

# **PBE Quick Start Procedure for SEL 501 & Motortronics**

## **MVC4**

- SEL password is 501
  - Use the labeled push buttons to navigate the settings legends.
  - Press enter to save settings changes.
  - 50H, is phase instantaneous overcurrent pickup
  - 51PP is phase time overcurrent pickup
  - 51PC is phase time overcurrent operating curve
  - 51PTD is phase time overcurrent time dial
- The Motortronics “menu” button toggles between the metering menu and the configuration menu. It will also quick exit from any branches.
- Use arrow buttons to navigate the branches
  - Basic configuration (Setpoint pg1) is motor parameters
  - Starter configuration (Setpoint pg2) is ramp parameter
  - Some settings require horizontal movement on the menu tree (i.e. initial voltage) – Press enter to initiate setting changes & press it again to save them
  - All other settings require passwords 100 (level 2) or 1000 (level 3)
- Note: Motor FLA is adjustable from 50 to 100% of the “Unit max current rating” setting (i.e. 400-800amp)
- Lowering the unit max current rating setting via factory password 48562 will allow lower FLA set points.

## SEL-501 Settings Report

### Overview Information

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|                        |                                      |
|------------------------|--------------------------------------|
| File Name              | New Settings 2                       |
| RDB                    | ats 413.rdb                          |
| Device                 | SEL-501                              |
| Setting Version Number | 000                                  |
| Part Number            | 050120BX561BXXB                      |
| Firmware ID            | SEL-501-2-RXXX-V0-Z000000-DXXXXXXXXX |

### Settings

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Port

Relay X

Relay Y

### Settings Legend

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Visible Setting

Hidden Setting

Invalid Setting

| Port <span style="float: right;">Top</span> |                                        |                           |       |
|---------------------------------------------|----------------------------------------|---------------------------|-------|
| Setting                                     | Description                            | Range                     | Value |
| PROTOCOL                                    | Communication Protocol                 | SEL, LMD, MOD             | SEL   |
| SPEED                                       | Baud Rate                              | 300-38400                 | 2400  |
| DATA_BITS                                   | Serial Data Bits                       | 7, 8                      | 8     |
| PARITY                                      | Parity                                 | N, E, O (None, Even, Odd) | N     |
| STOP                                        | Stop Bits                              | 1,2                       | 1     |
| TIMEOUT                                     | Port Timeout Time                      | 0-30 Minutes              | 5     |
| AUTO                                        | Send auto messages to port             | Y,N                       | Y     |
| RTS_CTS                                     | Enable Handshaking Protocol            | Y,N                       | N     |
| FAST_OP                                     | Enable Fast Operate Command Processing | Y,N                       | N     |
| PREFIX                                      | LMD Prefix                             | ~, #, \$, %, &            | @     |
| ADDRESS                                     | LMD Address                            | 01 - 99                   | 1     |
| SETTLE_TIME                                 | LMD Settling Time                      | 0-30                      | 0     |
| SLAVEID                                     | Modbus Slave ID                        | 1-247                     | 1     |
| Port <span style="float: right;">Top</span> |                                        |                           |       |

**Relay X**[Top](#)

| Setting | Description                                        | Range                                         | Value   |
|---------|----------------------------------------------------|-----------------------------------------------|---------|
| ID      | Relay Identifier                                   | 13 CHARACTERS                                 | RELAY X |
| CTR     | Current Transformer Ratio                          | 1-6000                                        | 120     |
| DATC    | Demand Ammeter Time Constant                       | OFF, 5-60 MINUTES                             | 5       |
| IN      | Programmable Input Function                        | EN,BLK,ET                                     | ET      |
| 50PP    | Phase Definite-Time Overcurrent Pickup             | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 6.3     |
| 50PD    | Phase Definite-Time Overcurrent Delay              | 0-16000 Cycles (0.25 steps)                   | 20.00   |
| 50PTT   | Assign 50PT to trip output contacts                | N,1,2,B                                       | B       |
| 50PTC   | 50PT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 50H     | Phase Instantaneous Overcurrent Pickup             | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 10.0    |
| 50HT    | Assign 50H to trip output contacts                 | N,1,2,B                                       | B       |
| 50HC    | 50H Controlled by Input IN or Remote Bit           | Y, N, IN, RB                                  | N       |
| 50QP    | Negative-Sequence Definite-Time Overcurrent Pickup | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 15.0    |
| 50QD    | Negative-Sequence Definite-Time Overcurrent Delay  | 1.5-16000 Cycles (0.25 steps)                 | 20.0    |
| 50QTT   | Assign 50QT to trip output contacts                | N,1,2,B                                       | B       |
| 50QTC   | 50QT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 50NP    | Ground Definite-Time Overcurrent Pickup            | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 15.0    |
| 50ND    | Ground Definite-Time Overcurrent Delay             | 0-16000 Cycles (0.25 steps)                   | 20.0    |
| 50NTT   | Assign 50NT to trip output contacts                | N,1,2,B                                       | B       |
| 50NTC   | 50NT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 50NH    | Ground Instantaneous Overcurrent Pickup            | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 6.3     |
| 50NHT   | Assign 50NH to trip output contacts                | N,1,2,B                                       | B       |
| 50NHC   | 50NH Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 51PP    | Phase-Time Overcurrent Pickup                      | OFF, 0.5-16 A sec (5A),<br>0.1-3.2 A sec (1A) | 1.5     |
| 51PC    | Phase-Time Overcurrent Operating Curve             | U1-U4 (US Curves); C1-C4 (IEC Curves)         | U3      |
| 51PTD   | Phase-Time Overcurrent Time-Dial                   | 0.5-15 (US Curves); 0.05-1.0 (IEC Curves)     | 1.00    |
| 51PRS   | Phase-Time Overcurrent Electromechanical Reset     | Y,N                                           | Y       |
| 51PTT   | Assign 51PT to trip output contacts                | N,1,2,B                                       | B       |
| 51PTC   | 51PT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 51QP    | Negative-Sequence Time-Overcurrent Pickup          | OFF, 0.5-16 A sec (5A),<br>0.1-3.2 A sec (1A) | 1.5     |
| 51QC    | Negative-Sequence Time-Overcurrent Operating Curve | U1-U4 (US Curves); C1-C4 (IEC Curves)         | U3      |

|                                                              |                                                               |                                               |     |
|--------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------|-----|
| 51QTD                                                        | Negative-Sequence Time-Overcurrent Time-Dial                  | 0.5-15 (US Curves); 0.05-1.0 (IEC Curves)     | 3.0 |
| 51QRS                                                        | Negative-Sequence Time-Overcurrent Electromechanical Reset    | Y,N                                           | Y   |
| 51QTT                                                        | Assign 51QT to trip output contacts                           | N,1,2,B                                       | B   |
| 51QTC                                                        | 51QT Controlled by Input IN or Remote Bit                     | Y, N, IN, RB                                  | N   |
| 51NP                                                         | Ground Time-Overcurrent Pickup                                | OFF, 0.5-16 A sec (5A),<br>0.1-3.2 A sec (1A) | 1.5 |
| 51NC                                                         | Ground Time-Overcurrent Operating Curve                       | U1-U4 (US Curves); C1-C4 (IEC Curves)         | U3  |
| 51NTD                                                        | Ground Time-Overcurrent Time Dial                             | 0.5-15 (US Curves); 0.05-1.0 (IEC Curves)     | 3.0 |
| 51NRS                                                        | Ground Time-Overcurrent Electromechanical Reset               | Y,N                                           | Y   |
| 51NTT                                                        | Assign 51NT to trip output contacts                           | N,1,2,B                                       | B   |
| 51NTC                                                        | 51NT Controlled by Input IN or Remote Bit                     | Y, N, IN, RB                                  | N   |
| TRPU1                                                        | TRIP1 Time-Delay Pickup                                       | 0-16000 Cycles (0.25 steps)                   | 0.0 |
| TDUR1                                                        | Minimum TRIP1 Duration                                        | 0-16000 Cycles (0.25 steps)                   | 6.0 |
| TRPU2                                                        | TRIP2 Time-Delay Pickup                                       | 0-16000 Cycles (0.25 steps)                   | 0.0 |
| TDUR2                                                        | Minimum TRIP2 Duration                                        | 0-16000 Cycles (0.25 steps)                   | 6.0 |
| ELTCH                                                        | Enable Phase Current Latch Condition for Trip Output Contacts | Y,N                                           | Y   |
| VALID                                                        | Settings Valid                                                | Y,N                                           | Y   |
| <b>Relay X</b> <span style="float: right;"><u>Top</u></span> |                                                               |                                               |     |

| Relay Y |                                                    |                                               |         |
|---------|----------------------------------------------------|-----------------------------------------------|---------|
|         |                                                    |                                               | Top     |
| Setting | Description                                        | Range                                         | Value   |
| ID      | Relay Identifier                                   | 13 CHARACTERS                                 | RELAY Y |
| CTR     | Current Transformer Ratio                          | 1-6000                                        | 120     |
| DATC    | Demand Ammeter Time Constant                       | OFF, 5-60 MINUTES                             | 5       |
| IN      | Programmable Input Function                        | EN,BLK,ET                                     | ET      |
| 50PP    | Phase Definite-Time Overcurrent Pickup             | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 6.3     |
| 50PD    | Phase Definite-Time Overcurrent Delay              | 0-16000 Cycles (0.25 steps)                   | 20.00   |
| 50PTT   | Assign 50PT to trip output contacts                | N,1,2,B                                       | B       |
| 50PTC   | 50PT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 50H     | Phase Instantaneous Overcurrent Pickup             | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 10.0    |
| 50HT    | Assign 50H to trip output contacts                 | N,1,2,B                                       | B       |
| 50HC    | 50H Controlled by Input IN or Remote Bit           | Y, N, IN, RB                                  | N       |
| 50QP    | Negative-Sequence Definite-Time Overcurrent Pickup | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 15.0    |
| 50QD    | Negative-Sequence Definite-Time Overcurrent Delay  | 1.5-16000 Cycles (0.25 steps)                 | 20.0    |
| 50QTT   | Assign 50QT to trip output contacts                | N,1,2,B                                       | B       |
| 50QTC   | 50QT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 50NP    | Ground Definite-Time Overcurrent Pickup            | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 15.0    |
| 50ND    | Ground Definite-Time Overcurrent Delay             | 0-16000 Cycles (0.25 steps)                   | 20.0    |
| 50NTT   | Assign 50NT to trip output contacts                | N,1,2,B                                       | B       |
| 50NTC   | 50NT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 50NH    | Ground Instantaneous Overcurrent Pickup            | OFF, 0.5-80 A sec (5A),<br>0.1-16 A sec (1A)  | 6.3     |
| 50NHT   | Assign 50NH to trip output contacts                | N,1,2,B                                       | B       |
| 50NHC   | 50NH Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 51PP    | Phase-Time Overcurrent Pickup                      | OFF, 0.5-16 A sec (5A),<br>0.1-3.2 A sec (1A) | 1.5     |
| 51PC    | Phase-Time Overcurrent Operating Curve             | U1-U4 (US Curves); C1-C4 (IEC Curves)         | U3      |
| 51PTD   | Phase-Time Overcurrent Time-Dial                   | 0.5-15 (US Curves); 0.05-1.0 (IEC Curves)     | 1.00    |
| 51PRS   | Phase-Time Overcurrent Electromechanical Reset     | Y,N                                           | Y       |
| 51PTT   | Assign 51PT to trip output contacts                | N,1,2,B                                       | B       |
| 51PTC   | 51PT Controlled by Input IN or Remote Bit          | Y, N, IN, RB                                  | N       |
| 51QP    | Negative-Sequence Time-Overcurrent Pickup          | OFF, 0.5-16 A sec (5A),<br>0.1-3.2 A sec (1A) | 1.5     |
| 51QC    | Negative-Sequence Time-Overcurrent Operating Curve | U1-U4 (US Curves); C1-C4 (IEC Curves)         | U3      |

|                |                                                               |                                               |                   |
|----------------|---------------------------------------------------------------|-----------------------------------------------|-------------------|
| 51QTD          | Negative-Sequence Time-Overcurrent Time-Dial                  | 0.5-15 (US Curves); 0.05-1.0 (IEC Curves)     | 3.0               |
| 51QRS          | Negative-Sequence Time-Overcurrent Electromechanical Reset    | Y,N                                           | Y                 |
| 51QTT          | Assign 51QT to trip output contacts                           | N,1,2,B                                       | B                 |
| 51QTC          | 51QT Controlled by Input IN or Remote Bit                     | Y, N, IN, RB                                  | N                 |
| 51NP           | Ground Time-Overcurrent Pickup                                | OFF, 0.5-16 A sec (5A),<br>0.1-3.2 A sec (1A) | 1.5               |
| 51NC           | Ground Time-Overcurrent Operating Curve                       | U1-U4 (US Curves); C1-C4<br>(IEC Curves)      | U3                |
| 51NTD          | Ground Time-Overcurrent Time Dial                             | 0.5-15 (US Curves); 0.05-1.0 (IEC Curves)     | 3.0               |
| 51NRS          | Ground Time-Overcurrent Electromechanical Reset               | Y,N                                           | Y                 |
| 51NTT          | Assign 51NT to trip output contacts                           | N,1,2,B                                       | B                 |
| 51NTC          | 51NT Controlled by Input IN or Remote Bit                     | Y, N, IN, RB                                  | N                 |
| TRPU1          | TRIP1 Time-Delay Pickup                                       | 0-16000 Cycles (0.25 steps)                   | 0.0               |
| TDUR1          | Minimum TRIP1 Duration                                        | 0-16000 Cycles (0.25 steps)                   | 6.0               |
| TRPU2          | TRIP2 Time-Delay Pickup                                       | 0-16000 Cycles (0.25 steps)                   | 0.0               |
| TDUR2          | Minimum TRIP2 Duration                                        | 0-16000 Cycles (0.25 steps)                   | 6.0               |
| ELTCH          | Enable Phase Current Latch Condition for Trip Output Contacts | Y,N                                           | Y                 |
| VALID          | Settings Valid                                                | Y,N                                           | Y                 |
| <b>Relay Y</b> |                                                               |                                               |                   |
|                |                                                               |                                               | <b><u>Top</u></b> |



# MOTORTRONICS™

*Solid State AC Motor Control*

## MVC<sub>4</sub>

MEDIUM VOLTAGE SOLID STATE SOFT STARTER



USER MANUAL  
1.0 - 7.2 kV



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# Chapter 1 - Introduction

This chapter is an introduction to the Reduced Voltage Solid State Soft Starter for medium voltage AC motors. It is highly recommended that users read this section thoroughly to become familiar with the basic configuration, operation and features before applying the Soft Starter.

## 1.1 Overview

The standard Soft Starter is an SCR-based controller designed for the starting, protection and control of AC medium voltage motors. It contains SCR stack assemblies, fiber optic connections, and low voltage control circuitry ready to be interfaced with an enclosure and the necessary equipment to create a complete a Class E2 medium voltage motor Soft Starter.

## 1.2 Specifications

| GENERAL                                                  |                                                                                                                                                                                                                              |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC Supply Voltage                                        | 1000 – 7200VAC +10 to – 15% (Model dependent)                                                                                                                                                                                |
| Unit Running Overload Capacity<br>(Percent of motor FLA) | 125% - Continuous<br>500% - 60 seconds, 600% - 30 seconds.<br>1 Cycle: Up to 14x FLA (Internally protected by the programmable short circuit)                                                                                |
| Frequency                                                | 50 or 60Hz, +2Hz hardware selectable                                                                                                                                                                                         |
| Power Circuit                                            | 6 SCRs, 12 SCRs, 18 SCRs (Model dependent)                                                                                                                                                                                   |
| SCR Peak Inverse Voltage<br>Ratings                      | 4500V - 19500V (Model dependent see Table 1) Note: Contact Factory                                                                                                                                                           |
| Phase Insensitivity                                      | User selectable phase sequence detection                                                                                                                                                                                     |
| Transient Voltage Protection                             | RC snubber dv/dt networks (One per inverse pair of SCRs)                                                                                                                                                                     |
| Ambient Condition Design                                 | Enclosed units: 0° to 40°C (32° to 104°F) (optional - 20° to 50° C with heaters)<br>5 - 95% relative humidity<br>0 - 3300 ft. (1000m) above sea level without de-rating<br>(Ratings for ambient conditions external to unit) |
| Control                                                  | 2 or 3 wire 120VAC (Customer supplied)                                                                                                                                                                                       |
| Auxiliary Contacts                                       | Multiple: Form C (Contacts), rated 5 Amps, 240VAC max.<br>8 Relays (4 programmable): Form C contacts<br>Fault Indicator: Form C contacts                                                                                     |
| BIL Rating                                               | 1000V – 30KV , 2300V - 7200V 60KV                                                                                                                                                                                            |
| Approvals                                                | UL recognized, Canadian UL (cUL) recognized                                                                                                                                                                                  |

| ADVANCED MOTOR PROTECTION                         |                                                                                                                                                                                                     |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Two Stage Electronic<br>Overload Curves           | Starting: Programmable for Class 5 through 30<br>Run: Programmable for Class 5 through 30 when "At-Speed" is detected.                                                                              |
| Overload Reset                                    | Manual                                                                                                                                                                                              |
| Retentive Thermal Memory                          | Overload circuit retains thermal condition of the motor regardless of control power status. Unit uses real time clock to adjust for off time.                                                       |
| Dynamic Reset Capacity                            | Overload will not reset until thermal capacity available in the motor is sufficient for a successful restart. Starter learns and retains this information by monitoring previous successful starts. |
| Phase Current Imbalance<br>Protection             | Imbalance Trip Level: 5 - 30% current between any two phases<br>Imbalance Trip Delay: 1 - 20 seconds                                                                                                |
| Over Current Protection<br>(Electronic Shear Pin) | Trip Level: 100 - 300% of motor FLA<br>Trip Delay: 1 - 20 seconds                                                                                                                                   |
| Load Loss Trip Protection                         | Under Current Trip Level: 10 -90 % of motor FLA<br>Under Current Trip Delay: 1 - 60 seconds                                                                                                         |
| Coast Down (Back Spin)<br>Lockout Timer           | Coast Down Time Range: 1 - 60 minutes                                                                                                                                                               |
| Starts-per-hour Lockout Timer                     | Range: 1 - 6 successful starts per hour<br>Time between starts: 1 - 60 minutes between start attempts                                                                                               |

| PROGRAMMABLE OUTPUTS     |                                                                                                                                                                                                                                            |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type / Rating            | Form C (SPDT), Rated 5 amps 240 VAC max, (1200 VA)                                                                                                                                                                                         |
| Run Indication           | Programmable                                                                                                                                                                                                                               |
| At Speed Indication      | Programmable                                                                                                                                                                                                                               |
| Acceleration Adjustments | Programmable Ramp Types: Voltage or Current Ramp (VR or CR)<br>Starting Torque: 0 - 100% of line voltage (VR) or 0 - 600% of motor FLA (CR)<br>Ramp Time: 1 to 120 seconds<br>Current Limit: 200 - 500% (VR or CR)<br>Power Ramp: 0 – 300% |
| Dual Ramp Settings       | 4 Options: VR1+VR2; VR1+CR2; CR1+CR2; CR1+VR2<br>Dual Ramp Control: Ramp 1 = Default<br>Ramp 2 = selectable via dry contact input                                                                                                          |
| Deceleration Adjustments | Begin Decel Level: 80 - 100% of line voltage<br>Stop Level: 0 to 1% less than Begin Decel Level<br>Decel Time: 1 - 60 seconds                                                                                                              |
| Jog Settings             | Voltage Jog: 5 - 75%                                                                                                                                                                                                                       |
| Kick Start Settings      | Kick Voltage: 10 - 100%<br>Kick Time: 0.1 - 2 seconds                                                                                                                                                                                      |
| Fault Display            | Shorted SCR, Phase Loss, Shunt Trip, Phase Imbalance Trip, Overload, Overtemp, Overcurrent, Short Circuit, Load Loss, Undervoltage or Any Trip                                                                                             |
| Lockout Display          | Coast Down Time, Starts Per Hour, Time Between Starts, and Any Lockout                                                                                                                                                                     |

| EVENT HISTORY   |                                                                                                                                      |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Up to 60 Events | Data includes cause of event, time, date, voltage, power factor and current for each phase and ground fault current at time of event |

| METERING FUNCTIONS |                                                                                       |
|--------------------|---------------------------------------------------------------------------------------|
| Motor Load         | Percent of FLA                                                                        |
| Current Data       | A, B, C Phase Current, Avg Current, Ground Fault (Option)                             |
| Thermal Data       | Remaining thermal register; thermal capacity to start                                 |
| Start Data         | Avg Start Time, Avg Start Current, Measured Capacity to start, time since last start. |
| RTD Data (Option)  | Temperature readings from up to 12 RTDs (6 stator RTDs)                               |
| Voltage Metering   | kW, kVAR, PF, kWh                                                                     |

| SERIAL COMMUNICATIONS |                                                                      |
|-----------------------|----------------------------------------------------------------------|
| Protocol              | Modbus RTU                                                           |
| Signal                | RS-485, RS-422 or RS232                                              |
| Network               | Up to 247 devices per mode                                           |
| Functionality         | Full operation, status view, and programming via communications port |

| OPERATOR INTERFACE      |                                                                                  |
|-------------------------|----------------------------------------------------------------------------------|
| LCD Readout             | Alpha numeric LCD display                                                        |
| Keypad                  | 8 function keys with tactile feedback                                            |
| Status Indicators       | 12 LEDs include Power, Run, Alarm, Trip, Aux Relays                              |
| Remote Mount Capability | Up to 1000 circuit-feet from chassis (Use twisted, shielded wire & power source) |

| CLOCK and MEMORY             |                                                 |
|------------------------------|-------------------------------------------------|
| Operating Memory             | SRAM loaded from F-RAM at initialization        |
| Factory Default Storage      | Flash Memory                                    |
| Customer Settings and Status | Non-volatile F-RAM, no battery backup necessary |
| Real Time Clock              | Lithium ion battery for clock memory only       |

### 1.3 Reference Chart

| SEC.      | Table or Drawing                                           | Page Number | SEC.   | Table or Drawing                                        | Page Number |
|-----------|------------------------------------------------------------|-------------|--------|---------------------------------------------------------|-------------|
| 1.2       | Specifications                                             | 1 - 2       |        | Setpoint Page 7 Displays - Custom Acceleration Curve    | 52-54       |
| 1.4       | Design Features (Unit PIV Ratings)                         | 4           |        | Setpoint Page 8 Displays - Overload Curve Configuration | 55-56       |
| 1.9 & 4.1 | Electronics (Keypad Operator Interface)                    | 8 & 26      |        | Setpoint Page 9 Displays - RTD Option Configuration     | 57-58       |
| 2.2       | TCB Board Layout and Connections                           | 10          | 5.2    | Setpoint Page 10 Displays - Set Password                | 59          |
|           | TB1, TB2 & TB3 Description                                 | 12          |        | Setpoint Page 11 Displays - Communications              | 59          |
|           | TB4, TB5 & TB6 Description                                 | 13          |        | Setpoint Page 12 Displays - System Setpoints            | 60-61       |
|           | TB7 & TB8 Description                                      | 14          |        | Setpoint Page 13 Displays - Calibration & Service       | 62          |
|           | Jumper Selections                                          | 15          | 6.1    | Metering Page List                                      | 54-64       |
|           | Switch Settings                                            | 15          | 6.2    | Metering Menu                                           | 65          |
|           | LED Indicators                                             | 16          |        | Metering Page 1 Displays - Metering Data                | 66          |
| 2.3       | Optional RTD Board                                         | 17          |        | Metering Page 2 Displays - Metering                     | 67          |
|           | Communications Board Layout & Connections: RS485 and RS422 | 17          |        | Metering Page 3 Displays - RTD Values                   | 68          |
|           | Power Board & Connections                                  | 18          |        | Metering Page 4 Displays - Status                       | 69          |
|           | CPU Board Layout & Connections                             | 19          |        | Metering Page 5 Displays - Event Recorder               | 70          |
|           |                                                            |             |        | Metering Page 6 Displays - Last Trip                    | 71          |
| 2.4       | Typical Wiring Diagram                                     | 20          |        | Metering Page 7 Displays - Statistics                   | 72          |
| 3.2       | Acceleration Adjustments                                   | 21          | 7.1    | Failure Analysis & Troubleshooting                      | 73-75       |
| 3.3       | Deceleration Adjustments                                   | 22          | 7.1    | SCR Testing Procedure                                   | 75          |
| 3.4       | Sequence of Operation                                      | 23          | NOTES- |                                                         |             |
| 4.2       | Menu Navigation                                            | 27          |        |                                                         |             |
|           | Changing Setpoints Example                                 | 25          |        |                                                         |             |
| 5.1       | Setpoints Page List                                        | 29 – 35     |        |                                                         |             |
| 5.2       | Setpoint Menu & Parameter Explanation                      | 36-65       |        |                                                         |             |
|           | Setpoint Page 1 Displays - Basic Configuration             | 36          |        |                                                         |             |
|           | Overload Class Trip Curves                                 | 37          |        |                                                         |             |
|           | Setpoint Page 2 Displays - Starter Configuration           | 37-42       |        |                                                         |             |
|           | Jog/Voltage Ramp                                           | 39          |        |                                                         |             |
|           | Setpoint Page 3 Displays - Phase & Ground Settings         | 41          |        |                                                         |             |
|           | Overcurrent Trip Delay Graph                               | 43          |        |                                                         |             |
|           | Setpoint Page 4 Displays - Relay Assignment                | 47-42       |        |                                                         |             |
|           | Setpoint Page 5 Displays - Relay Configuration             | 48          |        |                                                         |             |
|           | Setpoint Page 6 Displays - User I/O Configuration          | 49-51       |        |                                                         |             |

## 1.4 Design Features

The standard Soft Start panel has the following features:

- **SCR Power Modules:** For each phase, the SCRs are arranged in inverse parallel pairs and series strings as indicated in Table 1 below to facilitate sufficient Peak Inverse Voltage ratings for the application
- **RC Snubber Networks:** Provide Transient Voltage Protection for SCR Power Modules in each phase to avoid dv/dt damage.
- **Firing Circuit:** The SCRs are gated (turned on) using a Sustained Pulse Firing Circuit. This circuitry is isolated from the control voltage by means of fiber optics.

Table 1 Unit PIV Ratings

| 200 & 400 Amps Units |                |                      |              | 600 Amps Units |                |                      |              |
|----------------------|----------------|----------------------|--------------|----------------|----------------|----------------------|--------------|
| Voltage              | Series Devices | Total Number of SCRs | PIV Rating   | Voltage        | Series Devices | Total Number of SCRs | PIV Rating   |
| 1000V                | 0              | 6                    | 4500 V       | 2300 V         | 2              | 12                   | 9000 V       |
| 2300 V               | 0              | 6                    | 6500 V       | 3300 / 4160 V  | 4              | 24                   | 9000/18000 V |
| 3300 / 4160 V        | 2              | 12                   | 9000/13000 V | 6000 - 7200 V  | 4              | 36                   | 18000 V      |
| 6000 - 7200 V        | 3              | 18                   | 19500 V      |                |                |                      |              |

## 1.5 Theory of Operation

The Soft Starter is CPU controlled, using a microprocessor based protection and control system for the motor and starter assembly. The CPU uses Phase Angle Firing control of the SCRs to apply a reduced voltage to the motor, and then slowly and gently increases torque using voltage and current control until the motor accelerates to full speed. This starting method lowers the starting current of the motor, reducing electrical stresses on the power system and motor. It also reduces peak starting torque stresses on both the motor and mechanical load, promoting longer service life and less downtime.

### 1.5.1 Acceleration:

The soft starter comes standard with several methods of accelerating the motor so that it can be programmed to match almost any industrial AC motor application. The factory default setting applies a **Voltage Ramp** with **Current Limit** as this has been proven to be the most reliable starting method for the vast majority of applications. Using this starting method, the Initial Voltage setting applies just enough voltage to cause the motor shaft to begin to turn. This voltage is then gradually increased over the "Ramp Time" setting, until one of two things happen: the motor accelerates to full speed, or the Ramp Time expires and the Current Limit setting is reached.

If the motor accelerates to full speed before the ramp time has expired, an automatic Anti- Oscillation feature will override the remaining ramp time and full voltage will be applied. This will prevent any surging or pulsation in the motor torque, which might otherwise occur. If the motor has not reached full speed at the end of the ramp time setting, the current limit setting will proportionally regulate the maximum output torque. CPU algorithms provide protection against a stall condition, an overload condition or excessive acceleration time.

The Current Limit feature is provided to accommodate installations where there is limited power available (For example, on-site generator power or utility lines with limited capacity). The torque is increased until the motor current reaches the pre-set Current Limit value at which point it is then held. Current Limit overrides the ramp time setting so if the motor has not accelerated to full speed under the Current Limit setting, the current remains limited for as long as it takes the motor to accelerate to full speed.

When the motor reaches full speed and the current drops to running levels, the soft starter detects an At-Speed condition and automatically closes the Bypass Contactor. The Bypass Contactor serves to shunt power around the SCR stack assemblies to prevent heat build-up in the starter enclosure. At this point, the motor is operating at full voltage, speed and power.

Other starting methods available in the soft starter are:

- **Current Ramp:** Uses a closed loop current feedback algorithm to provide a linear current increase up to a Maximum Current level.
- **Constant Current:** current is immediately increased to the Current Limit point and held there until the motor reaches full speed.
- **Power (KW) Ramp:** Uses a True RMS KW feedback PID loop to provide a linear increase in True RMS motor power to a maximum set KW value.
- **Custom Curve:** Gives the user the ability to plot torque and time points on a graph. The soft starter will then accelerate the motor following these points.
- **Tachometer Feedback Ramp:** uses a closed loop speed follower method monitoring a tachometer input signal from the motor or load shaft to provide a linear RPM acceleration.

**1.5.2 Deceleration:** The soft starter provides the user with the option of having the load coast to a stop or controlling the deceleration by slowly reducing the voltage to the motor upon initiating a stop command. The Decel feature is the **opposite of DC injection braking** in that the motor will actually take longer to come to a stop than if allowed to coast to a stop. The most common application for the Decel feature is pumping applications where a controlled stop prevents water hammer and mechanical damage to the system.

## 1.6 General Protection

The Soft Starter is provided with a built-in motor protection relay that can be programmed for primary protection of the motor / load system. Operation of the Soft Starter can be divided into 4 modes; Ready, Start, Run and Stop.

**1.6.1. Ready Mode:** In this mode, control and line power are applied and the Starter is ready for a start command.

Protection during this mode includes the monitoring of current for leakage through multiple shorted SCRs or welded contacts on the Bypass Contactor. Other protection features in effect are:

- Starter Power Pole Temperature
- Shorted SCR
- Blown Fuse Indication
- Phase Reversal (if enabled)
- Line Frequency Trip Window
- External Input Faults (Digital Input Faults are active in all modes)
- Undervoltage
- Overvoltage

**Note:** The “Programming Mode” can only be entered from the Ready Mode. Any attempt to enter data while the motor is starting or running will be blocked. During programming, all protection features and start command are disabled.

**1.6.2 Start Mode:** These additional protection functions are enabled when the Soft Starter receives a valid Start command:

- Phase Reversal (if enabled) Phase Reversal will still be on and is not a newly activated feature when starting.
- Start Curve
- Acceleration Timer
- Phase Imbalance
- Short Circuit / Load Pre-check (Toe-in-the-Water)
- Ground Fault (Optional)
- External Input Faults
- Accumulated Starting FLA Units (12t Protection)
- Starting Overload Protection Curve Selection
- Thermal Capacity

**Note:** Shorted SCR protection is no longer in effect once the soft starter goes into the Start Mode.

**1.6.3 Run Mode:** The soft starter enters the Run Mode when it reaches full output voltage *and* the motor current drops below the FLA setting (motor nameplate FLA plus service factor) for a pre-determined period of time. During the Run Mode these additional protection features are enabled:

- Running Overload Protection Curve Selection
- Phase Loss
- Under Current / Load Loss
- Over Current / Electronic Shear Pin (Jam Protection)
- External Input Faults

**1.6.4 Stop Mode:** Once a Stop command has been given, the protection features change depending on which Stop Mode is selected.

- Decel Mode: Retains all protection features of the Run Mode. At the end of Decel, the motor will be stopped and the protection features change as indicated below.
- Coast-To-Stop Mode: Power is immediately removed from the motor and the Soft Starter returns to the Ready Mode.
- Additional protection features activated when the stop command is given include:
  - Coast-Down / Back Spin Timer
  - Starts-per-Hour
  - Time between Starts
  - External Input Faults

## **1.7 Thermal Overload Protection**

The Soft Starter plays an important role in the protection of your motor in that it monitors the motor for excessive thermal conditions due to starting, running and ambient conditions. The soft starter has a Dynamic Thermal Register system in the CPU that provides a mathematical representation of the thermal condition of the motor.

This thermal information is retained in memory and is monitored for excesses in both value and rate of change. Inputs are derived from current values, imbalances and (optional) RTD measurements making it dynamic to all processes involving the motor. The Soft Starter monitors these conditions separately during the Start and Run modes to provide proper thermal protection at all times.

**1.7.1 Start Mode overload protection** is selectable using one of three methods:

- **Basic Protection:** I<sup>2</sup>t data is accumulated and plotted based on an Overload Curve selected in programming. This is programmed per NEMA Class 5-30 standard curves and is based on the Locked Rotor Current (from the motor nameplate) as programmed into the Soft Starter.
- **Measured Start Capacity:** The user enters a measured amount of thermal capacity from a pre-selected successful start as a set point to the Thermal Register for the soft starter to follow.
- **Learned Curve Protection:** The user sets the soft starter to the “LEARN” mode and starts the motor under normal starting conditions. The CPU then samples and records 100 data points during the start curve, analyzes them and creates a graphical representation in memory. The soft starter is then switched to Curve Follow protection mode and monitors motor performance against this curve. This feature is especially useful in initial commissioning tests to record a base line performance sample (In this case, it is not necessarily used for motor protection).

**1.7.2 Run Mode overload protection** is initiated when the soft starter determines that the motor is At-Speed. Overload Protection is initiated when the motor RMS current rises above a “pick-up point” (as determined by the motor nameplate FLA and service factor). Run mode protection is provided by the CPU monitoring the Dynamic Thermal Register. Data for the Dynamic Thermal Register is accumulated from I<sup>2</sup>t calculations and cooling rates. A trip occurs when the register reaches 100% as determined by the selected Overload Protection Curve (NEMA Class 5-30 standard curves) and is based on the programmed Locked Rotor Current indicated on the motor nameplate. The Dynamic Thermal Register is altered, or “biased”, by the following conditions:

- **Current Imbalance** will bias the register higher due to additional motor heating as a result of a line current imbalance condition.
- **Normal Cooling** is provided when the motor current drops below the overload pick-up point or the motor is off line. The Cooling rate is lower for motors that are off-line (such as after a trip) since cooling fans are also inoperative.
- **RTD Input** (Requires the optional RTD monitor card) provides a separate means of motor protection based on actual temperatures measurements inside the motor. It runs independently of the Thermal Register Model and does not provide input to, or bias that model.
- **Dynamic Reset** is another feature that adds reliability and consistency to the performance of the soft starter. If a motor overload condition occurs and the Overload protection trips, it cannot be reset until sufficient cool down time has elapsed. This cool down time is determined by the "Learned Thermal Capacity" required to start the motor which must be regained before the overload can be reset. This ensures sufficient thermal capacity for a successful restart of the motor.
- **Retentive Memory** provides continuous overload protection and true thermal modeling by means of a running back up of the thermal register even if power is lost. Upon restoration of power, the soft starter will read the Real Time Clock, then recalculate and restore the thermal register to what it should be, given the elapsed time and the cool down rate of the motor.
- **Learned Reset Capacity** is a feature that is unique to the Soft Starter. By sampling the amount of thermal capacity used in the previous three successful starts, the starter will not allow a reset until a sufficient amount of thermal capacity has been regained in the motor. This prevents nuisance tripping and insures that unsuccessful start attempts (which would otherwise use up the starts-per-hour capacity of the motor) are not counted.

## 1.8 Firing Circuit

The SCR gate firing circuit is critical to the performance and stability of the system. The firing circuit includes several unique features which enhance the ruggedness, noise immunity and flexibility for maximized performance. These features include:

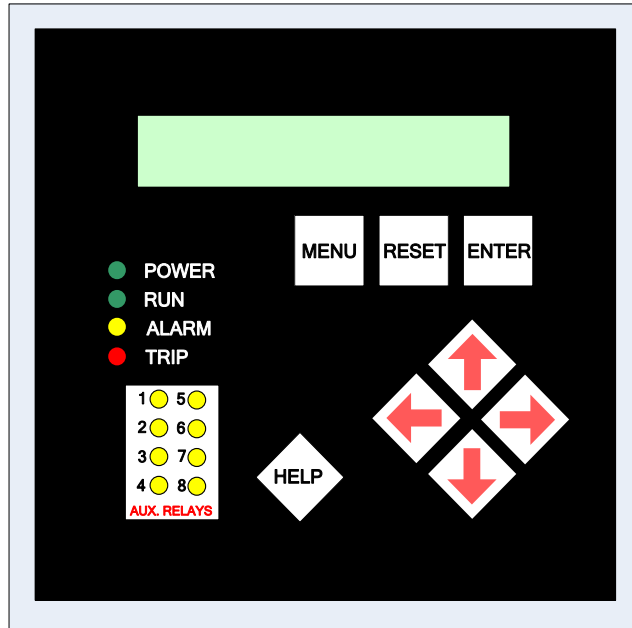
- **Auto Synchronizing** of the gate timing pulses match each phase firing angle to their respective phases. The Soft Starter actively tracks minor shifts in the line frequency avoiding nuisance tripping that may happen with conventional gate firing systems. This is especially useful on portable or backup generator supplies, allowing the soft starter to be used confidently in applications that have unstable power.
- **Sustained Pulse** firing keeps the firing signal active for 270 electrical degrees ensuring that the DC gate pulse forces the SCR to fire even if line noise is present. This provides the Soft Starter with superior noise immunity and protects against misfiring, enhancing the soft starter system stability.
- **Closed Loop Firing Control** is a method of balancing the SCR firing pattern. The CPU uses feedback signals from the output current and voltage providing to provide smooth output preventing imbalances during ramping which prevents unnecessary motor heating.
- **Transformer Isolation** of SCR firing information and signals prevents interference from line noise and EMI/RFI that may be present. Three phase isolation transformers provide potential measurement, firing board timing while providing isolation from the line voltage. High isolation Ring Transformers are used to step the 120v control voltage down to 28VAC for the Sustained Pulse firing circuit, providing further isolation for the SCR gates.
- **Fiber Optic Isolation** is provided for all gate drive and current feedback signal interfaces between the Medium and Low Voltage systems.

## 1.9 Electronics

The Soft Starter electronic systems are divided into two categories; Low Voltage and Medium Voltage and are based on where they are located in the Starter structure.

**1.9.1 Low Voltage** electronics include the Keypad Operator Interface, the CPU and Main Power PC boards which are located in an isolated Low Voltage compartment of the enclosure.

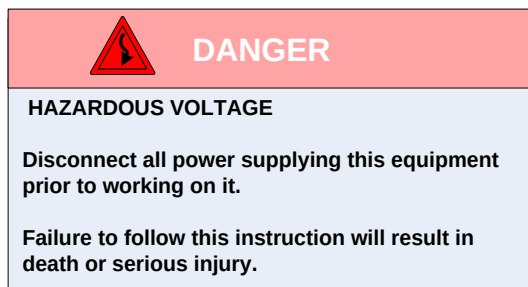
- **Keypad Operator Interface** is a 2 line x 20 character LCD display with back-lighting for low ambient light conditions. The display reads out in truncated English and can show multiple data points in each screen. Twelve LED indicators are included which show the status of, Power, RUN, ALARM, TRIP and the 8 AUX RELAYS. The Operator communicates with the CPU board via a serial cable link and can be remotely located up to 1000ft. from the starter. **FIG. 1.9** shows the Keypad Operator Interface.



**FIG. 1.9 Keypad Operator Interface.**

- **CPU Board** is where the microprocessor and communications co-processor are located. It is attached to the main Power board. The CPU determines operating functions, stores user programming, acts upon feedback signals for faults, and calculates metering and historical data. The board communicates with the Keypad Operator Interface via a serial link cable. Analog and Digital I/O are also located on the CPU board. (See **FIG. 2.3.4**)
- **Main Board** also referred to as the Firing Board, contains the Auxiliary I/O relays and interfaces to the TCB board (see below) for user interface. This board generates all firing signals for the SCR stacks and receives feedback signals which are isolated via fiber optics. The board also provides signal conditioning in preparation for analog to digital conversion. (See **FIG. 2.3.3**)

**1.9.2 Control Electronics** are located in the Medium Voltage section of the soft starter. They include the Gate Drive and Temp / CT boards.



- **TCB (Terminal and Control Board)** is the user connection interface board. This board contains the user terminal blocks, output relays (duplicated), inputs and control power connections. It also contains additional timed relays for interfacing with Power Factor Correction contactors (if used) and other external devices. Please note Power Factor Capacitor warnings in **Section 2.1.**; also see **FIG. 2.2.1.**
- **Gate Drive Boards** are located directly on the SCR stacks. These boards connect to the Main Power board via fiber optic cables. They amplify the gate pulse signals with power from the Ring Transformers to create the Sustained Pulse Firing of the SCRs. There is one Gate Drive board for each pair of SCRs in each stack.
- **Temp / CT Boards** are attached to the Gate Drive boards on the SCR stacks and provide the heat sink Temperature and line current signals back to the Main Power Board via fiber optic cables.
- **MOV Boards** are attached to standoffs mounted on the SCR heat sinks and are mounted directly below the Gate Drive boards. The MOV boards are used to protect the SCRs from over voltage.
- **DV/DT Boards** are also attached to standoffs mounted on the SCR heat sinks and are mounted below the MOV boards. The DV/DT boards are used to mitigate voltage transients across the stack assemblies.

## Chapter 2 – Connection

### 2.1 Warnings

- **Do not service this equipment with voltage applied!** The unit can be the source of fatal electric shock! To avoid shock hazard, disconnect main power and control power before working on the unit. Warning labels must be attached to terminals, enclosure and control panel to meet local codes observing Lock Out, Tag Out procedures.
- **Do not connect (PFC) capacitors or surge capacitors to the load side (motor side) of the unit.** This will cause di/dt damage to the SCRs when they are turned on and will void the warranty on this product. Capacitors can only be connected to the load side of the starter through the use of an isolating contactor which is closed after the soft starting sequence has been completed or when di/dt limiting inductors are factory installed.
- **Avoid connecting capacitors to the input side of the unit.** If you cannot avoid using capacitors across the power lines, they must be located as far upstream as possible of the input line contactor. In this situation, an optional power factor correction (PFC) capacitor contactor should be specified. For additional information and specifications or when di/dt limiting inductors are factory installed, please contact the factory.
- **Never interchange the input and output power connections on the unit.** This will cause excessive voltage to the control circuit logic.
- **For bus protection, it is strongly recommended to use non-gap MOV Type lightning arrestors in areas where lightning is a significant problem.** The arrestors should be mounted on the nearest utility pole at the Station or optionally included with the unit at the time of order.
- **Medium Voltage cables can have significant capacitance values by design which can elevate Di/Dt thru the SCRs to unsafe levels.** Compensating inductors can limit these values to safe levels. Contact the factory if you need more information on this subject.



#### DANGER

##### HAZARDOUS VOLTAGE

Disconnect all power supplying this equipment prior to working on it.

Failure to follow this instruction will result in death or serious injury.



#### CAUTION

##### SCR DAMAGE

Do not connect (PFC) capacitors to the load side of the unit.

Doing so will cause DI/DT damage to the SCRs when energized.



#### WARNING

##### SAFETY HAZARD

Do not bypass electrical or mechanical interlocks.

Failure to follow this instruction will cause severe equipment damage, serious injury or death.

## 2.2 Control Connections - TCB (Terminal and Control Board)

### 2.2.1 TCB Board

The TCB board, FIG. 2.2.1 shown below, provides interconnections between the main power and CPU boards and the customer's control logic connections. It is a 120 VAC control board with several auxiliary dry contacts, built-in time delay circuits and an emergency bypass function. It also controls the inline isolation and bypass contactor and provides provisions for shutdown interlocks. (See **Section 2.2.2** for terminal designations and descriptions)

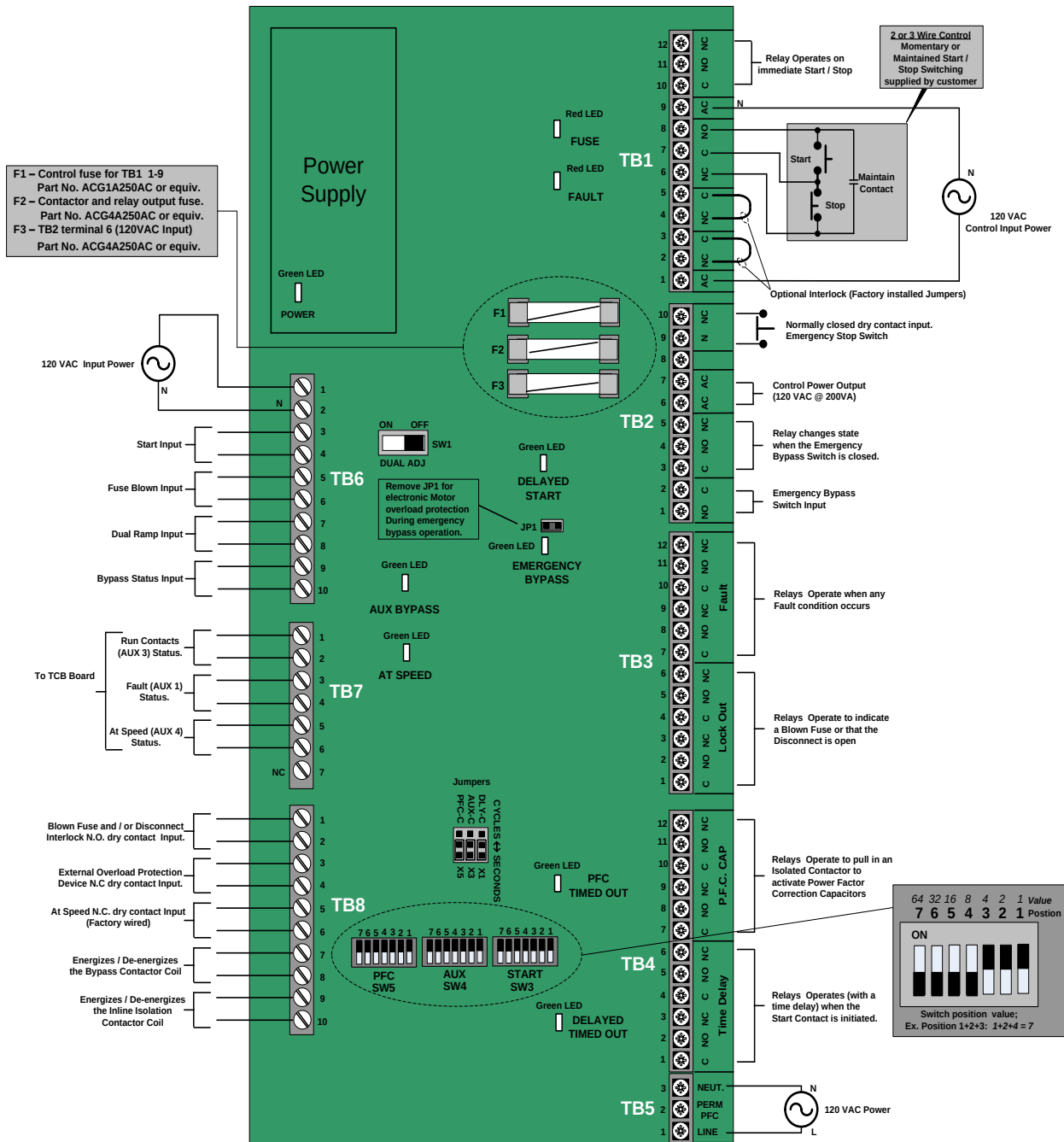


FIG. 2.2.1 TCB Terminal and Control Board

### 2.2.2 Description of Terminal Connections

| TB1 Start / Stop Control |               |                                                                                                                                                                              |
|--------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T                        | Description   |                                                                                                                                                                              |
| 1                        | AC            | 120 VAC Control Power (Line)                                                                                                                                                 |
| 2<br>3                   | NC<br>C       | Shutdown Input – Accepts customer N.C dry contact (Factory jumper installed)                                                                                                 |
| 4<br>5                   | NC<br>C       | Shutdown Input – Accepts customer N.C dry contact (Factory jumper installed)                                                                                                 |
| 6<br>7<br>8              | NC<br>C<br>NO | Terminal 6, 7 & 8;"2-wire control is connected to pins 6 & 8". Also; "For 3 wire control, connect the N.C. STOP button to pins 6 & 7 and the N.O. START button to pins 7 & 8 |
| 9                        | AC            | 120 VAC Control Power (Neutral)                                                                                                                                              |
| 10<br>11<br>12           | C<br>NO<br>NC | Common<br>Normally Open<br>Normally Closed, Form C Relay that changes state on Start and Stop commands                                                                       |

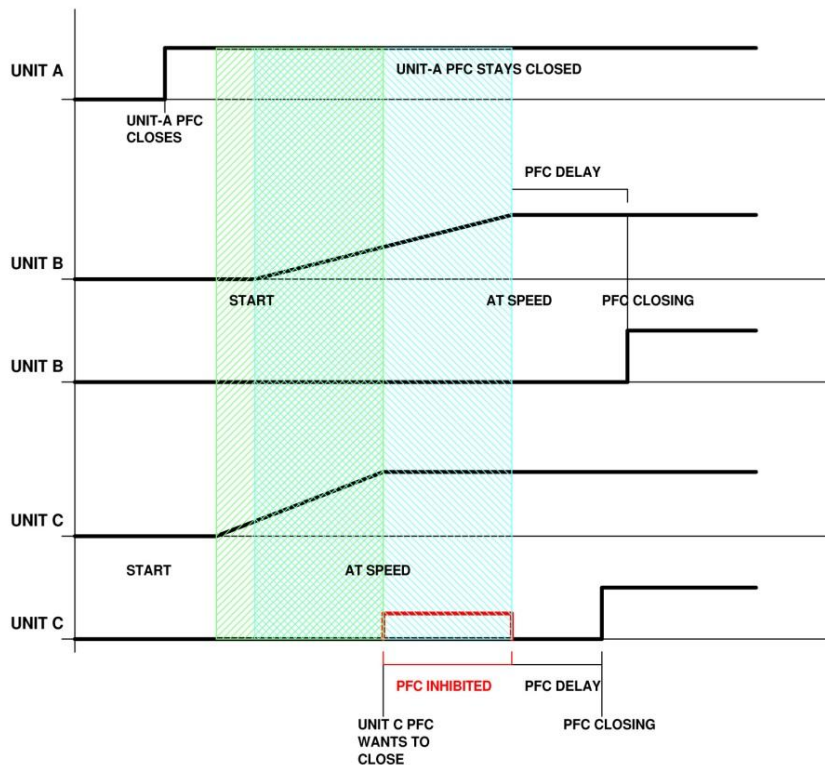
| TB2 Emergency Bypass Control |               |                                                                                                                                                             |
|------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T                            | Description   |                                                                                                                                                             |
| 1<br>2                       | NO<br>C       | When the N.O. contact closes the unit reverts to an electromechanical starter. When a start command is given the unit will start the motor across the line. |
| 3<br>4<br>5                  | C<br>NO<br>NC | Terminals 3, 4 and 5 is a form C output relay that changes state when the contact at TB2 pins 1 & 2 is closed                                               |
| 6<br>7                       | NO<br>NC      | 120 VAC @ 200VA Aux Control Power output.                                                                                                                   |
| 8                            | -             | Not Used                                                                                                                                                    |
| 9<br>10                      | N<br>NC       | Normally Closed Emergency Stop Dry Contact Input.<br>Open to activate the Emergency Stop Feature.                                                           |

| TB3 Fault Relay Outputs |               |                                                                                    |
|-------------------------|---------------|------------------------------------------------------------------------------------|
| T                       | Description   |                                                                                    |
| 1<br>2<br>3             | C<br>NO<br>NC | (2) Form C relay output that transfer on blown fuse or disconnect open indication. |
| 4<br>5<br>6             | C<br>NO<br>NC | (2) Form C relay output that transfer on blown fuse or disconnect open indication. |
| 7<br>8<br>9             | C<br>NO<br>NC | (2) Form C relay output that transfer on <b>any</b> fault indication.              |
| 10<br>11<br>12          | C<br>NO<br>NC | (2) Form C relay output that transfer on <b>any</b> fault indication.              |

### 2.2.2. Description of Terminal Connections - Continued

| TB4 Optional Relay Outputs |               |                                                                                                                                                  |
|----------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| T                          | Description   |                                                                                                                                                  |
| 1<br>2<br>3                | C<br>NO<br>NC | 2 Form C time delay Aux relay output contacts. Time delay starts when the Start command is given.                                                |
| 4<br>5<br>6                | C<br>NO<br>NC |                                                                                                                                                  |
| 7<br>8<br>9                | C<br>NO<br>NC |                                                                                                                                                  |
| 10<br>11<br>12             | C<br>NO<br>NC | 2 Form C time delay Aux relay output contacts. Time delay starts when the "At Speed" condition is reached ideal for controlling a PFC contactor. |

| TB5 TCB Power |             |                                                                                                                                                                                                                                                                                                              |
|---------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T             | Description |                                                                                                                                                                                                                                                                                                              |
| 1             | L           | By connecting TB5 of multiple units in parallel, PFC contactors will be inhibited from closing while a unit is soft starting. PFCs that are already on line will remain on line. The lead unit in the parallel string requires TB5 pins 1 & 3 to be connected to the 120Vac source and neutral respectively. |
| 2             | PFC         |                                                                                                                                                                                                                                                                                                              |
| 3             | N           |                                                                                                                                                                                                                                                                                                              |



Example: PFC Automatic inhibit control

### 2.2.2 Description of Terminal Connections - Continued

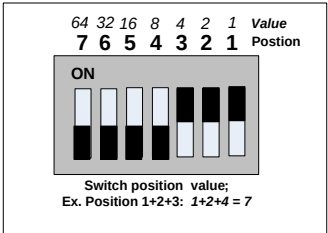
| TB6 Main and CPU Circuit Board Control Inputs |             |                                                            |
|-----------------------------------------------|-------------|------------------------------------------------------------|
| T                                             | Description |                                                            |
| 1<br>2                                        | L<br>N      | 120 Vac output to Control Power Input (Main & CPU Circuit) |
| 3<br>4                                        | -<br>-      | Start Input                                                |
| 5<br>6                                        | -<br>-      | Fuse Blown Input                                           |
| 7<br>8                                        | -<br>-      | Dual Ramp Input                                            |
| 9<br>10                                       | -<br>-      | Bypass Status Input                                        |

| TB7 Main and CPU Circuit Board Control Outputs |                                                                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| T                                              | Description                                                                                                         |
| 1<br>2                                         | Run contacts (AUX3) to the TCB board. <i>(Signal is used to hold the Main Contactor closed during deceleration)</i> |
| 3<br>4                                         | To the TCB board indicating the status of AUX 1.                                                                    |
| 5<br>6                                         | At Speed Contacts (AUX 4) used to signal the Bypass Contactor to close.                                             |
| 7                                              | Not Connected / Not Used                                                                                            |

| TB8 Control Inputs and Outputs |                                                                                                                       |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| T                              | Description                                                                                                           |
| 1<br>2                         | N.C. dry contact input from blown fuse and/or disconnect interlock.                                                   |
| 3<br>4                         | N.C. dry contact input from an external Overload Protection device. <i>(Required if emergency bypass is used)</i>     |
| 5<br>6                         | N.C. dry contact input from the Bypass Contactor for at speed indication.                                             |
| 7<br>8                         | Output connected to the Bypass Contactor and energizes / de-energizes the Contactor. <i>(Factory wired)</i>           |
| 9<br>10                        | Output connected to the Inline Isolation Contactor and energizes / de-energizes the Contactor. <i>(Factory wired)</i> |

### 2.2.3 Description of Jumper Selections and Functions

| Jumper Selection |    |                 |                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Jumper           |    | Time Delay      | Function                                                                                                                                                                                                                                                                                                                                                                          |
| DLY-C            | X1 | Seconds /Cycles | <b><u>Start Delay</u></b><br>Jumper selects between seconds or cycles (1/60 <sup>th</sup> of a second) for the start delay when a Start command is received and when the CPU actually receives the start signal. Default jumper setting is seconds.                                                                                                                               |
| AUX-C            | X3 | Seconds /Cycles | <b><u>Auxiliary (Start) Delay</u></b><br>Jumper selects between seconds or cycles (1/60 <sup>th</sup> of a second) for the auxiliary start delay when a Start command is received and when the CPU actually receives the start signal. Default jumper setting is seconds.                                                                                                         |
| PFC-C            | X5 | Seconds /Cycles | <b><u>PFC Contactor Delay</u></b><br>Jumper selects between seconds or cycles (1/60 <sup>th</sup> of a second) for the delay when the Bypass Contactor closes to when the Power Factor Capacitors Contactor is activated. Default jumper setting is seconds.                                                                                                                      |
| JP1              |    | N/A             | <b><u>Motor Protection Jumper</u></b><br>When this jumper is in place, the CPU will be disabled during operation in the Emergency Bypass Mode. <b><i>In this case, insure that there is an external means of overload protection.</i></b> When the jumper is removed, the CPU will be enabled to provide electronic motor protection when operating in the Emergency Bypass Mode. |

| DIP Switches |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Switch       | Function                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| SW1          | ON: Sets Dual Adjustment<br>OFF: Disabled |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| SW2          | Not Used                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| SW3          | Sets the Start Delay Value                | <p>SW3, SW4 and SW5 are 7 position DIP Switches that use binary coding to set the value of the time delay in Cycles or Seconds as selected via jumpers X1 to X6. (See Jumper Table.) The setting range is 0 to 127 (1+2+4+8+16+32+64). The example shown results in a value of 7 (1+2+4)</p>  <p>Switch position value:<br/>Ex. Position 1+2+3: 1+2+4 = 7</p> |
| SW4          | Sets the AUX Start Delay Value            |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| SW5          | Sets the PFC Contactor Delay Value        |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

### 2.2.5 Description of LED Indicators Functions

| LED Indicators                    |          |        |                                                                         |
|-----------------------------------|----------|--------|-------------------------------------------------------------------------|
| Function                          | Location | Color  | Function                                                                |
| <b>Fuse Blown/<br/>Disconnect</b> | D4       | Red    | ON: When a Fuse is blown and / or a Disconnect is open.                 |
| <b>Fault</b>                      | D16      | Red    | ON: When any Fault has occurred.                                        |
| <b>Start</b>                      | D7       | Yellow | ON: When a Start signal has been initiated.                             |
| <b>PFC Timed Out</b>              | D17      | Yellow | ON: When the Power Factor Correction Capacitors Contactor is energized. |
| <b>Delay Timed Out</b>            | D15      | Yellow | ON: When the Auxiliary Start Contacts have been energized.              |
| <b>+24V</b>                       | D28      | Green  | ON: +24V supply is good.                                                |

2.3 PCB Layout Section - THIS SECTION IS FOR REFERENCE ONLY. NO FIELD WIRING OR CONNECTIONS ARE REQUIRED.

2.3.1 Optional RTD Board

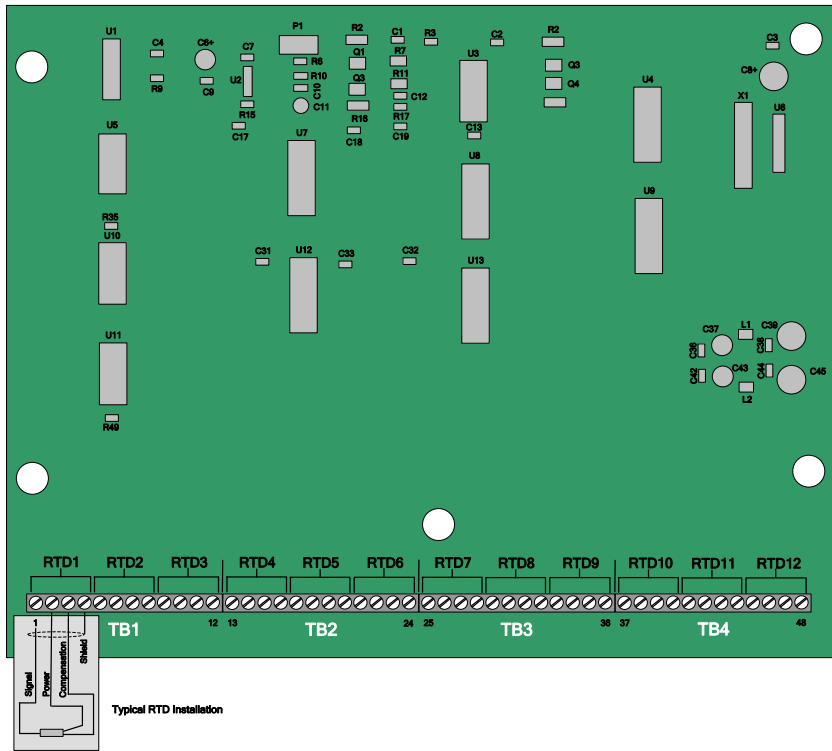


FIG. 2.3.1 Optional RTD Board

2.3.2 RS485 / RS422 Communications Board

**Note:** This Board is mounted on the back of the Keypad Interface

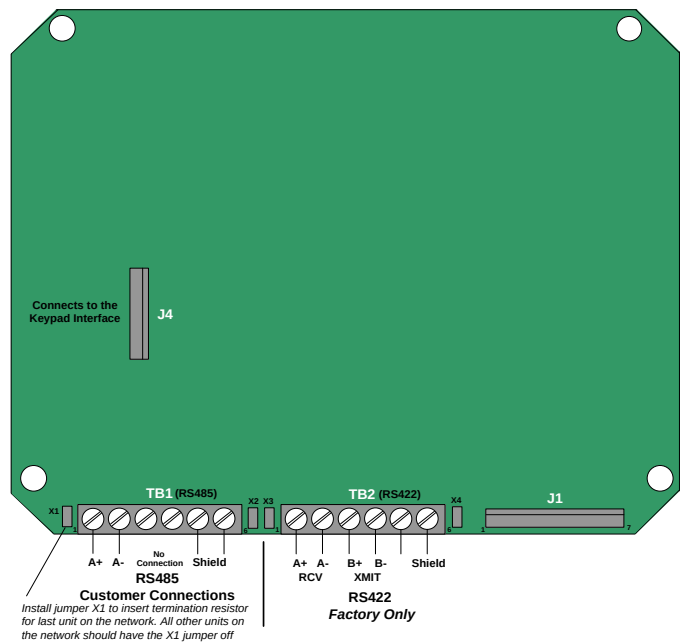


FIG. 2.3.2 RS485 / RS422 Communications Board

2.3.3 Main Board

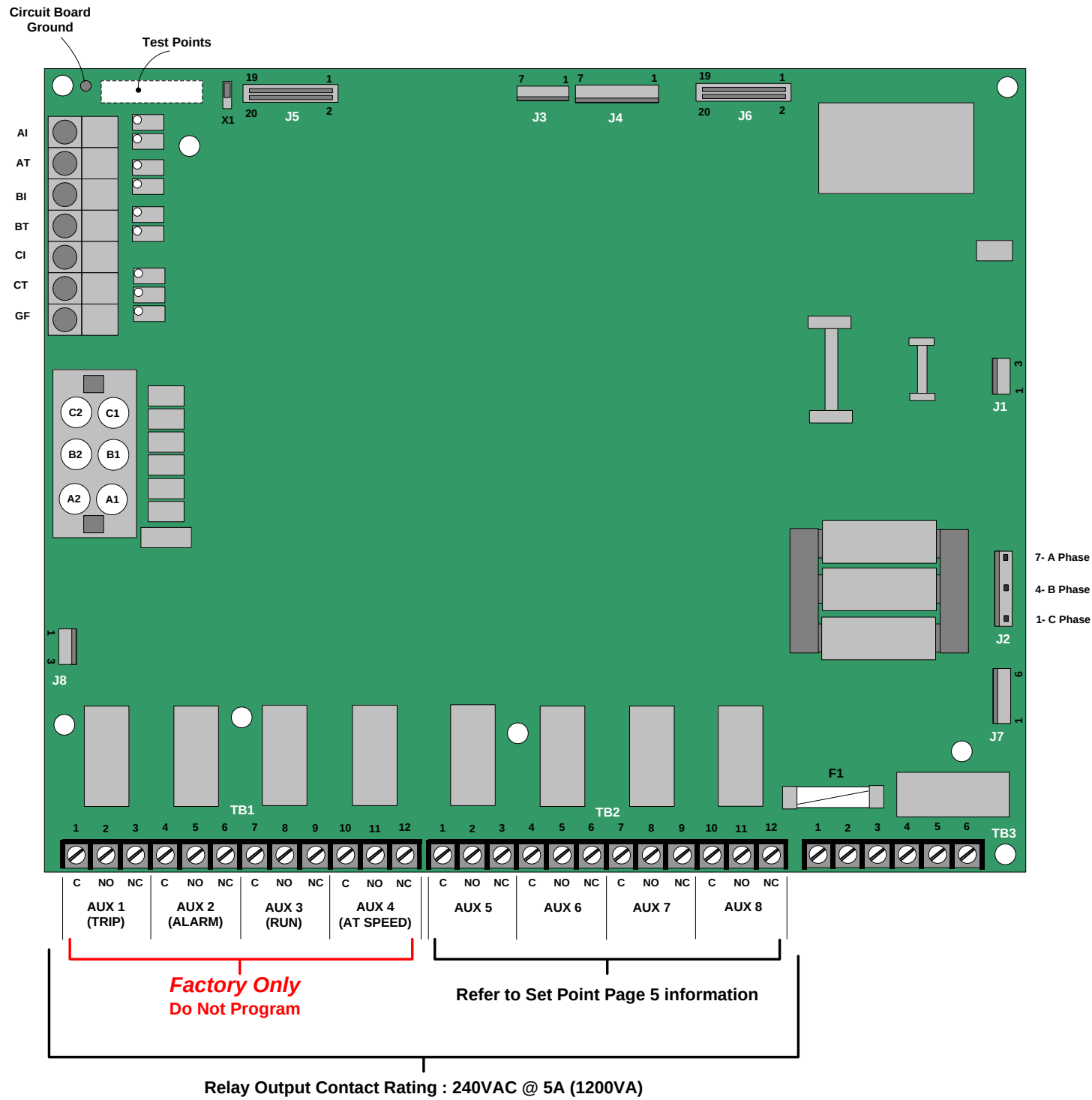


FIG. 2.3.3 Power Board

2.3.4 CPU Board

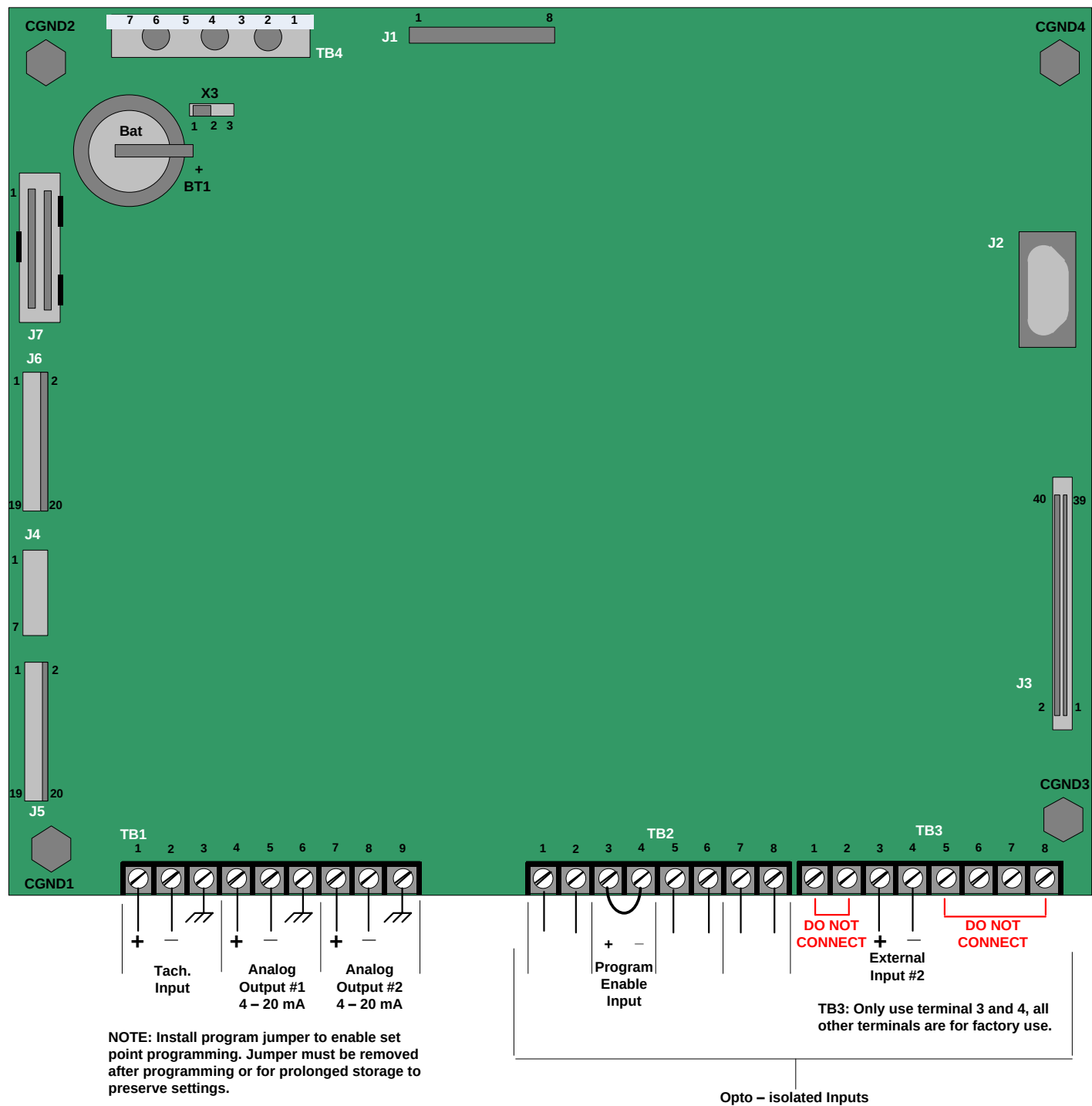
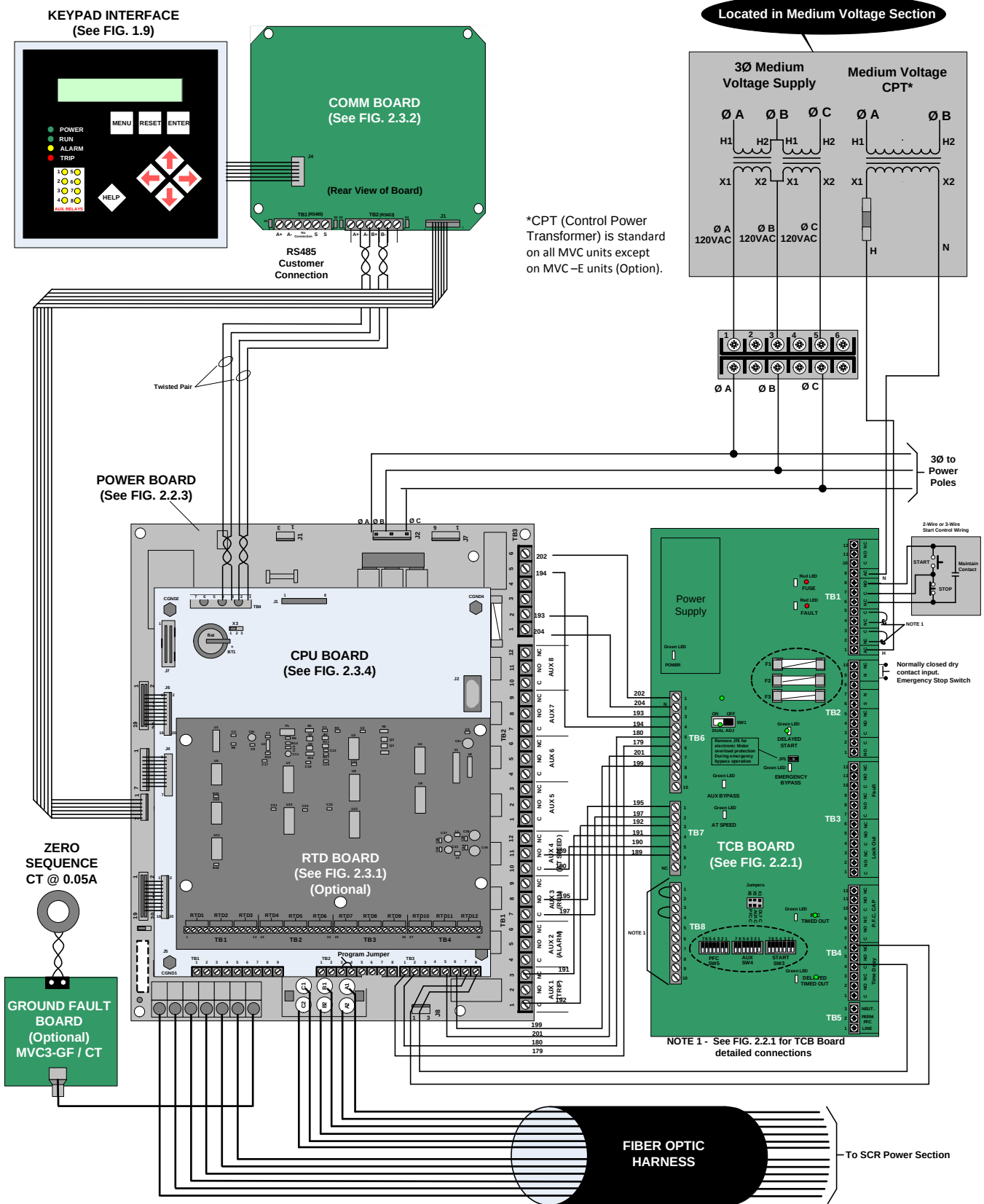


FIG. 2.3.4 CPU Board

## 2.4 Typical Wiring Diagram



### FIG. 2.4 Typical Wiring Diagram

## Chapter 3 - Start-up

### 3.1 Introduction

It is best to operate the motor at its full load starting condition to achieve the proper settings. Initial settings are set to accommodate most motor conditions. **TRY INITIAL SETTINGS FIRST.** See Section 5.1.2 Starter Configuration (Set Point Page 2) to make any adjustments.

### 3.2 Acceleration Adjustments

The unit is set at the factory with typical starting characteristics that perform well in most applications. When the system is ready to start, try the initial settings. If the motor does not come up to speed, increase the current limit setting. If the motor does not start to turn as soon as desired, raise the Initial voltage adjustment. Adjustment description and procedures are described as follows. See Section 5.1.2 Starter Configuration (Set Point Page 2) for additional Accel settings.

#### 3.2.1 Initial Voltage

**Factory Setting = 20% of line voltage**

**Range = 0% - 100% of line voltage**

Initial voltage adjustment changes the initial starting voltage level to the motor.

#### 3.2.2 Ramp Time

**Factory Setting = 10 sec.**

**Range = 0 - 120 sec.**

Ramp time adjustment changes the amount of time it takes to reach the current limit point or full voltage if the Current limit point was not reached.

**Note:** Refer to your motor manual for the maximum number of starts per hour allowed by the manufacturer and do not exceed the recommended number.

#### 3.2.3 Current Limit (see FIG. 3.2.3)

**Factory Setting = 350% of motor FLA**

**Range = 200% - 500% of motor FLA**

The main function of current limit is to limit the maximum current. It may also be used to extend the ramp time if required. The interaction between the voltage ramp and the current limit will allow the soft start to ramp the motor until the maximum current is reached and the current limit will hold the current at that level. The current limit must be set high enough to allow the motor to reach full speed. The factory setting of 350% is a good starting point.

**Do not set the current limit too low on variable starting loads. This could cause the motor to stall and eventually cause the overload protection to trip.**

**Note:** If the motor does stall, refer to the motor manufacturer's motor data for the proper cooling time.

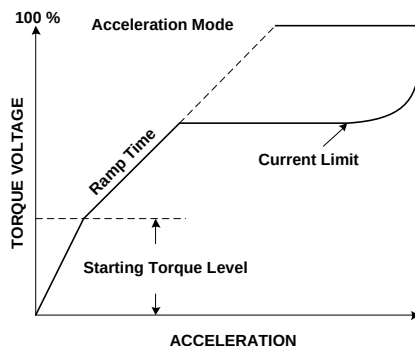


FIG. 3.2.3 Current Limit

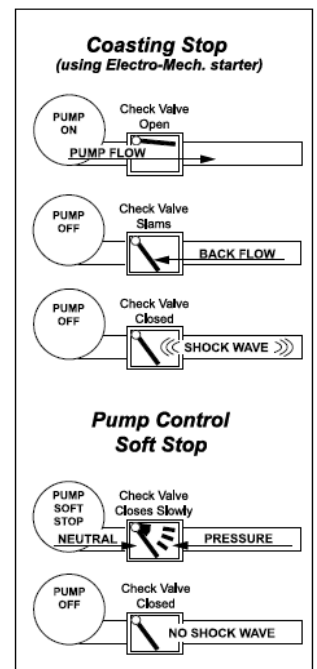
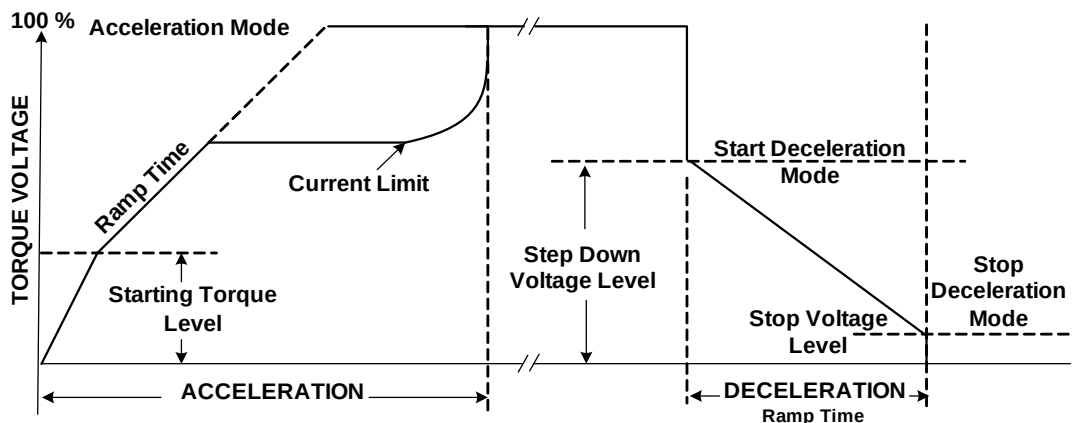
### 3.3 Deceleration Adjustments (Pump Control)

Decel control extends the stopping time on loads that would otherwise stop too quickly when power is removed. Decel control provides smooth deceleration until the load comes to a stop. Three adjustments optimize the deceleration curve to meet the most demanding requirements. **The unit is shipped from the factory with the Decel control feature disabled.**

#### 3.3.1 Deceleration Applications

Apply power and adjust the soft start before enabling or modifying the deceleration adjustments. Both, acceleration and deceleration adjustments should be made under normal load conditions. The deceleration feature provides a slow decrease in the output voltage, accomplishing a gentle decrease in motor torque during the stopping mode. This is the **OPPOSITE OF BRAKING** in that, it will take **longer** to come to a stop than if the starter were just turned off. The primary use of this function is to reduce the sudden changes in pressure that are associated with “Water Hammer” and slamming of check valves with centrifugal pumps. Decel control in pump applications is often referred to as **Pump Control**. In a pump system, liquid is being pushed uphill. The force exerted by gravity on the column of liquid as it goes up hill is called the “Head Pressure” in the system. The pump is sized to provide enough Output Pressure to overcome the Head Pressure and move the fluid up the pipe. When the pump is turned off, the Output Pressure rapidly drops to zero and the Head Pressure takes over to send the fluid back down the hill. A “Check Valve” is normally used somewhere in the system to prevent this (if necessary) by only allowing the liquid to flow in one direction. The kinetic energy in that moving fluid is suddenly trapped when the check valve slams closed. Since fluids can’t compress, that energy is transformed into a “Shock Wave” that travels through the piping system looking for an outlet in which to dissipate. The sound of that shock wave is referred to as “Water Hammer” and the energy in that shock wave can be extremely damaging to pipes, fittings, flanges, seals and mounting systems.

By using the Soft Stop/Deceleration feature of the soft starter, the pump output torque is gradually and gently reduced, which slowly reduces the pressure in the pipe. When the Output Pressure is just slightly lower than the Head Pressure, the flow slowly reverses and closes the Check Valve. By this time there is very little energy left in the moving fluid and the Shock Wave is avoided. When the output voltage to the motor is low enough to no longer be needed, the soft starter will end the Decel cycle and turn itself off. (See **FIG. 3.3**)



**FIG. 3.3 Deceleration Control**

Another common application for decel control is on material handling conveyors as a means to prevent sudden stops that may cause products to fall over or to bump into one another. In overhead crane applications, soft stopping of the Bridge or Trolley can prevent loads from beginning to over swing on sudden stops.

### 3.3.2 Start Deceleration Voltage

**Factory Setting = 100% of line voltage**  
**Range = 100% - 100% of line voltage**

The step down voltage adjustment eliminates the dead band in the deceleration mode that is experienced while the Voltage drops to a level where the motor deceleration is responsive to decreased voltage. This feature allows for an instantaneous drop in voltage when deceleration is initiated.

### 3.3.3 Stop Deceleration Voltage

**Factory Setting = 30% of line voltage**  
**Range = 0% - 99% of line voltage**

The stop voltage level set point is where the deceleration voltage drops to zero.

### 3.3.4 Deceleration Time

**Factory Setting = 5 sec.**  
**Range = 0 - 60 sec.**

The deceleration ramp time adjusts the time it takes to reach the stop voltage level set point. The unit should be restarted and stopped to verify that the desired deceleration time has been achieved. When calculating the number of starts per hour, a decel curve should be counted as a start curve. For example, recommended number of starts per hour = 6, allowable starts with decel cycle per hour = 3.

**Note:** Do not exceed the motor manufacturer's recommended number of starts per hour.

## 3.4 Sequence of Normal Operation

It is best to operate the motor at its full load starting condition to achieve the proper time, torque and ramp settings. Initial settings are set to accommodate most motor conditions.

**TRY INITIAL SETTINGS FIRST FOR:**

- Initial Voltage
- Current Limit
- Ramp Time

See section 5.1.2 Set-point Page 2 to make any adjustments. If the Decel function is enabled, related parameters may also need adjusting to achieve optimal Decel performance

#### Sequence:

- Close the disconnect switch to apply 3 phase power" Verify the power LED on the keypad comes on.

**MOTOR STOPPED**  
**READY TO START**

- Activate the start command, the motor should start accelerating and the RUN LED will come ON.

**MOTOR STARTING**  
**00 x FLA**

**OVERLOAD ALARM**  
**TIME TO TRIP .XXX SECS**

**Check:** If the motor decelerates, or stops, during the acceleration period, ***activate the Stop button immediately.*** Adjustments to the ramp time and or current limit setting are necessary to provide the motor sufficient energy to reach full speed. If the unit does not follow this operational sequence, please refer to the Troubleshooting Chapter.

If the motor does not enter the run mode in the set time (Acceleration time limit, see SP8.2), a trip will occur. When the Motor Reaches full speed the At Speed” LED will come on and the Aux 4 (At speed) relay will energize closing the bypass contactor. Phase A, B, C and Gnd Flt current is then shown on the keypad during operation.

|          |          |
|----------|----------|
| IA: ____ | IB: ____ |
| IC: ____ | GF: ____ |

### 3.5 Emergency Bypass Operation

#### Emergency Bypass (1.0 to 7.2kV Class)

- Remove input power by opening the disconnect switch and lock out.
- Close the emergency Bypass contact located on the TCB board at TB2 (See section 2.2.1 for location).
- Unlock and reclose the disconnect switch.

**Note:** In the emergency bypass mode, there is no overload protection unless a separate (optional or customer supplier) thermal overload relay is installed, or JP-1 (Motor Protection Jumper, Sec.2.2.3) is removed from the TCB Board.

The unit is operable as a normal across-the-line starter. When power is applied, the bypass contactor is energized, tying the input terminals directly to the output terminals. When the "START" command is given, the main (in line) contactor is energized and the motor line starts. When the "STOP" command is given, the motor is disconnected from the line power via the main (in-line) vacuum contactor.



**DANGER**

#### **HAZARDOUS OPERATION**

**Do not operate the Bypass Contactor with medium voltage power applied to the unit.**

**Failure to follow this instruction will cause the motor to start unexpectedly.**

## Chapter 4 - User Interface & Menu Navigation

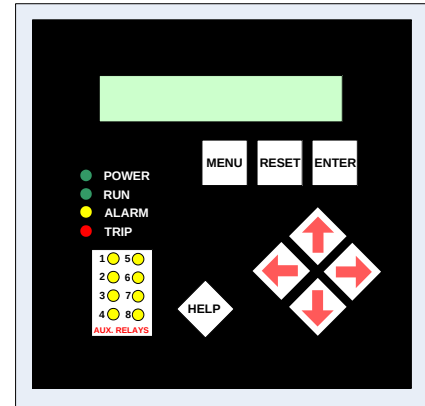
This chapter explains the keypad operator interface, the LCD descriptions and the programming features.

### 4.1 Keypad/Operator Interface

The user keypad/ operator interface consists of:

- 2 row by 20 characters Liquid Crystal Display (LCD)
- 12 LEDs
- 8 pushbuttons

**Note:** The soft starter is menu driven and there are three levels of programming. The programming for two of these levels is password protected. Level two requires a three digit password and level three requires a four digit password.

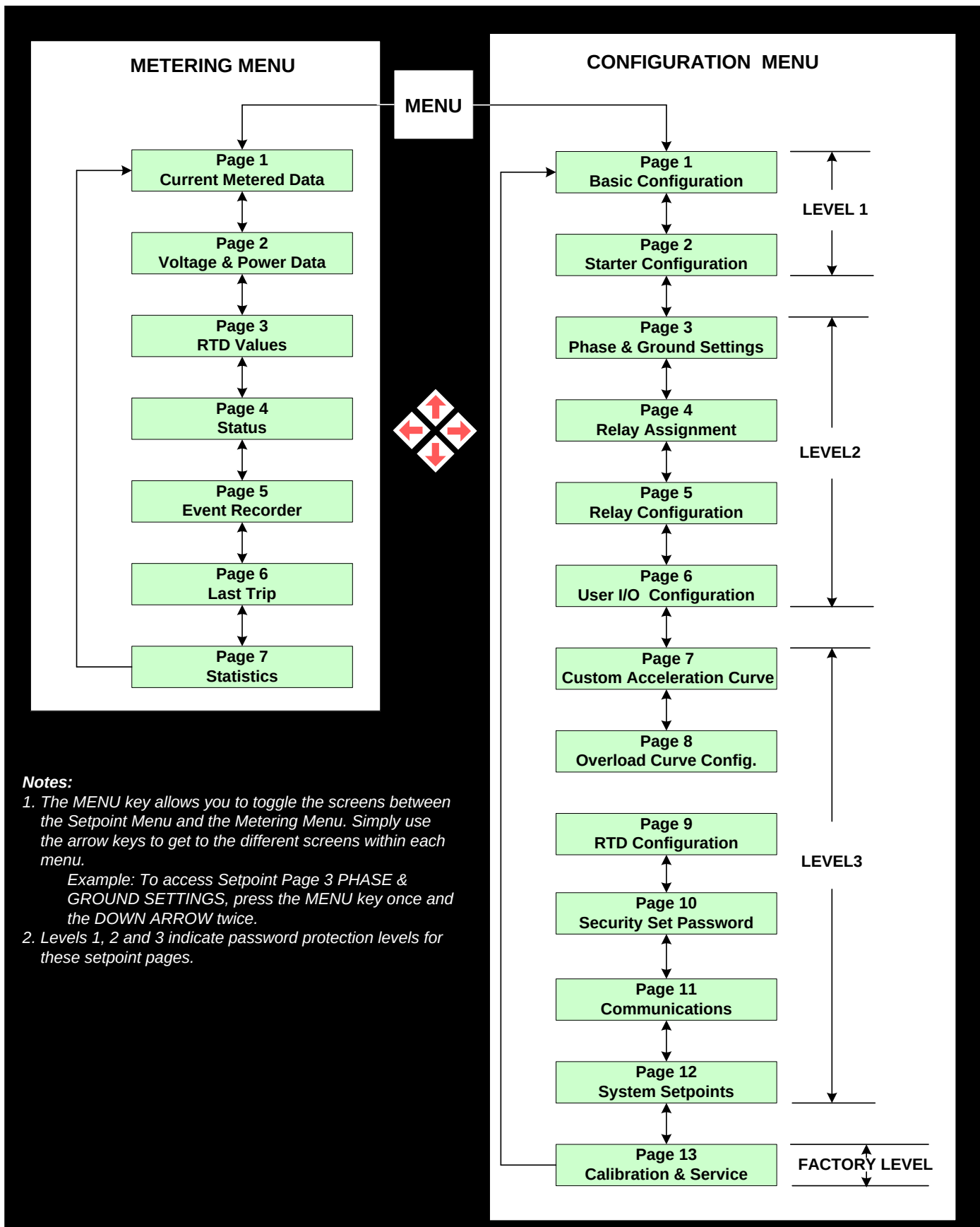


#### 4.1.1. Keypad Operator designations and functions

| ITEM | DESIGNATION | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| KEY  | MENU        | Toggle between the menu selection for metering and set point pages.                                                                                                                                                                                                                                                                                                                                                                                                         |
|      | RESET       | Will clear the trip indicator and release the trip relay.                                                                                                                                                                                                                                                                                                                                                                                                                   |
|      | ENTER       | Pressing the ENTER button once enters the EDIT mode where set point values can be changed. An "Asterisk" will appear on the display to indicate it is in the edit mode. After a set point value is changed, pressing the ENTER button again will save the revised value to memory and the asterisk will go off indicating the change has been saved. When not in the edit mode, the ENTER pushbutton will toggle through the event indicator list (such as alarms or trips) |
|      | HELP        | Provides general help information about a specific set point or action.                                                                                                                                                                                                                                                                                                                                                                                                     |
|      | UP ARROW    | Will scroll up through the set point and metering menu page. It will scroll to the top of the set point page or a section. In edit mode it will increase a set point in an incremental step or toggle through the available options in the set point.                                                                                                                                                                                                                       |
|      | RIGHT ARROW | In the main menu the RIGHT ARROW button provides access to the set point page. For set point pages with multiple columns, the RIGHT ARROW will scroll the set point page to the right. When in edit mode it will shift one character to the right.                                                                                                                                                                                                                          |
|      | DOWN ARROW  | Will scroll down through the set point pages and down through the set points. In edit mode, it will decrement through values and toggle available options in the set point.                                                                                                                                                                                                                                                                                                 |
|      | LEFT ARROW  | Will move to the left through set point pages with multiple columns. When in edit mode it will become the backspace key and will shift one character to the left.                                                                                                                                                                                                                                                                                                           |
| LED  | POWER       | Indicates control power is present                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|      | RUN         | Indicates unit/motor is running                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|      | ALARM       | Lights in conjunction with Relay AUX 2 to indicate an Alarm event or warn of possible critical condition.                                                                                                                                                                                                                                                                                                                                                                   |
|      | TRIP        | Lights in conjunction with Relay AUX 1 to indicate a Trip condition has occurred.                                                                                                                                                                                                                                                                                                                                                                                           |
|      | AUX 1- 8    | Auxiliary relays (Note: Relays 5-8 are available for customer use)                                                                                                                                                                                                                                                                                                                                                                                                          |

**Note:** The directional arrow buttons require careful operation. In edit mode, if the buttons are held for a long period, the scrolling speed will increase.

## 4.2 Menu Navigation



#### 4.2.1 Password Access

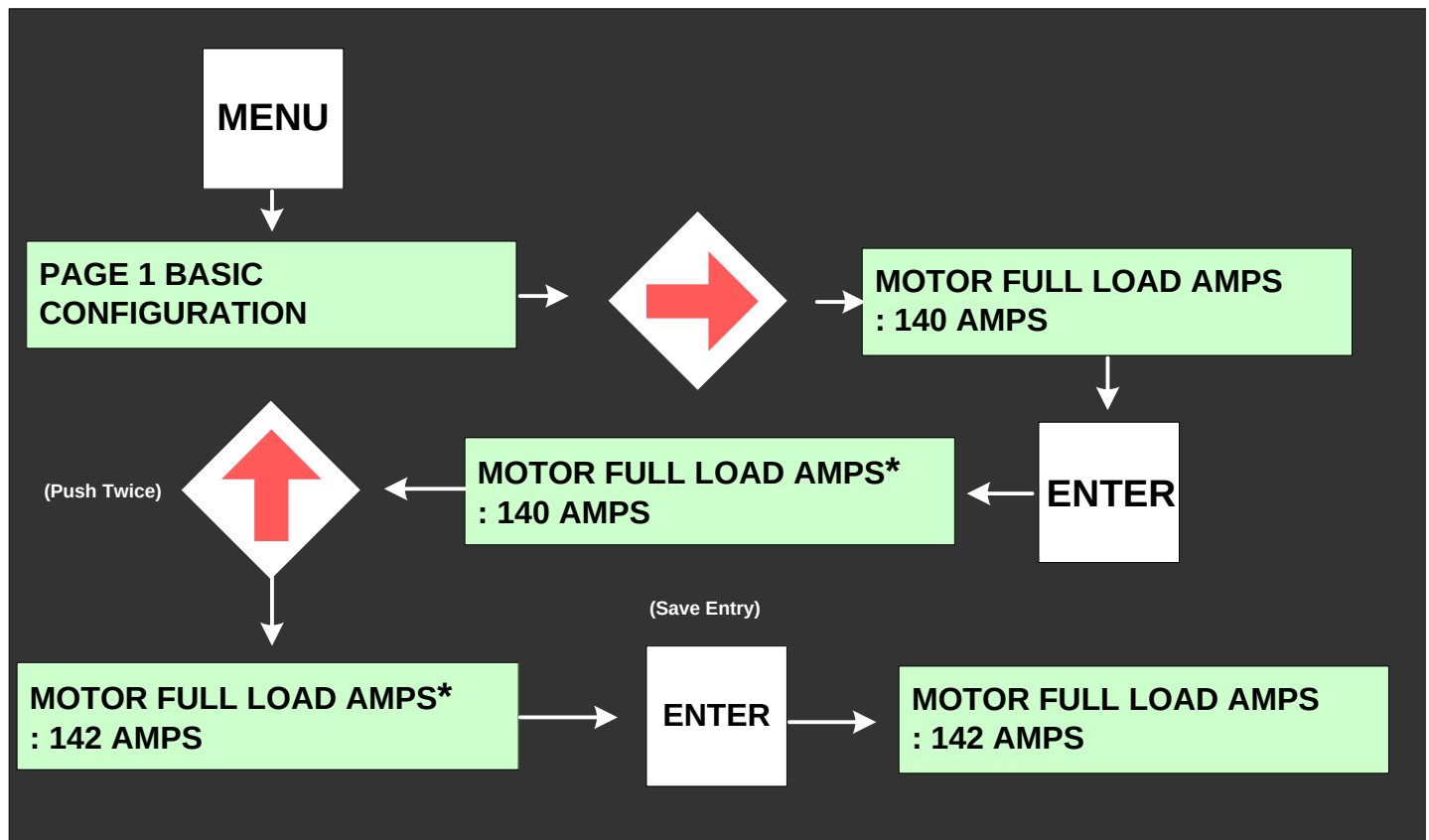
Screens in Level 1 of the set point menu can be changed without password access because they list basic motor information. Screens in Levels 2 and 3 require passwords because they provide more in-depth protection and control of the unit. The password in Levels 2 and 3 can be changed by the user.

**Note: Set Points can only be changed when the motor is in Stop/ Ready Mode! The soft starter will not allow a start if it is still in the Edit Mode. When the unit is in the Edit Mode, an asterisk is displayed in the top right corner screen.**

#### 4.2.2 Changing Set Points

##### Example 1: Changing Motor FLA from 140 AMPS to 142 AMPS

1. Press MENU button to display Set point Page 1, Basic Configuration
2. Press the RIGHT ARROW you will view the screen Motor Full Load Amps.
3. Press the ENTER button for edit mode. **Note:** The asterisk (\*) in the top right corner of the LCD screen that indicates Edit Mode.
4. To change the value, select the UP ARROW or DOWN ARROW. In this case push the UP ARROW twice (2x).
5. To accept the new value, press the ENTER button. The unit will accept the changes and will leave the edit mode. Note the \* is no longer in the top right corner of the LCD Display.



## Chapter 5 - Setpoint Programming

The soft starter has thirteen programmable Setpoint pages which define the motor data, ramp curves, protection, I/O configuration and communications. In Section 5.1, the Setpoint pages are outlined in chart form. In Section 5.2 the Setpoint pages are illustrated and defined for easy navigation and programming. **Note:** Setpoints can only be changed then the starter is in the Ready Mode. Also the soft start will not start when it is in programming mode.

### 5.1 Setpoints Page List

These charts list the Setpoint Page, the programmable functions and the section.

#### 5.1.1 Basic Configuration (Setpoint Page1)

| Setpoint Page                 | Security Level                  | Description                    | Factory Setting Default | Range                                                                        | Section |
|-------------------------------|---------------------------------|--------------------------------|-------------------------|------------------------------------------------------------------------------|---------|
| Page 1<br>Basic Configuration | Level 1<br>No Password Required | Motor Full Load Amps (FLA)     | Model dependent         | 50 - 100% of Unit Max Current Rating<br>(Model and Service Factor dependent) | SP1.1   |
|                               |                                 | Motor Full Load Amps (FLA) 2ND | Model dependent         |                                                                              |         |
|                               |                                 | Service Factor                 | 1.15                    | 1.00 – 1.3                                                                   | SP1.2   |
|                               |                                 | Overload Class                 | 10                      | O/L Class 5-30                                                               | SP1.3   |
|                               |                                 | NEMA Design                    | B                       | A-F                                                                          | SP1.4   |
|                               |                                 | Insulation Class               | B                       | A, B, C, E, F, H, K, N, S                                                    | SP1.5   |
|                               |                                 | Line Voltage                   | Model dependent         | 100 to 20000V                                                                | SP1.6   |
|                               |                                 | Line Frequency                 | 60                      | 50 or 60 HZ                                                                  | SP1.7   |

#### 5.1.2 Starter Configuration (Setpoint Page 2)

| Setpoint Page                   | Security Level                  | Description                | Factory Setting Default | Range                                                                                     | Section |
|---------------------------------|---------------------------------|----------------------------|-------------------------|-------------------------------------------------------------------------------------------|---------|
| Page 2<br>Starter Configuration | Level 1<br>No Password Required | Start Control Mode         | Start Ramp 1            | Jog, Start Ramp 1, Start Ramp 2, Custom Accel Curve, Start Disabled, Dual Ramp, Tach Ramp | SP2.1   |
|                                 |                                 | Jog Voltage                | 50%                     | 5-75%, Off                                                                                | SP2.2   |
|                                 |                                 | Start Ramp #1 Type         | Voltage                 | Voltage, Current                                                                          | SP2.3   |
|                                 |                                 | Initial Voltage #1         | 20%                     | 0-100%                                                                                    |         |
|                                 |                                 | Ramp Time #1               | 10 sec                  | 1-120 sec                                                                                 |         |
|                                 |                                 | Current Limit #1           | 350% FLA                | 200-500 %                                                                                 |         |
|                                 |                                 | Initial Current #1         | 200% FLA                | 0-300 %                                                                                   |         |
|                                 |                                 | Ramp Time #1               | 10 sec                  | 1-120 sec                                                                                 |         |
|                                 |                                 | Maximum Current #1         | 350% FLA                | 200-500 %                                                                                 |         |
|                                 |                                 | Start Ramp #2 Type         | Disabled                | Disabled, Voltage, Power                                                                  | SP2.4   |
|                                 |                                 | Initial Voltage #2         | 60%                     | 0-100 %                                                                                   |         |
|                                 |                                 | Ramp Time #2               | 10 sec                  | 1-120 sec                                                                                 |         |
|                                 |                                 | Current Limit #2           | 350% FLA                | 200-500 %                                                                                 |         |
|                                 |                                 | Initial Power #2           | 20%                     | 0-100 %                                                                                   |         |
|                                 |                                 | Ramp Time #2               | 10 sec                  | 1-120 sec                                                                                 |         |
|                                 |                                 | Maximum Power #2           | 80%                     | 0 – 300 %                                                                                 |         |
|                                 |                                 | Kick Start Type            | Disabled                | Voltage or Disabled                                                                       | SP2.5   |
|                                 |                                 | Kick Start Voltage         | 65%                     | 10-100 %                                                                                  |         |
|                                 |                                 | Kick Start Time            | 0.50 sec                | 0.10-2.00                                                                                 |         |
|                                 |                                 | Deceleration               | Disabled                | Enabled or Disabled                                                                       | SP2.6   |
|                                 |                                 | Start Deceleration Voltage | 100%                    | 100-100 %                                                                                 |         |
|                                 |                                 | Stop Deceleration Voltage  | 30%                     | 0-99 %                                                                                    |         |
|                                 |                                 | Deceleration Time          | 5 sec                   | 1-60 sec                                                                                  |         |
|                                 |                                 | Timed Output Time          | Off                     | 1-1000 sec, Off                                                                           | SP2.7   |
|                                 |                                 | Run Delay Time             | 1 Sec                   | 1-30 sec, Off                                                                             | SP2.8   |
|                                 |                                 | At Speed Delay Time        | 1 Sec                   | 1-30 sec, Off                                                                             | SP2.9   |
|                                 |                                 | Bypass Pull-in Current     | 100% FLA                | 90 – 300%                                                                                 | SP2.10  |

### 5.1.3 Phase and Ground Settings (Setpoint Page 3)

| Setpoint Page                       | Security Level                | Description                    | Factory Setting Default | Range                | Section |
|-------------------------------------|-------------------------------|--------------------------------|-------------------------|----------------------|---------|
| Page 3<br>Phase and Ground Settings | Level 2<br>Password Protected | Imbalance Alarm Level          | 15% FLA                 | 5-30 %, Off          | SP3.1   |
|                                     |                               | Imbalance Alarm Delay          | 1.5 sec                 | 1.0-20.0 sec         |         |
|                                     |                               | Imbalance Trip Level           | 20%                     | 5-30 %, Off          | SP3.2   |
|                                     |                               | Imbalance Trip Delay           | 2.0 sec                 | 1.0-20.0 sec         |         |
|                                     |                               | Undercurrent Alarm Level       | Off                     | 10-90 %, Off         | SP3.3   |
|                                     |                               | Undercurrent Alarm Delay       | 2.0 sec                 | 1.0-60.0 sec         |         |
|                                     |                               | Overcurrent Alarm Level        | Off                     | 100-300 %, Off       | SP3.4   |
|                                     |                               | Overcurrent Alarm Delay        | 2.0 sec                 | 1.0-20.0 sec         |         |
|                                     |                               | Overcurrent Trip Level         | Off                     | 100-300 %, Off       | SP3.5   |
|                                     |                               | Overcurrent Trip Delay         | 2.0 sec                 | 1.0-20.0 sec         |         |
|                                     |                               | Phase Loss Trip                | Enabled                 | Enabled or Disabled  | SP3.6   |
|                                     |                               | Phase Loss Trip Delay          | 0.1 sec                 | 0-20.0 sec           |         |
|                                     |                               | Phase Rotation Detection       | ABC                     | ABC, ACB or Disabled | SP3.7   |
|                                     |                               | Phase Rotation Trip Delay      | 1.0 sec                 | 1.0 - 20.0 sec       |         |
|                                     |                               | *Ground Fault Alarm Level      | Off                     | 5-90 %, Off          | SP3.8   |
|                                     |                               | *Ground Fault Alarm Delay      | 0.1 sec                 | 0.1-20.0 sec         |         |
|                                     |                               | *Ground Fault Loset Trip Level | Off                     | 5-90 %, Off          | SP3.9   |
|                                     |                               | *Ground Fault Loset Trip Delay | 0.5 sec                 | 0.1-20 sec           |         |
|                                     |                               | *Ground Fault Hiset Trip Level | Off                     | 5-90 %, Off          | SP3.10  |
|                                     |                               | *Ground Fault Hiset Trip Delay | 0.008 sec               | 0.008-0.250 sec      |         |
|                                     |                               | Overvoltage Alarm Level        | Off                     | 5 -30%, Off          | SP3.11  |
|                                     |                               | Overvoltage Alarm Delay        | 1.0 sec                 | 1.0-30.0 sec         |         |
|                                     |                               | Overvoltage Trip Level         | 10%                     | 5-30%, Off           | SP3.12  |
|                                     |                               | Overvoltage Trip Delay         | 2.0 sec                 | 1.0-30.0 sec         |         |
|                                     |                               | Undervoltage Alarm Level       | Off                     | 5-30%, Off           | SP3.13  |
|                                     |                               | Undervoltage Alarm Delay       | 1.0 sec                 | 1.0-30.0 sec         |         |
|                                     |                               | Undervoltage Trip Level        | 15%                     | 5-30%, Off           | SP3.14  |
|                                     |                               | Undervoltage Trip Delay        | 2.0 sec                 | 1.0-30.0 sec         |         |
|                                     |                               | Line Frequency Trip Window     | Disabled                | 0-6 Hz, Disabled     | SP3.15  |
|                                     |                               | Line Frequency Trip Delay      | 1.0 sec                 | 1.0-20.0 sec         |         |
|                                     |                               | P/F Lead P/F Alarm             | Off                     | 0.1-1.00, Off        | SP3.16  |
|                                     |                               | P/F Lead Alarm Delay           | 1.0 sec                 | 1-120 sec            |         |
|                                     |                               | P/F Lead P/F Trip              | Off                     | .01-1.00, Off        | SP3.17  |
|                                     |                               | P/F Lead Trip Delay            | 1.0 sec                 | 1-120 sec            |         |
|                                     |                               | P/F Lag P/F Alarm              | Off                     | .01-1.00, Off        | SP3.18  |
|                                     |                               | P/F Lag Alarm Delay            | 1.0 sec                 | 1-120 sec            |         |
|                                     |                               | P/F Lag P/F Trip               | Off                     | .01-1.00, Off        | SP3.19  |
|                                     |                               | P/F Lag Trip Delay             | 1.0 sec                 | 1-120 sec            |         |
|                                     |                               | Power Demand Period            | 10 min                  | 1 - 60 min           | SP3.20  |
|                                     |                               | KW Demand Alarm Pickup         | Off KW                  | Off, 1-100000        |         |
|                                     |                               | KVA Demand Alarm Pickup        | Off KVA                 | Off, 1-100000        |         |
|                                     |                               | KVAR Demand Alarm Pickup       | Off KVAR                | Off, 1-100000        |         |
|                                     |                               | Amps Demand Alarm Pickup       | Off Amps                | Off, 1-100000        |         |

\* Ground fault option must be installed

### 5.1.4 Relay Assignments (Setpoint Page 4)

| Setpoint Page               | Security Level                | Description                   | Factory Setting |      |      | Range                                                                                                                                                                                                                                                                                 | Section |
|-----------------------------|-------------------------------|-------------------------------|-----------------|------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
|                             |                               |                               | 1st             | 2nd  | 3rd  |                                                                                                                                                                                                                                                                                       |         |
| Page 4<br>Relay Assignments | Level 2<br>Password Protected | O/L Trip                      | Trip Only       | None | None | None<br>Trip(AUX1) / Trip Only<br>Alarm(AUX2)<br>AUX3<br>AUX4<br>AUX5 - 8<br>Only Available in 8 Relay System<br><br><b>Notes:</b><br><b>AUX1 to AUX4 are for Factory use only</b><br><b>Do not change!</b><br><b>Only AUX 5 - 8 are used in the 2nd &amp; 3rd relay assignments.</b> | SP4.1   |
|                             |                               | I/B Trip                      | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | S/C Trip                      | Trip Only       | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Overcurrent Trip              | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Stator RTD Trip               | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Non Stator RTD Trip           | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | *G/F Hi Set Trip              | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | *G/F Lo Set Trip              | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Phase Loss Trip               | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Accel. Time Trip              | Trip Only       | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Start Curve Trip              | Trip Only       | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Over Frequency Trip           | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Under Frequency Trip          | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | I* <sup>2</sup> T Start Curve | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Learned Start Curve           | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Phase Reversal                | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Overvoltage Trip              | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Undervoltage Trip             | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Power Factor Trip             | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Tach Accel Trip               | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Inhibits Trip                 | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Shunt Trip                    | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Bypass Discrepancy            | Trip Only       | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Low Control Voltage           | Trip Only       | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | TCB Fault /ESTOP              | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Two Speed                     | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Dual Ramp                     | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Thermostat                    | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | O/L Warning                   | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Overcurrent Alarm             | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | SCR Fail Shunt Alarm          | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | *Ground Fault Alarm           | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Under Current Alarm           | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Motor Running                 | AUX3            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | I/B Alarm                     | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Stator RTD Alarm              | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Non-Stator RTD Alarm          | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | RTD Failure Alarm             | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Self Test Fail                | Trip            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Thermal Register              | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | U/V Alarm                     | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | O/V Alarm                     | Alarm           | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Power Factor Alarm            | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | KW Demand Alarm               | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | KVA Demand Alarm              | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | KVAR Demand Alarm             | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Amps Demand Alarm             | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Timed Output                  | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | Run Delay Time                | None            | None | None |                                                                                                                                                                                                                                                                                       |         |
|                             |                               | At Speed                      | AUX4            | None | None |                                                                                                                                                                                                                                                                                       |         |

\* Ground fault option must be installed

### 5.1.5 Relay Configuration (Setpoint Page 5)

| Setpoint Page                 | Security Level                | Description                | Factory Setting Default | Range     | Section |
|-------------------------------|-------------------------------|----------------------------|-------------------------|-----------|---------|
| Page 5<br>Relay Configuration | Level 2<br>Password Protected | Trip (AUX1) Fail-Safe      | No                      | Yes or No | SP5.1   |
|                               |                               | Trip (AUX1) Relay Latched  | Yes                     |           | SP5.2   |
|                               |                               | Alarm (AUX2) Fail-Safe     | No                      |           | SP5.1   |
|                               |                               | Alarm (AUX2) Relay Latched | No                      |           | SP5.2   |
|                               |                               | AUX3 Relay Fail-Safe       | No                      |           | SP5.1   |
|                               |                               | AUX3 Relay Latched         | No                      |           | SP5.2   |
|                               |                               | AUX4 Relay Fail-Safe       | No                      |           | SP5.1   |
|                               |                               | AUX4 Relay Latched         | No                      |           | SP5.2   |
|                               |                               | AUX5 Relay Fail-Safe       | No                      |           | SP5.1   |
|                               |                               | AUX5 Relay Latched         | No                      |           | SP5.2   |
|                               |                               | AUX6 Relay Fail-Safe       | No                      |           | SP5.1   |
|                               |                               | AUX6 Relay Latched         | No                      |           | SP5.2   |
|                               |                               | AUX7 Relay Fail-Safe       | No                      |           | SP5.1   |
|                               |                               | AUX7 Relay Latched         | No                      |           | SP5.2   |
|                               |                               | AUX8 Relay Fail-Safe       | No                      |           | SP5.1   |
|                               |                               | AUX8 Relay Latched         | No                      |           | SP5.2   |

### 5.1.6 User I/O Configuration (Setpoint Page 6)

| Setpoint Page                    | Security Level                | Description                   | Factory Setting Default | Range                                                                                                                           | Section |
|----------------------------------|-------------------------------|-------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------|
| Page 6<br>User I/O Configuration | Level 2<br>Password Protected | Tachometer Scale Selection    | Disabled                | Enabled or Disabled                                                                                                             | SP6.1   |
|                                  |                               | Manual Tach Scale 4.0 mA:     | 0 RPM                   | 0 - 3600                                                                                                                        |         |
|                                  |                               | Manual Tach Scale 20.0 mA:    | 2000 RPM                | 0 - 3600                                                                                                                        |         |
|                                  |                               | Tach Accel Trip Mode Select   | Disabled                | Underspeed, Overspeed or Disabled                                                                                               | SP6.2   |
|                                  |                               | Tach Ramp Time                | 20 sec                  | 1 - 120                                                                                                                         |         |
|                                  |                               | Tach Underspeed Trip PT       | 1650 RPM                | 0 - 3600                                                                                                                        |         |
|                                  |                               | Tach Overspeed Trip PT        | 1850 RPM                | 0 - 3600                                                                                                                        |         |
|                                  |                               | Tach Accel Trip Delay         | 1 sec                   | 1 - 60                                                                                                                          | SP6.3   |
|                                  |                               | Analog Output #1              | RMS Current             | Off, RPM 0-3600, Hottest Non-Stator RTD 0-200°C, Hottest Stator RTD 0 - 200°C, RMS Current 0 - 7500 A, % Motor Load 0 - 600% Kw |         |
|                                  |                               | Analog Output #1 4mA:         | 0                       | 0-65535                                                                                                                         |         |
|                                  |                               | Analog Output #1 20mA:        | 250                     | 0-65535                                                                                                                         | SP6.4   |
|                                  |                               | Analog Output #2              | % Motor Load            | Same As Analog Input #1                                                                                                         |         |
|                                  |                               | Analog Output #2 4mA:         | 0                       | 0-65535                                                                                                                         |         |
|                                  |                               | Analog Output #2 20mA:        | 1000                    | 0-65535                                                                                                                         | SP6.5   |
|                                  |                               | User Programmable Ext. Inputs |                         |                                                                                                                                 |         |
|                                  |                               | TCB Fault/ESTOP               | Enabled                 | Enabled or Disabled                                                                                                             |         |
|                                  |                               | Name Ext. Input #1            | <User Defined>          | User Defined, up to 15 Characters                                                                                               |         |
|                                  |                               | TCB Fault/ESTOP Type          | NO                      | Normally Open or Closed                                                                                                         |         |
|                                  |                               | TCB Fault/ESTOP Time Delay    | 1 sec                   | 0-60 sec                                                                                                                        |         |
|                                  |                               | Two Speed                     | Two Speed               | Enabled, Disabled or Two Speed                                                                                                  |         |
|                                  |                               | Name Ext. Input #2            | <User Defined>          | User Defined, up to 15 Characters                                                                                               |         |
|                                  |                               | Two Speed Type                | NO                      | Normally Open or Closed                                                                                                         |         |
|                                  |                               | Two Speed Time Delay          | 0 sec                   | 0-60 sec                                                                                                                        |         |
|                                  |                               | Dual Ramp, Input #3           | Dual Ramp               | Enabled, Disabled or Dual Ramp                                                                                                  |         |
|                                  |                               | Name Ext. Input #3            | <User Defined>          | User Defined, up to 15 Characters                                                                                               |         |
|                                  |                               | Dual Ramp Type                | NO                      | Normally Open or Closed                                                                                                         |         |
|                                  |                               | Dual Ramp Time Delay          | 0 sec                   | 0-60 sec                                                                                                                        |         |
|                                  |                               | Thermostat                    | Thermostat              | Enabled, Disabled or Thermostat                                                                                                 |         |
|                                  |                               | Name Ext. Input #4            | <User Defined>          | User Defined, up to 15 Characters                                                                                               |         |
|                                  |                               | Thermostat Type               | NC                      | Normally Open or Closed                                                                                                         |         |
|                                  |                               | Thermostat Time Delay         | 0 sec                   | 0-60 sec                                                                                                                        |         |

### 5.1.7 Custom Acceleration Curve (Setpoint Page 7)

| Setpoint Page                       | Security Level                | Description             | Factory Setting Default | Range                                                      | Section |
|-------------------------------------|-------------------------------|-------------------------|-------------------------|------------------------------------------------------------|---------|
| Page 7<br>Custom Acceleration Curve | Level 3<br>Password Protected | Custom Accel Curve      | Disabled                | Disabled, Curve A, B, or C                                 | SP7.1   |
|                                     |                               | Custom Curve A          |                         |                                                            |         |
|                                     |                               | Curve A Voltage Level 1 | 25%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 1     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 2 | 30%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 2     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 3 | 37%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 3     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 4 | 45%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 4     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 5 | 55%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 5     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 6 | 67%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 6     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 7 | 82%                     | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 7     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Voltage Level 8 | 100%                    | 0-100%                                                     |         |
|                                     |                               | Curve A Ramp Time 8     | 2 sec                   | 1-60 sec                                                   |         |
|                                     |                               | Curve A Current Limit   | 350% FLA                | 200-500%                                                   |         |
|                                     |                               | Custom Curve B          |                         | Same Programmable Data Points and Ranges as Custom Curve A |         |
|                                     |                               | Custom Curve C          |                         | Same Programmable Data Points and Ranges as Custom Curve A |         |

### 5.1.8 Overload Curve Configuration (Setpoint Page 8)

| Setpoint Page                          | Security Level                | Description                   | Factory Setting Default | Range                    | Section |
|----------------------------------------|-------------------------------|-------------------------------|-------------------------|--------------------------|---------|
| Page 8<br>Overload Curve Configuration | Level 3<br>Password Protected | Basic Run Overload Curve      |                         |                          | SP8.1   |
|                                        |                               | Run Curve Locked Rotor Time   | O/L Class               | 1-30 sec, O/L Class      |         |
|                                        |                               | Run Locked Rotor Current      | 600% FLA                | 400-800%                 |         |
|                                        |                               | Coast Down Timer              | Disabled                | 1-60 Min, Disabled       |         |
|                                        |                               | Basic Start Overload Curve    |                         |                          | SP8.2   |
|                                        |                               | Start Curve Locked Rotor Time | O/L Class               | 1-30 sec, O/L Class      |         |
|                                        |                               | Start Locked Rotor Current    | 600% FLA                | 400-800%                 |         |
|                                        |                               | Acceleration Time Limit       | 30 sec                  | 1-300 sec, Disabled      |         |
|                                        |                               | Number of Starts Per Hour     | Disabled                | 1-6, Disabled            |         |
|                                        |                               | Time Between Starts Time      | 5 min                   | 1-60 Min, Disabled       |         |
|                                        |                               | Area Under Curve Protection   | Disabled                | Enabled or Disabled      | SP8.3   |
|                                        |                               | Max I*I*T Start               | 368 FLA                 | 1-2500 FLA*FLA*sec       |         |
|                                        |                               | Current Over Curve            | Disabled                | Disabled, Learn, Enabled | SP8.4   |
|                                        |                               | Learned Start Curve Bias      | 10%                     | 5-40%                    |         |
|                                        |                               | Time for Sampling             | 30 sec                  | 1-300 sec                |         |

### 5.1.9 RTD Option Configuration (Setpoint Page 9)

| Setpoint Page               | Security Level                | Description                  | Factory Setting Default | Range                                         | Section |
|-----------------------------|-------------------------------|------------------------------|-------------------------|-----------------------------------------------|---------|
| Page 9<br>RTD Configuration | Level 3<br>Password Protected | Use NEMA Temp for RTD Values | Disabled                | Enabled or Disabled                           | SP9.1   |
|                             |                               | # of RTD Used for Stator     | 4                       | 0-6                                           | SP9.2   |
|                             |                               | RTD Voting                   | Disabled                | Enabled or Disabled                           | SP9.3   |
|                             |                               | Stator Phase A1 Type         | Off                     | 120 OHM NI, 100 OHM NI, 100 OHM PT, 10 OHM CU | SP9.4   |
|                             |                               | RTD #1 Description           | STATOR PHAS A1          | User defined, Up to 15 Characters             |         |
|                             |                               | Stator Phase A1 Alarm Level  | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase A1 Trip Level   | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase A2 Type         | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #2 Description           | STATOR PHAS A2          | User defined, Up to 15 Characters             |         |
|                             |                               | Stator Phase A2 Alarm Level  | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase A2 Trip Level   | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase B1 Type         | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #3 Description           | STATOR PHAS B1          | User defined, Up to 15 Characters             |         |
|                             |                               | Stator Phase B1 Alarm Level  | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase B1 Trip Level   | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase B2 Type         | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #4 Description           | STATOR PHAS B2          | User defined, Up to 15 Characters             |         |
|                             |                               | Stator Phase B2 Alarm Level  | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase B2 Trip Level   | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase C1 Type         | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #5 Description           | STATOR PHAS C1          | User defined, Up to 15 Characters             |         |
|                             |                               | Stator Phase C1 Alarm Level  | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase C1 Trip Level   | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase C2 Type         | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #6 Description           | STATOR PHAS C2          | User defined, Up to 15 Characters             |         |
|                             |                               | Stator Phase C2 Alarm Level  | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Stator Phase C2 Trip Level   | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | End Bearing Type             | Off                     | Same as Stator A1                             |         |
|                             |                               | RTD #7 Description           | END BEARING             | User defined, Up to 15 Characters             |         |
|                             |                               | End Bearing Alarm Level      | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | End Bearing Trip Level       | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Shaft Bearing Type           | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #8 Description           | SHAFT BEARING           | User defined, Up to 15 Characters             |         |
|                             |                               | Shaft Bearing Alarm Level    | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | Shaft Bearing Trip Level     | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #9 Type                  | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #9 Description           | <User defined >         | User defined, Up to 15 Characters             |         |
|                             |                               | RTD #9 Alarm Level           | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #9 Trip Level            | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #10 Type                 | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #10 Description          | <User defined >         | User defined, Up to 15 Characters             |         |
|                             |                               | RTD #10 Alarm Level          | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #10 Trip Level           | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #11 Type                 | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #11 Description          | <User defined >         | User defined, Up to 15 Characters             |         |
|                             |                               | RTD #11 Alarm Level          | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #11 Trip Level           | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #12 Type                 | Off                     | Same as Stator Phase A1                       |         |
|                             |                               | RTD #12 Description          | <User defined >         | User defined, Up to 15 Characters             |         |
|                             |                               | RTD #12 Alarm Level          | Off                     | 0-240C (32-464F), Off                         |         |
|                             |                               | RTD #12 Trip Level           | Off                     | 0-240C (32-464F), Off                         |         |

### 5.1.10 Password Level Configuration (Setpoint Page10)

| Setpoint Page    | Security Level   | Description          | Factory Setting Default | Range                   | Section |
|------------------|------------------|----------------------|-------------------------|-------------------------|---------|
| Page 10 Password | Level 3 Password | Set Level 2 Password | 100                     | 000 – 999 Three Digits  | SP10.1  |
|                  |                  | Set Level 3 Password | 1000                    | 0000 – 9999 Four Digits | SP10.2  |

### 5.1.11 Communications Configuration (Setpoint Page11)

| Setpoint Page          | Security Level   | Description           | Factory Setting Default | Range                            | Section |
|------------------------|------------------|-----------------------|-------------------------|----------------------------------|---------|
| Page 11 Communications | Level 3 Password | Set Front Baud Rate   | 9.6 KB/sec              | 2.4, 4.8, 9.6, 19.2, 38.4 KB/sec | SP11.1  |
|                        |                  | Set Modbus Baud Rate  | 9.6 KB/sec              | 2.4, 4.8, 9.6, 19.2, 38.4 KB/sec | SP11.2  |
|                        |                  | Modbus Address Number | 247                     | 1 – 247                          | SP11.3  |
|                        |                  | Set Access Code       | 1                       | 1 – 999                          | SP11.4  |
|                        |                  | Set Link Baud Rate    | 38.4 KB/sec             | 2.4, 4.8, 9.6, 19.2, 38.4 KB/sec | SP11.5  |
|                        |                  | Remote Start/Stop     | Disabled                | Enabled or Disabled              | SP11.6  |

### 5.1.12 System (Setpoint Page 12)

| Setpoint Page            | Security Level             | Description                         | Factory Setting Default | Range                                                                                       | Section |
|--------------------------|----------------------------|-------------------------------------|-------------------------|---------------------------------------------------------------------------------------------|---------|
| Page 12 System Setpoints | Level 3 Password Protected | Default Display Screen              |                         |                                                                                             | SP12.1  |
|                          |                            | Metering Data Page #                | 1                       | Enter Metering Page (1-4)                                                                   |         |
|                          |                            | Metering Data Screen #              | 1                       | Enter Metering Screen<br>Page 1(1-10)<br>Page 2 (1-11)<br>Page 3 (1 - 29)<br>Page 4 (1 - 6) |         |
|                          |                            | Alarms                              |                         |                                                                                             | SP12.2  |
|                          |                            | RTD Failure Alarm                   | Disabled                | Enabled or Disabled                                                                         |         |
|                          |                            | Thermal Register Alarm              | 90%                     | Off, 40-95%                                                                                 |         |
|                          |                            | Thermal Alarm Delay                 | 10 sec                  | 1-20 sec                                                                                    |         |
|                          |                            | Thermal Register Setup Info         |                         |                                                                                             | SP12.3  |
|                          |                            | Cold Stall Time                     | O/L Class               | O/L Class (5-30) or 4-40 second time delay                                                  |         |
|                          |                            | Hot Stall Time                      | ½ O/L Class             | ½ O/L Class, 4-40 sec                                                                       |         |
|                          |                            | Stopped Cool Down Time              | 30 Min                  | 10-300 Min                                                                                  |         |
|                          |                            | Running Cool Down Time              | 15 Min                  | 10-300 Min                                                                                  |         |
|                          |                            | Relay Measured Cool Rates           | Disabled                | Enabled or Disabled                                                                         |         |
|                          |                            | Thermal Register Minimum            | 15%                     | 10-50%                                                                                      |         |
|                          |                            | Motor Design Ambient Temp           | 40C                     | 10-90C                                                                                      |         |
|                          |                            | Motor Design Run Temperature        | 80% Max                 | 50-100% of Motor Stator Max Temp                                                            |         |
|                          |                            | Motor Stator Max Temp               | INS CLS                 | INS CLS, 10-240 C                                                                           |         |
|                          |                            | I/B Input to Thermal Register       | Enabled                 | Enabled or Disabled                                                                         |         |
|                          |                            | Use Calculated K or Assign          | 7                       | 1-50, On                                                                                    | SP12.4  |
|                          |                            | Press Enter to Clr Thermal Register |                         |                                                                                             |         |

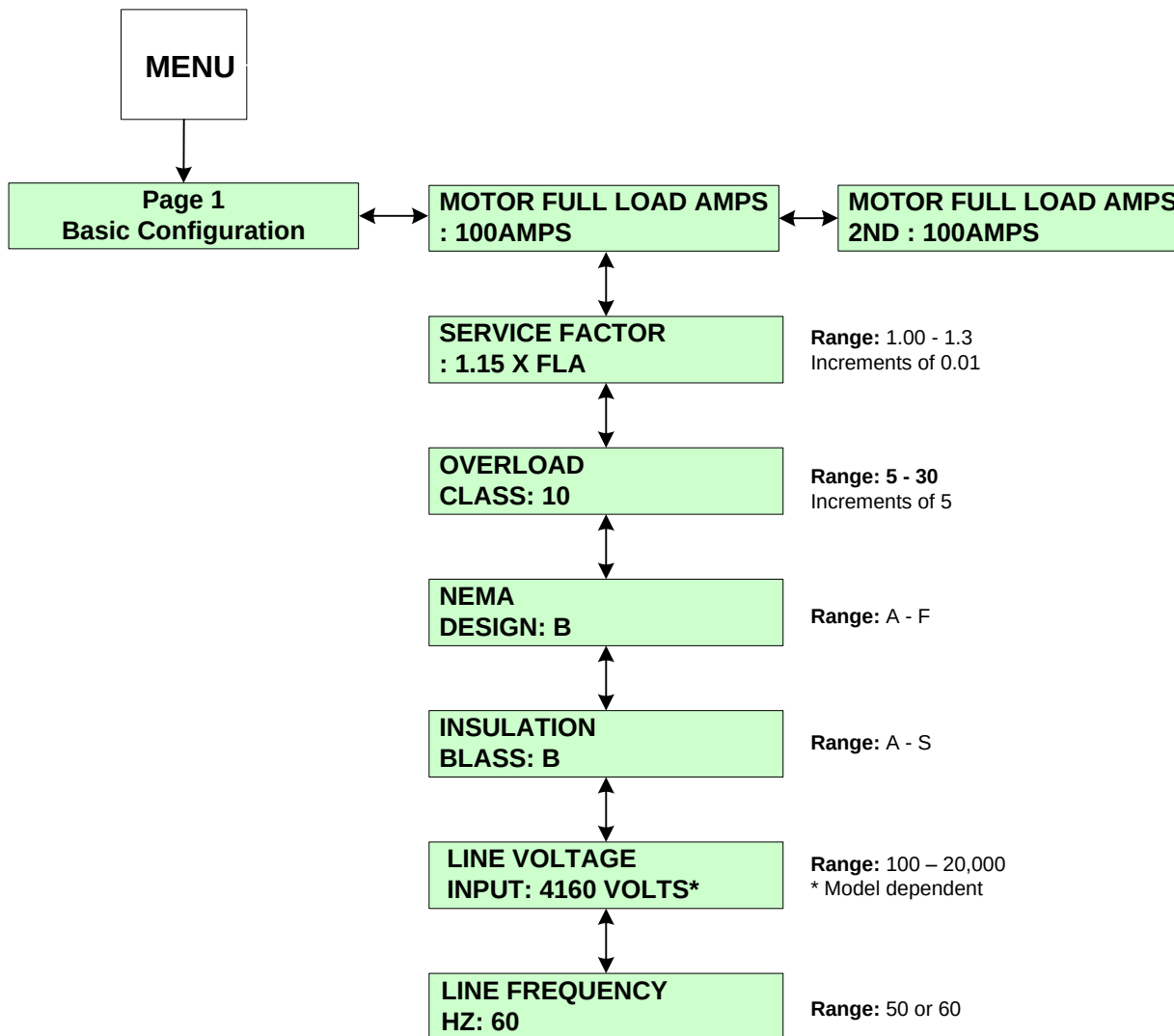
### 5.1.13 Calibration and Service (Setpoint Page 13)

| Setpoint Page                 | Security Level   | Description                            | Factory Setting Default           | Range                                    | Section |
|-------------------------------|------------------|----------------------------------------|-----------------------------------|------------------------------------------|---------|
| Page 13 Calibration & Service | Factory Use Only | Set Date and Time (DDMMYY:HHMM)        | FACTORY SET;<br>## / ## / ## : ## |                                          | SP13.1  |
|                               |                  | Enter Date (DDMMYYYY)                  | FACTORY SET;<br>## / ## / #####   | D=1-31, M=1-12, Y=1970-2069              |         |
|                               |                  | Enter Time (HH:MM)                     | FACTORY SET;<br>## :##            | H=00-23, M=0-59                          |         |
|                               |                  | Model #<br>Firmware REV. #             | FACTORY SET;<br>#####             | Display Only, Cannot be changed          | SP13.2  |
|                               |                  | Press Enter to Access Factory Settings |                                   | Available to Qualified Factory Personnel | SP13.3  |

## 5.2 Setpoints Menu and Parameter Explanation (SP1 – SP13)

### SP.1 Basic Configuration (Setpoint Page 1)

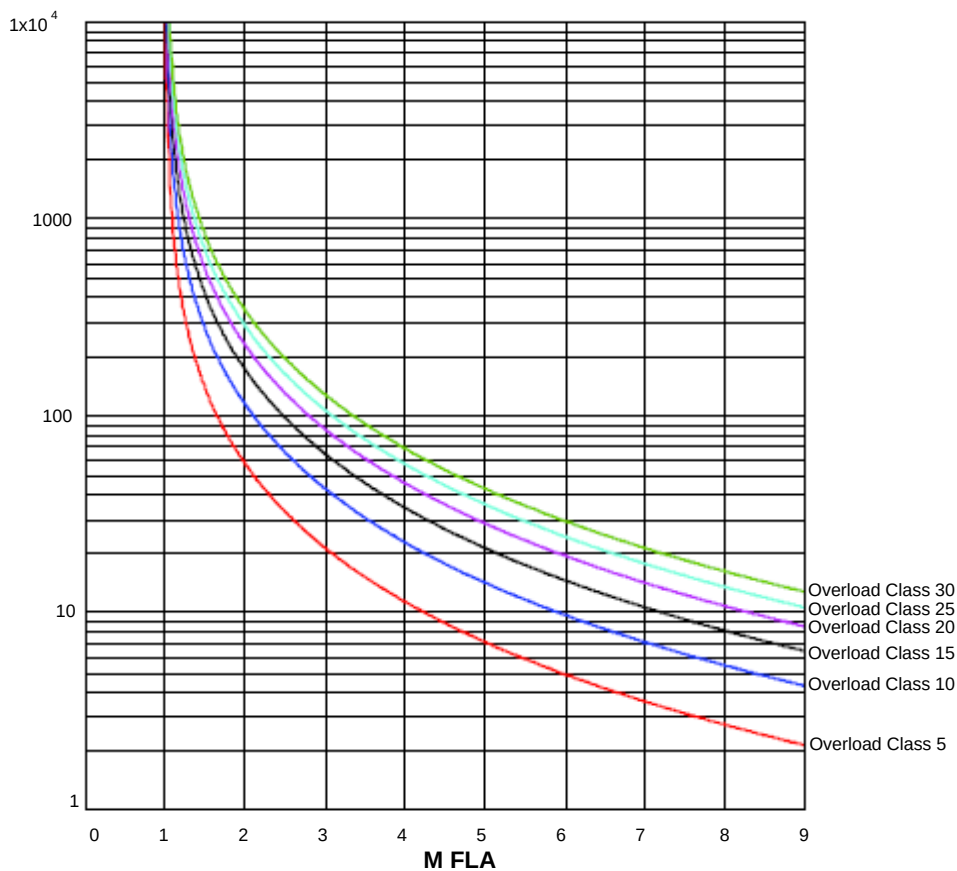
In Setpoint Page 1, is used to setup basic nameplate data of the motor.



**SP1.1 Motor Full Load Amps (FLA):** Allows the user to enter the motor's FLA rating. Range of adjustment is 50 - 100% (less programmed service factor).

**SP1.2 Service Factor:** Sets the pickup point on the overload curve as defined by the programmed motor full load current. Ex: If the motor FLA is 100 and the service factor is 1.15, the overload pickup point will be 115 Amps.

**SP1.3 Overload Class:** Choose the motor protection overload class, range from 5-30. Ex: Overload Class 10 will trip in 10 seconds at six times Motor FLA.



**SP1.4 NEMA design:** The motor design maximum allowed slip (Select from Class A through F).

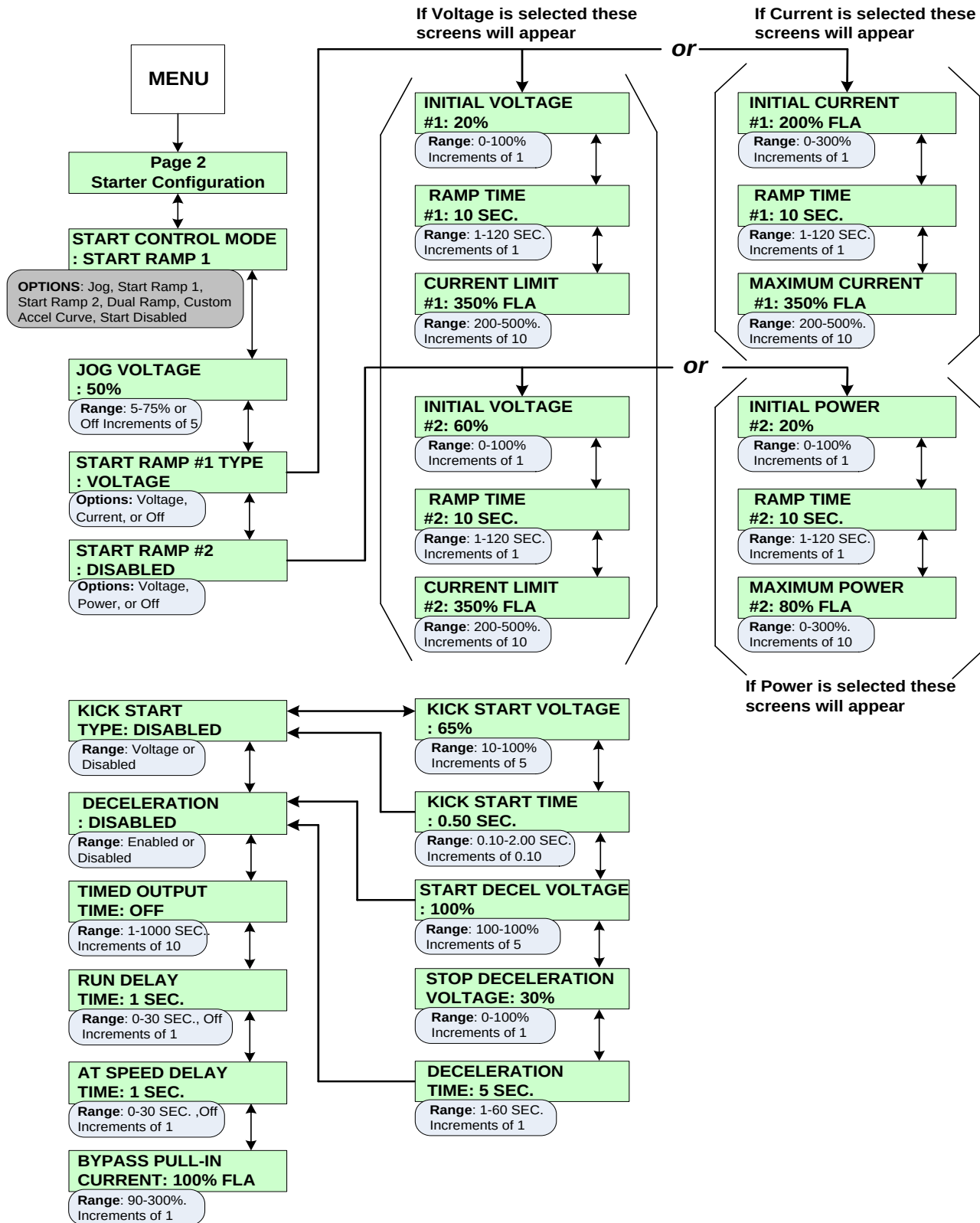
**SP1.5 Insulation Class:** The motor insulation temperature class (Select A, B, C, E, F, G, H, K, N or S).

**SP1.6 Line Voltage Input:** Applied Voltage.

**SP1.7 Line Frequency:** The user may choose either 50 Hz or 60 Hz.

## SP.2 Starter Configuration (Setpoint Page 2)

Provides multiple choices for starting ramps that can be selected for particular loads and applications.



## SP2 Starter Configuration (Setpoint Page 2) Menu Navigation

**SP2.1 Start Control Mode:** Dual Ramp, Custom Accel Curve, Jog Voltage, Start Ramp 1, Start Ramp 2.

- **Dual Ramp:** The dual ramp mode works in conjunction with External Input #3. This allows the user to switch between the two start ramps without having to reconfigure the start mode. (For details on configuring External Input #3 for DUAL RAMP see Setpoint **Page 6**.)

- **Custom Accel Curve:** Allows the user to custom design the acceleration start curve to the application. (See Setpoint page 7 for configuration setup.)

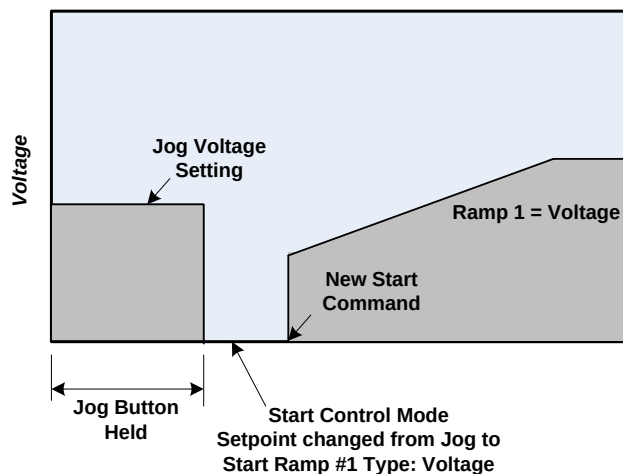
**Note:** If Custom Accel Curve has not been enabled in Setpoint page 7, the soft starter will ignore the start control mode and read this Setpoint as disabled.

**SP2.2 Jog Voltage:** The voltage level necessary to cause the motor to slowly rotate.

**SP2.3 Start Ramp 1 Type:** The ramp type can be setup for either Voltage or Current. If Voltage is selected, initial voltage, ramp time and current limit are adjustable. If Current is selected, initial current, ramp time and maximum current are adjustable.

### Start Ramp 1 Type: Voltage

- **Voltage Ramping** is the most reliable starting method, because the starter will eventually reach an output voltage high enough to draw full current and develop full torque. This method is useful for applications where the load conditions change frequently and where different levels of torque are required. Typical applications include material handling conveyors, positive displacement pumps and drum mixers. Voltage is increased from a starting point, (Initial Torque) to full voltage over an adjustable period of time (Ramp Time). To achieve Voltage Ramping, select VOLTAGE for the START RAMP #1 TYPE Setpoint and set CURRENT LIMIT #1 Setpoint to 500% (The maximum setting). Since this is essentially Locked Rotor Current on most motors, there is little or no Current Limit effect on the Ramp profile.



**FIG. SP2.3 Example of Switching from Jog to Start Ramp #1 Type: Voltage**

- **Voltage Ramping with Current Limit** is the most used curve and is similar to voltage ramping however, it adds an adjustable maximum current output. Voltage is increased gradually until the setting of the Maximum Current Limit Setpoint is reached. The output is held at this level until the motor accelerates to full speed. This may be necessary in applications where the electrical power is limited. Typical applications include portable or emergency generator supplies, utility power near the end of a transmission line and utility starting power demand restrictions.

**Note:** Using Current Limit will override the Ramp Time setting if necessary, so use this feature when acceleration time is not critical.

To set Voltage Ramping with Current Limit, select VOLTAGE for the START RAMP #1 Setpoint and set CURRENT LIMIT #1 Setpoint to a desired lower setting, as determined by your application requirements.

## **Start Ramp 1 Type: Current**

### **• Current Ramping** (Closed Loop Torque Ramping)

This method is used for smooth linear increase of output torque. This ramp is only used on some conveyor systems (long haul or down hill). For other applications, use Voltage Ramp or a custom Accel curve. Output voltage is constantly updated to provide the linear current ramp, and therefore the available torque is maximized at any given speed. This is for applications where rapid changes in torque may result in load damage or equipment changes. Typical applications include overland conveyors if belt stretching occurs; fans and mixers if blade warping is a problem; and material handling systems if stacked products fall over or break.

This feature can be used with or without the Maximum Current Limit setting. To achieve Current Ramping select CURRENT for START RAMP #1 TYPE Setpoint and set the MAXIMUM CURRENT #1 Setpoint to the desired level.

### **• Current Limit Only** (Current Step) uses the Current Limit feature exclusively.

This method of starting eliminates the Soft Start voltage/current ramp and instead, maximizes the effective application of motor torque within the limits of the motor. In this mode, Setpoint RAMP TIME #1 is set to minimum so that the output current jumps to the current limit setting immediately. Typically used with a limited power supply when starting a difficult load such as a centrifuge or a deep well pump, when the motor capacity is barely adequate (stall condition or overloading occurs) or if other starting modes fail. Since ramp times are set to minimum, START RAMP #1 TYPE is set to either VOLTAGE or CURRENT.

### **• Initial Torque (Initial Voltage #1 or Initial Current #1)**

Sets the initial start point of either Voltage Ramp or the Current Ramp. Every load requires some amount of torque to start from a standstill. It is inefficient to begin ramping the motor from zero every time, since between zero and the WK2 break-away torque level, no work is being performed. The initial torque level should be set to provide enough torque to start rotating the motor shaft, enabling a Soft Start and preventing torque shock damage. Setting this start point too high will not damage the starter, but may reduce or eliminate the soft start effect.

### **• Ramp Time #1**

Sets the maximum allowable time for ramping the initial voltage, current (torque) or power setting to either of the following:

- The Current Limit setting when the motor is still accelerating.
- Full output voltage if the Current Limit is set to maximum.
- kW if Power Ramp is selected.

Increasing the ramp time softens the start process by gradually increasing the voltage, current or power. Ideally, the ramp time should be set for the longest amount of time the application will allow (without stalling the motor). Some applications require a short ramp time due to the mechanics of the system. (i.e. centrifugal pumps, because pump problems can occur due to insufficient torque).

### **• Current Limit**

Sets the maximum motor current the starter will allow during the acceleration. As the motor begins to ramp, the Current Limit feature sets a maximum at which the current draw is held. Current Limit remains in effect until the following occurs:

- 1) The motor reaches full speed (Detected by the At-Speed detection circuit) or;
- 2) The Overload Protection trips on Motor Thermal Overload. Once the motor reaches full speed, the Current Limit feature becomes inactive. In the Voltage Ramp Profile, the voltage output is increased until it reaches the Current Limit. Ramp time is the maximum amount of time it takes for the voltage to increase until the Current Limit setting takes over. The Current Ramp profile varies the output voltage to provide a linear increase in current up to the Maximum Current Setpoint value. A closed loop feedback of motor current maintains the Current Ramp profile

**SP2.4 Start Ramp 2 Type:** Please refer to Ramp 1 settings for Ramp 2 Type: Voltage selection.

### **Start Ramp 2: Power**

The **Power Ramp** feature has three programmable set points, Initial Power, Ramp Time and Maximum Power.

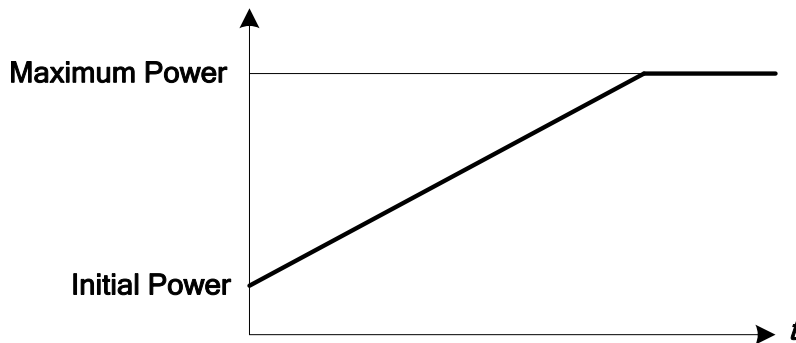
- The **Initial Power** set point allows the user to define an initial KW (motor power) value that will be applied to the motor when the start sequence is begun. It has a range of 0-100% and a default value of 20%.
- The **Ramp Time** set point functions as all other ramp time set points and allows the user to define a time period during which the applied KW (motor power) will be increased linearly to the Maximum Power value set point. The adjustment range is 1 to 120 seconds. Once the Power Limit value is reached, the system enters a constant power mode that regulates the applied motor power until the motor reaches full speed.
- The **Maximum Power** set point has an adjustment range of 0-300% and a default value of 80%.



### **CAUTION**

It is recommended to use the power ramp on a loaded motor! Using the power ramp on an unloaded motor may result in shorter than anticipated acceleration times.

**Power Ramp Calculations:** The basic motor power value is derived from the line voltage and motor FLA, using a unity power factor as a default. This allows for approximation of the motor power rating without any other input data. During the Power Ramp process, the RMS line voltage, RMS motor current and power factor are measured on a cycle by cycle basis and applied to the Power Ramp algorithm. The CPU then calculates the True RMS motor power and will control the SCR firing to deliver the programmed power ramp values to the motor.



**Power Ramp**

**FIG. SP2.4**

- **Initial Power:** The Initial power set point allows the user to define an initial KW (motor power) value that will be applied to the motor at the beginning of the start sequence.
- **Ramp Time #2:** See Ramp Time #1 for description
- **Maximum Power:** Sets the maximum motor power the starter will allow during the acceleration. As the motor begins to ramp, the "Maximum Power" sets a limit.

**SP2.5 Kick Start:** Used as an initial energy burst in applications with high friction loads.

- **Kick Start Voltage:** The initial voltage (as a percent of full voltage value) that is needed to start the motor. (i.e. Breakaway or Initial Torque.)
- **Kick Start Time:** The time the initial torque boost is applied.

**SP2.6 Deceleration:** Allows the motor to gradually come to a soft stop.

- **Start Deceleration Voltage:** Upon receiving a STOP command the output voltage initially drops to this voltage. (Represented as a percent of voltage value.)
- **Stop Deceleration Voltage:** The drop-off point of the deceleration ramp. (Percent of voltage value.) The point at which the unit output drops to zero to end the deceleration.
- **Deceleration Time:** The time to get to the stop Deceleration Voltage Set point value.

**SP2.7 Timed Output:** Used with an AUX (5-8) relay. When enabled, and upon a start command, it waits until the programmed time plus the run delayed time has expired. The relay energizes and remains so until a stop command is received. It de-energizes upon receiving a stop command.

**SP2.8 Run Delay Time:** Can be used with an AUX (5-8) relay. The delay timer begins upon receipt of the start command. The relay will then drop out when the time has expired.

**SP2.9 At Speed Delay Time:** Used with the AUX 4 relay, it energizes when the motor reaches At Speed and the programmed delay time has expired. The relay remains energized until a stop command has been received.

### SP.3 Phase & Ground Settings (Setpoint Page 3) (Security Level 2)

**SP3.1 Imbalance Alarm Level:** This is an advance warning of a phase imbalance problem. The problem may not be a fault in the motor, but merely caused by imbalanced voltages.

- **Imbalance Alarm Delay:** The amount of time the imbalance condition must exist before an alarm occurs.

**SP3.2 Imbalance Trip Level:** This will trip the motor on excessive phase imbalance. The trip level should be programmed to a higher value than the alarm level.

- **Imbalance Trip Delay:** The amount of time the imbalance condition must exist before a trip will occur.

**SP3.3 Undercurrent Alarm Level:** Typically used to warn of possible load loss, a coupling break or other mechanical problems.

- **Undercurrent Alarm Delay:** The amount of time the undercurrent condition must exist before an alarm will occur.

**SP3.4 Overcurrent Alarm Level:** Typically used to indicate when the motor is overloaded. This feature can be used to either stop the feed to the equipment or warn operators of an overload condition.

- **Overcurrent Alarm Delay:** The amount of time the overcurrent condition must exist before an alarm will occur.

**SP3.5 Overcurrent Trip Level:** Typically used to indicate the motor is severely overloaded and at which point a trip occurs.

- **Overcurrent Trip Delay:** The amount of time the overcurrent condition must exist before a trip will occur.

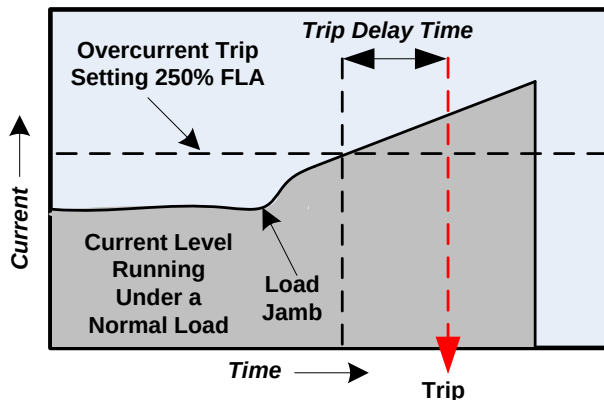
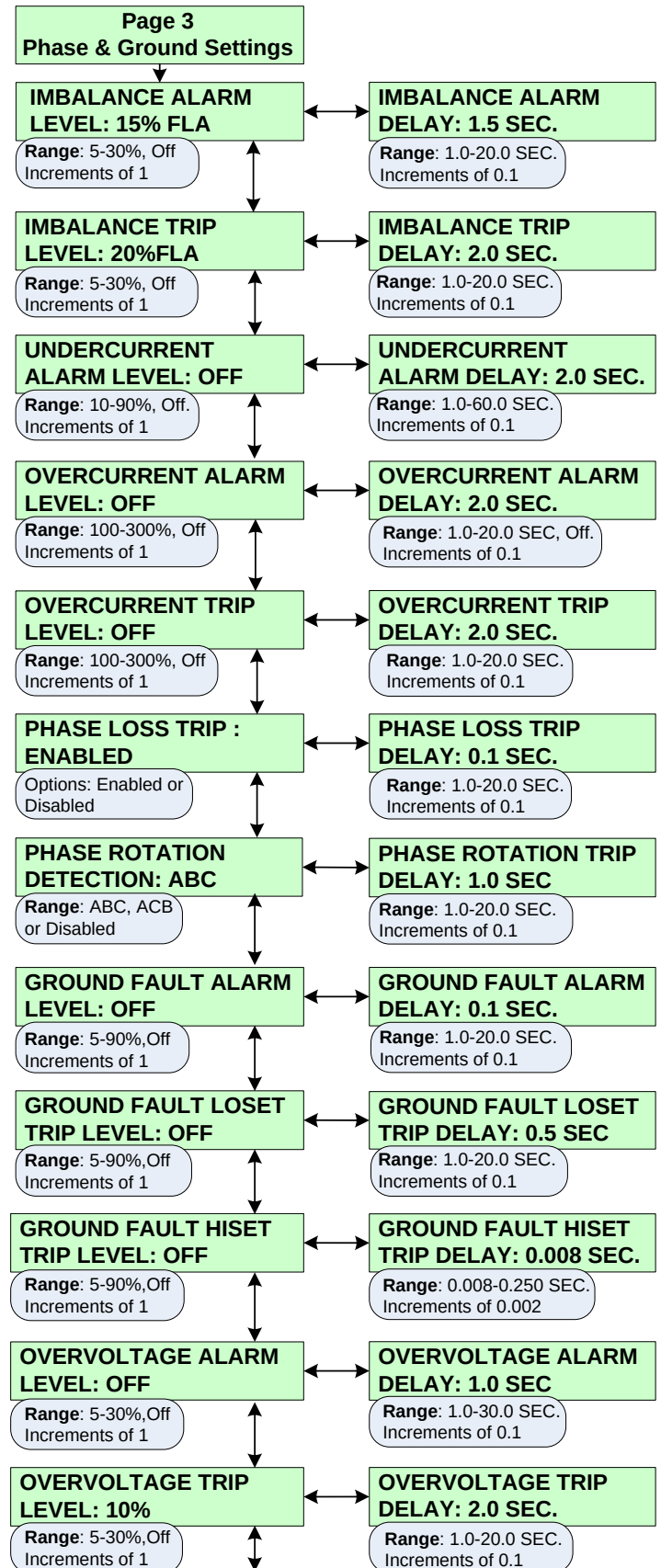


FIG. SP3.5



Continued (Next Page)

**SP3.6 Phase Loss Trip:** When enabled, the Soft Starter will trip the motor off-line upon a loss of phase power.

- **Phase Loss Trip Delay:** The amount of time the phase loss condition must exist before a trip will occur.

**SP3.7 Phase Rotation Detection:** The soft starter is continuously monitoring the phase rotation. Upon a start command, a trip will occur if it detects a change in the phase rotation.

- **Phase Rotation:** There are two possible phase rotation options: ABC or ACB. This Setpoint monitors the wiring to ensure that the phase rotation is correct. To view the present phase rotation, go to Metering Page1, screen number 4.

**SP3.8 \*Ground Fault Alarm:** Typically used to warn of low level ground current leakage

- **Ground Fault Alarm Delay:** The amount of time that the ground fault condition must exist before an alarm will occur.

**SP3.9 \*Ground Fault Loset Trip Level:** Typically used to trip the motor on a low level of ground current leakage. This Setpoint is intended to detect high impedance faults.

- **Ground Fault Loset Trip Delay:** The amount of time that the ground fault condition must exist before a trip will occur.

**\* Ground Fault Option must be installed**

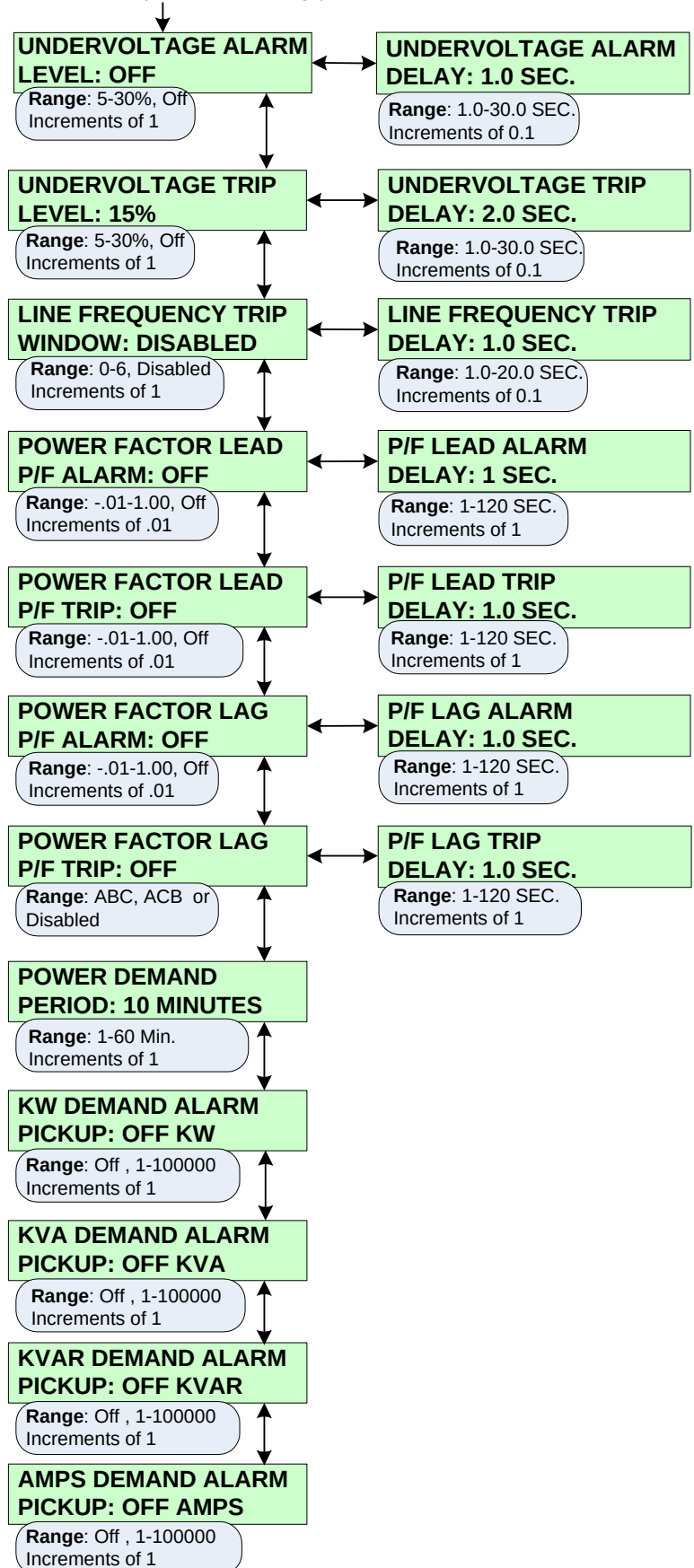
**SP3.10 \*Ground Fault Hiset Trip Level:** Used to trip the motor (within milliseconds) upon detecting a high level of ground current leakage. This Setpoint is intended to detect low impedance faults.

- **\*Ground Fault Hiset Trip Delay:** The amount of time that the ground fault condition must exist before a trip will occur.

**SP3.11 Overvoltage Alarm Level:** Typically used to indicate when the line voltage is too high. This is an alarm level.

- **Overvoltage Alarm Delay:** The amount of time that the overvoltage condition must exist before an alarm occurs.

Continued (From Previous Page)



**SP3.12 Overvoltage Trip Level:** Typically used to indicate that the line voltage is too high and at which point a trip occurs

- **Overvoltage Trip Delay:** The amount of time that the overvoltage condition must exist before a trip will occur.

**SP3.13 Undervoltage Alarm Level:** Typically used to indicate when the line voltage is too low. This is an alarm level.

- **Undervoltage Alarm Delay:** The amount of time that the undervoltage condition must exist before an alarm occurs.

**SP3.14 Undervoltage Trip Level:** Typically used to indicate that the line voltage is too low at which point a trip occurs.

- **Undervoltage Trip Delay:** The amount of time that the undervoltage condition must exist before a trip occurs.

**SP3.15 Line Frequency Trip Window:** The acceptable amount of drift above or below the line frequency (Hz) before a trip is generated.

- **Line Frequency Trip Delay:** The amount of time that the frequency drift condition must exist beyond the window before a trip occurs.

**SP3.16 Power Factor Lead Alarm:** Typically used to indicate a leading power factor.

- **Power Factor Lead Alarm Delay:** The amount of time that the power factor lead condition must exist beyond the window before an alarm occurs.

**SP3.17 Power Factor Lead Trip:** The acceptable amount of power factor lead before a trip is generated.

- **Power Factor Lead Trip Delay:** The amount of time that the power factor lead condition must exist beyond the window before a trip will occur.

**SP3.18 Power Factor Lag Alarm:** Typically used to indicate a lagging power factor.

- **Power Factor Lag Alarm Delay:** The amount of time that the power factor lagging condition must exist beyond the window before an alarm occurs.

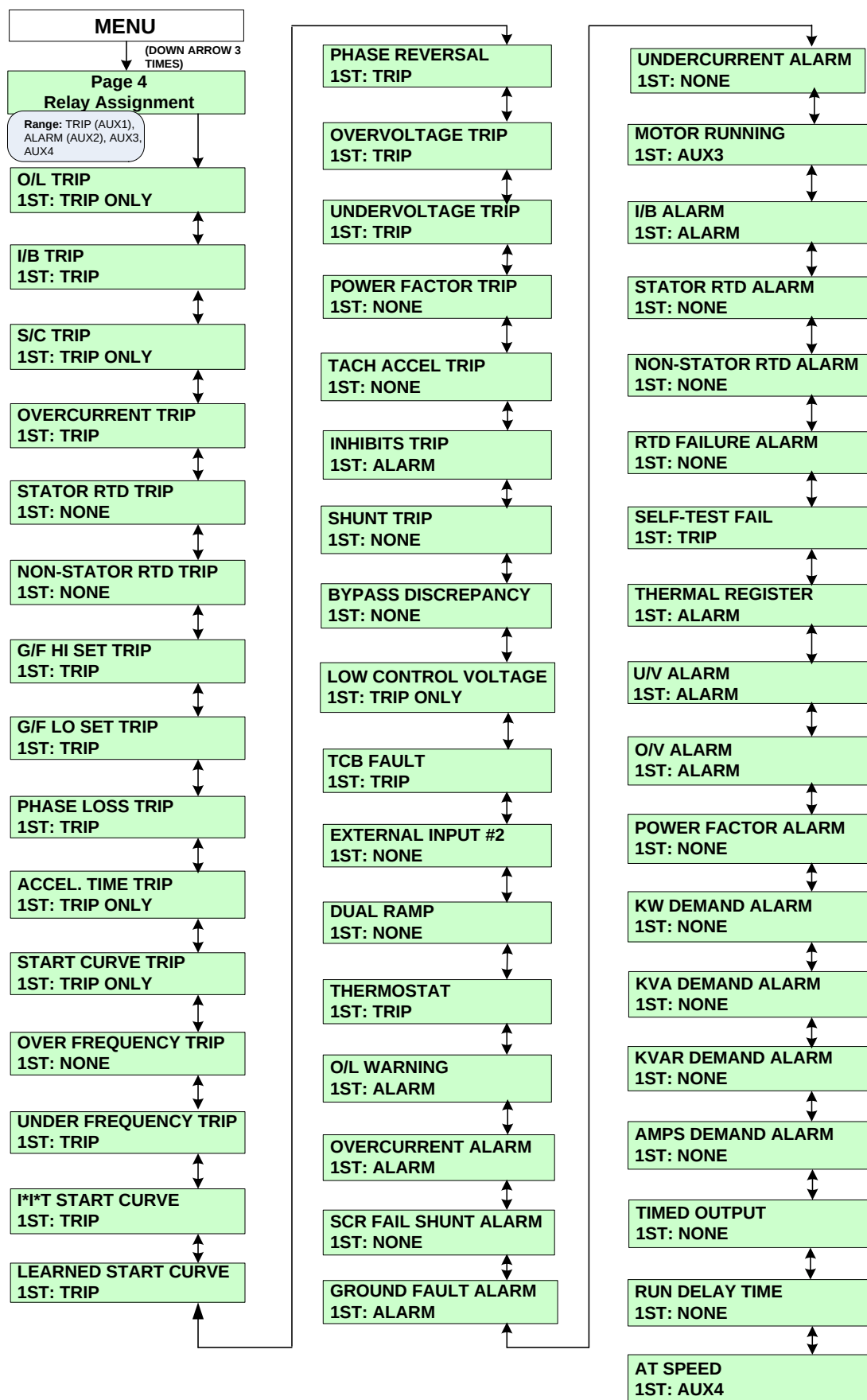
**SP3.19 Power Factor Lag Trip:** The acceptable amount of power factor lag before a trip is generated.

- **Power Factor Lag Trip Delay:** The amount of time that the power factor lag condition must exist beyond the window before a trip will occur.

**SP3.20 Power Demand Period:** The Soft Starter monitors the demand of the motor based on several parameters (current, kW, kVAR, kVA). Monitoring the demand of the motor assist in the energy management program where processes can be altered or scheduled to reduce overall demand. Demand is calculated by taking samples of the output current, kW, kVAR and kVA over a period of time, then averaged and stored into memory.

## SP.4 Relay Assignment (Setpoint Page 4)

(Security Level 2)



## SP.4 Relay Assignment (Setpoint Page 4) – Continued

### (Security Level 2)

All of the protective functions of the Soft Starter are user programmable to an output relay. The factory will ship with all tripping functions assigned to TRIP (AUX1) relay, and all alarm functions to ALARM (AUX2) relay.

**Note:** AUX1 - 4 are Factory Set and should not be changed.

**SP4.1** The following is a list of all the user programmable functions.

**Note:** The 1st Relay Assignments are factory defaults and should not be changed.

#### RELAY ASSIGNMENTS

| <u>FUNCTIONS</u>             | <u>1st</u>   | <u>2nd</u> | <u>3rd</u> |
|------------------------------|--------------|------------|------------|
| OVERLOAD TRIP                | TRIP ONLY    | NONE       | NONE       |
| IMBALANCE TRIP               | TRIP (AUX1)  | NONE       | NONE       |
| SHORT CIRCUIT TRIP           | TRIP ONLY    | NONE       | NONE       |
| OVERCURRENT TRIP             | TRIP (AUX1)  | NONE       | NONE       |
| STATOR RTD TRIP              | NONE         | NONE       | NONE       |
| NON-STATOR RTD TRIP          | NONE         | NONE       | NONE       |
| GROUND FAULT HI SET TRIP*    | TRIP (AUX1)  | NONE       | NONE       |
| GROUND FAULT LO SET TRIP*    | TRIP (AUX1)  | NONE       | NONE       |
| PHASE LOSS TRIP              | TRIP (AUX1)  | NONE       | NONE       |
| ACCEL TIME TRIP              | TRIP ONLY    | NONE       | NONE       |
| START CURVE TRIP             | TRIP ONLY    | NONE       | NONE       |
| OVER FREQUENCY TRIP          | NONE         | NONE       | NONE       |
| UNDER FREQUENCY TRIP         | TRIP (AUX1)  | NONE       | NONE       |
| I <sup>2</sup> T START CURVE | TRIP (AUX1)  | NONE       | NONE       |
| LEARNED START CURVE          | TRIP (AUX1)  | NONE       | NONE       |
| PHASE REVERSAL               | TRIP (AUX1)  | NONE       | NONE       |
| OVERVOLTAGE TRIP             | TRIP (AUX1)  | NONE       | NONE       |
| UNDERVOLTAGE TRIP            | TRIP (AUX1)  | NONE       | NONE       |
| POWER FACTOR TRIP            | NONE         | NONE       | NONE       |
| TACH ACCEL TRIP              | NONE         | NONE       | NONE       |
| INHIBITS TRIP                | ALARM (AUX2) | NONE       | NONE       |
| SHUNT TRIP                   | NONE         | NONE       | NONE       |
| BYPASS DISCREPANCY           | TRIP ONLY    | NONE       | NONE       |
| LOW CONTROL VOLTAGE          | TRIP ONLY    | NONE       | NONE       |
| TCB FAULT /ESTOP             | TRIP (AUX1)  | NONE       | NONE       |
| EXTERNAL INPUT 2             | NONE         | NONE       | NONE       |
| DUAL RAMP                    | NONE         | NONE       | NONE       |
| THERMOSTAT                   | TRIP (AUX1)  | NONE       | NONE       |
| OVERLOAD WARNING             | ALARM (AUX2) | NONE       | NONE       |
| OVERCURRENT ALARM            | ALARM (AUX2) | NONE       | NONE       |
| SCR FAIL SHUNT ALARM         | ALARM (AUX2) | NONE       | NONE       |
| GROUND FAULT ALARM*          | ALARM (AUX2) | NONE       | NONE       |
| UNDERCURRENT ALARM           | NONE         | NONE       | NONE       |
| MOTOR RUNNING                | AUX3         | NONE       | NONE       |
| IMBALANCE ALARM              | ALARM (AUX2) | NONE       | NONE       |
| STATOR RTD ALARM             | NONE         | NONE       | NONE       |
| NON-STATOR RTD ALARM         | NONE         | NONE       | NONE       |
| RTD FAILURE ALARM            | NONE         | NONE       | NONE       |
| SELF TEST FAIL               | TRIP (AUX1)  | NONE       | NONE       |
| THERMAL REGISTER             | ALARM (AUX2) | NONE       | NONE       |
| U/V ALARM                    | ALARM (AUX2) | NONE       | NONE       |
| O/V ALARM                    | ALARM (AUX2) | NONE       | NONE       |
| POWER FACTOR ALARM           | NONE         | NONE       | NONE       |
| KW DEMAND ALARM              | NONE         | NONE       | NONE       |
| KVA DEMAND ALARM             | NONE         | NONE       | NONE       |
| KVAR DEMAND ALARM            | NONE         | NONE       | NONE       |
| AMPS DEMAND ALARM            | NONE         | NONE       | NONE       |
| TIMED OUTPUT                 | NONE         | NONE       | NONE       |
| RUN DELAY TIME               | NONE         | NONE       | NONE       |
| AT SPEED                     | AUX4         | NONE       | NONE       |

\*Ground fault option must be installed

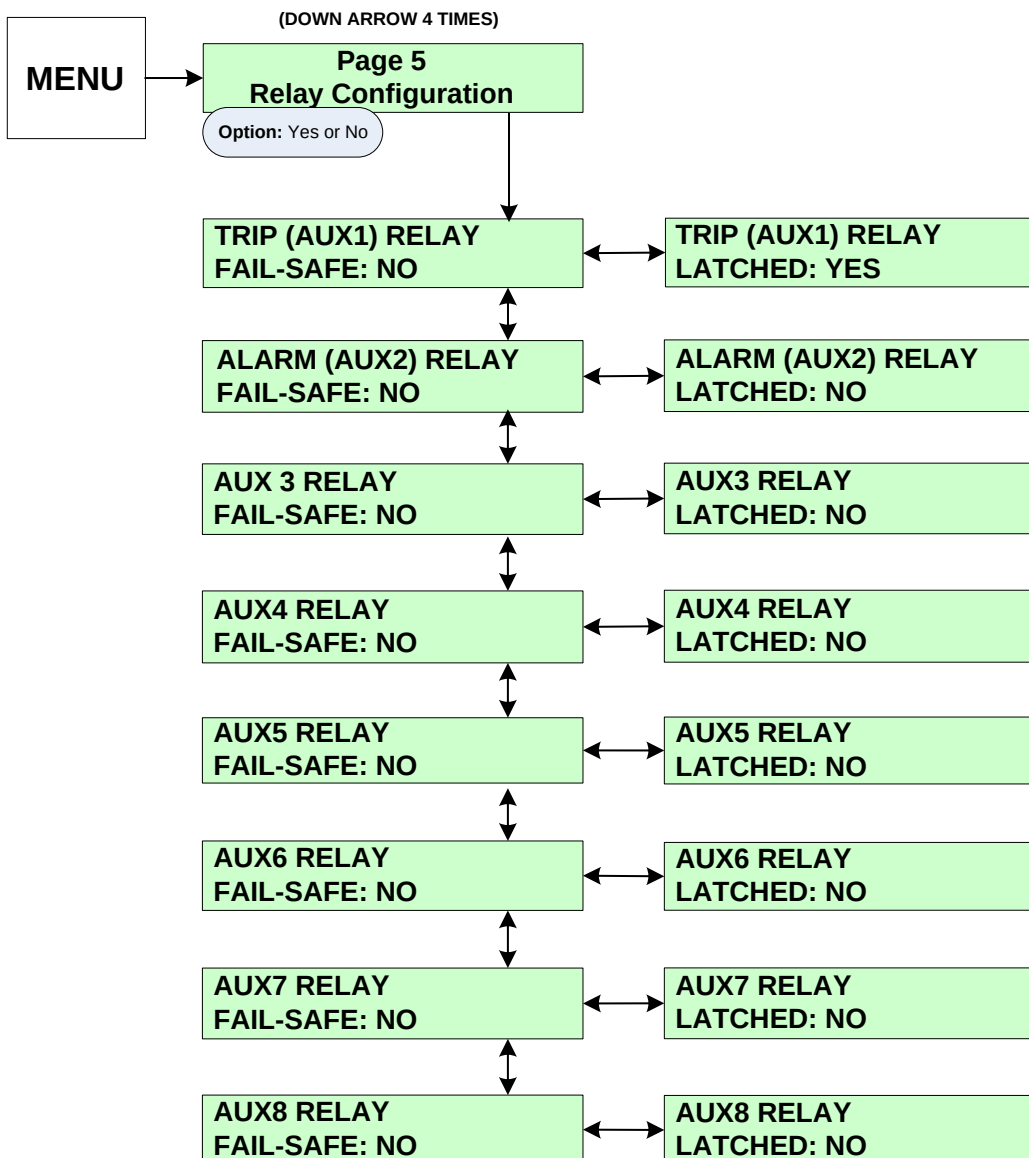
## SP.5 Relay Configuration (Setpoint Page 5) (Security Level 2)

In Setpoint Page 5 the user can configure the four output relays as either fail-safe or non fail-safe and latching or non-latching.

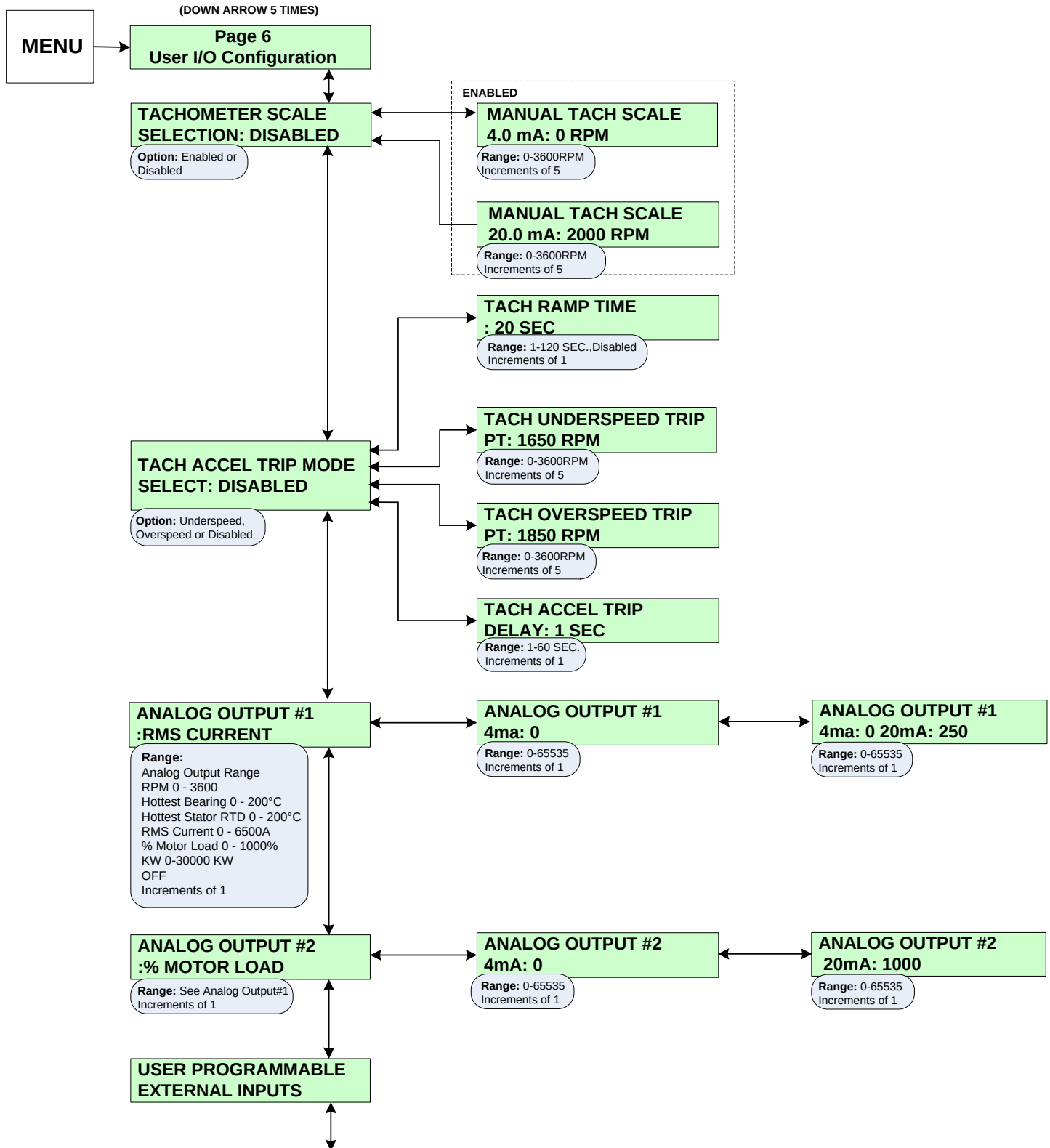
**SP5.1** When a relay has been configured for "Fail Safe" and power is applied to the unit the relay will energize and its contacts will change state. The relay will then de-energize and its contacts revert back when an event occurs or if power is removed.

**NOTE:** The relays in the soft starter will not prevent a start sequence unless they are wired in as interlocks. If power is lost, the motor power is also lost. Do not change the programming for AUX 1-4. These are for factory use only. AUX 5-8 are user defined outputs.

**SP5.2** A relay configured as non-latching will reset itself when the cause of the trip event is not continuous. The TRIP (AUX1) relay should always be programmed for latching, because this trip should require a visual inspection of the motor and starter before issuing a manual reset to release the relay after a trip has been stored.



**SP.6 User I/O Configuration (Setpoint Page 6)**  
**(Security Level 2)**



Continue on page 51

## **SP.6 User I/O Configuration (Setpoint Page 6) - Continued**

### **(Security Level 2)**

The Soft Starter can be configured to accept a tachometer feedback signal using the 4-20mA input.

**SP6.1** The first screen of Setpoint page 6 is TACHOMETER SCALE SELECTION. When this is set to ENABLED, the user will need to input the tachometer scale of the 4-20mA input range.

- **Manual Tach Scale 4.0 mA:** The unit is looking for an RPM value to assign to the lowest point on the scale. This Value should represent the motor at zero speed.
- **Manual Tach Scale 20.0 mA:** The unit is looking for an RPM value to assign to the highest point on the scale. This value should represent the motor at full speed.

**SP6.2 Tach Accel Trip Mode Select:** When enabled, the underspeed or overspeed must be selected for the Tach Accel Trip. If underspeed is selected, only the Tach Underspeed Trip Point will be used. If overspeed is selected, only the Tach Overspeed Trip Point will be used.

- **Tach Inhibit Time:** This is the duration of time before the starter begins sampling the tachometer.
- **Tach Underspeed Trip:** Defines the minimum motor speed using the Tach feedback. When the underspeed trip mode is enabled and the motor speed falls below this level for the time specified by the Tach Accel Trip Delay an underspeed trip occurs.
- **Tach Overspeed Trip:** Defines the maximum allowed motor speed using the Tach feedback. When the overspeed trip mode is enabled and the motor speed exceeds this level for the time specified by the Tach Accel Trip Delay an overspeed trip occurs.
- **Tach Accel Trip Delay:** The duration of time that the Tach Accel trip condition must persist before a trip is generated.

**SP6.3** The controller provides two 4-20mA analog outputs. Each analog output is independent of the other and can be assigned to monitor different functions. The available output ranges are; RPM, Hottest Non-Stator (Bearing) RTD, Hottest Stator RTD, RMS current, and % Motor Load.

- **Analog Output #1** – Select a function from the available five options to be transmitted from the 4-20mA output.

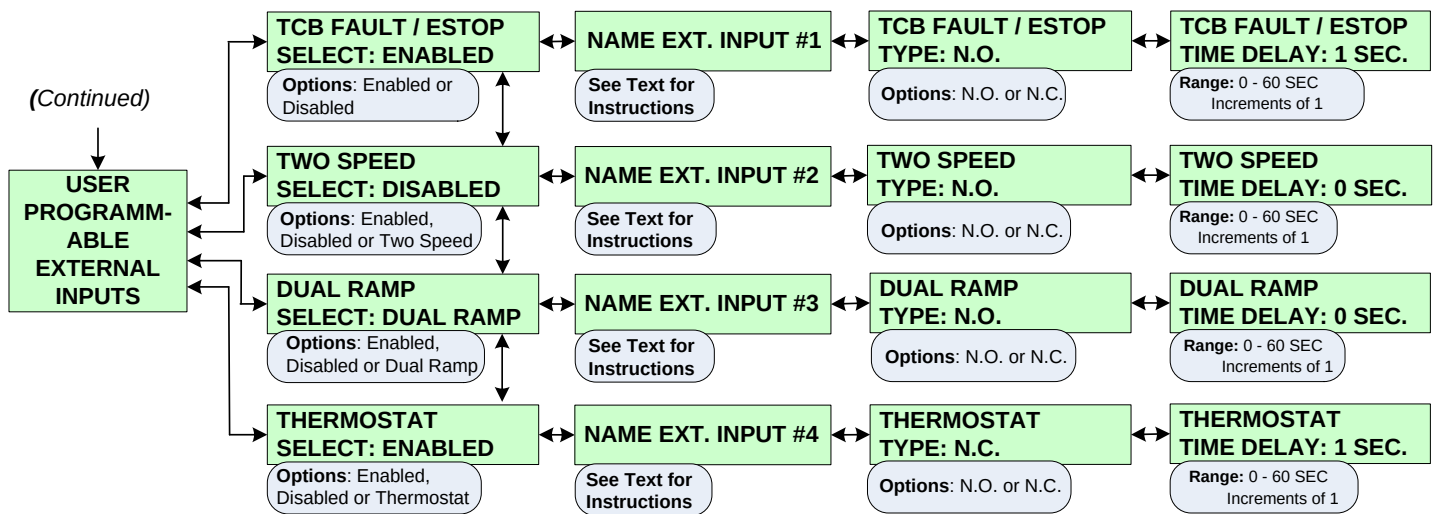
**Note:** *If selecting RPM, the Tachometer feedback input signal must be present in order for the controller to give proper output. If selecting RTD, the RTD option must be installed and an RTD input signal must be present for a proper output to be given from the analog output.*

- **Analog Output #1 (4 mA):** Enter a value that the 4mA level will represent for the selected function; typically this value should be 0.
- **Analog Output #1 (20 mA):** Enter a value that the 20mA level will represent for the selected function.

**SP6.4 Analog Output #2** – All of the Setpoints and setup screens for Analog Output #2 are the same as those for Analog Output #1.

## SP.6 User I/O Configuration (Setpoint Page 6) - Continued

(Security Level 2)



**SP6.5 User Programmable External Inputs:** The controller provides up to 4 digital external inputs which are individually programmable. A description name can be assigned to each individual input for easy identification.

- **TCB FAULT / ESTOP:** Factory programmed for TCB Fault/ESTOP. Input and can be enabled or disabled.
- **TWO SPEED:** Factory programmed for TWO SPEED. Input and can be enabled, disabled or Two Speed.
- **External Input #3:** The setup screens and Setpoints for External Input #3 includes the option of being configured for Dual Ramp. In Dual Ramp mode, the initial contact setting is the same as the START RAMP #1. Upon a change in input contact state, the controller will switch over to START RAMP #2 and use that setting for start control mode.

**Note:** The start RAMP types should only be switched while the motor is stopped. In Setpoint Page 4 Relay Assignments do not assign any output relay to this function. The controller is programmed with External input #3 programmed for dual ramp. If it is not needed, disable the dual ramp.

- **External Input #4:** Thermostat input and can be enabled, disabled or thermostat.

**Note:** It is recommended that this function remain enabled. If the thermostat indicates an over temperature condition, the controller will trip the motor.

**External Input #1, #2, #3, #4 Time Delay:** Upon a change in contact setting, the unit will wait the programmed amount of time before generating an output. If no delay is needed, then input 0 seconds. The controller will post an event upon seeing a change in state.

**External Input #1, #2, #3, #4 Type:** The external input can be set as either a normally open or normally closed contact.

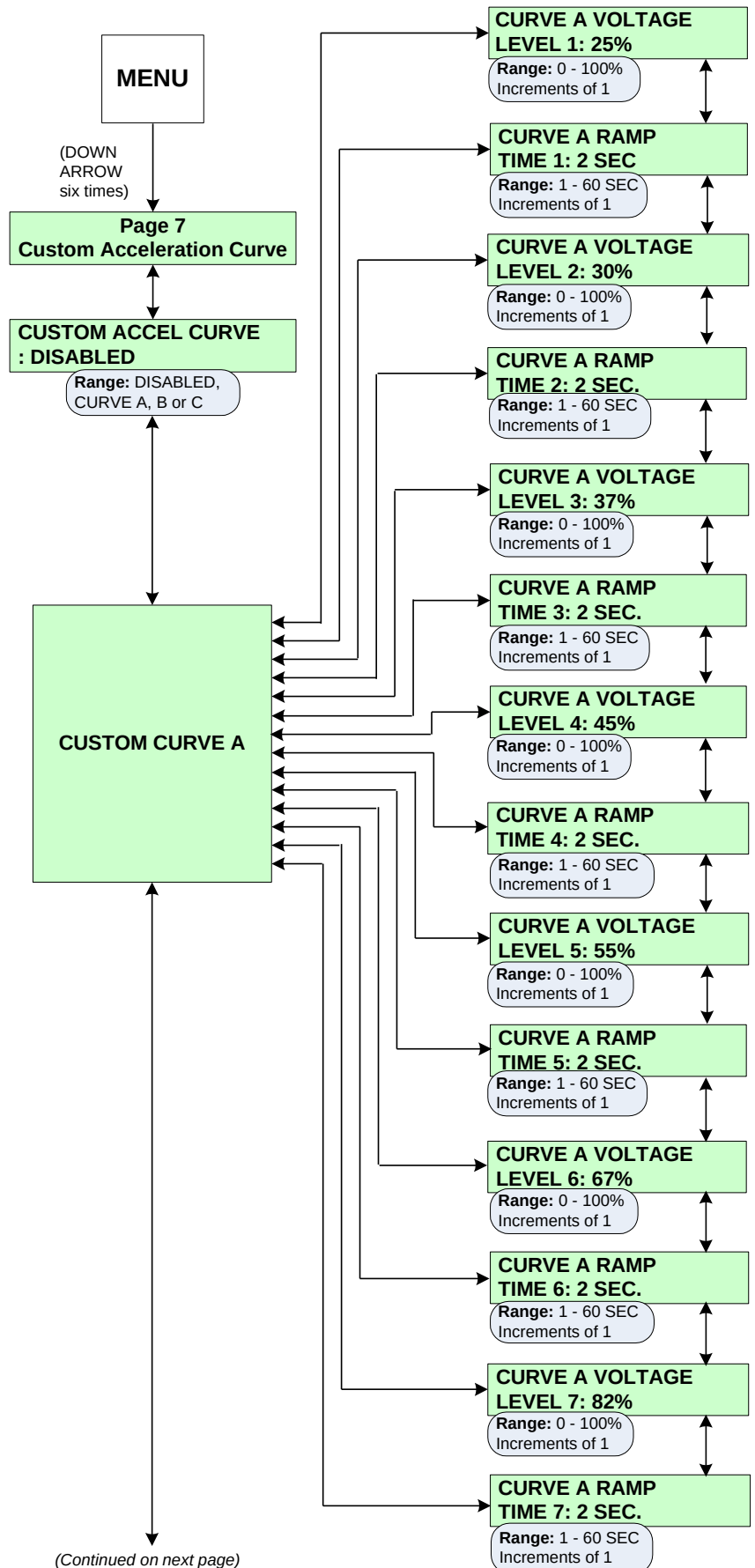
**Name Ext. Input #1, #2, #3, #4:** The user can assign a description name to the input. Up to 15 characters including spaces can be used to assign the name.

## SP.7 Custom Acceleration Curve (Setpoint Page 7) (Security Level 3)

**SP7.1** Setpoint Page 7 allows the user to custom design the acceleration curve (start curve) for a specific application. The custom design setup allows for up to three different curves in the Soft Starter. Only one curve can be active (enabled) at any given time. Each of the three curves allow for eight voltage plotting points, with corresponding ramp times and a current limit setting.

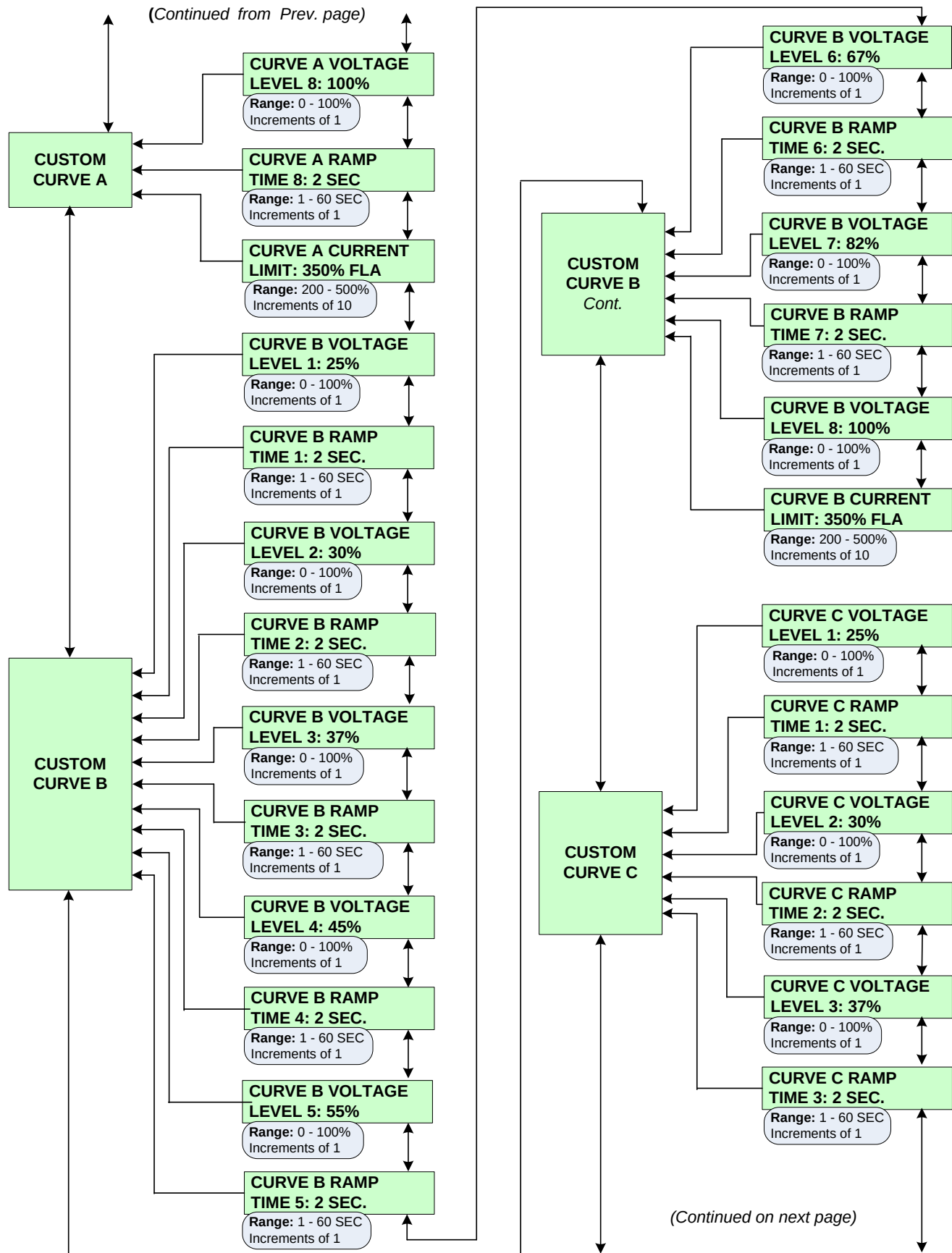
**Note:** Each successive voltage level must be programmed to a voltage level equal to or greater than the previous level. All eight voltage levels must be programmed and the eighth level has been preset at 100%.

- If Custom Accel Curve has been set to curve A, B or C on this page, the Soft Starter will override the Start Control Mode selected in Setpoint Page 2, (even if Start Control Mode in Setpoint Page 2 has not been set to Custom Accel Curve).

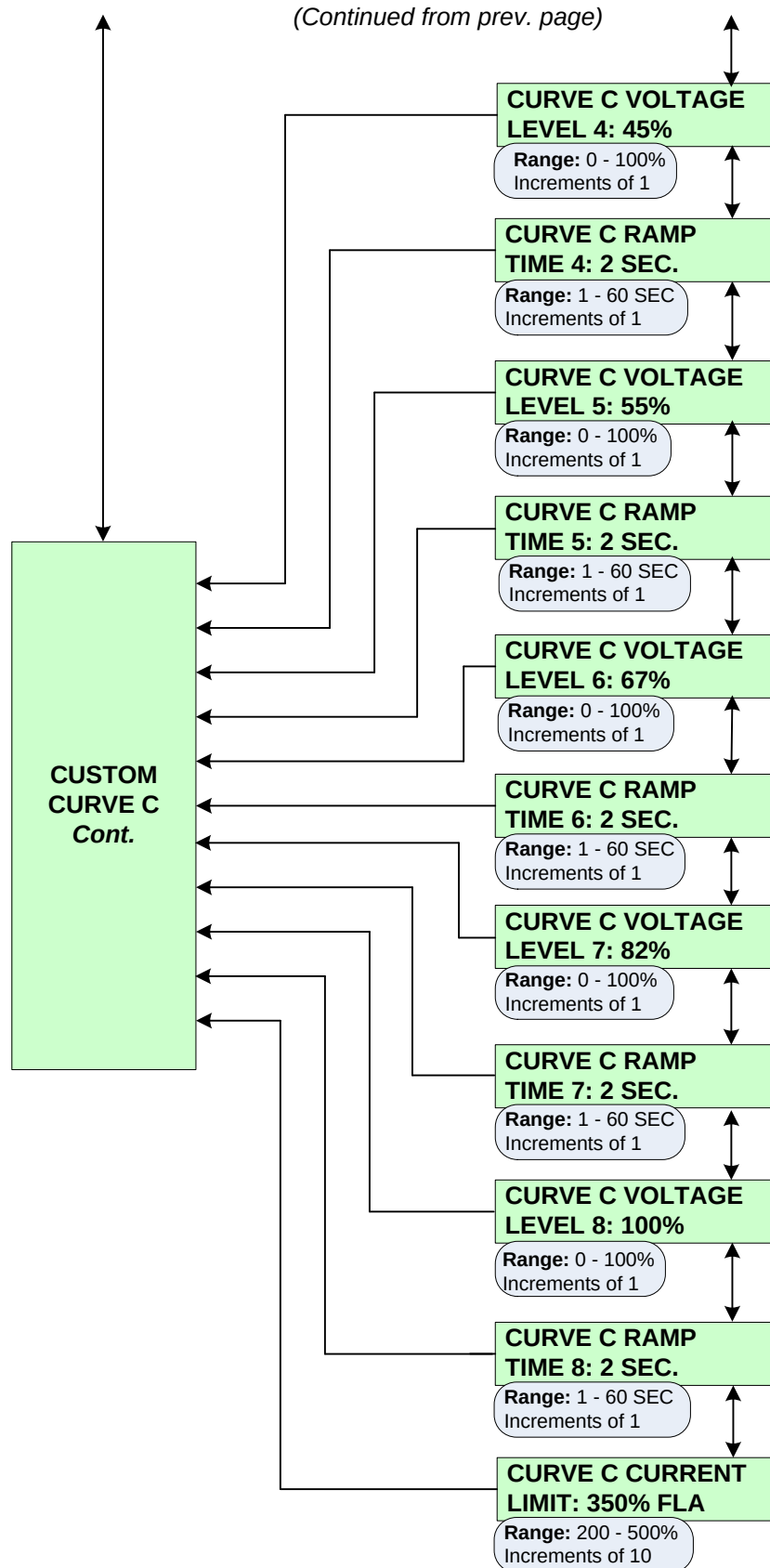


## SP.7 Custom Acceleration Curve (Setpoint Page 7) - Continued

(Security Level 3)



**SP.7 Custom Acceleration Curve (Setpoint Page 7) - Continued**  
(Security Level 3)

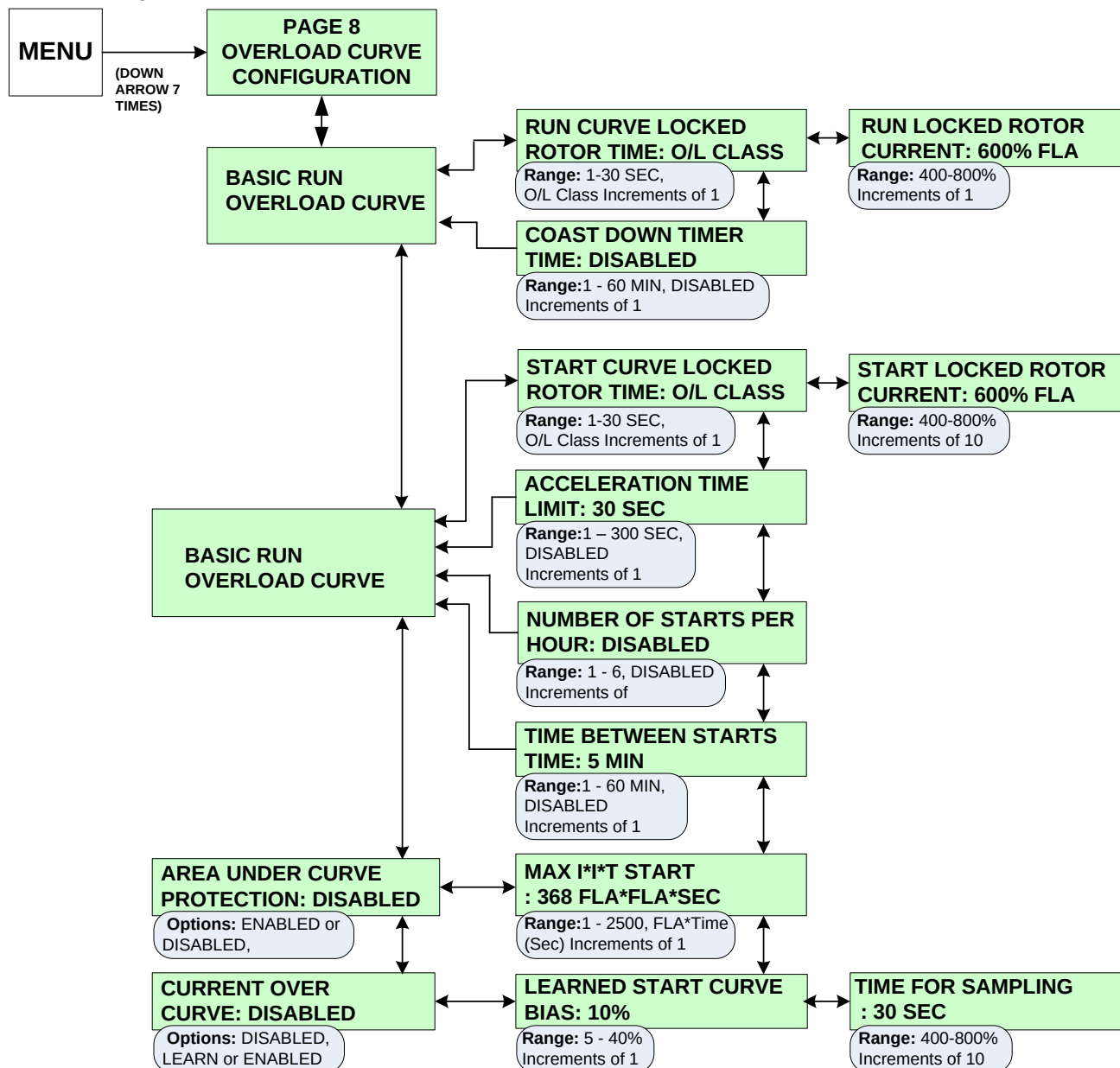


## SP.8 Overload Curve Configuration (Setpoint Page 8) (Security Level 3)

Configures the unit's start and run protection mode. The unit has independent start and run curve protection and the settings can be based on the OL Class or set by the motor's locked rotor current and time.

### SP8.1 Basic Run Overload Curve

- **Run Curve Locked Rotor Time:** Set the locked rotor time to the OL Class default chosen in Setpoint Page 1 or set the time in seconds. This is the time the locked rotor condition exists before a trip occurs.
- **Run Locked Rotor Current:** The current the motor draws with full voltage on the windings and no rotor movement (as a percent of motor FLA). Refer to the nameplate data or contact the motor manufacturer.
- **Coast Down Timer:** If enabled, this prevents the motor from restarting for the programmed amount of time, after a stop command is given.



### SP8.2 Basic Start Overload Curve

- **Start Curve Locked Rotor Time:** The locked rotor time can be set to the OL Class default chosen in Setpoint Page 1 or to a specific time. The overload condition must exist for the programmed amount of time before a trip occurs.
- **Start Locked Rotor Current:** The current the motor draws with full voltage on the windings and no motor movement (as a percent of motor FLA). Refer to the motor nameplate data or contact the motor manufacturer.
- **Acceleration Time Limit:** If the motor does not enter run mode (reach “at speed”) within the preset time, the unit trips on acceleration time limit.
- **Number of Starts per hour:** If enabled, this limits the maximum number of starts permitted per hour. This Setpoint allows a maximum of 6 starts per hour. Contact the motor manufacturer for further information regarding number of starts per hour.
- **Time Between Starts:** If enabled, the soft starter prevents another start attempt until the programmed time has expired.

**SP8.3 Area Under Curve Protection:** If enabled, this secondary start protection uses both the basic start protection and the area under the curve protection.

- **Max I<sup>2</sup>t Start:** The maximum I<sup>2</sup>t allowed during start. If the I<sup>2</sup>t to start exceeds this number then the Soft Starter will generate a trip.

**SP8.4 Current Over Curve:** Learns the motor’s starting characteristics and protects the motor based upon the learned curve. It is useful when commissioning a new motor.

- **Learn:** The unit reads the motor’s starting characteristics. Start the motor and allow it to come to full speed. The start feedback enables the motor protection based on the learned start curve.
- **Learned Start Curve Bias:** The maximum allowed deviation above or below the start curve before a trip is generated.
- **Time for sampling:** The time the soft starter continues to sample the start curve characteristic during learn mode.

## **SP.9 RTD Option Configuration (Setpoint Page 9)**

### **(Security Level 3)**

**Note:** The RTD is an option. Contact factory for additional information.

The Soft Starter is available with an optional RTD card that provides 12 programmable RTDs which are individually programmable for type. The available types are 100 ohm platinum, 100 ohm nickel, 120 ohm nickel and 10 ohm copper. Each RTD can be identified with a description name of up to 15 characters (including spacing). Also, each individual RTD has its own alarm and trip level.

#### **SP9.1 Use NEMA Temp for RTD Value:**

When this Setpoint is enabled, the Soft Starter will use the NEMA design insulation class to limit the maximum allowed range of the alarm and trip level. The maximum allowed temperature range is 240° C or (464°F).

#### **SP9.2 Number Of RTD'S Used for Stator:**

Up to six RTDs can be assigned to monitor the stator of the motor.

#### **SP9.3 RTD Voting:**

When this is enabled, the Soft Starter will not post a trip until 2 RTD's have exceeded the trip level. This prevents nuisance RTD tripping.

#### **SP9.4 RTD Setup:**

Each of the 12 RTDs is configured in the following manner. The first column is the RTD type, the second column is the RTD description, the third column is the alarm level, and the fourth column is the trip level. The first six RTDs have been pre-programmed with a description name for the STATOR, with two RTDs per phase.

RTDs #1 & #2 have been named STATOR PHASE A1 and A2 respectively. RTDs #3 & 4 are named STATOR PHASE B1 and B2, RTDs #5 & 6 are named STATOR PHASE C1 and C2.

If other description names are required, press the right arrow button from the RTD Type screen to go the RTD description screen. If no alarm or trip level is required these Setpoints can be turned off.

#### **RTD Available Settings:**

##### **RTD TYPE:**

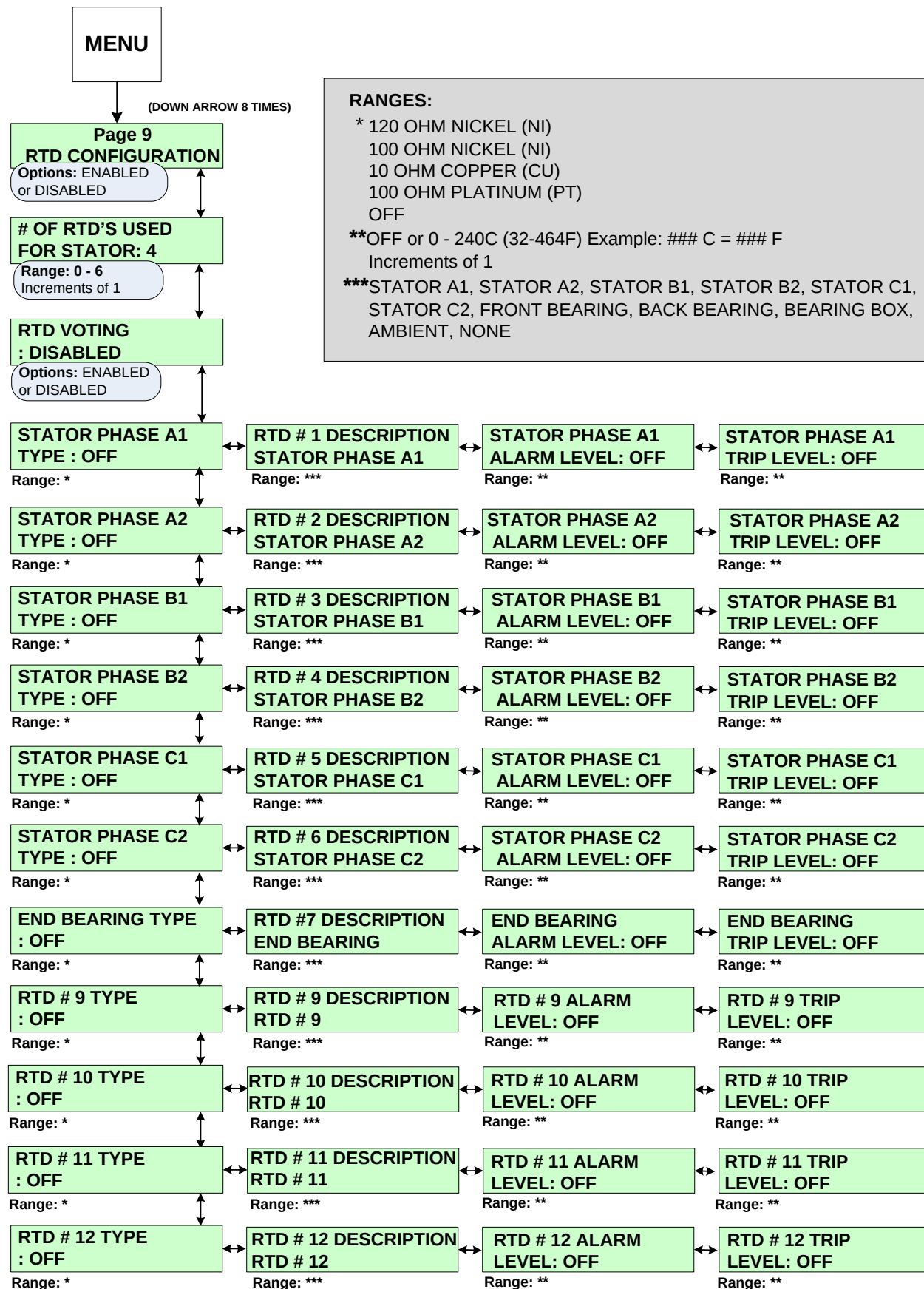
- 120 OHM NICKEL (NI)
- 100 OHM NICKEL (NI)
- 10 OHM COPPER (CU)
- 100 OHM PLATINUM (PT)
- OFF

**ALARM LEVEL:** OFF or 0 - 240C (32-464F) Example: #### C = #### F, Increments of 1

##### **RTD DESCRIPTION:**

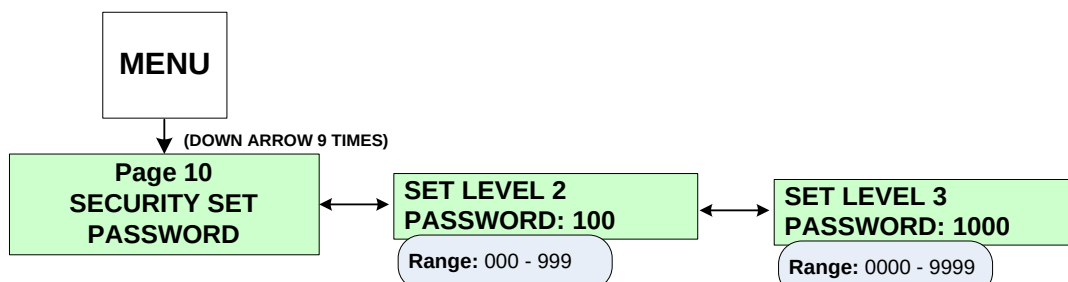
STATOR A1, STATOR A2, STATOR B1, STATOR B2, STATOR C1,  
STATOR C2, FRONT BEARING, BACK BEARING, BEARING BOX,  
AMBIENT, NONE

## SP.9 RTD Option Configuration (Setpoint Page 9) - Continued (Security Level 3)



### SP.10 Set Password (Setpoint Page 10) (Security Level 3)

The soft starter has three levels of user programmable setpoint screens. Level one setpoints do not require a password because the data contained in level one is basic nameplate data and starter control. Level two setpoint screens require a three-digit password to configure the protection schemes. Level three setpoint screens require a four-digit password to access the full range of protection and starter schemes.



**SP10.1 Set Level 2 Password:** This level uses a 3-digit password. The default level 2 password is 100.

**SP10.2 Set Level 3 Password:** Level three uses a 4-digit password. The default level 3 password is 1000.

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### SP.11 Communications (Setpoint Page 11) (Security Level 3)

**SP11.1 Set Front Baud Rate:** Configures the RS232 communications baud rate.

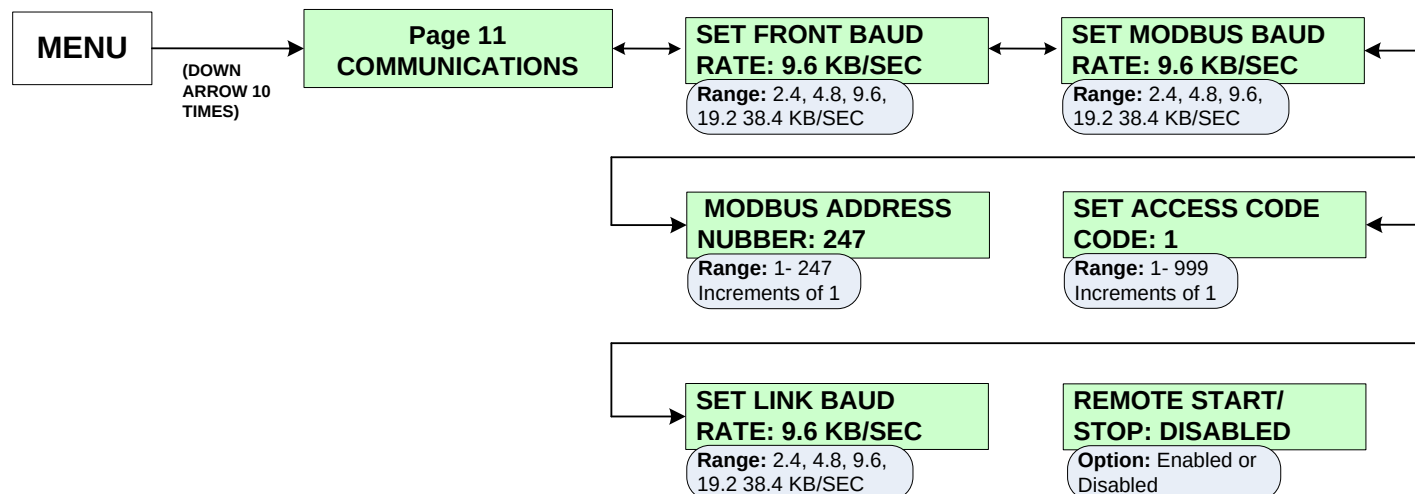
**SP11.2 Set Modbus Baud Rate:** Configures the Modbus communications baud rate

**SP11.3 Modbus Address Number:** Assigns a Modbus address to the unit.

**SP11.4 Set Access Code:** Assigns an access code to the Modbus addressing. This is typically not used

**SP11.5 Set Link Baud Rate:** Configures the RS422 communications baud rate between the keypad operator and the CPU board (For applications with remote keypad only).

**SP11.6 Remote Start/Stop:** Allows the RS485 Modbus communications to start and stop the motor. Contact factory for details.



## **SP.12 System Setpoints (Setpoint Page 12)**

### **(Security Level 3)**

**SP12.1 Default Display Screen:** This Setpoint group allows the user to choose the default screen the Soft Starter displays while the motor is running. Select the metering page number (1-3), then, select the metering screen number. The range varies depending on the selected page. To display a default screen, program the following two Setpoints:

- **Metering Data Page#:** Range is Page 1 - 3.
- **Metering Data Screen#:** If Page 1 is selected as the default page, then Screens 1- 10 are available. If Page 2 Screens 1-29 are available. If Page 3 is selected then Screens 1-6 are available. (See Metering Menu, MP.1, for screen number assignment.)

**SP12.2 Alarms:** Configures the RTD failure alarm (when RTD option is included) and the thermal register alarm.

- **RTD Failure Alarm:** If enabled, and an RTD shorts or open, an alarm occurs. (Only if RTD option is installed).
- **Thermal Register Alarm:** Sets a level in the thermal register to generate an alarm when the Thermal Register Capacity Used has exceeded this level.
- **Thermal Alarm Delay:** The amount of time that the Thermal Register Used must exceed the Setpoint before an alarm condition will occur.

**SP12.3 Thermal Register Setup Information:** This Setpoint group will configure the thermal register and indicate to the soft starter which inputs to use when thermal modeling.

- **Cold Stall Time:** Enter the time from the motor manufacturer's specification sheet or use the time defined by the OL Class. This Setpoint is used to define the thermal capacity of the motor.
- **Hot Stall Time:** Enter the amount of time specified by the motor manufacturer or use half of the time defined by the OL Class.
- **Stopped Cool Down Time:** The time the motor needs to cool down after it has stopped. Use only the data provided by the motor manufacturer. This Setpoint is used to configure the cooling rate of the thermal register.
- **Running Cool Down Time:** The amount of time the motor needs to cool down while running. Use only the data provided by the motor manufacturer.
- **Relay Measured Cool Rates:** When the RTD option is supplied, the Soft Starter can be configured to use the measured cooling rates from the RTDs instead of the programmed settings. This Setpoint should only be enabled when the RTD option is present.
- **Thermal Register Minimum:** Sets the value in the thermal register which represents a motor running at the nameplate current (with no overheating or negative sequence currents present).
- **Motor Design Ambient Temperature:** Use the data from the motor manufacturer's specifications. When RTD option is supplied, this Setpoint will be the base point for the RTD biasing of the Thermal Register.
- **Motor Design Run Temperature:** Use the data from the motor manufacturer's specifications. This Setpoint defines the operating temperature rise of the motor at full load amps or 100% load.
- **Motor Stator Max Temperature:** This represents the maximum temperature the stator insulation will withstand. The user may choose to use the temperature setting of the insulation class (selected in Setpoint Page 1) or enter a specific maximum temperature. This value should not exceed the stator's insulation temperature. This maximum temperature represents 100% thermal capacity.
- **U/B Input to Thermal Register:** Always enabled. It allows the soft starter to use the line current imbalance information to bias the Thermal Register.

- 
- ```

graph TD
    MENU[MENU] -- "(DOWN ARROW 11 TIMES)" --> P12[PAGE 12  
SYSTEM SETPOINTS]
    P12 <--> DDIS[DEFAULT  
DISPLAY SCREEN]
    DDIS <--> ALARMS[ALARMS]
    DDIS <--> M1[METERING DATA  
PAGE #: 1  
Enter Metering Page (1 - 4)  
Number for display]
    DDIS <--> RFA[RTD FAILURE ALARM  
ALARM: DISABLED  
Option: Enabled or Disabled]
    DDIS <--> TR90[THERMAL REGISTER  
ALARM: 90%  
Range: Off, 40 - 95%  
Increments of 1]
    DDIS <--> CST[COLD STALL TIME  
: O/L CLASS  
Range: O/L CLASS,  
4 - 40 SEC  
Increments of 1]
    DDIS <--> HST[HOT STALL TIME  
: 1/2 O/L CLASS  
Range: 1/2 O/L CLASS,  
4 - 40 SEC  
Increments of 1]
    DDIS <--> SCD[STOPPED COOL DOWN  
TIME: 30 MIN  
Range: 10 - 300 MIN  
Increments of 1]
    DDIS <--> RCD[RUNNING COOL DOWN  
TIME: 15 MIN  
Range: 10 - 300 MIN  
Increments of 1]
    DDIS <--> RMC[RELAY MEASURED COOL  
RATES: DISABLED  
Option: Enabled or Disabled]
    DDIS <--> TR15[THERMAL REGISTER  
MINIMUM: 15%  
Range: 10 - 50% ,Off  
Increments of 1]
    DDIS <--> MDA[MOTOR DESIGN AMBIENT  
TEMPERATURE: 40 C  
Range: 10 - 90 C  
Increments of 1]
    DDIS <--> MDR[MOTOR DESIGN RUN  
TEMPERATURE: 80% MAX  
Range: 50 - 100% of Motor  
Stator Max Temp.  
Increments of 1%]
    DDIS <--> MSTM[MOTOR STATOR MAX  
TEMPERATURE: INS CLS  
Range: Insulation Class  
10 - 240 C  
Increments of 1]
    DDIS <--> IBI[I/B INPUT TO THERMAL  
REGISTER: ENABLED  
Option: Enabled or Disabled]
    DDIS <--> UCK[USE CALCULATED K OR  
ASSIGN: 7  
Range: 1 - 50, ON]

    M1 <--> M2[METERING DATA  
SCREEN #: 1  
Enter Metering Screen  
Number for display]
    TR90 <--> TAD[THERMAL ALARM  
DELAY: 10 SEC.  
Range: 1 - 20 SEC.  
Increments of 1]

    TR90 <--> TRSI[THERMAL REGISTER  
SETUP  
INFORMATION]
    TRSI <--> PCTR[PRESS ENTER TO  
CLR THERMAL  
REGISTER]
    PCTR --> TR90
    PCTR --> TRSI
    PCTR --> ALARMS
    PCTR --> M1
    PCTR --> RFA
    PCTR --> CST
    PCTR --> HST
    PCTR --> SCD
    PCTR --> RCD
    PCTR --> RMC
    PCTR --> TR15
    PCTR --> MDA
    PCTR --> MDR
    PCTR --> MSTM
    PCTR --> IBI
    PCTR --> UCK
  
```
- The flowchart illustrates the navigation and configuration options for the Thermal Register Setup menu. It starts with the **MENU** screen, which leads to **PAGE 12 SYSTEM SETPOINTS** via 11 down arrow presses. From **PAGE 12 SYSTEM SETPOINTS**, users can navigate to **DEFAULT DISPLAY SCREEN**, **ALARMS**, or a series of configuration screens: **METERING DATA PAGE #: 1**, **RTD FAILURE ALARM ALARM: DISABLED**, **THERMAL REGISTER ALARM: 90%**, **COLD STALL TIME : O/L CLASS**, **HOT STALL TIME : 1/2 O/L CLASS**, **STOPPED COOL DOWN TIME: 30 MIN**, **RUNNING COOL DOWN TIME: 15 MIN**, **RELAY MEASURED COOL RATES: DISABLED**, **THERMAL REGISTER MINIMUM: 15%**, **MOTOR DESIGN AMBIENT TEMPERATURE: 40 C**, **MOTOR DESIGN RUN TEMPERATURE: 80% MAX**, **MOTOR STATOR MAX TEMPERATURE: INS CLS**, **I/B INPUT TO THERMAL REGISTER: ENABLED**, and **USE CALCULATED K OR ASSIGN: 7**. The **THERMAL REGISTER ALARM: 90%** screen is linked to **THERMAL ALARM DELAY: 10 SEC.** and **THERMAL REGISTER SETUP INFORMATION**. The **THERMAL REGISTER SETUP INFORMATION** screen is linked to **PRESS ENTER TO CLR THERMAL REGISTER**, which can clear the thermal register, return to the Thermal Register Alarm screen, or navigate to any of the other configuration screens listed.

## SP.13 Calibration & Service (Setpoint Page 13)

(Security Level 3)

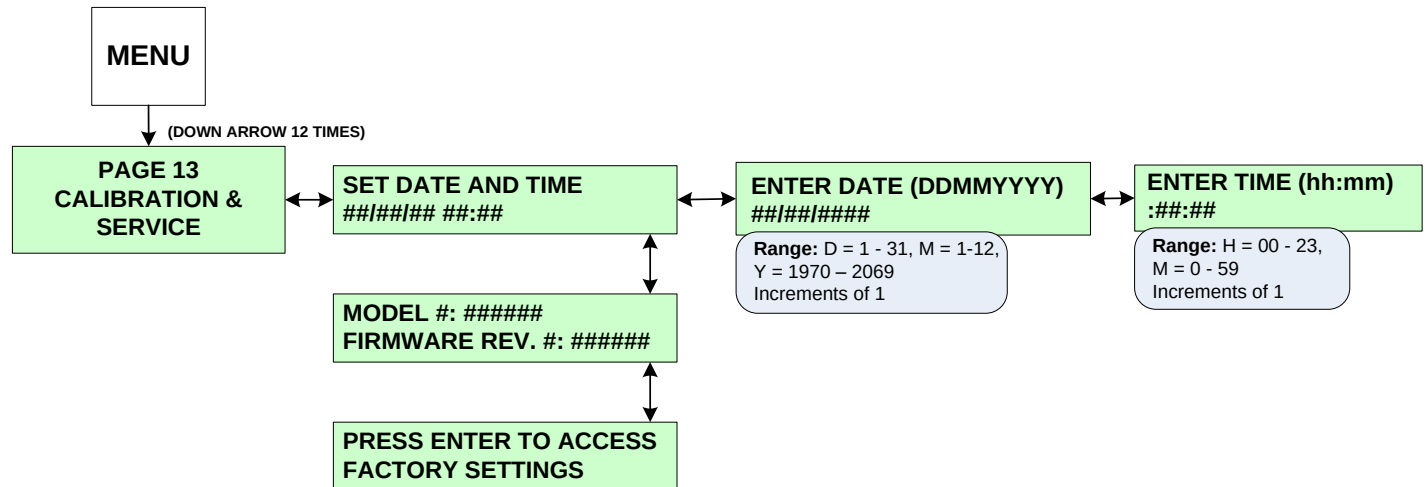
Certain screens are displayed for user information only, such as Current date and time, Model number and Firmware revision number. *Setpoint changes in this page will only be accessible to factory personnel.*

**SP13.1 Set Date and Time:** Displays the date and time.

- **Enter Date (DDMMYYYY):** Allows the factory personnel to program the date for the soft starter in the format shown.
- **Enter Time (HH:MM):** Allows the factory personnel to program the time for the soft starter.

**SP13.2 Model & Firmware #:** Displays the model number and firmware revision in the soft starter.

**SP13.3 Press Enter to Access Factory Settings:** Available to qualified personnel.



## Chapter 6 - Metering Pages

The Soft Starter offers performance metering which gives the user the ability to view information about the motor and the unit.

### 6.1 Metering Page List

The following charts list each Metering Page and the functions within that page. The applicable section of the manual is also referenced.

#### 6.1.1 Metering Menu & Data (Metering Page 1)

| Metering Page                  | Description of Display                                                      | Screen |
|--------------------------------|-----------------------------------------------------------------------------|--------|
| PAGE 1<br>Metering Menu & Data | Phase A, B, C and Ground Fault (Option)                                     | 1      |
|                                | Average current of the % of imbalance and the motor's RPM (Tach Option)     | 2      |
|                                | Motor load as a percentage of motor FLA                                     | 3      |
|                                | Line frequency and present phase sequence                                   | 4      |
|                                | Percentage of remaining Thermal Register                                    | 5      |
|                                | Thermal capacity required to start the motor                                | 6      |
|                                | Average time required to start                                              | 7      |
|                                | Average current during start                                                | 8      |
|                                | Measured I <sup>2</sup> T required to start the motor                       | 9      |
|                                | Amount of time required to start the motor during the last successful start | 10     |

#### 6.1.2 Metering (Metering Page 2)

| Metering Page      | Description of Display                           | Screen |
|--------------------|--------------------------------------------------|--------|
| PAGE 2<br>Metering | Phase A, B, C currents and Power Factor          | 1      |
|                    | Phase A, B, C currents and Ground Fault (Option) | 2      |
|                    | Displays KW and KVA                              | 3      |
|                    | Displays KVAR and Power Factor                   | 4      |
|                    | Displays Peak ON and KW Demand                   | 5      |
|                    | Displays Peak ON and KVA Demand                  | 6      |
|                    | Displays Peak ON and KVAR Demand                 | 7      |
|                    | Displays Peak ON and Amps Demand                 | 8      |
|                    | Clears Demand values                             | 9      |
|                    | Displays Megawatt hours used                     | 10     |
|                    | Press enter to clear statistics on MWH values    | 11     |

#### 6.1.3 RTD Option Values (Metering Page 3)

| Metering Page        | Description of Display                                             | Screen |
|----------------------|--------------------------------------------------------------------|--------|
| PAGE 3<br>RTD Values | Hottest stator RTD (#1 - 6)                                        | 1      |
|                      | Hottest non-stator RTD (#7 - 12)                                   | 2      |
|                      | Temperature of start phase A1 in °C and °F                         | 3      |
|                      | Maximum temperature for RTD #1                                     | 4      |
|                      | Same as Screens 3 - 4 for RTDs #2 - 12                             | 5 - 26 |
|                      | Clear the maximum temperature register (Level 3 password required) | 27     |
|                      | Measured running thermal stabilization time of motor (in minutes)  | 28     |
|                      | Measured stopped cooling time (to ambient) of motor (in minutes)   | 29     |

#### 6.1.4 Status (Metering Page 4)

| Metering Page    | Description of Display                                       | Screen |
|------------------|--------------------------------------------------------------|--------|
| PAGE 4<br>Status | Current status                                               | 1      |
|                  | Amount of time remaining before an overload trip occurs      | 2      |
|                  | Amount of time remaining from a thermal inhibit signal       | 3      |
|                  | Coast down time remaining                                    | 4      |
|                  | Amount of time remaining before a start command can be given | 5      |
|                  | Excessive number of starts per hour                          | 6      |

### 6.1.5 Event Recorder (Metering Page 5)

| Metering Page            | Description of Display                                                       | Screen |
|--------------------------|------------------------------------------------------------------------------|--------|
| PAGE 5<br>Event Recorder | Displays the event with date and time (Up to 60 events)                      | 1      |
|                          | Displays Phase A, B, C current values, Ground Fault (Option) at time of trip | 1A     |
|                          | Displays Vab, Vbc, Vca and Power Factor at time of trip                      | 1B     |

### 6.1.6 Last Trip (Metering Page 6)

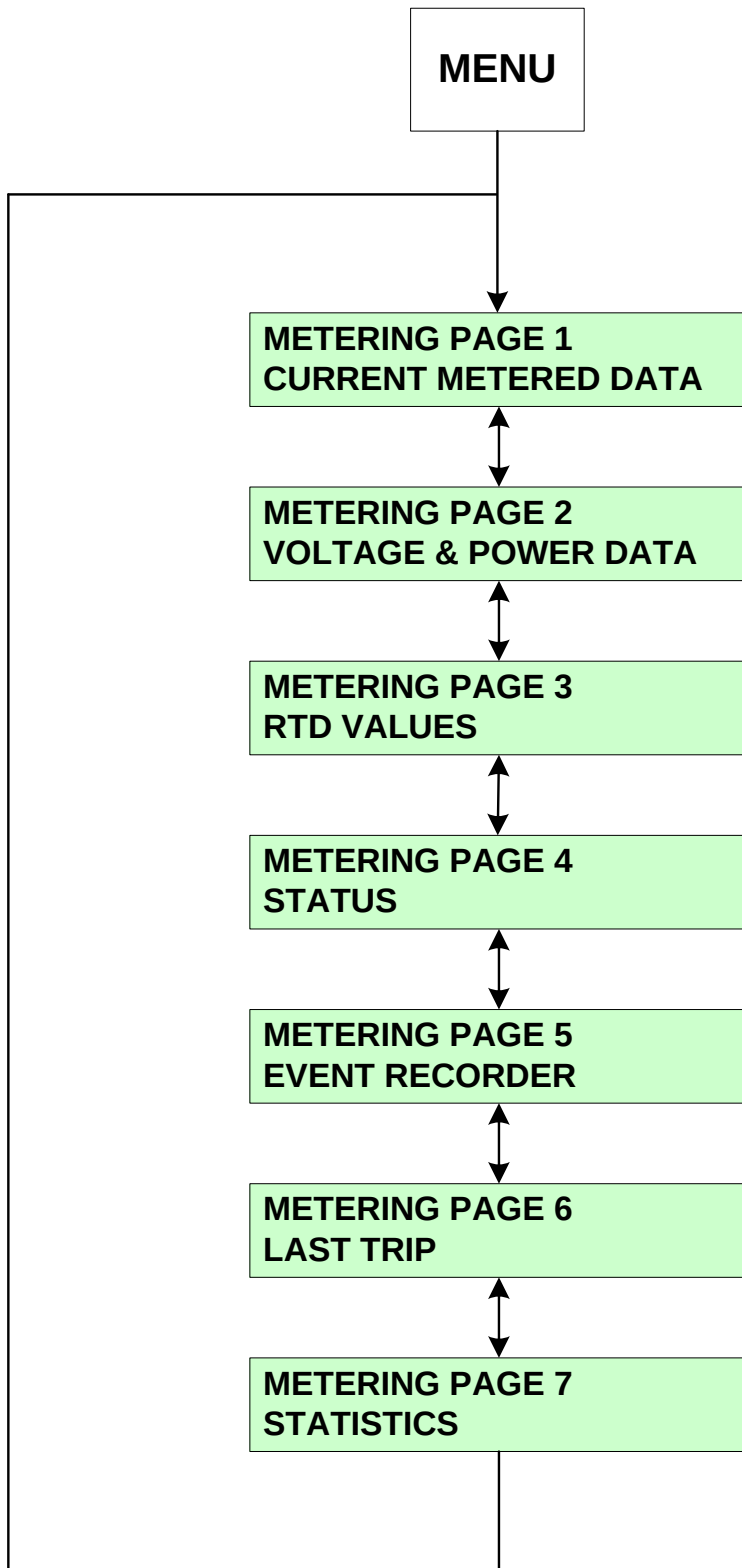
| Metering Page       | Description of Display                         | Screen |
|---------------------|------------------------------------------------|--------|
| PAGE 6<br>Last Trip | Cause of last trip                             | 1      |
|                     | Measured phase current                         | 2      |
|                     | Measured voltage and power factor              | 3      |
|                     | Imbalance percentage, the frequency and the kW | 4      |
|                     | Hottest stator RTD temperature                 | 5      |
|                     | Hottest non-stator RTD temperature             | 6      |

### 6.1.7 Statistics (Metering Page 7)

| Metering Page        | Description of Display                                                          | Screen |
|----------------------|---------------------------------------------------------------------------------|--------|
| PAGE 7<br>Statistics | Total Megawatt Hours                                                            | 1      |
|                      | Accumulated Total Running Hours                                                 | 2      |
|                      | Clear the Total Running Hour Count                                              | 3      |
|                      | Total Number of Trips / Number of Short Circuit Trips                           | 4      |
|                      | Number of Start and Run Overload Trips since the last statistical data clearing | 5      |
|                      | Number of frequency and Current Imbalance trips                                 | 6      |
|                      | Number of Over Current Trips                                                    | 7      |
|                      | Stator and Non-Stator RTD Trips                                                 | 8      |
|                      | Ground Fault Hiset and Loset Trips                                              | 9      |
|                      | Acceleration Time Trips                                                         | 10     |
|                      | Start Curve Trips                                                               | 11     |
|                      | I <sup>2</sup> T Start Curve Trips                                              | 12     |
|                      | Learned Start Curve Trips                                                       | 13     |
|                      | Shunt Trip Trips                                                                | 14     |
|                      | Phase Loss Trips                                                                | 15     |
|                      | Tach Acceleration Trips                                                         | 16     |
|                      | Undervoltage and Overvoltage Trips                                              | 17     |
|                      | Power Factor Trips                                                              | 18     |
|                      | Phase Reversal Trips                                                            | 19     |
|                      | Low Control Voltage Trips                                                       | 20     |
|                      | Ext Inp #1 Trips                                                                | 21     |
|                      | Ext Inp #2 Trips                                                                | 22     |
|                      | Ext Inp #3 Trips                                                                | 23     |
|                      | Ext Inp #4 Trips                                                                | 24     |
|                      | <b>Press ENTER to Clear Statistics</b>                                          | 25     |

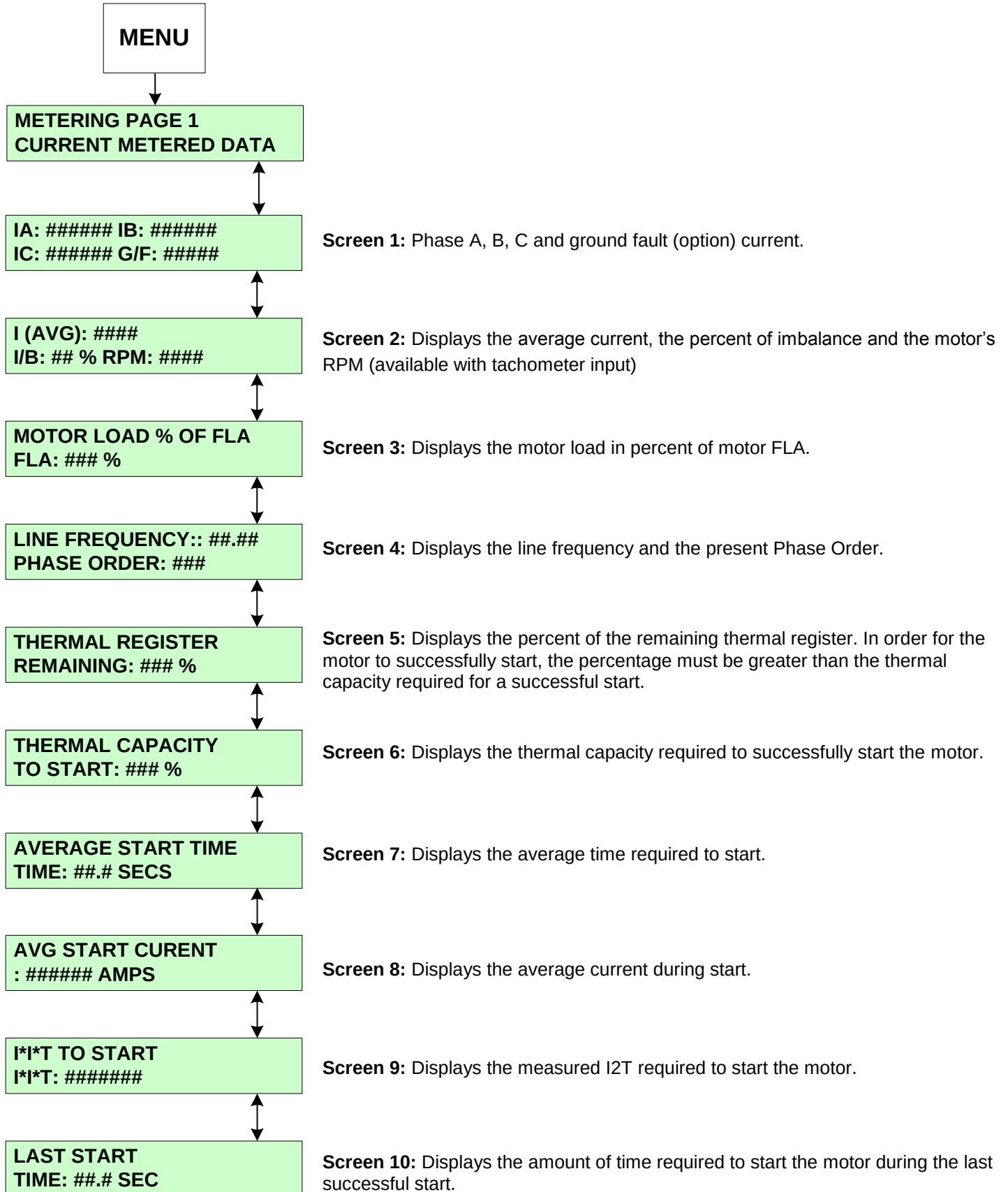
## 6.2 Metering Menu and Explanation

Push MENU key to toggle the screens between Setpoint Menu and Metering Menu and follow the arrow keys to get to different screens.



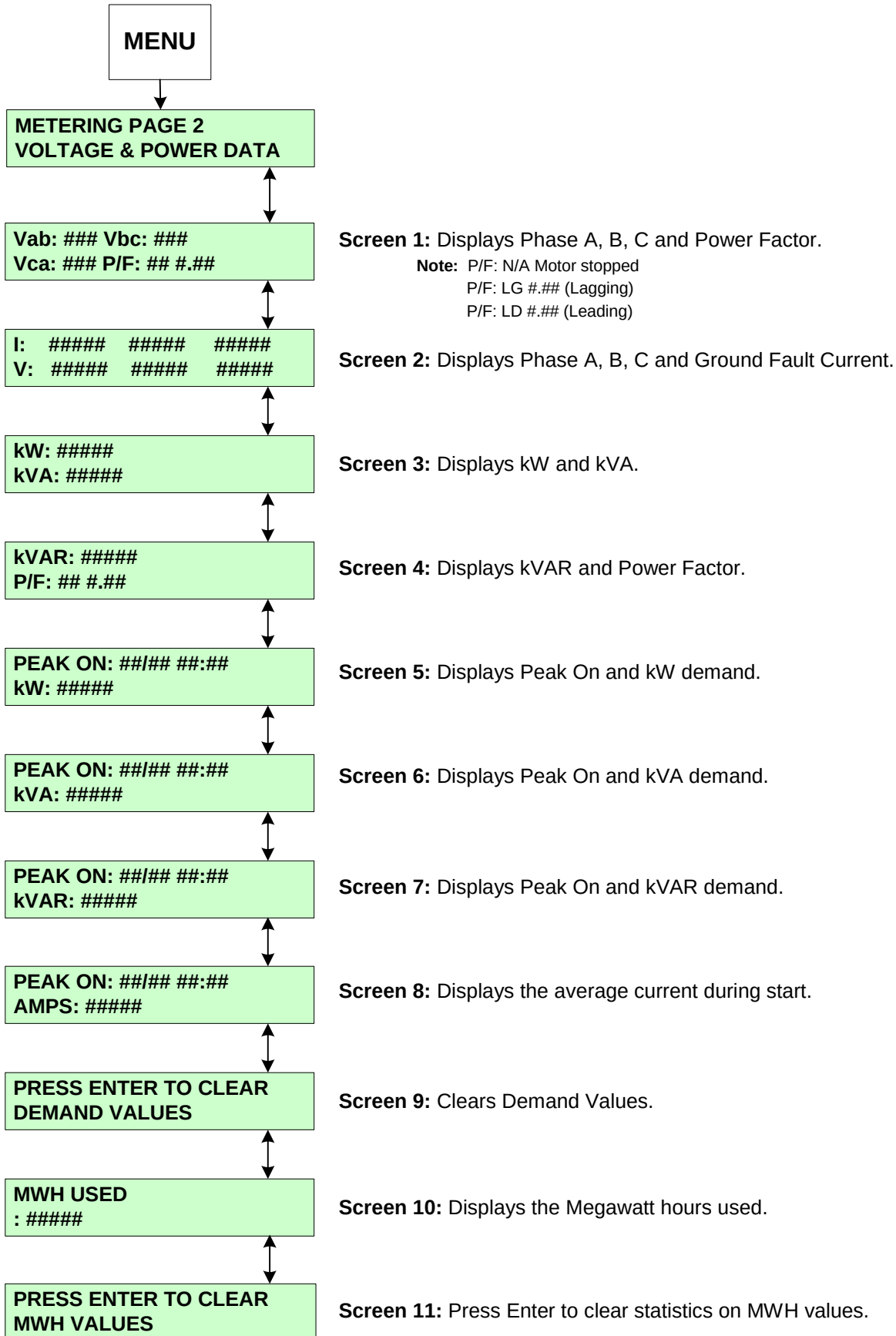
## MP.1 Metering (Metering Page 1)

Displays basic current metering data.



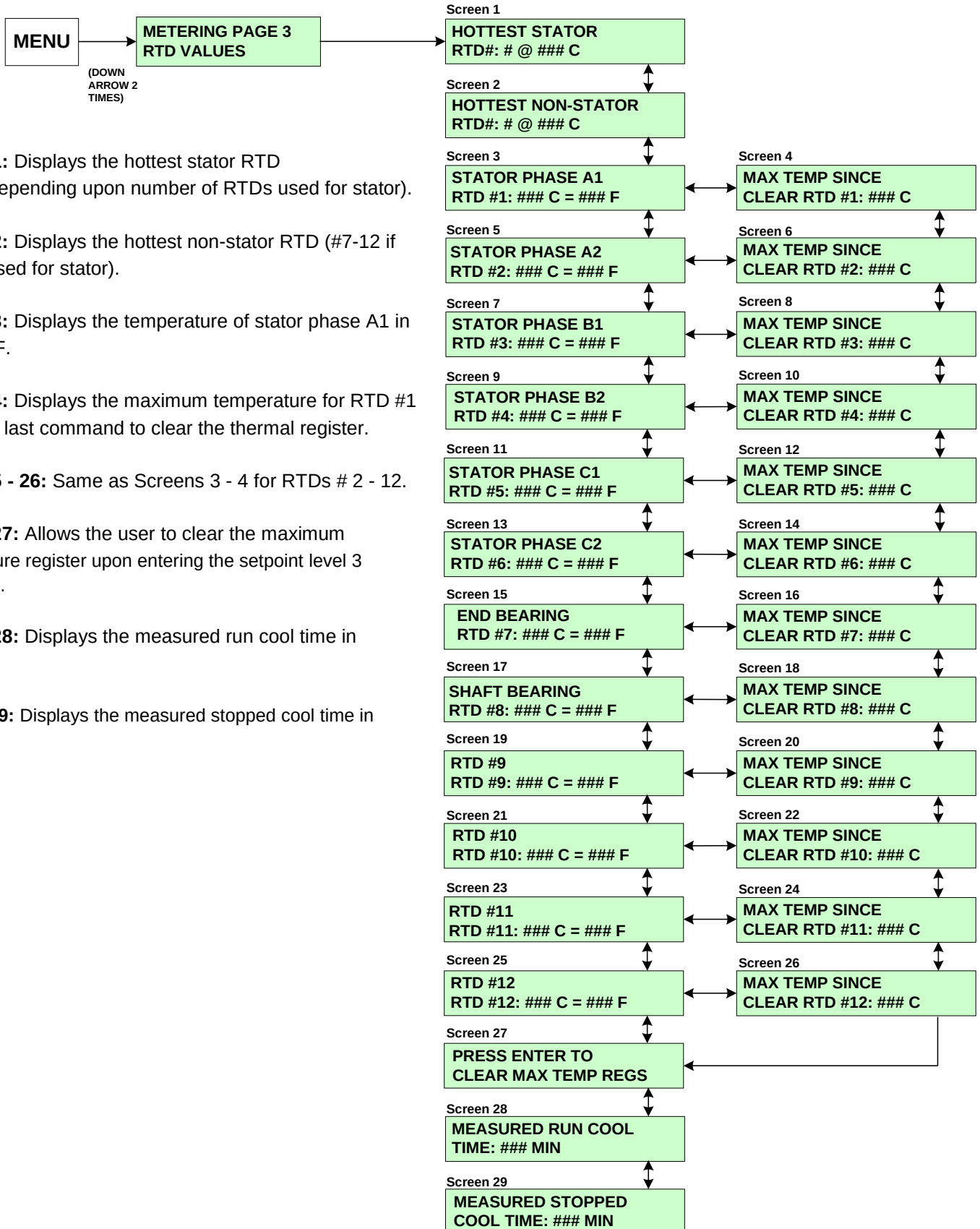
## MP.2 Metering (Metering Page 2)

Displays the soft starter statistical voltage metering information



### MP.3 Metering (Metering Page 3)

Displays the RTD information (When RTD option is installed)



## MP.4 Metering (Metering Page 4)

Displays the present status of the soft start

**\*Screen 1:** Displays the present state of the unit as follows:

**Screen 2:** Displays the amount of time remaining before an overload trip will occur.

**Screen 3:** Displays the amount of time remaining from a thermal inhibit. The inhibit time comes from the amount of thermal register remaining versus the amount of thermal capacity required to start.

**Screen 4:** Displays the coast down time remaining (Backspin time). The time remaining depends upon the user setting in Setpoint Page 8, Coast Down Time.

**Screen 5:** Displays the amount of time remaining before a start command can be given. The time remaining depends upon the setting in Setpoint page 5.

**Screen 6:** If the number of starts per hour has exceeded the setting in Setpoint page 8.

**\* NOTE: Screen 1 CURRENT STATUS Screens include:**

MOTOR STOPPED  
READY TO START

MOTOR STARTING  
MULT. OF FLA

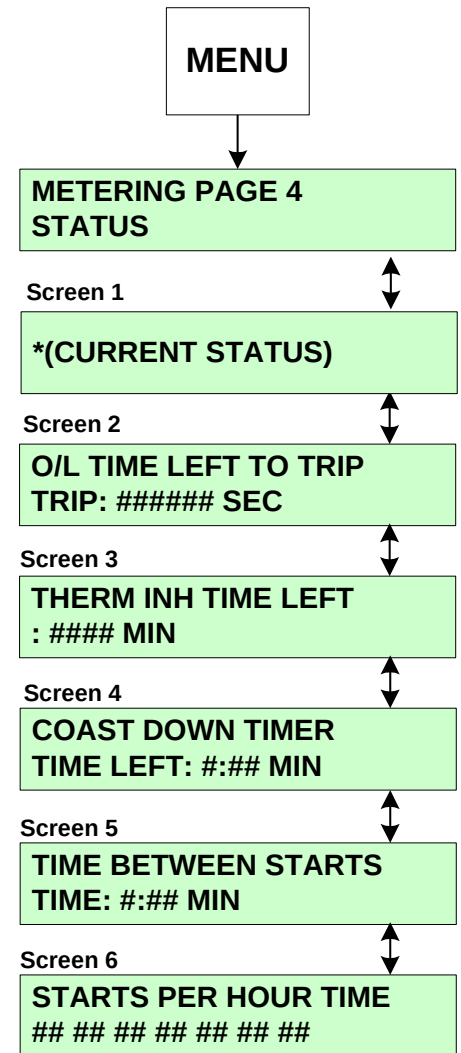
MOTOR RUNNING  
AT ###.## X FLA

LAST TRIP CAUSE  
NONE (or trip cause)

PROGRAMMING  
SETPOINTS

MOTOR STATUS  
UNKNOWN STATE ###

(Displays relay state upon error)



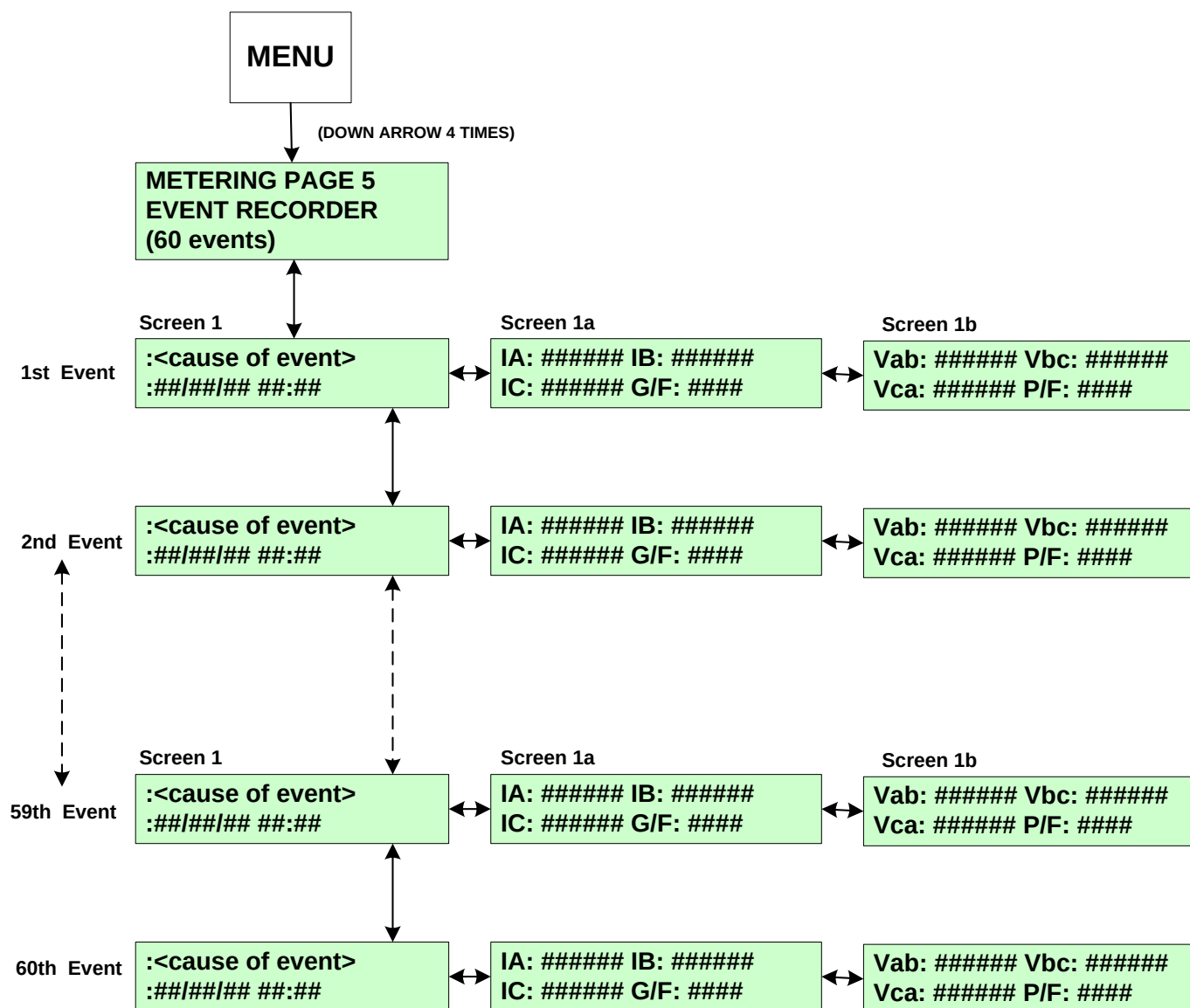
## MP.5 Metering (Metering Page 5)

Displays the present status of the soft start

**Screen 1:** Displays the event (i.e., Imbalance Trip) with the date and time it occurred.

**Screen 1a:** Displays the current at Phase A, B, C and the ground fault at the time of the event. (**Note:** Ground fault option must be present)

**Screen 1b:** Displays the Vab, Vbc, Vca and power factor at the time of event.



All events will be viewed from oldest event in buffer to most recent event.

NOTES-

## MP.6 Metering (Metering Page 6)

Displays the last trip information

**Screen 1:** Displays the cause of the last trip.

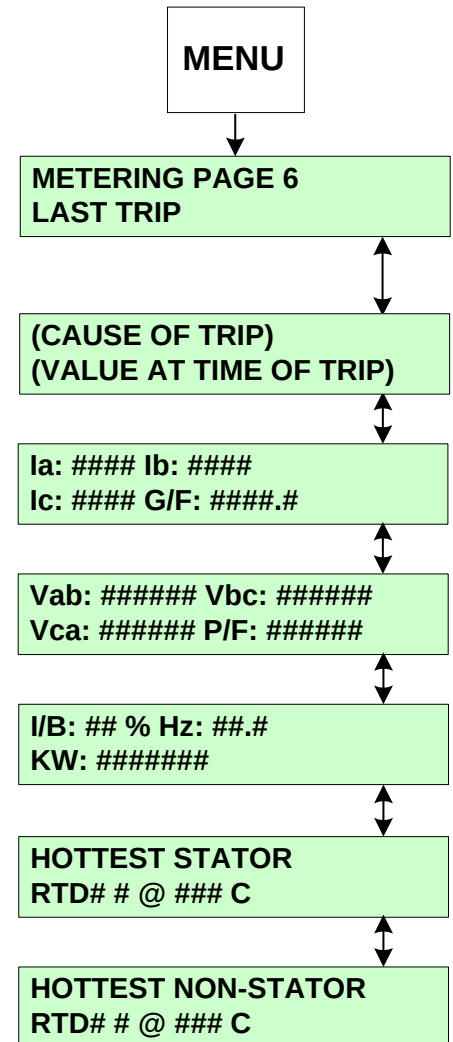
**Screen 2:** Displays the measured phase current at the time of the trip.

**Screen 3:** Displays the Vab, Vbc, Vca and power factor at the time of trip.

**Screen 4:** Displays the imbalance percentage, the frequency and the kW at the time of the trip.

**Screen 5:** Displays the hottest stator RTD temperature (when RTD option present) at time of the trip.

**Screen 6:** Displays the hottest non-stator RTD temperature (when RTD option present) at the time of the trip.



## MP.7 Statistics (Metering Page 7)

Displays the statistical trip information

**Screen 1:** Displays the total of megawatt hours.

**Screen 2:** Displays the accumulated total running hours.

**Screen 3:** Clears the total running hour count.

**Screen 4:** Displays the total number of trips since the last clearing of the statistical data and the total number of short circuit trips.

**Screen 5:** Displays the number of start overload and run overload trips since the last clearing of the statistical data.

**Screen 6:** Displays the number of frequency trips and Imbalance trips.

**Screen 7:** Displays the number of overcurrent trips

**Screen 8:** Displays the number of Stator and non-Stator RTD Trips

**Screen 9:** Displays the number of Ground Fault Hi and Lo Set trips

**Screen 10:** Displays the number of acceleration time trips.

**Screen 11:** Displays the number of start under curve trips

**Screen 12:** Displays the number start over curve trips

**Screen 13:** Displays the number of I2T start curve trips

**Screen 14:** Displays the number of learned start curve trips.

**Screen 15:** Displays the number of fail shunt trips.

**Screen 16:** Displays the number of phase loss trips.

**Screen 17:** Displays the number of tachometer acceleration trips.

**Screen 18:** Displays the number of undervoltage and overvoltage trips.

**Screen 19:** Displays the number of power factor trips.

**Screen 20:** Displays the number of phase reversal trips.

**Screen 21:** Displays the number of low control voltage trips.

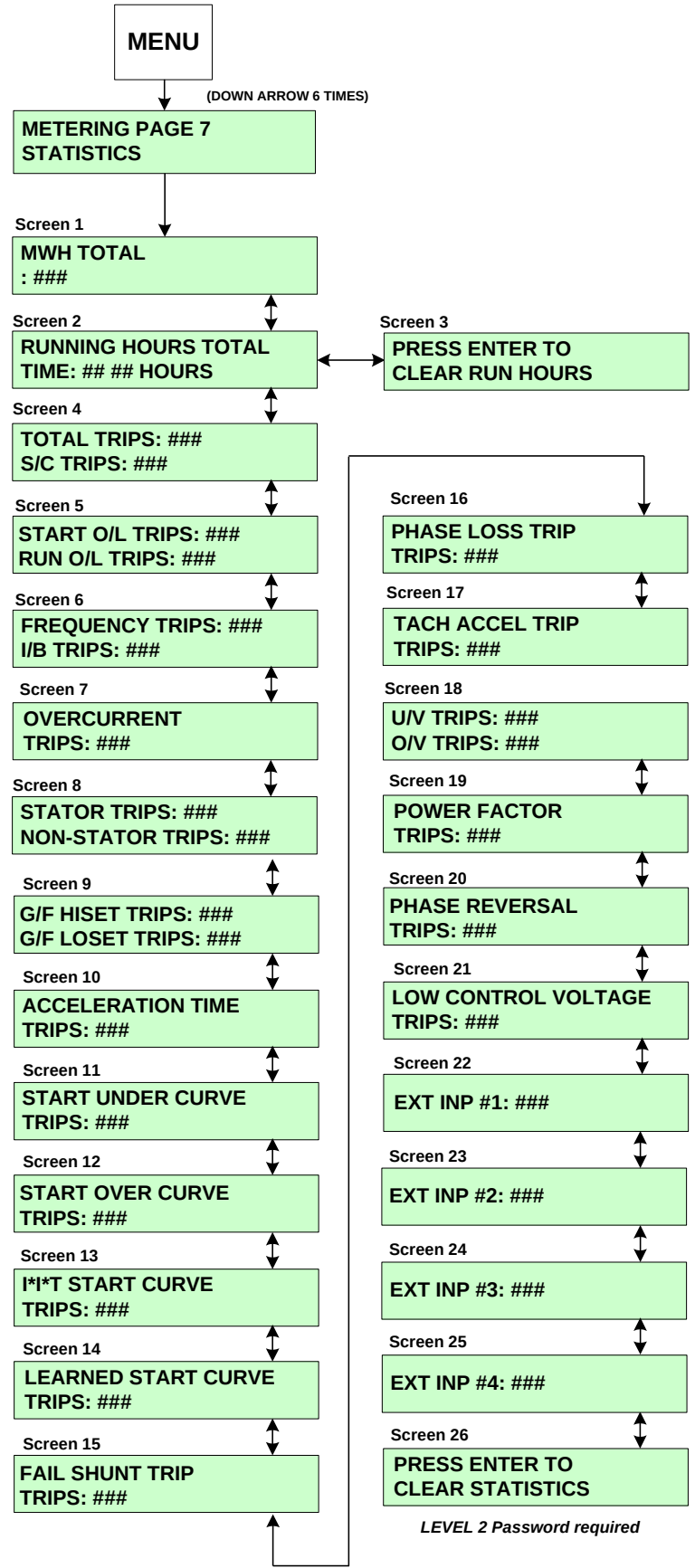
**Screen 22:** Displays the number of external input #1 trips.

**Screen 23:** Displays the number of external input #2 trips.

**Screen 24:** Displays the number of external input #3 trips.

**Screen 25:** Displays the number of external input #4 trips.

**Screen 26:** Requires a Security Level 2 password to clear the statistics.



## Chapter 7 - Maintenance and Troubleshooting

The Soft Starter is designed to be a maintenance-free product. However, as with all electronic equipment, the unit should be checked periodically for build-up of dirt, moisture or industrial contaminants. These can cause high voltage arc-over, carbon tracking or prevent proper cooling of the SCR heat sinks. All bolts should be checked annually for proper tightness using an accurate torque wrench. According to the manufacturer's manual, check the contactor for air gap spacing of the vacuum bottles.

**Note:** If the unit is installed in a contaminated environment and forced air cooling is used, blower filters must be checked and cleaned regularly to insure proper air flow and cooling of the enclosure.

### 7.1 Failure Analysis

When a fault occurs, the LCD will display the fault error while the listed LED and AUX Relay will be lit. Please clear all faults before attempting to restart the unit.

**Note:** If the problem persists after the required programming changes have been made, and all corrective action has been taken, please contact the factory for assistance.

| Problem                                                                                                 | CPU LCD Display                                                               | LED  | AUX Relay | Possible Cause                                                                                                                       | Solutions                                                                                                                   |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------|-----------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| One of the main fuses blows or circuit breaker opens when the power is applied or disconnect is closed. | <b>TCB FAULT TRIP</b>                                                         | Trip | AUX1      | Short circuit between the inputs                                                                                                     | Locate and remove short                                                                                                     |
|                                                                                                         |                                                                               |      |           | Faulty SCRs                                                                                                                          | Remove power and test SCR(s). Refer to Section 7.1.1 for the SCR testing procedure                                          |
|                                                                                                         |                                                                               |      |           | Emergency Stop Activated                                                                                                             | Check Emergency Stop Normally Closed Input. TB2: Terminal 9 & 10                                                            |
| Short Circuit Trip                                                                                      | <b>SHORT CIRCUIT TRIP</b>                                                     | Trip | AUX1      | Short circuit or ground fault in motor/cabling                                                                                       | Locate and remove short or ground                                                                                           |
|                                                                                                         |                                                                               |      |           | Phase Loss                                                                                                                           | Repair cause of phase loss                                                                                                  |
|                                                                                                         |                                                                               |      |           | Branch circuit protection not correctly sized                                                                                        | Verify correct sizing of branch circuit protection                                                                          |
|                                                                                                         |                                                                               |      |           | Faulty main circuit board                                                                                                            | Remove power and replace main circuit board.                                                                                |
|                                                                                                         |                                                                               |      |           | Faulty SCRs                                                                                                                          | Remove power and test SCR(s). Refer to Section 7.1.1 for the SCR testing procedure                                          |
| Single Phase Trip                                                                                       | <b>SINGLE PHASE TRIP</b><br>(Check LCD display for possible fault indicators) | Trip | AUX1      | Single phase incoming power                                                                                                          | Correct problem with incoming power                                                                                         |
|                                                                                                         |                                                                               |      |           | Faulty SCRs                                                                                                                          | Remove power and test SCR(s). Refer to Section 7.1.1 for the SCR testing procedure                                          |
|                                                                                                         |                                                                               |      |           | Environment Temperature over 122° F (ambient temperature for chassis units) or over 104°F (ambient temperature for enclosed version) | Place unit in environment temperature less than 122°F for panel version or less than 104°F for enclosed version.            |
|                                                                                                         |                                                                               |      |           | Bypass failed to close                                                                                                               | Check bypass contactor and wiring. The "At Speed" delay is incorrectly programmed. Reprogram back to factory default value. |

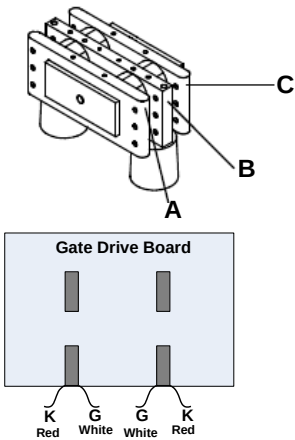
## 7.1 Failure Analysis - Continued

| Problem                            | CPU LCD Display                     | LED  | AUX Relay | Possible Cause                                                                                                                       | Solutions                                                                                                            |
|------------------------------------|-------------------------------------|------|-----------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <i>Thermostat trips during run</i> | <b>EXTERNAL TRIP ON THERMOSTAT</b>  | Trip | AUX1      | Fan(s) not functioning (If supplied)                                                                                                 | If fans have power, remove power and replace fan(s). If fans do not have power, find cause of power loss and repair. |
|                                    |                                     |      |           | Heatsink coated with dirt                                                                                                            | Remove power and clean heatsink with high pressure air (80 - 100 psi max clean and dry air).                         |
|                                    |                                     |      |           | Overcurrent on unit                                                                                                                  | Verify that running current does not exceed unit rating.                                                             |
|                                    |                                     |      |           | Environment temperature over 122° F (ambient temperature for chassis units) or over 104°F (ambient temperature for enclosed version) | Place unit in environment temperature less than 122°F for panel version or less than 104°F for enclosed version.     |
|                                    |                                     |      |           | Bypass failed to close                                                                                                               | Check bypass contactor and wiring.                                                                                   |
| <i>Phase Loss</i>                  | <b>PHASE LOSS</b>                   | Trip | AUX1      | Loss of 1 or more phases of power from utility or generated power.                                                                   | Check power source.                                                                                                  |
|                                    |                                     |      |           | Blown power fuses                                                                                                                    | Check for short circuits.                                                                                            |
| <i>Overload</i>                    | <b>OVERLOAD TRIP</b>                | Trip | AUX1      | Improper programming                                                                                                                 | Check motor nameplate versus programmed parameters.                                                                  |
|                                    |                                     |      |           | Possible load damage or jammed load                                                                                                  | Check motor currents.                                                                                                |
| <i>Stall prevention</i>            | <b>ACCEL TIME TRIP</b>              | Trip | AUX1      | Improper setting for motor load condition                                                                                            | Verify current limit setting.                                                                                        |
|                                    |                                     |      |           | Damaged load                                                                                                                         | Check for load failure.                                                                                              |
| <i>Under Voltage Trip</i>          | <b>UNDER VOLTAGE TRIP</b>           | Trip | AUX1      | Improper programming                                                                                                                 | Check Setpoint settings.                                                                                             |
|                                    |                                     |      |           | Wrong position of disconnect or breaker                                                                                              | Check disconnect or open breaker                                                                                     |
|                                    |                                     |      |           | Main contactor failed to close                                                                                                       | Check internal connections                                                                                           |
|                                    |                                     |      |           | Transformer too small                                                                                                                | Reduce current limit setting, saturation or sagging power supply transformer                                         |
|                                    |                                     |      |           | Unloaded motor                                                                                                                       | Check load                                                                                                           |
| <i>Under Current Trip</i>          | <b>UNDER CURRENT TRIP</b>           | Trip | AUX1      | Improper programming                                                                                                                 | Check setpoint settings                                                                                              |
|                                    |                                     |      |           | Unloaded motor                                                                                                                       | Check load                                                                                                           |
| <i>Self-test Failure</i>           | <b>SELF-TEST FAILURE</b>            | Trip | AUX1      | Failed CPU or Main Firing Board                                                                                                      | Contact factory                                                                                                      |
|                                    |                                     |      |           | Vibration                                                                                                                            | Check internal wiring connections                                                                                    |
| <i>Line Frequency Trip</i>         | <b>OVER OR UNDER FREQUENCY TRIP</b> | Trip | AUX1      | Generator Power Problem or grid change                                                                                               | Troubleshoot and repair generator                                                                                    |
|                                    |                                     |      |           |                                                                                                                                      | Contact utility company                                                                                              |
|                                    |                                     |      |           |                                                                                                                                      | Main board failure                                                                                                   |
|                                    |                                     |      |           |                                                                                                                                      | Three phase power removed from Main                                                                                  |

| Problem                                                                                      | CPU LCD Display                      | LED   | AUX Relay | Possible Cause                                                                                                                                                                                                                             | Solutions                                                                    |
|----------------------------------------------------------------------------------------------|--------------------------------------|-------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Any Ground Fault Trip                                                                        | <b>GROUND FAULT HI-SET OR LO-SET</b> | Trip  | AUX1      | Improper programming                                                                                                                                                                                                                       | Check Setpoint settings                                                      |
|                                                                                              |                                      |       |           | Any wire going to ground (I.e. stator ground, motor ground, soft start ground)                                                                                                                                                             | Check with megger or Hi-pot motor leads and motor                            |
|                                                                                              |                                      |       |           | High vibration or loose connections                                                                                                                                                                                                        | Check internal connections                                                   |
| Motor Stopped during run                                                                     | <b>Check for fault indication</b>    | Trip  | AUX1      |  <b>WARNING</b><br>This is a serious fault condition. Ensure that the fault condition is cleared on the load side before attempting to restart the motor. |                                                                              |
|                                                                                              |                                      |       |           | Load shorted                                                                                                                                                                                                                               | Remove power and repair.                                                     |
|                                                                                              |                                      |       |           | Faulty main circuit board                                                                                                                                                                                                                  | Replace the main circuit board                                               |
| Control circuit fuses blow after control power is applied.                                   | <b>None</b>                          | None  | None      | Short in Control Circuit                                                                                                                                                                                                                   | Remove Power, locate and remove the short.                                   |
|                                                                                              |                                      |       |           | Wrong Control Voltage                                                                                                                                                                                                                      | Apply the correct voltage to the control circuit.                            |
| Motor will not start                                                                         | <b>Any fault indication message</b>  | Trip  | AUX1      | No Control Voltage applied to Control Board                                                                                                                                                                                                | Apply control voltage to TCB board.                                          |
|                                                                                              |                                      |       |           | Control Power Transformer failure or CPT Fuse failure                                                                                                                                                                                      | Remove power and replace the power transformer or the CPT fuse               |
|                                                                                              |                                      |       |           | Start Circuit Wired Incorrectly                                                                                                                                                                                                            | Remove power and correct the start circuit wiring.                           |
|                                                                                              |                                      |       |           | No Start Command                                                                                                                                                                                                                           | Apply the start command.                                                     |
|                                                                                              |                                      |       |           | No 3 Phase Line Voltage                                                                                                                                                                                                                    | Apply 3 phase line voltage to the unit.                                      |
|                                                                                              |                                      |       |           | Shorted SCR in Starter                                                                                                                                                                                                                     | Remove power and Test SCR(s). Refer to Sec. 7.1.1 for the testing procedure. |
|                                                                                              |                                      |       |           | Faulty Control Logic                                                                                                                                                                                                                       | Remove power and repair the Control Logic.                                   |
|                                                                                              |                                      |       |           | Failure of Main Circuit Board                                                                                                                                                                                                              | Replace the Main Circuit Board.                                              |
| Motor vibrates / Motor growls while starting or extremely unbalanced motor currents run mode | <b>IMBALANCE TRIP</b>                | Trip  | AUX1      | Faulty Motor                                                                                                                                                                                                                               | Check the Motor and the Motor connections.                                   |
|                                                                                              |                                      |       |           | Faulty SCR(s)                                                                                                                                                                                                                              | Remove Power and perform the SCR device checks.                              |
|                                                                                              |                                      |       |           | Faulty Gate / Cathode on SCR(s)                                                                                                                                                                                                            | Remove Power and Test SCR(s). Refer to Sec. 7.1.1 for the testing procedure. |
|                                                                                              |                                      |       |           | Faulty Main Circuit Board.                                                                                                                                                                                                                 | Replace the Main Circuit Board.                                              |
|                                                                                              | <b>IMBALANCE ALARM</b>               | Alarm | AUX2      | Faulty Motor / Wiring                                                                                                                                                                                                                      | Troubleshoot and repair / replace wiring.                                    |
|                                                                                              |                                      |       |           | Faulty Main Circuit Board                                                                                                                                                                                                                  | Replace the Main Circuit Board.                                              |

7.1.1 - SCR Testing Procedure

Perform the SCR Heat Sink Ohm test on each Stack Assembly.



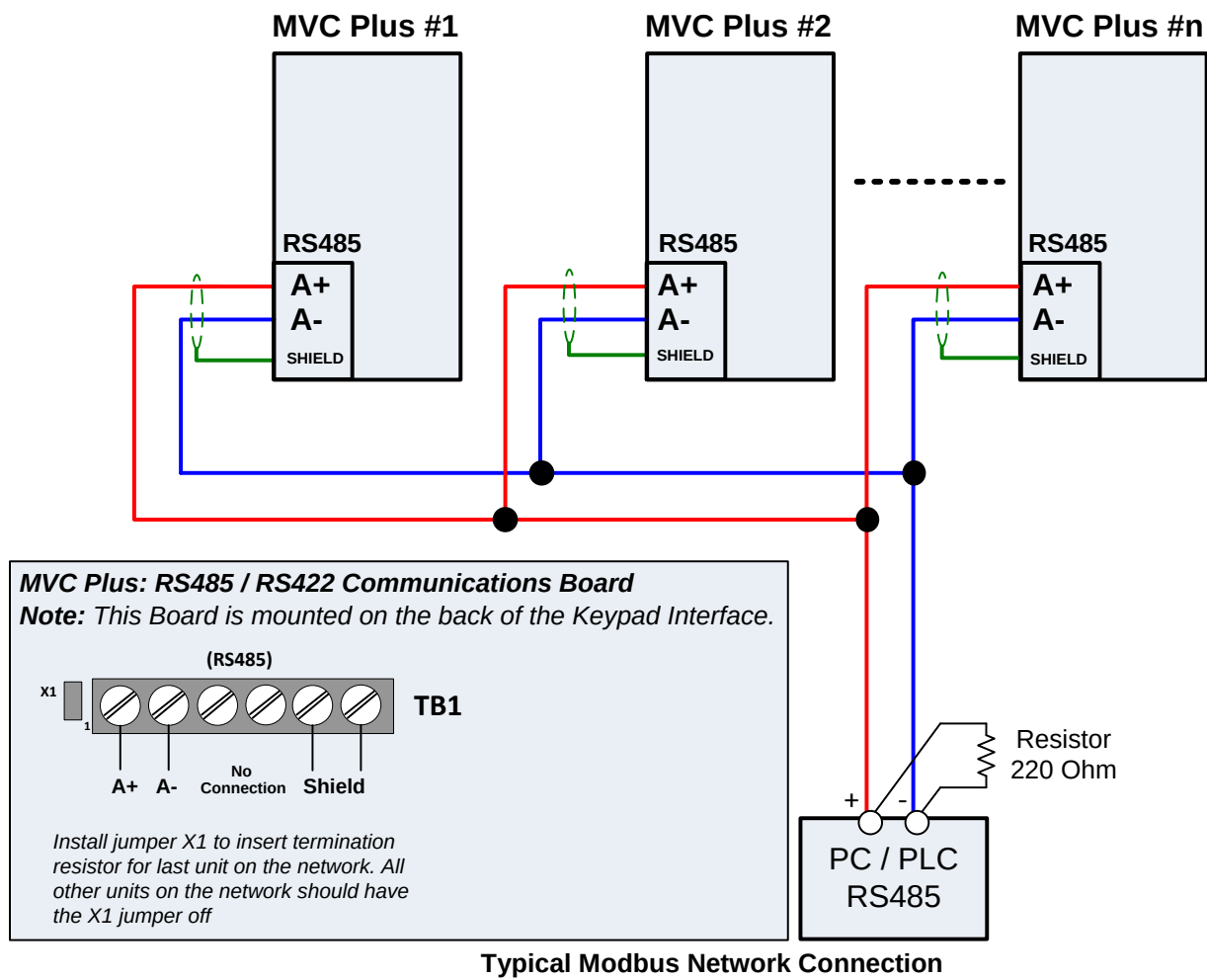
| Test Points                          | OHM Meter Reading                   | Test Results                |
|--------------------------------------|-------------------------------------|-----------------------------|
| From Position A to Position B        | Greater than 10K Ohm                | Pass                        |
|                                      | Less than 5K Ohm                    | Fail                        |
| From Position B to Position C        | Greater than 10K Ohm                | Pass                        |
|                                      | Less than 5K Ohm                    | Fail                        |
| Gate (G) to Cathode (K) for each SCR | 8 to 50 Ohms                        | Pass (Typical 8 to 20 Ohms) |
|                                      | Less than 8 or greater than 50 Ohms | Fail                        |

Notes

- 1 - Allow 15 minutes after shutdown for DV/DT network to discharge.
- 2 - Voltage sharing resistors may need to be disconnected to obtain correct readings for tests between positions A, B & C...

# Appendix A – Modbus RTU Communication and MVC Plus Registers

The MVC Plus RS485 port allows users to connect the MVC Plus to a Modbus RTU network.



The MVC Plus supports the following Modbus functions:

Table A-1: Modbus Functions

| Function Code | MVC Description           | Modbus Description        |
|---------------|---------------------------|---------------------------|
| 3             | Read Multiple Registers   | Read Holding Registers    |
| 4             | (same as Function code 3) | Read Input Registers      |
| 5             | Execution                 | Force Single Coil         |
| 6             | Write Single Registers    | Preset Single Registers   |
| 9             | Operation                 | -                         |
| 16            | Write Multiple Registers  | Preset Multiple Registers |

## Modbus Message Frame (data format)

### Function 3

- a) Query: See Table A-2: Query of Function 3 - Read Multiple Registers. In the MVC Plus the number of consecutive registers "Number of Registers" is limited to 125.
- b) Response: See Table A-3: Response to Function 3 - Read Multiple Registers.

Table A-2: Query of Function 3 - Read Multiple Registers (Instance)

| Field Name (byte)               | Decimal | Hexadecimal |
|---------------------------------|---------|-------------|
| Slave Address                   | 247     | F7          |
| Function                        | 3       | 03          |
| Starting Data Address High Byte | 1001    | 03          |
| Starting Data Address Low Byte  |         | E9          |
| Number of Registers High Byte   | 2       | 00          |
| Number of Registers Low Byte    |         | 02          |
| CRC Low Byte                    | 11521   | 01          |
| CRC High Byte                   |         | 2D          |

Table A-3: Response of Function 3 - Read Multiple Registers (Instance)

| Field Name (byte)                                                     | Decimal | Hexadecimal |
|-----------------------------------------------------------------------|---------|-------------|
| Slave Address                                                         | 247     | F7          |
| Function                                                              | 3       | 03          |
| Byte Count                                                            | 4       | 04          |
| Data High Byte of 1 <sup>st</sup> Register from Starting Data Address | 10      | 00          |
| Data Low Byte of 1 <sup>st</sup> Register from Starting Data Address  |         | 0A          |
| Data High Byte of 2 <sup>nd</sup> Register from Starting Data Address | 100     | 00          |
| Data Low Byte of 2 <sup>nd</sup> Register from Starting Data Address  |         | 64          |
| CRC Low Byte                                                          | 54605   | 4D          |
| CRC High Byte                                                         |         | D5          |

**Note:** The sum of Data High Bytes and Data Low Bytes equals the Byte Count.

**Function 4:** Same as Function 3

**Function 5**

a) Query: See Table A-4: Query of Function 5 - Send Access Code (Instance).

b) Response: See Table A-5: Response to Function 5 - Send Access Code (Instance).

Table A-4: Query of Function 5 and Sub Function 1 – Send Access Code (Instance)

| Field Name (byte)      | Decimal | Hexadecimal |
|------------------------|---------|-------------|
| Slave Address          | 247     | F7          |
| Function               | 5       | 05          |
| Sub Function Low Byte  | 1       | 01          |
| Sub Function High Byte |         | 00          |
| Data Low Byte          | 1       | 01          |
| Data High Byte         |         | 00          |
| CRC Low Byte           | 12505   | D9          |
| CRC High Byte          |         | 30          |

Table A-5: Response of Function 5 and Sub Function 1 – Send Access Code (Instance)

| Field Name (byte)      | Decimal | Hexadecimal |
|------------------------|---------|-------------|
| Slave Address          | 247     | F7          |
| Function               | 5       | 05          |
| Sub Function Low Byte  | 1       | 01          |
| Sub Function High Byte |         | 00          |
| Data Low Byte          | 1       | 01          |
| Data High Byte         |         | 00          |
| CRC Low Byte           | 12505   | D9          |
| CRC High Byte          |         | 30          |

Table A-6: Query of Function 5 and Sub Function 4 – Send Access Code (Instance)

| Field Name (byte)      | Decimal | Hexadecimal |
|------------------------|---------|-------------|
| Slave Address          | 247     | F7          |
| Function               | 5       | 05          |
| Sub Function Low Byte  | 4       | 04          |
| Sub Function High Byte |         | 00          |
| Data 1 Low Byte        | 25      | 19          |
| Data 1 High Byte       |         | 00          |
| Data 2 Low Byte        | 0       | 00          |
| Data 2 High Byte       |         | 00          |
| CRC Low Byte           | 29021   | 5D          |
| CRC High Byte          |         | 71          |

Table A-7: Response of Function 5 and Sub Function 4 – Send Access Code (Instance)

| Field Name (byte)      | Decimal | Hexadecimal |
|------------------------|---------|-------------|
| Slave Address          | 247     | F7          |
| Function               | 5       | 05          |
| Sub Function Low Byte  | 4       | 04          |
| Sub Function High Byte |         | 00          |
| Data 1 Low Byte        | 25      | 19          |
| Data 1 High Byte       |         | 00          |
| Data 2 Low Byte        | 0       | 00          |
| Data 2 High Byte       |         | 00          |
| CRC Low Byte           | 29021   | 5D          |
| CRC High Byte          |         | 71          |

## Function 6

a) Query: See Table A-8: Query of Function 6 - Write Single Registers.

b) Response: See Table A-9: Response to Function 6 - Write Single Registers

Table A-8: Query of Function 6 - Write Single Register (Instance)

| Field Name (byte)                                     | Decimal | Hexadecimal |
|-------------------------------------------------------|---------|-------------|
| Slave Address                                         | 247     | F7          |
| Function                                              | 6       | 06          |
| Starting Data Address High Byte                       | 1001    | 03          |
| Starting Data Address Low Byte                        |         | E9          |
| Data High Byte of Register from Starting Data Address | 50      | 00          |
| Data Low Byte of Register from Starting Data Address  |         | 32          |
| CRC Low Byte                                          | 52537   | 39          |
| CRC High Byte                                         |         | CD          |

Table A-9: Response of Function 6 - Write Single Register (Instance)

| Field Name (byte)                                     | Decimal | Hexadecimal |
|-------------------------------------------------------|---------|-------------|
| Slave Address                                         | 247     | F7          |
| Function                                              | 6       | 06          |
| Starting Data Address High Byte                       | 1001    | 03          |
| Starting Data Address Low Byte                        |         | E9          |
| Data High Byte of Register from Starting Data Address | 50      | 00          |
| Data Low Byte of Register from Starting Data Address  |         | 32          |
| CRC Low Byte                                          | 52537   | 39          |
| CRC High Byte                                         |         | CD          |

## Function 9

Function 9 is used for special operations in MVC plus. Function code 9 uses sub-function code 48 to represent Remote Start/Stop function. The byte following the sub-function code is the Start and Stop Control Settings byte see table A-12.

- a) Query: See Table A-10. Query of Function 9 – Reserved Operational Code.
- b) Response: See Table A-11. Response of Function 9 – Reserved Operational Code.
- c) Start and Stop Control Settings: See Table A-12. Start and Stop Control Settings.

Table A-10: Query of Function 9 – Reserved Operational Code (Instance)

| Field Name (byte)                | Decimal | Hexadecimal |
|----------------------------------|---------|-------------|
| Slave Address                    | 247     | F7          |
| Function                         | 9       | 09          |
| Sub Function (Remote Start/Stop) | 48      | 30          |
| Start and Stop Control Settings  | 26      | 1A          |
| CRC Low Byte                     | 39287   | 77          |
| CRC High Byte                    |         | 99          |

Table A-11: Response of Function 9 - Reserved Operational Code (Instance)

| Field Name (byte)                | Decimal | Hexadecimal |
|----------------------------------|---------|-------------|
| Slave Address                    | 247     | F7          |
| Function                         | 9       | 09          |
| Sub Function (Remote Start/Stop) | 48      | 30          |
| Start and Stop Control Settings  | 26      | 1A          |
| CRC Low Byte                     | 39287   | 77          |
| CRC High Byte                    |         | 99          |

Table A-12: Start and Stop Control Settings

| Start and Stop Control Settings | Decimal | Hexadecimal |
|---------------------------------|---------|-------------|
| Start                           | 26      | 1A          |
| Stop                            | 27      | 1B          |

**Function 16**

c) Query: See Table A-13: Query of Function 16 - Write Multiple Registers. In the MVC Plus the number of consecutive registers "Number of Registers" is limited to 125.

d) Response: See Table A-14: Response to Function 16 - Write Multiple Registers

Table A-13: Query of Function 16 - Write Multiple Registers (Instance)

| Field Name (byte)                                                     | Decimal | Hexadecimal |
|-----------------------------------------------------------------------|---------|-------------|
| Slave Address                                                         | 247     | F7          |
| Function                                                              | 16      | 10          |
| Starting Data Address High Byte                                       | 1001    | 03          |
| Starting Data Address Low Byte                                        |         | E9          |
| Number of Registers High Byte                                         | 2       | 00          |
| Number of Registers Low Byte                                          |         | 02          |
| Byte Count                                                            | 4       | 04          |
| Data High Byte of 1 <sup>st</sup> Register from Starting Data Address | 15      | 00          |
| Data Low Byte of 1 <sup>st</sup> Register from Starting Data Address  |         | 0F          |
| Data High Byte of 2 <sup>nd</sup> Register from Starting Data Address | 101     | 00          |
| Data Low Byte of 2 <sup>nd</sup> Register from Starting Data Address  |         | 65          |
| CRC Low Byte                                                          | 57028   | C4          |
| CRC High Byte                                                         |         | DE          |

**Note:** The sum of Data High Bytes and Data Low Bytes equals to the Byte Count, which equal to the Number of Registers times 2.

Table A-14: Response of Function 16 - Write Multiple Registers (Instance)

| Field Name (byte)               | Decimal | Hexadecimal |
|---------------------------------|---------|-------------|
| Slave Address                   | 247     | F7          |
| Function                        | 16      | 10          |
| Starting Data Address High Byte | 1001    | 03          |
| Starting Data Address Low Byte  |         | E9          |
| Number of Registers High Byte   | 2       | 00          |
| Number of Registers Low Byte    |         | 02          |
| CRC Low Byte                    | 61060   | 84          |
| CRC High Byte                   |         | EE          |

## Exception Response Frame

In normal response, the function field will always return the function code as was used in the Query sent. If the slave device sends back an Exception response, 80 (hex) will be added to function code value to indicate an Exception response. See Table A-15: Invalid Query of Function 3 - Read Multiple Registers (Instance) and Table A-16 Response of the Invalid Function 3 Query. Also see Table A-16: Exception Codes

Table A-15: Invalid Query of Function 3 - Read Multiple Registers (Instance)

| Field Name (byte)               | Decimal | Hexadecimal |
|---------------------------------|---------|-------------|
| Slave Address                   | 247     | F7          |
| Function                        | 3       | 03          |
| Starting Data Address High Byte | 999     | 03          |
| Starting Data Address Low Byte  |         | E8          |
| Number of Registers High Byte   | 1       | 00          |
| Number of Registers Low Byte    |         | 01          |
| CRC Low Byte                    | 61216   | 20          |
| CRC High Byte                   |         | EF          |

Table A-16: Response of the Invalid Function 3 Query

| Field Name (byte) | Decimal | Hexadecimal |
|-------------------|---------|-------------|
| Slave Address     | 247     | F7          |
| Function          | 131     | 83          |
| Exception Code    | 2       | 02          |
| CRC Low Byte      | 15392   | 20          |
| CRC High Byte     |         | 3C          |

Table A-17: Exception Codes

| Exception Code | Name                 | Description                                                                  |
|----------------|----------------------|------------------------------------------------------------------------------|
| 01             | Illegal Function     | Function code not supported.                                                 |
| 02             | Illegal Address      | The register address is invalid.                                             |
| 03             | Illegal Data Value   | Invalid data received from the Rx.                                           |
| 06             | Device Busy          | The MVC Plus is busy. The master should re-transmit the message again later. |
| 07             | Negative Acknowledge | The MVC Plus cannot perform function received from the query.                |
| 16             | Illegal Data Length  | The field "Number of Registers" from the query exceeds 125 registers.        |

## CRC Sequence

CRC sequence each message frame is to send the Low Byte first and High Byte second, according to the MODBUS specification. However, to communication with the RS232 Front Port, the CRC sequence has to be reversed in all the query and response frames, High Byte first and Low Byte second.

**Table A-18: MVC Plus Registers ordered by Modbus Address**

| MODBUS REGISTER MAP |                  |                                |      |              |     |         |                              |
|---------------------|------------------|--------------------------------|------|--------------|-----|---------|------------------------------|
| Setpoint Page #     | Register Address | Register Name                  | Data |              |     |         | Remark                       |
|                     |                  |                                | Min  | Max          | Inc | Default |                              |
| Setpoint Page 1     | 1000             | 2 <sup>ND</sup> FLA            | 1    | 2000         | 1   | 100     | Only for 2-speed f/w         |
|                     | 1001             | FLA                            | 1    | 2000         | 1   | 100     |                              |
|                     | 1002             | SF                             | 100  | 130          | 1   | 115     | => 1.0-1.30                  |
|                     | 1003             | NEMA Design                    | 0    | 5            | 1   | 1       |                              |
|                     | 1004             | Overload Class                 | 5    | 30           | 5   | 10      |                              |
|                     | 1005             | Insulation Class               | 0    | 8            | 1   | 1       |                              |
|                     | 1006             | Line Voltage                   | 100  | 20000        | 1   | 4160    |                              |
|                     | 1007             | Line Frequency                 | 50   | 60           | 10  | 60      |                              |
| Setpoint Page 2     | 1020             | Starter Mode                   | 0    | 6            | 1   | 2       |                              |
|                     | 1021             | Jog Voltage                    | 5    | 75           | 5   | 50      |                              |
|                     | 1022             | Start Ramp 1 Type              | 1    | 2            | 1   | 1       |                              |
|                     | 1023             | Voltage Ramp 1 Initial Voltage | 0    | 100          | 1   | 20      |                              |
|                     | 1024             | Voltage Ramp 1 Ramp Time       | 1    | 120          | 1   | 10      |                              |
|                     | 1025             | Voltage Ramp 1 Current Limit   | 200  | 600          | 10  | 350     |                              |
|                     | 1026             | Current Ramp 1 Initial Current | 0    | 300          | 1   | 200     |                              |
|                     | 1027             | Current Ramp 1 Ramp Time       | 1    | 120          | 1   | 10      |                              |
|                     | 1028             | Current Ramp 1 Maximum Current | 200  | 600          | 10  | 350     |                              |
|                     | 1034             | Start Ramp 2 Type              | 0    | 2            | 1   | 0       | Type changed since v6.5      |
|                     | 1035             | Voltage Ramp 2 Initial Voltage | 0    | 100          | 1   | 60      |                              |
|                     | 1036             | Voltage Ramp 2 Ramp Time       | 1    | 120          | 1   | 10      |                              |
|                     | 1037             | Voltage Ramp 2 Current Limit   | 200  | 600          | 10  | 350     |                              |
|                     | 1038             | Power Ramp 2 Initial Current   | 0    | 100          | 1   | 20      |                              |
|                     | 1039             | Power Ramp 2 Ramp Time         | 1    | 120          | 1   | 10      |                              |
|                     | 1040             | Power Ramp 2 Maximum Current   | 0    | 300          | 10  | 80      |                              |
|                     | 1046             | Kick Start Enable              | 0    | 1            | 1   | 0       |                              |
|                     | 1047             | Kick Start Voltage             | 10   | 100          | 5   | 65      |                              |
|                     | 1048             | Kick Start Voltage Time        | 10   | 200          | 10  | 50      |                              |
|                     | 1049             | Kick Start Current             | 200  | 600          | 10  | 200     |                              |
|                     | 1050             | Kick Start Current Time        | 10   | 200          | 10  | 50      |                              |
|                     | 1051             | Decel Enable                   | 0    | 1            | 1   | 0       |                              |
|                     | 1052             | Decel Start Voltage            | 100  | 100          | 1   | 100     |                              |
|                     | 1053             | Decel Stop Voltage             | 0    | 100          | 1   | 30      |                              |
|                     | 1054             | Decel Time                     | 1    | 60           | 1   | 5       |                              |
|                     | 1055             | Reserved                       |      |              |     |         |                              |
|                     | 1056             | Timed Output Time              | 1    | 1000, 0xffff | 1   | OFF     | 0xffff =>OFF; OFF => 0xffff. |
|                     | 1057             | Run Delay Time                 | 1    | 30, 0xffff   | 1   | 1       |                              |
|                     | 1058             | At Speed Delay Time            | 1    | 30, 0xffff   | 1   | 1       |                              |
|                     | 1059             | Bypass Pull-in Current         | 90   | 300          | 1   | 100     |                              |
| Setpoint Page 3     | 1082             | Imbalance Alarm Level          | 5    | 30, 0xffff   | 1   | 15      |                              |
|                     | 1083             | Imbalance Alarm Delay          | 10   | 200          | 1   | 15      |                              |
|                     | 1084             | Imbalance Trip Level           | 5    | 30, 0xffff   | 1   | 20      |                              |
|                     | 1085             | Imbalance Trip Delay           | 10   | 200          | 1   | 20      |                              |
|                     | 1086             | Under Current Alarm Level      | 10   | 90, 0xffff   | 1   | OFF     |                              |
|                     | 1087             | Under Current Alarm Delay      | 10   | 600          | 1   | 20      |                              |
|                     | 1088             | Over Current Alarm Level       | 100  | 300, 0xffff  | 1   | OFF     |                              |
|                     | 1089             | Over Current Alarm Delay       | 10   | 200          | 1   | 20      |                              |

|                 |      |                                    |     |                       |   |     |                            |
|-----------------|------|------------------------------------|-----|-----------------------|---|-----|----------------------------|
|                 | 1090 | Over Current Trip Level            | 100 | 300, 0xffff           | 1 | OFF |                            |
|                 | 1091 | Over Current Trip Delay            | 10  | 200                   | 1 | 20  |                            |
|                 | 1092 | Phase Loss Trip                    | 0   | 1                     | 1 | 1   | 0: Disabled;<br>1: Enabled |
|                 | 1093 | Phase Loss Trip Delay              | 0   | 200                   | 1 | 1   |                            |
|                 | 1094 | Phase Rotation Detection           | 0   | 2                     | 1 | 1   | 0: Dis<br>1: ABC<br>2: ACB |
|                 | 1095 | Phase Rotation Trip Delay          | 10  | 200                   | 1 | 10  |                            |
|                 | 1096 | GF Alarm Level                     | 5   | 90, 0xffff            | 1 | OFF |                            |
|                 | 1097 | GF Alarm Delay                     | 1   | 200                   | 1 | 1   |                            |
|                 | 1098 | GF Trip LoSet Level                | 5   | 90, 0xffff            | 1 | OFF |                            |
|                 | 1099 | GF LoSet Delay                     | 1   | 200                   | 1 | 5   |                            |
|                 | 1100 | GF Trip HiSet Level                | 5   | 90, 0xffff            | 1 | OFF |                            |
|                 | 1101 | GF HiSet Delay                     | 8   | 250                   | 2 | 8   |                            |
|                 | 1102 | Over Voltage Alarm Level           | 5   | 30, 0xffff            | 1 | OFF |                            |
|                 | 1103 | Over Voltage Alarm Delay           | 10  | 300                   | 1 | 10  |                            |
|                 | 1104 | Over Voltage Trip Level            | 5   | 30, 0xffff            | 1 | 10  |                            |
|                 | 1105 | Over Voltage Trip Delay            | 10  | 300                   | 1 | 20  |                            |
|                 | 1106 | Under Voltage Alarm Level          | 5   | 30, 0xffff            | 1 | OFF |                            |
|                 | 1107 | Under Voltage Alarm Delay          | 10  | 300                   | 1 | 10  |                            |
|                 | 1108 | Under Voltage Trip Level           | 5   | 30, 0xffff            | 1 | 15  |                            |
|                 | 1109 | Under Voltage Trip Delay           | 10  | 300                   | 1 | 20  |                            |
|                 | 1110 | Line Frequency Trip Window         | 0   | 6, 0xffff             | 1 | OFF |                            |
|                 | 1111 | Line Frequency Trip Delay          | 10  | 200                   | 1 | 10  |                            |
|                 | 1112 | Power Factor Lead Alarm            | 1   | 100, 0xffff           | 1 | OFF |                            |
|                 | 1113 | Power Factor Lead Alarm Delay      | 1   | 120                   | 1 | 1   |                            |
|                 | 1114 | Power Factor Lead Trip             | 1   | 100, 0xffff           | 1 | OFF |                            |
|                 | 1115 | Power Factor Lead Trip Delay       | 1   | 120                   | 1 | 1   |                            |
|                 | 1116 | Power Factor Lag Alarm             | 1   | 100, 0xffff           | 1 | OFF |                            |
|                 | 1117 | Power Factor Lag Alarm Delay       | 1   | 120                   | 1 | 1   |                            |
|                 | 1118 | Power Factor Lag Trip              | 1   | 100, 0xffff           | 1 | OFF |                            |
|                 | 1119 | Power Factor Lag Trip Delay        | 1   | 120                   | 1 | 1   |                            |
|                 | 1120 | Reserved                           |     |                       |   |     |                            |
|                 | 1121 | Reserved                           |     |                       |   |     |                            |
|                 | 1122 | Power Demand Period                | 1   | 60                    | 1 | 10  |                            |
|                 | 1123 | Reserved                           |     |                       |   |     |                            |
|                 | 1124 | KW Demand Alarm Pickup Low Byte    | 1   | 100000,<br>0xffffffff | 1 | OFF |                            |
|                 | 1125 | KW Demand Alarm Pickup High Byte   |     |                       |   |     |                            |
|                 | 1126 | KVA Demand Alarm Pickup Low Byte   | 1   | 100000,<br>0xffffffff | 1 | OFF |                            |
|                 | 1127 | KVA Demand Alarm Pickup High Byte  |     |                       |   |     |                            |
|                 | 1128 | KVAR Demand Alarm Pickup Low Byte  | 1   | 100000,<br>0xffffffff | 1 | OFF |                            |
|                 | 1129 | KVAR Demand Alarm Pickup High Byte |     |                       |   |     |                            |
|                 | 1130 | AMPS Demand Alarm Pickup Low Byte  | 1   | 100000,<br>0xffffffff | 1 | OFF |                            |
|                 | 1131 | AMPS Demand Alarm Pickup High Byte |     |                       |   |     |                            |
|                 |      |                                    |     |                       |   |     |                            |
| Setpoint Page 4 | 1250 | O/L Trip First                     | 1   | 1                     | 1 | 1   | Trip Only                  |
|                 | 1251 | O/L Trip Second                    | 5   | 9                     | 1 | 9   |                            |
|                 | 1252 | O/L Trip Third                     | 5   | 9                     | 1 | 9   |                            |
|                 | 1253 | I/B Trip First                     | 0   | 8                     | 1 | 1   |                            |
|                 | 1254 | I/B Trip Second                    | 5   | 9                     | 1 | 9   |                            |
|                 | 1255 | I/B Trip Third                     | 5   | 9                     | 1 | 9   |                            |
|                 | 1256 | S/C Trip First                     | 1   | 1                     | 1 | 1   | Trip Only                  |
|                 | 1257 | S/C Trip Second                    | 5   | 9                     | 1 | 9   |                            |
|                 | 1258 | S/C Trip Third                     | 5   | 9                     | 1 | 9   |                            |
|                 | 1259 | Over Current Trip First            | 0   | 8                     | 1 | 1   |                            |
|                 | 1260 | Over Current Trip Second           | 5   | 9                     | 1 | 9   |                            |
|                 | 1261 | Over Current Trip Third            | 5   | 9                     | 1 | 9   |                            |
|                 | 1262 | Stator Trip First                  | 0   | 8                     | 1 | 0   |                            |

|  |      |                             |   |   |   |   |           |
|--|------|-----------------------------|---|---|---|---|-----------|
|  | 1263 | Stator Trip Second          | 5 | 9 | 1 | 9 |           |
|  | 1264 | Stator Trip Third           | 5 | 9 | 1 | 9 |           |
|  | 1265 | Non-Stator Trip First       | 0 | 8 | 1 | 0 |           |
|  | 1266 | Non-Stator Trip Second      | 5 | 9 | 1 | 9 |           |
|  | 1267 | Non-Stator Trip Third       | 5 | 9 | 1 | 9 |           |
|  | 1268 | G/F Hi Set Trip First       | 0 | 8 | 1 | 1 |           |
|  | 1269 | G/F Hi Set Trip Second      | 5 | 9 | 1 | 9 |           |
|  | 1270 | G/F Hi Set Trip Third       | 5 | 9 | 1 | 9 |           |
|  | 1271 | G/F Lo Set Trip First       | 0 | 8 | 1 | 1 |           |
|  | 1272 | G/F Lo Set Trip Second      | 5 | 9 | 1 | 9 |           |
|  | 1273 | G/F Lo Set Trip Third       | 5 | 9 | 1 | 9 |           |
|  | 1274 | Phase Reversal First        | 0 | 8 | 1 | 2 |           |
|  | 1275 | Phase Reversal Second       | 5 | 9 | 1 | 9 |           |
|  | 1276 | Phase Reversal Third        | 5 | 9 | 1 | 9 |           |
|  | 1277 | Phase Loss Trip First       | 0 | 8 | 1 | 1 |           |
|  | 1278 | Phase Loss Trip Second      | 5 | 9 | 1 | 9 |           |
|  | 1279 | Phase Loss Trip Third       | 5 | 9 | 1 | 9 |           |
|  | 1280 | Accel Time First            | 1 | 1 | 1 | 1 | Trip Only |
|  | 1281 | Accel Time Second           | 5 | 9 | 1 | 9 |           |
|  | 1282 | Accel Time Third            | 5 | 9 | 1 | 9 |           |
|  | 1283 | Start Curve Trip First      | 1 | 1 | 1 | 1 | Trip Only |
|  | 1284 | Start Curve Trip Second     | 5 | 9 | 1 | 9 |           |
|  | 1285 | Start Curve Trip Third      | 5 | 9 | 1 | 9 |           |
|  | 1286 | Start Curve I*I*T First     | 0 | 8 | 1 | 1 |           |
|  | 1287 | Start Curve I*I*T Second    | 5 | 9 | 1 | 9 |           |
|  | 1288 | Start Curve I*I*T Third     | 5 | 9 | 1 | 9 |           |
|  | 1289 | Start Curve Over First      | 0 | 8 | 1 | 1 |           |
|  | 1290 | Start Curve Over Second     | 5 | 9 | 1 | 9 |           |
|  | 1291 | Start Curve Over Third      | 5 | 9 | 1 | 9 |           |
|  | 1292 | Over Frequency Trip First   | 0 | 8 | 1 | 0 |           |
|  | 1293 | Over Frequency Trip Second  | 5 | 9 | 1 | 9 |           |
|  | 1294 | Over Frequency Trip Third   | 5 | 9 | 1 | 9 |           |
|  | 1295 | Under Frequency Trip First  | 0 | 8 | 1 | 1 |           |
|  | 1296 | Under Frequency Trip Second | 5 | 9 | 1 | 9 |           |
|  | 1297 | Under Frequency Trip Third  | 5 | 9 | 1 | 9 |           |
|  | 1298 | Tach Accel Trip First       | 0 | 8 | 1 | 0 |           |
|  | 1299 | Tach Accel Trip Second      | 5 | 9 | 1 | 9 |           |
|  | 1300 | Tach Accel Trip Third       | 5 | 9 | 1 | 9 |           |
|  | 1301 | Inhibits Trip First         | 0 | 8 | 1 | 2 |           |
|  | 1302 | Inhibits Trip Second        | 5 | 9 | 1 | 9 |           |
|  | 1303 | Inhibits Trip Third         | 5 | 9 | 1 | 9 |           |
|  | 1304 | O/L Warning First           | 0 | 8 | 1 | 2 |           |
|  | 1305 | O/L Warning Second          | 5 | 9 | 1 | 9 |           |
|  | 1306 | O/L Warning Third           | 5 | 9 | 1 | 9 |           |
|  | 1307 | Over Current Alarm First    | 0 | 8 | 1 | 2 |           |
|  | 1308 | Over Current Alarm Second   | 5 | 9 | 1 | 9 |           |
|  | 1309 | Over Current Alarm Third    | 5 | 9 | 1 | 9 |           |
|  | 1310 | Shunt Trip First            | 0 | 8 | 1 | 0 |           |
|  | 1311 | Shunt Trip Second           | 5 | 9 | 1 | 9 |           |
|  | 1312 | Shunt Trip Third            | 5 | 9 | 1 | 9 |           |
|  | 1313 | Ground Fault Alarm First    | 0 | 8 | 1 | 2 |           |
|  | 1314 | Ground Fault Alarm Second   | 5 | 9 | 1 | 9 |           |
|  | 1315 | Ground Fault Alarm Third    | 5 | 9 | 1 | 9 |           |
|  | 1316 | Under Current Alarm First   | 0 | 8 | 1 | 0 |           |
|  | 1317 | Under Current Alarm Second  | 5 | 9 | 1 | 9 |           |
|  | 1318 | Under Current Alarm Third   | 5 | 9 | 1 | 9 |           |
|  | 1319 | I/B Alarm First             | 0 | 8 | 1 | 2 |           |
|  | 1320 | I/B Alarm Second            | 5 | 9 | 1 | 9 |           |
|  | 1321 | I/B Alarm Third             | 5 | 9 | 1 | 9 |           |

|      |                               |   |   |   |   |
|------|-------------------------------|---|---|---|---|
| 1322 | Stator Rtd Alarm First        | 0 | 8 | 1 | 0 |
| 1323 | Stator Rtd Alarm Second       | 5 | 9 | 1 | 9 |
| 1324 | Stator Rtd Alarm Third        | 5 | 9 | 1 | 9 |
| 1325 | Non-Stator Rtd Alarm First    | 0 | 8 | 1 | 0 |
| 1326 | Non-Stator Rtd Alarm Second   | 5 | 9 | 1 | 9 |
| 1327 | Non-Stator Rtd Alarm Third    | 5 | 9 | 1 | 9 |
| 1328 | Rtd Failure Alarm First       | 0 | 8 | 1 | 0 |
| 1329 | Rtd Failure Alarm Second      | 5 | 9 | 1 | 9 |
| 1330 | Rtd Failure Alarm Third       | 5 | 9 | 1 | 9 |
| 1331 | Self Test Fail First          | 0 | 8 | 1 | 1 |
| 1332 | Self Test Fail Second         | 5 | 9 | 1 | 9 |
| 1333 | Self Test Fail Third          | 5 | 9 | 1 | 9 |
| 1334 | Thermal Register Alarm First  | 0 | 8 | 1 | 2 |
| 1335 | Thermal Register Alarm Second | 5 | 9 | 1 | 9 |
| 1336 | Thermal Register Alarm Third  | 5 | 9 | 1 | 9 |
| 1337 | Motor Running First           | 0 | 8 | 1 | 3 |
| 1338 | Motor Running Second          | 5 | 9 | 1 | 9 |
| 1339 | Motor Running Third           | 5 | 9 | 1 | 9 |
| 1340 | Run Delay Time First          | 0 | 8 | 1 | 0 |
| 1341 | Run Delay Time Second         | 5 | 9 | 1 | 9 |
| 1342 | Run Delay Time Third          | 5 | 9 | 1 | 9 |
| 1343 | Timed Output First            | 0 | 8 | 1 | 0 |
| 1344 | Timed Output Second           | 5 | 9 | 1 | 9 |
| 1345 | Timed Output Third            | 5 | 9 | 1 | 9 |
| 1346 | At Speed First                | 0 | 8 | 1 | 4 |
| 1347 | At Speed Second               | 5 | 9 | 1 | 9 |
| 1348 | At Speed Third                | 5 | 9 | 1 | 9 |
| 1349 | External Input #1 First       | 0 | 8 | 1 | 1 |
| 1350 | External Input #1 Second      | 5 | 9 | 1 | 9 |
| 1351 | External Input #1 Third       | 5 | 9 | 1 | 9 |
| 1352 | External Input #2 First       | 0 | 8 | 1 | 1 |
| 1353 | External Input #2 Second      | 5 | 9 | 1 | 9 |
| 1354 | External Input #2 Third       | 5 | 9 | 1 | 9 |
| 1355 | External Input #3 First       | 0 | 8 | 1 | 0 |
| 1356 | External Input #3 Second      | 5 | 9 | 1 | 9 |
| 1357 | External Input #3 Third       | 5 | 9 | 1 | 9 |
| 1358 | External Input #4 First       | 0 | 8 | 1 | 1 |
| 1359 | External Input #4 Second      | 5 | 9 | 1 | 9 |
| 1360 | External Input #4 Third       | 5 | 9 | 1 | 9 |
| 1361 | Power Factor Alarm First      | 0 | 8 | 1 | 0 |
| 1362 | Power Factor Alarm Second     | 5 | 9 | 1 | 9 |
| 1363 | Power Factor Alarm Third      | 5 | 9 | 1 | 9 |
| 1364 | UV Alarm First                | 0 | 8 | 1 | 2 |
| 1365 | UV Alarm Second               | 5 | 9 | 1 | 9 |
| 1366 | UV Alarm Third                | 5 | 9 | 1 | 9 |
| 1367 | OV Alarm First                | 0 | 8 | 1 | 2 |
| 1368 | OV Alarm Second               | 5 | 9 | 1 | 9 |
| 1369 | OV Alarm Third                | 5 | 9 | 1 | 9 |
| 1370 | UV Trip First                 | 0 | 8 | 1 | 1 |
| 1371 | UV Trip Second                | 5 | 9 | 1 | 9 |
| 1372 | UV Trip Third                 | 5 | 9 | 1 | 9 |
| 1373 | OV Trip First                 | 0 | 8 | 1 | 1 |
| 1374 | OV Trip Second                | 5 | 9 | 1 | 9 |
| 1375 | OV Trip Third                 | 5 | 9 | 1 | 9 |
| 1376 | Power Factor Trip First       | 0 | 8 | 1 | 0 |
| 1377 | Power Factor Trip Second      | 5 | 9 | 1 | 9 |
| 1378 | Power Factor Trip Third       | 5 | 9 | 1 | 9 |
| 1379 | KW Alarm First                | 0 | 8 | 1 | 0 |
| 1380 | KW Alarm Second               | 5 | 9 | 1 | 9 |

|                 |      |                                        |   |       |   |      |                         |
|-----------------|------|----------------------------------------|---|-------|---|------|-------------------------|
|                 | 1381 | KW Alarm Third                         | 5 | 9     | 1 | 9    |                         |
|                 | 1382 | KVA Alarm First                        | 0 | 8     | 1 | 0    |                         |
|                 | 1383 | KVA Alarm Second                       | 5 | 9     | 1 | 9    |                         |
|                 | 1384 | KVA Alarm Third                        | 5 | 9     | 1 | 9    |                         |
|                 | 1385 | KVAR Alarm First                       | 0 | 8     | 1 | 0    |                         |
|                 | 1386 | KVAR Alarm Second                      | 5 | 9     | 1 | 9    |                         |
|                 | 1387 | KVAR Alarm Third                       | 5 | 9     | 1 | 9    |                         |
|                 | 1388 | AMPS Alarm First                       | 0 | 8     | 1 | 0    |                         |
|                 | 1389 | AMPS Alarm Second                      | 5 | 9     | 1 | 9    |                         |
|                 | 1390 | AMPS Alarm Third                       | 5 | 9     | 1 | 9    |                         |
|                 | 1391 | Bypass Discrepancy First               | 1 | 1     | 1 | 1    | Trip Only               |
|                 | 1392 | Bypass Discrepancy Second              | 5 | 9     | 1 | 9    |                         |
|                 | 1393 | Bypass Discrepancy Third               | 5 | 9     | 1 | 9    |                         |
|                 | 1394 | Low Control Voltage (Trip) First       | 1 | 1     | 1 | 1    | Trip Only               |
|                 | 1395 | Low Control Voltage (Trip) Second      | 5 | 9     | 1 | 9    |                         |
|                 | 1396 | Low Control Voltage (Trip) Third       | 5 | 9     | 1 | 9    |                         |
|                 |      |                                        |   |       |   |      |                         |
| Setpoint Page 5 | 1400 | Trip (Aux1) Relay Fail-Safe            | 0 | 1     | 1 | 0    |                         |
|                 | 1401 | Alarm (Aux2) Relay Fail-Safe           | 0 | 1     | 1 | 0    |                         |
|                 | 1402 | Aux3 Relay Fail-Safe                   | 0 | 1     | 1 | 0    |                         |
|                 | 1403 | Aux4 Relay Fail-Safe                   | 0 | 1     | 1 | 0    |                         |
|                 | 1404 | Aux5 Relay Fail-Safe                   | 0 | 1     | 1 | 0    |                         |
|                 | 1405 | Aux6 Relay Fail-Safe                   | 0 | 1     | 1 | 0    |                         |
|                 | 1406 | Aux7 Relay Fail-Safe                   | 0 | 1     | 1 | 0    |                         |
|                 | 1407 | Aux8 Relay Fail-Safe                   | 0 | 1     | 1 | 0    |                         |
|                 | 1408 | Trip (Aux1) Relay Latched              | 0 | 1     | 1 | 1    |                         |
|                 | 1409 | Alarm (Aux2) Relay Latched             | 0 | 1     | 1 | 0    |                         |
|                 | 1410 | Aux3 Relay Latched                     | 0 | 1     | 1 | 0    |                         |
|                 | 1411 | Aux4 Relay Latched                     | 0 | 0     | 1 | 0    |                         |
|                 | 1412 | Aux5 Relay Latched                     | 0 | 1     | 1 | 0    |                         |
|                 | 1413 | Aux6 Relay Latched                     | 0 | 1     | 1 | 0    |                         |
|                 | 1414 | Aux7 Relay Latched                     | 0 | 1     | 1 | 0    |                         |
|                 | 1415 | Aux8 Relay Latched                     | 0 | 1     | 1 | 0    |                         |
|                 |      |                                        |   |       |   |      |                         |
|                 |      |                                        |   |       |   |      |                         |
| Setpoint Page 6 | 1500 | Tach Ramp Time                         | 1 | 120   | 1 | 10   |                         |
|                 | 1501 | Tachometer Scale Selection             | 0 | 1     | 1 | 0    | 0/1:dis/en              |
|                 | 1502 | Manual Tach Scale 4ma                  | 0 | 3600  | 1 | 0    |                         |
|                 | 1503 | Manual Tach Scale 20ma                 | 0 | 3600  | 1 | 2000 |                         |
|                 | 1504 | Tach Accel Trip Mode Select            | 0 | 2     | 1 | 0    | 0: dis 1: under 2: over |
|                 | 1505 | Tach Underspeed Trip Pt                | 0 | 3600  | 1 | 1650 |                         |
|                 | 1506 | Tach Overspeed Trip Pt                 | 0 | 3600  | 1 | 1850 |                         |
|                 | 1507 | Tach Accel Trip Delay                  | 1 | 60    | 1 | 1    |                         |
|                 | 1508 | Analog Output #1 Select                | 0 | 6     | 1 | 4    |                         |
|                 | 1509 | Analog Output #1 4ma                   | 0 | 32767 | 1 | 0    |                         |
|                 | 1510 | Analog Output #1 20ma                  | 0 | 32767 | 1 | 250  |                         |
|                 | 1511 | Analog Output #2 Select                | 0 | 6     | 1 | 5    |                         |
|                 | 1512 | Analog Output #2 4ma                   | 0 | 32767 | 1 | 0    |                         |
|                 | 1513 | Analog Output #2 20ma                  | 0 | 32767 | 1 | 1000 |                         |
|                 |      |                                        |   |       |   |      |                         |
|                 | 1848 | External Input #1 Select               | 0 | 1     | 1 | 1    |                         |
|                 | 1849 | External Input #1 Type                 | 0 | 1     | 1 | 0    |                         |
|                 | 1850 | External Input #1 Time Delay           | 0 | 60    | 1 | 1    |                         |
|                 | 1851 | External Input #1 Name (Char2, Char1)  |   |       |   | C,T  | String                  |
|                 | 1852 | External Input #1 Name (Char4, Char3)  |   |       |   | ,B   | -                       |
|                 | 1853 | External Input #1 Name (Char6, Char5)  |   |       |   | A,F  | -                       |
|                 | 1854 | External Input #1 Name (Char8, Char7)  |   |       |   | L,U  | -                       |
|                 | 1855 | External Input #1 Name (Char10, Char9) |   |       |   | ,T   | -                       |

|                 |      |                                         |     |     |    |     |                                           |
|-----------------|------|-----------------------------------------|-----|-----|----|-----|-------------------------------------------|
|                 | 1856 | External Input #1 Name (Char12, Char11) |     |     |    |     | -                                         |
|                 | 1857 | External Input #1 Name (Char14, Char13) |     |     |    |     | -                                         |
|                 | 1858 | External Input #1 Name ( n/a , Char15)  |     |     |    |     | -                                         |
|                 | 1859 | External Input #2 Select                | 0   | 1   | 1  | 1   | For 2-speed f/w, range and default are 2. |
|                 | 1860 | External Input #2 Type                  | 0   | 1   | 1  | 0   |                                           |
|                 | 1861 | External Input #2 Time Delay            | 0   | 60  | 1  | 1   |                                           |
|                 | 1862 | External Input #2 Name (Char2, Char1)   |     |     |    |     | String                                    |
|                 | 1863 | External Input #2 Name (Char4, Char3)   |     |     |    |     | -                                         |
|                 | 1864 | External Input #2 Name (Char6, Char5)   |     |     |    |     | -                                         |
|                 | 1865 | External Input #2 Name (Char8, Char7)   |     |     |    |     | -                                         |
|                 | 1866 | External Input #2 Name (Char10, Char9)  |     |     |    |     | -                                         |
|                 | 1867 | External Input #2 Name (Char12, Char11) |     |     |    |     | -                                         |
|                 | 1868 | External Input #2 Name (Char14, Char13) |     |     |    |     | -                                         |
|                 | 1869 | External Input #2 Name ( n/a , Char15)  |     |     |    |     | -                                         |
|                 | 1870 | External Input #3 Select                | 0   | 2   | 1  | 2   |                                           |
|                 | 1871 | External Input #3 Type                  | 0   | 1   | 1  | 0   |                                           |
|                 | 1872 | External Input #3 Time Delay            | 0   | 60  | 1  | 0   |                                           |
|                 | 1873 | External Input #3 Name (Char2, Char1)   |     |     |    | U,D | String                                    |
|                 | 1874 | External Input #3 Name (Char4, Char3)   |     |     |    | L,A | -                                         |
|                 | 1875 | External Input #3 Name (Char6, Char5)   |     |     |    | R,  | -                                         |
|                 | 1876 | External Input #3 Name (Char8, Char7)   |     |     |    | M,A | -                                         |
|                 | 1877 | External Input #3 Name (Char10, Char9)  |     |     |    | ,P  | -                                         |
|                 | 1878 | External Input #3 Name (Char12, Char11) |     |     |    |     | -                                         |
|                 | 1879 | External Input #3 Name (Char14, Char13) |     |     |    |     | -                                         |
|                 | 1880 | External Input #3 Name ( n/a , Char15)  |     |     |    |     | -                                         |
|                 | 1881 | External Input #4 Select                | 0   | 2   | 1  | 1   |                                           |
|                 | 1882 | External Input #4 Type                  | 0   | 1   | 1  | 1   |                                           |
|                 | 1883 | External Input #4 Time Delay            | 0   | 60  | 1  | 1   |                                           |
|                 | 1884 | External Input #4 Name (Char2, Char1)   |     |     |    | H,T | String                                    |
|                 | 1885 | External Input #4 Name (Char4, Char3)   |     |     |    | R,E | -                                         |
|                 | 1886 | External Input #4 Name (Char6, Char5)   |     |     |    | A,M | -                                         |
|                 | 1887 | External Input #4 Name (Char8, Char7)   |     |     |    | S,L | -                                         |
|                 | 1888 | External Input #4 Name (Char10, Char9)  |     |     |    | A,T | -                                         |
|                 | 1889 | External Input #4 Name (Char12, Char11) |     |     |    | ,T  | -                                         |
|                 | 1890 | External Input #4 Name (Char14, Char13) |     |     |    |     | -                                         |
|                 | 1891 | External Input #4 Name ( n/a , Char15)  |     |     |    |     | -                                         |
|                 |      |                                         |     |     |    |     |                                           |
| Setpoint Page 7 | 1530 | Custom Accel Curve                      | 0   | 3   | 1  | 0   |                                           |
|                 | 1531 | Curve A Current Limit                   | 200 | 600 | 10 | 350 |                                           |
|                 | 1532 | Curve A Voltage Level 1                 | 0   | 100 | 1  | 25  |                                           |
|                 | 1533 | Curve A Ramp Time 1                     | 1   | 60  | 1  | 2   |                                           |
|                 | 1534 | Curve A Voltage Level 2                 | 0   | 100 | 1  | 30  |                                           |
|                 | 1535 | Curve A Ramp Time 2                     | 1   | 60  | 1  | 2   |                                           |
|                 | 1536 | Curve A Voltage Level 3                 | 0   | 100 | 1  | 37  |                                           |
|                 | 1537 | Curve A Ramp Time 3                     | 1   | 60  | 1  | 2   |                                           |
|                 | 1538 | Curve A Voltage Level 4                 | 0   | 100 | 1  | 45  |                                           |
|                 | 1539 | Curve A Ramp Time 4                     | 1   | 60  | 1  | 2   |                                           |
|                 | 1540 | Curve A Voltage Level 5                 | 0   | 100 | 1  | 55  |                                           |
|                 | 1541 | Curve A Ramp Time 5                     | 1   | 60  | 1  | 2   |                                           |
|                 | 1542 | Curve A Voltage Level 6                 | 0   | 100 | 1  | 67  |                                           |
|                 | 1543 | Curve A Ramp Time 6                     | 1   | 60  | 1  | 2   |                                           |

|                 |      |                                 |     |             |    |           |  |
|-----------------|------|---------------------------------|-----|-------------|----|-----------|--|
|                 | 1544 | Curve A Voltage Level 7         | 0   | 100         | 1  | 82        |  |
|                 | 1545 | Curve A Ramp Time 7             | 1   | 60          | 1  | 2         |  |
|                 | 1546 | Curve A Voltage Level 8         | 0   | 100         | 1  | 100       |  |
|                 | 1547 | Curve A Ramp Time 8             | 1   | 60          | 1  | 2         |  |
|                 | 1548 | Curve B Current Limit           | 200 | 600         | 10 | 350       |  |
|                 | 1549 | Curve B Voltage Level 1         | 0   | 100         | 1  | 25        |  |
|                 | 1550 | Curve B Ramp Time 1             | 1   | 60          | 1  | 2         |  |
|                 | 1551 | Curve B Voltage Level 2         | 0   | 100         | 1  | 30        |  |
|                 | 1552 | Curve B Ramp Time 2             | 1   | 60          | 1  | 2         |  |
|                 | 1553 | Curve B Voltage Level 3         | 0   | 100         | 1  | 37        |  |
|                 | 1554 | Curve B Ramp Time 3             | 1   | 60          | 1  | 2         |  |
|                 | 1555 | Curve B Voltage Level 4         | 0   | 100         | 1  | 45        |  |
|                 | 1556 | Curve B Ramp Time 4             | 1   | 60          | 1  | 2         |  |
|                 | 1557 | Curve B Voltage Level 5         | 0   | 100         | 1  | 55        |  |
|                 | 1558 | Curve B Ramp Time 5             | 1   | 60          | 1  | 2         |  |
|                 | 1559 | Curve B Voltage Level 6         | 0   | 100         | 1  | 67        |  |
|                 | 1560 | Curve B Ramp Time 6             | 1   | 60          | 1  | 2         |  |
|                 | 1561 | Curve B Voltage Level 7         | 0   | 100         | 1  | 82        |  |
|                 | 1562 | Curve B Ramp Time 7             | 1   | 60          | 1  | 2         |  |
|                 | 1563 | Curve B Voltage Level 8         | 0   | 100         | 1  | 100       |  |
|                 | 1564 | Curve B Ramp Time 8             | 1   | 60          | 1  | 2         |  |
|                 | 1565 | Curve C Current Limit           | 200 | 600         | 10 | 350       |  |
|                 | 1566 | Curve C Voltage Level 1         | 0   | 100         | 1  | 25        |  |
|                 | 1567 | Curve C Ramp Time 1             | 1   | 60          | 1  | 2         |  |
|                 | 1568 | Curve C Voltage Level 2         | 0   | 100         | 1  | 30        |  |
|                 | 1569 | Curve C Ramp Time 2             | 1   | 60          | 1  | 2         |  |
|                 | 1570 | Curve C Voltage Level 3         | 0   | 100         | 1  | 37        |  |
|                 | 1571 | Curve C Ramp Time 3             | 1   | 60          | 1  | 2         |  |
|                 | 1572 | Curve C Voltage Level 4         | 0   | 100         | 1  | 45        |  |
|                 | 1573 | Curve C Ramp Time 4             | 1   | 60          | 1  | 2         |  |
|                 | 1574 | Curve C Voltage Level 5         | 0   | 100         | 1  | 55        |  |
|                 | 1575 | Curve C Ramp Time 5             | 1   | 60          | 1  | 2         |  |
|                 | 1576 | Curve C Voltage Level 6         | 0   | 100         | 1  | 67        |  |
|                 | 1577 | Curve C Ramp Time 6             | 1   | 60          | 1  | 2         |  |
|                 | 1578 | Curve C Voltage Level 7         | 0   | 100         | 1  | 82        |  |
|                 | 1579 | Curve C Ramp Time 7             | 1   | 60          | 1  | 2         |  |
|                 | 1580 | Curve C Voltage Level 8         | 0   | 100         | 1  | 100       |  |
|                 | 1581 | Curve C Ramp Time 8             | 1   | 60          | 1  | 2         |  |
|                 |      |                                 |     |             |    |           |  |
| Setpoint Page 8 | 1600 | Run Curve Locked Rotor Time     | 1   | 30, 0xffff  | 1  | O/L CLASS |  |
|                 | 1601 | Run Lock Rotor Current          | 400 | 800         | 1  | 600       |  |
|                 | 1602 | Start Curve Locked Rotor Time   | 1   | 30, 0xffff  | 1  | O/L CLASS |  |
|                 | 1603 | Start Lock Rotor Current        | 400 | 800         | 10 | 600       |  |
|                 | 1604 | Area Under Curve Protection     | 0   | 1           | 1  | 0         |  |
|                 | 1605 | Maximum I* <sup>2</sup> T Start | 1   | 2500        | 1  | 368       |  |
|                 | 1606 | Current Over Curve              | 0   | 2           | 1  | 0         |  |
|                 | 1607 | Learned Start Start Curve Bias  | 5   | 40          | 1  | 10        |  |
|                 | 1608 | Time For Sampling               | 1   | 300         | 1  | 30        |  |
|                 | 1609 | Accel Time Limit                | 1   | 300, 0xffff | 1  | 30        |  |
|                 | 1610 | Coast Down Timer Time           | 1   | 60, 0xffff  | 1  | DISABLED  |  |
|                 | 1611 | Number of Starts Per Hour       | 1   | 6, 0xffff   | 1  | DISABLED  |  |
|                 | 1612 | Time Between Starts Time        | 1   | 60, 0xffff  | 1  | DISABLED  |  |
|                 | 1613 | Reserved                        |     |             |    |           |  |
|                 |      |                                 |     |             |    |           |  |

|                 |      |                              |   |             |   |     |        |
|-----------------|------|------------------------------|---|-------------|---|-----|--------|
| Setpoint Page 9 | 1620 | Use Nema Temp For Rtd Values | 0 | 1           | 1 | 0   |        |
|                 | 1621 | # of Rtd's Used For Stator   | 0 | 6           | 1 | 4   |        |
|                 | 1622 | Rtd Voting                   | 0 | 1           | 1 | 0   |        |
|                 | 1623 | Rtd #1 Description Reg0      |   |             |   |     | String |
|                 | 1624 | Rtd #1 Description Reg1      |   |             |   |     | -      |
|                 | 1625 | Rtd #1 Description Reg2      |   |             |   |     | -      |
|                 | 1626 | Rtd #1 Description Reg3      |   |             |   |     | -      |
|                 | 1627 | Rtd #1 Description Reg4      |   |             |   |     | -      |
|                 | 1628 | Rtd #1 Description Reg5      |   |             |   |     | -      |
|                 | 1629 | Rtd #1 Description Reg6      |   |             |   |     | -      |
|                 | 1630 | Rtd #1 Description Reg7      |   |             |   |     | -      |
|                 | 1631 | Stator Phase A1 Type         | 0 | 4           | 1 | 0   |        |
|                 | 1632 | Stator Phase A1 Alarm Level  | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1633 | Stator Phase A1 Trip Level   | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1634 | Reserved                     |   |             |   |     |        |
|                 | 1635 | Reserved                     |   |             |   |     |        |
|                 | 1636 | Reserved                     |   |             |   |     |        |
|                 | 1637 | Rtd #2 Description Reg0      |   |             |   |     | String |
|                 | 1638 | Rtd #2 Description Reg1      |   |             |   |     | -      |
|                 | 1639 | Rtd #2 Description Reg2      |   |             |   |     | -      |
|                 | 1640 | Rtd #2 Description Reg3      |   |             |   |     | -      |
|                 | 1641 | Rtd #2 Description Reg4      |   |             |   |     | -      |
|                 | 1642 | Rtd #2 Description Reg5      |   |             |   |     | -      |
|                 | 1643 | Rtd #2 Description Reg6      |   |             |   |     | -      |
|                 | 1644 | Rtd #2 Description Reg7      |   |             |   |     | -      |
|                 | 1645 | Stator Phase A2 Type         | 0 | 4           | 1 | 0   |        |
|                 | 1646 | Stator Phase A2 Alarm Level  | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1647 | Stator Phase A2 Trip Level   | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1648 | Reserved                     |   |             |   |     |        |
|                 | 1649 | Reserved                     |   |             |   |     |        |
|                 | 1650 | Reserved                     |   |             |   |     |        |
|                 | 1651 | Rtd #3 Description Reg0      |   |             |   |     | String |
|                 | 1652 | Rtd #3 Description Reg1      |   |             |   |     | -      |
|                 | 1653 | Rtd #3 Description Reg2      |   |             |   |     | -      |
|                 | 1654 | Rtd #3 Description Reg3      |   |             |   |     | -      |
|                 | 1655 | Rtd #3 Description Reg4      |   |             |   |     | -      |
|                 | 1656 | Rtd #3 Description Reg5      |   |             |   |     | -      |
|                 | 1657 | Rtd #3 Description Reg6      |   |             |   |     | -      |
|                 | 1658 | Rtd #3 Description Reg7      |   |             |   |     | -      |
|                 | 1659 | Stator Phase B1 Type         | 0 | 4           | 1 | 0   |        |
|                 | 1660 | Stator Phase B1 Alarm Level  | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1661 | Stator Phase B1 Trip Level   | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1662 | Reserved                     |   |             |   |     |        |
|                 | 1663 | Reserved                     |   |             |   |     |        |
|                 | 1664 | Reserved                     |   |             |   |     |        |
|                 | 1665 | Rtd #4 Description Reg0      |   |             |   |     | String |
|                 | 1666 | Rtd #4 Description Reg1      |   |             |   |     | -      |
|                 | 1667 | Rtd #4 Description Reg2      |   |             |   |     | -      |
|                 | 1668 | Rtd #4 Description Reg3      |   |             |   |     | -      |
|                 | 1669 | Rtd #4 Description Reg4      |   |             |   |     | -      |
|                 | 1670 | Rtd #4 Description Reg5      |   |             |   |     | -      |
|                 | 1671 | Rtd #4 Description Reg6      |   |             |   |     | -      |
|                 | 1672 | Rtd #4 Description Reg7      |   |             |   |     | -      |
|                 | 1673 | Stator Phase B2 Type         | 0 | 4           | 1 | 0   |        |
|                 | 1674 | Stator Phase B2 Alarm Level  | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1675 | Stator Phase B2 Trip Level   | 0 | 240, 0xffff | 1 | OFF |        |
|                 | 1676 | Reserved                     |   |             |   |     |        |
|                 | 1677 | Reserved                     |   |             |   |     |        |
|                 | 1678 | Reserved                     |   |             |   |     |        |

|      |                             |   |             |   |     |        |
|------|-----------------------------|---|-------------|---|-----|--------|
| 1679 | Rtd #5 Description Reg0     |   |             |   |     | String |
| 1680 | Rtd #5 Description Reg1     |   |             |   |     | -      |
| 1681 | Rtd #5 Description Reg2     |   |             |   |     | -      |
| 1682 | Rtd #5 Description Reg3     |   |             |   |     | -      |
| 1683 | Rtd #5 Description Reg4     |   |             |   |     | -      |
| 1684 | Rtd #5 Description Reg5     |   |             |   |     | -      |
| 1685 | Rtd #5 Description Reg6     |   |             |   |     | -      |
| 1686 | Rtd #5 Description Reg7     |   |             |   |     | -      |
| 1687 | Stator Phase C1 Type        | 0 | 4           | 1 | 0   |        |
| 1688 | Stator Phase C1 Alarm Level | 0 | 240, 0xffff | 1 | OFF |        |
| 1689 | Stator Phase C1 Trip Level  | 0 | 240, 0xffff | 1 | OFF |        |
| 1690 | Reserved                    |   |             |   |     |        |
| 1691 | Reserved                    |   |             |   |     |        |
| 1692 | Reserved                    |   |             |   |     |        |
| 1693 | Rtd #6 Description Reg0     |   |             |   |     | String |
| 1694 | Rtd #6 Description Reg1     |   |             |   |     | -      |
| 1695 | Rtd #6 Description Reg2     |   |             |   |     | -      |
| 1696 | Rtd #6 Description Reg3     |   |             |   |     | -      |
| 1697 | Rtd #6 Description Reg4     |   |             |   |     | -      |
| 1698 | Rtd #6 Description Reg5     |   |             |   |     | -      |
| 1699 | Rtd #6 Description Reg6     |   |             |   |     | -      |
| 1700 | Rtd #6 Description Reg7     |   |             |   |     | -      |
| 1701 | Stator Phase C2 Type        | 0 | 4           | 1 | 0   |        |
| 1702 | Stator Phase C2 Alarm Level | 0 | 240, 0xffff | 1 | OFF |        |
| 1703 | Stator Phase C2 Trip Level  | 0 | 240, 0xffff | 1 | OFF |        |
| 1704 | Reserved                    |   |             |   |     |        |
| 1705 | Reserved                    |   |             |   |     |        |
| 1706 | Reserved                    |   |             |   |     |        |
| 1707 | Rtd #7 Description Reg0     |   |             |   |     | String |
| 1708 | Rtd #7 Description Reg1     |   |             |   |     | -      |
| 1709 | Rtd #7 Description Reg2     |   |             |   |     | -      |
| 1710 | Rtd #7 Description Reg3     |   |             |   |     | -      |
| 1711 | Rtd #7 Description Reg4     |   |             |   |     | -      |
| 1712 | Rtd #7 Description Reg5     |   |             |   |     | -      |
| 1713 | Rtd #7 Description Reg6     |   |             |   |     | -      |
| 1714 | Rtd #7 Description Reg7     |   |             |   |     | -      |
| 1715 | End Bearing Type            | 0 | 4           | 1 | 0   |        |
| 1716 | End Bearing Alarm Level     | 0 | 240, 0xffff | 1 | OFF |        |
| 1717 | End Bearing Trip Level      | 0 | 240, 0xffff | 1 | OFF |        |
| 1718 | Reserved                    |   |             |   |     |        |
| 1721 | Reserved                    |   |             |   |     |        |
| 1720 | Reserved                    |   |             |   |     |        |
| 1721 | Rtd #8 Description Reg0     |   |             |   |     | String |
| 1722 | Rtd #8 Description Reg1     |   |             |   |     | -      |
| 1723 | Rtd #8 Description Reg2     |   |             |   |     | -      |
| 1724 | Rtd #8 Description Reg3     |   |             |   |     | -      |
| 1725 | Rtd #8 Description Reg4     |   |             |   |     | -      |
| 1726 | Rtd #8 Description Reg5     |   |             |   |     | -      |
| 1727 | Rtd #8 Description Reg6     |   |             |   |     | -      |
| 1728 | Rtd #8 Description Reg7     |   |             |   |     | -      |
| 1729 | Shaft Bearing Type          | 0 | 4           | 1 | 0   |        |
| 1730 | Shaft Bearing Alarm Level   | 0 | 240, 0xffff | 1 | OFF |        |
| 1731 | Shaft Bearing Trip Level    | 0 | 240, 0xffff | 1 | OFF |        |
| 1732 | Reserved                    |   |             |   |     |        |
| 1733 | Reserved                    |   |             |   |     |        |
| 1734 | Reserved                    |   |             |   |     |        |
| 1735 | Rtd #9 Description Reg0     |   |             |   |     | String |
| 1736 | Rtd #9 Description Reg1     |   |             |   |     | -      |
| 1737 | Rtd #9 Description Reg2     |   |             |   |     | -      |

|                  |      |                            |       |             |   |       |        |
|------------------|------|----------------------------|-------|-------------|---|-------|--------|
|                  | 1738 | Rtd #9 Description Reg3    |       |             |   |       | -      |
|                  | 1739 | Rtd #9 Description Reg4    |       |             |   |       | -      |
|                  | 1740 | Rtd #9 Description Reg5    |       |             |   |       | -      |
|                  | 1741 | Rtd #9 Description Reg6    |       |             |   |       | -      |
|                  | 1742 | Rtd #9 Description Reg7    |       |             |   |       | -      |
|                  | 1743 | Rtd #9 Type                | 0     | 4           | 1 | 0     |        |
|                  | 1744 | Rtd #9 Alarm Level         | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1745 | Rtd #9 Trip Level          | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1746 | Reserved                   |       |             |   |       |        |
|                  | 1747 | Reserved                   |       |             |   |       |        |
|                  | 1748 | Reserved                   |       |             |   |       |        |
|                  | 1749 | Rtd #10 Description Reg0   |       |             |   |       | String |
|                  | 1750 | Rtd #10 Description Reg1   |       |             |   |       | -      |
|                  | 1751 | Rtd #10 Description Reg2   |       |             |   |       | -      |
|                  | 1752 | Rtd #10 Description Reg3   |       |             |   |       | -      |
|                  | 1753 | Rtd #10 Description Reg4   |       |             |   |       | -      |
|                  | 1754 | Rtd #10 Description Reg5   |       |             |   |       | -      |
|                  | 1755 | Rtd #10 Description Reg6   |       |             |   |       | -      |
|                  | 1756 | Rtd #10 Description Reg7   |       |             |   |       | -      |
|                  | 1757 | Rtd #10 Type               | 0     | 4           | 1 | 0     |        |
|                  | 1758 | Rtd #10 Alarm Level        | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1759 | Rtd #10 Trip Level         | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1760 | Reserved                   |       |             |   |       |        |
|                  | 1761 | Reserved                   |       |             |   |       |        |
|                  | 1762 | Reserved                   |       |             |   |       |        |
|                  | 1763 | Rtd #11 Description Reg0   |       |             |   |       | String |
|                  | 1764 | Rtd #11 Description Reg1   |       |             |   |       | -      |
|                  | 1765 | Rtd #11 Description Reg2   |       |             |   |       | -      |
|                  | 1766 | Rtd #11 Description Reg3   |       |             |   |       | -      |
|                  | 1767 | Rtd #11 Description Reg4   |       |             |   |       | -      |
|                  | 1768 | Rtd #11 Description Reg5   |       |             |   |       | -      |
|                  | 1769 | Rtd #11 Description Reg6   |       |             |   |       | -      |
|                  | 1770 | Rtd #11 Description Reg7   |       |             |   |       | -      |
|                  | 1771 | Rtd #11 Type               | 0     | 4           | 1 | 0     |        |
|                  | 1772 | Rtd #11 Alarm Level        | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1773 | Rtd #11 Trip Level         | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1774 | Reserved                   |       |             |   |       |        |
|                  | 1775 | Reserved                   |       |             |   |       |        |
|                  | 1776 | Reserved                   |       |             |   |       |        |
|                  | 1777 | Rtd #12 Description Reg0   |       |             |   |       | String |
|                  | 1778 | Rtd #12 Description Reg1   |       |             |   |       | -      |
|                  | 1779 | Rtd #12 Description Reg2   |       |             |   |       | -      |
|                  | 1780 | Rtd #12 Description Reg3   |       |             |   |       | -      |
|                  | 1781 | Rtd #12 Description Reg4   |       |             |   |       | -      |
|                  | 1782 | Rtd #12 Description Reg5   |       |             |   |       | -      |
|                  | 1783 | Rtd #12 Description Reg6   |       |             |   |       | -      |
|                  | 1784 | Rtd #12 Description Reg7   |       |             |   |       | -      |
|                  | 1785 | Rtd #12 Type               | 0     | 4           | 1 | 0     |        |
|                  | 1786 | Rtd #12 Alarm Level        | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1787 | Rtd #12 Trip Level         | 0     | 240, 0xffff | 1 | OFF   |        |
|                  | 1788 | Reserved                   |       |             |   |       |        |
|                  | 1789 | Reserved                   |       |             |   |       |        |
|                  | 1790 | Reserved                   |       |             |   |       |        |
| Setpoint Page 10 | 1800 | Metering Password          | 0     | 999         | 1 | 123   |        |
|                  | 1801 | Level 2 Password           | 100   | 999         | 1 | 100   |        |
|                  | 1802 | Level 3 Password           | 1000  | 9999        | 1 | 1000  |        |
|                  | 1803 | Factory Password Low Byte  | 10000 | 99999       | 1 | 48562 |        |
|                  | 1804 | Factory Password High Byte |       |             |   |       |        |

|                  |      |                                  |    |             |   |             |                                                                                                                                                                                                             |
|------------------|------|----------------------------------|----|-------------|---|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  |      |                                  |    |             |   |             |                                                                                                                                                                                                             |
| Setpoint Page 11 | 1810 | Modbus Address Number            | 1  | 247         | 1 | 247         |                                                                                                                                                                                                             |
|                  | 1811 | Set Access Code                  | 1  | 999         | 1 | 1           | 1-993: Access all functions;<br>994: Only access Fn3;<br>995: Access Fn3,5 and 16;<br>996: Access Fn3,5,6 and 16;<br>997: Access Fn3,4,5,6 and 16;<br>998: Access Fn3,4,5,6,9, 16;<br>999: For factory use. |
|                  | 1812 | Set Front Baud Rate              | 1  | 7           | 1 | 3           |                                                                                                                                                                                                             |
|                  | 1813 | Set Modbus Baud Rate             | 1  | 6           | 1 | 3           |                                                                                                                                                                                                             |
|                  | 1814 | Reserved                         |    |             |   |             |                                                                                                                                                                                                             |
|                  | 1815 | Set Link Baud Rate               | 1  | 7           | 1 | 5           |                                                                                                                                                                                                             |
|                  | 1816 | Remote Start/Stop                | 0  | 1           | 1 | 0           |                                                                                                                                                                                                             |
|                  | 1817 | Reserved                         |    |             |   |             |                                                                                                                                                                                                             |
|                  |      |                                  |    |             |   |             |                                                                                                                                                                                                             |
|                  |      |                                  |    |             |   |             |                                                                                                                                                                                                             |
|                  |      |                                  |    |             |   |             |                                                                                                                                                                                                             |
| Setpoint Page 12 | 1830 | Metering Date Page #             | 1  | 4           | 1 | 1           |                                                                                                                                                                                                             |
|                  | 1831 | Metering Data Screen #           | 1  | 40          | 1 | 1           |                                                                                                                                                                                                             |
|                  | 1832 | RTD Failure Alarm                | 0  | 1           | 1 | 0           |                                                                                                                                                                                                             |
|                  | 1833 | Thermal Register Min             | 10 | 50, 0xffff  | 1 | 15          |                                                                                                                                                                                                             |
|                  | 1834 | Thermal Register Alarm           | 40 | 95, 0xffff  | 1 | 90          |                                                                                                                                                                                                             |
|                  | 1835 | Thermal Alarm Delay              | 1  | 20          | 1 | 10          |                                                                                                                                                                                                             |
|                  | 1836 | Stopped Cool Down Time           | 10 | 300         | 1 | 30          |                                                                                                                                                                                                             |
|                  | 1837 | Run Cool Down Time               | 10 | 300         | 1 | 15          |                                                                                                                                                                                                             |
|                  | 1838 | Hot Stall Time                   | 4  | 40, 0xffff  | 1 | ½ O/L CLASS |                                                                                                                                                                                                             |
|                  | 1839 | Cold Stall Time                  | 4  | 40, 0xffff  | 1 | O/L CLASS   |                                                                                                                                                                                                             |
|                  | 1840 | Relay Measured Cool Rates        | 0  | 1           | 1 | 0           |                                                                                                                                                                                                             |
|                  | 1841 | Motor Design Ambient temperature | 10 | 90          | 1 | 40          |                                                                                                                                                                                                             |
|                  | 1842 | Motor Design Run Temperature     | 50 | 100         | 1 | 80          |                                                                                                                                                                                                             |
|                  | 1843 | Motor Stator Max Temperature     | 10 | 240, 0xffff | 1 | INS CLS     |                                                                                                                                                                                                             |
|                  | 1844 | I/B Input To Thermal Register    | 0  | 1           | 1 | 1           |                                                                                                                                                                                                             |
|                  | 1845 | Use Calculated K Or Assign       | 1  | 50, 0xffff  | 1 | 7           |                                                                                                                                                                                                             |
|                  | 1846 | Reserved                         |    |             |   |             |                                                                                                                                                                                                             |
|                  |      |                                  |    |             |   |             |                                                                                                                                                                                                             |

| Metering Page # | Register Address | Register Name              | Data      |       |                                                            |         | Remark                                                                                                                |
|-----------------|------------------|----------------------------|-----------|-------|------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------|
|                 |                  |                            | Data Type | Scale | Unit                                                       | Example |                                                                                                                       |
| Metering Page 1 | 2000             | IA (RMS IphaseA)           | UI        | x1    | Amps                                                       |         | UI: Unsigned Integer<br>Note: Don't show scale later if it is x1.                                                     |
|                 | 2001             | IB (RMS IphaseB)           | UI        |       | Amps                                                       |         |                                                                                                                       |
|                 | 2002             | IC (RMS IphaseC)           | UI        |       | Amps                                                       |         |                                                                                                                       |
|                 | 2003             | G/F (RMS IGFault)          | UI        | x0.01 | Amps                                                       |         |                                                                                                                       |
|                 | 2004             | Vab (RMS Vab)              | UI        |       | Volts                                                      |         | In page 2.                                                                                                            |
|                 | 2005             | Vbc (RMS Vbc)              | UI        |       | Volts                                                      |         | In page 2.                                                                                                            |
|                 | 2006             | Vca (RMS Vca)              | UI        |       | Volts                                                      |         | In page 2.                                                                                                            |
|                 | 2007             | I(avg) RMS Iavg            | UI        |       | Amps                                                       |         |                                                                                                                       |
|                 | 2008             | RMS Vavg                   | UI        |       | Amps                                                       |         | In page 2.                                                                                                            |
|                 | 2009             | Motor Load % of FLA        | UI        |       | %                                                          |         |                                                                                                                       |
|                 | 2010             | G/F (RMS IGFault)          | UI        |       | Amps                                                       |         |                                                                                                                       |
|                 | 2011             | Thermal Register Remaining | IN        |       | %                                                          |         | IN: Integer                                                                                                           |
|                 | 2012             | Thermal Register to Start  | IN        |       | %                                                          |         |                                                                                                                       |
|                 | 2013             | I/B (Current ImBalance)    | IN        |       | %                                                          |         |                                                                                                                       |
|                 | 2014             | Reserved                   | IN        |       | -                                                          |         |                                                                                                                       |
|                 | 2015             | I*I*T to Start             | UI        |       | Amp*Amp*Sec                                                |         | See Reg Addr 1605                                                                                                     |
|                 | 2016             | Average Start Time         | UI        |       | Sec                                                        |         |                                                                                                                       |
|                 | 2017             | Last Start Time            | UI        |       | Sec                                                        |         |                                                                                                                       |
|                 | 2018             | Average Start Current      | UI        |       | Amps                                                       |         |                                                                                                                       |
|                 | 2019             | Reserved                   | UI        |       |                                                            |         |                                                                                                                       |
|                 | 2020             | Line Frequency             | UI        |       | Hz                                                         |         |                                                                                                                       |
|                 | 2021             | Power Factor               | IN        | x0.01 | -                                                          |         | In page 2.                                                                                                            |
|                 | 2022             | RPM                        | IN        |       | Rpm                                                        |         |                                                                                                                       |
|                 | 2023             | Phase Order                | UI        |       | -                                                          |         | 0=Unknown,<br>1=ABC,<br>2=ACB                                                                                         |
| Metering Page 2 | 2800             | Reserved                   | UI        |       | -                                                          |         |                                                                                                                       |
|                 | 2801             | Power Factor Sign          | UI        |       | -                                                          |         | 0: Lead; 1: Lag                                                                                                       |
|                 | 2802             | Power Factor               | IN        | x0.01 | -                                                          |         |                                                                                                                       |
|                 | 2803             | KWH Used                   | IN        |       | Kwh                                                        |         |                                                                                                                       |
|                 | 2804-5           | KW                         | UNS32     |       | Kw                                                         |         | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg: MSW.<br>LSW: Least Significant Word;<br>MSW: Most Significant Word; |
|                 | 2806-7           | KVA                        | UNS32     |       | Kw                                                         |         | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg: MSW.                                                                |
|                 | 2808-9           | KVAR                       | UNS32     |       | Kw                                                         |         |                                                                                                                       |
|                 | 2810-11          | MWH Used                   | UNS32     |       | Mwh                                                        |         |                                                                                                                       |
|                 | 2812-13          | Peak KW                    | UNS32     |       | Kw                                                         |         |                                                                                                                       |
|                 | 2814-15          | Peak KVA                   | UNS32     |       | Kw                                                         |         |                                                                                                                       |
|                 | 2816-17          | Peak KVAR                  | UNS32     |       | Kw                                                         |         |                                                                                                                       |
|                 | 2818-19          | Peak Amps                  | UNS32     |       | Amps                                                       |         |                                                                                                                       |
|                 | 2820-21          | Peak KW Time               | UNS32     |       | 1 <sup>st</sup> reg: hh,mm ;<br>2 <sup>nd</sup> reg: MM,DD |         | hh: hour,<br>mm: minute,<br>MM: month,<br>DD: day.                                                                    |

|                 |         |                                |       |  |                                                                  |  |  |
|-----------------|---------|--------------------------------|-------|--|------------------------------------------------------------------|--|--|
|                 | 2822-23 | Peak KVA Time                  | UNS32 |  | 1 <sup>st</sup> reg:<br>hh,mm ;<br>2 <sup>nd</sup> reg:<br>MM,DD |  |  |
|                 | 2824-25 | Peak KVAR Time                 | UNS32 |  | 1 <sup>st</sup> reg:<br>hh,mm ;<br>2 <sup>nd</sup> reg:<br>MM,DD |  |  |
|                 | 2826-27 | Peak Amps Time                 | UNS32 |  | 1 <sup>st</sup> reg:<br>hh,mm ;<br>2 <sup>nd</sup> reg:<br>MM,DD |  |  |
| Metering Page 3 | 2050    | Max Temp Since Clear RTD #1    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2051    | Max Temp Since Clear RTD #2    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2052    | Max Temp Since Clear RTD #3    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2053    | Max Temp Since Clear RTD #4    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2054    | Max Temp Since Clear RTD #5    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2055    | Max Temp Since Clear RTD #6    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2056    | Max Temp Since Clear RTD #7    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2057    | Max Temp Since Clear RTD #8    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2058    | Max Temp Since Clear RTD #9    | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2059    | Max Temp Since Clear RTD #10   | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2060    | Max Temp Since Clear RTD #11   | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2061    | Max Temp Since Clear RTD #12   | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2062    | Stator Phase A1 RTD #1 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2063    | Stator Phase A1 RTD #2 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2064    | Stator Phase A1 RTD #3 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2065    | Stator Phase A1 RTD #4 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2066    | Stator Phase A1 RTD #5 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2067    | Stator Phase A1 RTD #6 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2068    | Stator Phase A1 RTD #7 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2069    | Stator Phase A1 RTD #8 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2070    | Stator Phase A1 RTD #9 (Temp)  | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2071    | Stator Phase A1 RTD #10 (Temp) | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2072    | Stator Phase A1 RTD #11 (Temp) | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2073    | Stator Phase A1 RTD #12 (Temp) | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2074    | Measured Run Cool Time         | UI    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2075    | Measured Stop Cool Time        | UI    |  | Celsius<br>(Fahrenheit)                                          |  |  |
|                 | 2076    | Hottest Stator RTD#            | UI    |  | -                                                                |  |  |
|                 | 2077    | Hottest Stator RTD Temperature | IN    |  | Celsius<br>(Fahrenheit)                                          |  |  |

|                 |               |                                       |       |  |                         |           |                                                                                                                         |
|-----------------|---------------|---------------------------------------|-------|--|-------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------|
|                 | 2078          | Hottest Non-Stator RTD#               | UI    |  | -                       |           |                                                                                                                         |
|                 | 2079          | Hottest Non-Stator RTD Temp           | IN    |  | Celsius<br>(Fahrenheit) |           |                                                                                                                         |
| Metering Page 4 | 2100          | Model # + Firmware Rev #              | UI    |  | -                       |           | If Model # +<br>Firmware<br>Rev # is<br>6.22, it<br>shows 622<br>here.                                                  |
|                 | 2101          | O/L Time Left to Trip                 | UI    |  | Second                  |           |                                                                                                                         |
|                 | 2102          | Therm Inh Time Left                   | UI    |  | Minute                  |           |                                                                                                                         |
|                 | 2103-<br>2104 | Coast Down Timer Time Left            | UNS32 |  | Millisecond             |           | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg:<br>MSW.                                                               |
|                 | 2105-<br>2106 | Time Between Starts Time              | UNS32 |  | Millisecond             |           | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg:<br>MSW.                                                               |
|                 | 2107-<br>2108 | Starts Per Hour Time #0               | UNS32 |  | Minute                  |           | 60min –<br>Time since<br>1 <sup>st</sup> start.                                                                         |
|                 | 2109-<br>2110 | Starts Per Hour Time #1               | UNS32 |  | Minute                  |           | 60min –Time<br>since 2 <sup>nd</sup><br>start.                                                                          |
|                 | 2111-<br>2112 | Starts Per Hour Time #2               | UNS32 |  | Minute                  |           | 60min –Time<br>since 3 <sup>rd</sup><br>start.                                                                          |
|                 | 2113-<br>2114 | Starts Per Hour Time #3               | UNS32 |  | Minute                  |           | 60min –Time<br>since 4 <sup>th</sup><br>start.                                                                          |
|                 | 2115-<br>2116 | Starts Per Hour Time #4               | UNS32 |  | Minute                  |           | 60min –Time<br>since 5 <sup>th</sup><br>start.                                                                          |
|                 | 2117-<br>2118 | Starts Per Hour Time #5               | UNS32 |  | Minute                  |           | 60min –Time<br>since 6th<br>start.                                                                                      |
|                 | 2119          | Relay Status (Power on, Relay status) | UI    |  | -                       |           | Bit0 of high<br>byte: 0=Pwr<br>off; 1=Pwr<br>On;<br>Bit0-7 of low<br>byte: relay1-<br>8. 0=relay<br>off; 1=relay<br>on. |
|                 | 2120          | Present Lcd Line1 (Char2, Char1)      | UI    |  |                         | 'O', 'M', | e.g.: MOTOR<br>STOPPED                                                                                                  |
|                 | 2121          | Present Lcd Line1 (Char4, Char3)      | UI    |  |                         | 'O', 'T', |                                                                                                                         |
|                 | 2122          | Present Lcd Line1 (Char6, Char5)      | UI    |  |                         | ' ', 'R', |                                                                                                                         |
|                 | 2123          | Present Lcd Line1 (Char8, Char7)      | UI    |  |                         | 'T', 'S', |                                                                                                                         |
|                 | 2124          | Present Lcd Line1 (Char10, Cha9)      | UI    |  |                         | 'P', 'O', |                                                                                                                         |
|                 | 2125          | Present Lcd Line1 (Char12, Char11)    | UI    |  |                         | 'E', 'P', |                                                                                                                         |
|                 | 2126          | Present Lcd Line1 (Char14, Char13)    | UI    |  |                         | ' ', 'D', |                                                                                                                         |
|                 | 2127          | Present Lcd Line1 (Char16, Char15)    | UI    |  |                         | ' ', ' ', |                                                                                                                         |
|                 | 2128          | Present Lcd Line1 (Char18, Char17)    | UI    |  |                         | ' ', ' ', |                                                                                                                         |
|                 | 2129          | Present Lcd Line1 (Char20, Char19)    | UI    |  |                         | ' ', ' ', |                                                                                                                         |
|                 | 2130          | Present Lcd Line2 (Char2, Char1)      | UI    |  |                         | 'E', 'R', | e.g.: READY<br>TO START                                                                                                 |
|                 | 2131          | Present Lcd Line2 (Char4, Char3)      | UI    |  |                         | 'D', 'A', |                                                                                                                         |
|                 | 2132          | Present Lcd Line2 (Char6, Char5)      | UI    |  |                         | ' ', 'Y', |                                                                                                                         |
|                 | 2133          | Present Lcd Line2 (Char8, Char7)      | UI    |  |                         | 'O', 'T', |                                                                                                                         |
|                 | 2134          | Present Lcd Line2 (Char10, Cha9)      | UI    |  |                         | 'S', ' ', |                                                                                                                         |
|                 | 2135          | Present Lcd Line2 (Char12, Char11)    | UI    |  |                         | 'A', 'T', |                                                                                                                         |
|                 | 2136          | Present Lcd Line2 (Char14, Char13)    | UI    |  |                         | 'T', 'R', |                                                                                                                         |
|                 | 2137          | Present Lcd Line2 (Char16, Char15)    | UI    |  |                         | ' ', ' ', |                                                                                                                         |
|                 | 2138          | Present Lcd Line2 (Char18, Char17)    | UI    |  |                         | ' ', ' ', |                                                                                                                         |
|                 | 2139          | Present Lcd Line2 (Char20, Char19)    | UI    |  |                         | ' ', ' ', |                                                                                                                         |

|                 |           |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |       |  |                                                                                                            |
|-----------------|-----------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|--|------------------------------------------------------------------------------------------------------------|
| Metering Page 5 | 2900      | Event Count                     | UI -<br>1-64. Numbers of events in Event Recorder – ring buffer. It also can be used for pointer while the numbers of events are less than 64, i.e. ring buffer has not been full yet.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |       |  |                                                                                                            |
|                 | 2901      | Event Start                     | UI-<br>0-63. A rolling pointer points to the oldest event - the starting event, while numbers of events are over 64 in ring buffer. It will not count until ring buffer is full.<br>If (2900)<64, (2901) = 0;<br>If (2900)=64, (2901) >=0 and Newest event entry # = (2901) – 1. It is mod 64 subtraction.<br>For example, there are 64 events in event recorder, and the oldest event starts from event Entry #5 2980-2995. We then will have (2900)=64, Newest event entry # = (2901)-1 = 5-1= 4 and (2902)=64. And the newest event will be logged into Event Entry #4 2964-2979 because of the scrolling. Note that the newest event will override the “last” oldest event after the event recorder is full. The pointer 2901 will keep scrolling to tell us what the oldest event is - the starting event in this ring buffer. |  |       |  |                                                                                                            |
|                 | 2902      | Event Size                      | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | -     |  | 64. Fixed Number to indicate the size of Event Recorder.                                                   |
|                 | 2903-2915 | Reserved                        | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 2916      | Event Entry #1: Year            | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | -     |  |                                                                                                            |
|                 | 2917      | Event Entry #1: Month & Day     | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | MM,DD |  | MM: month, DD: day.                                                                                        |
|                 | 2918      | Event Entry #1: Minutes & Hours | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | mm,hh |  | hh: hour, mm: minute,                                                                                      |
|                 | 2919      | Event Entry #1: Milliseconds    | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | ms    |  |                                                                                                            |
|                 | 2920      | Event Entry #1: Event Code      | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |       |  | See Table 2-19                                                                                             |
|                 | 2921      | Event Entry #1: Event Parameter | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |       |  | See Table 2-20                                                                                             |
|                 | 2922      | Event Entry #1: Current PhaseA  | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Amps  |  |                                                                                                            |
|                 | 2923      | Event Entry #1: Current PhaseB  | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Amps  |  |                                                                                                            |
|                 | 2924      | Event Entry #1: Current PhaseC  | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Amps  |  |                                                                                                            |
|                 | 2925      | Event Entry #1: Current GFault  | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Amps  |  |                                                                                                            |
|                 | 2926      | Event Entry #1: VPhaseA         | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Volts |  |                                                                                                            |
|                 | 2927      | Event Entry #1: VPhaseB         | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Volts |  |                                                                                                            |
|                 | 2928      | Event Entry #1: VPhaseC         | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Volts |  |                                                                                                            |
|                 | 2929      | Event Entry #1: PwrFactor       | UI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | -     |  |                                                                                                            |
|                 | 2930      | Event Entry #1: Reserved        | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 2931      | Event Entry #1: Reserved        | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 2932-2947 | Event Entry #2                  | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  | Note:<br>1. Structure of #2- #64 are same as the #1.<br>2. Each event entry takes total sixteen registers. |
|                 | 2948-2963 | Event Entry #3                  | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 2964-2979 | Event Entry #4                  | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 2980-2995 | Event Entry #5                  | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 2996-3011 | Event Entry #6                  | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |
|                 | 3012-3027 | Event Entry #7                  | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | -     |  |                                                                                                            |

|                 |           |                                          |       |         |   |                   |
|-----------------|-----------|------------------------------------------|-------|---------|---|-------------------|
|                 | 3028-3043 | Event Entry #8                           | -     | -       | - |                   |
|                 | 3044-3059 | Event Entry #9                           | -     | -       | - |                   |
|                 | 3060-3075 | Event Entry #10                          | -     | -       | - |                   |
|                 | 3076-3091 | Event Entry #11                          | -     | -       | - |                   |
|                 | ---       | ---                                      | -     | -       | - |                   |
|                 | 3860-3875 | Event Entry #60                          | -     | -       | - |                   |
|                 | 3876-3891 | Event Entry #61                          | -     | -       | - |                   |
|                 | 3892-3907 | Event Entry #62                          | -     | -       | - |                   |
|                 | 3908-3923 | Event Entry #63                          | -     | -       | - |                   |
|                 | 3924-3939 | Event Entry #64                          | -     | -       | - |                   |
|                 |           |                                          |       |         |   |                   |
| Metering Page 6 | 2150      | Last Trip Cause                          | IN    | -       |   | See Table 2-20    |
|                 | 2151      | Last Trip Value                          | UI    | -       |   | N/A               |
|                 | 2152      | Last Trip Iphase A                       | IN    | Amps    |   |                   |
|                 | 2153      | Last Trip Iphase B                       | IN    | Amps    |   |                   |
|                 | 2154      | Last Trip Iphase C                       | IN    | Amps    |   |                   |
|                 | 2155      | Last Trip GF                             | IN    | Amps    |   |                   |
|                 | 2156      | Last Trip Vphase A                       | IN    | Volts   |   |                   |
|                 | 2157      | Last Trip Vphase B                       | IN    | Volts   |   |                   |
|                 | 2158      | Last Trip Vphase C                       | IN    | Volts   |   |                   |
|                 | 2159      | Last Trip PF                             | IN    | -       |   |                   |
|                 | 2160      | Last Trip IB                             | UI    | %       |   |                   |
|                 | 2161      | Last Trip Line Frequency (Hz)            | UI    | Hz      |   |                   |
|                 | 2162      | Last Trip KW                             | UI    | Kw      |   |                   |
|                 | 2163      | Last Trip Hot Stator RTD #               | UI    | -       |   |                   |
|                 | 2164      | Last Trip Hot Stator RTD Temperature     | IN    | Celsius |   |                   |
|                 | 2165      | Last Trip Hot Non-Stator RTD #           | UI    | -       |   |                   |
|                 | 2166      | Last Trip Hot Non-Stator RTD Temperature | IN    | Celsius |   |                   |
|                 | 2167      | Last Trip Phase Order                    | UI    | -       |   | See Reg Addr 1094 |
| Metering Page 7 | 2200-2201 | MWH Total                                | UNS32 | Mwh     |   |                   |
|                 | 2202      | Running Hours Total                      | UI    | Hours   |   |                   |
|                 | 2203      | Total Trips                              | UI    | -       |   |                   |
|                 | 2204      | S/C Trips                                | UI    | -       |   |                   |
|                 | 2205      | Start O/L Trips                          | UI    | -       |   |                   |
|                 | 2206      | Run O/L Trips                            | UI    | -       |   |                   |
|                 | 2207      | Frequency Trips                          | UI    | -       |   |                   |
|                 | 2208      | I/B Trips                                | UI    | -       |   |                   |
|                 | 2209      | Overcurrent Trips                        | UI    | -       |   |                   |
|                 | 2210      | Stator Trips                             | UI    | -       |   |                   |
|                 | 2211      | NonStator Trips                          | UI    | -       |   |                   |
|                 | 2212      | G/F HISET Trips                          | UI    | -       |   |                   |
|                 | 2213      | G/F LOSET Trips                          | UI    | -       |   |                   |
|                 | 2214      | Acceleration Time Trips                  | UI    | -       |   |                   |
|                 | 2215      | Start Curve Trips                        | UI    | -       |   |                   |
|                 | 2216      | I*I*T Start Curve Trips                  | UI    | -       |   |                   |
|                 | 2217      | Learned Start Curve Trips                | UI    | -       |   |                   |
|                 | 2218      | Shunt Trips                              | UI    | -       |   |                   |

|  |      |                           |    |  |   |  |  |
|--|------|---------------------------|----|--|---|--|--|
|  | 2219 | Phase Loss Trips          | UI |  | - |  |  |
|  | 2220 | Tach Accel Trips          | UI |  | - |  |  |
|  | 2221 | U/V Trips                 | UI |  | - |  |  |
|  | 2222 | O/V Trips                 | UI |  | - |  |  |
|  | 2223 | Power Factor Accel Trips  | UI |  | - |  |  |
|  | 2224 | Voltage Phase Rev Trips   | UI |  | - |  |  |
|  | 2225 | External Input #1 Trips   | UI |  | - |  |  |
|  | 2226 | External Input #2 Trips   | UI |  | - |  |  |
|  | 2227 | External Input #3 Trips   | UI |  | - |  |  |
|  | 2228 | External Input #4 Trips   | UI |  | - |  |  |
|  | 2229 | Misc Trips                | UI |  | - |  |  |
|  | 2230 | Low Control Voltage Trips | UI |  |   |  |  |
|  |      |                           |    |  |   |  |  |
|  | 8888 | Device Category Number    | UI |  |   |  |  |
|  | 8889 | Reserved                  |    |  |   |  |  |

| Metering Page # | Register Address | Register Name              | Data      |       |             |         | Remark                                                            |
|-----------------|------------------|----------------------------|-----------|-------|-------------|---------|-------------------------------------------------------------------|
|                 |                  |                            | Data Type | Scale | Unit        | Example |                                                                   |
| Metering Page 1 | 2000             | IA (RMS IphaseA)           | UI        | x1    | Amps        |         | UI: Unsigned Integer<br>Note: Don't show scale later if it is x1. |
|                 | 2001             | IB (RMS IphaseB)           | UI        |       | Amps        |         |                                                                   |
|                 | 2002             | IC (RMS IphaseC)           | UI        |       | Amps        |         |                                                                   |
|                 | 2003             | G/F (RMS IGFault)          | UI        | x0.01 | Amps        |         |                                                                   |
|                 | 2004             | Vab (RMS Vab)              | UI        |       | Volts       |         | In page 2.                                                        |
|                 | 2005             | Vbc (RMS Vbc)              | UI        |       | Volts       |         | In page 2.                                                        |
|                 | 2006             | Vca (RMS Vca)              | UI        |       | Volts       |         | In page 2.                                                        |
|                 | 2007             | I(avg) RMS Iavg            | UI        |       | Amps        |         |                                                                   |
|                 | 2008             | RMS Vavg                   | UI        |       | Amps        |         | In page 2.                                                        |
|                 | 2009             | Motor Load % of FLA        | UI        |       | %           |         |                                                                   |
|                 | 2010             | G/F (RMS IGFault)          | UI        |       | Amps        |         |                                                                   |
|                 | 2011             | Thermal Register Remaining | IN        |       | %           |         | IN: Integer                                                       |
|                 | 2012             | Thermal Register to Start  | IN        |       | %           |         |                                                                   |
|                 | 2013             | I/B (Current ImBalance)    | IN        |       | %           |         |                                                                   |
|                 | 2014             | Reserved                   | IN        |       | -           |         |                                                                   |
|                 | 2015             | I*I*T to Start             | UI        |       | Amp*Amp*Sec |         | See Reg Addr 1605                                                 |
|                 | 2016             | Average Start Time         | UI        |       | Sec         |         |                                                                   |
|                 | 2017             | Last Start Time            | UI        |       | Sec         |         |                                                                   |
|                 | 2018             | Average Start Current      | UI        |       | Amps        |         |                                                                   |
|                 | 2019             | Reserved                   | UI        |       |             |         |                                                                   |
|                 | 2020             | Line Frequency             | UI        |       | Hz          |         |                                                                   |
|                 | 2021             | Power Factor               | IN        | x0.01 | -           |         | In page 2.                                                        |
|                 | 2022             | RPM                        | IN        |       | Rpm         |         |                                                                   |
|                 | 2023             | Phase Order                | UI        |       | -           |         | 0=Unknown,<br>1=ABC,<br>2=ACB                                     |

|                 |         |                               |       |       |                                                            |  |                                                                                                                       |
|-----------------|---------|-------------------------------|-------|-------|------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------|
| Metering Page 2 | 2800    | Reserved                      | UI    |       | -                                                          |  |                                                                                                                       |
|                 | 2801    | Power Factor Sign             | UI    |       | -                                                          |  | 0: Lead; 1: Lag                                                                                                       |
|                 | 2802    | Power Factor                  | IN    | x0.01 | -                                                          |  |                                                                                                                       |
|                 | 2803    | KWH Used                      | IN    |       | kWh                                                        |  |                                                                                                                       |
|                 | 2804-5  | KW                            | UNS32 |       | kW                                                         |  | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg: MSW.<br>LSW: Least Significant Word;<br>MSW: Most Significant Word; |
|                 | 2806-7  | KVA                           | UNS32 |       | kW                                                         |  | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg: MSW.                                                                |
|                 | 2808-9  | KVAR                          | UNS32 |       | kW                                                         |  |                                                                                                                       |
|                 | 2810-11 | MWH Used                      | UNS32 |       | MWh                                                        |  |                                                                                                                       |
|                 | 2812-13 | Peak kW                       | UNS32 |       | kW                                                         |  |                                                                                                                       |
|                 | 2814-15 | Peak KVA                      | UNS32 |       | kW                                                         |  |                                                                                                                       |
|                 | 2816-17 | Peak KVAR                     | UNS32 |       | kW                                                         |  |                                                                                                                       |
|                 | 2818-19 | Peak Amps                     | UNS32 |       | Amps                                                       |  |                                                                                                                       |
|                 | 2820-21 | Peak kW Time                  | UNS32 |       | 1 <sup>st</sup> reg: hh,mm ;<br>2 <sup>nd</sup> reg: MM,DD |  | hh: hour,<br>mm: minute,<br>MM: month,<br>DD: day.                                                                    |
|                 | 2822-23 | Peak KVA Time                 | UNS32 |       | 1 <sup>st</sup> reg: hh,mm ;<br>2 <sup>nd</sup> reg: MM,DD |  |                                                                                                                       |
|                 | 2824-25 | Peak KVAR Time                | UNS32 |       | 1 <sup>st</sup> reg: hh,mm ;<br>2 <sup>nd</sup> reg: MM,DD |  |                                                                                                                       |
|                 | 2826-27 | Peak Amps Time                | UNS32 |       | 1 <sup>st</sup> reg: hh,mm ;<br>2 <sup>nd</sup> reg: MM,DD |  |                                                                                                                       |
|                 |         |                               |       |       |                                                            |  |                                                                                                                       |
| Metering Page 3 | 2050    | Max Temp Since Clear RTD #1   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2051    | Max Temp Since Clear RTD #2   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2052    | Max Temp Since Clear RTD #3   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2053    | Max Temp Since Clear RTD #4   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2054    | Max Temp Since Clear RTD #5   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2055    | Max Temp Since Clear RTD #6   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2056    | Max Temp Since Clear RTD #7   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2057    | Max Temp Since Clear RTD #8   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2058    | Max Temp Since Clear RTD #9   | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2059    | Max Temp Since Clear RTD #10  | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2060    | Max Temp Since Clear RTD #11  | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2061    | Max Temp Since Clear RTD #12  | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |
|                 | 2062    | Stator Phase A1 RTD #1 (Temp) | IN    |       | Celsius (Fahrenheit)                                       |  |                                                                                                                       |

|                 |               |                                |       |  |                         |  |                                                                           |
|-----------------|---------------|--------------------------------|-------|--|-------------------------|--|---------------------------------------------------------------------------|
|                 | 2063          | Stator Phase A1 RTD #2 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2064          | Stator Phase A1 RTD #3 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2065          | Stator Phase A1 RTD #4 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2066          | Stator Phase A1 RTD #5 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2067          | Stator Phase A1 RTD #6 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2068          | Stator Phase A1 RTD #7 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2069          | Stator Phase A1 RTD #8 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2070          | Stator Phase A1 RTD #9 (Temp)  | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2071          | Stator Phase A1 RTD #10 (Temp) | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2072          | Stator Phase A1 RTD #11 (Temp) | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2073          | Stator Phase A1 RTD #12 (Temp) | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2074          | Measured Run Cool Time         | UI    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2075          | Measured Stop Cool Time        | UI    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2076          | Hottest Stator RTD#            | UI    |  | -                       |  |                                                                           |
|                 | 2077          | Hottest Stator RTD Temperature | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
|                 | 2078          | Hottest Non-Stator RTD#        | UI    |  | -                       |  |                                                                           |
|                 | 2079          | Hottest Non-Stator RTD Temp    | IN    |  | Celsius<br>(Fahrenheit) |  |                                                                           |
| Metering Page 4 | 2100          | Firmware Rev                   | UI    |  | -                       |  | If whole rev #<br>is 6.22, only<br>show 22<br>here, without<br>model # 6. |
|                 | 2101          | O/L Time Left to Trip          | UI    |  | Second                  |  |                                                                           |
|                 | 2102          | Therm Inh Time Left            | UI    |  | Minute                  |  |                                                                           |
|                 | 2103-<br>2104 | Coast Down Timer Time Left     | UNS32 |  | Millisecond             |  | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg:<br>MSW.                 |
|                 | 2105-<br>2106 | Time Between Starts Time       | UNS32 |  | Millisecond             |  | 1 <sup>st</sup> reg: LSW;<br>2 <sup>nd</sup> reg:<br>MSW.                 |
|                 | 2107-<br>2108 | Starts Per Hour Time #0        | UNS32 |  | Minute                  |  | 60min –<br>Time since<br>1 <sup>st</sup> start.                           |
|                 | 2109-<br>2110 | Starts Per Hour Time #1        | UNS32 |  | Minute                  |  | 60min –Time<br>since 2 <sup>nd</sup><br>start.                            |
|                 | 2111-<br>2112 | Starts Per Hour Time #2        | UNS32 |  | Minute                  |  | 60min –Time<br>since 3 <sup>rd</sup><br>start.                            |
|                 | 2113-<br>2114 | Starts Per Hour Time #3        | UNS32 |  | Minute                  |  | 60min –Time<br>since 4 <sup>th</sup><br>start.                            |
|                 | 2115-<br>2116 | Starts Per Hour Time #4        | UNS32 |  | Minute                  |  | 60min –Time<br>since 5 <sup>th</sup><br>start.                            |
|                 | 2117-<br>2118 | Starts Per Hour Time #5        | UNS32 |  | Minute                  |  | 60min –Time<br>since 6th<br>start.                                        |

|                 |      |                                       |    |  |   |          |                                                                                                                                                                                   |
|-----------------|------|---------------------------------------|----|--|---|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | 2119 | Relay Status (Power on, Relay status) | UI |  | - |          | Bit0 of high byte: 0=Pwr off; 1=Pwr On;<br>Bit0-7 of low byte: relay1-8. 0=relay off; 1=relay on.                                                                                 |
|                 | 2120 | Present Lcd Line1 (Char2, Char1)      | UI |  |   | 'O','M', | e.g.: MOTOR STOPPED                                                                                                                                                               |
|                 | 2121 | Present Lcd Line1 (Char4, Char3)      | UI |  |   | 'O','T', |                                                                                                                                                                                   |
|                 | 2122 | Present Lcd Line1 (Char6, Char5)      | UI |  |   | ' ','R', |                                                                                                                                                                                   |
|                 | 2123 | Present Lcd Line1 (Char8, Char7)      | UI |  |   | 'T','S', |                                                                                                                                                                                   |
|                 | 2124 | Present Lcd Line1 (Char10, Cha9)      | UI |  |   | 'P','O', |                                                                                                                                                                                   |
|                 | 2125 | Present Lcd Line1 (Char12, Char11)    | UI |  |   | 'E','P', |                                                                                                                                                                                   |
|                 | 2126 | Present Lcd Line1 (Char14, Char13)    | UI |  |   | ' ','D', |                                                                                                                                                                                   |
|                 | 2127 | Present Lcd Line1 (Char16, Char15)    | UI |  |   | ' ',' ', |                                                                                                                                                                                   |
|                 | 2128 | Present Lcd Line1 (Char18, Char17)    | UI |  |   | ' ',' ', |                                                                                                                                                                                   |
|                 | 2129 | Present Lcd Line1 (Char20, Char19)    | UI |  |   | ' ',' ', |                                                                                                                                                                                   |
|                 | 2130 | Present Lcd Line2 (Char2, Char1)      | UI |  |   | 'E','R', | e.g.: READY TO START                                                                                                                                                              |
|                 | 2131 | Present Lcd Line2 (Char4, Char3)      | UI |  |   | 'D','A', |                                                                                                                                                                                   |
|                 | 2132 | Present Lcd Line2 (Char6, Char5)      | UI |  |   | ' ','Y', |                                                                                                                                                                                   |
|                 | 2133 | Present Lcd Line2 (Char8, Char7)      | UI |  |   | 'O','T', |                                                                                                                                                                                   |
|                 | 2134 | Present Lcd Line2 (Char10, Cha9)      | UI |  |   | 'S',' ', |                                                                                                                                                                                   |
|                 | 2135 | Present Lcd Line2 (Char12, Char11)    | UI |  |   | 'A','T', |                                                                                                                                                                                   |
|                 | 2136 | Present Lcd Line2 (Char14, Char13)    | UI |  |   | 'T','R', |                                                                                                                                                                                   |
|                 | 2137 | Present Lcd Line2 (Char16, Char15)    | UI |  |   | ' ',' ', |                                                                                                                                                                                   |
|                 | 2138 | Present Lcd Line2 (Char18, Char17)    | UI |  |   | ' ',' ', |                                                                                                                                                                                   |
|                 | 2139 | Present Lcd Line2 (Char20, Char19)    | UI |  |   | ' ',' ', |                                                                                                                                                                                   |
|                 |      |                                       |    |  |   |          |                                                                                                                                                                                   |
| Metering Page 5 | 2900 | Event Count                           | UI |  | - |          | 1-64.<br>Numbers of events in Event Recorder – ring buffer. It also can be used for pointer while the numbers of events are less than 64, i.e. ring buffer has not been full yet. |

|  |           |             |    |  |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--|-----------|-------------|----|--|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | 2901      | Event Start | UI |  | - | <p>0-63. A rolling pointer points to the oldest event - the starting event, while numbers of events are over 64 in ring buffer. It will not count until ring buffer is full. If <math>(2900) &lt; 64</math>, <math>(2901) = 0</math>; If <math>(2900) = 64</math>, <math>(2901) \geq 0</math> and Newest event entry # = <math>(2901) - 1</math>. It is mod 64 subtraction. For example, there are 64 events in event recorder, and the oldest event starts from Event Entry #5 2980-2995. We then will have <math>(2900) = 64</math>, Newest event entry # = <math>(2901) - 1 = 5 - 1 = 4</math> and <math>(2902) = 64</math>. And the newest event will be logged into Event Entry #4 2964-2979 because of the scrolling. Note that the newest event will override the "last" oldest event after the event recorder is full. The pointer 2901 will keep scrolling to tell us where is the oldest event - the starting event in this ring buffer.</p> |
|  | 2902      | Event Size  | UI |  | - | <p>64. Fixed Number to indicates the size of Event Recorder.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|  | 2903-2915 | Reserved    | -  |  | - |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                 |               |                                 |    |  |       |  |                                                                                                                                    |
|-----------------|---------------|---------------------------------|----|--|-------|--|------------------------------------------------------------------------------------------------------------------------------------|
|                 | 2916          | Event Entry #1: Year            | UI |  | -     |  |                                                                                                                                    |
|                 | 2917          | Event Entry #1: Month & Day     | UI |  | MM,DD |  | MM: month,<br>DD: day.                                                                                                             |
|                 | 2918          | Event Entry #1: Minutes & Hours | UI |  | mm,hh |  | hh: hour,<br>mm: minute,                                                                                                           |
|                 | 2919          | Event Entry #1: Milliseconds    | UI |  | ms    |  |                                                                                                                                    |
|                 | 2920          | Event Entry #1: Event Code      | UI |  |       |  | See Table<br>A-19                                                                                                                  |
|                 | 2921          | Event Entry #1: Event Parameter | UI |  |       |  | See Table<br>A-20                                                                                                                  |
|                 | 2922          | Event Entry #1: Current PhaseA  | UI |  | Amps  |  |                                                                                                                                    |
|                 | 2923          | Event Entry #1: Current PhaseB  | UI |  | Amps  |  |                                                                                                                                    |
|                 | 2924          | Event Entry #1: Current PhaseC  | UI |  | Amps  |  |                                                                                                                                    |
|                 | 2925          | Event Entry #1: Current GFault  | UI |  | Amps  |  |                                                                                                                                    |
|                 | 2926          | Event Entry #1: VPhaseA         | UI |  | Volts |  |                                                                                                                                    |
|                 | 2927          | Event Entry #1: VPhaseB         | UI |  | Volts |  |                                                                                                                                    |
|                 | 2928          | Event Entry #1: VPhaseC         | UI |  | Volts |  |                                                                                                                                    |
|                 | 2929          | Event Entry #1: PwrFactor       | UI |  | -     |  |                                                                                                                                    |
|                 | 2930          | Event Entry #1: Reserved        | -  |  | -     |  |                                                                                                                                    |
|                 | 2931          | Event Entry #1: Reserved        | -  |  | -     |  |                                                                                                                                    |
|                 | 2932-<br>2947 | Event Entry #2                  | -  |  | -     |  | Note:<br>1. Structure<br>of #2-#64 are<br>the same as<br>the #1.<br>2. Each<br>event entry<br>takes total<br>sixteen<br>registers. |
|                 | 2948-<br>2963 | Event Entry #3                  | -  |  | -     |  |                                                                                                                                    |
|                 | 2964-<br>2979 | Event Entry #4                  | -  |  | -     |  |                                                                                                                                    |
|                 | 2980-<br>2995 | Event Entry #5                  | -  |  | -     |  |                                                                                                                                    |
|                 | 2996-<br>3011 | Event Entry #6                  | -  |  | -     |  |                                                                                                                                    |
|                 | 3012-<br>3027 | Event Entry #7                  | -  |  | -     |  |                                                                                                                                    |
|                 | 3028-<br>3043 | Event Entry #8                  | -  |  | -     |  |                                                                                                                                    |
|                 | 3044-<br>3059 | Event Entry #9                  | -  |  | -     |  |                                                                                                                                    |
|                 | 3060-<br>3075 | Event Entry #10                 | -  |  | -     |  |                                                                                                                                    |
|                 | 3076-<br>3091 | Event Entry #11                 | -  |  | -     |  |                                                                                                                                    |
|                 | ---           | ---                             | -  |  | -     |  |                                                                                                                                    |
|                 | 3860-<br>3875 | Event Entry #60                 | -  |  | -     |  |                                                                                                                                    |
|                 | 3876-<br>3891 | Event Entry #61                 | -  |  | -     |  |                                                                                                                                    |
|                 | 3892-<br>3907 | Event Entry #62                 | -  |  | -     |  |                                                                                                                                    |
|                 | 3908-<br>3923 | Event Entry #63                 | -  |  | -     |  |                                                                                                                                    |
|                 | 3924-<br>3939 | Event Entry #64                 | -  |  | -     |  |                                                                                                                                    |
|                 |               |                                 |    |  |       |  |                                                                                                                                    |
|                 |               |                                 |    |  |       |  |                                                                                                                                    |
| Metering Page 6 | 2150          | Last Trip Cause                 | IN |  | -     |  | See Table 2-<br>20                                                                                                                 |
|                 | 2151          | Last Trip Value                 | UI |  | -     |  | N/A                                                                                                                                |
|                 | 2152          | Last Trip Iphase A              | IN |  | Amps  |  |                                                                                                                                    |

|                 |           |                                          |       |  |         |  |                    |
|-----------------|-----------|------------------------------------------|-------|--|---------|--|--------------------|
|                 | 2153      | Last Trip Iphase B                       | IN    |  | Amps    |  |                    |
|                 | 2154      | Last Trip Iphase C                       | IN    |  | Amps    |  |                    |
|                 | 2155      | Last Trip GF                             | IN    |  | Amps    |  |                    |
|                 | 2156      | Last Trip Vphase A                       | IN    |  | Volts   |  |                    |
|                 | 2157      | Last Trip Vphase B                       | IN    |  | Volts   |  |                    |
|                 | 2158      | Last Trip Vphase C                       | IN    |  | Volts   |  |                    |
|                 | 2159      | Last Trip PF                             | IN    |  | -       |  |                    |
|                 | 2160      | Last Trip IB                             | UI    |  | %       |  |                    |
|                 | 2161      | Last Trip Line Frequency (Hz)            | UI    |  | Hz      |  |                    |
|                 | 2162      | Last Trip kW                             | UI    |  | kW      |  |                    |
|                 | 2163      | Last Trip Hot Stator RTD #               | UI    |  | -       |  |                    |
|                 | 2164      | Last Trip Hot Stator RTD Temperature     | IN    |  | Celsius |  |                    |
|                 | 2165      | Last Trip Hot Non-Stator RTD #           | UI    |  | -       |  |                    |
|                 | 2166      | Last Trip Hot Non-Stator RTD Temperature | IN    |  | Celsius |  |                    |
|                 | 2167      | Last Trip Phase Order                    | UI    |  | -       |  | See Reg. Addr 1094 |
|                 |           |                                          |       |  |         |  |                    |
|                 |           |                                          |       |  |         |  |                    |
| Metering Page 7 | 2200-2201 | MWH Total                                | UNS32 |  | MWh     |  |                    |
|                 | 2202      | Running Hours Total                      | UI    |  | Hours   |  |                    |
|                 | 2203      | Total Trips                              | UI    |  | -       |  |                    |
|                 | 2204      | S/C Trips                                | UI    |  | -       |  |                    |
|                 | 2205      | Start O/L Trips                          | UI    |  | -       |  |                    |
|                 | 2206      | Run O/L Trips                            | UI    |  | -       |  |                    |
|                 | 2207      | Frequency Trips                          | UI    |  | -       |  |                    |
|                 | 2208      | I/B Trips                                | UI    |  | -       |  |                    |
|                 | 2209      | Overcurrent Trips                        | UI    |  | -       |  |                    |
|                 | 2210      | Stator Trips                             | UI    |  | -       |  |                    |
|                 | 2211      | Bearing Trips                            | UI    |  | -       |  |                    |
|                 | 2212      | G/F HISET Trips                          | UI    |  | -       |  |                    |
|                 | 2213      | G/F LOSET Trips                          | UI    |  | -       |  |                    |
|                 | 2214      | Acceleration Time Trips                  | UI    |  | -       |  |                    |
|                 | 2215      | Start Curve Trips                        | UI    |  | -       |  |                    |
|                 | 2216      | I*I*T Start Curve Trips                  | UI    |  | -       |  |                    |
|                 | 2217      | Learned Start Curve Trips                | UI    |  | -       |  |                    |
|                 | 2218      | Shunt Trips                              | UI    |  | -       |  |                    |
|                 | 2219      | Phase Loss Trips                         | UI    |  | -       |  |                    |
|                 | 2220      | Tach Accel Trips                         | UI    |  | -       |  |                    |
|                 | 2221      | U/V Trips                                | UI    |  | -       |  |                    |
|                 | 2222      | O/V Trips                                | UI    |  | -       |  |                    |
|                 | 2223      | Power Factor Accel Trips                 | UI    |  | -       |  |                    |
|                 | 2224      | Voltage Phase Rev Trips                  | UI    |  | -       |  |                    |
|                 | 2225      | External Input #1 Trips                  | UI    |  | -       |  |                    |
|                 | 2226      | External Input #2 Trips                  | UI    |  | -       |  |                    |
|                 | 2227      | External Input #3 Trips                  | UI    |  | -       |  |                    |
|                 | 2228      | External Input #4 Trips                  | UI    |  | -       |  |                    |
|                 | 2229      | Misc Trips                               | UI    |  | -       |  |                    |

Table A-19 lists Event Code shown in Metering Page 5

| Event Code | Shown in Event Recorder                  | Remark               |
|------------|------------------------------------------|----------------------|
| 6          | See Event Parameter for individual event | Alarm                |
| 7          | See Event Parameter for individual event | Trip                 |
| 8          | See Event Parameter for individual event | Trip and alarm clear |
| 27         | See Event Parameter for individual event | System Diagnostic    |
| 0xffff     | DS1 POWER ON                             | Power on             |

Table A-20 lists Event Parameter shown in Metering Page 5 and Last Trip Cause in Metering Page 6

| Event Parameter                                 | Shown in Event Recorder | Remark |
|-------------------------------------------------|-------------------------|--------|
| For Event Code 6 and 7,<br>and Last Trip Cause: |                         |        |
| 0                                               | OVERLOAD WARNING        |        |
| 1                                               | IMBALANCE ALARM         |        |
| 2                                               | GROUND FAULT ALARM      |        |
| 3                                               | UNDERCURRENT ALARM      |        |
| 4                                               | OVERCURRENT ALARM       |        |
| 5                                               | THERMAL REG ALARM       |        |
| 6                                               | SELT TEST ALARM         |        |
| 7                                               | OVER VOLTAGE ALARM      |        |
| 8                                               | UNDER VOLTAGE ALARM     |        |
| 9                                               | KW DEMAND ALARM         |        |
| 10                                              | KVA DEMAND ALARM        |        |
| 11                                              | KVAR DEMAND ALARM       |        |
| 12                                              | CURRENT DEMAND ALARM    |        |
| 13                                              | PWR FACTOR LD ALARM     |        |
| 14                                              | PWR FACTOR LAG ALARM    |        |
| 15                                              | STATOR RTD ALARM        |        |
| 16                                              | RTD ALARM               |        |
| 17                                              | RTD FAILURE ALARM       |        |
| 18                                              | SPARE INPUT 1 ALARM     |        |
| 19                                              | SPARE INPUT 2 ALARM     |        |
| 20                                              | SPARE INPUT 3 ALARM     |        |
| 21                                              | SPARE INPUT 4 ALARM     |        |
| 22                                              | OVERLOAD TRIP           |        |
| 23                                              | IMBALANCE TRIP          |        |
| 24                                              | SHORT CIRCUIT TRIP      |        |
| 25                                              | STATOR TRIP             |        |
| 26                                              | RTD TRIP                |        |
| 27                                              | OVERCURRENT TRIP        |        |
| 28                                              | GROUND FAULT LO TRIP    |        |
| 29                                              | GROUND FAULT HI TRIP    |        |
| 30                                              | PHASE LOSS TRIP         |        |
| 31                                              | PHASE ORDER TRIP        |        |
| 32                                              | ACCELERATION TRIP       |        |
| 33                                              | TACH TRIP @ xxxx RPM    |        |
| 34                                              | BASIC START CRV TRIP    |        |
| 35                                              | START CRV UNDER TRIP    |        |
| 36                                              | START CRV OVER TRIP     |        |
| 37                                              | OVER VOLTAGE TRIP       |        |
| 38                                              | UNDER VOLTAGE TRIP      |        |
| 39                                              | PWR FACTOR LEAD TRIP    |        |
| 40                                              | PWR FACTOR LAG TRIP     |        |
| 41                                              | OVERFREQUENCY TRIP      |        |
| 42                                              | UNDERFREQUENCY TRIP     |        |

|                    |                      |  |
|--------------------|----------------------|--|
| 43                 | THERMAL CAP INHIB    |  |
| 44                 | COASTDOWN TMR INHIB  |  |
| 45                 | TIME BETWEEN INHIB   |  |
| 46                 | STARTS PER HR INHIB  |  |
| 47                 | BYPASS DISCREPANCY   |  |
| 48                 | CURRENT RISE         |  |
| 49                 | CURRENT FALL OFF     |  |
| 50                 | INHIBITS CLEAR       |  |
| 51                 | MOTOR RUNNING        |  |
| 52                 | DELAYED RUN          |  |
| 53                 | AT SPEED             |  |
| 54                 | TIMED OUTPUT         |  |
| 55                 | FIRING OFF           |  |
| 56                 | SHUNT TRIP           |  |
| For Event Code 8:  |                      |  |
| 43                 | THERM CAP INHIB CLR  |  |
| 44                 | COASTDOWN INHIB CLR  |  |
| 45                 | TIME BETW INHIB CLR  |  |
| 46                 | STARTS PER HR CLEAR  |  |
| 47                 | BYPASS DISC. CLEAR   |  |
| 52                 | DELAYED RUN CLEAR    |  |
| 53                 | AT SPEED CLEAR       |  |
| 54                 | TIMED OUTPUT CLEAR   |  |
| 55                 | FIRING OFF CLEAR     |  |
| 56                 | SHUNT TRIP CLEAR     |  |
| For Event Code 27: |                      |  |
| 1                  | FIRMWARE UPGRADED    |  |
| 2                  | FACTORY RESET        |  |
| 3                  | THERMAL CAP RESET    |  |
| 4                  | FLASH READ ERROR     |  |
| 5                  | FLASH WRITE ERROR    |  |
| 6                  | MEM ERROR. BATTERY?  |  |
| 7                  | SOFTWARE RESET       |  |
| 8                  | WATCHDOG RESET       |  |
| 9                  | WARM REBOOT          |  |
| 10                 | RTD INIT ERROR       |  |
| 11                 | KEYPAD ENTRY TIMEOUT |  |



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