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## E. ASYMMETRICAL STARTING CURRENT

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<td>GROUNDING OF PHASE AND GROUND CTS</td>
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## INDEX
1 INTRODUCTION

1.1 MOTOR PROTECTION REQUIREMENTS

Three phase AC 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.

A modern protective device is required to fully protect these motors. 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 due to 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 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 Motor Protection Meter (MPM), the 269 Plus may also monitor voltages and power and perform several protection functions based on these values.

1.2 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 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 269 Plus custom curve feature provides additional flexibility. If one of the eight standard overload curves is not suitable for the application under consideration, the user can enter their own breakpoints to form a custom curve. As such, 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 Motor Management Relay is its ability to “learn” individual motor parameters. The relay actually adapts itself to each application by “learning” the values for motor inrush current, negative sequence current K factor, cool-down rates, and acceleration time. These values may be used to improve the protective capabilities of the 269 Plus (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 upon 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 also provides a complete statistical record of the motor being protected. The total motor running hours, total MegaWattHours, total 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 non-volatile memory. Thus, even when control power is removed from the relay, 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 CT secondary current, motor thermal capacity, or bearing temperature are available by field programming. An RS485 port allows access to all setpoints and actual values. A total of four output relays are provided, 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 lock-out 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 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.
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<tr>
<td>Stator Winding Overt</td>
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<td>Multiple Starts</td>
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<td>Unbalance/Single Phasing</td>
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<tr>
<td>Keypad programmable</td>
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<tr>
<td>48 character alphanumeric display</td>
</tr>
<tr>
<td>Built-in &quot;HELP&quot; function</td>
</tr>
<tr>
<td>Eight selectable standard overload curves</td>
</tr>
<tr>
<td>User-defined custom overload curve capability, FlexCurve™</td>
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<td>Ground fault (earth leakage) current measurement</td>
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<td>Up to six stator RTD inputs</td>
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<td>Four additional RTD inputs</td>
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<td>Monitoring of motor ambient air temperature</td>
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<td>Display of all SETPOINTS or ACTUAL VALUES upon request</td>
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<table>
<thead>
<tr>
<th>COMMUNICATIONS AND CONTROL FEATURES</th>
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<tbody>
<tr>
<td>One latched, main trip relay</td>
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<tr>
<td>One alarm relay</td>
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<tr>
<td>Two auxiliary relays</td>
</tr>
<tr>
<td>Emergency restart capability</td>
</tr>
<tr>
<td>Pre-trip alarm warnings</td>
</tr>
<tr>
<td>4-20mA output of motor current as a percentage of full load, motor thermal capacity, hottest stator RTD temperature, percentage of phase CT secondary current, or bearing RTD</td>
</tr>
<tr>
<td>Optional single-shot restart on running overload trip</td>
</tr>
<tr>
<td>Speed switch, differential relay, and spare input</td>
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<tr>
<td>RS485 port for connection to programmable controllers and computers.</td>
</tr>
</tbody>
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<thead>
<tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>Tamperproof setpoints stored in non-volatile memory</td>
</tr>
<tr>
<td>Microcomputer &quot;learns&quot; motor inrush current, acceleration time, cool down rates, and negative sequence current heating K factor</td>
</tr>
<tr>
<td>Complete record of motor statistical data: running hours, number of starts, number and type of relay trips</td>
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<table>
<thead>
<tr>
<th>VOLTAGE AND POWER METERING (AVAILABLE WITH MPM)</th>
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<tbody>
<tr>
<td>Display of 3 phase or line voltages, kWatts, kVars, Power Factor, and frequency.</td>
</tr>
<tr>
<td>Protection features based on Voltage, Power Factor, kVars, and voltage sensed phase reversals.</td>
</tr>
<tr>
<td>Pre-trip values of average voltage, kWatts, kVars, Power Factor, and frequency.</td>
</tr>
<tr>
<td>Accumulated MegaWattHours.</td>
</tr>
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</table>
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 AC motors.
**1.4 ORDER CODE / INFORMATION**

The 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 GE Multilin.

* CT information, failsafe code, and contact arrangement must be specified for drawout relays only; on standard 269 Plus models these features are field selectable.

** See Glossary for definitions
1.5 TECHNICAL SPECIFICATIONS

PHASE CURRENT INPUTS
conversion: calibrated RMS, sample time 2 ms
range: 0.05 to 12 × phase CT primary amps setpoint
full scale: 12 × phase CT primary amps setpoint
accuracy: ±0.5% of full scale
(0.05 to 2 × phase CT primary amps setpoint)
±1.0% of full scale
(over 2 × phase CT primary amps setpoint)
Frequency: 25 to 400 Hz sine wave

GROUND FAULT CURRENT INPUT
conversion: calibrated RMS, sample time 2 ms
range: 0.1 to 1.0 × G/F CT primary amps setpoint (5 A secondary CT)
0.3 to 10.0 amps 50:0.025 A (2000:1 ratio)
full scale: 1 × G/F CT primary amps setpoint (5 A secondary CT)
10 A (2000:1 CT)
accuracy: ±4% of G/F CT primary amps setpoint (5 A secondary CT)
±0.3 A primary (2000:1 CT HGF 3")
Frequency: 20 to 400 Hz for 5 A CTs
20 to 150 Hz for 2000:1 CTs

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 CT amps

UNBALANCE
display accuracy: ±2 percentage points of true negative sequence unbalance \((i_n/I_p)\)

RUNNING HOURS COUNTER
accuracy: ±1%

DIFFERENTIAL RELAY INPUT
relay response time: 100 msec. maximum
(contact closure to output relay activation)

RELAY LOCK-OUT TIME
accuracy: ±1 minute with control power applied
±20% of total lock-out time with no control power applied

TRIP/ALARM DELAY TIME ACCURACY
short circuit trip: instantaneous: 15 to 45 ms
delayed: ±1.5 seconds
ground fault: instantaneous: 15 to 45 ms
delayed 0.5 sec.: ±150 ms
delayed over 1 sec.: ±1 s or ±2.5% of total trip time
acceleration trip: ±200 ms or ±2% of total trip time
single phasing: ±1.5 seconds
immediate overload: 0.3 to 0.7 seconds
mechanical jam: ±1.5 seconds
rapid trip: ±1.0 seconds
undercurrent: ±1.5 sec. or ±2% of total trip time
current unbalance: ±1.0 sec. or ±2% of total trip time
metering: ±6.0 sec. ±2% of total trip time

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

ANALOG CURRENT OUTPUT (4-20 mA STANDARD)

<table>
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<tr>
<th>PROGRAMMABLE</th>
<th>OUTPUT</th>
<th>0-1 mA</th>
<th>0-20 mA</th>
<th>4-20 mA</th>
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<tr>
<td>MAX LOAD</td>
<td>2000 Ω</td>
<td>300 Ω</td>
<td>300 Ω</td>
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<tr>
<td>MAX OUTPUT</td>
<td>1.01 mA</td>
<td>20.2 mA</td>
<td>20.2 mA</td>
<td></td>
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accuracy: ±1% of full scale reading
polarity: terminal 58 ("–") must be at ground potential (i.e. output is not isolated)
Isolation: non-isolated, active source
Update Time: 250 ms 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**

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<th>MAKE/CARRY 0.2s</th>
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<td>RESISTIVE</td>
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<td>10</td>
<td>30</td>
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<tr>
<td></td>
<td>250 VDC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>INDUCTIVE (L/R=7ms)</td>
<td>30 VDC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>125 VDC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>250 VDC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>RESISTIVE</td>
<td>120 VAC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>250 VAC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>INDUCTIVE PF=0.4</td>
<td>120 VAC</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>250 VAC</td>
<td>10</td>
<td>30</td>
</tr>
</tbody>
</table>

**SWITCH INPUTS**

- Type: Dry contacts
- Configuration: FORM C NO/NC
- Contact material: silver alloy
- Minimum permissible load: 5 V DC, 100 mA
  - 12 V AC, 100 mA

**CT BURDEN DUE TO CONNECTION OF RELAY**

<table>
<thead>
<tr>
<th>CT INPUT (AMPS)</th>
<th>BURDEN</th>
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<tr>
<td></td>
<td>(VA)</td>
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<tr>
<td>PHASE CT (1A)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.04</td>
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<tr>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>13</td>
<td>4.8</td>
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<tr>
<td>PHASE CT (5A)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.06</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>65</td>
<td>8.5</td>
</tr>
<tr>
<td>G/F CT (5A)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.08</td>
</tr>
<tr>
<td>10</td>
<td>0.3</td>
</tr>
<tr>
<td>G/F CT (50:0.025)</td>
<td></td>
</tr>
<tr>
<td>0.025</td>
<td>0.435</td>
</tr>
<tr>
<td>0.1</td>
<td>3.29</td>
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<tr>
<td>0.5</td>
<td>50</td>
</tr>
</tbody>
</table>

**CONTROL POWER (INCLUDES TOLERANCES)**

- Frequency: 50/60 Hz
- LO range: 20 to 60 V DC
  - 20 to 48 V AC
- HI range: 90 to 300 V DC
  - 80 to 265 V AC
- Max. power consumption: 20 VA
- Voltage low ride-through time: 100 ms
  - (at 120 V AC/125 V DC)

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

**INTERNAL FUSE SPECIFICATIONS**

- T3.15A H 250 V
- Timelag high breaking capacity

**DIELECTRIC STRENGTH ROUTINE TEST**

- 2200 V AC, 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)

- 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 Figure 5–3: HI-POT TESTING on page 5–7.

- To avoid electrical shock, discharge J201 by shorting across the pins before reconnecting the J201 jumper.

---

**CT THERMAL WITHSTAND**

- Phase CT (1A, 5A) & G/F 5A tap:
  - 3 x: continuous
  - 6 x: 40 sec.
  - 12 x: 3 sec.
- Phase CT 1A & 5A:
  - 40 x: 2 sec.
  - 80 x: 1 sec.
- G/F 50:0.025 mA:
  - 6 x: continuous

---

GE Multilin

269 Plus Motor Management Relay

1-7
**TECHNICAL SPECIFICATIONS**

**1 INTRODUCTION**

**TYPE TESTS**

- **Dielectric Strength:** 2.0 kV for 1 minute to relays, CTs, power supply
- **Insulation Resistance:** IEC255-5, 500 V DC
- **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 with proper installation
- **Altitude Rating:** 2000m IEC 1010-1

**OPERATING AMBIENT TEMPERATURE & STORAGE TEMPERATURE**

-25°C to +60°C

**HAZARD** may result if the product is not used for intended purposes.

**WARNING**

- This equipment can only be serviced by trained personnel.
- Relay contacts must be considered unsafe to touch when the system is energized!

**PACKAGING**

- **269 Plus Motor Management Relay**
  - **Shipping box:** 11.40" x 7.50" x 16.00" (W x H x D)
  - **Ship weight:** 3.5 kg
  - **269 Plus Drawout**
  - **Shipping box:** 13.25" x 12.50" x 20.50" (L x H x D)
  - **Ship weight:** 12 kg

**CERTIFICATIONS**

- **ISO:** Manufactured to an ISO9001 certified program
- **UL:** UL recognized (file E83849)
  - UL 508 Industrial Control Equipment.
  - UL1053 - Ground Fault Protection Equipment.
- **CSA:** Certified per C22.2 No.14 - Industrial Control Equipment
- **CE:** Conforms to IEC 947-1, IEC 1010-1

Overvoltage Category: II
- **Pollution Degree:** 2
- **IP Code:** 40X

The 269 Plus Drawout does not meet CE compliance.
1.6 MPM OPTION SPECIFICATIONS

PHASE CURRENT INPUTS
Conversion: true rms, 64 samples/cycle
CT input: 1A and 5A secondary
Burden: 0.2 VA
Overload: 20 x CT for 1 s, 100 x CT for 0.2 s
Range: 1 to 150% of CT primary
Frequency: up to 32nd harmonic
Accuracy: ±1% of display

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

ANALOG OUTPUTS

<table>
<thead>
<tr>
<th>OUTPUT</th>
<th>0-1 mA (T1 option)</th>
<th>4-20 mA (T20 option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX LOAD</td>
<td>2400 Ω</td>
<td>600 Ω</td>
</tr>
<tr>
<td>MAX OUTPUT</td>
<td>1.1 mA</td>
<td>21 mA</td>
</tr>
</tbody>
</table>

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

MEASURED VALUES

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>ACCURACY % DISPLAY</th>
<th>RESOLUTION</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>±1%</td>
<td>1 V</td>
<td>20 to 100% of VT</td>
</tr>
<tr>
<td>Current</td>
<td>±1%</td>
<td>1 A</td>
<td>1 to 150% of CT</td>
</tr>
<tr>
<td>kW</td>
<td>±2%</td>
<td>1 kW</td>
<td>0 to 65535 kW</td>
</tr>
<tr>
<td>kvar</td>
<td>±2%</td>
<td>1 kvar</td>
<td>0 to 65535 kvar</td>
</tr>
<tr>
<td>PF</td>
<td>±2%</td>
<td>0.01</td>
<td>±0.00 to 1.00</td>
</tr>
<tr>
<td>Frequency</td>
<td>±0.2%</td>
<td>0.1 Hz</td>
<td>20.00 to 70.00 Hz</td>
</tr>
</tbody>
</table>

CONTROL POWER
Input: 90 to 300 V DC or 70 to 265 V AC, 50/60 Hz
Power: nominal 10 VA maximum 20 VA
Holdup: 100 ms typical (@ 120 V AC/125 V DC)

TYPE TESTS
Dielectric strength: 2.0 kV for 1 minute to relays, CTs, VTs, power supply
Insulation resistance: IEC255-5, 500 V DC
Transients:
- ANSI C37.90.1 Oscillatory 2.5 kV/1MHz
- ANSI C37.90.1 Fast Rise 5 kV/10 ns
- Ontario Hydro A-28M-82
- IEC255-4 Impulse/High Frequency Disturbance
  - Class III Level
- Impulse test: IEC 255-5 0.5 Joule 5 kV
- RFI: 50 MHz/15 W Transmitter
- EMI: C37.90.2 Electromagnetic Interference @ 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)
215 cm × 152 cm × 152 cm (L × H × D)
Ship weight: 5 lbs/2.3 kg

CERTIFICATION
ISO: Manufactured to an ISO9001 certified program
UL:
- UL listed (file E83849)
  - UL 508 - Industrial Control Equipment.
  - UL1053 - Ground Fault Protection Equipment.
CSA: Certified per C22.2 No.14 - Industrial Control Equipment

NOTE: It is recommended that all 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.
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 shown below.

GE Multilin also provides phase and ground fault CTs if required. Dimensions for these are shown in the figures on the following pages.

**Dimensions are for 100:5 to 1000:5 phase CTs; for dimensions of 50:5 and 75:5 CTs, consult GE Multilin.**

When selecting a phase CT, the 269 Plus uses the following formula to calculate the current resolution:

\[
\text{Current Resolution} = \frac{4 \times \text{Phase CT}}{255}
\]

If the chosen CT is relatively small, the resolution (increments of current) displayed will also be small.

Example: If the Phase CT selected is 50:1 or 5, then the 269 Plus displays current in increments of 1 A (0.78 A rounded). Likewise, if the Phase CT is selected as 1500:1 or 5, the currents will be displayed in increments of 24 A (23.5 A rounded).

![Figure 2–1: PHYSICAL DIMENSIONS](image-url)
Figure 2–2: PHASE CT DIMENSIONS
Figure 2–3: GROUND CT (50:0.025) 3" & 5" WINDOW
Figure 2–4: GROUND CT (50:0.025) 8” WINDOW
Figure 2–5: GROUND CT (x:5) DIMENSIONS
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 below. Four washers and ten 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.

Figure 2–6: RELAY MOUNTING
TABLE 2-1: 269 PLUS EXTERNAL CONNECTIONS

<table>
<thead>
<tr>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Supply Power L(+), G, N(–); universal AC/DC supply</td>
</tr>
<tr>
<td>• Phase CTs</td>
</tr>
<tr>
<td>• Ground Fault CTs (core balance CT)</td>
</tr>
<tr>
<td>• 6 Stator RTDs</td>
</tr>
<tr>
<td>• 4 additional RTDs</td>
</tr>
<tr>
<td>• Emergency Restart keyswitch</td>
</tr>
<tr>
<td>• External Reset pushbutton</td>
</tr>
<tr>
<td>• Programming Access jumper or keyswitch</td>
</tr>
<tr>
<td>• Speed Switch Input</td>
</tr>
<tr>
<td>• Differential Relay Input</td>
</tr>
<tr>
<td>• Spare Input</td>
</tr>
<tr>
<td>• Meter Communication Port</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 4 Sets of Relay Contacts (NO/NC)</td>
</tr>
<tr>
<td>• Programmable Analog Current Output Terminals</td>
</tr>
<tr>
<td>• RS485 Serial Communication Port</td>
</tr>
</tbody>
</table>

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

Relay contacts must be considered unsafe to touch when the system in energized!

Once correct control power is applied to the 269 Plus relay, a clicking sound will be heard approximately every second. This normal operation indicates that the relay is scanning through the RTDs regardless if RTDs are in use.
Figure 2–7: RELAY WIRING DIAGRAM (AC CONTROL POWER)
In locations where system voltage disturbances cause voltage levels to dip below the range specified in the SPECIFICATIONS, 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.

<table>
<thead>
<tr>
<th>FAILSAFE CODE</th>
<th>TRIP 29</th>
<th>TRIP 30</th>
<th>TRIP 31</th>
<th>TRIP 32</th>
<th>TRIP 33</th>
<th>TRIP 34</th>
<th>ALARM 35</th>
<th>ALARM 36</th>
<th>ALARM 37</th>
<th>AUX.1 38</th>
<th>AUX.1 39</th>
<th>AUX.1 40</th>
<th>AUX.2 41</th>
<th>AUX.2 42</th>
<th>AUX.2 43</th>
<th>AUX.2 44</th>
<th>AUX.2 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1</td>
<td></td>
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<tr>
<td>1 – 8 NO POWER APPLIED</td>
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</tbody>
</table>

NOTES: 1). CONTACTS SHOWN WITH CONTROL POWER APPLIED, NO TRIPS, NO ALARMS.
2). * :- FACTORY PRESET VALUE.
Figure 2–9: RELAY WIRING DIAGRAM (TWO PHASE CTs)
GE Multilin

269 Plus Motor Management Relay

2 INSTALLATION

EXTERNAL CONNECTIONS

269Plus TYPICAL WIRING FOR DC CONTROL POWER

* RTD10 CAN BE USED FOR AMBIENT SENSING ON THE 269 PLUS RELAY.

![RELAY WIRING DIAGRAM (DC CONTROL POWER)](image)

Figure 2–10: RELAY WIRING DIAGRAM (DC CONTROL POWER)
The relay is powered on using any one of two different switching power supplies: HI (90 to 300 V DC / 80 to 265 V AC) or LO (20 to 60 V DC / 20 to 48 V AC). Both 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 in the TECHNICAL SPECIFICATIONS section). 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.

**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 3.15 A, slow blow mini fuse (see Fuse Specifications in the TECHNICAL SPECIFICATIONS section) is accessible from the back of the 269 Plus by removing the perforated cover. See the following figure for details on replacing the fuse. Using #10 gauge wire or ground braid, connect terminal 42 to a solid ground, typically the copper ground bus in the switchgear. The 269 Plus incorporates extensive filtering and transient protection 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 meets the interference immunity requirements of IEC 1000-4-3/EN61000-4-3; EN 61000-4-6 as well as the emission requirements of IEC CISPR11/EN55011 and EN50082-2.
Figure 2–11: REPLACING A BLOWN FUSE
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 the RELAY WIRING DIAGRAM (AC CONTROL POWER) and RELAY WIRING DIAGRAM (DC CONTROL POWER) figures. The CTs used can have either a 1 A or 5 A secondary and should be chosen so that the motor full load current is between 75 and 100% of the rated CT primary current. 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.

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

<table>
<thead>
<tr>
<th>CSA (Canada):</th>
<th>Class10L100</th>
<th>10 = accuracy, L = protection, 100 = capacity, higher is better</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI (USA):</td>
<td>Class C 100 B4</td>
<td>C or T = protection, 100 = capacity, higher is better, B4 = accuracy</td>
</tr>
<tr>
<td>IEC (Europe):</td>
<td>20 VA Class 5P20</td>
<td>P = protection, 20 VA = capacity, higher is better</td>
</tr>
</tbody>
</table>

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

It is recommended to use the ring type of lugs for CT input connections.
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. If a safety ground is used it should pass outside the CT window; see the installation figures on the next page.

The connections to the 269 Plus internal ground CT are made directly via #10 screws. The ground CT is connected to Terminals 72 and 73 for a 5 A secondary CTs, or to Terminals 73 and 74 for GE Multilin 50:0.025A (2000:1 ratio) CTs, as shown in the RELAY WIRING DIAGRAM (AC CONTROL POWER), RELAY WIRING DIAGRAM (TWO PHASE CTs), and RELAY WIRING DIAGRAM (DC CONTROL POWER) figures. 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.

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 A secondary CT should be used.

For a solidly grounded system where higher ground fault currents will flow, a 5 A 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 A (primary) without requiring a separate ground CT. 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 is 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 the RELAY WIRING DIAGRAM (AC CONTROL POWER) and RELAY WIRING DIAGRAM (DC CONTROL POWER) diagrams. These terminals are designed to accept input from a 5 A secondary CT. The 269 Plus must also be programmed for a 5 A secondary ground CT with the primary being equal to the phase CT primary. This is done in Setpoints page 1.

It is recommended to use the ring type of lugs for CT input connections.
Figure 2–12: CORE BALANCE GROUND CT INSTALLATION (SHIELDED CABLE)

Figure 2–13: CORE BALANCE GROUND CT INSTALLATION (UNSHIELDED CABLE)
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 A at either 250 V AC or 30 V DC with a resistive load. Silver cadmium oxide contacts are used because of their ability to handle high inrush currents on inductive loads. Contact GE Multilin if these contacts are to be used for carrying low currents since they are not recommended for use below 0.1 A. Connection to the motor contactor or breaker is shown the RELAY WIRING DIAGRAM (AC CONTROL POWER), OUTPUT RELAY CONTACT STATES, and RELAY WIRING DIAGRAM (DC CONTROL POWER) figures.

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 the FRONT PANEL section in Chapter 3) if motor conditions allow, or by using the Emergency Restart feature (see the EMERGENCY RESTART TERMINALS section in this chapter), 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 the ACTUAL VALUES MODE section in Chapter 3 for factory preset configurations).

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

The rear of the 269 Plus relay shows output relay contacts in their power down state. The RELAY WIRING DIAGRAM (AC CONTROL POWER), RELAY WIRING DIAGRAM (TWO PHASE CTs), and RELAY WIRING DIAGRAM (DC CONTROL POWER) figures 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 the OUTPUT RELAY CONTACT STATES diagram for a list of all possible contact states.

In locations where system voltage disturbances cause voltage levels to dip below the range specified in the SPECIFICATIONS section, 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.
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; and self-test alarm (see Section a): STARTS/HOUR TIMER on page 3–15 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.

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 the ACTUAL VALUES MODE section in Chapter 3 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.
This relay provides another set of NO/NC contacts with the same ratings as the other relays (on a drawout 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 the STARTS/HOUR TIMER section in Chapter 3 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.

The rear of the 269 Plus relay shows output relay contacts in their power down state. The RELAY WIRING DIAGRAM (AC CONTROL POWER), RELAY WIRING DIAGRAM (TWO PHASE CTs), and RELAY WIRING DIAGRAM (DC CONTROL POWER) figures 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 the OUTPUT RELAY CONTACT STATES diagram for a list of all possible contact states.

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 allows 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 3.18 and 3.19 on pages 53 to 54). 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 relay must be returned to the factory.

![Figure 2–14: RTD WIRING](image)
Each RTD has four connections to the 269 Plus relay as shown in the RELAY WIRING DIAGRAM (AC CONTROL POWER), RELAY WIRING DIAGRAM (TWO PHASE CTs), and RELAY WIRING DIAGRAM (DC CONTROL POWER) figures. 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 Ω 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 RTD terminals on the 269 Plus, the terminals may be left open.

If less 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 used they should be connected to the terminals for RTD1, RTD2, and RTD3 (Terminals 1 to 12). Other RTDs should be connected to the terminals for RTD7 to RTD10 (Terminals 13 to 28) as shown in the RELAY WIRING DIAGRAM (AC CONTROL POWER) figure.

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

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 the THERMAL MEMORY section in Chapter 3). 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 decrements the relay's internal starts/hour counter by 1 allowing the operator to override a STARTS/HOUR inhibit or time between starts inhibit.

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 INSTALLATION EXTERNAL RESET TERMINALS

2.13 EXTERNAL RESET TERMINALS

An external reset switch, which operates similarly to the keypad RESET key (see the FRONT PANEL section in Chapter 3), 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 to $2.5 \times FLC$); 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 Setpoints page 5. 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 to 20 mA. However, this range may be changed in Setpoints page 5. The 4 mA output corresponds to a low scale reading (i.e. 0% thermal capacity used, $0.25 \times FLC$, 0°C hottest stator RTD temperature, RTD #7 temperature, or 0 A phase CT secondary current). The 20 mA output current corresponds to a high scale reading (i.e. 100% thermal capacity used, $2.5 \times FLC$ or lower phase current, 200°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 Ω for the 4 to 20 mA or the 0 to 20 mA range (2000 Ω for 0 to 1 mA range). The output will saturate at 20.2 mA for readings greater than 100% of full scale.

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 Setpoints page 5, 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 INSTALLATION

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 setpoint (see 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. 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.

Do not connect live circuits. Dry contacts connections only.

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 tamper-proof. 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 Setpoints page 6. See the STARTS/HOUR TIMER sub-section in Chapter 3 for further details.

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 RS485 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 the following figure. 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 the 269 PLUS SETPOINTS table in Chapter 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.

As shown in the following figure, the first and last devices in the link should have a terminating resistor and capacitor placed across Terminals 46 and 47. The value of this R-C network is typically a 120 Ω terminating resistor in series with a 1 nF capacitor.
Connection to the 269 Plus is made via a terminal block which can accommodate up to #16 AWG multi-strand wire.

If a large difference in ground potentials exists, serial communication 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.

Figure 2–15: SERIAL COMMUNICATION LINK WIRING
2.19 DISPLAY ADJUSTMENT

Once the 269 Plus has been installed and input power applied, the display contrast 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 trim-pot 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. These terminals may be used to sense the closure of a 52B contact of a breaker or equivalent normally closed auxiliary contact of a contactor to determine a motor “stop” condition by enabling the Spare Input to Read 52B Contact setpoint.

Do not connect live circuits. Dry contacts connections only.

WARNING

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.
The 269 Plus 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 the DRAWOUT RELAY PHYSICAL DIMENSIONS diagram. The relay should be mounted as shown in the DRAWOUT RELAY MOUNTING diagram at the end of this section.

The 269 Plus drawout 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 2¼” 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 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.

    - There must be at least ½” clearance on the hinged side of the drawout relay to allow the door to open. Once correct control power is applied to the relay, a clicking sound will be heard approximately every second. This normal operation indicates that the relay is scanning through the RTDs regardless if RTDs are in use.

    - **IMPORTANT**: 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 (see 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 the DRAWOUT RELAY TYPICAL WIRING DIAGRAM. If it is required that any of the output relay configurations in the DRAWOUT RELAY TYPICAL WIRING DIAGRAM be different than shown, this information must be stated when the relay is ordered.

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

No special ventilation requirements need to be observed during the installation of this unit.
FIGURE 2–16: DRAWOUT RELAY PHYSICAL DIMENSIONS
Figure 2–18: DRAWOUT RELAY TYPICAL WIRING DIAGRAM
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. The MPM also provides four isolated analog outputs representing current, watts, vars, and power factor. These meter outputs can provide the signals for the control of the motor or a process.

a) MPM EXTERNAL CONNECTIONS

Physical and cutout dimensions for the MPM are shown in the MPM MOUNTING DIMENSIONS diagram. Once the cutout and mounting holes are made, use the eight #6 self-tapping screws to secure the relay.

b) 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 following figures for suggested wiring. For proper operation of the MPM and 269 Plus, MPM control power and phase CTs/VTs must be connected. Other features may be wired depending on the MPM model ordered.

c) CONTROL POWER (5/6/7/8)

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 to 300 V DC and 70 to 265 V AC at 50/60 Hz. It is not necessary to adjust the MPM as long as the control voltage is within this range. A low voltage power supply is available as an option. It covers the range 20 to 60 V DC and 20 to 48 V AC at 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 for reliable operation. A 2.5 A 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 and 6 to a solid system ground, 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.

Figure 2–19: CONTROL POWER WIRING

When properly installed, the MPM meets the interference immunity requirements of IEC 801 and ANSI C37.90.1.
d) VT INPUTS (1-4)

The MPM can accept input voltages from 0 to 600 V AC between the voltage inputs \( V_1, V_2, V_3 \) and voltage common \( V_n \). These inputs can be directly connected or supplied via external VTs. If voltages greater than 600 V AC 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 \( V_n \) 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 A rating to ensure adequate interrupting capacity.

WARNING

e) CT INPUTS (9-20)

5 A or 1 A current transformer secondaries can be used with the MPM for phase and neutral sensing. Each current input has 3 terminals: 5 A input, 1 A input, and common. Select either the 1 A or 5 A terminal and common to match the phase CT secondary. Correct polarity as indicated in the wiring diagrams shown in this section 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.

f) SERIAL COMMUNICATIONS PORT (COM1 - 46, 47, 48)

The MPM communicates with the 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.

![Wiring Diagram](image)

The relay communicates the following information to the meter module:

1. Protocol Revision
2. Reset MWH
3. CT Primary
4. VT Ratio
5. Analog Output Scale Factor
6. Checksum.

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

1. Echo Protocol Revision
2. \( V_{ab}, V_{bc}, V_{ca} \) (VTs connected phase-to-phase) or \( V_{an}, V_{bn}, V_{cn} \) (VTs connected 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.

**g) MPM ANALOG OUTPUT**

The **ANALOG OUT SCALE FACTOR** setpoint represents the full-scale value for the MPM analog outputs (kW & kvars). This value is multiplied by 100 kW to determine the meter’s analog output full-scale for kW, or by 30 kvar to determine the meter’s analog output full-scale for kvar. 4 mA represents 0 kW and 0 kvars, 20 mA represents full scale. Average RMS current is produced in analog form where the MPM 4 to 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.
Figure 2–21: MPM MOUNTING DIMENSIONS
Figure 2–22: MPM TO 269 PLUS TYPICAL WIRING (4-WIRE WYE, 3 VTs)
Figure 2–23: MPM TO 269 PLUS TYPICAL WIRING (4-WIRE WYE, 2 VTs)
Figure 2–24: MPM TO 269 PLUS TYPICAL WIRING (3-WIRE DELTA, 2 VTs)
Figure 2–25: MPM TO 269 PLUS TYPICAL WIRING (2 CT)
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 2–26: MPM WIRING (OPEN DELTA)
Once the 269 Plus has been wired and control power applied, it is ready to be programmed. Programming is accomplished using the 12-key keypad and 48-character alphanumerical display shown below. The function of the keypad and indicators is briefly explained in the CONTROLS AND INDICATORS table in the next section.
### 3.2 CONTROLS AND INDICATORS

**Table 3–1: CONTROLS AND INDICATORS (Sheet 1 of 4)**

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| 1   | ![Actual Values](image) | **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  

**EFFECT**: This key places the relay into Actual Values mode. The flash message, **ACTUAL VALUES HAS SEVEN PAGES OF DATA** is displayed for 2 seconds, then the beginning of Actual Values page 1 is shown:  

**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 ▲] and [PAGE ▼] keys can be used. To go from line to line within a page the [LINE ▲] and [LINE ▼] keys can be used. |
| 2   | ![Setpoints](image) | **FUNCTION**: The [SETPOINTS] 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: GE Multilin Service Codes  
page 7: Metering Setpoints  

**EFFECT**: This key places the relay into SETPOINTS mode. The flash message, **SETPOINTS HAS SEVEN PAGES OF DATA** is displayed for 2 seconds and the beginning of Setpoints page 1 is shown:  

**USE**: This key can be pressed any time, in any mode, to view or alter relay setpoints. Use the [PAGE ▲] / [PAGE ▼] keys to navigate between pages, the [LINE ▲] / [LINE ▼] keys to scroll between lines in a page, and the [VALUE ▲] / [VALUE ▼] keys to alter setpoints. All setpoints increment/decrement to pre-determined limits. When the desired value is reached, use the [STORE] key to save the new setpoint. If an altered setpoint is not stored, the previous value remains 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. |
### 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 (i.e. a page header) on the display the message, is displayed. To obtain information on the function of a particular key, the key must be pressed. To obtain information on previously displayed Actual Values, Setpoints, or TRIP/ALARM messages, 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 has no effect when a flash message or HELP message is displayed. Once HELP mode is entered, the [LINE ▲] / [LINE ▼] keys can be used to view the HELP message. The [CLEAR] key exits from HELP mode. The [ACTUAL VALUES] and [SETPOINTS] keys may also be used to exit HELP mode.

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HELP</td>
<td><strong>Function</strong>: 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. <strong>Effect</strong>: Pressing this key will put the relay into HELP mode. If this key is pressed with the first line of a page (i.e. a page header) on the display the message, is displayed. To obtain information on the function of a particular key, the key must be pressed. To obtain information on previously displayed Actual Values, Setpoints, or TRIP/ALARM messages, 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. <strong>Use</strong>: This key has no effect when a flash message or HELP message is displayed. Once HELP mode is entered, the [LINE ▲] / [LINE ▼] keys can be used to view the HELP message. The [CLEAR] key exits from HELP mode. The [ACTUAL VALUES] and [SETPOINTS] keys may also be used to exit HELP mode.</td>
</tr>
<tr>
<td>4,5</td>
<td>PAGE</td>
<td><strong>Function</strong>: The [PAGE ▲] / [PAGE ▼] keys scan the next or previous Actual Values or Setpoints pages. If either key is held for more than 0.5 second, the next/previous pages are selected at a faster rate. <strong>Effect</strong>: The [PAGE ▼] key displays the first line of the next page of information, whereas the the [PAGE ▲] key displays the first line of the previous page. <strong>Use</strong>: These keys can be used any time the relay is in either the ACTUAL VALUES or SETPOINTS modes.</td>
</tr>
<tr>
<td>6,7</td>
<td>LINE</td>
<td><strong>Function</strong>: The [LINE ▼] and [LINE ▲] keys scan the next or previous lines of the selected page. To scroll at a faster rate, hold either key for more than 0.5 seconds. <strong>Effect</strong>: Pressing [LINE ▼] displays the next line of the selected page. Pressing [LINE ▲] displays the line immediately in front of the displayed line. <strong>Use</strong>: These keys can be used at any time in any mode of operation. If the last line of a page is displayed, the [LINE ▼] key has no effect. Likewise, if the the first line of a page is displayed, the [LINE ▲] key has no effect.</td>
</tr>
</tbody>
</table>
### Table 3–1: CONTROLS AND INDICATORS (Sheet 3 of 4)

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| 8,9 | VALUE ▲ / VALUE ▼ | **FUNCTION:** The [VALUE ▲] / [VALUE ▼] keys alter the currently selected setpoint. To increment/decrement at a faster rate, hold for more than 0.5 seconds. If held for more than 2 seconds, the value increments/decrements at a very fast rate.  
**EFFECT:** The [VALUE ▲] / [VALUE ▼] increments/decrements the displayed setpoint value. For YES/NO questions, pressing either key changes the answer. Any changed setpoint is not used internally until the [STORE] key is pressed.  
**USE:** These keys can be pressed any time a setpoint is displayed or a YES/NO question is displayed. Use the [STORE] key to save the desired setpoint value. If an altered setpoint is not stored, the previous value remains in effect. |
| 10  | RESET | **FUNCTION:** The [RESET] key allows resets 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 resets (i.e. returns 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 (e.g. an OVERLOAD TRIP lock-out or a high RTD temperature). Pre-trip motor values may be viewed in Actual Values page 5 (pre-trip data). If an immediate restart is required after an OVERLOAD or INHIBIT LOCKOUT, the Emergency Restart terminals (see the EMERGENCY RESTART TERMINALS section in Chapter 2) may be shorted together. This will reduce the lock-out time to 0. |
| 11  | CLEAR | **FUNCTION:** In SETPOINTS mode, the [CLEAR] key returns an altered, non-stored setpoint to its original value. In HELP mode, it returns to the previous display mode.  
**EFFECT:** When this key is pressed in SETPOINTS mode, any altered, currently displayed setpoint is returned to its original value. In HELP mode, this key returns the 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 ▲] / [VALUE ▼] keys but not stored. After a setpoint has been stored, the [CLEAR] key has no effect. In HELP mode, the [CLEAR] key can be used any time there is a HELP message on the display. |
### Table 3–1: CONTROLS AND INDICATORS (Sheet 4 of 4)

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| 12  | STORE | **FUNCTION:** The STORE key stores new setpoints into the relay's internal memory.  
**EFFECT:** When pressed in SETPOINTS mode, the displayed setpoint is stored and immediately comes into effect, and the following flash message is displayed: 

**NEW SETPOINT STORED**  
In ACTUAL VALUES mode, the [STORE] key can clear the maximum actual temperature data. To do this, the following YES/NO message from Actual Values page 2 must be changed from NO to YES with the [VALUE ▲] / [VALUE ▼] keys:  

**CLEAR LAST ACCESS DATA? YES**  
Then, when the [STORE] key is pressed the following flash message is displayed:  

**last access data cleared**  
The maximum actual temperature data (see the STATISTICAL DATA FEATURES section in this chapter) will be cleared. The [STORE] key can also start a new motor commissioning (i.e. clear statistical data). To do this, the following YES/NO message from Actual Values page 4 must be changed from NO to say YES:  

**START COMMISSIONING? YES**  
Then, when the [STORE] key is pressed the following flash message is displayed:  

**COMMISSIONING DATA cleared**  
All statistical data will then be cleared 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. This key has 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. |
| 17  | SERVICE | LED indicator used to show the result of the 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. |
The 269 Plus 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 operates correctly, giving full motor protection, regardless of which display mode is in effect. The different modes affect only the data that appears on the 48-character alphanumeric display.

The 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 the CONTROLS AND INDICATORS section in this chapter for details).

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 ▲] and [PAGE ▼] keys are used. To scan the lines on a page the [LINE ▲] and [LINE ▼] keys are used. In the HELP and TRIP/ALARM modes only the [LINE ▲] and [LINE ▼] 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.XXX
```

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.
3.4 ACTUAL VALUES MODE

a) MENUS

In ACTUAL VALUES mode, any of the parameters monitored or calculated by the 269 Plus 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 contents of these pages are shown in the table below:

Table 3–2: 269 Plus ACTUAL VALUES (Sheet 1 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>PAGE: ACTUAL VALUES PHASE CURRENT DATA</td>
<td>ACTUAL VALUES page 1 header.</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>MOTOR STARTING ###1###2###3###4###5###6</td>
<td>Motor starting current level (seen only during a motor start).</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>I1= XXXX I2= XXXX I3= XXXX (AMPS) ---</td>
<td>Motor phase current data. (--- becomes RUN when motor is running.) If Actual Values page 1, line 2 is set to be displayed, it will only show when the motor is starting, then default to this line. Programming the line the display defaults to is done in Setpoints page 5.</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>I(3 ph avg) = XXXX AMPS Max Stator RTD = XXX C</td>
<td>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.</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>UNBALANCE RATIO (In/Ip) U/B = XXX PERCENT</td>
<td>Ratio of negative to positive sequence currents.</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>GROUND FAULT CURRENT G/F = XX.X AMPS</td>
<td>Actual ground fault current</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>ST/HR TIMERS (MIN) XX XX XX XX XX</td>
<td>Starts/hours timers; see the STARTS/HOUR TIMER section for details</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>TIME BETWEEN STARTS TIMER = XX MIN</td>
<td>Time between starts timer; see the TIME BETWEEN STARTS TIMER section for details</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td></td>
<td>This line can be examined to ensure that all pixels in the 40 character display are functional.</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
### Actual Values Mode

#### Table 3–2: 269 Plus Actual Values (Sheet 2 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>END OF PAGE ONE</td>
<td>Last line of page 1.</td>
</tr>
</tbody>
</table>

#### Actual Values Page 2: RTD Temperature Data

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>PAGE 2: ACTUAL VALUES RTD TEMPERATURE DATA</td>
<td>Actual Values page 2 header. In all page 2 messages, temperatures are displayed in °C (indicated by C) or °F (indicated by F) depending on the Setpoints page 2, line 2 value.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>NO RTDs ARE CONNECTED TO THE 269Plus</td>
<td>This line is shown only if the answer to the question ARE THERE ANY RTDS CONNECTED? is NO. This setpoint is located on Setpoints page 2, line 3.</td>
</tr>
<tr>
<td>2</td>
<td>3 ‡</td>
<td>HOTTEST STATOR RTD RTD # X = XXX C</td>
<td>Maximum stator RTD temperature.</td>
</tr>
<tr>
<td>2</td>
<td>4 ‡</td>
<td>STATOR TEMPERATURE RTD #1= XXX DEGREES C</td>
<td>RTD #1 temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or RTD TEMPERATURE RTD #1= XXX DEGREES C</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5 ‡</td>
<td>STATOR TEMPERATURE RTD #2= XXX DEGREES C</td>
<td>RTD #2 temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or RTD TEMPERATURE RTD #2= XXX DEGREES C</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6 ‡</td>
<td>STATOR TEMPERATURE RTD #3= XXX DEGREES C</td>
<td>RTD #3 temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or RTD TEMPERATURE RTD #3= XXX DEGREES C</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7 ‡</td>
<td>STATOR TEMPERATURE RTD #4= XXX DEGREES C</td>
<td>RTD #4 temperature.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or RTD TEMPERATURE RTD #4= XXX DEGREES C</td>
<td></td>
</tr>
</tbody>
</table>

‡ Available only if a meter is online.

‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
### Table 3–2: 269 Plus ACTUAL VALUES (Sheet 3 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8 †</td>
<td>STATOR TEMPERATURE RTD #5 = XXX DEGREES C     or RTD TEMPERATURE RTD #5 = XXX DEGREES C</td>
<td>RTD #5 temperature.</td>
</tr>
<tr>
<td>2</td>
<td>9 †</td>
<td>STATOR TEMPERATURE RTD #6 = XXX DEGREES C     or RTD TEMPERATURE RTD #6 = XXX DEGREES C</td>
<td>RTD #6 temperature.</td>
</tr>
<tr>
<td>2</td>
<td>10 †</td>
<td>RTD TEMPERATURE RTD #7 = XXX DEGREES C</td>
<td>RTD #7 temperature.</td>
</tr>
<tr>
<td>2</td>
<td>11 †</td>
<td>RTD TEMPERATURE RTD #8 = XXX DEGREES C</td>
<td>RTD #8 temperature.</td>
</tr>
<tr>
<td>2</td>
<td>12 †</td>
<td>RTD TEMPERATURE RTD #9 = XXX DEGREES C</td>
<td>RTD #9 temperature.</td>
</tr>
<tr>
<td>2</td>
<td>13 †</td>
<td>RTD TEMPERATURE RTD #10 = XXX DEGREES C     or AMBIENT TEMPERATURE RTD #10 = XXX DEGREES C</td>
<td>RTD #10 temperature. Seen when RTD #10 is used for ambient sensing.</td>
</tr>
<tr>
<td>2</td>
<td>14 †</td>
<td>MAX. STATOR SINCE LAST ACCESS: RTD# X = XXX</td>
<td>Maximum stator RTD temperature since last access.</td>
</tr>
<tr>
<td>2</td>
<td>15 †</td>
<td>MAXIMUM RTD#7 TEMP SINCE LAST ACCESS = XXX C</td>
<td>Maximum RTD #7 temperature since last access.</td>
</tr>
<tr>
<td>2</td>
<td>16 †</td>
<td>MAXIMUM RTD#8 TEMP SINCE LAST ACCESS = XXX C</td>
<td>Maximum RTD #8 temperature since last access.</td>
</tr>
<tr>
<td>2</td>
<td>17 †</td>
<td>MAXIMUM RTD#9 TEMP SINCE LAST ACCESS = XXX C</td>
<td>Maximum RTD #9 temperature since last access.</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to **ARE THERE ANY RTDS CONNECTED?** is NO (located on Setpoints page 2, line 3).
### ACTUAL VALUES PAGE 3: MOTOR CAPACITY DATA

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>PAGE 3: ACTUAL VALUES MOTOR CAPACITY DATA</td>
<td>Actual Values page 3 header.</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>ESTIMATED TIME TO TRIP = XXX SECONDS</td>
<td>Estimated time to overload trip under present conditions (seen only during overloads).</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>MOTOR LOAD AS A PERCENT FULL LOAD = XXX PERCENT</td>
<td>Actual motor current as a percentage of full load.</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>THERMAL CAPACITY USED = XXX PERCENT</td>
<td>Percentage of motor thermal capacity used.</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>END OF PAGE THREE ACTUAL VALUES</td>
<td>Last line of page 3.</td>
</tr>
</tbody>
</table>

### ACTUAL VALUES PAGE 4: STATISTICAL DATA

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>PAGE 4: ACTUAL VALUES STATISTICAL DATA</td>
<td>Actual Values page 4 header.</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>RUNNING HOURS SINCE LAST COMMISSIONING XXXXX HRS</td>
<td>Total motor running hours since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>3†</td>
<td>MEGAWATTHOURS SINCE LAST COMMISSIONING XXXXX MWHR</td>
<td>Total megawatt hours since last commissioning (Displayed only if Meter option is enabled)</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td># OF STARTS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of motor starts since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td># OF TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay trips since last commissioning.</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
### Table 3–2: 269 Plus ACTUAL VALUES (Sheet 5 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6</td>
<td># O/L STARTS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay overload trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td># U/C TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay undercurrent trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td># RAPID TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay rapid trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td># U/B TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay unbalance trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td># G/F TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay ground fault and differential input trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td># RTD TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay RTD trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td># S/C TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay short circuit trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td># START TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of relay acceleration time and speed switch trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td># U/V TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of undervoltage trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td># O/V TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of overvoltage trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td># PF TRIPS SINCE LAST COMMISSIONING XXX</td>
<td>Total number of power factor trips since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>VOLTAGE PHASE REVERSALS SINCE COMMISSIONING XXX</td>
<td>Total number of voltage phase reversals since last commissioning.</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>START NEW COMMISSIONING XXX</td>
<td>Used to clear the data in the previous lines by storing YES (see the CONTROLS AND INDICATORS section for details).</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>END OF PAGE FOUR ACTUAL VALUES</td>
<td>Last line of page 4.</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
Table 3–2: 269 Plus ACTUAL VALUES (Sheet 6 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>PAGE 5: ACTUAL VALUES PRE-TRIP DATA</td>
<td>Actual page 5 header.</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>XXXXXXXXXXXX</td>
<td>This message is only displayed (and defaulted to) when a trip or alarm occurs and describes the trip/ alarm condition. Refer to the TRIP/ALARM MESSAGES AND FAULT DIAGNOSIS table for details. See also the CAUSE OF LAST TRIP section in this chapter.</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>CAUSE OF LAST EVENT: XXXXXXXXXXXX</td>
<td>Describes the cause of the last detected event (see the CAUSE OF LAST EVENT section for details). Updated when an event occurs (trip or inhibit).</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>CAUSE OF LAST TRIP: XXXXXXXXXXXX</td>
<td>Describes the cause of the last trip. It is updated when a trip occurs. See the CAUSE OF LAST TRIP section for details.</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>PRE-TRIP AVERAGE MOTOR CURRENT = XXXX AMPS</td>
<td>Average motor phase current prior to last relay trip.</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>PRE-TRIP PHASE CURRENT I1 = XXX AMPS</td>
<td>I1 motor phase current prior to last relay trip.</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>PRE-TRIP PHASE CURRENT I2 = XXX AMPS</td>
<td>I2 motor phase current prior to last relay trip.</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>PRE-TRIP PHASE CURRENT I3 = XXX AMPS</td>
<td>I3 motor phase current prior to last relay trip.</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>PRE-TRIP U/B RATIO (In/IP) XXX PERCENT</td>
<td>Ratio of negative to positive sequence currents prior to last relay trip.</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>PRE-TRIP G/F CURRENT G/F = XXX AMPS</td>
<td>Ground fault current prior to last relay trip. (= will be &gt; if delay is set to 0.0, 0.25, or 0.5)</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>PRE-TRIP MAX STATOR RTD RTD# X = XXX C</td>
<td>Maximum stator RTD temperature prior to last relay trip. Message displayed only if the answer to ARE THERE ANY RTDs CONNECTED? is YES (setpoint located on Setpoints page 2, line 3).</td>
</tr>
<tr>
<td>5</td>
<td>12†</td>
<td>PRE-TRIP AVERAGE VOLTAGE VOLTS = XXXX</td>
<td>Average voltage prior to last relay trip</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
Table 3–2: 269 Plus ACTUAL VALUES (Sheet 7 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>13 †</td>
<td>PRE-TRIP KWATTS</td>
<td>KW prior to last relay trip (see the POWER MEASUREMENT CONVENTIONS figure).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KW = +XXXXX</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>14 †</td>
<td>PRE-TRIP KVARS</td>
<td>Kvars prior to last relay trip (see the POWER MEASUREMENT CONVENTIONS figure).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KVAR = +XXXXX</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>15 †</td>
<td>PRE-TRIP POWER FACTOR</td>
<td>Power factor prior to last relay trip. The lead or lag messages are also captured and displayed prior to last relay trip.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PF = X.XX LAG</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>16 †</td>
<td>PRE-TRIP FREQUENCY</td>
<td>Frequency prior to last relay trip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HZ = XX.X</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>17</td>
<td>CLEAR PRE-TRIP DATA?</td>
<td>Clears 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>END OF PAGE FIVE</td>
<td>Last line of page 5.</td>
</tr>
</tbody>
</table>

ACTUAL VALUES PAGE 6: LEARNED PARAMETERS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>PAGE 6: ACTUAL VALUES LEARNED PARAMETERS</td>
<td>ACTUAL VALUES page 6 header.</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>LEARNED Istart (AVG. OF 4 STARTS) = XXX AMPS</td>
<td>Learned average motor starting current of 4 starts.</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>LEARNED Istart (last one) = XXX AMPS</td>
<td>Learned motor starting current from last start.</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>LEARNED K FACTOR K = XX.X</td>
<td>Learned value of negative-sequence K factor.</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>LEARNED RUNNING COOL TIME = XXX MIN.</td>
<td>Learned motor cooling time with motor running (see the THERMAL CAPACITY ALARM section).</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
Table 3–2: 269 Plus ACTUAL VALUES (Sheet 8 of 9)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
<td>LEARNED STOPPED COOL TIME = XXX MIN.</td>
<td>Learned motor cooling time with motor stopped (see the THERMAL CAPACITY ALARM section).</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>LEARNED ACCEL. TIME ACCEL. TIME = XX.X SEC.</td>
<td>Learned motor acceleration time.</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>LEARNED Start Capacity Last Start T.C. = XXX %</td>
<td>Learned motor thermal capacity used since last start. See the THERMAL CAPACITY ALARM section for details on using this value to adapt the relay to the motor.</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>LEARNED Start Capacity required = XX PERCENT</td>
<td>Learned motor thermal capacity used on start. This value is learned after 5 successful starts. The start thermal capacity for each of the last five starts are added together and divided by 4. This allows a margin of 24% to be built into the 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 on Setpoints page 5. See the THERMAL CAPACITY ALARM section for details.</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>END OF PAGE SIX ACTUAL VALUES</td>
<td>Last line of page 6.</td>
</tr>
</tbody>
</table>

**ACTUAL VALUES PAGE 7: METERING DATA**

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>PAGE 7: ACTUAL VALUES METERING DATA</td>
<td>ACTUAL VALUES page 7 header</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>METER MODULE NOT INSTALLED</td>
<td>Appears if meter not on-line (see Setpoints page 7, line 2)</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>PHASE TO PHASE VOLTAGE CONNECTION</td>
<td>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 the wiring diagrams in Chapter 2 for details. This message is displayed when the meter's VTs are wired to measure for phase to phase voltage.</td>
</tr>
<tr>
<td>7</td>
<td>3†</td>
<td>PHASE TO NEUTRAL VOLTAGE CONNECTION</td>
<td>This message is displayed when the meter’s VTs are wired for phase to neutral voltage measurement.</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>Vab = XXXX  Vbc = XXXX  Vca = XXXX  AVG.= XXXX V</td>
<td>Appears whether or not the meter is online. Three phase to phase voltages are displayed when the VT configuration above is phase to phase.</td>
</tr>
</tbody>
</table>

† Available only if a meter is online.
‡ Messages not shown if the answer to ARE THERE ANY RTDS CONNECTED? is NO (located on Setpoints page 2, line 3).
To place the relay in Actual Values mode, the [ACTUAL VALUES] key must be pressed. When this is done the following flash message appears for 2 seconds,

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

The display will then show the beginning of page 1:

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

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 Actual Values page 1. This default display line can be changed in Setpoints page 5. When in this mode the [PAGE ▲], [PAGE ▼], [LINE ▲], and [LINE ▼] keys (see the CONTROLS AND INDICATORS section for details) can be used to examine all of the actual motor data outlined above.

**b) 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 page 1, line 7. If the number of starts/hour programmed in Setpoints page 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 can be 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.

c) TIME BETWEEN STARTS TIMER
This timer corresponds to the TIME BETWEEN STARTS TIME DELAY feature in Setpoints page 5, line 24. 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 24.

d) CAUSE OF LAST TRIP
The message in Actual Values page 5, line 3 describes the cause of the last trip. It will be updated when a trip occurs. XXXXXXXXXX in the message represents one of the following trips:

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

e) 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 or time between starts. 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 Setpoints page 5 be changed to YES.
3 SETUP AND USE

3.5 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.

The [SETPOINTS] key must be pressed to enter SETPOINTS mode. If no key is pressed for more than four minutes in this mode, the display automatically goes into ACTUAL VALUES mode (see the ACTUAL VALUES MODE section above for details). Press the [SETPOINTS] key to return to SETPOINTS mode. When pressed, the following flash message will appear on the display,

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

The display will then show,

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

which is the first line of Setpoints page 1. The [PAGE ▲] [PAGE ▼], [LINE ▲], and [LINE ▼] keys (see the CONTROLS AND INDICATORS section earlier for details) may then be used to view the setpoints data.

The [VALUE ▲], [VALUE ▼], [STORE], and [CLEAR] keys (see the CONTROLS AND INDICATORS section) are used to change setpoints. Before any setpoints can be changed, however, the access terminals must first be shorted together (see the PROGRAMMING ACCESS TERMINALS section in Chapter 2). The [PAGE ▲], [PAGE ▼], [LINE ▲], and [LINE ▼] keys are used to scroll between setpoints. The setpoint values changed with the [VALUE ▲] / [VALUE ▼] keys. The [CLEAR] key returns setpoints to their original values. When the setpoint value is chosen, press the [STORE] key to save the value into the relay memory. When the STORE key is pressed, the following flash message is displayed and the new setpoint value implemented,

```
new setpoint stored
```

If an attempt is made to save a new setpoint value without the access terminals shorted together, the new value is ignored and the flash message is displayed,

```
ILLEGAL ACCESS
```

To ensure that setpoints are tamper-proof, 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 recommended that the motor is stopped before important protection parameters are changed. Setpoints are stored indefinitely in 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 the following table. Also shown are the default settings, the ranges and increments for each setpoint. It should be noted that the 269 Plus motor protection parameters are based on the data entered by the user. Thus this data must be complete and accurate for the given system.
### SETPOINTS PAGE 1: MOTOR AMPS SETPOINTS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>PAGE 1: SETPOINT VALUES MOTOR AMPS SETPOINTS</td>
</tr>
</tbody>
</table>
| 1    | 2    | PHASE CT RATIO  
CT SECONDARY = X AMP  
Range: 1, 5  
Factory Value: 5; Manual Reference: 3.8 |
| 1    | 3    | PHASE CT RATIO  
CT PRIMARY = XXXX:X  
Range: 20 to 1500 in steps of 1  
Factory Value: 100; Manual Reference: 3.8 |
| 1    | 4    | MOTOR FULL LOAD CURRENT  
FLC= XXXX AMPS  
Range: 10 to 1500 in steps of 1  
Factory Value: 10 A; Manual Reference: 3.8 |
| 1    | 5    | O/L PICKUP LEVEL  
LEVEL = 1.05 x FLC  
Range: 1.05 to 1.25 x FLC in steps of 0.01  
Factory Value: 1.05 x FLC  
Manual Reference: 3.20 |
| 1    | 6    | ACCEL. TIME= XXX.X SECONDS  
Consult motor data sheet  
Range: 0.5 to 125.0 seconds or OFF in steps of 0.5  
Factory Value = 10.0 sec.; Manual Reference: 3.9 |
| 1    | 7    | STARTS/HOUR= X  
Consult motor data sheet  
Range: 1 to 5 starts or OFF in steps of 1  
Factory Value = 3; Manual Reference: 3.10 |
| 1    | 8    | UNBALANCE ALARM LEVEL  
U/B ALARM= XX PERCENT  
Range: 4 to 30% or OFF in steps of 1%  
Factory Value = 10%; Manual Reference: 3.11 |
| 1    | 9    | U/B ALARM TIME DELAY  
TIME DELAY = XXX SEC  
Range: 3 to 255 in steps of 1 second  
Factory Value = 5 sec.; Manual Reference: 3.11 |
| 1    | 10   | UNBALANCE TRIP LEVEL  
U/B TRIP= XX PERCENT  
Range: 4 to 30% or OFF in steps of 1%  
Factory Value = 15%; Manual Reference: 3.11 |
| 1    | 11   | U/B TRIP TIME DELAY  
U/B DELAY= XXX SECONDS  
Range: 3 to 255 seconds in steps of 1  
Factory Value = 5 sec.; Manual Reference: 3.11 |
| 1    | 12   | G/F CT RATIO :5 ? XXX  
(NO indicates 2000:1)  
Range: YES (5 A secondary), NO (GE Multilin 50:0.025 A CT with ratio of 2000:1)  
Factory Value: NO; Manual Reference: 3.12 |
| 1    | 13   | GROUND CT PRIMARY  
GROUND CT = XXX:5  
Range: 20 to 1500 in steps of 1  
(Not seen if ratio is 2000:1)  
Factory Value = 100; Manual Reference: 3.12 |
| 1    | 14   | GROUND FAULT ALARM LEVEL  
G/F ALARM= XXX AMPS  
Range: For 50:0.025A (2000:1 ratio) CT, 1.0 to 10 A or OFF, in steps of 1  
Factory Value = 4 A; Manual Reference: Section 3.12 |
<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>Range: For 5 A secondary CT, 0.1 to 1.0 x CT rating or OFF, in steps of 0.1 (not seen if ratio is 2000:1) Factory Value = 0.4 x CT; Manual Reference: 3.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>GROUND FAULT ALARM LEVEL  G/F ALARM = XXX xCT</td>
<td>Range: 1 to 255 seconds in steps of 1 Factory Value = 10 seconds; Manual Reference: 3.12</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>G/F ALARM TIME DELAY  TIME DELAY = XXX SEC</td>
<td>Range: For 50:0.025A (2000:1 ratio) CT, 1.0 to 10.0 A or OFF, in steps of 1 A Factory Value = 8; Manual Reference: Section 3.12</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>GROUND FAULT TRIP LEVEL  G/F TRIP = XX xCT</td>
<td>Range: 0.0 (Instantaneous) to 20.0 seconds in steps of 0.5. Additional time delay of 0.25 sec. after 20.0. Factory Value = 0.0 sec.; Manual Reference: Section 3.12</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td>G/F TRIP TIME DELAY  G/F DELAY = XX.X SECONDS</td>
<td>Range: 1 to 1000 amps or OFF, in steps of 1 A Factory Value = OFF; Manual Reference: 3.14</td>
</tr>
<tr>
<td>1</td>
<td>19</td>
<td>UNDERCURRENT ALARM LEVEL  U/C ALARM = XXXX AMPS</td>
<td>Range: 1 to 1000 amps or OFF, in steps of 1 A Factory Value = OFF; Manual Reference: 3.14</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>UNDERCURRENT ALARM DELAY  TIME DELAY = XX SECONDS</td>
<td>Range: 1 to 255 seconds in steps of 1 Factory Value = 10 sec.; Manual Reference: 3.14</td>
</tr>
<tr>
<td>1</td>
<td>21</td>
<td>UNDERCURRENT TRIP LEVEL  U/C TRIP = OFF AMPS</td>
<td>Range: 1 to 255 seconds in steps of 1 Factory Value = OFF; Manual Reference: 3.14</td>
</tr>
<tr>
<td>1</td>
<td>22</td>
<td>UNDERCURRENT TRIP DELAY  TIME DELAY = XXX SECONDS</td>
<td>Range: 1 to 255 seconds in steps of 1 Factory Value = 5 sec.; Manual Reference: 3.14</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td>MECHANICAL JAM ALARM  ALARM LEVEL = XXX xFLC</td>
<td>Range: 1.5 to 6.0 x FLC or OFF, in steps of 0.5 Factory Value = OFF; Manual Reference: 3.15</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>MECH. JAM ALARM TIME  DELAY = XXX.X SECONDS</td>
<td>Range: 0.5 to 125.0 seconds in steps of 0.5 Factory Value = 5.0; Manual Reference: 3.15</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>RAPID TRIP / MECH. JAM TRIP LEVEL = X.X x FLC</td>
<td>Range: 1.5 to 6.0 x FLC or OFF, in steps of 0.5 Factory Value = 2.5 x FLC; Manual Reference: 3.15</td>
</tr>
<tr>
<td>1</td>
<td>26</td>
<td>RAPID TRIP TIME DELAY  DELAY = XXX.X SECONDS</td>
<td>Range: 0.5 to 125.0 seconds in steps of 0.5 sec. Factory Value = 10.0 sec.; Manual Reference: 3.15</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
<td>SHORT CIRCUIT TRIP LEVEL  S/C TRIP = XX x PLC</td>
<td>Range: 4 to 12 x FLC or OFF, in steps of 1 x FLC Factory Value = OFF; Manual Reference: 3.16</td>
</tr>
<tr>
<td>1</td>
<td>28</td>
<td>SHORT CIRCUIT TIME DELAY  S/C DELAY = XX.X SECONDS</td>
<td>Range: INST (instantaneous) or 0.5 to 20.5 seconds in steps of 0.5 sec. Factory Value = INST; Manual Reference: 3.16</td>
</tr>
</tbody>
</table>
### TABLE 3-3: 269 PLUS SETPOINTS (SHEET 3 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 1    | 30   | **IMMEDIATE OVERLOAD**  
LEVEL = X.XX × FLC  
Range: 1.01 to 1.50 ×FLC or OFF, in steps of 0.01  
Factory Value = OFF; Manual Reference: 3.17 |
| 1    | 31   | **END OF PAGE ONE**  
SETPOINT VALUES |

**SETPOINTS PAGE 2: RTD SETPOINTS**

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 2    | 1    | **PAGE 2: SETPOINT VALUES**  
RTD SETPOINTS |
| 2    | 2    | **RTD SENSOR TYPE**  
TYPE = 100 OHM PLATINUM  
Range: 100 OHM PLATINUM, 10 OHM COPPER, 100 OHM NICKEL, 120 OHM NICKEL.  
Displays the RTD type accepted by the relay. To change, contact the factory. Manual Reference: 3.18 |
| 2    | 3    | **ARE THERE ANY RTDs CONNECTED?**  
XXX  
Range: YES or NO  
If set to NO, RTD messages in Setpoints and Actual Values are not displayed. If no RTDs are connected and Alarm and Trip levels are set, trips will occur.  
Factory Value = YES; Manual Reference: 3.18 |
| 2    | 4    | **RTD MESSAGE DISPLAY = C**  
(C:CELSIUS/F:FAHRENHEIT)  
Range C (*Celsius) or F (*Fahrenheit)  
Factory Value = C; Manual Reference: 3.18 |
| 2    | 5    | **# OF STATOR RTDS USED**  
# OF RTDs = X  
Range: 0 to 6 in steps of 1  
Factory Value = 6; Manual Reference: 3.18 |
| 2    | 6    | **STATOR #1 ALARM LEVEL**  
= XXX DEGREES C  
Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)  
Factory Value = OFF; Manual Reference: 3.18  
or  
**RTD #1 ALARM LEVEL**  
= XXX DEGREES C  
Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)  
Factory Value = OFF; Manual Reference: 3.18 |
| 2    | 7    | **STATOR #1 HIGH ALARM LEVEL**  
= XXX DEGREES C  
Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)  
Factory Value = OFF; Manual Reference: 3.18  
or  
**RTD #1 HIGH ALARM LEVEL**  
= XXX DEGREES C  
Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)  
Factory Value = OFF; Manual Reference: 3.18 |
| 2    | 8    | **STATOR #1 TRIP LEVEL**  
= XXX DEGREES C  
Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)  
Factory Value = OFF; Manual Reference: 3.18  
or  
**RTD #1 TRIP LEVEL**  
= XXX DEGREES C  
Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)  
Factory Value = OFF; Manual Reference: 3.18 |
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 4 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 2    | 9    | **STATOR #2 ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | **RTD #2 ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | Range: 0 to 200°C or OFF, in steps of 1°C  
       |       | (32 to 392°F in steps of 1°F if Fahrenheit)  
       |       | Factory Value = OFF  
       |       | or  
       | 10   | **STATOR #2 HIGH ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | **RTD #2 HIGH ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | Range: 0 to 200°C or OFF, in steps of 1°C  
       |       | (32 to 392°F in steps of 1°F if Fahrenheit)  
       |       | Factory Value = OFF; Manual Reference: 3.18  
       | 11   | **STATOR #3 TRIP LEVEL**  
       |       | = XXX DEGREES C  
       |       | **RTD #3 TRIP LEVEL**  
       |       | = XXX DEGREES C  
       |       | Range: 0 to 200°C or OFF, in steps of 1°C  
       |       | (32 to 392°F in steps of 1°F if Fahrenheit)  
       |       | Factory Value = OFF; Manual Reference: 3.18  
       | 12   | **STATOR #3 ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | **RTD #3 ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | Range: 0 to 200°C or OFF, in steps of 1°C  
       |       | (32 to 392°F in steps of 1°F if Fahrenheit)  
       |       | Factory Value = OFF; Manual Reference: 3.18  
       | 13   | **STATOR #3 HIGH ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | **RTD #3 HIGH ALARM LEVEL**  
       |       | = XXX DEGREES C  
       |       | Range: 0 to 200°C or OFF, in steps of 1°C  
       |       | (32 to 392°F in steps of 1°F if Fahrenheit)  
       |       | Factory Value = OFF; Manual Reference: 3.18  
       | 14   | **STATOR #3 TRIP LEVEL**  
       |       | = XXX DEGREES C  
       |       | **RTD #3 TRIP LEVEL**  
       |       | = XXX DEGREES C  
       |       | Range: 0 to 200°C or OFF, in steps of 1°C  
       |       | (32 to 392°F in steps of 1°F if Fahrenheit)  
       |       | Factory Value = OFF; Manual Reference: 3.18
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 5 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>15</td>
<td><strong>STATOR #4 ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or <strong>RTD #4 ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 0 to 200°C or OFF, in steps of 1°C&lt;br&gt;(32 to 392°F in steps of 1°F if Fahrenheit)&lt;br&gt;Factory Value = OFF; Manual Reference: 3.18</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td><strong>STATOR #4 HIGH ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or <strong>RTD #4 HIGH ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 0 to 200°C or OFF, in steps of 1°C&lt;br&gt;(32 to 392°F in steps of 1°F if Fahrenheit)&lt;br&gt;Factory Value = OFF; Manual Reference: 3.18</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td><strong>STATOR #4 TRIP LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or <strong>RTD #4 TRIP LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 0 to 200°C or OFF, in steps of 1°C&lt;br&gt;(32 to 392°F in steps of 1°F if Fahrenheit)&lt;br&gt;Factory Value = OFF; Manual Reference: 3.18</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td><strong>STATOR #5 ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or <strong>RTD #5 ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 0 to 200°C or OFF, in steps of 1°C&lt;br&gt;(32 to 392°F in steps of 1°F if Fahrenheit)&lt;br&gt;Factory Value = OFF; Manual Reference: 3.18</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td><strong>STATOR #5 HIGH ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or <strong>RTD #5 HIGH ALARM LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 0 to 200°C or OFF, in steps of 1°C&lt;br&gt;(32 to 392°F in steps of 1°F if Fahrenheit)&lt;br&gt;Factory Value = OFF; Manual Reference: 3.18</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td><strong>STATOR #5 TRIP LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or <strong>RTD #5 TRIP LEVEL</strong>&lt;br&gt;= XXX DEGREES C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range: 0 to 200°C or OFF, in steps of 1°C&lt;br&gt;(32 to 392°F in steps of 1°F if Fahrenheit)&lt;br&gt;Factory Value = OFF; Manual Reference: 3.18</td>
</tr>
</tbody>
</table>

Range: 0 to 200°C or OFF, in steps of 1°C<br>(32 to 392°F in steps of 1°F if Fahrenheit)<br>Factory Value = OFF; Manual Reference: 3.18
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 6 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 2    | 21   | STATOR #6 ALARM LEVEL  
     |  | = XXX DEGREES C  
     |  | or  
     |  | RTD #6 ALARM LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.18  
| 2    | 22   | STATOR #6 HIGH ALARM LEVEL = XXX DEGREES C  
     |  | or  
     |  | RTD #6 HIGH ALARM LEVEL = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.18  
| 2    | 23   | STATOR #6 TRIP LEVEL  
     |  | = XXX DEGREES C  
     |  | or  
     |  | RTD #6 TRIP LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.18  
| 2    | 24   | RTD #7 ALARM LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 25   | RTD #7 TRIP LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 26   | RTD #8 ALARM LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 27   | RTD #8 TRIP LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 28   | RTD #9 ALARM LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 29   | RTD #9 TRIP LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 30   | RTD #10 ALARM LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  
| 2    | 31   | RTD #10 TRIP LEVEL  
     |  | = XXX DEGREES C  
     |  | Factory Value = OFF; Manual Reference: 3.19  

Range: 0 to 200°C or OFF, in steps of 1°C  
(32 to 392°F in steps of 1°F if Fahrenheit)
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 7 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>32</td>
<td>END OF PAGE TWO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SETPOINT VALUES</td>
</tr>
</tbody>
</table>

#### SETPOINTS PAGE 3: O/L CURVE SETPOINTS

<table>
<thead>
<tr>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>PAGE 3: SETPOINT VALUES O/L CURVE SETPOINTS</td>
</tr>
<tr>
<td></td>
<td>NOTE: Lines 4 through 25 are not seen when using a standard curve.</td>
</tr>
<tr>
<td>3</td>
<td>CUSTOM CURVE? XXX YES voids selected curve</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 8 step 1 Factory Value = 4; Manual Reference: 3.20</td>
</tr>
<tr>
<td>3</td>
<td>SELECTED CURVE NUMBER CURVE # = X</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 8 step 1 Factory Value = 4; Manual Reference: 3.20 This line is not seen when using a custom curve.</td>
</tr>
<tr>
<td>3</td>
<td>Check all custom curve entries before exiting</td>
</tr>
<tr>
<td></td>
<td>This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.05 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 12000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.10 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 12000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.20 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 12000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.30 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 12000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.40 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 12000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.50 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 12000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 1.75 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 2000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 2.00 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 2000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
<tr>
<td>3</td>
<td>TRIP TIME @ 2.25 X FLC = XXXXX SECONDS</td>
</tr>
<tr>
<td></td>
<td>Range: 1 to 2000 sec., step 1 Manual Reference: 3.20 This line is not seen when using a standard curve</td>
</tr>
</tbody>
</table>
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 8 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
<th>Range: 1 to 2000 sec., step 1</th>
<th>Manual Reference: 3.20</th>
<th>This line is not seen when using a standard curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>13</td>
<td>TRIP TIME @ 2.50 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>TRIP TIME @ 2.75 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>TRIP TIME @ 3.00 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>16</td>
<td>TRIP TIME @ 3.50 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>TRIP TIME @ 4.00 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>TRIP TIME @ 4.50 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>TRIP TIME @ 5.00 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>TRIP TIME @ 5.50 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>TRIP TIME @ 6.00 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td>TRIP TIME @ 6.50 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>TRIP TIME @ 7.00 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>TRIP TIME @ 7.50 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>TRIP TIME @ 8.00 X FLC = XXXXX SECONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>26</td>
<td>END OF PAGE THREE SETPOINT VALUES</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This page assigns trip and alarm functions to the output relays. Each trip/alarm function is assigned separately to the appropriate relay or to "NO" relay. If an alarm is assigned to no relay, it can still become active (i.e. cause the appropriate alarm message to be displayed) but no output relay activation occurs. Possible assignments are shown below.

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

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>POSSIBLE ASSIGNMENTS</th>
<th>FACTORY VALUE</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>OIL TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>U/B TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>S/C TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>U/C TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>RAPID TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>STATOR RTD TRIP †</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>RTD TRIP †</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>G/F TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>ACCEL. TIME TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>PHASE REVERSAL TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>INHIBIT LOCKOUTS</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>AUX. 1 RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>SPEED SWITCH TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>DIFFERENTIAL TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td></td>
</tr>
<tr>
<td>SINGLE PHASE</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>U/V TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>O/V TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>POWER FACTOR TRIP</td>
<td>TRIP or AUX. 1 or TRIP &amp; AUX. 1</td>
<td>TRIP RELAY</td>
<td>METER OPTION</td>
</tr>
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<td>OIL WARNING</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td></td>
</tr>
<tr>
<td>G/F ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td></td>
</tr>
<tr>
<td>U/B ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td></td>
</tr>
<tr>
<td>U/C ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td></td>
</tr>
<tr>
<td>MECHANICAL JAM ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 1 RELAY</td>
<td></td>
</tr>
<tr>
<td>STATOR RTD ALARM †</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td></td>
</tr>
<tr>
<td>STATOR RTD HIGH ALARM †</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 1 RELAY</td>
<td></td>
</tr>
<tr>
<td>RTD ALARM †</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 1 RELAY</td>
<td></td>
</tr>
<tr>
<td>RTD HIGH ALARM †</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 1 RELAY</td>
<td></td>
</tr>
<tr>
<td>NO SENSOR ALARM †</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 1 RELAY</td>
<td></td>
</tr>
<tr>
<td>LOW TEMP. ALARM †</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 1 RELAY</td>
<td></td>
</tr>
<tr>
<td>SPARE INPUT ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>NO RELAY</td>
<td></td>
</tr>
<tr>
<td>T.C. ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>NO RELAY</td>
<td></td>
</tr>
<tr>
<td>U/V TRIP</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>O/V TRIP</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>PF ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>KVAR ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>ALARM RELAY</td>
<td>METER OPTION</td>
</tr>
<tr>
<td>METER ALARM</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 2 RELAY</td>
<td></td>
</tr>
<tr>
<td>SELF TEST FAIL</td>
<td>ALARM or AUX. 1 or AUX. 2 or NO</td>
<td>AUX. 2 RELAY</td>
<td></td>
</tr>
</tbody>
</table>

† These messages are displayed only when there are RTDs connected to the relay.
### 3 SETUP AND USE

#### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 10 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SETPOINTS PAGE 5: SYSTEM CONFIGURATION</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 5    | 1    | **PAGE 5: SETPOINT VALUES**  
**SYSTEM CONFIGURATION** |
|      |      | This page configures the 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. |
| 5    | 2    | **NORMAL RUN DISPLAY SHOWS**  
**LINE = LINE XX** |
|      |      | This setpoint determines the line of the selected Actual Values page to display if no key is pressed for more than four minutes and no trips or alarms are present.  
*Range: 1 to 40 – line number in selected page (see the 269 Plus ACTUAL VALUES table)*  
*Factory Value = 2* |
| 5    | 3    | **NORMAL RUN DISPLAY SHOWS**  
**PAGE = PAGE XX** |
|      |      | This setpoint determines the Actual Values Page to display if no key is pressed for more than four minutes and no trips or alarms are present.  
*Range: 1 to 6 (see the 269 Plus ACTUAL VALUES table)*  
*Factory Value = page 1* |
| 5    | 4    | **DEFEAT NO SENSOR ALARM?**  
**XXX** |
|      |      | This setpoint enables or defeats the Broken RTD Sensor Alarm. This alarm will only become active for open circuit RTDs chosen for use. This message is not displayed if the **ARE THERE ANY RTD CONNECTED?** setpoint (page 2, line 3) is set to **NO**.  
*Range: YES (defeated); NO (enabled)*  
*Factory Value = YES* |
| 5    | 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 Sections 3.18 and 3.19). This message is not displayed if the **ARE THERE ANY RTD CONNECTED?** setpoint (page 2, line 3) is set to **NO**.  
*Range: YES (enabled); NO (disabled)*  
*Factory Value = NO* |
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 11 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 5    | 6    | **ENABLE STATOR RTD VOTING**
|      |      | (2 RTDs>=TRIP)? XXX |

This setpoint enables or defeats 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 must exceed their individual trip setpoints before a trip signal is issued. The second stator RTD above its trip setpoint causes the trip. In addition, a reset of a stator RTD trip will not be allowed unless both stator RTD temperatures are below their respective setpoints. Stator RTD Alarms are not affected by this feature. Stator RTD Alarms will still be issued based on individual RTD temperatures. This message is not displayed if the **ARE THERE ANY RTD CONNECTED?** setpoint (page 2, line 3) is set to NO.

If the number of stator RTDs is programmed to 1, then no stator RTD voting takes place.

*Range: YES (RTD Voting enabled); NO (RTD Voting disabled)*  
*Factory Value = YES*

| 5    | 7    | **DEFEAT RTD INPUT TO THERMAL MEMORY ? XXX** |

This setpoint enables or defeats the thermal memory RTD bias feature (see the THERMAL MEMORY section in this chapter). With this feature defeated, the effect of the stator RTD temperature is not included in the thermal memory. This message is not displayed if the **ARE THERE ANY RTD CONNECTED?** setpoint (page 2, line 3) is set to NO.

*Range: YES (defeated), NO (enabled)*  
*Factory Value = YES*

| 5    | 8    | **RTD BIAS CURVE MINIMUM VALUE = XXX °C** |

Not displayed when **RTD INPUT TO THERMAL MEMORY** (Setpoints page 5, line 7) is defeated – see Section 3.18.

This setpoint sets the RTD bias minimum value (see the STANDARD OVERLOAD CURVES WITH OVERLOAD PICKUP figure in this chapter); this setpoint is typically programmed as the ambient temperature.

*Range: 0°C to (RTD Bias Center Temp – 1) in °C or °F*  
*Factory Value = 40°C*

| 5    | 9    | **RTD BIAS CENTER T.C. VALUE = XX PERCENT** |

Not seen when **RTD INPUT TO THERMAL MEMORY** (Setpoints page 5, line 7) 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.

\[
\text{Center T.C.} = \left[ 1 - \frac{\text{Hot Motor Stall Time}}{\text{Cold Motor Stall Time}} \right] \times 100\%
\]

*Range: 1 to 99% in steps of 1%*  
*Factory Value = 15*
### Table 3–3: 269 Plus Setpoints (Sheet 12 of 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10</td>
<td><strong>RTD Bias Center Temp.</strong>&lt;br&gt;<strong>VALUE = XXX °C</strong>&lt;br&gt;Not seen when <strong>RTD Input to Thermal Memory</strong> (Setpoints page 5, line 7) is defeated.&lt;br&gt;This is the temperature value for the center point of the two part curve.&lt;br&gt;<em>Range: (RTD Bias Min Temp + 1) to (RTD Bias Max Temp – 1) in °C or °F&lt;br.Factory Value = 110 °C</em></td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td><strong>RTD Bias Curve Maximum</strong>&lt;br&gt;<strong>VALUE = XXX °C</strong>&lt;br&gt;Not seen when <strong>RTD Input to Thermal Memory</strong> (Setpoints page 5, line 7) is defeated.&lt;br&gt;This setpoint sets the RTD bias maximum value (see the STANDARD OVERLOAD CURVES WITH OVERLOAD PICKUP figure in this chapter).&lt;br&gt;<em>Range: (RTD Bias Center Temp + 1) to 200 °C (392 °F)&lt;br.Factory Value = 155 °C</em></td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td><strong>Defeat U/B Input to Thermal Memory ? XXX</strong>&lt;br&gt;This code defeats or enables the unbalance bias function. With this feature defeated, the effect of negative-sequence unbalance is not included in the thermal memory:&lt;br&gt;*NOTE&lt;br&gt;This setpoint should not be changed to <strong>NO</strong> until the 269 Plus has learned a value for K. The K factor is used to bias the thermal memory as explained in the THERMAL MEMORY section in this chapter. The learned K factor can be examined in Actual Values page 6.&lt;br&gt;<em>Range: 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).&lt;br.Factory Value = YES</em></td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td><strong>Defeat K Value = XX</strong>&lt;br&gt;Select a value for the negative-sequence unbalance K factor (see Section 3.22). This message is not seen if setpoint <strong>Defeat U/B Input to Thermal Memory</strong> is set to Yes.&lt;br&gt;*K = ( \frac{175}{I_{LR}^2} ) where ( I_{LR} ) is the locked rotor current value in per unit; ( I_{LR} = \frac{I_{LR} \text{(amps)}}{I_{FLC} \text{(amps)}} )&lt;br&gt;<em>Range: 1 to 19 in steps of 1 or OFF (OFF indicates that learned K value is to be used)&lt;br.Factory Value = 6</em></td>
</tr>
</tbody>
</table>
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 13 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>14</td>
<td><strong>DEFEAT LEARNED COOL TIME? XX</strong></td>
</tr>
</tbody>
</table>
|      |      | This setpoint tells the 269 Plus to use the learned motor cooling time values. (see Actual Values page 6). When learned values are not used, the user entered values are used.  
*Range: YES (default cool times); NO (learned cool times from Actual Values page 6)*  
*NOTE: This setpoint should not be changed unless the 269 Plus has learned reasonable motor cool down times.*  
*Factory Value = YES* |
| 5    | 15   | **ENTER RUNNING COOL TIME = XX MINUTES** |
|      |      | This setpoint is seen when the learned motor cooling times are not used. It represents the time for the thermal memory to discharge from 100% to 0% with the motor running in a non-overload condition:  
*Range: 1 to 45 minutes in steps of 1 minute (cooling time in minutes)*  
*Factory Value = 15 minutes* |
| 5    | 16   | **ENTER STOPPED COOL TIME = XXX MINUTES** |
|      |      | This setpoint is seen when the learned motor cooling times are not used. This value represents the time for thermal memory to discharge from 100% to 0% with the motor stopped. The OVERLOAD TRIP lockout time is 85% of this value (see Section 3.22).  
*Range: 5 to 213 minutes in steps of 1 minute (cooling time in minutes)*  
*Factory Value = 30 minutes* |
| 5    | 17   | **RTD10 AMBIENT SENSOR? XXX** |
|      |      | This setpoint is used to select RTD10 as an ambient air temperature sensor; see Section 3.22. This message is not displayed if the ARE THERE ANY RTD CONNECTED? setpoint (page 2, line 3) is set to NO.  
*Range: YES, NO*  
*Factory Value = NO* |
| 5    | 18   | **ENABLE DIFFERENTIAL TRIP? XXX** |
|      |      | This setpoint enables or defeats the Differential Trip function. The 269 Plus does not have an 87 element but can accept contact closures from an external differential relay at Terminals 48 & 49 to issue a differential trip. When this value is NO, a contact closure at Terminals 48 & 49 has no effect. Changing this setpoint to NO after a differential trip has the same effect as when Terminals 48 and 49 are open-circuited and the [RESET] key is pressed, i.e. the differential trip is automatically reset.  
*Range: YES (enabled); NO (disabled)*  
*Factory Value = NO* |
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 14 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 5    | 19   | **DEFEAT SPEED SWITCH**  
|      |      | XXX  
|      |      | This setpoint is used to defeat or enable the Speed Switch trip.  
|      |      | **Range**: YES (speed Switch function disabled); NO (speed Switch function enabled)  
|      |      | **Factory Value** = YES |
| 5    | 20   | **SPEED SWITCH**  
|      |      | **TIME DELAY = XXX.X SEC.**  
|      |      | This setpoint sets the time delay for the operation of the speed switch function. This setpoint is not seen if the Speed Switch function is disabled.  
|      |      | **Range**: 0.5 to 100.0 seconds in steps of 0.5 seconds  
|      |      | **Factory Value** = 2.0 sec. |
| 5    | 21   | **ANALOG OUTPUT PARAMETER**  
|      |      | = XXXXXXXXXXXXXX  
|      |      | This setpoint is used to select the analog current output function.  
|      |      | **Range**: Motor Load (Motor current as a percentage of full load), Thermal Memory (Motor thermal capacity used), Max Stator RTD (Hottest stator RTD temperature, 0 to 200°C), RTD #7 (RTD #7 temperature 0 to 200°C), Bearing RTD, CT secondary (CT secondary current as a percentage of CT secondary amps rating).  
|      |      | **Factory Value** = Max Stator RTD |
| 5    | 22   | **ANALOG OUTPUT TYPE**  
|      |      | **TYPE = X-XX mA**  
|      |      | This setpoint is used to select the analog output range.  
|      |      | **Range**: "4-20 mA", "0-20 mA", "0-1 mA"  
|      |      | **Factory Value** = "4-20 mA" |
| 5    | 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.  
|      |      | **Range**: 25% to 250% in steps of 1%.  
|      |      | **Factory Value** = 100%. |
| 5    | 24   | **Enable Single-shot restart? XXX**  
|      |      | This setpoint is used to enable or disable the single-shot restart feature.  
|      |      | **Range**: YES, NO.  
|      |      | **Factory Value** = NO. |
This setpoint is used to enable or disable the start inhibit feature. This setpoint should not be changed until a reasonable value has been obtained for the LEARNED START CAPACITY REQUIRED (Actual Values page 6).

Range: YES, NO.
Factory Value = NO.

This line is only seen when the start inhibit feature is enabled. The LEARNED START THERMAL CAPACITY actual value is obtained from this setpoint. This is done after the motor is started and then stopped. The relay updated the LEARNED START THERMAL CAPACITY with this setpoint value and uses it in the calculation of any lockout time required for a start inhibit (see the THERMAL MEMORY section for details).

Range: 10 to 80% in steps of 1%.
Factory Value = 40%.

This setpoint is used to enable or disable the special external reset feature described in the RAPID TRIP / MECHANICAL JAM SETPOINTS section in this chapter.

Range: YES, NO.
Factory Value = NO.

This values sets the output relay latch attributes. A latched output relay must be manually reset. An unlatched relay is automatically reset when the condition causing the relay activation goes away. This setpoint allows alarm functions to be manually or automatically reset. The Immediate O/L Alarm function is automatically reset regardless of the Latchcode.

Trip functions must always be manually reset regardless of the Latchcode value chosen here.

Range: 1 to 7 step 1 (see table below)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>TRIP</th>
<th>ALARM</th>
<th>AUX. 1</th>
<th>AUX. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>latched</td>
<td>unlatched</td>
<td>unlatched</td>
<td>latched</td>
</tr>
<tr>
<td>2 or 3</td>
<td>latched</td>
<td>latched</td>
<td>unlatched</td>
<td>latched</td>
</tr>
<tr>
<td>4 or 5</td>
<td>latched</td>
<td>unlatched</td>
<td>latched</td>
<td>latched</td>
</tr>
<tr>
<td>6 or 7</td>
<td>latched</td>
<td>latched</td>
<td>latched</td>
<td>latched</td>
</tr>
</tbody>
</table>

Factory Value = 1
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 16 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 5    | 29   | **DRAWOUT FAILSAFE ACCESS**  
      |      | CODE = 0 (See manual) |

This setpoint appears only if the relay is a drawout. Entering value from factory for this setpoint allows access of the failsafe codes for approximately 3 minutes.

**NOTE**

*FOR PROPER OPERATION OF A DRAWOUT UNIT, HARDWARE CHANGES MAY BE REQUIRED IF THE FAILSAFE CODE IS CHANGED (CONTACT FACTORY).*

Factory Value = 0

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 5    | 30   | **RELAY FAILSAFE**  
      |      | CODE = X |

This message does not appear on drawout versions 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).

<table>
<thead>
<tr>
<th>VALUE</th>
<th>TRIP</th>
<th>ALARM</th>
<th>AUX. 1</th>
<th>AUX. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FS</td>
<td>NFS</td>
<td>NFS</td>
<td>FS</td>
</tr>
<tr>
<td>2</td>
<td>NFS</td>
<td>FS</td>
<td>NFS</td>
<td>FS</td>
</tr>
<tr>
<td>3</td>
<td>FS</td>
<td>FS</td>
<td>NFS</td>
<td>FS</td>
</tr>
<tr>
<td>4</td>
<td>NFS</td>
<td>NFS</td>
<td>FS</td>
<td>FS</td>
</tr>
<tr>
<td>5</td>
<td>FS</td>
<td>NFS</td>
<td>FS</td>
<td>FS</td>
</tr>
<tr>
<td>6</td>
<td>NFS</td>
<td>FS</td>
<td>FS</td>
<td>FS</td>
</tr>
<tr>
<td>7</td>
<td>FS</td>
<td>FS</td>
<td>FS</td>
<td>FS</td>
</tr>
<tr>
<td>8</td>
<td>NFS</td>
<td>NFS</td>
<td>NFS</td>
<td>FS</td>
</tr>
</tbody>
</table>

Factory Value = 1

**NOTE**

*Due to the drawout relay hardware configuration, this code cannot be changed without corresponding hardware change.*

**WARNING**

In locations where system voltage disturbances cause voltage levels to dip below the range specified in the TECHNICAL SPECIFICATIONS in Chapter 1, 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”, the trip contacts should be programmed failsafe. See the WIRING DIAGRAM FOR CONTACTORS and WIRING DIAGRAM FOR BREAKERS in this chapter.
### SPARE INPUT TO READ 52B CONTACT?

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 relay operation, it is required that a 52B contact be wired to terminals 44 and 45 and this setpoint programmed to **YES**. The 269 Plus will determine a “stop” condition if motor current is less than 5% CT primary and the 52b contact is closed. 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**. Setting to **YES** defeats the Spare Input Alarm and Trip.

If this setpoint is **NO**, the 269 Plus detects a motor stop condition when current drops below 5% of CT. This may result in nuisance lockouts if the motor (synchronous or induction) is running unloaded or idling, and if the starts/hour or time between starts are programmed.

**Range:** YES, NO  
**Factory Value:** NO (enable Spare Input Alarm and Trip)

### SPARE INPUT ALARM TIME DELAY = XXX SEC.

This line sets the Spare Input Alarm time delay (see the SPARE INPUT TERMINALS in Chapter 2 for details). Seen only if **SPARE INPUT TO READ 52 CONTACT?** is set to **NO**.

**Range:** 1 to 254 seconds in steps of 1 sec. or OFF  
**Factory Value:** OFF.

### SPARE INPUT TRIP TIME DELAY = XXX SEC.

This line sets the Spare Input Trip time delay (see the SPARE INPUT TERMINALS in Chapter 2 for details). Seen only if **SPARE INPUT TO READ 52 CONTACT?** is set to **NO**.

**Range:** 1 to 254 seconds in steps of 1 sec. or OFF  
**Factory Value:** OFF.

### 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).

**Range:** 1 to 254 minutes in steps of 1 min. or OFF  
**Factory Value:** OFF.

### TIME BETWEEN STARTS TIME DELAY

This setpoint is used to inhibit the current start attempt if the time specified has not elapsed since the most recent start.

**Range:** 1 to 254 minutes or OFF, in steps of 1 (OFF disables this function)  
**Factory Value:** OFF.
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 18 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 5    | 36   | **FLC THERMAL CAPACITY REDUCTION = XX PERCENT**<br>This setpoint sets 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 3.22.<br><br>\[
TCR = \left(1 - \frac{\text{Hot Motor Stall Time}}{\text{Cold Motor Stall Time}}\right) \times 100\%
\]
*Range: 0 to 90% in steps of 1% (0 disables this feature)*<br>*Factory Value = 15%* |
| 5    | 37   | **THERMAL CAPACITY USED ALARM LEVEL = XXX%**<br>This line sets 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.<br><br>*Range: 1 to 100% or OFF, in steps of 1%*<br>*Factory Value = OFF* |
| 5    | 38   | **THERMAL CAPACITY USED TIME DELAY = XXX SEC**<br>This setpoint is used to set the time delay for operation of the Thermal Capacity Alarm function.<br><br>*Range: 1 to 255 seconds in steps of 1 sec.*<br>*Factory Value = 5 seconds* |
| 5    | 39   | **SLAVE ADDRESS = XXX**<br>This setpoint is used to set the address of the relay to distinguish it from other devices in a serial communications link (see the RS485 SERIAL COMMUNICATIONS TERMINALS section in Chapter 2 for details).<br><br>*Range: 1 to 254 or OFF*<br>*Factory Value = 254* |
| 5    | 40   | **END OF PAGE FIVE SETPOINT VALUES** |
This page is used for 269 Plus relay testing both in the field and at the GE Multilin. 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.

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 relay remains in test mode. Normal updating of these Actual Values resumes once the 269 Plus is placed in normal running mode by changing this setpoint to **NO**.

**Range:** YES, NO  
**Factory Value = NO**

This line tests the operation of the output relay contacts and any connected switchgear. This can only be done when the motor is stopped and not tripped. With the access terminals shorted, pressing the **[VALUE V]** or **[VALUE W]** keys, followed by the **[STORE]** key, causes different output relays to change state:

**Range:** 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)

This line forces the relay to read a single RTD. The RTD number is chosen by pressing the **[VALUE ▲]** or **[VALUE ▼]** keys.

**Range:** 1 to 10 in steps of 1 (RTD number to be read continuously)  
This message is not displayed if the answer to the question **ARE THERE ANY RTDS CONNECTED?** is NO (see Setpoints page 2, line 3).

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.

**Range:** NORMAL (unchanged), ZERO (forced to zero), MID (forced to middle of scale)  
FULL (forced to full scale output)
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 20 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 6    | 6    | **STATUS = XXXXXX**  
FOR: XXXXXXXXXXXX SWITCH  
This line checks the status (either OPEN or SHORT) of any of the following terminals:  
Reset: EXT.RESET, EMG.RESTART, ACCESS, SPEED, DIFF., SPARE |
| 6    | 7    | **SOFTWARE ACCESS = OFF**  
ACCESS STATUS: ENABLED  
This line displays the access status as **ENABLED** or **DISABLED**, reflecting whether setpoints may be stored or not. Setting this value of **OFF** the software access feature. Access is then strictly a function of the access jumper. Once the status is **ENABLED**, a value between 1 and 500 may be stored to activate the software access feature. The stored value is displayed until the user moves to a new line, presses the [CLEAR] button, or access is disabled. The access status remains 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 the software access code.  
**Range**: 0 to 500 or **OFF**, in steps of 1 (**OFF** disables the software access feature).  
**Factory Value** = **OFF** |
| 6    | 8    | **SERVICE USE ONLY**  
**CODE = XX**  
This line is used by GE Multilin service personnel for calibration and service. |
| 6    | 9    | **CAN.SERVICE: 905-294-6222**  
**http://www.gemultilin.com**  
Canadian and United States service phone number and web site. |
| 6    | 10   | **ENCRYPTED SECURITY**  
**ACCESS CODE = XXX**  
In the event that the user should forget or lose the software access code, this value may be used by GE Multilin service personnel for deciphering. |
| 6    | 11   | **MULTILIN 269 PLUS RELAY**  
**REVISION 269P.XX.X**  
This is the 269 Plus relay firmware revision identifier line. |
| 6    | 12   | **269 PLUS SERIAL NUMBER**  
**SERIAL #: E52 X XXXX**  
This is the 269 Plus relay serial number identifier, where:  
**E**: Hardware revision  
**52**: Product code  
**X**: Last digit of production year  
**XXXX**: Four digit serial number |
This page enables the 269 Plus to display and/or trip and alarm on voltage or power values received from a GE Multilin MPM meter.

**NOTE:** The CT and VT ratio must be programmed before "YES" is entered for this setpoint.

*Range:* YES (initiates communication and enables all page 7 setpoints)  
NO (disables communications and disables all page 7 setpoints).

Factory Value = NO

---

This message is shown when the answer to the question in the above setpoint is NO; i.e. the meter is not online.

**NOTE:** Failure to enter a correct value for CT primary will result in incorrect values from the meter!

*Range:* 20 to 1500 A in steps of 1 A.  
Factory Value = 100

**NOTE:** Failure to enter a correct value for VT ratio will result in incorrect values from the meter.

*Range:* 1 to 255 in steps of 1  
Factory Value = 1
### Table 3–3: 269 Plus Setpoints (Sheet 22 of 25)

<table>
<thead>
<tr>
<th>Page</th>
<th>Line</th>
<th>Information Line</th>
</tr>
</thead>
</table>
| **6** | **METER PHASE VT SECONDARY**<br>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.  
Range: 40 to 240 V in steps of 1 V  
Factory Value = 120 volts |
| **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.  
Range: YES (Enables undervoltage trip & 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, no undervoltage trip or alarm is issued. 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) |
| **8** | **UNDERVOLTAGE ALARM LEVEL**<br>U/V ALARM = XX %VT | This line sets the threshold for the undervoltage alarm as a percentage of VT primary. The alarm level programmed here is compared to the average voltage received from the meter.  
To detect an undervoltage trip upon complete loss of all three phases, the ENABLE U/V TRIP & ALARM IF AVG. VOLTS=0? setpoint must be set to YES.  
Range: 30 to 95% of VT or OFF, in steps of 1%  
Factory Value = OFF |
| **9** | **U/V ALARM TIME DELAY**<br>TIME DELAY = XXX SEC | This setpoint sets the time that an undervoltage alarm condition must persist in order to facilitate an alarm.  
Range: 1 to 255 seconds in steps of 1 sec.  
Factory Value = 10 seconds |
| **10** | **UNDERVOLTAGE TRIP LEVEL**<br>U/V TRIP = XX %VT | This line sets the threshold for the undervoltage trip condition as a percentage of VT primary. This value is compared to the average voltage received from the meter.  
To detect an undervoltage trip upon complete loss of all three phases, the ENABLE U/V TRIP & ALARM IF AVG. VOLTS=0? setpoint must be set to YES.  
Range: 30 to 95% of VT or OFF, in steps of 1%  
Factory Value = OFF |
TABLE 3–3: 269 PLUS SETPOINTS (SHEET 23 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 7    | 11   | **U/V TRIP TIME DELAY**  
|      |      | TIME DELAY = XXX SEC |

This line sets the time for an undervoltage trip condition to persist in order to facilitate a trip.  
*Range: 1 to 255 seconds in steps of 1 sec.*  
*Factory Value = 5 seconds*

| 7    | 12   | **OVERVOLTAGE ALARM LEVEL**  
|      |      | O/V ALARM = XXX %VT |

This line sets the threshold for the overvoltage alarm as a percentage of VT primary. The alarm level programmed here is compared to the average voltage received from the meter.  
*Range: 101 to 115% of VT or OFF, in steps of 1%*  
*Factory Value = OFF.*

| 7    | 13   | **OVERVOLTAGE ALARM TIME DELAY = XXX SEC** |

Sets the time that an overvoltage alarm must persist in order to facilitate an alarm. The alarm level programmed here is compared to the average voltage received from the meter.  
*Range: 1 to 255 seconds in steps of 1 sec.*  
*Factory Value = 10 seconds*

| 7    | 14   | **OVERVOLTAGE TRIP LEVEL**  
|      |      | O/V TRIP = XXX %VT |

This line sets the threshold for the overvoltage trip condition as a percentage of VT primary. The trip level programmed here is compared to the average voltage received from the meter.  
*Range: 101 to 115% of VT or OFF, in steps of 1%*  
*Factory Value = OFF.*

| 7    | 15   | **U/V TRIP TIME DELAY**  
|      |      | TIME DELAY = XXX SEC |

This line sets the time that an overvoltage trip must persist in order to facilitate a trip.  
*Range: 1 to 255 seconds in steps of 1 sec.*  
*Factory Value = 5 seconds*

| 7    | 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.  
*Range: YES (BLOCK PF ALARM & TRIP ON START BY is shown and may be enabled; PF PROTECTION DELAY is not shown), NO (BLOCK PF ALARM & TRIP ON START BY is not shown; PF PROTECTION DELAY is shown and may be enabled)*  
*Factory Value = NO.*
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 24 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>17</td>
<td><strong>BLOCK PF ALARM &amp; TRIP</strong>&lt;br/&gt;<strong>ON START BY: XXX SECONDS</strong>&lt;br/&gt;When enabled, Power Factor alarm and trip protection are blocked from the time the motor starts until the time delay programmed expires.&lt;br/&gt;Range: 1 to 254 seconds or OFF, in steps of 1 sec. (OFF disables this function)&lt;br/&gt;Factory Value = OFF</td>
</tr>
<tr>
<td>7</td>
<td>18</td>
<td><strong>PF PROTECTION DELAY</strong>&lt;br/&gt;<strong>TIME DELAY = XXX SEC</strong>&lt;br/&gt;When enabled after a successful start, the power factor must be within range of the power factor lead/lag trip levels for this time before the power factor trip &amp; alarm features are active.&lt;br/&gt;Range: 1 to 254 seconds or OFF, in steps of 1 sec. (OFF disables this function)&lt;br/&gt;Factory Value = OFF</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td><strong>POWER FACTOR LEAD</strong>&lt;br/&gt;<strong>ALARM LEVEL = X.XX</strong>&lt;br/&gt;This line sets the power factor &quot;lead&quot; alarm threshold level for a power factor alarm condition.&lt;br/&gt;Range: 0.05 to 0.99 in steps of 0.01 or OFF. Factory Value = OFF</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td><strong>POWER FACTOR LAG</strong>&lt;br/&gt;<strong>ALARM LEVEL = X.XX</strong>&lt;br/&gt;This line sets the power factor &quot;lag&quot; alarm threshold level for a power factor alarm condition.&lt;br/&gt;Range: 0.05 to 0.99 or OFF, in steps of 0.01&lt;br/&gt;Factory Value = OFF</td>
</tr>
<tr>
<td>7</td>
<td>21</td>
<td><strong>POWER FACTOR ALARM</strong>&lt;br/&gt;<strong>TIME DELAY = XXX</strong>&lt;br/&gt;This line sets the time that a power factor alarm condition must persist to facilitate an alarm.&lt;br/&gt;Range: 1 to 255 seconds in steps of 1 sec.&lt;br/&gt;Factory Value = 10 seconds</td>
</tr>
<tr>
<td>7</td>
<td>22</td>
<td><strong>POWER FACTOR LEAD</strong>&lt;br/&gt;<strong>TRIP LEVEL = X.XX</strong>&lt;br/&gt;This line sets the power factor &quot;lead&quot; trip threshold level for a power factor trip condition.&lt;br/&gt;Range: 0.05 to 0.99 or OFF, in steps of 0.01&lt;br/&gt;Factory Value = OFF</td>
</tr>
<tr>
<td>7</td>
<td>23</td>
<td><strong>POWER FACTOR LAG</strong>&lt;br/&gt;<strong>TRIP LEVEL = X.XX</strong>&lt;br/&gt;This setpoint sets the power factor &quot;lag&quot; trip threshold level for a power factor trip condition.&lt;br/&gt;Range: 0.05 to 0.99 or OFF, in steps of 0.01&lt;br/&gt;Factory Value = OFF</td>
</tr>
</tbody>
</table>
### TABLE 3–3: 269 PLUS SETPOINTS (SHEET 25 OF 25)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>LINE</th>
<th>INFORMATION LINE</th>
</tr>
</thead>
</table>
| 7    | 24   | **POWER FACTOR TRIP**  
**TIME DELAY = XXX**  
This line sets the time that a power factor trip condition must persist to facilitate a trip.  
*Range: 1 to 255 seconds in steps of 1 sec.*  
*Factory Value = 5 seconds* |
| 7    | 25   | **POSITIVE KVAR ALARM**  
**LEVEL = +XXXXX KVARS**  
This setpoint is used to set the positive KVAR limit threshold for a kvar alarm condition.  
*Range: 100 to 25000 KVARS or OFF, in steps of 100*  
*Factory Value = OFF* |
| 7    | 26   | **NEGATIVE KVAR ALARM**  
**LEVEL = -XXXXX KVARS**  
This setpoint is used to set the negative KVAR limit threshold for a kvar alarm condition.  
*Range: 100 to 25000 KVARS or OFF, in steps of 100*  
*Factory Value = OFF* |
| 7    | 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.  
*Range: 1 to 255 seconds in steps of 1 sec.*  
*Factory Value = 5 seconds* |
| 7    | 28   | **ENABLE VOLTAGE PHASE REVERSAL? XXX**  
This line enables or disables the phase reversal trip feature as detected from the meter monitoring the line voltages.  
*Range: YES - enable voltage phase reversal; NO - disable voltage phase reversal* |
| 7    | 29   | **ANALOG OUT SCALE FACTOR**  
100KWxXXX 30KVARxXXX  
This line sets the full scale value for the meter's analog output (kW and kvars).  
*Range: 1 to 255 in steps of 1. Factory Value = 1* |
| 7    | 30   | **END OF PAGE SEVEN**  
**SETPOINT VALUES** |
3 SETUP AND USE

HEHelp Mode

3.6 HELP MODE

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

If the [HELP] key is pressed on the first line of a page the following message appears:

Press KEY of interest or HELP again for details

Press the key for which instruction is required or press [HELP] again for information on the previously displayed ACTUAL VALUES, SETPOINTS, or TRIP/ALARM message. When the desired key is pressed, the following message appears:

Press LINE DOWN for info or CLEAR to exit

The [LINE ▼] key displays the requested HELP message.

If the [HELP] key is pressed when any line that is not a page header is displayed, the 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 returns the display to the page and line of the mode in effect when the [HELP] key was originally pressed. The [ACTUAL VALUES] and [SETPOINTS] keys may also be pressed to exit HELP mode.

3.7 TRIP/ALARM MODE

The TRIP/ALARM mode can only be entered when an actual motor value exceeds a setpoint value or an alarm becomes active. Every trip and alarm condition has a separate message to easily identify the exact nature of the problem.

TRIP/ALARM mode is 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, press the [ACTUAL VALUES], [SETPOINTS], or [HELP] keys. This will not change the state of the output relays, but allows access to other motor and relay information so the cause of the trip may be determined. The active TRIP/ALARM messages are found in Actual Values page 5, immediately preceding the pre-trip motor data. If any trip/alarm function is active and no keypress occurs for 20 seconds, the display returns to the appropriate TRIP/ALARM message.

Only one type of relay trip can occur at any time. However, a trip and an alarm, or multiple alarms, can occur simultaneously. In this case, the TRIP/ALARM message for the trip or alarm with the highest priority is displayed. Any other active messages can be examined by using the [LINE ▼] key. The complete set of TRIP/ALARM messages is shown in the following table. The messages are shown in order of display priority.

Only one TRIP function or inhibit can occur at any one time. TRIP functions must 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, other ALARM messages may be viewed with the LINE DOWN key.
### Table 3–4: TRIP/ALARM MESSAGES AND FAULT DIAGNOSIS

<table>
<thead>
<tr>
<th>PRI</th>
<th>INFORMATION LINE</th>
<th>EXPLANATION</th>
<th>SUGGESTIONS</th>
<th>MANUAL SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SELF TEST ALARM</td>
<td>Problem in A/D circuit detected by internal self-test. Service required.</td>
<td>Return relay for service.</td>
<td>3.24</td>
</tr>
<tr>
<td></td>
<td>A/D H/W FAIL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SELF TEST ALARM</td>
<td>Problem in RTD circuit detected by internal self-test. Service required. Number of stator RTDs is set to 0, and all RTD setpoints are set to OFF.</td>
<td>Return relay for service.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RTD H/W FAIL. RTDs OFF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SELF TEST ALARM</td>
<td>Problem in RAM detected by internal self-test. Service required.</td>
<td>Return relay for service.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAM FAIL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SELF TEST ALARM</td>
<td>Problem in NOVRAM detected by internal self-test. Service required.</td>
<td>Return relay for service.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FACTORY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>PHASE S/C TRIP</td>
<td>Short Circuit Trip Level exceeded for a time greater than the Short Circuit Time Delay.</td>
<td>Check for motor winding shorts.</td>
<td>3.15</td>
</tr>
<tr>
<td>3</td>
<td>RAPID TRIP</td>
<td>Rapid trip / Mech. Jam Trip Level exceeded for a time greater than the Rapid Trip Time Delay.</td>
<td>Check system for jams / excessive load.</td>
<td>3.14</td>
</tr>
<tr>
<td>4</td>
<td>SINGLE PHASE TRIP</td>
<td>Unbalance of over 30% present for a time greater than 4 seconds.</td>
<td>Check continuity of incoming three phase supply.</td>
<td>3.11</td>
</tr>
<tr>
<td>5</td>
<td>GROUND FAULT TRIP</td>
<td>Ground Fault Trip Level exceeded for a time greater than the Ground Fault Trip Time Delay.</td>
<td>Check for motor winding to case or ground shorts. Check motor for moisture or conductive particles.</td>
<td>3.12</td>
</tr>
<tr>
<td>6</td>
<td>OVERLOAD TRIP</td>
<td>Motor thermal capacity exceeded. Motor lock-out time is also shown.</td>
<td>Excessive load with motor running or locked rotor on start. Wait for motor to cool.</td>
<td>3.19</td>
</tr>
<tr>
<td></td>
<td>LOCKOUT TIME = XXX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>START INHIBIT</td>
<td>Insufficient thermal capacity available for motor to start (i.e. less than Learned Start Capacity)</td>
<td>Wait for motor to cool.</td>
<td>3.21</td>
</tr>
<tr>
<td></td>
<td>LOCKOUT TIME = XXX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>STARTS/HOUR</td>
<td>Total number of motor starts over the past hour greater than Number of Starts per Hour setpoint.</td>
<td>Reduce number of starts during normal motor operation.</td>
<td>3.10, 3.4a</td>
</tr>
<tr>
<td></td>
<td>LOCKOUT TIME = XXX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>TIME BETWEEN STARTS</td>
<td>Time elapsed since the last start has not exceeded Time Between Starts setpoint.</td>
<td>Wait until Inhibit expires.</td>
<td>3.4a</td>
</tr>
<tr>
<td></td>
<td>LOCKOUT TIME = XXX MIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>BACKSPIN TIMER</td>
<td>Time elapsed since motor has stopped has not exceeded the Backspin Timer setpoint</td>
<td>Wait until inhibit expires.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOCKOUT TIME = XXX MIN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>UNBALANCE TRIP</td>
<td>Unbalance Trip Level exceeded for a time greater than the Unbalance Trip Time Delay (all phases &gt; 0.1 × FLC).</td>
<td>Check incoming supply phases for unbalance; Check for motor winding shorts; Increase Trip Level if required.</td>
<td>3.11</td>
</tr>
</tbody>
</table>

* Available only if a GE Multilin meter (MPM) is installed and on-line (see Setpoints page 7, line 2)
Table 3–4: TRIP/ALARM MESSAGES AND FAULT DIAGNOSIS (Continued)

<table>
<thead>
<tr>
<th>PRI</th>
<th>INFORMATION LINE</th>
<th>EXPLANATION</th>
<th>SUGGESTIONS</th>
<th>MANUAL SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>STATOR RTD TRIP</td>
<td>Stator RTD Trip Level temperature exceeded on at least 1 stator RTD.</td>
<td>Check motor ventilation and ambient temperature. Allow motor to cool.</td>
<td>3.17</td>
</tr>
<tr>
<td></td>
<td>RTD # X = XXX C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>RTD TRIP</td>
<td>RTD Trip Level temperature exceeded.</td>
<td></td>
<td>3.18</td>
</tr>
<tr>
<td></td>
<td>RTD # X = XXX C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>ACCEL. TIME TRIP</td>
<td>Motor did not enter a normal running state (i.e. phase current &lt; FLC) within Acceleration Time setpoint.</td>
<td>Excessive load or locked rotor on start.</td>
<td>3.9</td>
</tr>
<tr>
<td>15*</td>
<td>PHASE REVERSAL TRIP</td>
<td>Phases not connected to motor in proper sequence.</td>
<td>Check incoming phase sequence and VT polarity.</td>
<td>3.20</td>
</tr>
<tr>
<td>16</td>
<td>UNDERCURRENT TRIP</td>
<td>Phase current less than U/C Trip setpoint for a time period greater than the U/C trip time delay.</td>
<td>Check system for loss of load.</td>
<td>3.13</td>
</tr>
<tr>
<td>17</td>
<td>SPEED SWITCH TRIP</td>
<td>Non-closure of speed switch contacts within Speed Switch Time Delay</td>
<td>Locked motor on start</td>
<td>2.16</td>
</tr>
<tr>
<td>18</td>
<td>DIFFERENTIAL INPUT TRIP</td>
<td>Closure of differential relay contacts.</td>
<td>Differential relay trip</td>
<td>2.15</td>
</tr>
<tr>
<td>19</td>
<td>SPARE INPUT TRIP</td>
<td>Spare Input contact closure</td>
<td>Check device connected to Spare Input terminals</td>
<td></td>
</tr>
<tr>
<td>20*</td>
<td>UNDERVOLTAGE TRIP</td>
<td>Low incoming voltage from substation.</td>
<td>Adjust transformer tap changer.</td>
<td></td>
</tr>
<tr>
<td>21*</td>
<td>OVERVOLTAGE TRIP</td>
<td>High incoming voltage from substation.</td>
<td>Adjust transformer tap changer.</td>
<td></td>
</tr>
<tr>
<td>22*</td>
<td>POWER FACTOR TRIP</td>
<td>Fault in excitation control system.</td>
<td>Check excitation.</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>OVERLOAD WARNING TIME TO TRIP = XXXXX</td>
<td>Phase current greater than Immediate O/L Level setpoint.</td>
<td>Reduce motor load.</td>
<td>3.16</td>
</tr>
<tr>
<td>24</td>
<td>GROUND FAULT ALARM G/F = XX PERCENT</td>
<td>Ground Fault Alarm Level exceeded for a time greater than the Ground Fault Time Delay.</td>
<td>Check motor windings for shorts, moisture, or conductive particles.</td>
<td>3.12</td>
</tr>
<tr>
<td>25</td>
<td>UNBALANCE ALARM U/B = XX %</td>
<td>Unbalance Alarm Level exceeded for a time greater than the Unbalance Time Delay.</td>
<td>Check incoming phases for unbalance.</td>
<td>3.11</td>
</tr>
<tr>
<td>26</td>
<td>UNDERCURRENT ALARM I(3 ph avg) = XXXX A</td>
<td>Phase current less than Undercurrent Alarm Level for a time greater than the Undercurrent Alarm Time Delay.</td>
<td>Check system for loss of load.</td>
<td>3.13</td>
</tr>
</tbody>
</table>

* Available only if a GE Multilin meter (MPM) is installed and on-line (see Setpoints page 7, line 2)
Table 3–4: TRIP/ALARM MESSAGES AND FAULT DIAGNOSIS (Continued)

<table>
<thead>
<tr>
<th>PRI</th>
<th>INFORMATION LINE</th>
<th>EXPLANATION</th>
<th>SUGGESTIONS</th>
<th>MANUAL SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>MECHANICAL JAM ALARM</td>
<td>I(3 ph avg) = XXX AMPS</td>
<td>Phase current exceeded Mechanical Jam Alarm Level for a time greater than the Mechanical Jam Alarm Time Delay.</td>
<td>Check system for jams/excessive load.</td>
</tr>
<tr>
<td>28</td>
<td>STATOR RTD ALARM</td>
<td>RTD # XX = XXX °C</td>
<td>Stator RTD Alarm Level temperature exceeded on at least one stator RTD.</td>
<td>Check motor ventilation and ambient temperature.</td>
</tr>
<tr>
<td>29</td>
<td>RTD ALARM</td>
<td>RTD # XX = XXX °C</td>
<td>RTD Alarm Level temperature exceeded.</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>STATOR RTD HIGH ALARM</td>
<td>RTD # XX = XXX °C</td>
<td>Stator RTD High Alarm Level temperature exceeded.</td>
<td>Check motor ventilation and ambient temperature.</td>
</tr>
<tr>
<td>31</td>
<td>RTD HIGH ALARM</td>
<td>RTD # XX = XXX °C</td>
<td>RTD High Alarm Level temperature exceeded.</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>BROKEN RTD LINE</td>
<td>see RTD ACTUAL VALUES</td>
<td>Open circuit on RTD.</td>
<td>Check continuity of RTDs.</td>
</tr>
<tr>
<td>33</td>
<td>LOW TEMPERATURE ALARM</td>
<td>RTD # XX</td>
<td>Indicates a possibly shorted RTD in ambient temperature above 0°C.</td>
<td>Check continuity of RTDs.</td>
</tr>
<tr>
<td>34</td>
<td>SPARE INPUT ALARM</td>
<td></td>
<td>Spare Input contact closure</td>
<td>Check device connected to Spare Input terminals</td>
</tr>
<tr>
<td>35</td>
<td>THERMAL CAPACITY ALARM</td>
<td>USED = XXX PERCENT</td>
<td>Thermal capacity used equals or exceeds setpoint</td>
<td></td>
</tr>
<tr>
<td>36•</td>
<td>UNDERVOLTAGE ALARM</td>
<td>V(3 ph avg) = XXXXX</td>
<td>Low incoming voltage from substation.</td>
<td>Adjust transformer tap changer.</td>
</tr>
<tr>
<td>37•</td>
<td>OVERVOLTAGE ALARM</td>
<td>V(3 ph avg) = XXXXX</td>
<td>High incoming voltage from substation.</td>
<td>Adjust transformer tap changer.</td>
</tr>
<tr>
<td>38•</td>
<td>POWER FACTOR ALARM</td>
<td>PF = XX.XX LAG</td>
<td>Fault in excitation control system.</td>
<td>Check excitation.</td>
</tr>
<tr>
<td>39•</td>
<td>KVAR LIMIT ALARM</td>
<td>KVAR = +XXXXX</td>
<td>Machine KVAR limit exceeded.</td>
<td>Adjust excitation.</td>
</tr>
<tr>
<td>40•</td>
<td>METER FAILURE (COMMUNICATION HARD-</td>
<td></td>
<td>Meter is not connected or not responding.</td>
<td>Check meter control power; Check meter wiring</td>
</tr>
<tr>
<td>41•</td>
<td>METER FAILURE (INCOMPATIBLE REVI-</td>
<td></td>
<td>Meter firmware is an older revision than the 269 Plus firmware.</td>
<td>Upgrade meter firmware</td>
</tr>
</tbody>
</table>

* Available only if a GE Multilin meter (MPM) is installed and on-line (see Setpoints page 7, line 2)
3.8 PHASE CT & MOTOR FULL LOAD CURRENT SETPOINTS

The **PHASE CT RATIO** is entered in Setpoints page 1. This value must be entered correctly for the relay to read the actual motor phase currents. The choice of phase CTs depends on the motor Full Load Current. 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 motor FLC should be equal to the phase CT primary, but never more (see the PHYSICAL DIMENSIONS and PHASE CT INPUTS sections). The maximum phase CT primary current is 1500 A. For higher ratings, please contact GE Multilin.

The **MOTOR FULL LOAD CURRENT** is used 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 in Setpoints page 1.

If the motor has a service factor, it may be accommodated using the **OVERLOAD PICKUP LEVEL** setpoint; see Sections 3.20 and 3.22 for additional information.

When the relay detects a current greater than the **OVERLOAD PICKUP LEVEL** × FLC, the time/overload curve comes into effect and the Trip relay activates 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.

3.9 ACCELERATION TIME SETPOINT

The acceleration time of the drive system is entered in Setpoints 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 (i.e. synchronous 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 the INHIBITS section).

To protect against a locked rotor condition the 269 Plus relay allows its thermal memory (see the THERMAL MEMORY section) 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 **ACCEL. TIME** function is not required, the setpoint should be set to **OFF**.
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 lock-out time remaining. Neither 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 and 3.23 for details).

The allowable number of motor Starts per Hour is entered in Setpoints page 1. The relay keeps a record of the number of motor starts over the past hour and causes 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 value 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 relay must detect all motor start attempts (see the ACCELERATION TIME SETPOINT section above) in order for this feature to operate correctly.

A value in minutes for the TIME BETWEEN STARTS feature is entered in Setpoints page 5. The time between starts timer is loaded during a start condition and begins to decrement (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 3.22.

A value in minutes for the BACKSPIN TIMER is entered in Setpoints page 5. This timer prevents 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 this setpoint is enabled, the timer is loaded once the motor starts and the inhibit becomes active. The inhibit will time out when the Backspin Timer is zero and another start will be possible.

It is recommended that a very liberal time be set for the BACKSPIN TIMER as it is only a timer and cannot sense motor rotation!

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 will allow the 269 Plus to 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 Actual Values page 5 clearly shows whether the last event was a TRIP or an INHIBIT.

Inhibit lockouts are assigned to the AUX1 relay as a factory default. Ensure that AUX1 contactors are properly wired in your control circuit. See the WIRING DIAGRAM FOR CONTACTORS and WIRING DIAGRAM FOR BREAKERS figures in this chapter for wiring details.
3 SETUP AND USE

3.11 UNBALANCE SETPOINTS

Unbalanced three-phase supply voltages are a major cause of induction motor thermal damage. Unbalance is 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 in 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.

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 calculates the ratio of the negative to positive sequence currents ($I_n/I_p$) and uses this ratio in two separate protective functions. It is used to bias the 269 Plus thermal memory which represents the thermal capacity of the motor as a whole (enabled in Setpoints page 5). The method of determining $I_n/I_p$ is independent of actual line frequency or phase current lead/lag characteristics, and when enabled is used to bias the thermal memory. 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 an unbalance example see Appendix A). For phase currents below 100% FLC, the relay calculates the ratio of $I_n$ to full load current ($I_n/I_{FLC}$) and uses this to provide protection. This avoids nuisance trips due to relatively high levels of $I_n$ with lower levels of $I_p$ that may create high U/B levels at low loads.

For unbalance protection, trip and alarm $I_n/I_p$ ratios may be chosen along with appropriate persistence times (time delays) in Setpoints page 1. If no separate 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 greater than 25%, and any one phase reads zero, this will also be considered a single phase condition. The single phase time delay can be adjusted by contacting the factory.

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. For example, if 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 motors driving 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.
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, all three of the motor conductors must pass through a separate ground fault CT (see the GROUND CT INPUT section in Chapter 2). The CT may be either GE Multilin’s 50:0.025A (2000:1 ratio) or 50:5 up to 1500:5 and is chosen in Setpoints page 1. Separate ground fault trip and alarm levels, 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 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.

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.
3.13 CONTACTOR/BREAKER WIRING

NOTES
OUTPUT CONTACTS SHOWN WITH CONTROL POWER APPLIED AND NO TRIPS OR ALARM PRESENT
FAILSAFE CODE = "8"
TRIP IS NON-FAILSAFE
ALARM IS NON-FAILSAFE
AUX.1 IS NON-FAILSAFE
AUX.2 IS FAILSAFE

Figure 3–2: WIRING DIAGRAM FOR CONTACTORS

Figure 3–3: WIRING DIAGRAM FOR BREAKERS
3.14 UNDERCURRENT SETPOINTS

These setpoints are located in Setpoints 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 setpoint, 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.

3.15 RAPID TRIP / MECHANICAL JAM SETPOINTS

These setpoints are found in Setpoints 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 setpoints should be set to OFF. The RAPID TRIP TIME DELAY and MECHANICAL JAM TIME DELAY setpoints will then be disregarded by the relay.

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

3.16 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 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.

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 SETUP AND USE

IMMEDIATE OVERLOAD ALARM SETPOINT

3.17 IMMEDIATE OVERLOAD ALARM SETPOINT

The IMMEDIATE OVERLOAD ALARM LEVEL setpoint is located at Setpoints page 1, line 30. It is adjustable from 1.01 to 1.50 \( \times \) 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.

3.18 STATOR RTD SETPOINTS

The 269 Plus is ordered with one of the following RTD types: 100 \( \Omega \) platinum, 10 \( \Omega \) copper, 100 \( \Omega \) nickel, or 120 \( \Omega \) nickel. Setpoints page 2, line 2, indicates the type of RTD built into the relay. It is possible to operate the 269 Plus without connecting any RTDs. Setpoints page 2, line 3, asks the question:

\[ \text{ARE THERE ANY RTDS CONNECTED? NO} \]

If the answer is NO, the 269 Plus hides all RTD related setpoints and actual values, making it easier to program the application. If Alarm and Trip Levels are set prior to setting this setpoint to NO, alarms and trips will still remain active.

The 269 Plus displays temperatures in either degrees 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.

CARE MUST BE TAKEN NOT TO ENTER CELSIUS VALUES FOR SETPOINT PARAMETERS WHEN IN FAHRENHEIT MODE AND VICE-VERSA.

A WARNING

The 269 Plus 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 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 to 12).

There are individual trip, alarm, and high alarm setpoints for each stator RTD, and trip and alarm setpoints for other (e.g. bearing) RTDs. For stator RTDs, a TRIP relay activation will occur when at least two stator RTDs exceed 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 calculations.

The RTD temperature readings may be displayed in Actual Values mode. If no connection is made to the RTD terminals, the display for that RTD reads "no RTD". If the answer to ARE THERE ANY RTDS CONNECTED? is NO, the display shows NO RTDS ARE CONNECTED TO THE 269 PLUS. If the # OF STATOR RTDS USED setpoint is 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 reads "no RTD". The disconnected RTD will then be ignored. The 269 Plus will enter TRIP/ALARM mode to warn the user of the faulty RTD if the NO SENSOR ALARM is enabled (see Setpoints page 5). Similarly, if the LOW TEMPERATURE ALARM is enabled (see Setpoints page 5) the relay enters 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 tem-
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 will not allow the active output relays to be reset until the temperature has fallen 4°C below the exceeded setpoint.

### 3.19 OTHER RTD SETPOINTS

A total of 10 RTD inputs are provided with 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 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 read “no RTD”. If the **NO SENSOR ALARM** is enabled (see 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 (see 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 269 Plus RTD terminals must all be of the same type. After an RTD temperature trip or alarm setpoint is exceeded, the 269 Plus 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 for ambient air temperature sensing a setpoint in Setpoints page 5 must be changed (see the STARTS/HOUR TIMER sub-section earlier in this chapter).

> **NOTE**

Once correct control power is applied to the 269 Plus relay, a clicking sound will be heard approximately every second. This normal operation indicates that the relay is scanning through the RTDs regardless if RTDs are in use.
The overload curve is chosen in Setpoints page 3. The curve will come into effect when the motor phase current goes over the Overload Pickup level \( \times \) FLC (see the figure below). 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 the THERMAL MEMORY section). A choice of eight standard curves, as shown in the STANDARD OVERLOAD CURVES figure, is available for the 269 Plus.

**Figure 3–4: STANDARD OVERLOAD CURVES WITH OVERLOAD PICKUP**
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.

If one of the standard curves is desired for the given application, then the CUSTOM CURVE? setpoint should be NO. In this case, the desired curve can be chosen from one of the eight standard curves. If a different curve is required, then the CUSTOM CURVE? setpoint should be YES. In this case, the following lines in the setpoints page will be the choice of breakpoints as shown in Section 3.5. These points should be entered and checked carefully since motor overload protection will be largely based on the chosen 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? setpoint and then examining the next few lines of setpoint values. The overload levels and trip times are shown in the following table.

Table 3–5: STANDARD OVERLOAD CURVE TRIP TIMES (IN SECONDS)

<table>
<thead>
<tr>
<th>OVERLOAD LEVEL</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.05</td>
<td>853</td>
<td>1707</td>
<td>2560</td>
<td>3414</td>
<td>5975</td>
<td>7682</td>
<td>10243</td>
<td>12804</td>
</tr>
<tr>
<td>1.10</td>
<td>416</td>
<td>833</td>
<td>1249</td>
<td>1666</td>
<td>2916</td>
<td>3749</td>
<td>4999</td>
<td>6249</td>
</tr>
<tr>
<td>1.20</td>
<td>198</td>
<td>397</td>
<td>596</td>
<td>795</td>
<td>1391</td>
<td>1789</td>
<td>2385</td>
<td>2982</td>
</tr>
<tr>
<td>1.30</td>
<td>126</td>
<td>253</td>
<td>380</td>
<td>507</td>
<td>887</td>
<td>1141</td>
<td>1521</td>
<td>1902</td>
</tr>
<tr>
<td>1.40</td>
<td>91</td>
<td>182</td>
<td>273</td>
<td>364</td>
<td>637</td>
<td>820</td>
<td>1093</td>
<td>1366</td>
</tr>
<tr>
<td>1.50</td>
<td>70</td>
<td>140</td>
<td>210</td>
<td>280</td>
<td>490</td>
<td>630</td>
<td>840</td>
<td>1050</td>
</tr>
<tr>
<td>1.75</td>
<td>42</td>
<td>84</td>
<td>127</td>
<td>169</td>
<td>296</td>
<td>381</td>
<td>508</td>
<td>636</td>
</tr>
<tr>
<td>2.00</td>
<td>29</td>
<td>58</td>
<td>87</td>
<td>116</td>
<td>203</td>
<td>262</td>
<td>349</td>
<td>436</td>
</tr>
<tr>
<td>2.25</td>
<td>21</td>
<td>43</td>
<td>64</td>
<td>86</td>
<td>150</td>
<td>193</td>
<td>258</td>
<td>322</td>
</tr>
<tr>
<td>2.50</td>
<td>16</td>
<td>33</td>
<td>49</td>
<td>66</td>
<td>116</td>
<td>149</td>
<td>199</td>
<td>249</td>
</tr>
<tr>
<td>2.75</td>
<td>13</td>
<td>26</td>
<td>39</td>
<td>53</td>
<td>92</td>
<td>119</td>
<td>159</td>
<td>198</td>
</tr>
<tr>
<td>3.00</td>
<td>10</td>
<td>21</td>
<td>32</td>
<td>43</td>
<td>76</td>
<td>98</td>
<td>131</td>
<td>163</td>
</tr>
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<td>3.50</td>
<td>7</td>
<td>15</td>
<td>23</td>
<td>30</td>
<td>54</td>
<td>69</td>
<td>92</td>
<td>115</td>
</tr>
<tr>
<td>4.00</td>
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</table>

* Factory preset value.
Figure 3–5: STANDARD OVERLOAD CURVES
If the standard curves do not sufficiently match the motor data, the 269 Plus allows for the creation of a custom overload curve. Motors with non-standard overload characteristics can be fully protected since almost any curve shape can be entered. The 269 Plus accepts 22 points and will internally form a smooth curve through these points. If the custom curve requires a discontinuity (shown in B below), the 269 Plus will insert it at the appropriate place. A discontinuity occurs when a time entered is greater than the time entered for the previous overload level. Examples of custom curves and breakpoints are shown below:

### A: smooth curve

<table>
<thead>
<tr>
<th>OVERLOAD LEVEL</th>
<th>TIME TO TRIP SETPOINT</th>
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<tbody>
<tr>
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### B: discontinuity

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**Figure 3–6: CUSTOM CURVE EXAMPLES**
3.21 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.

3.22 THERMAL MEMORY

a) DESCRIPTION

The 269 Plus 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 into 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, the unbalance present, as well as the RTD bias. The RTD bias can be defeated in Setpoints page 5. 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.

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 minutes). 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 × 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, in an exponential fashion, even if control power is removed from the 269 Plus.

Thermal memory can be cleared to 0% by using the Emergency Restart feature (see the EMERGENCY RESTART section in this chapter).

If the phase current is between 1.00 × FLC and the Overload Pickup level × 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) × 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 capacity reduction may be calculated using the following formula:

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

b) U/B INPUT TO THERMAL MEMORY

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

$$ I_{eq} = I_{avg} \quad \text{(with U/B input to thermal memory disabled; factory preset)} $$

$$ I_{eq} = \sqrt{I_p^2 + K \cdot I_n^2} \quad \text{(with U/B input to thermal memory enabled)} $$

where: $$ K = \frac{175}{(I_{start}/I_{FLC})^2} $$
Thus the larger the value for K the greater the effect of current unbalance on the thermal memory of the 269 Plus relay.

c) RTD INPUT TO THERMAL MEMORY

When the hottest Stator RTD temperature is included in the thermal memory (Setpoints 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 CURVE MAXIMUM value (Setpoints page 5, line 11) the thermal capacity used is 100%. When the hottest stator RTD temperature is below the RTD BIAS CURVE MINIMUM value (Setpoints page 5, line 8), 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 designed ambient temperature of the motor (e.g. 40°C), the center point for thermal capacity could be set to the difference between the hot and cold curves (e.g. 15%), the center point temperature could be set for hot running temperature (e.g. 110°C), and, the maximum value could be set to the insulation rating (e.g. 155°C) The RTD bias can be set as liberally or conservatively as the user desires.

The thermal capacity values for the RTD bias curve must increase with temperature. For this reason, there is range checking on the temperature setpoints (e.g. 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 feature as it is based on thermal capacity.
d) LEARNED COOLING TIMES

Through various measurement and averaging techniques the 269 Plus “learns” a number of motor parameters. All learned values can be examined in Actual Values page 6. 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. 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. If no stator RTDs are used, or if the DEFEAT LEARNED COOL TIME setpoint (Setpoints page 5) is left as YES, the relay will use the default stopped and running cool time setpoints.

The learned cooling times should not be enabled until the 269 Plus 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 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.

e) START INHIBIT

An OVERLOAD TRIP caused by the exhaustion of motor thermal capacity will cause a lock-out. A relay reset is not 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 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 learns the actual Start Capacity required by the motor, this value defaults to 40%.

The LEARNED START CAPACITY REQUIRED is the 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 Actual Values page 6 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 Setpoints page 6:

When in this mode, the 269 Plus suspends all learning functions and stops updating the learned parameters on Actual Values page 6 and the statistical parameters Actual Values page 4. 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 INITIAL START CAPACITY, TC REQUIRED (Setpoints page 5) 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:

\[
\text{Lockout Time} = \frac{(\text{SC}_{\text{learned}} + \text{TC} - 100) \times \text{SC}}{100}
\]

where:
- \(\text{SC}_{\text{learned}}\) = learned start capacity required
- \(\text{TC}\) = thermal capacity used
- \(\text{SC}\) = stopped cool time

3.23 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 (see 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 the POWER MEASUREMENT CONVENTIONS figure in this chapter. 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 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.

### 3.24 RESETTING THE RELAY

**a) DESCRIPTION**

Resetting the 269 Plus 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 (see Setpoints 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 (e.g. 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 lockout time, allowing the relay to be reset immediately.

**If RTD input to thermal memory is enabled (see 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 and the maximum stator RTD temperature (see the THERMAL MEMORY section earlier in this chapter)**

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

The 269 Plus 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.

**If an external 86 Lockout device is used and connected to the 269 Plus, ensure that the relay is reset prior to attempting to reset the lockout switch. If the relay is still tripped it will immediately re-trip the lockout switch. Also, if the lockout switch is held reset, the high current draw of the lockout switch coil may cause damage to itself and/or the 269 Plus output relay.**

**b) SINGLE SHOT RESTART**

The 269 Plus 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 lock-out time delay (20 minutes), 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 Setpoints page 5 and is factory preset as disabled.
c) SPECIAL EXTERNAL RESET
The 269 Plus also has a special external reset feature which can be selected in Setpoints page 5. 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.

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.

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).

3.25 RELAY SELF-TEST
The 269 Plus internal circuitry contains three separate self-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.

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.

3.26 STATISTICAL DATA FEATURES
The 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 Actual Values page 2 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 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 Actual Values page 5.

The statistical data (see Actual Values page 4) 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. The statistics on Actual Values page 4 will reset to zero after reaching 255. The running hours and MegaWatt hours data will reset to zero after each reaching the number 65535.
3 SETUP AND USE

If a 269 Plus 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 Actual Values page 4 and call the factory for a detailed procedure on transferring this information to the new relay. The 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.

3.27 FACTORY SETPOINTS

The 269 Plus is shipped with 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 the RELAY SELF-TEST section), the 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 the PRESET FACTORY RELAY CONFIGURATIONS AND FUNCTIONS table. For other factory setpoints see the 269 PLUS SETPOINTS table earlier in this chapter.

3.28 METER OPTION

a) DESCRIPTION

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, the METER PHASE CT PRIMARY, VT RATIO and VT SECONDARY setpoints on Setpoints page 7 must be programmed. These setpoints will be sent to the meter via the communication link for meter calculations.

**IMPORTANT** Only after the above steps are complete may the meter be brought on-line by changing the METER SETPOINTS SET AND METER ON-LINE setpoint (see Setpoints page 7, line 2) to YES. The 269 Plus will then initiate communication with the meter and actual values from the meter may be displayed.

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

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 requires that the measured power factor comes between the user specified **POWER FACTOR TRIP LEAD** and **POWER FACTOR TRIP 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 **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.

**Figure 3–8: POWER MEASUREMENT CONVENTIONS**

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 condenser, 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.

Enabling Voltage Phase Reversal allows the 269 Plus to trip or inhibit based on phase reversal sensed from voltage from the MPM. This allows sensing of phase reversal when the bus is energized before the motor is started. There is a 3 to 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 waveshape.

The **ANALOG OUT SCALE FACTOR** setpoint is entered to set the full-scale value for the MPM analog outputs (kWatts and kvars). The value entered here is the multiplier: it is multiplied by 100 kW to determine the MPM full-scale analog output for kW, or by 30 kvars to determine the MPM analog output Full Scale for kvar. 4 mA represents 0 kW / 0 kvar and 20 mA represents full-scale. Average RMS current is produced in analog form, where 4 to 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 values respectively.

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 an MPM, 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 MPM 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 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.

**b) 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. This is shown in the 269 Plus as positive watts, positive vars and positive watts, negative vars respectively (see the diagram below).

Since the motor is unloaded, the real power or kW required to run the machine is at a 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 below, and hence it has a high value with the field applied. The result is a significantly low power factor 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 is either leading or lagging. This is clearly seen in the POWER MEASUREMENT CONVENTIONS figure, where around 270°, the PF is very low and changes signs with the slightest movement around this angle in either direction.
c) RECOMMENDATIONS

By examining the POWER MEASUREMENT CONVENTIONS diagram, 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 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 above, it can be safely assumed that there may be some switchgear wiring problems. However, it is important not to ignore the other values, since a large kW value (regardless of its sign) is also an indication of wiring problems. Similarly, a large value for the PF, regardless of its sign, is an indication of wiring problems.
### 3.29 PRESET CONFIGURATIONS AND FUNCTIONS

#### OUTPUT RELAY

<table>
<thead>
<tr>
<th>CONFIGURATION / FUNCTION</th>
<th>TRIP</th>
<th>ALARM</th>
<th>AUX. 1</th>
<th>AUX. 2</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latched (Manual Reset)</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unlatched (Automatic Reset)</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fail-safe</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-fail-safe</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### ALARM SIGNALS

<table>
<thead>
<tr>
<th>CONFIGURATION / FUNCTION</th>
<th>TRIP</th>
<th>ALARM</th>
<th>AUX. 1</th>
<th>AUX. 2</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate O/L Warning</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G/F Alarm</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/B Alarm</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/C Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Jam Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stator RTD Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stator RTD High Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTD Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTD High Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broken Sensor Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Temperature Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare Input Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/V Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O/V Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KVAR Alarm</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meter Alarm</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self Test Alarm</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### TRIP SIGNALS

<table>
<thead>
<tr>
<th>CONFIGURATION / FUNCTION</th>
<th>TRIP</th>
<th>ALARM</th>
<th>AUX. 1</th>
<th>AUX. 2</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>O/L Trip</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/B Trip</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/C Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/C Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rapid Trip</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stator RTD Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTD Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G/F Trip</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceleration Time Trip</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase Reversal Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhibits</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed Switch Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differential Relay Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Phase Trip</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare Input Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U/V Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O/V Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Factor Trip</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4 COMMUNICATIONS

4.1 INTRODUCTION

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 Modbus protocol subset supported by the 269 Plus Motor Protection relays. For additional information about the Modbus protocol, visit the www.modbus.org website.

4.2 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, the 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 269Plus relays using up to 4000 ft. of cable are supported.
- Serial communication interface (SCI) boxes can be purchased to support the RS232 standard for the connection of a group of relays on an RS485 bus to a PC or PLC RS232 port.
- Since the operation of the 269 Plus is register based, a master computer can monitor and control relay operation by reading or writing to the relay registers. Therefore, only the Register Read and Write functions of the MODBUS are supported. These are described in Section 4.6: SUPPORTED FUNCTIONS on page 4–5.
- The 269 Plus provides flexibility towards master computer corrective actions upon communication errors and timeouts. This is left to the discretion of the master programmer.

4.3 PHYSICAL LAYER

The electrical interface is a two-wire bidirectional multi-drop RS485 on a shielded twisted-pair cable. A Belden 9841 insulated 24 gauge shielded twisted pair cable should be used. The connection to the 269 Plus is by Terminals 46 (–) and 47 (+), where + is the positive wire and – is 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 RS232 to RS485 converter is used, no grounding of the shield is necessary. The cable should be terminated at the two extreme ends by resistors equal to its characteristic impedance (120 Ω for the Belden 9841 AWG twisted pair) in series with 1 nF / 50 V capacitors. See Figure 4–1: SERIAL COMMUNICATION LINK for details. A terminator assembly with the resistor/capacitor network may be obtained from GE Multilin.

Communication to the 269 Plus is half-duplex. This means that the 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 300 bps). The rates at which data can be communicated are 300, 1200, or 2400 bps. The unit defaults to 2400 bps. If 300 or 1200 bps is desired, contact the factory.

Each relay on the network is identified by a one byte address which is programmed into the 269 Plus non-volatile memory (NOVRAM). This address is located in Setpoints page 5.
Figure 4–1: SERIAL COMMUNICATION LINK
Communication with the 269 Plus occurs in packets, which are groups of asynchronous bytes that are framed by silent time gaps. The packet format of Modbus RTU is adopted by the GE Multilin 269 Plus relays. This format is as follows:

<table>
<thead>
<tr>
<th>SILENT TIME</th>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC</th>
<th>SILENT TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 byte</td>
<td>1 byte</td>
<td>N bytes</td>
<td></td>
<td>2 bytes</td>
<td>1 byte</td>
</tr>
</tbody>
</table>

where:

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

- the SLAVE ADDRESS data block is the ID of the 269 Plus. The SLAVE ADDRESS setpoint must be programmed in Setpoints page 5. Only the addressed 269 Plus responds to the master command. It sends its own ID to the master to identify who is responding. The address 00 is a broadcast address used by the master to issue a command to all slave devices (as per the Modbus protocol). The broadcast command is not supported by 269 Plus and is ignored.

- the FUNCTION data block is the command op-code sent to the slave to indicate which function to perform. The 269 Plus supports Modbus functions 03, 04, and 16 (10H).

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

- the CRC data block 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 the received code is different from that sent, an error in transmission has occurred.
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:

Table 4–1: HANDSHAKE DATA

<table>
<thead>
<tr>
<th>BYTES READ</th>
<th>MIN. RESPONSE TIME (ms)</th>
<th>AVG. RESPONSE TIME (ms)</th>
<th>MAX. RESPONSE TIME (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>66</td>
<td>75</td>
<td>117</td>
</tr>
<tr>
<td>10</td>
<td>78</td>
<td>82</td>
<td>123</td>
</tr>
<tr>
<td>250</td>
<td>206</td>
<td>222</td>
<td>242</td>
</tr>
</tbody>
</table>

If the reply from the slave arrives within this time, and 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. The 269 Plus is quite flexible in this regard: it replies when commanded, regardless of the command 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.
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:

a) FUNCTION 03h: READ SETPOINTS (HOLDING REGISTERS)

The Modbus Read Holding Registers command 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. The broadcast command is not allowed with this function.

The 269 Plus Motor Protection Setpoint Register map is given in the Memory Map. 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:

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>03h</td>
<td>06h 6Bh</td>
<td>00h 03h</td>
</tr>
</tbody>
</table>

Slave number 11h replies with

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>03h</td>
<td>06h 02h 2Bh</td>
<td>00h 00h</td>
</tr>
</tbody>
</table>

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.
b) FUNCTION 04H: READ ACTUAL VALUES (INPUT REGISTERS)

The Modbus Read Input Registers command 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 269 Plus circuit values. The Modbus protocol allows up to 125 registers to be read with one command. The broadcast command is not allowed with this function.

The 269 Plus Actual Value register map is shown in the Table 4–2: 269PLUS MEMORY MAP on page 4–10. 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 one actual value register starting from register address 0008h from slave number 11H, sends the command:

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>04h</td>
<td>00h 08h</td>
<td>00h 01h</td>
</tr>
</tbody>
</table>

Slave number 11h replies with

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>04h</td>
<td>02h 00h</td>
<td>78h F3h</td>
</tr>
</tbody>
</table>

c) FUNCTION 16 (10H): WRITE SETPOINT VALUES

The Modbus Write Multiple Holding Registers command 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 allows 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 highly recommended.

The master computer sends the following command to write 2 consecutive registers starting at address 0087H

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>10h</td>
<td>00h 87h</td>
<td>00h 02h</td>
</tr>
</tbody>
</table>

Slave number 11h replies with

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>10h</td>
<td>00h 87h</td>
<td>F3h 71h</td>
</tr>
</tbody>
</table>
4 COMMUNICATIONS

When the master command 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 the 269 Plus 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

There is no range checking on 269 Plus setpoint values. Therefore, extra care must be taken when writing setpoints directly to the memory map to ensure they are within range.

For example, the master requests reading an actual value register by sending the following data block:

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION</th>
<th>DATA BYTES</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>04h</td>
<td>05h A1h</td>
<td>00h 01h</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SLAVE ADDRESS</th>
<th>FUNCTION with MSB set</th>
<th>ERROR CODE</th>
<th>CRC (low, high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>02h</td>
<td>02h</td>
<td>C3h 04h</td>
</tr>
</tbody>
</table>
a) DESCRIPTION

The error checking code mentioned previously is a standard cyclic redundancy check (CRC). The 269 Plus employs an ANSI CRC-16 scheme. 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 (11000000000000101b). Only the 16-bit remainder of this division is used as the CRC code. It is transmitted MSB first. The receiver calculates the CRC value for the received data and compares this to the sender’s CRC code. If the two CRC codes do not match, an error has occurred. If an error is detected by the receiver, then the received command is not executed and the 269 Plus will not respond. If no errors are detected by the receiver, then the received command is executed.

b) 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). This algorithm requires the characteristic polynomial to be reverse bit ordered. The MSbit of the characteristic polynomial is dropped as it does not affect the value of the remainder. A few terms used in the algorithm are defined below:

\[-->\] = 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.
\[= 11000000000000101\text{ normally}\]
\[= 1010000000000001\text{ with MSbit dropped, and bit order reversed.}\]
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, with the LSbit of the high order byte of x shifted into the MSbit of the low order byte of x.
N = number of data bytes to be processed.

The algorithm is shown below:

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 i = 0?
   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
c) SAMPLE PACKET WITH CRC-16

The following is a sample packet to read 102 bytes of actual values information from Slave number 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

4.9 MEMORY MAP

The 269 Plus memory map is broken up into two areas: the Actual Values address space and the Setpoints address space. Each space has a total of 256 bytes. There are separate commands used to access the two different spaces. The memory map is Table 4–2: 269PLUS MEMORY MAP on page 4–10. The data formats are in Table 4–3: MEMORY MAP FORMAT CODES on page 4–24.

Since some Master PLCs only support command 03, the Actual Values registers may be accessed using a set-point 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.
### Table 4–2: 269PLUS MEMORY MAP (Sheet 1 of 14)

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### Table 4–2: 269PLUS MEMORY MAP (Sheet 2 of 14)

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### Table 4–2: 269PLUS MEMORY MAP (Sheet 6 of 14)

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## Table 4–2: 269PLUS MEMORY MAP (Sheet 7 of 14)

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## Table 4–2: 269PLUS MEMORY MAP (Sheet 8 of 14)

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### Table 4–2: 269PLUS MEMORY MAP (Sheet 11 of 14)

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### Table 4-3: MEMORY MAP FORMAT CODES (Sheet 1 of 7)

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<td>16 bits</td>
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<td></td>
<td>0000 0000 0000 1001</td>
<td>xxxx:1 Phase CT</td>
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<td>xxxx:5 Phase CT</td>
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<td>0000 0000 0001 0010</td>
<td>TRIP and AUX.1</td>
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<td>16 bits</td>
<td>D/A Output Parameter</td>
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<td>0000 0000 0010 1101</td>
<td>Max stator temperature outputted</td>
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<td>Thermal memory used outputted</td>
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<td>Motor load as a % of full load outputted</td>
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<tr>
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<td>0000 0000 0000 0110</td>
<td>L L L L</td>
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<td>(L = latched, U = unlatched)</td>
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<td>0000 0000 0000 0100</td>
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<td>N F F F</td>
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<td>0000 0000 0000 0111</td>
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<tr>
<td></td>
<td></td>
<td>(N = non-failsafe, F = failsafe)</td>
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<td>0-20 mA</td>
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<td>0000 0000 0011 0100</td>
<td>0-1 mA</td>
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### Table 4–3: MEMORY MAP FORMAT CODES (Sheet 2 of 7)

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<td>16 bits</td>
<td>Slave Function</td>
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<td>0000 0000 0000 0000</td>
<td>Check integrity of SCL without doing anything</td>
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<td>0000 0001 0000 0000</td>
<td>undefined</td>
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<tr>
<td></td>
<td>0000 0100 0000 0000</td>
<td>simulate Differential Trip</td>
</tr>
<tr>
<td></td>
<td>0000 1000 0000 0000</td>
<td>simulate Emergency Restart</td>
</tr>
<tr>
<td></td>
<td>0010 0000 0000 0000</td>
<td>Reserved</td>
</tr>
<tr>
<td></td>
<td>0100 0000 0000 0000</td>
<td>Reserved</td>
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<tr>
<td></td>
<td>1000 0000 0000 0000</td>
<td>Reserved</td>
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<td><strong>F9</strong></td>
<td>16 bits</td>
<td>Relay Force Code (after protected motor is stopped)</td>
</tr>
<tr>
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<td>0000 0000 0000 0000</td>
<td>NO relay</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td>0000 0000 0000 1101</td>
<td>ALARM</td>
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<tr>
<td></td>
<td>0000 0000 0000 1110</td>
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</tr>
<tr>
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<td>0000 0000 0000 1111</td>
<td>AUX. 2</td>
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<tr>
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<td>ALL relays</td>
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<td>16 bits</td>
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<td>0000 0000 0000 0000</td>
<td>normal scan</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>0000 0000 0010 1100</td>
<td>Spare Input</td>
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### Table 4–3: MEMORY MAP FORMAT CODES (Sheet 3 of 7)

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<td>Setpoints Status Register 1</td>
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<td>0000 0000 0000 0001</td>
<td>Custom Curve selected (set trip times starting at address 0080H)</td>
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<td>Reserved</td>
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<tr>
<td></td>
<td>0000 0000 0000 0100</td>
<td>Reserved</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 1000</td>
<td>RTD Bias defeated</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0001 0000</td>
<td>Start Inhibit Feature enabled</td>
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<tr>
<td></td>
<td>0000 0000 0010 0000</td>
<td>Unbalance Bias defeated</td>
</tr>
<tr>
<td></td>
<td>0000 0000 1000 0000</td>
<td>Phase Reversal enabled</td>
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<tr>
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<td>0000 0001 0000 0000</td>
<td>Single Shot Restart enabled</td>
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<td>0000 0001 0000 0000</td>
<td>G/F CT = xxx:5 (2000:1 if '0')</td>
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<td>0000 0010 0000 0000</td>
<td>Reserved</td>
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<tr>
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<td>0000 1000 0000 0000</td>
<td>Set to clear RTD last access data</td>
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<td>0000 1000 0000 0000</td>
<td>Set to clear commissioning data</td>
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<td>0001 0000 0000 0000</td>
<td>No Sensor Alarm defeated</td>
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<td>RTD 10 made ambient sensor</td>
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<td>Setpoints Status Register 2</td>
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<td>Reserved</td>
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<tr>
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<td>0000 0000 0000 1000</td>
<td>Set to Place 269 in Test Mode</td>
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<tr>
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<td>Enable PF Trip/Alarm Block on Start</td>
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<td>Reserved</td>
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<td>Are there any RTDs connected to the 269 Plus? Yes =1, No = 0</td>
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<td>Voltage Phase Reversal enabled</td>
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<td>Spare enabled as 52b</td>
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<td>0001 0000 0000 0000</td>
<td>Enable Differential Trip</td>
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<td>0010 0000 0000 0000</td>
<td>Enable Stator RTD Voting</td>
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<td>Set to 1 if 2-Input Wye, Reset to 0 if Open Delta (DO NOT ALTER)</td>
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<td>269 Plus Motor Management Relay</td>
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### Table 4–3: MEMORY MAP FORMAT CODES (Sheet 4 of 7)

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<td>5.0.2 (starting B5.0)</td>
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<td>0000 0000 0000 1000</td>
<td>Undercurrent Alarm</td>
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<td>Stator RTD Alarm</td>
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Table 4–3: MEMORY MAP FORMAT CODES (Sheet 5 of 7)

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<td>Phase Reversal Trip</td>
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<td>Inhibits</td>
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<td>0000 0100 0000 0000</td>
<td>Speed Switch Trip</td>
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<tr>
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<td>Differential Input Trip</td>
</tr>
<tr>
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<td>0001 0000 0000 0000</td>
<td>Single Phase Trip</td>
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<tr>
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<td>0010 0000 0000 0000</td>
<td>Spare Input Trip</td>
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<td>Undervoltage Trip</td>
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<td>Mechanical Jam Alarm</td>
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<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0100 0000</td>
<td>Stator RTD High Alarm</td>
</tr>
<tr>
<td></td>
<td>0000 0000 1000 0000</td>
<td>RTD High Alarm</td>
</tr>
<tr>
<td>F22</td>
<td>16 bits</td>
<td>Motor Trip Status 2</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0001</td>
<td>Overvoltage Trip</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0010</td>
<td>Undercurrent Trip</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0100</td>
<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 1000</td>
<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0001 0000</td>
<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0010 0000</td>
<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0100 0000</td>
<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0000 0000 1000 0000</td>
<td>Undefined</td>
</tr>
<tr>
<td>F23</td>
<td>16 bits</td>
<td>Motor Current Status</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0000</td>
<td>Motor Stopped (Iavg &lt; 5% FLC)</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0001</td>
<td>Motor Running Normal (Iavg &lt; Iflc)</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0010</td>
<td>Motor in Overload (Iavg &gt; Iflc)</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0011</td>
<td>Motor Starting</td>
</tr>
<tr>
<td>F24</td>
<td>16 bits</td>
<td>Inhibit Type</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0000</td>
<td>Starts per Hour</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0011</td>
<td>Start Inhibit</td>
</tr>
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</table>
### Table 4–3: MEMORY MAP FORMAT CODES (Sheet 6 of 7)

<table>
<thead>
<tr>
<th>FORMAT CODE</th>
<th>APPLICABLE BITS</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 0000 0011 1001</td>
<td>Time Between Starts</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0011 1010</td>
<td>Backspin Timer</td>
<td></td>
</tr>
<tr>
<td><strong>F25</strong></td>
<td><strong>16 bits</strong></td>
<td><strong>Meter Communication Failure Type</strong></td>
</tr>
<tr>
<td>0000 0000 0011 1011</td>
<td>Incompatible Revisions</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0011 1100</td>
<td>Hardware Failure</td>
<td></td>
</tr>
<tr>
<td><strong>F26</strong></td>
<td><strong>16 bits</strong></td>
<td><strong>Illuminated LEDs</strong></td>
</tr>
<tr>
<td>0000 0000 0000 0001</td>
<td>AUX. 2 relay active</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0010</td>
<td>AUX. 1 relay active</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0100</td>
<td>ALARM relay active</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 1000</td>
<td>TRIP relay active</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0001 0000</td>
<td>undefined</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0010 0000</td>
<td>undefined</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 0000</td>
<td>undefined</td>
<td></td>
</tr>
<tr>
<td>0000 0000 1000 0000</td>
<td>undefined</td>
<td></td>
</tr>
<tr>
<td><strong>F27</strong></td>
<td><strong>16 bits</strong></td>
<td><strong>Power Sign</strong></td>
</tr>
<tr>
<td>0000 0000 0011 0101</td>
<td>'+'</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0011 0110</td>
<td>'-'</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1110</td>
<td>' ‘ Blank</td>
<td></td>
</tr>
<tr>
<td><strong>F28</strong></td>
<td><strong>16 bits</strong></td>
<td><strong>Cause of Last Trip</strong></td>
</tr>
<tr>
<td>0000 0000 0100 0101</td>
<td>Overload Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 0110</td>
<td>Unbalance Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 0111</td>
<td>Short Circuit Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1000</td>
<td>Rapid Trip Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1001</td>
<td>Stator RTD Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1010</td>
<td>RTD Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1011</td>
<td>Ground Fault Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1100</td>
<td>Acceleration Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1101</td>
<td>Phase Reversal Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0100 1110</td>
<td>BLANK - No Cause of Last Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 1111</td>
<td>Speed Switch Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0000</td>
<td>Differential Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0001</td>
<td>Single Phase Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0010</td>
<td>Spare Input Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0011</td>
<td>Power Factor Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0100</td>
<td>Undervoltage Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0101</td>
<td>Overvoltage Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0110</td>
<td>Undercurrent Trip</td>
<td></td>
</tr>
<tr>
<td>0000 0000 0101 0111</td>
<td>Undefined</td>
<td></td>
</tr>
</tbody>
</table>
### Table 4–3: MEMORY MAP FORMAT CODES (Sheet 7 of 7)

<table>
<thead>
<tr>
<th>FORMAT CODE</th>
<th>APPLICABLE BITS</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F29</td>
<td>16 bits</td>
<td>Power Factor Sign</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0100 1110</td>
<td>'            '  Blank</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0101 1101</td>
<td>Lead</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0101 1110</td>
<td>Lag</td>
</tr>
<tr>
<td>F30</td>
<td>16 bits</td>
<td>RTD Type</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0000</td>
<td>100 Ohm Platinum RTD</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0001</td>
<td>100 Ohm Nickel RTD</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0010</td>
<td>120 Ohm Nickel RTD</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0011</td>
<td>10 Ohm Copper RTD</td>
</tr>
<tr>
<td>F31</td>
<td>16 bits</td>
<td>Serial Number Letter Code</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0110 0010</td>
<td>Hardware Revision &quot;D&quot;</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0110 0001</td>
<td>Hardware Revision &quot;C&quot;</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0110 0011</td>
<td>Hardware Revision &quot;E&quot;</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0110 0100</td>
<td>Hardware Revision &quot;B&quot;</td>
</tr>
<tr>
<td>F32</td>
<td>16 bits</td>
<td>Setpoints Status Register 3</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0001</td>
<td>Enable U/V Trips &amp; Alarm if Avg. Volts = 0</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0000 0010</td>
<td>Enable Differential Input to Read 52b</td>
</tr>
<tr>
<td>F33</td>
<td>16 bits</td>
<td>Self Test Alarm Status</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0001 0011</td>
<td>Analog to Digital (A/D) Hardware Failure Alarm</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0001 0100</td>
<td>RTD Hardware (H/W) Failure Alarm</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0001 0101</td>
<td>RAM Memory Failure Alarm</td>
</tr>
<tr>
<td></td>
<td>0000 0000 0001 1000</td>
<td>Board/PROM Mismatch Failure</td>
</tr>
</tbody>
</table>
5 RELAY TESTING

5.1 PRIMARY INJECTION TESTING

Using the factory default setpoints to test the analog current output, a 4 to 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 the SECONDARY INJECTION TEST (AC INPUT TO 269Plus) figure. 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).

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 Plus from a secondary injection test set as described in the following sections. “Multiamp” or “Doble” test equipment may be used to do current and timing tests.

5.2 SECONDARY INJECTION TESTING

Single phase secondary injection testing can be performed using the setup in the SECONDARY INJECTION TEST (AC INPUT TO 269 Plus) figure. Tests should be performed to verify correct operation of relay input (A/D), output, memory, and RTD circuitry. 269 Plus 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.

5.3 PHASE CURRENT INPUT FUNCTIONS

All phase current functions use digital current information converted from the analog phase CT 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 page 1. With factory setpoints stored in the relay the displayed current should be:

\[
\text{displayed current} = \frac{\text{actual injected current}}{5} \times 100
\]

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

When selecting a phase CT, the 269 Plus uses the following formula to calculate the current resolution:

\[
\text{Current Resolution} = \frac{4 \times \text{Phase CT}}{255}
\]

If the chosen CT is relatively small, the resolution (increments of current) displayed will also be small. For example, if the Phase CT selected is 50:1 or 5, the 269 Plus displays current in increments of 1 A (0.78 A rounded). Likewise, if the Phase CT is selected as 1500:1 or 5, the current is displayed in increments of 24 A (23.5 rounded).

To simulate an overload condition turn ACCEL. TIME= to OFF (see Setpoints page 1) and inject a current of 9 A in all three phases. This will be read by the relay as:

\[
\text{displayed current} = \frac{\text{actual injected current}}{5} \times 100 = \frac{9 \text{ A}}{5} \times 100 = 180 \text{ A}
\]
which is two times the Full Load Current setpoint of 90 A. 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 $I_1 = 5.0$ A, $I_2 = 5.0$ A and $I_3 = 3.9$ A 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.
FIGURE 5–1: SECONDARY INJECTION TEST (AC INPUT TO 269PLUS)
FIGURE 5–2: SECONDARY INJECTION TEST (DC INPUT TO 269PLUS)
**5 RELAY TESTING**

**GROUND FAULT CURRENT FUNCTIONS**

### 5.4 GROUND FAULT CURRENT FUNCTIONS

The ground fault current function uses digital current information converted from the analog ground fault CT input. The 269 Plus 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 the SECONDARY INJECTION TEST (AC INPUT TO 269PLUS) figure. The actual injected current should then be the same as the **GROUND FAULT CURRENT** display in Actual Values. If the injected cur-rent is adjusted to over 4.0 A for longer than 10.0 seconds the ground fault alarm should become active. If over 8.0 A is injected for more than 50 ms, a ground fault trip should occur. These tests can be performed for other CT 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 configured for use with 100 Ω platinum RTDs, 100 Ω potentiometers and resistors can be used. These should be connected to each RTD as shown the SECONDARY INJECTION TEST (AC INPUT TO 269Plus) figure. The table below shows RTD resistances for various temperatures. Individual, actual stator and bearing RTD temperatures can be viewed in Actual Values page 2.

#### Table 5–1: RTD RESISTANCE VS. TEMPERATURE

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 Ω Pt *</td>
</tr>
<tr>
<td>0</td>
<td>100.00</td>
</tr>
<tr>
<td>10</td>
<td>103.90</td>
</tr>
<tr>
<td>20</td>
<td>107.79</td>
</tr>
<tr>
<td>30</td>
<td>111.67</td>
</tr>
<tr>
<td>40</td>
<td>115.54</td>
</tr>
<tr>
<td>50</td>
<td>119.39</td>
</tr>
<tr>
<td>60</td>
<td>123.24</td>
</tr>
<tr>
<td>70</td>
<td>127.07</td>
</tr>
<tr>
<td>80</td>
<td>130.89</td>
</tr>
<tr>
<td>90</td>
<td>134.70</td>
</tr>
<tr>
<td>100</td>
<td>138.50</td>
</tr>
<tr>
<td>110</td>
<td>142.99</td>
</tr>
<tr>
<td>120</td>
<td>146.06</td>
</tr>
<tr>
<td>130</td>
<td>149.82</td>
</tr>
<tr>
<td>140</td>
<td>153.58</td>
</tr>
<tr>
<td>150</td>
<td>157.32</td>
</tr>
<tr>
<td>160</td>
<td>161.04</td>
</tr>
<tr>
<td>170</td>
<td>164.76</td>
</tr>
<tr>
<td>180</td>
<td>168.47</td>
</tr>
<tr>
<td>190</td>
<td>172.46</td>
</tr>
<tr>
<td>200</td>
<td>175.84</td>
</tr>
</tbody>
</table>

Note: * = DIN 43760. 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.
5.6 POWER FAILURE TESTING

When the AC/DC voltage applied to the 269 Plus HI supply decreases below approximately 50 V (or 7 V for the LO supply), all relay LEDs should become illuminated. 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

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.

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 are 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 are simulated using the procedures outlined in previous sections.

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 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 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).

To test the operation of devices connected to the Access terminals, Emergency Restart terminals, and External Reset terminals the STATUS setpoint can be used (in Setpoints page 6). 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 is Hi-Pot tested at the factory for one second at 2200 V AC in order to verify its dielectric strength. See the figure below 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 relay.

1. REMOVE J201, ENSURE HI-POT TESTER IS OFF AND VOLTAGE ADJUST IS SET TO ZERO.
2. CONNECT GROUND CABLE FROM HI-POT TESTER TO TERMINAL 42 ON 269 RELAY.
3. TURN TESTER ON AND RESET ANY PRESENT FAULTS
4. APPLY LIVE TERMINAL OF TESTER TO TERMINAL 26.
5. STEADILY INCREASE VOLTAGE ADJUST DIAL UNTIL METER READS 2.2kVAC, HOLD FOR 1 SECOND AND QUICKLY DECREASE VOLTAGE ADJUST DIAL BACK TO ZERO.
6. REPEAT THIS PROCEDURE FOR TERMINALS 30 THROUGH 41
   CAUTION - DO NOT APPLY 2.2kVAC TO TERMINAL 42.
7. REPEAT STEP 5 FOR TERMINALS 43 AND 72 THROUGH 83.
   CAUTION - AVOID TOUCHING PERFORATED PROTECTIVE METAL COVER.
8. REMOVE GROUND CABLE OF HI-POT TESTER FROM TERMINAL 42.
9. CONNECT TERMINALS 41 & 43 TOGETHER TO GROUND CABLE OF TESTER.
10. APPLY LIVE TERMINAL TO A SCREW ON PERFORATED COVER AND REPEAT STEP 5.
11. REMOVE ALL WIRES ATTACHED TO THE 269 RELAY.
    NOTE: NO OTHER TERMINALS ON THE 269 RELAY SHOULD BE HI-POT TESTED.
    TERMINALS 1 THROUGH 28, 44 THROUGH 71 & 86 THROUGH 88 ARE ALL LOW VOLTAGE TERMINALS (<32VDC)
    ALL OF THESE TERMINALS ARE PROTECTED WITH SURGE & NOISE FILTERING DEVICES THAT MAY BE DAMAGED IF HI-POT TESTED. (e.g. TRANSORS)

Figure 5–3: HI-POT TESTING
All relay functions are controlled by an 80C32 8-bit microcomputer. The microprocessor contains internal RAM and timers, but all firmware and display messages are stored in an external EPROM. A 12-key keypad and a 2 row by 24-character display are used to enter relay setpoints and display all values and messages. A hardware block diagram is shown in the HARDWARE BLOCK DIAGRAM below.

The power supply uses a dual primary / triple secondary transformer for connection to a 120/240 V AC source. A 24 / 48 / 125 / 250 V DC input switching power supply is also available as an option. Regulated ±5 V supplies are created for use by logic and analog Is. A regulated +10 V supply is used to drive the RTD selection relays and LED indicators, and an isolated +10 V supply is used 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 signalled regularly by a firmware generated voltage or else the microcomputer will be reset.

Three-phase CTs are used to scale the incoming current signals to the 269 Plus. 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 269 Plus provides a separate ground fault CT 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 269 Plus temperature monitoring circuitry 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 to 20 mA. The microcomputer also drives an 8255A I/O port which handles keypad inputs, LED 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 opto-isolators and are powered by a separate, isolated +10 V supply. An SN75176 transceiver provides an RS485 communications interface for programmable controllers and computers connected to the 269 Plus.

All connections to the 269 Plus are made on the I/O circuit board; transient protection and filtering are provided on all inputs.
Figure 6–1: HARDWARE BLOCK DIAGRAM
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 in this chapter.

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.

The O/L module uses the positive to negative sequence current ratio calculated by the U/B module 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 $I_b/I_a$ and $I_c/I_a$, and uses them in conjunction with a look-up table to determine the negative to positive sequence current unbalance ratio $I_n/I_p$. 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 uses the number of programmed stator RTDs to compute 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 1 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 the RELAY SELF-TEST in Chapter 3.

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.
Figure 6–2: FIRMWARE BLOCK DIAGRAM
7 APPLICATION EXAMPLES

7.1 RELAY POWERED FROM ONE OF MOTOR PHASE INPUTS

If a 269 Plus is powered from one of the three motor phase inputs, a single phase condition could cause control power to be removed from the relay. To ensure that the motor is taken off-line if this condition arises, the 269 Plus output relay (e.g. TRIP, AUX. 1) used to trip the motor must change state when control power is removed from the relay. 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 Setpoints page 5.

7.2 CONTROL POWER LOSS DUE TO SHORT CIRCUIT/GROUND FAULT

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

7.3 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% of FLC.

For example, if FLC Thermal Capacity Reduction 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% of FLC, the thermal capacity used will settle at 15% (that is, 50% of 30%). An 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 the THERMAL LIMIT CURVES figure below.

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:

$$ TCR = \left[ 1 - \frac{\text{Hot Motor Stall Time}}{\text{Cold Motor Stall Time}} \right] \times 100\% $$
we have:

\[ TCR = \left(1 - \frac{\text{Hot Motor Stall Time}}{\text{Cold Motor Stall Time}}\right) \times 100\% = \left(1 - \frac{15.4}{22}\right) \times 100\% = 30\% \]

Therefore, the 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 $1 \times \text{FLC}$ 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
The 269PC software, provided with every 269 Plus relay, allows easy access to all relay setpoints and actual values via a personal computer running Windows® 3.1/95 or higher and one of the PC’s RS232 ports: COM1 or COM2. With 269PC, 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

The regular 269 relay does not support communications. Therefore, the 269PC software can only be used with a 269 Plus relay. The 269PC software can be used “stand-alone”, without a 269 Plus relay, to create or edit 269 Plus setpoint files.

### 8.2 HARDWARE & 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 or higher recommended, minimum 540 K of conventional memory
- **Hard Drive:** 20 MB free space required before installation of software

**WINDOWS 3.1/3.11 CONSIDERATIONS:**

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

### 8.3 TOOLBAR SUMMARY

- 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 MENU SUMMARY

Create a new setpoint file with factory defaults
Open an existing file
Save setpoints to a file
Configure 269PC when in FILE EDIT mode
Send a setpoint file to the relay
Option of printing Actual Values, All Setpoints, or Enabled Setpoints
Print a relay or file setpoints
Exit the 269PC program

Edit 269Plus Motor Amps setpoints
Edit Temperature setpoints
Edit Overload setpoints
Edit System Configuration setpoints
Edit Meter Setpoints
Edit Testing Setpoints

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

Set computer communications parameters
Dial a phone number using the modem
View/modify memory map locations

Display 269Plus Instruction Manual
Display help on using Windows Help
Display 269PC program information
The figure below shows the required connections and equipment for the RS485 rear terminal interface. The interface consists of the following:

1. GE Multilin F485 RS232-to-RS485 converter.
2. A standard “straight-through” serial cable connected from your computer to GE Multilin F485. 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 R-C series network (i.e. 120 Ω, 1 nF) at the two extreme ends of the communication link as described in Chapter 4: COMMUNICATIONS.
Installation of the 269PC software is accomplished as follows:

1. Start the Windows® operating system.

2. Insert the GE Multilin Products CD into the appropriate drive or go to the GE Multilin website at www.GEin-dustrial.com/multilin. The Products CD is essentially a “snapshot” of the GE Multilin website at the date printed on the CD. Therefore, the installation procedure is identical for both the CD and the web.

3. Select the Index by Product Name item from the main page and then click the 269 Plus Motor Manage-ment Relay item to open the 269 Plus product page.

4. Click the Software item from the Product Resources list to load the 269 Plus software page.

5. The latest version of the 269PC software will be shown. Click on the 269PC Program item to download the installation program to your local PC. Run the installation program and follow the prompts to install to the desired directory. When complete, the GE Multilin group window appears containing the 269PC icon.
1. Double-click on the **269PC** program icon inside the **GE Multilin** group.

2. The main window will appear once the software has finished loading. The communications status of the 269 Plus is displayed on the bottom right corner of the screen.

3. Select the **Communications > Computer** menu item.

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

   - **Slave Address**: 254
   - **Communication Port #**: COM2
   - **Baud Rate**: 2400
   - **Parity**: NONE
   - **Control Type**: No Control Type
   - **Startup Mode**: File mode / w default settings

   Set the Startup Mode based on user preference. In the “Communicate with relay” mode, the PC attempts to establish communications with the 269Plus immediately on startup. In the “File mode w/ default settings” mode, 269PC waits for the user to click the ON button before attempting communications – this mode is preferred when the 269PC software is being used without a 269Plus unit.

   Set to match the RS232-RS485 converter type. If connected to a GE Power Management F485 converter, select “MULTLIN 232/485 Converter”. If connected to a modem select “Modem”. If connected to a third-party converter, 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** (the 269Plus setpoint defaults to 2400)

   Set the COM port number on the local PC connected to the 269Plus (i.e. COM1 or COM2). On most computers, COM1 is used by the mouse; as such, COM2 is usually available for communications.

   Set to match the **SLAVE ADDRESS** (the 269Plus setpoint defaults to 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 **269PC is now talking to 269+** will be displayed, and the status at the bottom right hand corner of the screen will indicate “Communicating”. If communications are not established, the message **269PC is having problems connecting with 269. 269PC will keep trying to establish communication** will be displayed.
The following example illustrates the entering of setpoints from the 269PC software.

1. Select the **Setpoint > Motor Amps** menu item.

2. From the Setpoints / Motor Amps window select the **Motor Specs** tab.

3. The following dialog box appears where setpoint information for the 269 Plus is to be entered:

![Setpoints / Motor Amps dialog box](image)

4. 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.

![Numerical keypad](image)

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

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

Click on **Cancel** to exit from the keypad and keep the old value.
5. For setpoints requiring non-numerical values (example, Analog Output Parameter) clicking anywhere inside the setpoint box will cause a selection menu to be displayed.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Scale</th>
<th>Motor Load Full Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Load as a % of Full Load</td>
<td>Maximum Stator Temperature</td>
<td>Motor Load as a % of Full Load</td>
</tr>
<tr>
<td>Thermal Memory Used</td>
<td>% C.T. Secondary</td>
<td>RTD #7 Temperature</td>
</tr>
</tbody>
</table>

- Click on **OK** to save values into the computer’s memory and close the window when in Edit Mode, or store values to communicating relay and close the window
- Click on **Cancel** to retain the previous value
- Click on **Store** to send the values to the 269 Plus (if communicating)
- Click on **Help** to display the selected help related topic
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.

![File / Properties dialog box]

2. After the setpoints have been configured select the File > Save As menu item.

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:

![Save As dialog box]

4. The software will then read all the relay setpoint values and store them to the selected file.
Loading the 269 Plus with setpoints from a file is accomplished as follows:

1. Select the **File > Open** menu item.

2. The following dialog box will pop-up. The software 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. Select the **File > Send Info to Relay** menu item. The software will then download the setpoints to the 269 Plus.
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. Select the Actual Values > Temperature Data menu item.
2. The following display box will pop up automatically displaying the appropriate temperatures.

3. To view measured current, select the Actual Values > Popup Currents menu item.
4. 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.
5. This window, when selected, remains open. To close it, click on its close button.
6. If an alarm or trip occurs, the following window will be displayed in 269PC:

![Trip / Alarm Status Window](image)

7. 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).

![Actual Values / Status Window](image)

**NOTE**

If the trip/alarm status window is closed during an alarm, and a subsequent alarm or trip occurs, the window may 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**:
8.12 TRENDING

1. To view trending data, select the **Actual Values > Trending** menu item. The trending window will appear.

2. Trending is a feature of the 269PC software 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.

3. The CURSOR1, CURSOR2, and DELTA buttons choose which displayed value to display in the legend.

4. The Sample Rate sets how often the trending graph is updated.

5. Click the actual values to trend in the legend window. Any combination may be selected.

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

7. 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.

8. 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.
1. The 269PC software offers the Troubleshooting feature that allows users to read values and write values to specific registers at specified addresses on the 269 Plus. Ensure that the relay is successfully communicating with the 269PC software prior to the reading or writing of values.

2. The Troubleshooting feature is opened by selecting the Communication > Troubleshooting menu item.

3. The following window will be displayed:

4. The READ DATA section is used to read or monitor AV (Actual Values) or SP (Setpoint) register data at a HEX (Hexadecimal) specified address. In the above example, notice the address 0010H. Both addresses are the same, however, one is reading an AV INT (integer) data value while the second is reading a SP HEX data value.

5. When reading register data, ensure that the Address and Type of data are specified correctly. Refer to 269 Plus Memory Map in the 269PC software Help file or Instruction Manual.

6. The WRITE DATA section is used to write values to a specified HEX address.

7. In the above example, the WORD value 0015H will be written to address 0010H of the 269 Plus. This value will be written to the SP address, not AV address.

8. The address 0002H will receive the value of 0050H. This value is converted to 80 as an INT (Integer). However, the register will actually store half this value, i.e. 40, since the units are in increments of 0.5 seconds. Therefore, in the above example, the Acceleration Time Setpoint will be stored as 40 seconds once the SEND button is clicked. The Transmit Totals in the Write Data section will then increment to one while the Transmit Totals in the Read Data section continue to increment indicating that successful communications are still established.

**WARNING**

ENSURE THAT CORRECT VALUES ARE WRITTEN TO THE PROPER ADDRESS. RANGE CHECKING IS NOT IMPLEMENTED IN THIS FEATURE. PLEASE REFER TO THE 269 Plus MEMORY MAP BEFORE WRITING ANY VALUES!
### Table 9–1: COMMISSIONING TABLE (Sheet 1 of 7)

<table>
<thead>
<tr>
<th>SETPOINTS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAGE 1: MOTOR AMPS SETPOINTS</td>
<td></td>
</tr>
<tr>
<td>PHASE CT SECONDARY</td>
<td></td>
</tr>
<tr>
<td>PHASE CT PRIMARY</td>
<td></td>
</tr>
<tr>
<td>MOTOR FULL LOAD CURRENT</td>
<td>A</td>
</tr>
<tr>
<td>O/L PICKUP LEVEL</td>
<td>%</td>
</tr>
<tr>
<td>ACCELERATION TIME</td>
<td>sec.</td>
</tr>
<tr>
<td>STARTS/HOUR</td>
<td></td>
</tr>
<tr>
<td>UNBALANCE ALARM LEVEL</td>
<td>%</td>
</tr>
<tr>
<td>UNBALANCE ALARM DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>UNBALANCE TRIP LEVEL</td>
<td>%</td>
</tr>
<tr>
<td>UNBALANCE TRIP DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>GROUND FAULT CT RATIO :5?</td>
<td></td>
</tr>
<tr>
<td>GROUND FAULT CT PRIMARY</td>
<td></td>
</tr>
<tr>
<td>GROUND FAULT ALARM LEVEL</td>
<td>A</td>
</tr>
<tr>
<td>GROUND FAULT ALARM DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>GROUND FAULT TRIP LEVEL</td>
<td></td>
</tr>
<tr>
<td>GROUND FAULT TRIP DELAY</td>
<td></td>
</tr>
<tr>
<td>UNDERCURRENT ALARM LEVEL</td>
<td>A</td>
</tr>
<tr>
<td>UNDERCURRENT ALARM DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>UNDERCURRENT TRIP LEVEL</td>
<td></td>
</tr>
<tr>
<td>UNDERCURRENT TRIP DELAY</td>
<td></td>
</tr>
<tr>
<td>MECHANICAL JAM ALARM</td>
<td>x FLC</td>
</tr>
<tr>
<td>MECHANICAL JAM ALARM DELAY</td>
<td></td>
</tr>
<tr>
<td>RAPID TRIP / MECHANICAL JAM LEVEL</td>
<td>x FLC</td>
</tr>
<tr>
<td>RAPID TRIP DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>SHORT CIRCUIT TRIP LEVEL</td>
<td>x FLC</td>
</tr>
<tr>
<td>SHORT CIRCUIT TRIP DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>IMMEDIATE OVERLOAD</td>
<td>x FLC</td>
</tr>
</tbody>
</table>

1 Not seen if ratio is 2000:1
2 If NO, all RTD setpoints on all pages are not visible
3 Not seen if DEFEAT RTD INPUT is YES
4 Not seen if DEFEAT U/B INPUT is YES
5 Only seen if 269Plus is a drawout relay
6 Not seen if BLOCK PF PROTECTION ON START is YES
7 Not seen if BLOCK PF PROTECTION ON START is NO

### Table 9–1: COMMISSIONING TABLE (Sheet 2 of 7)

<table>
<thead>
<tr>
<th>SETPOINTS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAGE 2: RTD SETPOINTS</td>
<td></td>
</tr>
<tr>
<td>RTD SENSOR TYPE (not a setpoint)</td>
<td></td>
</tr>
<tr>
<td>ANY RTDs CONNECTED?</td>
<td></td>
</tr>
<tr>
<td>RTD MESSAGE DISPLAY</td>
<td></td>
</tr>
<tr>
<td># OF STATOR RTDs USED</td>
<td></td>
</tr>
<tr>
<td>RTD/STATOR 1 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 1 HIGH ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 1 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 2 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 2 HIGH ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 2 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 3 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 3 HIGH ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 3 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 4 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 4 HIGH ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 4 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 5 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 5 HIGH ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 5 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 6 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 6 HIGH ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD/STATOR 6 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 7 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 7 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 8 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 8 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 9 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
</tbody>
</table>

1 Not seen if ratio is 2000:1
2 If NO, all RTD setpoints on all pages are not visible
3 Not seen if DEFEAT RTD INPUT is YES
4 Not seen if DEFEAT U/B INPUT is YES
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7 Not seen if BLOCK PF PROTECTION ON START is NO
### Table 9–1: COMMISSIONING TABLE (Sheet 3 of 7)

<table>
<thead>
<tr>
<th>SETPOINTS</th>
<th>VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD 9 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 10 ALARM LEVEL</td>
<td>°C/°F</td>
</tr>
<tr>
<td>RTD 10 TRIP LEVEL</td>
<td>°C/°F</td>
</tr>
</tbody>
</table>

#### PAGE 3: O/L CURVE SETPOINTS

- **CUSTOM CURVE?**
- **SELECTED CURVE NUMBER**
- **TRIP TIME AT 1.05 ¥ FLC** sec.
- **TRIP TIME AT 1.10 ¥ FLC** sec.
- **TRIP TIME AT 1.20 ¥ FLC** sec.
- **TRIP TIME AT 1.30 ¥ FLC** sec.
- **TRIP TIME AT 1.40 ¥ FLC** sec.
- **TRIP TIME AT 1.50 ¥ FLC** sec.
- **TRIP TIME AT 1.75 ¥ FLC** sec.
- **TRIP TIME AT 2.00 ¥ FLC** sec.
- **TRIP TIME AT 2.25 ¥ FLC** sec.
- **TRIP TIME AT 2.50 ¥ FLC** sec.
- **TRIP TIME AT 2.75 ¥ FLC** sec.
- **TRIP TIME AT 3.00 ¥ FLC** sec.
- **TRIP TIME AT 3.50 ¥ FLC** sec.
- **TRIP TIME AT 4.00 ¥ FLC** sec.
- **TRIP TIME AT 4.50 ¥ FLC** sec.
- **TRIP TIME AT 5.00 ¥ FLC** sec.
- **TRIP TIME AT 5.50 ¥ FLC** sec.
- **TRIP TIME AT 6.00 ¥ FLC** sec.
- **TRIP TIME AT 6.50 ¥ FLC** sec.
- **TRIP TIME AT 7.00 ¥ FLC** sec.
- **TRIP TIME AT 7.50 ¥ FLC** sec.
- **TRIP TIME AT 8.00 ¥ FLC** sec.

1. Not seen if ratio is 2000:1
2. If NO, all RTD setpoints on all pages are not visible
3. Not seen if DEFEAT RTD INPUT is YES
4. Not seen if DEFEAT U/B INPUT is YES
5. Only seen if 269Plus is a drawout relay
6. Not seen if BLOCK PF PROTECTION ON START is YES
7. Not seen if BLOCK PF PROTECTION ON START is NO

### Table 9–1: COMMISSIONING TABLE (Sheet 4 of 7)

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<th>SETPOINTS</th>
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<tr>
<td>PAGE 4: RELAY CONFIGURATION</td>
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<tr>
<td>OVERLOAD TRIP</td>
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<tr>
<td>UNBALANCE TRIP</td>
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<td>SHORT CIRCUIT TRIP</td>
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</tr>
<tr>
<td>UNDERCURRENT TRIP</td>
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<td>RAPID TRIP</td>
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<tr>
<td>STATOR RTD TRIP</td>
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</tr>
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<td>RTD TRIP</td>
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<td>GROUND FAULT TRIP</td>
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</tr>
<tr>
<td>ACCELERATION TIME TRIP</td>
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<td>PHASE REVERSAL TRIP</td>
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<td>INHIBIT LOCKOUTS</td>
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<td>SPEED SWITCH TRIP</td>
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<td>DIFFERENTIAL TRIP</td>
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<td>SINGLE PHASE TRIP</td>
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<td>SPARE INPUT TRIP</td>
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<tr>
<td>UNDervoltage TRIP</td>
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<tr>
<td>OVERVOLTAGE TRIP</td>
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<tr>
<td>POWER FACTOR TRIP</td>
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<td>OVERLOAD WARNING</td>
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<td>GROUND FAULT ALARM</td>
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<td>UNBALANCE ALARM</td>
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</tr>
<tr>
<td>UNDERCURRENT ALARM</td>
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</tr>
<tr>
<td>MECHANICAL JAM ALARM</td>
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</tr>
<tr>
<td>STATOR RTD ALARM</td>
<td></td>
</tr>
<tr>
<td>STATOR RTD HIGH ALARM</td>
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<td>RTD ALARM</td>
<td></td>
</tr>
<tr>
<td>RTD HIGH ALARM</td>
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<tr>
<td>LOW TEMPERATURE ALARM</td>
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1. Not seen if ratio is 2000:1
2. If NO, all RTD setpoints on all pages are not visible
3. Not seen if DEFEAT RTD INPUT is YES
4. Not seen if DEFEAT U/B INPUT is YES
5. Only seen if 269Plus is a drawout relay
6. Not seen if BLOCK PF PROTECTION ON START is YES
7. Not seen if BLOCK PF PROTECTION ON START is NO
Table 9–1: COMMISSIONING TABLE (Sheet 5 of 7)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>SPARE INPUT ALARM</td>
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<td>TC ALARM</td>
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<tr>
<td>UNDERVOLTAGE ALARM</td>
<td></td>
</tr>
<tr>
<td>OVERVOLTAGE ALARM</td>
<td></td>
</tr>
<tr>
<td>POWER FACTOR ALARM</td>
<td></td>
</tr>
<tr>
<td>KVAR ALARM</td>
<td></td>
</tr>
<tr>
<td>METER ALARM</td>
<td></td>
</tr>
<tr>
<td>SELF-TEST FAIL</td>
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</table>

| PAGE 5: SYSTEM CONFIGURATION                    |        |
| NORMAL RUN DISPLAY SHOWS LINE                  |        |
| NORMAL RUN DISPLAY SHOWS PAGE                  |        |
| DEFEAT NO SENSOR ALARM?                        |        |
| ENABLE LOW TEMPERATURE ALARM                   |        |
| ENABLE STATOR RTD VOTING                       |        |
| DEFEAT RTD INPUT TO THERMAL MEM                |        |
| RTD BIAS CURVE MINIMUM VALUE \(^3\)            | °C     |
| RTD BIAS CENTER T.C. VALUE \(^3\)             | %      |
| RTD BIAS CENTER TEMP. VALUE \(^3\)            | °C     |
| RTD BIAS CURVE MAXIMUM VALUE \(^3\)           | °C     |
| DEFEAT U/B INPUT TO THERMAL MEM                |        |
| DEFAULT K VALUE \(^4\)                         |        |
| DEFEAT LEARNED COOL TIME                       |        |
| ENTER RUNNING COOL TIME                        | min.   |
| ENTER STOPPED COOL TIME                        | min.   |
| RTD 10 AMBIENT SENSOR?                         |        |
| ENABLE DIFFERENTIAL TRIP                       |        |
| DEFEAT SPEED SWITCH                             |        |
| SPEED SWITCH DELAY                             | sec.   |
| ANALOG OUTPUT PARAMETER                        |        |
| ANALOG OUTPUT TYPE                              |        |

Table 9–1: COMMISSIONING TABLE (Sheet 6 of 7)

<table>
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<th>SETPOINTS</th>
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<tr>
<td>MOTOR LOAD ANALOG OUT FULL SCL.</td>
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<tr>
<td>ENABLE SINGLE SHOT RESTART?</td>
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</tr>
<tr>
<td>ENABLE START INHIBIT?</td>
<td></td>
</tr>
<tr>
<td>INITIAL START CAP. T.C. REQUIRED</td>
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</tr>
<tr>
<td>ENABLE SPECIAL EXTERNAL RESET?</td>
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</tr>
<tr>
<td>RELAY ALARM LATCHCODE</td>
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</tr>
<tr>
<td>DRAWOUT FAILSAFE ACCESS CODE (^5)</td>
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</tr>
<tr>
<td>RELAY FAILSAFE CODE</td>
<td></td>
</tr>
<tr>
<td>SPARE INPUT TO READ 52B CONTACT</td>
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</tr>
<tr>
<td>SPARE INPUT ALARM DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>SPARE INPUT TRIP DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>BACKSPIN TIMER DELAY</td>
<td>min.</td>
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<tr>
<td>TIME BETWEEN STARTS TIME DELAY</td>
<td>min.</td>
</tr>
<tr>
<td>FLC THERMAL CAPACITY REDUCTION</td>
<td>%</td>
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<tr>
<td>THERMAL CAPACITY USED ALARM LVL</td>
<td>%</td>
</tr>
<tr>
<td>THERMAL CAPACITY USED TIME DLY</td>
<td>%</td>
</tr>
<tr>
<td>SLAVE ADDRESS</td>
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<table>
<thead>
<tr>
<th>PAGE 6: GE MULILINE SERVICE CODES (applicable for service use only)</th>
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<tbody>
<tr>
<td>PLACE 269 PLUS IN TEST MODE?</td>
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<tr>
<td>EXERCISE RELAY</td>
<td></td>
</tr>
<tr>
<td>TEMP. = XXX FOR FORCED RTD #</td>
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</tr>
<tr>
<td>ANALOG OUTPUT FORCED TO</td>
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</tr>
<tr>
<td>STATUS = XXXXXX FOR</td>
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<tr>
<td>SOFTWARE ACCESS</td>
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<td>SERVICE USE ONLY CODE =</td>
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<td>ENCRYPTED SECURE ACCESS CODE</td>
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<td>269PLUS SERIAL NO. (not a setpoint)</td>
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\(^1\) Not seen if ratio is 2000:1
\(^2\) Not seen if all RTD setpoints on all pages are not visible
\(^3\) Not seen if DEFEAT RTD INPUT is YES
\(^4\) Not seen if DEFEAT U/B INPUT is YES
\(^5\) Only seen if 269Plus is a drawout relay
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\(^7\) Not seen if BLOCK PF PROTECTION ON START is NO

GE Multilin

269 Plus Motor Management Relay

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Table 9–1: COMMISSIONING TABLE (Sheet 7 of 7)

<table>
<thead>
<tr>
<th>SETPOINTS</th>
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<td>METERING SETPOINTS SET ON LINE?</td>
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<tr>
<td>METER PHASE CT PRIMARY</td>
<td>A</td>
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<tr>
<td>PHASE VT RATIO</td>
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</tr>
<tr>
<td>METER PHASE VT SECONDARY</td>
<td>V</td>
</tr>
<tr>
<td>ENABLE U/V TRIP &amp; ALARM IF AVG.V=0</td>
<td></td>
</tr>
<tr>
<td>UNDervOLTAGE ALARM LEVEL</td>
<td>% VT</td>
</tr>
<tr>
<td>U/V ALARM TIME DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>UNDervOLTAGE TRIP LEVEL</td>
<td>% VT</td>
</tr>
<tr>
<td>U/V TRIP TIME DELAY</td>
<td>sec.</td>
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<tr>
<td>OVERVOLTAGE ALARM LEVEL</td>
<td>% VT</td>
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<tr>
<td>OVERVOLTAGE ALARM TIME DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>OVERVOLTAGE TRIP LEVEL</td>
<td>% VT</td>
</tr>
<tr>
<td>O/V TRIP TIME DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>BLOCK PF PROTECTION ON START?</td>
<td></td>
</tr>
<tr>
<td>BLOCK PF ALM. &amp; TRIP ON START BY 7</td>
<td>sec.</td>
</tr>
<tr>
<td>PF PROTECTION DELAY</td>
<td>sec.</td>
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<tr>
<td>POWER FACTOR LEAD ALARM LEVEL</td>
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<tr>
<td>POWER FACTOR LAG ALARM LEVEL</td>
<td></td>
</tr>
<tr>
<td>POWER FACTOR ALARM TIME DELAY</td>
<td></td>
</tr>
<tr>
<td>POWER FACTOR LEAD TRIP LEVEL</td>
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<tr>
<td>POWER FACTOR LAG TRIP LEVEL</td>
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<tr>
<td>POWER FACTOR TRIP TIME DELAY</td>
<td>sec.</td>
</tr>
<tr>
<td>POSITIVE KVAR ALARM LEVEL</td>
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<tr>
<td>NEGATIVE KVAR ALARM LEVEL</td>
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<tr>
<td>KVAR ALARM TIME DELAY</td>
<td>sec.</td>
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<tr>
<td>ENABLE VOLTAGE PHASE REVERSAL?</td>
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</tr>
<tr>
<td>ANALOG OUT SCALE FACTOR</td>
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</tr>
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</table>

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### Table 9–2: REVISION HISTORY TABLE

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A 269 PLUS UNBALANCE EXAMPLE

A.1 DESCRIPTION

The 269 Plus unbalance algorithm makes the following two 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 three phases may be drawn in the shape of a triangle as shown in the example below (the three vectors must cancel each other). From this diagram, it is obvious that no phasor magnitude could change without corresponding magnitudes and/or phase angles changing. Phase angles can always be derived from magnitudes using simple trigonometry.

A.2 EXAMPLE

Consider the following example for phase magnitudes 3.9, 5, and 5 s.

![Figure A–1: UNBALANCE PHASE DIAGRAM](image)

From the figure above, we have \( a = 3.9 \angle 0^\circ \), \( b = 5 \angle -112.95^\circ \), and \( c = 5 \angle 112.95^\circ \). Symmetrical component analysis of unbalance (the ratio of negative-sequence current to positive sequence current) yields:

![Figure A–2: UNBALANCE SYMMETRICAL COMPONENT ANALYSIS](image)

For ease of calculation, 'a' is referenced as 0°.
Therefore, the unbalance is $|0.1534| \times 100\% = 15.34\%$

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 $\frac{I_{avg}}{I_{FLC}}$.

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

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

Finally, the ratio of negative sequence to positive sequence current for any magnitude of phase current may be displayed on a graph as shown below (providing the supply is a true three phase supply and there is no zero sequence current flowing, no ground fault).
Discrete time based algorithm, 250 ms update.

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.
Figure B–2: 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
The following is an explanation of how the RTD circuitry works in the 269 Plus Motor Management Relay.

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

\[ V_{AB} = V_{LeadA} + V_{LeadB} \quad \text{and} \quad V_{BC} = V_{LeadC} + V_{RTD} + V_{LeadB} \]

or

\[ V_{AB} = V_{COMP} + V_{RETURN} \quad \text{and} \quad V_{BC} = V_{HOT} + V_{RTD} + V_{RETURN} \]

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

\[ R_{LeadA} = R_{LeadB} = R_{LeadC} = R_{Lead} \]

or

\[ R_{HOT} = R_{COMP} = R_{RETURN} = R_{Lead} \]

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

\[ V_{BC} - V_{AB} = (V_{Lead} + V_{RTD} + V_{Lead}) - (V_{Lead} + V_{Lead}) \]

\[ V_{BC} - V_{AB} = V_{RTD} \]
To connect 6 stator RTDs with only 8 wires, the wiring diagram below 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.

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

Figure C–2: CONNECTING 6 RTDS WITH 8 WIRES

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:

\[
V_{1,2} = V_{\text{Lead1HOT}} + V_{\text{RTD1}} + V_{\text{Link I}} + V_{\text{Link II}} + V_{\text{Link III}} + V_{\text{Link IV}} + V_{\text{Link V}} + V_{\text{Lead6RETURN}}
\]

\[
V_{2,3} = V_{\text{Link I}} + V_{\text{Link II}} + V_{\text{Link III}} + V_{\text{Link IV}} + V_{\text{Link V}} + V_{\text{Lead6COMP}} + V_{\text{Lead6RETURN}}
\]

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 is shown below.

**NOTE**

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

![RTD Circuitry Diagram](image)

**Figure C–3: 2-WIRE RTD LEAD COMPENSATION**

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

\[
R_{\text{Lead Compensation}} = R_{\text{Lead Hot}}
\]

we have

\[
V_{17, 18} = V_{\text{Lead Hot}} + V_{\text{Lead Hot 1}} + V_{\text{RTD}} + V_{\text{Lead Return 1}} + V_{\text{Lead Return}}
\]

\[
= V_{\text{Lead Comp}} + V_{R_{\text{Comp}}} + V_{\text{Lead Return}}
\]

\[
V_{18, 19} = V_{\text{Lead Comp}} + V_{R_{\text{Comp}}} + V_{\text{Lead Return}}
\]

Since \(V_{\text{Lead Compensation}} = V_{\text{Lead Hot}}\), we have

\[
V_{17, 18} - V_{18, 19} = (V_{\text{Lead Hot}} + V_{\text{Lead Hot 1}} + V_{\text{RTD}} + V_{\text{Lead Return 1}} + V_{\text{Lead Return}})
\]

\[
-(V_{\text{Lead Comp}} + V_{R_{\text{Comp}}} + V_{\text{Lead Return}})
\]

\[
= (V_{\text{Lead Hot 1}} + V_{\text{RTD}} + V_{\text{Lead Return 1}}) - V_{R_{\text{Comp}}}
\]

This implies

\[
(V_{17, 18} - V_{18, 19} = V_{\text{RTD}}) \text{ only if } V_{R_{\text{Comp}}} = V_{\text{Lead Hot 1}} + V_{\text{Lead Return 1}}
\]

\[
\text{or } R_{\text{Comp}} = R_{\text{Lead Hot 1}} + R_{\text{Lead Return 1}}
\]

The illustration shown above is for RTD #8, but it may be applied to any of the RTDs.
The purpose of this Appendix is to illustrate how two CTs may be used to sense three phase currents.

The proper configuration for the use of two CTs rather than three to detect phase current is shown. Each of the two CTs acts as a current source. The current that comes out of the CT on phase ‘A’ flows into the interposing CT on the relay marked ‘A’. From there, the current sums with the current that is flowing from the CT on phase ‘C’ which has just passed through the interposing CT on the relay marked ‘C’. This ‘summed’ current flows through the interposing CT marked ‘B’ and from there, the current splits up to return to its respective source (CT). **Polarity is very important since the value of phase ‘B’ must be the negative equivalent of ‘A’ + ‘C’ in order for the sum of all the vectors to equate to zero.** Note: there is only one ground connection as shown; if two ground connections are made, a parallel path for current has been created.

![Figure D–1: TWO PHASE WIRING](image)

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.**

![Figure D–2: VECTORS SHOWING REVERSE POLARITY](image)
To illustrate the point further, the diagram here shows how the current in phases 'A' and 'C' sum up to create phase 'B'.

Figure D–3: RESULTANT PHASE CURRENT – CORRECTLY WIRED $2\Phi$ CT SYSTEM

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.

Figure D–4: RESULTANT PHASE CURRENT – INCORRECTLY WIRED $2\Phi$ SYSTEM

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'.
It is commonly known that current lags voltage by 90° when a voltage is applied to a purely inductive load. As can be seen from the figure below, if the AC voltage is applied at a peak, the current will rise from 0 A 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.

Thus, as shown below, 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 ($2 \times I_{\text{max}}$).

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

$$I_{\text{RMSasym}} = \sqrt{\text{DC}^2 + \text{AC}^2} = \sqrt{2I_{\text{RMS}}^2 + I_{\text{RMS}}^2}$$

$$\Rightarrow I_{\text{RMSasym}}^2 = (\sqrt{2I_{\text{RMS}}^2})^2 + I_{\text{RMS}}^2 = 3I_{\text{RMS}}^2$$

$$\Rightarrow I_{\text{RMSasym}} = \sqrt{3}I_{\text{RMS}}$$

where $I_{\text{RMS}}$ 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.
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 waveforms shown in above are not necessarily the waveforms 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.
F DOs AND DON'Ts

F.1 DESCRIPTION

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

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

F.2 DOs

a) 269PLUS GROUNDING

Users are requested to ground the 269 Plus to a solid ground, preferably directly to the main GROUND BUS at ONE TERMINAL ONLY, Terminal 42. Except for the communications circuitry (see Chapter 4: COMMUNICATIONS), all other internal circuitry ties to the same ground at Terminal #42. The benefits of proper grounding are numerous, for example:

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

b) 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 solid grounding of the ground CT, a shielded twisted-pair be employed, especially when the GE Multilin 2000:1 Ground CT sensor is used, since the 2000:1 CT is usually used on high resistance grounded systems where faults are limited to 200 A or less, and the relay is set to trip instantaneously on low levels of ground current anywhere between 1 and 10 A. The 1 to 10 A primary current on the 2000:1 CT translates into very small signals (0.5 to 5 mA) on the CT secondary, and this signal seen by the 269 Plus. Because the 269 Plus relay must detect even the smallest of signals, we have to ensure that noise from any other source does not present itself to the relay's ground CT terminals.

c) RTDS

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

1. 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.
2. RTD shields are internally connected to the 269 Plus ground (Terminal 42) and must not be grounded anywhere else.
3. RTD signals are characterized as very small, sensitive signals. Therefore, cables carrying RTD signals should be routed as far away as possible from power carrying cables such as power supply and CT cables.
4. 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: shorted RTD; RTD hot and compensation leads are reversed (i.e. hot lead in compensation terminal and compensation lead in hot terminal).
d) RS485 COMMUNICATIONS PORT

The 269 Plus provides for direct or remote RS485 communications (via a modem). An RS232-to-RS485 converter is used to tie the 269 Plus to a PC/PLC or DCS system. The 269 Plus uses the Modicon Modbus RTU protocol (Functions 03, 04, and 16) to interface with PCs, PLCs, and DCS systems.

The following list of systems have been proven to successfully interface with the 269 Plus:

1. Modicon
2. Allen Bradley
3. Bailey Network
4. Honeywell
5. GE Fanuc
6. Foxboro
7. Square D (a modification is required for this interface – contact GE Multilin for details)
8. Siemens

Any interface not listed above can be attempted providing one or more of the following criteria are met:

• The first, and cleanest, solution to an interface problem is a driver (module, or firmware) in the PLC/DCS that supports the Modbus RTU protocol (commands 03, 04, and 16) as a MASTER.

• Secondly, if the PLC/DCS has a BASIC or programmable module that allows for total control of the communications port, a competent programmer can create a simple program to handle communications.

GE Multilin constantly works with PLC/DCS manufacturers, third-party integrators, and end users to develop ways on interfacing the 269 Plus with other PLC/DCS devices 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 for the 269 Plus because it allows communications over long distances up to 4000 feet. However, care must be taken for the relay to operate properly and trouble free. The recommendations listed below must be followed to ensure reliable communications:

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

2. **No more than 32 devices** (e.g. 269 Plus, PQM, MTM, or any non-GE Multilin devices that uses the Modbus protocol) can co-exist on the same link. If more than 32 devices are required, a REPEATER should 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). This is necessary since if shields are grounded at different points, a potential difference between grounds might exist which may place one or more 269 Plus transceiver chips in an unknown state (i.e. not receiving or sending) and cause communications to be erroneous, intermittent, or unsuccessful.

3. **Two sets of 120 $\Omega$ / 0.5 W resistors and 1 nF / 50 V capacitors in series must be used** (the value matches the characteristic impedance of the line). One set at the 269 Plus end, connected between the positive and negative terminals (Terminals 46 and 47), and another at the other end of the communications link. This prevents reflections and ringing on the line. If a different value resistor is used, the line may be overloaded and communications may be erroneous, intermittent, or unsuccessful.

4. It is highly recommended that the 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 required to minimize ringing and reflections on the line.
F DOs AND DON'Ts

DON'T APPLY DIRECT VOLTAGE TO DIGITAL INPUTS

There are 6 switch inputs on the 269 Plus; Spare, Speed, Differential, Access, Emergency Restart, and External Reset. These inputs are designed for dry contact connections only. By applying direct voltage to them may result in component damage to the Digital input circuitry.

DON'T RESET 86 LOCKOUT SWITCH BEFORE RESETTING RELAY

DON'T Reset an 86 Lockout Switch before resetting the 269 Plus.

If an external 86 Lockout device is used and connected to the 269 Plus, ensure that the 269 Plus is reset prior to attempting to reset the lockout switch. If the 269 Plus is still tripped it will immediately re-trip the lockout switch. Also, if the lockout switch is held reset, the high current draw of the lockout switch coil may cause damage to itself and/or the 269 Plus output relay.

DON'T INSTALL WIRING CLOSE TO HIGH VOLTAGE AND CURRENT CARRYING CONDUCTORS

Although the 269 Plus circuitry is internally shielded to minimize unwanted noise pickup and interference, ensure that any high voltage/current carrying conductors or sources of strong electromagnetic fields are directed away from the 269 Plus or any of its input/output wiring such as control power, phase and ground CTs, RTDs, digital inputs and output relays.
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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 further details.

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.
| DESCRIPTION | G GROUND FAULT & SHORT CIRCUIT INSTANTANEOUS ELEMENTS |
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 the 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 A.

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 250 ms (the 269 Plus reaction time is less than 50 ms + breaker clearing time).

Care must be 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 250 ms bursts. The CTs were capable of handling 500 A for short bursts. The 500 A current relates to a 100 times the CT primary rating. If the time duration required is less than 250 ms, the withstand level will increase.

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, T100, 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 20 x 5 A, therefore an appropriate external burden would be 1 Ω 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 the following figure represents a typical excitation curve for a CT. The y-axis represents 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.

![Figure H–1: TYPICAL CT EXCITATION CURVE](image)

For a Protection Class CT with a 5 A 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 A secondary exciting current point (10% of $20 \times 5$ A). 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 the following figure. 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 $100 \text{ V} / (20 \times 5 \text{ A})$ or $1 \Omega$.

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–2: EXCITATION CURVES METHOD
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