Custom
2		Voltage Dependent
FC129	Unsigned 16 bit integer	ANALOG INPUT SELECTION
0		Disabled
1		4-20 mA
2		0-20 mA
3		0-1 mA
FC130	Unsigned 16 bit integer	PICKUP TYPE
0		Over
1		Under
FC131	Unsigned 16 bit integer	INPUT SWITCH STATUS
0		Open
1		Shorted
FC132	Unsigned 16 bit integer	TRIP COIL SUPERVISION STATUS
0		No Coil
1		Coil
FC133	Unsigned 16 bit integer	MOTOR STATUS
0		Stopped
1		Starting
2		Running
3		Overloaded
4		Tripped
FC134	Unsigned 16 bit integer	CAUSE OF EVENT / CAUSE OF LAST TRIP (UP TO 45)
0		No Event / No Trip To Date
1		Incomplete Sequence Trip
2		Remote Trip
3		Speed Switch Trip
4		Load Shed Trip
5		Pressure Sw. Trip
6		Vibration Sw. Trip
7		Tachometer Trip
8		General Sw. A Trip
9		General Sw. B Trip
10		General Sw. C Trip
11		General Sw. D Trip
12		Overload Trip
13		Short Circuit Trip
14		Short Circuit Backup
15		Mechanical Jam Trip
16		Undercurrent Trip
17		Current U/B Trip
18		Ground Fault Trip
19		Ground Fault Backup
20		Differential Trip
21		Acceleration Trip
22		RTD 1 Trip

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 8 of 12)

FORMAT CODE	TYPE	DEFINITION
23		RTD 2 Trip
24		RTD 3 Trip
25		RTD 4 Trip
26		RTD 5 Trip
27		RTD 6 Trip
28		RTD 7 Trip
29		RTD 8 Trip
30		RTD 9 Trip
31		RTD 10 Trip
32		RTD 11 Trip
33		RTD 12 Trip
34		Undervoltage Trip
35		Overvoltage Trip
36		Phase Reversal Trip
37		Volt. Frequency Trip
38		Power Factor Trip
39		Reactive Power Trip
40		Underpower Trip
41		Analog I/P 1 Trip
42		Analog I/P 2 Trip
43		Analog I/P 3 Trip
44		Analog I/P 4 Trip
45		Single Phasing Trip
46		Reverse Power Trip
47		Field Circuit Open Trip
48		Analog Differential 1-2 Trip
49		Analog Differential 3-4 Trip
50		----
51		Remote Alarm
52		Pressure Sw. Alarm
53		Vibration Sw. Alarm
54		Counter Alarm
55		Tachometer Alarm
56		General Sw. A Alarm
57		General Sw. B Alarm
58		General Sw. C Alarm
59		General Sw. D Alarm
60		Thermal Model Alarm
61		Overload Alarm
62		Undercurrent Alarm
63		Current U/B Alarm
64		Ground Fault Alarm
65		RTD 1 Alarm
66		RTD 2 Alarm
67		RTD 3 Alarm
68		RTD 4 Alarm
69		RTD 5 Alarm
70		RTD 6 Alarm
71		RTD 7 Alarm
72		RTD 8 Alarm
73		RTD 9 Alarm
74		RTD 10 Alarm
75		RTD 11 Alarm

6

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 9 of 12)

FORMAT CODE	TYPE	DEFINITION
76		RTD 12 Alarm
77		Open RTD Alarm
78		Short/Low RTD Alarm
79		Undervoltage Alarm
80		Overvoltage Alarm
81		Volt. Frequency Alarm
82		Power Factor Alarm
83		Reactive Power Alarm
84		Underpower Alarm
85		Trip Counter Alarm
86		Starter Failed Alarm
87		Current Demand Alarm
88		kW Demand Alarm
89		kvar Demand Alarm
90		kVA Demand Alarm
91		Broken Rotor Bar
92		Analog I/P 1 Alarm
93		Analog I/P 2 Alarm
94		Analog I/P 3 Alarm
95		Analog I/P 4 Alarm
96		Reverse Power Alarm
97		Incomplete Sequence Alarm
98		Analog Differential 1-2 Alarm
99		Analog Differential 3-4 Alarm
Ø		Ø
101		Service Alarm
102		Control Power Lost
103		Cont. Power Applied
104		Emergency Rst. Close
105		Emergency Rst. Open
106		Start While Blocked
107		Relay Not Inserted
108		Trip Coil Super.
109		Breaker Failure
110		Welded Contactor
111		Simulation Started
112		Simulation Stopped
Ø		Ø
118		Digital Trace Trigger
119		Serial Trace Trigger
120		RTD 1 High Alarm
121		RTD 2 High Alarm
122		RTD 3 High Alarm
123		RTD 4 High Alarm
124		RTD 5 High Alarm
125		RTD 6 High Alarm
126		RTD 7 High Alarm
127		RTD 8 High Alarm
128		RTD 9 High Alarm
129		RTD 10 High Alarm
130		RTD 11 High Alarm
131		RTD 12 High Alarm
132		Overtorque Alarm

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 10 of 12)

FORMAT CODE	TYPE	DEFINITION
133		R1 Relay Forced
134		R2 Relay Forced
135		R3 Relay Forced
136		R4 Relay Forced
137		R5 Relay Forced
138		Force R1 Disabled
139		Force R2 Disabled
140		Force R3 Disabled
141		Force R4 Disabled
142		Force R5 Disabled
143		Motor Started
FC135	Unsigned 16 bit integer	MOTOR SPEED
0		Low Speed (Speed 1)
1		High Speed (Speed 2)
FC136	Unsigned 16 bit integer	ORDER CODE
Bit 0		0 - Code P5 (5A phase CT), 1 - Code P1 (1A phase CT)
Bit 1		0 - Code HI (High Voltage Power Supply), 1 - Code LO (Low Voltage Power Supply)
Bit 2		0 - Code A20 (4-20 mA Analog Outputs), 1 - Code A1 (0-1 mA Analog Outputs)
FC137	Unsigned 16 bit integer	CONTROL RELAYS FOR REDUCED VOLTAGE STARTING
0		Auxiliary 2
1		Auxiliary 2 & Auxiliary 3
2		Auxiliary 3
FC138	Unsigned 16 bit integer	SIMULATION MODE
0		Off
1		Simulate Pre-Fault
2		Simulate Fault
3		Pre-Fault to Fault
FC139	Unsigned 16 bit integer	FORCE OPERATION OF RELAYS
0		Disabled
1		R1 Trip
2		R2 Auxiliary
3		R3 Auxiliary
4		R4 Alarm
5		R5 Block Start
6		R6 Service
7		All Relays
8		No Relays
FC140	Unsigned 16 bit integer	GENERAL STATUS
bit 0		Relay in Service
bit 1		Active Trip Condition
bit 2		Active Alarm Condition
bit 3		Reserved
bit 4		Reserved
bit 5		Reserved
bit 6		Reserved
bit 7		Reserved
bit 8		Motor Stopped

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 11 of 12)

FORMAT CODE	TYPE	DEFINITION
bit 9		Motor Starting
bit 10		Motor Running
bit 11		Overload Pickup
bit 12		Unbalance Pickup
bit 13		Ground Pickup
bit 14		Hot RTD
bit 15		Loss of Load
FC141	Unsigned 16 bit integer	OUTPUT RELAY STATUS
bit 0		R1 Trip
bit 1		R2 Auxiliary
bit 2		R3 Auxiliary
bit 3		R4 Alarm
bit 4		R5 Block Start
bit 5		R6 Service
bit 6 – bit 15		Not Used
FC142	Unsigned 16 bit integer	TRIP COIL SUPERVISION SELECTION
0		Disabled
1		S2 Close
2		S2 Open/Close
FC143	Unsigned 16 bit integer	SINGLE VT SELECTION
0		Off
1		AN (Wye) AB (Delta)
2		BN (Wye) BC (Delta)
3		CN (Wye) N/A (Delta)

Table 6–2: MEMORY MAP DATA FORMATS (Sheet 12 of 12)

FORMAT CODE	TYPE	DEFINITION
FC144	Unsigned 16 bit integer	PULSED OUTPUT RELAY SELECTION
0		Off
1		Auxiliary2
2		Auxiliary3
3		Alarm
FC145	Unsigned 16 bit integer	ANALOG IN DIFFERENTIAL COMPARISON
0		% Difference
1		Absolute Difference
FC146	Unsigned 16 bit integer	ANALOG IN DIFFERENTIAL LOGIC
0		1>2 (or 3>4)
1		2>1 (or 4>3)
2		1<>2 (or 3<>4)
FC147	Unsigned 16 bit integer	ANALOG IN DIFFERENTIAL ACTIVE WHEN
0		Always
1		Start/Run
FC148	Unsigned 16 bit integer	TORQUE DISPLAY UNITS
0		Newton-meter
1		Foot-pound
FC149	Unsigned 16 bit integer	UNDERVOLTAGE TRIP MODE
0		1-Phase
1		3-Phase

7.1.1 TEST SETUP

The purpose of this testing description is to demonstrate the procedures necessary to perform a complete functional test of all the 469 hardware while also testing firmware/hardware interaction in the process. Since the 469 is packaged in a drawout case, a demo case (metal carry case in which an 469 may be mounted) may be useful for creating a portable test set. Testing of the relay during commissioning using a primary injection test set will ensure that CTs and wiring are correct and complete.

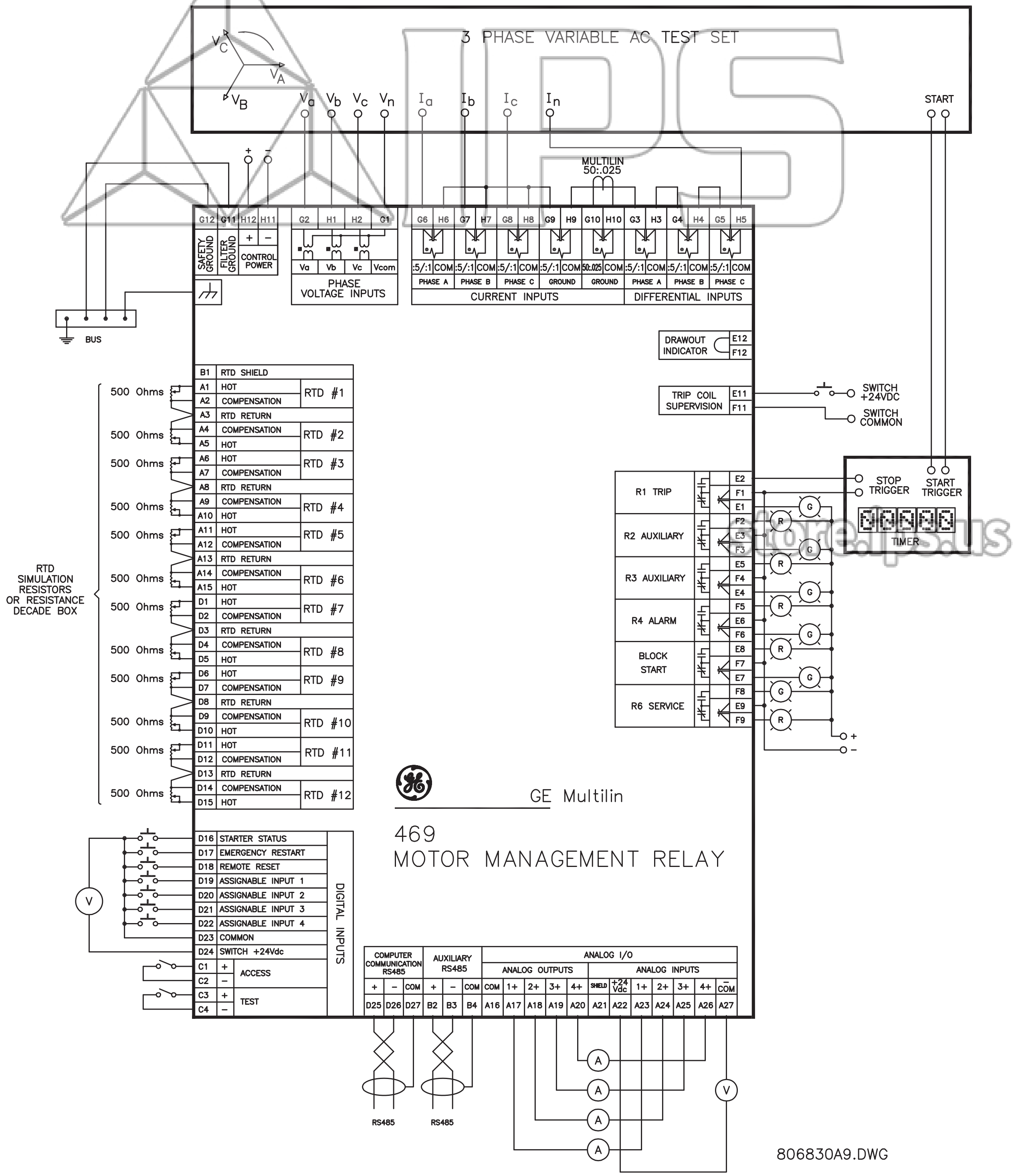


Figure 7–1: SECONDARY INJECTION TEST SETUP

7.2.1 PHASE CURRENT ACCURACY TEST

The 469 specification for phase current accuracy is ±0.5% of 2 × CT when the injected current is less than 2 × CT. Perform the steps below to verify accuracy.

1. Alter the following setpoint:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨ PHASE CT PRIMARY: "1000 A"

2. Measured values should be ±10 A. Inject the values shown in the table below and verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨ CURRENT METERING

INJECTED CURRENT 1 A UNIT	INJECTED CURRENT 5 A UNIT	EXPECTED CURRENT READING	MEASURED CURRENT PHASE A	MEASURED CURRENT PHASE B	MEASURED CURRENT PHASE C
0.1 A	0.5 A	100 A			
0.2 A	1.0 A	200 A			
0.5 A	2.5 A	500 A			
1.0 A	5.0 A	1000 A			
1.5 A	7.5 A	1500 A			
2.0 A	10 A	2000 A			

7.2.2 VOLTAGE INPUT ACCURACY TEST

The 469 specification for voltage input accuracy is ±0.5% of full scale (273 V). Perform the steps below to verify accuracy.

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨ VT CONNECTION TYPE: "Wye"
   S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨⇩ VOLTAGE TRANSFORMER RATIO: "10.00:1"

2. Measured values should be ±13.65 V. Apply the voltage values shown in the table and verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨⇩ VOLTAGE METERING

APPLIED LINE-NEUTRAL VOLTAGE	EXPECTED VOLTAGE READING	MEASURED VOLTAGE A-N	MEASURED VOLTAGE B-N	MEASURED VOLTAGE C-N
30 V	300 V			
50 V	500 V			
100 V	1000 V			
150 V	1500 V			
200 V	2000 V			
270 V	2700 V			

7

7.2.3 GROUND AND DIFFERENTIAL ACCURACY TEST

The 469 specification for differential current and 1 A/5 A ground current input accuracy is ±0.5% of 1 × CT for the 5 A input and 0.5% of 5 × CT for the 1 A input. Perform the steps below to verify accuracy.

a) 5 A INPUT

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ GROUND CT: 5A Secondary
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ GROUND CT PRIMARY: 1000 A
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ PHASE DIFFERENTIAL CT: 5A Secondary
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ PHASE DIFFERENTIAL CT PRIMARY: 1000 A

2. Measured values should be ±5 A. Inject the values shown in the table below into one phase only and verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨ CURRENT METERING

INJECTED CURRENT 5 A UNIT	EXPECTED CURRENT READING	MEASURED GROUND CURRENT	MEASURED DIFFERENTIAL CURRENT		
			PHASE A	PHASE B	PHASE C
0.5 A	100 A				
1.0 A	200 A				
2.5 A	500 A				
5.0 A	1000 A				

b) 1 A INPUT

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ GROUND CT: 1A Secondary
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ GROUND CT PRIMARY: 1000 A
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ PHASE DIFFERENTIAL CT: 1A Secondary
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ PHASE DIFFERENTIAL CT PRIMARY: 1000 A

2. Measured values should be ±25 A. Inject the values shown in the table below into one phase only and verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨ CURRENT METERING

INJECTED CURRENT 1 A UNIT	EXPECTED CURRENT READING	MEASURED GROUND CURRENT	MEASURED DIFFERENTIAL CURRENT		
			PHASE A	PHASE B	PHASE C
0.1 A	100 A				
0.2 A	200 A				
0.5 A	500 A				
1.0 A	1000 A				

7.2.4 GE MULTILIN 50:0.025 GROUND ACCURACY TEST

The 469 specification for GE Multilin 50:0.025 ground current input accuracy is ±0.5% of CT rated primary (25 A). Perform the steps below to verify accuracy.

1. Alter the following setpoint:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ GROUND CT: "50:0.025"

2. Measured values should be ±0.125 A. Inject the values shown in the table below either as primary values into a GE Multilin 50:0.025 Core Balance CT or as secondary values that simulate the core balance CT. Verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨ CURRENT METERING

PRIMARY INJECTED CURRENT	SECONDARY INJECTED CURRENT	EXPECTED CURRENT READING	MEASURED GROUND CURRENT
0.25 A	0.125 mA	0.25 A	
1 A	0.5 mA	1.00 A	
10 A	5 mA	10.00 A	
25 A	12.5 mA	25.00 A	

7.2.5 RTD ACCURACY TEST

The 469 specification for RTD input accuracy is ±2°. Perform the steps below to verify accuracy.

1. Alter the following setpoints:

   S8 RTD TEMPERATURE ⇨ RTD TYPES ⇨ STATOR RTD TYPE: "100 Ohm Platinum" (select desired type)
   S8 RTD TEMPERATURE ⇨⇩ RTD #1 ⇨ RTD #1 APPLICATION: "Stator" (repeat setting for RTDs 2 through 12)

2. Measured values should be ±2°C or ±4°F. Alter the resistances applied to the RTD inputs as per the table below to simulate RTDs and verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨⇩ TEMPERATURE

Table 7–1: 100 Ω PLATINUM TEST

APPLIED RESISTANCE 100 Ω PLATINUM	EXPECTED RTD TEMPERATURE READING		MEASURED RTD TEMPERATURE SELECT ONE: ____(°C) ____(°F)											
	°CELSIUS	°FAHRENHEIT	1	2	3	4	5	6	7	8	9	10	11	12
80.31 Ω	–50°C	–58°F												
100.00 Ω	0°C	32°F												
119.39 Ω	50°C	122°F												
138.50 Ω	100°C	212°F												
157.32 Ω	150°C	302°F												
175.84 Ω	200°C	392°F												
194.08 Ω	250°C	482°F												

Table 7–2: 120 Ω NICKEL TEST

APPLIED RESISTANCE 120 Ω NICKEL	EXPECTED RTD TEMPERATURE READING		MEASURED RTD TEMPERATURE SELECT ONE: ____(°C) ____(°F)											
	°CELSIUS	°FAHRENHEIT	1	2	3	4	5	6	7	8	9	10	11	12
86.17 Ω	–50°C	–58°F												
120.00 Ω	0°C	32°F												
157.74 Ω	50°C	122°F												
200.64 Ω	100°C	212°F												
248.95 Ω	150°C	302°F												
303.46 Ω	200°C	392°F												
366.53 Ω	250°C	482°F												

Table 7–3: 100 Ω NICKEL TEST

APPLIED RESISTANCE 100 Ω NICKEL	EXPECTED RTD TEMPERATURE READING		MEASURED RTD TEMPERATURE SELECT ONE: ____(°C) ____(°F)											
	°CELSIUS	°FAHRENHEIT	1	2	3	4	5	6	7	8	9	10	11	12
71.81 Ω	–50°C	–58°F												
100.00 Ω	0°C	32°F												
131.45 Ω	50°C	122°F												
167.20 Ω	100°C	212°F												
207.45 Ω	150°C	302°F												
252.88 Ω	200°C	392°F												
305.44 Ω	250°C	482°F												

Table 7–4: 10 Ω COPPER TEST

APPLIED RESISTANCE 10 Ω COPPER	EXPECTED RTD TEMPERATURE READING		MEASURED RTD TEMPERATURE SELECT ONE: ____(°C) ____(°F)											
	°CELSIUS	°FAHRENHEIT	1	2	3	4	5	6	7	8	9	10	11	12
7.10 Ω	–50°C	–58°F												
9.04 Ω	0°C	32°F												
10.97 Ω	50°C	122°F												
12.90 Ω	100°C	212°F												
14.83 Ω	150°C	302°F												
16.78 Ω	200°C	392°F												
18.73 Ω	250°C	482°F												

7.2.6 DIGITAL INPUTS AND TRIP COIL SUPERVISION

The digital inputs and trip coil supervision can be verified easily with a simple switch or pushbutton. Verify the SWITCH +24 V DC with a voltmeter. Perform the steps below to verify functionality of the digital inputs.

1. Open switches of all of the digital inputs and the trip coil supervision circuit.
2. View the status of the digital inputs and trip coil supervision in:

   ACTUAL VALUES ⇨ A1 STATUS ⇨⇩ DIGITAL INPUTS

3. Close switches of all of the digital inputs and the trip coil supervision circuit.
4. View the status of the digital inputs and trip coil supervision in:

   A1 STATUS ⇨⇩ DIGITAL INPUTS

INPUT	EXPECTED STATUS (SWITCH OPEN)	PASS / FAIL	EXPECTED STATUS (SWITCH CLOSED)	PASS / FAIL
ACCESS	Open		Shorted	
TEST	Open		Shorted	
STARTER STATUS	Open		Shorted	
EMERGENCY RESTART	Open		Shorted	
REMOTE RESET	Open		Shorted	
ASSIGNABLE INPUT 1	Open		Shorted	
ASSIGNABLE INPUT 2	Open		Shorted	
ASSIGNABLE INPUT 3	Open		Shorted	
ASSIGNABLE INPUT 4	Open		Shorted	
TRIP COIL SUPERVISION	No Coil		Coil	

7.2.7 ANALOG INPUTS AND OUTPUTS

The 469 specification for analog input and analog output accuracy is ±1% of full scale. Perform the steps below to verify accuracy. Verify the Analog Input +24 V DC with a voltmeter.

a) 4-20 MA

1. Alter the following setpoints:

   S12 ANALOG I/O ⇨⇩ ANALOG INPUT1 ⇨ ANALOG INPUT1: "4-20 mA"
   S12 ANALOG I/O ⇨⇩ ANALOG INPUT1 ⇨⇩ ANALOG INPUT1 MINIMUM: "0"
   S12 ANALOG I/O ⇨⇩ ANALOG INPUT1 ⇨⇩ ANALOG INPUT1 MAXIMUM: "1000" (repeat this value for Analog Inputs 2 to 4)

2. Analog output values should be ±0.2 mA on the ammeter. Measured analog input values should be ±10 units. Force the analog outputs using the following setpoints:

   S13 TESTING ⇨⇩ TEST ANALOG OUTPUT ⇨ FORCE ANALOG OUTPUTS FUNCTION: "Enabled"
   S13 TESTING ⇨⇩ TEST ANALOG OUTPUT ⇨⇩ ANALOG OUTPUT 1 FORCED VALUE: "0%"
   (enter desired value in percent; repeat for Analog Outputs 2 through 4)

3. Verify the ammeter readings as well as the measured analog input readings. For the purposes of testing, the analog input is fed in from the analog output (see Figure 7–1: Secondary Injection Test Setup on page 7–1). View the measured values in:

   A2 METERING DATA ⇨⇩ ANALOG INPUTS

ANALOG OUTPUT FORCE VALUE	EXPECTED AMMETER READING	MEASURED AMMETER READING (MA)				EXPECTED ANALOG INPUT READING	MEASURED ANALOG INPUT READING (UNITS)			
		1	2	3	4		1	2	3	4
0%	4 mA					0 mA				
25%	8 mA					250 mA				
50%	12 mA					500 mA				
75%	16 mA					750 mA				
100%	20 mA					1000 mA				

b) 0-1 MA

1. Alter the following setpoints:

   S12 ANALOG I/O ⇨⇩ ANALOG INPUT1 ⇨ ANALOG INPUT1: "0-1 mA"
   S12 ANALOG I/O ⇨⇩ ANALOG INPUT1 ⇨⇩ ANALOG INPUT1 MINIMUM: "0"
   S12 ANALOG I/O ⇨⇩ ANALOG INPUT1 ⇨⇩ ANALOG INPUT1 MAXIMUM: "1000" (repeat for Analog Inputs 2 to 4)

2. Analog output values should be ±0.01 mA on the ammeter. Measured analog input values should be ±10 units. Force the analog outputs using the following setpoints:

   S13 TESTING ⇨⇩ TEST ANALOG OUTPUT ⇨ FORCE ANALOG OUTPUTS FUNCTION: "Enabled"
   S13 TESTING ⇨⇩ TEST ANALOG OUTPUT ⇨⇩ ANALOG OUTPUT 1 FORCED VALUE: "0%"
   (enter desired percent, repeats for analog output 2-4)

3. Verify the ammeter readings as well as the measured analog input readings. View the measured values in:

   A2 METERING DATA ⇨⇩ ANALOG INPUTS

ANALOG OUTPUT FORCE VALUE	EXPECTED AMMETER READING	MEASURED AMMETER READING (MA)				EXPECTED ANALOG INPUT READING	MEASURED ANALOG INPUT READING (UNITS)			
		1	2	3	4		1	2	3	4
0%	0 mA					0 mA				
25%	0.25 mA					250 mA				
50%	0.50 mA					500 mA				
75%	0.75 mA					750 mA				
100%	1.00 mA					1000 mA				

7.2.8 OUTPUT RELAYS

To verify the functionality of the output relays, perform the following steps:

1. Using the setpoint:

   S13 TESTING ⇨⇩ TEST OUTPUT RELAYS ⇨ FORCE OPERATION OF RELAYS: "R1 Trip"

   select and store values as per the table below, verifying operation

FORCE OPERATION SETPOINT	EXPECTED MEASUREMENT ✔ FOR SHORT												ACTUAL MEASUREMENT ✔ FOR SHORT											
	R1		R2		R3		R4		R5		R6		R1		R2		R3		R4		R5		R6	
	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO	NC
R1 Trip	✔			✔		✔		✔		✔	✔													
R2 Auxiliary		✔	✔			✔		✔		✔	✔													
R3 Auxiliary		✔		✔	✔			✔		✔	✔													
R4 Alarm		✔		✔		✔	✔			✔	✔													
R5 Block Start		✔		✔		✔		✔	✔		✔													
R6 Service		✔		✔		✔		✔		✔		✔												
All Relays	✔		✔		✔		✔		✔			✔												
No Relays		✔		✔		✔		✔		✔	✔													

NOTE

R6 Service relay is failsafe or energized normally, operating R6 causes it to de-energize.

7

7.3.1 OVERLOAD CURVE TEST

The 469 specification for overload curve timing accuracy is ±100 ms or ±2% of time to trip. Pickup accuracy is as per the current inputs (±0.5% of 2 × CT when the injected current is less than 2 × CT and ±1% of 20 × CT when the injected current is ≥ 2 × CT). Perform the steps below to verify accuracy.

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨ PHASE CT PRIMARY: “1000”
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ MOTOR FULL LOAD AMPS FLA: “1000”

   S5 THERMAL MODEL ⇨ THERMAL MODEL ⇨ SELECT CURVE STYLE: “Standard”
   S5 THERMAL MODEL ⇨ THERMAL MODEL ⇨⇩ OVERLOAD PICKUP LEVEL: “1.10”
   S5 THERMAL MODEL ⇨ THERMAL MODEL ⇨⇩ UNBALANCE BIAS K FACTOR: “0”
   S5 THERMAL MODEL ⇨ THERMAL MODEL ⇨⇩ HOT/COLD SAFE STALL RATIO: “1.00”
   S5 THERMAL MODEL ⇨ THERMAL MODEL ⇨⇩ ENABLE RTD BIASING: “No”
   S5 THERMAL MODEL ⇨⇩ O/L CURVE SETUP ⇨ STANDARD OVERLOAD CURVE NUMBER: “4”

2. Any trip must be reset prior to each test. Short the emergency restart terminals momentarily immediately prior to each overload curve test to ensure that the thermal capacity used is zero. Failure to do so will result in shorter trip times. Inject the current of the proper amplitude to obtain the values as shown and verify the trip times. Motor load may be viewed in:

   A2 METERING DATA ⇨ CURRENT METERING

3. Thermal capacity used and estimated time to trip may be viewed in:

   A1 STATUS ⇨ MOTOR STATUS

AVERAGE PHASE CURRENT DISPLAYED	PICKUP LEVEL	EXPECTED TIME TO TRIP	TOLERANCE RANGE	MEASURED TIME TO TRIP
1050 A	1.05	never	n/a	
1200 A	1.20	795.44 sec.	779.53 to 811.35 sec.	
1750 A	1.75	169.66 sec.	166.27 to 173.05 sec.	
3000 A	3.00	43.73 sec.	42.86 to 44.60 sec.	
6000 A	6.00	9.99 sec.	9.79 to 10.19 sec.	
10000 A	10.00	5.55 sec.	5.44 to 5.66 sec.	

7

7.3.2 POWER MEASUREMENT TEST

The specification for reactive and apparent power is ±1% of $\sqrt{3} \times 2 \times CT \times VT \times VT$ full scale at $I_{avg} < 2 \times CT$. Perform the steps below to verify accuracy.

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨ PHASE CT PRIMARY: "1000"
   S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨ VT CONNECTION TYPE: "Wye"
   S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨⇩ VOLTAGE TRANSFORMER RATIO: "10.00:1"

2. Inject current and apply voltage as per the table below. Verify accuracy of the measured values. View the measured values in:

   A2 METERING DATA ⇨⇩ POWER METERING

INJECTED CURRENT 1A UNIT, APPLIED VOLTAGE (IA IS THE REFERENCE VECTOR)	INJECTED CURRENT 5A UNIT, APPLIED VOLTAGE (IA IS THE REFERENCE VECTOR)	EXPECTED LEVEL OF POWER QUANTITY	TOLERANCE RANGE OF POWER QUANTITY	MEASURED POWER QUANTITY	EXPECTED POWER FACTOR	MEASURED POWER FACTOR
Ia = 1 A ∠0° Ib = 1 A ∠120° Ic = 1 A ∠240° Va = 120 V ∠342° Vb = 120 V ∠102° Vc = 120 V ∠222°	Ia = 5 A ∠0° Ib = 5 A ∠120° Ic = 5 A ∠240° Ia = 120 V ∠342° Vb = 120 V ∠102° Vc = 120 V ∠222°	+ 3424 kW	3329 to 3519 kW		0.95 lag	
Ia = 1 A ∠0° Ib = 1 A ∠120° Ic = 1 A ∠240° Va = 120 V ∠288° Vb = 120 V ∠48° Vc = 120 V ∠168°	Ia = 5 A ∠0° Ib = 5 A ∠120° Ic = 5 A ∠240° Va = 120 V ∠288° Vb = 120 V ∠48° Vc = 120 V ∠168°	+ 3424 kvar	3329 to 3519 kvar		0.31 lag	

7.3.3 UNBALANCE TEST

The 469 measures the ratio of negative sequence current (I_2) to positive sequence current (I_1). This value as a percent is used as the unbalance level when motor load exceeds FLA. When the average phase current is below FLA, the unbalance value is derated to prevent nuisance tripping as positive sequence current is much smaller and negative sequence current remains relatively constant. The derating formula is:

$$\left|\frac{I_2}{I_1}\right| \times \frac{I_{avg}}{FLA} \times 100\% \qquad \textbf{(EQ 7.1)}$$

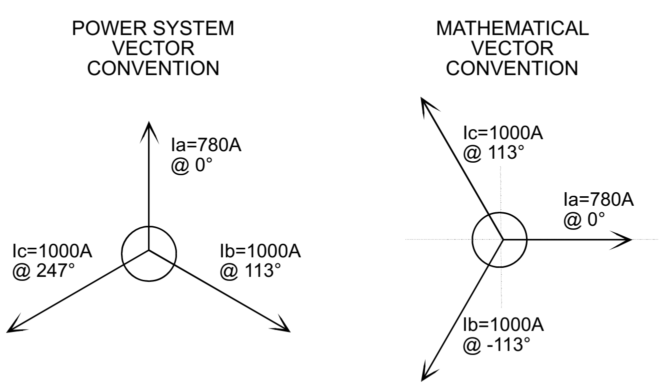


Figure 7–2: THREE PHASE EXAMPLE FOR UNBALANCE CALCULATION

Symmetrical component analysis of vectors using the mathematical vector convention yields a ratio of negative sequence current to positive sequence current as shown:

$$\frac{I_2}{I_1} = \frac{\frac{1}{3}(I_a + a^2 I_b + a I_c)}{\frac{1}{3}(I_a + a I_b + a^2 I_c)} \quad \text{where } a = 1\angle 120^\circ = -0.5 + j0.886 \qquad \textbf{(EQ 7.2)}$$

Given the values in the figure above, we have:

$$\begin{aligned}\frac{I_2}{I_1} &= \frac{780\angle 0^\circ + (1\angle 120^\circ)^2(1000\angle{-113^\circ}) + (1\angle 120^\circ)(1000\angle 113^\circ)}{780\angle 0^\circ + (1\angle 120^\circ)(1000\angle{-113^\circ}) + (1\angle 120^\circ)^2(1000\angle 113^\circ)} \\ &= \frac{780\angle 0^\circ + 1000\angle 127^\circ + 1000\angle 233^\circ}{780\angle 0^\circ + 1000\angle 7^\circ + 1000\angle 353^\circ} = \frac{780 - 601.8 + j798.6 - 601.8 - j798.6}{780 + 992.5 + j121.9 + 992.5 - j121.9} = \frac{-423.6}{2765} = -0.1532\end{aligned} \qquad \textbf{(EQ 7.3)}$$

If FLA = 1000, then:

$$I_{avg} = \frac{780 + 1000 + 1000}{3}\text{ A} = 926.7\text{ A} \qquad \textbf{(EQ 7.4)}$$

and since $I_{avg} = 926.7\text{ A} < 1000 = \text{FLA}$ the 469 unbalance is:

$$\text{469 Unbalance} = |-0.1532| \times \frac{926.7}{1000} \times 100\% = 14.2\% \qquad \textbf{(EQ 7.5)}$$

The 469 specification for unbalance accuracy is ±2%. Perform the steps below to verify accuracy.

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨ PHASE CT PRIMARY: "1000 A"
   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨⇩ MOTOR FULL LOAD AMPS FLA: "1000 A"

2. Inject the values shown in the table below and verify accuracy of the measured values. View the measured values in:

A2 METERING DATA ⇨ CURRENT METERING

INJECTED CURRENT		EXPECTED UNBALANCE LEVEL	MEASURED UNBALANCE LEVEL
1 A UNIT	5 A UNIT		
Ia = 0.78 A ∠0° Ib = 1 A ∠247° Ic = 1 A ∠113°	Ia = 3.9 A ∠0° Ib = 5 A ∠247° Ic = 5 A ∠113°	14%	
Ia = 1.56 A ∠0° Ib = 2 A ∠247° Ic = 2 A ∠113°	Ia = 7.8 A ∠0° Ib = 10 A ∠247° Ic = 10 A ∠113°	15%	
Ia = 0.39 A ∠0° Ib = 0.5 A ∠247° Ic = 0.5 A ∠113°	Ia = 1.95 A ∠0° Ib = 2.5 A ∠247° Ic = 2.5 A ∠113°	7%	

7.3.4 VOLTAGE PHASE REVERSAL TEST

The 469 can detect voltage phase rotation and protect against phase reversal. To test the phase reversal element, perform the following steps:

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨⇩ VOLTAGE SENSING ⇨ VT CONNECTION TYPE: "Wye" or "Delta"
   S2 SYSTEM SETUP ⇨⇩ POWER SYSTEM ⇨⇩ SYSTEM PHASE SEQUENCE: "ABC"

   S9 VOLTAGE ELEMENTS ⇨⇩ PHASE REVERSAL ⇨ PHASE REVERSAL TRIP: "Latched"
   S9 VOLTAGE ELEMENTS ⇨⇩ PHASE REVERSAL ⇨⇩ ASSIGN TRIP RELAYS: "Trip"

2. Apply voltages as per the table below. Verify the 469 operation on voltage phase reversal.

APPLIED VOLTAGE	EXPECTED RESULT ✘ NO TRIP ✔ PHASE REVERSAL TRIP	OBSERVED RESULT ✘ NO TRIP ✔ PHASE REVERSAL TRIP
Va = 120 V ∠0° Vb = 120 V ∠120° Vc = 120 V ∠240°	✘	
Va = 120 V ∠0° Vb = 120 V ∠240° Vc = 120 V ∠120°	✔	

7.3.5 SHORT CIRCUIT TEST

The 469 specification for short circuit timing is +50 ms. The pickup accuracy is as per the phase current inputs. Perform the steps below to verify the performance of the short circuit element.

1. Alter the following setpoints:

   S2 SYSTEM SETUP ⇨ CURRENT SENSING ⇨ PHASE CT PRIMARY: "1000"

   S6 CURRENT ELEMENTS ⇨ SHORT CIRCUIT TRIP ⇨ SHORT CIRCUIT TRIP: "On"
   S6 CURRENT ELEMENTS ⇨ SHORT CIRCUIT TRIP ⇨⇩ ASSIGN TRIP RELAYS: "Trip"
   S6 CURRENT ELEMENTS ⇨ SHORT CIRCUIT TRIP ⇨⇩ SHORT CIRCUIT TRIP PICKUP: "5.0 × CT"
   S6 CURRENT ELEMENTS ⇨ SHORT CIRCUIT TRIP ⇨⇩ INTENTIONAL S/C DELAY: "0"

2. Inject current as per the table below, resetting the unit after each trip by pressing the RESET key, and verify timing accuracy. Pre-trip values may be viewed by pressing NEXT after each trip.

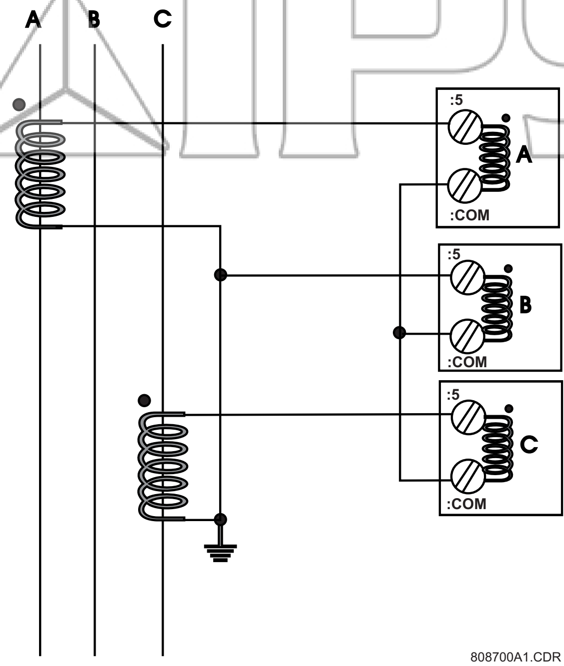
INJECTED CURRENT		EXPECTED TIME TO TRIP	MEASURED TIME TO TRIP
5 A UNIT	1 A UNIT		
30 A	6 A	< 50 ms	
40 A	8 A	< 50 ms	
50 A	10 A	< 50 ms	

7

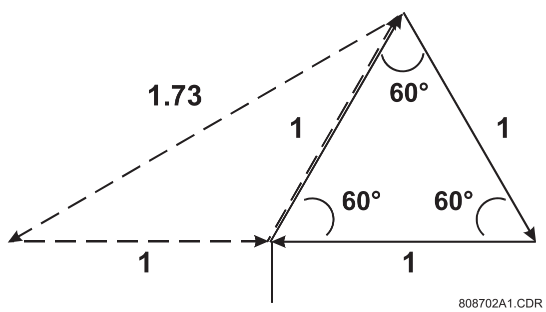
A.1.1 DESCRIPTION

This appendix illustrates how two CTs may be used to sense three phase currents.

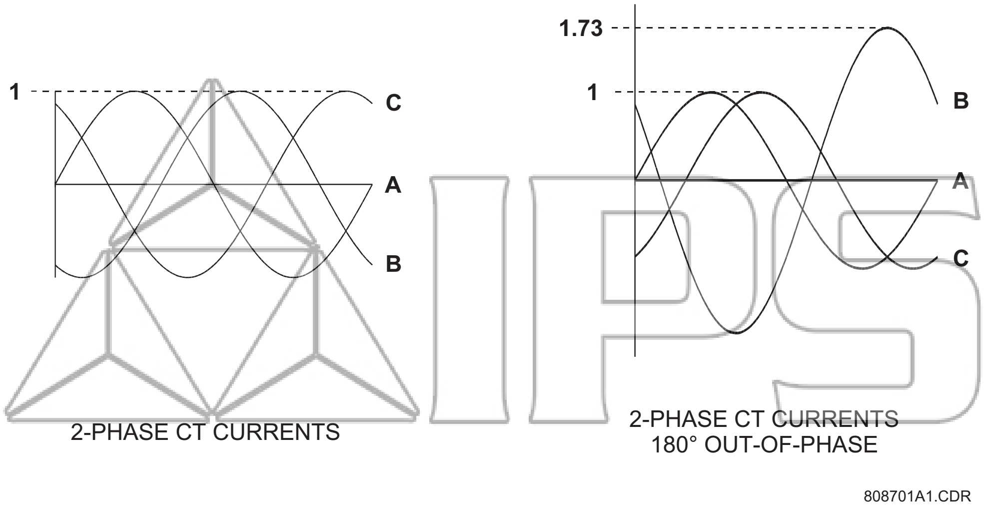
The proper configuration for the use of two CTs rather than three to detect phase current is shown. Each of the two CTs acts as a current source. The current that comes out of the CT on phase A flows into the interposing CT on the relay marked A. From there, the current sums with the current that is flowing from the CT on phase C which has just passed through the interposing CT on the relay marked C. This 'summed' current flows through the interposing CT marked B and from there, the current splits up to return to its respective source (CT). **Polarity is very important since the value of phase B must be the negative equivalent of A + C in order for the sum of all the vectors to equate to zero**. Note that there is only one ground connection as shown. If two ground connections are made, a parallel path for current has been created.



In the two CT configuration, the currents will sum vectorially at the common point of the two CTs. The diagram illustrates the two possible configurations. If one phase is reading high by a factor of 1.73 on a system that is known to be balanced, simply reverse the polarity of the leads at one of the two phase CTs (taking care that the CTs are still tied to ground at some point). **Polarity is important**.



To illustrate the point further, the following diagram shows how the current in phases A and C sum up to create phase 'B'.



Once again, if the polarity of one of the phases is out by 180°, the magnitude of the resulting vector on a balanced system will be out by a factor of 1.73.

On a three wire supply, this configuration will always work and unbalance will be detected properly. In the event of a single phase, there will always be a large unbalance present at the interposing CTs of the relay. If for example phase A was lost, phase A would read zero while phases B and C would both read the magnitude of phase C. If on the other hand, phase B was lost, at the supply, phase A would be 180° out-of-phase with phase C and the vector addition would equal zero at phase B.

A.2.1 SELECTION OF COOL TIME CONSTANTS

Thermal limits are not a black and white science and there is some art to setting a protective relay thermal model. The definition of thermal limits mean different things to different manufacturers and quite often, information is not available. Therefore, it is important to remember what the goal of the motor protection thermal modeling is: to thermally protect the motor (rotor and stator) without impeding the normal and expected operating conditions that the motor will be subject to.

The 469 thermal model provides integrated rotor and stator heating protection. If cooling time constants are supplied with the motor data they should be used. Since the rotor and stator heating and cooling is integrated into a single model, use the longer of the cooling time constants (rotor or stator).

If however, no cooling time constants are provided, settings will have to be determined. Before determining the cool time constant settings, the duty cycle of the motor should be considered. If the motor is typically started up and run continuously for very long periods of time with no overload duty requirements, the cooling time constants can be large. This would make the thermal model conservative. If the normal duty cycle of the motor involves frequent starts and stops with a periodic overload duty requirement, the cooling time constants will need to be shorter and closer to the actual *thermal limit* of the motor.

Normally motors are rotor limited during starting. Thus RTDs in the stator do not provide the best method of determining cool times. Determination of reasonable settings for the running and stopped cool time constants can be accomplished in one of the following manners listed in order of preference.

The motor running and stopped cool times or constants may be provided on the motor data sheets or by the manufacturer if requested. Remember that the cooling is exponential and the time constants are one fifth the total time to go from 100% thermal capacity used to 0%.

Attempt to determine a conservative value from available data on the motor. See the following example for details.

If no data is available an educated guess must be made. Perhaps the motor data could be estimated from other motors of a similar size or use. Note that conservative protection is better as a first choice until a better understanding of the motor requirements is developed. Remember that the goal is to protect the motor without impeding the operating duty that is desired.

A.2.2 EXAMPLE

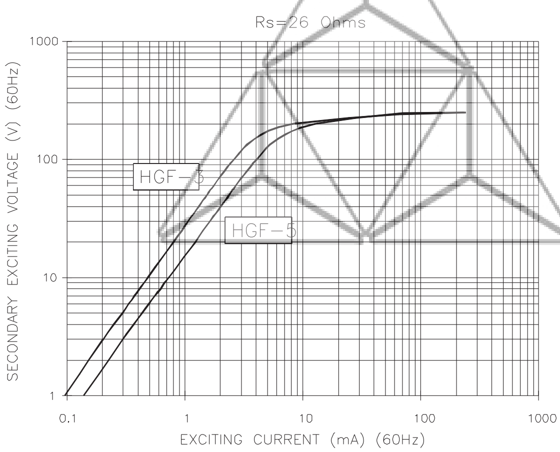
Motor data sheets state that the starting sequence allowed is 2 cold or 1 hot after which you must wait 5 hours before attempting another start.

- This implies that under a normal start condition the motor is using between 34 and 50% thermal capacity. Hence, two consecutive starts are allowed, but not three.
- If the hot and cold curves or a hot/cold safe stall ratio are not available program 0.5 (1 hot / 2 cold starts) in as the hot/cold ratio.
- Programming *Start Inhibit* ‘On’ makes a restart possible as soon as 62.5% (50 × 1.25) thermal capacity is available.
- After 2 cold or 1 hot start, close to 100% thermal capacity will be used. Thermal capacity used decays exponentially (see Section e): Motor Cooling on page 4–39 for calculation). There will be only 37% thermal capacity used after 1 time constant which means there is enough thermal capacity available for another start. Program 300 minutes (5 hours) as the *stopped cool time constant*. Thus after 2 cold or 1 hot start, a stopped motor will be blocked from starting for 5 hours.
- Since the rotor cools faster when the motor is running, a reasonable setting for the running cool time constant might be half the stopped cool time constant or 150 minutes.

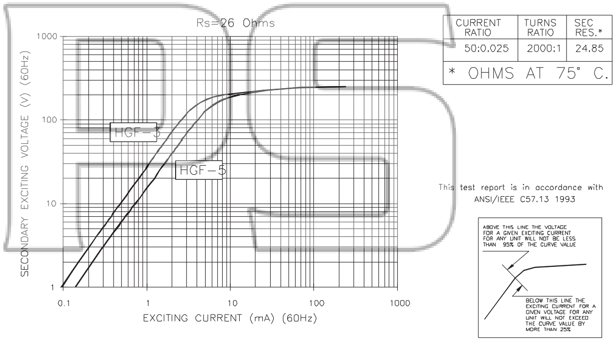
A.3.1 GROUND FAULT CTS FOR 50:0.025 A CT

CTs that are specially designed to match the ground fault input of GE Multilin motor protection relays should be used to ensure correct performance. These CTs have a 50:0.025A (2000:1 ratio) and can sense low leakage currents over the relay setting range with minimum error. Three sizes are available with 3½", 5½", or 8" diameter windows.

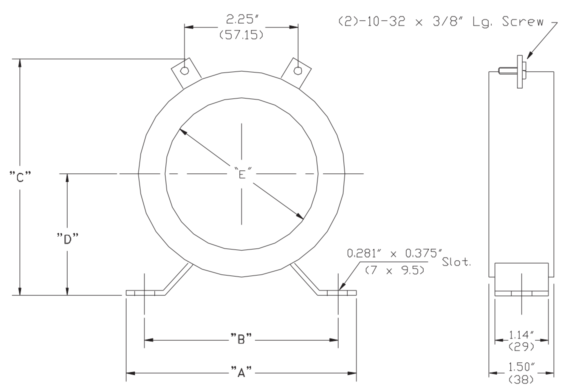
HGF3 / HGF5



HGF8

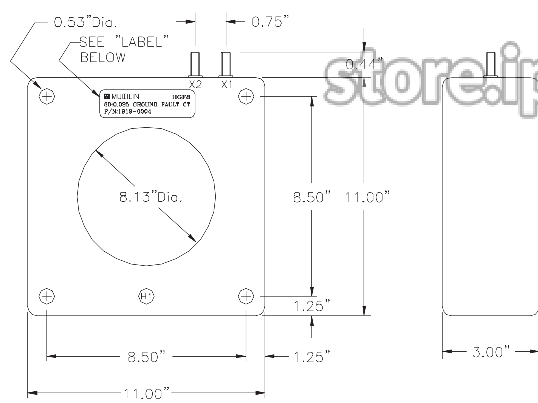


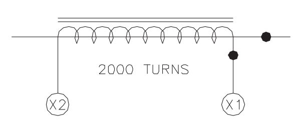
DIMENSIONS



PART NO.	DIMENSIONS																	
	A		B		C						D		E					
					Min.		Nom.		Max.				Min.		Nom.		Max.	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
CT-HGF5	7.80	198	7.00	178	8.40	213	8.50	216	8.60	218	4.50	114	5.50	140	5.70	145	5.90	150
CT-HGF3	6.00	152	5.25	133	5.65	144	5.75	146	5.85	149	2.90	74	3.50	89	3.70	94	3.90	99

DIMENSIONS



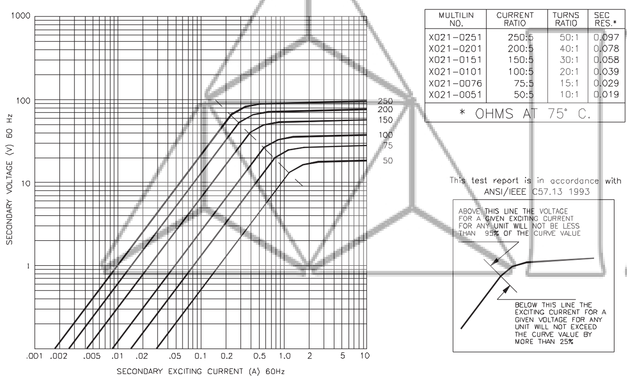


808710A1.CDR

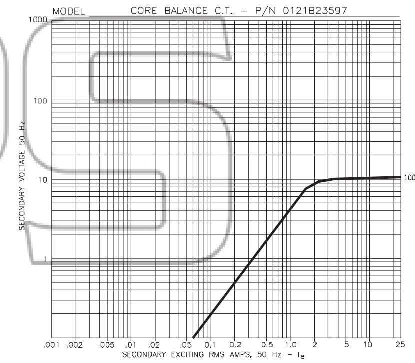
A.3.2 GROUND FAULT CTS FOR 5 A SECONDARY CT

For low resistance or solidly grounded systems, a 5 A secondary CT should be used. Two sizes are available with 5½” or 13” × 16” windows. Various Primary amp CTs can be chosen (50 to 250).

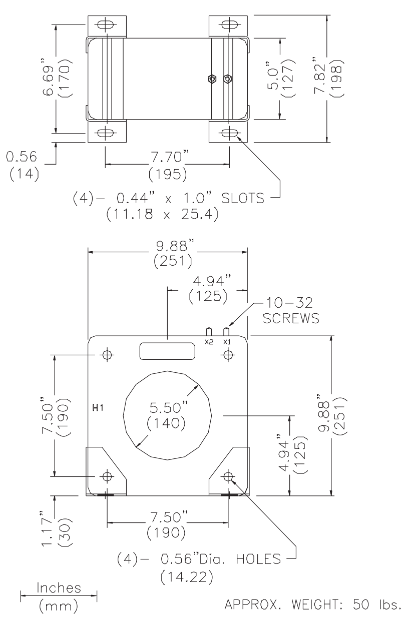
GCT5



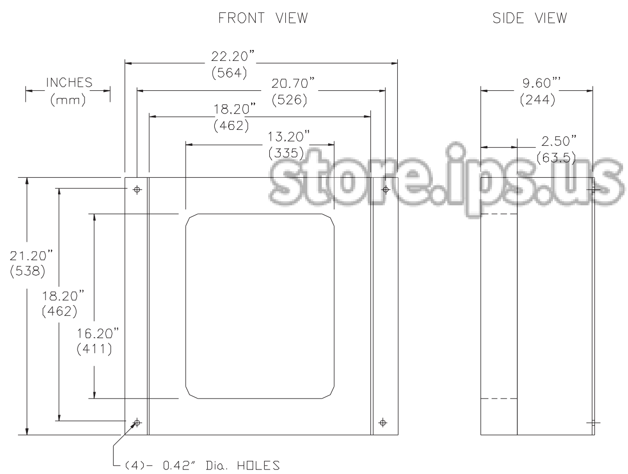
GCT16



DIMENSIONS



DIMENSIONS

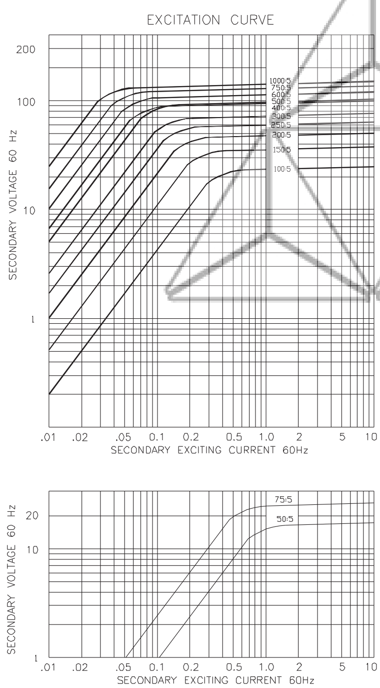


808709A1.CDR

A

A.3.3 PHASE CTS

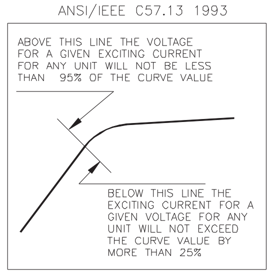
Current transformers in most common ratios from 50:5 to 1000:5 are available for use as phase current inputs with motor protection relays. These come with mounting hardware and are also available with 1 A secondaries. Voltage class: 600 V BIL 10 kV.

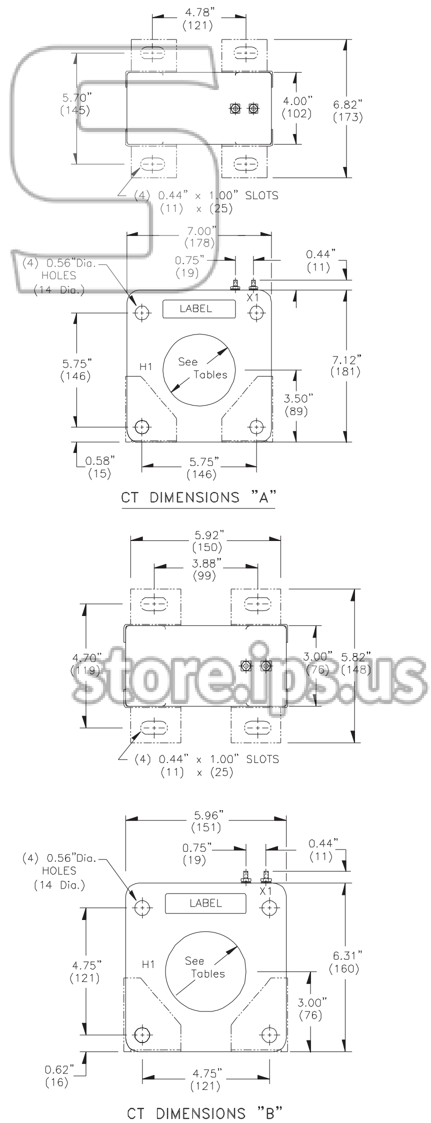


CURRENT TRANSFORMER SPECIFICATIONS				
CURRENT RATIO	WINDOW SIZE	CT CLASS	MULTILIN No.	CT Dims.
50:5	2.75"	C10	X911–0010	A
75:5	2.75"	C10	X911–0011	A
100:5	3.00"	C10	X911–0012	B
150:5	3.00"	C10	X911–0013	B
200:5	3.00"	C20	X911–0014	B
250:5	3.00"	C20	X911–0015	B
300:5	3.00"	C20	X911–0016	B
400:5	3.00"	C20	X911–0017	B
500:5	3.00"	C50	X911–0018	B
600:5	3.00"	C50	X911–0019	B
750:5	3.00"	C50	X911–0020	B
1000:5	3.75"	C50	X911–0021	B

909068A1.DWG

This test report is in accordance with ANSI/IEEE C57.13 1993





808712A1.CDR

B

GE Multilin

General Electric Multilin
215 Anderson Ave. Markham, Ontario   Canada. L6E 1B3
Tel: (905) 294-6222 Fax: (905) 294-8512

EU DECLARATION OF CONFORMITY

Applicable Council Directive(s): 73/23/EEC The Low Voltage Directive
89/336/EEC The EMC Directive

Standards to Which Conformity is Declared:

IEC 1010-1:1990+ A 1:1992+ A 2:1995	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
EN 50263:	EMC Product Standard for Measuring Relays and protective Equipment

Manufacturer's Name: General Electric Multilin

Manufacturer's Address: 215 Anderson Ave.
Markham, Ontario, Canada
L6E 1B3

Manufacturer's Representative in the EU: Jokin Galletero
GE Multilin
Avenida Pinoa 10
48170 Zamudio, Spain
Tel.: 34-94-4858817   Fax: 34-94-4858838

Type of Equipment: Motor Protection Relay

Model Number: SR469

First Year of Manufacture: 1995

I the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

Full Name: Jeff Mazereeuw

Position: Technology Manager

Signature:

Place: 215 Anderson Ave.
Markham, Ontario, Canada
L6E 1B3

Date: June. 11. 2004

GE Multilin Relay Warranty

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

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

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

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

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

Numerics

A

B

C

H

I

J

K

L

M

T

U

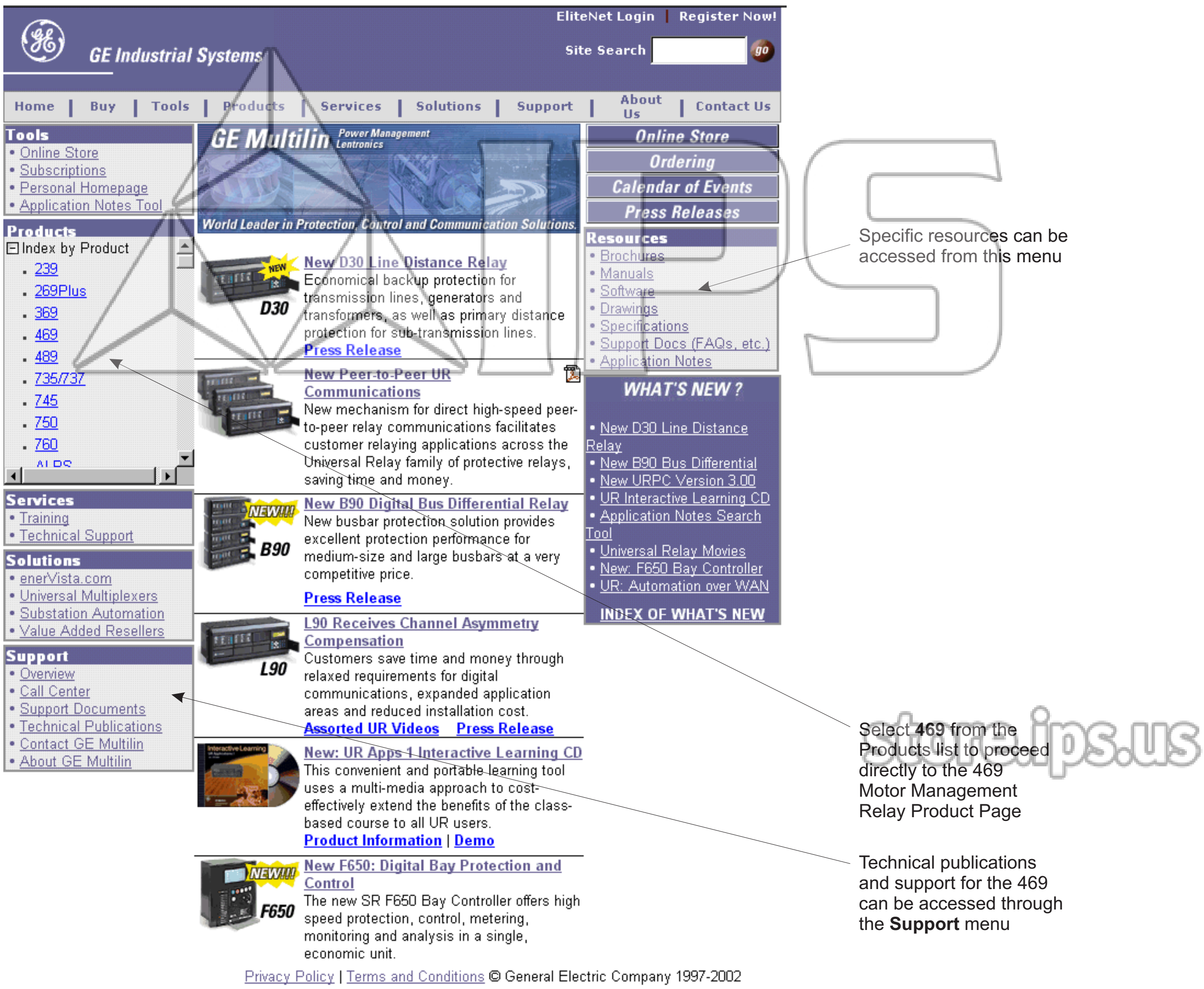
V

W

Z

GE MULTILIN WEBSITE

The latest product information for the 469 Motor Management Relay is available on the Internet via the GE Multilin home page at http://www.GEindustrial.com/multilin.



806973A1.CDR

This site provides access to the following customer services:

- Digital Products Directory
  A brief description of products can be viewed online.
- Product Catalog
  Individual product brochures can be downloaded and printed
- Product Selector Guide
  A graphical tool for finding the product you are interested in
- Sales Offices
  A complete listing of world-wide sales offices
- Technical Support
  Complete contact information is available
- Instruction Manuals
  Manuals are available in PDF format
- GE Product Software
  The latest working versions of product software
- Technical Drawings
  Many technical drawings are available in either AutoCAD, CorelDRAW, or PDF formats.
- Order Codes
  Order codes for many products can be downloaded and printed
- Technical Publications
  Application notes and technical papers related to power management and GE products are available.

Much more is also available. Visit us online at: **http://www.GEindustrial.com/multilin**.