Motorpact™ Soft Start
Class 8198

ENGLISH

Instruction Bulletin

Retain for future use.

a brand of Schneider Electric

SQUARE D

HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

Signals a reference to another document.

Provides additional information to clarify or simplify a procedure.

Lists the tools needed for procedure.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

ENGLISH

TABLE OF CONTENTS

ENGLISH

LIST OF FIGURES

ENGLISH

LIST OF TABLES

ENGLISH

SECTION 1— INTRODUCTION

This instruction bulletin contains ratings, start-up procedures, programming information, troubleshooting procedures, and wiring diagrams for the Motorpact™ Soft Start.

Refer to the applicable Motorpact Medium Voltage Motor Controllers bulletin for instructions pertaining to the main controller section:

- # 46032-700-06 for NEMA enclosures

Refer to the applicable contactor bulletin, shipped with the equipment, for information regarding the Motorpact medium voltage vacuum contactor:

- # 46032-700-02 for 200/ 400/ 450 A contactors

The Motorpact Soft Start is a complete NEMA Class E-2 motor controller designed to start, protect, and control AC medium voltage motors. It contains the motor disconnect switch, motor circuit fuses, a control power transformer (CPT), a line isolation contactor, semiconductor controlled rectifier (SCR) stack assemblies, a bypass contactor, low voltage controls, and motor terminal blocks. See Figures 1 and 2.

Figure 1: 4160 V, 200–400 A Standard Soft Start

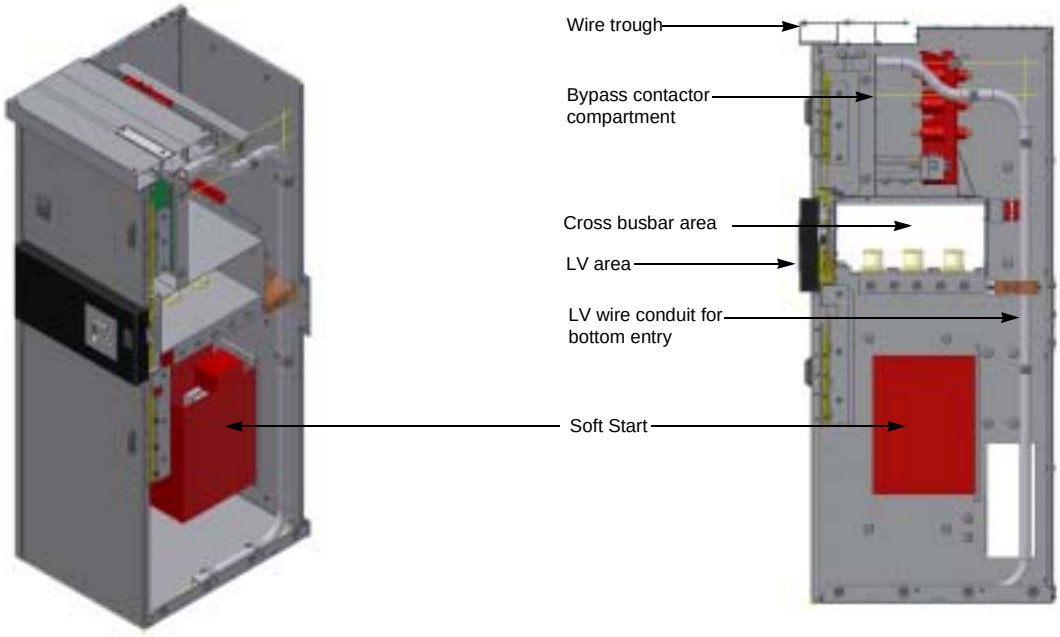

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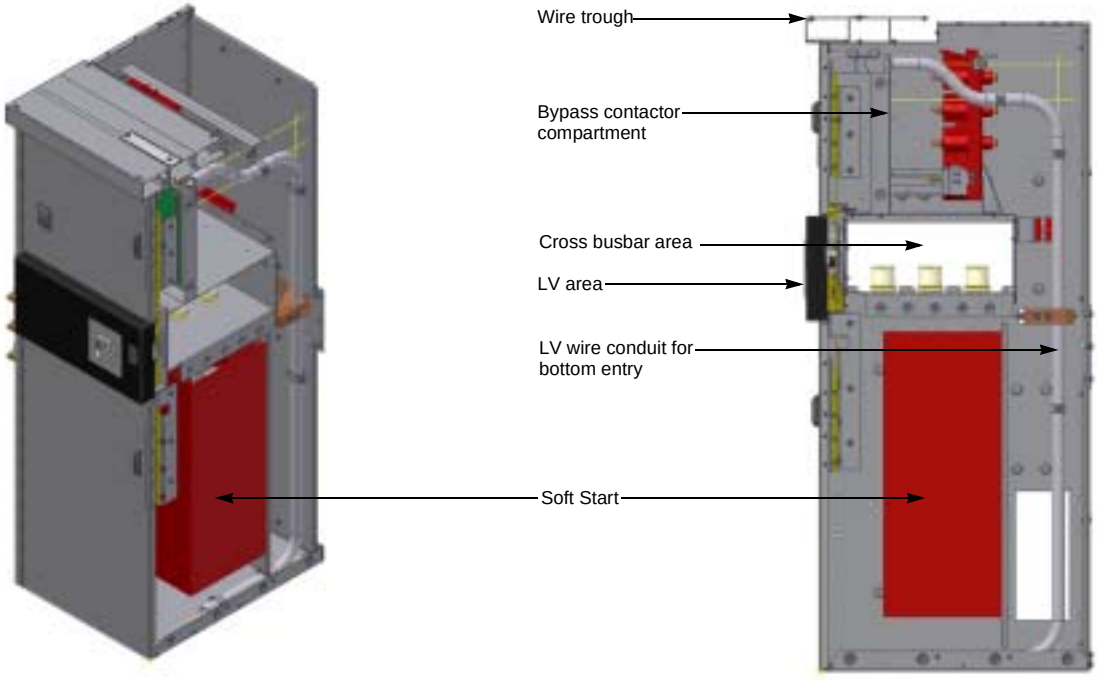
Figure 2: 6600 V, 200–400 A Standard Soft Start



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SECTION 2— SAFETY PRECAUTIONS

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel familiar with medium voltage equipment are to perform work described in this set of instructions. Workers must understand the hazards involved in working with or near medium voltage circuits.
- Perform such work only after reading and understanding all of the instructions contained in this bulletin.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- Turn off all power before working on or inside equipment.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Handle this equipment carefully and install, operate, and maintain it correctly in order for it to function properly. Neglecting fundamental installation and maintenance requirements may lead to personal injury, as well as damage to electrical equipment or other property.
- Do not make any modifications to the equipment or operate the system with the interlocks removed. Contact your local field sales representative for additional instruction if the equipment does not function as described in this manual.
- Carefully inspect your work area and remove any tools and objects left inside the equipment.
- Replace all devices, doors, and covers before turning on power to this equipment.
- All instructions in this manual are written with the assumption that the customer has taken these measures before performing maintenance or testing.

Failure to follow these instructions will result in death or serious injury.

ENGLISH

SECTION 3— SPECIFICATIONS, RATINGS, AND DIMENSIONS

Table 1: Motorpact Soft Start Specifications

Type of load	Three-phase AC induction motors or synchronous motors
AC supply voltage	2300, 3300, 4160, 7200 Vac + 10% to -15%
Nominal hp ratings	2300 V 50–1500 hp 3300 V 50–2250 hp 4160 V 50–2750 hp 6000/7200 V 50–5000 hp
Unit overload capacity (percent of motor full load amps)	125%—Continuous 500%—60 seconds 600%—30 seconds 1 cycle: Up to 14 x full load amps (internally protected by the programmable short circuit)
Frequency	50 or 60 Hz, ±2 Hz hardware selectable
Power circuit	6, 12, or 18 SCRs (model dependent)
SCR peak inverse voltage ratings	6500—21000 V (model dependent, see “Silicon Controlled Rectifier (SCR) Power Modules” on page 13)
Phase insensitivity	User selectable phase sequence detection
Transient voltage protection	One RC snubber dv/dt network per SCR power module
Cooling	Convection fan for NEMA 1 or NEMA 12 units > 400 A
Bypass contactor	Line rated vacuum contactor included as standard
Ambient condition design	Chassis units: 32° to 122° F (0° to 50° C) Enclosed units: 32° to 104° F (0° to 40° C). Optional: -4° to 122° F (-20° to 50° C) with heaters. 5–95% relative humidity 0–3300 ft. (1000 m) above sea level without derating
Control	2- or 3-wire 110/120 Vac (customer supplied) CPTs are included on standard units
Auxiliary contacts	Multiple: Form C (contacts), rated 4 A, 250 Vac max. 8 relays (4 programmable): Form C contacts Fault indicator: Form C contact
BIL rating	2300—7200 V, 60 kV
Approvals	UL Listed, Canadian UL (cUL) Listed
Advanced Motor Protection	
Two-stage electronic overload curves	Starting: programmable for Class 5 through 30 Run: Programmable for Class 5 through 30 when “At-Speed” is detected
Overload reset	Manual (default) or automatic
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 enough for a successful restart. Starter learns and retains this information by monitoring previous successful starts.
Phase current imbalance protection	Imbalance trip level: 5–30% current between any two phases Imbalance trip delay: 1–20 seconds
Over current protection (electronic shear pin)	Trip level: 100–300% of motor full load amps (FLA) Trip delay: 1–20 seconds

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Table 1: Motorpact Soft Start Specifications *(continued)*

Advanced Motor Protection *(continued)*	
Load loss trip protection	Under current trip level: 10–90% of motor FLA Under current trip delay: 1–60 seconds
Coast down (back spin) lockout timer	Range: 1–60 minutes
Starts-per-hour lockout timer	Range: 1–6 successful starts per hour Time between starts: 1–60 minutes between start attempts
Programmable Outputs	
Type/rating	Form C (DPDT), rated 5 A Continuous Inductive 35% PF, 240 Vac max. (960 VA)
Run indication	Aux 3
At speed indication	Aux 4
Acceleration adjustments	Programmable ramp types: voltage or current ramp (VR or CR) Starting torque: 0–100% of line voltage (VR) or 0–600% of motor FLA (CR) Ramp time: 1–120 seconds Current limit: 200–600% (VR or CR)
Dual ramp settings	4 options: VR1 + VR2; VR1 + CR2; CR1 + CR2; CR1 + VR2 Dual ramp control: ramp 1 = default Ramp 2 = selectable via dry contact input
Deceleration adjustments	Begin decel level: 0–100% of line voltage Stop level: 0–1% less than begin decel level Decel time: 1–60 seconds
Jog settings	Voltage jog: 5–75%
Kick start settings	Kick voltage: 10–100% or OFF 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, average current, ground fault (option)
Thermal data	Remaining thermal register; thermal capacity to start
Start data	Average start time, average start current, measured capacity to start, time since last start
RTD data	Temperature readings from up to 12 RTDs (6 stators)
Voltage metering	KW, KVAR, PF, KWh
Serial Communications	
Protocol	Modbus® RTU
Signal	RS-485, RS-422, or RS-232
Network	Up to 247 devices per mode
Functionality	Full operation, status view, and programming via communications port

ENGLISH

Table 1: Motorpact Soft Start Specifications *(continued)*

Operator Interface	
LCD readout	Alphanumeric LCD display
Keypad	8 function keys with tactile feedback
Status indicators	12 LEDs include Power, Run, Alarm, Trip, Auxiliary Relays
Remote mount capability	Up to 1000 ft (305 m) from chassis (use twisted, shielded wire)
Clock and Memory	
Operating memory	SRAM loaded from EEPROM at initialization
Factory default storage	Flash EPROM, field replaceable
Customer settings and status	Non-volatile EEPROM, no battery backup necessary
Real time clock	Lithium ion battery for clock memory only

Table 2: 200 and 400 A Unit Ratings

Voltage (V)	Series Pairs	Total No. of SCRs	PIV Rating (V)
2300	0	6	6500
3300/4160	2	12	13000
6000/7200	3	18	19500

Table 3: Motorpact Soft Start Dimensions

Ratings				MOTORPACT Class E2 Soft Start			
Volts	Maximum Amps	Nominal Maximum Hp	KW	Model	NEMA 1/1A		
					H	W	D
2300	200	800	500	MVC3-23200-SE	92 in. (2337 mm)	29.5 in. (749 mm)	37.25 in. (946 mm)
	400	1500	1000	MVC3-23400-SE			
3300	200	1000	600	MVC3-33200-SE			
	400	2250	1200	MVC3-33400-SE			
4160	200	1250	1000	MVC3-41200-SE			
	400	2750	2000	MVC3-41400-SE			
6600/6900	200	2500	2000	MVC3-66200-SE			
	400	5000	3750	MVC3-66400-SE			

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SECTION 4— APPLICATION INFORMATION

DESIGN FEATURES

Silicon Controlled Rectifier (SCR) Power Modules

For each phase, the SCRs are matched devices arranged in inverse parallel pairs and in series strings to facilitate sufficient peak inverse voltage (PIV) ratings for the applied voltage (see Table 2 on page 12).

Resistive, Capacitive (RC) Snubber Networks

RC snubber networks provide transient voltage protection for SCR power modules in each phase to reduce dv/dt damage.

Firing Circuit

The SCRs are gated (turned on) using a sustained pulse firing circuit. This circuitry is amplified and isolated from the control voltage by means of fiber optics for current and ring transformers.

Vacuum Contactors

A sequencing feature controls the vacuum contactors. Under normal operating conditions, this ensures that both the in-line and SCR bypass contactors make and break under no-load conditions to maximize contactor life. Both contactors are rated for the maximum starting requirement of the unit design. The bypass contactor is rated to be capable of emergency start.

Low Voltage Control Compartment

A low voltage control compartment houses the digital microprocessor controller and LCD keypad operator interface, along with any other low voltage devices. This allows the operator to make adjustments without exposure to the line voltages.

THEORY OF OPERATION

The power of the Motorpact™ Soft Start is in the central processing unit (CPU), a microprocessor-based protection and control system for the motor and starter assembly. The CPU applies a reduced voltage to the motor by phase angle firing the SCRs, and then slowly and gently increases torque through control of the voltage and current until the motor accelerates to full speed. This starting method

- lowers the starting current of the motor;
- reduces electrical stresses on the power system and motor;
- reduces peak starting torque stresses on the motor and load mechanical components; and
- promotes longer service life and less downtime.

Acceleration

The standard Motorpact Soft Start is equipped with several methods for accelerating the motor.

ENGLISH

Default Setting

The default setting applies a Voltage Ramp with Current Limit, the most reliable starting method for the vast majority of applications. Using this starting method, the Initial Torque setting applies just enough voltage to the motor to cause the motor shaft to begin to turn. This voltage is then gradually increased over time (as per the Ramp Time setting) until either:

- the motor accelerates to full speed,
- the Ramp Time expires, or
- a Current Limit setting is reached.

If the motor accelerates to full speed before the ramp time setting has expired, an automatic anti-oscillation feature will override the remaining ramp time and apply full voltage.

If the motor has not reached full speed at the end of the ramp time setting, the current limit setting will proportionally control the maximum output torque. Feedback sensors in the soft start provide protection from a stall condition, an overload condition, or excessive acceleration time.

The Current Limit feature accommodates installations with limited power available. The torque is increased until the motor current reaches the preset Current Limit point and then holds it at that level. Current Limit overrides the ramp time setting. Therefore, 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 start detects an At-Speed condition and closes the Bypass Contactor. The Bypass Contactor shunts power around the SCR stack assemblies. At this point, the motor is operating at full voltage.

Current Ramp

This starting method uses a closed current feedback PID loop to provide a linear torque increase up to a maximum current level.

Constant Current

With this method, current is immediately increased to the Current Limit point and held there until the motor reaches full speed.

Custom Curve

The Custom Curve method gives the ability to plot torque and time points on a graph. The soft start will then accelerate the motor following these points.

Tachometer Feedback Ramp

The Tachometer Feedback Ramp uses a closed loop speed follower method monitoring a tachometer input signal from the motor or load shaft.

Deceleration

The Motorpact Soft Start provides the option of either 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**,** since 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 in which a controlled stop prevents water hammer and mechanical damage to the system.

GENERAL PROTECTION

Motorpact Soft Start operation can be divided into 4 modes: Ready, Start, Run, and Stop. The CPU provides motor and load protection in all four modes.

Ready Mode

In this mode, control and line power are applied and the soft start is ready for a start command. Protection during this mode includes current monitoring for leakage through multiple shorted SCRs or welded contacts on the bypass contactor. Other protection features in effect are:

- Starter temperature
- Shorted SCR
- Blown fuse indication
- Phase reversal (if enabled)
- Line frequency trip window
- External input faults

The “Programming Mode” can only be entered from the Ready Mode. During programming, all protection features and start commands are disabled.

Start Mode

These additional protection functions are enabled when the soft start receives a valid Start command:

- Phase reversal (if enabled)
- Start curve
- Acceleration timer
- Phase imbalance
- Short circuit / load pre-check (toe-in-the-water)
- Ground fault
- External input faults
- Accumulated starting FLA units (I^2t protection)
- Overload protection
- Thermal capacity

Shorted SCR and shunt trip protection are no longer in effect once the soft starter goes into the Start mode.

Run Mode

The soft start 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 curve
- Phase loss
- Under current/load loss
- Over current/electronic shear pin
- External input faults

Stop Mode

Once a Stop command has been given, the Motorpact Soft Start protection features change, depending on which Stop mode is selected.

Decel Mode

This mode retains all protection features of the Run mode. At the end of Decel, the motor will stop and these protection features will be activated:

- Coast-down/back spin timer
- Starts-per-hour
- Time between starts
- External input faults

Coast-To-Stop Mode

In this mode, power is immediately removed from the motor and the soft start 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

THERMAL OVERLOAD PROTECTION

The Motorpact Soft Start monitors the motor for excessive thermal conditions due to starting, running, or ambient conditions. The dynamic thermal register system in the CPU provides a mathematical representation of the thermal state of the motor. This thermal state information is derived from current imbalances and (optional) RTD measurements, and is retained and monitored for excesses in value and rate of change. The soft start monitors these conditions separately during Start and Run modes to provide proper thermal overload protection at all times.

Start Mode Overload Protection

You can select Start mode overload protection by using one of three methods:

Basic Protection

I^2t data is accumulated and plotted based on an overload curve selected in programming. The curve 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 start.

Measured Start Capacity

The user enters a measured amount of thermal capacity from a pre-selected successful start as a setpoint to the thermal register.

Learned Curve Protection

The user sets the soft start 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 start is then switched to Curve Follow protection mode and monitors motor performance against this curve. This feature is useful in initial commissioning tests to record a base line performance sample (in this case, it is not necessarily used for motor protection).

Run Mode Overload Protection

This protection is initiated when the Motorpact Soft Start determines that the motor is at speed. This occurs 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^2t 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 to add protection from additional motor heating during a current imbalance condition.
- **Normal Cooling** is provided when the motor current drops below the pick-up point or the motor is offline. The cooling rate is lower for offline motors (such as after a trip) since cooling fans are also inoperative.
- **RTD Input** (requires the optional RTD monitor card) will bias the register in either direction based on real-time input of the motor, bearing, and ambient temperature conditions.
- **Dynamic Reset:** If a motor overload condition occurs and the soft starter trips, it cannot be reset until sufficient cooldown time has elapsed. This cooldown time is determined by the thermal state of the motor when it tripped. The cooldown time is also biased by RTD measurements, when used.

Retentive Memory

Retentive Memory provides continuous overload protection and real time reset, even if power is lost. When power is restored, the soft start will read the real time clock and restore the thermal register to the correct value.

Learned Reset Capacity

The Motorpact Soft Start samples the amount of thermal capacity used in the previous three successful starts, and will not allow a reset until the motor has regained a sufficient amount of thermal capacity. This prevents nuisance tripping and unsuccessful start attempts.

SCR GATE FIRING CIRCUIT

The Motorpact Soft Start contains a firing circuit that includes several unique features that maximize performance, without the need for reactors or field installed devices used in other systems, regardless of conditions. These features include:

Auto Synchronizing

Auto Synchronizing of the gate timing pulses matches each phase firing angle to their respective phases. The soft start actively tracks minor shifts in the line frequency, avoiding nuisance tripping that may happen with conventional gate firing systems.

Sustained Pulse Firing

Sustained pulse firing keeps the firing signal active for 270 electrical degrees, ensuring that the dc gate pulse causes the SCR to fire even if line noise is present at a critical moment. This provides noise immunity and protects against misfiring, enhancing system reliability.

Closed Loop Firing Control

Closed loop firing control is a method of balancing the SCR firing pattern based on the desired output. The CPU uses feedback signals from both the output current and voltage, providing smooth output and preventing imbalances during ramping and unnecessary motor heating.

Transformer Isolation

Transformer isolation of the firing signals prevents interference from line noise and EMI/RFI signals that may be present. Specially designed 120 V, 3-phase isolation transformers provide potential measurement, firing board power, and gate power systems while isolated from the line voltage. High isolation ring transformers are used to step this down to 28 Vac for the sustained pulse firing circuit, providing further isolation for the SCR gates. Additional magnetic isolation is provided via a separate control power transformer (CPT), which powers the low voltage controls and the CPU.

Fiber Optic Isolation

Fiber optic isolation is provided for all signal interfaces between the medium and low voltage systems. The current signals from CTs are converted to fiber optic signals for maximum isolation.

ELECTRONICS

Motorpact Soft Start electronics systems are divided into two categories, low and medium voltage.

Low Voltage

Low voltage electronics include the keypad operator interface, CPU, and main power PC boards, and are located in isolated low voltage compartments of the enclosure.

Keypad Operator Interface

This is a 2-line x 20-character LCD display with backlighting for low ambient conditions. The display reads out in truncated English and can show multiple data points in each screen. Also included are 12 LED indicators, which include Power, Run, Alarm, Trip and the status of the 8 auxiliary relays. It communicates to the CPU via a serial link and, if necessary, can be remotely mounted up to 1000 ft. (305 m) from the soft starter.

CPU Board

This is where the microprocessor and communications co-processor reside. The CPU Board is attached to the main power board, and communicates to it and the keypad operator interface via serial links. The CPU determines operating functions, stores user programming, and acts on feedback signals for faults, metering, and historical data. This board also contains the flash EEPROM and SRAM memory, as well as the analog I/O and terminations.

Main Power Board

This is also referred to as the firing board. It contains the digital I/O relays and interfaces to the TCB for user interface. See “Terminal and Control Board (TCB)” below. It also controls the sequencing of the isolation and bypass contactors with the SCR firing. This board generates all firing signals for the SCR stacks and receives feedback signals from fiber optic transmitters. It converts analog levels to digital signals for the CPU. These firing pulses are via fiber optic signals to isolate them from the medium voltage environment.

Medium Voltage

Control electronics are located in the medium voltage section of the soft start. The main line power must be disconnected before accessing these electronics, which include the TCB (terminal and control board), gate drive, and temp/CT (current transformer) boards.

Terminal and Control Board (TCB)

This is the user connection interface board. It is located in the medium voltage section in order to satisfy UL termination requirements, but does not actually connect directly to the medium voltage components other than the contactor coils. 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.

Gate Drive Boards

These are located directly on the SCR stacks. These boards communicate 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

These boards are attached to the gate drive boards on the SCR stacks and provide the heat sink temperature and current signals back to the main power board via fiber optic cables.

MOV Boards

These boards are attached to the standoffs mounted on the SCR heat sinks and are mounted directly below the Gate Drive boards. The MOV boards are used to protect the gate/cathode section of the SCRs.

DV/DT Boards

The DV/DT boards are used to reduce voltage transients across the stack assemblies.

ENGLISH

SECTION 5— RECEIVING, HANDLING, AND STORAGE

RECEIVING, HANDLING, AND STORAGE

Follow the instructions contained in the “Receiving, Handling, and Storage” section of the applicable Motorpact Medium Voltage Motor Controllers bulletin for receiving and handling guidelines:

- # 46032-700-06 for NEMA enclosures

LOCATION

In order to achieve the Motorpact Soft Start controller’s specified performance and normal operation lifetime, always install it in a location that:

- Has an ambient operating temperature of 32° F to 122° F (0° C to 50° C). The factory can provide optional space heaters for operation in ambient temperatures to -4° F (-20° C).
- Is protected from rain and moisture.
- Has humidity of 5–95%, non-condensing.
- Is free from metallic particles, conductive dust, and corrosive gas.
- Is free from excessive vibration (no greater than 0.5 G).

ENGLISH

SECTION 6— START-UP

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel familiar with this equipment are to perform work described in this set of instructions.
- Perform such work only after reading and understanding all of the instructions contained in this bulletin.
- Turn off all power before working on or inside equipment.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

PRELIMINARY START-UP CHECKLIST

Before applying power to the Motorpact™ Soft Start, perform the following checks on the equipment:

- ❑ Make sure that qualified personnel have hi-potted the line and load wiring before connecting to the soft start (typically 1.5 x rated voltage).
- ❑ Verify that all wiring is completed and all connections are tightened.
- ❑ Check the motor nameplate and confirm the unit is programmed with the correct motor FLA.

The “Phase Rotation Protection” will be activated unless you connect the line power to L1, L2, and L3.

- ❑ Verify control logic via a 120 V test switcher. A separate 120 Vac test receptical can be supplied to the control logic for testing without applying power to the medium voltage section. The test receptical also isolates the 120 Vac from back-feeding the control power transformer. The “On” and “Stop” LEDs will light up.
- ❑ Review all parameters and adjust if required. See Section 8— “Programming” on page 36 for detailed instructions. Try the factory settings first.
- ❑ Verify that the interlocks for the system are installed and working properly.
- ❑ Verify that the feed transformer is correctly sized for the motor(s).
- ❑ Check for any loose mechanical parts or metal debris in the enclosure.
- ❑ Check the motor strapping and connections.
- ❑ Verify that the unit is properly grounded.
- ❑ Remove tie straps from the blown fuse indicator.
- ❑ Connect line voltage to line terminals.

ENGLISH

INTRODUCTION

It is best to operate the motor at its full load starting condition to achieve the proper time, torque, and ramp settings. Initial factory settings are set to accommodate most motor conditions. Try these before making adjustments. If adjustments are required, see “Setpoint Page 2” on page 42.

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 unit 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 starting voltage adjustment. See Figure 3 and Table 4 for adjustment description and procedures.

Figure 3: Acceleration

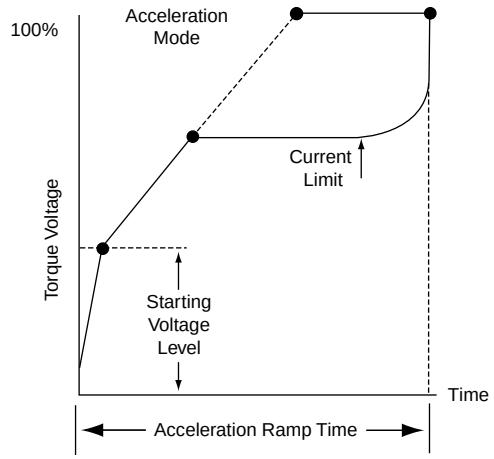


Table 4: Acceleration Adjustments

Adjustment	Factory Setting	Range	Description
Starting voltage	20% of line voltage	0–100% of line voltage	Starting voltage adjustment changes the initial starting voltage level to the motor.
Ramp time	10 seconds	0–120 seconds	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.[1]
Current limit	350% of unit FLA	200–600% of unit FLA	Current limit caps the peak current and extends ramping time if required. The interaction between the voltage ramp and current limit allows the soft start to ramp the motor until reaching the maximum current. The current limit must be set high enough to allow the motor to reach full speed.

[1] Refer to your motor manual for the maximum number of starts the manufacturer allows. Do not exceed this number.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

When adjusting the current limit, do not set the limit too low on variable starting loads.

Failure to follow this instruction can cause the motor to stall and the overload protection to trip.

DECELERATION ADJUSTMENTS

Deceleration extends the stopping time on loads that would otherwise stop too quickly if allowed to coast to stop. Deceleration control provides smooth deceleration until the load comes to a stop. Three adjustments— start deceleration voltage, stop deceleration voltage, and deceleration time—optimize the deceleration curve to meet the most demanding requirements (see Table 5 on page 23).

The Motorpact™ Soft Start is shipped from the factory with the decel feature disabled. Before enabling or modifying the deceleration adjustments, apply power and adjust the soft start. Make any acceleration and deceleration adjustments 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. It will take longer to come to a stop than it would by simply turning off the starter.

Table 5: Deceleration Adjustments

Adjustment	Factory Setting	Range	Description
Start deceleration voltage	60% of line voltage	0–100% of line voltage	The start deceleration voltage adjustment eliminates the dead band in the deceleration mode that occurs when the voltage drops to a level to which the motor deceleration is responsive. This adjustment allows for an instantaneous drop in voltage when deceleration is initiated.
Stop deceleration voltage	20% of line voltage	0–100% of line voltage	The stop voltage level setpoint is where the deceleration voltage drops to zero.
Deceleration time	5 seconds	0–60 seconds	The deceleration ramp time adjusts the time it takes to reach the stop voltage level setpoint. Start and stop the soft start unit to verify that the desired deceleration time has been achieved.

CAUTION

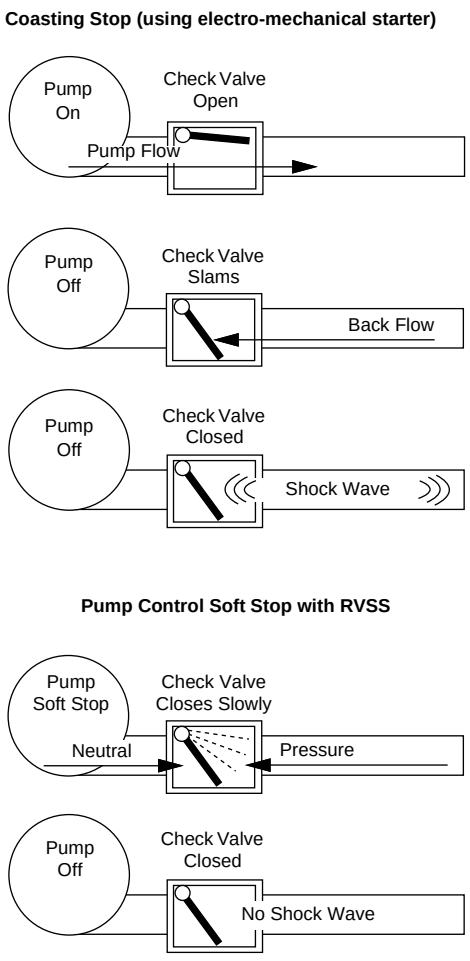
HAZARD OF EQUIPMENT DAMAGE

Do not exceed the motor manufacturer's recommended number of starts per hour. When calculating the number of starts per hour, count a decel curve as part of a start curve. For example, if the recommended number of starts per hour = 6, the allowable starts with decel cycle per hour = 3.

Failure to follow this instruction can result in equipment damage.

Applications

Figure 4: Coasting Stop and Pump Control



The primary use of deceleration is to reduce the sudden changes in pressure that are associated with "water hammer" and slamming of check valves with centrifugal pumps (see descriptions below). Deceleration control in pump applications is often referred to as "pump control."

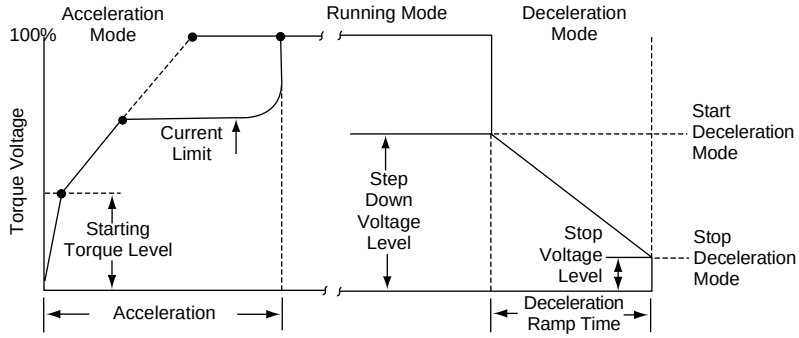
In a pump system, liquid is pushed uphill. The force exerted by gravity on the column of liquid as it travels uphill is called the "head pressure" in the system. The pump is sized to provide enough output pressure to overcome the head pressure and move the fluid up the pipe. When the pump is turned off, 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 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 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 it dissipates (see Figure 4). The sound of that shock wave is referred to as "water hammer." Shock wave energy can be extremely damaging to pipes, fittings, flanges, seals, and mounting systems.

The soft stop/deceleration feature of the Motorpact Soft Start gradually and gently reduces the pump output torque and 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 a shock wave is avoided. When the output voltage to the motor is low enough to no longer be needed, the soft start will end the Decel cycle and turn itself off.

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 the bridge or trolley can prevent loads from over-swinging on sudden stops.

ENGLISH

Figure 5: Deceleration



OPERATION

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off all power before working on or inside equipment.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

Figure 6: Operation Displays

1	**MOTOR STOPPED READY TO START**
2	**MOTOR STARTING 00 X FLA**
3	**OVERLOAD ALARM TIME TO TRIP: XXX SECS.**
4	**IA: _ _ _ IB: _ _ _ IC: _ _ _ G/F: _ _ _**

1. Apply control power and make sure the “Power” LED comes on (Figure 6, display 1).
2. Apply three phase power to the unit. The motor should run only when the start command is applied.
3. Apply the start command (Figure 6, display 2).
   - — The RUN LED will be lit (Figure 6, display 3).
   - — The AUX3 LEDs will be lit. If the motor does not enter run mode in the set time, a trip will occur.
   - — The POWER, RUN, and AUX3 LEDs will be lit, indicating that the contact has energized. IA, IB, and IC will display the current setting for Phase A, Phase B, and Phase C. G/F indicates ground fault current (Figure 6, display 4).
4. When the motor reaches full speed, the “AUX4” LED (At Speed) will be lit.
5. If the motor decelerates or stops during the acceleration period, press the stop button immediately and open the isolation means (disconnector).

If the unit does not follow this operational sequence, refer to Section 9—“Maintenance and Troubleshooting” on page 76.

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 the initial settings first. See “Setpoint Page 2” on page 42 to make any adjustments to:

- Initial voltage
- Soft start curve
- Current limit
- Acceleration time

If decel is enabled, you must also program the following parameters for deceleration time, start decel voltage, and stop decel voltage (see “Setpoint Page 2” on page 42).

EMERGENCY BYPASS OPERATION

CAUTION

HAZARD OF EQUIPMENT DAMAGE

Never operate the emergency bypass contactor with power applied to the soft start.

Failure to follow this instruction will result in equipment damage.

In the emergency bypass mode, there is no overload protection unless a separate (optional or customer-supplied) thermal overload relay is installed.

Bi-metallic overload protection is required, and is supplied with the equipment when the emergency overload protection option is selected. If this option is not included, the customer must supply bi-metallic overload protection.

1. Remove input power by using the line start section and lockout disconnect. To do this, open the main contactor, move the isolation means to the grounded position, and lock it out.
2. Close the emergency bypass contact. See Section 6—Control Connections for the Terminal and Control Board on page 26.
3. Reclose the disconnect on the line start panel.

   The line start panel is operable as a normal across-the-line starter. When power is applied, the bypass contactor energizes, tying the input terminals directly to its output terminals. When the “ON/OFF” contact is closed, the main contactor energizes and the motor line starts. When the “ON/OFF” contact is opened, the motor is disconnected from the line via the main in-line vacuum contactor.

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SECTION 7— CONTROL CONNECTIONS FOR THE TERMINAL AND CONTROL BOARD

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This equipment must be installed and serviced only by qualified personnel.
- Qualified persons performing diagnostics or troubleshooting that require electrical conductors to be energized must comply with NFPA 70 E – Standard for Electrical Safety Requirements for Employee Workplace and OSHA Standards – 29 CFR Part 1910 Subpart S – Electrical.
- Turn off all power supplying this equipment before working on or inside.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Never interchange the input and output power connections on the unit.
- Do not bypass the electrical or mechanical interlocks.
- Do not connect power factor correction (PFC) capacitors to the load (motor) side of the soft start.
- Do not connect the capacitors to the input side of the unit. If you cannot avoid using capacitors across the power lines, locate them as far upstream as possible from the input line contactor. An optional PFC capacitor contactor should be specified for this situation. For additional information and specifications, contact the factory.
- Use non-gap lightning arrestors for bus protection in areas where lightning is a significant problem.

Failure to follow these instructions will result in death or serious injury.

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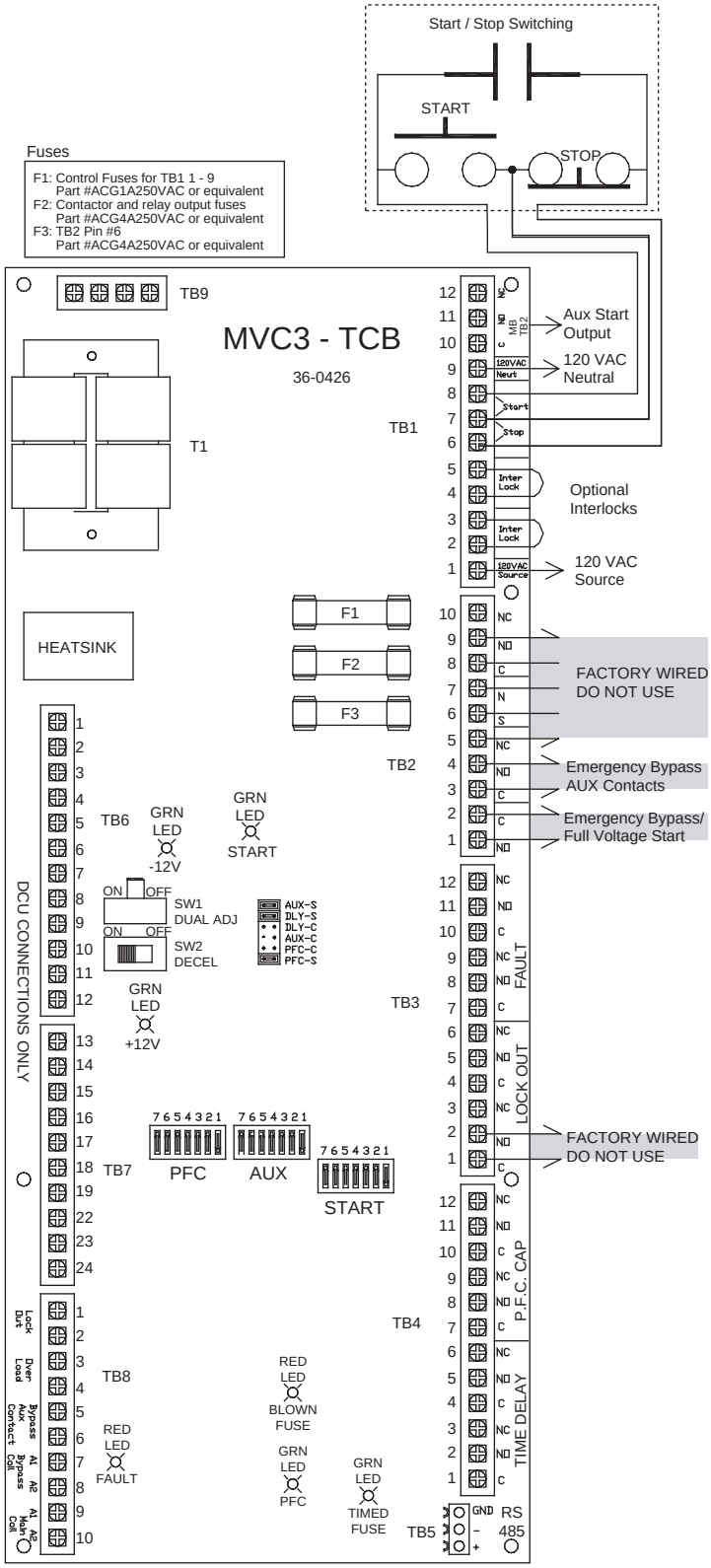
Figure 7: Terminal and Control Board



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The Motorpact™ Soft Start TCB board provides interconnections between the main power and CPU boards and the customer's control logic connections. The TCB board is a 120 Vac control board with several auxiliary dry control contacts, built-in time delay circuits, and emergency bypass functions. It also controls the sequence of the inline isolation and bypass contactor, and provides provisions for shutdown interlocks.

START/STOP CONTROL—TERMINAL BLOCK 1 (TB1)

Positions 1 and 9 are the Vac control power. The recommended VA is 750 VA or higher.

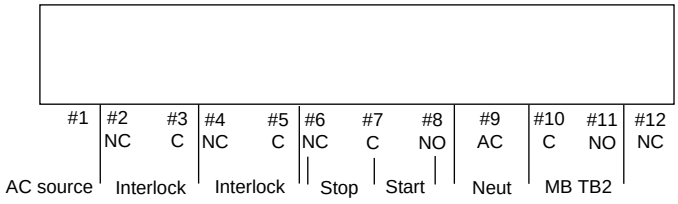
NOTE: The current power transformer (CPT) that is included in Motorpact Soft Start units should not be used for other 120 Vac operations or power sources.

Positions 2-3 and 4-5 are jumpered at the factory and can be removed for a customer's normally closed, dry, shutdown contacts.

Positions 6-7-8 are for either two-wire or three-wire start/stop logic. Two-wire control is connected to positions 6 and 8 with a normally open (N.O.) dry, maintained start/stop contact. Three-wire control is connected to 6 with 7 as the stop pushbutton, and the start pushbutton is connected to 7 and 8.

Positions 10-11-12 are a dry Form C contact. The contact is an immediate start/stop contact.

Figure 8: Terminal Block 1



EMERGENCY BYPASS CONTROL—TERMINAL BLOCK 2 (TB 2)

Positions 1 and 2 are for an emergency bypass contact. If a dry contact closes positions 1 and 2, the CPU is shut off and there is no display. Then, when a start is initiated, it pulls in the inline isolation contactor, starting the motor across the line.

Positions 3-4-5 are for a Form C contact. This is a dry contact initiated when the emergency contact is closed. It indicates the emergency bypass mode.

Positions 6 and 7 are for a customer connection for control power. Position 6 is the 120 Vac supply at 400 VA and position 7 is the return.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

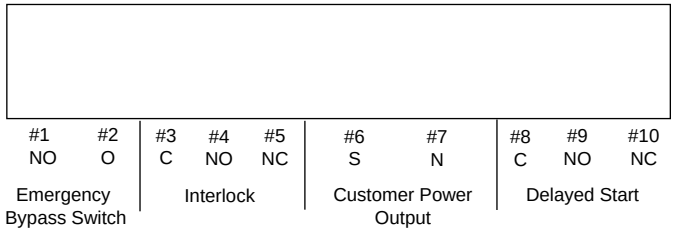
When using the contactor in the Emergency Bypass mode, the electronic overload protection is no longer functional. You must provide external motor overload protection.

Failure to follow this instruction can result in equipment damage.

Positions 8-9-10 are a Form C contact. It is a dry, delayed, start/stop contact. The amount of delay is determined by X1, X2, and SW3 (see “Jumper Selection” and “Switch Positions” on page 31).

NOTE: Additional time delay to SP2 of the CPU programming.

Figure 9: Terminal Block 2

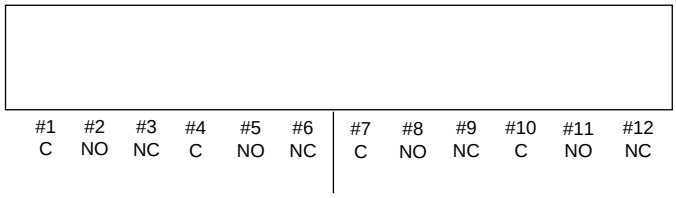


FAULT—TERMINAL BLOCK 3 (TB3)

Positions 1-2-3 and 4-5-6 are sets of Form C contacts. These are dry contacts that operate when a blown fuse indication is given or the disconnect is open.

Positions 7-8-9 and 10-11-12 are also sets of Form C contacts. These are fault contacts that change state if any fault condition occurs.

Figure 10: Terminal Block 3



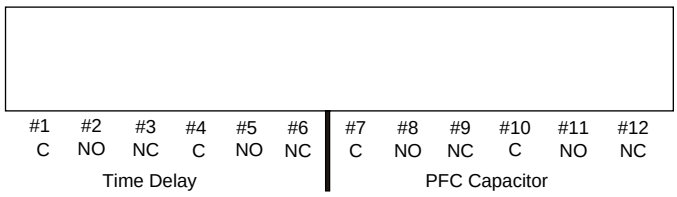
OPTIONAL RELAY—TERMINAL BLOCK 4 (TB4)

Positions 1-2-3 and 4-5-6 are sets of Form C contacts. They are auxiliary time delay contacts that will change state (after a delay) when the Start contact is initiated. X3, X4, and SW4 (see Figure 12 on page 31) determine the amount of delay. See “Jumper Selection” and “Switch Positions” on page 31.

Positions 7-8-9 and 10-11-12 are also sets of Form C contacts. They are power factor correction (PFC) capacitor contacts that pull in an isolation contactor for the PFC capacitors, if required by the application. The PFC capacitor contacts change state when the At Speed contact is initiated. X5, X6, and SW5 (see Figure 12 on page 31) determine the amount of delay. See “Jumper Selection” and “Switch Positions” on page 31.

NOTE: Additional time delay to SP2 of the CPU programming.

Figure 11: Terminal Block 4



TERMINAL BLOCK 5 (TB5)

Terminal block 5 is for RS-485 connections: appropriate software is required. Contact the factory. If the wiring distance is less than 25 ft. (7.6 m), use termination resistors as needed. Minimum 22 gauge twisted-pair wiring.

TERMINAL BLOCK 6 (TB6)

Terminal block 6 is wired at the factory, and contains main power board connections 1–12 (see Figure 18 on page 34).

TERMINAL BLOCK 7 (TB7)

Terminal block 7 is wired at the factory, and contains main power board connections 13–24 (see Figure 18 on page 34).

TERMINAL BLOCK 8 (TB8)

If a complete Motorpact NEMA E2 controller is supplied, terminal block 8 is wired at the factory. If only a soft start is supplied, the customer wires the terminal block.

Positions 1 and 2 accept dry, normally closed (N.C.) contacts from blown fuse indicators and/or a disconnect interlock contact.

Positions 3 and 4 accept dry, N.C. contacts from an external overload protection device (required if using emergency bypass mode).

Positions 5 and 6 accept dry, N.C. contacts from the bypass contactor for an At Speed indication. These positions are wired at the factory.

Positions 7 and 8 are wired at the factory to the coil of the bypass contactor. They energize and de-energize the contactor.

NOTE: All customer contacts are 960 VA, 120 Vac (max.) rated dry contacts.

LEDS ON THE TCB BOARD

Table lists the LEDs provided on the TCB board (see Figure 12 on page 31). These LEDs are for low voltage testing only.

Table 6: LEDs on the TCB Board

LED	Description
-12 Vdc	Power supply
+12 Vdc	Power supply
Start	Start is initiated to the TCB board
Fault	Any fault has occurred
Fuse Blown	The disconnect is open or a blown fuse has activated
PFC On	The power factor correction capacitor contacts have energized
Timed Out	The auxiliary time delay contacts have energized

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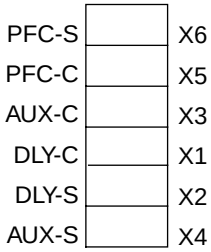
JUMPER SELECTION

Figure 12: Jumper Selection on the TCB Board



Start Delay

Start delay is a selectable delay period between the time the start command is initiated and the CPU actually receives the start signal. Selecting jumper X1 or X2 (see Figure 12) determines the method by which this delay is calculated. The delay is measured in cycles or seconds. See the description of SW3 in Table 7 on page 31 for instructions on setting the actual delay time.

X1 = (DLY-C) Start time delay in cycles

X2 = (DLY-S) Start time delay in seconds (factory setting)

Auxiliary (Start) Delay

The auxiliary delay is a selectable delay period between the time the bypass closes and the contacts change state. Selecting jumper X3 or X4 (see Figure 12) determines the method by which this delay is calculated. The delay is measured in cycles or seconds. See the description of SW4 in Table 7 on page 31 for instructions on setting the actual delay time.

X3 = (AUX-C) Auxiliary time delay in cycles

X4 = (AUX-S) Auxiliary time delay in seconds (factory setting)

Power Factor Correction (PFC) Capacitor Contact Delay

The PFC capacitor contact delay is a selectable delay period between the time the bypass closes and the contacts change state. Selecting jumper X5 or X6 (see Figure 12) determines the method by which this delay is calculated. The delay is measured in cycles or seconds. See the description of SW5 in Table 7 on page 31 for instructions on setting the actual delay time.

X5 = (PFC-C) Time delay in cycles

X6 = (PFC-S) Time delay in seconds (factory setting)

SWITCH POSITIONS

Table 7: Switch Positions

Switch Position[a]	Description
SW1	
ON	Dual adjustment
OFF	Disabled
SW2[b]	Not used
SW3	Start delay. Factory setting: 1seconds
SW4[c]	Auxiliary (start) delay. Factory setting: 1 seconds
SW5[c]	PFC time delay. Factory setting: 1 seconds

a. Switches SW3, SW4, and SW5 are 7-position dip switches that use binary code to count up to 127 seconds/cycles (see “Jumper Selection” on page 31).

b. This switch interacts with CPU programming requiring that Decel is enabled.

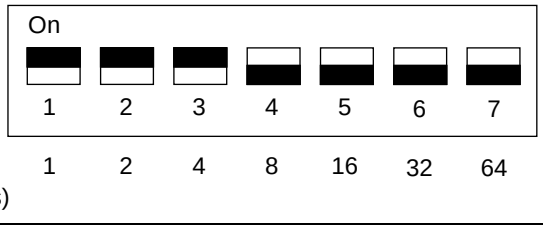
c. These times are in addition to SP2 in the CPU setpoints.

Figure 13: Switch Positions

Example

Switch settings are cumulative. Setting dip switch positions 1,2, and 3 to “on” = 1+2+4 = 7 seconds total time.

NOTE: Applies to SW3, SW4, and SW5.



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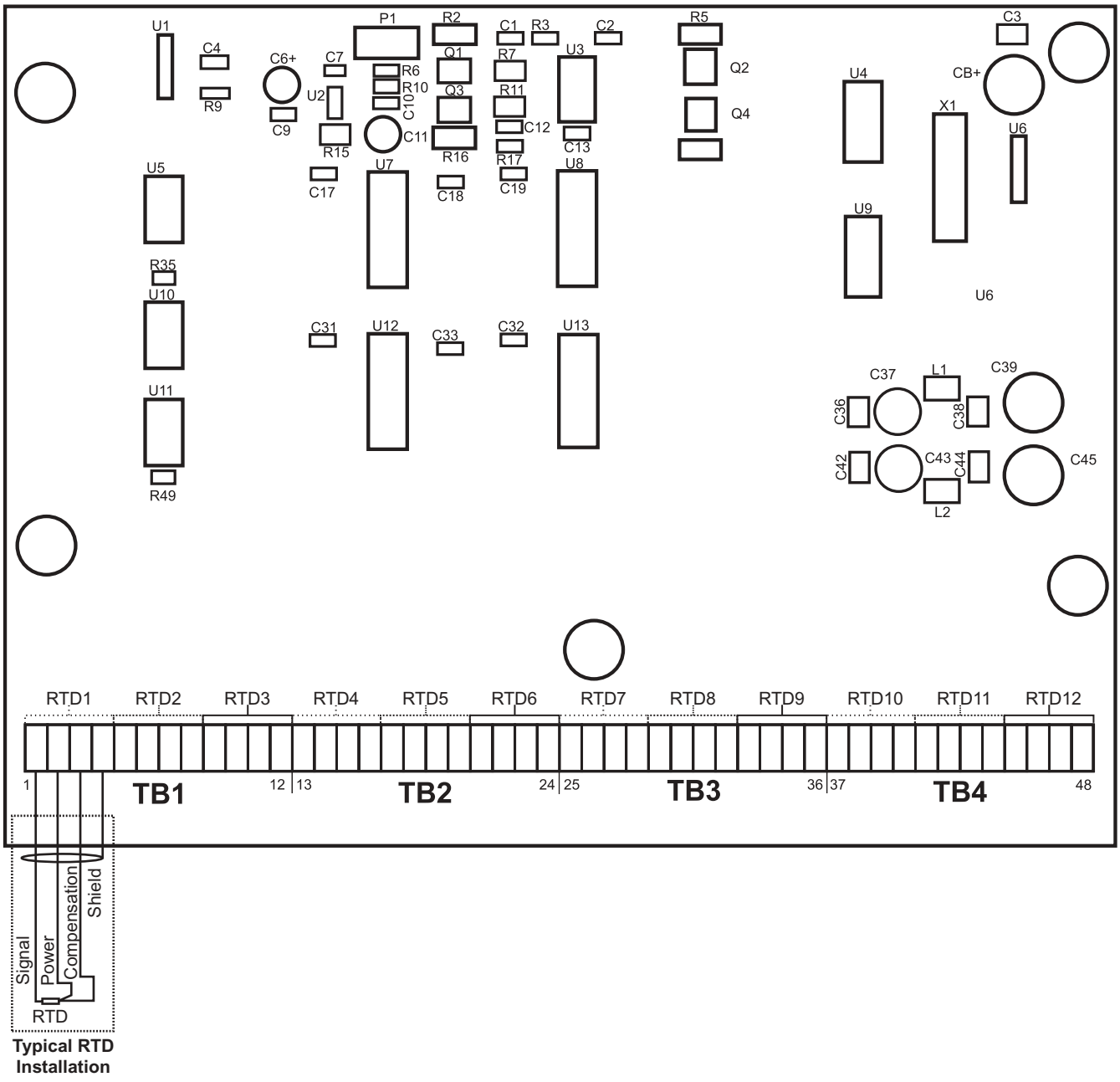
CONNECTIONS DIAGRAMS

Figure 14: Optional RTD Board



Typical RTD Installation

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Figure 15: Communications Board

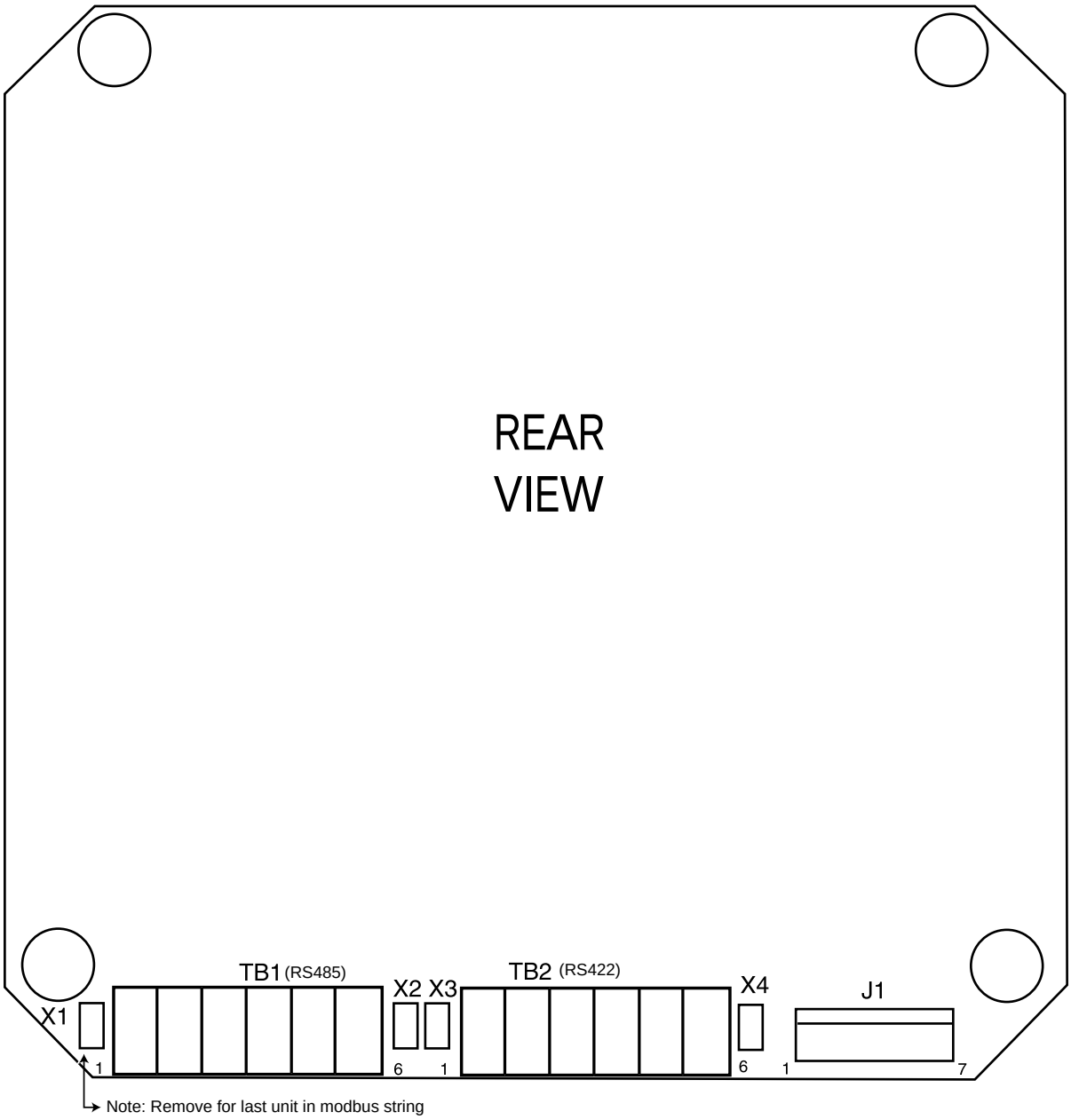
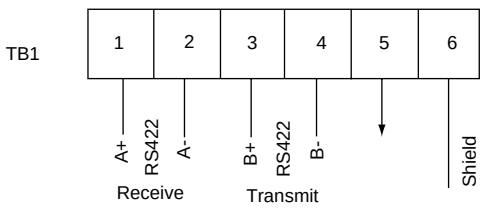
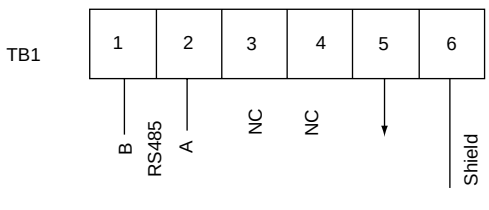


Figure 16: Communications Board Connections



RS422 Connections (Customer Connections)



RS485 Connections (Factory Only)

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Figure 17: Power Board

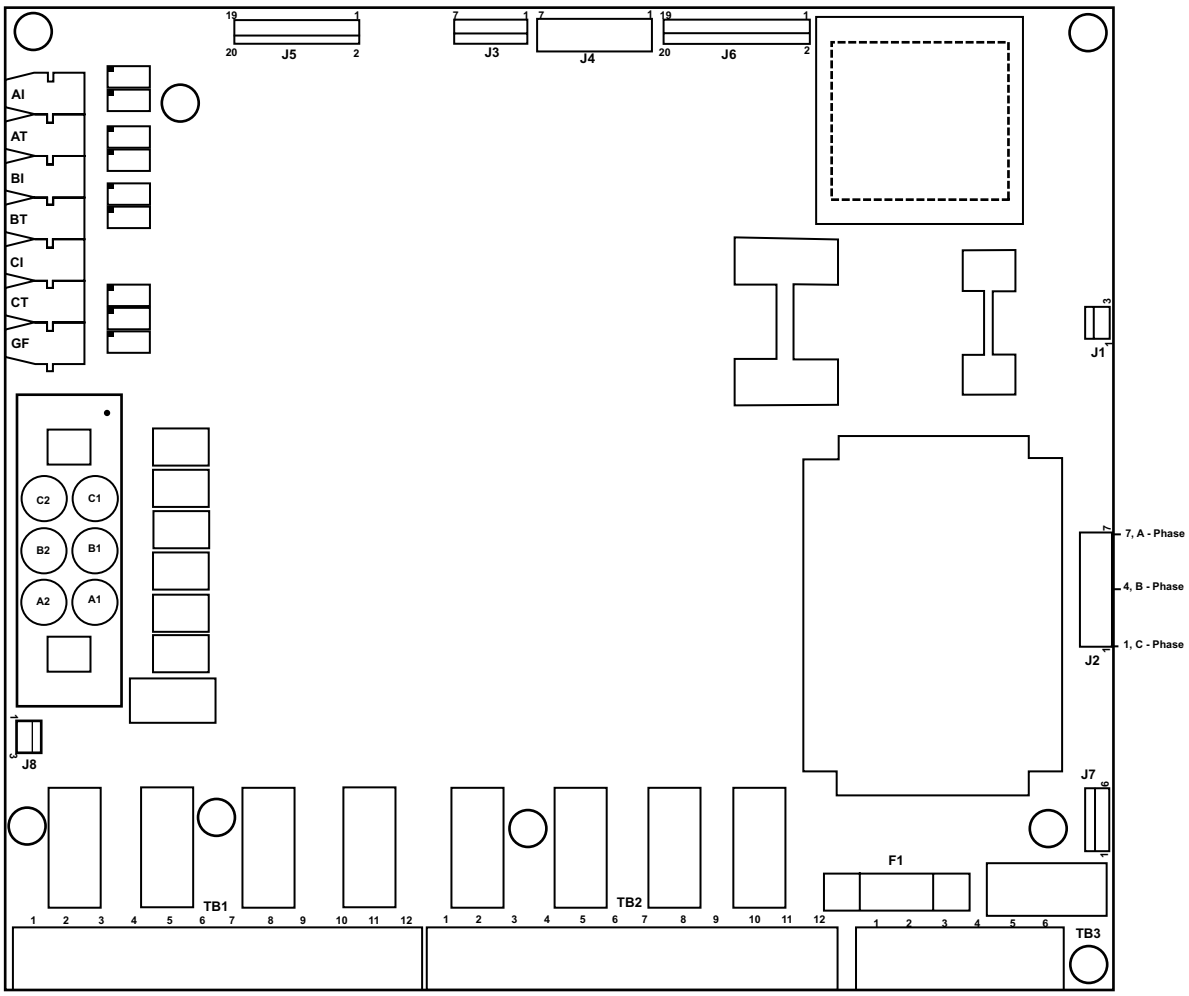

Figure 18: Power Board Connections

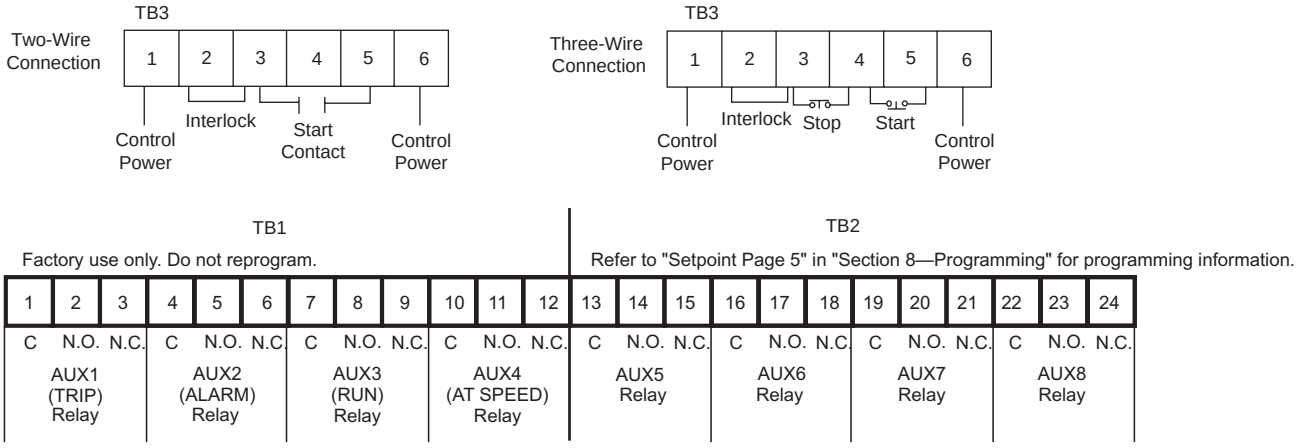

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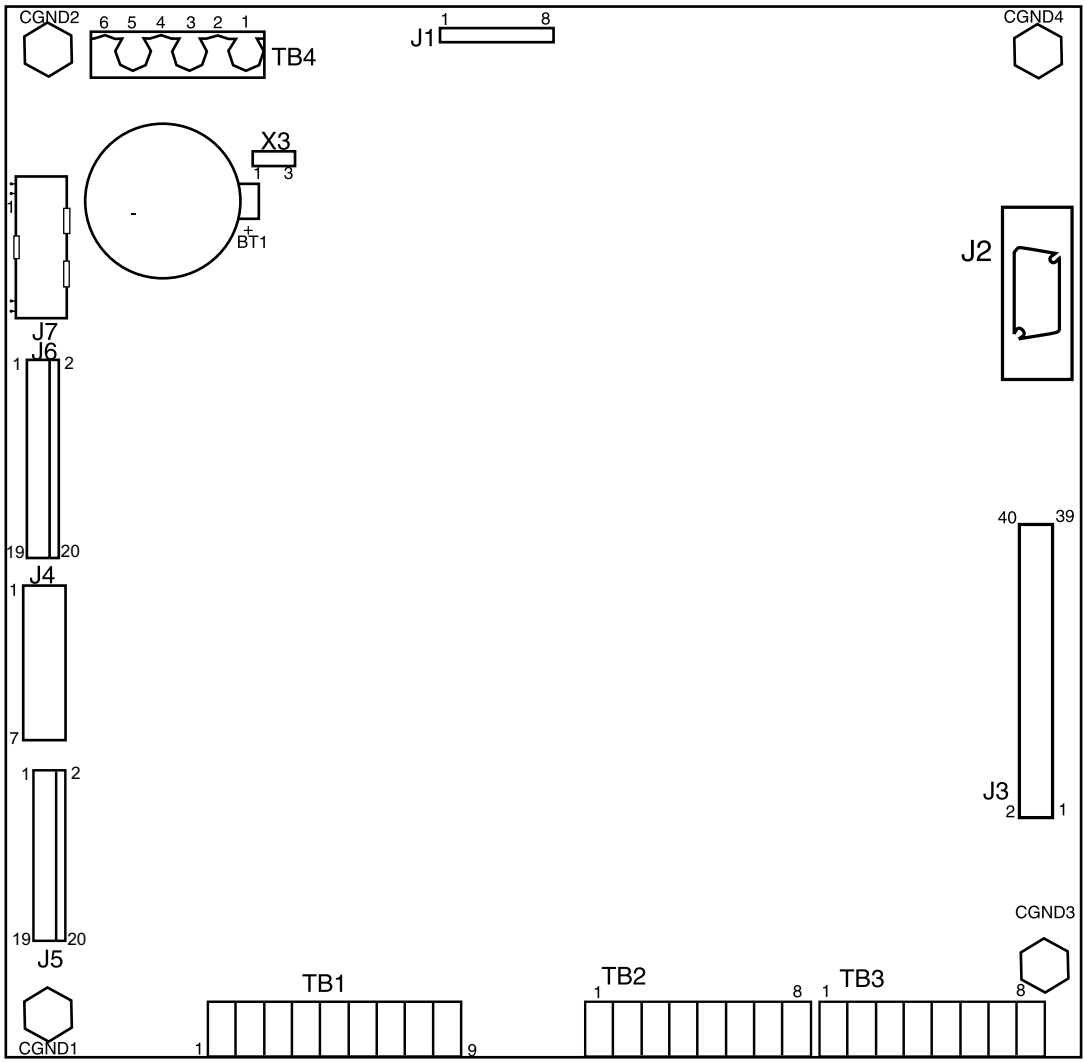
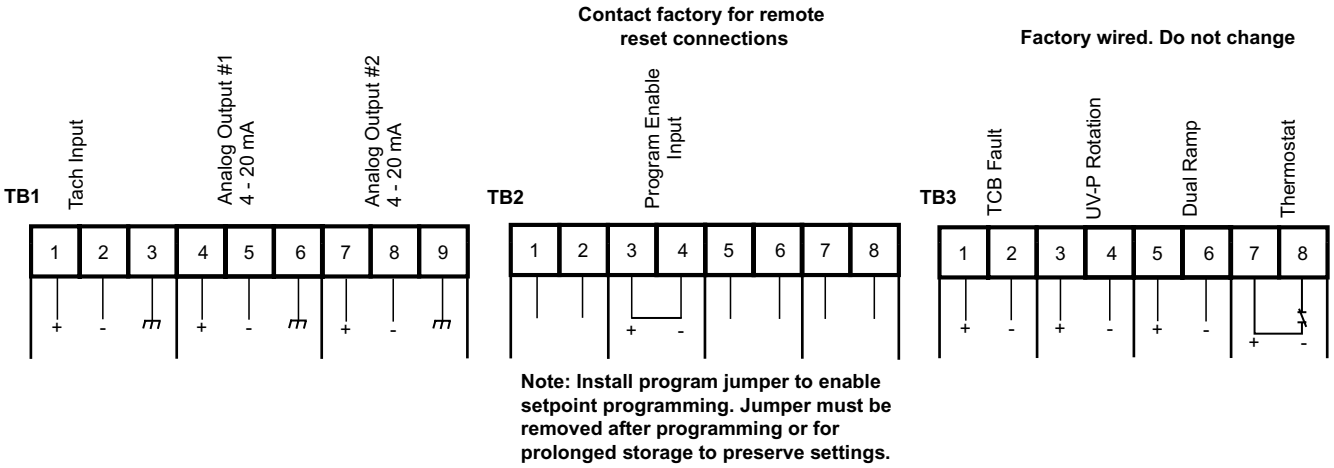
Figure 19: CPU Board Connections





Note: Install program jumper to enable setpoint programming. Jumper must be removed after programming or for prolonged storage to preserve settings.

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SECTION 8— PROGRAMMING

KEYPAD OPERATOR INTERFACE

The Motorpact™ Soft Start is equipped with a keypad operator interface that consists of:

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

The Motorpact Soft Start is menu-driven, and there are three levels of programming. Level one is not password-protected. Level two requires a three-digit password. Level three requires a four-digit password.

Figure 20: Keypad Operator Interface

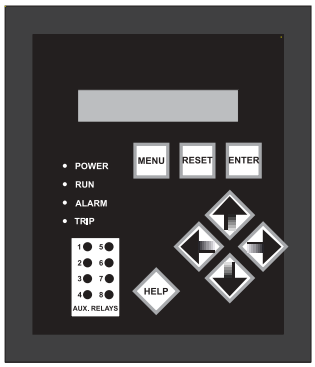

Table 8: Keypad Operator Interface

Display Type	Name	Description/Function
Button	Menu	Toggle between the menu selection for metering and setpoint pages.
	Reset	Will clear the trip indicator and release the trip relay.
	Enter	In the edit mode, press the ENTER pushbutton for the unit to accept the new programming information. 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 setpoint or action.
	Up Arrow[a]	Scrolls up through the setpoint and metering menu page. It will scroll to the top of the setpoint page or a section. In edit mode it will increase a setpoint in an incremental step or toggle through the available options in the setpoint.
	Right Arrow[a]	In the main menu, the RIGHT ARROW button provides access to the setpoint page. For setpoint pages with multiple columns, the RIGHT ARROW will scroll the setpoint page to the right. When in edit mode, it will shift one character to the right.
	Down Arrow[a]	The DOWN ARROW button will scroll down through the setpoint pages and down through the setpoints. In edit mode, it will decrement through values and toggle available options in the setpoint.
	Left Arrow[a]	The LEFT ARROW button will move to the left through setpoint pages with multiple columns. When in edit mode, it will become the backspace key and will shift one character to the left.

Table 8: Keypad Operator Interface *(continued)*

Display Type	Name	Description/Function
LED	Power	Indicates control power is present.
	Run	Indicates unit/motor is running.
	Alarm	Lights in conjunction with AUX 2 to indicate an event or warn of a possible critical condition.
	Trip	Lights in conjunction with AUX 1 to indicate a critical condition has occurred.
	AUX 1–8	Auxiliary relays.

a. The directional arrow buttons are sensitive. In edit mode, if the buttons are held for a long period, the scrolling speed will increase.

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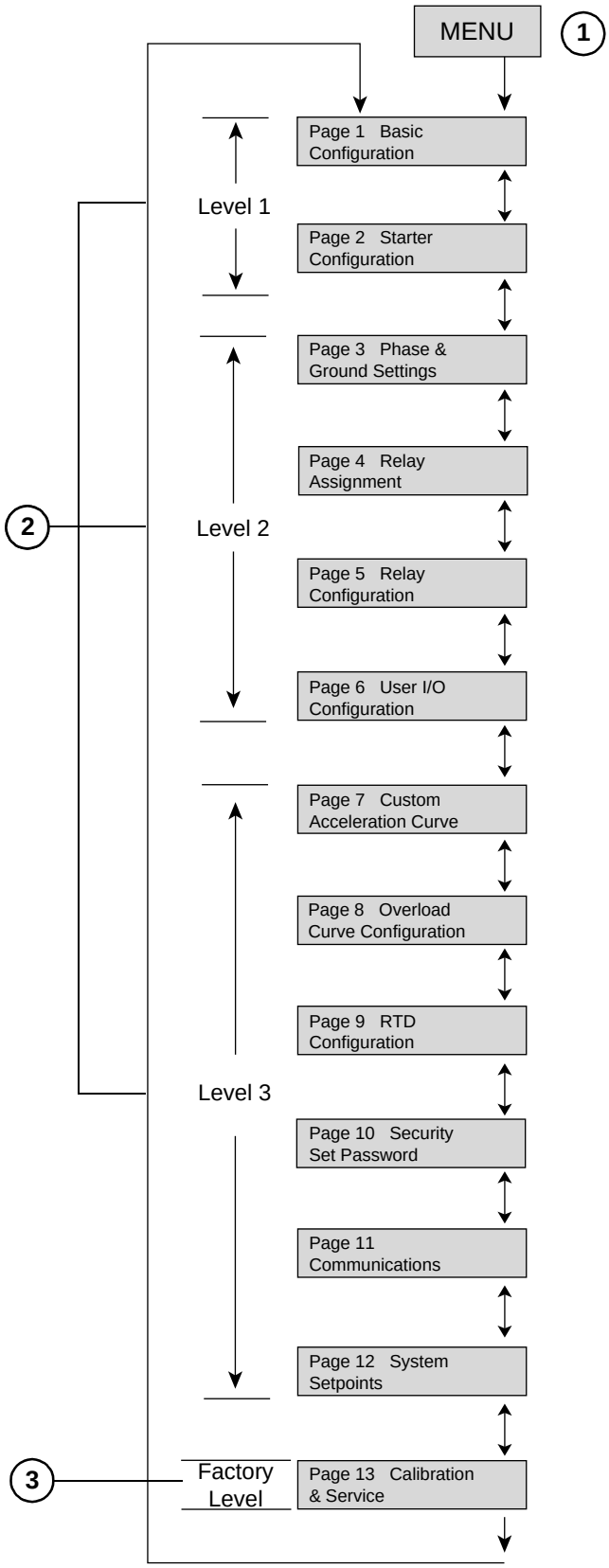
Menu Navigation

Notes:

1. The MENU keys allow you to toggle the screens between the setpoint menu and the metering menu. Use the arrow keys to navigate to different screens within each menu.

   Example: To access Setpoint Page 3, press the MENU key once and the DOWN ARROW button two times.

2. Levels 1, 2, and 3 indicate password protection levels for these setpoint pages.
3. Setpoint Page 13 screens are displayed for information only. Only factory personnel can access Setpoint Page 13 to make changes.



Password Access

You can change screens in Level 1 of the setpoint menu without password access because these screens list basic motor information only. Screens in Levels 2 and 3 require passwords because they provide more in-depth protection and control of the Motorpact Soft Start unit. You can change the password in Levels 2 and 3.

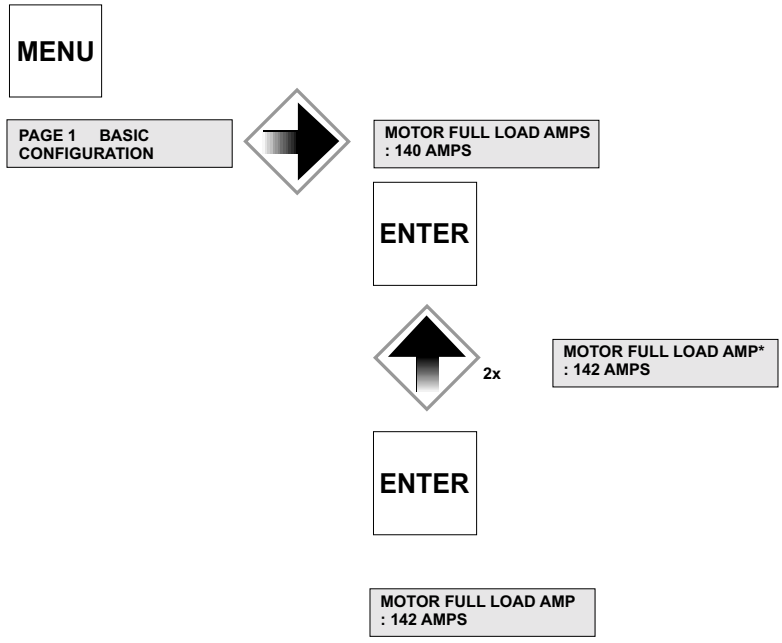
Changing Setpoints

Setpoints can only be changed when the motor is in the Stop/Ready mode. The Motorpact Soft Start will not allow a start if the motor is still in the Edit mode. To determine if the unit is in Edit mode, check the top right corner of the display: an asterisk (*) indicates the unit is in Edit mode.

Example **Changing Motor FLA** (see Figure 21)

1. Press the MENU button to display setpoint page 1, Basic Configuration.
2. Press the RIGHT ARROW to view the Motor Full Load Amps screen.
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.
5. To accept the new value, press the ENTER button. The unit will accept the changes and will leave the Edit mode. Note that the asterisk (*) is no longer in the top right corner of the LCD display.

Figure 21: Changing Motor FLA



SETPOINT PROGRAMMING

The Motorpact Soft Start has twelve programmable setpoint pages that define the motor data, ramp curves, protection, I/O configuration, and communications.

Setpoints can only be changed when the starter is in the Stop/ Ready Mode. The soft start will not start when it is in Programming mode.

Setpoint Page 1

Table 9: Setpoint Page 1—Basic Configuration

Security Level	Description	Factory Setting Default	Range	Notes
Level 1—No Password Required	Motor full load amps	Model dependent	50–100% of unit max. current (model and service factor dependent)	—
	Service factor	1.15	1.00–1.3	Sets the pickup point on the overload curve as defined by the programmed motor full load current. See Figure 23. *Example:* If the motor FLA is 100 and the service factor is 1.15, the pickup point will be 115 A.
	Overload class	10	5–30 overload class	*Example:* Overload class 10 will trip in 10 seconds at six times FLA.
	NEMA design	B	A–F	The motor design maximum allowed slip.
	Insulation class	B	A, B, C, E, F, H, K, N, S	The motor insulation temperature class.
	Line voltage	4160	100 to 7200 V	Applied voltage.
	Line frequency	60	50 or 60 Hz	—

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Figure 22: Setpoint Page 1—Basic Configuration

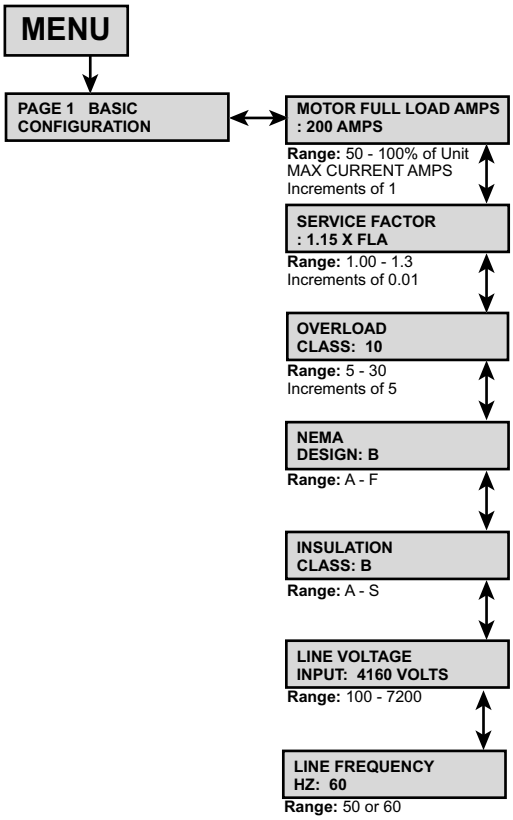
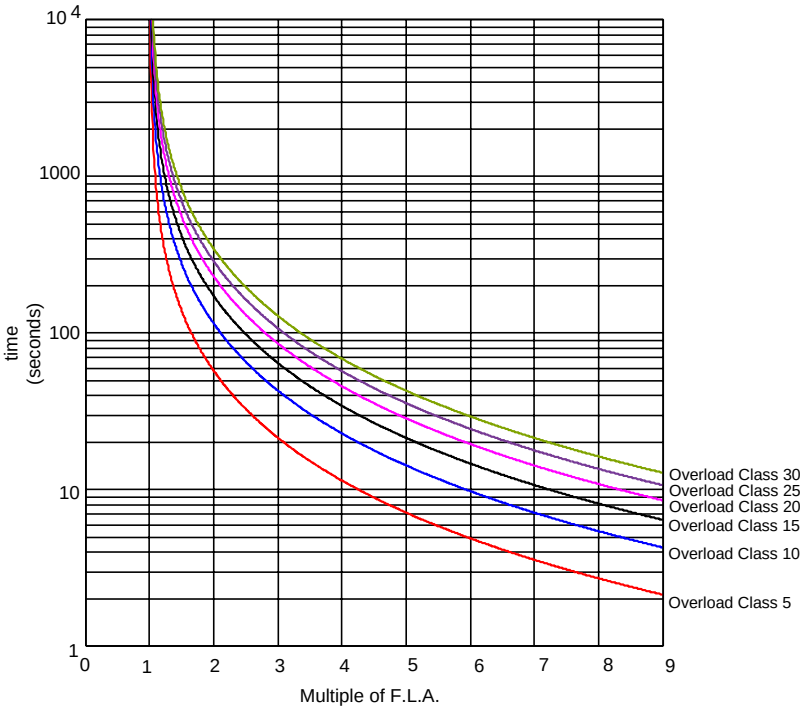


Figure 23: Overload Curve Definition



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Setpoint Page 2

Table 10: Setpoint Page 2—Starter Configuration

Security Level	Description	Factory Setting Default	Range	Notes
Level 1—No Password Required	Start control mode	Start ramp 1	Jog, Start, Ramp 1, Start Ramp 2, Tach Ramp, Custom Accel Curve, Start Disabled, Dual Ramp	*Tach Ramp:* See “Setpoint Page 6” on page 52. *Custom Accel Curve:* See “Setpoint Page 7” on page 54. If Custom Accel Curve is not enabled in setpoint page 7, the soft start will ignore the start control mode and read this setpoint as disabled. *Dual Ramp:* Works in conjunction with external input #3, allowing the user to switch between the two start ramps without reconfiguring the start mode. See “Setpoint Page 6” on page 52.
	Jog voltage	50%	5–75%, Off	The voltage level necessary to cause the motor to slowly rotate.
	Start ramp #1 type	Voltage	Current, Voltage, Off	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. See “Start Ramp #1 Type” on page 43 for detailed explanations of start ramp types.
	Initial voltage #1	20%	0–100%	Set the initial level 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	10 s	0–120 s	Sets the maximum allowable time for ramping the initial voltage or current (torque) setting to either of the following: 1. the current limit setting when the motor is still accelerating, or 2. full output voltage if the current limit is set to maximum. Increasing the ramp time softens the start process by gradually increasing the voltage or current. Ideally, the ramp time should be set for the longest amount of time the application will allow, without stalling the motor.
	Current limit #1	350% FLA	200–600%	Sets the maximum motor current the starter will allow during ramping. Current limit remains in effect until the motor reaches full speed (detected by the At-Speed detection circuit), or the overload protection trips on motor thermal overload. Once the motor reaches full speed, the current limit feature becomes inactive. 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. With some load conditions, the current limit is reached before the ramp time expires.
	Initial current #1	200% FLA	0–300%	See Initial Voltage #1 above.
	Ramp time #1	10 s	0–120 s	See Ramp time #1 above.
	Maximum current #1	350% FLA	200–600%	Sets the maximum motor current the starter will allow during ramping. Current limit remains in effect until the motor reaches full speed (detected by the At-Speed detection circuit), or the overload protection trips on motor thermal overload. Once the motor reaches full speed, the current limit feature becomes inactive. 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.
	Start ramp #2 type	Disabled	Current, Voltage, Off	Start ramp 2 has the same options and screen setups as start ramp 1. Custom Accel Curve overrides the voltage or current start in ramps 1 and 2 when it is selected as the start control mode.
	Initial voltage #2	60%	0–100%	
	Ramp time #2	10 s	0–120 s	
	Current limit #2	350% FLA	200–600%	
	Initial current #2	200% FLA	0–600%	
	Ramp time #2	10 s	0–120 s	
	Maximum current #2	350% FLA	200–600%	
	Kick start type	Disabled	Voltage or Off	Used as an initial energy burst in applications with high friction loads.

Continued on next page

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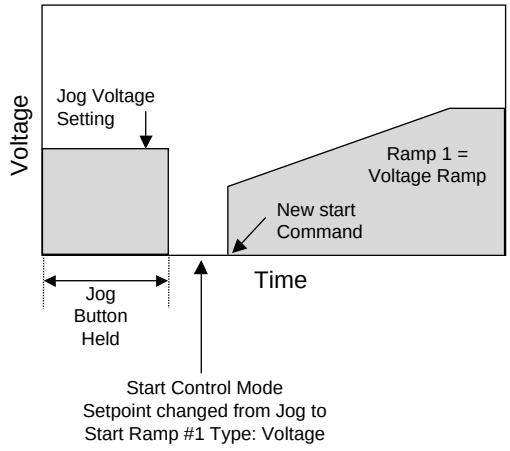
Table 10: Setpoint Page 2—Starter Configuration *(continued)*

Security Level	Description	Factory Setting Default	Range	Notes
Level 1—No Password Required	Kick start voltage	65%	10–100%	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	0.50 s	0.10–2.00	The time the initial torque boost is applied.
	Deceleration time	Disabled	Enabled or Disabled	Allows the motor to gradually come to a soft stop.
	Start deceleration voltage	60%	0–100%	The first part of the deceleration ramp. The soft start initially drops to this voltage level upon receiving a STOP command (represented as a percent of voltage value).
	Stop deceleration voltage	30%	0–59%	The drop-off point of the deceleration ramp (percent of voltage value).
	Deceleration time	5 s	1–60 s	Deceleration ramp time.
	Timed output time	Off	1–1000, Off	Used with an auxiliary relay. When enabled, and upon a start command, it energizes the assigned relay for the programmed time. At the end of the programmed time, the relay de-energizes. See “Setpoint Page 4” on page 48.
	Run delay time	1 s	1–30, Off	Used with an AUX3 relay. When enabled, and upon a start command, it waits until the programmed time has expired. The relay energizes and remains so until a stop command is received. It de-energizes upon receiving a stop command. See “Setpoint Page 4” on page 48.
	At speed delay time	1 s		Used with an AUX4 relay. It waits until after the motor reaches the end of the ramp and the programmed delay time has expired. The relay energizes until a stop command is received. See “Setpoint Page 4” on page 48.

Start Ramp #1 Type

Figure 24: Voltage Ramping



Voltage Ramping: (see Figure 24) 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 the Current Limit #1 setpoint to 600% (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.

Voltage Ramping with Current Limit: Voltage is gradually increased until the setting of the maximum current limit setpoint is reached. The voltage is held at this level until the motor accelerates to full speed. To achieve voltage ramping with current limit, select Voltage for the Start Ramp #1 setpoint and set the Current Limit #1 setpoint to a desired lower setting, as determined by your application requirements.

Current Ramping (Closed Loop Torque Ramping): Output voltage is constantly updated to provide the linear current ramp; therefore, the available torque is maximized at any given speed.

This feature can be used with or without the maximum current limit setting. To achieve current ramping, select Current for the Start Ramp #1 Type setpoint and set the Maximum Current #1 setpoint to the desired level.

The **Current Limit Only** (Current Step) start uses the current limit feature exclusively. This starting method 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, the Ramp Time #1 setpoint is set to zero (0), so the output current jumps to the current limit setting immediately. Start Ramp #1 Type is set to either Voltage or Current.

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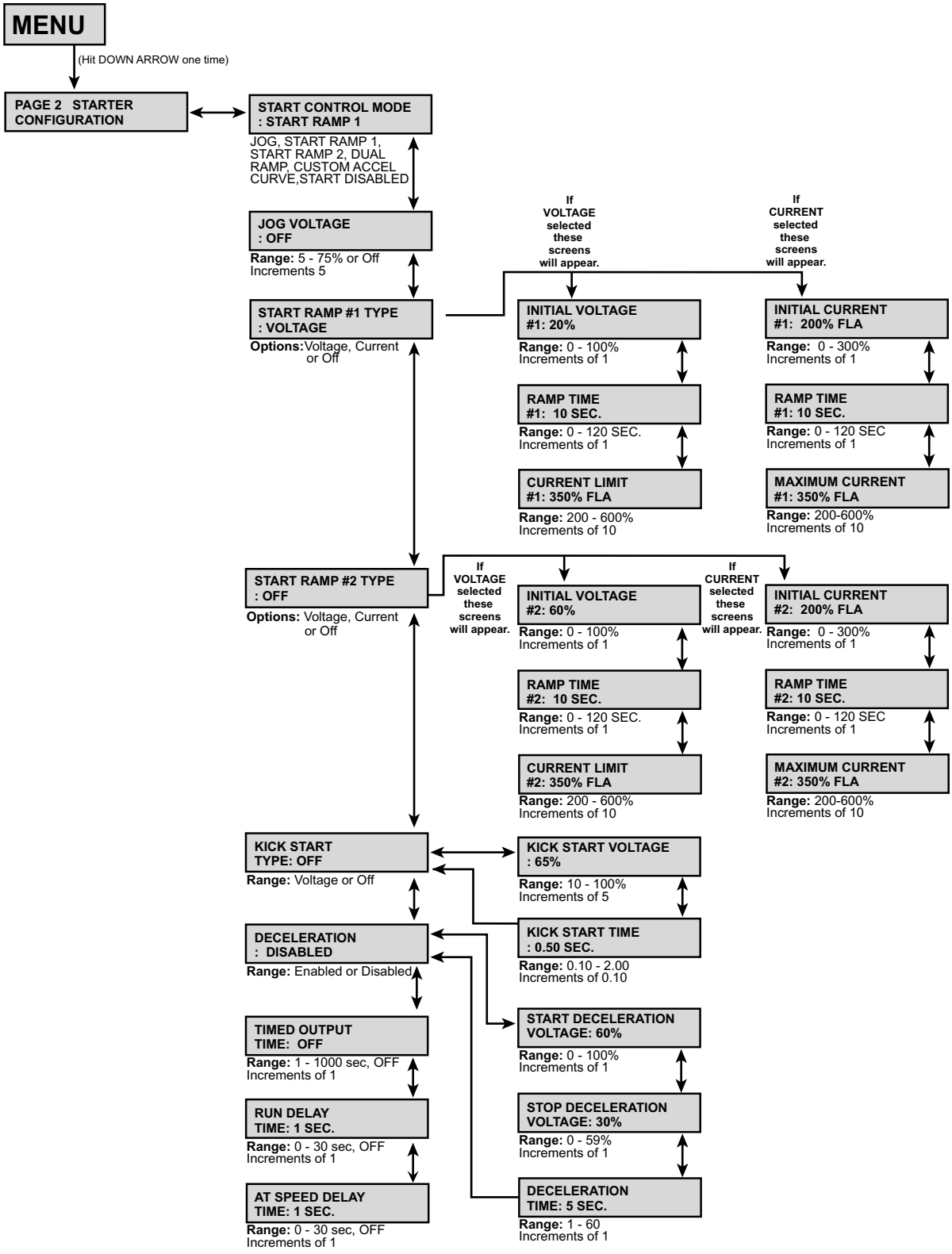
Figure 25: Setpoint Page 2—Starter Configuration



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Setpoint Page 3

Table 11: Setpoint Page 3—Phase and Ground Settings

Security Level	Description	Factory Setting Default	Range	Notes
Level 2—Password Protection	Imbalance alarm level	15% FLA	5–30%, Off	An advance warning of a phase imbalance problem. The problem may be caused by imbalanced voltages.
	Imbalance alarm delay	1.5 s	1.0–20.0 s	The amount of time an imbalance condition must exist before an alarm occurs.
	Imbalance trip level	20%	5–30%, Off	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	2.0 s	1.0–20.0 s	The amount of time an imbalance condition must exist before a trip occurs.
	Undercurrent alarm level	Off	10–90%, Off	Typically used to warn of possible load loss, a breaking coupling, or other mechanical problems.
	Undercurrent alarm delay	2.0 s	1.0–60.0 s	The amount of time the undercurrent condition must exist before an alarm occurs.
	Overcurrent alarm level	Off	100–300%, Off	Typically used to indicate when the motor is overloaded. This feature can be used to either stop the feed to the equipment or to warn operators of an overload condition.
	Overcurrent alarm delay	2.0 s	1.0–20.0 s	The amount of time the overcurrent condition must exist before an alarm occurs.
	Overcurrent trip level	Off	100–300%, Off	Typically used to indicate the motor is severely overloaded. It is the point at which a trip occurs. See Figure 26.
	Overcurrent trip delay	2.0 s	1.0–20.0 s	The amount of time the overcurrent condition must exist before a trip occurs.
	Phase loss trip	Disabled	Enabled or Disabled	When enabled, the soft start trips the motor off-line upon a loss of phase power.
	Phase loss trip delay	0.1 s	0–20.0 s	The amount of time the phase loss condition must exist before a trip occurs.
	Phase rotation detection	Enabled	Enabled only	The Motorpact Soft Start continuously monitors the phase rotation. When a start command is initiated, a trip will occur if the soft start detects a change in the phase rotation.
	Phase rotation	ABC	ABC	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 Page 1, screen number 4.
	Ground fault alarm level	Off	5–90%, Off	Typically used to warn of low level ground current leakage.
	Ground fault alarm delay	0.1 s	0.1–20.0 s	The amount of time a ground fault condition must exist before an alarm occurs.
	Ground fault lo set trip level	Off	5–90%, Off	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 lo set trip delay	0.5 s	0.1–20.0 s	The amount of time a ground fault condition must exist before a trip occurs.
	Ground fault hi set trip level	Off	5–90%, Off	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 hi set trip delay	0.008 s	0.008–0.250 s	The amount of time a ground fault condition must exist before a trip occurs.
	Overvoltage alarm level	Off	5–30%, Off	Typically used to indicate when the line voltage is too high. This is an alarm level.
	Overvoltage alarm delay	1.0 s	1.0–30.0 s	The amount of time that the overvoltage condition must exist before a trip will occur.
	Overvoltage trip level	Off	5–30%, Off	Typically used to indicate that the line voltage is too high and at which point a trip occurs.
	Overvoltage trip delay	2.0 s	1.0–30.0 s	The amount of time that the overvoltage condition must exist before a trip will occur.
	Undervoltage alarm level	Off	5–30%, Off	Typically used to indicate when the line voltage is too low. This is an alarm level.
	Undervoltage alarm delay	1.0 s	1.0–30.0 s	The amount of time that the overvoltage condition must exist before a trip will occur.
	Undervoltage trip level	Off	5–30%, Off	Typically used to indicate that the line voltage is too low and at which point a trip occurs.
	Undervoltage trip delay	2.0 s	1.0–30.0 s	The amount of time that the undervoltage condition must exist before a trip will occur.
	Line frequency trip window	Disabled	0–6 Hz, Disabled	The acceptable amount of drift above or below the line frequency (Hz) before a trip is generated.
	Line frequency trip delay	1.0 s	1.0–20.0 s	The amount of time the frequency drift condition must exist beyond the window before a trip occurs.
	P/F lead P/F alarm	Off	0.1–1.0, Off	Typically used to indicate a leading power factor.
	P/F lead alarm delay	1.0 s	1.0–120 s	The amount of time that the power factor lead condition must exist beyond the window before a trip will occur.
	P/F lead P/F trip	Off	.01–1.00, Off	The acceptable amount of power factor lead before a trip is generated.
	P/F lead trip delay	1.0 s	1.0–120 s	The amount of time that the power factor lead condition must exist beyond the window before a trip will occur.

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Table 11: Setpoint Page 3—Phase and Ground Settings *(continued)*

Security Level	Description	Factory Setting Default	Range	Notes
Level 2—Password Protection	P/F lag P/F alarm	Off	.01–1.00, Off	Typically used to indicate a lagging power factor.
	P/F lag alarm delay	1.0 s	1.0–120 s	The amount of time that the power factor lagging condition must exist beyond the window before a trip will occur.
	P/F lag P/F trip	Off	.01–1.00, Off	The acceptable amount of power factor lag before a trip is generated.
	P/F lag trip delay	1.0 s	1.0–120 s	The amount of time that the power factor lag condition must exist beyond the window before a trip will occur.
	Power demand period	10 min.	1.0–60.00 min.	The Motorpact Soft Start measures the demand of the motor for several parameters (current, kW, kVAR, kVA). The demand values of motors assists in energy management programs where processes may be altered or scheduled to reduce overall demand. Demand is calculated by a programmed amount of time where current, kW, kVAR, and kVA samples are taken and then averaged and stored to assess demand.
	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	

Figure 26: Overcurrent Trip Level

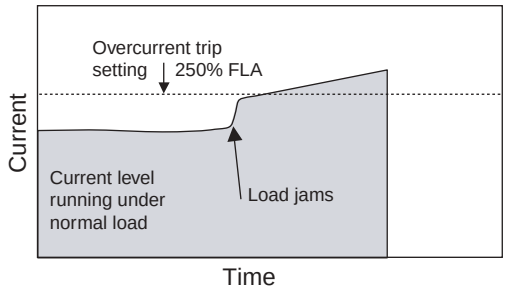

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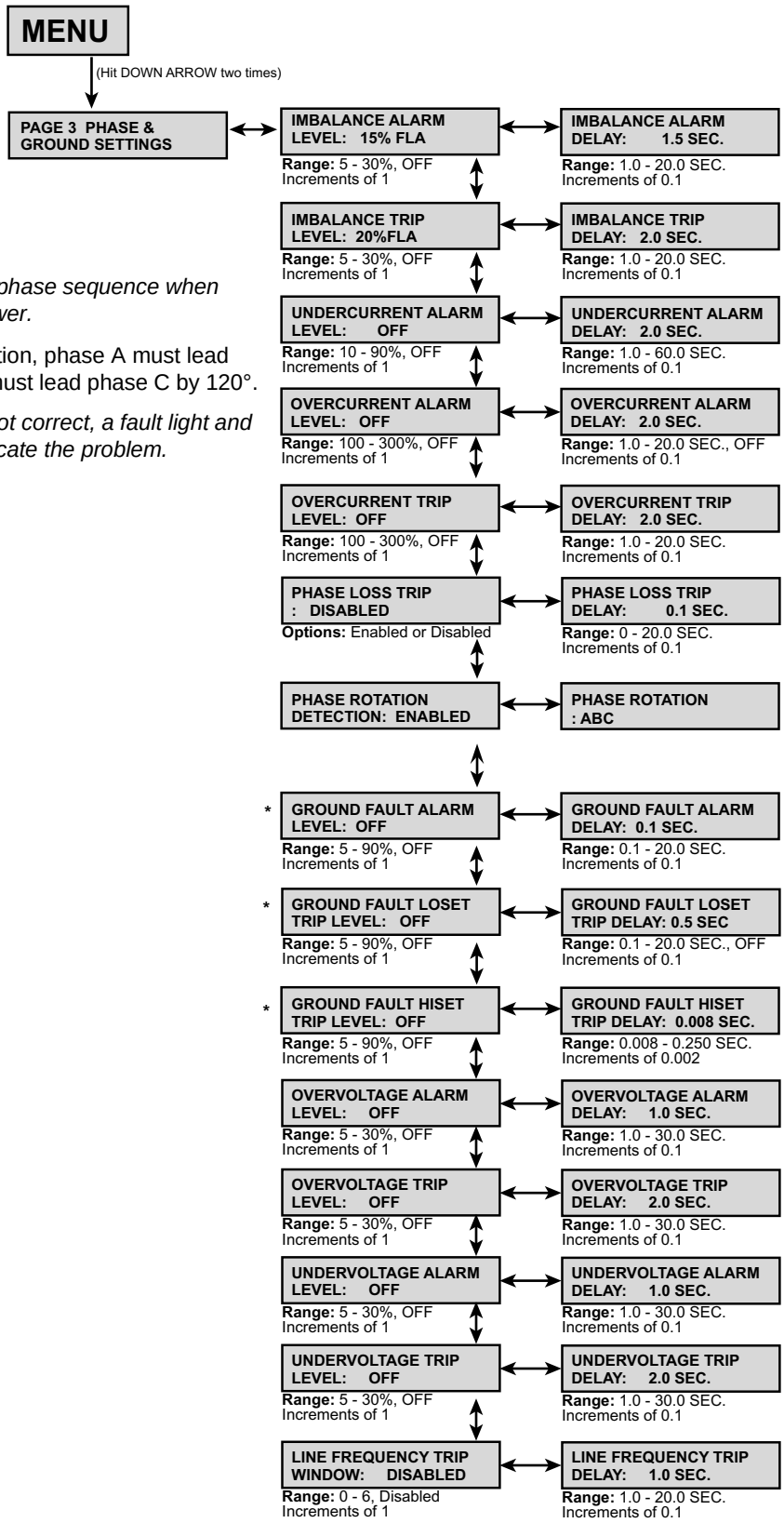
Figure 27: Setpoint Page 3—Phase and Ground Settings



NOTE: Observe proper phase sequence when connecting the input power.

Example: For ABC rotation, phase A must lead phase B, which in turn must lead phase C by 120°.

If the phase rotation is not correct, a fault light and the LCD display will indicate the problem.

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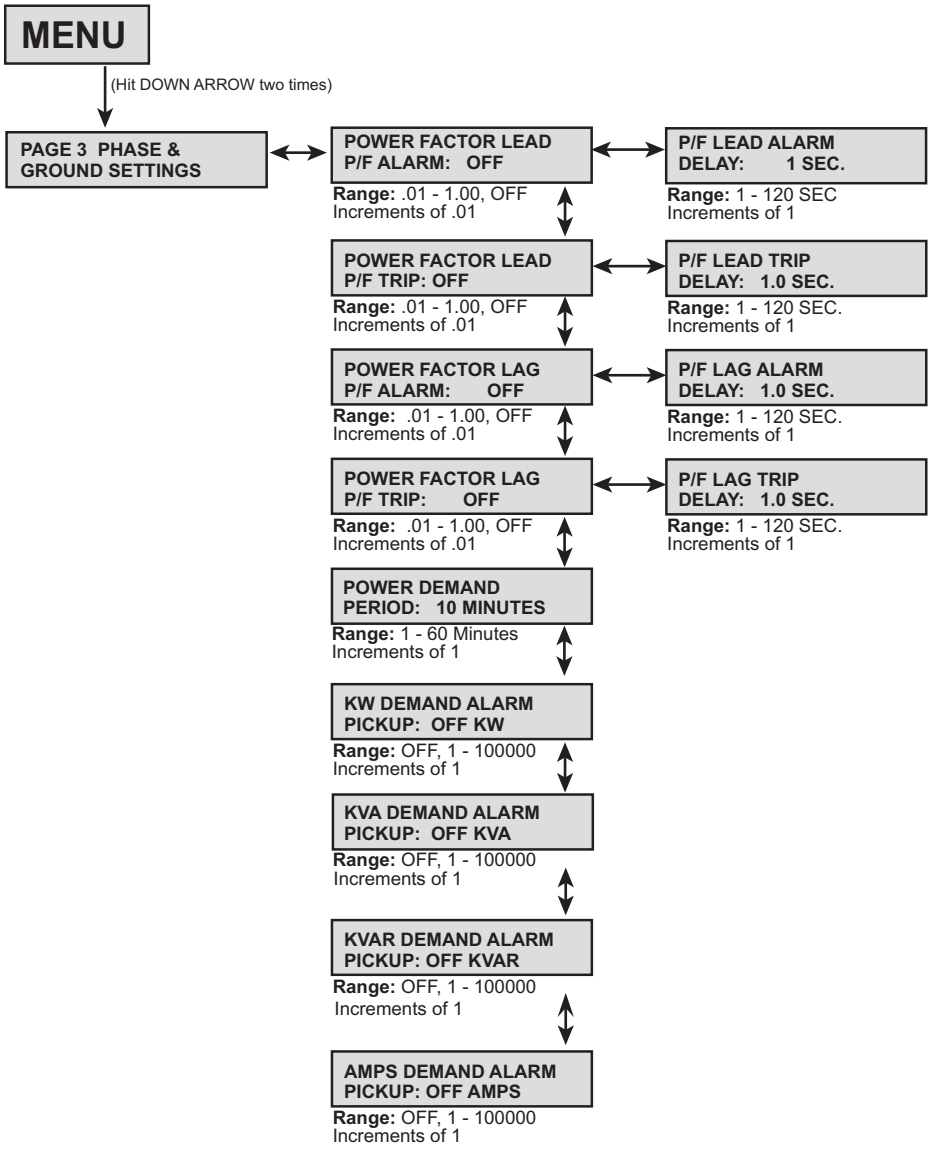
Figure 28: Setpoint Page 3—Phase and Ground Settings



Setpoint Page 4

All of the Motorpact Soft Start protection functions are user programmable to an output relay. The equipment is set at the factory with all tripping functions assigned to a Trip (AUX1) relay, and all alarm functions are assigned to an Alarm (AUX2) relay.

AUX1–4 are factory set and should not be changed.

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Table 12: Setpoint Page 4—Relay Assignments

Security Level	Description	Factory Setting			Range[a]	Factory Set Relay Assignment
		1st	2nd	3rd		
Level 2—Password Protection	O/L trip	Trip only	None	None	None Trip (AUX1) Alarm (AUX2) AUX3 AUX4 AUX5–8 Only available in 8 relay system.	Trip (AUX1)
	I/B trip	Trip	None	None		
	S/C trip	Trip only	None	None		
	Overcurrent trip	Trip	None	None		
	Stator RTD trip		None	None		
	Bearing RTD trip		None	None		
	Ground fault hi set trip[b]		None	None		
	Ground fault lo set trip[b]		None	None		
	Phase loss trip		None	None		
	Acceleration time trip	Trip only	None	None		
	Start curve trip		None	None		
	Over frequency trip	Trip	None	None		
	Under frequency trip		None	None		
	I*I*T start curve		None	None		
	Learned start curve		None	None		
	Phase reversal		None	None		
	Overvoltage trip		None	None		
	Undervoltage trip		None	None		
	Power factor trip		None	None		
	Tach Acceleration trip	None	None	None		None
	Inhibits trip	Trip	None	None		Trip (AUX1)
	TCB fault	Trip	None	None		
	External input #2	None	None	None		None
	Dual ramp	None	None	None		
	Thermostat	Trip	None	None		Trip (AUX1)
	Overload warning	Alarm	None	None		Alarm (AUX2)
	Overcurrent Alarm		None	None		
	SCR fail shunt alarm	None	None	None		
	Ground fault alarm[b]	Alarm	None	None		
	Undercurrent alarm	None	None	None		None
	Motor running	AUX3	None	None		AUX3
	I/B Alarm	Alarm	None	None		Alarm (AUX2)
	Stator RTD Alarm	None	None	None		None
	Non-Stator RTD Alarm	None	None	None		
	RTD failure alarm	None	None	None		
	Self test fail	Trip	None	None		Trip (AUX1)
	Thermal register	Alarm	None	None		Alarm (AUX2)
	Undervoltage alarm		None	None		
	Overvoltage alarm		None	None		
	Power factor alarm	None	None	None		None
	KW demand alarm		None	None		
	KVA demand alarm		None	None		
	KVAR demand alarm		None	None		
	Amps demand alarm		None	None		
	Timed output		None	None		
	Run delay time		None	None		
	At speed	AUX4	None	None		AUX4

a. AUX1 to AUX4 are for factory use only. Do not change. Only AUX5–AUX8 are used in the 2nd and 3rd relay assignments.

b. Ground fault option must be installed.

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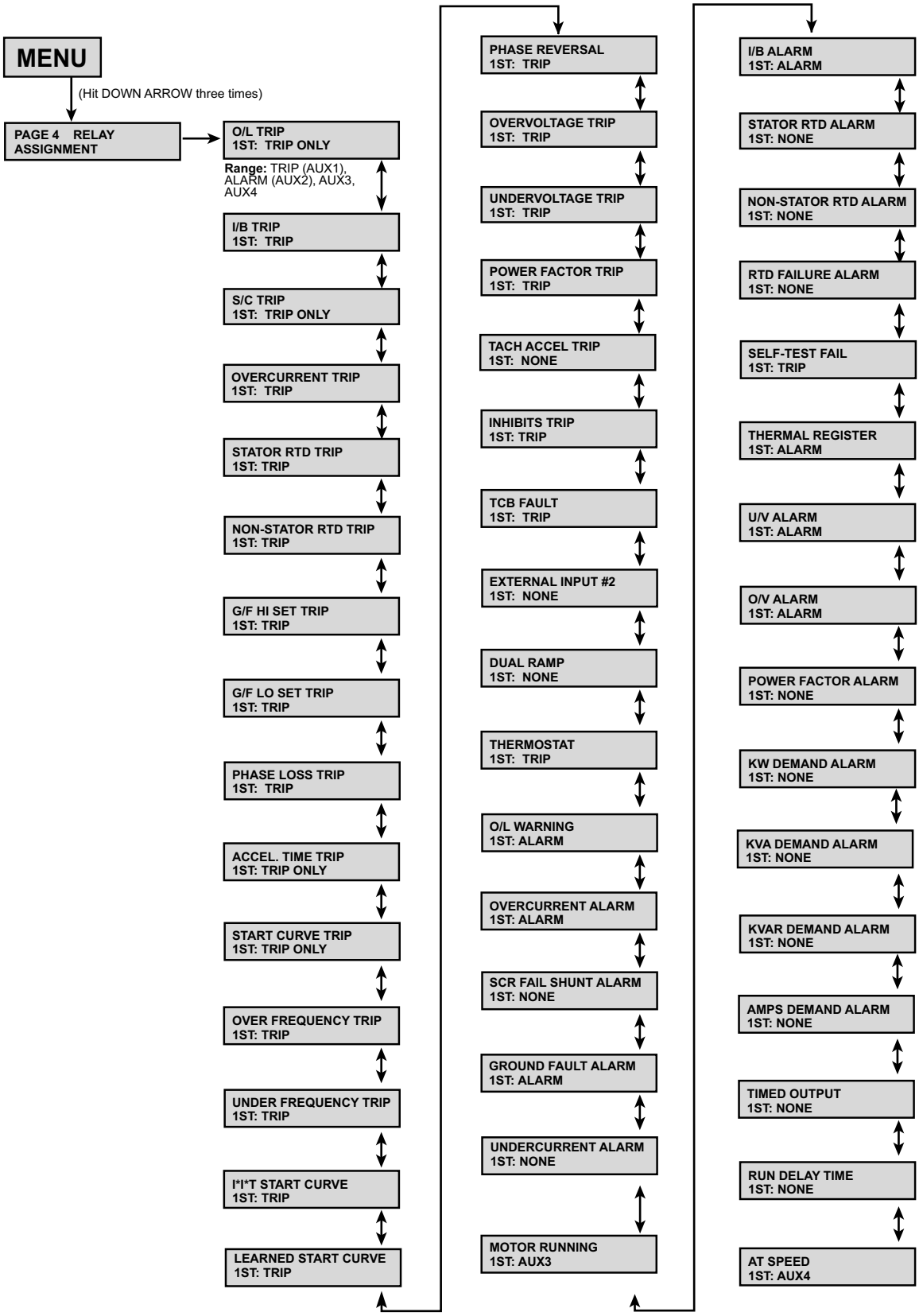
Figure 29: Setpoint Page 4—Relay Assignment



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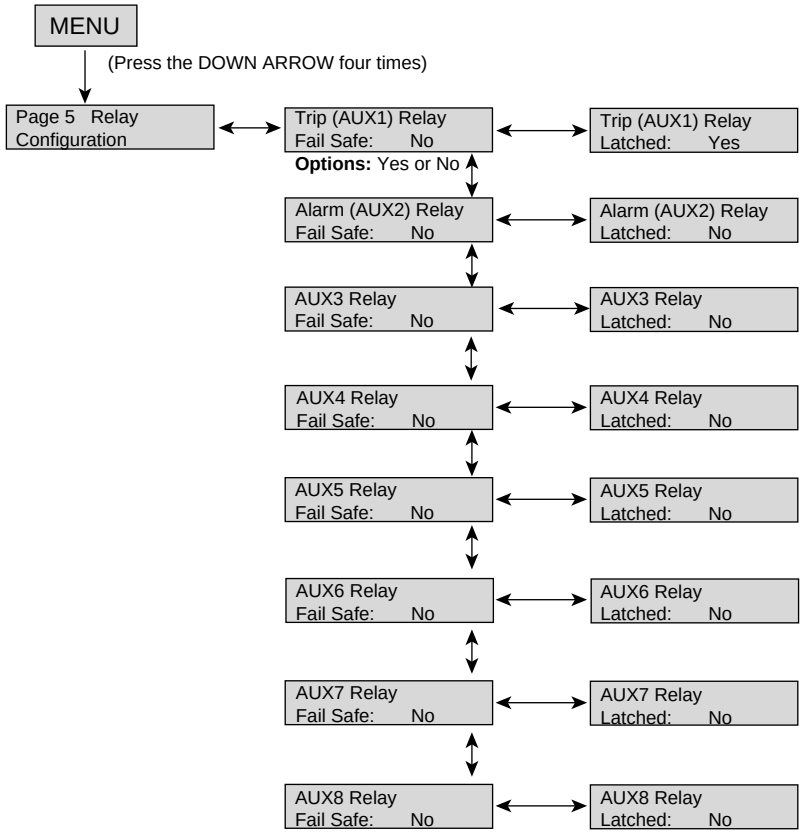
Setpoint Page 5

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

Table 13: Setpoint Page 5—Relay Configuration

Security Level	Description	Factory Setting Default	Range	Notes
Level 2—Password Protection	Trip (AUX1) fail-safe	No	Yes or No	When a relay has been configured as fail-safe and power is applied, the relay will be energized. The relay will then de-energize when an event occurs or when power is lost. *Note: Relays in the Motorpact Soft Start 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. 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.
	Trip (AUX1) relay latched	Yes		
	Alarm (AUX2) fail-safe	No		
	Alarm (AUX2) relay latched			
	AUX3 relay fail-safe			
	AUX3 relay latched			
	AUX4 relay fail-safe			
	AUX4 relay latched			
	AUX5 relay fail-safe			
	AUX5 relay latched			
	AUX6 relay fail-safe			
	AUX6 relay latched			
	AUX7 relay fail-safe			
	AUX7 relay latched			
	AUX8 relay fail-safe			
	AUX8 relay latched			

Figure 30: Setpoint Page 5—Relay Configuration



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Setpoint Page 6

Table 14: Setpoint Page 6—User I/O Configuration

Security Level	Description	Factory Setting Default	Range	Notes
Level 2—Password Protection	Tachometer scale selection	Disabled	Enabled or Disabled	When set to Enabled, the display prompts you to input the tachometer scale of the 4–20 mA input range.
	Manual tachometer scale 4.0 mA:	0 RPM	0–3600	Assign an RPM value to the lowest point on the scale. This value should represent the motor at zero speed.
	Manual tachometer scale 20.0 mA:	2000 RPM	0–3600	Assign an RPM value to the highest point on the scale. This value should represent the motor at full speed.
	Tachometer acceleration trip mode select	Disabled	Underspeed, Overspeed, or Disabled	When enabled, the underspeed or overspeed must be selected for the Tach Accel Trip. If the underspeed is selected, only the Tach Underspeed Trip Point will be used. If the overspeed is selected, only the Tach Overspeed Trip Point will be used.
	Tachometer ramp time	20 s	1–120	The duration of time before the tachometer begins to sample.
	Tachometer underspeed trip PT	1650 RPM	0–3600	The minimum value of motor RPM which must be achieved before the Tach Ramp Time sample is taken.
	Tachometer overspeed trip PT	1850 RPM	0–3600	The maximum motor RPM allowed when the Tach Ramp Time sample is taken.
	Tachometer acceleration trip delay	1 s	1–60	The duration of time the Tach Accel trip condition must persist before a trip occurs.
	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%	Select a function from the available five options to be transmitted from the 4–20 mA output. If selecting RPM, the tachometer feedback input signal must be present in order for the soft start to give proper output. If selecting RTD, the RTD option must be installed and an RTD input signal must be present for proper analog output.
	Analog output #1 4 mA:	0	0–65535	Enter a value that the 4 mA level will represent for the selected function. Typically, this value should be 0.
	Analog output #1 20 mA:	250		Enter a value that the 20 mA level will represent for the selected function.
	Analog output #2	% motor load	Same as analog input #1	All of the setpoints and setup screens for analog output #2 are the same as those for analog output #1.
	Analog output #2 4 mA:	0	0–1000%	
	Analog output #2 20 mA:	1000	0–1000%	
	User programmable external inputs			The Motorpact Soft Start provides up to four digital programmable external inputs. Assign a description name to each input for easy identification.
	TCB fault	Enabled	Enabled or Disabled	If used, this setpoint must be enabled.
	Name external input #1	TCB fault	User defined, up to 15 characters	Factory programmed for the TCB fault.
	TCB fault type	NO	Normally open or normally closed	
	TCB fault time delay	1 s	0–60 s	
	External input#2	Disabled	Enabled or Disabled	If used, this setpoint must be enabled.
	Name external input #2		User defined, up to 15 characters	The user can assign a description name to the input to easily identify the cause of external trip or alarm. Up to 15 characters including spaces can be used to assign the name.
	External input #2 type	NO	Normally open or normally closed	The external input can be set as either a normally open or normally cosed contact.
	External input #2 time delay	0 s	0–60 s	If a contact setting is changed, the unit will wait a programmed amount of time before generating output. If no delay is needed, then input 0 s. The soft start will post an event upon seeing a change in state.
	Second ramp	Dual ramp	Enabled or Disabled or Dual Ramp	

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Table 14: Setpoint Page 6—User I/O Configuration *(continued)*

Security Level	Description	Factory Setting Default	Range	Notes
Level 2—Password Protection	Name external input #3	Second ramp	User defined, up to 15 characters	In dual ramp mode, the initial contact setting is the same as start ramp #1. If the input contact state changes, the soft start will switch to start ramp #2 and use that setting for start control mode. The start ramp types should only be switched while the motor is stopped. In Setpoint Page 4, do not assign any output relay to this function. The soft start will ship with External input #3 programmed for dual ramp. If it is not needed, disable the dual ramp.
	Second ramp type	NO	Normally open or normally closed	
	Second ramp time delay	0 s	0–60 s	
	Thermostat	Enabled	Enabled or Disabled	
	Name external input #4	Thermostat	User defined, up to 15 characters	These input screens are for thermostat input. It is recommended that this function remain enabled. If the thermostat indicates an over temperature condition, the soft start will trip the motor.
	Thermostat type	NC	Normally open or normally closed	
	Thermostat time delay	1 s	0–60 s	

Figure 31: Setpoint Page 6—User I/O Configuration

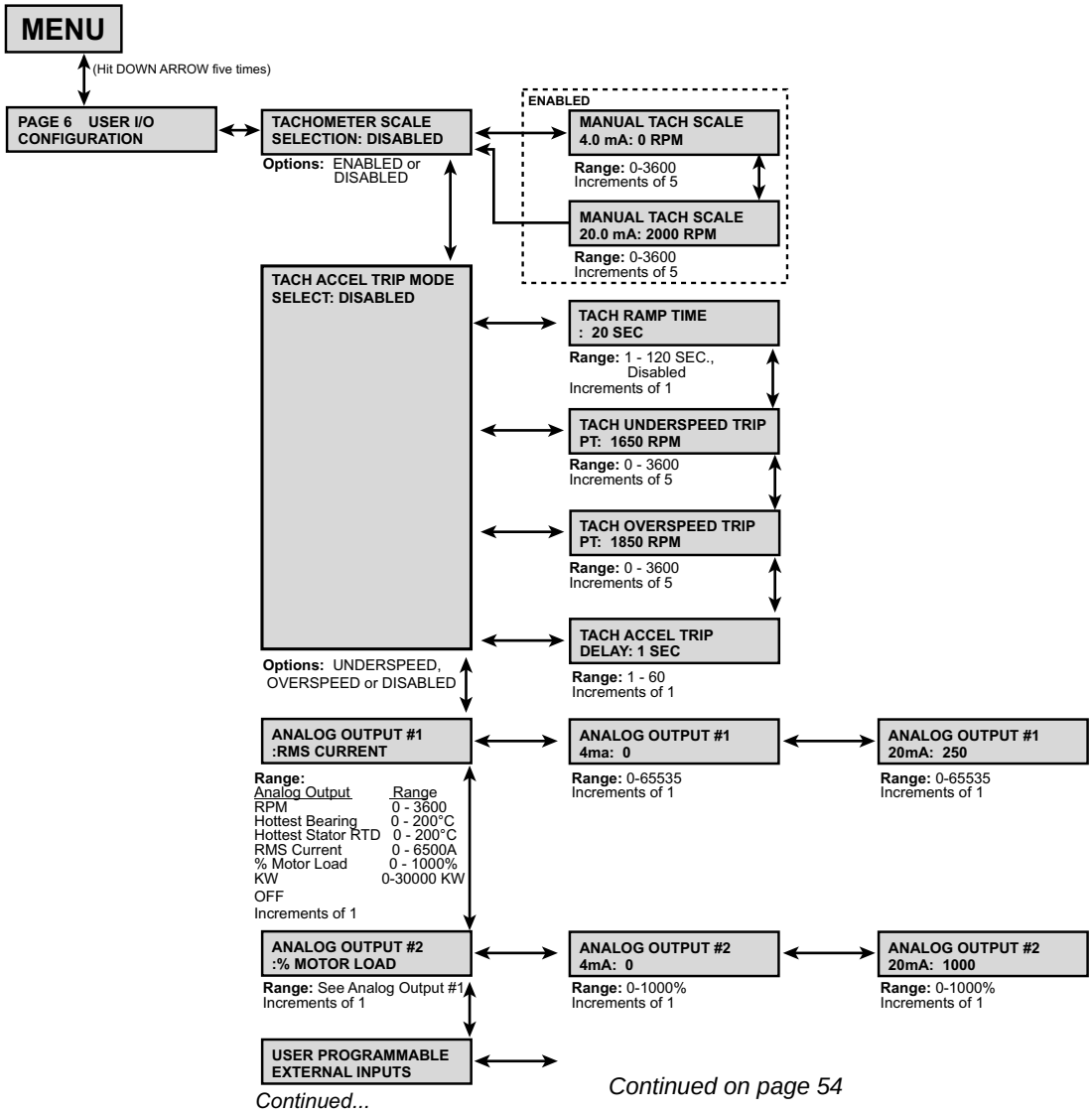

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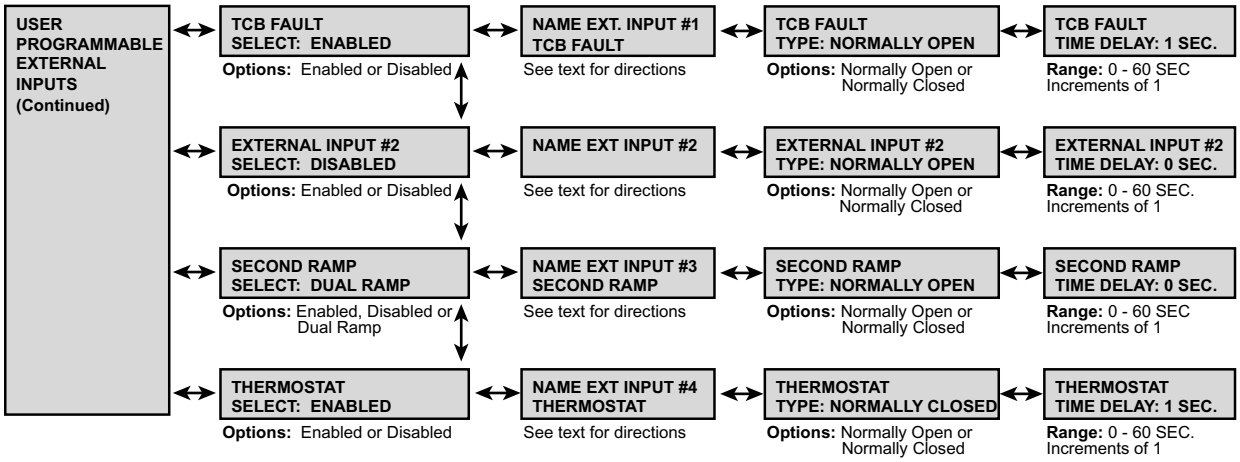
Figure 32: Setpoint Page 6—User I/O Configuration *(continued from page 53)*



Setpoint Page 7

Table 15: Setpoint Page 7—Custom Acceleration Curve

Security Level	Description	Factory Setting Default	Range	Notes
Level 3—Password Protection	Custom acceleration curve	Disabled	Disabled, Curve A, B, or C	Setpoint Page 7 allows you to custom design the acceleration (start) curve to a specific application. You can design up to three different curves in the soft start. Only one curve at a time can be active (enabled). Each of the three custom curves has eight voltage levels, with corresponding ramp times and a current limit setting. You must program each successive voltage level to one greater than the previous level. All eight voltage levels must be programmed. The eighth level has been preset to 100%. If the custom accel curve is set to curve A, B, or C on Setpoint Page 7, the soft start will override the start control mode selected in Setpoint Page 2, even if the start control mode is not set to custom accel curve.
	Custom Curve A			
	Curve A voltage level 1	25%	0–100%	
	Curve A ramp time 1	2 s	1–60 s	
	Curve A voltage level 2	30%	0–100%	
	Curve A ramp time 2	2 s	1–60 s	
	Curve A voltage level 3	37%	0–100%	
	Curve A ramp time 3	2 s	1–60 s	
	Curve A voltage level 4	45%	0–100%	
	Curve A ramp time 4	2 s	1–60 s	
	Curve A voltage level 5	55%	0–100%	
	Curve A ramp time 5	2 s	1–60 s	
	Curve A voltage level 6	67%	0–100%	
	Curve A ramp time 6	2 s	1–60 s	
	Curve A voltage level 7	82%	0–100%	
	Curve A ramp time 7	2 s	1–60 s	
	Curve A voltage level 8	100%	0–100%	
	Curve A ramp time 8	2 s	1–60 s	
	Curve A current limit	350% FLA	200–600%	
	Custom Curve B	Same programmable data points and ranges as custom curve A		
	Custom Curve C			

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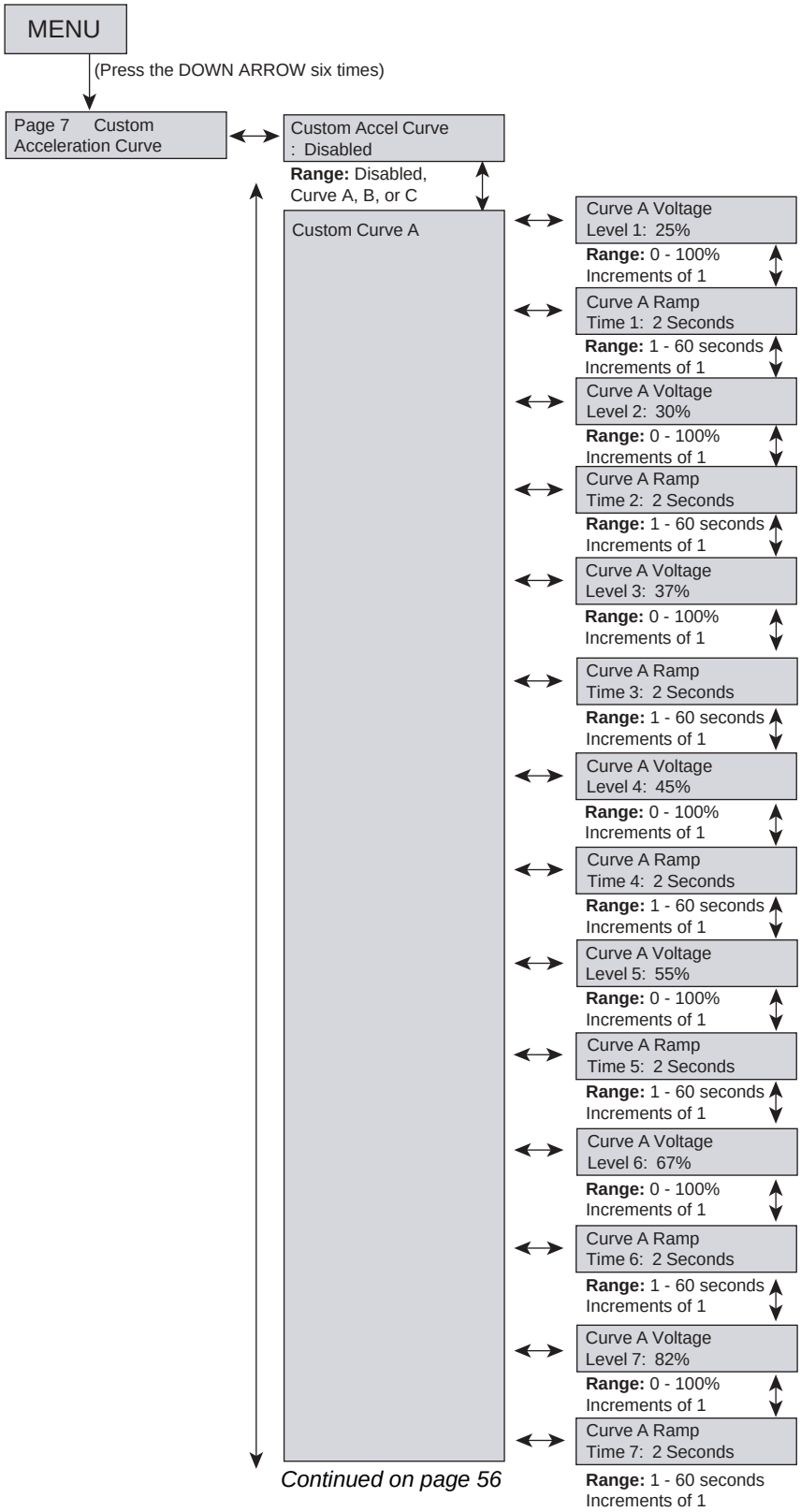
Figure 33: Setpoint Page 7—Custom Acceleration Curve



Continued on page 56

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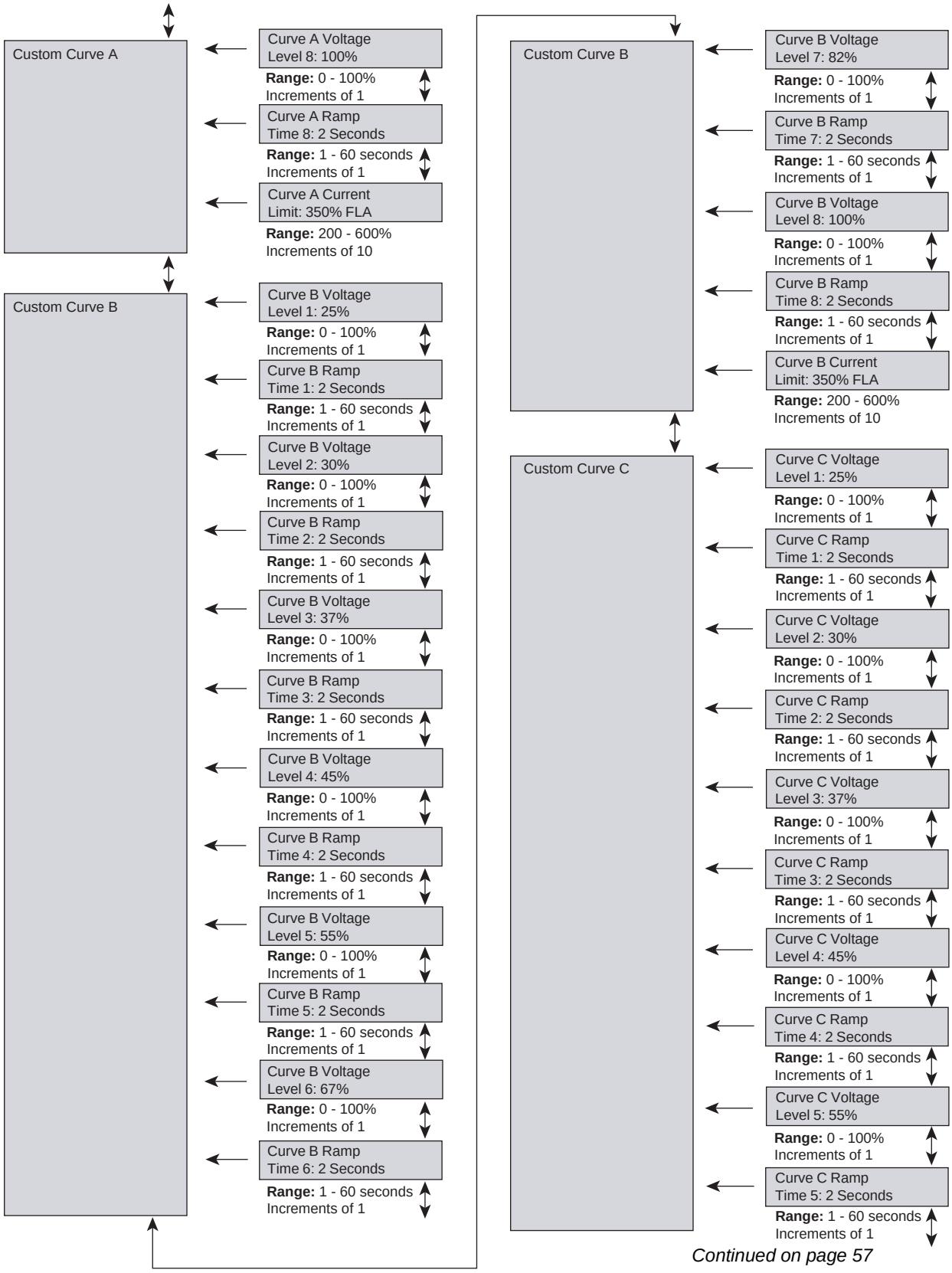
Figure 34: Setpoint Page 7—Custom Acceleration Curve *(continued from page 55)*



Continued on page 57

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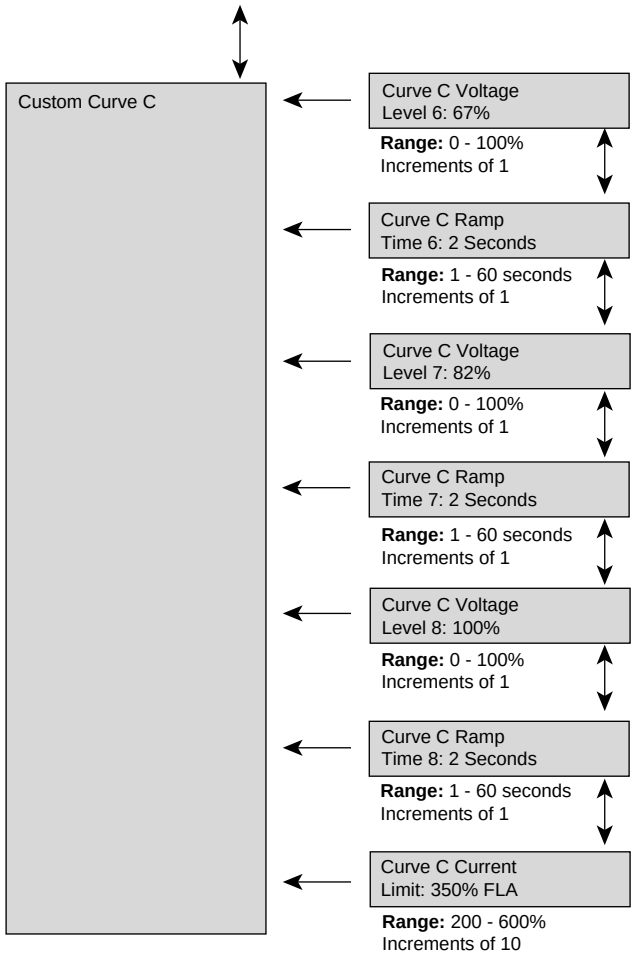
Figure 35: Setpoint Page 7—Custom Acceleration Curve *(continued from page 56)*



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Setpoint Page 8

Setpoint page 8 configures the unit's start and run protection mode. The unit has independent start and run curve protection. The settings can be based on the overload class or set by the motor's locked rotor current and time.

Table 16: Setpoint Page 8—Overload Curve Configuration

Security Level	Description	Factory Setting Default	Range	Notes
Level 3—Password Protection	**Basic Run Overload Curve**			
	Run curve locked rotor time	Overload class	1–30 s, overload class	Set the locked rotor time to the overload 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	600% FLA	400–800%	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	Disabled	1–60 min., Disabled	If enabled, this prevents the motor from restarting for the programmed amount of time, after a stop command is given.
	Basic Start Overload Curve			
	Start curve locked rotor time	Overload class	1–30 s, overload class	The locked rotor time can be set to the overload 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	600% FLA	400–800%	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	30 s	1–300 s, Disabled	If the motor does not enter run mode (reach at speed) within the preset time, the unit will trip.
	Number of starts per hour	Disabled	1–6, Disabled	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 specific recommendations.
	Time between starts time	Disabled	1–60 min., Disabled	If enabled, the soft start prevents another start attempt until the programmed time has expired.
	Area under curve protection	Disabled	Enabled or Disabled	If enabled, this secondary start protection uses both the basic start protection and the area under the curve protection.
	Max I*I*T start	368 FLA	1–2500 FLA*FLA*s	The maximum I^2T allowed during start. If the I^2T to start exceeds this number, the soft start will generate a trip.
	Curve over curve	Disabled	Disabled, Learn, Enabled	Learns the motor's starting characteristics and protects the motor based upon the learned curve. It is useful when commissioning a new motor.
	Learned start curve bias	10%	5–40%	The maximum allowed deviation above or below the start curve before a trip is generated.
	Time for sampling	30 s	1–300 s	The time the soft start continues to sample the start curve characteristic during the learn mode.

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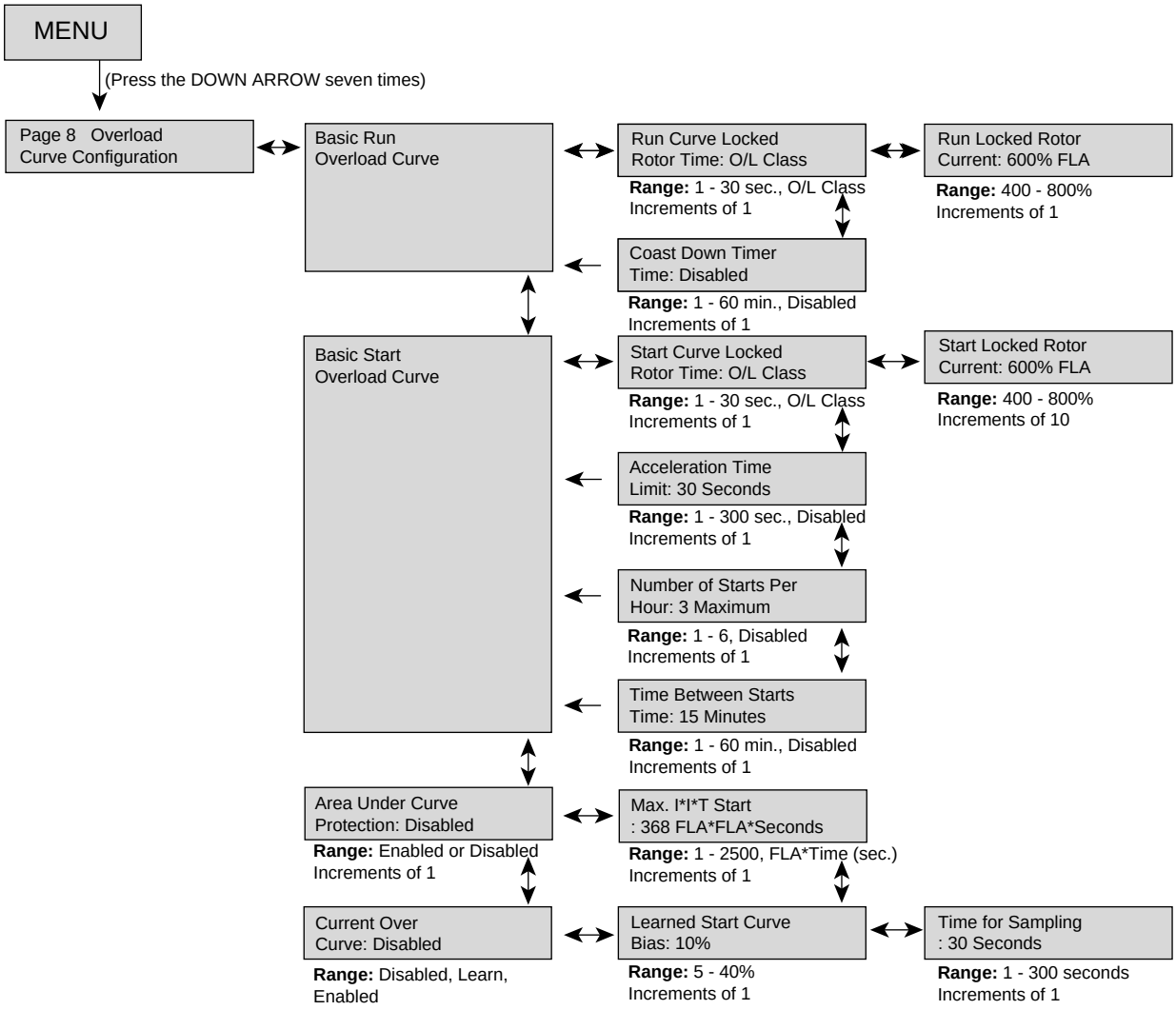
Figure 36: Setpoint Page 8—Overload Curve Configuration



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Setpoint Page 9

The Motorpact Soft Start is available with an optional RTD card that provides 12 programmable RTDs. 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.

Table 17: Setpoint Page 9—RTD Configuration

Security Level	Description	Factory Setting Default	Range	Notes
Level 3—Password Protection	Use NEMA temp. for RTD values	Disabled	Enabled or Disabled	When this setpoint is enabled, the soft start 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 (464°F).
	# of RTD used for stator	4	0–6	Up to six RTDs can be assigned to monitor the stator of the motor.
	RTD volting	Disabled	Enabled or Disabled	When this is enabled, the soft start will not post a trip until two RTDs have exceeded the trip level. This prevents nuisance RTD tripping.
	Stator phase A1 type	Off	120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	All 12 RTDs are configured as follows: 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 and #2 have been named stator phase A1 and A2, respectively. RTDs #3 and #4 are named stator phase B1 and B2. RTDs #5 and #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 to the RTD description screen. If no alarm or trip level is required, these setpoints can be turned off.
	RTD #1 description	Stator A1	User defined, up to 15 characters	
	Stator phase A1 alarm level	Off	0–240 °C (32–464 °F), Off	
	Stator phase A1 trip level			
	Stator phase A2 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #2 description	Stator A2	User defined, up to 15 characters	
	Stator phase A2 alarm	Off	0–240 °C (32–464 °F), Off	
	Stator phase A2 trip level			
	Stator phase B1 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #3 description	Stator B1	User defined, up to 15 characters	
	Stator phase B1 alarm level	Off	0–240 °C (32–464 °F), Off	
	Stator phase B1 trip level			
	Stator phase B2 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #4 description	Stator B2	User defined, up to 15 characters	
	Stator phase B2 alarm level	Off	0–240 °C (32–464 °F), Off	
	Stator phase B2 trip level			
	Stator phase C1 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #5 description	Stator C1	User defined, up to 15 characters	
	Stator phase C1 alarm level	Off	0–240 °C (32–464 °F), Off	
	Stator phase C1 trip level			
	Stator phase C2 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #6 description	Stator C2	User defined, up to 15 characters	
	Stator phase C2 alarm level	Off	0–240 °C (32–464 °F), Off	
	Stator phase C2 trip level			
	End bearing type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #7 description	End bearing	User defined, up to 15 characters	
	End bearing alarm level	Off	0–240 °C (32–464 °F), Off	
	End bearing trip level			
	Shaft bearing type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #8 description	Shaft bearing	User defined, up to 15 characters	

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Table 17: Setpoint Page 9—RTD Configuration *(continued)*

Security Level	Description	Factory Setting Default	Range	Notes
Level 3—Password Protection	Shaft bearing alarm level	Off	0–240 °C (32–464 °F), Off	All 12 RTDs are configured as follows: 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 and #2 have been named stator phase A1 and A2, respectively. RTDs #3 and #4 are named stator phase B1 and B2. RTDs #5 and #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 to the RTD description screen. If no alarm or trip level is required, these setpoints can be turned off.
	Shaft bearing trip level			
	RTD #9 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #9 description	User defined	User defined, up to 15 characters	
	RTD #9 alarm level	Off	0–240 °C (32–464 °F), Off	
	RTD #9 trip level			
	RTD #10 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #10 description	User defined	User defined, up to 15 characters	
	RTD #10 alarm level	Off	0–240 °C (32–464 °F), Off	
	RTD #10 trip level		0–240 °C (32–464 °F), Off	
	RTD #11 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #11 description	User defined	User defined, up to 15 characters	
	RTD #11 alarm level	Off	0–240 °C (32–464 °F), Off	
	RTD #11 trip level			
	RTD #12 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
	RTD #12 description	User defined	User defined, up to 15 characters	
	RTD #12 alarm level	Off	0–240°C (32–464°F), Off	
	RTD #12 trip level			

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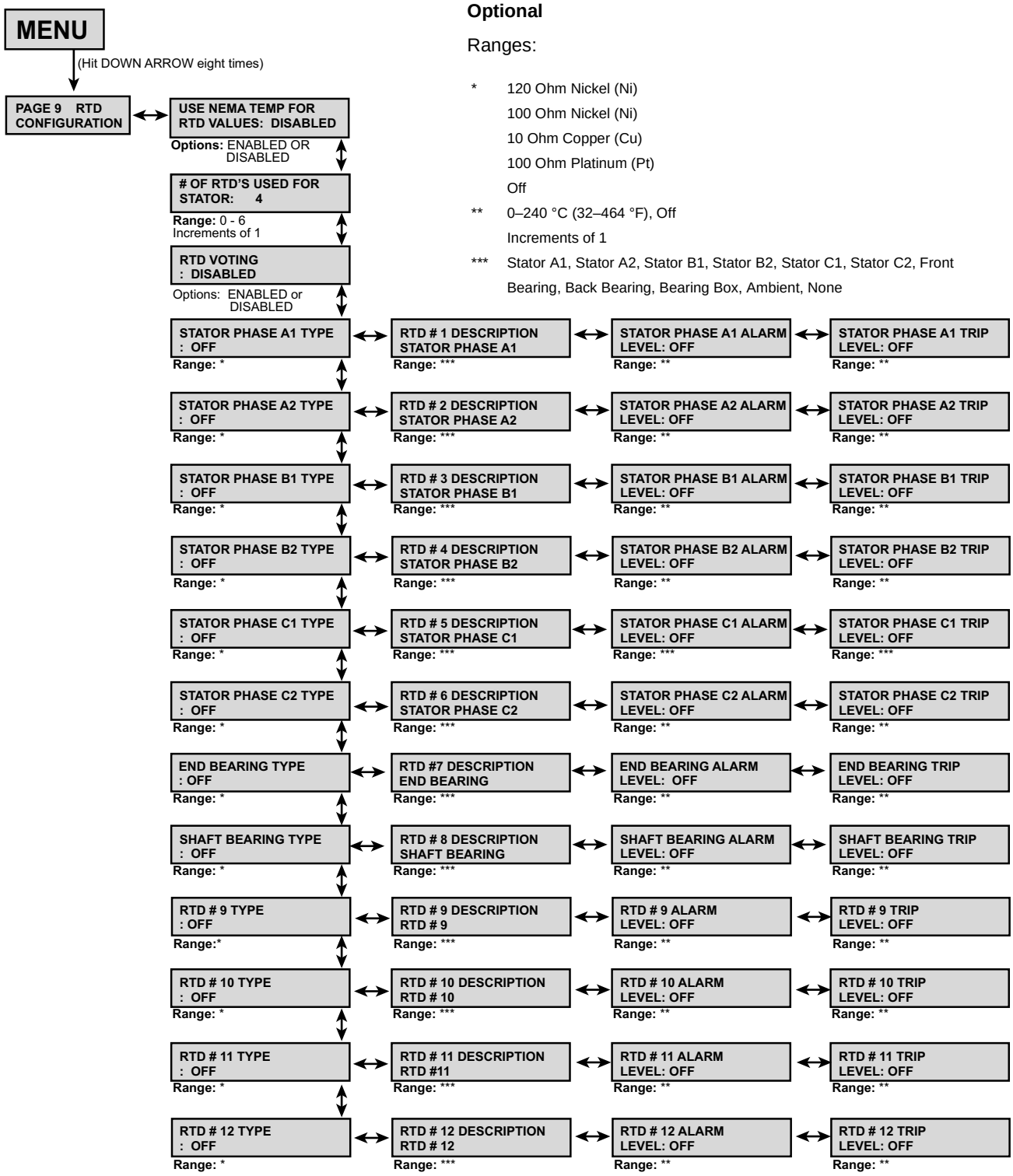
Figure 37: Setpoint Page 9—RTD Configuration



Optional

Ranges:

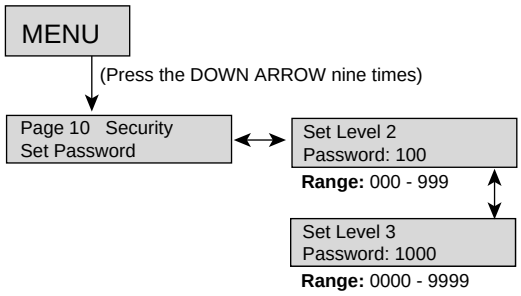
* 120 Ohm Nickel (Ni)
100 Ohm Nickel (Ni)
10 Ohm Copper (Cu)
100 Ohm Platinum (Pt)
Off

** 0–240 °C (32–464 °F), Off
Increments of 1

*** Stator A1, Stator A2, Stator B1, Stator B2, Stator C1, Stator C2, Front Bearing, Back Bearing, Bearing Box, Ambient, None

Setpoint Page 10

Figure 38: Setpoint Page 10—Set Password



The Motorpact Soft Start has three levels of user programmable setpoint screens. Level one setpoints do not require a password because they contain basic nameplate and starter control data. 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.

Table 18: Setpoint Page 10—Security Set Password

Security Level	Description	Factory Setting Default	Range
Level 3—Password Protection	Set Level 2 password	100	000–999 three digits
	Set Level 3 password	1000	0000–9999 four digits

Setpoint Page 11

Table 19: Setpoint Page 11—Communications

Security Level	Description	Factory Setting Default	Range	Notes
Level 3—Password Protection	Set front baud rate	9.6 Kb/s	2.4, 4.8, 9.6, 19.2, 38.4 Kb/s	Configures the RS232 communications baud rate.
	Set Modbus baud rate			Configures the Modbus communications baud rate.
	Modbus address number	247	1–247	Assigns a Modbus address to the Motorpact soft start relay.
	Set access code	1	1–999	Assigns an access code to the Modbus addressing. This is typically not used.
	Set link baud rate	38.4 Kb/s	2.4, 4.8, 9.6, 19.2, 38.4 Kb/s	Configures the RS422 communications baud rate between the keypad operator and the CPU board. (For applications with remote keypad only.)
	Remote start/stop	Disabled	Enabled or Disabled	Allows the RS485 Modbus communications to start and stop the motor. Contact factory for details.

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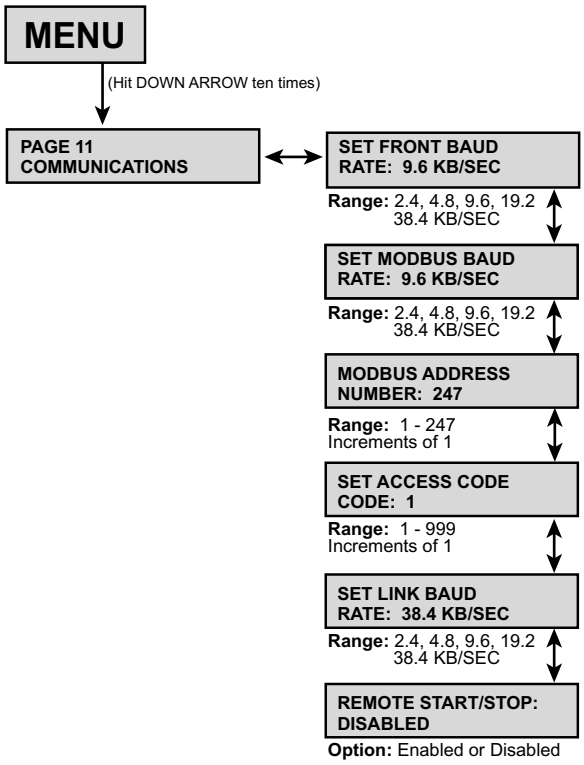
Figure 39: Setpoint Page 11—Communications



Setpoint Page 12

Table 20: Setpoint Page 12—System Setpoints

Security Level	Description	Factory Setting Default	Range	Notes
Level 3—Password Protection	**Default display screen**			Choose the default screen the soft start displays while the motor is running. Select the metering page number (1-3), then select the metering screen number.
	Metering data page #	1	Enter metering page (1–3)	—
	Metering data screen #	1	Enter metering screen Page 1 (1–10) Page 2 (1–29) Page 3 (1–6)	If page 1 is selected as the default page, screens 1–10 are available. If page 2 is selected, screens 1–29 are available. If page 3 is selected, screens 1–6 are available. See “Metering Page 1” on page 68 for screen number assignment.
	Alarms			
	RTD failure alarm	Disabled	Enabled or Disabled	If enabled, and an RTD shorts or opens, an alarm occurs (only if the RTD option is installed).
	Thermal register alarm	90%	40–95%	Sets a level in the thermal register to generate an alarm when the thermal register capacity used has exceeded this level.
	Thermal alarm delay	10 s	1–20 s	The amount of time that the thermal register used must exceed the setpoint before an alarm condition will occur.
	Thermal register setup information			This setpoint group configures the thermal register and indicates to the soft start which inputs to use when thermal modeling.
	Cold stall time	Overload class	Overload class, 4–40 s	This setpoint is used to define the thermal capacity of the motor. Enter the time from the motor manufacturer’s specification sheet, or use the time defined by the overload class.
	Hot stall time	1/2 overload class	1/2 overload class, 4–40 s	Enter the amount of time specified by the motor manufacturer, or use half of the time defined by the overload class.
	Stopped cool down time	30 min.	10–300 min.	The time the motor requires 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	15 min.	10–300 min.	The amount of time the motor requires for cooling down while running. Use only the data provided by the motor manufacturer.
	Relay measured cool rates	Disabled	Enabled or Disabled	Enable this setpoint only if the RTD option is present.Use this setpoint to configure the soft start to use the measured cool rates from the RTDs instead of the programmed settings.
	Thermal register minimum	15%	10–50%	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	40 °C	10–90 °C	Use the data from the motor manufacturer’s specifications. When the RTD option is supplied, this setpoint will be the base point for the RTD thermal register biasing.
	Motor design run temperature	80% max.	50–100% of motor stator max. temp.	Use the data from the motor manufacturer’s specifications. This setpoint defines the operating temperature rise of the motor at full load amps (FLA) or 100% load.
	Motor stator max. temperature	INS CLS	INS CLS, 10–240 °C	The maximum temperature the stator insulation will withstand. Either 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.
	I/B input to thermal register	Enabled	Enabled only	When enabled, it allows the soft start to use the line current imbalance information to bias the thermal register.
	Use calculated K or assign	7	1–50, On	When the setpoint is set to On, the soft start will calculate the K constant factor for biasing the thermal register, or you can assign the K value.
	Press ENTER to Clr thermal register	—	—	Allows a level three password user to clear the thermal register for emergency restarts.

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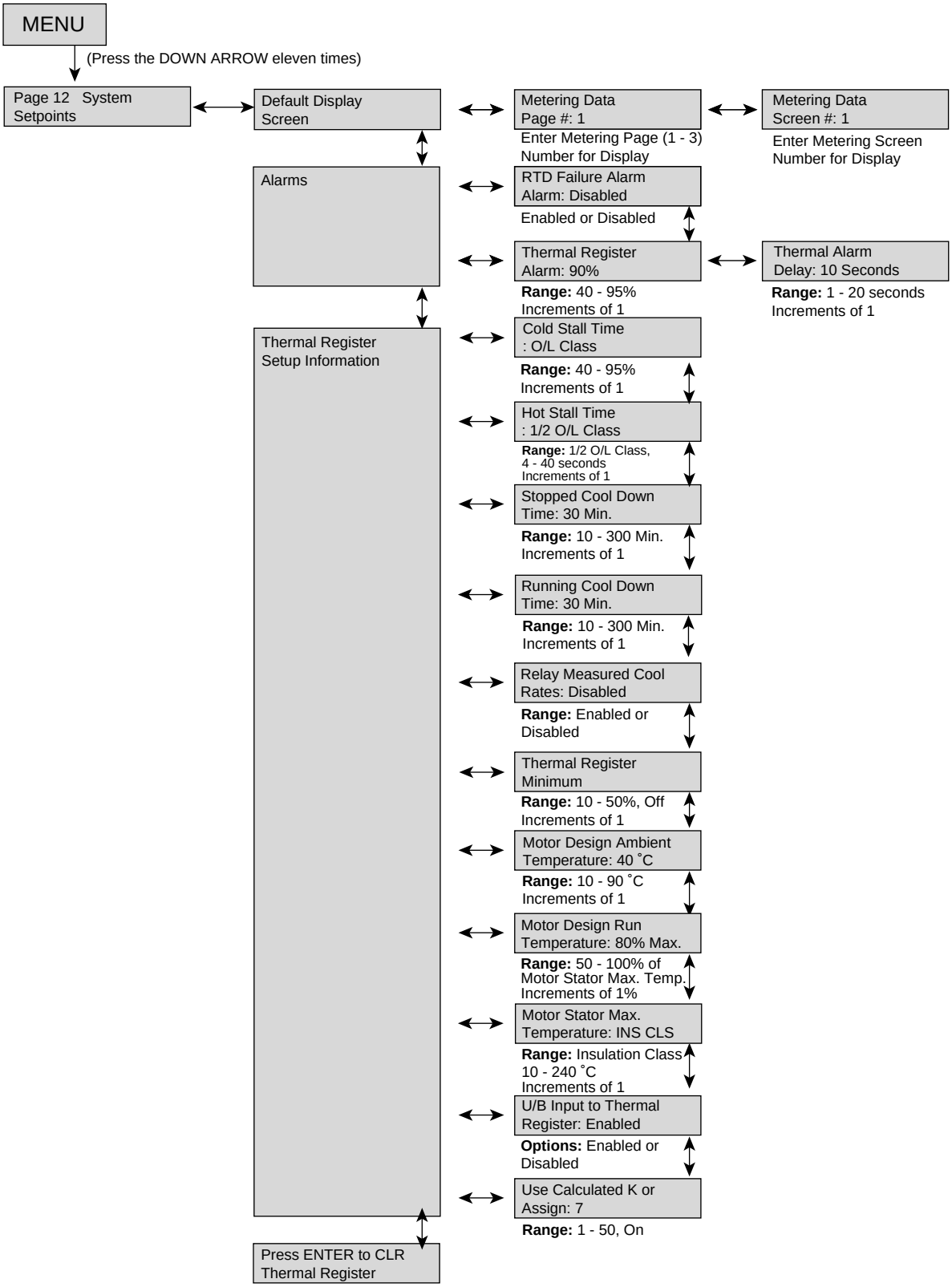
Figure 40: Setpoint Page 12—System Setpoints



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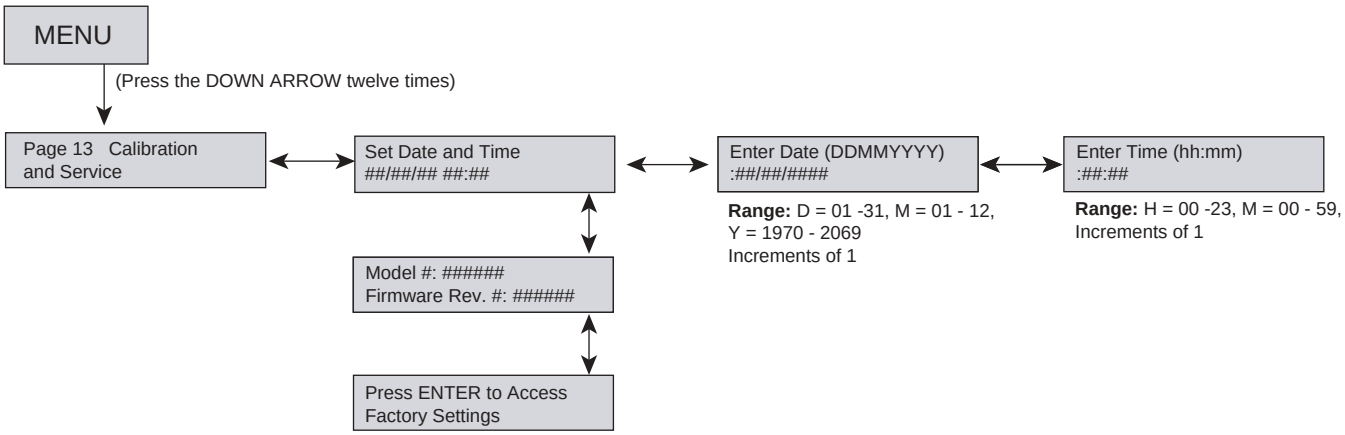
Setpoint Page 13

Setpoint Page 13 screens are displayed for information only: Current Date and Time, Model Number, and Firmware Revision Number. Only factory personnel can access Setpoint Page 13 to make changes.

Table 21: Setpoint Page 13—Calibration and Service

Security Level	Description	Factory Setting Default	Range	Notes
Factory Use Only	Set date and time	Factory set: ##/##/## ##:##	—	Displays the date and time.
	Enter date (DDMMYYYY)	Factory set: ##/##/####	D=1–31, M=1–12, Y=1970–2069	Allows the factory personnel to program the date for the soft start in the format shown.
	Enter time (HH:MM)	Factory set: ##:##	H=00–23, M=00–59	Allows the factory personnel to program the time for the soft start.
	Model # Firmware Rev. #	Factory set: ###### ######	Display only; cannot be changed	Displays the model number and firmware revision in the soft start.
	Press ENTER to access factory settings	—	Available to qualified factory personnel	

Figure 41: Setpoint Page 13—Calibration and Service



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METERING PAGES

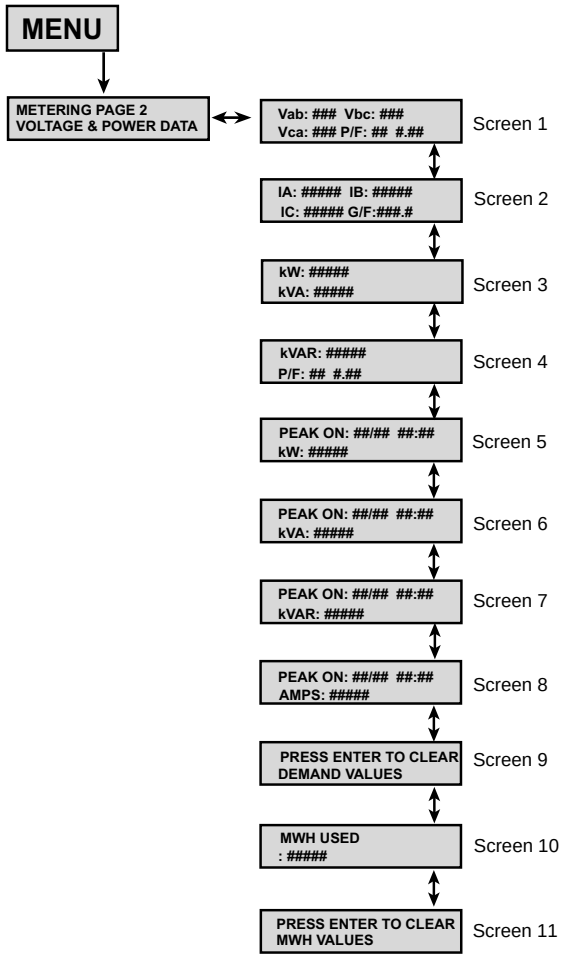
The Motorpact Soft Start offers performance metering, allowing you to view information about the motor and the soft start unit.

Metering Page 1

Table 22: Metering Page 1—Metering Menu and Data

Screen	Description
1	Phase A, B, and C and ground fault (option)
2	Average current of the % of imbalance and the motor's RPM
3	Motor load as a percentage of motor FLA
4	Line frequency and present phase order
5	Percentage of remaining thermal register.
6	Thermal capacity required to start the motor
7	Average time required to start
8	Average current during start
9	Measured I^2T required to start the motor
10	Amount of time required to start the motor during the last successful start

Figure 42: Metering Page 1—Metering Menu and Data



Metering Page 2

Table 23: Metering Page 2—Metering

Screen	Description
1	Phase A, B, and C currents and Power Factor
2	Phase A, B, and C currents and Ground Fault (option)
3	Displays kW and kVA
4	Displays kVAR and Power Factor
5	Displays Peak On and kW Demand
6	Displays Peak On and kVA Demand
7	Displays Peak On and kVAR Demand
8	Displays Peak On and Amps Demand
9	Clears demand values
10	Displays megawatt hours used
11	Press enter to clear statistics on MWH values

Figure 43: Metering Page 2—Metering

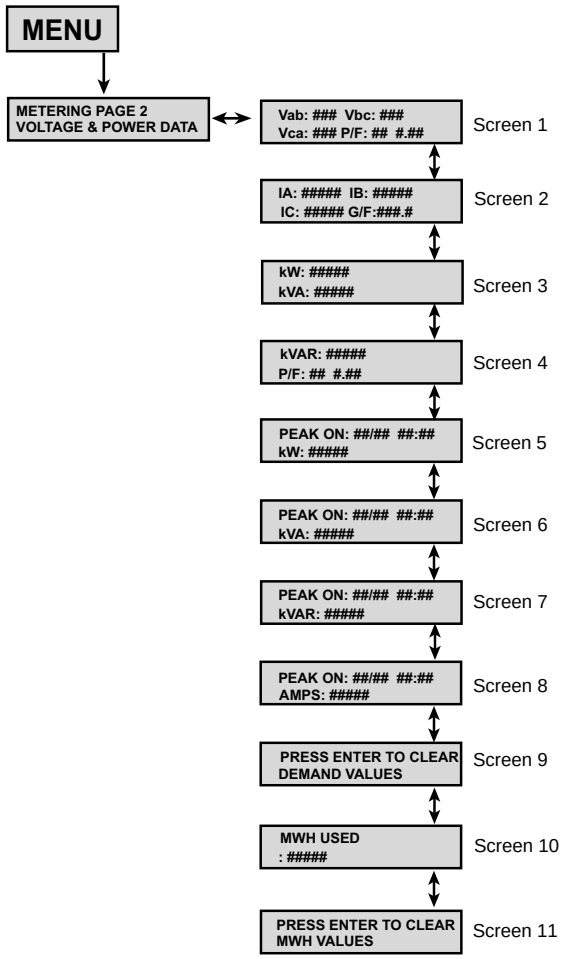


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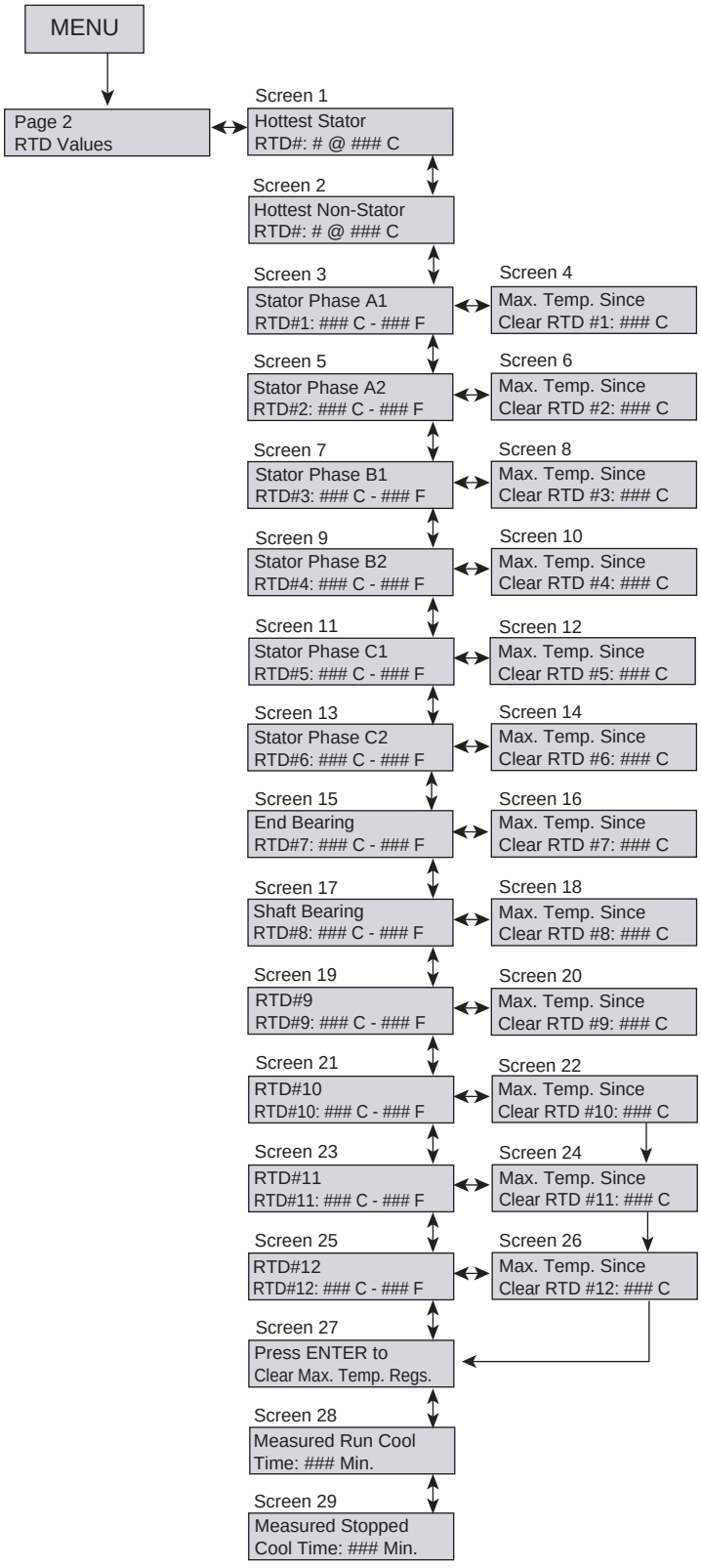
Table 24: Metering Page 2—RTD Values

Screen	Description
1	Hottest stator RTD (#1–6, depending on the number of RTDs used for stator)
2	Hottest non-stator RTD (#7–12 if #1–6 are used for stator)
3	Temperature of start phase A1 in °C and °F
4	Maximum temperature for RTD #1 since the last command to clear the thermal register
5–26	Same as screens 3 and 4
27	Clear the maximum temperature register (Level 3 password required)
28	Measured run cool time in minutes
29	Measured stopped cool time in minutes

Figure 44: Metering Page 2—RTD Values

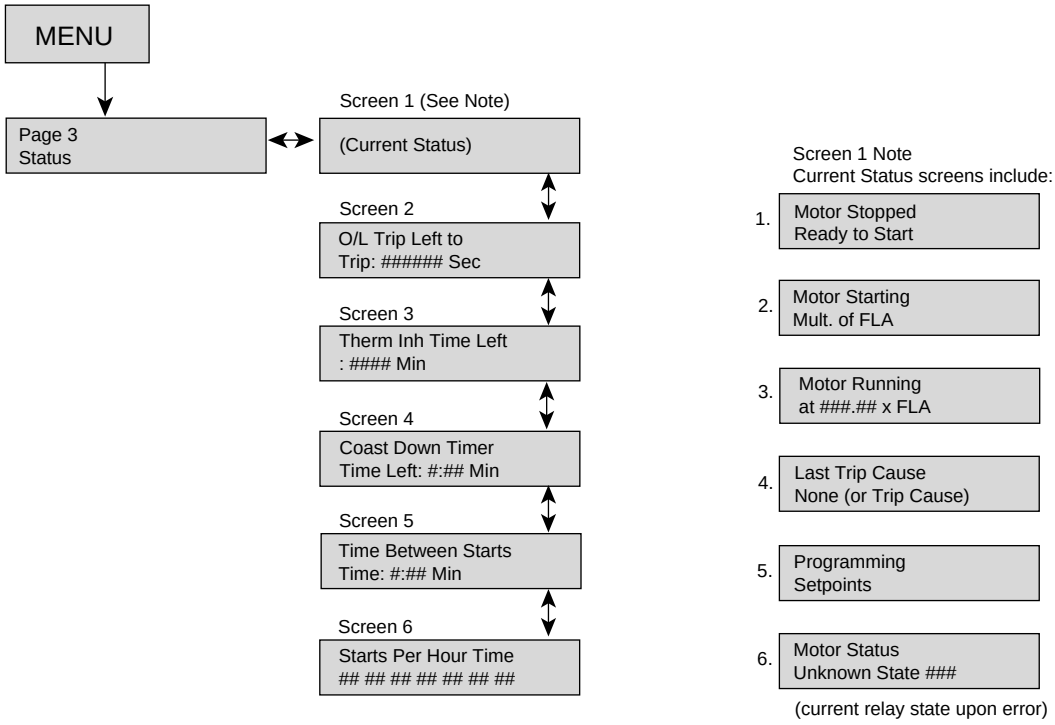


Metering Page 3

Table 25: Metering Page 3—Status

Screen	Description
1	Current status
2	Amount of time remaining before an overload trip occurs
3	Amount of time remaining from a thermal inhibit signal. The inhibit time comes from the amount of thermal register remaining versus the amount of thermal capacity required to start.
4	Coast down (back spin) time remaining. The time remaining depends upon the user setting in Setpoint Page 8, Coast Down Time.
5	Amount of time remaining before a start command can be given
6	Excessive number of starts per hour

Figure 45: Metering Page 3—Status



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Metering Page 4

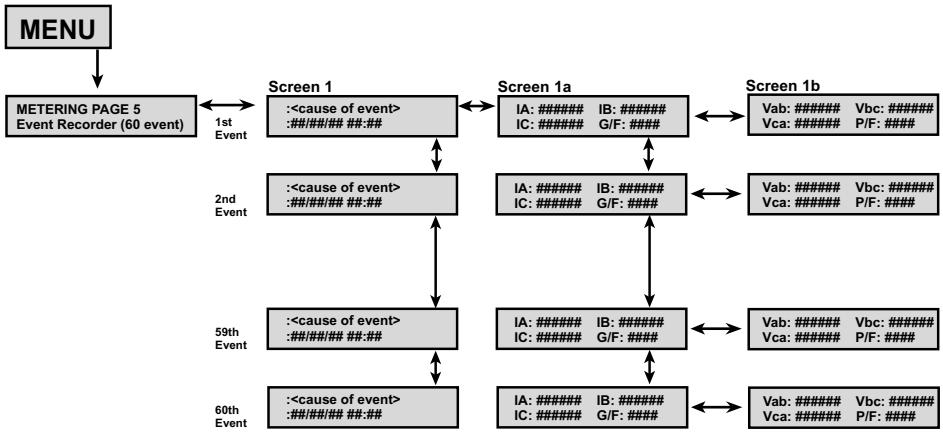
Events are listed from oldest to most recent.

Table 26: Metering Page 4—Event Recorder

Screen	Description [a]
1	Displays the event with date and time
1a	Displays Phase A, B, and C current values, Ground Fault (option) at time of trip
1b	Displays Vab, Vbc, Vca, and Power Factor at time of trip

a. Note: This recorder displays up to 60 events.

Figure 46: Metering Page 4—Event Recorder



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

Metering Page 5

Table 27: Metering Page 5—Last Trip

Screen	Description
1	Cause of last trip
2	Measured phase current
3	Measured voltage and power factor
4	Imbalance percentage, the frequency and the kW
5	Hottest stator RTD temperature
6	Hottest non-stator RTD temperature

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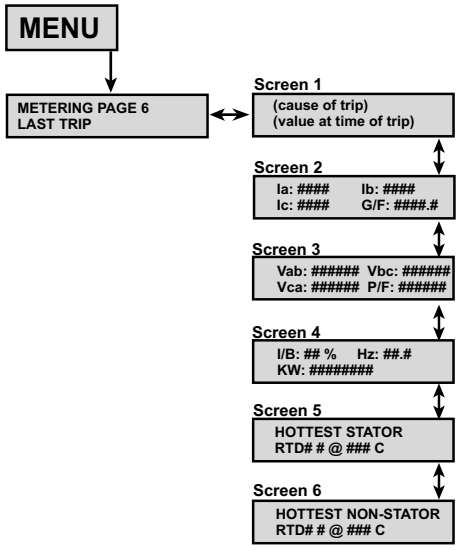
Figure 47: Metering Page 5—Last Trip



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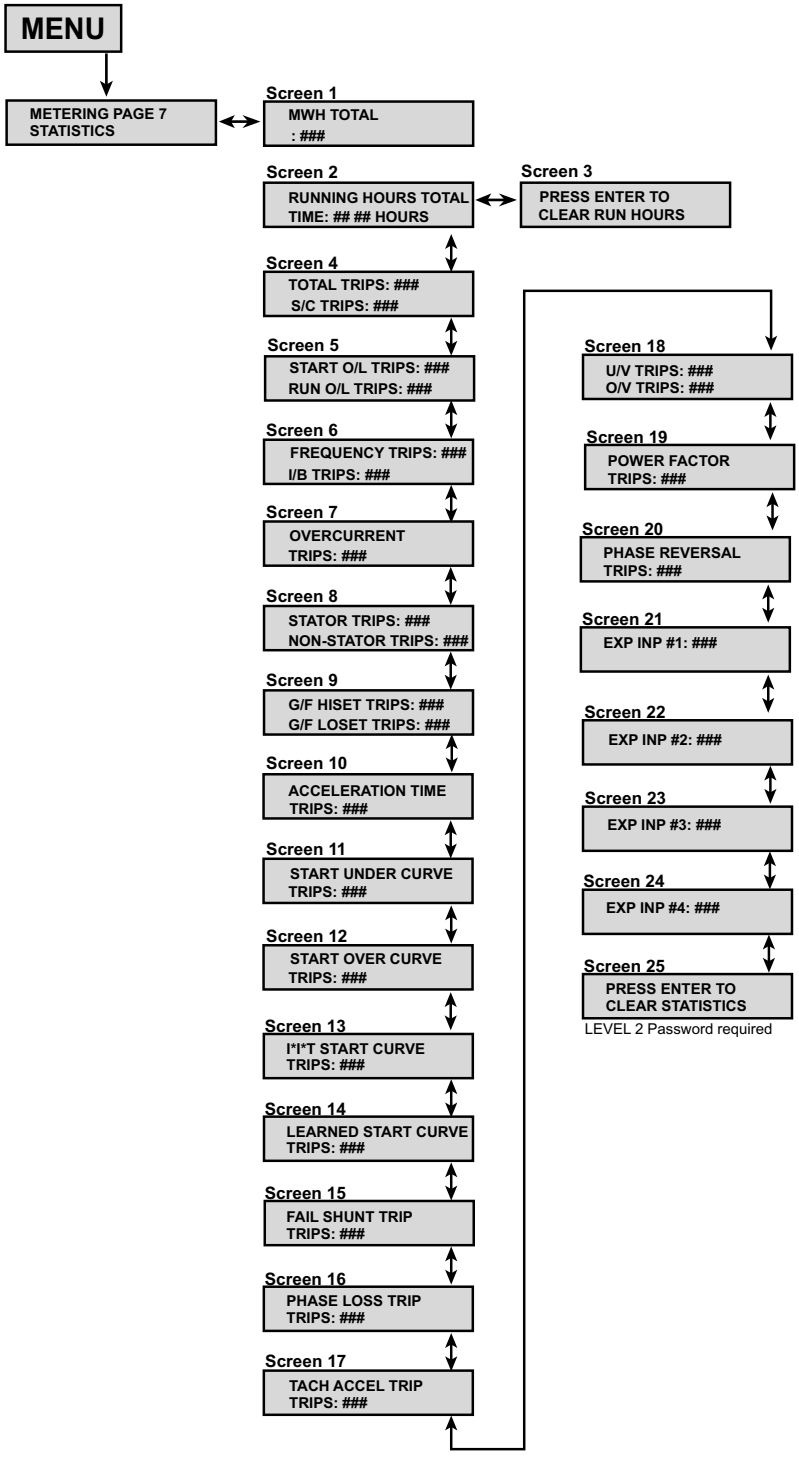
Metering Page 6

Table 28: Metering Page 6—Statistics

Screen	Description
1	Accumulated total running hours
2	Clear the total running hour count
3	Total number of trips
4	Number of start and run overload trips since the last statistical data clearing
5	Number of frequency trips and imbalance trips
6	Number of overcurrent trips
7	Number of stator and non-stator RTD trips
8	Number of ground fault Hi set and Lo set trips
9	Number of acceleration time trips
10	Number of start under curve trips
11	Number of start over curve trips
12	Number of I^2T start curve trips
13	Number of learned start curve trips
14	Number of fail shunt trips
15	Number of phase loss trips
16	Number of tachometer acceleration trips
17	Undervoltage and overvoltage trips
18	Power factor trips
19	Phase reversal trips
20	Number of external input #1 trips
21	Number of external input #2 trips
22	Number of external input #3 trips
23	Number of external input #4 trips
24	Press enter to clear statistics

Figure 48: Metering Page 6—Statistics

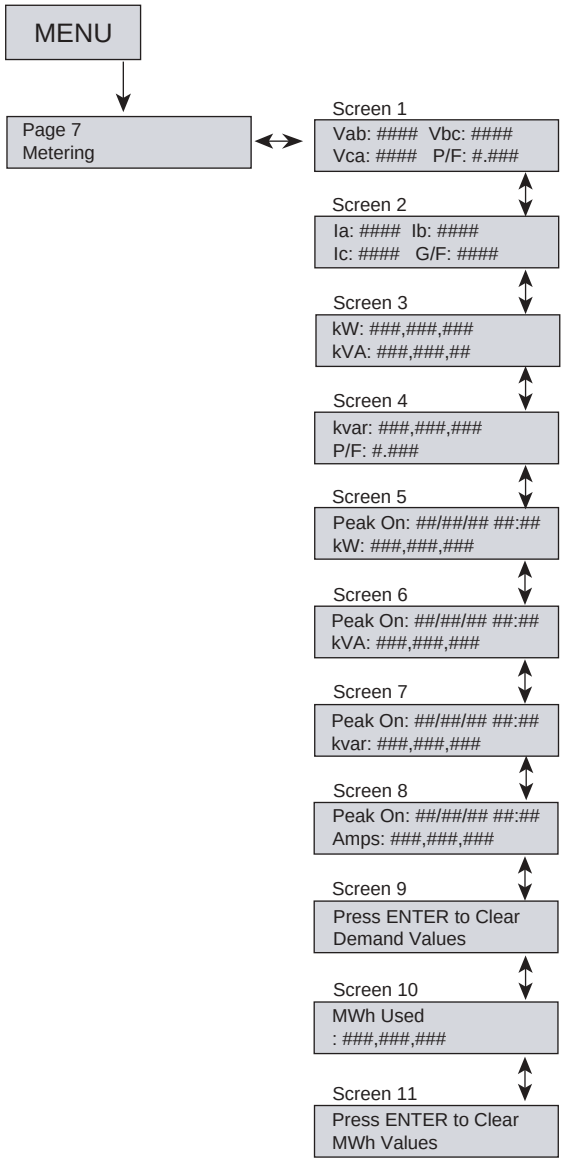


Metering Page 7

Table 29: Metering Page 7—Metering

Screen	Description
1	Displays phase A, B, and C power factor
2	Displays phase A, B, and C and ground fault current
3	Displays kilowatt (kW) and kilovolt-ampere (kVA)
4	Displays kilovar (kvar) and power factor
5	Displays peak On and kW demand
6	Displays peak On and kVA demand
7	Displays peak On and kvar demand
8	Displays peak On and Amps demand
9	Clears demand values
10	Displays megawatt hours (MWh) used
11	Press ENTER to clear statistics on MWh values

Figure 49: Metering Page 7—Metering



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SECTION 9— MAINTENANCE AND TROUBLESHOOTING

MAINTENANCE

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This equipment must be installed and serviced only by qualified electrical personnel.
- Qualified persons performing diagnostics or troubleshooting that require electrical conductors to be energized must comply with NFPA 70 E – Standard for Electrical Safety Requirements for Employee Workplace and OSHA Standards – 29 CFR Part 1910 Subpart S - Electrical.

Failure to follow these instructions will result in death or serious injury.

Periodically check the equipment for dirt, moisture, or industrial contaminants. These can cause high voltage arc-over, carbon tracking, or prevention of proper SCR heat sink cooling.

Annually, check all bolts for proper tightness, using an accurate torque wrench.

If the soft start is installed in a contaminated environment using forced air cooling, regularly check and clean blower filters to ensure that air flows properly and the enclosure is cooled properly.

Refer to the applicable contactor manual for contactor maintenance procedures and guidelines:

- bulletin # 46032-700-02 for 200/400/450 A Motorpact vacuum contactors

Refer to the NEMA Motorpact Medium Voltage Motor Controller bulletin, # 46032-700-06, for general equipment maintenance procedures.

TROUBLESHOOTING

For general equipment troubleshooting, refer to the appropriate Motorpact Medium Voltage Motor Controller bulletin:
46032-700-06 for NEMA enclosures

When the soft start experiences a problem, the LCD will display the error. The LED and auxiliary relays displayed will light. Table 30 on page 77 lists possible problems, associated displays, LEDs, and auxiliary relays, possible causes, and solutions to remedy the problem. Clear all problem displays before attempting to restart the soft start.

If the problem persists after making all required programming changes and taking all corrective action, contact the factory for assistance.

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Table 30: Soft Start Troubleshooting

Problem	CPU LCD Display	LED	Aux. Relay	Possible Cause	Solutions
• One of the main fuses blows • Circuit breaker opens when the power is applied or the disconnect is open	TCB Fault Trip	Trip	AUX1	Short circuit between the inputs	Locate and remove short.
				Problem with the SCRs	Remove power and test the SCR(s). See “SCR Testing” on page 79.
Short circuit trip	Short Circuit Trip	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	Make sure the branch circuit protection is correctly sized.
				Problem with the main circuit board	Remove power and replace the main circuit board.
				Problem with the SCRs	Remove power and test the SCR(s). See “SCR Testing” on page 79.
Single phase trip	Single Phase Trip (Check LCD display for possible fault indicators)	Trip	AUX1	Single phase incoming power	Correct the problem with incoming power.
				Problem with the SCRs	Remove power and test the SCR(s). See “SCR Testing” on page 79.
Thermostat trips during run	External Trip on Thermostat	Trip	AUX1	Fan(s) not functioning (if supplied)	If fans have power, disconnect power and replace the fan(s). If fans do not have power, find the cause of power loss and repair.
				Heatsink coated with dirt	Disconnect power and clean the 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 did not close	Check the bypass contactor and wiring.
Phase loss	Phase Loss	Trip	AUX1	Loss of one or more phases of power from utility or generated power	Check the power source.
				Blown power fuses	Check for short circuits.
Overload	Overload Trip	Trip	AUX1	Improper programming	Check motor nameplate versus programmed parameters.
				Possible load damage or jammed load	Check motor currents.
Stall prevention	Accel Time Trip	Trip	AUX1	Improper setting for motor load condition	Verify the current limit setting.
				Damaged load	Check the load.
Under voltage trip	Under Voltage Trip	Trip	AUX1	Improper programming	Check setpoint settings.
				Disconnected breaker in the wrong position	Check the disconnect or open breaker.
				Main contactor did not close	Check internal connections.
				Transformer is too small	Replace the current limit setting, saturation, or sagging power supply transformer.
Under current trip	Under Current Trip	Trip	AUX1	Improper programming or unloaded motor	Check setpoint settings.
					Check load.
Self-test failure	Self-Test Failure	Trip	AUX1	Main firing board or CPU not working properly	Contact the factory.
				Vibration	Check internal wiring connections.

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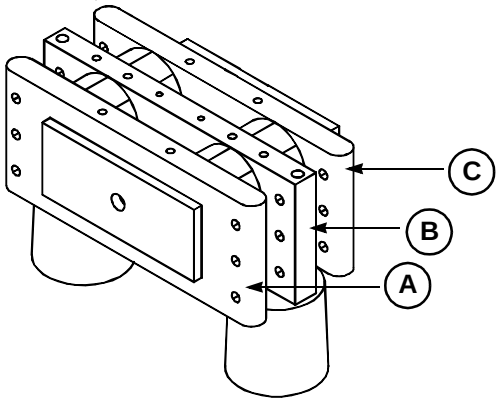
Table 30: Soft Start Troubleshooting *(continued)*

Problem	CPU LCD Display	LED	Aux. Relay	Possible Cause	Solutions
Line frequency trip	Over or Under Frequency Trip	Trip	AUX1	Generator power problem or grid change	Troubleshoot and repair generator.
					Contact the utilities company.
					Main board is not working properly.
					Three-phase power was removed from the main board.
Any ground fault trip	Ground Fault Hi-Set or Lo-Set	Trip	AUX1	Improper programming	Check program setpoints.
				Any wire going to ground (stator ground, motor ground, soft start ground)	Check wires with meggar or hi-pot motor leads and motor.
				High vibration or loose connections	Check internal connections.
Motor stopped during run	Check for fault indication	Trip	AUX1	**⚠ WARNING** **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH** Make sure the fault condition is cleared on the load before attempting to restart the motor. **Failure to follow this instruction will result in injury or equipment damage.**	
				Load is shorted, grounded, not working properly	Disconnect all sources of power and repair.
				Main circuit board is not working properly	Replace the main circuit board.
Control circuit fuses blow after control power is applied	—	—	—	Short in control circuit	Disconnect power and locate and remove the short.
				Wrong control voltage	Apply the correct voltage to the control circuit
Motor will not start	Any fault indication message	Trip	AUX1	No control voltage applied to control board	Apply control voltage to TB1 pins 1 and 6 on the power board.
				Control power transformer or CPT fuse not working properly	Disconnect power and replace the control power transformer or CPT fuse.
				Start circuit wired incorrectly	Disconnect power and correct the start circuit wiring.
				No start command	Apply the start command.
				No three-phase line voltage	Apply the three-phase line voltage to the unit.
				Shorted SCR in starter	Disconnect power and test SCR(s). See “SCR Testing” below.
				Control logic not working properly	Disconnect power and repair the control logic.
				Main circuit board not working properly	Replace the main circuit board.
Motor vibrates/motor growls while starting or extremely unbalanced motor currents run mode	Imbalance Trip Imbalance Alarm	Trip Alarm	AUX1 AUX2	Motor is not working properly	Check the motor and the motor connections.
				SCRs are not working properly	Disconnect power and test the SCR(s). See “SCR Testing” below.
				Gate/cathode on SCRs not working properly	Disconnect power and test the SCR(s). See “SCR Testing” below.
				Main circuit board not working properly	Replace the main circuit board.
				Wiring is incorrect or not functioning properly	Troubleshoot and repair or replace the wiring.

SCR Testing

Figure 50: SCR Positions



Perform the SCR Heat Sink Ohm test on each stack assembly.

Table 31: SCR Tests

Test	Ohm Meter Reading	Result
From position A to position B	Greater than 10 kΩ	Pass
	Less than 10 kΩ	Fail
From position B to position C	Greater than 10 kΩ	Pass
	Less than 10 kΩ	Fail
Gate to cathode for each SCR	10 to 100 Ω	Pass (typical 11 to 20 Ω)
	Less than 10 or greater than 100 Ω	Fail

Allow 15 minutes after shutdown for the DV/DT network to discharge DC voltage.

Low Voltage Troubleshooting

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- This equipment must be installed and serviced only by qualified electrical personnel.
- Qualified persons performing diagnostics or troubleshooting that require electrical conductors to be energized must comply with NFPA 70 E – Standard for Electrical Safety Requirements for Employee Workplace and OSHA Standards – 29 CFR Part 1910 Subpart S - Electrical.

Failure to follow these instructions will result in death or serious injury.

Tool needed: Ungrounded oscilloscope

1. Open the test switch and stop the motor.
2. Setpoint Page 5 AUX4 is set to non-fail safe. Change this setpoint to fail safe. See “Setpoint Page 5” on page 51.
3. Make sure that the bypass contactor closes immediately.
4. Place the oscilloscope on the 2 ms time scale and 1 V per division.
5. Connect the oscilloscope probe to the gate and cathode of the SCRs. The gate and cathode leads are the white wires on the soft start gate drive (GD) board in the medium voltage compartment.
6. If the waveform is inverted, swap the oscilloscope connections to achieve proper polarity. Close the temporary Start switch and allow the test motor to reach full speed.
7. Verify that all gating signals connect to each SCR (there are two gating signals on every GD board). See Figure 51 for an example of a correct waveform.
8. If any improper signals are found, note their location(s) and contact the factory.

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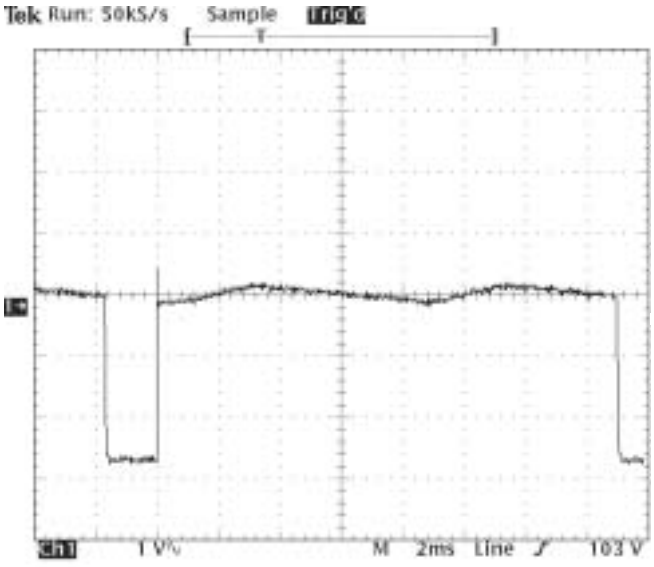
Figure 51: Correct Waveform



Correct Waveform

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SECTION 10—WIRING DIAGRAMS

Figure 52: Typical Block Diagram

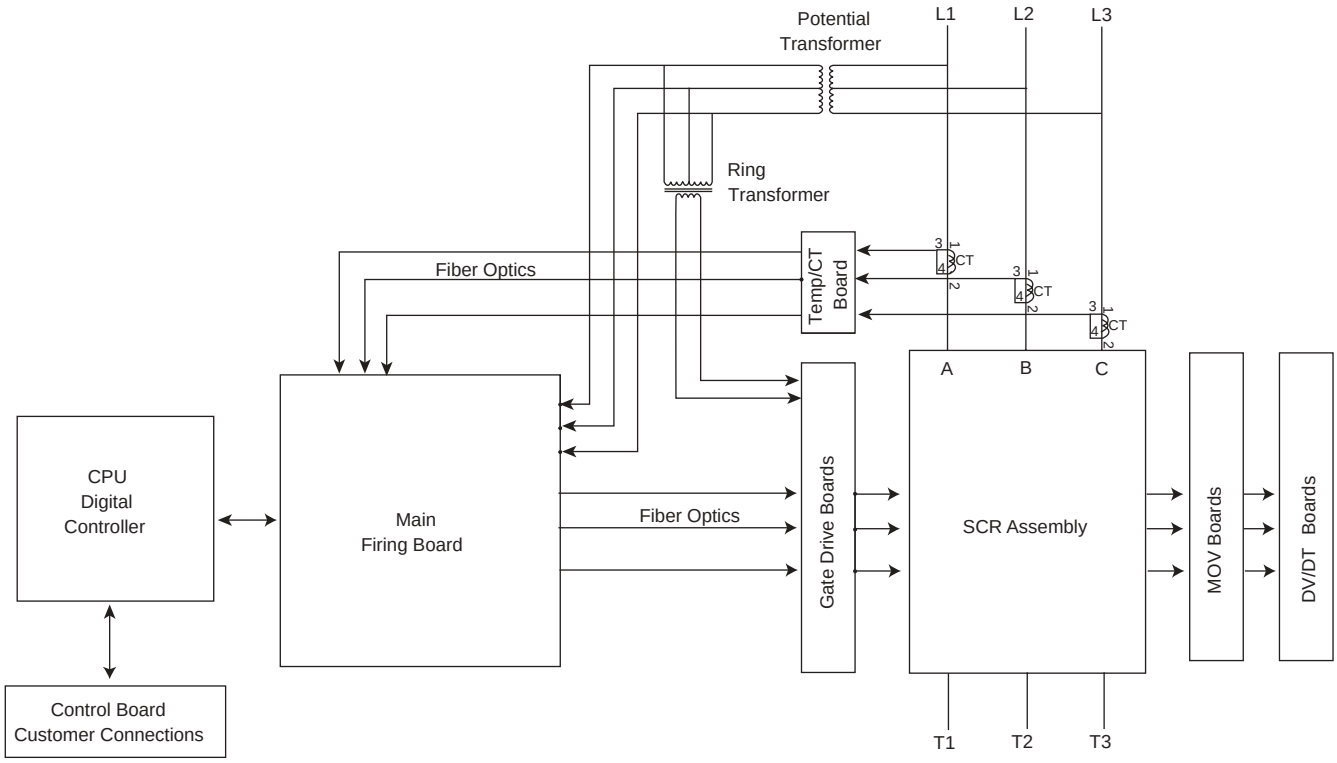

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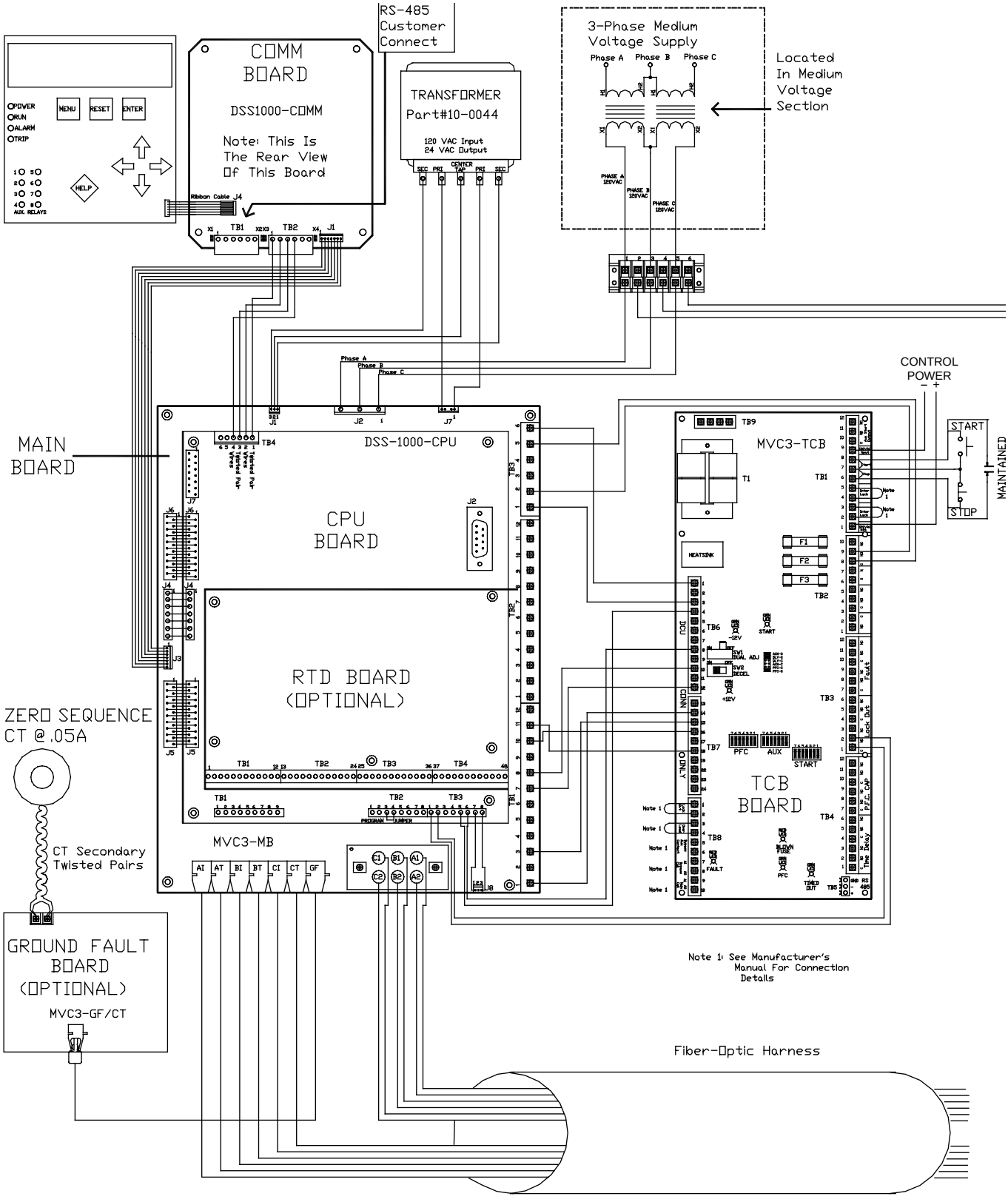
Figure 53: Typical Wiring Diagram for Models Rated 2300–6900 V



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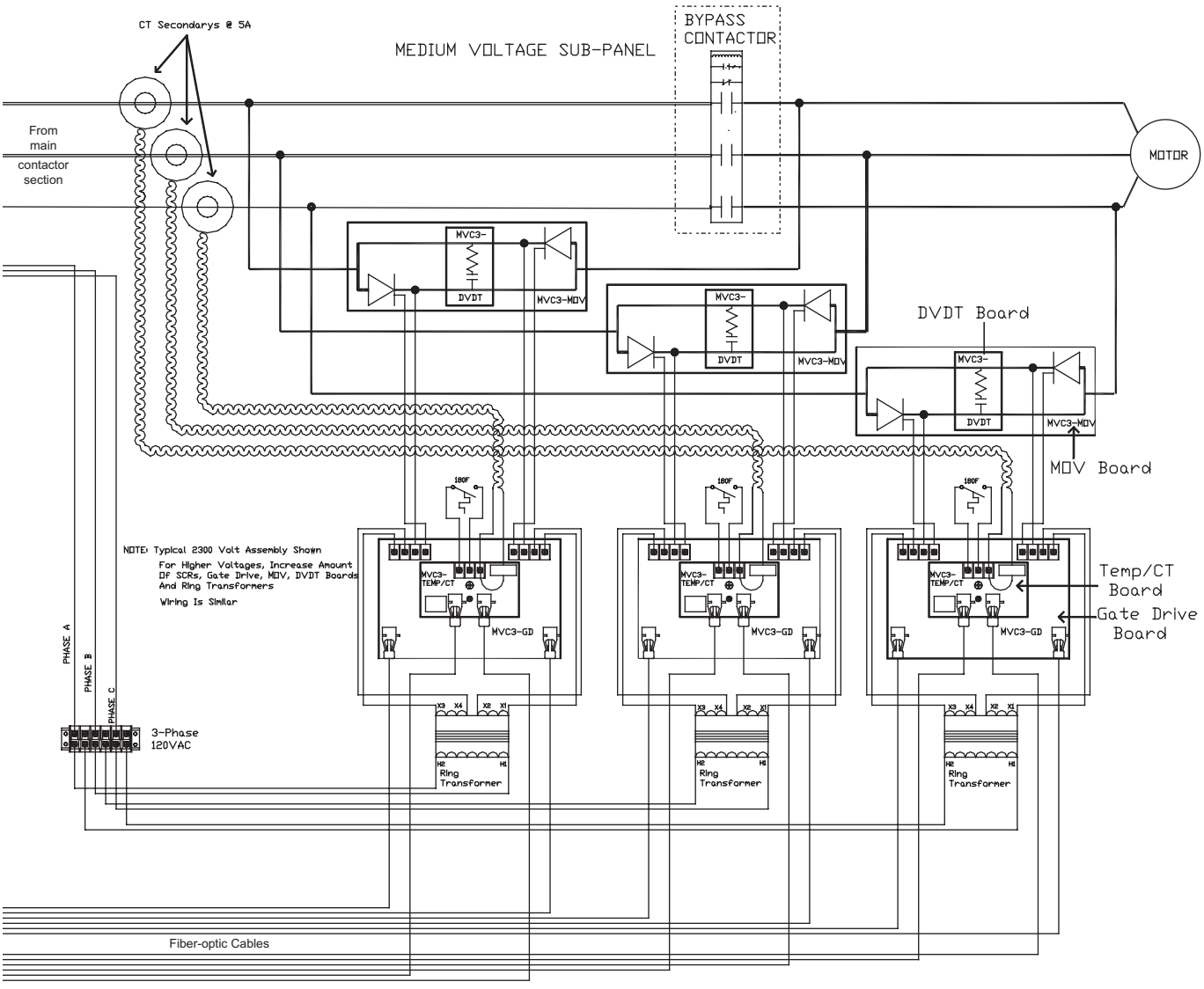

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SECTION 11—REPLACEMENT

REPLACEMENT PARTS

Table 32: Replacement Parts

Description	Part Number	Unit Voltage and Amp Rating	Quantity per Unit
Current transformer	Contact factory	Specify model number	3
Heatsink assembly with boards (one phase)	MVC3-STK23200	2300 V, 200 A	3
	MVC3-STK23400	2300 V, 400 A	
	MVC3-STK41200	3300/4160 V, 200 A	
	MVC3-STK41400	3300/4160 V, 400 A	
	MVC3-STK72200	6600/7200 V, 200 A	
	MVC3-STK72400	6600/7200 V, 400 A	
SCR(s) clamped in heat sink alone	25-0200-6500-23	2300 V, 200 A	3
	25-0400-6500-23	2300 V, 400 A	
	25-0200-6500-41	3300/4160 V, 200 A	
	25-0400-6500-41	3300/4160 V, 400 A	
	25-0200-6500-72	6600/7200 V, 200 A	
	25-0400-6500-72	6600/7200 V, 400 A	
Gate drive transformer	10-0090	2300 V, 200 and 400 A	3
		3300/4160 V, 200 and 400 A	6
		6600/7200 V, 200 and 400 A	9
Potential transformers	10-0068	2300 V	1
	10-0072-50	3300 V	2
	10-0067	4160 V	1
	10-0084	6600/7200 V	2
Control power transformers	10-0080	2300 V	1
	10-0072-50	3300 V	
	10-0083	4160 V	
	10-0084	6600/7200 V	
Current and temperature board	MVC3-Temp/CT-PS	All models	3
Gate drive boards	MVC3-GD	2300 V, 200 and 400 A	3
		3300/4160 V, 200 and 400 A	6
		6600/7200 V, 200 and 400 A	15
MOV board	MVC2-MOV	2300 V, 200 and 400 A	3
		3300/4160 V, 200 and 400 A	6
		6600/7200 V, 200 and 400 A	15
Dv/Dt board	MVC2-Dv/Dt	2300 V, 200 and 400 A	3
		3300/4160 V, 200 and 400 A	6
		6600/7200 V, 200 and 400 A	15
Main firing board	MVC3-MB-MTR	All models	1
Digital controller	MVC3-CPU-MTR	All models	1
Control board	MVC3-TCB	All models	1
Medium voltage fuses	Contact factory	FLA	Contact factory
Communications board	DSS1000-COM	All models	1
RTD board	DSS1000–RTD	Option	1
Ground fault board	MVC3–GFCT	Option	1
Ground fault CT	11–0029B	Option	1

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STACK REPLACEMENT

Refer to Figure 54 and the instructions on page 86 to replace stacks.

Figure 54: Stack Replacement

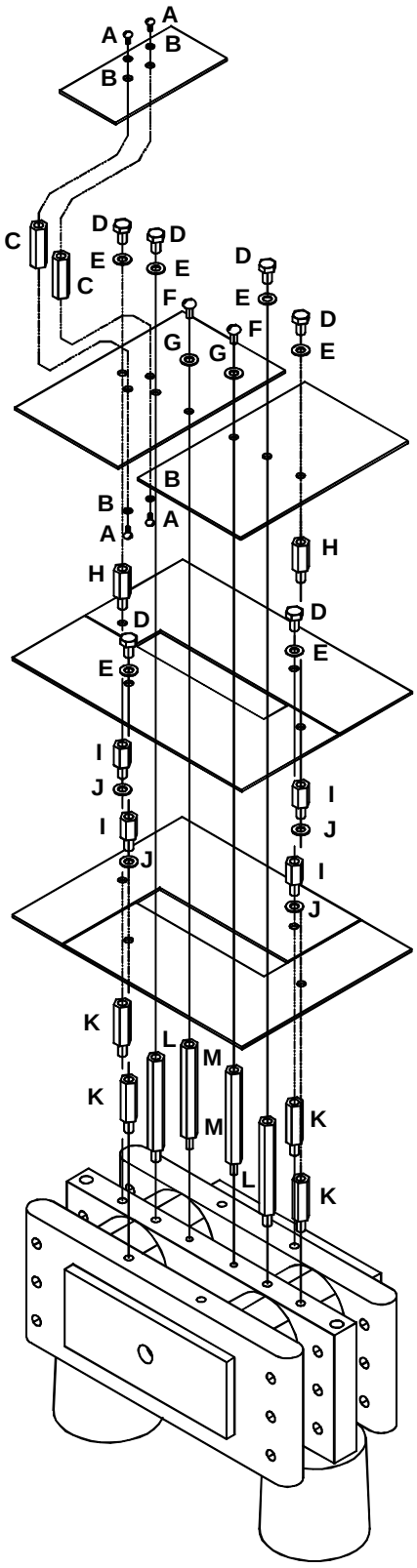

Table 33: Stack Replacement Parts

Item in Figure	Description
A	8–32 x 3/8 in. large screw
B	#8 flat washer
C	8–32 x 1.5 in. large standoff
D	1/4–20 x 3/8 in. large bolt
E	1/4 conical washer
F	10–32 x 3/8 in. large screw
G	#10 conical washer
H	1/4–20 x 1 in. large standoff
I	1/4–20 x 3/4 in. large standoff
J	Flat copper washer
K	1/4–20 x 1.5 in. large standoff
L	1/4–20 x 3.5 in. large standoff
M	10–32 x 3.5 in. large standoff

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Tools Needed

- Phillips screwdriver
- 3/8 in. 12-point socket set
- two (2) 9/16 in. wrenches
- 1/2 in. wrench
- AC/DC multimeter

Procedures

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel familiar with medium voltage equipment are to perform work described in this set of instructions.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- Turn off all power before working on or inside equipment.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death, serious injury, or equipment damage.

1. Using a properly rated voltage testing device, verify that no DC or AC voltage is present on any of the power components.
2. Disconnect all four wires connected to terminal block 1 (TB1) positions 1-3 on the temperature CT board.
3. Disconnect the 4 red transformer wires on each of the gate drive boards. These are TB1, positions 3 and 5 for each gate drive board. Typically, a 2300 V unit will have only four wires per phase to disconnect, a 4160 V unit will have eight wires per phase, a 6900 V unit will have twelve wires per phase, and a 13.8 kV unit will have 24 wires. A 6900 V/400 A unit will also have 24 wires.
4. Using a 9/16 in. wrench, carefully unbolt all of the line and load power connections attached to the heat sinks.

If the unit is a 6900 V or 13.8 kV, remove the power strap connecting one side of the stack to the stack directly below it.

5. Note the labels on the fiber optic wiring cables to ensure they will be replaced in the correct socket.
6. Remove all fiber optic connectors on the stack.
7. Gently push on the connector tab and pull with a gentle left-to-right motion on the connector in the direction away from the fiber optic device. There are two connectors per gate drive board, and one duplex connector on the small Temp/CT board on top.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

Do not touch the tip of the connectors or contaminate the connection sockets with any dust or foreign material.

Failure to follow this instruction can result in equipment damage.

8. Remove the wires from the Temp/CT board terminal block (3 screws).
9. Using a 9/16 in.socket with a 6 in. extension, remove the lower bolt that routes through the front face of the heat sink and into the isolation standoff mounted to the white panel.
10. Carefully hold the heat sink in place with one hand and remove the top bolt from the heat sink.
11. Ensure the fiber optic connectors and all wires are positioned out of the way.
12. Remove the heat sink from the unit.

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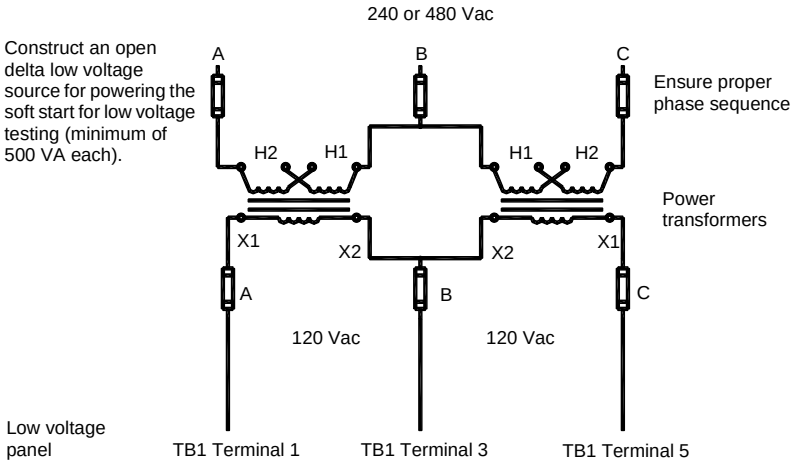
LOW VOLTAGE TESTING

Refer to Figure 55 and the instructions beginning on this page to perform a low voltage test.

Figure 55: Connecting to the Main Firing Board



Tools Needed

- Phillips screwdriver
- Appropriate personal protective equipment for removing fuses
- Two control power transformers (test CPTs), 500 VA min.
- 120 Vac control power (test plug)
- Low voltage motor strapped for the proper voltage (typically 5 hp or less)
- Oscilloscope if available
- Wire jumper
- Test switch (single pole)

Procedures

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel familiar with medium voltage equipment are to perform work described in this set of instructions.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- Turn off all power before working on or inside equipment.
- Use a properly rated voltage sensing device to confirm that the power is off.
- Before performing visual inspections, tests, or maintenance on the equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Replace all devices, doors, and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

1. Using a properly rated voltage testing device, verify that no DC or AC voltage is present on any of the power components.
2. Verify that CPTs are set up for the proper voltage. If using 240 or 480 Vac three-phase, verify that the transformers are strapped for that voltage. Configure as an open delta for three-phase as shown in Figure 55 on page 87.
3. Verify that the medium voltage isolation means is open and remove the medium voltage fuses. For fuse removal procedures, refer to the appropriate Motorpact Medium Voltage Motor Controllers instruction bulletin: # 46032-700-06 for NEMA enclosures.
4. Connect 240 or 480 Vac three-phase power to the downstream side of the fuses. *Do not* connect to the isolation means side of the fuses. The small test motor used will determine the required size cable or current.
5. Connect the primaries of the test CPT in the proper phase sequence of A-B-C.
6. Disconnect the medium voltage motor.
7. Connect the low voltage motor (typically 5 hp or less).
8. Connect a wire jumper between TB8 pins 1 and 2 on the soft start's terminal control board (TCB) located in the medium voltage compartment to bypass the disconnect and blown fuse indicators.
9. Install a (test) switch on TB1 pins 1 and 8 on the soft start TCB to bypass all interlocks, such as stop-start signals.
10. Verify or wire a 120 Vac plug to the test plug supplied by the factory (line start packages only).
11. Remove both control power fuses on the medium voltage CPT.
12. Remove all three fuses from the medium voltage potential transformer (PT).
13. Verify that the 120 V test switch is in the "NORMAL" position (line start package only).
14. Connect test power to the test plug connector and place the 120 V test switch in the "TEST" position.
15. The keypad should be energized with the "Power LED," Stop LED.
16. Close the temporary Start switch, which is connected to the control board.
17. The main vacuum contactor should close and the keypad should trip on "Under Voltage." Open the temporary test switch and reset the CPU fault.
18. Connect the secondary of the test PT to panel TB1 on the main firing board as follows (see Figure 55 on page 87):
    - — position 1 - phase A
    - — position 3 - phase B
    - — position 5 - phase C

    The main firing board is located behind the low voltage compartment door.
19. Verify that all connections are good. Energize the low voltage of either 240 or 480 V, three phases.
20. Use the multimeter on the AC scale and verify three-phase 120 Vac (phase to phase) at TB1 pins 1, 3, and 5 on the main firing board.
21. If all 120 Vac three-phase is present, de-energize the low voltage of 240 or 480 Vac.
22. Re-energize the low voltage of 240 or 480 Vac.

23. All test voltages should be 240 or 480 Vac, three-phase 120 Vac (test PT), and 120 Vac single phase for control power.
24. Close the temporary Start switch and the test motor should start smoothly.
25. Use the multimeter on the AC scale and check (phase to phase) voltages on T1, T2, and T3 motor leads. The voltages should be balanced.
26. If the motor does not start smoothly, the soft starter is not functioning properly. See “Low Voltage Troubleshooting” on page 79.
27. If the motor starts and runs smoothly, repeat the steps of this procedure in reverse to restore the starter to operating condition.

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SECTION 12—COMMISSIONING

INSTALLATION DATA SHEET

Figure 56: Installation Data Sheet

Startup Date:	Model #:	Serial # :

Owner (End user)		
Company Name :		
Address:		State: Zip Code:
Contact:	Phone:	Fax:
Purchased from (Distributor) :		

Motor Information				
Type of Motor: ☐ Standard Induction ☐ Synchronous ☐ Wound Rotor			Serial # _____	
MOTOR NAMEPLATE DATA			If synchronous motor:	If wound rotor motor:
HP:	SF:	Mfgr:	☐Brush ☐Brushless	Secondary Volts:
VOLTAGE:	LRA:		Field Amps:	Secondary Amps:
FLA:	NEMA Design:		Field Discharge Resistor (ohms):	Secondary Resistance (ohms):
RPM:	Frame:			
FREQ:	KVA Code:		Other Info:	

Application Information		
Type of driven load:		
Mfgr. of driven equipment:	Model #:	Serial #:

Power System			
☐Utility Power	Transformer Rating:_____ kVA	☐Generator Power	Generator Rating:_____ kW
Power cable run from source to starter:_____ FT. (approx)		Power cable run from starter to motor: _____ FT. (approx)	
☐ Power Factor / Surge Capacitors moved to line side of solid state starter or removed. **DANGER:** Equipment may be damaged or personal injury may result if equipment is started with power factor capacitors or surge capacitors connected on the load side of solid state motor controls.			

Startup Procedures (See Chapters 2 & 3 of the manual)		
☐ Visual Unit Inspection	☐ Acceptable Location	☐ Proper Connections (Power & Control)
☐ Startup procedures followed	☐ Proper Adjustments Made	☐ Successful Start / Ramp / Run
Name of person completing this report:		Signature:

Warranty Status (For Motortronics' office use only)	
Date Shipped:	Comments:
Commissioning/ Start-up performed by (Name):	
Company:	Signature:
Expiration Date:	Approved by:

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COMMISSIONING SETTINGS

Model #: _____

Serial #: _____

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 1—Basic Configuration	Level 1—No Password Required	Motor full load amps	Model dependent	50–100% of unit max. current (model and service factor dependent)	
		Service factor	1.15	1.00–1.3	
		Overload class	10	5–30 overload class	
		NEMA design	B	A–F	
		Insulation class	B	A, B, C, E, F, H, K, N, S	
		Line voltage	4160	100 to 7200 V	
		Line frequency	60	50 or 60 Hz	

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 2—Starter Configuration	Level 1—No Password Required	Start control mode	Start ramp 1	Jog, Start, Ramp 1, Start Ramp 2, Tach Ramp, Custom Accel Curve, Start Disabled, Dual Ramp	
		Jog voltage	50%	5–75%, Off	
		Start ramp #1 type	Voltage	Current, Voltage, Off	
		Initial voltage #1	20%	0–100%	
		Ramp time #1	10 s	0–120 s	
		Current limit #1	350% FLA	200–600%	
		Initial current #1	200% FLA	0–300%	
		Ramp time #1	10 s	0–120 s	
		Maximum current #1	350% FLA	200–600%	
		Start ramp #2 type	Disabled	Current, Voltage, Off	
		Initial voltage #2	60%	0–100%	
		Ramp time #2	10 s	0–120 s	
		Current limit #2	350% FLA	200–600%	
		Initial current #2	200% FLA	0–600%	
		Ramp time #2	10 s	0–120 s	
		Maximum current #2	350% FLA	200–600%	
		Kick start type	Disabled	Voltage or Off	
		Kick start voltage	65%	10–100%	
		Kick start time	0.50 s	0.10–2.00	
		Deceleration time	Disabled	Enabled or Disabled	
		Start deceleration voltage	60%	0–100%	
		Stop deceleration voltage	30%	0–59%	
		Deceleration time	5 s	1–60 s	
		Timed output time	Off	1–1000, Off	
		Run delay time	1 s	1–30, Off	
		At speed delay time	1 s		

ENGLISH

Model #: _____

Serial #: _____

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Level 3—Phase and Ground Settings	Level 2—Password Protection	Imbalance alarm level	15% FLA	5–30%, Off	
		Imbalance alarm delay	1.5 s	1.0–20.0 s	
		Imbalance trip level	20%	5–30%, Off	
		Imbalance trip delay	2.0 s	1.0–20.0 s	
		Undercurrent alarm level	Off	10–90%, Off	
		Undercurrent alarm delay	2.0 s	1.0–60.0 s	
		Overcurrent alarm level	Off	100–300%, Off	
		Overcurrent alarm delay	2.0 s	1.0–20.0 s	
		Overcurrent trip level	Off	100–300%, Off	
		Overcurrent trip delay	2.0 s	1.0–20.0 s	
		Phase loss trip	Disabled	Enabled or Disabled	
		Phase loss trip delay	0.1 s	0–20.0 s	
		Phase rotation detection	Enabled	Enabled only	
		Phase rotation	ABC	ABC	
		Ground fault alarm level	Off	5–90%, Off	
		Ground fault alarm delay	0.1 s	0.1–20.0 s	
		Ground fault lo set trip level	Off	5–90%, Off	
		Ground fault lo set trip delay	0.5 s	0.1–20.0 s	
		Ground fault hi set trip level	Off	5–90%, Off	
		Ground fault hi set trip delay	0.008 s	0.008–0.250 s	
		Overvoltage alarm level	Off	5–30%, Off	
		Overvoltage alarm delay	1.0 s	1.0–30.0 s	
		Overvoltage trip level	Off	5–30%, Off	
		Overvoltage trip delay	2.0 s	1.0–30.0 s	
		Undervoltage alarm level	Off	5–30%, Off	
		Undervoltage alarm delay	1.0 s	1.0–30.0 s	
		Undervoltage trip level	Off	5–30%, Off	
		Undervoltage trip delay	2.0 s	1.0–30.0 s	
		Line frequency trip window	Disabled	0–6 Hz, Disabled	
		Line frequency trip delay	1.0 s	1.0–20.0 s	
		P/F lead P/F alarm	Off	0.1–1.0, Off	
		P/F lead alarm delay	1.0 s	1.0–120 s	
		P/F lead P/F trip	Off	.01–1.00, Off	
		P/F lead trip delay	1.0 s	1.0–120 s	
		P/F lag P/F alarm	Off	.01–1.00, Off	
		P/F lag alarm delay	1.0 s	1.0–120 s	
		P/F lag P/F trip	Off	.01–1.00, Off	
		P/F lag trip delay	1.0 s	1.0–120 s	
		Power demand period	10 min.	1.0–60.00 min.	
		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	

ENGLISH

Model #: _____

Serial #: _____

Setpoint Page	Security Level	Description	Factory Setting			Range[1]	Setting
			1st	2nd	3rd		
Page 4—Relay Assignments	Level 2—Password Protection	O/L trip	Trip only	None	None	None Trip (AUX1) Alarm (AUX2) AUX3 AUX4 AUX5–8 Only available in 8 relay system.	
		I/B trip	Trip	None	None		
		S/C trip	Trip only	None	None		
		Overcurrent trip	Trip	None	None		
		Stator RTD trip		None	None		
		Bearing RTD trip		None	None		
		Ground fault hi set trip[2]		None	None		
		Ground fault lo set trip[2]		None	None		
		Phase loss trip		None	None		
		Acceleration time trip	Trip only	None	None		
		Start curve trip		None	None		
		Over frequency trip	Trip	None	None		
		Under frequency trip		None	None		
		I*I*T start curve		None	None		
		Learned start curve		None	None		
		Phase reversal		None	None		
		Overvoltage trip		None	None		
		Undervoltage trip		None	None		
		Power factor trip		None	None		
		Tach Acceleration trip	None	None	None		
		Inhibits trip	Trip	None	None		
		TCB fault	Trip	None	None		
		External input #2	None	None	None		
		Dual ramp	None	None	None		
		Thermostat	Trip	None	None		
		Overload warning	Alarm	None	None		
		Overcurrent Alarm		None	None		
		SCR fail shunt alarm	None	None	None		
		Ground fault alarm[2]	Alarm	None	None		
		Undercurrent 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		
		Undervoltage alarm		None	None		
		Overvoltage alarm		None	None		
		Power factor alarm	None	None	None		
		KW demand alarm		None	None		
		KVA demand alarm		None	None		
		KVAR demand alarm		None	None		
		Amps demand alarm		None	None		
		Timed output		None	None		
		Run delay time		None	None		
		At speed	AUX4	None	None		

[1] AUX1 to AUX4 are for factory use only. Do not change. Only AUX5–AUX8 are used in the 2nd and 3rd relay assignments.
[2] Ground fault option must be installed.

ENGLISH

Model #: _____

Serial #: _____

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 5—Relay Configuration	Level 2—Password Protection	Trip (AUX1) fail-safe	No	Yes or No	
		Trip (AUX1) relay latched	Yes		
		Alarm (AUX2) fail-safe	No		
		Alarm (AUX2) relay latched			
		AUX3 relay fail-safe			
		AUX3 relay latched			
		AUX4 relay fail-safe			
		AUX4 relay latched			
		AUX5 relay fail-safe			
		AUX5 relay latched			
		AUX6 relay fail-safe			
		AUX6 relay latched			
		AUX7 relay fail-safe			
		AUX7 relay latched			
		AUX8 relay fail-safe			
		AUX8 relay latched			

ENGLISH

Model #: _____

Serial #: _____

Setpoint Range	Security Level	Description	Factory Setting Default	Range	Setting
Page 6—User I/O Configuration	Level 2—Password Protection	Tachometer scale selection	Disabled	Enabled or Disabled	
		Manual tachometer scale 4.0 mA:	0 RPM	0–3600	
		Manual tachometer scale 20.0 mA:	2000 RPM	0–3600	
		Tachometer acceleration trip mode select	Disabled	Underspeed, Overspeed, or Disabled	
		Tachometer ramp time	20 s	1–120	
		Tachometer underspeed trip PT	1650 RPM	0–3600	
		Tachometer overspeed trip PT	1850 RPM	0–3600	
		Tachometer acceleration trip delay	1 s	1–60	
		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%	
		Analog output #1 4 mA:	0	0–65535	
		Analog output #1 20 mA:	250		
		Analog output #2	% motor load	Same as analog input #1	
		Analog output #2 4 mA:	0	0–1000%	
		Analog output #2 20 mA:	1000	0–1000%	
		User programmable external inputs			
		TCB fault	Enabled	Enabled or Disabled	
		Name external input #1	TCB fault	User defined, up to 15 characters	
		TCB fault type	NO	Normally open or normally closed	
		TCB fault time delay	1 s	0–60 s	
		External input#2	Disabled	Enabled or Disabled	
		Name external input #2		User defined, up to 15 characters	
		External input #2 type	NO	Normally open or normally closed	
		External input #2 time delay	0 s	0–60 s	
		Second ramp	Dual ramp	Enabled or Disabled or Dual Ramp	
		Name external input #3	Second ramp	User defined, up to 15 characters	
		Second ramp type	NO	Normally open or normally closed	
		Second ramp time delay	0 s	0–60 s	
		Thermostat	Enabled	Enabled or Disabled	
		Name external input #4	Thermostat	User defined, up to 15 characters	
		Thermostat type	NC	Normally open or normally closed	
		Thermostat time delay	1 s	0–60 s	

ENGLISH

Model #: _____

Serial #: _____

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 7—Custom Acceleration Curve	Level 3—Password Protection	Custom acceleration curve	Disabled	Disabled, Curve A, B, or C	
		Custom Curve A			
		Curve A voltage level 1	25%	0–100%	
		Curve A ramp time 1	2 s	1–60 s	
		Curve A voltage level 2	30%	0–100%	
		Curve A ramp time 2	2 s	1–60 s	
		Curve A voltage level 3	37%	0–100%	
		Curve A ramp time 3	2 s	1–60 s	
		Curve A voltage level 4	45%	0–100%	
		Curve A ramp time 4	2 s	1–60 s	
		Curve A voltage level 5	55%	0–100%	
		Curve A ramp time 5	2 s	1–60 s	
		Curve A voltage level 6	67%	0–100%	
		Curve A ramp time 6	2 s	1–60 s	
		Curve A voltage level 7	82%	0–100%	
		Curve A ramp time 7	2 s	1–60 s	
		Curve A voltage level 8	100%	0–100%	
		Curve A ramp time 8	2 s	1–60 s	
		Curve A current limit	350% FLA	200–600%	
		Custom Curve B	Same programmable data points and ranges as custom curve A		
		Custom Curve C			

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 8—Overload Curve Configuration	Level 3—Password Protection	**Basic Run Overload Curve**			
		Run curve locked rotor time	Overload class	1–30 s, overload class	
		Run locked rotor current	600% FLA	400–800%	
		Coast down timer	Disabled	1–60 min., Disabled	
		Basic Start Overload Curve			
		Start curve locked rotor time	Overload class	1–30 s, overload class	
		Start locked rotor current	600% FLA	400–800%	
		Acceleration time limit	30 s	1–300 s, Disabled	
		Number of starts per hour	Disabled	1–6, Disabled	
		Time between starts time	Disabled	1–60 min., Disabled	
		Area under curve protection	Disabled	Enabled or Disabled	
		Max I*I*T start	368 FLA	1–2500 FLA*FLA*s	
		Curve over curve	Disabled	Disabled, Learn, Enabled	
		Learned start curve bias	10%	5–40%	
		Time for sampling	30 s	1–300 s	

ENGLISH

Model #: _____

Serial #: _____

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 9—RTD Configuration	Level 3—Password Protection	Use NEMA temp. for RTD values	Disabled	Enabled or Disabled	
		# of RTD used for stator	4	0–6	
		RTD volting	Disabled	Enabled or Disabled	
		Stator phase A1 type	Off	120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #1 description	Stator A1	User defined, up to 15 characters	
		Stator phase A1 alarm level	Off	0–240 °C (32–464 °F), Off	
		Stator phase A1 trip level			
		Stator phase A2 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #2 description	Stator A2	User defined, up to 15 characters	
		Stator phase A2 alarm	Off	0–240 °C (32–464 °F), Off	
		Stator phase A2 trip level			
		Stator phase B1 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #3 description	Stator B1	User defined, up to 15 characters	
		Stator phase B1 alarm level	Off	0–240 °C (32–464 °F), Off	
		Stator phase B1 trip level			
		Stator phase B2 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #4 description	Stator B2	User defined, up to 15 characters	
		Stator phase B2 alarm level	Off	0–240 °C (32–464 °F), Off	
		Stator phase B2 trip level			
		Stator phase C1 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #5 description	Stator C1	User defined, up to 15 characters	
		Stator phase C1 alarm level	Off	0–240 °C (32–464 °F), Off	
		Stator phase C1 trip level			
		Stator phase C2 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #6 description	Stator C2	User defined, up to 15 characters	
		Stator phase C2 alarm level	Off	0–240 °C (32–464 °F), Off	
		Stator phase C2 trip level			
		End bearing type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #7 description	End bearing	User defined, up to 15 characters	
		End bearing alarm level	Off	0–240 °C (32–464 °F), Off	
		End bearing trip level			
		Shaft bearing type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #8 description	Shaft bearing	User defined, up to 15 characters	

Continued on next page

ENGLISH

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 9—RTD Configuration	Level 3—Password Protection	Shaft bearing alarm level	Off	0–240 °C (32–464 °F), Off	
		Shaft bearing trip level			
		RTD #9 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #9 description	User defined	User defined, up to 15 characters	
		RTD #9 alarm level	Off	0–240 °C (32–464 °F), Off	
		RTD #9 trip level			
		RTD #10 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #10 description	User defined	User defined, up to 15 characters	
		RTD #10 alarm level	Off	0–240 °C (32–464 °F), Off	
		RTD #10 trip level		0–240 °C (32–464 °F), Off	
		RTD #11 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #11 description	User defined	User defined, up to 15 characters	
		RTD #11 alarm level	Off	0–240 °C (32–464 °F), Off	
		RTD #11 trip level			
		RTD #12 type		120 Ohm Ni, 100 Ohm Ni, 100 Ohm Pt, 10 Ohm Cu	
		RTD #12 description	User defined	User defined, up to 15 characters	
		RTD #12 alarm level	Off	0–240°C (32–464°F), Off	
		RTD #12 trip level			

Setpoint Range	Security Level	Description	Factory Setting Default	Range	Setting
Page 10—Set Password	Level 3—Password Protection	Set Level 2 password	100	000–999 three digits	
		Set Level 3 password	1000	0000–9999 four digits	

Setpoint Range	Security Level	Description	Factory Setting Default	Range	Setting
Page 11—Communications	Level 3—Password Protection	Set front baud rate	9.6 Kb/s	2.4, 4.8, 9.6, 19.2, 38.4 Kb/s	
		Set Modbus baud rate			
		Modbus address number	247	1–247	
		Set access code	1	1–999	
		Set link baud rate	38.4 Kb/s	2.4, 4.8, 9.6, 19.2, 38.4 Kb/s	
		Remote start/stop	Disabled	Enabled or Disabled	

ENGLISH

Model #: _____

Serial #: _____

	Security Level	Description	Factory Setting Default	Range	Setting
Page 12—System Setpoints	Level 3—Password Protection	**Default display screen**			
		Metering data page #	1	Enter metering page (1–3)	
		Metering data screen #	1	Enter metering screen Page 1 (1–10) Page 2 (1–29) Page 3 (1–6)	
		Alarms			
		RTD failure alarm	Disabled	Enabled or Disabled	
		Thermal register alarm	90%	40–95%	
		Thermal alarm delay	10 s	1–20 s	
		Thermal register setup information			
		Cold stall time	Overload class	Overload class, 4–40 s	
		Hot stall time	1/2 overload class	1/2 overload class, 4–40 s	
		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 temperature	40 °C	10–90 °C	
		Motor design run temperature	80% max.	50–100% of motor stator max. temp.	
		Motor stator max. temperature	INS CLS	INS CLS, 10–240 °C	
		I/B input to thermal register	Enabled	Enabled only	
		Use calculated K or assign	7	1–50, On	
		Press ENTER to Clr thermal register	—	—	

Setpoint Page	Security Level	Description	Factory Setting Default	Range	Setting
Page 13—Calibration and Service	Factory Use Only	Set date and time	Factory set: ##/##/## ##:##	—	
		Enter date (DDMMYYYY)	Factory set: ##########	D=1–31, M=1–12, Y=1970–2069	
		Enter time (HH:MM)	Factory set: ##:##	H=00–23, M=00–59	
		Model # Firmware Rev. #	Factory set: ###### ##### #	Display only; cannot be changed	
		Press ENTER to access factory settings	—	Available to qualified factory personnel	

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