269 Plus

MOTOR MANAGEMENT RELAY®

Instruction Manual

Firmware Rev.: 269P.D6.0.4
Manual P/N: 1601-0013-D3

MULTILIN

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1.1 Motor Protection Requirements

Three phase A.C. motors have become standard in modern industry. These motors are generally rugged and very reliable when used within their rated limits. Newer motors, however, tend to be designed to run much closer to these operational limits and thus, there is less margin available for any type of abnormal supply, load, or operating conditions.

In order to fully protect these motors, a modern protective device is required. Accurate stator and rotor thermal modeling is necessary to allow the motor to operate within its thermal limits and still give the maximum desired output. As well, other features can be incorporated into a modern relay to fully protect the motor, the associated mechanical system, and the motor operator from all types of faults or overloads.

Motor thermal limits can be exceeded due to increased current from mechanical overloads or supply unbalance. Unbalance can greatly increase heating in the rotor because of the large negative sequence current components present during even small voltage unbalances. A locked or stalled rotor can cause severe heating because of the associated large currents drawn from the supply. Many motor starts over a short period of time can cause overheating as well. Phase-to-phase and phase-to-ground faults can also cause damage to motors and hazards to personnel. Bearing overheating and loss of load can cause damage to the mechanical load being driven by the motor.

The ideal motor protection relay should monitor the rotor and stator winding temperatures exactly and shut off the motor when thermal limits are reached. This relay should have an exact knowledge of the temperature and proper operating characteristics of the motor and should shut down the motor on the occurrence of any potentially damaging or hazardous condition.

The GE Multilin Model 269 Plus Motor Management Relay® uses motor phase current readings combined with stator RTD temperature readings to thermally model the motor being protected. In addition, the 269 Plus takes into account the heating effects of negative sequence currents in the rotor, and calculates the cooling times of the motor. The relay also monitors the motor and mechanical load for faults and problems. With the addition of a GE Multilin meter (MPM), the 269 Plus may also monitor voltages and power and perform several protection functions based on these values.

1.2 269 Plus Relay Features

The GE Multilin Model 269 Plus Motor Management Relay® is a modern microcomputer-based product designed to provide complete, accurate protection for industrial motors and their associated mechanical systems. The 269 Plus offers a wide range of protection, monitoring, and diagnostic features in a single, integrated package. All of the relay setpoints may be programmed in the field using a simple 12 position keypad and 48 character alphanumeric display. A built-in "HELP" function can instruct the user on the proper function of each of the programming keys and on the meaning of each displayed message.

One 269 Plus relay is required per motor. Phase and ground fault currents are monitored through current transformers so that motors of any line voltage can be protected. The relay is used as a pilot device to cause a contactor or breaker to open under fault conditions; that is, it does not carry the primary motor current.

The model 269 Plus incorporates the following features: custom curve selectability, motor statistical records, speed switch input, differential relay input, 10 RTD inputs, single shot emergency restart feature, an RS485 communications port, unbalance input to thermal memory, start inhibit feature, and spare input.

The custom curve feature of the model 269 Plus gives the user additional flexibility. If one of the eight standard overload curves is not suitable for the application under consideration, the user can enter his own breakpoints to form a custom curve. This means that the 269 Plus can offer optimum motor protection in situations where other relays cannot. Such applications include induced fan drives where the motor stator and rotor thermal capacities can differ significantly.

An important feature of the GE Multilin 269 Plus relay, is its ability to "learn" individual motor parameters. The relay actually adapts itself to each application by "learning" values of motor inrush current, negative sequence current K factor, cool down rates, and acceleration time. These values may be used to improve the 269 Plus' protective capabilities (when enabled) and are continually updated.

The 269 Plus calculates the ratio of positive to negative sequence currents. The equivalent motor heating current is calculated based on the "learned" K factor. This, combined with RTD temperature readings by a motor thermal modeling algorithm, gives the 269 Plus a complete thermal model of the motor being protected. Thus, the 269 Plus will allow maximum motor power output while providing complete thermal protection.

The 269 Plus relay provides a complete statistical record of the motor being protected. The total motor running hours, total MegaWattHours, the number of motor starts, and the total number of relay trips since the last commissioning are stored and can be viewed on the display. As well, the number of short circuit, RTD, ground fault, unbalance, overload, start, rapid trips, and undercurrent trips can be recalled by simple keypad commands. These values are stored along with all of the relay setpoints in a non-volatile memory within the relay. Thus, even when control power is removed from the 269 Plus, the statistical record, all relay setpoints, learned parameters, and pre-trip values will remain intact.

The 269 Plus can provide one of various output signals for remote metering or programmable controller attachment. Analog signals of motor current as a percentage of full load, hottest stator RTD temperature, percentage of phase C.T. secondary current, motor thermal capacity, or bearing temperature are available by simple field programming. An RS485 port allows access to all setpoints and actual values. A total of four output relays are provided on the 269 Plus, including a latched trip relay, an alarm relay, and two auxiliary relays. All output relays may be programmed via the keypad to trip on specific types of faults or alarms.

When an output relay becomes active, the 269 Plus will display the cause of the trip, and if applicable, the lockout time remaining. Pre-trip values of average and individual line motor current, unbalance, ground fault current, and maximum stator RTD temperature are stored by the 269 Plus and may be recalled using the keypad.

The correct operation of the GE Multilin 269 Plus relay is continually checked by a built-in firmware self-test routine. If any part of the relay malfunctions under this self-test, an alarm indication will tell the operator that service is required.

Table 1-1 Model 269 Plus Relay Features

Protection Features
- Overloads - Stator Winding Overtemperature (Alarm, High Alarm and Trip) - Multiple Starts - Short Circuit - Locked Rotor - Rapid Trip/Mechanical Jam - Unbalance/Single Phasing - Ground Fault (Alarm and Trip) - Bearing Overtemperature (Alarm and Trip) - Undercurrent (Alarm and Trip) - Variable Lock-Out Time - Phase Reversal (Meter Option)
Operational Features
- Microcomputer controlled - Keypad programmable - 48 character alphanumeric display - Built-in "HELP" function - Eight selectable standard overload curves - User defined custom overload curve capability, FlexCurve™ - Continual relay circuitry self-check
Monitoring and Display Features
- Negative sequence phase current unbalance measurement - Ground fault (earth leakage) current measurement - Up to six stator RTD inputs - Four additional RTD inputs - Monitoring of motor ambient air temperature - Display of all SETPOINTS or ACTUAL VALUES upon request - Display of relay TRIP/ALARM and HELP messages
Communications and Control Features
- One latched, main trip relay - One alarm relay - Two auxiliary relays - Emergency restart capability - Pre-trip alarm warnings - 4-20mA output of motor current as a percentage of full load, motor thermal capacity, hottest stator RTD temperature, percentage of phase C.T. secondary current, or bearing RTD. - Optional single-shot restart on running overload trip - Speed switch, differential relay, and spare input - RS 485 port for connection to programmable controllers and computers
Statistical and Memory Features
- Recall of all pre-trip motor values - Tamperproof setpoints stored in non-volatile memory - Microcomputer "learns" motor inrush current, acceleration time, cool down rates, and negative sequence current heating K factor - Complete record of motor statistical data: motor running hours, number of starts, number and type of relay trips
Voltage and Power Metering (available with MPM)
- Display of 3 phase or line voltages, kWatts, kVars, Power Factor, and frequency. - Protection features based on Voltage, Power Factor, kVars, and voltage sensed phase reversals. - Pretrip values of average voltage, kWatts, kVars, Power Factor, and frequency. - Accumulated MegaWattHours.

1.3 Typical Applications

The many features of the 269 Plus make it an ideal choice for a wide range of motor protection applications. Versatile features and controls allow the relay to protect associated mechanical equipment as well as the motor. The 269 Plus should be considered for the following and other typical uses:

1. Protection of motors and equipment from operator abuse.
2. Protection of personnel from shock hazards due to winding shorts or earth leakage current from moisture.
3. Protection of gears, pumps, fans, saw mills, cutters, and compressors from mechanical jam.
4. Protection for loss of suction for pumps or loss of air flow for fans using the undercurrent feature.
5. Protection of motor and load bearings from excessive heat buildup due to mechanical wear.
6. Protection of motors operated in environments with varying ambient temperatures.
7. Communication with programmable controllers and computers for integrated plant control.
8. Protection of high inertia, long acceleration drive systems using a custom overload curve.
9. Statistical record-keeping for effective maintenance programs.
10. Complete protection, allowing maximum motor utilization with minimum downtime, for all a.c. motors.

1.4 Order Code/Information

269PLUS * * * * * *

269PLUS	Motor management relay
SV	Standard version
D/O	Drawout version
	Phase CT[1] **Ground CT** (required for D/O only)
1	:5 2000:1
2	:5 :5
3	:1 2000:1
4	:1 :5

	Relay fail safe code[2] (required for D/O only)			
	Trip	Alarm	Aux1	Aux 2
1	FS	NFS	NFS	FS
2	NFS	FS	NFS	FS
3	FS	FS	NFS	FS
4	NFS	NFS	FS	FS
5	FS	NFS	FS	FS
6	NFS	FS	FS	FS
7	FS	FS	FS	FS
8	NFS	NFS	NFS	FS

	Relay contact arrangement[3] (required for D/O only)		
	Alarm	Aux1	Aux2
1	N.O.	N.O.	N.O.
2	N.O.	N.O.	N.C.
3	N.O.	N.C.	N.O.
4	N.O.	N.C.	N.C.
5	N.C.	N.O.	N.O.
6	N.C.	N.O.	N.C.
7	N.C.	N.C.	N.O.
8	N.C.	N.C.	N.C.

100P	100 Ohm platinum RTD
10C	10 Ohm copper RTD
100N	100 Ohm nickel RTD
120N	120 Ohm nickel RTD
120	120 AC/125 DC control voltage
240	240 AC/250 DC control voltage
24DC	24 DC control voltage
48DC	48 DC control voltage

[1] For CT ratings greater than 1500:5, consult the factory.

[2] FS=Fail safe; A fail safe relay is one that changes state when control power is applied to the 269 Plus.
NFS= Non fail safe; A non fail safe relay is one that remains in its shelf state when control power is applied to the 269 Plus.

[3] N.O. and N.C. are defined as open and closed contacts of an output relay with control power applied to the 269 Plus and no trips or alarms are present.

EXAMPLE:
For a standard 269 Plus: 269PLUS-SV-100P-120
For a 269 Plus Drawout: 269PLUS-D/O-3-4-7-100P-240

The model 269 Plus relay is almost entirely field programmable. The information shown above must be specified when the relay is ordered as these options are not selectable in the field. Additional features can be made available on special order by contacting the GE Multilin factory.

**** See glossary for definition**

*** CT information, fail-safe code, and contact arrangement must be specified for drawout relays only; on standard 269 Plus's these features are field selectable.**

1.5 Technical Specifications

Phase Current Inputs
conversion: calibrated RMS, sample time 2ms
range: 0.05 to 12 × phase C.T. primary amps setpoint
full scale: 12 × phase C.T. primary amps setpoint
accuracy: ± 0.5% of full scale (0.05 to 2 × phase C.T. primary amps setpoint)
± 1.0% of full scale (over 2 × phase C.T. primary amps setpoint)
Frequency: 20–400 Hz

Ground Fault Current Input
conversion: calibrated RMS, sample time 2ms
range: 0.1 to 1.0 × G/F C.T. primary amps setpoint (5 Amp secondary C.T.)
1.0 to 10.0 amps, 50:0.025A (2000:1 ratio)
full scale: 1 × G/F C.T. primary amps setpoint (5 Amp secondary C.T.)
10 amps (2000:1 C.T.)
accuracy: ± 4% of G/F C.T. primary amps setpoint (5 Amp secondary C.T.)
± 0.3 amps primary (2000:1 C.T.)
Frequency: 20–400 Hz

Overload Curves
curves: 8 curves, fixed shape
1 custom curve
trip time accuracy: ± 1 sec. up to 13 sec.
± 8% of trip time over 13 sec.
detection level: ± 1% of primary C.T. amps

Unbalance
display accuracy: ± 2 percentage points of true negative sequence unbalance (In/Ip)

Running Hours Counter
accuracy: ± 1%

Relay Lock-out Time
accuracy: ± 1 minute with control power applied
lock-out time with no control power applied

Trip/Alarm Delay Times
accuracy: ± 0.5 sec. or 2% of total time, whichever is greater with the exception of:

1. "INST." setpoints: 20–45ms
2. Ground Fault 0.5 Second delay: ± 150 msec.
3. Ground Fault 250 msec delay: +75 msec, -150 msec.
4. Metering setpoints (Page 7): ± 1.5sec or 2% of total time

Differential Relay Input
relay response time: 100 msec. maximum (contact closure to output relay activation)

RTD Inputs
sensor types: 10 OHM copper
100 OHM nickel
120 OHM nickel
100 OHM platinum
(specified with order)
display accuracy: ± 2 °C
trip/alarm setpoint range: 0-200 °C
dead band: 3 °C
maximum lead resistance: 25% of RTD 0 °C resistance

Analog Current Output (4-20 mA standard)

	PROGRAMMABLE		
OUTPUT	0-1 mA	0-20 mA	4-20 mA
MAX LOAD	2000 Ω	300 Ω	300 Ω
MAX OUTPUT	1.01 mA	20.2 mA	20.2 mA

accuracy: ± 1% of full scale reading
polarity: terminal 58 ("-") must be at ground potential (ie. output is not isolated)
Isolation: non-isolated, active source
Update time: 250 msec max.

Communications
Type: RS485 2-wire, half duplex, isolated
Baud Rate: 300, 1200, 2400
Protocol: Subset of Modbus® RTU
Functions: Read/write setpoints (03/16),
Read actual values (03/04)

Relay Contacts

VOLTAGE		MAKE/CARRY CONTINUOUS	MAKE/CARRY 0.2 sec	BREAK
	30 VDC	10	30	10
RESISTIVE	125 VDC	10	30	0.5
	250 VDC	10	30	0.3
	30 VDC	10	30	5
INDUCTIVE	125 VDC	10	30	0.25
(L/R=7ms)	250 VDC	10	30	0.15
RESISTIVE	120 VAC	10	30	10
	250 VAC	10	30	10
INDUCTIVE	120 VAC	10	30	4
PF=0.4	250 VAC	10	30	3
CONFIGURATION		FORM C NO/NC		
CONTACT MATERIAL		SILVER ALLOY		
MINIMUM PERMISSIBLE LOAD:		5 VDC, 100 mA 12 VAC, 100 mA		

Switch Inputs
Type: dry contacts

C.T. Burden Due to Connection of 269 Plus Relay

	CT INPUT (AMPS)	BURDEN (VA)	BURDEN (mΩ)
PHASE CT (1A)	1	0.04	43
	4	0.5	31
	13	4.8	28
PHASE CT (5A)	5	0.06	2.4
	20	1	2.5
	65	8.5	2.01
G/F CT (5A)	5	0.08	3
	10	0.3	3
G/F CT (50:0.025)	0.025	0.435	696 Ω
	0.1	3.29	329 Ω
	0.5	50	200 Ω

CT Thermal Withstand

Phase CTs G/F 5 amp tap: 3× - continuous
6× - 40 sec
12× - 3 sec
G/F (2000:1): 6× - continuous

Control Power (Includes Tolerances)

frequency: 50/60 Hz
24 VDC, range: 20-30 VDC
48 VDC, range: 30-55 VDC
120 VAC/125 VDC, range: 80-150 VAC/VDC
240 VAC/250 VDC, range: 160-300 VAC/VDC
maximum power consumption: 20 VA
Voltage loss ride-through time:
100ms (@ 120VAC/125VDC)

NOTE: Relay can be powered from either AC or DC source. If Control Power input exceeds 250V, an external 3A fuse must be used rated to the required voltage.

Fuse Specifications

T3.15A H 250V
Timelag high breaking capacity

Dielectric Strength

2200 VAC, 50/60 Hz, for 1 sec.
GROUND (Terminal 42) to
Output Contacts (Terminals 29 through 40)
Control Power (Terminals 41 & 43)
Current Transformer Inputs (Terminals 72 through 83)

NOTE: If Hi-Pot tests are performed, jumper J201 beside terminal 43 should be placed in the "HI-POT" position. Upon completion of Hi-Pot tests, the jumper should be placed in the "GND" position. See Fig. 5.3.

Type Tests

Dielectric Strength: 2.0 kV for 1 minute to relays, CTs, power supply
Insulation Resistance: IEC255-5,500Vdc
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 5kV
RFI: 50 MHz/15W Transmitter
EMI: C37.90.2 Electromagnetic Interference @ 150 MHz and 450 MHz, 10V/m
Static: IEC 801-2 Static Discharge
Humidity: 95% non- condensing
Temperature: -25°C to +60°C ambient
Environment: IEC 68-2-38 Temperature/Humidity Cycle
Dust/Moisture: NEMA 12/IP53

Ambient Temperature and Storage Temperature

-25°C to +60°C

Packaging

Shipping box: 11.40" x 7.50" x 16.00" (WxHxD)
290mm x 190mm x 410mm (WxHxD)
Ship weight: 3.5 kg
7.75 lb

<u>269 Plus drawout:</u>

Shipping box: 13.25" x 12.50" x 20.50" (WxHxD)
340mm x 320mm x 520mm
Ship weight: 12 kg
26.4 lb

Certifications

ISO: Manufactured to an ISO9001 certified program
UL: UL recognized under E83849
CSA: Approved under LR41286
CE: Conforms to IEC 947-1, IEC 1010-1
Overvoltage Category: II
Pollution Degree: 2
IP Code: 40X

Note: 269 Plus Drawout does not meet CE compliance.

WARNING: HAZARD may result if the product is not used for intended purposes. This equipment can only be serviced by trained personnel.

MPM OPTION SPECIFICATIONS

PHASE CURRENT INPUTS

Conversion: true rms, 64 samples/cycle
CT input: 1A & 5A secondary
Burden: 0.2 VA
Overload: 20xCT for 1s, 100xCT for 0.2s
Range: 1-150% of CT pri
Frequency: up to 32nd harmonic
Accuracy: ± 1% of display

VOLTAGE INPUTS

Conversion: true rms, 64 samples/cycle
VT pri/Sec: direct or 120-72000:69-240
Input range: 20-600 VAC
Full scale: 150/600 VAC autoscaled
Frequency: up to 32nd harmonic
Accuracy: ± 1% of display

ANALOG OUTPUTS

	OUTPUT	
	0-1 mA (T1 Option)	4-20 mA (T20 Option)
MAX LOAD	2400 Ω	600 Ω
MAX OUTPUT	1.1 mA	21 mA

Accuracy: ±2% of full scale reading
Isolation: 50V isolated, active source

MEASURED VALUES

PARAMETER	ACCURACY (% OF FULL SCALE)	RANGE
VOLTAGE	±0.2%	20% TO 100% OF VT
kW	±0.4%	0-999,999.99 kW
kvar	±0.4%	0-999,999.99 kvar
kVA	±0.4%	0-999,999.99 kVA
kWh	±0.4%	0-999,999,999 kWh
PF	±1.0%	±0.00-1.00
FREQUENCY	±0.02Hz	20.00-70.00 Hz

CONTROL POWER

Input: 90 – 300 VDC or
70 – 265 VAC, 50/60 Hz
Power: nominal 10VA
maximum 20VA
Holdup: 100 ms typical (@ 120 VAC/125 VDC)

TYPE TESTS

Dielectric strength: 2.0 kV for 1 minute to relays, CTs, VTs, power supply
Insulation resistance: IEC255-5,500Vdc
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 5kV
RFI: 50 MHz/15W Transmitter
EMI: C37.90.2 Electromagnetic Interference @ 150 MHz and 450 MHz, 10V/m
Static: IEC 801-2 Static Discharge
Humidity: 95% non-condensing
Temperature: -10°C to +60°C ambient
Environment: IEC 68-2-38 Temperature/Humidity Cycle
Dust/moisture: NEMA 12/IP53

PACKAGING

Shipping box: 8½" × 6" × 6" (L×H×D) 215cm × 152cm × 152 cm (L×H×D)
Ship weight: 5 lbs/2.3 kg

CERTIFICATION

ISO: Manufactured to an ISO9001 certified program
UL: Recognized under E83849
CSA: Recognized under LR41286

Note: It is recommended that all 269 Plus, MPM relays be powered up at least once per year to avoid deterioration of electrolytic capacitors in the power supply.

Due to updating technology, specifications may be improved without notice.

2.1 Physical Dimensions

The 269 Plus relay is contained in a compact plastic and metal housing with the keypad, display, and all indicators located on the front panel. The physical dimensions of the 269 Plus unit are given in Figure 2.1.

GE Multilin also provides phase and ground fault CTs if required. Dimensions for these are shown in Figure 2.2a, Figure 2.2b, Figure 2.2c, and Figure 2.2d. *Note*: Dimensions of a are for 100:5 to 1000:5 phase CT's; for the dimensions of 50:5 and 75:5 CT's, consult factory.

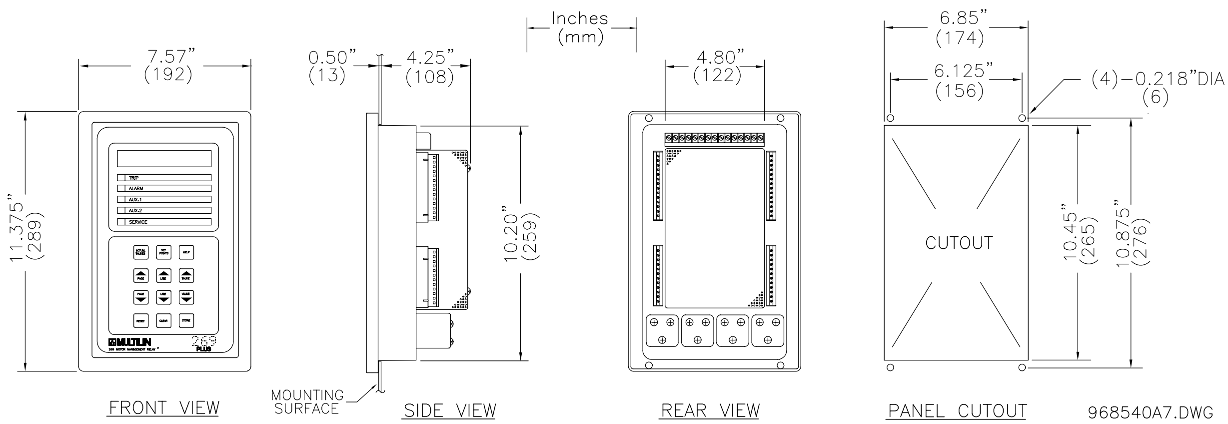
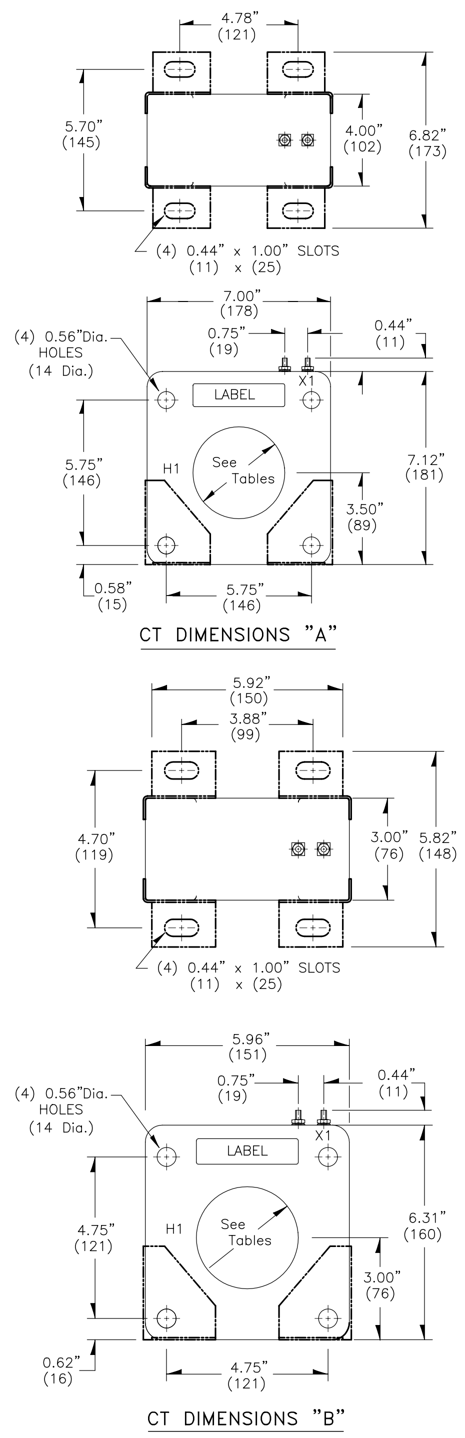


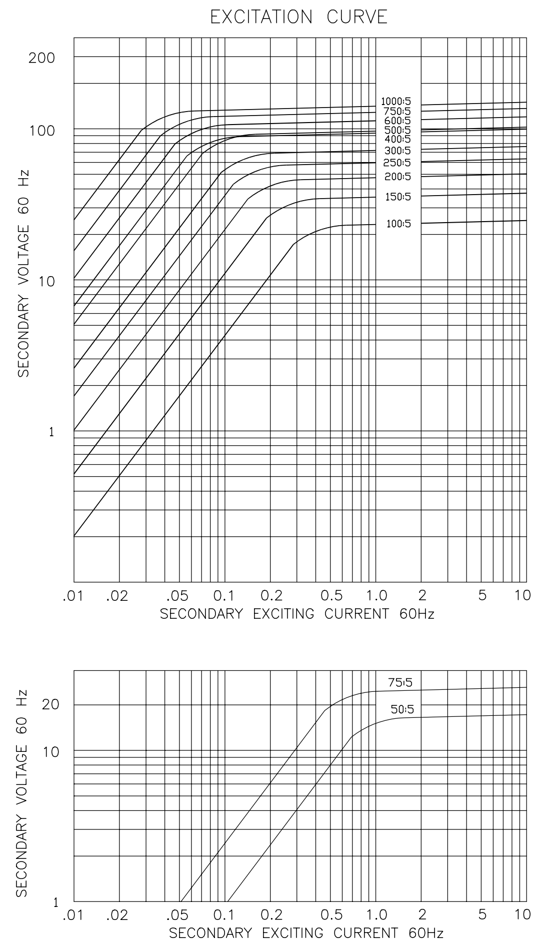
Figure 2.1 Physical Dimensions

MULTILIN

PHASE CURRENT TRANSFORMERS

RATIOS FROM 50:5 through to 1000:5

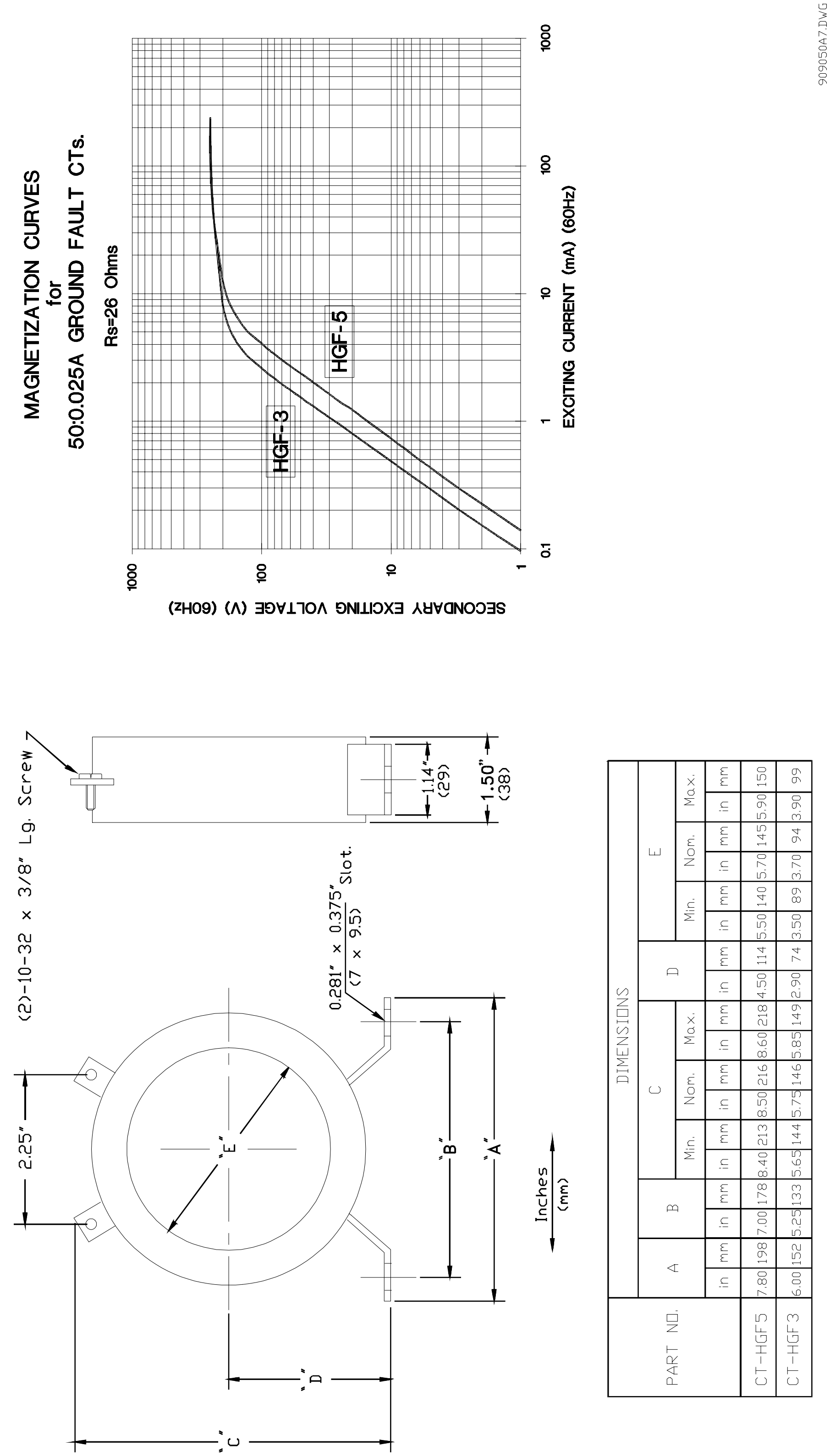




CURRENT TRANSFORMER SPECIFICATIONS				
CURRENT RATIO	WINDOW SIZE	CT CLASS	MULTILIN No.	CT Dims.
50:5	2.75"	C10	X911–0010	A
75:5	2.75"	C10	X911–0011	A
100:5	3.00"	C10	X911–0012	B
150:5	3.00"	C10	X911–0013	B
200:5	3.00"	C20	X911–0014	B
250:5	3.00"	C20	X911–0015	B
300:5	3.00"	C20	X911–0016	B
400:5	3.00"	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

Figure 2.2a Phase CT Dimensions



PART NO.	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

Figure 2.2b Ground CT (50:0.025) 3" and 5" window

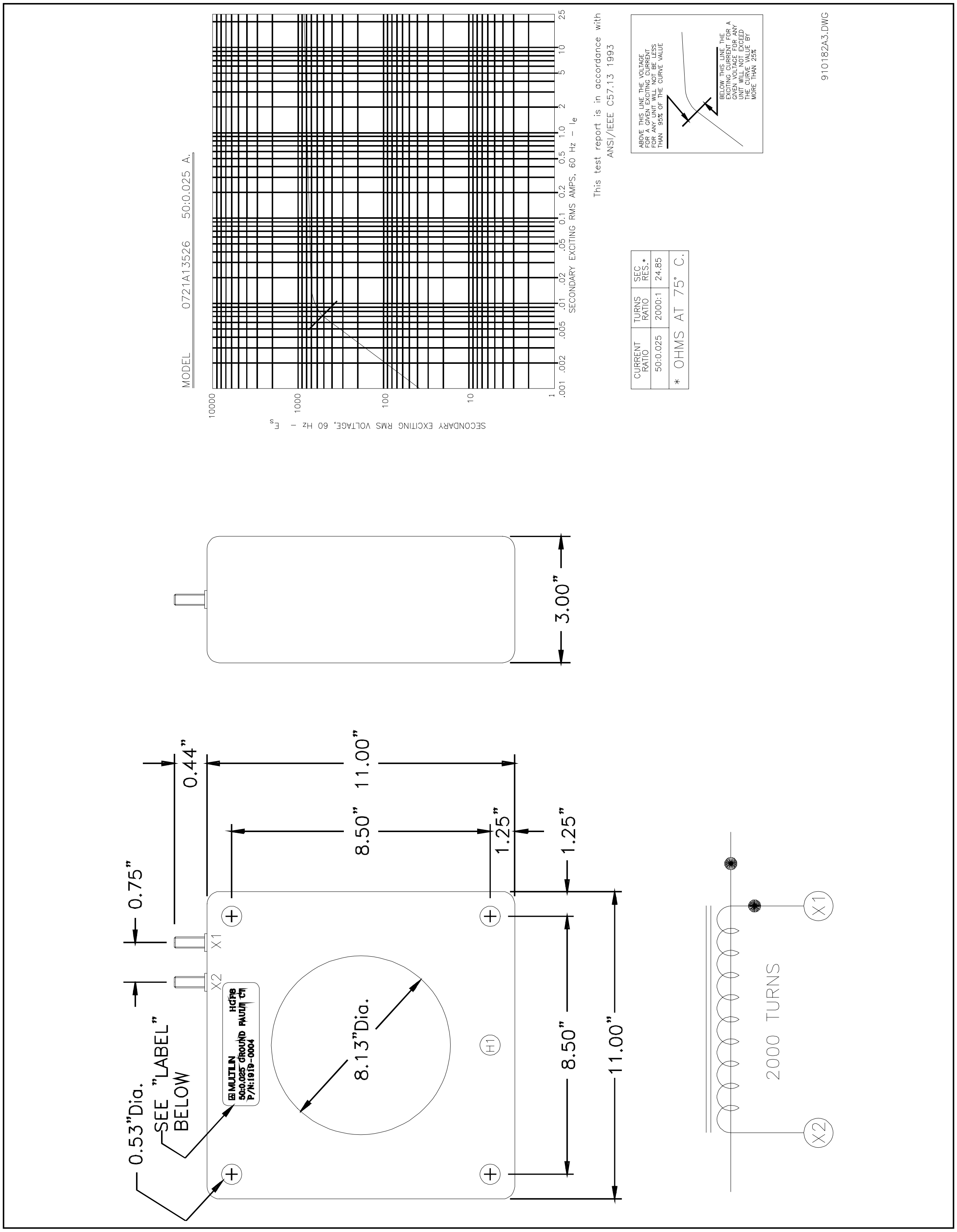


Figure 2.2c Ground CT (50:0.025) 8” window

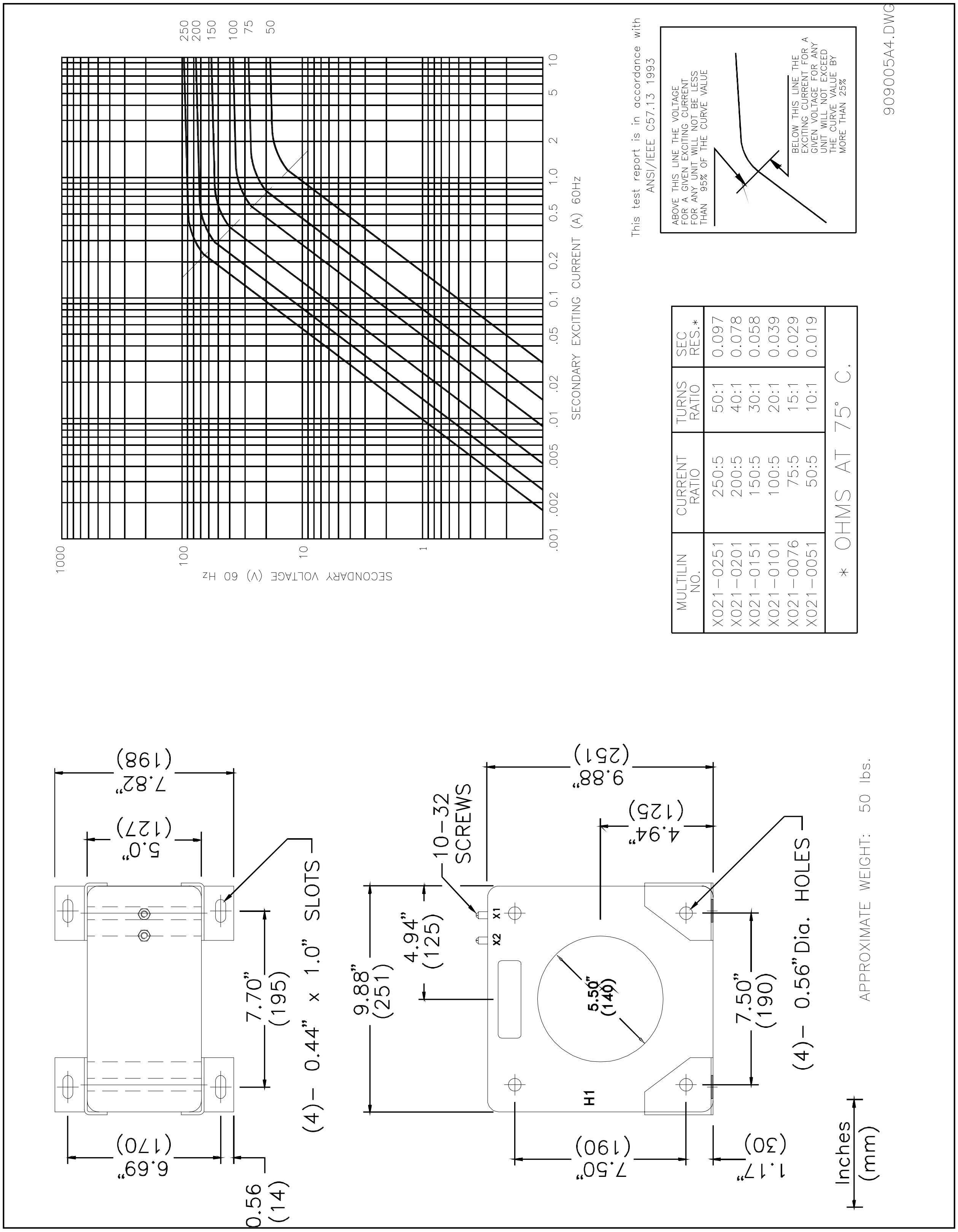


Figure 2.2d Ground CT (x:5) Dimensions

2.2 Mounting

The 269 Plus should be positioned so that the display is visible and the front panel keypad is accessible. A cut-out is made in the mounting panel and the unit is mounted as shown in Figure 2.3. Four washers and 10-32 × 3/8" mounting screws are provided.

Although the 269 Plus circuitry is internally shielded, to minimize noise pickup and interference the relay should be placed away from high current conductors or sources of strong magnetic fields. Connections to the relay are made through terminal blocks and CTs located on the rear of the unit.

2.3 External Connections

The connections made to the 269 Plus relay will vary depending on the programming of the unit. It is not necessary to use all of the connections provided; a minimal configuration would include supply power, three phase current CT inputs and the Trip relay contacts wired in series with the contactor control relay or circuit breaker shunt trip coil. Connections to these and the other terminals outlined below will be explained in the following sections.

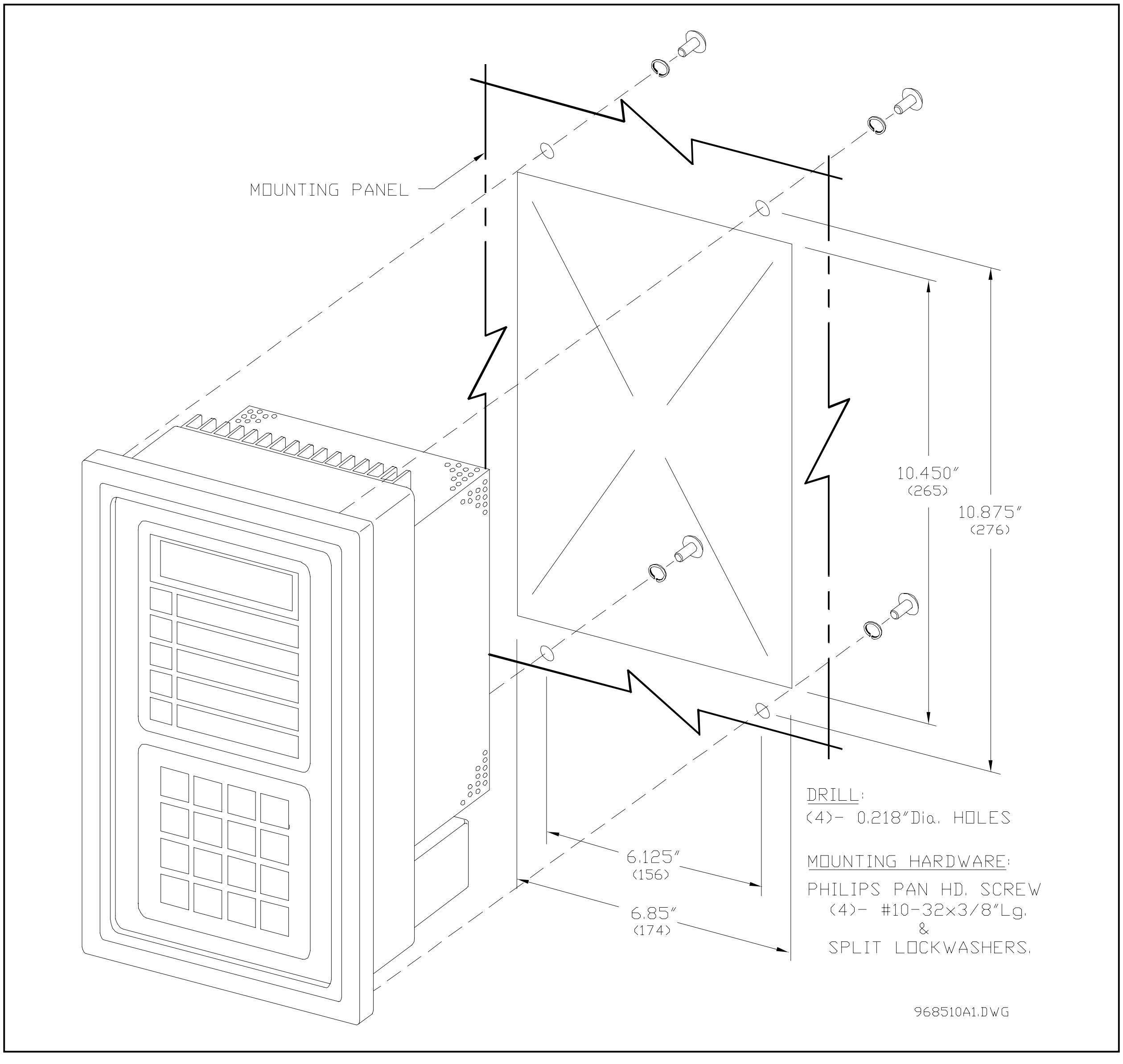


Figure 2.3 Relay Mounting

Figure 2.4, Figure 2.6, and Figure 2.7 show typical connections to the 269 Plus relay.

NOTE: The rear of the 269 Plus relay shows output relay contacts in their power down state. Figure 2.4, Figure 2.6, and Figure 2.7 show output relay contacts with power applied, no trips or alarms, Factory Configurations, i.e. TRIP - fail-safe, ALARM - non-fail-safe, AUX.1 - non-fail-safe, AUX.2 - fail-safe). See Figure 2.5 for a complete list of all possible output relay contact states. See SETPOINTS page 5 for a description of the RELAY FAILSAFE CODE.

Table 2-1 269 Plus External Connections

Inputs
-Supply Power L(+), G, N(–) - universal AC/DC supply -Phase CTs -Ground Fault CTs (core balance CT) -6 Stator RTDs -4 additional RTDs -Emergency Restart keyswitch -External Reset pushbutton -Programming Access jumper or keyswitch -Speed Switch input -Differential Relay input -Spare input -Meter Communication Port
Outputs
-4 Sets of Relay Contacts (NO/NC) -Programmable Analog Current Output Terminals
-RS 485 Serial Communication Port

WARNING: HAZARD may result if the product is not used for intended purposes. This equipment can only be serviced by trained personnel.

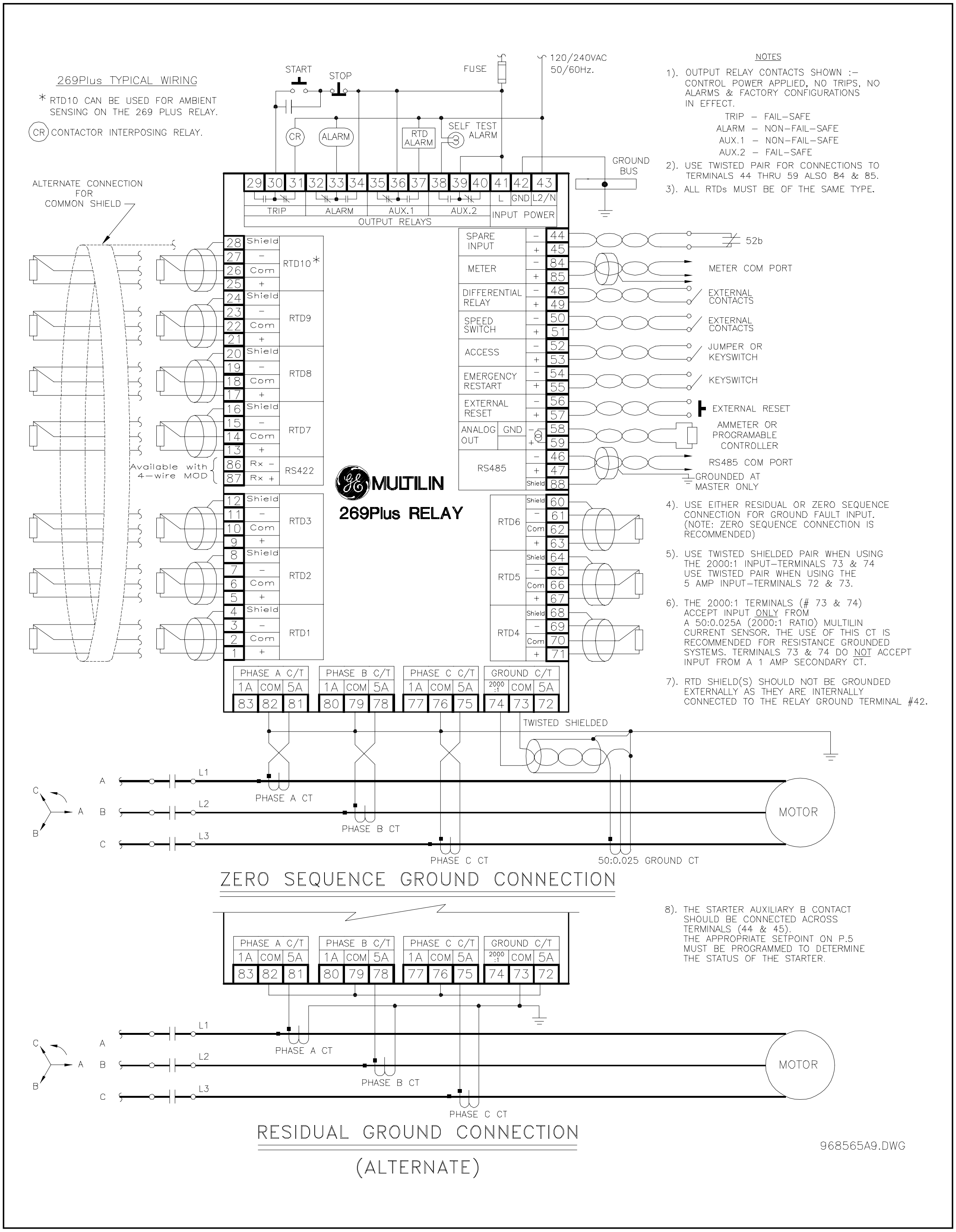
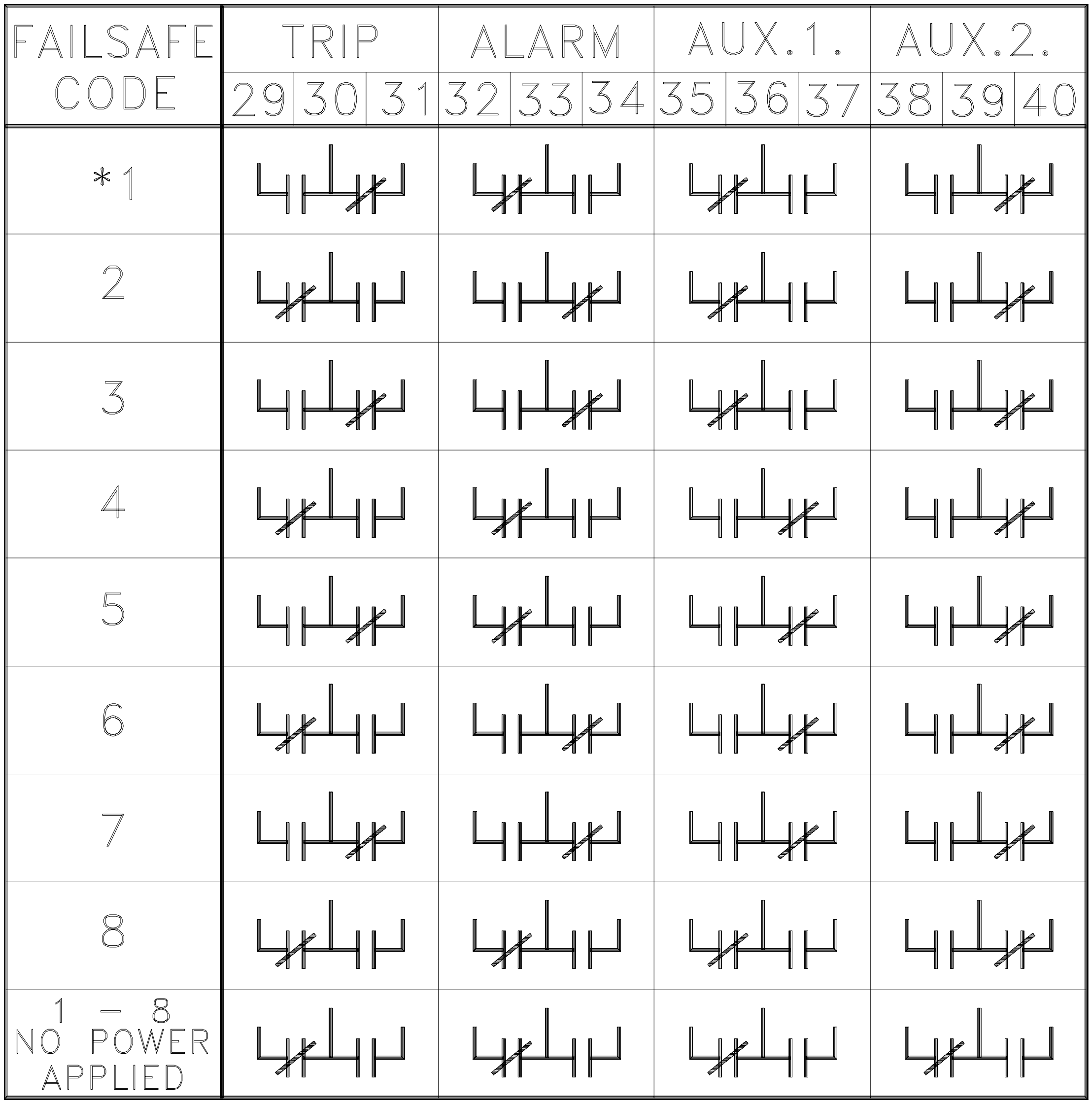


Figure 2.4 Relay Wiring Diagram (AC Control Power)



NOTES: 1). CONTACTS SHOWN WITH CONTROL POWER APPLIED, NO TRIPS, NO ALARMS.

2). * :– FACTORY PRESET VALUE.

Figure 2.5 Output Relay Contact States

WARNING: In locations where system voltage disturbances cause voltage levels to dip below the range specified in the Specifications (1.5), any relay contact programmed failsafe may change state. Therefore, in any application where the "process" is more critical than the motor, it is recommended that the trip relay contacts be programmed non-failsafe. In this case, it is also recommended that the AUX2 contacts be monitored for relay failure. If, however, the motor is more critical than the "process," then the trip contacts should be programmed failsafe.

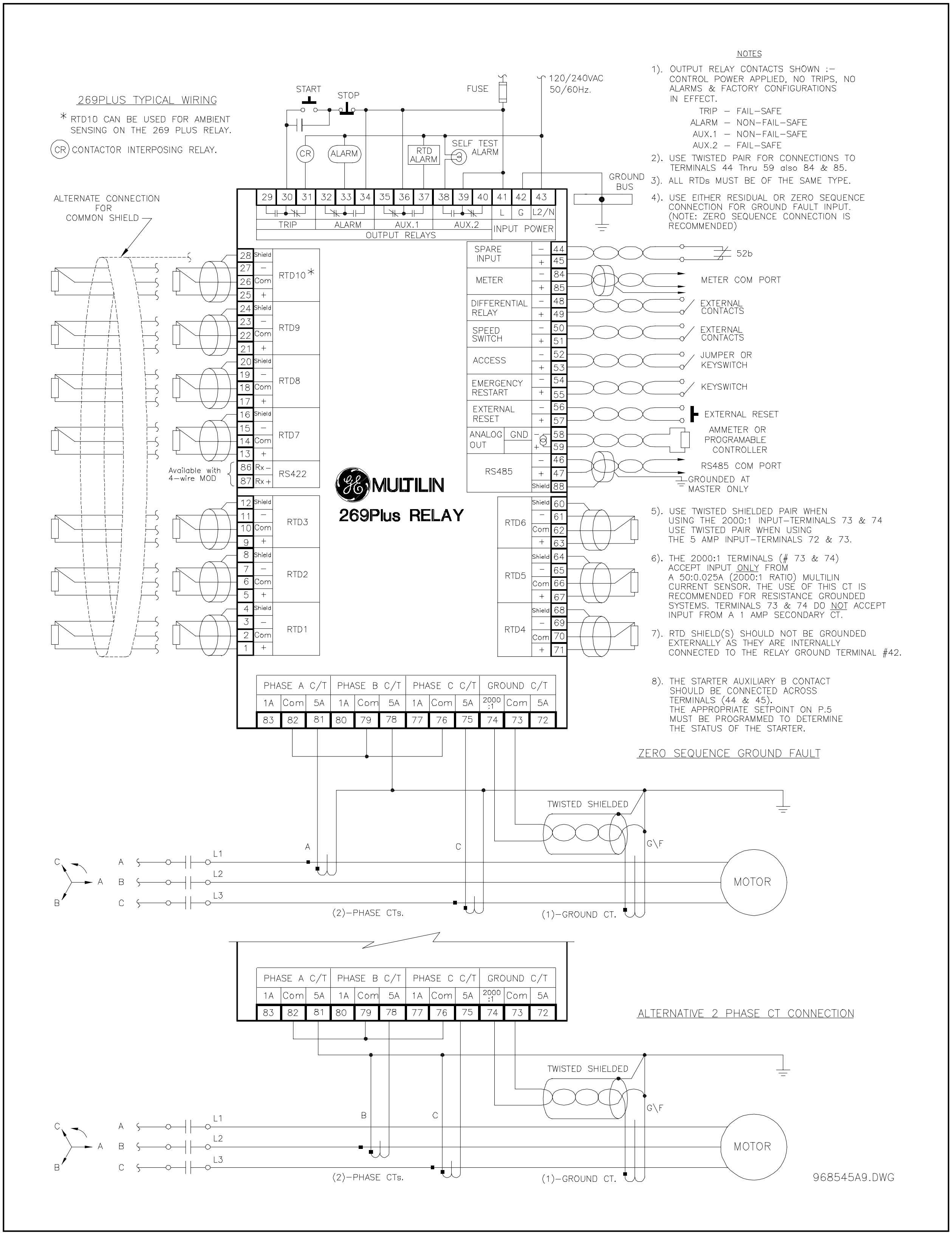


Figure 2.6 Relay Wiring Diagram (Two Phase CTs)

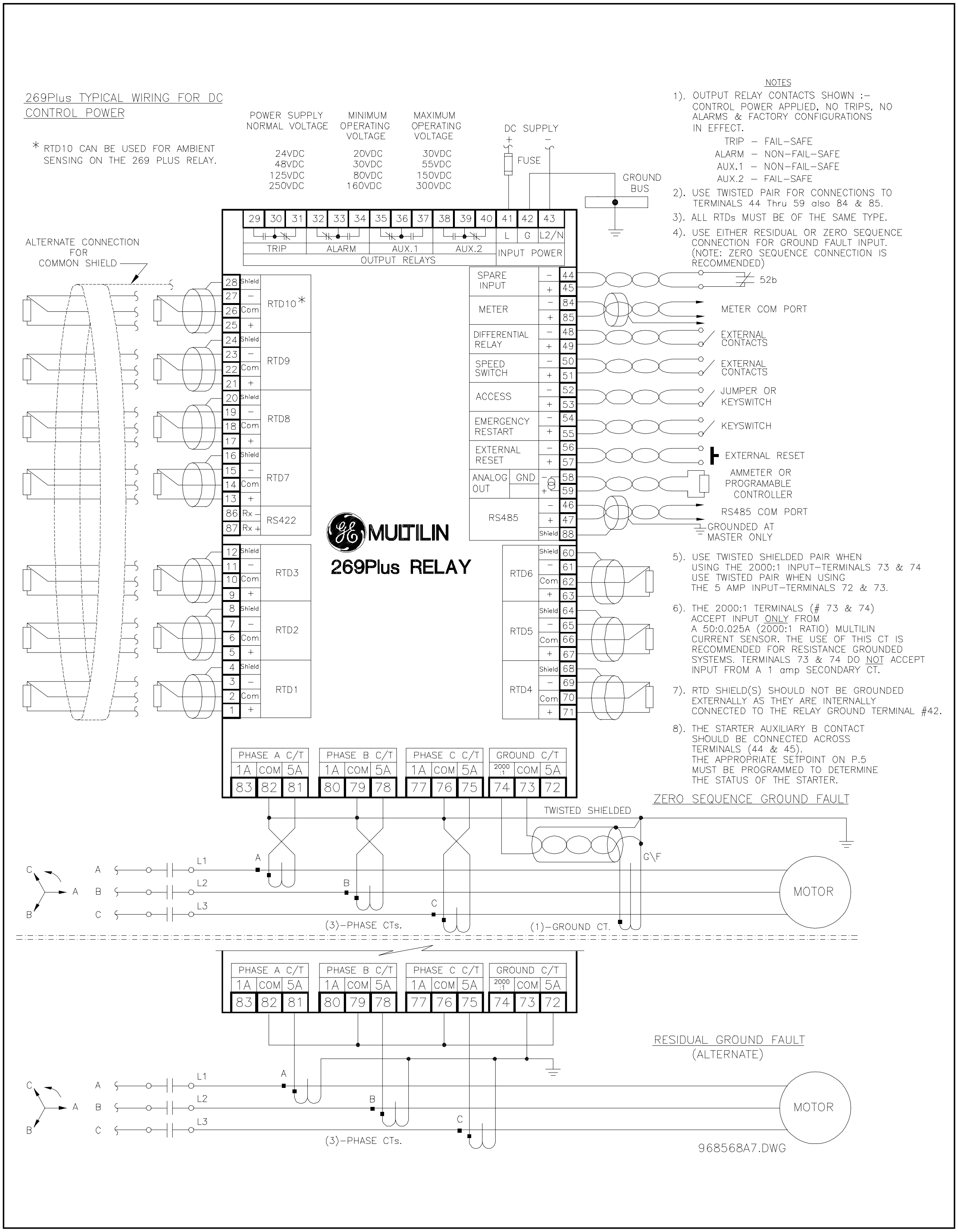


Figure 2.7 Relay Wiring Diagram (DC Control Power)

2.4 Control Power

The relay is powered on using any one of four different switching power supplies: 120-125 VAC/VDC, 240-250 VAC/VDC, 48 VDC, or 24 VDC. The first two versions have been designed to work with either AC or DC control power. Maximum power consumption for the unit is 20 VA.

The 269 Plus will operate properly over a wide range of supply voltages typically found in industrial environments (see control power specifications in section 1.5). When the supply voltage drops below the minimum, the output relays will return to their power down states but all setpoints and statistical data will remain stored in the relay memory. Motor lock-out time will be adhered to with or without control power applied. If control power is removed, the relay keeps track of the Motor Lockout time for up to an hour.

Control power must be applied to the 269 Plus relay, and the relay programmed, before the motor is energized. Power is applied at terminals 41, 42, and 43 which are terminal blocks having #6 screws.

Note: Chassis ground terminal 42 must be connected directly to the dedicated cubicle ground bus to prevent transients from damaging the 269 Plus resulting from changes in ground potential within the cubicle. Terminal 42 must be grounded for both AC and DC units for this reason.

Verify from the product identification label on the back of the relay that the control voltage matches the intended application. Connect the control voltage input to a stable source of supply for reliable operation. A 3.15A, slow blow mini fuse (see Fuse Specifications in Technical Specifications) is accessible from the back of the 269 Plus by removing the perforated cover. See Figure 2.8 for details on replacing the fuse. Using #10 gauge wire or ground braid, connect terminal 42 to a solid ground which is typically the copper ground bus in the switchgear. Extensive filtering and transient protection is built into the 269 Plus to ensure reliable operation under harsh industrial operating environments. Transient energy must be conducted back to the source through filter ground. The filter ground is separated from the safety ground terminal 42 at jumper J201 on the back of the relay to allow dielectric testing of a switchgear with a 269 Plus wired up. Jumper J201 must be removed during dielectric testing. It must be put back in place once the dielectric testing is done.

When properly installed, the 269 Plus will meet the interference immunity requirements of IEC 1000-4-3/EN61000-4-3; EN 61000-4-6. It also meets the emission requirements of IEC CISPR11/EN55011 and EN50082-2.

2.5 Phase CT Inputs

One CT for each of the three motor phases is required to input a current into the relay proportional to the motor phase current. The phase sequence must be as shown in Figure 2.4 and Figure 2.7. The CTs used can have either a 1 amp or 5 amp secondary and should be chosen so that the motor full load current is between 75 and 95 percent of the rated CT primary amps. The CT ratio should thus be of the form n:1 or n:5 where n is between 20 and 1500. The ratio of the CT used must be programmed into the 269 Plus (see section 3.7).

The CT connections to the relay are made between the ":1" and "COM" terminals for 1 amp CTs or between the ":5" and "COM" terminals for CTs with a 5 amp secondary.

The connections to the 269 Plus internal phase CTs are made directly via #10 screws.

CTs should be selected to be capable of supplying the required current to the total secondary load which includes the 269 Plus relay burden of 0.1 VA at rated secondary current and the connection wiring burden. The CT must not saturate under maximum current conditions which can be up to 8 times motor full load during starting or up to 20 times during a short circuit. Only CTs rated for protective relaying should be used since metering CTs are usually not rated to provide enough current during faults. Typical CT ratings are:

CSA (Canada):	Class10L100	10=accuracy, L=protection, 100=capacity, higher is better
ANSI (USA):	Class C 100 B4	C or T=protection, 100=capacity, higher is better, B4=accuracy
IEC (Europe):	20 VA Class 5P20	P=protection, 20VA=capacity, higher is better

Refer to Appendix H for details on CT withstand, CT size and saturation, as well as the safe use of 600V class window type CTs on a 5 kV circuit.

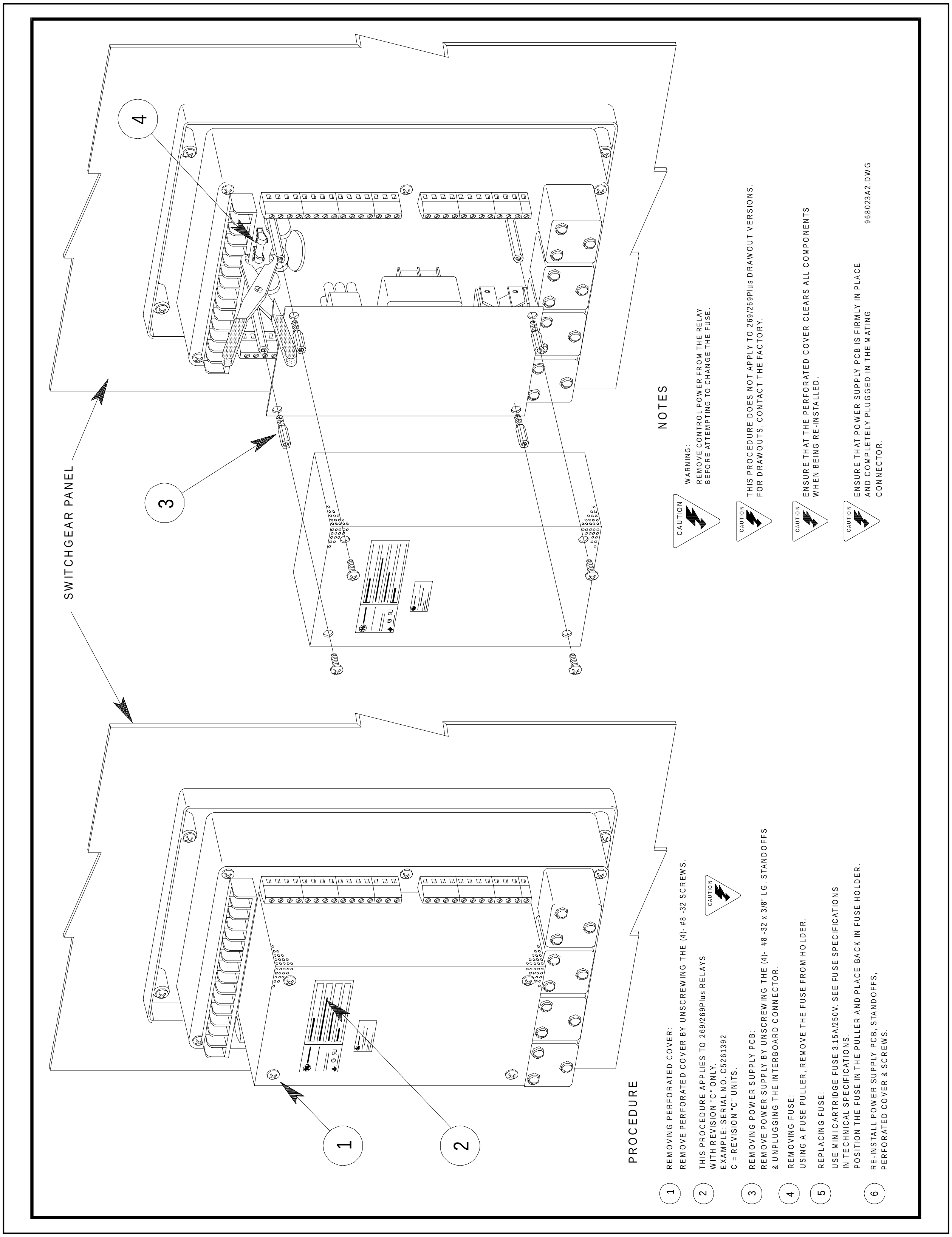


Figure 2.8 Replacing a blown fuse

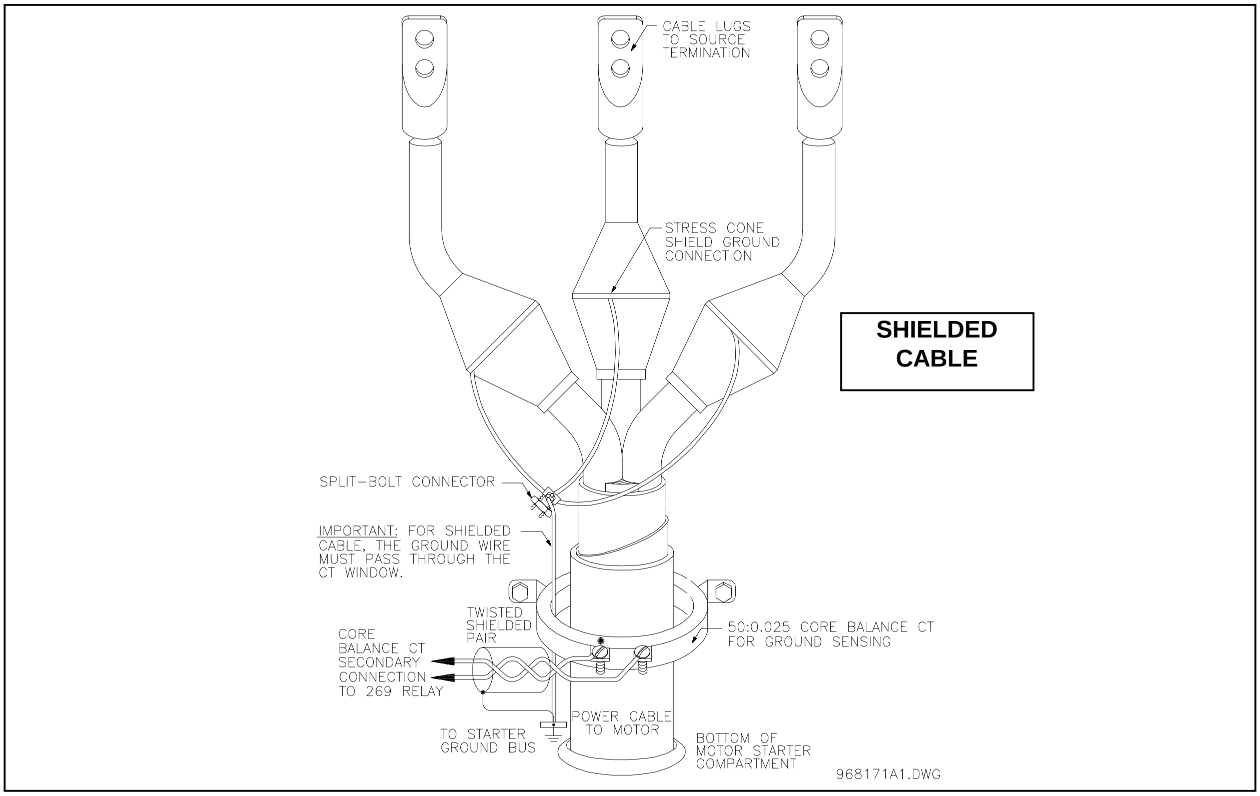


Figure 2.9a Core Balance Ground CT Installation using Shielded Cable

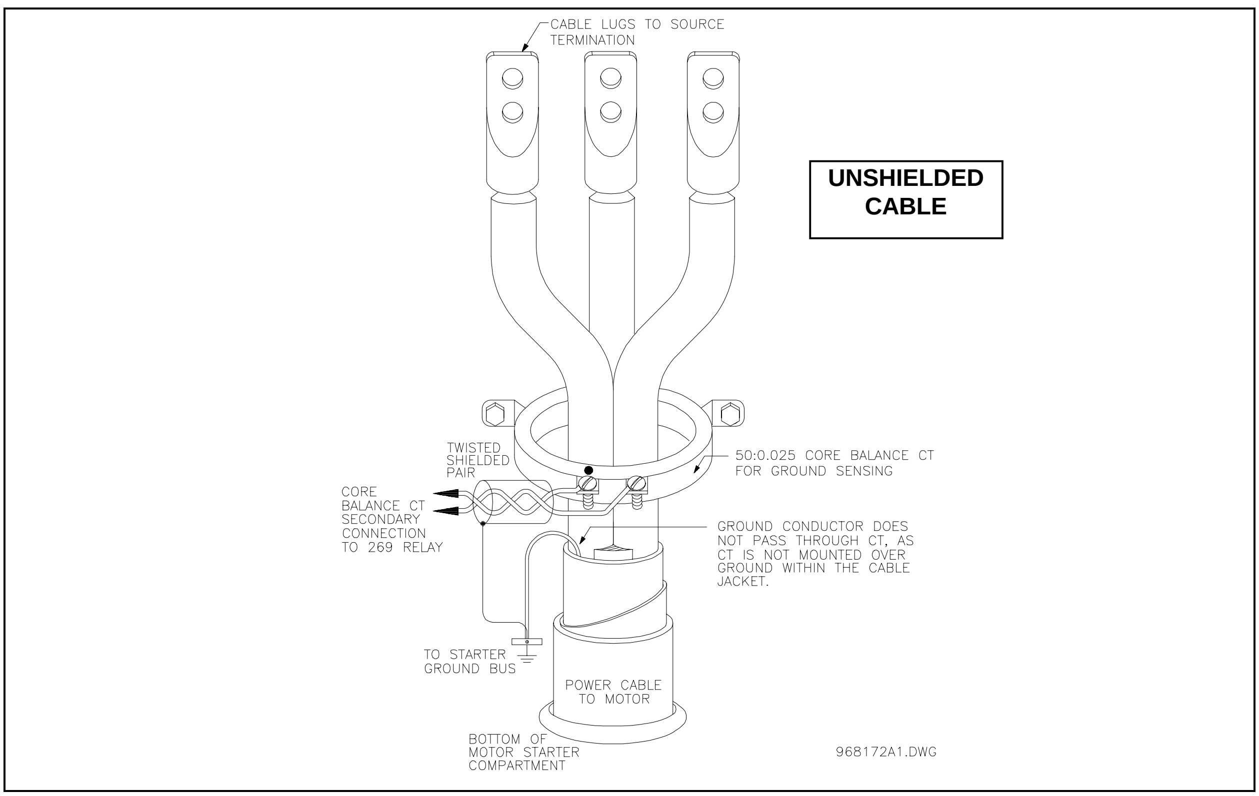


Figure 2.9b Core Balance Ground CT Installation using Unshielded Cable

2.6 Ground CT Input

All current carrying conductors must pass through a separate ground fault CT in order for the ground fault function to operate correctly. If the CT is placed over a 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; see Figure 2.9a. If a safety ground is used it should pass outside the CT window; see Figure 2.9b.

The connections to the 269 Plus internal ground CT are made directly via #10 screws. The ground CT is connected to terminals 73 and 72 for a 5 amp secondary CTs, or to terminals 73 and 74 for a GE Multilin 50:0.025A (2000:1 ratio) CTs, as shown in Figure 2.4, Figure 2.5, and Figure 2.7. The polarity of the ground CT connection is not important. **It is recommended that the two CT leads be twisted together to minimize noise pickup**. If a 50:0.025A (2000:1 ratio) ground CT is used, the secondary output will be a low-level signal which allows for sensitive ground fault detection.

NOTE: The GE Multilin 2000:1 CT is actually a 50:0.025A CT recommended for resistance grounded systems where sensitive ground fault detection is required. If higher levels are to be detected, a 5 Amp secondary CT should be used.

For a solidly grounded system where higher ground fault currents will flow, a 5 amp secondary CT with a primary between 20 and 1500 A may be used to surround all phase conductors. The phase CTs may also be residually connected to provide ground sensing levels as low as 10% of the phase CT primary rating. For example, 100:5 CTs connected in the residual configuration can sense ground currents as low as 10 amps (primary) without requiring a separate ground CT. See Figure 2.4 and Figure 2.7. This saves the expense of an extra CT, however 3 phase CTs are required. If this connection is used on a high resistance grounded system verify that the ground fault alarm and trip current setpoints are below the maximum ground current that can flow due to limiting by the system ground resistance. Sensing levels below 10% of the phase CT primary rating are not recommended for reliable operation.

When the phase CTs are connected residually, the secondaries must be connected in such a way to allow the 269 Plus to sense any ground current that might be flowing. To correctly display ground current and trip or alarm on ground fault, the connection to the 269 Plus must be made at terminals 72 and 73 as shown in Figure 2.4 and Figure 2.7. These terminals are designed to accept input from a 5A secondary CT. The 269 Plus must also be programmed for a 5A secondary ground CT with the primary being equal to the phase CT primary. This is done in SETPOINTS, page 1.

2.7 Trip Relay Contacts

The main control relay or shunt trip coil of the motor starter or circuit breaker should be connected to the Trip relay contacts of the 269 Plus. These contacts are available as normally open (NO), normally closed (NC), and can switch up to 10 amps at either 250 VAC or 30 VDC with a resistive load. Silver cadmium oxide contacts are used because of their ability to handle high inrush currents on inductive loads. <u>Contact GE Multilin if these contacts are to be used for carrying low currents since they are not recommended for use below 0.1 amps.</u> Connection to the motor contactor or breaker is shown in Figure 2.4, Figure 2.5, and Figure 2.7.

The Trip output relay will remain latched after a trip. This means that once this relay has been activated it will remain in the active state until the 269 Plus is manually reset. The Trip relay contacts may be reset by pressing the RESET key (see section 3.1) if motor conditions allow, or by using the Emergency Restart feature (see section 2.12), or the External Reset terminals, or by remote communications via the RS485 port.

The Trip relay may be programmed to be fail-safe or non-fail-safe. When in the fail-safe mode, relay activation or a loss of power condition will cause the relay contacts to go to their power down state. Thus, in order to cause a trip on loss of power to the 269 Plus, output relays should be programmed as fail-safe.

The Trip relay cannot be reset if a lock-out is in effect. Lock-out time will be adhered to regardless of whether control power is present or not. A maximum of one hour lockout time is observed if control power is not present.

The Trip relay can be programmed to activate on any combination of the following trip conditions: overload, stator RTD overtemperature, rapid trip, unbalance, ground fault, short circuit, RTD overtemperature, acceleration time, number of starts per hour, single phase, speed switch closure on start, differential relay closure, spare input closure, and start inhibit (see section 3.4 for factory preset configurations).

Connections to the Trip relay contacts are made via a terminal block which uses #6 screws.

NOTE: The rear of the 269 Plus relay shows output relay contacts in their power down state. Figure 2.4, Figure 2.6, and Figure 2.7 show output relay contacts with power applied, no trips or alarms, and Factory Configurations in effect (i.e. TRIP - fail-safe, ALARM -

non-fail-safe, AUX.1 - non-fail-safe, AUX.2 - fail-safe). See Figure 2.5 for a list of all possible contact states.

__WARNING__**: In locations where system voltage disturbances cause voltage levels to dip below the range specified in the Specifications (1.5), any relay contact programmed fail-safe may change state. Therefore, in any application where the "process" is more critical than the motor, it is recommended that the trip relay contacts be programmed non-failsafe. In this case, it is also recommended that the AUX2 contacts be monitored for relay failure. If, however, the motor is more critical than the "process" then the trip contacts should be programmed fail-safe.**

2.8 Alarm Relay Contacts

These contacts are available as normally open (NO), normally closed (NC), with the same ratings as the Trip relay but can only be programmed to activate when alarm setpoint levels are reached. (On a Drawout version of the 269 Plus, only one set of alarm contacts is available and the user must specify normally open or normally closed and failsafe or non-failsafe when ordering). Thus these contacts may be used to signal a low-level fault condition prior to motor shut-down.

Conditions which can be programmed to activate the relay are alarm levels for the following functions: immediate overload; mechanical jam; unbalance; undercurrent; ground fault; stator RTD overtemperature; high stator RTD overtemperature; RTD overtemperature; high RTD overtemperature; broken RTD; low temperature or shorted RTD; spare input alarm; self-test alarm (see section 3.4 for factory preset configurations). The relay can be configured as latched or unlatched and fail-safe or non-fail-safe.

Connections to the Alarm relay contacts are made via a terminal block which uses #6 screws.

NOTE: The rear of the 269 Plus relay shows output relay contacts in their power down state. Figure 2.4, Figure 2.6 and Figure 2.7 show output relay contacts with power applied, no trips or alarms, and Factory Configurations in effect (i.e. TRIP - fail-safe, ALARM - non-fail-safe, AUX.1 - non-fail-safe, AUX.2 - fail-safe). See Figure 2.5 for a list of all possible contact states.

2.9 Auxiliary Relay #1 Contacts

Auxiliary relay #1 is provided to give an extra set of NO/NC contacts which operate independently of the other relay contacts. (On a Drawout version of the 269 Plus, only one set of Aux.1 contacts is available and the user must specify normally open or normally closed and failsafe or non-failsafe when ordering). This auxiliary relay has the same ratings as the Trip relay.

Auxiliary relay #1 can be configured as latched or unlatched and fail-safe or non-fail-safe. The conditions that will activate this relay can be any trip or alarm indications (see section 3.4 for factory preset configurations).

These contacts may be used for alarm purposes or to trip devices other than the motor contactor. For example, the ground fault and short circuit functions may be directed to Auxiliary relay #1 to trip the main circuit breaker rather than the motor starter.

Connections to the relay contacts are made via a terminal block which uses #6 screws.

NOTE: The rear of the 269 Plus relay shows output relay contacts in their power down state. Figure 2.4, Figure 2.6, and Figure 2.7 show output relay contacts with power applied, no trips or alarms, and Factory Configurations in effect (i.e. TRIP - fail-safe, ALARM - non-fail-safe, AUX.1 - non-fail-safe, AUX.2 - fail-safe). See Figure 2.5 for a list of all possible contact states.

2.10 Auxiliary Relay #2 Contacts

This relay provides another set of NO/NC contacts with the same ratings as the other relays. (On a Draw-out version of 269 Plus, only one set of Aux.2 contacts is available and the user must specify normally open or normally closed when ordering). This relay is different from the others in the fact that it is permanently programmed as latched and fail-safe.

This relay may be programmed to activate on any combination of alarm conditions (see section 3.4 for factory preset configurations). The feature assignment programming is thus the same as for the Alarm relay.

Connections to the relay contacts are made via a terminal block which uses #6 screws.

NOTE: The rear of the 269 Plus relay shows output relay contacts in their power down state. Figure 2.4, Figure 2.6, and Figure 2.7 show output relay contacts with power applied, no trips or alarms, and Factory Configurations in effect (i.e. TRIP - fail-safe, ALARM - non-fail-safe, AUX.1 - non-fail-safe, AUX.2 - fail-safe). See Figure 2.5 for a list of all possible contact states.

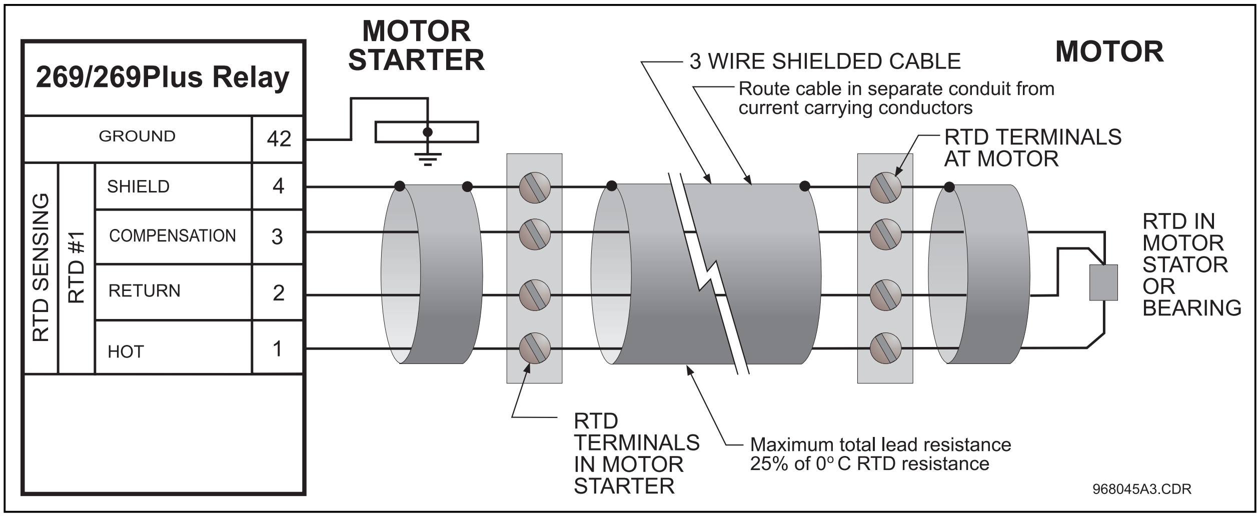


Figure 2.10 RTD Wiring

2.11 RTD Sensor Connections

Up to six resistance temperature detectors (RTDs) may be used for motor stator temperature monitoring. The remaining RTD inputs may be used for motor and load bearing, or other temperature monitoring functions. All RTDs must be of the same type. RTD # 10 may be used to monitor ambient air temperature. This is done to enhance protection in environments where the ambient temperature varies considerably. Use of stator RTDs will allow the 269 Plus to “learn” the actual cooling times of the motor. When no stator RTDs are used, the 269 Plus will not learn the actual motor cooling times, but will rely on the user defined preset values. The number of stator RTDs used together with RTD trip and alarm temperatures must be programmed into the 269 Plus (see sections 3.16, 3.17). The RTD type to be used must be specified when ordering the 269 Plus relay. If the type of RTD in use is to be changed, the 269 Plus must be returned to the factory.

Each RTD has four connections to the 269 Plus relay as shown in Figure 2.4, Figure 2.6, and Figure 2.7. Since the RTD indicates temperature by the value of its resistance, it is necessary to compensate for the resistance of the connecting wires, which is dependent on lead length and ambient temperature. The 269 Plus uses a circuit to cancel this resistance and reads only the actual RTD resistance. Correct operation will occur providing all three wires are of the same length and the resistance of each lead is not greater than 25% of the RTD 0°C resistance. This can be accomplished by using identical lengths of the same type of wire. If 10 ohm copper RTDs are to be used, special care should be taken to keep the lead resistance as low as possible.

If RTD #10 is to be used for ambient air temperature measurement, the RTD should be placed and mounted somewhere in the motor cooling air intake flow. The sensor should be in direct contact with the cooling air but not with any surface that is at a temperature other than the cooling air. This RTD is selected for ambient temperature use in page 5 of SETPOINTS mode.

If no RTD sensor is to be connected to any of the RTD terminals on the 269 Plus, the terminals may be left open.

If fewer than 6 stator RTDs are to be employed, they should be connected to the lowest numbered relay RTD connections. For example, if 3 stator RTDs are to be used they should be connected to the terminals for RTD1, RTD2, and RTD3 (terminals #1-12). Other RTDs should be connected to the terminals for RTD7-RTD10 (terminals #13-28) as shown in Figure 2.4.

The connections are made via terminal blocks which can accommodate up to #16 AWG multi-strand wire.

Note: Shielded, three-wire cable must be used in industrial environments to prevent noise pickup. Wherever possible, the RTD leads should be kept close to grounded metal casings and avoid areas of high electromagnetic or radio frequency fields. RTD leads should not run adjacent to, or in the same conduit as high current carrying wires. It is recommended to use a three wire shielded cable of #18 AWG copper conductors. The shield connection of the RTD should not be grounded at the sensor end as there is an internal ground on

the 269 Plus. This arrangement prevents noise pickup that would otherwise occur from circulating currents due to differences in ground potentials on a doubly grounded shield.

2.12 Emergency Restart Terminals

If it is desired to override relay trips or lock-outs and restart the motor, a normally open keyswitch should be installed between terminals 54 and 55. Momentarily shorting these terminals together will cause the thermal memory of the 269 Plus to discharge to 0% (if RTD input to thermal memory is enabled, thermal memory can be reduced to 0% by keeping terminals 54 and 55 shorted together for more than 11 seconds; see section 3.20). The Emergency Restart terminals can thus be used to override an OVERLOAD TRIP or a START INHIBIT lock-out. Shorting the Emergency Restart terminals together will also decrement the relay's internal starts/hour counter by 1 and therefore allow the operator to override a STARTS/HOUR inhibit or time between Starts Inhibit.

Note: This option should be used only when an immediate restart after a lock-out trip is required for process integrity or personnel safety. Discharging the thermal memory of the 269 Plus gives the relay an unrealistic value for the thermal capacity remaining in the motor and it is possible to thermally damage the motor by restarting it. Thus, complete protection may be compromised in order to restart the motor using this feature.

A twisted pair of wires should be used. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.13 External Reset Terminals

An external reset switch, which operates similarly to the keypad RESET key (see section 3.1), can be connected to terminals 56 and 57 for remote reset operation. The switch should have normally open contacts. Upon closure of these contacts the relay will be reset. This external reset is equivalent to pressing the keypad RESET key. Keeping the External Reset terminals shorted together will cause the 269 Plus to be reset automatically whenever motor conditions allow.

A twisted pair of wires should be used. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.14 Analog Output Terminals (Non-Isolated)

Terminals 58 and 59 of the 269 Plus are available for an analog current output representing one of: percentage of motor thermal capacity used; motor current as a percentage of full load (i.e. 0.25-2.5 ×FLC); hottest stator RTD temperature as a percentage of 200°C; RTD #7 (bearing) temperature as a percentage of 200°C; or CT secondary current as a percentage of CT secondary amps rating. The choice of output is selected in page 5 of SETPOINTS mode. This selection can be made or changed at any time without affecting the protective features of the relay.

The output current range is factory default at 4-20 mA. However, this range may be enlarged in page 5 of SETPOINTS mode. 4 mA output corresponds to a low scale reading (i.e. 0% thermal capacity used, 0.25xFLC, 0^{o}C hottest stator RTD temperature, RTD #7 temperature, or 0 A phase CT secondary current). 20 mA output current corresponds to a high scale reading (i.e. 100% thermal capacity used, 2.5xFLC or lower phase current, 200^{o}C for hottest stator RTD and RTD #7 temperature, or either 1 A or 5 A phase CT secondary depending on the CT used).

This output is an active, non isolated current source suitable for connection to a remote meter, chart recorder, programmable controller, or computer load. Current levels are not affected by the total lead and load resistance as long as it does not exceed 300 ohms for the 4-20 mA or the 0-20 mA range (2000 ohms for 0-1 mA range). For readings greater than 100% of full scale the output will saturate at 20.2 mA.

This analog output is not isolated. Terminal 58 is internally connected to system ground. Consequently the negative terminal of the connected load device must be at ground potential. When isolation is necessary, an external two-wire isolated transmitter should be used between the 269 Plus and the load (e.g. PLC).

A twisted pair of wires should be used. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.15 Differential Relay Terminals

Terminals 48 and 49 are provided for connection to a differential relay. This allows an external differential relay to be connected to the 269 Plus. When the differential trip function is enabled on page 5 of SETPOINTS, a contact closure between terminals 48 and 49 will cause an immediate activation of the output relay assigned to the differential relay input function. After a DIFFERENTIAL INPUT TRIP, terminals 48 and 49 must be open circuited, or the function disabled in order to reset the relay.

If no differential relay is to be used terminals 48 and 49 should be left open, and the function disabled.

A twisted pair of wires should be used. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.16 Speed Switch Terminals

Terminals 50 and 51 are provided for connection to an external speed switch. This allows the 269 Plus relay to utilize a speed device for locked rotor protection. During a motor start attempt if no contact closure between terminals 50 and 51 occurs within the "SPEED SWITCH TIME DELAY" (SETPOINTS, page 5) the output relay assigned to the speed switch function will activate. This function must be enabled in order for operation to occur (SETPOINTS, page 5). After a SPEED SWITCH TRIP terminals 50 and 51 must be open circuited in order to reset the relay.

If no speed switch is to be used terminals 50 and 51 should be left open.

A twisted pair of wires should be used. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.17 Programming Access Terminals

When a jumper wire is connected between ACCESS terminals 52 and 53 all setpoints and configurations can be programmed using the keypad. Once programming is complete the jumper will normally be removed from these terminals. When this is done all actual and setpoint values can still be accessed for viewing; however, if an attempt is made to store a new setpoint value the message "ILLEGAL ACCESS" will appear on the display and the previous setpoint will remain intact. In this way all of the programmed setpoints will remain secure and tamperproof. Alternatively, these terminals can be wired to an external keyswitch to permit setpoint programming upon closure of the switch. For additional tamper proof protection, a software access code may be programmed on Page 6 of SETPOINTS. See section 3 (Setup and Use).

A twisted pair of wires should be used for connection to an external switch. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.18 RS-485 Serial Communications Terminals

Terminals 46 and 47 are provided for a digital serial communication link with other 269 Plus relays, computers, or programmable controllers. Up to 32 269 Plus "SLAVES" can be connected to one "MASTER" (PC/DCS/PLC) as shown in Figure 2.11. The GE Multilin 269 Plus Relay Communication Protocol (MODBUS RTU Compatible Protocol) is described in Chapter 4. Note that when using a 269 Plus SLAVE, setpoints sent to the SLAVE must be within the ranges listed in Table 3-3.

Each communication link must have only one MASTER. The MASTER should be centrally located and can be used to view ACTUAL VALUES and SETPOINTS from each relay SLAVE. SETPOINTS in each SLAVE can also be changed from the MASTER. Each SLAVE in the communication link must be programmed with a different SLAVE ADDRESS.

To avoid contention and improper reading of data ensure that the following conditions are met:

1. Each communication link has only one MASTER.
2. Each 269 Plus SLAVE in the link has a different SLAVE ADDRESS.

The wires joining relays in the communication link should be a shielded twisted pair (typically 24AWG). These wires should be routed away from high power AC lines and other sources of electrical noise. The total length of the communications link should not exceed 4000 feet using 24AWG shielded twisted pair. When connecting units in a communication link each 269 Plus relay must have terminal 47 connected to terminal 47 of the next unit in the link, and terminal 46 connected to terminal 46.

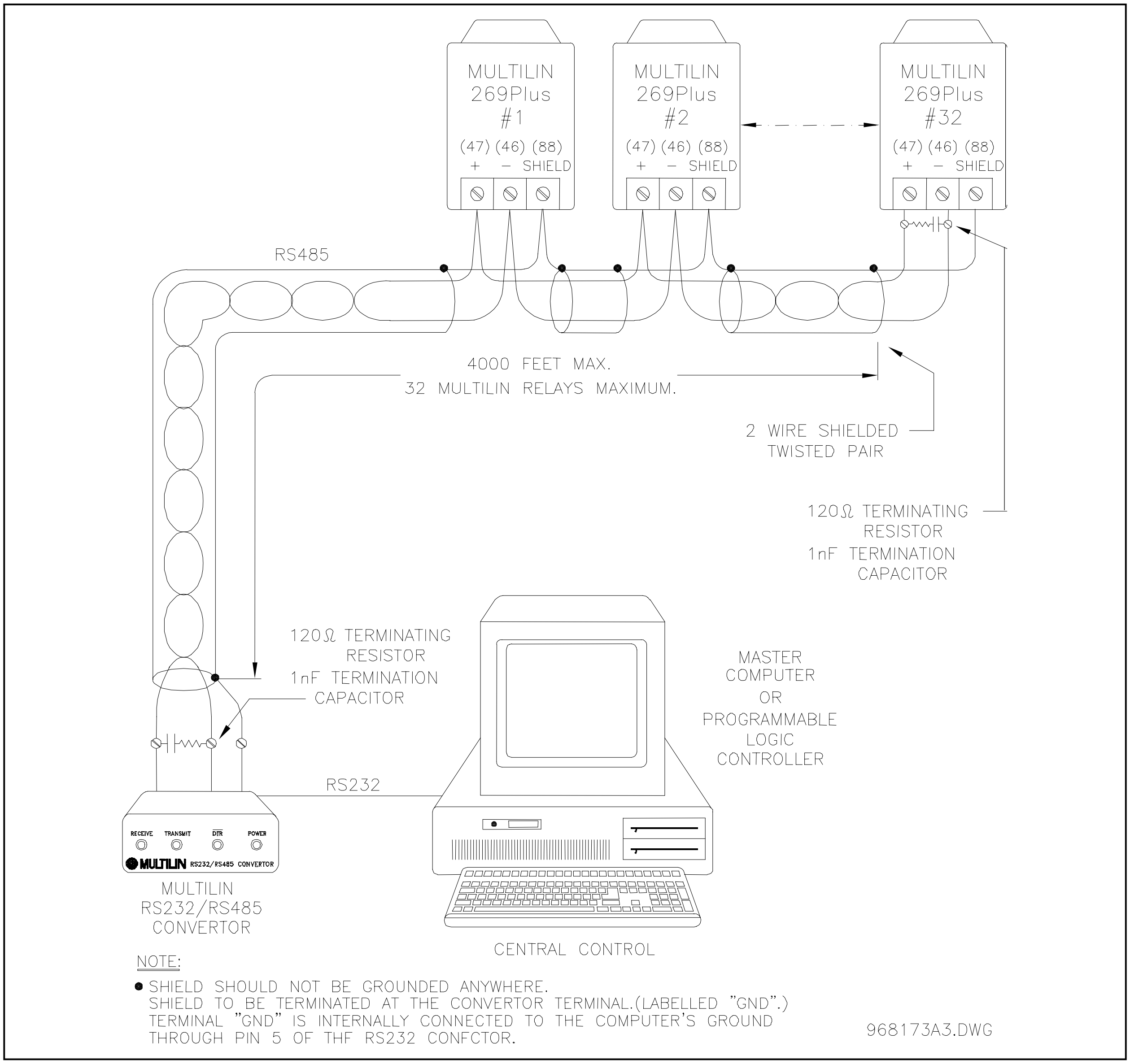


Figure 2.11 Serial Communication Link Wiring

As shown in Figure 2.11 the first and last devices in the link should have a terminating resistor and capacitor placed across terminals 46 and 47. The value of these resistors should match the characteristic impedance of the line wire being used.

Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

NOTE: If a large difference in ground potentials does exist, communication on the serial communication link will not be possible. Therefore, it is imperative that the serial master and 269 Plus slave are both at the same ground potential. This is accomplished by joining terminal 88 of every unit together and grounding it at the master only. If a GE Multilin RS232/RS485 converter is used between the 269 Plus and the master, terminal 88 *must not* be connected to ground anywhere, as it is internally connected to the master computer ground via pin 1 of the RS232 connector.

2.19 Display Adjustment

Once the 269 Plus relay has been installed and input power applied, the contrast of the LCD display may have to be adjusted. This adjustment has been made at the factory for average lighting conditions and a standard viewing angle but can be changed to optimize the display readability in different environments. To alter the display contrast the trimpot on the rear of the unit marked "CONTRAST" must be adjusted with a small slotted screwdriver.

2.20 Front Panel Faceplate

The front panel faceplate is composed of a polycarbonate material that can be cleaned with isopropyl or denatured alcohol, freon, naphtha, or mild soap and water.

2.21 Spare Input Terminals

Terminals 44 and 45 are provided for an additional relay contact input. A contact closure between these terminals will cause a "SPARE INPUT TRIP" and/or a "SPARE INPUT ALARM" after the appropriate time delay (page 5 of SETPOINTS). These terminals must be open circuited in order to reset the relay after a SPARE INPUT TRIP or ALARM.

A twisted pair of wires should be used. Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

2.22 269 Drawout Relay

The model 269 Plus relay is available in a drawout case option. The operation of the relay is the same as described elsewhere in this manual except for the differences noted in this section. The physical dimensions of the drawout relay are as shown in Figure 2.12. The relay should be mounted as shown in Figure 2.13.

The drawout 269 Plus relay can be removed from service without causing motor shut-down. This can be useful for replacing, calibrating, or testing units.

RELAY MOUNTING - Make cutout as shown and drill six 7/32" holes on mounting panel. Approximately 2-1/2" should be clear at the top and bottom of the cutout in the panel for the hinged door. Ensure that the five #6-32 nuts are removed from the threaded studs in the mounting flange and that the drawout chassis has been removed from the drawout case. Install the case from the rear of the mounting panel by aligning the five #6-32 threaded case studs to the previously drilled holes. With the studs protruding through the holes secure the case on the right hand side with two #6-32 nuts provided. Install the hinged door on the front of the mounting panel using three #6-32 nuts provided.

FIELD ADJUSTMENTS - There are four screws holding the plastic 269 Plus case to the drawout cradle. These screw into holes which are slotted to compensate for panel thickness. If the 269 Plus case is mounted at the extreme end of the slot intended for thin panels, the relay will not seat properly and the door will not shut over the relay when installed on a thick panel. Loosening the screws and moving the relay forward before retightening will fix the problem.

RELAY REMOVAL - Open the hinged door. Next remove the two ten finger connecting plugs making sure the top one is removed first. Swivel the cradle-to-case hinged levers at each end of the 269 Plus cradle assembly and slide the assembly out of the case.

RELAY INSTALLATION - Slide the 269 Plus cradle assembly completely into the case. Swivel the hinged levers in to lock the 269 Plus cradle assembly into the drawout case. Install the two ten finger connecting plugs making sure the bottom plug is installed first. Close the hinged door and secure with the captive screw.

NOTE: There must be at least ½" clearance on the hinged side of the drawout relay to allow the door to open.

IMPORTANT NOTE: When removing the drawout relay cradle assembly the top ten finger connecting plug must be withdrawn first. This isolates the 269 Plus output relay contacts before power is removed from the relay. When installing the drawout relay cradle assembly the bottom ten finger connecting plug must be installed first. This causes power to be applied to the 269 Plus relay before the output relay contacts are placed in the circuit.

After a 269 Plus relay cradle assembly has been removed from the drawout case it is recommended that the hinged door be closed in order to reduce the risk of electric shock.

Due to the hardware configuration of the drawout relay shorting bars, the RELAY FAILSAFE CODE (SETPOINTS, page 5) should not be changed without consulting the factory. Spare shorting bars are included with each drawout specifically for the required modification. Wiring for the 269 Plus drawout is shown in Figure 2.14. If it is required that any of the output relay configurations in Figure 2.14 be different than shown, this information must be stated when the relay is ordered.

The 269 Plus Drawout does not meet IEC947-1 and IEC1010-1.

No special ventilation requirements need to be observed during the installation of this unit.

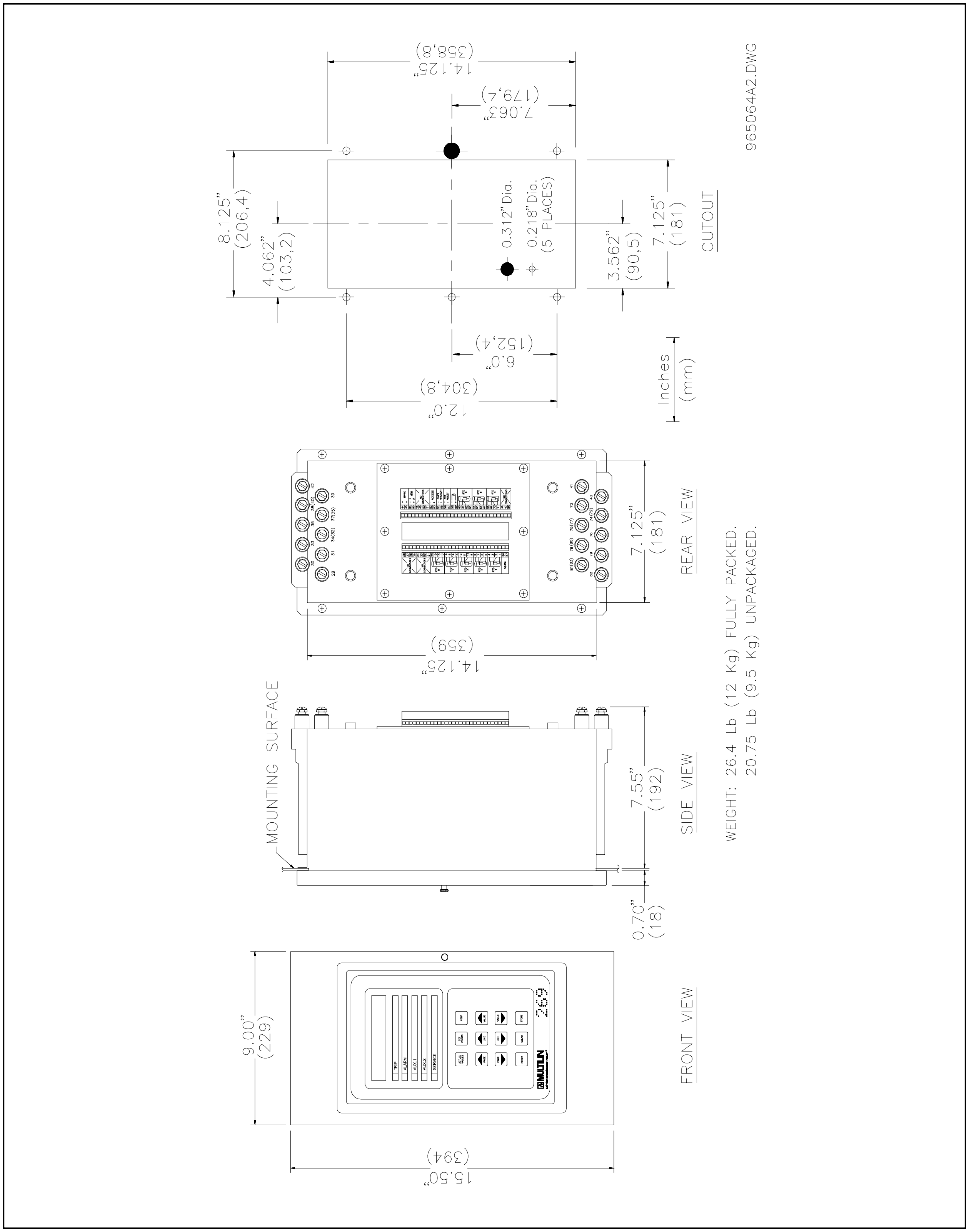


Figure 2.12 269 Plus Drawout Relay Mounting

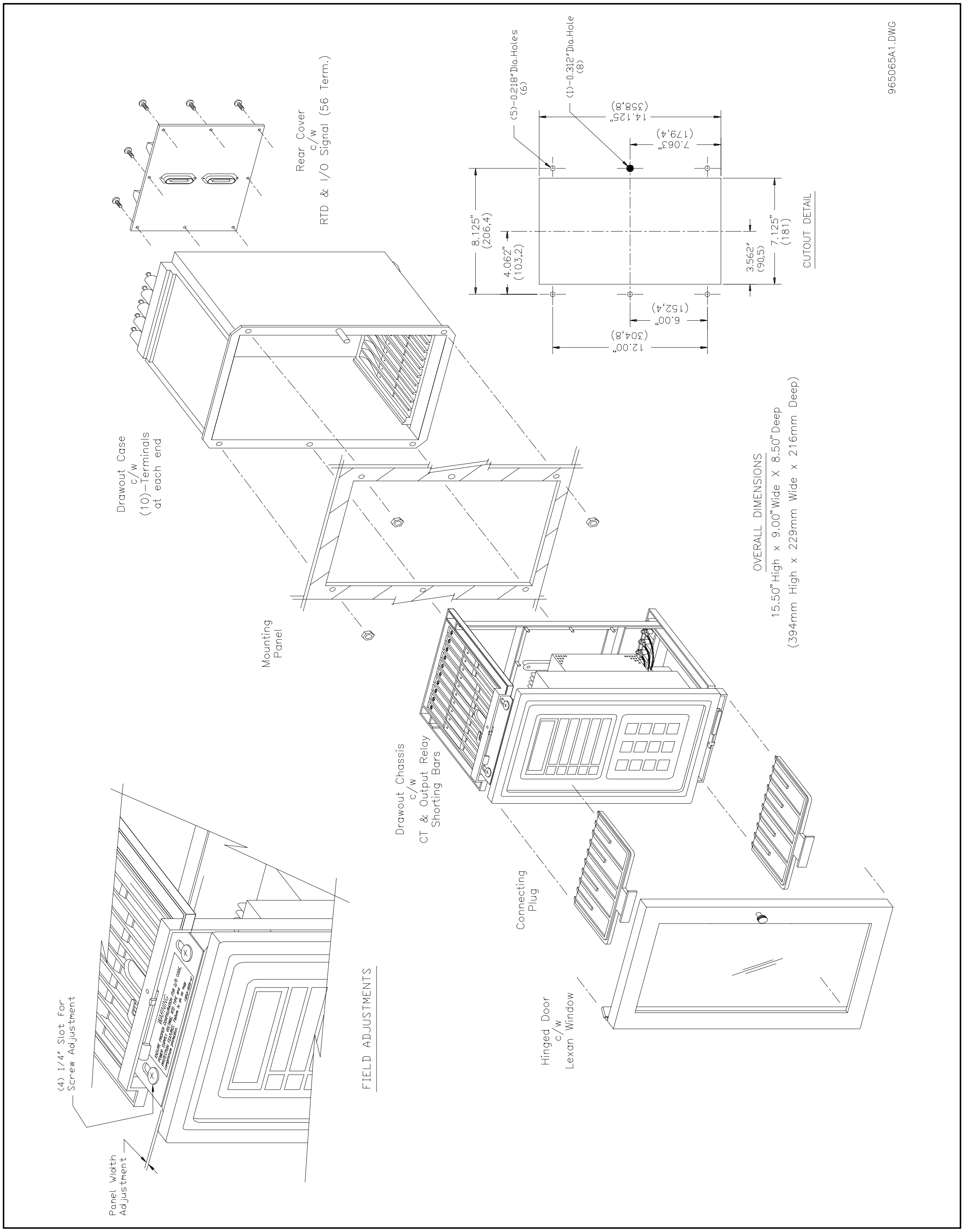


Figure 2.13 269 Plus Drawout Relay Mounting

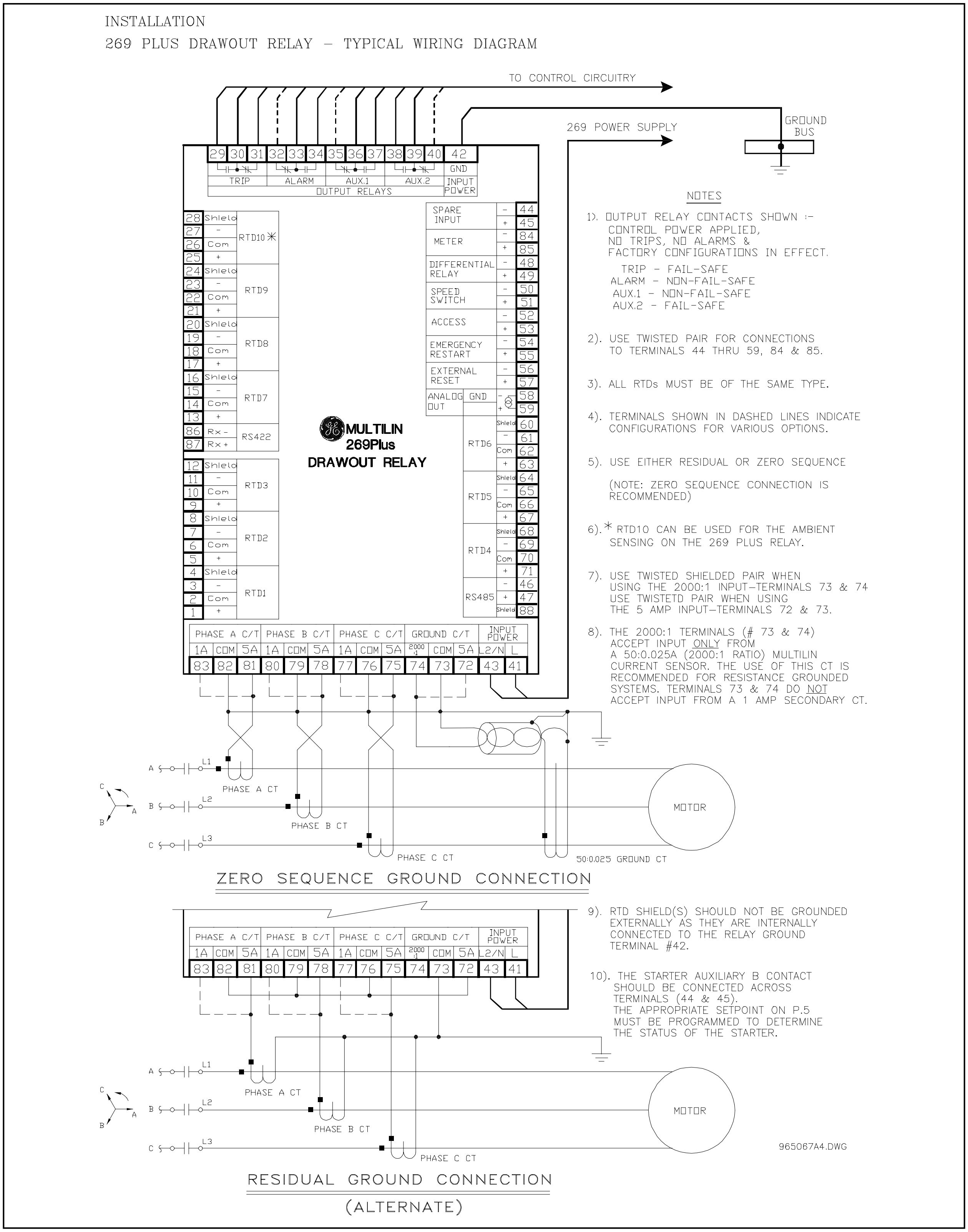


Figure 2.14 269 Plus Drawout Relay Typical Wiring Diagram

2.19 Meter Option Installation

The addition of a GE Multilin MPM (Motor Protection Meter) option allows the 269 Plus user to monitor and assign protective features based on voltage and power measurement. Either meter also provides four isolated analog outputs representing: Current, Watts, Vars, and Power Factor. These outputs from the meter can provide the signals for the control of the motor or a process.

MPM External Connections
Physical dimensions for the MPM and the required cutout dimensions are shown in Figure 2.17. Once the cutout and mounting holes are made in the panel, use the eight #6 self tapping screws to secure the relay.

MPM Wiring
Signal wiring is to box terminals that can accommodate wire as large as 12 gauge. CT, VT and control power connections are made using #8 screw ring terminals that can accept wire as large as 8 gauge.

Consult the wiring Figure 2.18 through 2.22 for suggested wiring. For proper operation of the MPM and 269 Plus set, MPM control power and phase CTs/VTs must be connected. Other features may be wired depending on the MPM model ordered.

Control Power (5/6/7/8)

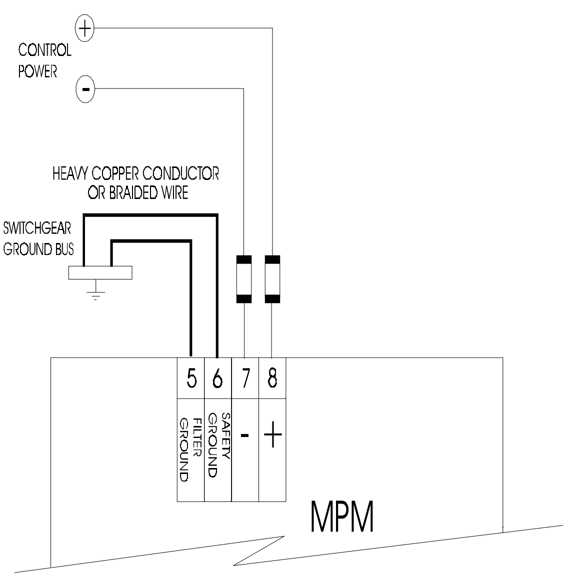


Figure 2.15 Control Power Wiring

Control power supplied to the MPM must match the installed power supply. If the applied voltage does not match, damage to the unit may occur.

A universal AC/DC power supply is standard. It covers the range 90 - 300 VDC and 70 - 265 VAC 50/60 Hz. It is not necessary to make any adjustment to the MPM as long as the control voltage falls within this range. A low voltage power supply is available as an option. It covers the range 20 - 60 VDC and 20 - 48 VAC 50/60 Hz. Verify from the product identification label on the back of the MPM that the control voltage matches the intended application. Connect the control voltage input to a stable source of supply for reliable operation. A 2 amp fuse is accessible from the back of the MPM by sliding back the fuse access door. Using #8 gauge wire or ground braid, connect terminals 5 & 6 to a solid system ground which is typically a copper bus in the switchgear. Extensive filtering and transient protection is built into the MPM to ensure reliable operation under harsh industrial operating environments. Transient energy must be conducted back to the source through filter ground terminal 5. The filter ground terminal (5) is separated from the safety ground terminal (6) to allow dielectric testing of switchgear with a MPM wired up. Connections to the filter ground terminal must be removed during dielectric testing.

When properly installed, the MPM will meet the interference immunity requirements of IEC 801 and ANSI C37.90.1.

VT Inputs (1-4)
The MPM can accept input voltages from 0 - 600VAC between the voltage inputs (V_1, V_2, V_3) and voltage common (Vn). These inputs can be directly connected or supplied via external VTs. If voltages greater than 600VAC are to be measured, external VTs are required. When measuring line to line quantities using inputs V_1, V_2 and V_3, ensure that the voltage common input Vn is grounded. This input is used as a reference for measuring the voltage inputs.

All connections to the MPM voltage inputs should be connected using HRC fuses with a 2 AMP rating to ensure adequate interrupting capacity.

CT Inputs (9-20)
5 amp or 1 amp current transformer secondaries can be used with the MPM for phase and neutral sensing. Each current input has 3 terminals: 5 amp input, 1 amp input and common. Select either the 1 amp or 5 amp terminal and common to match the phase CT

secondary. Correct polarity as indicated in the wiring Figure 2.17 through Figure 2.21 is essential for correct measurement of all power quantities.

CTs should be selected to be capable of supplying the required current to the total secondary load which includes the MPM relay burden of 0.2 VA at rated secondary current and the connection wiring burden.

Serial Communications Port (COM1 - 46,47,48)
The MPM will communicate with 269 Plus via COM1. The connection must be made as shown below. The MPM must be connected to only one 269 Plus relay at any given time for successful communication.

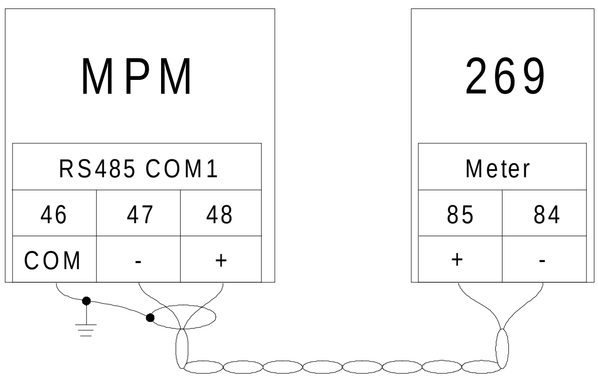


Figure 2.16 MPM and 269 Plus Communication Wiring

The 269 Plus communicates the following information to the meter module: 1) 269/meter Protocol Revision; 2) Reset MWH; 3) CT Primary; 4) VT Ratio; 5) Analog Output Scale Factor; and 6) Checksum.

The meter, in turn, sends back the following information to the 269 Plus:

1) Echo Protocol Revision
2) Vab, Vbc, Vca or Van, Vbn, Vcn (depending on whether the VTs are connected phase to phase or phase to neutral)
3) Average Voltage
4) kW
5) kvar
6) Frequency
7) Voltage Phase Reversal Status
8) VT Wiring Configuration (open delta or 2 input wye)
9) kW sign
10) kvar sign
11) Meter Revision
12) Power Factor
13) Power Factor sign indication
    +: Lead
    –: Lag
14) MWh
15) Checksum

This exchange of information takes place once every 0.5 second.

MPM Analog Output
The Analog Out Scale Factor setpoint is entered in the 269 Plus SETPOINTS, page 7, to set the Full Scale value for the MPM analog outputs (KWATTS and KVARS). The value entered here is the multiplier that is multiplied by 100 kW to determine the meter's analog output Full Scale for KWATTS, or by 30 KVAR to determine the meter's analog output Full Scale for KVAR. 4 mA represents 0 KWATTS and 0 KVARS and 20 mA represents full scale. Average RMS current is produced in analog form where the MPM 4-20 mA is equivalent to 0 A to 1×CT rating. Power factor is produced in analog form where 4/12/20 mA represents 0.01 lag/1/0.01 lead power factor value respectively.

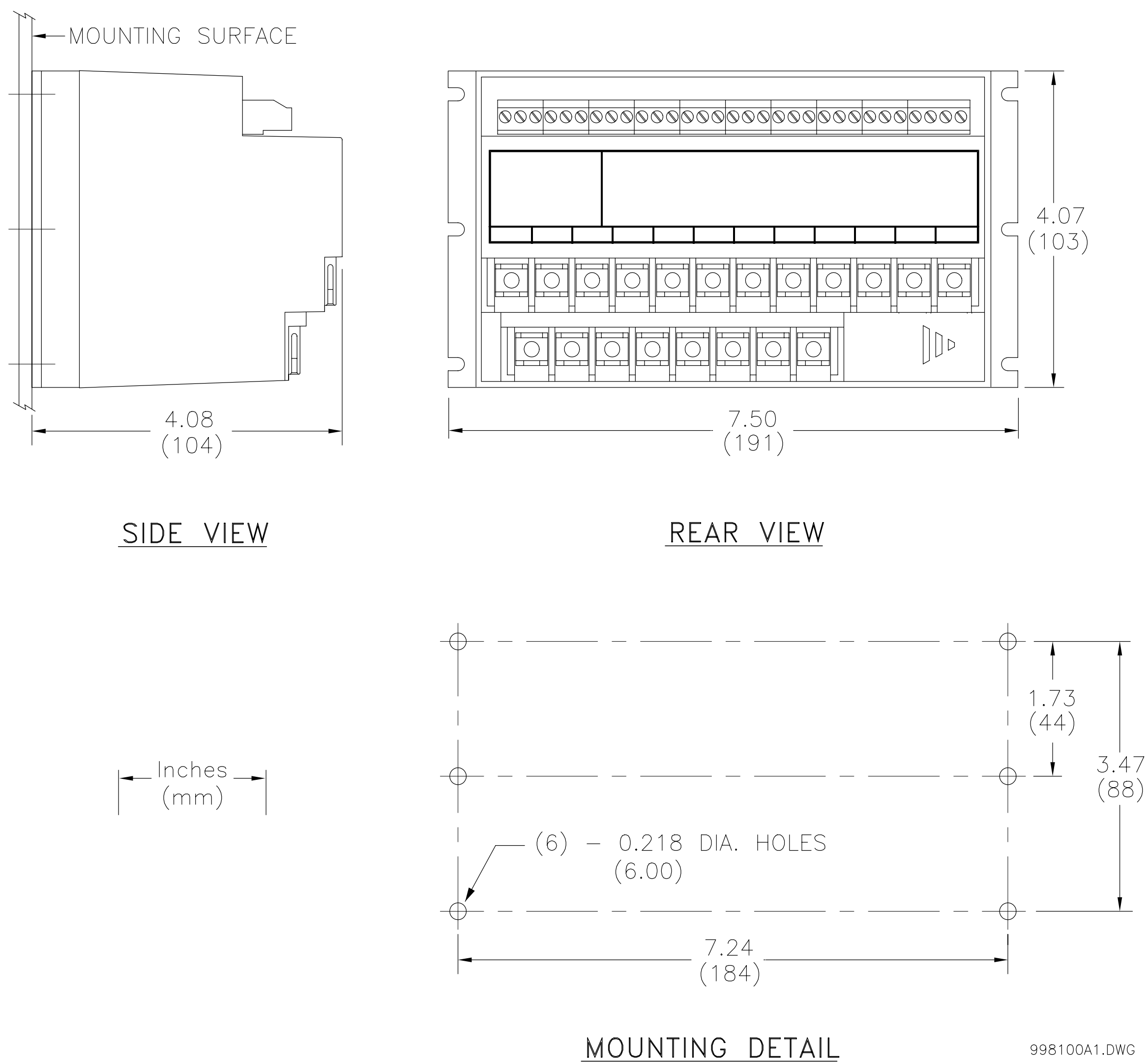


Figure 2.17 MPM Mounting Dimensions

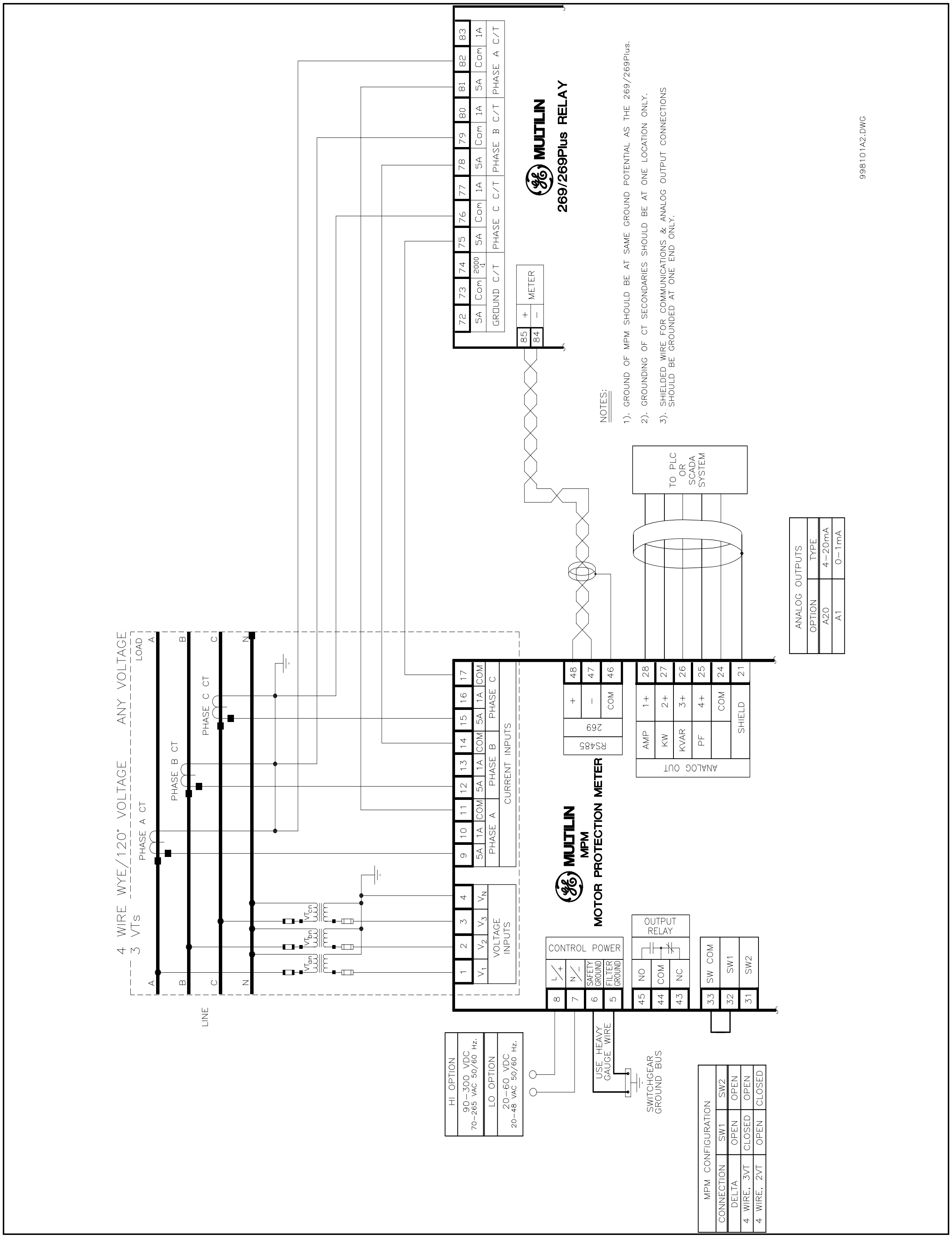


Figure 2.18 MPM to 269 Plus Typical Wiring (4-wire Wye, 3 VTs)

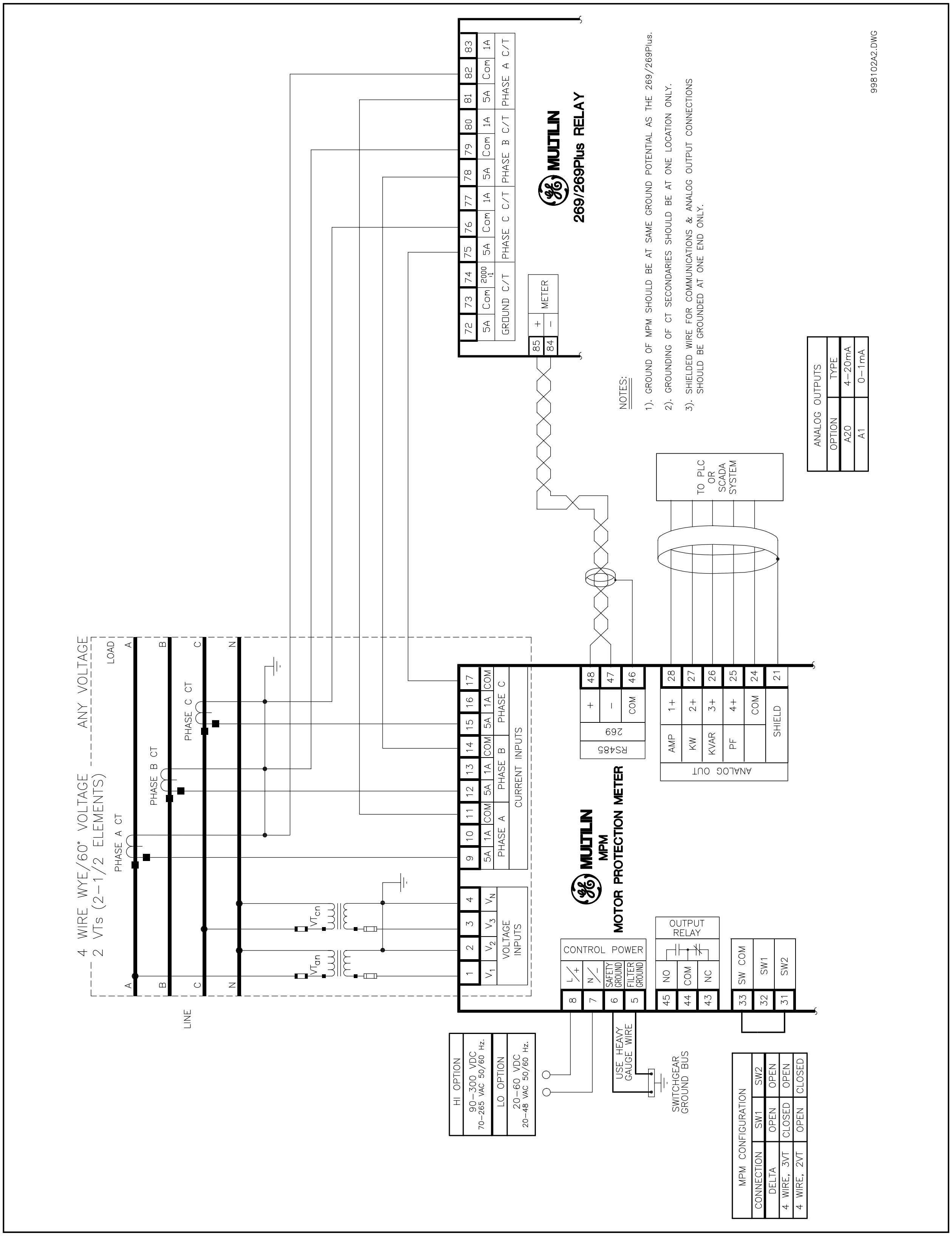


Figure 2.19 MPM to 269 Plus Typical Wiring (4-wire Wye, 2 VTs)

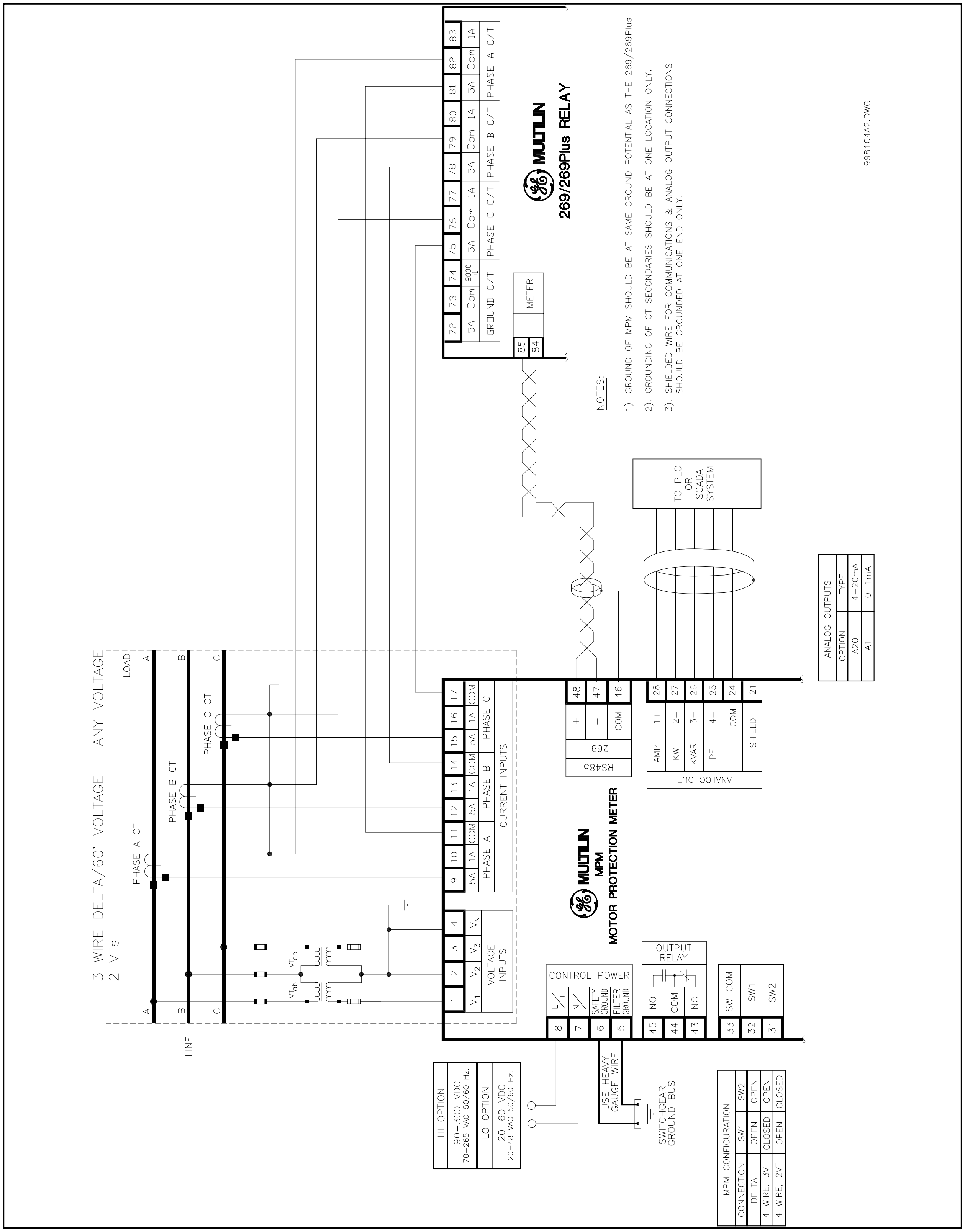


Figure 2.20 MPM to 269 Plus Typical Wiring (3-wire Delta, 2 VTs)

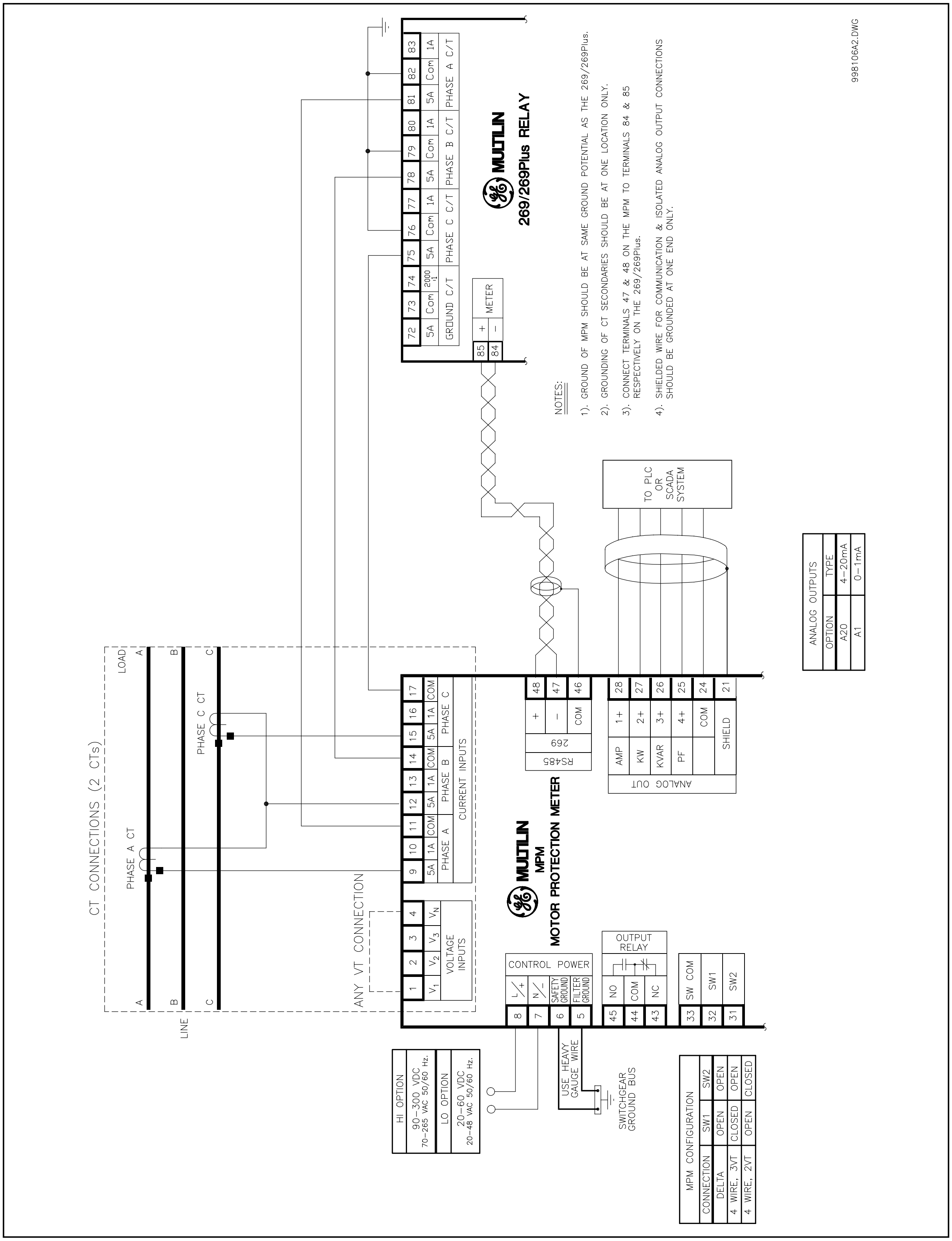
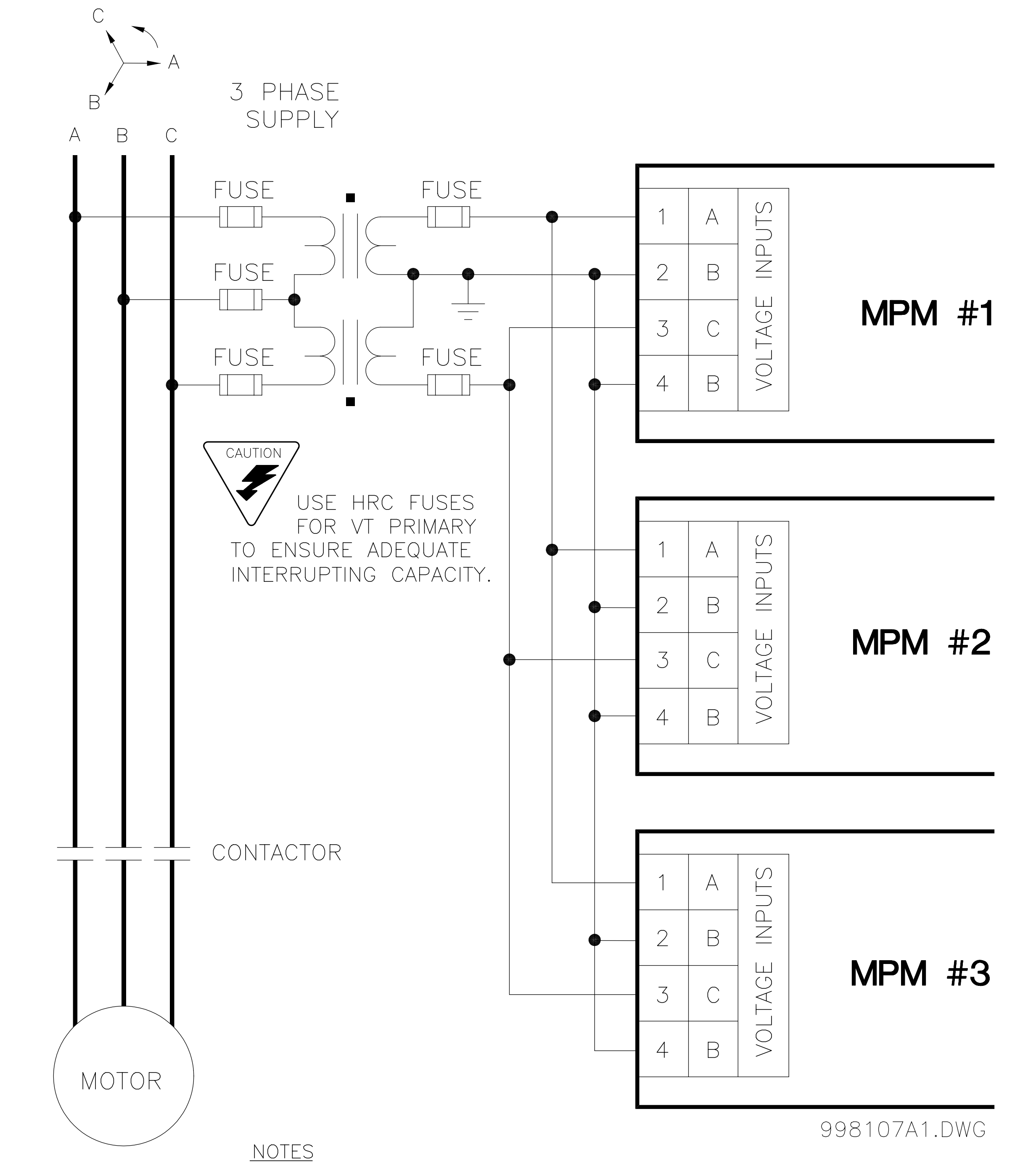


Figure 2.21 MPM to 269 Plus Typical Wiring (2 CT)



NOTES

1). GROUNDING OF VT SECONDARY SHOULD BE AT VT END ONLY.

2). MPM LOAD IS APPROX. 1VA Max. PER VT.

3). WARNING: IF THE VT's TRY TO SUPPLY TOO CLOSE TO THE RATED VA, A PHASE SHIFT WILL OCCUR BETWEEN VOLTAGE AND CURRENT, CAUSING ADDITIONAL ERROR IN THE METER.

4). TERMINALS 31 & 32, SW1 & SW2, TO BE LEFT OPEN TO SELECT OPEN DELTA CONNECTION.

Figure 2.22 MPM Wiring (Open Delta)

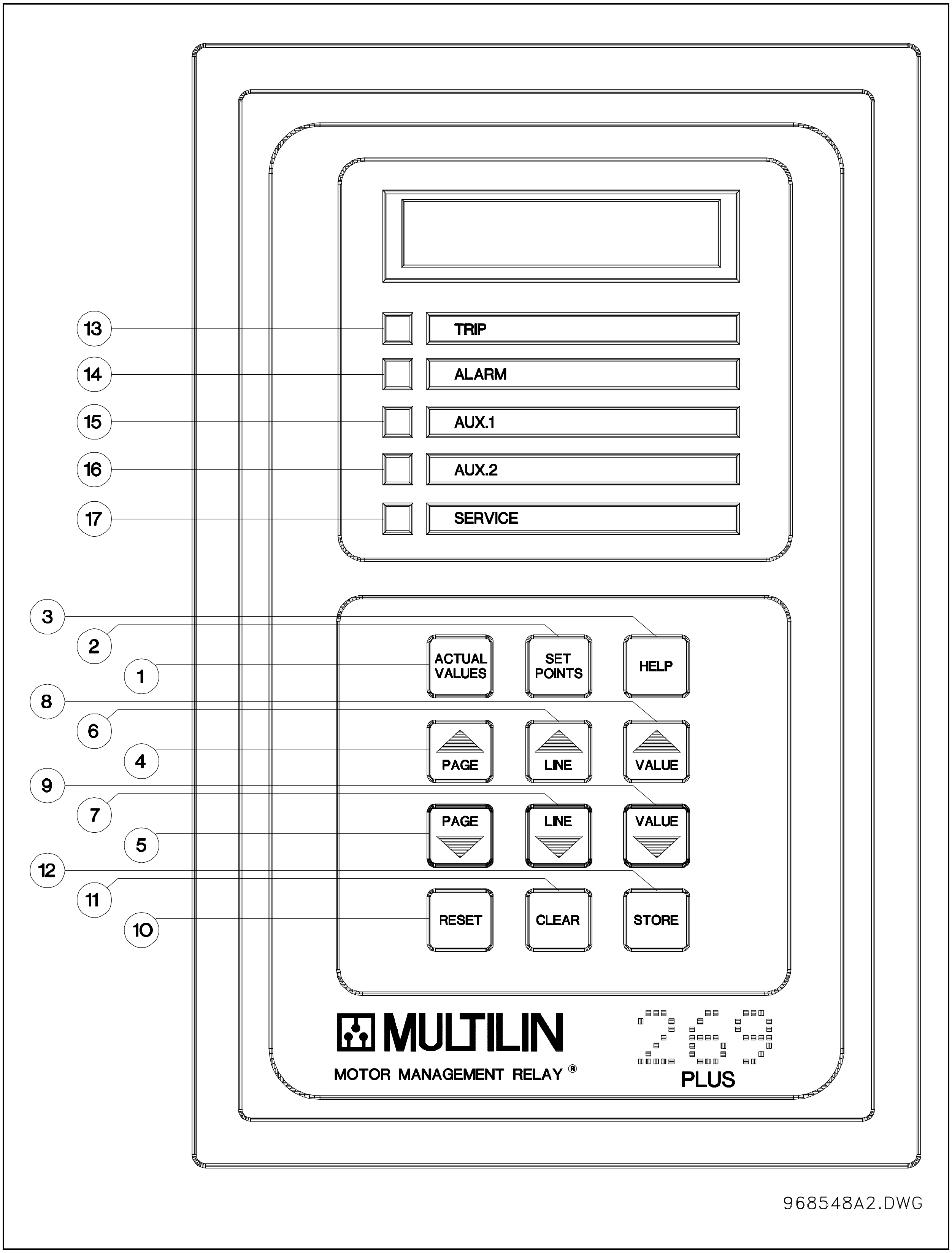


Figure 3.1 Front Panel Controls and Indicators

3.1 Controls and Indicators

Once the 269 Plus relay has been wired and control power applied, it is ready to be programmed for the given application. Programming is accomplished using the 12 position keypad and 48 character alphanumeric display shown in Figure 3.1. The function of each key on the keypad and each of the indicators is briefly explained in Table 3-1.

Table 3-1 Controls and Indicators

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">ACTUAL VALUES</td><td>FUNCTION: The ACTUAL VALUES key allows the user to examine all of the actual motor operating parameters. There are seven pages of ACTUAL VALUES data:

page 1: Phase Current Data
page 2: RTD Temperature Data
page 3: Motor Capacity Data
page 4: Statistical Data
page 5: Pre-trip Data
page 6: Learned Parameters
page 7: Metering Data</td></tr>
<tr><td>EFFECT: Pressing this key will put the relay into ACTUAL VALUES mode. The flash message,

<code>ACTUAL VALUES HAS SEVEN</code>
<code>PAGES OF DATA</code>

will be displayed for 2 seconds. The beginning of page 1 of ACTUAL VALUES mode will then be shown:

<code>PAGE 1: ACTUAL VALUES</code>
<code>PHASE CURRENT DATA</code></td></tr>
<tr><td>USE: This key can be pressed at any time, in any mode to view actual motor values. To go from page to page the PAGE UP and PAGE DOWN keys can be used. To go from line to line within a page the LINE UP and LINE DOWN keys can be used.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">SET POINTS</td><td>FUNCTION: The SET POINTS key allows the user to examine and alter all trip, alarm, and other relay setpoints. There are seven pages of setpoints data:

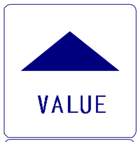
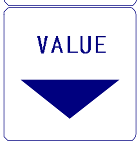
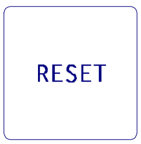
page 1: Motor Amps Setpoints
page 2: RTD Setpoints
page 3: O/L Curve Setpoints
page 4: Relay Configuration
page 5: System Configuration
page 6: Multilin Service Codes
page 7: Metering Setpoints</td></tr>
<tr><td>EFFECT: Pressing this key will put the relay into SETPOINTS mode. The flash message,

<code>SETPOINTS HAS SEVEN</code>
<code>PAGES OF DATA</code>

will be displayed for 2 seconds. The beginning of page 1 of SETPOINTS mode will then be shown:

<code>PAGE 1: SETPOINT VALUES</code>
<code>MOTOR AMPS SETPOINTS</code></td></tr>
</table>

No.	Name	Description
		USE: This key can be pressed at any time, in any mode, to view or alter relay setpoints. To go from page to page the PAGE UP and PAGE DOWN keys can be used. To go from line to line within a page the LINE UP and LINE DOWN keys can be used. To alter a setpoint, the VALUE UP and VALUE DOWN keys can be used. All setpoints will increment and decrement to pre-determined limits. When the desired value is reached, the STORE key must be used to save the new setpoint. If an altered setpoint is not stored the previous value will still be in effect. If the Access jumper is not installed a STORE will not be allowed and the flash message "ILLEGAL ACCESS" will be displayed for 2 seconds.
3	HELP	**FUNCTION**: The HELP key allows the user to obtain information on the function and use of each of the other keys on the keypad and on each of the ACTUAL VALUES, SETPOINTS, and TRIP/ALARM messages.
		EFFECT: Pressing this key will put the relay into HELP mode. If this key is pressed with the first line of a page (ie. a page header) on the display the message, `Press KEY of interest or` `HELP again for details` will be displayed. To obtain information on the function of a particular key, the key must be pressed. To obtain information on the previously displayed ACTUAL VALUES, SETPOINTS, or TRIP/ALARM message the HELP key should be pressed again. If this key is pressed with any other message shown on the display, only information on the previous line will be available.
		USE: This key will have no effect when a flash message or HELP message is shown on the display. Once HELP mode is entered the LINE UP and LINE DOWN keys can be used to view the HELP message. The CLEAR key is used to exit from HELP mode and return to the previous display mode. The ACTUAL VALUES and SET POINTS keys can also be used to exit HELP mode.
4,5	▲ PAGE PAGE ▼	**FUNCTION**: The PAGE DOWN and PAGE UP keys allow the user to scan the next or previous pages of either ACTUAL VALUES or SETPOINTS modes. If either key is held for more than 1/2 second the next or previous pages will be selected at a fast rate.
		EFFECT: Pressing the PAGE DOWN key will cause the display to show the first line of the next page of information. Pressing the PAGE UP key will cause the display to show the first line of the previous page.
		USE: These keys can be used any time the relay is in either the ACTUAL VALUES or SETPOINTS modes.
6,7	▲ LINE LINE ▼	**FUNCTION**: The LINE DOWN, and LINE UP keys allow the user to scan the next or previous lines of the currently selected page. If either key is held for more than 1/2 second the next or previous lines will be selected at a fast rate.
		EFFECT: Pressing the LINE DOWN key will cause the display to show the next line of the currently selected page of information. Pressing the LINE UP key will cause the display to show the line immediately in front of the currently displayed line.
		USE: These keys can be used at any time in any relay mode of operation. If the display shows the last line of a page the LINE DOWN key will have no effect. If the display shows the first line of a page the LINE UP key will have no effect.

No.	Name	Description
8,9		**FUNCTION**: The VALUE UP and VALUE DOWN keys allow the user to alter the currently selected setpoint. If either key is held for more than 1/2 second the setpoint selected will increment or decrement at a fast rate. If either key is held for more than 2 seconds the setpoint selected will increment or decrement at a very fast rate.
		EFFECT: Pressing the VALUE UP key will cause the currently displayed setpoint value to increment. Pressing the VALUE DOWN key will cause the currently displayed setpoint value to decrement. For YES/NO questions, pressing either key will cause the answer to change. Any changed setpoint will not be used internally until the STORE key is pressed.
		USE: These keys can be pressed any time a setpoint is displayed in SETPOINTS mode or when a YES/NO question is displayed in ACTUAL VALUES mode (see STORE key). When the desired setpoint value is reached the STORE key is used to save it. If an altered setpoint is not stored the previous value will still be in effect.
10		**FUNCTION**: The RESET key allows the user to reset the 269 Plus after any of the latched output relays have become active so that a motor start can be attempted.
		EFFECT: Pressing this key will reset (ie. return to an inactive state) any of the active output relay contacts if motor conditions allow (see below). The message, `RESET NOT POSSIBLE -` `Condition still present` will be displayed if any active output relays cannot be reset
		USE: A latched relay cannot be reset if the trip/alarm condition persists (eg. an OVERLOAD TRIP lock-out or a high RTD temperature).Pre-trip motor values may be viewed in ACTUAL VALUES mode page 5 (Pre-trip Data). If an immediate restart is required after an OVERLOAD or INHIBIT LOCKOUT the Emergency Restart terminals (see section 2.12) may be shorted together. This will reduce the lock-out time to 0 minutes.
11		**FUNCTION**: In SETPOINTS mode the CLEAR key allows the user to return an altered, non-stored setpoint to its original value. In HELP mode the CLEAR key allows the user to return to the previous display mode.
		EFFECT: When this key is pressed in SETPOINTS mode any altered, currently displayed setpoint will be returned to its original value. When this key is pressed in HELP mode the relay will return to the line and page of the mode active when the HELP key was pressed.
		USE: This key can be used in SETPOINTS or HELP modes only. In SETPOINTS mode it can only be used when a displayed setpoint has been changed with the VALUE UP/VALUE DOWN keys but has not yet been stored. After a setpoint has been stored the CLEAR key will have no effect. In HELP mode the CLEAR key can be used any time there is a HELP message on the display.

No.	Name	Description
12	STORE	**FUNCTION**: The STORE key allows the user to store new setpoints into the 269 Plus relay's internal memory.

EFFECT: When this key is pressed in SETPOINTS mode the currently displayed setpoint will be stored and will immediately come into effect. When a setpoint is stored the flash message,

```
new setpoint stored
```

will appear on the display.

The STORE key can be pressed in ACTUAL VALUES mode to clear the maximum actual temperature data. To do this the following message from page 2 of ACTUAL VALUES mode must be displayed after the "NO" value is altered to say "YES" by pressing the VALUE UP/VALUE DOWN key:

```
CLEAR LAST ACCESS DATA ?
YES
```

Then when the STORE key is pressed the following flash message will appear on the display:

```
last access data cleared
```

The maximum actual temperature data (see section 3.24) will then be cleared. The STORE key can be pressed in ACTUAL VALUES mode to start a new motor commissioning (ie. clear statistical data). To do this the following message from page 4 of ACTUAL VALUES mode must be displayed after the "NO" value is altered to say "YES" by pressing the VALUE UP/VALUE DOWN key:

```
START COMMISSIONING?
YES
```

Then when the STORE key is pressed the following flash message will appear on the display:

```
COMMISSIONING data
cleared
```

All statistical data (see section 3.24) will then be cleared.

USE: The STORE key can be used only in SETPOINTS mode to store new setpoints, or in ACTUAL VALUES mode to clear the maximum actual temperature data or start a new commissioning (ie. clear statistical data). This key will have no effect unless the Access terminals are shorted together.

13	☐ TRIP	LED indicator used to show the state of the Trip output relay. When on, the trip relay is active. When off, the Trip relay is inactive.
14	☐ ALARM	LED indicator used to show the state of the Alarm output relay. When on, the Alarm relay is active. When off, the Alarm relay is inactive.
15	☐ AUX.1	LED indicator used to show the state of Auxiliary relay #1. When on, Aux. relay #1 is active. When off, Aux. relay #1 is inactive.
16	☐ AUX.2	LED indicator used to show the state of Auxiliary relay #2. When on, Aux. relay #2 is active. When off, Aux. relay #2 is inactive.

No.	Name	Description
17	☐ SERVICE	LED indicator used to show the result of the 269 Plus self-test feature. When flashing, the relay has failed the self-test and service is required. When on steady, the supply voltage may be too low. This LED may be on momentarily during relay power up.

3.2 269 Plus Relay Display Modes

The 269 Plus relay display is used for viewing actual motor values, setpoint values, HELP messages, and TRIP/ALARM messages. This is accomplished by having the relay in one of four possible modes of operation:

1. ACTUAL VALUES mode
2. SETPOINTS mode
3. HELP mode
4. TRIP/ALARM mode

The relay will operate correctly, giving full motor protection, regardless of which display mode is currently in effect. The different modes affect only the data that appears on the 269 Plus relay's 48 character alphanumeric display.

TRIP/ALARM mode can only be entered by having one or more of the trip or alarm level setpoints exceeded. The other display modes can be entered using the ACTUAL VALUES, SET POINTS, or HELP keys (see section 3.1).

The ACTUAL VALUES and SETPOINTS modes are based on a book-like system of "pages" and "lines". One line from any page may be displayed at any given time. To "turn" a page, the PAGE UP and PAGE DOWN keys are used. To scan the lines on a page the LINE UP and LINE DOWN keys are used. In the HELP and TRIP/ALARM modes only the LINE UP and LINE DOWN keys are needed.

When control power is applied to the relay the following power up message will be displayed:

```
MULTILIN 269 PLUS RELAY
REVISION XXX      XX/XX
```

After this the display will show, (factory default settings)

```
 I1=  XXX      I2=  XXX
 I3=  XXX       (AMPS)
```

which is in page 1 of ACTUAL VALUES mode.

A description of each display mode is given in the following sections.

3.3 ACTUAL VALUES Mode

In ACTUAL VALUES mode, any of the parameters monitored or calculated by the 269 Plus relay may be viewed by the user. This mode is divided into seven separate pages of data each of which contains a different group of actual motor values. The seven pages and the lines in each page are as shown in Table 3-2.

Table 3-2 ACTUAL VALUES

Page	Line	Information Line	Description
1	1	PAGE 1: ACTUAL VALUES PHASE CURRENT DATA	ACTUAL VALUES page 1 header.
	2	MOTOR STARTING ###1###2###3###4###5###6	Motor starting current level (seen only during a motor start).
	3 *	I1= XXXX I2= XXXX I3= XXXX (AMPS) ---	Motor phase current data. ("---" becomes "RUN" when motor is running.)
	4	I(3 ph avg) = XXXX AMPS Max Stator RTD = XXX C	Average of 3 phase currents. Maximum of 6 stator RTDs. This line is shown only if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “YES”. This setpoint is located on page 2 of setpoints, line 3.
		I(3 ph avg) = XXXX AMPS T.C. USED = XXX PERCENT	Average of 3 phase currents. Thermal capacity used. This line is shown only if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.
	5	UNBALANCE RATIO (In/Ip) U/B = XXX PERCENT	Ratio of negative to positive sequence currents.
	6	GROUND FAULT CURRENT G/F = XX.X AMPS	Actual ground fault current.
	7	ST/HR TIMERS (MIN) XX XX XX XX XX	Starts/hour timers (see section 3.3a).
	8	TIME BETWEEN STARTS TIMER = XX MIN	Time between starts timer (see section 3.3b).
	9	■■■1■■■2■■■3■■■4■■■5 ■■■1■■■2■■■3■■■4■■■5	This line can be examined to ensure that all pixels in the 40 character liquid crystal display are functional
	10	END OF PAGE ONE ACTUAL VALUES	Last line of page 1.

* If line 2 is programmed to be displayed, it will only show when the motor is starting. It will then default to line 3. Programming which line the display will default to is done in Setpoint Values, page 5.

Page	Line	Information Line	Description
2	1	PAGE 2: ACTUAL VALUES RTD TEMPERATURE DATA	ACTUAL VALUES page 2 header. (See note at end of Actual Values pg.2).
	2	NO RTDs ARE CONNECTED TO THE 269 PLUS	This line is shown only if the answer to the question "ARE THERE ANY RTDs CONNECTED?" is "NO". This setpoint is located on page 2 of setpoints, line 3.
	3 •	HOTTEST STATOR RTD RTD # X = XXX C	Maximum stator RTD temperature.
	4 •	STATOR TEMPERATURE RTD #1= XXX DEGREES C or RTD TEMPERATURE RTD #1= XXX DEGREES C	RTD #1 temperature.
	5 •	STATOR TEMPERATURE RTD #2= XXX DEGREES C or RTD TEMPERATURE RTD #2= XXX DEGREES C	RTD #2 temperature.
	6 •	STATOR TEMPERATURE RTD #3= XXX DEGREES C or RTD TEMPERATURE RTD #3= XXX DEGREES C	RTD #3 temperature.
	7 •	STATOR TEMPERATURE RTD #4= XXX DEGREES C or RTD TEMPERATURE RTD #4= XXX DEGREES C	RTD #4 temperature.
	8 •	STATOR TEMPERATURE RTD #5= XXX DEGREES C or RTD TEMPERATURE RTD #5= XXX DEGREES C	RTD #5 temperature.
	9 •	STATOR TEMPERATURE RTD #6= XXX DEGREES C or RTD TEMPERATURE RTD #6= XXX DEGREES C	RTD #6 temperature.
	10 •	RTD TEMPERATURE RTD #7= XXX DEGREES C	RTD #7 temperature.
	11 •	RTD TEMPERATURE RTD #8= XXX DEGREES C	RTD #8 temperature.

Page	Line	Information Line	Description
	12 •	RTD TEMPERATURE RTD #9= XXX DEGREES C	RTD #9 temperature.
	13 •	RTD TEMPERATURE RTD #10= XXX DEGREES C	RTD #10 temperature.
		or	
		AMBIENT TEMPERATURE RTD #10= XXX DEGREES C	Seen when RTD 10 is used for ambient sensing on 269 Plus.
	14 •	MAX. STATOR SINCE LAST ACCESS: RTD# X = XXX	Maximum stator RTD temperature since last access.
	15 •	MAXIMUM RTD#7 TEMP SINCE LAST ACCESS:XXX DEGREES C	Maximum RTD #7 temperature since last access.
	16 •	MAXIMUM RTD#8 TEMP SINCE LAST ACCESS = XXX C	Maximum RTD #8 temperature since last access.
	17 •	MAXIMUM RTD#9 TEMP SINCE LAST ACCESS = XXX C	Maximum RTD #9 temperature since last access.
	18 •	MAXIMUM RTD#10 TEMP SINCE LAST ACCESS = XXX C	Maximum RTD #10 temperature since last access.
	19 •	CLEAR LAST ACCESS DATA? XXX	Used to clear the data in the last 5 lines (see section 3.1, STORE key).
	20	END OF PAGE TWO ACTUAL VALUES	Last line of page 2.

- In the above messages, temperatures may be displayed in either Celsius (indicated by “C”) or Fahrenheit (indicated by “F”) depending on the setting in Setpoints pg.2 line 2.
- Lines 3 to 19 in the above messages are not shown if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.

Page	Line	Information Line	Description
3	1	PAGE 3: ACTUAL VALUES MOTOR CAPACITY DATA	ACTUAL VALUES page 3 header.
	2	ESTIMATED TIME TO TRIP = XXX SECONDS	Estimated time to overload trip under present conditions (seen only during overloads).
	3	MOTOR LOAD AS A PERCENT FULL LOAD = XXX PERCENT	Actual motor current as a percentage of full load.
	4	THERMAL CAPACITY USED = XXX PERCENT	Percentage of motor thermal capacity used.
	5	END OF PAGE THREE ACTUAL VALUES	Last line of page 3.

Page	Line	Information Line	Description
4	1	PAGE 4: ACTUAL VALUES STATISTICAL DATA	ACTUAL VALUES page 4 header.
	2	RUNNING HRS SINCE LAST COMMISSIONING XXXXX HRS	Total motor running hours since last commissioning.
	3 •	MEGAWATTHOURS SINCE LAST COMMISSIONING XXXXX MWHR	Total megawatthours since last commissioning
	4	# OF STARTS SINCE LAST COMMISSIONING XXX	Total number of motor starts since last commissioning.
	5	# OF TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay trips since last commissioning.
	6	# O/L TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay overload trips since last commissioning.
	7	# U/C TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay undercurrent trips since last commissioning.
	8	# RAPID TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay rapid trips since last commissioning.
	9	# U/B TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay unbalance trips since last commissioning.
	10	# G/F TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay ground fault and differential input trips since last commissioning.
	11	# RTD TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay RTD trips since last commissioning.
	12	# S/C TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay short circuit trips since last commissioning.
	13	# START TRIPS SINCE LAST COMMISSIONING XXX	Total number of relay acceleration time, and speed switch trips since last commissioning.
	14	# U/V TRIPS SINCE LAST COMMISSIONING XXX	Total number of undervoltage trips since last commissioning.
	15	# O/V TRIPS SINCE LAST COMMISSIONING XXX	Total number of overvoltage trips since last commissioning.
	16	# PF TRIPS SINCE LAST COMMISSIONING XXX	Total number of power factor trips since last commissioning.
	17	VOLTAGE PHASE REVERSALS SINCE COMMISSIONING XXX	Total number of voltage phase reversals since last commissioning.
	18	START NEW COMMISSIONING XXX	Used to clear the data in the previous lines (see section 3.1, STORE key).
	19	END OF PAGE FOUR ACTUAL VALUES	Last line of page 4.

• Available only if a meter is online.

Page	Line	Information Line	Description
5	1	PAGE 5: ACTUAL VALUES PRE-TRIP DATA	ACTUAL VALUES page 5 header.
	2	XXXXXXXXXXX	This message is only displayed, and defaulted to, when a trip or alarm occurs and describes the trip/alarm condition. Refer to Table 3-4 Trip/Alarm Messages and Fault Diagnosis. See section 3.3c.
	3	CAUSE OF LAST EVENT: XXXXXXXXXXXXXXXXXXX	This message describes the cause of the last event detected by the 269 Plus. See section 3.3d. It will be updated when an event occurs (trip or alarm).
	4	CAUSE OF LAST TRIP: XXXXXXXXXXXX	This message describes the cause of the last trip. It will be updated when a trip occurs. See section 3.3c.
	5	PRE-TRIP AVERAGE MOTOR CURRENT = XXXXX AMPS	Average motor phase current prior to last relay trip.
	6	PRE-TRIP PHASE CURRENT I1 = XXX AMPS	I1 motor phase current prior to last relay trip.
	7	PRE-TRIP PHASE CURRENT I2 = XXX AMPS	I2 motor phase current prior to last relay trip.
	8	PRE-TRIP PHASE CURRENT I3 = XXX AMPS	I3 motor phase current prior to last relay trip.
	9	PRE-TRIP U/B RATIO (In/Ip) XXX PERCENT	Ratio of negative to positive sequence currents prior to last relay trip.
	10	PRE-TRIP G/F CURRENT G/F = XXX AMPS	Ground fault current prior to last relay trip. ("=" will be ">" if delay set to 0.0, 0.25, 0.5)
	11	PRE-TRIP MAX STATOR RTD RTD # X = XXX C	Maximum stator RTD temperature prior to last relay trip. This message is displayed only if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “YES”. This setpoint is on page 2 of setpoints, line 3.
	12 •	PRE-TRIP AVERAGE VOLTAGE VOLTS = XXXXX	Average voltage prior to last relay trip
	13 •	PRE-TRIP KWATTS KW = +XXXXX	Positive or negative kwatts prior to last relay trip. (See Figure 3.8 for power measurement conventions.)
	14 •	PRE-TRIP KVARS KVAR = +XXXXX	Positive or negative kvars prior to last relay trip. (See Figure 3.8 for power measurement conventions.)
	15 •	PRE-TRIP POWER FACTOR PF = X.XX LAG	Power factor prior to last relay trip. The Lead or Lag word messages are also captured and displayed prior to last relay trip.
	16 •	PRE-TRIP FREQUENCY HZ = XX.X	Frequency prior to last relay trip

Page	Line	Information Line	Description
5	17	CLEAR PRE-TRIP DATA? NO	Used to clear all pre-trip data, cause of last event, and cause of last trip. Data can be cleared before or after the reset of a trip or alarm. Pre-trip data can be cleared by changing the "NO" to a "YES" using the value up key, and storing it. Once the data is cleared, the flash message "PRE-TRIP DATA CLEARED" is displayed for a few seconds. Once cleared, the cause of last event and cause of last trip messages will be blank, all pre-trip data will be equal to zero, the PF sign will be reset to a default of Lag, and the pre-trip kW and pre-trip kvar signs will be reset to a default of "+". See section 3.24.
	18	END OF PAGE FIVE ACTUAL VALUES	Last line of page 5.

• Available only if a GE Multilin meter (MPM) is installed and online (see Setpoints Page 7, Line 2)

Page	Line	Information Line	Description
6	1	PAGE 6: ACTUAL VALUES LEARNED PARAMETERS	ACTUAL VALUES page 6 header.
	2	LEARNED Istart (AVG.OF 4 STARTS) = XXX AMPS	Learned average motor starting current of 4 starts.
	3	LEARNED Istart (last one) = XXX AMPS	Learned motor starting current from last start.
	4	LEARNED K FACTOR K = XX.X	Learned value of negative sequence K factor.
	5	LEARNED RUNNING COOL TIME= XXX MIN.	Learned motor cooling time with motor running (see section 3.20).
	6	LEARNED STOPPED COOL TIME= XXX MIN.	Learned motor cooling time with motor stopped (see section 3.20).
	7	LEARNED ACCEL. TIME ACCEL. TIME = XX.X SEC.	Learned motor acceleration time.
	8	LEARNED Start Capacity Last Start T.C. = XXX %	Learned motor thermal capacity used during the last start. See section 3.20 for details on how this value can be used to better adapt the 269 Plus to the motor.
	9	LEARNED Start Capacity required = XX PERCENT	Learned motor thermal capacity used on start. This value is learned after five successful starts are accomplished. Start thermal capacity for each of the last five starts are added together and divided by four. This allows for a margin of 24% to be built into this value. Each start is limited between 10% and 70% of the thermal capacity used on start. This learned parameter is used with the start inhibit function in page 5 of setpoints. See section 3.20 for details.
	10	END OF PAGE SIX ACTUAL VALUES	Last line of page 6.

Page	Line	Information Line	Description
7	1	PAGE 7: ACTUAL VALUES METERING DATA	ACTUAL VALUES page 7 header
	2	METER MODULE NOT INSTALLED	Appears if meter not on-line (setpoints page 7 line 2)
	3	PHASE TO PHASE VOLTAGE CONNECTION	Appears whether or not the meter is online. When the meter is online, this message displays the VT configuration as connected to the meter. See Figures 2.16, 2.17a, 2.17b, and 2.24 to 2.30. This message is displayed when the meter's VTs are wired to measure phase to phase voltage.
	3 •	PHASE TO NEUTRAL VOLTAGE CONNECTION	This message is displayed when the meter's VTs are wired to neutral for phase to neutral measurement.
	4	Vab = XXXX Vbc = XXXX Vca = XXXX AVG.= XXXX V	Appears whether or not the meter is online. 3 phase to phase voltages. Displayed when the VT configuration above is phase to phase.
	4 •	Van = XXXX Vbn = XXXX Vcn = XXXX AVG.= XXXX V	3 phase to neutral voltages. Displayed only when the VT configuration is phase to neutral.
	5 •	3 PHASE KWATTS KW = +XXXXX	Positive or negative 3 phase kwatts. See Figure 3.8 for Power Measurement Conventions.
	6 •	3 PHASE KVARS KVAR = +XXXXX	Positive or negative 3 phase kvars See Figure 3.8 for Power Measurement Conventions.
	7 •	POWER FACTOR PF = X.XX LAG	Power factor and Lead or Lag sign. See Figure 3.8 for Power Measurement Conventions.
	8 •	FREQUENCY HZ = XX.X	Frequency
	9	END OF PAGE SEVEN ACTUAL VALUES	Last line of page 7

• Available only if a GE Multilin meter (MPM) is installed and on-line (see pg. 7 setpoints, line 2)

To place the relay in ACTUAL VALUES mode, the ACTUAL VALUES key must be pressed. When this is done the following flash message will appear for 2 seconds,

```
ACTUAL VALUES HAS SEVEN
   PAGES OF DATA
```

The display will then show,

```
PAGE 1: ACTUAL VALUES
PHASE CURRENT DATA
```

which is the beginning of page 1.

If the relay is in SETPOINTS mode or ACTUAL VALUES mode and no key is pressed for more than four minutes the display will change to, (factory default settings)

```
I1=  XXX     I2=  XXX
I3=  XXX      (AMPS)
```

which is the second line in page 1 of ACTUAL VALUES mode. This default display line can be changed in page 5 of SETPOINTS mode.

When in this mode the PAGE UP, PAGE DOWN, LINE UP, and LINE DOWN keys (see section 3.1) can be used to examine all of the actual motor data outlined above.

3.3a Starts/Hour Timer

An individual starts/hour timer is activated each time a motor start condition is detected and starts to time out beginning from 60 minutes. All starts/hour timers can be viewed in Actual Values pg. 1 line 7. If the number of starts/hour programmed in SETPOINTS pg.1 line 7 is exceeded within one hour, a start/hour inhibit is initiated with a lockout time equal to the smallest start/hour timer. A maximum of five starts/hour may be programmed, or the setpoint turned OFF.

In the case of an emergency, when the lockout time has to be bypassed and an additional start is required, the Emergency Restart button can be pushed (terminals #54 and 55 temporarily shorted) making the smallest start/hour timer zero, resetting the inhibit and effectively allowing an additional start. Note that the other timers continue to time out unaffected.

Every time the Emergency Restart button is pushed, another timer is emptied and an additional start/hour is allowed. For example, pushing the Emergency Restart button again will empty the second timer and two more starts/hour are allowed before another start/hour inhibit is initiated.

3.3b Time Between Starts Timer

This timer corresponds to the “Time Between Starts Time Delay” feature in Setpoints pg. 5 line 36. The time displayed is the actual lockout time that the user has to wait before an additional start can be performed.

This timer is updated continuously until it expires, then a zero is displayed. When the timer expires, this indicates to the user that a start is allowed immediately after a motor stop without any lockout time.

The time between starts timer is equal to zero in the following two cases:

1. If the timer has expired and therefore there’s no lockout time prior to starting again after a motor stop condition is detected.
2. If the “Time Between Starts Time Delay” feature is set to “OFF” in SETPOINTS page 5 line 36.

3.3c Cause of Last Trip

The message in Actual Values pg.5 line 3 describes the cause of the last trip. It will be updated when a trip occurs. “XXXXXXXXXXX” in the message represents one of the following trips:

Overload trip	Speed Switch trip
Short Circuit trip	Differential trip
Rapid Trip	Single Phase trip
Stator RTD trip	Spare Input trip
RTD trip	Power Factor trip
Ground Fault trip	Undervoltage trip
Acceleration trip	Overvoltage trip
Phase Reversal trip	Undercurrent trip

3.3d Cause of Last Event

An event is defined as a TRIP or an INHIBIT. If the last event was a trip, then the message “CAUSE OF LAST EVENT” and the following message “CAUSE OF LAST TRIP” are the same, mainly displaying the cause of the trip. However, it is possible to have a trip which is immediately followed by an inhibit such as starts/hour, time between starts, start inhibit or backspin timer. In this case, “INHIBIT LOCKOUT” is displayed as the “CAUSE OF LAST EVENT” message and the cause of the trip is displayed as the “CAUSE OF LAST TRIP” message. Sometimes only an inhibit activates the TRIP, AUX1 or TRIP and AUX1 relays. This may happen when the motor is intentionally stopped, but more often, it happens accidentally on an unloaded motor when current drops below 5% of CT. 5% of CT is the cutoff point for the 269 Plus, where a motor stop condition is registered. In this case, the cause of the last trip is not updated. Only the cause of last event message is updated to show “INHIBIT LOCKOUT”. This message should greatly assist in the diagnosis of the problem, because the activation of the TRIP relay will not be misunderstood and treated as an actual trip. Instead, the solution may be fairly simple to implement, and it may only require that a 52b contact for a breaker, or equivalent for a contactor, be wired to terminals 44 and 45 on the 269 Plus, and the setpoint “SPARE INPUT TO READ 52b?” on page 5 of setpoints be changed to

3.4 SETPOINTS Mode

In SETPOINTS mode any or all of the motor trip/alarm setpoints may be either viewed or altered. This mode is divided into seven separate pages of data each of which contains a different group of relay setpoints.

To enter SETPOINTS mode the SET POINTS key must be pressed. When in this mode, if no key is pressed for more than four minutes, the display will automatically go into ACTUAL VALUES mode as explained in section 3.3. To return to SETPOINTS mode the SET

POINTS key must be pressed. When this key is pressed the following flash message will appear on the display,

```
SETPOINTS HAS SEVEN
   PAGES OF DATA
```

Then the display will show,

```
PAGE 1: SETPOINT VALUES
MOTOR AMPS SETPOINTS
```

which is the first line of the first page of SETPOINTS mode. The PAGE UP, PAGE DOWN, LINE UP, and LINE DOWN keys (see section 3.1) may then be used to view all of the SETPOINTS data.

When setpoints are to be changed, the VALUE UP, VALUE DOWN, STORE, and CLEAR keys (see section 3.1) are used. The Access terminals must first be shorted together (see section 2.17). The PAGE UP, PAGE DOWN, LINE UP, and LINE DOWN keys are used to display the setpoints that are to be changed. The setpoints themselves are changed by pressing the VALUE UP or VALUE DOWN keys until the desired setpoint value is reached. To return the setpoint to its original value, the CLEAR key can be used. When the setpoint is adjusted to its proper value the STORE key should be pressed in order to store the setpoint into the 269 Plus' internal memory. Once the STORE key is pressed the flash message,

```
 new setpoint stored
```

will appear on the display and the new setpoint value will be used by the 269 Plus relay.

If an attempt is made to store a new setpoint value without the Access terminals shorted together the new value will not be stored and the flash message,

```
   ILLEGAL ACCESS
```

will appear on the display. To make the setpoints tamperproof the Access terminals should be shorted together only when setpoints are to be changed.

Setpoints may be changed while the motor is running; however it is not recommended to change important protection parameters without first stopping the motor.

Setpoints will remain stored indefinitely in the 269 Plus relay's internal non-volatile memory even when control power to the unit is removed.

All seven pages of data and the lines in each page are as shown in Table 3-3. Also shown are the default settings, ranges and increments for each setpoint. It should be noted that the 269 Plus relay's motor protection parameters are based on the data entered by the user. Thus this data must be complete and accurate for the given system.

Table 3-3 SETPOINTS

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
1	1	PAGE 1: SETPOINT VALUES MOTOR AMPS SETPOINTS		
	2	PHASE C.T. RATIO C.T. SECONDARY = X AMP	:1 or :5 *Factory Value = 5*	3.7
	3	PHASE C.T. RATIO C.T. PRIMARY = XXXX:X	20-1500 (increments of 1) *Factory Value = 100*	3.7
	4	MOTOR FULL LOAD CURRENT FLC= XXXX AMPS	10-1500 amps (increments of 1) *Factory Value = 10*	3.7
	5	O/L PICKUP LEVEL LEVEL = 1.05 x FLC	1.05-1.25 ×FLC (increments of 0.01) *Factory Value = 1.05*	3.18,3.20
	6	ACCEL.TIME= XXX.X SECONDS Consult motor data sheet	0.5-125.0 or OFF (increments of 0.5) *Factory Value = 10.0*	3.8
	7	STARTS/HOUR= X Consult motor data sheet	1-5 starts or OFF (increments of 1) *Factory Value = 3*	3.9
	8	UNBALANCE ALARM LEVEL U/B ALARM= XX PERCENT	4-30 % or OFF (increments of 1) *Factory Value = 10*	3.10
	9	U/B ALARM TIME DELAY TIME DELAY = XXX SEC	3-255 seconds (increments of 1) *Factory Value = 5*	3.10
	10	UNBALANCE TRIP LEVEL U/B TRIP= XX PERCENT	4-30 % or OFF (increments of 1) *Factory Value = 15*	3.10
	11	U/B TRIP TIME DELAY U/B DELAY= XXX SECONDS	3-255 seconds (increments of 1) *Factory Value = 5*	3.10
	12	G/F C.T. RATIO :5 ? XXX (NO indicates 2000:1)	YES (5 amp secondary) or NO (GE Multilin's 50:0.025A CT w/ ratio of 2000:1) *Factory Value = NO*	3.11
	13 •	GROUND C.T. PRIMARY GROUND C.T. = XXX:5	20-1500 (increments of 1) (Not seen if ratio is 2000:1) *Factory Value = 100*	3.11
	14	GROUND FAULT ALARM LEVEL G/F ALARM= XXX AMPS	50:0.025A (2000:1 ratio) C.T.: 1-10 amps or OFF (increments of 1) *Factory Value = 4*	3.11
	15 •	GROUND FAULT ALARM LEVEL G/F ALARM= XXX xCT	5 A secondary C.T.: 0.1–1.0 xCT or OFF (increments of 0.1) (Not seen if ratio is 2000:1) *Factory Value = 0.4*	

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
1	16	G/F ALARM TIME DELAY TIME DELAY = XXX SEC	1-255 seconds (increments of 1) *Factory Value = 10*	3.11
	17	GROUND FAULT TRIP LEVEL G/F TRIP = XXX AMPS	50:0.025A (2000:1 ratio) C.T.: 1.0-10.0 amps or OFF (increments of 1.0) *Factory Value = 8*	3.11
	18 •	GROUND FAULT TRIP LEVEL G/F TRIP = XXX xCT	5 A secondary C.T.: 0.1–1.0 xCT or OFF (increments of 0.1) (Not seen if ratio is 2000:1) *Factory Value = 0.8*	
	19	G/F TRIP TIME DELAY G/F DELAY= XX.X SECONDS	0.0 (Instantaneous) - 20.0 seconds (increments of 0.5). Additional time delay of 0.25 seconds following 20.0. *Factory Value = 0.0*	3.11
	20	UNDERCURRENT ALARM LEVEL U/C ALARM= XXXX AMPS	1-1000 amps or OFF (increments of 1) *Factory Value = OFF*	3.12
	21	UNDERCURRENT ALARM DELAY TIME DELAY= XXX SECONDS	1-255 seconds (increments of 1) *Factory Value = 10*	3.12
	22	UNDERCURRENT TRIP LEVEL U/C TRIP = OFF AMPS	1–1000 amps or OFF (increments of 1) *Factory Value = OFF*	3.12
	23	UNDERCURRENT TRIP DELAY TIME DELAY= XXX SECONDS	1–255 seconds (increments of 1) *Factory Value = 5*	3.12
	24	MECHANICAL JAM ALARM ALARM LEVEL= XXX xFLC	1.5–6.0 xFLC or OFF (increments of 0.5) *Factory Value = OFF*	3.13
	25	MECH. JAM ALARM TIME DELAY = XXX.X SECONDS	0.5–125.0 seconds (increments of 0.5) *Factory Value = 5.0*	3.13
	26	RAPID TRIP / MECH. JAM TRIP LEVEL= X.X x FLC	1.5–6.0 ×FLC or OFF (increments of 0.5×FLC) *Factory Value = 2.5*	3.13
	27	RAPID TRIP TIME DELAY DELAY= XXX.X SECONDS	0.5-125.0 seconds (increments of 0.5) *Factory Value = 10.0*	3.13
	28	SHORT CIRCUIT TRIP LEVEL S/C TRIP= XX x FLC	4×FLC-12×FLC or OFF (increments of 1×FLC) *Factory Value = OFF*	3.14
	29	SHORT CIRCUIT TIME DELAY S/C DELAY= XX.X SECONDS	Instantaneous or 0.5-20.5 seconds (increments of 0.5) *Factory Value = INST*	3.14
	30	IMMEDIATE OVERLOAD LEVEL = X.XX x FLC	1.01×FLC-1.50×FLC or OFF (increments of 0.01×FLC) *Factory Value = OFF*	3.15

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
	31	END OF PAGE ONE SETPOINT VALUES		

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
2	1	PAGE 2: SETPOINT VALUES RTD SETPOINTS		
	2	RTD SENSOR TYPE TYPE = 100 OHM PLATINUM	*Not a setpoint.* Displays the RTD type the relay will accept. To change the RTD type, contact the factory. 100 ohm platinum, 10 ohm copper, 100 ohm nickel, 120 ohm nickel.	3.16
	3	ARE THERE ANY RTDs CONNECTED? XXX	YES or NO When programmed to "NO", all RTD messages in Setpoints and Actual Values are not displayed. *Factory Value = YES*	3.16
	4	RTD MESSAGE DISPLAY = C (C:CELSIUS/F:FAHRENHEIT)	C or F *Factory Value = C*	3.16
	5	# OF STATOR RTDS USED # OF RTDs = X	0-6 (increments of 1) *Factory Value = 6*	3.16
	6	STATOR #1 ALARM LEVEL = XXX DEGREES C or RTD #1 ALARM LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	7	STATOR #1 HIGH ALARM LEVEL = XXX DEGREES C or RTD #1 HIGH ALARM LEVEL = XXX DEGREES C	0–200 degrees C or OFF (increments of 1) 32–392 degrees F or OFF *Factory Value = OFF*	
	8	STATOR #1 TRIP LEVEL = XXX DEGREES C or RTD #1 TRIP LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	9	STATOR #2 ALARM LEVEL = XXX DEGREES C or RTD #2 ALARM LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	10	STATOR #2 HIGH ALARM LEVEL = XXX DEGREES C or RTD #2 HIGH ALARM LEVEL = XXX DEGREES C	0–200 degrees C or OFF (increments of 1) 32–392 degrees F or OFF *Factory Value = OFF*	

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
2	11	STATOR #2 TRIP LEVEL = XXX DEGREES C or RTD #2 TRIP LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	12	STATOR #3 ALARM LEVEL = XXX DEGREES C or RTD #3 ALARM LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	13	STATOR #3 HIGH ALARM LEVEL = XXX DEGREES C or RTD #3 HIGH ALARM LEVEL = XXX DEGREES C	0–200 degrees C or OFF (increments of 1) 32–392 degrees F or OFF *Factory Value = OFF*	
	14	STATOR #3 TRIP LEVEL = XXX DEGREES C or RTD #3 TRIP LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	15	STATOR #4 ALARM LEVEL = XXX DEGREES C or RTD #4 ALARM LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	16	STATOR #4 HIGH ALARM LEVEL = XXX DEGREES C or RTD #4 HIGH ALARM LEVEL = XXX DEGREES C	0–200 degrees C or OFF (increments of 1) 32–392 degrees F or OFF *Factory Value = OFF*	
	17	STATOR #4 TRIP LEVEL = XXX DEGREES C or RTD #4 TRIP LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	18	STATOR #5 ALARM LEVEL = XXX DEGREES C or RTD #5 ALARM LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
2	19	`STATOR #5 HIGH ALARM` `LEVEL =  XXX  DEGREES C` or `RTD #5 HIGH ALARM` `LEVEL =  XXX  DEGREES C`	0–200 degrees C or OFF (in-crements of 1) 32–392 degrees F or OFF *Factory Value = OFF*	
	20	`STATOR #5 TRIP LEVEL` `=  XXX  DEGREES C` or `RTD #5 TRIP LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	21	`STATOR #6 ALARM LEVEL` `=  XXX  DEGREES C` or `RTD #6 ALARM LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	22	`STATOR #6 HIGH ALARM` `LEVEL =  XXX  DEGREES C` or `RTD #6 HIGH ALARM` `LEVEL =  XXX  DEGREES C`	0–200 degrees C or OFF (in-crements of 1) 32–392 degrees F or OFF *Factory Value = OFF*	
	23	`STATOR #6 TRIP LEVEL` `=  XXX  DEGREES C` or `RTD #6 TRIP LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16
	24	`RTD #7 ALARM LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	25	`RTD #7 TRIP LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	26	`RTD #8 ALARM LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	27	`RTD #8 TRIP LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	28	`RTD #9 ALARM LEVEL` `=  XXX  DEGREES C`	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
	29	RTD #9 TRIP LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	30	RTD #10 ALARM LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	31	RTD #10 TRIP LEVEL = XXX DEGREES C	0-200 degrees C or OFF (increments of 1) 32-392 degrees F or OFF *Factory Value = OFF*	3.16, 3.17
	32	END OF PAGE TWO SETPOINT VALUES		

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
3	1	PAGE 3: SETPOINT VALUES O/L CURVE SETPOINTS		
	2	CUSTOM CURVE? XXX YES voids selected curve	YES or NO *Factory Value = NO*	3.18
	3	SELECTED CURVE NUMBER CURVE # = X	1-8 (line not seen when using a custom curve) *Factory Value = 4*	3.18
	3 •	Check all custom curve entries before exiting		
	4 •	TRIP TIME @ 1.05 X FLC = XXXXX SECONDS	1-12000 seconds (increments of 1)	3.18
	5 •	TRIP TIME @ 1.10 X FLC = XXXXX SECONDS	1-12000 seconds (increments of 1)	3.18
	6 •	TRIP TIME @ 1.20 X FLC = XXXXX SECONDS	1-12000 seconds (increments of 1)	3.18
	7 •	TRIP TIME @ 1.30 X FLC = XXXXX SECONDS	1-12000 seconds (increments of 1)	3.18
	8 •	TRIP TIME @ 1.40 X FLC = XXXXX SECONDS	1-12000 seconds (increments of 1)	3.18
	9 •	TRIP TIME @ 1.50 X FLC = XXXXX SECONDS	1-12000 seconds (increments of 1)	3.18
	10•	TRIP TIME @ 1.75 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	11•	TRIP TIME @ 2.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	12•	TRIP TIME @ 2.25 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	13•	TRIP TIME @ 2.50 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	14•	TRIP TIME @ 2.75 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	15•	TRIP TIME @ 3.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	16•	TRIP TIME @ 3.50 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	17•	TRIP TIME @ 4.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	18•	TRIP TIME @ 4.50 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18

Page	Line	Information Line	Setpoint Range and Units	Manual Ref.
	19•	TRIP TIME @ 5.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	20•	TRIP TIME @ 5.50 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	21•	TRIP TIME @ 6.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	22•	TRIP TIME @ 6.50 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	23•	TRIP TIME @ 7.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	24•	TRIP TIME @ 7.50 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	25•	TRIP TIME @ 8.00 X FLC = XXXXX SECONDS	1-2000 seconds (increments of 1)	3.18
	26	END OF PAGE THREE SETPOINT VALUES		

• These lines are not displayed when using a standard curve.

```
PAGE 4: SETPOINT VALUES
RELAY CONFIGURATION
```

This page is used to assign trip and alarm functions to specific output relays (ie. TRIP, ALARM, AUX. 1, AUX. 2) on the 269 Plus. Each trip/alarm function is assigned separately to the appropriate relay or to "NO" relay. If an alarm feature is assigned to no relay, it can still become active (ie. cause the appropriate alarm message to be displayed if setpoints are exceeded) but no output relay activation will occur. Possible assignments and factory values are shown below.

Note: Only one TRIP may occur at any one time. TRIP functions and inhibits must therefore be used to trip or lockout the motor. Once one TRIP or INHIBIT function is active, no other trip or inhibit may occur.

```
Assign XXXXXXXXXXXXXXX
to XXXXXXXXXXXX relay
```

Feature	Possible Assignments	Factory Value	Comments
O/L TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
U/B TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
S/C TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
U/C TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
RAPID TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
•STATOR RTD TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
•RTD TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
G/F TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
ACCEL. TIME TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
PHASE REVERSAL TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	METER OPTION
INHIBIT LOCKOUTS	TRIP or AUX. 1 or TRIP & AUX.1	AUX. 1 RELAY	
SPEED SWITCH TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
DIFFERENTIAL TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
SINGLE PHASE	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
SPARE INPUT TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	
U/V TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	METER OPTION
O/V TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	METER OPTION
POWER FACTOR TRIP	TRIP or AUX. 1 or TRIP & AUX.1	TRIP RELAY	METER OPTION
O/L WARNING	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	
G/F ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	
U/B ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	
U/C ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	
MECH. JAM ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 1 RELAY	
•STATOR RTD ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	
•STATOR RTD HIGH ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 1 RELAY	
•RTD ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 1 RELAY	
•RTD HIGH ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 1 RELAY	
•NO SENSOR ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 1 RELAY	
•LOW TEMP ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 1 RELAY	
SPARE INPUT ALARM	ALARM or AUX. 1 or AUX. 2 or NO	NO RELAY	
T.C. ALARM	ALARM or AUX. 1 or AUX. 2 or NO	NO RELAY	
U/V ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	METER OPTION
O/V ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	METER OPTION
PF ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	METER OPTION
KVAR ALARM	ALARM or AUX. 1 or AUX. 2 or NO	ALARM RELAY	METER OPTION
METER ALARM	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 2 RELAY	METER OPTION
SELF TEST FAIL	ALARM or AUX. 1 or AUX. 2 or NO	AUX. 2 RELAY	

• These messages are not displayed when no RTDs are connected to the 269 Plus.

Line	Description
1	PAGE 5: SETPOINT VALUES SYSTEM CONFIGURATION This page is used to configure the 269 Plus relay to exactly match the motor and motor system being protected. Various special features can be selected, defeated, or adjusted in this page of setpoints.
2	NORMAL RUN DISPLAY SHOWS LINE = LINE XX This setpoint determines the line of the selected page in ACTUAL VALUES MODE to which the display will return if no key is pressed for more than four minutes and no trips or alarms are present: 1-40 - line number in selected page (see Table 3-2) Factory Value = 2
3	NORMAL RUN DISPLAY SHOWS PAGE = PAGE XX This setpoint determines the page in ACTUAL VALUES mode to which the display will return if no key is pressed for more than four minutes and no trips or alarms are present: 1 - page 1 (see Table 3-2) 2 - page 2 3 - page 3 4 - page 4 5 - page 5 6 - page 6 Factory Value = 1
4 •	DEFEAT NO SENSOR ALARM? XXX This setpoint is used to enable or defeat the Broken RTD Sensor Alarm. This alarm will only become active for open circuit RTDs chosen for use: YES - RTD Broken Sensor Alarm defeated. NO - RTD Broken Sensor Alarm enabled. Factory Value = YES
5 •	ENABLE LOW TEMPERATURE ALARM? XXX This setpoint is used to enable or defeat the RTD LOW TEMP. ALARM. This alarm will only become active for RTDs measuring 0°C (32°F) (see section 3.16–3.17). YES - RTD Low Temperature Alarm enabled NO - RTD Low Temperature Alarm disabled. Factory Value = NO

- Messages are not displayed if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.

Line	Description
6 •	ENABLE STATOR RTD VOTING (2 RTDs>=TRIP)? XXX This setpoint is used to enable or defeat the stator RTD voting feature. If enabled, any one Stator RTD alone will not trip the motor even when it exceeds its trip setpoint. A minimum of two stator RTDs will have to exceed their individual trip setpoints before a trip signal is issued by the 269 Plus. The second stator RTD encountered that is above its trip setpoint will be the cause of the trip. In addition, a reset of a stator RTD trip will not be allowed unless both stator RTD temperatures are below their respective set-points. Stator RTD Alarms are not affected by this feature. Stator RTD Alarms will still be issued based on individual RTD temperatures. If the number of stator RTDs is programmed to 1, then no stator RTD voting takes place. YES - RTD Voting enabled NO - RTD Voting disabled Factory Value = YES
7 •	DEFEAT RTD INPUT TO THERMAL MEMORY ? XXX This setpoint is used to enable or defeat the thermal memory RTD bias feature of the relay (see section 3.20). With this feature defeated, the effect of the stator RTD temperature is not included in the thermal memory: YES - RTD bias defeated (RTD temperature does not affect thermal memory) NO - RTD bias enabled (thermal memory affected as per section 3.20). Factory Value = YES
8 *	RTD BIAS CURVE MINIMUM VALUE = XXX C *(Not seen when RTD input to thermal memory is defeated.)* (See section 3.16) This setpoint is used to set the RTD bias minimum value (see Figure 3.7): This setpoint is typically programmed as the ambient temperature. Limits: 0°C to (RTD Bias Center Temp - 1) in degrees C or F Factory Value = 40
9 *	RTD BIAS CENTER T.C. VALUE = XX PERCENT *(Not seen when RTD input to thermal memory is defeated)* This is the thermal capacity value for the center point of the two part curve. This level may be set as the percentage difference of the hot motor thermal damage curve to the cold motor thermal damage curve. $\text{Center TC} = \left[1 - \frac{\text{Hot motor stall time}}{\text{Cold motor stall time}}\right] \times 100$ Limits: 1-99 Factory Value = 15%

• Messages are not displayed if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.

* Messages are not displayed when “RTD INPUT TO THERMAL MEMORY” (setpoints page 5, line 7) is defeated.

Line	Description
10*	**RTD BIAS CENTER TEMP. VALUE = XXX C** *(Not seen when RTD input to thermal memory is defeated)* This is the temperature value for the center point of the two part curve. This setpoint should reflect the temperature of the motor when it is running hot, i.e. Motor running at rated load for a period of time. Limits: (RTD Bias Min Temp + 1) to (RTD Bias Max Temp – 1) in degrees C or F Factory Value = 110
11*	**RTD BIAS CURVE MAXIMUM VALUE = XXX C** *(Not seen when RTD input to thermal memory is defeated.)* This setpoint is used to set the RTD bias maximum value (see Figure 3.7): Limits: (RTD Bias Center Temp + 1) to 200°C or 392°F Factory Value = 155
12	**DEFEAT U/B INPUT TO THERMAL MEMORY ? XXX** This code is used to defeat or enable the unbalance bias function. With this feature defeated the effect of negative sequence unbalance is not included in the thermal memory: YES - Unbalance bias defeated, thermal memory affected by average of three phase currents. NO - Unbalance bias enabled, thermal memory affected by equivalent motor heating current (including negative sequence contribution). **Note: This setpoint should not be changed to NO until the 269 Plus relay has learned a value for K. The learned K factor is used to bias the thermal memory as explained in section 3.20. The learned K value can be examined in ACTUAL VALUES mode, page 6.** Factory Value = YES
13•	**DEFAULT K VALUE = XX (OFF selects learned K)** This setpoint is used to select a value for the negative sequence unbalance K factor (see section 3.20): $K = \frac{175}{I_{LR}^2}$; I_{LR} is the locked rotor current value in per unit; $I_{LR} = \frac{I_{LR}\text{ (amps)}}{I_{FLC}\text{ (amps)}}$ 1-19 (increments of 1) or OFF - OFF indicates learned K value is to be used. Factory Value = 6

* Messages are not displayed when “RTD INPUT TO THERMAL MEMORY” (setpoints page 5, line 7) is defeated.

• Message is not displayed when “DEFEAT U/B INPUT TO THERMAL MEMORY” is set to “Yes”.

Line	Description
14	`DEFEAT LEARNED` `COOL TIME ? XX` This setpoint is used to tell the 269 Plus relay to use the learned motor cooling time values. These times can be examined in ACTUAL VALUES mode, page 6. When learned values are not used, the user entered default times will be used: YES - Relay uses default cool times NO - Relay uses learned cool times from page 6 of ACTUAL VALUES **Note: This setpoint should not be changed until the 269 Plus relay has learned reasonable motor cool down times.** Factory Value = YES
15	`ENTER RUNNING` `COOL TIME = XXX  MINUTES` This setpoint is seen when the learned motor cooling times are not used. This value represents the time for the thermal memory to discharge from 100% to 0% with the motor running in a non-overload condition: 1-45 - cooling time in minutes Factory Value = 15
16	`ENTER STOPPED` `COOL TIME = XXX  MINUTES` This setpoint is seen when the learned motor cooling times are not used by the 269 Plus. This value represents the time for the thermal memory to discharge from 100% to 0% with the motor stopped. The OVERLOAD TRIP lockout time is 85% of this value (see section 3.20). 5-213 - cooling time in minutes Factory Value = 30
17•	`RTD10 AMBIENT SENSOR ?` ` XXX` This setpoint is used to select one of the bearing RTDs, RTD10, as an ambient air temperature sensor. See section 3.20. YES - Indicated RTD will be used for ambient air temperature measurement NO - Indicated RTD will be used for other (non-stator) temperature measurement Factory Value = NO

- Messages are not displayed if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.

Line	Description
18	`ENABLE DIFFERENTIAL` `TRIP?   XXX` This setpoint is used to enable or defeat the Differential Trip function in the relay. The 269 Plus does not have a built-in 87 element, but can accept a contact closure from an external differential relay at terminals 48 and 49 to issue a Differential Trip. When this setpoint is programmed to “NO”, a contact closure at terminals 48 and 49 has no effect. Changing this setpoint to “NO” after a Differential Trip has the same effect obtained when terminals 48 and 49 are open circuited and the RESET key is pressed (See section 2.15), i.e. the Differential Trip is automatically reset. YES - Differential Trip ENABLED NO - Differential Trip DISABLED Factory Value = NO
19	`DEFEAT SPEED SWITCH` `XXX` This setpoint is used to defeat or enable the Speed Switch Trip. (See section 2.16.) YES - Speed Switch function disabled, no speed switch used NO - Speed Switch function enabled, speed switch can be used Factory Value = YES
20	`SPEED SWITCH` `TIME DELAY = XXX.X SEC.` *(Not seen if speed switch function is disabled.)* This setpoint is used to set the time delay for the operation of the speed switch function. (See section 2.16) 0.5-100.0 (increments of 0.5) - time delay in seconds Factory Value = 2.0
21	`ANALOG OUTPUT PARAMETER` `= XXXXXXXXXXXXXX` This setpoint is used to select the analog current output function. Motor Load - Motor current as a percentage of full load Thermal Memory - Motor thermal capacity used • Max Stator RTD - Hottest stator RTD temperature (0-200°C) • RTD#7 - RTD #7 temperature (0-200°C), bearing RTD CT secondary - CT secondary current as a percentage of CT secondary amps rating Factory Value = Motor Load

• Messages are not displayed if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.

Line	Description
22	ANALOG OUTPUT TYPE TYPE = X-XX mA This setpoint is used to select the analog output range. Possible ranges: "4-20 mA" "0-20 mA" "0-1 mA" Factory Value = "4-20 mA"
23	MOTOR LOAD ANALOG OUTPUT FULL SCALE = XXX %FLC This setpoint is used when the “Analog Output Parameter” setpoint is set to “MOTOR LOAD”. Motor load as a percent of full scale can then be represented by the analog output signal. 25% – 250%, in increments of 1%. Factory Value = 100%.
24	Enable Single-shot restart ? XXX This setpoint is used to enable or defeat the single-shot restart feature described in section 3.22. YES - Single-shot restart enabled NO - Single-shot restart disabled Factory Value = NO
25	Enable start inhibit? XXX This setpoint is used to enable or defeat the Start Inhibit feature of the relay described in section 3.20: YES - Start Inhibit enabled NO - Start Inhibit disabled **Note: This setpoint should not be changed until the 269 Plus relay has obtained a reasonable value for the "LEARNED Start Capacity required" (Actual Values mode, page 6).** Factory Value = NO
26	INITIAL START CAPACITY T.C. required = XXX % This line is only seen when the “START INHIBIT” feature in the above setpoint is enabled. Any time this setpoint is modified, the “Learned start thermal capacity” found on page 6 of Actual Values is made equal to this setpoint. This is done after the motor is started and then stopped. The 269 Plus updates the “Learned start T.C.” with the value of this setpoint and uses it in the calculation of any lock-out time that may be required for a start inhibit. (See section 3.20 for more details.) 10–80 (increments of 1) Factory Value = 40

Line	Description
27	**Enable special external reset function? XXX** This setpoint is used to enable or defeat the special external reset feature described in sections 2.13, 3.22. YES - special external reset enabled NO - special external reset disabled Factory Value = NO
28	**RELAY ALARM LATCHCODE = XX** This setpoint allows the choice of output relay latch attributes. A latched output relay must be manually reset. An unlatched relay will be automatically reset when the condition that caused the relay activation goes away. **Note: Trip functions must always be manually reset regardless of the Latchcode value chosen here.** This setpoint allows Alarm functions to be either manually or automatically reset. The Immediate O/L Alarm function will always be automatically reset regardless of the Latchcode. latched = manual reset, unlatched = automatic reset Value / Trip / Alarm / Aux. 1 / Aux. 2 1 / latched / unlatched / unlatched / latched 2 or 3 / latched / latched / unlatched / latched 4 or 5 / latched / unlatched / latched / latched 6 or 7 / latched / latched / latched / latched Factory Value = 1
29	**DRAWOUT FAILSAFE ACCESS CODE = 0 (See manual)** This setpoint appears only if the 269 Plus is a drawout. **NOTE: FOR PROPER OPERATION OF A DRAWOUT UNIT, HARDWARE CHANGES MAY BE REQUIRED IF THE FAILSAFE CODE IS CHANGED. (CONTACT FACTORY)** Entering value from factory for this setpoint allows access of the fail-safe codes for approximately 3 minutes. Factory Value = 0

Line	Description
30	**RELAY FAILSAFE** **CODE = X** *(message does not appear on Drawout versions of 269 Plus unless proper code is entered for the previous setpoints)* This code allows the choice of output relay fail-safe attributes. FS = fail-safe, NFS = non-fail-safe (see Glossary). Value / Trip / Alarm / Aux. 1 / Aux. 2 1 / FS / NFS / NFS / FS (see Figure 2.5) 2 / NFS / FS / NFS / FS 3 / FS / FS / NFS / FS 4 / NFS / NFS / FS / FS 5 / FS / NFS / FS / FS 6 / NFS / FS / FS / FS 7 / FS / FS / FS / FS 8 / NFS / NFS / NFS / FS Factory Value = 1 **Note: Due to the hardware configuration of the 269 Plus drawout relay this code cannot be changed on any drawout models without corresponding hardware change.** **WARNING: In locations where system voltage disturbances cause voltage levels to dip below the range specified in specifications (1.5), any relay contact programmed fail-safe may change state. Therefore, in any application where the "process" is more critical than the motor, it is recommended that the trip relay contacts be programmed non-fail-safe. In this case, it is also recommended that the AUX2 contacts be monitored for relay failure. If, however, the motor is more critical than the "process" then the trip contacts should be programmed fail-safe. See Figure 3.2 and Figure 3.3.**
31	**SPARE INPUT TO READ** **52B CONTACT? XXX** This setpoint is designed to read the 52b contact of a breaker or equivalent normally closed auxiliary contact of a contactor to determine a motor "stop" condition. For proper operation of the 269 Plus, it is required that a 52b contact be wired to terminals 44 and 45 and this setpoint programmed to “YES”. Only if the spare input terminals are to be used for trip or alarm purposes (see next two setpoints), should this setpoint be programmed to “NO”. Programming this setpoint to “NO” results in the 269 Plus detecting a motor stop condition when current drops below 5% of CT. This may result in nuisance lockouts being initiated by the 269 Plus if the motor (synchronous or induction) is running unloaded or idling, and if the starts/hour, time between starts or backspin timer are programmed. YES - Enables the spare input to read the 52B contact and defeats SPARE INPUT ALARM & TRIP. NO - Disables the spare input from reading a 52B contact and allows enabling of SPARE INPUT TRIP & ALARM. Factory Value = NO

Line	Description
32 †	SPARE INPUT ALARM TIME DELAY = XXX SEC. This setpoint is used to set the time delay for the Spare Input Alarm: (See section 2.21) 1-254 (increments of 1) or OFF - time delay in seconds (OFF disables this function) Factory Value = OFF
33 †	SPARE INPUT TRIP TIME DELAY = XXX SEC. This setpoint is used to set the time delay for the operation of the Spare Input Trip function: (See section 2.21) 1-254 (increments of 1) or OFF - time delay in seconds (OFF disables this function) Factory Value = OFF
34	BACKSPIN TIMER TIME DELAY = XXX MIN This setpoint is designed as an Inhibit to prevent starting a motor for a set period of time after the motor stops, for applications on pumps for instance. 1-254 (increments of 1) or OFF - time delay in minutes (OFF disables this function) Factory Value = OFF

† Setpoints are not displayed if “SPARE INPUT TO READ 52B CONTACT?” is set to “YES”.

Line	Description
35	TIME BETWEEN STARTS TIME DELAY = XXX MIN This setpoint is used to inhibit the current start attempt if the time specified has not elapsed since the most recent start. 1-254 (increments of 1) or OFF - time delay in minutes (OFF disables this function) Factory Value = OFF
36	FLC THERMAL CAPACITY REDUCTION = XX PERCENT This setpoint is used to program the level which the thermal memory will discharge to when the motor is running at full load current. This level may be set as the percentage difference of the hot motor thermal damage curve to the cold motor thermal damage curve. (See section 3.20) TCR = $\left[1-\frac{\text{(Hot motor stall time)}}{\text{(Cold motor stall time)}}\right]\times 100$ Range: 0% - 90% increments of 1% (0 disables this feature) Factory Value = 15%

Line	Description
37	THERMAL CAPACITY USED ALARM LEVEL = XXX% This setpoint is used to set the level to which the thermal capacity will be compared. If the thermal capacity equals or exceeds this setpoint for the specified time delay, an alarm will occur (see section 3.19). Range: 1% - 100% increments of 1%, or OFF Factory Value = OFF
38	THERMAL CAPACITY USED TIME DELAY = XXX SEC This setpoint is used to set the time delay for operation of the Thermal Capacity Alarm function. Range: 1 - 255 sec (increments of 1) Factory Value = 5
39	SLAVE ADDRESS = XXX This setpoint is used to set the address of the relay to distinguish it from other devices in a serial communication link (see section 2.18): 1-254 or OFF - relay SLAVE address (OFF indicates no address) Factory Value = 254
40	END OF PAGE FIVE SETPOINT VALUES

Line	Description
1	**PAGE 6: SETPOINT VALUES** **MULTILIN SERVICE CODES** This page is used for 269 Plus relay testing both in the field and at the GE Multilin factory. The first five lines of this page are available to the user for testing the relay once it is installed. The other lines in this page are only accessible to GE Multilin service personnel by entering an access code.
2	**PLACE 269 PLUS IN** **TEST MODE? XXX** All statistical values in Actual Values page 4 and all learned parameters in Actual Values page 6 are not updated when this setpoint is set to “YES”; i.e. as long as the 269 Plus remains in test mode. Normal updating of these Actual Values pages resumes once the 269 Plus is placed in normal running mode by changing this setpoint to “NO”. YES - Places 269 Plus in test mode NO - Places 269 Plus in normal running mode Factory Value = NO
3	**EXERCISE RELAY :** **XXXXXX** This line is used to test the operation of the 269 Plus output relay contacts and to test any connected switchgear. This can only be done when the motor is stopped and not tripped. With the access terminals shorted, pressing the VALUE UP or VALUE DOWN keys, followed by the STORE key, will cause different output relays to change state: NO - No output relays activated TRIP - Trip relay activated ALARM - Alarm relay activated AUX.1 - Aux. 1 relay activated AUX.2 - Aux. 2 relay activated ALL - All output relays activated
4 •	**TEMPERATURE= XXX C FOR** **FORCED RTD # X** This line is used to force the 269 Plus relay to read a single RTD. The RTD number is chosen by pressing the VALUE UP or VALUE DOWN keys. 1-10 - RTD number to be read continuously
5	**ANALOG OUT FORCED** **TO: XXXXXX SCALE** This line is used to force the analog current output of the 269 Plus relay to a certain value to test the relay and any associated meters. NORMAL - Analog current output left unchanged ZERO - Analog current output forced to zero MID - Analog current output forced to the middle of the scale FULL - Analog current output forced to a full scale output

• Messages are not displayed if the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”. This setpoint is located on page 2 of setpoints, line 3.

Line	Description
6	`STATUS = XXXXXX` `FOR: XXXXXXXXXXXX SWITCH` This line can be used to check the status (either OPEN or SHORT) of any of the following terminals: EXT.RESET, EMG.RESTART, ACCESS, SPEED, DIFF., or SPARE
7	`SOFTWARE ACCESS = OFF` `ACCESS STATUS: ENABLED` This line will display the access status as ENABLED or DISABLED, reflecting whether setpoints may be stored or not. Storing a value of OFF for “Software Access” defeats the software access feature. Access is then strictly a function of the access jumper. Once the status reflects ENABLED, a value may be stored for “Software Access”. This value (1–500) will activate the software access feature. The value stored will remain on the screen until the user moves to a new line, presses the CLEAR button, or access becomes disabled. The display of the Software Access code will then revert to “0” so that the code cannot be viewed (a value of “0” may never be stored for this setpoint). The Access Status will remain enabled for approximately 4 minutes after the last key is pressed, or until the access jumper is removed. To enable access again, the user must ensure the access jumper is installed and then store his software access code. 0–500, in increments of 1, or OFF (A value of OFF disables the Software Access feature. A value of “0” indicates that the feature is enabled). Factory Value = OFF.
8	`SERVICE USE ONLY` `CODE = XX` This line is used by GE Multilin service personnel for calibration and service to the 269 Plus relay.
9	`CAN.SERVICE: 905-294-6222` `http://www.ge.com/edc/pm` Canadian service phone number and web site address.
10	`ENCRYPTED SECURITY` `ACCESS CODE = XXX` In the event that the user should forget or lose his Software Access code, the value displayed on this line may be used by a GE Multilin Service person to decipher and notify the user of his Software Access code.
11	`MULTILIN 269 PLUS RELAY` `REVISION  269P.XX.X` This is the 269 Plus relay firmware revision identifier line.

Line	Description
12	**269 PLUS SERIAL NUMBER** **SERIAL #: D52 X XXXX** *(Not a setpoint.)* This is the 269 Plus relay serial number identifier, where: D: Hardware revision 52: Product code X: Last digit of production year XXXX: Four digit serial number
13	**END OF PAGE SIX** **SETPOINT VALUES**

Line	Description
1	**PAGE 7: SETPOINT VALUES** **METERING SETPOINTS** This page is used to enable the 269 Plus to display and/or trip and alarm on voltage or power values received from a GE Multilin meter (MPM).
2	**METERING SETPOINTS SET** **AND METER ON LINE? XXX** This setpoint is used to enable 269 Plus communication with a GE Multilin meter. **NOTE**: CT and VT ratio must be programmed before "YES" is entered for this setpoint. YES - 269 Plus initiates communication and enables all page 7 setpoints as programmed. NO - 269 Plus no longer communicates with the meter and all page 7 setpoints are disabled. Factory Value = NO
3	**METER MODULE** **NOT INSTALLED** This message is shown when the answer to the question in the above setpoint is “NO”; i.e. the meter is not online.
4	**METER PHASE CT** **PRIMARY = XXX AMPS** Enter the phase CT primary value of the current transformers connected to the meter. **NOTE**: Failure to enter a correct value for CT primary will result in incorrect values from the meter. 20-1500 (increments of 1) Factory Value = 100
5	**PHASE V.T. RATIO** **V.T. RATIO = XXX:1** Enter the phase VT ratio of the voltage transformers connected to the meter. VT Ratio = VT Primary / VT Secondary (round to one decimal point). **NOTE**: Failure to enter a correct value for VT ratio will result in incorrect values from the meter. 1.0-255.0 in steps of 0.1 Factory Value = 1
6	**METER PHASE VT SECONDARY** **VT SECONDARY = XXX VOLT** Enter the VT secondary of the voltage transformer connected between the system and the meter. All under and overvoltage protection is expressed as a percent of this setpoint. 40–240 (increments of 1) Factory Value = 120

Line	Description
7	ENABLE U/V TRIP & ALARM IF AVG. VOLTS=0? XXX This setpoint should be used if an undervoltage alarm or trip is desired on a dead bus, i.e. when the average voltage of all three phases is zero. YES - Enables undervoltage trip and alarm features if the average voltage received from the meter is zero. Reset of an U/V trip or alarm is only possible if the average voltage goes above the setpoints. NO - If the bus is de-energized (or dead), the 269 Plus will not issue an undervoltage trip or alarm. In fact, if an undervoltage trip or alarm condition existed prior to the average voltage becoming zero, these conditions may be reset after the average voltage becomes zero. Factory Value = NO
8	UNDERVOLTAGE ALARM LEVEL U/V ALARM = XX %VT This setpoint sets the threshold for the undervoltage alarm condition as a percentage of VT primary. The alarm level programmed in this setpoint is compared to the average voltage received from the meter. NOTE: To detect an undervoltage alarm upon complete loss of all three phases, the setpoint "Enable U/V Trip & Alarm if Avg. Volts=0?" must be set to Yes. 30-95 % (increments of 1) or OFF Factory Value = OFF
9	U/V ALARM TIME DELAY TIME DELAY = XXX SEC This setpoint sets the time that an undervoltage alarm condition must persist in order to facilitate an alarm. 1-255 seconds (increments of 1) Factory Value = 10
10	UNDERVOLTAGE TRIP LEVEL U/V TRIP = XX %VT This setpoint sets the threshold for the undervoltage trip condition as a percentage of VT primary. The trip level programmed in this setpoint is compared to the average voltage received from the meter. NOTE: To detect an undervoltage trip upon complete loss of all three phases, the setpoint "Enable U/V Trip & Alarm if Avg. Volts=0?" must be set to Yes. 30-95 % (increments of 1) or OFF Factory Value = OFF

Line	Description
11	U/V TRIP TIME DELAY TIME DELAY = XXX SEC This setpoint sets the time that an undervoltage trip condition must persist in order to facilitate a trip. 1-255 seconds (increments of 1) Factory Value = 5
12	OVERVOLTAGE ALARM LEVEL O/V ALARM = XXX %VT This setpoint sets the threshold for the overvoltage alarm condition as a percentage of VT primary. The alarm level programmed in this setpoint is compared to the average voltage received from the meter. 101–115% (increments of 1) or OFF. Factory Value = OFF.
13	OVERVOLTAGE ALARM TIME DELAY = XXX SEC This setpoint sets the time that an overvoltage alarm condition must persist in order to facilitate an alarm. The alarm level programmed in this setpoint is compared to the average voltage received from the meter. 1-255 seconds (increments of 1) Factory Value = 10
14	OVERVOLTAGE TRIP LEVEL O/V TRIP = XX %VT This setpoint sets the threshold for the overvoltage trip condition as a percentage of VT primary. The trip level programmed in this setpoint is compared to the average voltage received from the meter. 101–115 % (increments of 1) or OFF Factory Value = OFF
15	O/V TRIP TIME DELAY TIME DELAY = XXX SEC This setpoint sets the time that an overvoltage trip condition must persist in order to facilitate a trip. 1-255 seconds (increments of 1) Factory Value = 5

Line	Description
16	BLOCK PF PROTECTION ON START? XXX When programmed to “YES”, the “PF PROTECTION DELAY” setpoint is not shown. Instead, the “BLOCK PF ALARM & TRIP ON START” setpoint is shown. YES - “BLOCK PF ALARM & TRIP ON START BY” is shown and may be enabled; “PF PROTECTION NO - “BLOCK PF ALARM & TRIP ON START BY” is not shown; “PF PROTECTION DELAY” is shown and may be enabled. Factory Value = NO
17	BLOCK PF ALARM & TRIP ON START BY: XXX SECONDS When enabled, Power Factor alarm and trip protection are blocked from the time the motor starts until the time delay programmed expires. 1–254 seconds (increments of 1) or OFF (OFF disables this function)
18	PF PROTECTION DELAY TIME DELAY = XXX SEC When enabled, after a successful start, the Power Factor must come within range of the Power Factor lead/lag trip levels for the specified period of time before the Power Factor trip and alarm features become active. 1-254 seconds (increments of 1) or OFF (OFF disables this function) Factory Value = OFF
19	POWER FACTOR LEAD ALARM LEVEL = X.XX This setpoint is used to set the power factor "lead" alarm threshold level for a power factor alarm condition. 0.05-0.99 (increments of 0.01) or OFF Factory Value = OFF
20	POWER FACTOR LAG ALARM LEVEL = X.XX This setpoint is used to set the power factor "lag" alarm threshold level for a power factor alarm condition. 0.05-0.99 (increments of 0.01) or OFF Factory Value = OFF

Line	Description
21	**POWER FACTOR ALARM** **TIME DELAY = XXX** This setpoint is used to set the time delay that a power factor alarm condition must persist for in order to facilitate an alarm. 1-255 seconds (increments of 1) Factory Value = 10
22	**POWER FACTOR LEAD** **TRIP LEVEL = X.XX** This setpoint is used to set the power factor "lead" trip threshold level for a power factor trip condition. 0.05-0.99 (increments of 1) or OFF Factory Value = OFF
23	**POWER FACTOR LAG** **TRIP LEVEL = X.XX** This setpoint is used to set the power factor "lag" trip threshold level for a power factor trip condition. 0.05-0.99 (increments of 0.01) or OFF Factory Value = OFF
24	**POWER FACTOR TRIP** **TIME DELAY = XXX** This setpoint is used to set the time delay that a power factor trip condition must persist for in order to facilitate a trip. 1-255 seconds (increments of 1) Factory Value = 5
25	**POSITIVE KVAR ALARM** **LEVEL = +XXXXX KVARS** This setpoint is used to set the positive kvar limit threshold for a kvar alarm condition. 100-25000 (increments of 100) or OFF Factory Value = OFF

Line	Description
26	NEGATIVE KVAR ALARM LEVEL = -XXXXX KVARS This setpoint is used to set the negative kvar limit threshold for a kvar alarm condition. 100–25000 (increments of 100) or OFF Factory Value = OFF
27	KVAR ALARM TIME DELAY = XXX SEC This setpoint is used to set the time that a KVAR alarm condition must persist for in order to facilitate an alarm. 1-255 seconds (increments of 1) Factory Value = 5
28	ENABLE VOLTAGE PHASE REVERSAL? XXX This setpoint is used to enable or disable the phase reversal trip feature as detected from the meter monitoring the line voltages. YES - enable voltage phase reversal NO - disable voltage phase reversal Factory Value = NO
29	ANALOG OUT SCALE FACTOR 100KWxXXX 30KVARxXXX This setpoint is used to set the full scale value for the meter's analog output (KWATTS and KVARS). 1-255 (increments of 1) Factory Value = 1
30	END OF PAGE SEVEN SETPOINT VALUES

3.5 HELP Mode

This display mode should be used whenever help is required in using the 269 Plus relay. The HELP key can provide the user with information on the proper function and use of each key on the keypad or can provide information about the currently displayed ACTUAL VALUES, SETPOINTS, or TRIP/ALARM message. Pressing the HELP key has no effect when a flash message or HELP message is on the display.

If the HELP key is pressed with the first line of a page (ie. a page header) on the display the following message will appear:

```
Press KEY of interest or
HELP again for details
```

The user should then press the key for which instruction is required or press the HELP key again to access information on the previously displayed ACTUAL VALUES, SETPOINTS, or TRIP/ALARM message. When the desired key is pressed the display will show the message:

```
Press LINE DOWN for
info or CLEAR to exit
```

The LINE DOWN key can then be used to display the requested HELP message.

If the HELP key is pressed with any line that is not a page header on the display the HELP message shown will be for the previously displayed ACTUAL VALUES, SETPOINTS, or TRIP/ALARM message.

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

3.6 TRIP/ALARM Mode

TRIP/ALARM mode can only be entered when a motor value exceeds a setpoint value or an alarm becomes active. Every trip and alarm condition has a separate message so that the nature of the problem can be identified.

TRIP/ALARM mode will be entered whenever a setpoint is exceeded or an alarm condition arises regardless of whether an output relay activation occurs. For example, if the "STATOR RTD ALARM LEVEL" setpoint is exceeded, but this function is assigned to "NO" output relay, the 269 Plus will enter TRIP/ALARM mode but no output relay activation will occur.

To leave TRIP/ALARM mode the ACTUAL VALUES, SET POINTS, or HELP keys can be pressed. Doing this will not change the state of the output relays but will allow the user to access other motor and relay information to determine the cause of the trip. The active TRIP/ALARM messages are found in ACTUAL VALUES mode, page 5, immediately in front of the pre-trip motor data. If any trip/alarm function is active and no key is pressed for a time of 20 seconds, the 269 Plus relay display will return to the appropriate TRIP/ALARM message.

Only one type of relay trip can occur at any one time. However, a trip and an alarm or multiple alarms can occur at the same time. If this is the case the 269 Plus relay display will show the TRIP/ALARM message for the trip or alarm with the highest priority. Any other active messages can be examined by using the LINE DOWN key. The complete set of TRIP/ALARM messages is shown in Table 3-4 together with a description of the conditions causing the relay to enter TRIP/ALARM mode. The messages are shown in order of display priority.

NOTE: Only one TRIP function or Inhibit can occur at any one time. TRIP functions <u>must</u> therefore be used to trip out the motor. Once one TRIP function or Inhibit is active no other TRIPs can occur. If multiple ALARMs occur, the other ALARM messages may be viewed by pressing the LINE DOWN key.

Table 3-4 TRIP/ALARM Messages and Fault Diagnosis

Pri.	Information Line	Explanation	Suggestions	Manual Ref.
1	SELF-TEST ALARM A/D H/W FAIL	Problem in A/D circuit detected by internal self-test. Service required.	- Return relay for service.	**3.23**
	SELF-TEST ALARM RTD H/W FAIL. RTDs OFF	Problem in RTD circuit detected by internal self-test. Service required. Number of stator RTDs is set to zero, and all RTD setpoints are set to “OFF”.	- Return relay for service.	
	SELF-TEST ALARM RAM FAIL	Problem in RAM detected by internal self-test. Service required.	- Return relay for service.	
	SELF-TEST ALARM FACTORY SETPOINTS LOADED	Problem in NOVRAM detected by internal self-test. Service required.	- Return relay for service.	
2	PHASE S/C TRIP	Short Circuit Trip Level exceeded for a time greater than the Short Circuit Time Delay.	- Check for motor winding shorts.	3.14
3	RAPID TRIP	Rapid trip / Mech. Jam Trip Level exceeded for a time greater than the Rapid Trip Time Delay.	- Check system for jams / excessive load.	3.13
4	SINGLE PHASE TRIP	Unbalance of over 30% present for a time greater than 4 seconds.	- Check continuity of incoming three phase supply.	3.10
5	GROUND FAULT TRIP	Ground Fault Trip Level exceeded for a time greater than the Ground Fault Trip Time Delay.	- Check for motor winding to case or ground shorts. - Check motor for moisture or conductive particles.	3.11
6	OVERLOAD TRIP LOCKOUT TIME = XXX MIN.	Motor thermal capacity exceeded. Motor lock-out time is also shown.	- Excessive load with motor running or locked rotor on start. - Wait for motor to cool.	3.18
7	START INHIBIT LOCKOUT TIME = XXX MIN.	Insufficient thermal capacity available for motor to start (ie. capacity remaining is less than Learned Start Capacity).	- Wait for motor to cool.	3.20
8	STARTS/HOUR LOCKOUT TIME = XXX MIN.	Total number of motor starts over the past hour greater than Number of Starts per Hour setpoint.	- Reduce number of starts during normal motor operation.	3.9
9	TIME BETWEEN STARTS LOCKOUT TIME = XXX MIN	Time elapsed since the last start has not exceeded Time Between Starts setpoint.	- Wait until Inhibit expires.	
10	BACKSPIN TIMER LOCKOUT TIME = XXX MIN	Time elapsed since the motor has stopped has not exceeded the Backspin Timer setpoint.	- Wait until inhibit expires.	
11	UNBALANCE TRIP	Unbalance Trip Level exceeded for a time greater than the Unbalance Trip Time Delay (all phases > 0.1 × FLC).	- Check incoming supply phases for unbalance. - Check for motor winding shorts. - Increase Trip Level if required.	3.10
12	STATOR RTD TRIP RTD # X = XXX C	Stator RTD Trip Level temperature exceeded on at least one stator RTD.	- Check motor ventilation and ambient temperature. - Allow motor to cool.	3.16
13	RTD TRIP RTD # X = XXX C	RTD Trip Level temperature exceeded.		3.17
14	ACCEL. TIME TRIP	Motor did not enter a normal running state (ie. phase current < FLC) within Acceleration Time setpoint.	- Excessive load or locked rotor on start.	3.8
15•	PHASE REVERSAL TRIP	Phases not connected to motor in proper sequence.	- Check incoming phase sequence and VT polarity.	3.19
16	UNDERCURRENT TRIP	Phase current less than U/C Trip setpoint for a time greater than the U/C Trip time delay.	- Check system for loss of load.	3.12

Pri.	Information Line	Explanation	Suggestions	Manual Ref.
17	SPEED SWITCH TRIP	Non-closure of speed switch contacts within Speed Switch Time Delay.	- Locked rotor on start.	2.16
18	DIFFERENTIAL INPUT TRIP	Closure of differential relay contacts.	- Differential relay trip.	2.15
19	SPARE INPUT TRIP	Spare Input contact closure.	- Check device connected to Spare Input terminals.	2.21
20•	UNDERVOLTAGE TRIP	Low incoming voltage from substation.	- Adjust transformer tap changer.	
21•	OVERVOLTAGE TRIP	High voltage from substation.	- Adjust transformer tap changer.	
22•	POWER FACTOR TRIP	Fault in excitation control system.	- Check excitation.	
23	OVERLOAD WARNING TIME TO TRIP = XXXXX	Phase current greater than Immediate O/L Level setpoint.	- Reduce motor load.	3.15
24	GROUND FAULT ALARM G/F = XX PERCENT	Ground Fault Alarm Level exceeded for a time greater than the Ground Fault Time Delay.	- Check motor windings for shorts, moisture, or conductive particles.	3.11
25	UNBALANCE ALARM U/B = XX PERCENT	Unbalance Alarm Level exceeded for a time greater than the Unbalance Time Delay.	- Check incoming phases for unbalance.	3.10
26	UNDERCURRENT ALARM I(3 ph avg) = XXXX A RMS	Phase current less than Undercurrent Alarm Level for a time greater than the Undercurrent Alarm Time Delay.	- Check system for loss of load.	3.12
27	MECHANICAL JAM ALARM I(3 ph AVG) = XXX AMPS	Phase current exceeded Mechanical Jam Alarm Level for a time greater than the Mechanical Jam Alarm Time Delay.	- Check system for jams/excessive load.	3.13
28	STATOR RTD ALARM RTD # X = XXX C	Stator RTD Alarm Level temperature exceeded on at least one stator RTD.	- Check motor ventilation and ambient temperature.	3.16
29	RTD ALARM RTD # XX = XXX C	RTD Alarm Level temperature exceeded.		3.17
30	STATOR RTD HIGH ALARM RTD # XX = XXX C	Stator RTD High Alarm Level temperature exceeded.	- Check motor ventilation and ambient temperature.	3.16
31	RTD HIGH ALARM RTD # XX = XXX C	RTD High Alarm Level temperature exceeded.		3.17
32	BROKEN RTD LINE see RTD ACTUAL VALUES	Open circuit on RTD.	- Check continuity of RTDs.	3.16, 3.17
33	LOW TEMPERATURE ALARM RTD # XX	Indicating a possibly shorted RTD if normal motor running temperature is above 0°C (32°F).	- Check continuity of RTD	3.16 3.17
34	SPARE INPUT ALARM	Spare Input contact closure.	- Check device connected to Spare Input terminals.	2.21
35	THERMAL CAPACITY ALARM USED = XXX PERCENT	Thermal capacity used equals or exceeds setpoint		
36•	UNDERVOLTAGE ALARM V(3 ph avg) = XXXXX	Low incoming voltage from substation.	- Adjust transformer tap changer.	

Pri.	Information Line	Explanation	Suggestions	Manual Ref.
37•	OVERVOLTAGE ALARM V(3 ph avg) = XXXX	High incoming voltage from substation.	- Adjust transformer tap changer.	
38•	POWER FACTOR ALARM PF = XX.XX LAG	Fault in excitation control system.	- Check excitation.	
39•	KVAR LIMIT ALARM KVAR = +XXXXX	Machine KVAR limit exceeded.	- Adjust excitation.	
40•	METER FAILURE (COMMUNICATION HARDWARE)	Meter is not connected or not responding.	- Check meter control power. - Check meter wiring to 269.	
41•	METER FAILURE (INCOMPATIBLE REVISIONS)	Meter firmware is an older revision than the 269 firmware.	- Upgrade meter firmware	

• Available only if a GE Multilin meter (MPM) is installed and on-line (see pg. 7 setpoints, line 2)

3.7 Phase CT and Motor Full Load Current Setpoints

The "PHASE C.T. RATIO" is entered into the 269 Plus relay in SETPOINTS mode, page 1. This value must be entered correctly in order for the relay to read the actual motor phase currents. The choice of phase CTs depends on the Full Load Current of the motor. The Phase CTs should be chosen such that the Full Load Current is not less than 50% of the rated phase CT primary. For maximum accuracy, the phase CT primary should be equal to the FLC of the motor, but never more. The maximum phase CT primary current is 1500A. For higher ratings, please contact the factory.

The "MOTOR FULL LOAD CURRENT" setpoint is used by the relay as the maximum continuous current that the motor can draw without overheating and should be taken from the motor nameplate or data sheets. It is entered into the relay in SETPOINTS mode, page 1.

If the motor has a service factor, it may be accommodated using the Overload Pickup Level setpoint. See Sections 3.18 and 3.20.

When the relay detects a current greater than the Overload Pickup level x FLC, the time/overload curve will come into effect, and the Trip relay will activate after a time determined by the overload curve shape, the amount of phase current unbalance present and the RTD bias (when enabled), and the thermal memory contents.

3.8 Acceleration Time Setpoint

The acceleration time of the drive system is entered into the 269 Plus relay in SETPOINTS mode, page 1. This feature is strictly a timer that can be used to protect the equipment driven by the motor. This time does not affect the thermal memory calculated by the relay.

The acceleration time is used by the relay as the maximum allowable time between a motor start attempt and the beginning of normal running operation. A motor start attempt is detected by the 269 Plus when an average phase current greater than one full load current is detected within one second following a motor stop condition. A normal running condition will be detected by the relay when the phase current drops below overload pickup ×FLC for any length of time following a start. When the phase current drops below 5% of CT primary rated amps, a motor stop will be detected. In the case where a motor may idle at less than 5% of rated CT primary Amps (ie. synchronous motor or unloaded induction motor) it is imperative that a 52b contact is input to the 269 Plus (52b contact reflects the opposite state of the breaker). The 269 Plus will then determine a “STOP” condition if motor current is less than 5% of CT primary and the 52b contact is closed (see section 3.9).

To protect against a locked rotor condition the 269 Plus relay allows its thermal memory (see section 3.20) to fill during a start. Thus if the heat produced by a locked rotor condition causes the thermal capacity of the motor to be exceeded, an overload trip will be initiated. The acceleration time setpoint can only be used for driven load protection, not locked rotor protection.

If the Acceleration Time function is not required, the setpoint should be set to "OFF".

3.9 Inhibits

An Inhibit is a feature that becomes active only once a motor 'STOP' condition has been detected and prevents motor starting until the Inhibit has timed out. There are four Inhibit features in the 269 Plus. They are Starts/Hour, Time Between Starts, Start Inhibit, and Backspin Timer. These four features are assigned to output relays in one group as Inhibits. After a motor has stopped, if any of the Inhibits are active, the output relay(s) assigned to Inhibits will activate, and the message that appears will represent the Inhibit with the longest lockout time remaining. None of the Inhibits will increment any of the statistical values of page four of actual values, and all of the Inhibits are always auto-reset, unless they are assigned to AUX1 and the Special External Reset function in Setpoints page 5 is enabled (see sections 2.13 & 3.22).

The allowable number of motor Starts per Hour is entered into the 269 Plus relay in SETPOINTS mode, page 1. The relay keeps a record of the number of motor starts over the past hour and will cause an output relay activation when this value is equal to the setpoint value. An Inhibit will occur only after the motor is stopped. This setpoint should be obtained from the motor manufacturer's data sheets. If more than 5 starts/hour are allowed, this setpoints should be stored as "OFF". The relay starts/hour counter will be saved if power is lost to the unit. Note that the 269 Plus relay must detect all motor start attempts (see section 3.8) in order for this feature to operate correctly.

A value in minutes for the Time Between Starts feature is entered into the 269 Plus relay in setpoints mode, page 5. The time between starts timer is loaded during a start condition and begins to decrement (see Actual Values page 1, line 7). Once the motor stops, if the timer has not decremented to zero, an Inhibit will occur. The Inhibit will time out when the timer decrements to zero, and another start will be possible. The Start Inhibit feature is explained in detail in section 3.20.

A value in minutes for the Backspin Timer feature may be entered into the 269 Plus relay in Setpoints mode, page 5. This timer has been developed to prevent motor starts while the rotor continues to rotate. In the case of a pump motor, the rotor may actually spin backwards when the pump is stopped creating a very hazardous condition for a motor start. If the setpoint is enabled, the timer is loaded once the motor stops and the inhibit becomes active. The inhibit will time out when the Backspin Timer is zero, and another start will be possible.

All of the Inhibits will be cleared if the Emergency Restart terminals are shorted (3.21), with the exception of the Backspin Timer. Due to the potentially dangerous conditions of a rotor spinning backwards, the only way to defeat the Backspin Timer is to turn the setpoint "OFF".

NOTE: It is recommended that a very liberal time be set for the Backspin Timer, as it is only a timer and cannot sense rotor rotation.

NOTE: Due to the nature of the Inhibit features, they fall into the class of 269 Plus Trip features and therefore they must be active only during a motor 'STOP' condition. (ONLY ONE TRIP OR INHIBIT MAY OCCUR AT ANY ONE TIME). The detection of a motor 'STOP' condition is important. In the case where a motor may idle at less than 5% of rated CT primary amps (i.e. synchronous motors), it is imperative that a 52B contact is input to the spare terminals (44,45) to detect a motor 'STOP' condition (52B contact reflects the opposite state of the breaker). Enabling the 52B contact setpoint in page 5 of setpoints defeats the Spare Input trip/alarm features and the 269 Plus will determine a 'STOP' condition if motor current is less than 5% CT primary and the 52B contact is closed.

It is recommended that the trip functions and inhibit features be assigned to different relays. For example, all the trip functions may be assigned to activate the TRIP relay when a trip condition is met. The Inhibit Lockout should then be assigned to activate the AUX1 relay when the motor stops and an inhibit is issued by the 269 Plus. Separating TRIPs and INHIBITs in this manner makes it easier for operators to properly diagnose problems and take appropriate corrective action.

Also, the “CAUSE OF LAST EVENT” message seen on page 5 of Actual Values clearly shows whether the last event was a TRIP or an INHIBIT.

Note: Inhibit lockouts are assigned to the AUX1 relay as a factory default. Ensure that AUX1 contacts are properly wired in your control circuit. See Figure 3.2 and Figure 3.3 for wiring details.

3.10 Unbalance Setpoints

Unbalanced three phase supply voltages are a major cause of induction motor thermal damage. Unbalance can be caused by a variety of factors and is common in industrial environments. Causes can include increased resistance in one phase due to pitted or faulty contactors, transformer faults and unequal tap settings, or non-uniformly distributed three phase loads. The incoming supply to a plant may be balanced but varying single phase loads within the plant can cause voltage unbalance at the motor terminals. The most serious case of unbalance is single phasing which is the complete loss of one phase of the incoming supply. This can be caused by a utility supply problem or by a blown fuse in one phase and can seriously damage a three phase motor.

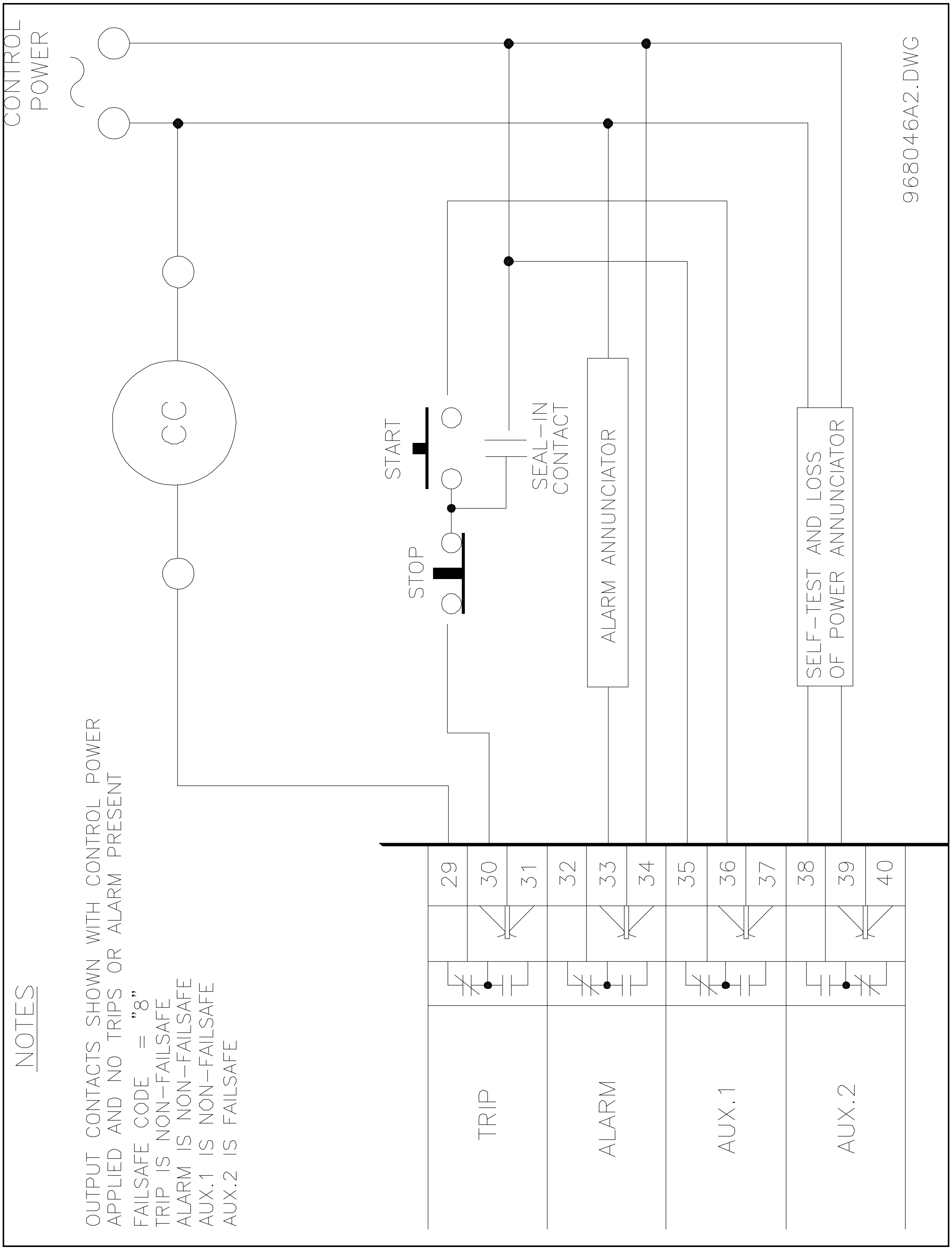


Figure 3.2 Wiring Diagram for Contactors

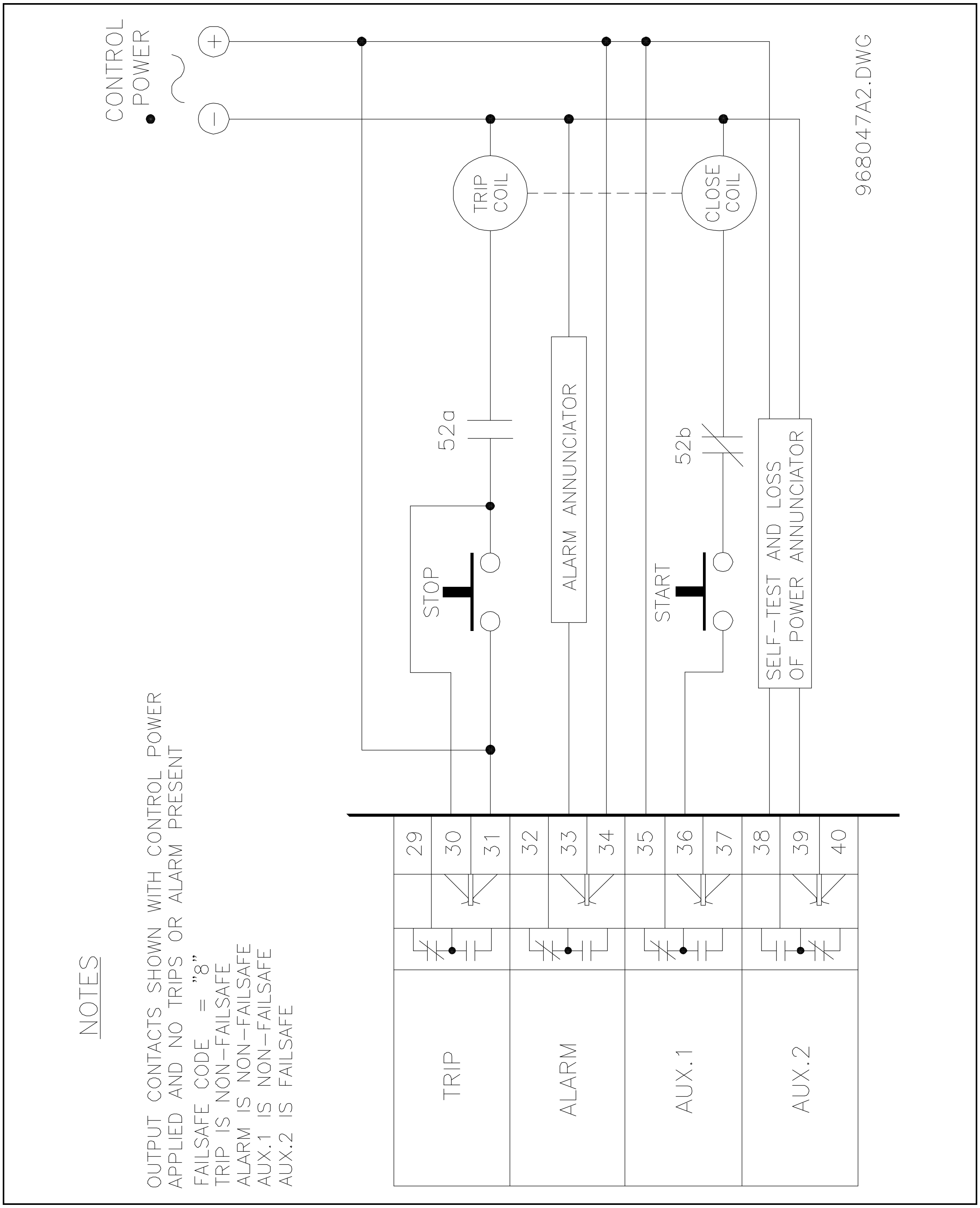


Figure 3.3 Wiring Diagram for Breakers

Unbalance at the motor terminals means an increase in the applied negative sequence voltage. This results in a large increase in the negative sequence current drawn by the motor due to the relatively small negative sequence impedance of the rotor. This current is normally at about twice the power supply frequency and produces a torque in the opposite direction to the desired motor output. For small unbalances the overall output torque will remain constant, but the motor will be developing a large positive torque to overcome the negative sequence torque. These opposing torques and the high negative sequence current produce much higher rotor losses and consequently greatly increased rotor heating effects. Stator heating is increased as well, but to a much smaller extent. The amount of unbalance that a given motor can tolerate is therefore dependent on the rotor design and heat dissipation characteristics.

Persistent, minor voltage unbalance can thus lead to rotor thermal damage while severe unbalance such as single phasing can very quickly lead to a motor burnout.

For phase currents above 100% FLC, the 269 Plus relay calculates the ratio of the negative to positive sequence currents (In/Ip) and uses this ratio in two separate protective functions. It is used to bias the thermal memory of the relay which represents the thermal capacity of the motor as a whole (this can be enabled in SETPOINTS mode, page 5), and it is used for separate unbalance protection. The method of determining In/Ip is independent of actual line frequency or phase current lead/lag characteristics, and when enabled is used to bias the thermal memory (see section 3.20). This negative sequence unbalance method provides readings similar to the NEMA unbalance calculation but gives more realistic results for the thermal effect of unbalance on the motor (for a 269 Plus unbalance example, see Appendix A). For phase currents below 100% FLC, the relay calculates the ratio of In to full load current (In/IFLC) and uses this to provide protection. This avoids nuisance trips due to relatively high levels of In with lower levels of Ip that may create high U/B levels at low loads.

For unbalance protection, trip and alarm In/Ip ratios may be chosen along with appropriate persistence times (time delays) in SETPOINTS mode, page 1. If no unbalance protection is desired, the trip and alarm levels should be set to "OFF". The delay times will then be disregarded by the relay. Above 100% FLC, if an unbalance of more than 30% persists for more than 4 seconds, a "SINGLE PHASE TRIP" will result. Below 100% FLC, if motor load is >25%, and any one phase reads zero, this will also be considered a single phase condition. The single phase time delay may be adjusted by contacting the factory.

Note: If the "UNBALANCE TRIP LEVEL" is set to "OFF," single phase protection will be turned off.

It should be noted that a 1% voltage unbalance typically translates into a 6% current unbalance. So, if for example the supply voltage is normally unbalanced up to 2%, the current unbalance seen by a typical motor would be $2 \times 6 = 12\%$. Set the alarm pickup at 15% and the trip at 20% to prevent nuisance tripping. 5 or 10 seconds is a reasonable delay.

Other factors may produce unbalanced phase currents. Cyclic, pulsating and rapidly changing loads have been observed to create unbalance in machines such as ball mill grinders, shredders, crushers, and centrifugal compressors, where the load characteristics are constantly and rapidly changing.

Under such circumstances, and in order to prevent nuisance unbalance trips or alarms, the pickup level should not be set too low. Also, a reasonable time delay should be set to avoid nuisance trips or alarms. It is recommended that the unbalance input to thermal memory be used to bias the thermal model, thus accounting for motor heating that may be caused by cyclic short term unbalances.

3.11 Ground Fault (Earth Leakage) Setpoints

Aging and thermal cycling can eventually cause a lowering of the dielectric strength of the insulation in the stator winding. This can produce a low impedance path from the supply to ground resulting in ground fault currents which can be quite high in solidly grounded systems. In resistance grounded systems there is a resistance in series with the supply source to limit ground fault current and allow the system to continue operating for a short time under fault conditions. The fault should be located and corrected as soon as possible, however, since a second fault on another phase would result in a very high current flow. In addition to damaging the motor, a ground fault can place the motor casing above ground potential thus presenting a safety hazard to personnel.

On the occurrence of a ground fault caused by insulation breakdown, an unprotected motor will commonly suffer severe structural damage and have to be replaced. The fault could also shut down the power supply bus to which the faulty motor is connected.

Ground faults can occur in otherwise good motors because of environmental conditions. Moisture or conductive dust, which are often present in mines, can provide an electrical path to ground thus allowing ground fault current to flow. In this case, ground fault protection should shut down the motor immediately so that it can be dried or cleaned before being restarted.

For ground fault protection by the 269 Plus relay, all three of the motor conductors must pass through a separate ground fault CT (see section 2.6). The CT may be either GE Multilin's 50:0.025A (2000:1 ratio) or 20:5 up to 1500:5 and is chosen in SETPOINTS mode, page 1. Separate ground fault trip and alarm levels (entered in actual ground fault amps), and persistence times (time delays) may also be set. The ground fault trip can be instantaneous, or up to 20.0 seconds of time delay can be chosen to allow the 269 Plus relay to be coordinated with other protective devices and switchgear.

The amount of current that will flow due to a fault depends on where the fault occurs in the motor winding. A high current flow will result if a short to ground occurs near the end of the stator winding nearest the terminal voltage. A low ground fault current will flow if a fault occurs at the neutral end of the winding since this end should be a virtual ground. Thus a low level of ground fault pickup is desirable to protect as much of the stator winding as possible and to prevent the motor casing from becoming a shock hazard. In resistance grounded systems the ground fault trip level must be set below the maximum current limited by the ground resistor or else the relay will not see a large enough ground fault current to cause a trip.

The ground fault trip level should be set as low as possible, although too sensitive a setting may cause nuisance trips due to capacitive current flow. If nuisance trips occur with no apparent cause the trip level should be increased; conversely if no nuisance trips occur a lower fault setpoint may be desirable.

CAUTION: Care must be taken when turning on this feature. If the interrupting device (circuit breaker or contactor) is not rated to break ground fault current (low resistance or solidly grounded systems), the trip setpoint should be set to "OFF". The feature may be assigned to the AUX1 relay and connected such that it trips an upstream device that is capable of breaking the fault current.

3.12 Undercurrent Setpoints

These setpoints are found in SETPOINTS mode, page 1 and are normally used to detect a decrease in motor current flow caused by a loss of, or decrease in, motor load. This is especially useful for indication of loss of suction for pumps, loss of airflow for fans, or a broken belt for conveyors. When the current falls below the setpoint value for the setpoint time, the relay assigned to the undercurrent trip or alarm function will become active.

If this feature is used for loss of load detection, the "UNDERCURRENT ALARM LEVEL" or "UNDERCURRENT TRIP LEVEL" setpoints should be chosen to be just above the motor current level for the anticipated reduced load condition. If the feature is not desired, the alarm and trip levels should be set to "OFF". The delay time setpoints will then be ignored by the relay.

If the motor is normally operated at a current level below its rated full load current, this feature may be used for a pre-overload warning. This is accomplished by setting the "UNDERCURRENT ALARM LEVEL" to be above the normal operating current of the motor but below the rated full load current. In this way the undercurrent function will cause the relay assigned to it to become inactive if the motor current increases above the Undercurrent setpoint level. This would indicate an abnormal loading condition prior to an actual motor overload.

The output relay assigned to the undercurrent alarm function will automatically reset itself when the motor stops (i.e. when the phase current becomes zero) unless this relay is programmed as latched (see "RELAY ALARM LATCHCODE", SETPOINTS, page 5).

The undercurrent trip function is always latched and a reset is required to clear the trip.

3.13 Rapid Trip / Mechanical Jam Setpoints

These setpoints are found in SETPOINTS mode, page 1 and are used to protect the driven mechanical system from jams. If used, this feature is active only after the motor has successfully started, and will cause relay activation in the event of a stall while the motor is running.

A current surge of 150% to 600% of motor full load from 0.5 to 125.0 seconds during motor operation, depending on the setpoints chosen, will cause the relay assigned to the Rapid Trip or Mechanical Jam alarm functions to become active. To disable the Rapid Trip or Mechanical Jam alarm functions, the "RAPID TRIP/MECH. JAM TRIP LEVEL" or "MECHANICAL JAM ALARM LEVEL" setpoint should be set to "OFF". The "RAPID TRIP TIME DELAY" and "MECHANICAL JAM ALARM TIME DELAY" setpoints will then be disregarded by the relay.

Note: These features are not recommended for use with systems that experience overloads as part of normal operation.

3.14 Short Circuit Setpoints

The Short Circuit protective function provides overriding protection for any large phase current. Complete protection from phase-to-phase and phase-to-ground faults is provided with this feature. This feature is active at all times, including during motor starts, unless the "SHORT CIRCUIT TRIP LEVEL" is set to OFF. The setpoints are in SETPOINTS mode, page 1.

The phase current short circuit trip level can be set from 4 to 12 times motor full load current. The trip can be instantaneous or can be delayed by up to 20.5 seconds to facilitate coordination with system switchgear. If this feature is not desired the "SHORT CIRCUIT TRIP LEVEL" setpoint should be set to "OFF". If this is done the relay will disregard the "SHORT CIRCUIT TIME DELAY" setpoint.

CAUTION: When using this feature be certain that the interrupting device can safely open to break the short circuit duty. Otherwise this setpoint must be set to OFF. Other means of interrupting fault currents must then be used (e.g. fuses).

3.15 Immediate Overload Alarm Level Setpoint

The Immediate Overload Alarm Level setpoint is found in SETPOINTS mode, page 1. It is adjustable from 1.01 ×FLC to 1.50 ×FLC. An output relay activation will occur immediately when the average phase current goes over the setpoint value. This function can never cause latched (manual reset) relay operation.

An Immediate Overload Alarm will not be issued when the motor is started. This function is only active when the motor is in the run mode.

3.16 Stator RTD Setpoints

The 269 Plus is ordered with one of the following RTD types: 100 ohm platinum, 10 ohm copper, 100 ohm nickel, or 120 ohm nickel. A message on page 2 of Setpoints may be examined to determine the type of RTD built into the relay.

It is possible to operate the 269 Plus without connecting any RTDs to it. A setpoint on page 2 of Setpoints asks the question:

```
ARE THERE ANY RTDs
CONNECTED?  NO
```

if the answer is “NO”, the 269 Plus hides all RTD related Setpoints and Actual Values thus making it easier to program for the application.

The 269 Plus relay displays temperatures in either Celsius or Fahrenheit depending on the RTD Message Display setpoint. If Fahrenheit option is chosen the increment can vary between 1 and 2 due to the conversion from Celsius to Fahrenheit and the rounding of the result. NOTE: RTD temperature values are available on the RS485 communications port in Celsius only, even if the Fahrenheit option is chosen. **NOTE: CARE MUST BE TAKEN NOT TO ENTER CELSIUS VALUES FOR SETPOINT PARAMETERS WHEN IN FAHRENHEIT MODE AND VICE-VERSA.**

The 269 Plus relay has 6 sets of 4 terminals available for the connection of RTDs to monitor the temperature of the stator windings. If fewer than 6 RTDs are to be used they must be connected to the lowest numbered RTD connections on the rear of the relay. The stator RTD setpoints are found in SETPOINTS mode, page 2. The "# OF STATOR RTDS USED" setpoint should be chosen to represent the number of RTDs actually connected to the motor stator windings. Thus if 3 RTDs are connected to the stator, the "# OF STATOR RTDS USED" setpoint should be set to 3, and the 3 RTDs must be connected to the terminals for RTD1, RTD2, and RTD3 (terminals #1-12).

There are individual trip, alarm, and high alarm setpoints for each stator, and trip and alarm setpoints for other (eg. bearing) RTDs. For stator RTDs a TRIP relay activation will occur when at least two stator RTDs go over their corresponding setpoints. This is the case when the “Stator RTD Voting” scheme is in effect. Other RTDs are not affected by the voting feature. Trip relay activation for other RTDs will occur when any one of the RTD temperatures goes over its setpoint value. This is also the case for stator RTDs if voting is defeated. Stator RTD Alarms and High Alarms, and other RTD Alarms are also issued based on individual RTD setpoints. The maximum stator RTD temperature at any time will be used for relay thermal calculation.

When the relay is in ACTUAL VALUES mode the temperature readings from all of the RTDs may be displayed. If no connection has been made to any RTD terminals, the display for that RTD will be "no RTD". If the answer to the question “ARE THERE ANY RTDs CONNECTED?” is “NO”, the display will show “NO RTDs ARE CONNECTED TO THE 269PLUS”. If the "# OF STATOR RTDS USED" setpoint is stored as 3, only the maximum temperature from RTD1, RTD2, and RTD3 will be used for motor temperature calculations. Thus, in this case, RTD4, RTD5, and RTD6 may be used for any other RTD temperature monitoring function desired.

If a stator RTD becomes open circuited during use, the ACTUAL VALUES display for that RTD will be "no RTD". Readings from the disconnected RTD will then be ignored. The 269 Plus relay will enter TRIP/ALARM mode to warn the user of the faulty RTD if the "No Sensor Alarm" is enabled (SETPOINTS, page 5). Similarly, if the “Low Temperature Alarm” is enabled (Setpoints, page 5) the relay will enter Trip/Alarm mode to warn the user of any one RTD measuring 0°C (32°F). This setpoint can be used to detect shorted RTDs given that the normal running temperature of the motor’s stator, bearing and other RTDs is not 0°C or less. After a stator RTD temperature trip, alarm, or high alarm setpoint is exceeded the 269 Plus relay will not allow the active output relays to be reset until the temperature has fallen 4°C below the exceeded setpoint.

3.17 Other RTD Setpoints

A total of 10 RTD inputs is provided on the 269 Plus. Any RTD inputs not used for stator RTD protection can be used for other temperature monitoring functions. These will commonly be used for motor and load bearings. Separate alarm and trip level temperatures can be selected for each RTD in SETPOINTS mode, page 2.

Trip and alarm level setpoints should be set to "OFF" for any unused RTD terminals. When no connection is made to a set of RTD terminals or if a sensor becomes damaged, the ACTUAL VALUES display for that RTD will be "no RTD". If the "No Sensor Alarm" is enabled (SETPOINTS, page 5) the relay will enter TRIP/ALARM mode to warn the user of any open RTD connection that does not have its trip and alarm level setpoints stored as "OFF". Similarly, if the “Low Temperature Alarm” is enabled (Setpoints, page 5) the relay will enter Trip/Alarm mode to warn the user of any one RTD measuring 0°C (32°F). The 269 Plus can detect shorted RTDs in motors where the normal running temperature, hence stator RTD and bearing RTD temperature, is not 0°C (32°F) or less. If an RTD becomes shorted, and the “Low Temperature Alarm” setpoint is enabled, the 269 Plus will detect that shorted RTD, and displays a message indicating a “Low Temperature Alarm” for that specific RTD. The RTD number is also displayed for ease of troubleshooting. This feature is not recommended to be used in harsh environments where normal running motor temperature (stator and bearing RTD temperature) can go to 0°C or less.

RTDs connected to the RTD terminals of the 269 Plus relay must all be of the same type. After an RTD temperature trip or alarm setpoint is exceeded, the 269 Plus relay will not allow the activated output relays to be reset until the temperature has fallen 4°C below the exceeded setpoint.

To use RTD #10 on the 269 Plus for ambient air temperature sensing a setpoint in page 5 of SETPOINTS mode must be changed (see sections 3.4, 3.20).

3.18 Overload Curve Setpoints

The overload curve is chosen in SETPOINTS mode, page 3. The curve will come into effect when the motor phase current goes over the overload pickup × FLC level (see Figure 3.4). When this is true the motor thermal capacity will be decreased accordingly; the output relay assigned to the OVERLOAD TRIP function will activate when 100% of the available thermal capacity has been exhausted. Thermal capacity may be reduced by the presence of unbalance and RTD bias as well as overload (if the U/B and RTD inputs to thermal memory are enabled). Thus the times on the overload curve may be reduced due to phase current unbalance (see section 3.20). A choice of eight standard curves, as shown in Figure 3.5, is available on the 269 Plus.

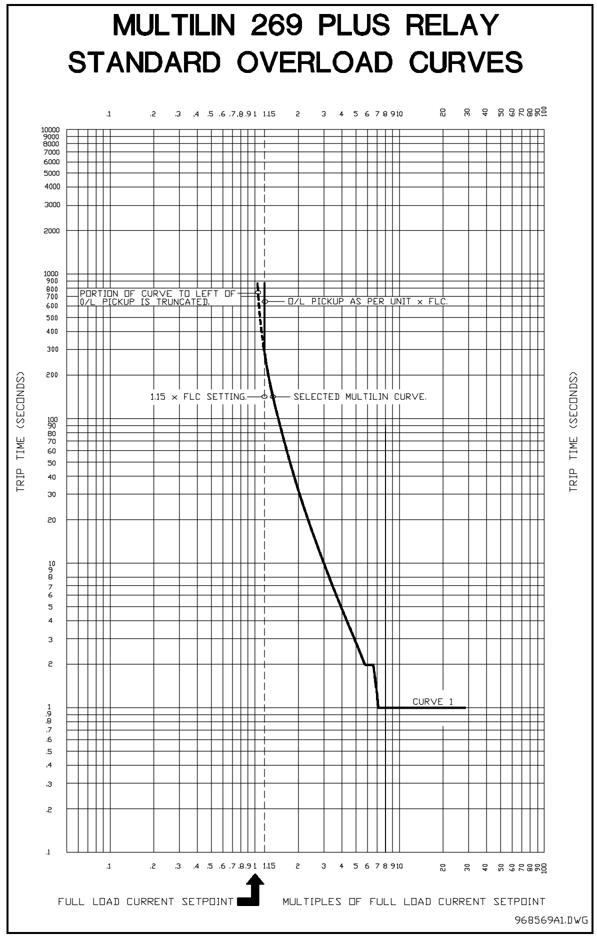


Figure 3.4 Standard Overload Curves with Overload Pickup

If one of the standard curves shown in Figure 3.5 is desired for the given application, the answer to the SETPOINTS question, "CUSTOM CURVE?", should be "NO". In this case the desired curve can be chosen from the 8 standard curves available. If it is required to have a different curve the answer to the "CUSTOM CURVE?" question should be "YES". In this case the following lines in SETPOINTS mode will be the choice of breakpoints as shown in section 3.4. These points should be entered carefully and checked since motor overload protection is based largely on this curve. After a standard curve has been chosen, the numerical values for the breakpoints can be viewed by storing a "YES" for the "CUSTOM CURVE?" question and then examining the next few lines of setpoint values. The overload levels and trip times for the standard overload curves are as shown in Table 3-5.

If none of the standard curves match the motor data well enough, the model 269 Plus relay allows the formation of a custom overload curve. Motors with non-standard overload characteristics can be fully protected since almost any shape of curve can be entered into the relay. The 269 Plus will accept 22 points and will internally form a smooth curve through these points.

If it is required to have a discontinuity in a custom overload curve, as shown in Figure 3.6 (b), the 269 Plus will insert it at the appropriate place. A discontinuity will occur when a time is entered that is greater than the time entered for the previous overload level. Examples of custom curves formed by the 269 Plus relay with the breakpoints given are shown in Figure 3.6.

Protection of a motor with a service factor that is not 1.0 may use the Overload Pickup Level setpoint to ensure the overload curve does not pick up until the desired level. This setpoint determines where the overload curve picks up as a percent of FLC; it effectively cuts off the overload curve below the setpoint x FLC.

Note: If a new standard curve number or a custom curve point is stored when the motor is running the new curve or point will not come into effect until the motor stops.

Table 3-5 Standard Overload Curve Trip Times (in seconds)

Overload Level	GE Multilin Standard Curve Number							
	1	2	3	4*	5	6	7	8
1.05	853	1707	2560	3414	5975	7682	10243	12804
1.10	416	833	1249	1666	2916	3749	4999	6249
1.20	198	397	596	795	1391	1789	2385	2982
1.30	126	253	380	507	887	1141	1521	1902
1.40	91	182	273	364	637	820	1093	1366
1.50	70	140	210	280	490	630	840	1050
1.75	42	84	127	169	296	381	508	636
2.00	29	58	87	116	203	262	349	436
2.25	21	43	64	86	150	193	258	322
2.50	16	33	49	66	116	149	199	249
2.75	13	26	39	53	92	119	159	198
3.00	10	21	32	43	76	98	131	163
3.50	7	15	23	30	54	69	92	115
4.00	5	11	17	23	40	52	69	87
4.50	4	9	13	18	31	40	54	67
5.00	3	7	10	14	25	32	43	54
5.50	2	5	8	11	20	26	35	43
6.00	2	4	7	9	17	22	29	36
6.50	2	4	6	8	14	18	24	30
7.00	1	3	5	7	12	16	21	27
7.50	1	3	4	6	10	13	18	22
8.00	1	2	3	5	9	11	15	19

* - Factory preset value

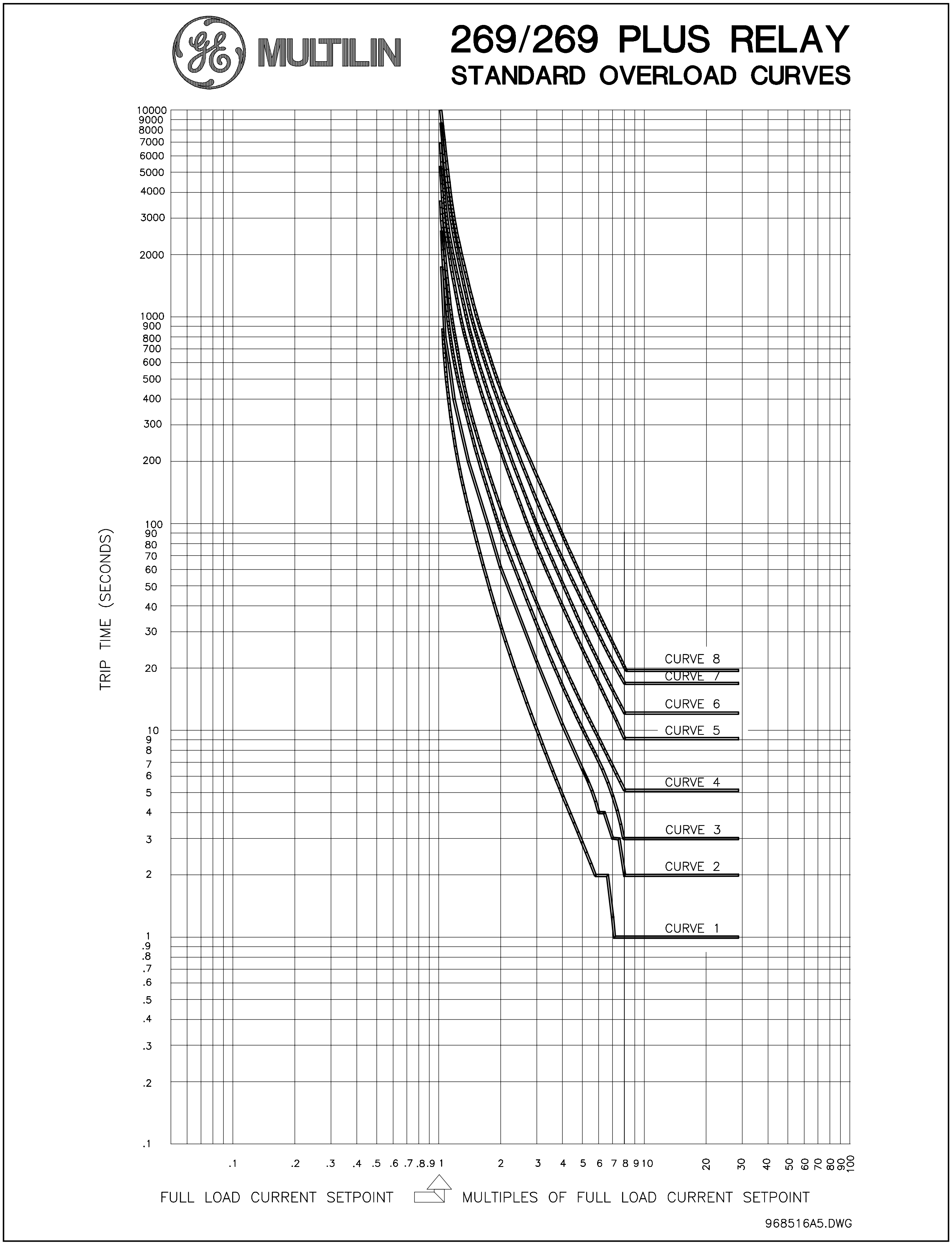
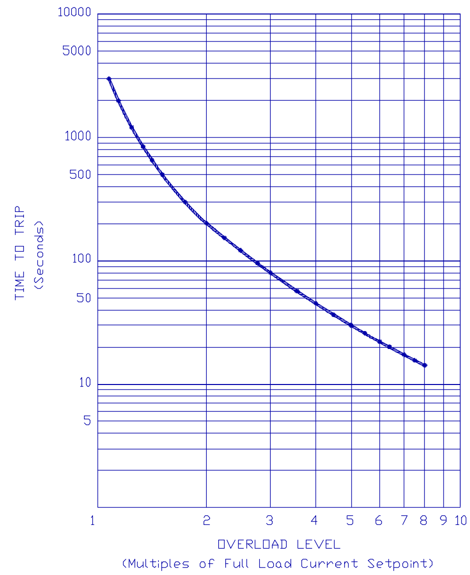


Figure 3.5 Standard Overload Curves

A

OVERLOAD LEVEL	TIME TO TRIP SETPOINT
1.05	3000
1.10	2000
1.20	1200
1.30	850
1.40	650
1.50	500
1.75	300
2.00	200
2.25	160
2.50	120
2.75	95
3.00	80
3.50	58
4.00	45
4.50	38
5.00	32
5.50	28
6.00	23
6.50	21
7.00	18
7.50	17
8.00	15



B

OVERLOAD LEVEL	TIME TO TRIP SETPOINT
1.05	3000
1.10	2000
1.20	1200
1.30	850
1.40	650
1.50	500
1.75	300
2.00	200
2.25	150
2.50	115
2.75	95
3.00	75
3.50	55
4.00	40
4.50	400
5.00	120
5.50	65
6.00	35
6.50	22
7.00	16
7.50	12
8.00	10

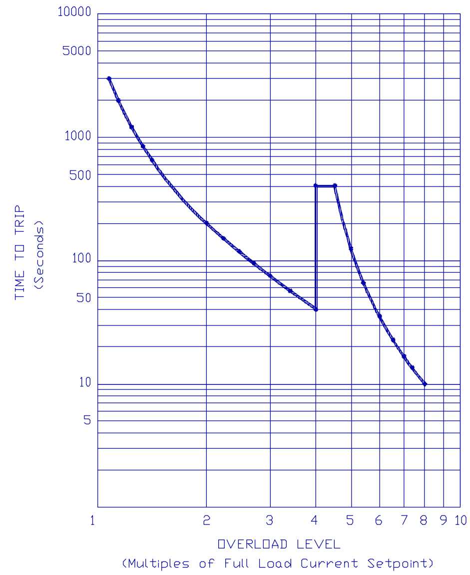


Figure 3.6 Custom Curve Examples

3.19 Thermal Capacity Alarm

The Thermal Capacity Alarm setpoint level determines the threshold that thermal capacity must equal or exceed for an alarm condition to exist. The time delay set determines the amount of time that these conditions must persist before an actual alarm occurs.

3.20 Thermal Memory

The 269 Plus relay uses an internal thermal memory register to represent the thermal capacity of the motor. To "fill" this register, the square of the equivalent motor heating current is integrated over time. This equivalent current is a biased average of the 3 phase currents. The biasing factor is derived from the amount of negative sequence current flowing in the motor, if the U/B input to TC is enabled. The rate at which the memory fills is thus dependent on the amount of overload, unbalance present, as well as RTD bias. The unbalance input to thermal memory as well as RTD bias can be defeated using a setpoint in page 5 of SETPOINTS mode. When the thermal memory register fills to a value corresponding to 100% motor thermal capacity used, an OVERLOAD TRIP will be initiated. This value is determined from the overload curve.

If the phase current is between 1.00 x FLC and the Overload Pickup level x FLC, one of two thermal model algorithms can be observed. If the THERMAL CAPACITY USED is less than the phase current (as a multiple of FLC) x the FLC Thermal Capacity Reduction setpoint, the THERMAL CAPACITY USED will rise to that value. If, on the other hand, the THERMAL CAPACITY USED is above that value, it will remain unchanged (neither increase nor decrease) unless RTD BIAS is enabled, in which case the greater of the two values will be used.

Thermal memory is emptied in certain situations. If the motor is in a stopped state the memory will discharge within the motor STOPPED COOL TIME (factory value = 30 min.). If the motor is running at less than full load, thermal memory will discharge at a programmed rate to a certain value. This value is determined by the "FLC Thermal Capacity Reduction" setpoint. For example, a value of 25% may be chosen for this setpoint. If the current being drawn by the motor drops below full load current to 80%, then the thermal memory will empty to 80% of the FLC Thermal Capacity Reduction setpoint, namely, 20% (0.8 x 25%). In this way the thermal memory will discharge to an amount related to the present motor current in order to represent the actual temperature of the motor closely. Thermal memory will discharge at the correct rate which is approximately exponential, even if control power is removed from the 269 Plus. Thermal memory can be cleared to 0% by using the Emergency Restart feature (see section 3.21).

Thermal Capacity Reduction can be calculated using the following formula:

$$TCR = \left[1 - \frac{\text{(Hot Motor Stall Time)}}{\text{(Cold Motor Stall Time)}}\right] \times 100$$

U/B INPUT TO THERMAL MEMORY - When U/B input to thermal memory is defeated the 269 Plus relay will use the average of the three phase currents for all overload calculations (ie. any time the overload curve is active). When U/B input to thermal memory is enabled the 269 Plus relay will use the equivalent motor heating current calculated as shown:

Ieq = Iavg (with U/B input to thermal memory disabled; factory preset)
Ieq = $\sqrt{Ip^2 + K \times In^2}$ (with U/B input to thermal memory enabled)

where K = $\dfrac{175}{(I_{start} / I_{flc})^2}$ or user entered value

(negative sequence current heating factor; see below)
Ieq = equivalent motor heating current
Iavg = average of three phase currents
Iflc = motor full load current
Istart = learned motor starting current (avg. of last 4 starts)
Ip = positive sequence component of phase current
In = negative sequence component of phase current

Thus the larger the value for K the greater the effect of current unbalance on the thermal memory of the 269 Plus relay.

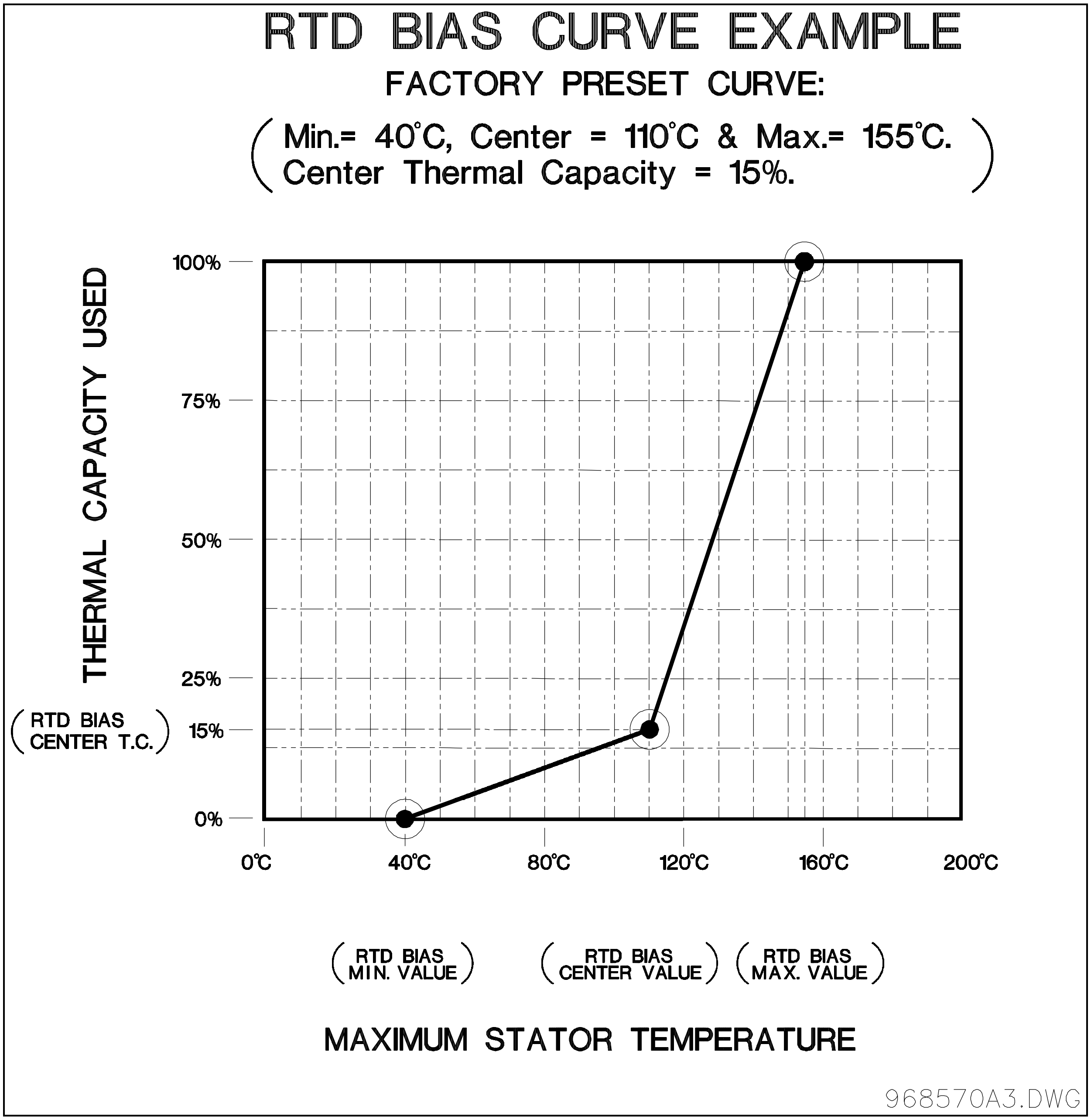


Figure 3.7 Hot Motor Thermal Capacity Reduction

RTD INPUT TO THERMAL MEMORY - When the hottest Stator RTD temperature is included in the Thermal memory (Setpoints mode, page 5, factory preset disabled) the maximum measured stator RTD temperature is used to bias (correct) the thermal model. The RTD BIAS curve acts as a double check of the thermal model based on feedback from the actual stator temperature (as measured from the RTDs). When the hottest stator temperature is at or above the RTD Bias Maximum value (Setpoints mode, page 5) the thermal capacity used is 100%. When the hottest stator RTD temperature is below the RTD Bias Minimum value (Setpoints mode, page 5) there is no effect on the thermal capacity used. Between these two extremes, the thermal capacity used is determined by looking up the value of the Hottest Stator RTD on the user's curve (RTD BIAS Min, Center, Max temperatures, RTD BIAS Center Thermal Capacity) and finding the corresponding Thermal Capacity used. The Hottest Stator RTD value for Thermal Capacity used is compared to the value of THERMAL CAPACITY USED generated by the thermal model, (overload curve and cool times). The larger of the two values is used from that point onward. This feedback provides additional protection in cases where cooling is lost, the overload curve was selected incorrectly, the ambient temperature is unusually high, etc.

The two-part curve allows for easy fitting of HOT / COLD curves to the RTD BIAS feature. The minimum value could be set to the ambient temperature the motor was designed to (40°C). The center point for thermal capacity could be set to the difference between the hot and cold curves (eg. 15 %). The center point temperature could be set for hot running temperature (eg. 110°C). Finally, the Maximum value could be set to the rating of the insulation (eg. 155°C) The user has the flexibility to set the RTD BIAS as liberally or conservatively as he/she desires.

It should be noted that the Thermal Capacity values for the RTD BIAS curve MUST increase with temperature. For this reason, there is range checking on the temperature setpoints (eg. the minimum setpoint cannot be larger than the center temperature setpoint). It may take a couple of attempts to set the parameters to the desired values (it is best to start with the minimum or maximum value).

It should also be noted that RTD BIAS may force the THERMAL CAPACITY USED value to 100%, but it will never alone cause a trip. If the RTD BIAS does force THERMAL CAPACITY USED to 100%, when the motor load increases above the overload pickup value, a trip will occur immediately (see Appendix B). A trip by RTDs will only occur when the RTD values exceed the user's trip level for RTD trip, as defined in page 2 of setpoints.

Additionally, RTD bias may artificially sustain lockout times for the O/L and Start Inhibit features as they are based on thermal capacity.

LEARNED COOLING TIMES - Through various measurement and averaging techniques the 269 Plus relay "learns" a number of motor parameters. All learned values can be examined in page 6 of ACTUAL VALUES mode. <u>If RTDs are used to monitor the temperature of the motor stator the relay will learn the running and stopped cooling times of the motor.</u> In this way the 269 Plus provides increased accuracy in the thermal modeling of the protected motor. When RTD #10 is used for ambient air temperature monitoring even greater thermal protection is provided since the cooling air temperature is known. In this case the learned cool times are based on the difference between the ambient temperature and the average stator RTD temperature. When no ambient sensing is used the learned cool times are based only on the average stator RTD temperature. <u>If no stator RTDs are used, or if the DEFEAT LEARNED COOL TIME setpoint (SETPOINTS mode, page 5) is left as "YES", the relay will use the default stopped and running cool time setpoints.</u>

NOTE: The learned cooling times should not be enabled until the 269 Plus relay has had sufficient time to learn the actual motor cooling times. The time required will vary between motors, however several start/stop cycles will be necessary.

The 269 Plus relay learns the motor cooling times over various temperature ranges. Thus the times shown in page 6 of ACTUAL VALUES mode (LEARNED RUNNING COOL TIME, LEARNED STOPPED COOL TIME) will reflect the total cooling time as a combination of the cooling times over each temperature range.

START INHIBIT - An OVERLOAD TRIP caused by the exhaustion of motor thermal capacity will cause a lock-out. A relay reset will not be allowed until the memory has discharged to 15% thermal capacity used. At this point the relay can be reset.

If the Start Inhibit feature is enabled (SETPOINTS, page 5) a motor start will not be allowed until the thermal memory has discharged sufficiently to make the start possible. The 269 Plus relay uses the "LEARNED Start Capacity required" (ACTUAL VALUES, page 6) to determine if a start is possible. If sufficient thermal capacity is available for a start, the start will be successful. Thus the START INHIBIT lock-out time is adjusted to allow for optimum motor usage. To override a START INHIBIT or OVERLOAD TRIP lock-out condition the Emergency Restart feature can be used. If the Start Inhibit feature is disabled the OVERLOAD TRIP lock-out time will not be adjusted by the learned starting capacity value and will represent the time for the thermal memory to discharge to 15% thermal capacity used. Thus the lockout time will equal 85% of the STOPPED COOL TIME when Start Inhibit is disabled. When Start Inhibit is enabled the OVERLOAD TRIP lock-out time will represent the time for the thermal memory to discharge to the "LEARNED Start Capacity required" value.

Before the 269 Plus relay has learned the actual Start Capacity required by the motor, this value will default to 40%.

The “Learned start capacity required” is the amount of thermal capacity used and learned by the relay over the last five starts. To ensure successful completion of the longest and most demanding starts, a safe margin between the actual start capacity required and the learned value is built-in. This safety margin can be as high as 24%.

Every start is examined and its thermal capacity is captured and shown on page 5 of Actual Values as the “Learned start capacity, last start TC”. If the value learned is less than 10%, it is forced to 10% when it is used in calculating the “Learned start capacity required” over the last 5 starts. It is forced to a maximum of 70% if the TC learned for the last start is more than 70%. It is recommended that the “Start inhibit” feature should not be enabled until the 269 Plus has had sufficient time to learn the actual motor start thermal capacity under normal operating conditions. The time required should include at least five start/stop cycles. To prevent the 269 Plus from learning bogus numbers when it is being tested, or upon commissioning, the relay should be placed in “Test mode”. This can be done on page 6 of Setpoints:

```
PLACE 269 PLUS IN
TEST MODE?  YES
```

When in this mode, the 269 Plus suspends all learning functions and stops updating the learned parameters on page 5 of Actual Values and the statistical parameters on page 4 of Actual Values. Ensure that the 269 Plus is returned to normal running mode by changing the above setpoint to “NO”.

If it is desired to enable the “Start inhibit” after the first true start, the setpoint “Initial start capacity, TC required” (located on page 5 of Setpoints) can be programmed to match the “Learned start capacity, last start TC” value. A few percentage points may be added to this value as a safety margin.

When the “Initial start capacity, TC required” setpoint is programmed, the 269 Plus replaces the “Learned start capacity required” value with it and uses it to calculate any lockout time that may be required before the next start, where:

$$\text{Lockout time} = \frac{\left(SC_{\text{learned}} + TC - 100\right) \times SC}{100}$$

where: SC_{learned} = learned start capacity required
TC = thermal capacity used
SC = stopped cool time

3.21 Emergency Restart

When production or safety considerations become more important than motor protection requirements it may be necessary to restart a faulted motor. Momentarily shorting together the Emergency Restart terminals will discharge the thermal memory to 0% so that the relay can be reset after an OVERLOAD TRIP. In this way the lock-out is avoided. The Emergency Restart feature will also reduce the relay's starts/hour counter by one each time the terminals are shorted together, so that a STARTS/HOUR INHIBIT can be defeated.

When RTD input to thermal memory (SETPOINTS, page 5) is enabled and the Emergency Restart feature is used, thermal capacity will be reduced to 0% only for as long as the Emergency Restart terminals are held shorted (note: it may take up to 11 seconds for the "Thermal Capacity Used" display to change to 0%). When the Emergency Restart terminals are opened again, the thermal capacity will change to what is used according to the maximum stator RTD temperature and Figure 3.7. Thus, momentarily shorting the Emergency Restart terminals with RTD input to thermal memory enabled may not reduce the thermal capacity used to 0% when the motor is hot.

Shorting the Emergency Restart terminals together will have no effect unless the motor is stopped. Thus having these terminals permanently shorted together will cause the memory to be cleared when the motor stops. This will allow for an immediate restart after an OVERLOAD TRIP.

Caution is recommended in the use of this feature since the 269 Plus relay's thermal protective functions will be overridden and it is possible to damage the motor if Emergency Restart is used.

All of the inhibits will be cleared if the Emergency Restart terminals are shorted with the exception of the backspin timer (section 3.9). Due to the potentially dangerous conditions of a rotor spinning backwards, the only way to defeat the backspin timer is to turn the setpoint “OFF”.

3.22 Resetting The 269 Plus Relay

Resetting the 269 Plus relay after a trip must be done manually by pressing the RESET key, or by shorting together the External Reset terminals. Alarm functions can cause latched (manual reset) or unlatched (automatic reset) output relay operation depending on the RELAY ALARM LATCHCODE (SETPOINTS mode, page 5). A latched relay will stay activated until the RESET key is pressed or the External Reset feature is used. Remote reset via communications is also possible. See Chapter 4, Communications.

If a trip/alarm condition persists (eg. a high RTD temperature), or if the relay has locked out the motor, pressing the RESET key will cause the flash message,

```
RESET NOT POSSIBLE -
Condition still present.
```

to be displayed. However, shorting the Emergency Restart terminals together will reduce the lock-out time, allowing the relay to be reset immediately.

Note: If RTD input to thermal memory is enabled (SETPOINTS, page 5) the lock-out time may not be reduced to 0 minutes since the thermal capacity available is dependent on the RTD bias curve (Figure 3.7) and the maximum stator RTD temperature (see section 3.21).

If the External Reset terminals are permanently shorted together the relay will be reset immediately when motor conditions allow (eg. when the lock-out time runs out).

The 269 Plus relay cannot be reset after a Differential Input Trip or Spare Input Trip until the contacts connected across the Differential Input or Spare Input terminals have been opened.

SINGLE SHOT RESTART - The 269 Plus relay has a selectable single-shot restart feature which will allow the motor to be restarted immediately after an overload trip. To allow the motor to be restarted the relay decreases its internal value for motor thermal capacity used. However if two overload trips occur within a lockout time delay, the 269 Plus will not allow an immediate restart. The displayed lock-out time must be allowed to run out before the motor can be restarted. This feature can be selected in page 5 of SETPOINTS mode and is factory preset as disabled.

SPECIAL EXTERNAL RESET - The 269 Plus relay also has a special external reset feature which can be selected in page 5 of SETPOINTS mode. When this feature is enabled, shorting the External Reset terminals together will cause all output relays to be reset, while pressing the keypad reset key will cause all relays except AUX. 1 to be reset. This feature is factory preset as disabled.

Note: This feature works for 269 Plus relay trip functions only. Trip functions assigned to the TRIP & AUX. 1 output relays cannot be reset using the reset key.

If the 269 Plus relay trips and then loses control power, the trip function will become active again once control power is re-applied. For example, if a GROUND FAULT TRIP occurs and then control power for the relay is removed and later returned, the message "GROUND FAULT TRIP" will appear on the display and the output relay assigned to the Ground Fault Trip function will become active.

Note: If control power is removed for more than one hour after a trip the 269 Plus relay may be reset when power is re-applied (for O/L trips).

3.23 269 Plus Relay Self-Test

The 269 Plus relay's internal circuitry self-test consists of three separate tests. A/D, RTD, and memory circuitry tests are continually performed. The A/D test involves sending a known, precise voltage level through the A/D circuitry and seeing if it is converted correctly. The RTD test involves reading a known, internal resistance and checking to see if the correct temperature is determined. To test the memory circuitry, test data is stored in the 269 Plus relay's non-volatile RAM and is then read and compared with the original data.

Should any of these tests indicate an internal circuitry failure, the "SERVICE" LED will start to flash and the output relay programmed for the self-test feature will activate.

Note: When a relay A/D or memory self-test failure occurs, all metering and protective functions will be suspended. The ACTUAL VALUES display for all parameters will be zero in order to avoid nuisance tripping. When in this state, the relay will not provide motor protection. If a memory failure occurs, the factory setpoints will be reloaded into the 269 Plus. If an RTD hardware failure occurs the "# OF STATOR RTDS USED" setpoint will be automatically set to 0 and the RTD ALARM and TRIP levels will be automatically set to OFF; however all current-related functions will continue to operate normally.

3.24 Statistical Data Features

The model 269 Plus relay offers a record of maximum RTD temperatures and pre-trip current and RTD values in addition to a full range of motor statistical data. The maximum RTD temperature data is found on page 2 of ACTUAL VALUES mode and can be cleared to zero by storing a YES in response to the "CLEAR LAST ACCESS DATA?" question at the end of page 2. Pre-trip motor current and temperature values are found in ACTUAL VALUES mode, page 5. These values will be updated only when a relay trip occurs. Note that if a trip function setpoint is set to INST. (instantaneous) and this type of trip occurs, the values for pre-trip current will not be recorded exactly. This is because the relay has tripped instantaneously and thus did not have enough time to update the registers holding this information. The pre-trip values can be cleared to zero by storing a “YES” in response to the “CLEAR PRE-TRIP DATA?” question at the end of page 5 of Actual Values.

On the model 269 Plus statistical data is found on page 4 of ACTUAL VALUES mode. All of this data can be cleared to zero by storing a value of YES in response to the "START NEW COMMISSIONING?" question at the end of page 4.

All of the statistics in this page will reset to zero after reaching 255. The running hours and megawatthours data will reset to zero after each reaching the number 65535.

If a 269 Plus relay is to be taken out of service for maintenance or testing purposes, the statistical data accumulated by the relay may be copied to the new relay replacing it. Simply record the information from page 4 of Actual Values and call the factory for a detailed procedure on transferring this information to the new relay.

The obvious benefit of this exercise is the ability of the new relay to start with accurate data about the motor and the system to maintain a continuity from relay to relay during maintenance or testing of the original 269 Plus.

When the original relay is ready to be reinstalled, the same procedure may be followed to transfer the accumulated statistical data from the replacement relay to the original 269 Plus.

3.25 Factory Setpoints

When the 269 Plus relay is shipped, it will have default setpoints stored in its non-volatile memory. These values are meant to be used as a starting point for programming the relay and should be changed as each application requires.

In the event of a non-volatile memory failure, which will be detected by the self-test feature (see section 3.23), the 269 Plus relay will reload the factory setpoints but will not provide motor protection.

A list of the motor current, RTD, and overload curve setpoints is given in Table 3-6. For other factory setpoints see Tables 3-7 and 3-3.

3.26 Meter Option

The addition of a GE Multilin MPM meter to a 269 Plus provides valuable voltage and power measurement. These values are good for troubleshooting and protective features.

In order to install the MPM, all connections to the meter must be made. Then, on the 269 Plus page 7 of Setpoints, meter CT primary, VT ratio, and VT secondary must be programmed. These setpoints will be sent to the meter via the comm. link for meter calculations. ** IMPORTANT ** Only after the above steps are complete may the MPM be brought on-line by changing the meter on-line setpoint (page 7) to YES. The 269 Plus will then initiate communication with the meter and actual values from the meter may be displayed.

A value for MegaWattHours from 0-65535 may be displayed in the Statistical data of Actual Values page 4. Voltage, kWatts, KVARS, Power Factor, and Frequency may be viewed on page 7 of Actual Values. These values may also be seen as their pre-trip levels on page 5 of Actual Values.

The Undervoltage trip and alarm levels determine the threshold that voltage must fall below for an alarm or trip condition to exist. The time delay set determines the amount of time that these conditions must persist before an actual trip or alarm occurs.

The Power Factor Lag and Power Factor Lead trip and alarm levels determine the threshold that the power factor must fall below for an alarm or trip condition to exist. The time delay set determines the amount of time that these conditions must persist before an actual trip or alarm occurs.

Power Factor is commonly used for synchronous motor protection. Ideally, synchronous motors run at unity power factor. Conditions may exist where the power factor drops below an acceptable level. This may be caused by several factors, such as the loss of field to the main exciter, accidental tripping of the field breaker, short circuits in the field currents, poor brush contact in the exciter, or loss of AC supply to the excitation system.

Power Factor Lead and Power Factor Lag alarm and trip setpoints with programmable time delays can be used to detect such conditions as out of step, loss of synchronism, or loss of field.

Where the motor is started unloaded and the field applied later in the start, the power factor may be poor until the motor is loaded and synchronous speed is attained. It may then be necessary to block power factor protection until the motor is up to speed.

A setpoint on page 7 allows the user to pick one of two methods of blocking power factor protection on start. Answering “NO” to the setpoint “BLOCK PF PROTECTION ON START?” puts the 269 Plus in a mode where the “Power Factor protection delay” feature may be enabled. So, when programmed, after the motor has successfully completed a start, this setpoint required that the measured power factor comes between the user specified POWER FACTOR TRIP LEAD and LAG setpoints for the specified period of time (user’s value for Power Factor protection delay) before the power factor trip and alarm features become active. A stop condition resets the algorithm.

Answering “YES” to the setpoint “BLOCK PF PROTECTION ON START?” puts the 269 Plus in another mode where “Block PF alarm & trip on start by: XXX seconds” may be enabled. When this delay is programmed, the 269 Plus blocks power factor lag and power factor lead alarm and trip protection from start until the time expires. When programming this delay, consideration must be given to the time it takes the motor to start, apply the field and the load.

The positive kvar alarm and negative kvar alarm setpoint levels determine the threshold that kvars must exceed for an alarm or trip condition to exist. The time delay set determines the amount of time that these conditions must persist before an actual trip or alarm occurs.

All motors (synchronous and induction) require vars from the system to run. The 269 Plus displays consumed vars by the motor as positive vars. Conversely, if a synchronous motor is run overexcited as a synchronous condensor, it may be capable of supplying vars back to the system. Such motors are typically used to correct a poor PF in an industrial plant. The 269 Plus displays motor supplied vars as negative vars when a synchronous motor is running at synchronous speed, its power factor is unity and the vars required to run the motor are completely supplied by the field. So, ideally the reactive power for a unity synchronous motor coming from the AC system is zero. Hence, another way of indicating abnormal running conditions on synchronous and induction motors is by using the positive kvar alarm and negative kvar alarm levels and the kvar alarm time delay.

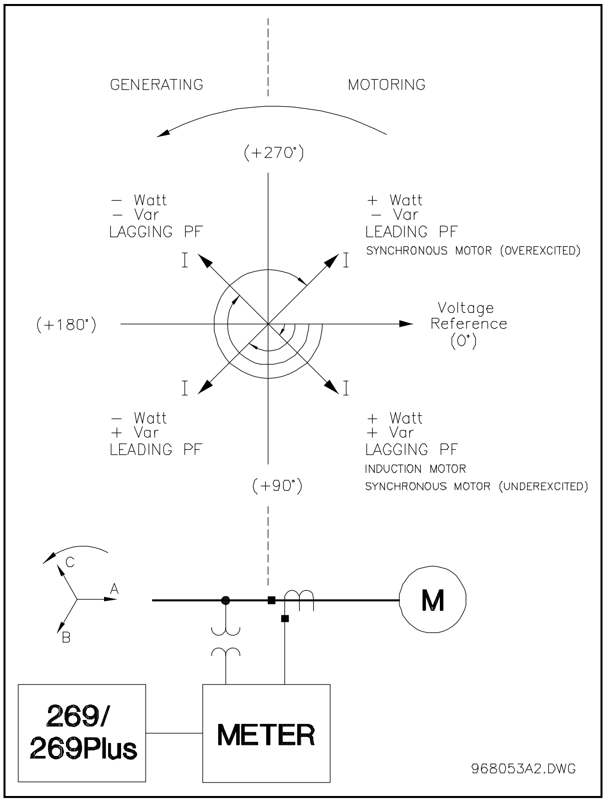


Figure 3.8 Power Measurement Conventions

Enabling Voltage Phase Reversal allows the 269 Plus to trip or inhibit based on phase reversal sensed from voltage from the meter. This allows sensing of phase reversal when the bus is energized before the motor is started. There is a 3-4 second delay for voltage phase reversal, and it is also defeated on starts to prevent nuisance trips caused by distortion of the bus voltage wave shape.

The Analog Out Scale Factor setpoint is entered to set the Full Scale value for the meter analog outputs (KWATTS and KVARS). The value entered here is the multiplier that is multiplied by 100 KW to determine the meter's analog output Full Scale for KWATTS, or by 30 KVAR to determine the meter's analog output Full Scale for KVAR. 4 mA represents 0 KWATTS and 0 KVARS and 20 mA represents full scale. Average RMS current is produced in analog form where 4-20 mA is equivalent to 0 A to 1×CT rating. Power factor is produced in analog form where 4/12/20 mA represents -0/1/+0 power factor value respectively.

NOTE: If a meter Communications Failure occurs, it may be necessary to press the RESET key to remove the message if that alarm is assigned to a latching relay.

On commissioning of a synchronous motor protected by a 269 Plus and a meter, correct wiring of the VTs and CTs is crucial for accurate measurement and protection. Typically, commissioning and testing starts with the motor unloaded. It is also typical to examine the power factor to verify the wiring and proper operation of the relays, motor and associated equipment. Under such circumstances, the power factor measured by the meter and displayed by the 269 Plus appears to be swinging from a very low lagging value to a very low leading value with the field being constant. This may mislead you to believe that wiring problems such as reversed CT or VT polarities or wrong connections exist. More often than not however, there is nothing wrong with the wiring. In order to understand why the displayed power factor is swinging from lead to lag, it is important to understand how power factor is determined and why power factor is not the best indication of proper operation and wiring when the motor is unloaded and the field applied. Recommendations will be made for commissioning and checking for wiring problems.

THE PHENOMENON

By convention, an induction motor consumes watts and vars. This is shown in the 269 Plus as positive watts and positive vars. A synchronous motor can consume watts and vars or consume watts and generate vars (synchronous condensors). This is shown in the 269 Plus as positive watts, positive vars and positive watts, negative vars respectively. See Figure 3.8.

Since the motor is unloaded, the real power or kW required to run the machine is at its minimum. The reactive power or kvar is a function of the field and motor requirement, and is at a high value with the field applied. In fact the motor will be running extremely overexcited. The apparent power or kVA is the vector sum of both kW and kvar as seen in Figure 3.9, and hence it is at a high value with the field applied. The result is a power factor that is significantly low with PF = kW/kVA (low value/high value). Because of these unrealistic motor conditions, and because of digital technology of sampling waveforms, it is possible that the PF sign is detected to be either leading or lagging. This is clearly seen in Figure 3.8 where at around 270°, the PF is very low and changes signs with the slightest movement around this angle in either direction.

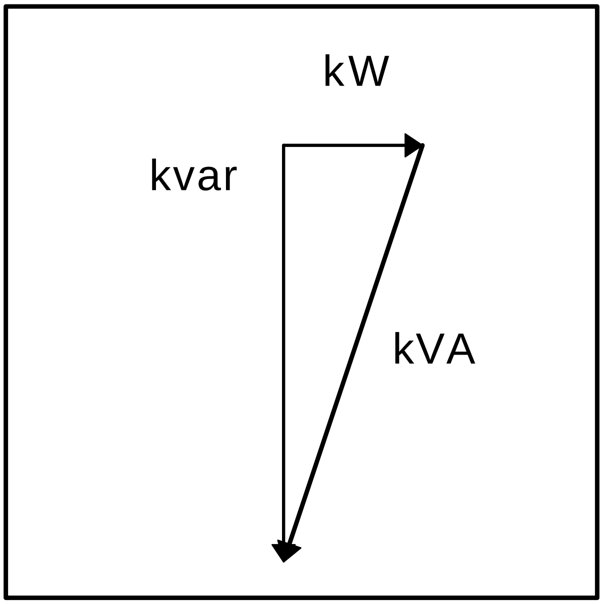


Figure 3.9

RECOMMENDATIONS

By examining Figure 3.8, it is very obvious that the only stable and reliable number that should be checked on commissioning of unloaded synchronous motors with the field applied is the signed REACTIVE POWER or kvar. Under such circumstances the kvar number should always be NEGATIVE with a value that is significantly larger than that of the real power or kW. Glancing at the kW number, it should be a very small value with possible fluctuations in the sign from positive to negative. By examining the apparent power or kVA number, it should always be positive and also relatively large, almost equal to the kvar number. Consequently, the PF number will be a very small value in the order of 0.02 to 0.2, also with a possible unstable sign going from leading to lagging.

Once the kvar value is examined and found to be inconsistent with the observations made above, it could be safely assumed that there may be some wiring problems in the switchgear. It is important however, not to ignore the other values, because if the kW value is examined and found to be a large number, regardless of its sign, it is also an indication of wiring problems. Similarly, a large value for the PF, regardless of its sign is an indication of wiring problems.

Table 3-6 Preset Factory Relay Configurations and Functions

CONFIGURATION/FUNCTION	OUTPUT RELAY				
	TRIP	ALARM	AUX. 1	AUX. 2	NO
CONFIGURATION					
Latched (Manual Reset)	●			●	
Unlatched (Automatic Reset)		●	●		
Fail-safe	●			●	
Non-fail-safe		●	●		
ALARM SIGNALS					
Immediate O/L Warning		❍			
G/F Alarm		●			
U/B Alarm		●			
U/C Alarm		❍			
Mechanical Jam Alarm			❍		
Stator RTD Alarm		❍			
Stator RTD High Alarm			❍		
RTD Alarm			❍		
RTD High Alarm			❍		
Broken Sensor Alarm			❍		
Low Temperature Alarm			❍		
Spare Input Alarm					❍
TC Alarm					❍
U/V Alarm		❍			
O/V Alarm		❍			
PF Alarm		❍			
KVAR Alarm		❍			
Meter Alarm				●	
Self Test Alarm				●	
TRIP SIGNALS					
O/L Trip	●				
U/B Trip	●				
S/C Trip	❍				
U/C Trip	❍				
Rapid Trip	●				
Stator RTD Trip	❍				
RTD Trip	❍				
G/F Trip	●				
Acceleration Time Trip	●				
Phase Reversal Trip	❍				
Inhibits			●		
Speed Switch Trip	❍				
Differential Relay Trip	❍				
Single Phase Trip	●				
Spare Input Trip	❍				
U/V Trip	❍				
O/V Trip	❍				
Power Factor Trip	❍				

●Function programmed ON
❍Function programmed OFF

The 269 Plus Motor Protection relays communicate with other computerized equipment such as programmable controllers, personal computers or plant master computers with the Modicon Standard Data Communication Network (MODBUS RTU).

This document describes the subset of protocol as supported by the 269 Plus Motor Protection relays.

4.1 Modes of Operation

- GE Multilin 269 Plus relays always act as MODBUS slaves, meaning they never initiate a dialogue but listen and respond to the bus master computer.

- Only the Remote Terminal Unit (RTU) format of the MODBUS protocol is adopted for the 269 Plus. The format is described later and features binary data format rather than ASCII character communications.

- As the physical layer of the protocol, two-wire (4-wire is also available as a modification for a moderate cost) Multi-drop RS485 standard is supported. This standard uses twisted pair cable. Up to 32 269 Plus relays on up to 4000 ft of cable can be supported.

- Optionally, Serial Communication Interface (SCI) boxes can be purchased to support RS232 standard for the connection of a group of relays on an RS485 bus to RS232 which is supported by PCs and some PLCs.

- Since the operation of 269 Plus relays are register based, a master computer can monitor and control the operation of the relays by reading or writing to the relay registers. Therefore, the Register Read and Write functions of the MODBUS are supported only. These are described later.

- 269 Plus relays provide flexibility towards master computer corrective actions upon communication errors and timeouts. This is left to the discretion of the master programmer.

The protocol, as supported by 269 Plus relays, features the following:

4.2 Physical Layer

The electrical interface is a two-wire bidirectional multi-drop RS485 on a shielded twisted pair cable. A Belden 9841 insulated 24 Gage shielded twisted pair cable should be used. The connection to the 269 Plus is by 2 terminals on a terminal block on the 269 Plus marked as:

47	46
+	–

Where + is the positive wire, and – the negative wire. The shield must be connected at terminal 88 on each 269 Plus throughout the link and **GROUNDED AT THE MASTER ONLY**. If a GE Multilin SCI box (RS232/RS485 converter) is used, no grounding of the shield is necessary. See Fig. 4.1. The cable should be terminated, at the two extreme ends, by resistors equal in value to its characteristic impedance (120Ω for the Belden 9841 AWG twisted pair.) in series with 1nF/50V capacitors. See Figure 4.1. A terminator assembly with the resistor/capacitor network may be obtained from GE Multilin.

The communication to the 269 Plus is half-duplex. This means a 269 Plus listens to receive a command, services it, then transmits the reply. The 269 Plus will not service and process a new request until the current request is processed.

The message bytes are communicated as asynchronous items with 1 start bit, 8 data bits and one stop bit. This produces a 10 bit data frame. (Some modems do not support 11 bit data frames at baud rates of greater than 300bps). The rates at which data can be communicated are 300, 1200 or 2400bps. The unit defaults to 2400 baud. If 300 or 1200 baud is desired, contact the factory.

Each relay on the network is identified by a one byte ADDRESS which is locally programmed to the 269 non-volatile memory (NOVRAM). This is a setpoint located on page 5 of Setpoints.

4.3 Packet Format

The communications take place in packets which are groups of asynchronous bytes that are framed by silent time gaps. The packet format of RTU version of MODBUS is adopted by GE Multilin 269 Plus relays. This format is as follows:

SILENT TIME	ADDRESS	FUNCTION	DATA BYTES	CRC	SILENT TIME
	1 byte	1 byte	N bytes	2 bytes	

Where:
- silent times are used as packet frames and separators. They are equivalent to 3.5 bytes transmission silent time (29.2ms for 1200 baud). The receiving device, upon detecting this silent time, readies itself to recognize the next received byte as the ADDRESS.

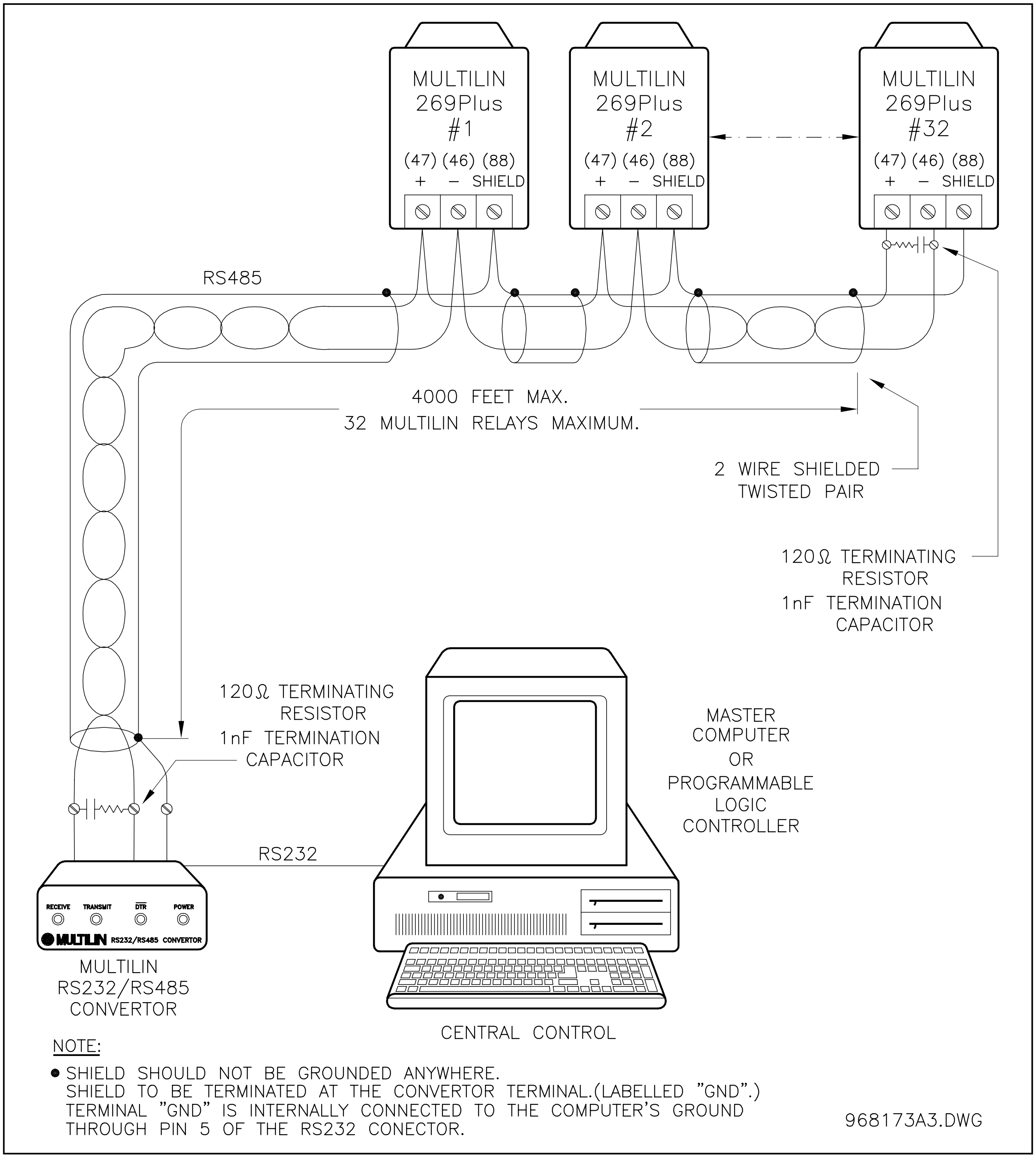


Figure 4.1 Serial Communication Link

- SLAVE ADDRESS is the ID of slave 269 Plus to be communicated with. The SLAVE ADDRESS must be programmed in the 269 Plus in Setpoints, page 5. Only the 269 Plus addressed responds to the master command. It sends its own ID back to the master to let the master know who is responding. The address 00 is a broadcast ADDRESS used by the master to issue a command to all slave devices as per MODBUS protocol. The broadcast command is not supported by 269 Plus relays and is ignored.

- FUNCTION is the command op-code sent to the slave to indicate what function to perform. 269 Plus relays support functions 03, 04, and 16 (10H), to be described later.

- DATA BYTES are the information needed to perform the requested function. This field may contain values, address references, byte counts and limits.

- CRC is the error check code. It is a 16-bit Cyclic Redundancy Check (CRC) computed by the sender and appended to the packet. The code is recomputed by the receiver and compared to the received code. If different, an error in transmission has occurred.

4.4 The Handshake

The Master always initiates the dialogue by sending a command. It also starts a response timer to see that the slave is replying in time. This timer is a function of transmission time of the command, reply packets, plus the time required by the 269 Plus to collect information from its registers. It is determined mutually by the master programmer and GE Multilin depending on the number of register data to be processed in one command. The following is a table of results recorded from the 269 Plus at 2400 baud:

BYTES READ	MIN. RESPONSE TIME (ms)	AVG. RESPONSE TIME (ms)	MAX. RESPONSE TIME (ms)
2	66	75	117
10	78	82	123
250	206	222	242

If the reply from the slave arrives within this time, and it is error free, the master considers the dialogue successful and accepts the confirmation reply and any received data. Otherwise, if the reply is not in time or if it contains an error or exception reply, the master takes a corrective action at the discretion of the master programmer.

Such a corrective action could include repeating the command for this slave for a predetermined number of times, continuing the scan with the next slave, or posting a note on the old un-updated data and then continuing the scan. 269 Plus relays are quite flexible in this regard; they simply reply if they are commanded regardless of it being an original query or a repetition.

Every time the master attempts a new dialogue to a new slave or repeats the command to the same slave, it should observe a 3.5 character silent time. The slaves detect the silent time and reset themselves for a new dialogue.

If a slave detects a communication error in the master command (CRC), it does not provide a reply back. This way the master times out and repeats the command, if it is so programmed. However, if the master command contains functional errors such as wrong function op-code, wrong register address or out of range data is detected, it provides an error code to the master to invoke corrective action. The error messages and exception replies are discussed later in the document.

4.5 Supported Functions

The following functions are supported:

03 Read Relay Setpoint Registers.
04 Read Relay Actual Values.
16 (10h) Write Relay Setpoints.

These functions are described in detail as follows:

FUNCTION 03h, READ SETPOINTS (Holding Registers)

MODBUS "Read Holding Registers" is interpreted here as "Read 269 Plus Setpoints". It is used by the Master Computer to program the relaying parameters. Up to 125 consecutive registers (250 bytes) can be read with one command. Broadcast command is not allowed with this function.

The 269 Plus Motor Protection Setpoint Register map is given in Table 4-1. This table represents the registers as inserted in the packet to be communicated. They are 16-bit words. The format of the packets communicated is given, with an example as follows:

The Master computer, in order to read the 3 consecutive setpoint registers starting from register address 006Bh from slave number 11H, sends the command:

		HI LO	HI LO	LO HI
11h	03h	00h 6Bh	00h 03h	76h 87h
ADDRESS	FUNCTION	START REG	COUNT	CRC

slave number 11h replies with:

			HI LO	HI LO	HI LO	LO HI
11h	03h	06h	02h 2Bh	00h 00h	00h 64h	C8h BAh
ADDRESS	FUNCTION	BYTE COUNT	REG DATA	REG DATA	REG DATA	CRC

(the successive registers are the setpoint values as identified in the setpoint map.)

NOTE: Since some master PLCs only support command 03, the Actual Values registers may be accessed using a Setpoint read command (03) beginning at offset 0200 (hex). Therefore, accessing of these registers using a Setpoint read command may be accomplished simply by adding 0200 hex (or 512 decimal) to the address.

FUNCTION 04h, READ ACTUAL VALUES (Input Registers)

MODBUS "Read Input Registers" is interpreted here as "Read 269 Plus Actual Values". This function is used by the PLC or Master Computer to read the measured or calculated circuit values from the 269 Plus Relay. MODBUS protocol allows up to 125 registers to be read with one command. The broadcast command is not allowed.

The actual value register map for the 269 Plus Relay is also given in Table 4-1. This table represents the registers as inserted in the packet to be communicated. They are 16-bit words. The format of the packets communicated is given, with an example as follows:

The Master computer, in order to read 1 actual value register starting from register address 0008h from slave number 11H, sends the command:

		HI LO	HI LO	LO HI
11h	04h	00h 08h	00h 01h	B2h 98h
ADDRESS	FUNCTION	START REG	COUNT	CRC

slave number 11h replies with:

			HI LO	LO HI
11h	04h	02h	00h 00h	78h F3h
ADDRESS	FUNCTION	BYTE COUNT	REG DATA	CRC

FUNCTION 16 (10h), WRITE SETPOINT VALUES

MODBUS "Write Multiple Holding Registers" is interpreted here as "Write Setpoint Values". It can be used to remotely program the 269 Plus setpoint registers. Although MODBUS limits the number of registers that may be written to in a single command to 60, the 269 Plus will allow up to 125. The use of this function may not be authorized in some customer installations. Care must be taken when using this command and a software access code is recommended.

The Master computer, in order to write 2 consecutive registers starting at address 0087H, sends the command:

		HI LO		HI LO	HI LO	
11h	10h	00h 87h	00h 02h	04h	00h 0Ah	...
ADDRESS	FUNC.	START REG	REG COUNT	BYTE COUNT	DATA	

	HI LO	LO HI
...	01h 02h	4Eh BAh
	DATA	CRC

slave number 11h replies with:

		HI LO	HI LO	LO HI
11h	10h	00h 87h	00h 02h	F3h 71h
ADDRESS	FUNCTION REG	START COUNT	REG	CRC

4.6 Exception or Error Replies

When the master command received by a 269 Plus cannot be performed, the 269 Plus replies with an error code. This is different from detecting communication related errors such as CRC error for which the 269 Plus ignores the command.

The format of an error reply is to return the received address and function back to the master with most significant bit of the function code set. Also, a one byte error code is added to the reply packet to identify the problem.

The error codes supported by 269 Plus relays are:

01 illegal function
02 register address out of range or start register+register count=register address out of range
03 register count is out of range

NOTE: There is no range on 269 Plus setpoint values, therefore, extra care must be taken when writing setpoints to ensure they are within range.

An example involving an error reply is:

Master requests reading an actual value register by sending:

		HI LO	HI LO	LO HI
11h	04h	05h A1h	00h 01h	62h 74h
ADDRESS	FUNCTION	START REG	COUNT	CRC

The actual value register 05A1h does not exist in the 269 Plus. Therefore, it replies:

			LO HI
11h	84h	02h	C3h 04h
ADDRESS	FUNCTION WITH MSB SET	WRONG DATA ADDRESS ERROR CODE	CRC

4.7 Error Checking Code

The error checking code mentioned previously is a standard cyclic redundancy check (CRC). A CRC-16 scheme as defined by ANSI is employed by the 269. This scheme considers the data stream as one large binary number. All start, stop and parity bits are excluded from the CRC calculation.

The data stream is multiplied by x^{16}, then divided by a characteristic polynomial. This polynomial is $x^{16} + x^{15} + x^2 + 1$, and is expressed as a 16 bit binary number (11000000000000101). Only the 16 bit remainder of this division is used as the CRC code. It is transmitted MSB first. The receiver will calculate the CRC value for the data it receives, and compares this to the CRC code from the sender. If the two CRC codes do not match, an error is detected. If an error is detected by the receiver, then the received COMMAND is not executed, and the 269 Plus unit will not respond. If no error is detected by the receiver, then the received COMMAND is executed.

4.7.1 CRC-16 Algorithm

The following algorithm describes the generation of the CRC code. Once the algorithm is complete, the working register "A" contains the CRC value to be transmitted (AL transmitted first, AH second). 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'. Before listing the algorithm, a few terms should be defined.

-->	=	data transfer
A	=	a 16 bit working register
AL	=	the low order byte of A
AH	=	the high order byte of A
i & j	=	loop counters
(+)	=	logical exclusive OR operator
Di	=	ith data byte (i = 0 to N - 1)
G	=	16 bit characteristic polynomial.
	=	1100000000000101 normally
	=	1010000000000001 with MSbit dropped, and bit order reversed. This reverse ordered, truncated binary number is the value used throughout the algorithm.
Shr(x)	=	Shift right. The LSbit of low order byte of x shifts into carry, and a '0' is shifted into MSbit of high order byte of x. Of course, the LSbit of the high order byte of x is shifted into the MSbit of the low order byte of x).
N	=	number of data bytes to be processed.

<u>Algorithm CRC</u>:

1)	FFFF hex --> A	
2)	0 --> i	
3)	0 --> j	
4)	Di (+) AL --> AL	
5)	j + 1 --> j	
6)	shr(A)	
7)	is there a carry?	
		NO: go to 8)
		YES: G (+) A --> A
8)	is j = 8?	
		YES: go to 9)
		NO: go to 5)
9)	i + 1 --> i	
10)	is i = N?	
		YES: go to 11)
		NO: go to 3)
11)	A --> CRC	

4.7.2 A Sample Packet with CRC-16

The following is a sample packet to read 102 bytes of actual values information from slave #64, starting at address 00H. The CRC-16 code is accurate and this packet may be used for testing purposes.

ADDRESS	= 40 hex
FUNCTION	= 04 hex
START REG (HI)	= 00 hex
START REG (LO)	= 00 hex
REG. COUNT (HI)	= 00 hex
REG. COUNT (LO)	= 33 hex
CRC (LO)	= BF hex
CRC (HI)	= 0E hex

4.8 Memory Map

The 269 PLUS relay has its memory broken up into two spaces — ACTUAL VALUES address space and SETPOINTs address space. Each space has a total of 256 bytes. There are separate COMMANDs used to access the two different spaces. The 269 Plus memory map and data formats are listed on the following pages, in Table 4-1.

Since some Master PLCs only support command 03, the Actual Values registers may be accessed using a setpoint read command (03) beginning at offset 0200H (or 512 decimal). Therefore, accessing these registers using a setpoint read command may be accomplished simply by adding 0200H (or 512 decimal) to the Actual Values register in question.

All MEMORY MAP ADDITIONS AND CHANGES HAVE BEEN IDENTIFIED BY TYPING THEM IN BOLD AND ITALIC LETTERING

Table 4-1 Memory Map

269 Plus Memory Map (Revision 269P.D6.0.4)						
ADDRESS			**DESCRIPTION**	**RANGE**	**UNITS**	**FORMAT CODE**
MODICON	**(hex)**	**(dec)**				
Setpoints - READ/WRITE						
40001	0000	0	Phase C.T. ratio	20 to 1500	x1	
40002	0001	1	Motor Full load current	10 to 1500	AMPS	
40003	0002	2	Acceleration time	1 to 251 (251 = OFF)	X0.5 SEC.	
40004	0003	3	Starts per hour	1 to 6 (6 = OFF)		
40005	0004	4	Unbalance Alarm level	4 to 31 (31 = OFF)	%	
40006	0005	5	Unbalance Alarm delay	3 to 255	SECONDS	
40007	0006	6	Unbalance Trip level	4 to 31 (31 = OFF)	%	
40008	0007	7	Unbalance Trip delay	3 to 255	SECONDS	
40009	0008	8	G/F C.T. Primary (only if G/F CT is chosen as xxx:5)	20 to 1500	x1	
40010	0009	9	G/F Alarm level	1 to 11 (11 = OFF)	x0.1 (x:5)	
					x1 (2000:1)	
40011	000A	10	G/F Alarm delay	1 to 255	SECONDS	
40012	000B	11	G/F Trip level	1 to 11 (11 = OFF)	x0.1 (x:5)	
					x1 (2000:1)	
40013	000C	12	G/F Trip delay	0 to 41 (41 = 0.25 sec)	X0.5 SEC.	
40014	000D	13	Undercurrent Alarm level	1 to 1001 (1001 = OFF)	AMPS	
40015	000E	14	Undercurrent Alarm delay	1 to 255	SECONDS	
40016	000F	15	Rapid Trip level	3 to 13 (13 = OFF)	X0.5 FLC	
40017	0010	16	Rapid Trip delay	1 to 250	X0.5 SECS.	
40018	0011	17	Short Circuit level	4 to 13 (13 = OFF)	X1 FLC	
40019	0012	18	Short Circuit delay	0 to 41 (0 = INST)	X0.5 SECS.	
40020	0013	19	Immediate overload	101 to 151 (151 = OFF)	x0.01 XFLC	
40021	0014	20	Phase C.T. Secondary	9 to 10		F1
40022	0015	21	Overload Pickup Level	105 to 125	x0.01 ×FLC	
				105 to 195 (service only)		
40023	0016	22	Mechanical Jam Alarm Level	3 to 13 (13 = OFF)	x 0.5 FLC	
40024	0017	23	Mechanical Jam Alarm Delay	1 to 250	x 0.5 SECONDS	
40025	0018	24	Celsius/Fahrenheit	41H to 42H		F2
40026	0019	25	Number of stator RTDs selected	0 to 6		
40027	001A	26	RTD 1 Alarm Level	0 to 201 (201 = OFF)	°C	
40028	001B	27	RTD 1 Trip Level	0 to 201 (201 = OFF)	°C	
40029	001C	28	RTD 2 Alarm Level	0 to 201 (201 = OFF)	°C	
40030	001D	29	RTD 2 Trip Level	0 to 201 (201 = OFF)	°C	
40031	001E	30	RTD 3 Alarm Level	0 to 201 (201 = OFF)	°C	
40032	001F	31	RTD 3 Trip Level	0 to 201 (201 = OFF)	°C	

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40033	0020	32	RTD 4 Alarm Level	0 to 201 (201 = OFF)	°C	
40034	0021	33	RTD 4 Trip Level	0 to 201 (201 = OFF)	°C	
40035	0022	34	RTD 5 Alarm Level	0 to 201 (201 = OFF)	°C	
40036	0023	35	RTD 5 Trip Level	0 to 201 (201 = OFF)	°C	
40037	0024	36	RTD 6 Alarm Level	0 to 201 (201 = OFF)	°C	
40038	0025	37	RTD 6 Trip Level	0 to 201 (201 = OFF)	°C	
40039	0026	38	RTD 7 Alarm Level	0 to 201 (201 = OFF)	°C	
40040	0027	39	RTD 7 Trip Level	0 to 201 (201 = OFF)	°C	
40041	0028	40	RTD 8 Alarm Level	0 to 201 (201 = OFF)	°C	
40042	0029	41	RTD 8 Trip Level	0 to 201 (201 = OFF)	°C	
40043	002A	42	RTD 9 Alarm Level	0 to 201 (201 = OFF)	°C	
40044	002B	43	RTD 9 Trip Level	0 to 201 (201 = OFF)	°C	
40045	002C	44	RTD 10 Alarm Level	0 to 201 (201 = OFF)	°C	
40046	002D	45	RTD 10 Trip Level	0 to 201 (201 = OFF)	°C	
40047	002E	46	Undercurrent Trip Level	1 to 1001 (1001 = OFF)	x 1 AMPS	
40048	002F	47	Undercurrent Trip Delay	1 to 255	x 1 SECONDS	
40049	0030	48	Selected Overload curve	1 to 8		
40050	0031	49	Trip time at 1.05 XFLC	1 to 12000	SECONDS	
40051	0032	50	Trip time at 1.10 XFLC	1 to 12000	SECONDS	
40052	0033	51	Trip time at 1.20 XFLC	1 to 12000	SECONDS	
40053	0034	52	Trip time at 1.30 XFLC	1 to 12000	SECONDS	
40054	0035	53	Trip time at 1.40 XFLC	1 to 12000	SECONDS	
40055	0036	54	Trip time at 1.50 XFLC	1 to 2000	SECONDS	
40056	0037	55	Trip time at 1.75 XFLC	1 to 2000	SECONDS	
40057	0038	56	Trip time at 2.00 XFLC	1 to 2000	SECONDS	
40058	0039	57	Trip time at 2.25 XFLC	1 to 2000	SECONDS	
40059	003A	58	Trip time at 2.50 XFLC	1 to 2000	SECONDS	
40060	003B	59	Trip time at 2.75 XFLC	1 to 2000	SECONDS	
40061	003C	60	Trip time at 3.00 XFLC	1 to 2000	SECONDS	
40062	003D	61	Trip time at 3.50 XFLC	1 to 2000	SECONDS	
40063	003E	62	Trip time at 4.00 XFLC	1 to 2000	SECONDS	
40064	003F	63	Trip time at 4.50 XFLC	1 to 2000	SECONDS	
40065	0040	64	Trip time at 5.00 XFLC	1 to 2000	SECONDS	
40066	0041	65	Trip time at 5.50 XFLC	1 to 2000	SECONDS	
40067	0042	66	Trip time at 6.00 XFLC	1 to 2000	SECONDS	
40068	0043	67	Trip time at 6.50 XFLC	1 to 2000	SECONDS	
40069	0044	68	Trip time at 7.00 XFLC	1 to 2000	SECONDS	
40070	0045	69	Trip time at 7.50 XFLC	1 to 2000	SECONDS	
40071	0046	70	Trip time at 8.00 XFLC	1 to 2000	SECONDS	
40072	0047	71	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40073	0048	72	Undefined			
40074	0049	73	Overload Trip assignment	16 to 18		F3
40075	004A	74	Unbalance Trip assignment	16 to 18		F3
40076	004B	75	Short Circuit Trip assignment	16 to 18		F3
40077	004C	76	Rapid Trip assignment	16 to 18		F3
40078	004D	77	Stator RTD Trip assignment	16 to 18		F3
40079	004E	78	RTD Trip assignment	16 to 18		F3
40080	004F	79	Ground Fault Trip assignment	16 to 18		F3
40081	0050	80	Acceleration Trip assignment	16 to 18		F3
40082	0051	81	Phase Reversal Trip assignment	16 to 18		F3
40083	0052	82	Inhibits Trip assignment	16 to 18		F3
40084	0053	83	Speed Switch Trip assignment	16 to 18		F3
40085	0054	84	Differential Input Trip assignment	16 to 18		F3
40086	0055	85	Single Phase Trip assignment	16 to 18		F3
40087	0056	86	Spare Input Trip assignment	16 to 18		F3
40088	0057	87	Power Factor Trip assignment	16 to 18		F3
40089	0058	88	Undervoltage Trip assignment	16 to 18		F3
40090	0059	89	Overload Warning assignment	13 to 16		F3
40091	005A	90	Ground Fault Alarm assignment	13 to 16		F3
40092	005B	91	Unbalance Alarm assignment	13 to 16		F3
40093	005C	92	Undercurrent Alarm assignment	13 to 16		F3
40094	005D	93	Stator RTD Alarm assignment	13 to 16		F3
40095	005E	94	RTD Alarm assignment	13 to 16		F3
40096	005F	95	No Sensor Alarm assignment	13 to 16		F3
40097	0060	96	Self-Test assignment	13 to 16		F3
40098	0061	97	Spare Input Alarm assignment	13 to 16		F3
40099	0062	98	No Slave Message assignment	13 to 16		F3
40100	0063	99	Power Factor Alarm assignment	13 to 16		F3
40101	0064	100	Undervoltage Alarm assignment	13 to 16		F3
40102	0065	101	KVAR Limit Alarm assignment	13 to 16		F3
40103	0066	102	Meter Comm. Alarm assignment	13 to 16		F3
40104	0067	103	Thermal capacity alarm assignment	13 to 16		F3
40105	0068	104	Low temp alarm assignment	13 to 16		F3
40106	0069	105	Undefined			
40107	006A	106	Undefined			
40108	006B	107	Undefined			
40109	006C	108	Undefined			
40110	006D	109	Default Display Line Code	1 to 40		
40111	006E	110	Default Display Page Code	1 to 10		
40112	006F	111	RTD Bias minimum value (Only if RTD Bias enabled)	0 to 200 (0°C≤RTD bias min<RTD bias center)	°C	

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40113	0070	112	RTD Bias maximum value (Only if RTD Bias enabled)	0 to 200 (RTD bias center<RTD bias max≤200°C)	°C	
40114	0071	113	Default Running Cool Time (only if learned cool time defeated)	1 to 45	MINUTES	
40115	0072	114	Default Stopped Cool Time (only if learned cool time defeated)	5 to 213	MINUTES	
40116	0073	115	D/A Output parameter	45 to 49		F4
40117	0074	116	Alarm Relay Latchcode	1 to 7		F5
40118	0075	117	Relay Failsafe code	1 to 8		F6
40119	0076	118	Speed Switch Delay	1 to 200	X 0.5 SECS	
40120	0077	119	Spare Input Alarm Delay	1 to 255 (255 = OFF)	SECONDS	
40121	0078	120	Spare Input Trip Delay	1 to 255 (255 = OFF)	SECONDS	
40122	0079	121	Default K	1 to 20 (20 = Learned)		
40123	007A	122	FLC Thermal Capacity Reduction	0 to 90	%	
40124	007B	123	Type of User Analog	32H to 34H		F7
40125	007C	124	Backspin Timer Setpoint	1 to 255 (255 = OFF)	MINUTES	
40126	007D	125	Time Between Starts	1 to 255 (255 = OFF)	MINUTES	
40127	007E	126	Thermal Capacity Alarm Level	1 to 101 (101 = OFF)	% TC USED	
40128	007F	127	Thermal Capacity Alarm Delay	1 to 255	SECONDS	
40129	0080	128	RTD Bias Center Thermal Capacity	1 to 99	% TC USED	
40130	0081	129	RTD Bias Center Temperature	1 to 199 (RTD bias min<RTD bias cen<RTD	°C	
40131	0082	130	Analog Output Motor Load Full Scale	25 to 250	%	
40132	0083	131	SLAVE FUNCTION Register 1	0 to 65535		F8
40133	0084	132	SLAVE FUNCTION Register 2	0 to 65535		F8
40134	0085	133	SLAVE FUNCTION Register 3	0 to 65535		F8
40135	0086	134	Initial Start Thermal Capacity	10 to 80	%	
40136	0087	135	Undefined			
40137	0088	136	User relay force code	1BH to 20H		F9
40138	0089	137	User RTD force code	0 to 10		F10
40139	008A	138	User RTD force code value	0 to 201	°C	
40140	008B	139	User analog force code	0 to 255 (0=0mA; 255=20mA)		
40141	008C	140	Switch Input Force Code	27H to 2CH		F12
40142	008D	141	Switch Input Status	25H to 26H		F12
40143	008E	142	Reserved REMOVED FROM MAP	DO NOT ALTER		
40144	008F	143	Undefined REMOVED FROM MAP	DO NOT ALTER		
40145	0090	144	Undefined REMOVED FROM MAP	DO NOT ALTER		
40146	0091	145	Undefined REMOVED FROM MAP	DO NOT ALTER		
40147	0092	146	Reserved REMOVED FROM MAP	DO NOT ALTER		
40148	0093	147	Undefined REMOVED FROM MAP	DO NOT ALTER		
40149	0094	148	Reserved (Factory Setpoints Loaded)	DO NOT ALTER		
40150	0095	149	Undefined	DO NOT ALTER		
40151	0096	150	Undefined	DO NOT ALTER		
40152	0097	151	Undefined	DO NOT ALTER		

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40153	0098	152	Setpoints Status Bits Register 3	0 to 65535		F32
40154	0099	153	Setpoints Status Bits Register 1	0 to 65535		F13
40155	009A	154	Setpoints Status Bits Register 2	0 to 65535		F14
40156	009B	155	TRPMSGCONT (Reserved)			
40157	009C	156	TIMEOUT (Display timeout counter)			
40158	009D	157	Undefined	DO NOT ALTER		
40159	009E	158	Meter VT Secondary	40 to 240	x1 Volts	
40160	009F	159	Meter CT Primary	20 to 1500	x 1	
40161	00A0	160	Meter VT Ratio	10 to 2550	x 0.1	
40162	00A1	161	Undervoltage Alarm Level	30 to 96 (96 = OFF)	% VT	
40163	00A2	162	Undervoltage Alarm Delay	1 to 255	SECONDS	
40164	00A3	163	Undervoltage Trip Level	30 to 96 (96 = OFF)	% VT	
40165	00A4	164	Undervoltage Trip Delay	1 to 255	SECONDS	
40166	00A5	165	Power Factor Lead Alarm Level	5 to 100 (100 = OFF)	x 0.01	
40167	00A6	166	Power Factor Lag Alarm Level	5 to 100 (100 = OFF)	x 0.01	
40168	00A7	167	Power Factor Alarm Delay	1 to 255	SECONDS	
40169	00A8	168	Power Factor Lead Trip Level	5 to 100 (100 = OFF)	x 0.01	
40170	00A9	169	Power Factor Lag Trip Level	5 to 100 (100 = OFF)	x 0.01	
40171	00AA	170	Power Factor Trip Delay	1 to 255	SECONDS	
40172	00AB	171	Positive KVAR Alarm Level	1 to 251 (251 = OFF)	x 100	
40173	00AC	172	KVAR Alarm Delay	1 to 255	SECONDS	
40174	00AD	173	Analog Output Scale Factor	1 to 255	x 1	
40175	00AE	174	Power Factor Protection Delay	1 to 255 (255 = OFF)	SECONDS	
40176	00AF	175	Overvoltage Alarm Level	101 to 116 (116 = OFF)	% VT	
40177	00B0	176	Overvoltage Alarm Delay	1 to 255	SECONDS	
40178	00B1	177	Overvoltage Trip Level	101 to 116 (116 = OFF)	% VT	
40179	00B2	178	Overvoltage Trip Delay	1 to 255	SECONDS	
40180	00B3	179	RTD1 High Alarm Level	0 to 201 (201=OFF)	°C	
40181	00B4	180	RTD2 High Alarm Level	0 to 201 (201=OFF)	°C	
40182	00B5	181	RTD3 High Alarm Level	0 to 201 (201=OFF)	°C	
40183	00B6	182	RTD4 High Alarm Level	0 to 201 (201=OFF)	°C	
40184	00B7	183	RTD5 High Alarm Level	0 to 201 (201=OFF)	°C	
40185	00B8	184	RTD6 High Alarm Level	0 to 201 (201=OFF)	°C	
40186	00B9	185	Negative KVAR Alarm Level	1 to 251 (251 = OFF)	x100	
40187	00BA	186	Power Factor Trip/Alarm Start Block Delay	1 to 255 (255 = OFF)	SECONDS	
40188	00BB	187	Undefined			
40189	00BC	188	Undefined			
40190	00BD	189	Undefined			
40191	00BE	190	Undefined			
40192	00BF	191	Undefined			

269 Plus Memory Map (Revision 269P.D6.0.4)						
ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40193	00C0	192	Overvoltage Trip Assignment	16 to 18		F3
40194	00C1	193	Undercurrent Trip Assignment	16 to 18		F3
40195	00C2	194	Undefined			
40196	00C3	195	Undefined			
40197	00C4	196	Undefined			
40198	00C5	197	Undefined			
40199	00C6	198	Undefined			
40200	00C7	199	Undefined			
40201	00C8	200	Overvoltage Alarm Assignment	13 to 16		F3
40202	00C9	201	Mechanical Jam Alarm Assignment	13 to 16		F3
40203	00CA	202	Undefined			
40204	00CB	203	Undefined			
40205	00CC	204	Undefined			
40206	00CD	205	Undefined			
40207	00CE	206	Stator RTD High Alarm Assignment	13 to 16		F3
40208	00CF	207	RTD High Alarm Assignment	13 to 16		F3
40209	00D0	208	Undefined			
40210	00D1	209	Undefined			
40211	00D2	210	Undefined			
40212	00D3	211	Undefined			
40213	00D4	212	Undefined			
40214	00D5	213	Undefined			
40215	00D6	214	Undefined			
40216	00D7	215	Undefined			
40217	00D8	216	Undefined			
40218	00D9	217	Undefined			
40219	00DA	218	Undefined			
40220	00DB	219	Undefined			
40221	00DC	220	Undefined			
40222	00DD	221	Undefined			
40223	00DE	222	Undefined			
40224	00DF	223	Undefined			
40225	00E0	224	Undefined			
40226	00E1	225	Undefined			
40227	00E2	226	Undefined			
40228	00E3	227	Undefined			
40229	00E4	228	Undefined			
40230	00E5	229	Undefined			
40231	00E6	230	Undefined			
40232	00E7	231	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40233	00E8	232	Undefined			
40234	00E9	233	Undefined			
40235	00EA	234	Undefined			
40236	00EB	235	Undefined			
40237	00EC	236	Undefined			
40238	00ED	237	Undefined			
40239	00EE	238	Undefined			
40240	00EF	239	Undefined			
40241	00F0	240	Reserved			
40242	00F1	241	Reserved			
40243	00F2	242	Reserved			
40244	00F3	243	Reserved			
40245	00F4	244	Undefined			
40246	00F5	245	Undefined			
40247	00F6	246	Undefined			
40248	00F7	247	Undefined			
40249	00F8	248	Undefined			
40250	00F9	249	Undefined			
40251	00FA	250	Undefined			
40252	00FB	251	Undefined			
40253	00FC	252	Serial Number: Hardware Letter Code	61h to 64h		F31
40254	00FD	253	Serial Number: Last Digit of Production year	0 TO 9		
40255	00FE	254	Serial Number: Four Digit Unit Serial Number	0 to 9999		
40256	00FF	255	Undefined			
Actual Values - READ ONLY						
40513	0000	0	Multilin product device code	20 or 52		F15
40514	0001	1	Multilin product hardware rev code	0000H to FFFFH		F16
40515	0002	2	Multilin product firmware rev code	0100H to FFFFH		F17
40516	0003	3	Multilin Mod. File Number	0 to FFFFH		F18
40517	0004	4	Undefined			
40518	0005	5	Undefined			
40519	0006	6	Undefined			
40520	0007	7	Undefined			
40521	0008	8	Undefined			
40522	0009	9	Undefined			
40523	000A	10	Undefined			
40524	000B	11	Undefined			
40525	000C	12	Undefined			
40526	000D	13	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT
MODICON	(hex)	(dec)				CODE
40527	000E	14	Undefined			
40528	000F	15	Undefined			
40529	0010	16	phase 1 current	0 to 18000	AMPS	
40530	0011	17	phase 2 current	0 to 18000	AMPS	
40531	0012	18	phase 3 current	0 to 18000	AMPS	
40532	0013	19	average current	0 to 18000	AMPS	
40533	0014	20	hottest stator temperature	0 to 200	°C	
40534	0015	21	unbalance ratio	0 to 31	%	
40535	0016	22	ground fault current	0 to 255	x0.1 A (2000:1)	
40536	0017	23	bargraph count	0 to 24	x0.25 FLC	
40537	0018	24	undefined			
40538	0019	25	undefined			
40539	001A	26	undefined			
40540	001B	27	undefined			
40541	001C	28	hottest stator RTD #	1 to 6		
40542	001D	29	hottest stator temperature	0 to 200	°C	
40543	001E	30	RTD 1 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40544	001F	31	RTD 2 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40545	0020	32	RTD 3 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40546	0021	33	RTD 4 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40547	0022	34	RTD 5 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40548	0023	35	RTD 6 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40549	0024	36	RTD 7 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40550	0025	37	RTD 8 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40551	0026	38	RTD 9 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40552	0027	39	RTD 10 temperature	0 to 201 (200 = 200+, 201 = no RTD)	°C	
40553	0028	40	hottest stator RTD # since last acc.	1 to 6		
40554	0029	41	hottest stator temp. since last acc.	0 to 200	°C	
40555	002A	42	max. RTD 7 since last acc.	0 to 200	°C	
40556	002B	43	max. RTD 8 since last acc.	0 to 200	°C	
40557	002C	44	max. RTD 9 since last acc.	0 to 200	°C	
40558	002D	45	max. RTD 10 since last acc.	0 to 200	°C	
40559	002E	46	undefined			
40560	002F	47	undefined			
40561	0030	48	undefined			
40562	0031	49	undefined			
40563	0032	50	# of overvoltage trips since last commissioning	0 to 255		
40564	0033	51	estimated-time-to-trip	0-65535 (65535 = no reading)	SECONDS	
40565	0034	52	motor load (% Full load)	0 to 1200	%	
40566	0035	53	thermal capacity used	0 to 100	%	

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT
MODICON	(hex)	(dec)				CODE
40567	0036	54	starts/hr counter 1	0 to 60	MINUTES	
40568	0037	55	starts/hr counter 2	0 to 60	MINUTES	
40569	0038	56	starts/hr counter 3	0 to 60	MINUTES	
40570	0039	57	starts/hr counter 4	0 to 60	MINUTES	
40571	003A	58	starts/hr counter 5	0 to 60	MINUTES	
40572	003B	59	running hours since commissioning	0 to 65535	HOURS	
40573	003C	60	# of starts since commissioning	0 to 65535		
40574	003D	61	# of trips since commissioning	0 to 65535		
40575	003E	62	# of O/L trips since commissioning	0 to 255		
40576	003F	63	# of Rapid trips since commissioning	0 to 255		
40577	0040	64	# of U/B trips since commissioning	0 to 255		
40578	0041	65	# of G/F trips since commissioning	0 to 255		
40579	0042	66	# of RTD trips since commissioning	0 to 255		
40580	0043	67	# of start trips since commissioning	0 to 255		
40581	0044	68	# of S/C trips since commissioning	0 to 255		
40582	0045	69	MegaWattHours since commissioning	0 to 65535	MWHR	
40583	0046	70	# of undervoltage trips since commissioning	0 to 255		
40584	0047	71	# of power factor trips since commissioning	0 to 255		
40585	0048	72	voltage phase reversal trips since commissioning	0 to 255		
40586	0049	73	Motor Alarm Status 2	0 to 255		F21
40587	004A	74	Motor Trip Status 2	0 to 255		F22
40588	004B	75	Lotemp Alarm RTD Num	1 to 10		
40589	004C	76	Reserved			
40590	004D	77	Motor Current Status	0 to 3		F23
40591	004E	78	Motor Alarm Status 1	0 to 65535		F19
40592	004F	79	Motor Trip Status 1	0 to 65535		F20
40593	0050	80	Inhibit Type	37H to 3AH		F24
40594	0051	81	Meter Failure Type	3BH to 3CH		F25
40595	0052	82	Setpoint Status bits Register 1	0 to 65535		F13
40596	0053	83	Setpoint Status bits Register 2	0 to 65535		F14
40597	0054	84	LEDATA	0 to 255		F26
40598	0055	85	Lockout Time	0 to 60	MINUTES	
40599	0056	86	Pre-Trip average current	0 to 18000	AMPS	
40600	0057	87	Pre-Trip unbalance ratio	0 to 31	%	
40601	0058	88	Pre-Trip ground fault current	0 to 255	x 0.1 A (2000:1)	
40602	0059	89	Pre-Trip maximum stator #	1 to 6		
40603	005A	90	Pre-Trip maximum stator temp.	0 to 200	°C	
40604	005B	91	Pretrip Average Voltage	0 to 65535	VOLTS	
40605	005C	92	Pretrip Watts	0 to 65535	KWATTS	
40606	005D	93	Pretrip VARS	0 to 65535	KVARS	

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT
MODICON	(hex)	(dec)				CODE
40607	005E	94	Pretrip Power Factor	0 to 100 (100 = OFF)	x 0.01	
40608	005F	95	Pretrip Power Factor sign	4E H, 5D H, 5E H		F29
40609	0060	96	Pretrip Frequency	0, 400 to 720 (0 = out of range)	x 0.1	
40610	0061	97	Tripped RTD Trip Level	0 to 200	°C	
40611	0062	98	Tripped RTD Number	1 to 10		
40612	0063	99	Pre-Trip kWatt Sign	35H to 36H		F27
40613	0064	100	Pre-Trip kVAR Sign	35H to 36H		F27
40614	0065	101	Cause of Last Trip Message	45H to 56H		F28
40615	0066	102	Learned avg. Istart (average of 4 starts)	0 to 18000	AMPS	
40616	0067	103	Learned last Istart	0 to 18000	AMPS	
40617	0068	104	Learned K factor	3 to 19	x 0.1	
40618	0069	105	Learned running cool time	5 to 60	MINUTES	
40619	006A	106	Learned stopped cool time	5 to 60	MINUTES	
40620	006B	107	Learned acceleration time	0 to 255	x0.5 SECS.	
40621	006C	108	Learned start capacity	10 to 90	%	
40622	006D	109	Time between starts counter	1 to 254	MINUTES	
40623	006E	110	Learned Last Start Thermal Capacity	0 to 100	%	
40624	006F	111	Pre-Trip Phase 1 Current (Ia)	0 to 18000	AMPS	
40625	0070	112	Pre-Trip Phase 2 Current (Ib)	0 to 18000	AMPS	
40626	0071	113	Pre-Trip Phase 3 Current (Ic)	0 to 18000	AMPS	
40627	0072	114	Cause of Last Event	45H to 56H and 5FH		F28
40628	0073	115	# of Undercurrent Trips Since Last Commissioning	0 to 255		
40629	0074	116	Undefined			
40630	0075	117	Undefined			
40631	0076	118	Undefined			
40632	0077	119	Undefined			
40633	0078	120	Average Volts	0 to 65535	VOLTS	
40634	0079	121	Voltage AB	0 to 65535	VOLTS	
40635	007A	122	Voltage BC	0 to 65535	VOLTS	
40636	007B	123	Voltage CA	0 to 65535	VOLTS	
40637	007C	124	Actual Watts	0 to 65535	KWATTS	
40638	007D	125	Actual VARS	0 to 65535	KVARS	
40639	007E	126	Power Factor	0 to 100 (100 = OFF)	x 0.01	
40640	007F	127	Power Factor sign	4E H, 5D H, 5E H		F29
40641	0080	128	Frequency	0, 400 to 720 (0 = out of range)	x 0.1	
40642	0081	129	kWatt Sign	35H to 36H		F27
40643	0082	130	kVAR Sign	35H to 36H		F27
40644	0083	131	Undefined			
40645	0084	132	Undefined			
40646	0085	133	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT
MODICON	(hex)	(dec)				CODE
40647	0086	134	Undefined			
40648	0087	135	Undefined			
40649	0088	136	Undefined			
40650	0089	137	Undefined			
40651	008A	138	Undefined			
40652	008B	139	Self Test Alarm Status	13H, 14H, 15H, 18H		F33
40653	008C	140	RTD Type	0 to 3		F30
40654	008D	141	Alarmed Stator RTD Level	0 to 200	°C	
40655	008E	142	Alarmed Stator RTD Number	1 to 6		
40656	008F	143	Alarmed RTD Level	0 to 200	°C	
40657	0090	144	Alarmed RTD Number	1 to 10		
40658	0091	145	High Alarmed Stator RTD Level	0 to 200	°C	
40659	0092	146	High Alarmed Stator RTD Number	1 to 6		
40660	0093	147	High Alarmed RTD Level	0 to 200	°C	
40661	0094	148	High Alarmed RTD Number	1 to 6		
40662	0095	149	Undefined			
40663	0096	150	Undefined			
40664	0097	151	Undefined			
40665	0098	152	Undefined			
40666	0099	153	Undefined			
40667	009A	154	Undefined			
40668	009B	155	Undefined			
40669	009C	156	Undefined			
40670	009D	157	Undefined			
40671	009E	158	Undefined			
40672	009F	159	Undefined			
40673	00A0	160	Undefined			
40674	00A1	161	Undefined			
40675	00A2	162	Undefined			
40676	00A3	163	Undefined			
40677	00A4	164	Undefined			
40678	00A5	165	Undefined			
40679	00A6	166	Undefined			
40680	00A7	167	Undefined			
40681	00A8	168	Undefined			
40682	00A9	169	Undefined			
40683	00AA	170	Undefined			
40684	00AB	171	Undefined			
40685	00AC	172	Undefined			
40686	00AD	173	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40687	00AE	174	Undefined			
40688	00AF	175	Undefined			
40689	00B0	176	Undefined			
40690	00B1	177	Undefined			
40691	00B2	178	Undefined			
40692	00B3	179	Undefined			
40693	00B4	180	Undefined			
40694	00B5	181	Undefined			
40695	00B6	182	Undefined			
40696	00B7	183	Undefined			
40697	00B8	184	Undefined			
40698	00B9	185	Undefined			
40699	00BA	186	Undefined			
40700	00BB	187	Undefined			
40701	00BC	188	Undefined			
40702	00BD	189	Undefined			
40703	00BE	190	Undefined			
40704	00BF	191	Undefined			
40705	00C0	192	Undefined			
40706	00C1	193	Undefined			
40707	00C2	194	Undefined			
40708	00C3	195	Undefined			
40709	00C4	196	Undefined			
40710	00C5	197	Undefined			
40711	00C6	198	Undefined			
40712	00C7	199	Undefined			
40713	00C8	200	Undefined			
40714	00C9	201	Undefined			
40715	00CA	202	Undefined			
40716	00CB	203	Undefined			
40717	00CC	204	Undefined			
40718	00CD	205	Undefined			
40719	00CE	206	Undefined			
40720	00CF	207	Undefined			
40721	00D0	208	Undefined			
40722	00D1	209	Undefined			
40723	00D2	210	Undefined			
40724	00D3	211	Undefined			
40725	00D4	212	Undefined			
40726	00D5	213	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40727	00D6	214	Undefined			
40728	00D7	215	Undefined			
40729	00D8	216	Undefined			
40730	00D9	217	Undefined			
40731	00DA	218	Undefined			
40732	00DB	219	Undefined			
40733	00DC	220	Undefined			
40734	00DD	221	Undefined			
40735	00DE	222	Undefined			
40736	00DF	223	Undefined			
40737	00E0	224	Undefined			
40738	00E1	225	Undefined			
40739	00E2	226	Undefined			
40740	00E3	227	Undefined			
40741	00E4	228	Undefined			
40742	00E5	229	Undefined			
40743	00E6	230	Undefined			
40744	00E7	231	Undefined			
40745	00E8	232	Undefined			
40746	00E9	233	Undefined			
40747	00EA	234	Undefined			
40748	00EB	235	Undefined			
40749	00EC	236	Undefined			
40750	00ED	237	Undefined			
40751	00EE	238	Undefined			
40752	00EF	239	Undefined			
40753	00F0	240	Undefined			
40754	00F1	241	Undefined			
40755	00F2	242	Undefined			
40756	00F3	243	Undefined			
40757	00F4	244	Undefined			
40758	00F5	245	Undefined			
40759	00F6	246	Undefined			
40760	00F7	247	Undefined			
40761	00F8	248	Undefined			
40762	00F9	249	Undefined			
40763	00FA	250	Undefined			
40764	00FB	251	Undefined			
40765	00FC	252	Undefined			
40766	00FD	253	Undefined			

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ADDRESS			DESCRIPTION	RANGE	UNITS	FORMAT CODE
MODICON	(hex)	(dec)				
40767	00FE	254	Undefined			
40768	00FF	255	Undefined			

269 Plus Data Formats (Revision 269P.D6.0.4)

FORMAT CODE	APPLICABLE BITS	DEFINITION
F1	16 bits	Phase CT
	0000 0000 0000 1001	xxxx:1 Phase CT
	0000 0000 0000 1010	xxxx:5 Phase CT
F2	16 bits	Temperature Display
	0000 0000 0100 0001	Celsius
	0000 0000 0100 0010	Fahrenheit
F3	16 bits	Relay Assignment
	0000 0000 0000 1101	AUX.2
	0000 0000 0000 1110	ALARM
	0000 0000 0000 1111	NO
	0000 0000 0001 0000	AUX.1
	0000 0000 0001 0001	TRIP
	0000 0000 0001 0010	TRIP and AUX.1
F4	16 bits	D/A Output Parameter
	0000 0000 0010 1101	Max stator temperature outputted
	0000 0000 0010 1110	Thermal memory used outputted
	0000 0000 0010 1111	Motor load as a % of full load outputted
	0000 0000 0011 0000	% CT secondary outputted
	0000 0000 0011 0001	RTD7 temperature outputted
F5	16 bits	TRIP ALARM AUX.1 AUX.2 latchcodes
	0000 0000 0000 0001	L U U L
	0000 0000 0000 0010	L L U L
	0000 0000 0000 0100	L U L L
	0000 0000 0000 0110	L L L L (L=latched, U=unlatched)
F6	16 bits	TRIP ALARM AUX.1 AUX.2 Relay Failsafe Codes
	0000 0000 0000 0001	F N N F
	0000 0000 0000 0010	N F N F
	0000 0000 0000 0011	F F N F
	0000 0000 0000 0100	N N F F
	0000 0000 0000 0101	F N F F
	0000 0000 0000 0110	N F F F
	0000 0000 0000 0111	F F F F
	0000 0000 0000 1000	N N N F (N=non-failsafe, F=failsafe)
F7	16 bits	Analog Output Scale
	0000 0000 0011 0010	4-20 mA
	0000 0000 0011 0011	0-20 mA
	0000 0000 0011 0100	0-1 mA
F8	16 bits	Slave Function
	0000 0000 0000 0000	Check integrity of SCL without doing anything
	0000 0001 0000 0000	undefined
	0000 0010 0000 0000	simulate Differential Trip
	0000 0100 0000 0000	undefined
	0000 1000 0000 0000	simulate Emergency Restart
	0001 0000 0000 0000	simulate External Reset
	0010 0000 0000 0000	Reserved
	0100 0000 0000 0000	Reserved
	1000 0000 0000 0000	Reserved

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FORMAT CODE	APPLICABLE BITS	DEFINITION
F9	16 bits	Relay Force Code (after protected motor is stopped)
	0000 0000 0001 1011	NO relay
	0000 0000 0001 1100	TRIP
	0000 0000 0001 1101	ALARM
	0000 0000 0001 1110	AUX. 1
	0000 0000 0001 1111	AUX. 2
	0000 0000 0010 0000	ALL relays
F10	16 bits	User RTD Force Code
	0000 0000 0000 0000	normal scan
	0000 0000 0000 0001	RTD 1
	0000 0000 0000 0010	RTD 2
	0000 0000 0000 0011	RTD 3
	0000 0000 0000 0100	RTD 4
	0000 0000 0000 0101	RTD 5
	0000 0000 0000 0110	RTD 6
	0000 0000 0000 0111	RTD 7
	0000 0000 0000 1000	RTD 8
	0000 0000 0000 1001	RTD 9
	0000 0000 0000 1010	RTD 10
F12	16 bits	Switch Input Force Code & Status
	0000 0000 0010 0101	Status: short
	0000 0000 0010 0110	Status: open
	0000 0000 0010 0111	External Reset
	0000 0000 0010 1000	Emergency Reset
	0000 0000 0010 1001	Access
	0000 0000 0010 1010	Speed Switch
	0000 0000 0010 1011	Differential Input
	0000 0000 0010 1100	Spare Input
F13	16 bits	Setpoints Status Register 1
	0000 0000 0000 0001	Custom Curve selected (set trip times starting at address 0080H)
	0000 0000 0000 0010	Reserved
	0000 0000 0000 0100	Reserved
	0000 0000 0000 1000	RTD Bias defeated
	0000 0000 0001 0000	Start Inhibit Feature enabled
	0000 0000 0010 0000	Unbalance Bias defeated
	0000 0000 0100 0000	Phase Reversal enabled
	0000 0000 1000 0000	Single Shot Restart enabled
	0000 0001 0000 0000	G/F CT = xxx:5 (2000:1 if '0')
	0000 0010 0000 0000	Reserved
	0000 0100 0000 0000	Set to clear RTD last access data
	0000 1000 0000 0000	Set to clear commissioning data
	0001 0000 0000 0000	No Sensor Alarm defeated
	0010 0000 0000 0000	Learned Cool Rate defeated
	0100 0000 0000 0000	RTD 10 made ambient sensor
	1000 0000 0000 0000	Speed Switch Input defeated
F14	16 bits	Setpoints Status Register 2
	0000 0000 0000 0001	Special External Reset enabled
	0000 0000 0000 0010	Reserved

MULTILIN

269 Plus Data Formats (Revision 269P.D6.0.4)		
FORMAT CODE	APPLICABLE BITS	DEFINITION
	0000 0000 0000 0100	Reserved
	0000 0000 0000 1000	Set to Place 269 in Test Mode
	0000 0000 0001 0000	Enable PF Trip/Alarm Block on Start
	0000 0000 0010 0000	Reserved
	0000 0000 0100 0000	Are there any RTDs connected to the 269 Plus? Yes =1, No = 0
	0000 0000 1000 0000	Reserved
	0000 0001 0000 0000	Meter on-line
	0000 0010 0000 0000	Voltage Phase Reversal enabled
	0000 0100 0000 0000	Spare enabled as 52b
	0000 1000 0000 0000	Enable Differential Trip
	0001 0000 0000 0000	Enable RTD Lotemp Alarm
	0010 0000 0000 0000	Enable Stator RTD Voting
	0100 0000 0000 0000	Set to 1 if 2-Input Wye, Reset to 0 if Open Delta (DO NOT ALTER)
	1000 0000 0000 0000	Clear Pre-Trip Data
F15	16 bits	Product Code
	0000 0000 0011 0100	269 Plus Motor Management Relay
	0000 0000 0001 0010	269 Motor Management Relay
F16	16 bits	Hardware Revision Letter
	0000 0000 0000 0000	undefined
	0000 0000 0000 0001	A'
	0000 0000 0000 0010	B'
	etc	
F17	16 bits	Product Firmware Revision Code
	0000 0001 0000 0000	1.0
	0000 0001 0000 0001	1.0.1
	0000 0101 0000 0010	5.0.2 (starting B5.0)
	0000 0001 0001 0000	1.1.0
	etc.	
F18	16 bits	Modification Number
	0000 0000 0000 0000	no modification (i.e. standard unit)
	0000 0000 1111 1011	Mod #248
	0000 0001 0000 1010	Mod #266
	etc.	
F19	16 bits	Motor Alarm Status 1
	0000 0000 0000 0001	Immediate O/L Warning
	0000 0000 0000 0010	Ground Fault Alarm
	0000 0000 0000 0100	Unbalance Alarm
	0000 0000 0000 1000	Undercurrent Alarm
	0000 0000 0001 0000	Stator RTD Alarm
	0000 0000 0010 0000	Bearing RTD Alarm
	0000 0000 0100 0000	Broken Sensor Alarm
	0000 0000 1000 0000	Self-Test Failure
	0000 0001 0000 0000	Spare Input Alarm
	0000 0010 0000 0000	undefined
	0000 0100 0000 0000	Power Factor Alarm
	0000 1000 0000 0000	Undervoltage Alarm
	0001 0000 0000 0000	kvar Limit Alarm
	0010 0000 0000 0000	Meter Communication Failure Alarm

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FORMAT CODE	APPLICABLE BITS	DEFINITION
	0100 0000 0000 0000	Thermal Capacity Alarm
	1000 0000 0000 0000	RTD Lotemp Alarm
F20	16 bits	Motor Trip Status 1
	0000 0000 0000 0001	Overload Trip
	0000 0000 0000 0010	Unbalance Trip
	0000 0000 0000 0100	Short Circuit Trip
	0000 0000 0000 1000	Rapid Trip
	0000 0000 0001 0000	Stator RTD Trip
	0000 0000 0010 0000	RTD Trip
	0000 0000 0100 0000	Ground Fault Trip
	0000 0000 1000 0000	Acceleration Time Trip
	0000 0001 0000 0000	Phase Reversal Trip
	0000 0010 0000 0000	Inhibits
	0000 0100 0000 0000	Speed Switch Trip
	0000 1000 0000 0000	Differential Input Trip
	0001 0000 0000 0000	Single Phase Trip
	0010 0000 0000 0000	Spare Input Trip
	0100 0000 0000 0000	Power Factor Trip
	1000 0000 0000 0000	Undervoltage Trip
F21	16 bits	Motor Alarm Status 2
	0000 0000 0000 0001	Overvoltage Alarm
	0000 0000 0000 0010	Mechanical Jam Alarm
	0000 0000 0000 0100	Undefined
	0000 0000 0000 1000	Undefined
	0000 0000 0001 0000	Undefined
	0000 0000 0010 0000	Undefined
	0000 0000 0100 0000	Stator RTD High Alarm
	0000 0000 1000 0000	RTD High Alarm
F22	16 bits	Motor Trip Status 2
	0000 0000 0000 0001	Overvoltage Trip
	0000 0000 0000 0010	Undercurrent Trip
	0000 0000 0000 0100	Undefined
	0000 0000 0000 1000	Undefined
	0000 0000 0001 0000	Undefined
	0000 0000 0010 0000	Undefined
	0000 0000 0100 0000	Undefined
	0000 0000 1000 0000	Undefined
F23	16 bits	Motor Current Status
	0000 0000 0000 0000	Motor Stopped (Iavg < 5% FLC)
	0000 0000 0000 0001	Motor Running Normal (Iavg < Iflc)
	0000 0000 0000 0010	Motor in Overload (Iavg > Iflc)
	0000 0000 0000 0011	Motor Starting
F24	16 bits	Inhibit Type
	0000 0000 0011 0111	Starts per Hour
	0000 0000 0011 1000	Start Inhibit
	0000 0000 0011 1001	Time Between Starts
	0000 0000 0011 1010	Backspin Timer
F25	16 bits	Meter Communication Failure Type

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FORMAT CODE	APPLICABLE BITS	DEFINITION
	0000 0000 0011 1011	Incompatible Revisions
	0000 0000 0011 1100	Hardware Failure
F26	16 bits	Illuminated LEDs
	0000 0000 0000 0001	AUX. 2 relay active
	0000 0000 0000 0010	AUX. 1 relay active
	0000 0000 0000 0100	ALARM relay active
	0000 0000 0000 1000	TRIP relay active
	0000 0000 0001 0000	undefined
	0000 0000 0010 0000	undefined
	0000 0000 0100 0000	undefined
	0000 0000 1000 0000	undefined
F27	16 bits	Power Sign
	0000 0000 0011 0101	'+'
	0000 0000 0011 0110	'–'
	0000 0000 0100 1110	‘ ‘ Blank
F28	16 bits	Cause of Last Trip
	0000 0000 0100 0101	Overload Trip
	0000 0000 0100 0110	Unbalance Trip
	0000 0000 0100 0111	Short Circuit Trip
	0000 0000 0100 1000	Rapid Trip Trip
	0000 0000 0100 1001	Stator RTD Trip
	0000 0000 0100 1010	RTD Trip
	0000 0000 0100 1011	Ground Fault Trip
	0000 0000 0100 1100	Acceleration Trip
	0000 0000 0100 1101	Phase Reversal Trip
	0000 0000 0100 1110	BLANK - No Cause of Last Trip
	0000 0000 0100 1111	Speed Switch Trip
	0000 0000 0101 0000	Differential Trip
	0000 0000 0101 0001	Single Phase Trip
	0000 0000 0101 0010	Spare Input Trip
	0000 0000 0101 0011	Power Factor Trip
	0000 0000 0101 0100	Undervoltage Trip
	0000 0000 0101 0101	Overvoltage Trip
	0000 0000 0101 0110	Undercurrent Trip
	0000 0000 0101 0111	Undefined
	0000 0000 0101 1000	Undefined
	0000 0000 0101 1001	Undefined
	0000 0000 0101 1010	Undefined
	0000 0000 0101 1111	Inhibit Lockout
F29	16 bits	Power Factor Sign
	0000 0000 0100 1110	‘ ‘ Blank
	0000 0000 0101 1101	Lead
	0000 0000 0101 1110	Lag
F30	16 bits	RTD Type
	0000 0000 0000 0000	100 Ohm Platinum RTD
	0000 0000 0000 0001	100 Ohm Nickel RTD
	0000 0000 0000 0010	120 Ohm Nickel RTD
	0000 0000 0000 0011	10 Ohm Copper RTD

269 Plus Data Formats (Revision 269P.D6.0.4)		
FORMAT CODE	**APPLICABLE BITS**	**DEFINITION**
F31	16 bits	Serial Number Letter Code
	0000 0000 0110 0001	Hardware Revision “C”
	0000 0000 0110 0010	Hardware Revision “D”
	0000 0000 0110 0011	Hardware Revision “E”
	0000 0000 0110 0100	***Hardware Revision “B”***
F32	16 bits	Setpoints Status Register 3
	0000 0000 0000 0001	Enable U/V Trips & Alarm if Avg. Volts = 0
	0000 0000 0000 0010	Enable Differential Input to Read 52b
F33	16 bits	Self Test Alarm Status
	0000 0000 0001 0011	Analog to Digital (A/D) Hardware Failure Alarm
	0000 0000 0001 0100	RTD Hardware (H/W) Failure Alarm
	0000 0000 0001 0101	RAM Memory Failure Alarm
	0000 0000 0001 1000	EPROM Mismatch/Model Failure Alarm

5. 1 Primary Injection Testing

Prior to relay commissioning at an installation, complete system operation can be verified by injecting current through the phase and ground fault CTs. To do this a primary (high current) injection test set is required.

Operation of the entire relay system, except the phase CTs, can be checked by applying input signals to the 269 relay from a secondary injection test set as described in the following sections.

"Multiamp" or "Doble" test equipment can be used to do current and timing tests.

5.2 Secondary Injection Testing

Single phase secondary injection testing can be performed using the test set up shown in figure 5.1. Tests should be performed to verify correct operation of relay input (A/D), output, memory, and RTD circuitry. 269 Plus relay functions are firmware driven and thus testing is required only to verify correct firmware/ hardware interaction.

All tests described in the following sections will be applicable with factory setpoints and configurations left unchanged. Similar tests can be performed after new setpoints have been stored in the 269 Plus relay.

5.3 Phase Current Input Functions

All phase current functions use digital current information converted from the analog phase C.T. inputs. Functions that use phase current readings are overload, unbalance, short circuit, and rapid trip. The 269 Plus must read the injected phase currents correctly in order for these functions to operate properly. To determine if the relay is reading the proper current values inject a phase current into the relay and view the three current readings in ACTUAL VALUES mode, page 1. With factory setpoints stored in the relay the displayed current should be:

displayed current = actual injected current × 100/5 (phase CT ratio)

Various trip and alarm conditions can be simulated by adjusting the injected phase currents. All trip/alarm conditions using phase current readings will operate as described in Section 3 providing the 269 Plus relay reads the correct phase current.

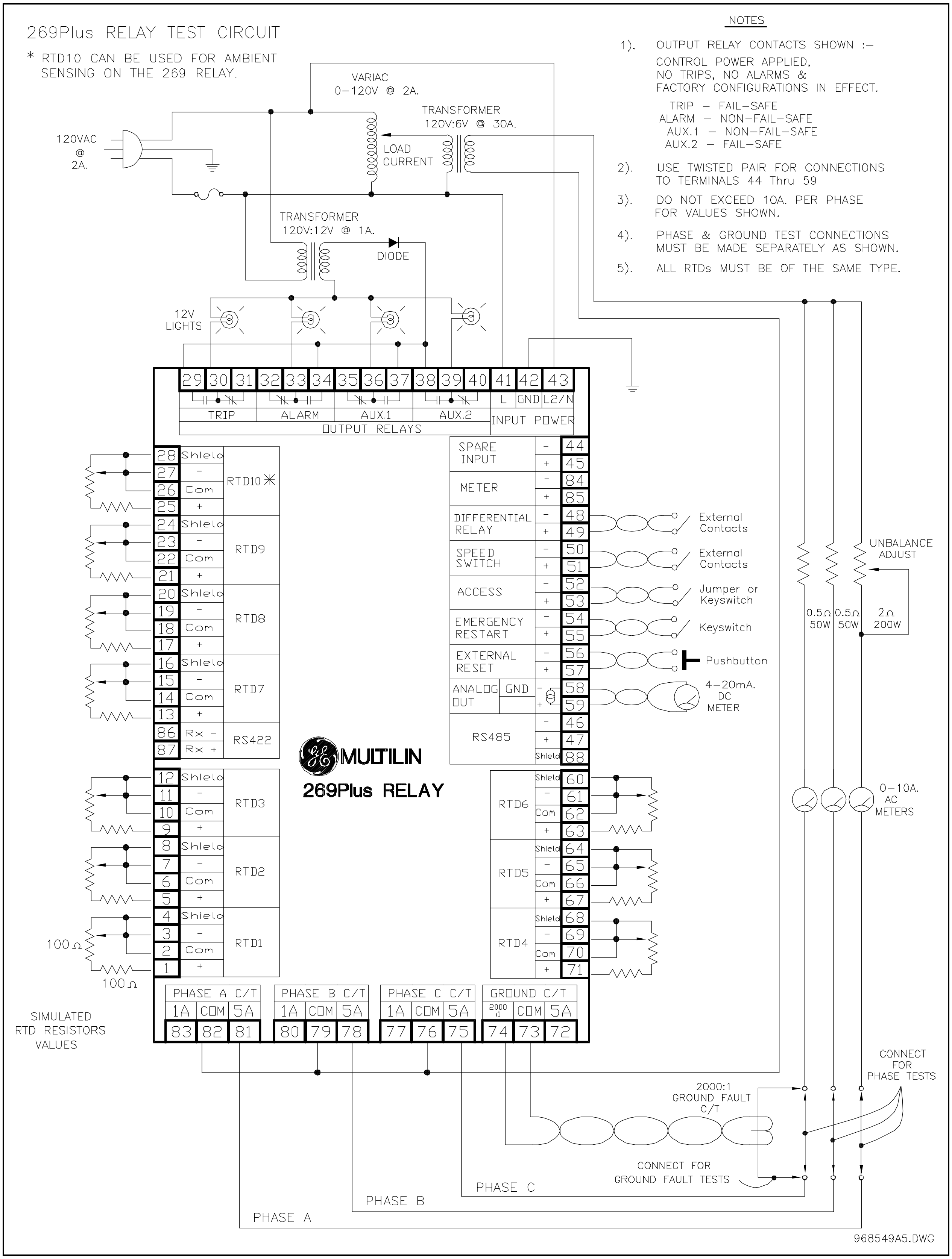


Figure 5.1 Secondary Injection Test Set (AC Input to 269 Plus Relay)

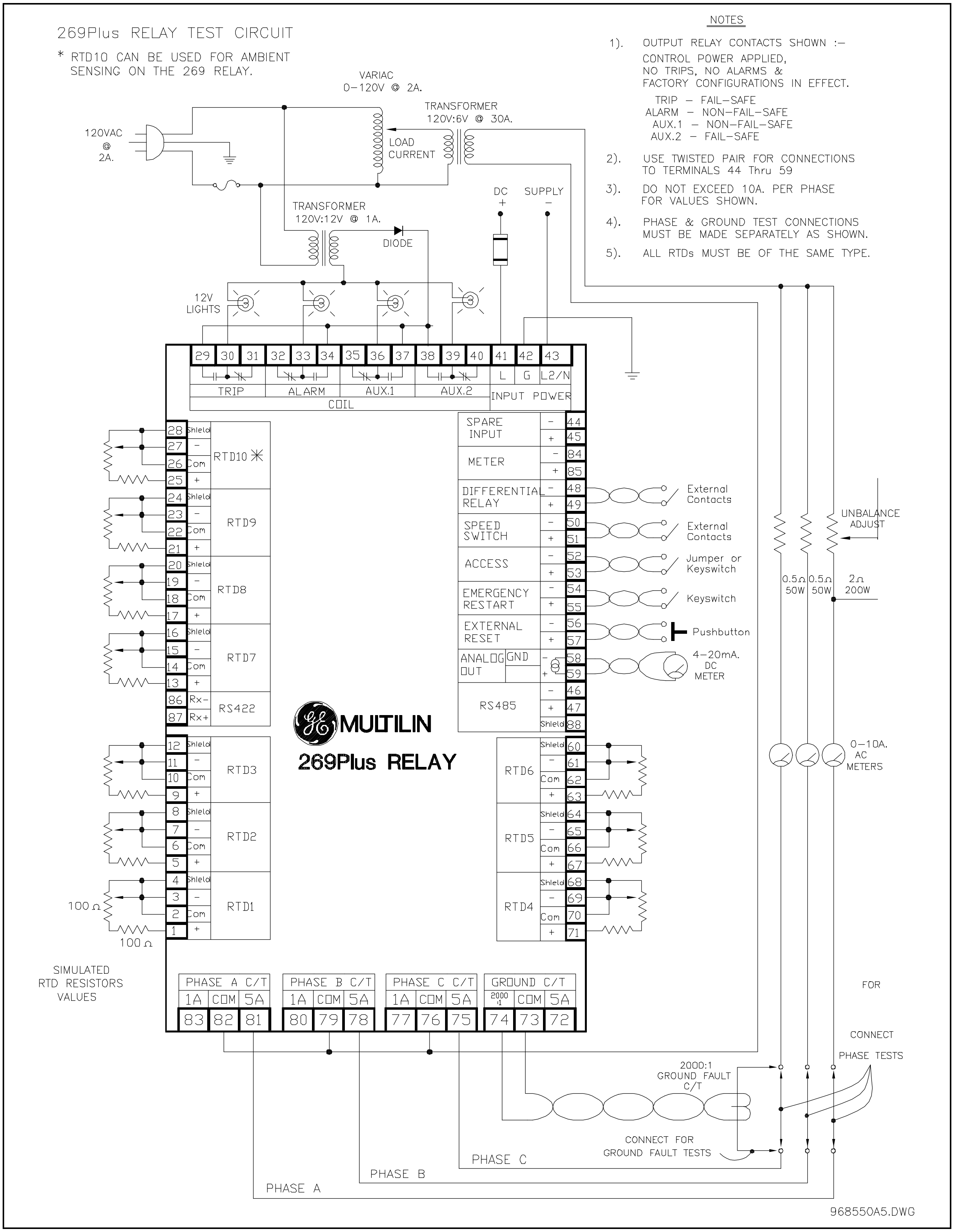


Figure 5.2 Secondary Injection Test Set (DC Input to 269 Plus Relay)

To simulate an overload condition turn "ACCEL. TIME=" to "off" (SETPOINTS, page 1) and inject a current of 9 Amps in all three phases. This will be read by the relay as:

displayed current = 9 Amps x 100/5 = 180 Amps

which is two times the Full Load Current setpoint of 90 Amps. The trip output relay should activate after a time of 116 seconds which is the time to trip for a 200% overload using curve #4. This time may be less due to the charging of thermal memory because of the presence of unbalance or previous overloads. Thermal memory may be discharged to 0% by shorting together the Emergency Restart terminals (54, 55) momentarily.

To check the displayed negative to positive sequence unbalance ratio inject currents of 5.0 Amps, 5.0 Amps and 3.9 Amps into the relay and examine the "UNBALANCE RATIO". The reading should be 14%. Other unbalance conditions can be checked by calculating the negative to positive sequence current ratio for the injected phase currents and comparing this to the ACTUAL VALUES display.

5.4 Ground Fault Current Functions

The ground fault current function uses digital current information converted from the analog ground fault C.T. input. The 269 Plus relay must read the injected ground fault current correctly in order for the ground fault function to operate properly. Using factory default setpoints to test the ground fault input circuitry, pass a phase current conductor through the ground fault CT window as shown in figure 5.1. The actual injected current should then be the same as the "GROUND FAULT CURRENT" display in ACTUAL VALUES mode. If the injected current is adjusted to over 4.0 Amps for longer than 10.0 seconds the ground fault alarm should become active. If over 8.0 Amps is injected for more than 50 msec. a ground fault trip should occur. These tests can be performed for other C.T. ratios and setpoints.

5.5 RTD Measurement Tests

The correct operation of each of the RTD inputs can be tested by simulating RTDs with potentiometers. To test a 269 Plus relay configured for use with 100 OHM platinum RTDs, 100 OHM potentiometers and resistors can be used. These should be connected to each RTD as shown in figure 5.1.

Table 5-1 shows RTD resistances for various temperatures. Individual, actual stator and bearing RTD temperatures can be viewed in ACTUAL VALUES mode, page 2.

To test overtemperature trip/alarm functions the simulated RTD potentiometers should be adjusted to correspond to high RTD temperatures.

Stator RTD Voting in Setpoint Values page 5 should be defeated first. This allows for individual trip/alarm overtemperature testing.

Table 5-1 RTD Resistance vs. Temperature

TEMP °C	OHMS 100 OHM Pt (DIN 43760)	OHMS 120 OHM Ni	OHMS 100 OHM Ni	OHMS 10 OHM Cu
0	100.00	120.00	100.00	9.04
10	103.90	127.17	105.97	9.42
20	107.79	134.52	112.10	9.81
30	111.67	142.06	118.38	10.19
40	115.54	149.79	124.82	10.58
50	119.39	157.74	131.45	10.97
60	123.24	165.90	138.25	11.35
70	127.07	174.25	145.20	11.74
80	130.89	182.84	152.37	12.12
90	134.70	191.64	159.70	12.51
100	138.50	200.64	167.20	12.90
110	142.29	209.85	174.87	13.28
120	146.06	219.29	182.75	13.67
130	149.82	228.96	190.80	14.06
140	153.58	238.85	199.04	14.44
150	157.32	248.95	207.45	14.83
160	161.04	259.30	216.08	15.22
170	164.76	269.91	224.92	15.61
180	168.47	280.77	233.97	16.00
190	172.46	291.96	243.30	16.39
200	175.84	303.46	252.88	16.78

5.6 Power Failure Testing

When the AC. voltage applied to a 120VAC 269 Plus relay decreases to below about 80 V, all relay L.E.D.s should become illuminated. If a different supply voltage is being used (240VAC, 125VDC, 250VDC, 24VDC, or 48VDC) consult the specifications section for power fail levels. All output relays will also go to their power down states. To test the memory circuitry of the relay, remove and then re-apply control power. All stored setpoints and statistical data should be unchanged. The displayed lock-out time after an overload trip should continue to decrease even when control power is removed.

5.7 Analog Current Output

Using the factory default setpoints to test the analog current output, a 4-20 mA DC. ammeter should be connected between terminals 58 and 59. While viewing the "HOTTEST STATOR RTD" actual value adjust the resistance of the simulated stator RTD potentiometers shown in figure 5.1. A displayed reading of 0 C should correspond to a 4 mA output. A reading of 200 C should correspond to an output of 20 mA. The output should be a linear function of temperature between these extremes. Similar tests can be performed for the other output options (thermal capacity used, motor load as a percentage of full load).

5.8 Routine Maintenance Verification

Once a relay has been properly installed, annual testing should be performed to check correct operation of the protection system. Many conditions can be simulated without creating the actual trip/alarm conditions themselves. This is done by changing relay setpoints to values which will initiate trips and alarms during normal motor operation. Changed setpoints should be returned to their proper values when tests have been completed. The Access terminals must be shorted together to allow setpoint changes. The Emergency Restart terminals should be shorted together momentarily 5 times before each test to ensure that the relay thermal memory is fully discharged and starts per hour counter is fully cleared.

To test relay functions using phase current data, with the motor running, change the "MOTOR FULL LOAD CURRENT" setpoint to a value under the actual motor current. Stop the motor and short the Emergency Restart terminals together momentarily to discharge the thermal memory in the relay. The trip relay should activate after a time determined from the overload curve, amount of unbalance present, and motor RTD temperature. The time to trip at a given overload level should never be greater than the time on the overload curve. Current unbalance and high stator RTD temperatures will cause this time to be shorter (if the RTD bias and/or U/B bias functions are enabled).

Larger overloads, representing short circuits or mechanical jams, can be simulated by changing the "MOTOR FULL LOAD CURRENT" setpoint to a value much lower than the actual motor phase current.

Unbalance trip or alarm conditions can be simulated by changing the Unbalance Trip or Alarm Level setpoints to values below the actual unbalance present at the motor terminals.

Other trip or alarm conditions using ground fault current data and RTD temperature data can be simulated using the procedures outlined in the previous sections.

To test the operation of the 269 Plus output relays and the switchgear connected to them the "EXERCISE: XXXXX RELAY" setpoint in page 6 of SETPOINTS mode can be used. The motor must be stopped in order for this function to operate. Any or all of the output relays can be toggled using this setpoint.

To test the analog output current hardware the "ANALOG OUT FORCED TO: XXXXXX SCALE" setpoint can be used. The output current can be forced to "ZERO", "MID", or "FULL" scale. This feature can be used to test the calibration of the 269 Plus as well as the operation of any device through which the current is flowing. The motor must be stopped in order for this function to operate.

To test the operation of devices connected to the Spare Input, Differential Input, Speed Switch Input, Access terminals, Emergency Restart terminals, and External Reset terminals the "STATUS" setpoint can be used. This is in page 6 of SETPOINTS mode. This line will give the status of each pair of terminals as either "OPEN" or "SHORT".

5.9 Dielectric Strength (Hi-Pot) Test

The 269 Plus relay is Hi-Pot tested at the factory for 1 second at 2200 VAC in order to verify its dielectric strength. See Fig 5.3 for the test procedure.

If the 269 Plus is of the Drawout version, Hi-Pot testing of wires in the switchgear is possible without the need to remove wires attached to the drawout case terminals. However, the 269 Plus in its cradle should be withdrawn from the case before Hi-Pot testing starts. Failure to do so may result in internal damage to the 269 Plus.

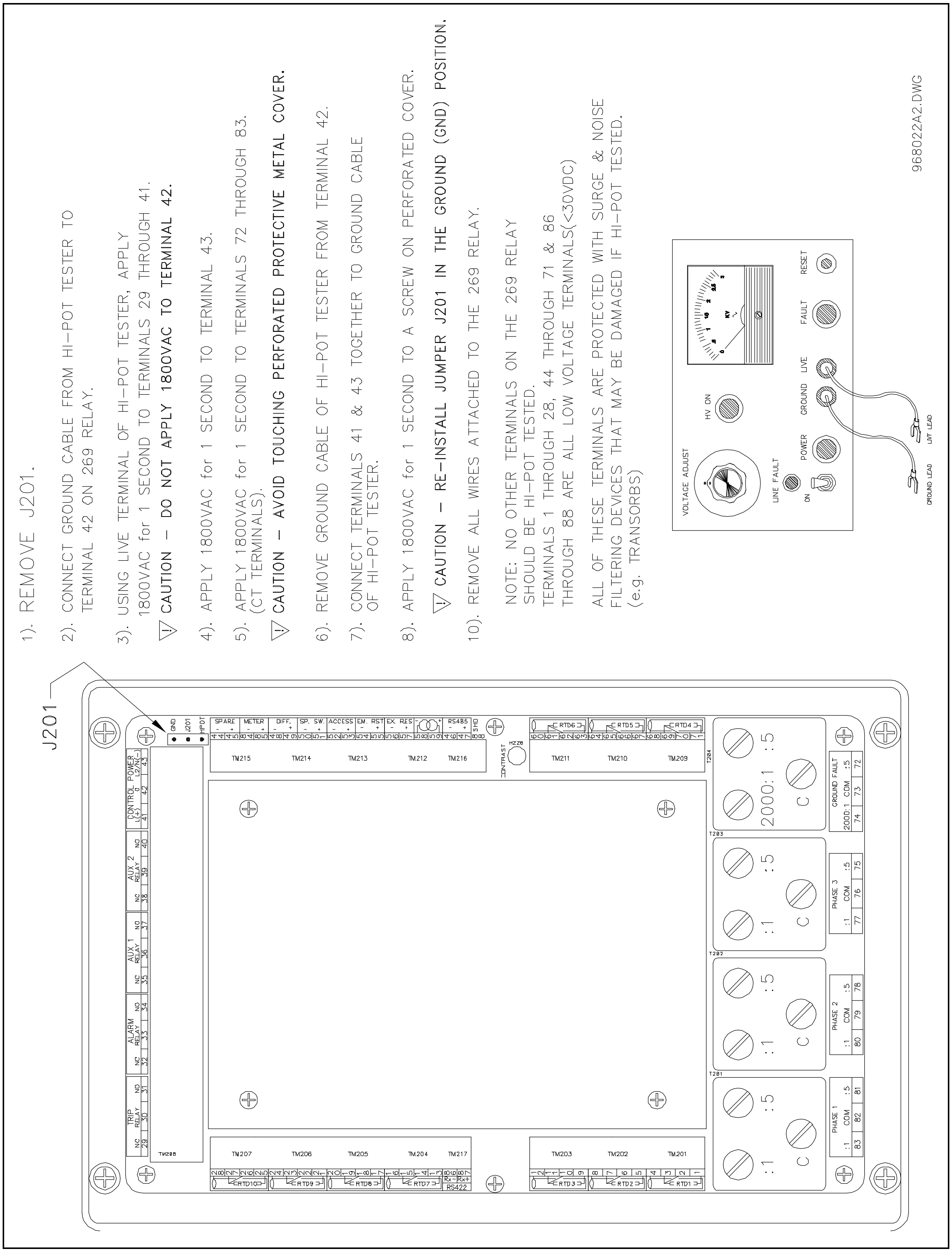


Figure 5.3 Hi-Pot Testing Procedure

6.1 Hardware

All relay functions are controlled by an 80C32 8 bit microcomputer. This I.C. contains internal RAM and timers, but all firmware and display messages are stored in an external EPROM I.C. A 12 key keypad and a 2 row × 24 character display are used to enter relay setpoints and display all values and messages. A hardware block diagram is shown in figure 6.1.

The power supply uses a dual primary / triple secondary transformer for connection to 120/240 VAC. A 24/48/125/250 VDC input switching power supply is also available as an option. Regulated ±5 V supplies are created for use by logic and analog I.C.s. An unregulated +10 V supply is used to drive the RTD selection relays and L.E.D. indicators, and an isolated +10 V supply is used on the AC input versions to drive the output relays and read the contact inputs. +2.5 V reference voltages are derived from temperature compensated precision voltage reference diodes to provide stable, drift-free references for the analog circuitry. A power fail detector circuit is used to reset the relay whenever the supply voltage goes out of the proper operational range. This hardware watchdog circuit must be signaled regularly by a firmware generated voltage or else the microcomputer will be reset.

Three phase C.T.s are used to scale the incoming current signals to the 269 Plus relay. The current waveforms are then rectified and fed through fixed burdens to produce a voltage signal of 430 mV peak/ FLC. This signal is then multiplexed. The multiplexed signal is buffered and fed to an A/D converter. The digital signal is then fed to the microcomputer for analysis. A separate ground fault C.T. is provided on the 269 Plus relay to scale the input ground fault current. This current signal is rectified and fed through a resistive burden to convert it to 1.25 V peak/ secondary amps rating. This is then fed to the same multiplexer as the phase input signals.

The temperature monitoring circuitry of the 269 Plus relay consists of 10 RTD connections multiplexed by miniature relays and a 4 to 10 decoder. Mechanical relays are used because of their excellent isolation, transient immunity, and almost zero on-resistance. A stable current source feeds each of the RTDs in turn, and 128 readings are taken over a period of one second for each RTD. This provides for stable averaging and good 50/60 Hz noise rejection. An RTD lead compensation circuit subtracts the RTD lead resistance and then the analog RTD voltage is multiplexed along with the phase and ground fault signals. A no sensor detector circuit indicates when no current flows in an RTD in order to distinguish a faulty sensor from a high temperature reading.

The 80C32 microcomputer interfaces with an 8155H I/O port and static RAM to drive an intelligent display module and provide a digital output signal for a D/A converter. The analog output signal from the DAC is then converted to a current and scaled to be 4-20 mA. The microcomputer also drives an 8255A I/O port which handles keypad inputs, L.E.D. drivers, and external switch inputs. The data lines from the 80C32 are latched before being passed to the address lines of the EPROM and NOVRAM. NOVRAM store cycles are initiated every time control power goes out of the recommended operating range. The output relays are controlled by the microcomputer through optoisolators and are powered by a separate, isolated +10 V supply. An SN 75176 transceiver is used to provide an RS485 communications interface for programmable controllers and computers for the 269 Plus.

All connections to the 269 Plus relay are made on the I/O circuit board; transient protection and filtering are provided on all inputs.

6.2 Firmware

All mathematical, logic and control functions are performed on an 80C32 microcomputer by a program stored on a separate EPROM. The program execution flow is shown in the firmware block diagram of figure 6.2.

Every 2 mS the system clock generates an interrupt. At this time all timers are updated, the keypad is read and debounced, and five A/D conversions are performed by the A/D module. These conversions are the ground fault current reading, three phase current readings, and a single RTD, voltage reference, or power fail circuit reading. At this point the RMS values of the currents are calculated, and short circuit and ground fault tests are made. The EOC interrupt routine checks for a motor start condition and if this is true the phase sequence is checked, a start timer is initiated, and the start register is updated.

The INITIALIZE module is performed whenever the relay is powered on to ensure that the system comes up in a known state. Parts of this module are executed whenever the relay is reset as well. The SYSTEM EXECUTIVE then causes execution to loop through a series of modules which perform most of the relay functions.

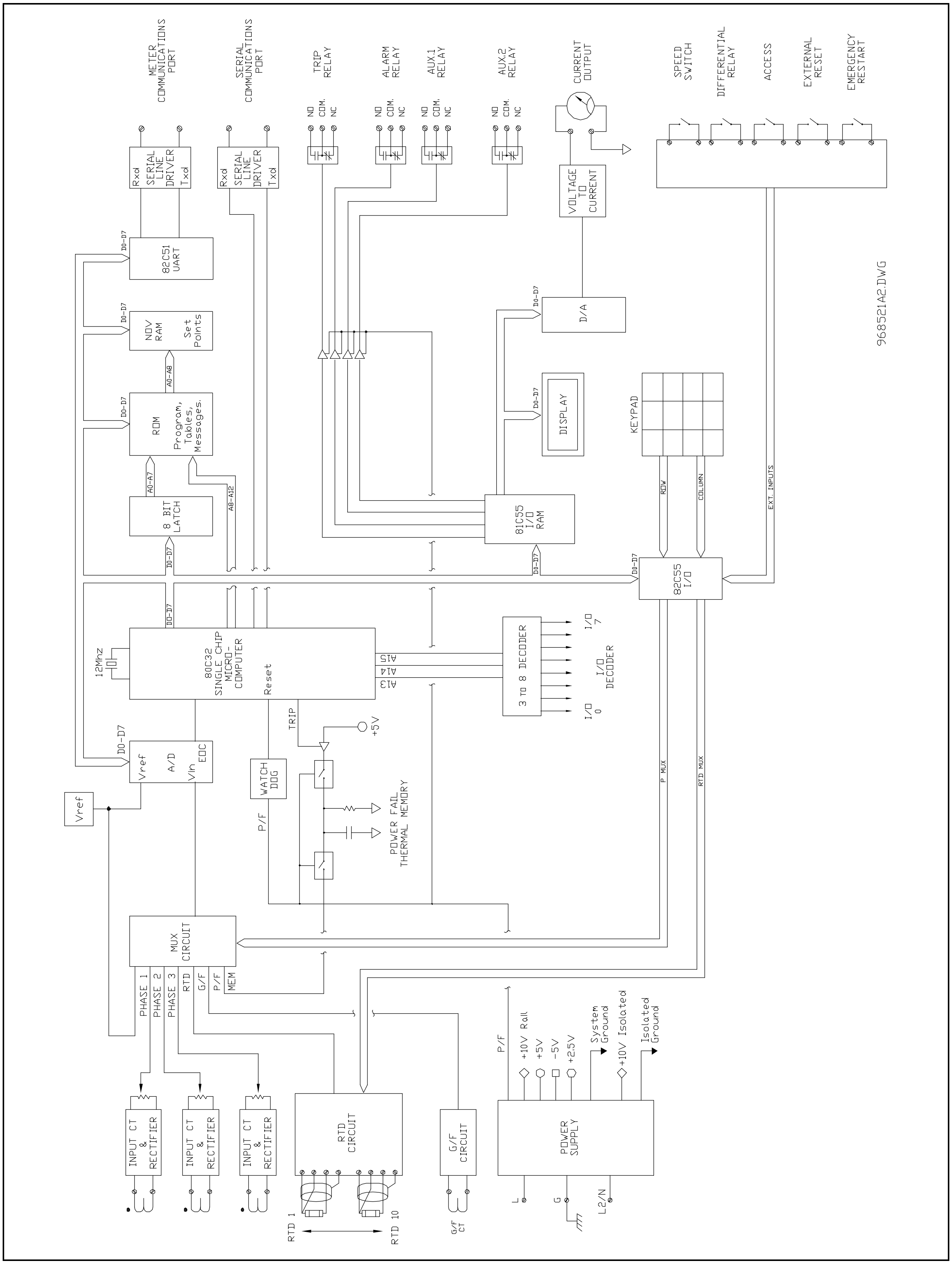


Figure 6.1 Hardware Block Diagram

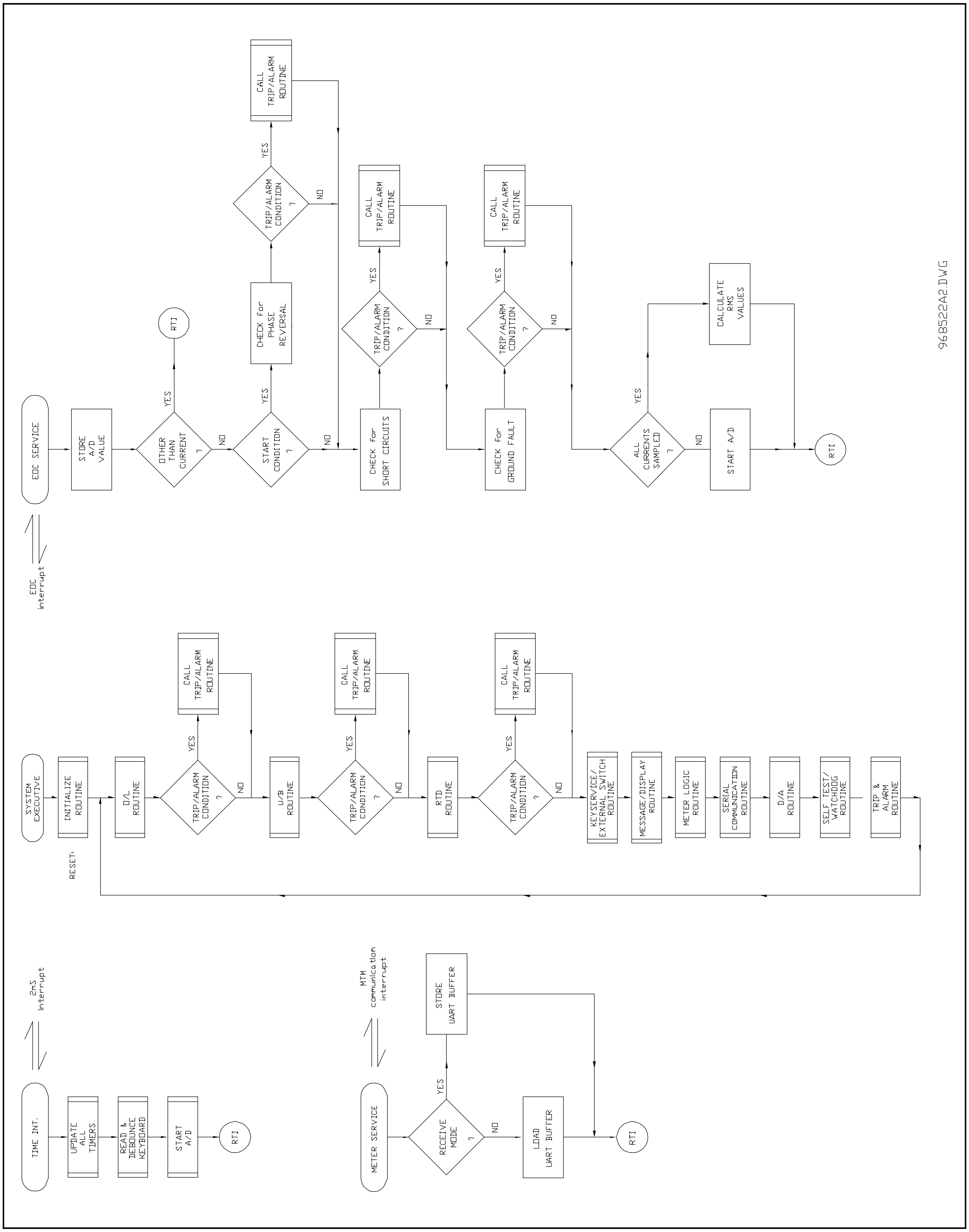


Figure 6.2 Firmware Block Diagram

The O/L module uses the positive to negative sequence current ratio calculated by the U/B module, the learned K factor, and the RMS phase currents to fill a thermal memory register. The O/L module discharges this register at either a learned or preset cooling rate when no overload is present. The average stator RTD temperature calculated in the RTD module is used to bias the thermal memory. This module also compares the RMS phase current values to the Undercurrent and Rapid Trip / Mechanical Jam trip and alarm levels, and starts appropriate timers if the current levels are out of range.

The U/B module computes the phase current ratios Ib/Ia and Ic/Ia, and uses them in conjunction with a look-up table to determine the negative to positive sequence current unbalance ratio In/Ip. This value is compared to the Unbalance trip and alarm levels and appropriate timers are initiated if trip/alarm conditions are met.

The RTD module uses the RTD voltage reading from each of the 10 RTD inputs and computes the average stator RTD temperature. This is then used to bias the thermal memory. The RTD readings are compared to the trip and alarm levels and relay activation is initiated if conditions are met. Each RTD is read 128 times over a one second scan interval.

The KEYSERVICE/EXTERNAL SWITCH module takes in all of the data associated with the keypad and executes the function of each key. Timers for the closure times of the VALUE UP/DOWN, PAGE UP/DOWN, and LINE UP/DOWN keys are initiated and the display is updated accordingly. This module also reads the Emergency Restart, External Reset, Differential Relay, and Speed Switch inputs and initiates appropriate action.

The MESSAGE module handles all of the message look-up functions and sends the message data to the display. The displayed messages are made up of individual messages, common message strings, and variable data. Non-displayed control bytes are used to indicate the message type, variable data type, decimal point placement, and other control information.

The D/A module gives the DAC the current digital value for the selected option output for conversion to an analog value. This analog voltage is then fed to a voltage-to-current converter circuit.

The SELF-TEST module causes the 80C32 to send out regular voltage signals to indicate to the power supply watchdog circuit that the system is operating properly. This module also performs all of the self-test features outlined in section 3.23.

The TRIP/ALARM module is executed when any relay trip or alarm setpoint has been exceeded. This module handles output relay activation and TRIP/ALARM message output.

Statistical data is updated whenever a statistical value changes. For example, the total number of motor starts value is updated every time a motor start is detected.

7.1 269 Plus Relay Powered from One of Motor Phase Inputs

If a 269 Plus relay is powered from one of the three motor phase inputs, a single phase condition could cause control power to be removed from the relay. In order to ensure that the motor is taken off-line if this condition arises, the 269 Plus output relay (eg. TRIP, AUX. 1) used to trip the motor must change state when control power is removed from the 269 Plus. This is accomplished by making this output relay fail-safe. Factory defaults are:

TRIP: Fail-Safe
ALARM: Non-fail-safe
AUX. 1: Non-fail-safe
AUX. 2: Fail-safe

These can be changed using the RELAY FAILSAFE CODE in page 5 of SETPOINTS mode.

7.2 Loss of Control Power Due to Short Circuit or Ground Fault

If the input voltage (terminals 41-43) to a 269 Plus relay drops below the low end specification (80 VAC on 120 VAC units), the 269 Plus output relays will return to their power down states. If the input voltage drops due to a short circuit or ground fault on a motor, the 269 Plus relay protecting the motor may or may not be able to trip out the motor. For example, if a 120 VAC 269 Plus relay is set to trip after 0.5 seconds of an 8.0 ×FLC short circuit current, the input voltage must remain above 90 VAC for at least 0.5 seconds after the short circuit has occurred or else the 269 Plus relay will not be able to trip. As explained in section 6.1 above, in order to trip the motor when control power for the 269 Plus is lost, the 269 Plus output relay used to trip the motor must be configured as fail-safe.

7.3 Example Using FLC Thermal Capacity Reduction Setpoint

The purpose of the FLC Thermal Capacity Reduction Setpoint is to accurately reflect the reduction of thermal capacity available (increase the thermal capacity used) in a motor that is running normally (100% of FLC or less). This setpoint allows the user to define the amount of thermal capacity used by their motor running at 1 FLC. A motor that is running at 10% of FLC will obviously use less thermal capacity than a motor at 100% FLC.

For example, if the FLC Thermal Capacity Reduction Setpoint is set at 30%, then with the motor running at 1 FLC, the thermal capacity used will settle at 30%. Using the same example, with the motor running at 50% FLC, the thermal capacity used will settle at 15% (50% of 30%). A practical example of implementation of this setpoint to coordinate hot/cold damage curves is illustrated below.

Assume the motor manufacturer has provided the following information:

1. Maximum permissible locked rotor time (hot motor) = 15.4 seconds.
2. Maximum permissible locked rotor time (cold motor) = 22 seconds.
3. Recommended thermal limit curves are as shown in Figure 7.1.

Note: Hot motor is defined as a motor that has been running at 1 FLC, but not in an overload, for a period of time such that the temperature remains constant (typical 90 °C). Cold motor is defined as a motor which has been stopped for a period of time such that the temperature remains constant (ambient temperature is defined by NEMA standard as 40 °C).

From the formula:

$$\text{TCR} = \left(1 - \frac{\text{(Hot Motor Stall Time)}}{\text{(Cold Motor Stall Time)}}\right) \times 100$$

TCR = [1 - (15.4/22)] × 100
Thermal Capacity Reduction = 30%

The hot motor locked rotor time is 30% less than the cold motor locked rotor time. Therefore the FLC Thermal Capacity Reduction Setpoint should be set to 30%. The overload curve selected should lie below the cold thermal damage curve. Once the motor has been running for a period of time at 1 FLC the thermal capacity used will remain constant at 30%. The time to trip at any overload value will correspondingly be 30% less.

Once a motor comes out of an overload condition, the thermal capacity used will discharge at the correct rate which is exponential and settle at a value defined by the FLC Thermal Capacity Reduction Setpoint and the present current value. Using the example above if the motor came out of an overload and the present current value was 50% FLC the thermal capacity used would discharge to a value of 15% (50% of 30%).

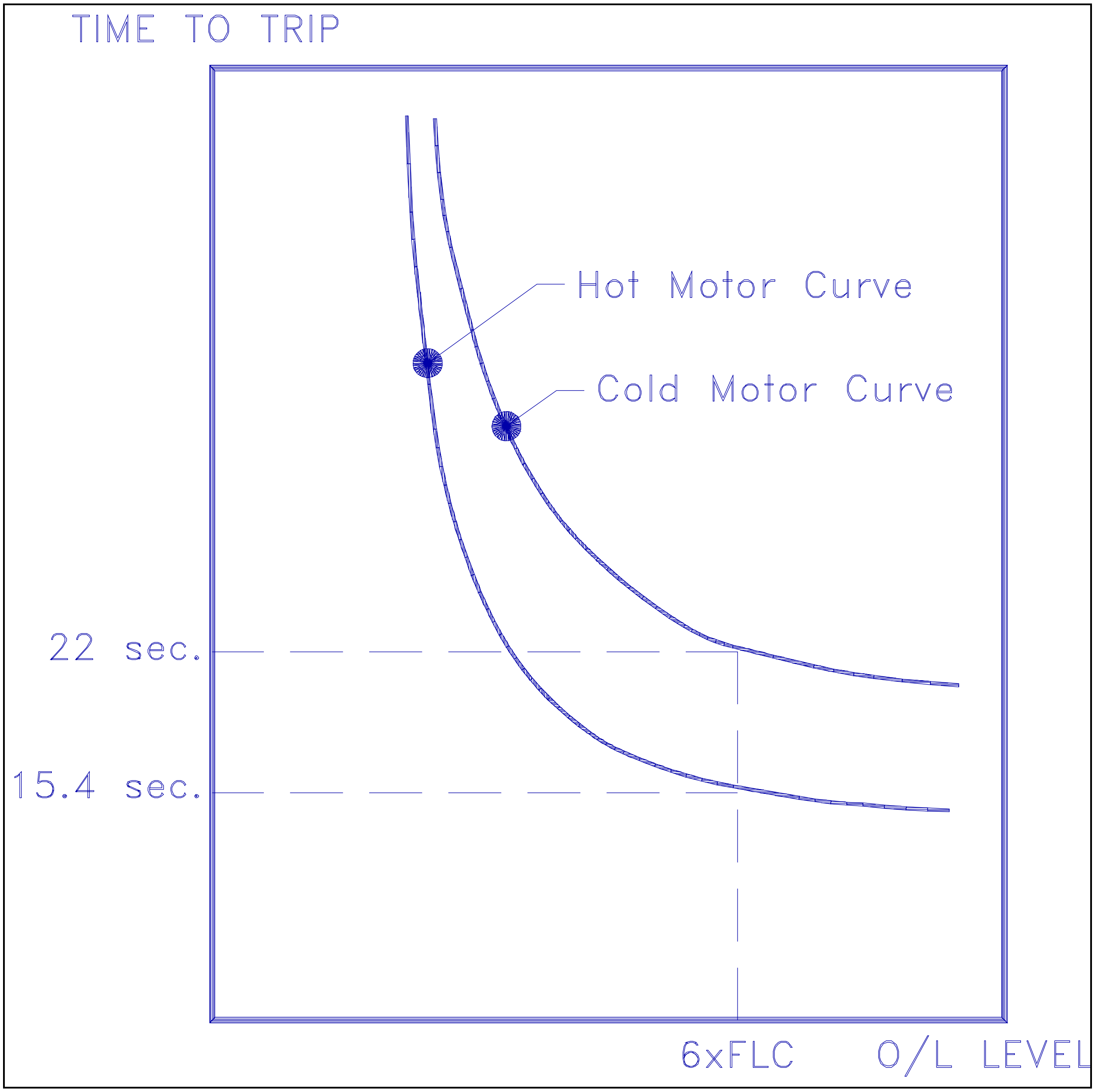


Figure 7.1 Thermal Limit Curves

8.1 Overview

The 269PC program, provided with every 269 PLUS relay, allows easy access to all relay setpoints and actual values via a personal computer running Windows® 3.1 or higher and one of the PC's RS232 ports - COM1 or COM2. The user can:

- Program/modify setpoints
- Load/save setpoint files from/to disk
- Read actual values
- Monitor status
- Plot/print/view trending graphs of selected actual values
- Get help on any topic

269PC Program Startup Window

The 269PC program can be used "stand-alone", without a 269 PLUS relay, to create or edit 269 PLUS setpoint files.

8.2 Hardware and Software Requirements

The configuration listed is for both a minimum configured and an optimal configured system. Running on a minimum configuration causes the performance of the PC program to slow down.

Processor:	minimum 486, Pentium recommended
Memory:	minimum 4 Mb, 16 Mb recommended, minimum 540 K of conventional memory
Hard Drive:	20 Mb free space required before installation of PC program.

<u>WINDOWS 3.1/3.11 CONSIDERATIONS</u>

- Installation of SHARE.EXE required.
- Do not run other applications (spreadsheet or word processor) before running the PC program to eliminate any problems because of low memory.

8.3 Menu Summary

Top level menu summary:

File	Setpoints	Actual Values

Menu item	Shortcut	Description
New	Ctrl+N	Create a new setpoint file with factory defaults
Open...	Ctrl+O	Open an existing file
Save As...	Ctrl+S	Save setpoints to a file
Properties		Configure 269PC when in FILE EDIT mode
Send Info to Relay		Send a setpoint file to the relay
Page Setup...		Option of printing Actual Values, All Setpoints, or Enabled Setpoiints
Print Preview		
Print...	Ctrl+P	Print a relay or file setpoints
Exit		Exit the 269PC program

Setpoints	Actual Values

Menu item	Description
Motor Amps	Edit 269 PLUS Motor Amps setpoints
Temperature	Edit Temperature setpoints
Overload Curve	Edit Overload setpoints
System Configuration	Edit System Configuration setpoints
Metering	Edit Meter Setpoints
Testing	Edit Testing Setpoints

*Note that **Testing** can only be selected while the motor is stopped and communications are enabled*

Actual Values	Communica

Menu item	Description
Status	View Satus of output relays
Phase Current Data	View Phase Current Data
Temperature Data	View Temperature Data
Motor Capacity Data	View Motor Capacity Data
Statistical Data	View Statistical Data
Pre-Trip Data	View Pre-Trip Data
Learned Parameters	View Learned Parameters
Metering Data	View Metering Data
Product Information	View Product Information
Popup Currents	View Popup Current Window
Trending	View Trending Data

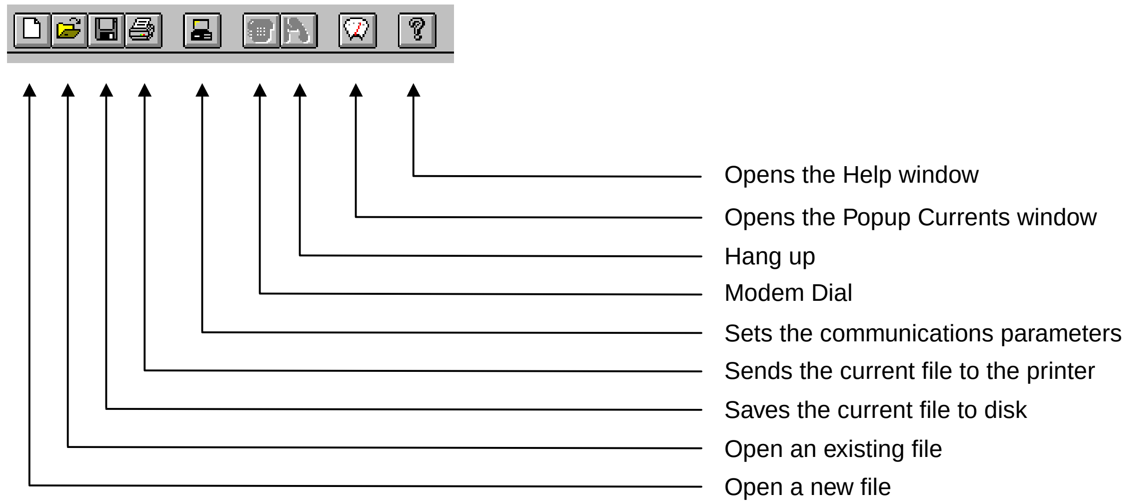
Communication	Help

Menu item	Description
Computer	Set computer communications parameters
Modem	Dial a phone number using the modem
Troubleshooting	View/modify memory map locations

Help

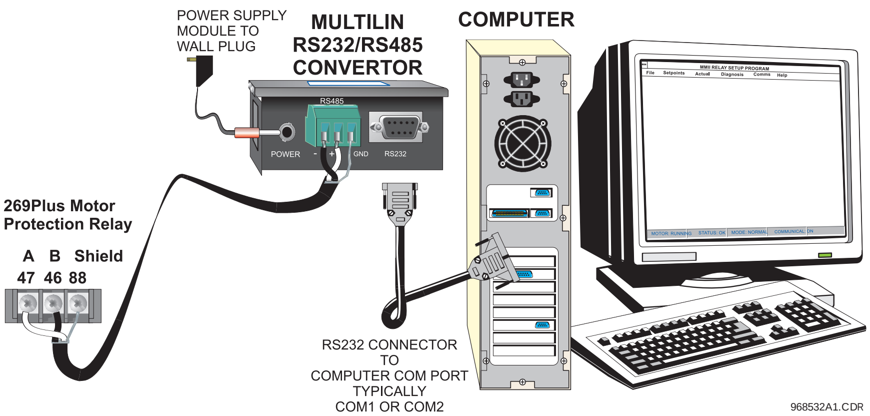
Menu item	Description
Instruction Manual	Display the 269 PLUS Instruction Manual
Using Help	Display help on using Windows Help
About 269PC...	Display 269PC program information

TOOL BAR


Opens the Help window
Opens the Popup Currents window
Hang up
Modem Dial
Sets the communications parameters
Sends the current file to the printer
Saves the current file to disk
Open an existing file
Open a new file

8.4 Hardware Configuration

Communications Setup via 269 PLUS Rear Panel RS485 Communications Port



The figure above shows the required connections and equipment for the RS485 rear terminal interface. The interface consists of the following:

1. Multilin's RS232/RS485 Converter box.

2. A standard "straight through" serial cable connected from your computer to Multilin's RS232/RS485 Converter box. The converter box end should be DB-9 male and the computer end DB-9 or DB-25 female for COM1 or COM2 respectively.

3. Connect shielded twisted pair (20, 22 or 24 AWG) cable from converter box to the 269 PLUS rear terminals. The converter box (+ , -, GND) terminals are connected to terminals 47, 46 and 88 respectively. The line should also be terminated in an RC series network (i.e. 120ohm, 1nF) at the two extreme ends of the communication link as described in Chapter 4.

8.5 269 PC Installation

Installation of the 269PC software is accomplished as follows:

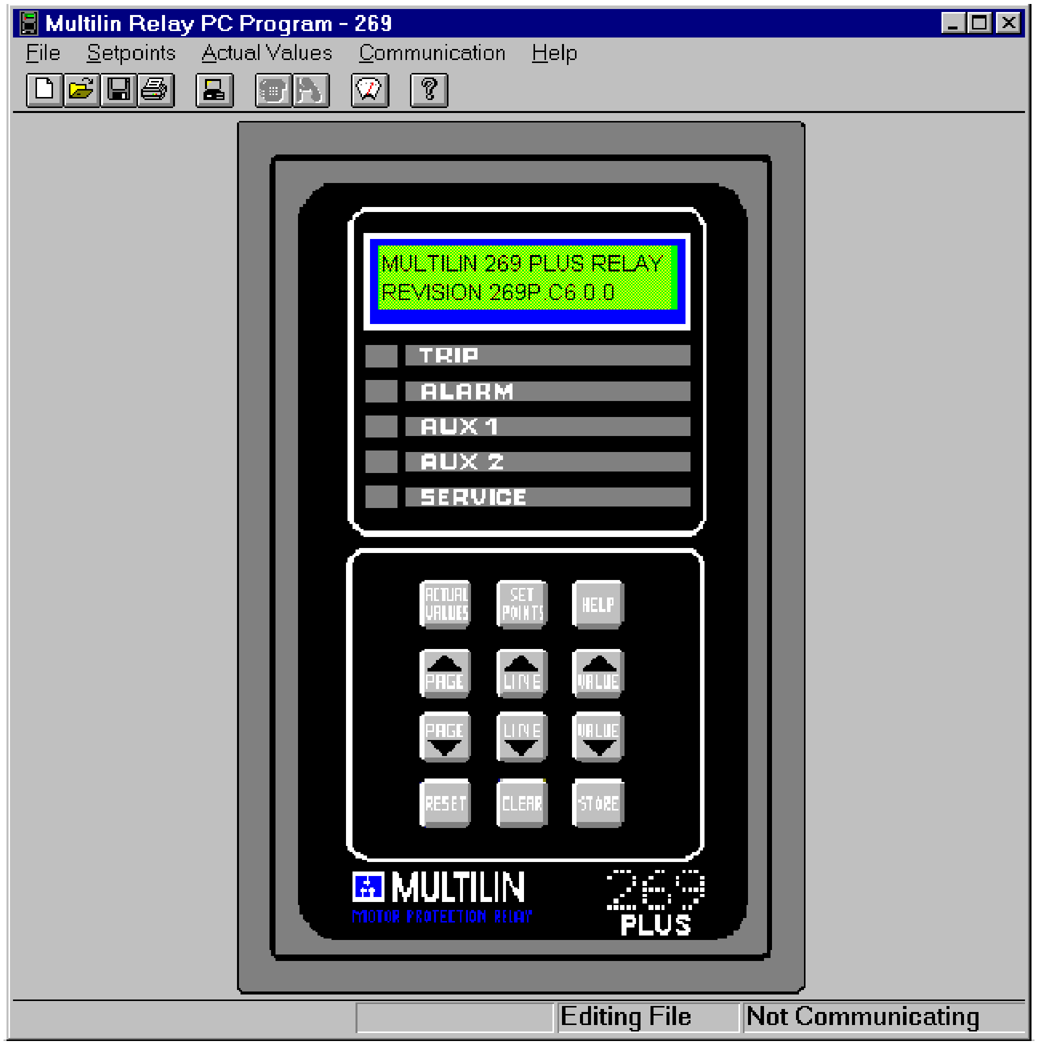
1. Start the Windows® program
2. Insert the GE Multilin Products CD or Disk 1 of the 269PC Program into the appropriate drive
3. Select Install PC Software, or from the **Start** menu select Run, type in the appropriate drive letter, backslash ("\"), INSTALL.
4. Select 269PC if you are installing from the GE Multilin Products CD.
5. Follow the onscreen instructions

8.6 Startup and Communications Configuration

Startup of the 269PC software is accomplished as follows:

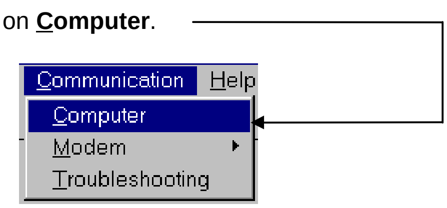
1. Double-click on the **269PC** program icon inside the **GE Power Management** group.

2. The following window will come up once the program has finished loading. The communications status of the 269 to the PC is displayed on the bottom right corner of the screen:

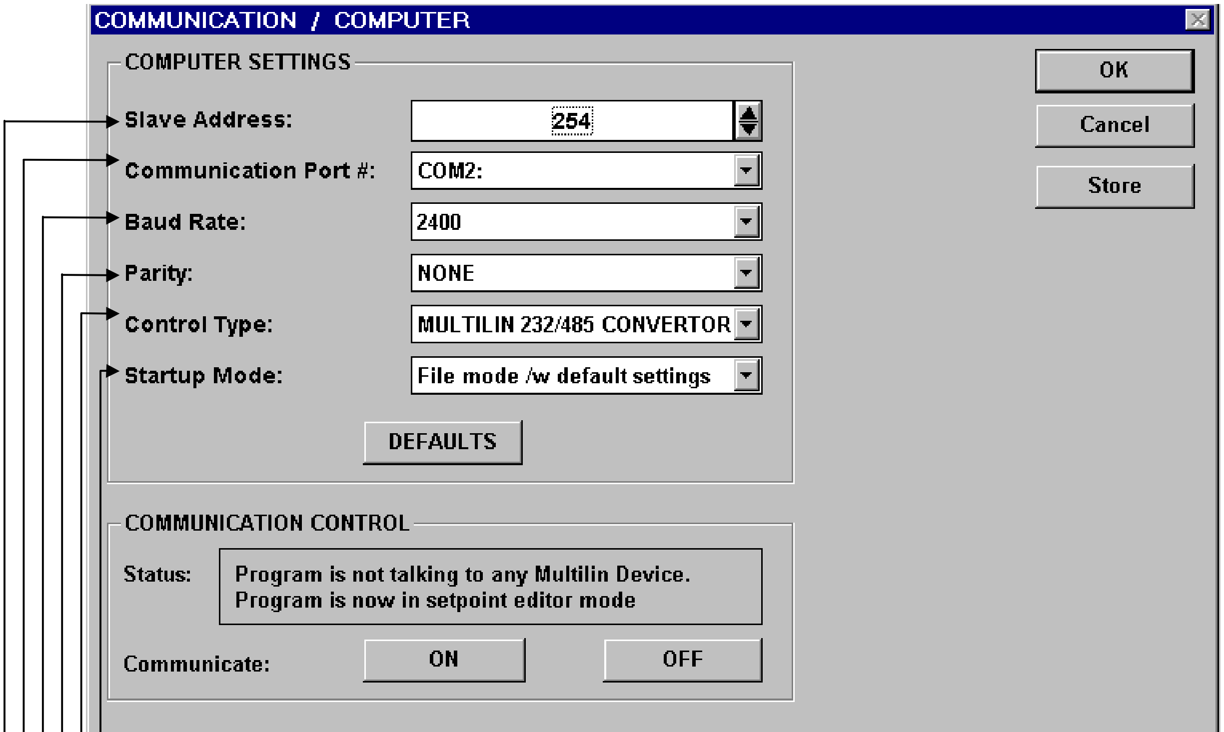


To configure communications with a 269 PLUS click on the **Communications** menu.

3. From the **Communications** menu select on **Computer**.



4. The COMMUNICATION / COMPUTER dialog box will appear with communications settings for the computer. These settings should be modified as follows:



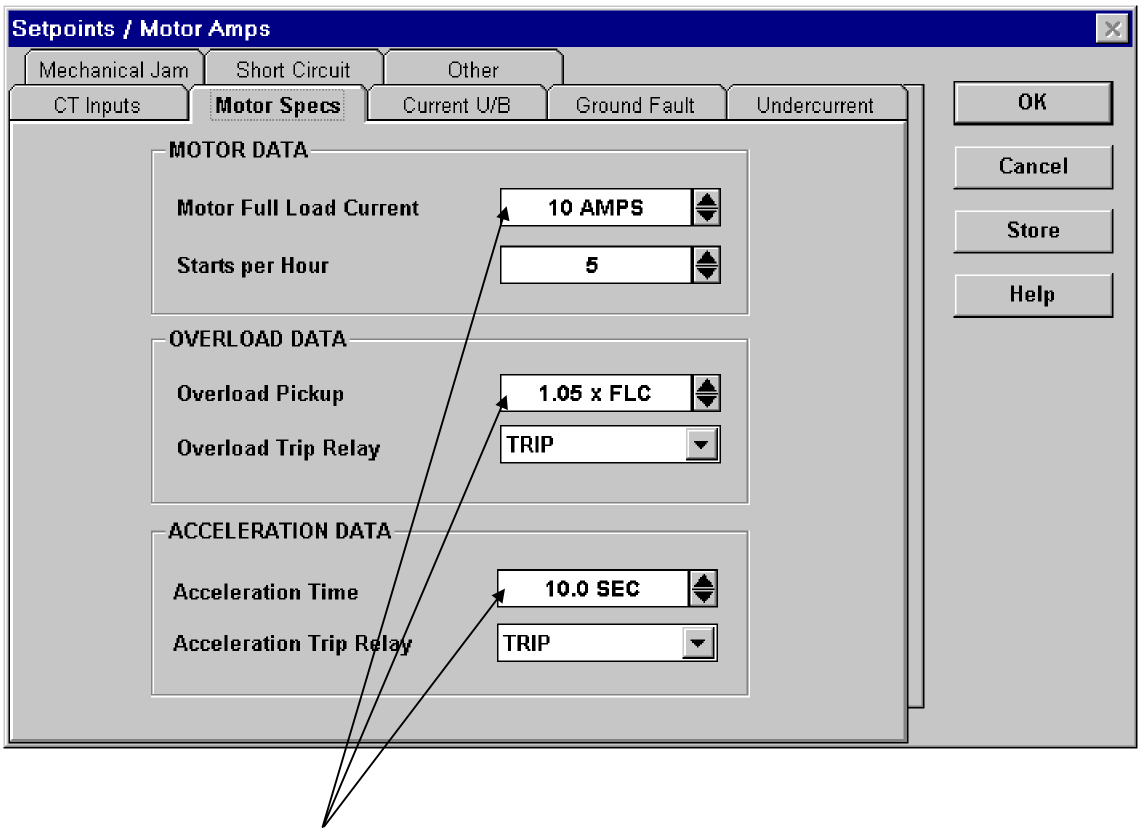
- Set the **Startup Mode** based on user preference. In the "Communicate with relay" mode the 269PC will attempt to establish communications with the 269 PLUS immediately on startup. While in the "File mode /w default settings" the program waits for the user to click the "ON" button before attempting to establish communications - this is preferred when the 269PC software is being used without a 269 PLUS.
- Set to match the type of RS232/RS485 converter control type. If you are connected to a MULTILIN RS232/RS485 converter select "MULTILIN 232/485 Converter". If you are connected to a modem select "Modem". If you are connected to a third party's converter box select the appropriate control type from the available list and the manufacturer's specifications.
- Set to match the **PARITY** (must be set to "NONE").
- Set to match the **BAUD RATE** (Setpoint in the 269 PLUS is set to 2400).
- Set to the COM port # **on your computer** which is connected to the 269 PLUS (i.e. COM1 or COM2). On most PCs COM1 is used by the mouse device and so COM2 is usually available for communications.
- Set to match the **SLAVE ADDRESS** (Default Setpoint in the 269 PLUS is 254).

To begin communications click on the **ON** button in the COMMUNICATION CONTROL section of the dialog box. The Status section of the dialog box will indicate the communication status. If communications are established the message "***Program is now talking to a Multilin device***" will be displayed, and the status at the bottom right hand corner of the screen will indicate "*Communicating*".

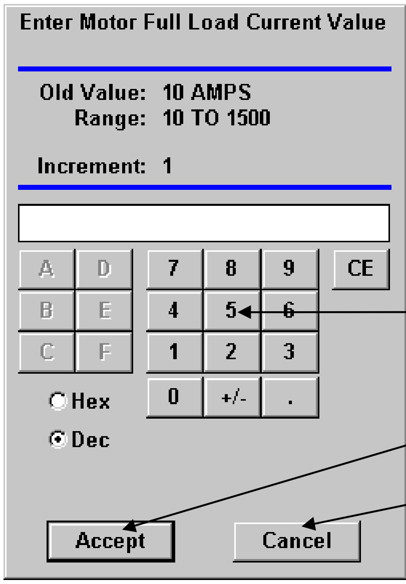
8.7 Entering Setpoints

The following example illustrates the entering of setpoints from the 269PC program.

1. From the **Setpoint** menu select **Motor Amps**.
2. From the **Setpoints / Motor Amps** window select **Motor Specs.**
3. The following dialog box will pop up where setpoint information for the 269 PLUS is to be entered:



- For setpoints requiring numerical values click the mouse pointer anywhere inside the setpoint box. This will cause a numerical keypad to be displayed showing the OLD value, RANGE and INCREMENT of the setpoint value being modified.

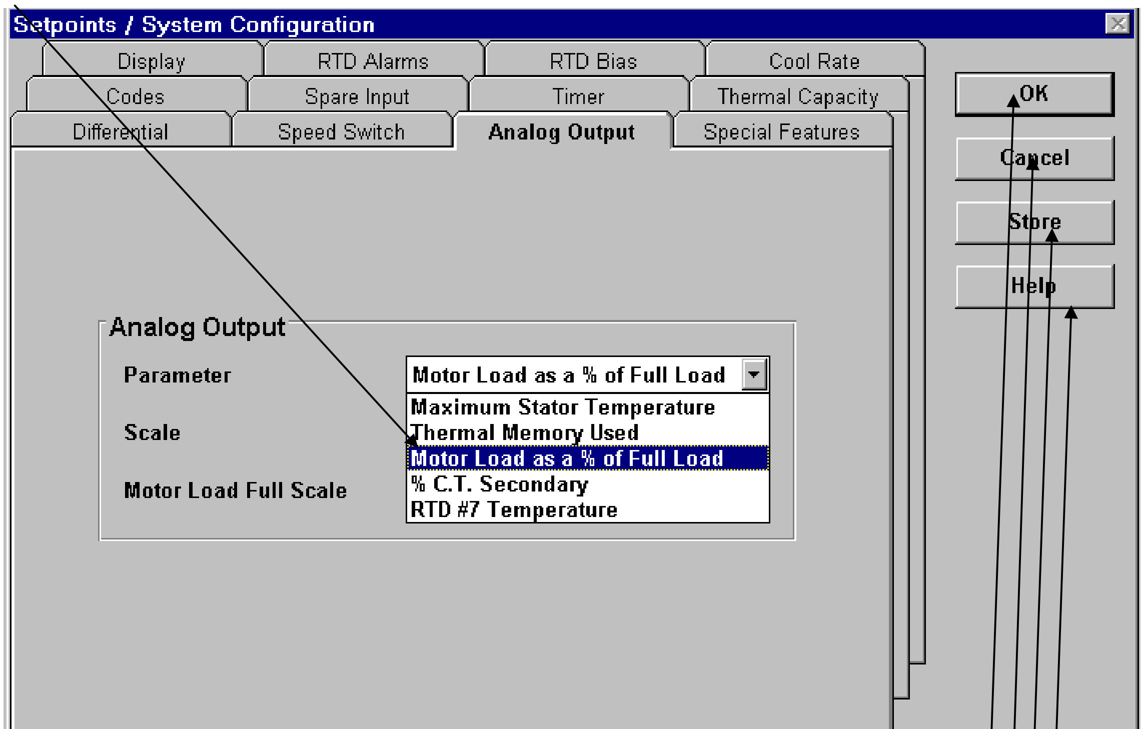


Enter the new value by clicking on the numerical keys, or typing the number directly.

Click on **Accept** to exit from the keypad and keep the new value.

Click on **Cancel** to exit from the keypad and keep the old value.

- For setpoints requiring non-numerical values (example, Analog Output Parameter) clicking anywhere inside the setpoint box will cause a selection menu to be displayed.

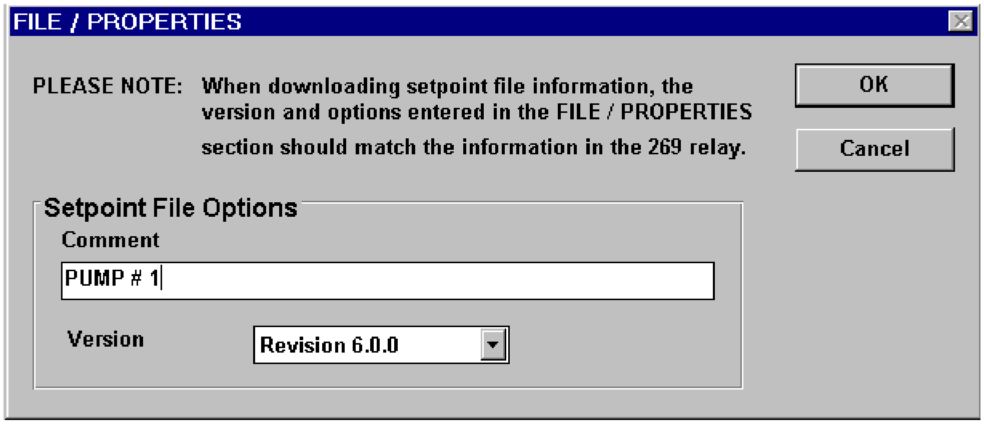


- Click on **OK** to save values into the computer's memory
- Click on **Cancel** to retain the previous value
- Click on **Store** to send the values to the 269 PLUS (if connected)
- Click on **Help** to display the selected help related topic

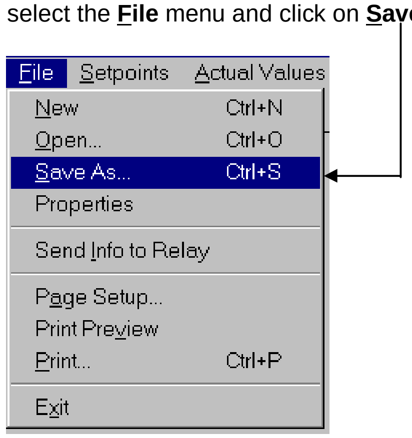
8.8 Saving Setpoints to a File

Saving setpoints to a file on your PC is accomplished as follows:

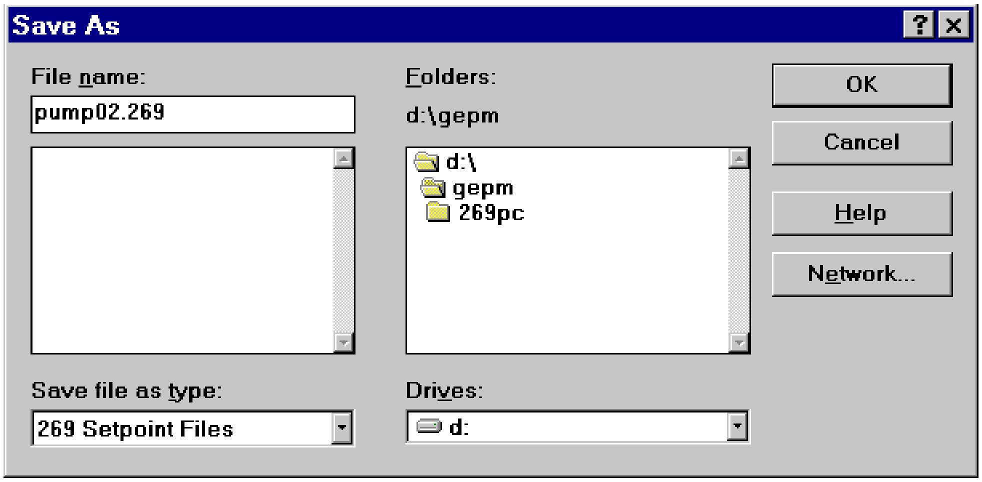
1. An optional comment may be entered into the Setpoint file, which will be printed when the Setpoint file is printed. Select **Properties** from the **File** menu to display the following dialog box, enter any desired comment, and click **OK**.



2. After the setpoints have been configured select the **File** menu and click on **Save As..**.



3. The following dialog box will pop-up. Enter the file name under which the file will be saved in the File Name box or click on any of the file names displayed in the box below. All 269 PLUS setpoint files should have the extension ***.269*** (i.e. ***pump01.269***). Click on **OK** to proceed:

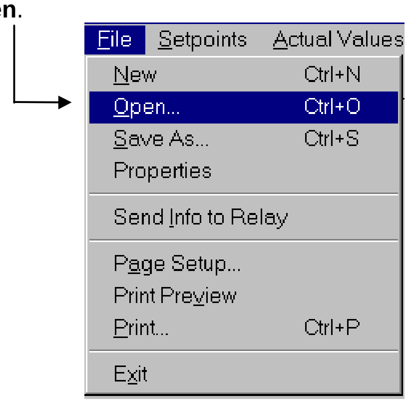


4. The program will then read all the relay setpoint values and store them to the selected file.

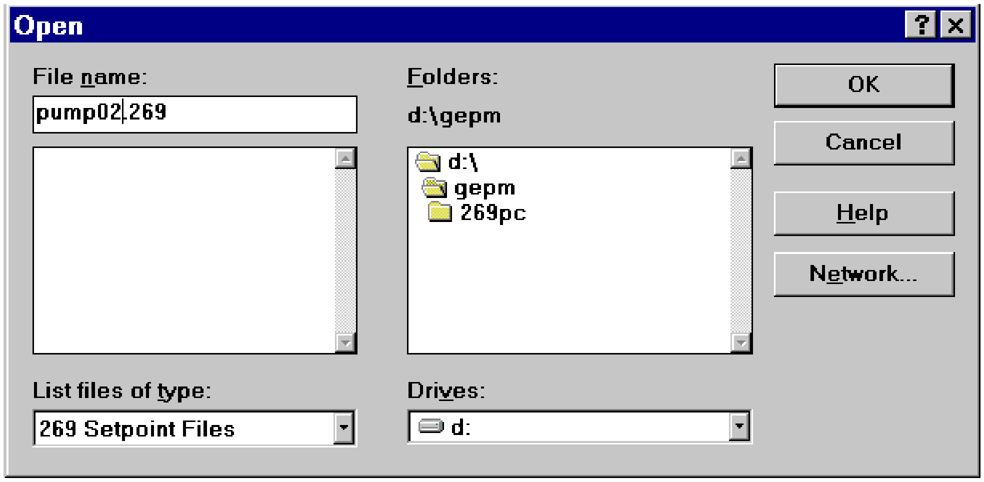
8.9 Loading Setpoints From a File

Loading the 269 PLUS with setpoints from a file is accomplished as follows:

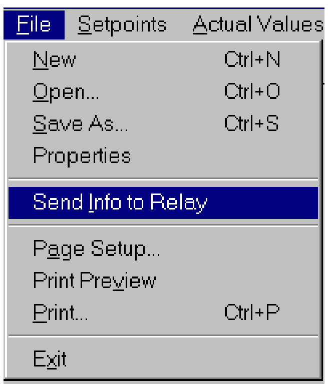
1. From the **File** menu select **Open**.

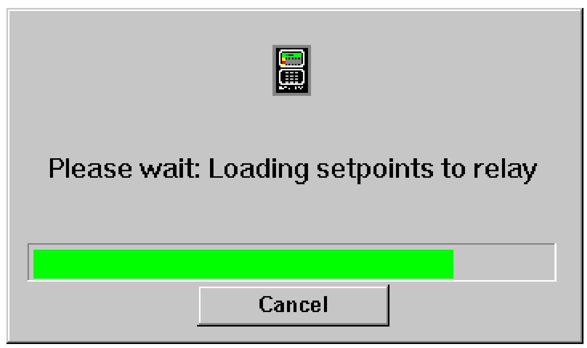


2. The following dialog box will pop-up. The program will display all filenames with the extension ***.269*** . Select the file name of the setpoint file to download to the 269 PLUS - the selected file name will appear in the file name box. Click the **OK** button to continue



3. From the **File** menu select **Send Info to Relay**. The program will then download the setpoints to the 269 PLUS.



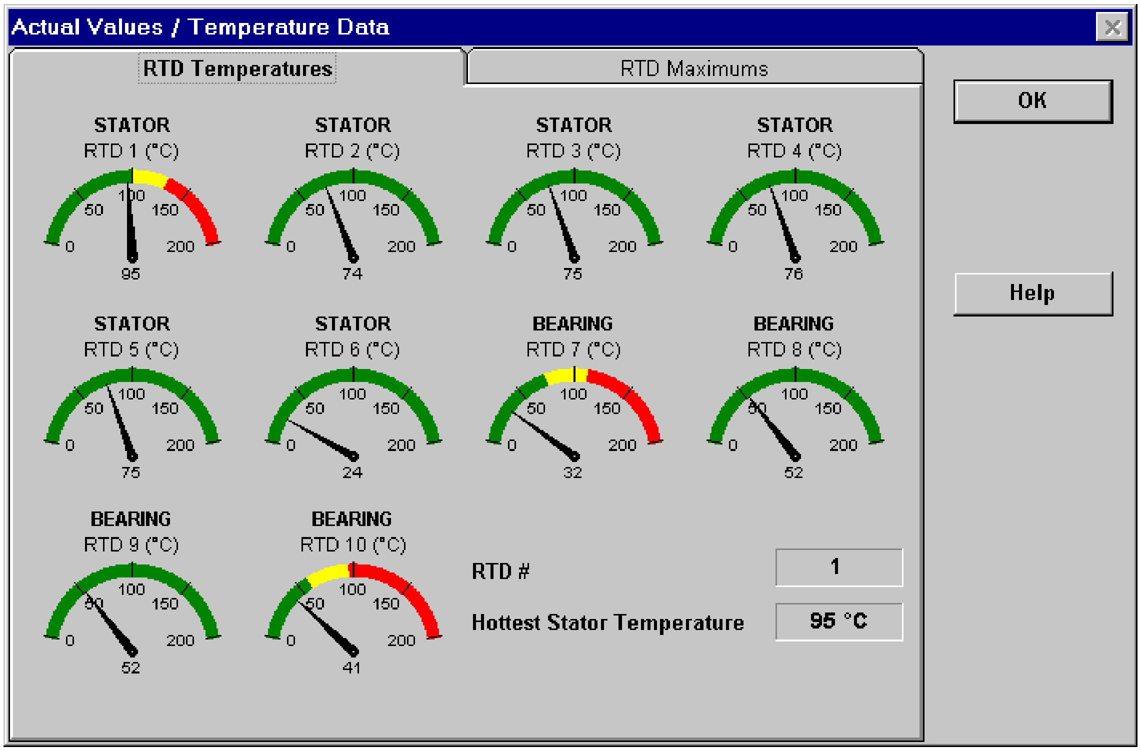


8.10 Viewing Actual Values

The following examples illustrate how any of the measured or monitored values can be displayed. In the following example it is desired to view the RTD Temperatures:

1. From the **Actual Values** menu select **Temperature Data**.

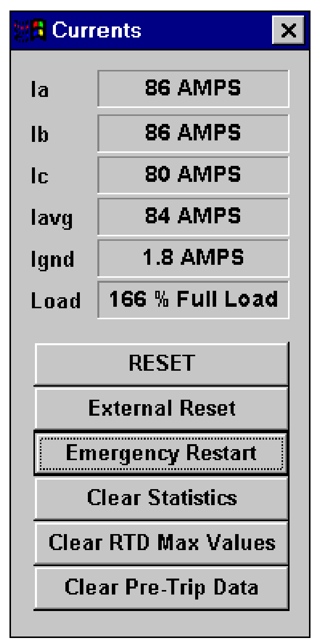
2. The following display box will pop up automatically displaying the appropriate temperatures.



In the following example, it is desired to view measured currents.

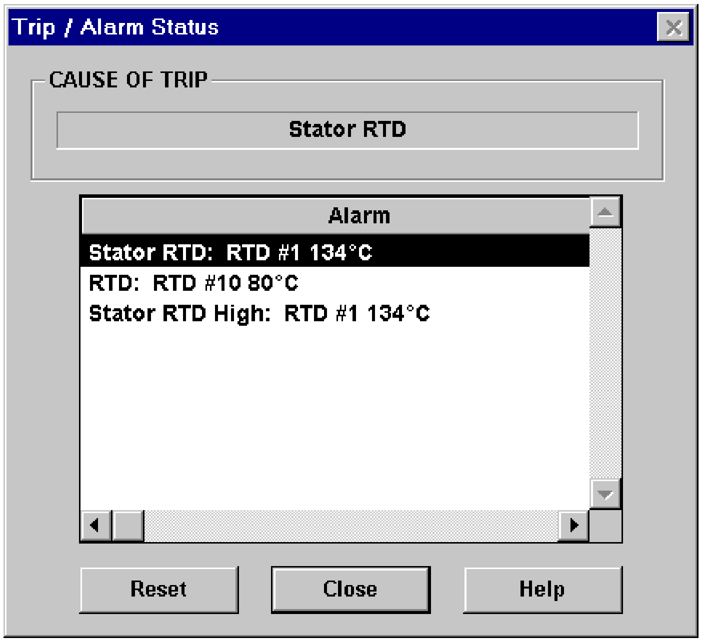
1. From the **Actual Values** menu, select **Popup Currents**.

2. The following window will popup, displaying measured currents. The window also allows you to perform certain functions: Reset, External Reset, Emergency Restart, Clear Statistics, Clear RTD Max Values, and Clear Pre-Trip Data. This window, when selected, remains open. To close it, click on its close button.



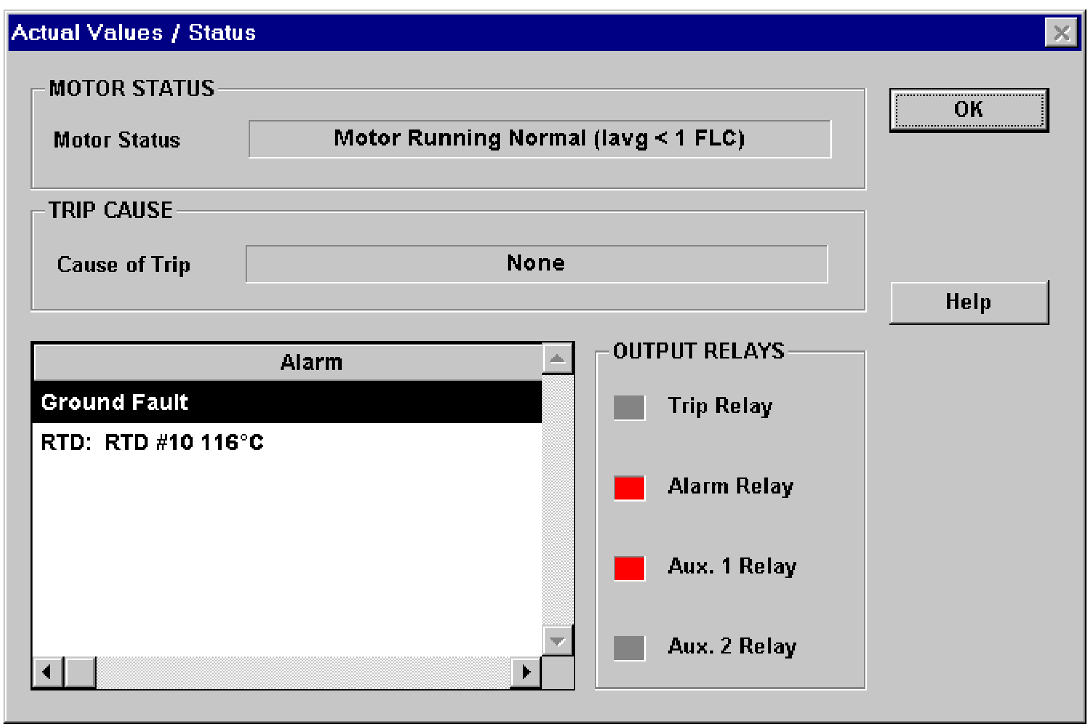
In the following example, a trip has occurred.

1. If an alarm or trip occurs, the following window will be displayed in 269PC:



2. To reset the trip/alarm, click on the **Reset** button, or click on the **Close** button to close the window (the trip/alarm remains active).

NOTE: If the trip/alarm status window is closed during an alarm, and a subsequent alarm or trip occurs, the window will not pop up again indicating that alarm or trip. To display the alarms or trip status, select the **Actual Values** menu and click on **Status**:



8.11 Trending

1. To view trending data, select the **Actual Values** menu and click **Trending**.

Select how often the graph should be updated

Choose which displayed value (in the graph) you wish to display in the legend, cursor 1, cursor 2, or the difference

Click to select each actual value you wish to trend

Use the Zoom buttons to zoom in or out of the graph

The actual values chosen will be graphed in this area, for the selected sampling rate. Click on the green or red lines with the mouse to move cursor 1 or cursor 2.

Trending is a feature of the 269PC program that allows the operator to view eight separate actual value parameters over a period of time at selected intervals. This data is displayed graphically with an option of saving the data to a CSV file (by clicking on the **File** button) for viewing from a spreadsheet program.

Time Intervals

To change the time intervals of the trending select the list box located at the top left corner of the trending screen. Time intervals range start at one second and end at a time interval of one hour.

Saving Trend Data

Before saving the trending data the file needs to be defined. Click in the box below Filename to bring up a File dialog box to allow you to locate the destination for the trending data. Before trending starts select the checkbox on this screen to indicate that the data should be written to the file.

It is possible to save trending data at intervals of one second between samples. On slow machines or if the destination file is to a floppy disk the trending data intervals may occur slightly slower than one second due to the performance of the computer.

269 Plus UNBALANCE EXAMPLE

The unbalance algorithm of the 269 Plus makes 2 assumptions:

1) The three-phase supply is a true three-phase supply.

2) There is no zero sequence current flowing (no ground fault).

For simplicity, the 3ϕ may be drawn in the shape of a triangle (three vectors must cancel each other). This also makes it plain to see that no phasor could change in magnitude without corresponding magnitudes and/or phase angles changing. From magnitudes, phase angles can always be derived using simple trigonometry.

Example. Phase magnitudes 3.9, 5, 5

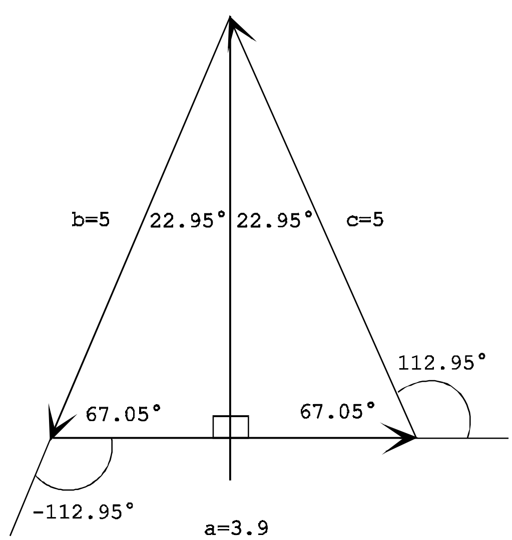


Figure 1

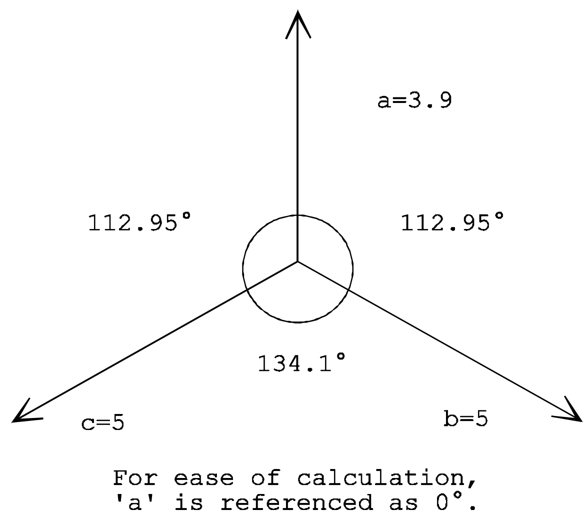


Figure 2

From fig. 1: a=3.9 ∠ 0 b=5 ∠ -112.95 c=5 ∠ 112.95

Symmetrical component analysis of unbalance (the ratio of negative sequence current to positive sequence current) in this example yields:

$$
\begin{aligned}
\frac{I_n}{I_P} = \frac{I_2}{I_1} &= \frac{\frac{1}{3}(I_a + x^2 I_b + x I_c)}{\frac{1}{3}(I_a + x I_b + x^2 I_c)} \text{ where } x = 1\angle 120 = -0.5 + j\ 0.866 \\
&= \frac{3.9\angle 0 + (1\angle 120)^2 (5\angle -112.95) + 1\angle 120\ (5\angle 112.95)}{3.9\angle 0 + 1\angle 120\ (5\angle -112.95) + (1\angle 120)^2 (5\angle 112.95)} \\
&= \frac{3.9\angle 0 + 5\angle 127.05 + 5\angle 232.95}{3.9\angle 0 + 5\angle 7.05 + 5\angle 352.95} \\
&= \frac{3.9 - 3.01 + j\ 3.99 - 3.01 - j\ 3.99}{3.9 + 4.96 + j\ 0.61 + 4.96 - j\ 0.61} \\
&= \frac{-2.12}{13.82} \\
&= -0.1534
\end{aligned}
$$

Therefore, unbalance is | -0.1534 | × 100% = 15.34 %

When a motor is lightly loaded however, the ratio of negative sequence to positive sequence current will increase as the positive sequence current becomes a relatively small value. This may result in nuisance trips even though a lightly loaded motor can withstand relatively large amounts of unbalance. The 269 Plus derates unbalance below Full Load by multiplying the unbalance by Iavg/IFLC.

Assuming full load=100% of CT, the 15.34% unbalance now becomes:

$$\frac{(3.9+5+5)/3}{1.0\times 5}\times 15.34\%$$
$$=14.22\%$$

Finally, the ratio of negative sequence to positive sequence current for any magnitude of phase current may be displayed on a graph as shown in Fig.3 (providing the supply is a true three phase supply and there is no zero sequence current flowing, no ground fault).

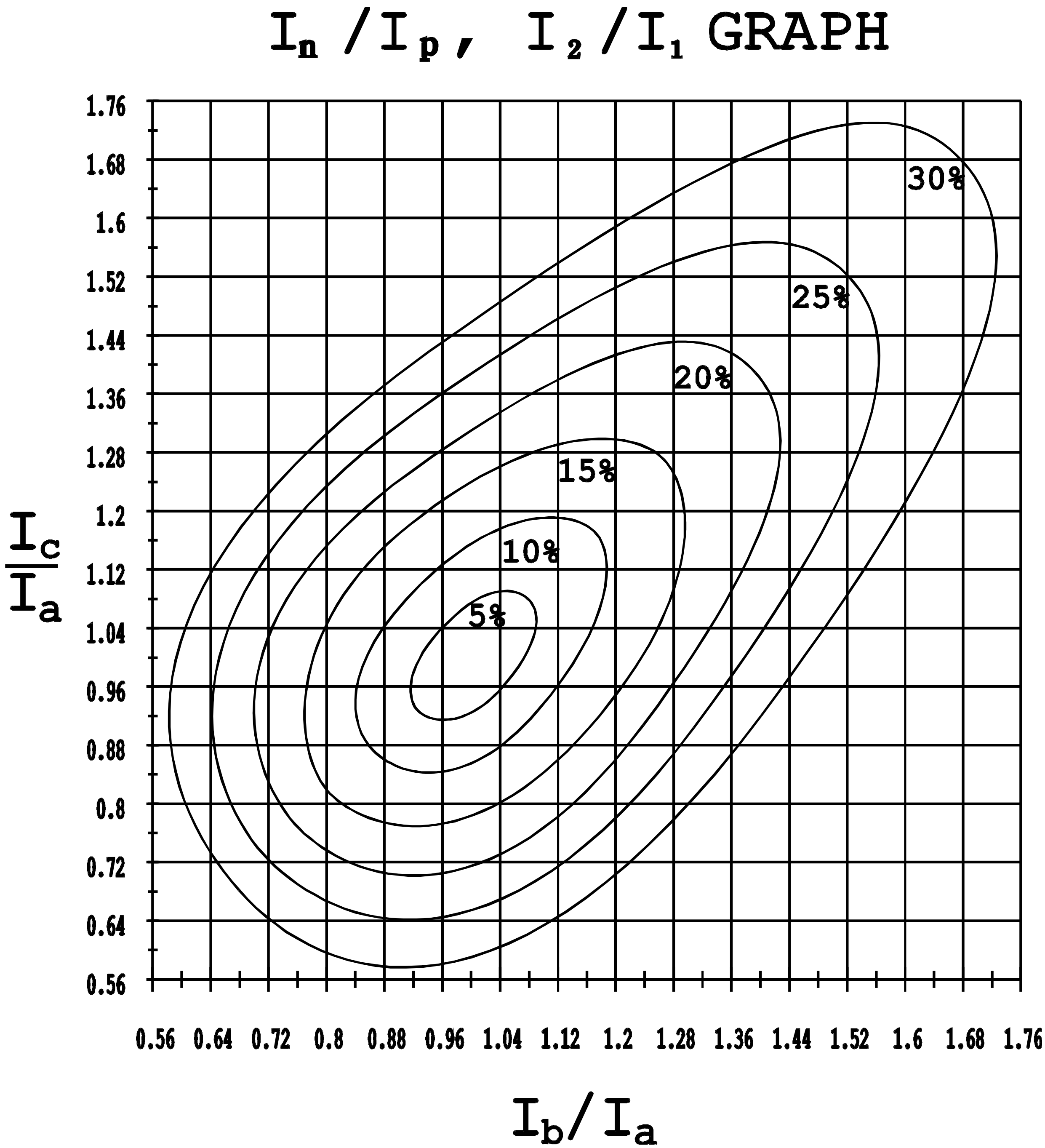
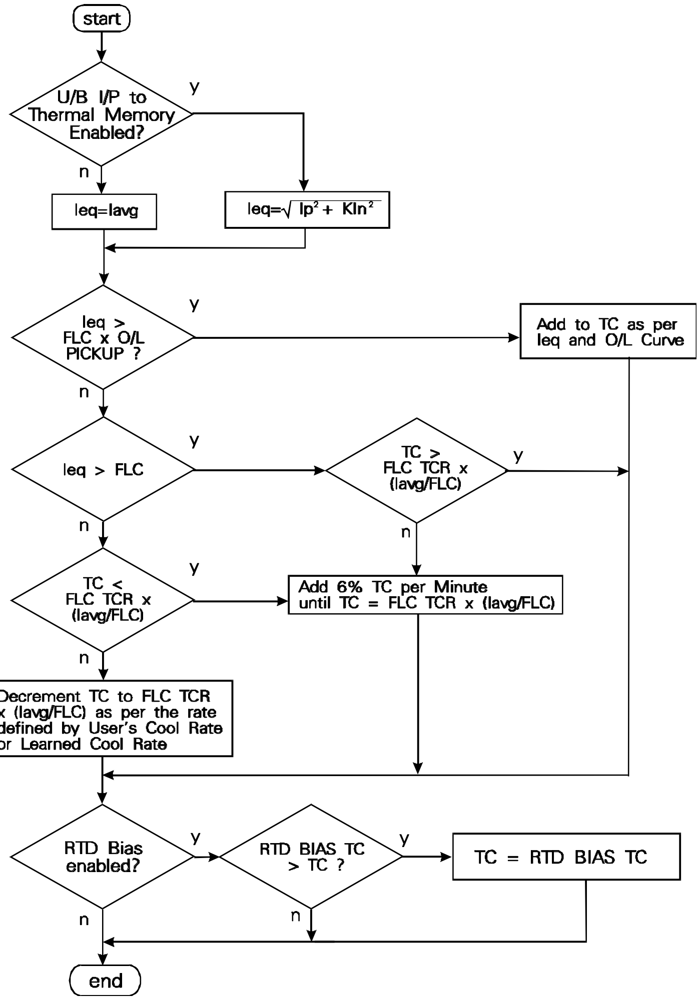


Figure 3

269 Plus Thermal Model

(Discreet time based algorithm, 250 ms update).

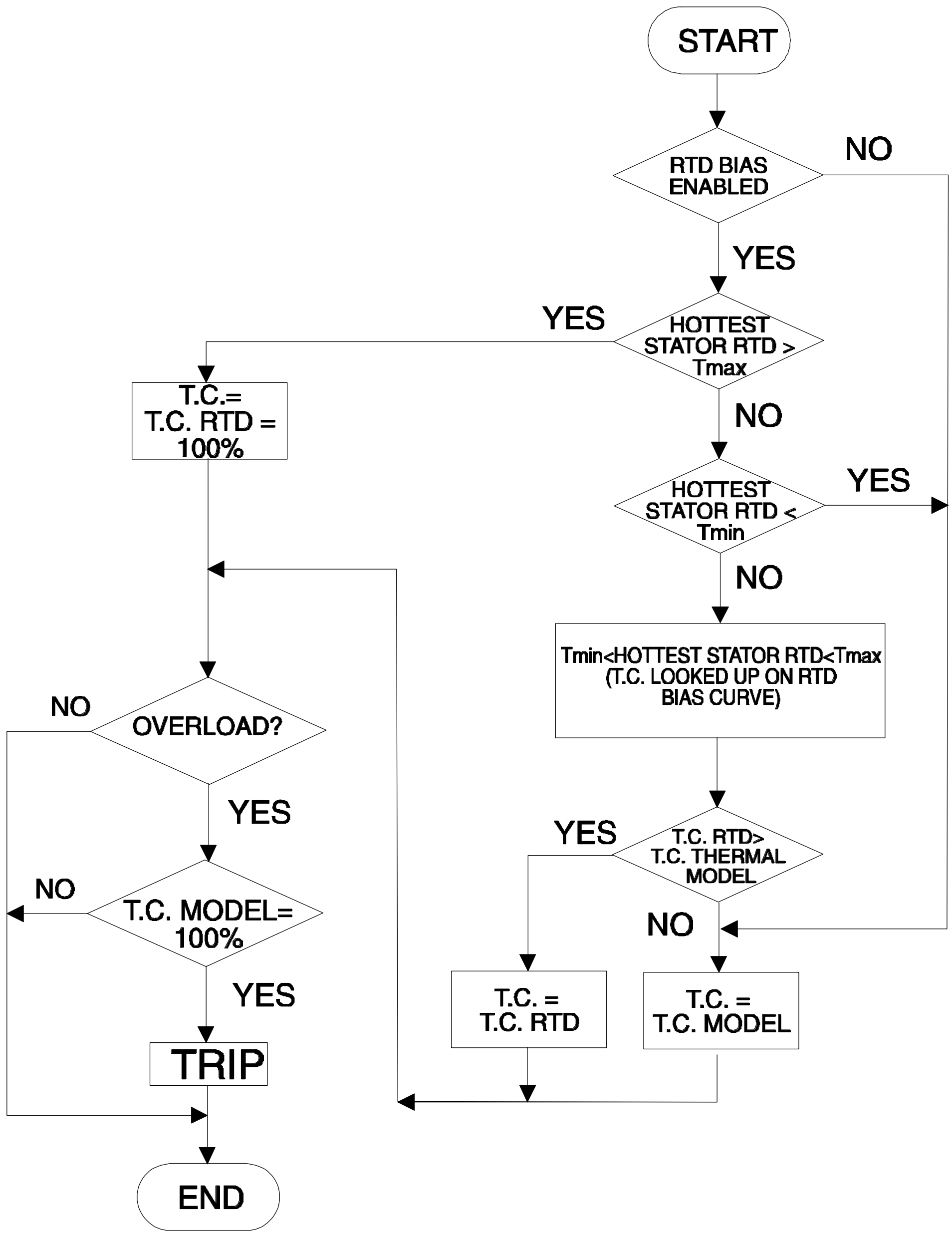


LEGEND

U/B .... Unbalance
I/P .... Input
Iavg .... Average Three Phase Current
Ieq .... Equivalent Average Three Phase Current
Ip .... Positive Sequence Current
In .... Negative Sequence Current
K .... Constant Multiplier that Equates In to Ip
FLC .... Full Load Current
FLC TCR .... FLC Thermal Capacity Reduction Setpoint
TC .... Thermal Capacity used
RTD BIAS TC...... TC Value looked up from RTD Bias Curve

NOTE: If Unbalance input to thermal memory is enabled, the increase in heating is reflected in the thermal model. If RTD Input to Thermal Memory is enabled, the feedback from the RTDs will correct the thermal model.

269 Plus RTD Bias Feature



LEGEND	
Tmax..............	RTD Bias Maximum Temperature Value
Tmin...............	RTD Bias Minimum Temperature Value
Hottest RTD....	Hottest Stator RTD measured
TC..................	Thermal Capacity Used
TC RTD..........	Thermal Capacity Looked up on RTD Bias Curve.
TC Model........	Thermal Capacity based on the Thermal Model

269 Plus RTD Circuitry

The following is an explanation of how the RTD circuitry works in the 269 Plus Motor Protection Relays.

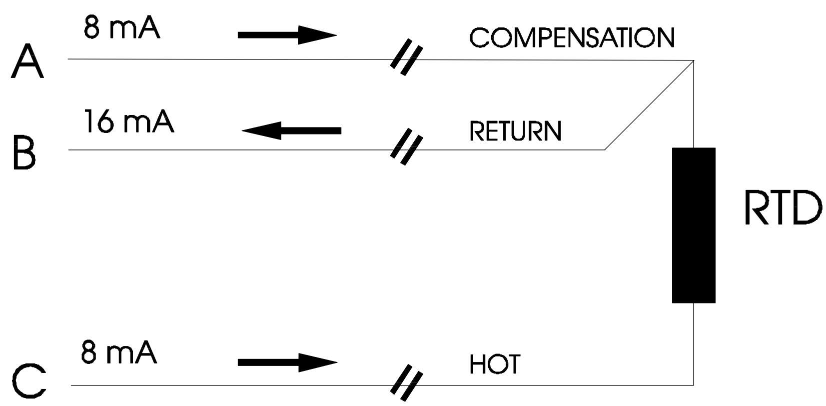


FIGURE 1.

A constant current source sends 8mA DC down legs A and C. 16mA DC returns down leg B. It may be seen that:

$V_{AB} = V_{Lead\ A} + V_{Lead\ B}$ and
$V_{BC} = V_{Lead\ C} + V_{RTD} + V_{Lead\ B}$

or

$V_{AB} = V_{COMP} + V_{RETURN}$ and
$V_{BC} = V_{HOT} + V_{RTD} + V_{RETURN}$

The above holds true providing that all three leads are the same length, gage, and material, hence the same resistance.

$\Rightarrow \quad R_{Lead\ A} = R_{Lead\ B} = R_{Lead\ C} = R_{Lead}$
or $\quad R_{HOT} = R_{COMP} = R_{RETURN} = R_{Lead}$

Electronically, subtracting V_{AB} from V_{BC} leaves only the voltage across the RTD. In this manner lead length is effectively negated:

$$V_{BC} - V_{AB} = \{V_{Lead} + V_{RTD} + V_{Lead}\} - \{V_{Lead} + V_{Lead}\}$$
$$V_{BC} - V_{AB} = V_{RTD}$$

In order to connect 6 Stator RTDs with only 8 wires, the wiring illustrated in Figure 2 may be used. However, this is **not** a recommended wiring practice. All the **HOT** wires must travel to the 269 Plus (6 wires). The compensation and RETURN leads must be daisy chained at the motor.

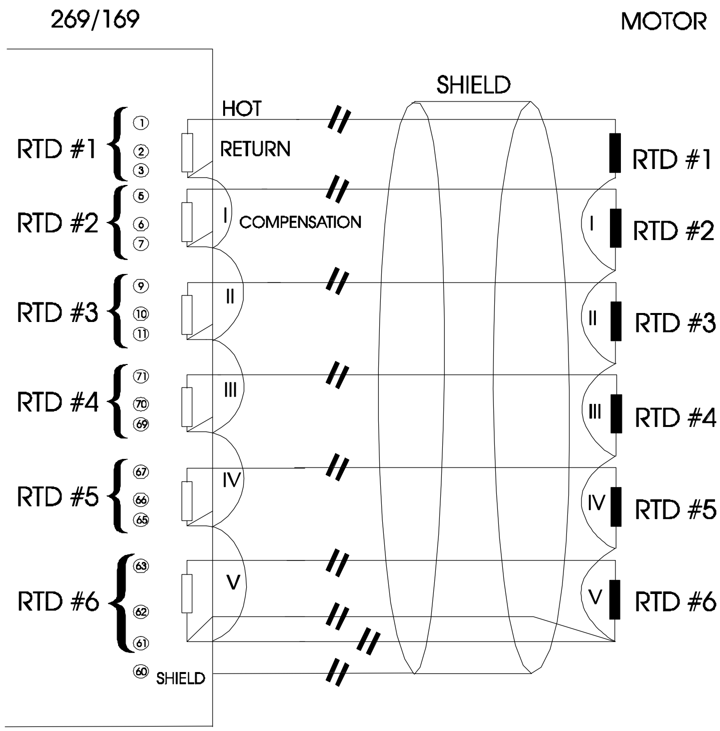


FIGURE 2.

Providing the daisy chain is short and RTDs are not Copper, (Copper is very sensitive to extra resistance), the wiring illustrated in Figure 2 should work properly. After the wiring, a quick test of RTD actual values is recommended to ensure that all six RTDs are reading correctly.

To illustrate this further, let us consider RTD #1. Following the concept demonstrated earlier for finding the RTD voltage, which will then be translated into temperature, we find that:

$$V_{1,2} = V_{\text{Lead 1 HOT}} + V_{\text{RTD\#1}} + V_{\text{Link I}} + V_{\text{Link II}} + V_{\text{Link III}} + V_{\text{Link IV}} + V_{\text{Link V}} + V_{\text{Lead 6 RETURN}}$$
$$V_{2,3} = V_{\text{Link I}} + V_{\text{Link II}} + V_{\text{Link III}} + V_{\text{Link IV}} + V_{\text{Link V}} + V_{\text{Lead 6 COMP.}} + V_{\text{Lead 6 RETURN}}$$

Assuming that the links at the motor side and at the relay side are the same length, gage, and material, therefore the same resistance, and all the hot, return and compensation leads have also the same resistance, we can conclude that:

$$V_{1,2} - V_{2,3} = V_{\text{RTD\#1}}$$

An illustration of how to compensate a two wire RTD with a run of wire to a central terminal may be seen in Figure 3.

NOTE: Wires must all be the same gage, type, and length to ensure that they all have the same resistance, otherwise additional calculations are required.

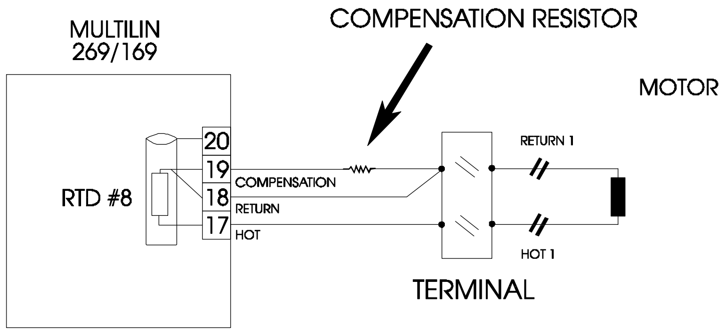


FIGURE 3.

The value of the compensation resistor is equal to the resistance of RETURN 1 plus HOT 1.
Assuming,

$$R_{\text{Lead Compensation}} = R_{\text{Lead Hot}}$$

$$V_{17,18} = V_{\text{Lead Hot}} + V_{\text{Lead Hot 1}} + V_{\text{RTD}} + V_{\text{Lead Return 1}} + V_{\text{Lead Return}}$$
$$V_{18,19} = V_{\text{Lead Comp.}} + V_{\text{R Comp.}} + V_{\text{Lead Return}}$$

Since,

$$V_{\text{Lead Compensation}} = V_{\text{Lead Hot}}$$

$\Rightarrow$ $$V_{17,18} - V_{18,19} = \{V_{\text{Lead Hot}} + V_{\text{Lead Hot 1}} + V_{\text{RTD}} + V_{\text{Lead Return 1}} + V_{\text{Lead Return}}\} - \{V_{\text{Lead Comp.}} + V_{\text{R Comp.}} + V_{\text{Lead Return}}\}$$

$$V_{17,18} - V_{18,19} = \{V_{\text{Lead Hot 1}} + V_{\text{RTD}} + V_{\text{Lead Return 1}}\} - V_{\text{R Comp.}}$$

$\Rightarrow$ $V_{17,18} - V_{18,19} = V_{\text{RTD}}$ **ONLY IF**
$V_{\text{R Comp.}} = V_{\text{Lead Hot 1}} + V_{\text{Lead Return 1}}$ or

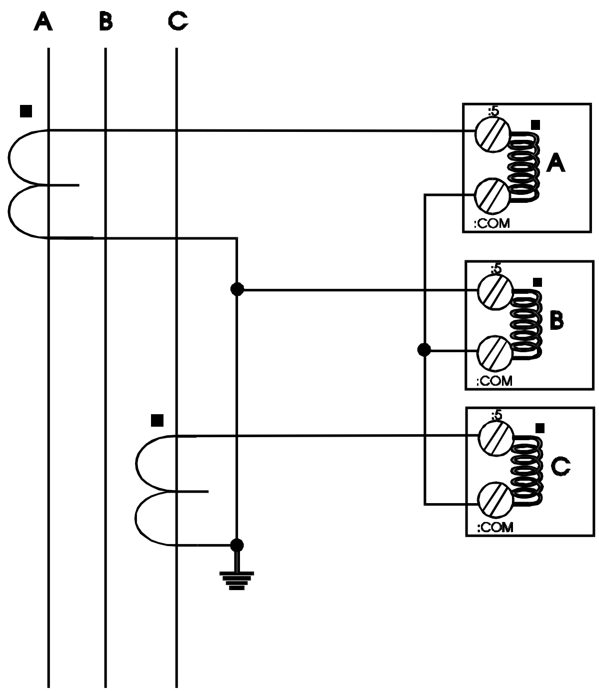
$$R_{\text{Comp}} = R_{\text{Lead Hot 1}} + R_{\text{Lead Return 1}}$$

The illustration shown in Figure 3 is for RTD #8, but it may be applied to any of the RTDs.

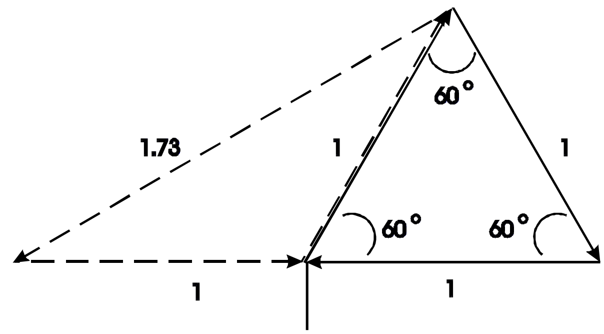
2ϕ CT Configuration

The purpose of this Appendix is to illustrate how two CT's may be used to sense three phase currents.

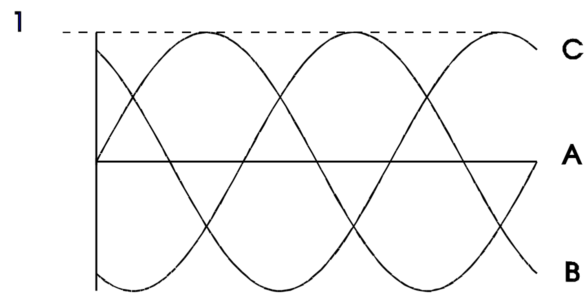
The proper configuration for the use of two CTs rather than three to detect phase current is shown. Each of the two CTs acts as a current source. The current that comes out of the CT on phase 'A' flows into the interposing CT on the relay marked 'A'. From there, the current sums with the current that 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, there is only one ground connection as shown. If two ground connections are made, a parallel path for current has been created.



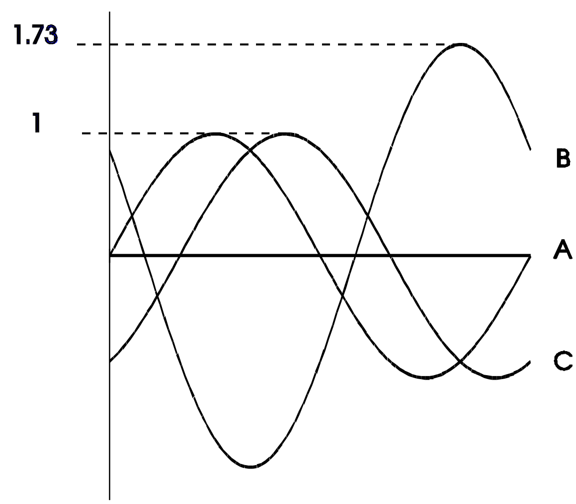
In the two CT configuration, the currents will sum vectorially at the common point of the two CTs. The diagram illustrates the two possible configurations. If one phase is reading high by a factor of 1.73 on a system that is known to be balanced, simply reverse the polarity of the leads at one of the 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 diagram here 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, 'A' would be 180° out of phase with phase 'C' and the vector addition would equal zero at phase 'B'.

Asymmetrical Starting Current

It is a commonly known fact that current lags voltage by 90° when a voltage is applied to a purely inductive load. As can be seen from Figure 1, if the AC voltage is applied at a peak, the current will rise from 0 to its peak, 90° later in time. It may also be seen that during the time voltage completes a positive or negative half-cycle, current has made the transition from one peak to another.

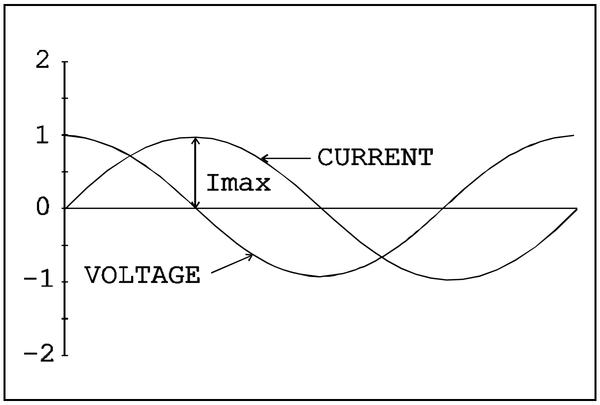


Figure 1

Thus, as shown in Figure 2, if voltage is applied at a zero crossing, current will make the transition from minimum peak to maximum peak. Current of course, cannot instantaneously be at its minimum value, it must begin at zero.

Thus it rises from zero to a value that is equal to 2 times the peak value (2 × Imax).

Depending on when the voltage is applied, the RMS current may vary by as much as 1.73 times.

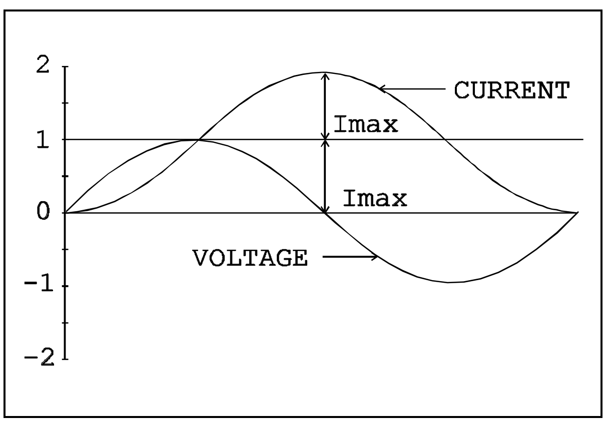


Figure 2

$$I_{RMSasymm} = \sqrt{DC^2 + AC^2}$$

$$I_{RMS\ asymm} = \sqrt{[(\sqrt{2}I_{RMS})^2 + I_{RMS}^2]}$$

$$I_{RMS\ asymm}{}^2 = (\sqrt{2}I_{RMS})^2 + I_{RMS}^2$$

$$I_{RMS\ asymm}{}^2 = 3I_{RMS}^2$$

$$I_{RMS\ asymm} = \sqrt{3}I_{RMS}$$

Where I_{rms} is current when voltage is applied at a maximum, or the symmetrical current.

A motor or a transformer is never a perfect inductor, therefore, the value of 1.73 will never be reached. The DC offset will die away as a function of the X/R ratio (typically a few cycles). Figure 3 represents an exaggeration of the three phase current of a motor starting.

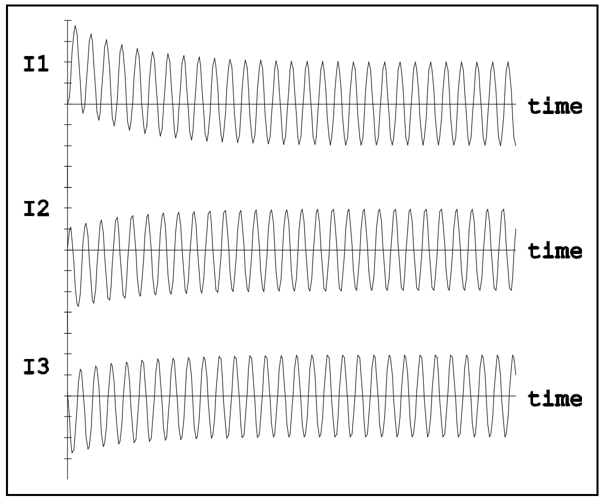


Figure 3

When is this 'asymmetrical current' a concern?

When setting instantaneous relays, care must be taken to ensure that the instantaneous element does not operate during normal operating conditions such as a motor start. Symptoms of an instantaneous element that is set too sensitive are nuisance or intermittent tripping of the relay during energizing of the system.

Furthermore, CTs do not react predictably when a DC current is applied. The waveform that is shown in Figure 3 is not necessarily the waveform that each of three phase CTs would output. If there is a residual connection for ground fault detection, that element could operate when asymmetrical currents are present.

269 Plus Do's and Don'ts Checklist

For proper, orderly and reliable operation of the 269 Plus relay, it is imperative that the steps, recommendations, and practices listed in the checklist below be adhered to at all times.

The 269 Plus's reliability and proven track record as the best Motor Protection Relay on the market to date, including the years that its predecessor the 169 Plus has contributed, allowed us to compile the following "DO'S and DON'TS" list that should, if followed, guarantee durable, reliable and trouble free operation of the 269 Plus Relay in all medium voltage motor protection applications.

① 269 Plus Grounding

Users are requested to ground the 269 Plus relay to ground, preferably directly to the main GROUND BUS at ONE TERMINAL ONLY, terminal #42. Except for the communications circuitry (which we will discuss later!), all other internal circuitry in the 269 Plus ties to the same ground at terminal #42. The benefits of proper grounding of the 269 Plus are numerous, e.g.,

- Elimination of nuisance tripping
- Elimination of internal hardware failures
- Reliable operation of the relay
- Higher MTBF (Mean Time Between Failures)

It is recommended that a tinned copper braided shielding and bonding cable be used. A Belden 8660 cable or equivalent should be used as a minimum to connect the relay directly to the ground bus.

② Grounding of Phase and Ground CTs

- All phase and Ground CTs must be grounded. The potential difference between the CT's ground and the ground bus should be minimal (ideally zero).
- It is highly recommended that, in addition to the solid grounding of the ground CT as described above, a shielded twisted pair be employed especially when the Multilin 2000:1 Ground CT sensor is used. The reason being the 2000:1 CT is usually used on high resistance grounded systems where faults are limited to 200 Amps or less, and the relay is set to trip instantaneously on low levels of ground current anywhere between 1 and 10 Amps. 1 to 10 Amp primary current on the 2000:1 CT translate into very small signals (0.5 to 5 mA) on the secondary of that same CT, which is the signal that the 269 Plus relay sees. Because we are calling upon the 269 Plus relay to detect even the smallest of signals, we have to make sure that noise from any other source does not present itself to the relay's ground CT terminals.

③ RTDs

Consult appendix C for the full description of the 269 Plus RTD circuitry and the different RTD wiring schemes acceptable for the proper operation of the 269 Plus. However, for best results the following recommendations should be adhered to:

a) Use a 3 wire twisted, shielded pair to connect the RTDs from the motor to the 269 Plus. The shields should be connected to the proper terminals on the back of the 269 Plus.

b) RTD shields are internally connected to the 269 Plus ground (terminal #42) and **must not be grounded** anywhere else.

c) RTD signals can be characterized as very small, sensitive signals. Therefore, cables carrying RTD signals should be routed as much away as possible from power carrying cables such as power supply and CT cables.

d) If, after wiring the RTD leads to the 269 Plus, the RTD temperature displayed by the Relay is zero, then check for the following conditions:
   1 - shorted RTD
   2 - RTD hot and compensation leads are reversed, i.e. hot lead in compensation terminal and compensation lead in hot terminal.

④ RS485 Communications Port

The 269 Plus can provide for direct or remote communications (via a modem). An RS232 to RS485 converter is used to tie it to a PC/PLC or DCS system. The 269 Plus uses the Modicon **MODBUS RTU** protocol (functions 03, 04, & 16) to interface with PC's, PLC's and DCS systems.

Following is a list of systems that have been proven to successfully interface with the 269 Plus:

a) Modicon
b) Allen Bradley
c) Bailey Network
d) Honeywell
e) GE Fanuc
f) Foxboro
g) Square D (A modification is required for this interface. Contact the factory for more details)
h) Siemens

Any interface not listed above could be attempted providing one of the following criteria is met. The first, and cleanest solution to an interface problem is a driver (Module, or Firmware) in the PLC/DCS that supports Modbus RTU protocol (commands 03, 04, & 16) as a MASTER. As a second solution, if the PLC/DCS has a BASIC Module or programmable Module that allows total control of a communications port, a competent programmer could write a simple program to take care of communications.

GE Multilin constantly works with PLC/DCS manufacturers, third party integrators and end users to develop ways of interfacing the 269 Plus with other PLC/DCS systems not listed above. Users are urged to contact the factory to obtain the most up to date list of all interfaces.

RS485 communications was chosen to be used with the 269 Plus because it allows communications over long distances of up to 4000 ft. However, care must be taken for it to operate properly and trouble free. The recommendations listed below must be followed to obtain reliable communications:

a) A twisted, shielded pair (preferably a 24 gage Belden 9841 type or 120 equivalent) must be used, and routed away from power carrying cables, such as power supply and CT cables.

b) **No more than 32 devices** (269 Plus's, PQM's, or any other non-Multilin device that communicates using the same protocol) can co-exist on the same link. If however, more than 32 devices should be daisy chained together, a REPEATER must be used. Note that a repeater is just another RS232 to RS485 converter device. The **shields** of all 269 Plus units should also be daisy chained together and **grounded at the MASTER** (PC/PLC) only. This is due to the fact that if shields are grounded at different points, a potential difference between grounds might exist, which can result in placing one or more 269 Plus transceiver chips (chip used for communications) in an unknown state, i.e. not receiving nor sending, and the corresponding 269 Plus communications might be erroneous, intermittent or unsuccessful.

c) **Two sets of 120Ω/0.5W resistor and 1nF/50V capacitor in series must** be used (value matches the characteristic impedance of the line). One set at the 269 Plus end, connected between the positive and negative terminals (#46 & #47 on 269 Plus) and the second at the other end of the communications link. This is to prevent reflections and ringing on the line. If a different value resistor is used, it runs the risk of over loading the line and communications might be erroneous, intermittent or totally unsuccessful.

d) It is highly recommended that connection from the 269 Plus communication terminals be made directly to the interfacing Master Device (PC/PLC/DCS), **without the use of any stub lengths and/or terminal blocks**. This is also to minimize ringing and reflections on the line.

Ground Fault and Short Circuit Instantaneous Elements

The 269 Plus has two programmable instantaneous elements, for Short Circuit and Ground Fault protection. When the Short Circuit instantaneous element is programmed, care must be taken not to set the trip level too sensitively, to minimize nuisance tripping, especially on start. It is a known fact that on motor starts, and for the first cycle or more there is an asymmetrical component associated with the motor starting current that can reach as much as twice the starting current level. Please consult appendix E for more details on "Asymmetrical Starting Current".

Also, care must be taken when the instantaneous Ground Fault level is set, especially in applications where motors are fairly large (2000 HP or more) and/or several of these motors are being fed from the same line. At start a large motor may induce a large amount of current in its zero sequence CT. It may induce ground current in adjacent motors as well, causing their zero sequence CTs and relays to pick up and possibly trip. This nuisance trip may occur if the ground fault instantaneous element for any of those motors is set. This phenomenon has been seen and identified to last a cycle or more depending on many factors, such as the size of the motors, the trip levels set, the sensitivity of the relay as well as the number and proximity of motors to each other. For the above reasons, and to eliminate nuisance tripping on start, the 269 Plus has been equipped with a 2 cycle delay built in both the Short Circuit and Ground Fault instantaneous elements to ride through such phenomena.

In addition, to accommodate for even larger motors with ground currents persisting for longer than 2 cycles induced at start, users are urged to contact the factory to get instructions on programming the 269 Plus instantaneous ground fault feature to ride through an additional cycle, bringing the total delay on instantaneous ground fault tripping to approximately 48 ms or 3 cycles, still meeting the NEMA standards for instantaneous elements of less than 50 ms.

I. 269 Plus CT Withstand

When is withstand important?

Withstand is important when the phase or ground CT has the capability of driving a large amount of current into the interposing CTs in the relay. This typically occurs on retrofit installations when the CTs are not sized to the burden of the relay. (New electronic relays have typically low burdens (2 mΩ for 269 Plus), while the older electromechanical relays have typically high burdens (1 Ω).)

For high current ground faults, the system will be either low resistance or solidly grounded. The limiting factor that determines the amount of ground fault current that can flow in these types of systems is the capacity of the source. Withstand is **not** important for ground fault on high resistance grounded systems. On these systems, a resistor makes the connection from source to ground at the source (generator, transformer). The resistor value is chosen such that in the event of a ground fault, the current that flows is limited to a low value, typically 5, 10, or 20 Amps.

Since the potential for very large faults exists (ground faults on high resistance grounded systems excluded), the fault must be cleared as quickly as possible. It is therefore recommended that the time delay for short circuit and high ground faults be set to instantaneous. Then, the duration for which the 269 Plus CTs subjected to high withstand will be less than 250ms (269 reaction time is less than 50ms + breaker clearing time).

NOTE: Care must he taken to ensure that the interrupting device is capable of interrupting the potential fault. If not, some other method of interrupting the fault should be used, and the feature in question should be disabled (e.g. a fused contactor relies on fuses to interrupt large faults).

The 269 Plus CTs were subjected to high currents for 250ms bursts. The CTs were capable of handling 500A for short bursts. 5OOA relates to a 100 times the CT primary rating. If the time duration required is less than 250ms, the withstand level will increase.

II. CT Size and Saturation

How do I know how much current my CTs can output?

CT characteristics may be acquired by one of two methods.

The rating (as per ANSI/IEEE C57.13.1) for relaying class CTs may be given in a format such as these: 2.5C100, 10T200, T1OO, 10C50, or C200. The number preceding the letter represents the maximum ratio correction; no number in this position implies that the CT accuracy remains within a 10% ratio correction from 0 to 20 times rating. The letter is an indication of the CT type. A 'C' (formerly L) represents a CT with a low leakage flux in the core where there is no appreciable effect on the ratio when used within the limits dictated by the class and rating. The 'C' stands for calculated; the actual ratio correction should be different from the calculated ratio correction by no more than 1%. A 'C' type CT is typically a bushing, window, or bar type CT with uniformly distributed windings. A 'T' (formerly H) represents a CT with a high leakage flux in the core where there is significant effect on CT performance. The 'T' stands for test; since the ratio correction is unpredictable, it is to be determined by test. A 'T' type CT is typically primary wound with unevenly distributed windings. The subsequent number specifies the **secondary terminal voltage** that may be delivered by the full winding at 20 times rated secondary current without exceeding the ratio correction specified by the first number of the rating. (Example: a 10C100 can develop 100V at 2Ox5A, therefore an appropriate external burden would be 1Ω or *less* to allow 20 times rated secondary current with less than 10% ratio correction.) Note that the voltage rating is at the secondary terminals of the CT and the internal voltage drop across the secondary resistance must be accounted for in the design of the CT. There are seven voltage ratings: 10, 20, 50, 100, 200, 400, and 800. If a CT comes close to a higher rating, but does not meet or exceed it, then the CT must be rated to the lower value.

The curve in Figure H.1 represents a typical excitation curve for a CT. The Y-axis represent secondary exciting voltage; the X-axis represents the secondary exciting current. When the CT secondary exciting voltage level is picked off the graph, the corresponding secondary exciting current is the amount of current required to excite the core of the CT. With respect to the ideal CT that conforms perfectly to its ratio, the exciting current could be considered loss.

For a Protection Class CT with a 5A secondary and maximum 10% ratio error correction, it is probable that the design point for 20 times rated secondary will be at or slightly lower than the 10 amp secondary exciting current point (10% of 20x5A). To design such that the 20 times rated secondary current is in the linear region would be more expensive.

In order to determine how much current CTs can output, the secondary resistance of the CTs is required. This resistance will be part of the equation as far as limiting the current flow. This is determined by the maximum voltage that may be developed by the CT secondary divided by the entire secondary resistance, CT secondary resistance included.

The easiest method of evaluating a CT is by the Excitation Curves Method, as illustrated by the curves shown in Figure H.2. The Y-axis represents secondary exciting voltage; the X-axis represents the secondary exciting current. These curves may be obtained from the CT manufacturer, or by experimentation (see ANSI/IEEE C57.13.1 for procedures). The curves illustrate the values of secondary volts for which the output of the CT will be linear. The desired operating secondary voltage is below the knee point (A or B on the graph (ANSI or IEC respectively) or just slightly above it, staying within 10% CT ratio error correction at 20 times rating. Using this information, it is important to recognize that the secondary exciting voltage is the total voltage that the CT can develop at the secondary. In this case, that voltage will drop across the secondary winding resistance as well as any load that is applied to the unit. Therefore, the secondary winding resistance must always be included with the excitation curves, or the information is incomplete. A curve with a knee at 100 V for example could drive a total burden of 100V/(20*5A) or 1Ω.

Evaluation of CT performance is best determined from the excitation curves. They present the complete story and eliminate any guess work. Most CT manufacturers will provide excitation curves upon request.

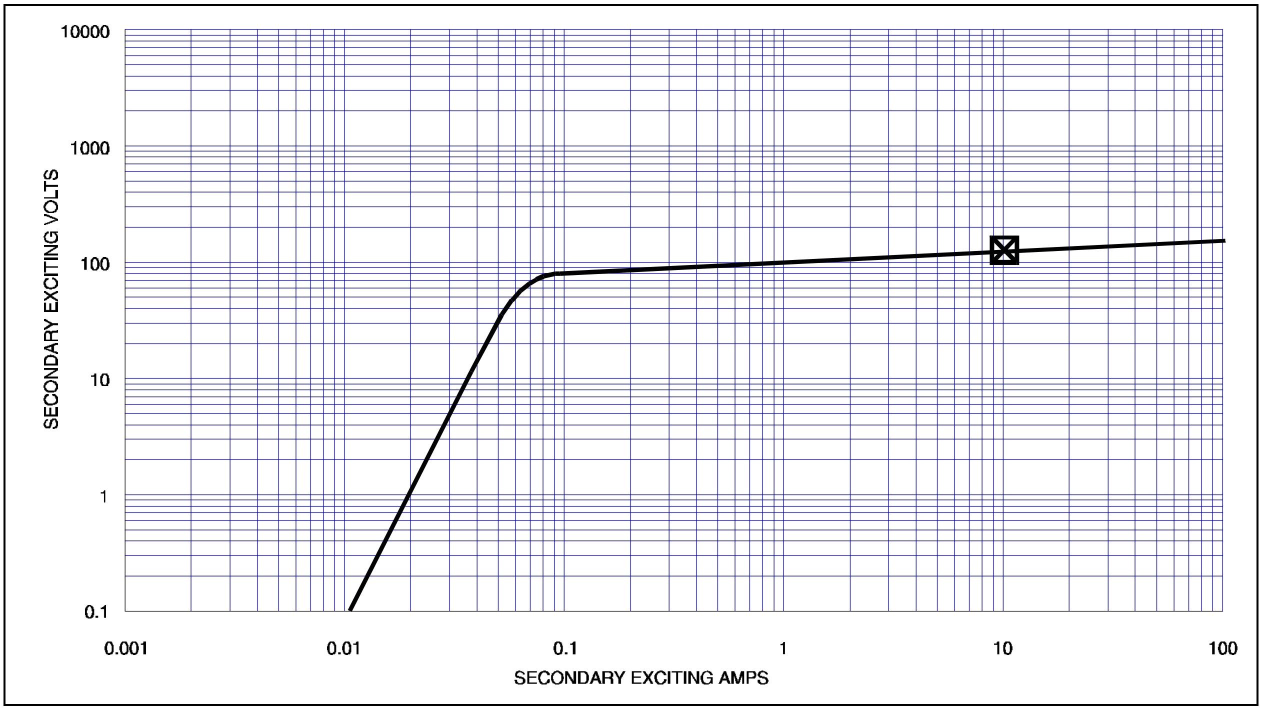


Figure H.1 Excitation Curves

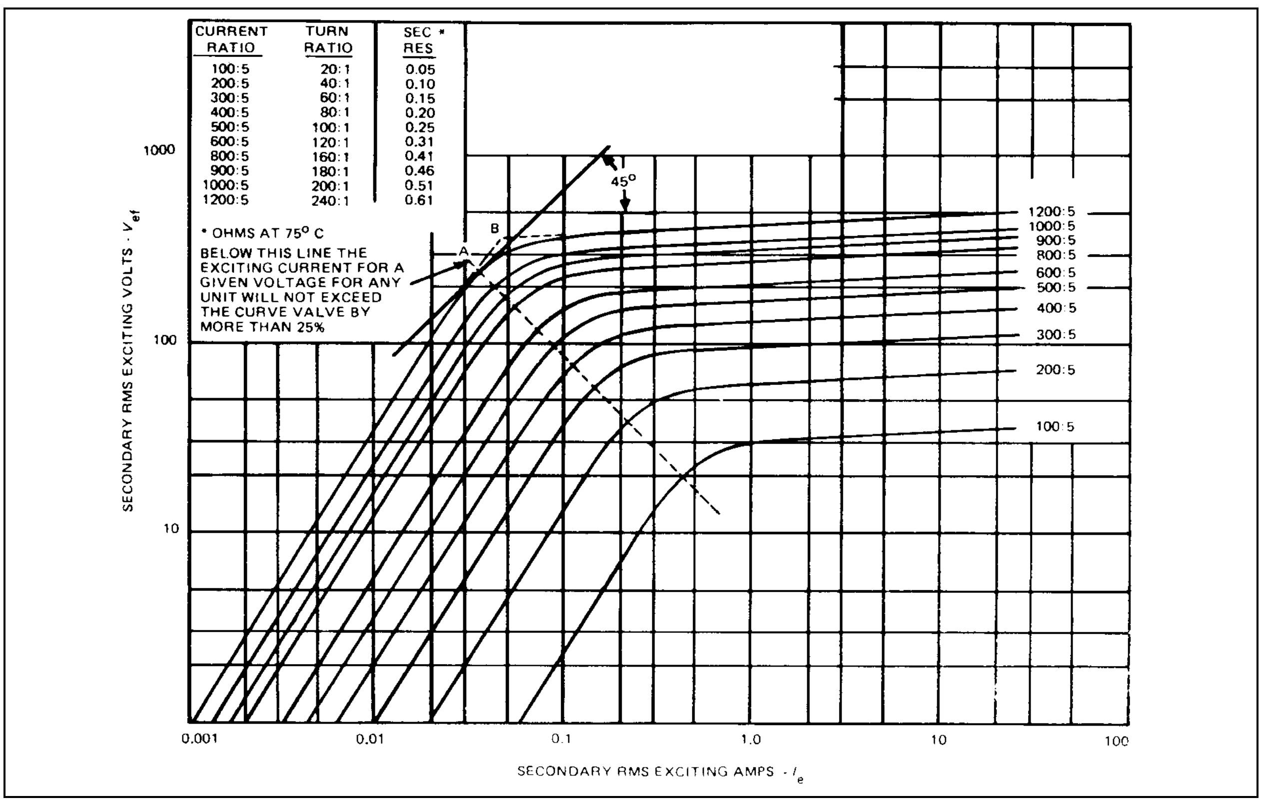


Figure H.2 Excitation Curves Method

APPENDIX I - 269 Plus Commissioning Summary 269P.D6.0.4

PAGE 1: SETPOINT VALUES MOTOR AMPS SETPOINTS	
Phase CT Secondary	
Phase CT Primary	
Motor FLC (amps)	
O/L Pickup Level (%)	
Accel. Time (secs)	
Starts/Hour	
U/B Alarm Level (%)	
U/B Alarm Delay (secs)	
U/B Trip Level (%)	
U/B Trip Delay (secs)	
G/F CT Ratio :5 ? (NO indicates 2000:1)	
G/F CT Primary[1]	
G/F Alarm Level (amps)	
G/F Alarm Delay (secs)	
G/F Trip Level (amps)	
G/F Trip Delay (secs)	
U/C Alarm Level (amps)	
U/C Alarm Delay (secs)	
U/C Trip Level (amps)	
U/C Trip Delay	
Mech. Jam Alarm (xFLC)	
Mech. Jam Alarm Del. (s)	
Rapid Trip (× FLC)	
Rapid Trip Delay (secs)	
S/C Trip Level (× FLC)	
S/C Trip Delay (secs)	
Immediate O/L (× FLC)	

[1] Not seen if ratio is 2000:1

PAGE 2: SETPOINT VALUES RTD SETPOINTS	
RTD Sensor Type[2]	
Any RTDs Connected?[3]	
RTD Message Display	
# of Stator RTDs used	
RTD 1 Alarm Level (°C)	
RTD 1 Hi Alarm Lev (°C)	
RTD 1 Trip Level (°C)	
RTD 2 Alarm Level (°C)	
RTD 2 Hi Alarm Lev (°C)	
RTD 2 Trip Level (°C)	
RTD 3 Alarm Level (°C)	
RTD 3 Hi Alarm Lev (°C)	
RTD 3 Trip Level (°C)	
RTD 4 Alarm Level (°C)	
RTD 4 Hi Alarm Lev (°C)	
RTD 4 Trip Level (°C)	
RTD 5 Alarm Level (°C)	
RTD 5 Hi Alarm Lev (°C)	
RTD 5 Trip Level (°C)	
RTD 6 Alarm Level (°C)	
RTD 6 Hi Alarm Lev (°C)	
RTD 6 Trip Level (°C)	
RTD 7 Alarm Level (°C)	
RTD 7 Trip Level (°C)	
RTD 8 Alarm Level (°C)	
RTD 8 Trip Level (°C)	
RTD 9 Alarm Level (°C)	
RTD 9 Trip Level (°C)	
RTD 10 Alarm Level (°C)	
RTD 10 Trip Level (°C)	

[2] Not a setpoint
[3] If answer is NO, all RTD setpoints on all pages are not seen.

PAGE 3: SETPOINT VALUES O/L CURVE SETPOINTS	
Custom Curve[4]	
Curve Number[5]	
Trip Time @ 1.05×FLC[6]	
Trip Time @ 1.10[6]	
Trip Time @ 1.20[6]	
Trip Time @ 1.30[6]	
Trip Time @ 1.40[6]	
Trip Time @ 1.50[6]	
Trip Time @ 1.75[6]	
Trip Time @ 2.00[6]	
Trip Time @ 2.25[6]	
Trip Time @ 2.50[6]	
Trip Time @ 2.75[6]	
Trip Time @ 3.00[6]	
Trip Time @ 3.50[6]	
Trip Time @ 4.00[6]	
Trip Time @ 4.50[6]	
Trip Time @ 5.00[6]	
Trip Time @ 5.50[6]	
Trip Time @ 6.00[6]	
Trip Time @ 6.50[6]	
Trip Time @ 7.00[6]	
Trip Time @ 7.50[6]	
Trip Time @ 8.00[6]	

[4] YES voids selected curve
[5] Curve # setpoint is not seen if custom curve is programmed
[6] Not seen if custom curve is not selected

PAGE 4: SETPOINT VALUES RELAY CONFIGURATION	
O/L Trip	
U/B Trip	
S/C Trip	
U/C Trip	
Rapid Trip	
Stator RTD Trip	
RTD Trip	
G/F Trip	
Accel. Time Trip	
Phase Rev. Trip	
Inhibit Lockouts	
Speed Switch Trip	
Differential Trip	
Single Phase Trip	
Spare Input Trip	
U/V Trip	
O/V Trip	
PF Trip	
O/L Warning	
G/F Alarm	
U/B Alarm	
U/C Alarm	
Mech. Jam Alarm	
Stator RTD Alarm	
Stator RTD Hi Alarm	
RTD Alarm	
RTD Hi Alarm	
No Sensor Alarm	
Low Temp. Alarm	
Spare Input Alarm	
TC Alarm	
U/V Alarm	
O/V Alarm	
PF Alarm	
KVAR Alarm	
Meter Alarm	
Self-Test Fail	

NOTE: Shaded setpoints in commissioning summary have been added or altered as compared to last revision.

PAGE 5: SETPOINT VALUES SYSTEM CONFIGURATION	
Norm Run Disp Line	
Norm Run Disp Page	
Defeat No Sensor Alarm[7]	
Enable Low Temp. Alarm[7]	
Enable Stator RTD Voting[7]	
Defeat RTD Input[7]	
RTD Bias Curve Min (°C)[8]	
RTD Bias Center (%)[8]	
RTD Bias Center Temp(°C)[8]	
RTD Bias Curve Max (°C)[8]	
Defeat U/B Input	
Default K Value[9]	
Defeat Learned Cool Time	
Running Cool Time (min)[10]	
Stopped Cool Time (min)[10]	
RTD 10 Ambient Sensor[7]	
Enable Differential Trip?	
Defeat Speed Switch	
Speed Switch Delay (sec)[11]	
Analog Output	
Analog Output Type	
Motor Load Anlg. Out FS	
Single Shot Restart	
Start Inhibit	
Init. Start Cap. T.C. Req'd	
Special Ext Reset	
Relay Alarm Latchcode	
Drawout Failsafe Code[12]	
Relay Failsafe Code	
Sp. Inp. to Read 52B?	
Sp. Inp. Alarm Delay (sec)[13]	
Sp. Inp. Trip Delay (sec)[13]	
Backspin Timer Delay (min)	
Time Between Starts (min)	
FLC Therm. Cap. Red. (%)	
TC Used Alarm Level (%)	
TC Used Alarm Delay (sec)	
Slave Address	

[7] Not seen if no RTDs are connected (see note 3)
[8] Not seen if "Defeat RTD Input" is YES
[9] Not seen if "Defeat U/B Input" is YES
[10] Not seen if "Defeat Learned Cool Time" is NO
[11] Not seen if "Defeat Speed Switch" is YES
[12] Only seen if 269+ is a drawout relay
[13] Not seen if "Spare Input to Read 52b" is YES

PAGE 6: SETPOINT VALUES MULTILIN SERVICE CODES	
Applicable for Service Application Only.	
Place 269+ in Test Mode	
Software Access	
Encrypted Code	

PAGE 7: SETPOINT VALUES METERING SETPOINTS	
Setpoints Set/On Line?	
Meter CT Primary (amps)	
V.T. Ratio	
Meter VT Sec. (volts)	
U/V Trip/Alarm Avg V=0?	
U/V Alarm Level (% VT)	
U/V Alarm Delay (sec)	
U/V Trip Level (% VT)	
U/V Trip Delay (sec)	
O/V Alarm Level (% VT)	
O/V Alarm Delay (sec)	
O/V Trip Level (% VT)	
O/V Trip Delay (sec)	
Block PF Prot. on Start	
PF Protection Delay (sec)[14]	
Blk PF Alarm/Trip By (sec)[15]	
PF Lead Alarm Level	
PF Lag Alarm Level	
PF Alarm Delay (sec)	
PF Lead Trip Level	
PF Lag Trip Level	
PF Trip Delay (sec)	
Pos KVAR Alarm Level	
Neg KVAR Alarm Level	
KVAR Alarm Delay	
Voltage Phase Rev.?	
Analog Out Scale Factor	

[14] Not seen if "Block PF Protection on Start" is YES
[15] Not seen if "Block PF Protection on Start" is NO

NOTE: Shaded setpoints in commissioning summary have been added or altered as compared to last revision.

PAGE 1: SETPOINT VALUES MOTOR AMPS SETPOINTS	
Phase CT Secondary	
Phase CT Primary	
Motor FLC (amps)	
O/L Pickup Level (%)	
Accel. Time (secs)	
Starts/Hour	
U/B Alarm Level (%)	
U/B Alarm Delay (secs)	
U/B Trip Level (%)	
U/B Trip Delay (secs)	
G/F CT Ratio :5 ? (NO indicates 2000:1)	
G/F CT Primary[1]	
G/F Alarm Level (amps)	
G/F Alarm Delay (secs)	
G/F Trip Level (amps)	
G/F Trip Delay (secs)	
U/C Alarm Level (amps)	
U/C Alarm Delay (secs)	
U/C Trip Level (amps)	
U/C Trip Delay	
Mech. Jam Alarm (xFLC)	
Mech. Jam Alarm Del. (s)	
Rapid Trip (× FLC)	
Rapid Trip Delay (secs)	
S/C Trip Level (× FLC)	
S/C Trip Delay (secs)	
Immediate O/L (× FLC)	

[1] Not seen if ratio is 2000:1

PAGE 2: SETPOINT VALUES RTD SETPOINTS	
RTD Sensor Type[2]	
Any RTDs Connected?[3]	
RTD Message Display	
# of Stator RTDs used	
RTD 1 Alarm Level (°C)	
RTD 1 Hi Alarm Lev (°C)	
RTD 1 Trip Level (°C)	
RTD 2 Alarm Level (°C)	
RTD 2 Hi Alarm Lev (°C)	
RTD 2 Trip Level (°C)	
RTD 3 Alarm Level (°C)	
RTD 3 Hi Alarm Lev (°C)	
RTD 3 Trip Level (°C)	
RTD 4 Alarm Level (°C)	
RTD 4 Hi Alarm Lev (°C)	
RTD 4 Trip Level (°C)	
RTD 5 Alarm Level (°C)	
RTD 5 Hi Alarm Lev (°C)	
RTD 5 Trip Level (°C)	
RTD 6 Alarm Level (°C)	
RTD 6 Hi Alarm Lev (°C)	
RTD 6 Trip Level (°C)	
RTD 7 Alarm Level (°C)	
RTD 7 Trip Level (°C)	
RTD 8 Alarm Level (°C)	
RTD 8 Trip Level (°C)	
RTD 9 Alarm Level (°C)	
RTD 9 Trip Level (°C)	
RTD 10 Alarm Level (°C)	
RTD 10 Trip Level (°C)	

[2] Not a setpoint
[3] If answer is NO, all RTD setpoints on all pages are not seen.

PAGE 3: SETPOINT VALUES O/L CURVE SETPOINTS	
Custom Curve[4]	
Curve Number[5]	
Trip Time @ 1.05×FLC[6]	
Trip Time @ 1.10[6]	
Trip Time @ 1.20[6]	
Trip Time @ 1.30[6]	
Trip Time @ 1.40[6]	
Trip Time @ 1.50[6]	
Trip Time @ 1.75[6]	
Trip Time @ 2.00[6]	
Trip Time @ 2.25[6]	
Trip Time @ 2.50[6]	
Trip Time @ 2.75[6]	
Trip Time @ 3.00[6]	
Trip Time @ 3.50[6]	
Trip Time @ 4.00[6]	
Trip Time @ 4.50[6]	
Trip Time @ 5.00[6]	
Trip Time @ 5.50[6]	
Trip Time @ 6.00[6]	
Trip Time @ 6.50[6]	
Trip Time @ 7.00[6]	
Trip Time @ 7.50[6]	
Trip Time @ 8.00[6]	

[4] YES voids selected curve
[5] Curve # setpoint is not seen if custom curve is programmed
[6] Not seen if custom curve is not selected

PAGE 4: SETPOINT VALUES RELAY CONFIGURATION	
O/L Trip	
U/B Trip	
S/C Trip	
U/C Trip	
Rapid Trip	
Stator RTD Trip	
RTD Trip	
G/F Trip	
Accel. Time Trip	
Phase Rev. Trip	
Inhibit Lockouts	
Speed Switch Trip	
Differential Trip	
Single Phase Trip	
Spare Input Trip	
U/V Trip	
O/V Trip	
PF Trip	
O/L Warning	
G/F Alarm	
U/B Alarm	
U/C Alarm	
Mech. Jam Alarm	
Stator RTD Alarm	
Stator RTD Hi Alarm	
RTD Alarm	
RTD Hi Alarm	
No Sensor Alarm	
Low Temp. Alarm	
Spare Input Alarm	
TC Alarm	
U/V Alarm	
O/V Alarm	
PF Alarm	
KVAR Alarm	
Meter Alarm	
Self-Test Fail	

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PAGE 5: SETPOINT VALUES SYSTEM CONFIGURATION	
Norm Run Disp Line	
Norm Run Disp Page	
Defeat No Sensor Alarm[7]	
Enable Low Temp. Alarm[7]	
Enable Stator RTD Voting[7]	
Defeat RTD Input[7]	
RTD Bias Curve Min (°C)[8]	
RTD Bias Center (%)[8]	
RTD Bias Center Temp(°C)[8]	
RTD Bias Curve Max (°C)[8]	
Defeat U/B Input	
Default K Value[9]	
Defeat Learned Cool Time	
Running Cool Time (min)[10]	
Stopped Cool Time (min)[10]	
RTD 10 Ambient Sensor[7]	
Enable Differential Trip?	
Defeat Speed Switch	
Speed Switch Delay (sec)[11]	
Analog Output	
Analog Output Type	
Motor Load Anlg. Out FS	
Single Shot Restart	
Start Inhibit	
Init. Start Cap. T.C. Req'd	
Special Ext Reset	
Relay Alarm Latchcode	
Drawout Failsafe Code[12]	
Relay Failsafe Code	
Sp. Inp. to Read 52B?	
Sp. Inp. Alarm Delay (sec)[13]	
Sp. Inp. Trip Delay (sec)[13]	
Backspin Timer Delay (min)	
Time Between Starts (min)	
FLC Therm. Cap. Red. (%)	
TC Used Alarm Level (%)	
TC Used Alarm Delay (sec)	
Slave Address	

[7] Not seen if no RTDs are connected (see note 3)
[8] Not seen if "Defeat RTD Input" is YES
[9] Not seen if "Defeat U/B Input" is YES
[10] Not seen if "Defeat Learned Cool Time" is NO
[11] Not seen if "Defeat Speed Switch" is YES
[12] Only seen if 269+ is a drawout relay
[13] Not seen if "Spare Input to Read 52b" is YES

PAGE 6: SETPOINT VALUES MULTILIN SERVICE CODES	
Applicable for Service Application Only.	
Place 269+ in Test Mode	
Software Access	
Encrypted Code	

PAGE 7: SETPOINT VALUES METERING SETPOINTS	
Setpoints Set/On Line?	
Meter CT Primary (amps)	
V.T. Ratio	
Meter VT Sec. (volts)	
U/V Trip/Alarm Avg V=0?	
U/V Alarm Level (% VT)	
U/V Alarm Delay (sec)	
U/V Trip Level (% VT)	
U/V Trip Delay (sec)	
O/V Alarm Level (% VT)	
O/V Alarm Delay (sec)	
O/V Trip Level (% VT)	
O/V Trip Delay (sec)	
Block PF Prot. on Start	
PF Protection Delay (sec)[14]	
Blk PF Alarm/Trip By (sec)[15]	
PF Lead Alarm Level	
PF Lag Alarm Level	
PF Alarm Delay (sec)	
PF Lead Trip Level	
PF Lag Trip Level	
PF Trip Delay (sec)	
Pos KVAR Alarm Level	
Neg KVAR Alarm Level	
KVAR Alarm Delay	
Voltage Phase Rev.?	
Analog Out Scale Factor	

[14] Not seen if "Block PF Protection on Start" is YES
[15] Not seen if "Block PF Protection on Start" is NO

NOTE: Shaded setpoints in commissioning summary have been added or altered as compared to last revision.

Active - Refers to the state of an output relay. An output relay will become active (activate) when any of the functions assigned to that relay indicate a trip/alarm condition.

Inactive - Refers to the state of an output relay. An output relay will be inactive whenever none of the conditions assigned to that relay indicate trip/alarm conditions.

Latched - Refers to the configuration of an output relay. Latched relays must be manually reset after activation. This can be done by using the Reset key or the External Reset terminals. Trip and Aux. 2 relays are always latched.

Unlatched - Refers to the configuration of an output relay. An unlatched relay will be automatically reset after the conditions causing its activation are removed.

Fail-safe (FS) - Refers to the configuration of an output relay. When a fail-safe relay is in the no trip/no alarm (inactive) state its coil will be energized (ie. have a voltage across it). Thus when control power is removed from the 269 all fail-safe output relays will go to the active state. Aux. 2 relay is always fail-safe.

Non-fail-safe (NFS) - Refers to the configuration of an output relay. When a non-fail-safe relay is in the no trip/no alarm state its coil will be de-energized (ie. have no voltage across it). Thus when control power is removed from the 269 relay all non-fail-safe output relays will go to the inactive state.

Tripped - Refers to the state of the motor controller, starter, or system circuit breaker. When one of these devices is tripped the power to the motor will be removed. Normally the Trip relay of the 269 is used to control this operation.

Mode - The large amount of information that can be viewed on the 269 relay display is divided into four modes: ACTUAL VALUES, SETPOINTS, HELP, and TRIP/ALARM. The relay can be put into any one of these modes for viewing specific information. The ACTUAL VALUES and SETPOINTS modes each contain many pages of data while all four modes contain many lines.

Page - The ACTUAL VALUES and SETPOINTS modes are divided into a number of pages containing different sets of information. Each page contains many lines, only one of which can be viewed on the display at any one time.

Line - Each relay display mode is divided into a number of lines of data. Each line consists of 2 rows X 24 characters. One line will always be visible on the 269 relay display.

Flash Message - Flash messages are one line messages that appear on the display in response to certain key closures or timer indications. Flash messages stay on the display for 2 seconds.

Thermal Memory - This is an internal 269 relay register which is used to thermally model the motor being protected. When this register reaches a value of 100% the entire thermal capacity of the motor has been used and an OVERLOAD TRIP is initiated.

REVISION HISTORY

Manual Part No.	269 Software Revision	Release Date	ECO
269-M04/09/90	Revision A1.	04/09/90	
269-M08/07/90	Revision B1.	08/07/90	
269-M10/19/90	269P.B2.0	10/19/90	
269P-M01/01/91	269P.B3.1	01/01/91	
269P-M07/11/91	269P.B3.4	07/11/91	
269P-M08/13/91	269P.B3.6	08/13/91	
269P-M09/26/91	269P.B3.7	09/26/91	
269P-M01/09/92	269P.B4.0	01/09/92	
1601-0013-B1	269P.B4.0	03/09/93	
1601-0013-B5	269P.B5.0	05/26/93	
1601-0013-B6	269P.B5.0.2	10/05/93	
1601-0013-B7	269P.B5.0.2	02/25/94	269-165
1601-0013-B8	269P.B5.0.2	04/20/94	269-170
1601-0013-B9	269P.B5.1.0	05/26/94	269-175
1601-0013-BA	269P.B5.1.0	01/23/95	GEN-128
1601-0013-BB	269P.B5.1.1	01/26/95	269-187/269-199
1601-0013-BC	269P.B5.2.0	04/11/95	269-205
1601-0013-C1	269P.C5.2.1	08/21/95	269-218
1601-0013-C2	269P.C5.2.1	09/01/95	269-218
1601-0013-C3	269P.C5.2.1	04/25/96	269-246
1601-0013-C4	269P.C6.0.0	11/28/96	269-249
1601-0013-C5	269P.C6.0.0	03/05/97	269-279
1601-0013-C6	269P.C6.0.0	07/07/98	269-294
1601-0013-C7	269P.C6.0.1	03/23/98	269-334
1601-0013-C8	269P.C6.0.1	04/21/98	269-339
1601-0013-D1	269P.D6.0.4	06/15/98	269-348
1601-0013-D2	269P.D6.0.4	09/28/98	269-371
1601-0013-D3	269P.D6.0.4	10/05/98	269-384

LIST OF FIGURES

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.