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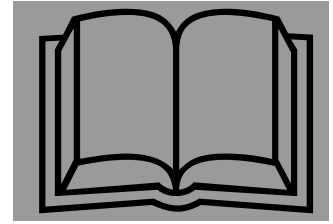
OTIS ELEVATOR COMPANY  

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INSTALLATION PROCESS MANUAL  

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ID 1.1.14-3



# Hydraulic Elevator Pump Motor Soft Starter Installation

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## 1. Introduction

This manual provides application information, instructions for installation, and a troubleshooting guide for the Otis solid state starter for hydraulic elevator pump motors (p/n AAA21240ADxx).

### 1.1 Description

A soft starter combines microprocessor and SCR technology to control AC induction motor starting and operation. The primary function of this unit is to provide current limit starting, which produces a “soft” start for the elevator pump motor. Electronically controlling the voltage applied to the motor windings during starting eliminates high inrush current and reduces mechanical stress on the hydraulic pump. The starting current limit is adjustable from 200% to 450% of the motor full-load current.

There are two main components: a control/power module and a fault contactor (see Figure 1). The fault contactor is provided to interrupt power to the motor in the event a fault condition occurs, such as a shorted SCR. Following application of control power to the starter, a diagnostic self-test is performed and the mainline supply is checked for proper phase rotation. If the self-test passes and the phase rotation is A – B – C, the fault contactor closes. Another check is performed to determine if the motor is wired properly and that the mainline is a balanced 3-phase supply. The fault contactor opens if there is a motor wiring error or a mainline power quality problem. Otherwise, the contactor remains closed and the starter is ready to run the motor. In normal operation, the motor is started and stopped electronically by applying/removing the RUN signal. The fault contactor stays closed until control power is removed or a fault condition is detected.

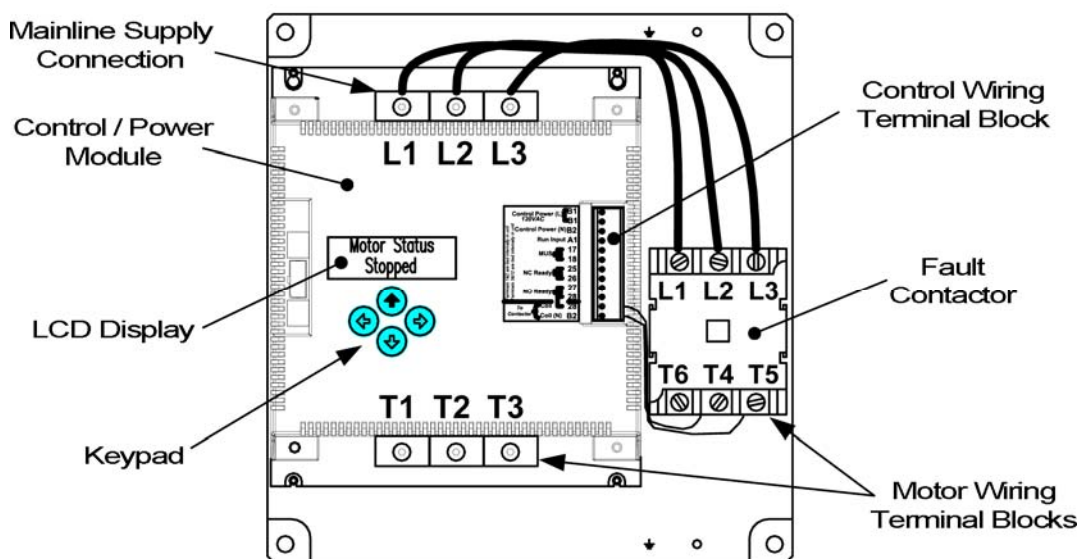


Figure 1: AAA21240ADxx Solid State Starter

## 1.2 Features

- Replacement for Across-the-Line, Inside-Delta, Wye-Delta, and Reduced Voltage starters
- Infinitely adjustable start profile controls current from 200 % to 450 % of the motor full-load current to provide a “soft” start that eliminates a sudden surge on building power
- Interfaces with microprocessor or relay logic based hydraulic elevator controllers
- Motor protection is provided by built-in overload relay, phase loss detection, current imbalance, and reverse phase detection.
- Capability to cycle the fault contactor before each start if required by code or elevator control system design. Refer to the description of “Cycle Fault contactor” in Section 5.8, OEM Parameters, for additional information.
- 16-character, 2-line liquid crystal display to show values of configuration parameters, starter status, and fault/diagnostic data.
- 4-button keypad to navigate menu-driven setup, change configuration parameters, and retrieve fault and diagnostic data.
- Built-in test detects microprocessor errors, over/under voltage, shorted SCRs, and motor wiring errors. Diagnostics store fault type, starting currents, and starter runtime data. Refer to Section 7, Electrical Specifications, for additional information.

## 1.3 Line and Phase Current Relationship

Figure 2 represents a 3-phase, 6-lead, delta-connected motor. As shown in the diagram, the **line current** is split between two motor windings. The current flowing through each delta-connected motor winding is known as **phase current**. In a 3-phase system, the relationship between line current and phase current is:

$$\text{Phase Current} = \text{Line Current} / 1.732$$

Carrying out the division shows that phase current is approximately 57% of line current.

### Example:

40 Hp, 230 VAC Motor

Full Load (line) Current = 104 Amps

Phase Current =  $104 / 1.732 = 60$  Amps

For inside-delta connection, use starter p/n AAA21240AD8.

For across-the-line connection, use starter p/n AAA21240AD10.

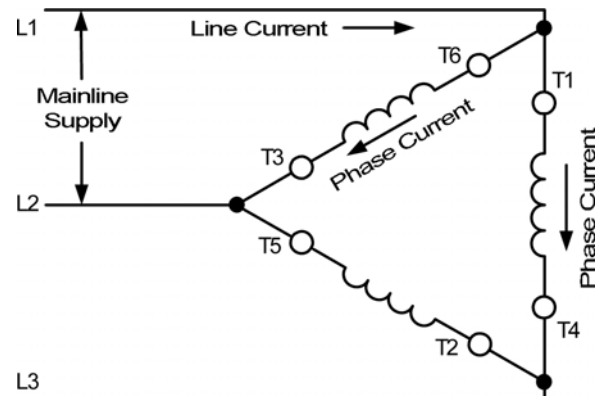


Figure 2: Line vs. Phase Current Relationship

By connecting a starter “inside-the-delta” a motor of a higher current rating than that of the starter can be operated. In this case, the starter carries 57% of the motor full load (nameplate) current. Should the starter be connected in-line (across-the-line starting), a larger unit capable of carrying 100% of the motor full load current is required.

To take advantage of using a smaller size unit, soft starters are factory wired for inside-delta connection (6- or 12-lead motors). Starters are field convertible for across-the-line starting (3- or 9-lead motors). The starter unit automatically recognizes whether it is connected inside-delta or across-the-line and adjusts the **overload** range accordingly. Ratings (tables 1 through 4 in section 2) take into consideration the line current vs. phase current relationship and provide the appropriate starter part number according to motor voltage, hp, and connection type; no calculations are necessary.

#### 1.4 Mainline Power Quality

To prevent damage to the motor, the solid state starter monitors incoming power for high/low voltage conditions, phase imbalance, reverse phase, phase angle, and phase loss. As such, the unit will not work where mainline power does not meet balanced, 3-phase service requirements. Mainline power quality is affected where a rotary converter, static converter, add-a-phase, or similar equipment is used to synthesize 3-phase power. Should the required mainline service not be available, a Phase Perfect<sup>®</sup> Digital Phase Converter can be used to produce high quality, 3-phase power that is compatible with the solid state starter.

## 2. Starter Application Tables

Tables 1 through 4 list the starter required for a particular application by wiring configuration (inside delta or across-the-line) and motor rating along with mainline supply voltage.

**Table 1: Inside-Delta Connection, Mainline up to 480 VAC**

Mainline 200–220 VAC	Mainline 200–220 VAC	Mainline 220–240 VAC	Mainline 440–480 VAC	Motor Full Load Current Range (Amps)	Soft Starter P/N
hp @ 200 VAC	hp @208 VAC	hp @230 VAC	hp @ 460 VAC		
5	5	5	5 to 10	5 to 22	AAA21240AD11
7.5 to 20	7.5 to 20	7.5 to 20	15 to 50	17 to 68	AAA21240AD5
25	25	25	60	20 to 80	AAA21240AD6
30	30	30	75	26 to 105	AAA21240AD7
40	40	40	100	32 to 130	AAA21240AD8
50	50	50	125	39 to 156	AAA21240AD9
60 to 75	60 to 75	60 to 100	---	63 to 252	AAA21240AD10

**Table 2: Inside-Delta Connection, Mainline up to 600 VAC**

Mainline 550–600 VAC	Motor Full Load Current Range (Amps)	Soft Starter P/N
hp @ 575 VAC		
5 to 15	5 to 22	AAA21240AD11
20 to 30	9 to 35	AAA21240AD12
40	10 to 42	AAA21240AD13
50	14 to 55	AAA21240AD14
60	17 to 68	AAA21240AD15
75	20 to 80	AAA21240AD16
100	26 to 105	AAA21240AD17
125	32 to 130	AAA21250AD18



**Table 3: Across-the-Line Connection, Mainline up to 480 VAC**

<b>Mainline 200–220 VAC</b>	<b>Mainline 200–220 VAC</b>	<b>Mainline 220–240 VAC</b>	<b>Mainline 440–480 VAC</b>	<b>Motor Full Load Current Range (Amps)</b>	<b>Soft Starter P/N</b>
<b>hp @ 200 VAC</b>	<b>hp @208 VAC</b>	<b>hp @230 VAC</b>	<b>hp @ 460 VAC</b>		
---	---	---	5 to 7.5	3 to 13	AAA21240AD11
5 to 10	5 to 10	5 to 10	10 to 25	10 to 39	AAA21240AD5
---	---	15	30	12 to 46	AAA21240AD6
15	15	20	40	15 to 60	AAA21240AD7
20	20	25	50	19 to 75	AAA21240AD8
25	25	30	60	23 to 90	AAA21240AD9
30 to 40	30 to 50	40 to 50	---	37 to 145	AAA21240AD10

**Table 4: Across-the-Line Connection, Mainline up to 600 VAC**

<b>Mainline 550–600 VAC</b>	<b>Motor Full Load Current Range (Amps)</b>	<b>Soft Starter P/N</b>
<b>hp @ 575 VAC</b>		
5 to 10	3 to 13	AAA21240AD11
15	5 to 20	AAA21240AD12
20	6 to 24	AAA21240AD13
25	10 to 31	AAA21240AD14
30	10 to 39	AAA21240AD15
40	12 to 46	AAA21240AD16
50	15 to 60	AAA21240AD17
60	19 to 75	AAA21250AD18

### 3. Installation

The following instructions are recommended as guidelines for proper installation of the starter. Due to the variety of job sites and local requirements, all of these guidelines may not pertain to your particular system. In addition to the instructions provided, installation including protection, grounding, and wiring must be in compliance with all applicable rules as required by the National Electric Code, ASME A17.1 Safety Code for Elevators and Escalators, and any local regulations.

#### 3.1 Tools and Materials

Table 5: Tools and Materials

<input type="checkbox"/>	Personal Protective Equipment (PPE)	<input type="checkbox"/>	Wire Strippers
<input type="checkbox"/>	Multimeter, Fluke Model 177	<input type="checkbox"/>	Diagonal Cutting Pliers
<input type="checkbox"/>	Lock and Tag Kit	<input type="checkbox"/>	3/8 in. sq. Drive, 5/32 in. Hex Key Bit
<input type="checkbox"/>	Torque Wrench, 25–150 in.-lbs., 3/8 in. sq. dr.	<input type="checkbox"/>	3/8 in. sq. Drive, 1/4 in. Screwdriver Bit
<input type="checkbox"/>	Task Lighting	<input type="checkbox"/>	Wago Insertion Tool
<input type="checkbox"/>	Mechanic's Hand Tools	<input type="checkbox"/>	Ferrule Crimp Tool

#### 3.2 Mounting

Mount the starter on a vertical panel using 1/4 inch hardware. Orient the starter such that the heat sink fins are aligned vertically (airflow through the unit is vertical, from bottom to top). Refer to Section 8, Figures 17 through 19, starter outline drawings, for mounting hole size, hole center-to-center dimensions, and overall dimensions.

Adequate cooling is essential for proper operation and expected service life. When installing the starter in an enclosure, leave at least 6 inches of clearance above and below the unit to allow unimpeded natural convection of air flow. The starter must be mounted a minimum of 3 inches above the bottom air inlet and 6 inches below the top air outlet as shown in Figure 3, Air Flow Clearance. The enclosure must be sized or force ventilated for continuous power dissipation as listed in Table 6.

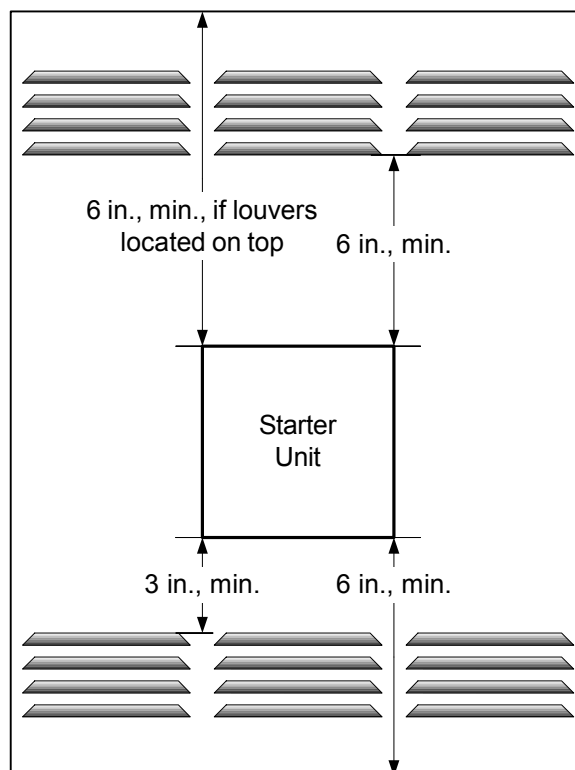


Figure 3: Air Flow Clearance

**Table 6: Power Dissipation and Power Terminal Torque**

Otis P/N	Power Dissipation (W)	Power Terminal Torque (in-lbs)	
		Control Module	Fault Contctr
AAA21240AD3	31	35–63	40
AAA21240AD4	41		
AAA21240AD5	48		
AAA21240AD6	58		
AAA21240AD7	74	90–110	50
AAA21240AD8	99		
AAA21240AD9	110		120
AAA21240AD10	179		
AAA21240AD11	19	35–63	50
AAA21240AD12	25		
AAA21240AD13	31		
AAA21240AD14	41		
AAA21240AD15	48		
AAA21240AD16	58		
AAA21240AD17	74	90–110	120
AAA21240AD18	99		
AAA21240AD19	110		

### 3.3 Grounding

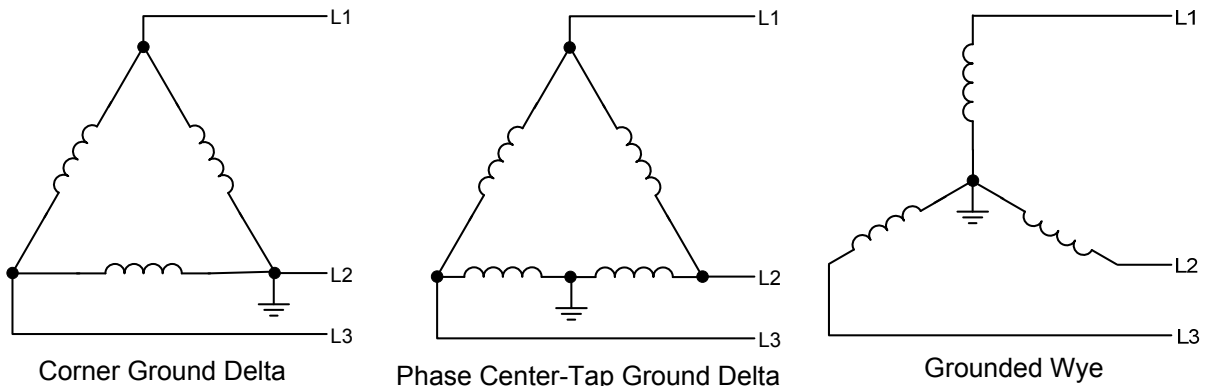
The starter back panel and the motor frame must be grounded according to all applicable codes. Bond the starter back panel to an enclosure ground terminal block or the enclosure itself. Use a star type washer to cut through any paint or surface corrosion and into the steel if connecting the ground wire to the cabinet. The ampacity of the ground conductor is based on the fuse size of the mainline disconnect.

### 3.4 Mainline Power and Motor Wiring

The mainline supply to the starter unit needs to be a balanced 3-phase source. That is equal phase-to phase voltages ( $L1 - L2 = L2 - L3 = L1 - L3$ ) and 120 degree phase displacement. Most of the 3-phase distribution transformer grounding schemes shown in Figure 4—phase center-tap ground, corner ground delta, and grounded wye—are compatible as long as the phase-to-phase relationships are maintained.

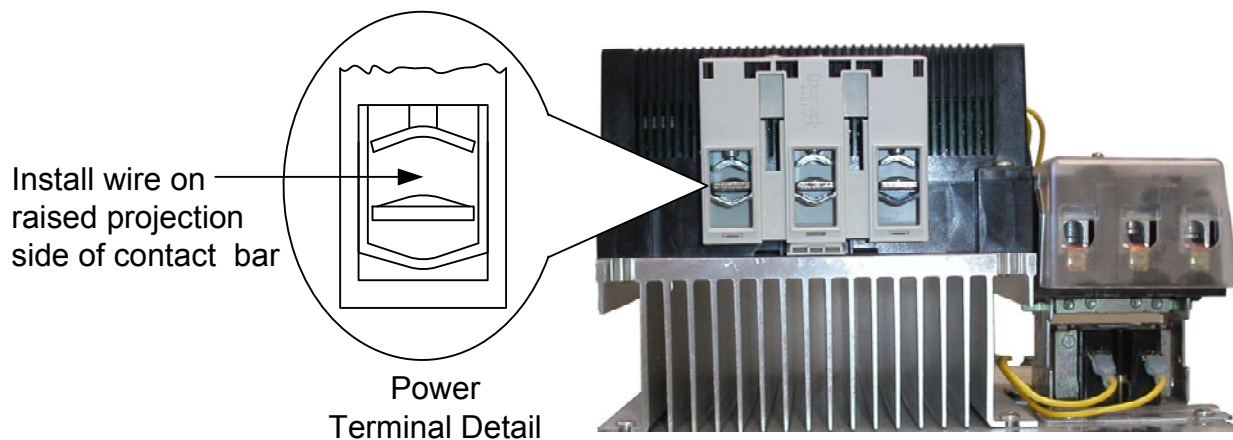
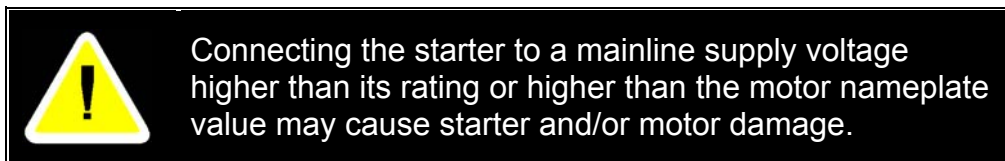
The ampacity of the mainline supply and motor wiring are based on the time duty rating and motor nameplate current as specified by the National Electric Code and any applicable local codes. Use 90° C, or higher, THHN stranded copper wire only between the starter and mainline disconnect. Use 105° C type MTW or TEW wire between the

starter and motor. Route the mainline power and motor wiring in a conduit or wire trough separate from control wiring.



**Figure 4: Typical 3-Phase Distribution Transformer Grounding**

Main line and motor wires are be connected to the power/control unit as shown in Figure 5. Power wires must be installed on the “raised projection” side of the contact bar.



**Figure 5: Motor Connections to Power/Control Unit**

### 3.4.1 Inside-Delta Connection (6 or 12 lead motors)

Refer to Figure 6, Mainline and Motor Wiring for Inside-Delta Connection. Connect the mainline supply from a fused disconnect or circuit breaker to power module terminals L1, L2, and L3. Connect the motor to power module terminals T1, T2, T3 and fault contactor (FC) terminals T4, T5, and T6. Torque the mainline power and motor terminal setscrews according to Table 6 or the labels on the power module and FC terminal blocks.

The inset shown in Figure 6 is for a typical 12-lead, dual voltage motor; it is important to maintain the correct pairing of motor leads. Motor windings must be connected according to the manufacturer's terminal designations. Motor wires are identified to designate phase pairs **and** polarity. The direction in which a motor winding encircles its core establishes the polarity. If a phase pair is swapped, for example, connecting T4, T1 in place of T1, T4, the T1–T4 magnetic field is reversed and the motor will run poorly.

### **3.4.2 Across-the-Line connection (3 or 9 lead motors)**

The soft starter is factory wired for an inside-delta connection. If the starter is to be used with a 3- or 9-lead motor, it needs to be re-wired as shown in Figure 7, Conversion from Inside-Delta to Across-the-Line. Remove the heavy gauge interconnecting wires between the power/control module and FC and re-connect as shown in Figure 7. Torque the power and motor terminal setscrews according to Table 6 or the labels on the power/control module and FC terminal blocks.

Refer to Figure 8, Mainline and Motor Wiring for Across-the-Line Connection. Connect the mainline supply from a fused disconnect or circuit breaker to power module terminals L1, L2, and L3. Connect the motor to fault contactor (FC) terminals L1, L2, and L3. Torque the mainline power and motor terminal setscrews according to Table 6 or the labels on the power/control module and FC terminal blocks. Across-the-Line connections for a 9-lead motor are shown in Figure 9.

Notes:

1. Fusible Disconnect or Circuit Breaker must be provided for starter protection.
2. Fusible disconnect shall be sized per NEC with a maximum breaking capability of 100,000 amps.
3. Circuit breaker shall be sized per NEC with a maximum breaking capability of 42,000 amps.
4. Motor terminal designations shown below are NEMA standard; refer to the motor nameplate as some manufacturers conventions may be different

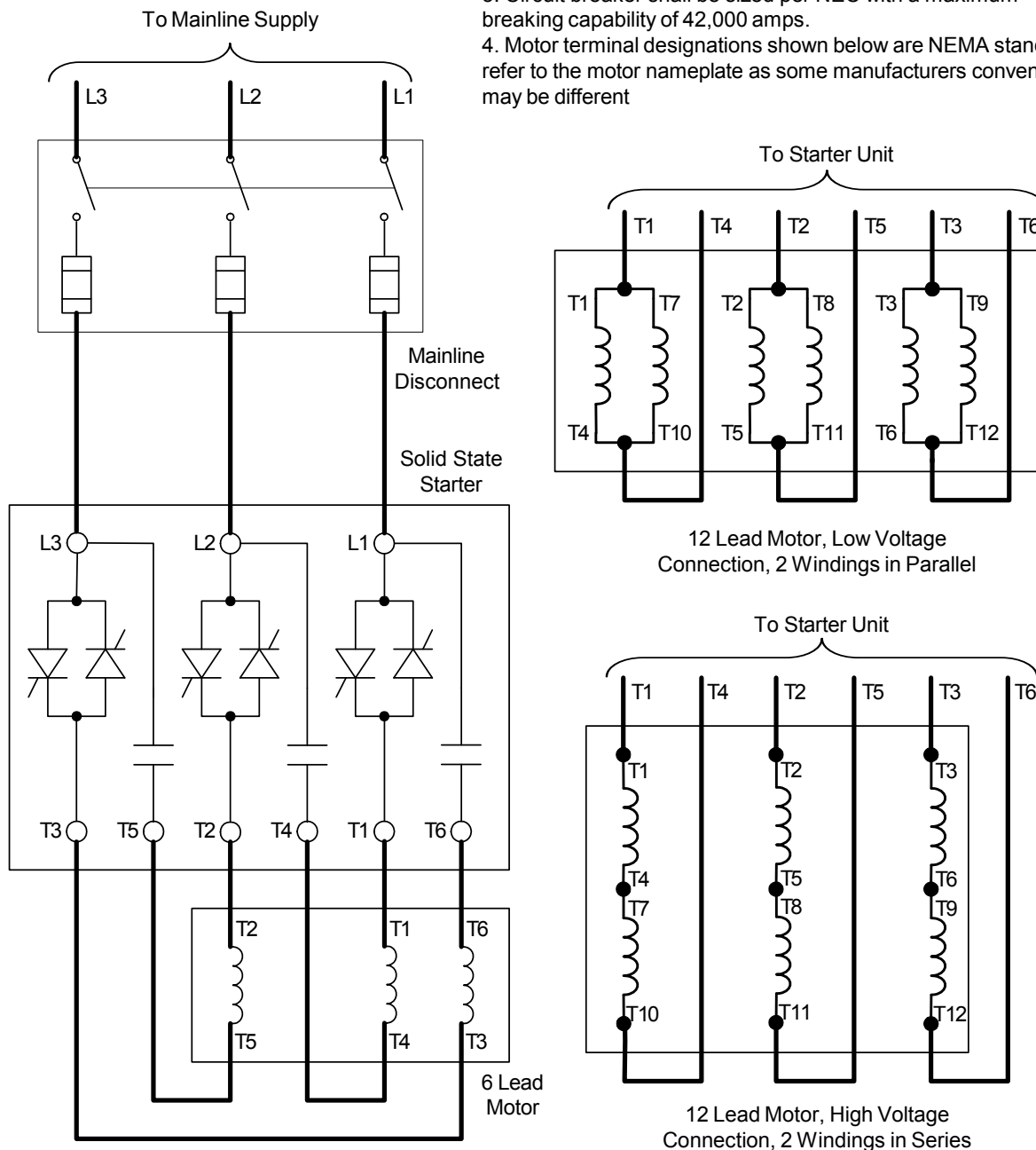
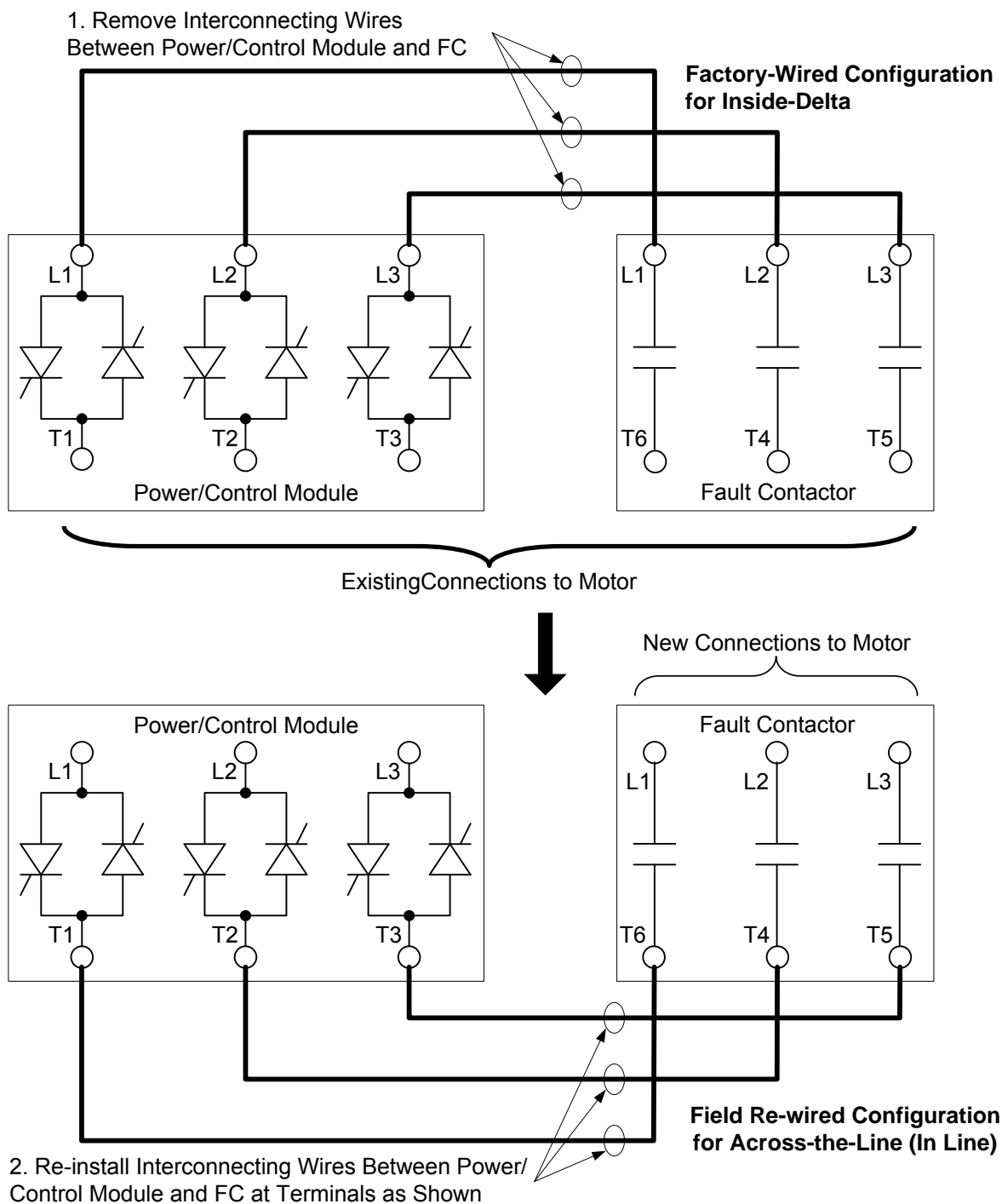


Figure 6: Mainline and Motor Wiring for Inside-Delta Connection



**Figure 7: Conversion from Inside-Delta to Across-the-Line Starting**

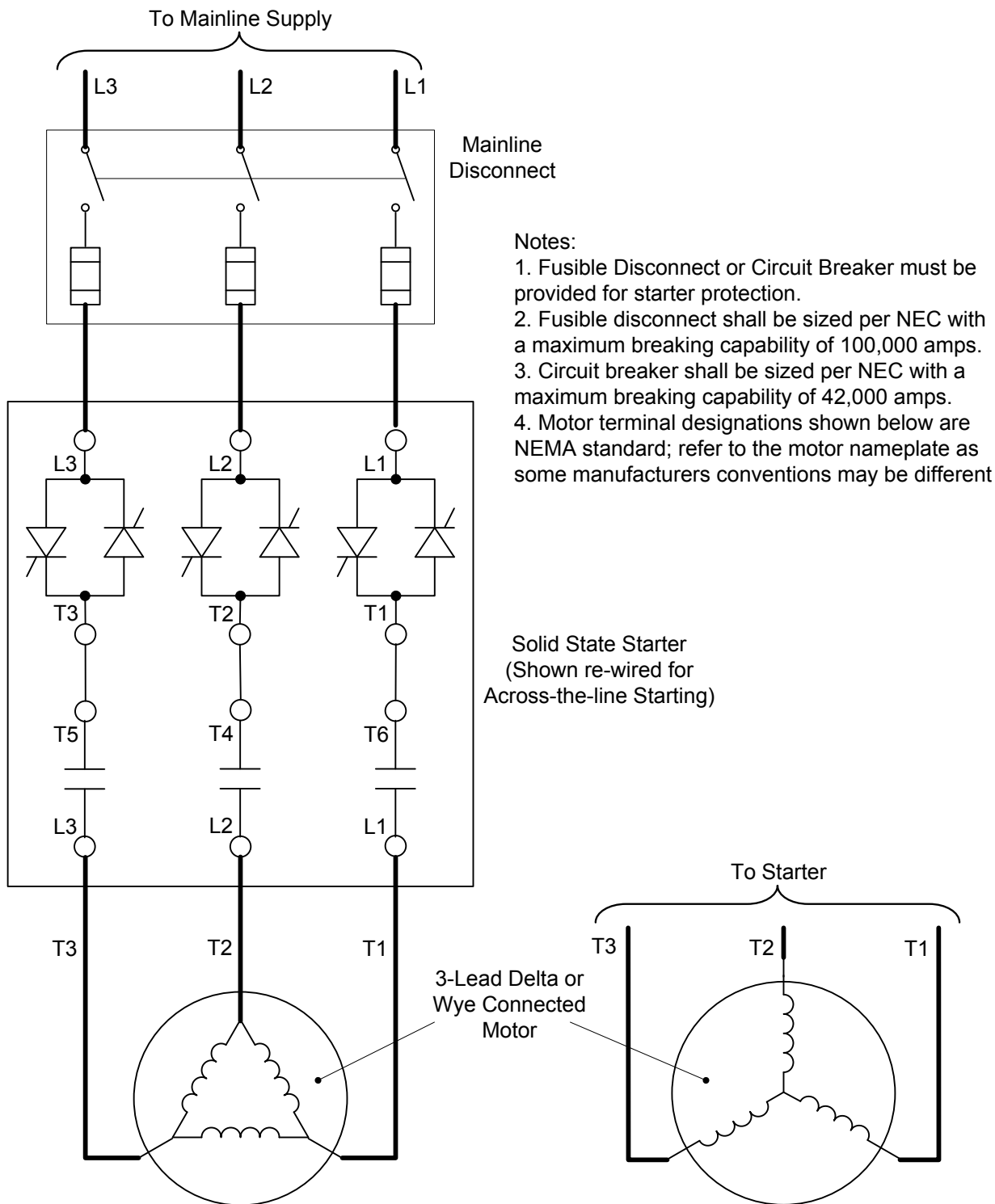


Figure 8: Mainline and Motor Wiring for Across-the-Line Connection



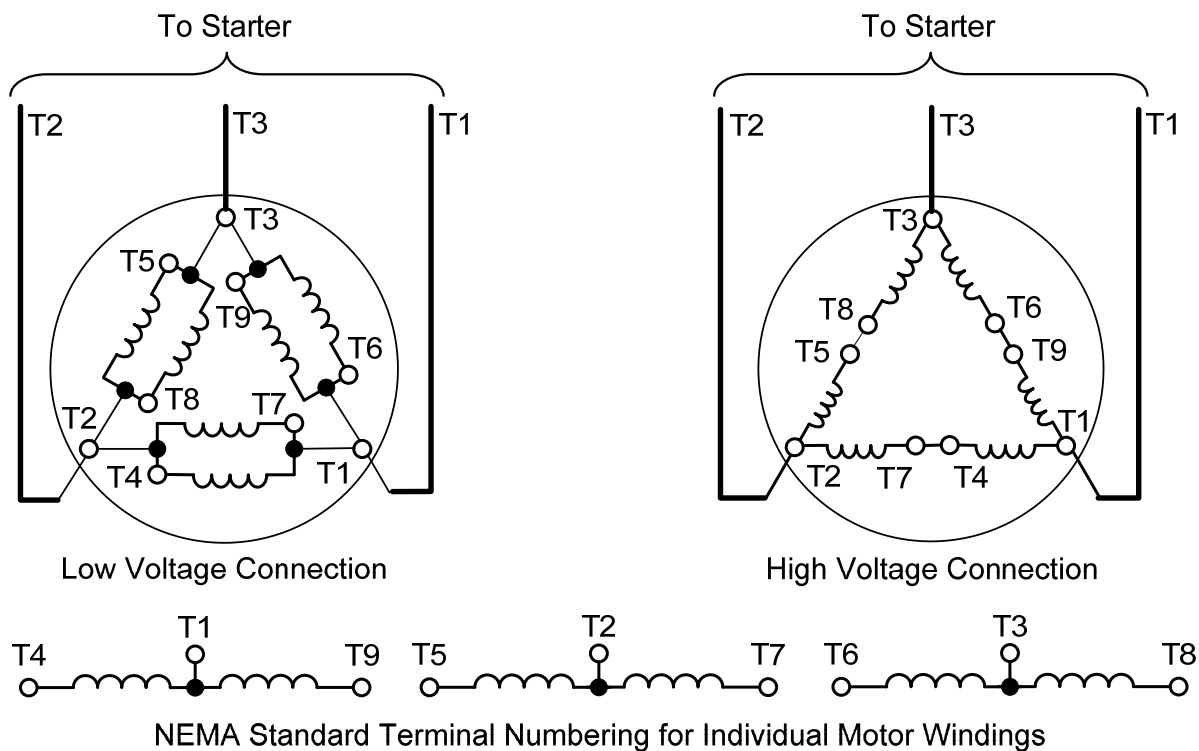


Figure 9: 9-Lead Motor Wiring for Across-the-Line Connection

### 3.5 Control Wiring

For a typical hydraulic elevator pump motor application, the mainline supply and control power are continuously applied to the starter. The motor is started and stopped by using the “RUN” input to the starter’s control circuitry. Refer to Table 7 for a list and description of control signals. Figure 10 shows a layout of the control wiring connector.

Control wiring is connected to a cage-clamp style connector that plugs directly into the Power/Control module. Use ferrules to terminate 14 AWG to 18 AWG stranded conductors at the connector. Control wiring should be kept separate from power and motor wiring; run control wiring in a separate trough or conduit if required.

A solid-state motor up-to-speed output (MUS) is provided to interlock the hydraulic control valve with the solid state starter. It is used to prevent a load from being applied to the motor during the start sequence. The MUS output remains open until the start sequence is finished. When the motor reaches approximately 85% speed, the MUS output closes and stays closed until the run signal is removed or a fault is detected (fault contactor opens).

If the starter is used with a relay type elevator controller, a relay “MUSR” (120 VAC coil) must be used to isolate the MUS electronic switch output from the valve control circuit. Wire an RC suppressor across the coil to prevent inductive kickback from damaging the

output. Refer to Figure 10 for a typical control wiring diagram with an MUSR isolation relay.

**Table 7: Control Signal Description**

Terminal	Signal Description
B1, B2	<b>Control Power (L), Control Power (N):</b> A constant 120 VAC @ 500 VA provides power for the control module logic, input/output interface, and fault contactor. Fault contactor draws 310 VA inrush, 26 VA, sealed.
A1, B2	<b>RUN, Motor Run Input:</b> Signal to start and stop the motor. A1 (referenced to B2) = 120 VAC: Motor start and run. When the run input is activated, the motor current draw is ramped to the value set by the starting current limit and motor speed steadily increases. When the motor attains approximately 85 % running speed, the current begins to decrease to normal operating current, depending on load. A1 (referenced to B2) < 20 VAC or open circuit: Motor stop; power module phases back SCRs to remove power from the motor. The motor coasts to a stop.
17, 18	<b>MUS, Motor up to Speed.</b> Solid state switch indicates the start sequence is finished and a load can be applied to the motor. R C suppression required if MUS is driving an inductive load such as a relay or solenoid. 120 VAC only. Refer to Figure 9 for example. MUS Closed: Run command is active and the start sequence is finished (motor speed > 85%). Permissive to apply a load to the motor. MUS Open: Run Command inactive, Run Command is active and the start cycle is in progress (motor speed < 85%), or fault contactor operated during run cycle (2 sec delay).
25, 26	<b>NC Ready.</b> Normal closed dry contact; indicates Control/Power module and Motor fault status. <b>NC Ready OPEN:</b> No fault state. Contact opens after 3-phase and control power are applied, the control/power module passes a built-in-test, and no fault conditions exist. <b>NC Ready CLOSED:</b> Fault detected. Contact remains closed after application of control power if mainline power is not applied, the phase rotation is reversed, or a shorted SCR is detected. Contact closes if a fault condition (e.g. overload, phase loss) is detected during the start sequence or full speed operation. Contact opens then closes following application of mainline and control power if a motor wiring fault is detected. Refer to the section on Troubleshooting and Electrical Specifications for a list of detected faults.
27, B2	<b>NO Ready.</b> 120 VAC switched through normally open dry contact; indicates fault status for the Control/ Power module and Motor. Inverse of NC Ready. 27 (referenced B2) = 120 VAC: NO Ready closed; Fault Contactor picked, no detected soft starter fault. 27 (referenced B2) = 0 VAC: NO Ready open; Fault Contactor dropped, soft starter fault detected, mainline or control power not applied, or motor wiring fault.

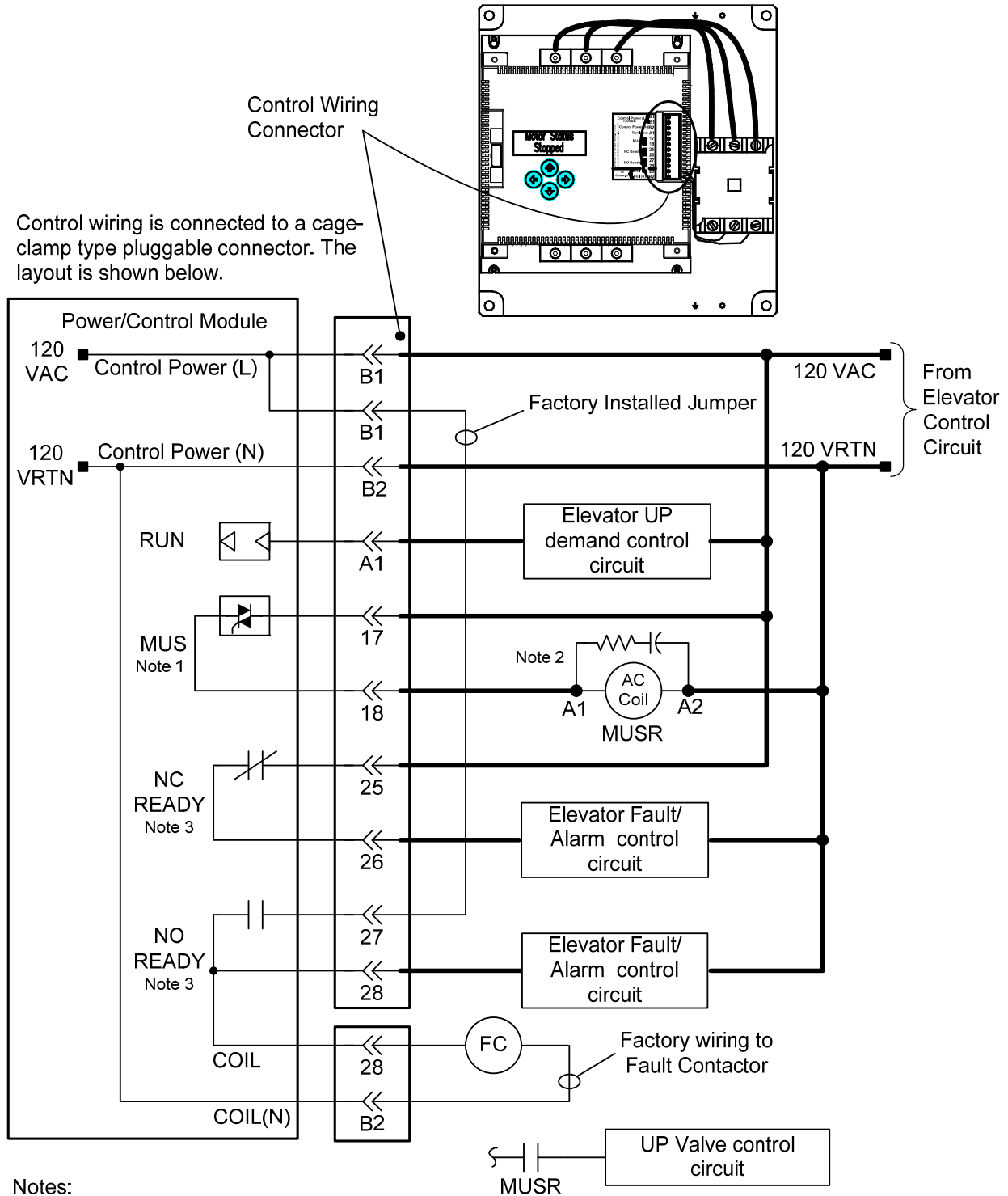


Figure 10: Typical Soft Starter Control Wiring

## 4. Setup and Operation



The hydraulic control valve must be preset for bypass and full-speed UP operation.

### 4.1 Power-Up Voltage Checks


1. Remove all debris from the controller cabinet. Inspect for metal chips, nuts, bolts, washers, tools, and other material that could affect operation.
2. Check the installation for wiring errors, loose connections, and wire strands. Dress the wires into neat bundles with wire ties. Route the power connections to the starter from the mainline and motor.
3. Set up the elevator controller such that the starter will not attempt to run the pump motor when mainline power is applied by any of the following means:
  - Switch the controller on inspection or other manual mode
  - Open the Safety Chain
  - Temporarily disconnect the starter “RUN” input signal
4. Turn on the mainline power. The fault contactor may pick or pick and drop; that’s OK for now. Measure the voltages listed in Table 8 and tabulate them in the “Measured Value” column.

**Table 8: Startup Voltage Measurements**

Measurement	Expected Value	Measured Value
Starter L1–L2	According to Controller/Motor nameplate	
Starter L2–L3		
Starter L1–L3		
Starter B1–B2	120 VAC +/- 10 %	



Troubleshoot and correct any mainline power problems if the voltage measurements are not the expected values.

5. Press the  button several times to scroll to “Line Volts,” the voltages should be within 7% of the measured values recorded in the table above.

## 4.2 Set Installation Parameters

The soft starter needs to be configured—that is, to set values of installation parameters—according to job site conditions. Even if the starter is factory installed, these steps need to be performed to check the values. Section 5.1, Menu Navigation, describes how to use the keypad and access menus. Section 5.2, Changing Values of Parameters, describes how to change values of parameters. Section 5.4, Parameter Menu, contains a list and description of all configuration parameters.

1. Obtain the full load current from the motor nameplate or a tag on the tank indicating the full load amps. (A motor that runs on 230/460 will have full load amps for both voltages. Be sure to use the proper value based on the incoming mainline voltage.) Use a value from Table 9 if the full load current is not listed on the tank or is otherwise not accessible.

**Table 9: Full Load Current in 3-Phase AC Motors\***

HP	200 VAC	208 VAC	230 VAC	460 VAC	575 VAC
5	17.5	16.7	15.2	7.6	6.1
7.5	25.3	24.2	22	11	9
10	32.2	30.8	28	14	11
15	48.3	46.2	42	21	17
20	62.1	59.4	54	27	22
25	78.2	74.8	68	34	27
30	92	88	80	40	32
40	120	114	104	52	41
50	150	143	130	65	52
60	177	169	154	77	63
75	221	211	192	96	77
100	285	273	248	124	99
125	359	343	312	156	125
150	414	396	360	180	144

\* From National Electric Code 2011 Edition Table 430.250

2. Use the 4-button keypad to access the parameter menu. The display should read “Starting Amps” on the top line, and a percentage on the bottom line.
3. Set “Starting Amps” to 230% for new equipment jobs and 250% for all others unless jobsite power conditions require running at a lower percentage (such as running on a temporary generator). A starting current of 250% provides about a one second start time—that is, MUS turns on 1 second after the run signal is applied. Never set Starting Amps less than 200%.
4. Set “Full Load Amps” to the motor full load current as determined in Step 1.
5. Set “Line Rotation” to ABC.

6. Set “Off Delay Ms” to 0.
7. Set “On Delay Ms” to 0.
8. Use the 4-button keypad to navigate to the status menu. The message on the display should read “Motor Status Stopped” if the mainline phase rotation is consistent with the value of the “Line Rotation” parameter and the motor is wired properly.
9. If the display indicates “Wrong Phase Rotation,” two of the mainline supply wires need to be swapped. **Turn off mainline power, lockout and tagout the disconnect, test and verify power is removed.** Swap L1 with L2 at the mainline supply connection on the power/control module. Reapply mainline power and observe the message on the status display.
10. If the Fault Contactor momentarily picks then drops and the display indicates “Fault - Motor Wiring,” the motor is wired incorrectly; refer to Section 3.4, for Motor Wiring diagrams. Recheck connections between the starter and motor windings and measure the resistance of each winding checking for a possible open circuit. For other faults, refer to Section 6, Troubleshooting.



If the motor is verified to be properly wired and the motor is not open circuit but the starter continues to indicate “Fault - Motor Wiring”, there may be a mainline power quality problem. In this case, the mainline must be checked to ensure a balanced 3-phase supply is provided.

11. Turn off the mainline. Reconnect any wires that that were removed to prevent the pump motor from running during the initial checkout.

#### 4.3 Check Operation



Take appropriate precautions as the following steps require the elevator to move.

1. Position the elevator at or near the bottom terminal.
2. Record the value of Motor Full Load Current in Table 10 in the space provided.
3. Put the elevator controller on inspection or other manual mode. Turn on the mainline; the starter display should indicate “Motor Status Stopped.”
4. Valve Bypass Run (car should not move). Use a temporary jumper to connect 120 VAC from B1 to A1 (“Run” input) to start the motor. In about two seconds the display should read “Motor Up To Volt.” Motor Status messages displayed during a normal start are shown in Figure 11. Some messages, like “Motor Status Start Ramp,” are on for a very short time and may not be cleanly displayed.

5. Press the keypad down button to display Line Amps. Record the value for all three phases in Table 10 on the "Valve Bypass" line. Disconnect the jumper between B1 and A1 to stop the motor. The no-load (valve bypass) current should be about 50 percent of the motor full load current.
6. Press the keypad up button to display motor status then initiate an inspection UP demand. In about 2 seconds the display should up read "Motor Up To Volt."

**Table 10: Startup Current Measurements**

<b>Full Load Current</b>			
<b>Valve Bypass</b>			
<b>Empty Car Up</b>			

7. Press the keypad down button to display Line Amps. Record the value for all three phases in Table 10 on the "Empty Car Up" line. Remove the UP demand. The empty car up current should be about 75 percent of the motor full load current.
8. If the line currents are much lower or higher than the expected values, it is possible that the motor is either oversized or undersized for the job. An improperly sized motor will result in unreliable elevator operation. Consult your engineering or technical department to determine the motor power required for the elevator duty.

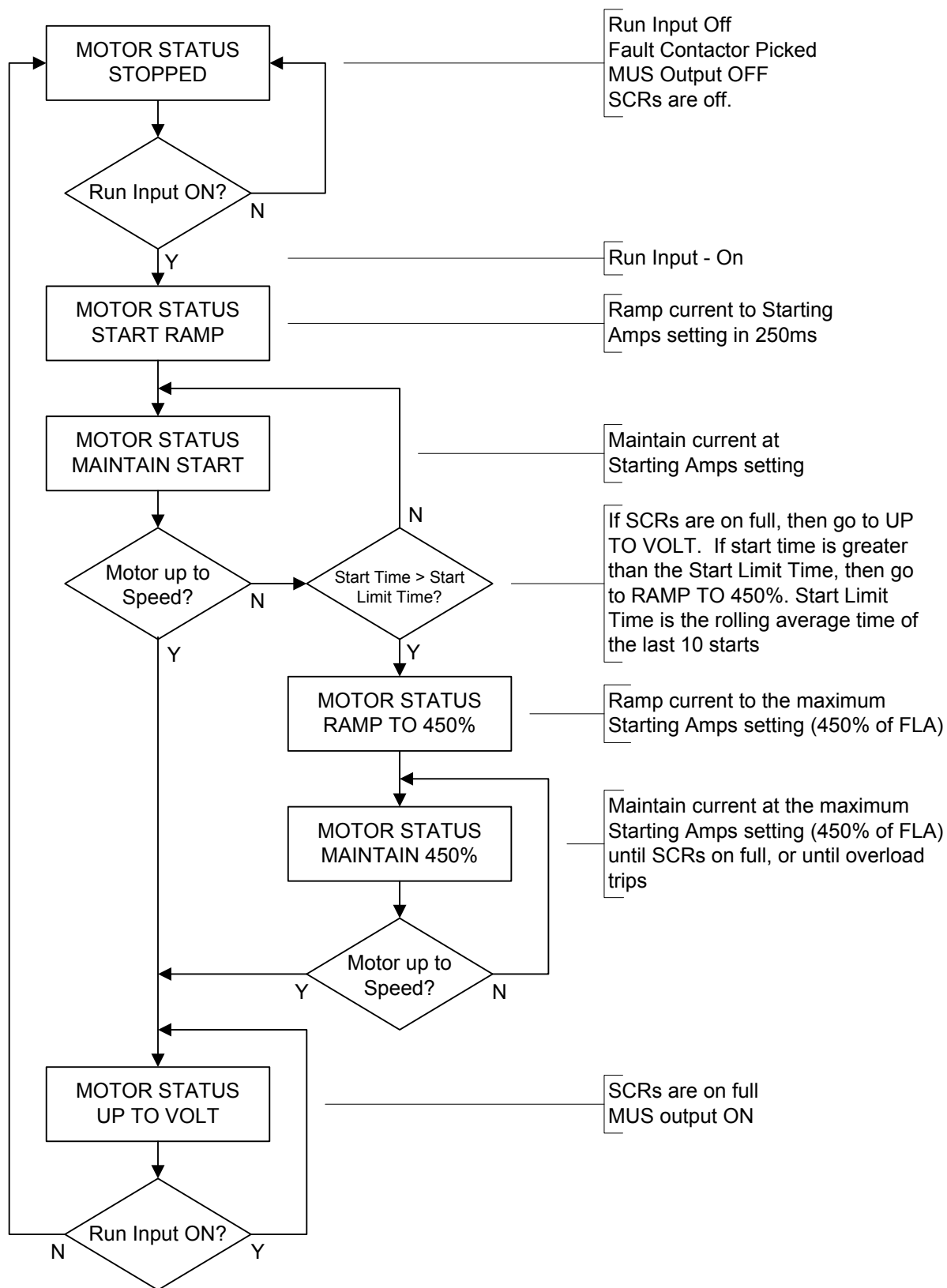


Figure 11: Motor Start Sequence



#### 4.4 In Case of Difficulty

If the status remains “Motor Stopped” and the motor doesn’t start in response to an UP demand, check the elevator controller wiring, safety chain, stop switches, and installation parameter settings. If the motor attempts to start and then stops while up demand is maintained or otherwise runs intermittently, refer to section 6, Troubleshooting. For each fault message, a description, test, and suggested solution are provided.

Data that will assist in troubleshooting is contained in the Status Menu, Diagnostic Menu, and Fault Menu, sections 5.3, 5.4, and 5.6, respectively. When troubleshooting with engineering or the Siemens Hotline, fill in the Fault Data Log, Appendix A, before cycling power or otherwise resetting the starter unit. If calling the Siemens Hotline, the Siemens Part No., Serial Number, and Date Code are required. This information is on a label on the power/control unit as shown in Figure 12.

**Siemens Hotline (800) 333 - 7421**

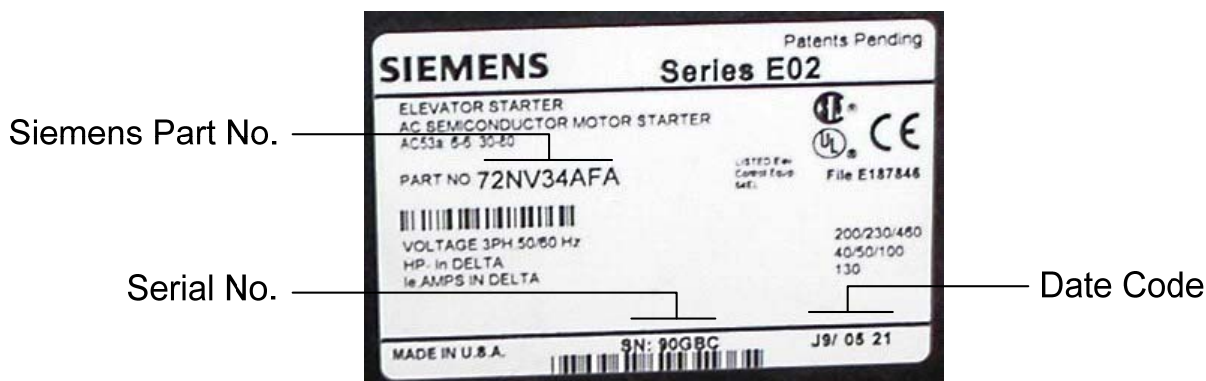


Figure 12: Part Number – Date Code Label

## 5. Keypad Operation

The user interface to the starter is a 4-button keypad and LCD display shown in Figure 13. The keypad is used to navigate through a series of menus to display the starter status, retrieve fault and diagnostic data, and set values of configuration parameters.

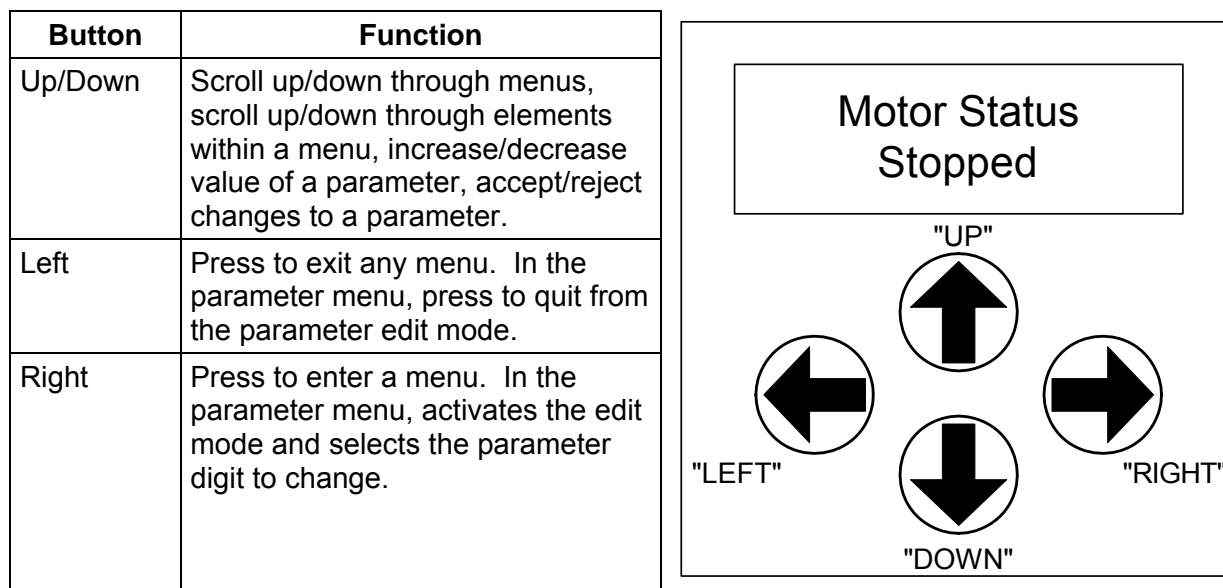


Figure 13: Keypad and LCD Display

### 5.1 Menu Navigation

The menu tree structure is shown in Figure 14. Upon power up the starter's status menu is displayed. If a fault is present, it will be displayed. Press the buttons as indicated to navigate from menu to menu and to parameters within a menu. The starter returns to the status menu from any other menu after two minutes of inactivity on the keypad.

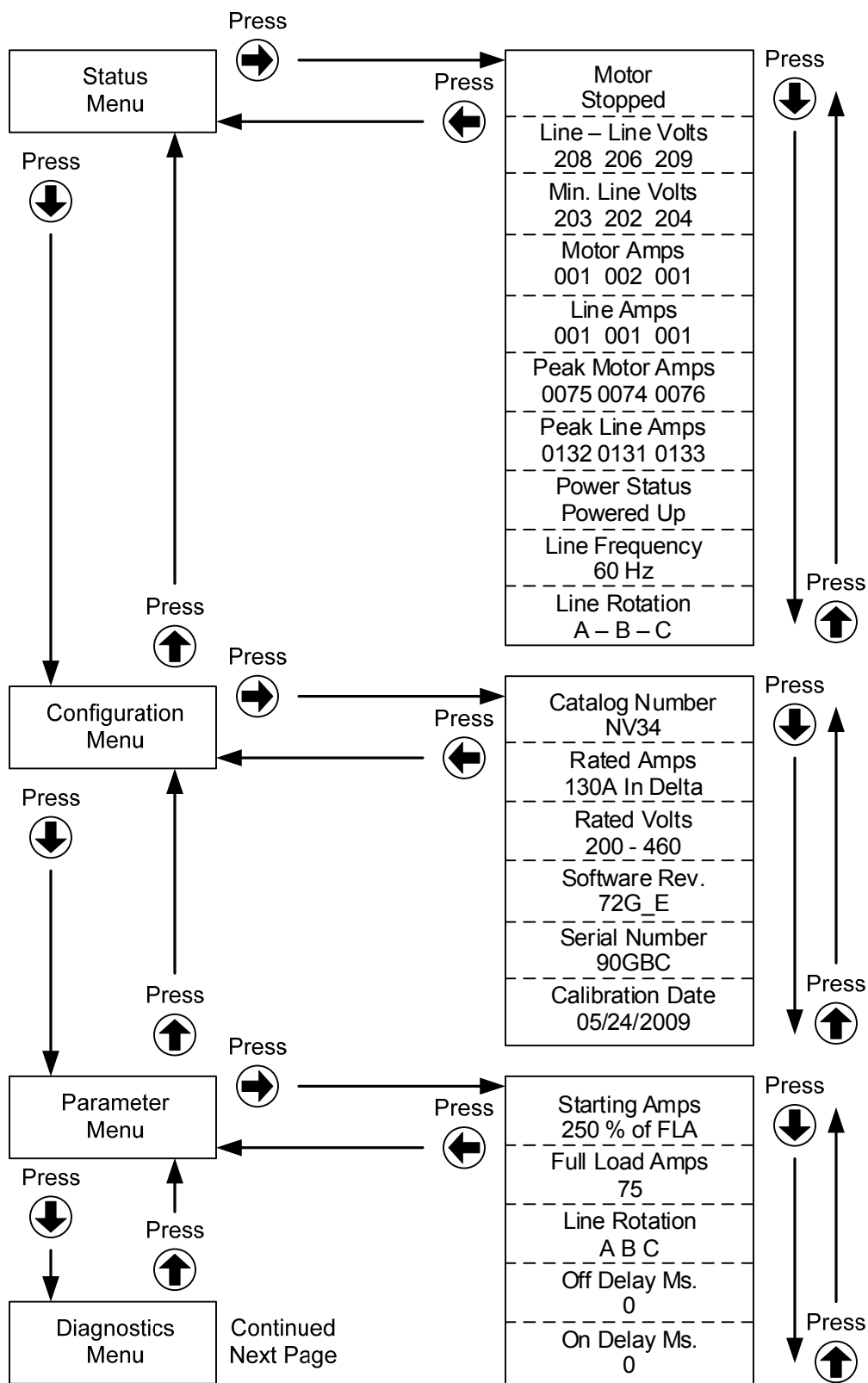


Figure 14: Soft Starter Menu Tree

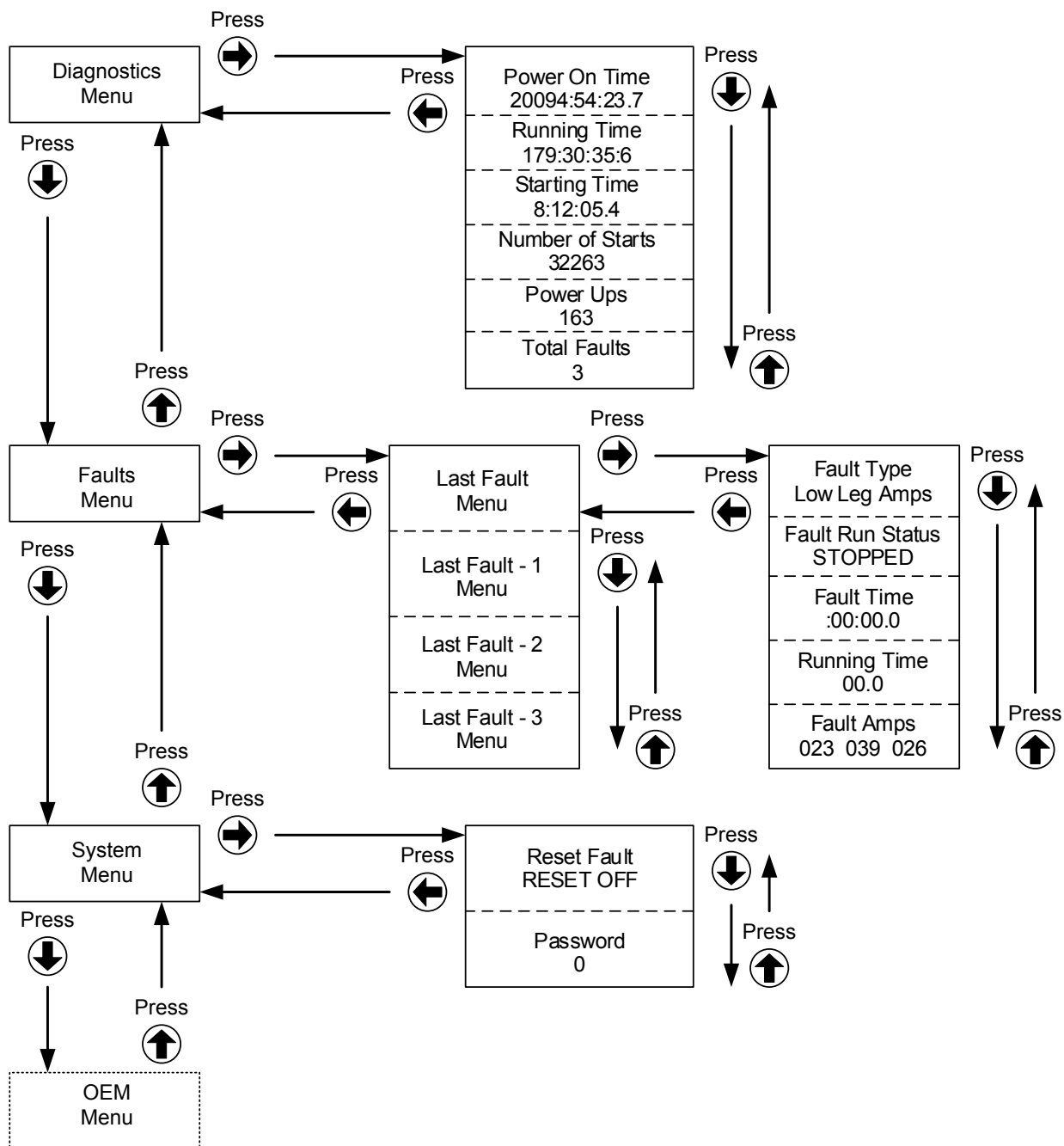


Figure 14: Soft Starter Menu Tree (continued)

## 5.2 Changing values of Parameters

To change the value of a parameter, press the LEFT button to get to the main menu level, then the DOWN button to scroll to the Parameter Menu. The display shows:

Parameter  
Menu

Press the RIGHT button to enter the Parameter Menu. The display shows the first parameter:

Starting Amps  
250% of FLA

Press the RIGHT button again to activate the edit mode. The first digit on the left side of the value blinks, indicating it can be changed. Use the UP/DOWN keys to increase/decrease the value.

Starting Amps  
250% of FLA

Press the RIGHT button again to move to the next character. The number blinks, indicating it can be changed. Use the UP/DOWN keys to increase/decrease the value.

Starting Amps  
300% of FLA

When the desired value is set, press the LEFT button to quit the edit mode. The new value is displayed along with a prompt for confirmation. The screen shows:

↑ACCEPT ↓REJECT  
300% of FLA

Press the UP button to accept the new value or the DOWN button to reject. Press the UP button to accept, the display shows the new value:

Starting Amps  
300% of FLA

Press the DOWN button to scroll to the next parameter; the display shows:

Full Load Amps  
250% of FLA

Parameters that affect the functionality of the starter are contained in a password protected OEM menu. The password may be obtained from Otis Engineering.

To access the OEM menu, press the DOWN button to scroll to the System Menu. The display shows:

System  
Menu

Press the RIGHT button to enter the System Menu. The display shows the first parameter:

Reset Fault  
RESET OFF

Press the DOWN button to scroll to the password, then the RIGHT button to enter the edit mode. The first digit on the left blinks, indicating it can be changed; the display shows:

Password  
0000

Set the value of the password then press the LEFT button to quit the edit mode. The password is displayed along with a prompt for confirmation. The screen shows:

↑ACCEPT ↓REJECT  
1234

Press the UP button to accept; the display shows:

Password  
0

Press the LEFT button to return to the menu select level; the display shows:

System  
Menu

Press the DOWN button to scroll to the OEM menu; the display shows:

OEM  
Menu

A list and description of OEM parameters is given in section 5.8, OEM Parameters.

---

### 5.3 Status Menu

Motor Status	Operational state during a start or fault message (if any). Refer to the flowchart in Figure 11 for motor status messages and Section 6 for a list and description of fault messages.
Line – Line Volts	Current value of mainline supply voltage, line-to-line VAC, L1 – L2, L2 – L3, L1 – L3.
Min. Line Volts	Minimum value of mainline supply voltage, L1–L2, L2–L3, L1–L3, during the last start.
Motor Amps	Present value of motor current, phase A, phase B, phase C. Value is <i>phase current</i> if starter is connected in-delta or <i>line current</i> if starter is connected in-line.
Line Amps	Present value of line current, phase A, phase B, phase C.
Peak Motor Amps	Peak motor current, phase A, phase B, phase C, during the last start cycle.
Peak Line Amps	Peak line current, phase A, phase B, phase C, during the last start cycle.
Power Status	Powered Down: control voltage < 90 V Under Voltage: 90 V < control voltage < 102 V Powered Up: 102 V < control voltage < 145 V Over Voltage: control voltage > 145 V
Line Frequency	Frequency of mainline power supply, 50 or 60 Hz.
Line Rotation	Actual value of mainline supply phase rotation, ABC or CBA.

## 5.4 Parameter Menu

Starting Amps	<p>This parameter sets the limit for line current during the motor start cycle. It is a percentage of the full load amps of the motor. While lower settings reduce the inrush currents, they increase the starting time. Starting Amps will typically be set to 230% or 250%, but may be reduced if necessary for jobsite power conditions, such as running on a temporary generator. This setting should never be less than 200%.</p> <p>Range = 150% to 450%</p> <p>Recommended setting for NAA NEB = 230%</p> <p>Recommended setting for NAA Mod = 250%</p>
Full Load Amps	<p>Class 10 electronic overload trip current</p> <p>Range = Refer to Section 2, Starter Ratings, Tables 1 – 4</p> <p>Characteristics: Class 10 Electronic Overload, see Figure 15.</p> <p>Starter automatically adjusts overload according to line-to-phase current relationship depending on In-Line or In-Delta connection.</p> <p><b>Example:</b> p/n AAA21240AD5</p> <p>In-Delta Connection Overload Range = 17 to 68 amps</p> <p>In-Line Connection Overload Range = 10 to 40 amps</p> <p>Recommended setting = Set at the full load current listed on the motor nameplate.</p>
Line Rotation	<p>Expected mainline supply phase rotation. If the starter indicates “wrong phase rotation,” change “line rotation” from A – B – C to C – B – A, or vice-versa. If the motor runs in the wrong direction after achieving the correct phase rotation, swap two incoming power wires and change the value of <i>line rotation</i> to match.</p> <p>Range = A – B – C or C – B – A</p> <p>Recommended setting = as required</p>
Off Delay	<p>The length of time the starter continues to run the motor after the run signal is removed.</p> <p>Range = 0 to 2500 milliseconds</p> <p>Recommended setting = always set to 0</p>
On Delay	<p>The time delay between receiving an active run signal and initiating the start cycle.</p> <p>Range = 0 to 2500 milliseconds</p> <p>Recommended setting = always set to 0</p>



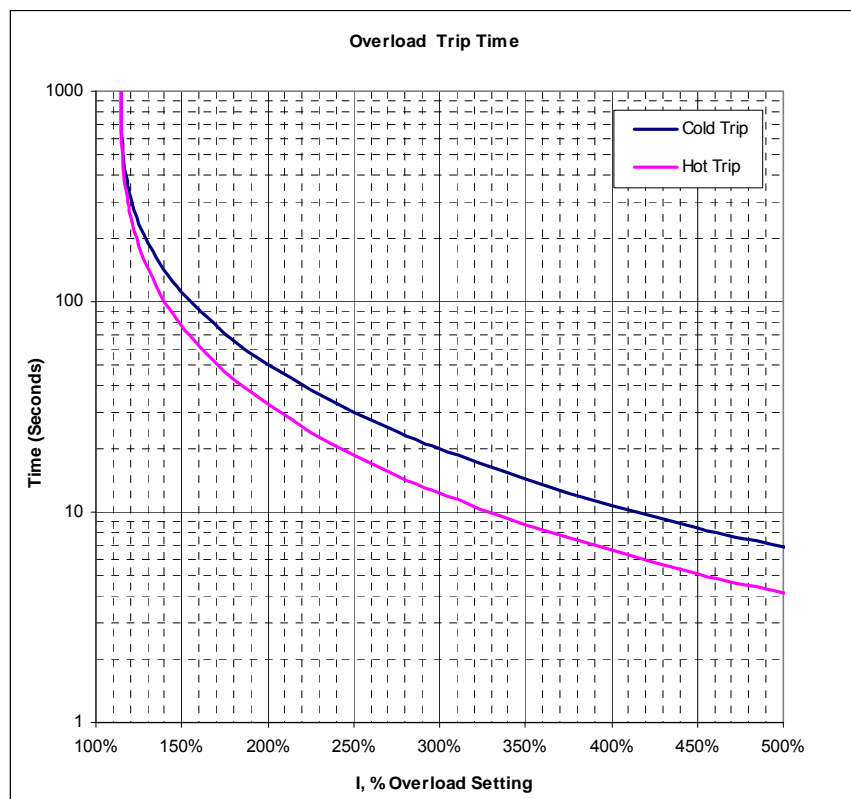


Figure 15: Class 10 Overload Trip Curve

72 G Class 10  
Electronic Overload  
Examples:

1. Motor drawing 100% FLA – overload never trips (infinite trip time).
2. Motor drawing 250% FLA – overload trips in 19 seconds.
3. Motor drawing 450% FLA – overload trips in 5 seconds.

## 5.5 Diagnostics Menu

Power On Time	Cumulative time control power was applied to the starter. HOURS:MINUTES:SECONDS.TENTHS SECONDS
Running Time	Cumulative time of all motor run cycles, inclusive of start cycle. HOURS:MINUTES:SECONDS.TENTHS SECONDS
Starting Time	Cumulative time of all start cycles. HOURS:MINUTES:SECONDS.TENTHS SECONDS
Number of Starts	Total number of motor run cycles.
Power Ups	Total number of times control power was applied to the starter.
Total Faults	Total number of faults detected by the starter. The starter retains the last four faults and associated parametric data.

## 5.6 Faults Menu (see Figure 16)

The Faults Menu contains two submenus: The first submenu is an index into the last four faults detected; the second is the parametric data corresponding to each fault. Select *Last Fault* in the first list to display the values of parametric data corresponding to the last fault logged. Select *Last Fault-1* in the first submenu to display the values of parametric data corresponding to the previous fault logged, and so on.

Last Fault Menu, Last Fault -1, -2, -3	Last Fault = Latest Fault detected, Last Fault – 1 = previous fault detected, Last Fault -2 = the next previous, and so on.
Fault Type	Name of Fault Logged (refer to Section 6, Troubleshooting, for a list of faults).
Fault Run Status	Motor Status when fault was detected. Refer to Figure 11, Motor Start Sequence, for a list of possible messages.
Fault Time	Power on Time at which fault was detected HOURS:MINUTES:SECONDS.TENTHS SECONDS
Running Time	Time into current run cycle that fault was detected. SECONDS.TENTHS SECONDS
Fault Amps	Motor current, phase A, phase B, and phase C, when fault was detected. Value is phase current if starter is connected in-delta or line current if starter is connected in-line.

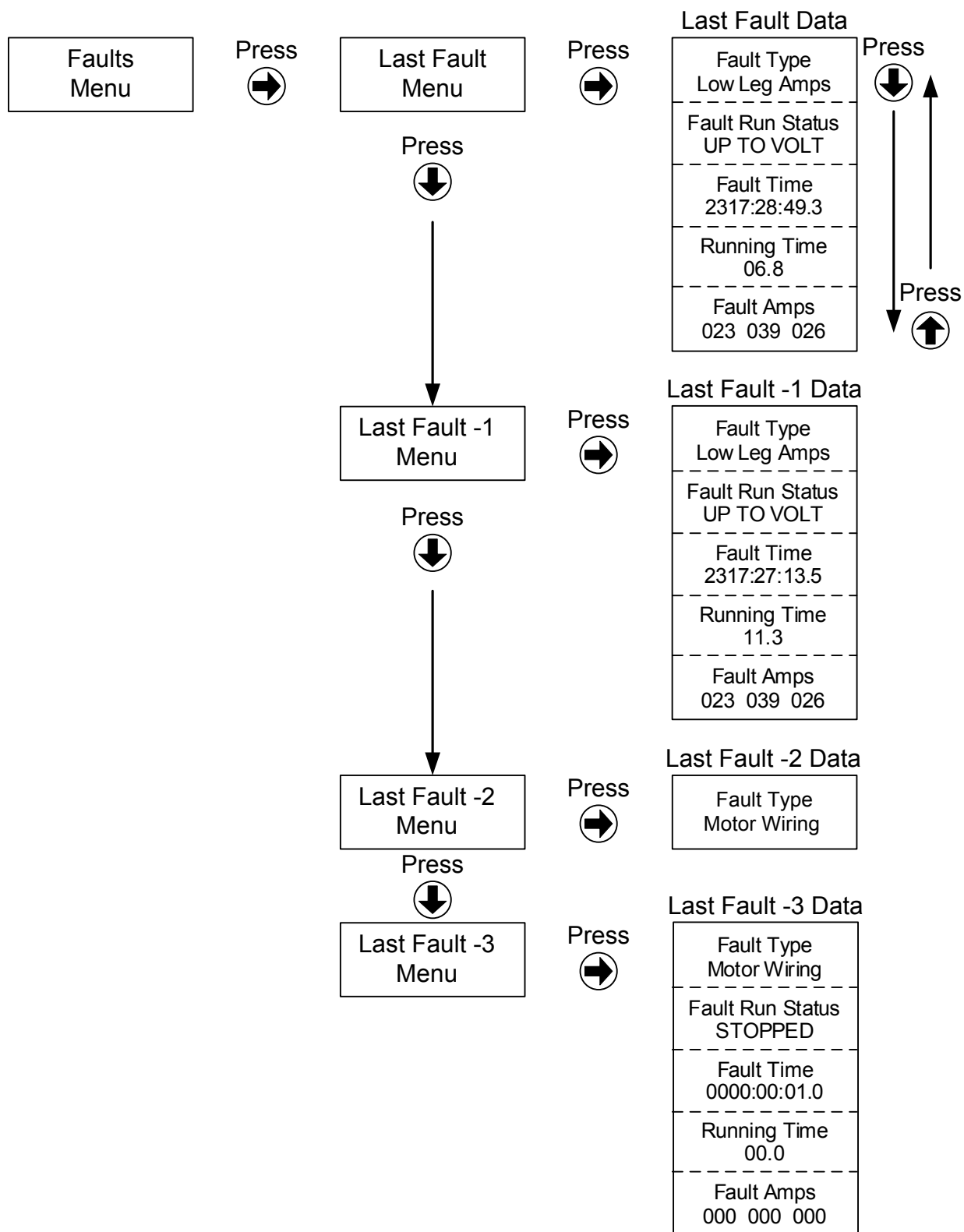


Figure 16: Faults Menu Structure

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## 5.7 System Menu

Reset Fault	<p>Clears the last fault detected. To reset the starter: Press the RIGHT key followed by the UP key then the LEFT key. Press the UP key again to accept. The value changes from RESET OFF → RESET ON → RESET OFF.</p> <p>Faults can also be reset by:</p> <ul style="list-style-type: none"><li>(1) Pressing the UP and DOWN keys at the same time or</li><li>(2) Cycle control power</li></ul>
Password	<p>four-digit code to access OEM parameter menu. Available from Otis Engineering only.</p>

## 5.8 OEM Menu

Reset Defaults	<p>Sets values of all adjustable parameters, including OEM, to factory defaults. Changing this parameter to “RESET ON” causes the starter to exit the OEM menu and automatically revert to “RESET OFF.”</p> <p>Range = RESET OFF or RESET ON Recommended setting = as required</p>
Starting Mode	<p>Selects between Average and Peak Current modes. Average uses all three line currents for the starting current mode. Peak uses the line with the highest currents for the starting mode.</p> <p>Range = Average Current or Peak Current Recommended setting = Average Current (default)</p>
Overload Mode	<p>Selects the mode for the overload protection. Average current uses an average of the three line currents. All three phases use the motor winding with the most current.</p> <p>Range = Average Current or All 3 Phases Recommended setting = Average Current (default)</p>
Amp Imbalance	<p>Current Imbalance trip ratio. The starter detects current imbalances by comparing the lowest motor current to the highest motor current (low amps divided by high amps). A higher setting offers the greatest level of motor protection but, may also cause nuisance trips. A lower value provides the most immunity to nuisance trips but only offers protection against an open or shorted winding.</p>

Range = 10% (0.1) to 75% (0.75)

Recommended setting = 60% (default)

#### Imbalance Enable

Enables current imbalance protection as a percentage of overload setting. This parameter provides a means to disable the Amp Imbalance detection when the line currents are at a low value to prevent nuisance trips

##### **Examples:**

A setting of 0% enables Amp Imbalance protection all the time.

A setting of 50% disables Amp Imbalance protection until the line current is greater than or equal to 0.5 x full load amps.

A setting of 100% disables Amp Imbalance protection until the line current is greater than or equal to 1.0 x full load amps.

Range = 0% to 100% (of overload current)

Recommended setting = 100% (default)

#### Low Amp UTS

Controls motor up to speed output in the event of low current conditions. Use this parameter if a starter is sized well above the motor rating to allow the MUS to remain closed following the start sequence.

Disable: Motor-Up-to-Speed (MUS) switch automatically opens if the line currents drop below approximately 10% of the starter rated current.

Enable: MUS remains closed following the start sequence, regardless of line current.

Range = Enable or Disable

Recommended setting = Disable (default)

#### Cycle Fault Cont

This parameter allows the fault contactor to cycle with each start. When Cycle Fault Cont is enabled, the starter waits for the run signal to be asserted before performing its motor wiring check. Following a successful check on the motor wiring configuration, the motor will start.

When this mode is selected, an external logic circuit must be provided to control the fault contactor.

Range = Enable or Disable

Recommended setting = Disable (default)

Stall Detect	<p>Allows tuning of the stall detection. The counts represent the change in the motor voltage's running average sampled on an interval set by the Stall Time ms. Menu. If the counts representing the running average of the motor voltage do not increase by the setting in one sample period, the starter will initiate the ramp to 450% mode.</p> <p>Range = 0 to 99 Recommended setting = 1 (default)</p>
Stall Time ms.	<p>Sets the sampling period for the stall detection. A value of 0 disables this feature.</p> <p>Range = 0 to 1000 milliseconds Recommended setting = 0 (default)</p>
Start Limit Time	<p>Sets the start time. When set to 0 ms, the starter will allow twice the average start time before increasing the current limit setting. When set to any other value, once that time has passed, the starter will increase the current limit if the motor is not at full voltage.</p> <p>Range = 0 to 5000 milliseconds Recommended setting = 0 (default)</p>
Shorted SCR %FLA	<p>Sets the fault level for a Shorted SCR. If the current in one of the SCRs exceeds this setting when the starter is in a stopped condition, then it will display a Shorted SCR Fault.</p> <p>Range = 1% to 100% Recommended setting = 25%</p>

## 6. Troubleshooting

Symptom / Message	Description/ Common Cause	Testing	Solution
LCD not working. Display is blank and/or back light off after pressing any of the buttons on the keypad.	1. The control voltage applied at the time of a power cycle is less than 85 VAC. The starter does not power up and the display remains blank.	Measure the control voltage between B1 and B2. It should be 120 VAC nominal; 105 VAC min. to 135 VAC max.	1. Troubleshoot the control voltage supply to the starter if it is out of range.
	2. The internal low voltage power supply is failed.		2. Replace the control board in the Power/Control module if the supply is 120 VAC.
Motor will not start when there is UP demand and the message is:  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;">                     Status Motor Stopped                 </div>	The starter is not detecting a run signal.  <b>NOTE:</b> This is the normal status message displayed when a "RUN" command is not asserted and the starter is in a "no fault" state.	1. Measure the voltage between A1 and B2 when a "run" command is issued to the starter (elevator has an UP demand). This should be greater than 105 VAC.	1. Troubleshoot the car controller motor RUN circuit if the run signal is less than 105 VAC.
		2. Apply 120 VAC between A1 (RUN) and B2; the motor should start.	2. Replace the control board in the Power/Control module if the motor doesn't start with 120 VAC at A1.
Motor is running and the pump is spinning but there is no oil pressure.	Motor running in the wrong direction. The mainline supply phase rotation is opposite of that needed for correct mechanical direction of rotation.	Check for oil flow through the valve. Install a pressure gauge at the "pump" pressure port. The pressure should be some non-zero value when the motor is running,	Turn off mainline power. Swap L1 with L2 at the mainline supply connection on the power/control module. Reapply power; the display should read "Wrong Rotation." Navigate to the parameter menu and change the value of the <i>Line Rotation</i> parameter from "ABC" to "CBA" or vice-versa. Cycle power and check operation.

<b>Symptom / Message</b>	<b>Description/ Common Cause</b>	<b>Testing</b>	<b>Solution</b>
Upon power up the message is: <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;">Control Voltage Powered Down</div>	1. The control voltage is less than 90 VAC. 2. The internal low voltage power supply is failed.	Measure the control voltage between B1 and B2. It should be 120 VAC nominal; 105 VAC min. to 140 VAC max.	1. Troubleshoot the control voltage supply to the starter if it is less than 120 VAC. 2. Replace the control board in the Power/Control module if the control voltage is 120 VAC.
Motor does not start and the message is: <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;">Control Voltage Under Voltage</div>	1. The control voltage is between 90 and 105 VAC. 2. The internal low voltage power supply is failed.	Measure the AC control voltage between B1 and B2. It should be 120 VAC nominal; 105 VAC min. to 140 VAC max.	1. Troubleshoot the control voltage supply to the starter if it is less than 120 VAC. 2. Replace the control board in the Power/Control module if the control voltage is 120 VAC.
Upon power up the message is: <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;">Control Voltage Over Voltage</div>	1. The control voltage is greater than 145 VAC. 2. The internal low voltage power supply is failed.	Measure the AC control voltage between B1 and B2. It should be 120 VAC nominal; 105 VAC min. to 145 VAC max.	1. Troubleshoot the control voltage supply to the starter if it is higher than 120 VAC. 2. Replace the control board in the Power/Control module.
Upon power up the message is: <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px 0;">Fault EEPROM Memory</div>	The starter built-in-test detected a problem with its EEPROM Memory.	Cycle power and observe whether or not the fault is detected. Repeat 3 times.	Replace the control board in the Power/Control module.



Symptom / Message	Description/ Common Cause	Testing	Solution
Motor trips during a run and the message is: <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;">Fault Phase Loss</div>	During a motor run cycle, the voltage zero crossings of two phases are closer than 15 degrees. 1. A mainline disconnect fuse cleared. 2. There is a mainline phase voltage imbalance: $V_{high} - V_{low} > 0.2 \times V_{nom}$	1. Check the mainline fuses. 2. Measure the mainline supply voltage across all three phases. The difference between the highest and lowest mainline voltage should be less than 20 pct. of nominal.	1. Replace all 3 mainline fuses if any one is open. 2. Correct a mainline power problem if there is a voltage imbalance.
<b>Following a power up the message is:</b> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;">Wrong Rotation CBA set as ABC</div> or <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;">Wrong Rotation ABC set as CBA</div>	3-phase mainline supply phasing is opposite of the <i>Line Rotation</i> parameter.	Use a "Phase Rotation Meter" to check the phase sequence at power/control module terminals L1, L2, and L3.	Change the value of the <i>Line Rotation</i> parameter from "ABC" to "CBA" or vice-versa, cycle power, and check the status display. Replace the starter if "Wrong Rotation" continues to be detected. Verify the motor is running in the correct direction of rotation. If not, swap L1 with L2 at the mainline supply connection on the power/control module and change <i>Line Rotation</i> back to its initial value.
Motor does not start and the message is: <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;">Fault Shorted SCR A</div>	The Starter has a shorted SCR in the indicated phase. A shorted SCR is detected if the current through any SCR is greater than 25% of FLA or the voltage across an SCR is less than 80 % of the mainline supply when the motor is stopped.	Starter unit related fault; no further testing required.	Replace the starter.

<b>Symptom / Message</b>	<b>Description/ Common Cause</b>	<b>Testing</b>	<b>Solution</b>
Control voltage is applied to the starter and the message is:  <div style="border: 1px solid black; padding: 2px; width: fit-content;">Incoming Power Not Detected</div>	Mainline supply voltage is less than 51 VAC for starters rated 460 V.  Mainline supply voltage is less than 68 VAC for starters rated 575 V.	Measure the mainline voltage between starter terminals L1 to L2, L2 to L3, and L1 to L3. All 3-phases should be at the rated system voltage.	If the mainline is dead, check the incoming supply at the mainline switch, the mainline fuses, and the wiring between the disconnect and the starter.
Following a power up the message is:  <div style="border: 1px solid black; padding: 2px; width: fit-content;">Frequency Not Detected</div>	Mainline supply voltage frequency is outside of 45 Hz and 65 Hz.  It can be caused by poor speed regulation in a temporary generator.	Measure the frequency of the mainline supply voltage, L1 – L2, L2 – L3, and L1 – L3.	If the frequency is not steady at 60 +/- 1 Hz (or 50 +/- 1 Hz), correct a mainline power problem.
Motor runs and the message is:  <div style="border: 1px solid black; padding: 2px; width: fit-content;">Warning: Current Loss</div>	The motor current is less than 8% of the starter rating after MUS is detected.	Disconnect the “UP” valve solenoid(s) and start the motor by applying 120 VAC to the “RUN” input. When the motor status is “up to volt,” scroll to Line Amps and record the values.	<p>If the value of Line Amps is 8% or less than the starter rating the starter is oversized for the application. Verify the starter is rated for the motor nameplate hp and voltage according to Tables 1 through 4. Replace the starter if not sized properly.</p> <p>The motor may be unloaded (pump coupling sheared or belts slipping). Repair the mechanical problem.</p>

Symptom / Message	Description/ Common Cause	Testing	Solution
<p>Following a power up, the fault contactor <b>picks momentarily</b>, then drops and the display indicates:</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Fault Motor Wiring</p> </div>	<p>1. The motor is not correctly connected to the starter, or the motor has an open winding.</p>	<p>Turn off mainline power and disconnect the motor from the starter. Refer to Figure 6 for in-delta connection and Figure 8 for an across-the-line connection. Ring out the wiring to verify the terminal markings on each pair of winding leads. Check for open circuits by measuring the resistance of each winding. The resistance of any individual winding (T1 – T4, etc. for 6 or 12 lead motors) or phase-to-phase (for 3-lead motors) should be less than 10 ohms.</p>	<p>1a. Correct the motor wiring. 1b. Replace the motor if there are any open or unbalanced windings.</p>
	<p>2. There is a shorted SCR. Depending on the version of software, subsequent resets after a shorted SCR may show up as motor wiring fault.</p>	<p>Turn off mainline power. Measure the resistance across each phase of the power/control unit: L1 to T1, L2 to T2, and L1 to T3. A resistance of less than 3000 ohms indicates a shorted SCR.</p>	<p>Replace the starter.</p>
	<p>3. Defective Fault Contactor. There is a voltage drop across the contacts due to mis-aligned contacts or high resistance.</p>	<p>(For inside-delta connection only.) Turn off mainline power. Disconnect the run signal from starter terminal A1. Temporarily move the jumper wire from 27 to 28 on the terminal block. Restore mainline power. The fault contactor is energized and remains picked.  Measure the voltage across the Fault contactor : T6 to T4, T4 to T5, T6 to T5. All 3-phases should be at the rated system voltage.</p>	<p>Replace the fault contactor if any voltage measurement is less than the mainline line-line voltage by 5 volts, or more,</p>
	<p>4. Power quality</p>	<p>Use a 3-phase power analyzer to verify the mainline is a balanced, 3-phase source.</p>	<p>2. Correct the mainline power problem if the voltage, frequency, and phase displacement do not meet 3-phase service requirements.</p>

Symptom / Message	Description/ Common Cause	Testing	Solution
Following a power up, the fault contactor <b>never</b> picks; the display indicates:  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">             Fault Motor Wiring           </div>	1. Fault contactor coil or wiring is open circuit.	Turn off mainline power. Disconnect the fault contactor from the power/control module at plug terminals 28 and B2. Measure the resistance directly across the fault contactor coil and across pins 28, B2. The resistance should be 20 to 25 ohms.	Replace the fault contactor if the coil is open. Repair the wiring between the fault contactor and plug connection to the power/control module.
	2. Connection from starter terminal B1 to 27 is missing or open circuit	Turn on mainline power. Measure the voltage from terminal 27 to B2; it should be 120 VAC.	If there is no voltage at pin 27, install a jumper between power/control module terminals B1 and 27 (see Figure 10). If the jumper was removed for the “cycle fault contactor” option, check the wiring to the fault contactor control logic circuit.
	3. Starter “NO Ready” contact (terminals 27, 28) failed open.	Momentarily push both UP and DOWN buttons. The fault contactor should pick and drop about 2 seconds after buttons are released.	Replace the starter control board if the FC doesn’t pick/drop after pressing the UP/DOWN buttons and tests (1) and (2) passed.
Motor does not start and the message is:  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">             Fault Highline Volts           </div>	The unit detected a mainline overvoltage condition.  For starters rated 200/230/460, a <i>Highline</i> is detected if the mainline voltage is 529 VAC, or higher.  For starters rated 460/575, a <i>Highline</i> is detected if the mainline voltage is 632 VAC, or higher.	1. Measure the mainline supply voltage. The mainline must be less than 10% above the starter’s rating.	1. For mainline supply voltages up to 480 VAC, use starters rated 460 V. For mainline up to 600 VAC, use starters rated 575 V. Starters rated 575 can be used for 200 VAC through 600 VAC applications.  Correct a problem with the mainline service if the voltage is higher than 529 V for 480 V systems or higher than 661 V for 600 V systems.
		2. Measure the mainline voltage between starter terminals L1 to L2, L2 to L3, and L1 to L3. Compare the meter readings with the Line – Line volts on the status menu. All three phases of the two measurements should match within 7 percent.	2. If one or more of the starter Line – Line voltages does not match the meter reading, replace the starter.

Symptom / Message	Description/ Common Cause	Testing	Solution
<p>Motor starts, but does not come up to speed in a timely manner, or the overload trips. The display rapidly transitions from</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">Motor Status Maintain Start</div> <p style="text-align: center;">to</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">Motor Status Ramp to 450%</div> <p style="text-align: center;">Before switching to</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">Motor Status Maintain 450%</div>	<p>The Start Limit Time is the rolling average of the last 10 start times. If the Start Limit Time is exceeded, the current is ramped to the maximum starting amps setting of 450% of FLA, and maintained until the motor is up to speed (SCRs on full) or the overload trips.</p>	<p>Obtain the full load current from the motor nameplate, a tag on the tank, or from Table 9.</p>	<p>Use the keypad to navigate to the “Parameter Menu.” Verify that the <i>Starting Amps</i> is set to 250% (230% for NEB). <i>Starting Amps</i> must not be set below 200%. Verify that <i>Overload Amps</i> is set to motor nameplate FLA. If <i>Full Load Amps</i> cannot be set to motor nameplate FLA, the starter is underrated for the application. Refer to Tables 1 through 4 for starter application information.</p>
	<p>1. Current limit is set too low.</p>	<p>Inspect the motor wire connections to the power/control unit and compare to Figure 5</p>	<p>Install motor wires on the raised projection side of the power/control unit contact bar as shown in Figure 5. Tighten setscrews to torque listed in Table 6.</p>
	<p>2. Loose motor wiring connections.</p>	<p>Turn off mainline power. Disconnect all the wires from the starter terminal 18 (MUS output). Turn on mainline power. With the RUN signal off (motor stopped) and 120 VAC applied to terminal 17, measure the voltage at MUS-18. It should be less than 10 volts.</p>	<p>If the voltage at MUS-18 to B2 (120 Vrtn) is more than 50 VAC with the motor stopped, MUS is shorted, replace the starter control board.</p>
	<p>3. The “MUS” output is failed short allowing a load on the motor during a start.</p>	<p>Disconnect the “UP” valve solenoid(s) and start the motor by applying 120 VAC to the “RUN” input. Observe the message on the status display.</p>	<p>If the motor starts normally and the status transitions to “UP TO VOLT” within about two seconds, troubleshoot the MUS interlock control circuit.</p>
	<p>4. The interlock circuit to the UP hydraulic control valve is faulty and allows a load on the motor during a start.</p>	<p>5. A mechanical problem is causing an excessive load on the motor during a start.</p>	<p>a. If the oil temperature is less than 90 deg F, check that the oil viscosity control, such as a tank heater or recirculation, is operational. b. Inspect the motor and pump for mechanical damage.</p>

Symptom / Message	Description/ Common Cause	Testing	Solution
<p>Motor trips after running up to speed and the message is:</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Fault Low Leg Amps</p> </div>	<p>During a run cycle, the starter has detected an imbalance in the motor currents. Software compares the lowest phase (or line) current to the highest phase (or line) current. That is</p> <p>Imbalance = <math>I_{low} / I_{high}</math></p> <p>The default current imbalance trip ratio is 60% (0.6). If the imbalance is lower than 0.6, a Low Leg Amp fault is detected.</p> <p><b>Example:</b></p> <p>Low leg current = 59 amps, High leg current = 100 amps Imbalance = <math>59 / 100 = 0.59</math></p> <p>Since the imbalance is less than 0.6, a Low Leg Amp fault is detected.</p> <p>Can be caused by mainline voltage imbalance, failed current sensor, SCR phase control problem, or shorted motor windings.</p>	<ol style="list-style-type: none"> <li>1. Turn off mainline power. Measure the resistance across each motor winding. The three resistances should be equal +/- 1 ohm, and less than 10 ohms.</li> <li>2. Restore mainline power. Measure the voltage across all three phases, L1 – L2, L2 – L3, and L1 – L3. All 3-phases should be at the rated system voltage.</li> <li>3. Attempt to make bottom-to-top terminal no-load runs. Take the following measurements when the car is moving. <ol style="list-style-type: none"> <li>a. Use a clamp-on ammeter to measure the mainline current in each of the three phases.</li> <li>b. Measure the AC voltage across the SCRs (L1 to T1, L2 to T2, L3 to T3) at the Power Control unit. This voltage should be less than 5 VAC and all three should be within a volt or two.</li> <li>c. Scroll to Line Amps in the status menu. Observe the value in each phase as the car is running.</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the motor if the resistance of one winding is much higher or lower than the other two.</li> <li>2. Correct a mainline power problem if the voltage across one phase is more than 8 pct higher or lower than the other two.</li> <li>3a. If the car runs and the line amps are about equal when the car is running, suspect an intermittent mainline voltage imbalance. Adjust the Imbalance Ratio to a lower value to avoid nuisance faults. This setting is adjustable in the OEM menu accessible via a password. Contact Otis Engineering to adjust OEM parameters.</li> <li>3b. Replace the starter if: <ul style="list-style-type: none"> <li>• The starter continues trip with a Low Leg Amps fault</li> <li>• One or more of the starter Line amps does not match the ammeter current measurements (difference of 10 pct, or more), replace the starter.</li> <li>• The voltage across any SCRs leg is greater than 5 VAC.</li> </ul> </li> </ol>

Symptom / Message	Description/ Common Cause	Testing	Solution
<p>Motor trips while the car is running up and the message is:</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Fault Overload</p> </div>	<p>The Starter has detected an Overload condition and shut off. A class 10 overload trip characteristic, shown in Figure 15, is implemented in the starter. As indicated by the curve, the higher the current, the shorter the time to trip.</p> <p><b>Examples:</b></p> <p>(1) If the line current is maintained at 450% of FLA, the starter will trip in five seconds.</p> <p>(2) If the line current is maintained at 250% of FLA, the starter will trip in 19 seconds.</p> <p><b>Causes:</b></p> <p>1. Overload setting is too low.</p>	<p>1. Obtain the full load current from the motor nameplate, a tag on the tank, or from Table 9.</p>	<p>1. The value of <i>Full Load Amps</i> should be set to motor nameplate FLA. If <i>Full Load Amps</i> cannot be set to motor nameplate FLA, the starter is underrated for the application. Refer to Tables 1 through 4 for starter ratings.</p>
	<p>2. Loose motor wiring connections.</p>	<p>2. Inspect the motor wire connections to the power/control unit and compare to Figure 5.</p>	<p>2. Install motor wires on the raised projection side of the power/control unit contact bar as shown in Figure 5. Tighten setscrews to torque listed in Table 6.</p>
	<p>3. A mechanical problem is causing an excessive load on the motor.</p>	<p>3a. If the oil temperature is less than 90 deg F, check that the oil viscosity control, such as a tank heater or recirculation, is operational.</p> <p>3b. Inspect the motor and pump for mechanical damage.</p> <p>3c. Inspect the jack for a mechanical problem restricting UP travel.</p>	<p>3a. Repair the tank heater or recirculation control circuit.</p> <p>3b. Replace the motor or pump if either component is damaged.</p> <p>3c. Correct a problem with the hydraulic jack.</p>

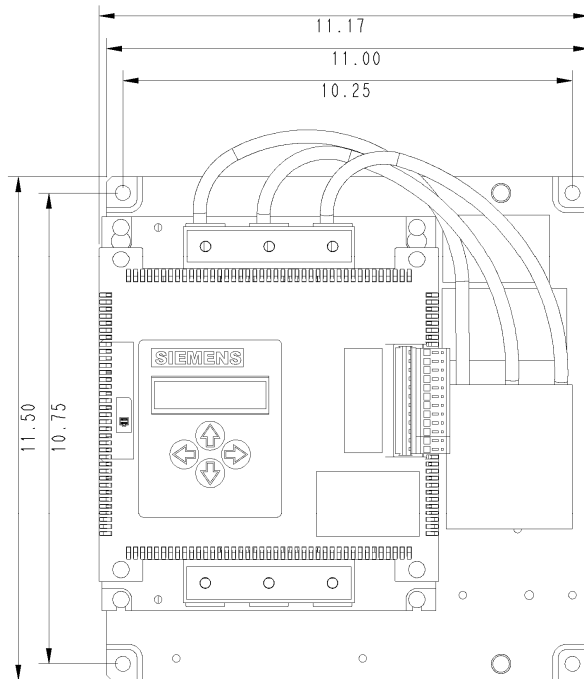
Symptom / Message	Description/ Common Cause	Testing	Solution
<p><i>(continued)</i> Motor trips while the car is running up and the message is:</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Fault Overload</p> </div>	4. Hydraulic relief valve not adjusted properly and the elevator is overloaded.	4. Obtain the full-load working pressure. Install a pressure gauge at the valve and run the car onto the stop ring. The relief valve should operate between 115 and 125 pct full-load working pressure.	4. Adjust the relief valve to operate between 115 and 125 pct full-load working pressure. See step 5 if the overload trips before reaching 115 pct full-load working pressure.
	5. Motor is undersized for the elevator duty.	5. Repeat step 4 to determine if the pump can deliver at least 115 pct full-load working pressure.	5. If the starter overload trips before reaching 115 pct full-load working pressure, the motor may be underrated for the elevator duty. Consult your engineering or technical department to determine the motor power required for the elevator duty.



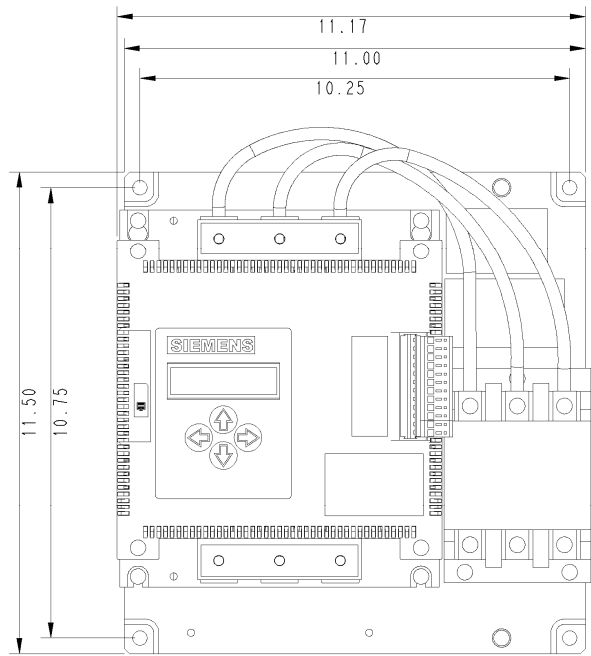
## 7. Electrical Specifications

<b>Input and Control Power</b>	Mainline Supply	200/230/460 VAC, +10% / -15% 460/575 VAC, +10% / -15% Balanced 3-phase, 50/60 Hz, $\pm$ 5 Hz
	Control Power	120 VAC $\pm$ 15%, 500 VA Single phase, 50/60 Hz, $\pm$ 5 Hz
	Motor Run Discrete Input	120 VAC $\pm$ 15%, nominal, 10 mA Pull in: 79 VAC, max. Drop out: 20 VAC, min. Off State Leakage: 1.5mA max.
	Up to Speed Discrete Output Contact Rating	Normally Open Solid State Relay 1 Amp, resistive, @ 120 VAC Solid State Relay rated for AC only
	Ready Discrete Output Contact Rating	Two dry contacts, 1 Normally Open, 1 Normally Closed 1.5 Amps @ 120 VAC
<b>Duty Cycle</b>	30% @ 140% of rated FLA; 80 starts/hour	
<b>Motor Protection</b>	Overload Type	Class 5
	Current Imbalance	Adjustable trip ratio (lowest motor winding current divided by the highest motor winding current) from 0.1 to 0.75. Two-second delay allows for system to recover if possible. Fault contactor opens.
	Reverse Phase	Trips if any two phases are reversed from selected phase rotation. Fault contactor opens.
	Phase Loss Detection	Trips if zero crossings are closer than 15 degrees for 2.5 seconds. Fault contactor opens.
	Shorted SCR	Trips in two seconds if current flow greater than 10% of the starter FLA is sensed when the starter is in the off state. Fault contactor opens.
<b>Adjustments</b>	Starting Current Limit	100% to 425% of Overload current setting
	Incoming Phase Rotation	ABC or CBA, selectable
	Off Delay	0 to 2500 mS
	On Delay	0 to 2500 mS
<b>Display</b>	Type	LCD, 16 characters by 2 lines
	Backlight	On for two minutes after last keypad input.
<b>Environmental</b>	Humidity	5% ....95% non-condensing
	Operating Temperature	32 deg F to 122 deg F
<b>Agency Approvals</b>	CE	IEC 947-4-2 File Number:
	UL and cUL	UL & cUL 508 File Number: E1878467,02NK50596
	CSA	File Number: LR6535

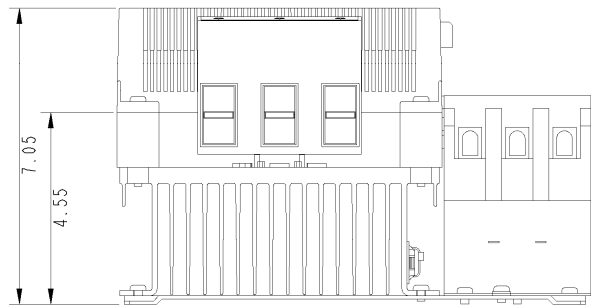
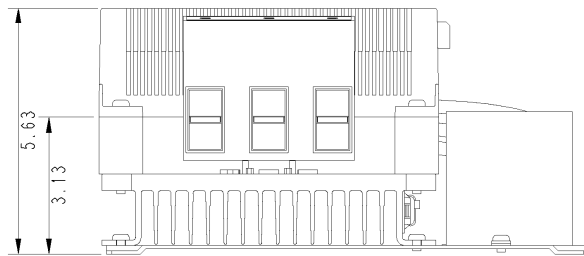
## 8. Mechanical Specifications



**Figure 17: Dimensional Outline for p/ns:  
AAA21240AD3 – AD5, AD11 – AD15**



**Figure 18: Dimensional Outline for p/ns:  
AAA21240AD6 – AD9, AD16 – AD19**



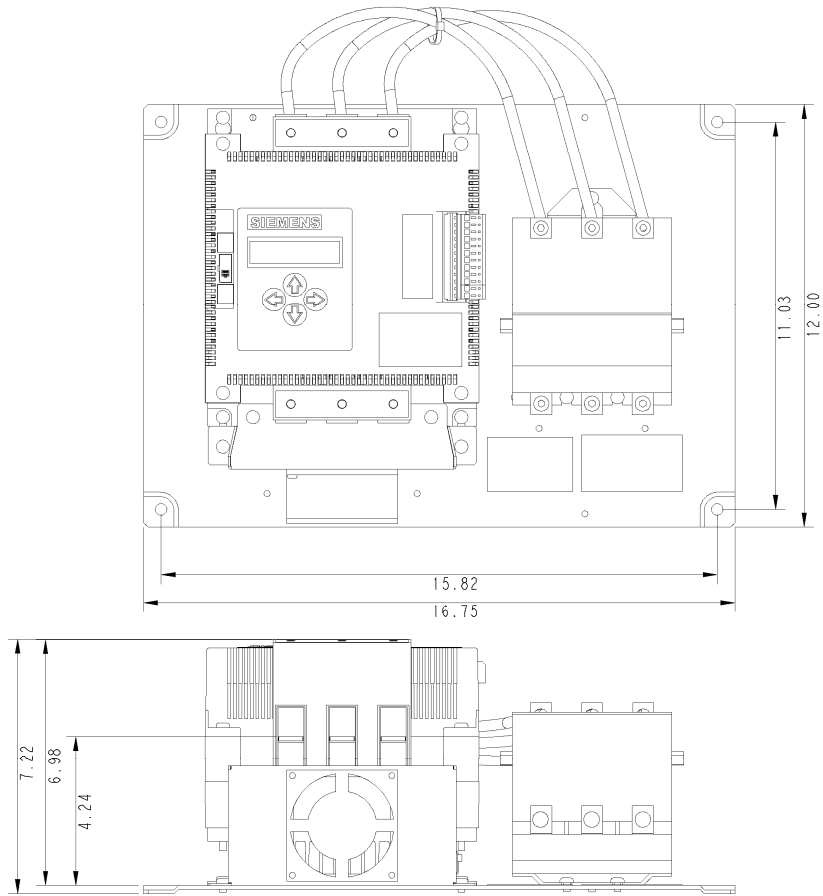


Figure 19: Dimensional Outline for p/n AAA21240AD10

## Appendix A: Fault and Diagnostic Data Log

### Starter Nameplate Data

Siemens Part No.	
Serial Number	
Date Code	

### Status Menu

Motor Status			
Line-Line Volts			
Minimum Line Volts			
Peak Motor Amps			
Peak Line Amps			
Power Status			

### Parameter Menu

Starting Amps	
Overload Amps	

### Diagnostics Menu

Power On Time	
Running Time	
Starting Time	
Number of Starts	
Power Ups	
Total Faults	

### Fault Menu, Last Fault

Fault Type			
Fault Run Status			
Fault Time			
Running Time			
Fault Amps			