Motorpact™ IEC Soft Start

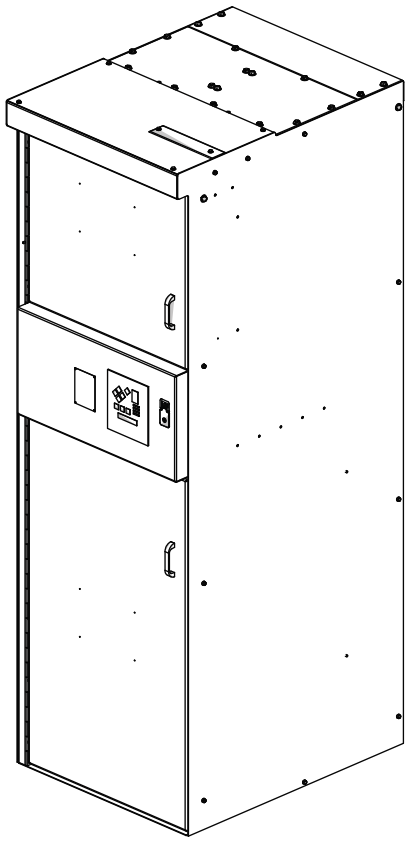
Quick Start Guide

Class 8198

Instruction Bulletin

46032-700-20A

Retain for future use.



Schneider Electric

Introduction

Tools needed

- Phillips screwdriver
- Medium voltage fuse pullers
- Two control power transformers (Test PT) 500 VA minimum
- 120 Vac control power (test plug)
- Oscilloscope
- Wire jumper
- Test switch (single pole, i.e., light switch)
- Dielectric withstand (hi-pot) tester
- Volt-ohm meter
- Low voltage phase rotation meter
- Instruction bulletins 46032-700-10_ (Motorpact™ Soft Start), 46032-700-02_ (Motorpact 200/400/450 A Vacuum Contactors), and either 46032-700-08_ (Motorpact Medium Voltage Motor Controllers) or 46032-700-18 (Motorpact RVSS Standalone Section)

Preliminary start-up checklist

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- 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.

Before performing the start-up procedure, read this instruction bulletin in its entirety.

NOTICE

Be aware of the danger of static discharge when using electronic components. To avoid static discharge, use proper personal grounding equipment such as a grounding wrist strap (see Figure 1).

Failure to follow this instruction can result in equipment damage.

Figure 1: Grounding wrist strap

Customer requirements (prior to FSR arrival)

Prior to a field service representative (FSR) arriving on site, ensure that the following requirements have been met to reduce start-up time and the cost of additional trips by the FSR:

- ❏ Report any shipping damage that may affect the operation of the unit.
- ❏ Provide 120 Vac power for test equipment.
- ❏ Perform dielectric withstand (hi-pot) testing of the line and load cables **prior** to connecting to the Motorpact soft start controller. Testing must be performed by qualified personnel.
- ❏ Complete installation of the Motorpact™ switchgear. This includes proper grounding and anchoring of the enclosure.
- ❏ Remove all capacitive devices from the load side of the soft start, including motor capacitors and power factor correction devices. Connecting these devices to the line side of the incoming power is an acceptable practice and will not cause damage to the unit or prevent operation.
- ❏ Connect the motor and make it available for inspection.
- ❏ During commissioning, the unit will initially be operated with only control power and later with utility power. Power will not be applied until all mechanical checks have been performed and safety interlocks verified.

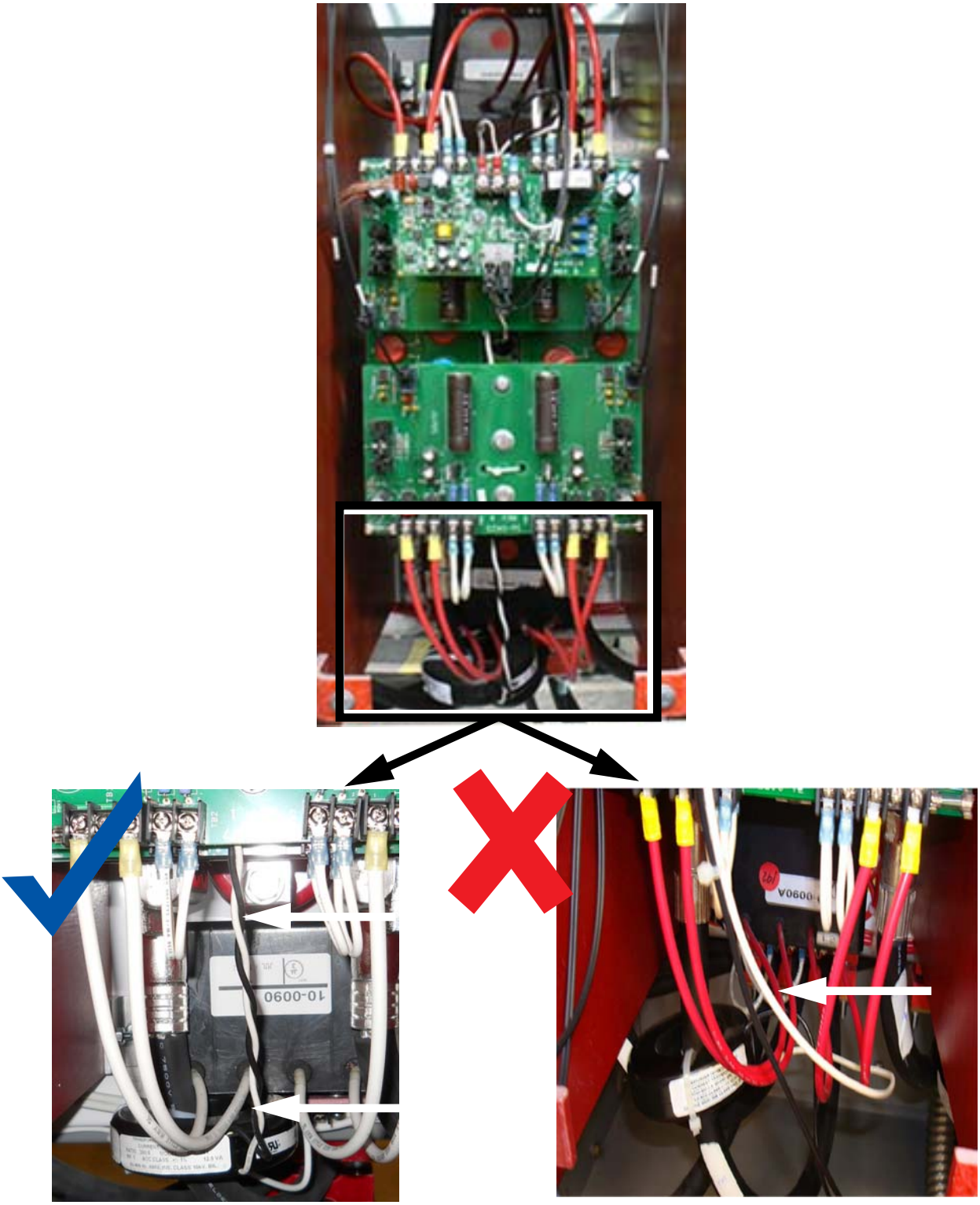
FSR requirements (upon arrival)

Before applying power to the Motorpact soft start, perform the following checks on the equipment:

Power cable CT wiring

	Yes	No
Are CT wires twisted?		
Is black wire exiting top of CT?		

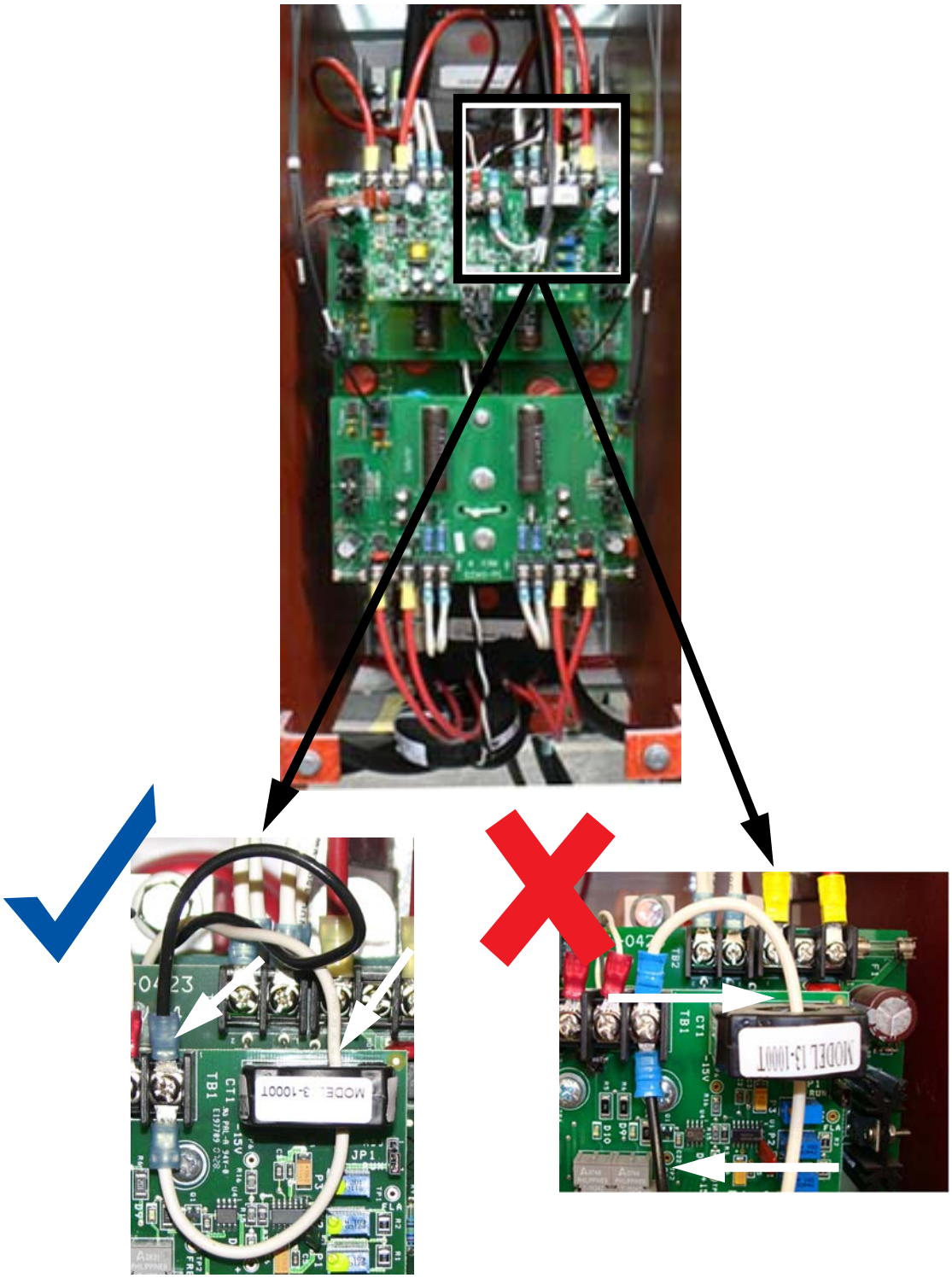
Figure 2: Correct wiring for power cable CT



Power cable CT polarity

	Yes	No
Is power cable CT (white wire) passing through board CT from top to bottom?		

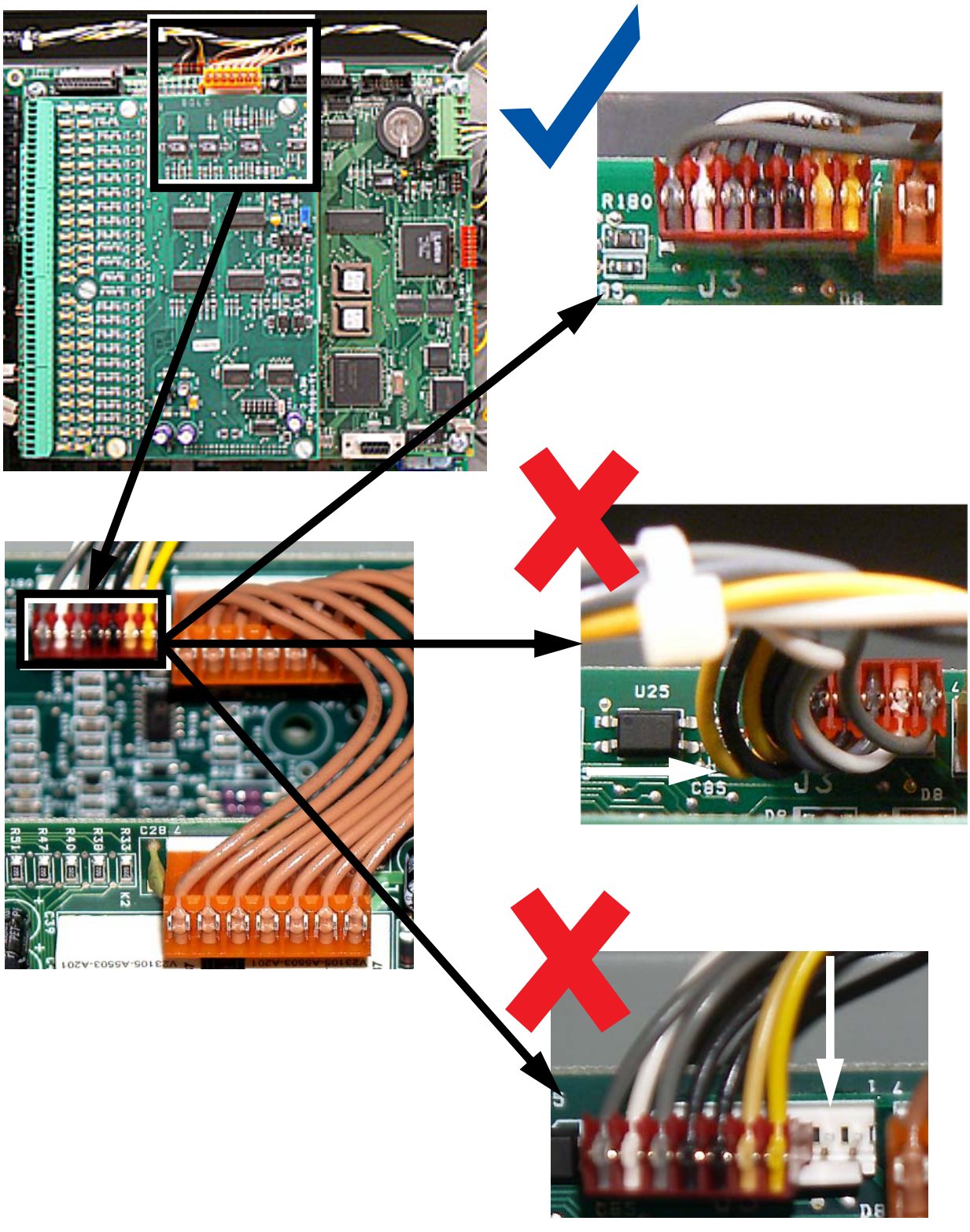
Figure 3: Correct wiring for power cable CT polarity



Communication board J3 connection

	Yes	No
Is J3 connector (red plug) connected with wires pointing outward?		
Is J3 connector properly aligned?		

Figure 4: Correct wiring for communication board JP3 connector

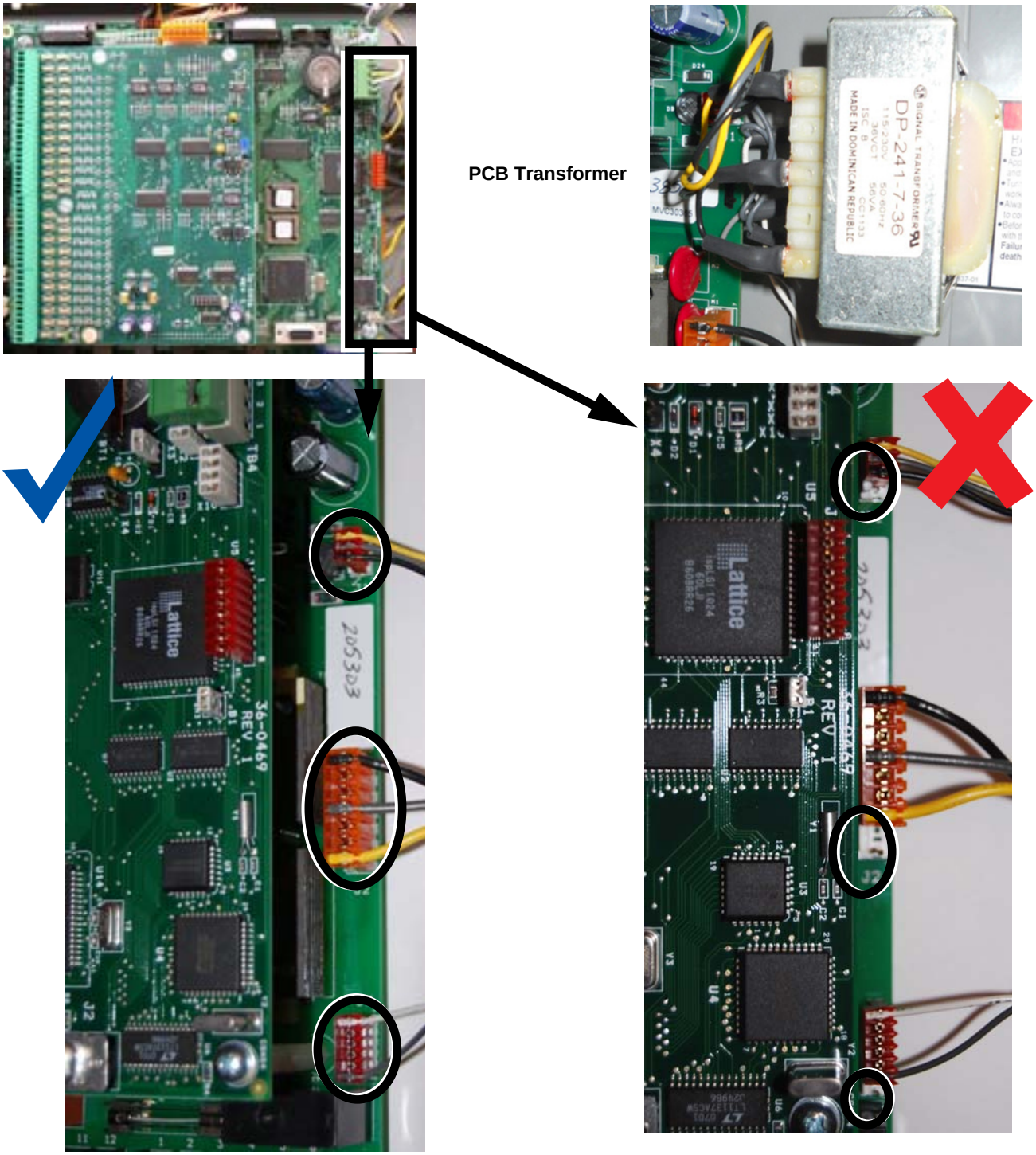


Transformer and transformer block connections J1-J2-J7

Connections shown are for MVC3 units. Newer MVC4 units do not have the separate PCB transformer that connects to J1 and J7. The MVC model number is listed on the serial number decal located on the thyristor (SCR) stack mounting pan.

	Yes	No
Is J1 connector in correct location?		
Are all pins aligned for J1 connection?		
Is J2 connector in correct location?		
Are all pins aligned for J2 connection?		
Is J7 connector in correct location?		
Are all pins aligned for J7 connection?		

Figure 5: Correct wiring for transformer and transformer block connections J1-J2-J7

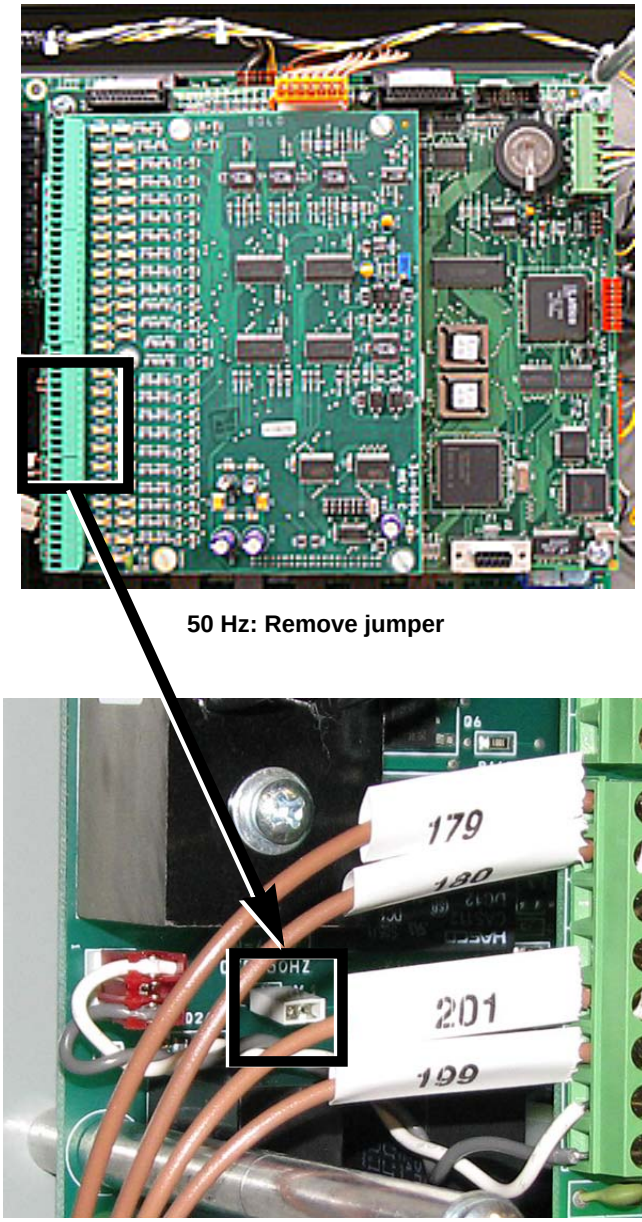


50 Hz / 60 Hz jumper

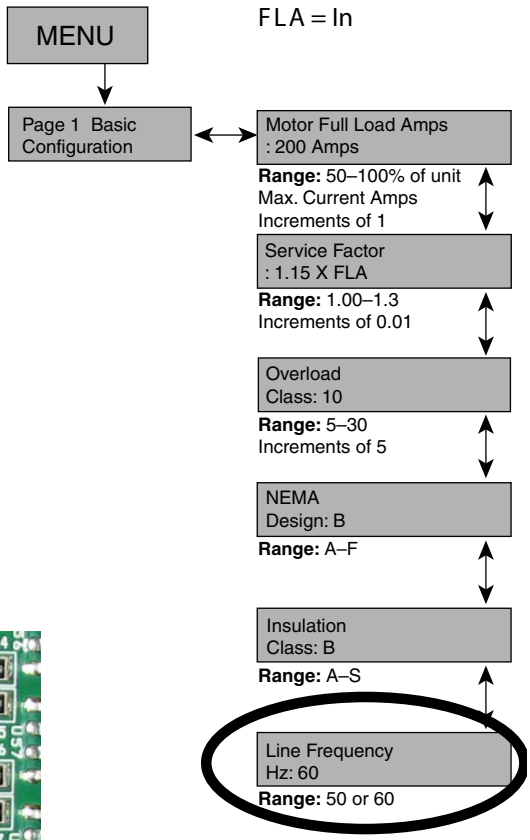
Because the Motorpact controller is manufactured in different geographical locations, the board can be pre-configured to either 50 Hz or 60 Hz operation. Check the configuration and modify the jumper position and software configuration as required for the local supply frequency (see “Setpoint Page 1–Basic Configuration” in Figure 6 below).

	Yes	No
Is jumper installed because operating with 60 Hz?		
Is jumper removed for 50 Hz operation?		
Is line frequency on Setpoint Page 1 changed to 50 Hz?		

Figure 6: Jumper installation



Setpoint Page 1–Basic Configuration



Fiber optic cable

The fiber optic cable must be secured to the glastic barriers and bus tunnel and have a smooth radius (no sharp bends). The cable must not be cut, kinked, pinched, or touch hot surfaces (such as resistors or heat sinks).

	Yes	No
Is cable secured to bus tunnel?		
Is cable secured to glastic barriers?		
Is cable cut, kinked, or pinched?		
Is cable touching resistor or heat sink?		

Figure 7: Fiber optic installation

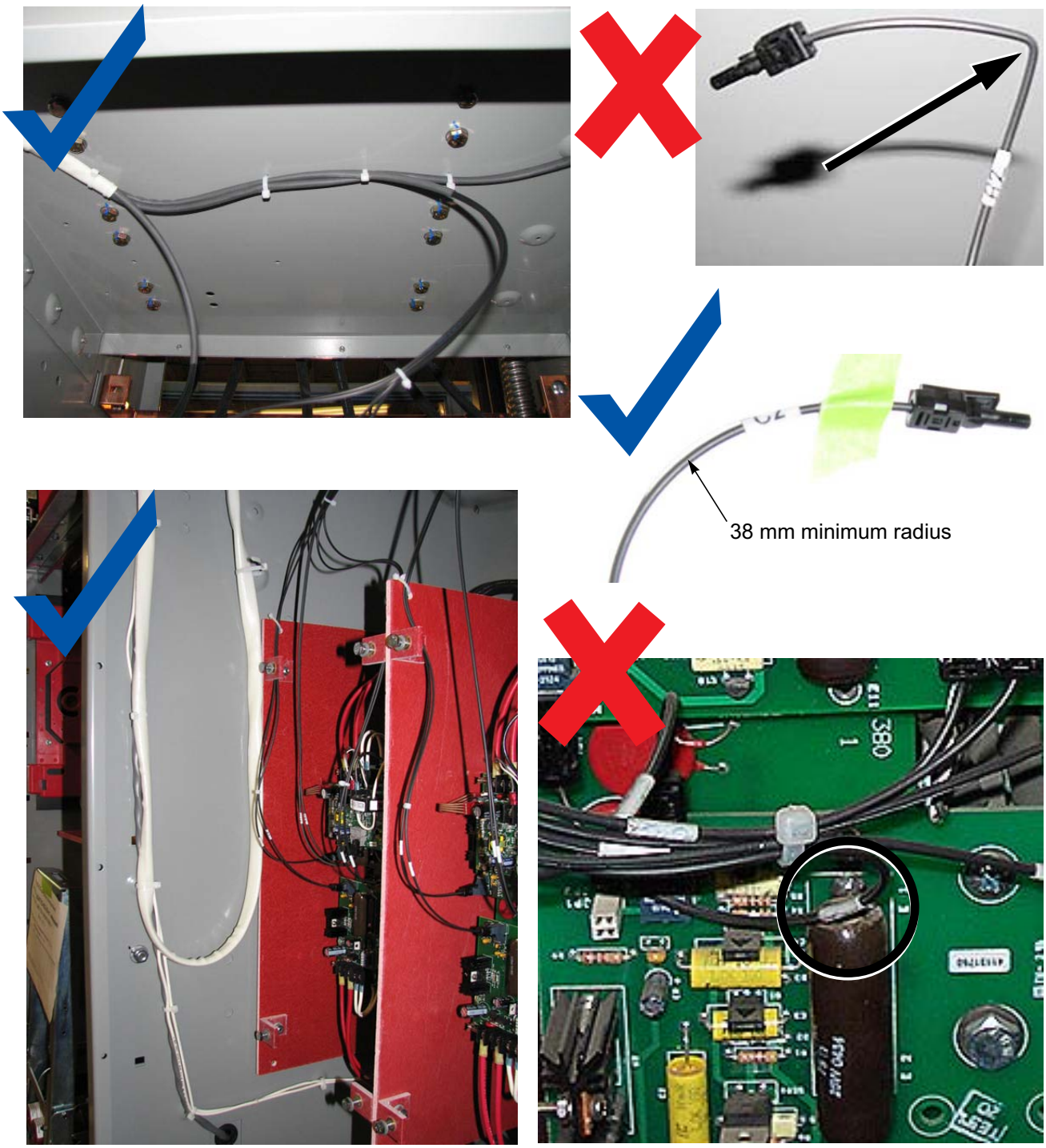


Figure 8: Gate-cathode jumper wires

Figure 9: Thyristor (SCR) jumper wires

- ❑ Make sure that qualified personnel have conducted a dielectric withstand (hi-pot) test on the line and load cables before connecting the cables to the soft start (typically 1.5 x rated voltage).

Refer to section “Dielectric withstand (hi-pot) testing” in document no. 46032-700-08_ or 46032-700-18.

NOTICE

POSSIBLE OVERVOLTAGE ON ELECTRONIC COMPONENTS

Dielectric withstand (hi-pot) testing is conducted on the new soft start section at the factory. For a new soft start section, dielectric withstand (hi-pot) testing in the field is only necessary if repairs such as replacing a thyristor (SCR) stack or similar activities occurred. If dielectric withstand (hi-pot) testing is necessary, it should only performed by qualified, trained field service personnel.

Failure to follow this instruction can result in equipment damage.

- ❑ When doing dielectric withstand (hi-pot) testing of the soft start section:
  - — Remove all medium voltage power fuses and VT fuses.
  - — Place a jumper wire from the gate to the cathode on the gate drive board (where the two white wires connect). See Figure 8.
  - — Place a jumper across each thyristor (SCR). See Figure 9.
  - — Place a jumper across the ring transformer primaries and jumper to ground. See Figure 10.
  - — Place a jumper across the VT inputs and jumper to ground. See Figure 11.
  - — Close the bypass contactor.
  - — After completing dielectric withstand testing make sure to remove all jumpers.

Figure 10: Ring transformer primaries to ground

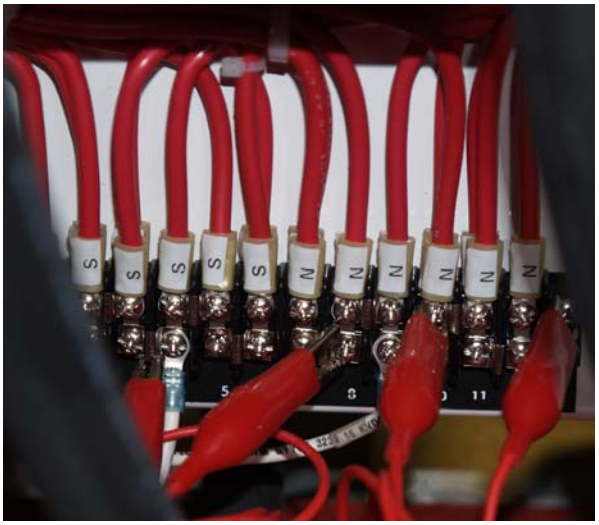
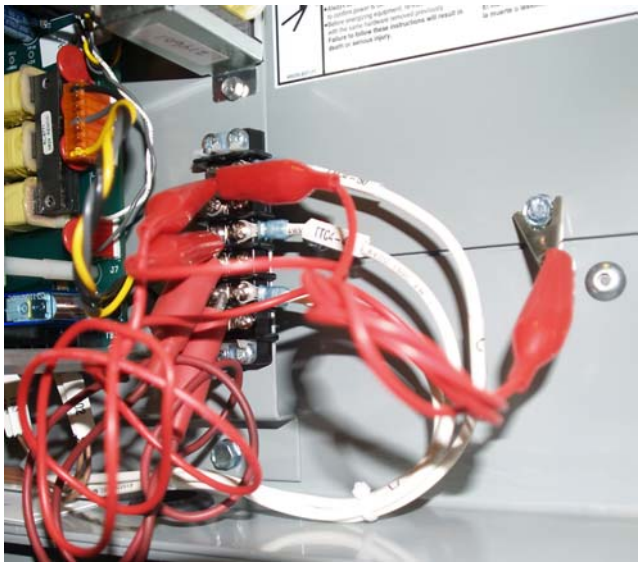


Figure 11: VT input to ground jumper



- ❏ Document all device ratings such as motor and feeder transformer nameplates.
- ❏ Ensure the proper phase rotation of line and load cabling.
- ❏ Check the motor strapping and connections.
- ❏ Ensure that no capacitors are connected to the load side of the soft start. Be sure to check in the motor connection box.
- ❏ Verify that the feeder transformer is correctly sized for the motor(s).
- ❏ Inspect the unit for damage, proper grounding, and anchoring.
- ❏ Verify that all wiring is complete and all connections are tight.
- ❏ Verify that the interlocks for the system are installed and working properly.
- ❏ Clean and test vacuum contactors. Perform contact resistance and insulation resistance for each contactor. Perform vacuum integrity test on each vacuum bottle per manufacturer's instructions and in accordance with ANSI standards.

Rated Maximum Voltage	Field Test Voltage	
	AC	DC
4.76 kV	14 kV	20 kV
7.2 kV	27 kV	38 kV

- ❏ Check the continuity of all power fuses and control power fuses.
- ❏ Inspect all phase barriers to ensure proper installation and clearance of energized components to ground.
- ❏ Inspect fiber optic cable and connections for correct seating (see Figure 12), bend radius (38 mm min.), and damage.
- ❏ Remove the covers to the inter-cubicle wiring; ensure that any inter-cubicle wiring has been correctly reattached.
- ❏ Check for loose mechanical parts or debris in the enclosure.
- ❏ Remove the tie straps from the blown fuse indicator (if provided).
- ❏ Ensure that the current transformer primary ampere rating is between 50% and 125% of motor full load amperes.
- ❏ Perform checks on thyristors, as called silicon controlled rectifiers (SCRs). Refer to the section "thyristor (SCR) heat sink ohm test" on page 19.
- ❏ Ensure JP1 on the TCB board is either jumped for separate protection in bypass mode or stored on one pin for integral protection in bypass mode.
- ❏ To verify the control logic, connect the appropriate control voltage. A test power inlet may be provided in the LV compartment for this function; if fitted, this allows for testing without applying the medium voltage to the panel. The "Run" or "Stop" LED will light up.
- ❏ When initially applying voltage to the soft start, press the reset button. (An error message may appear when applying voltage. Pressing the reset button will clear the error message.)
- ❏ The soft start may allow you to get only program settings when exiting a selection (by going to the menu) rather than saving the setting (by pressing "Enter"). To reset your ability to access all items, turn the power off for at least 15 seconds.

Figure 12: Fiber Optic Connections

- ❑ Review all parameters and adjust if required. Refer to document no. 46032-700-10_, “Programming” for detailed instructions. Enter motor nameplate information, coordination study settings, and any additional parameters provided by the customer.

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

- ❑ Enter the maximum number of starts for the motor into parameters. **The customer or motor manufacturer must provide this information**.
- ❑ Verify that initial starting settings have been changed to match the application. Initial starting settings programmed at the factory are for motors with minimal loads. Some typical application starting adjustment settings are listed in Table 4 on page 19.
- ❑ Remove control power and energize unit with utility power.
- ❑ Confirm “Phase Rotation Detection at Setpoint Page 3” is “Enabled” and in ABC (123) rotation.
- ❑ Ensure that the relay assignment on “Setpoint Page 4 for Phase Reversal Trip” is set for “Trip (Aux 1).”
- ❑ Verify controller status (motor stopped, ready to start), by pressing the “Enter” button on the keypad while the system is displaying a Setpoint or Metering title page.
- ❑ Check the phase rotation using a low voltage phase rotation meter at the appropriate terminals.
- ❑ Check initial settings and adjustments to achieve a successful start. Refer to the section “Acceleration adjustments” on page 14.
- ❑ Do a minimum of three successful starts with motor at full starting load before leaving the site.

Acceleration adjustments

The unit is set at the factory with typical starting characteristics that perform well in applications with minimal starting loads. For best results, program the initial starting settings to match the application. If, however, you try the factory settings and the motor does not start to turn as soon as desired, raise the starting voltage adjustment. If the motor does not come up to speed, increase the current limit setting by 25 percentage points. For adjustment description and procedures, see Figure 13 and Table 1. If the motor starts too easily, decrease the current limit setting by 25 percentage points at a time (for the best economy). Refer to “Starting adjustments” on page 19 for more details.

Adjustments

Figure 13: Acceleration

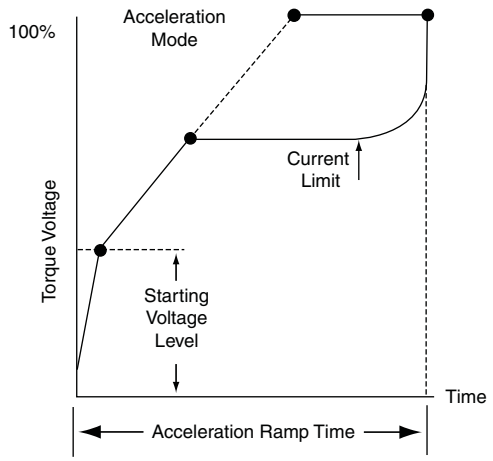


Table 1: Acceleration Adjustments

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.*
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.

* Refer to the motor manual for the maximum number of starts the manufacturer allows. Do not exceed this number.

NOTE: The three adjustable values are interdependent.

NOTICE

PERCENTAGE TOO LOW ON CURRENT LIMIT

Do not adjust current limit percentage too low for motors with 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 a 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 2).

The Motorpact™ soft start is shipped from the factory with the deceleration 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.

NOTICE

POSSIBLE OVERHEATING OF MOTOR OR STARTER

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

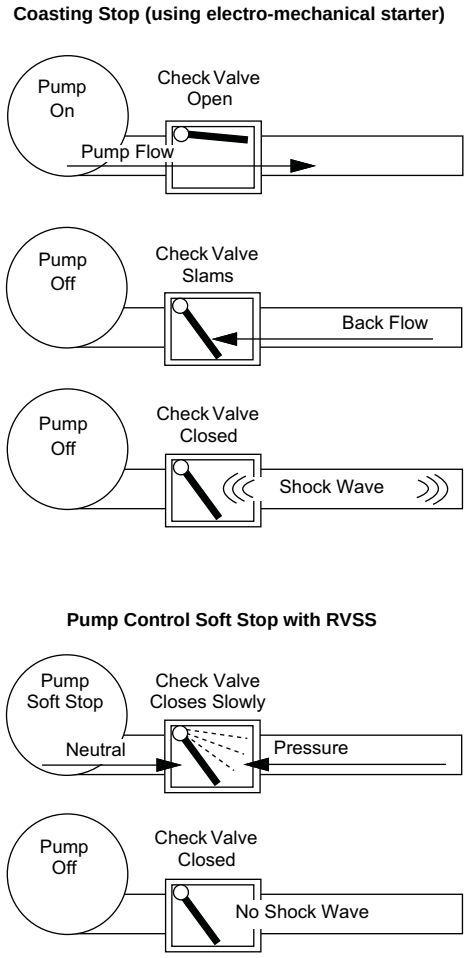
Failure to follow this instruction can result in equipment damage.

Table 2: 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	200–600% of unit FLA	The stop voltage level setpoint is where the deceleration voltage drops to zero.
Ramp deceleration time	5 seconds	0–120 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.

Applications

Figure 14: Coasting Stop and Pump Control



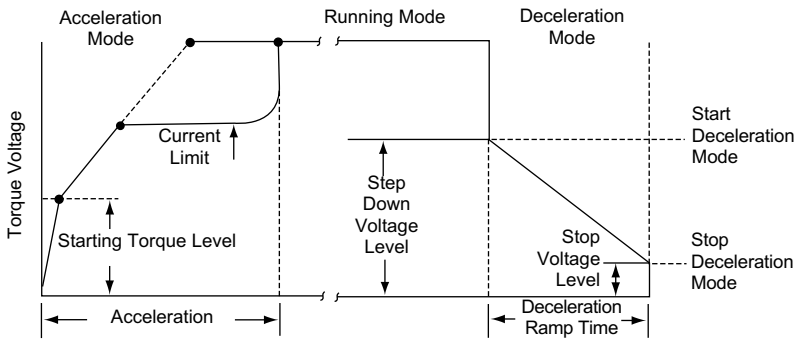
The primary use of deceleration is to reduce the sudden changes in pressure that are associated with “water hammer” and slamming of check valves with centrifugal pumps (see descriptions below). Deceleration control in pump applications is often referred to as “pump control.”

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 to dissipate through (see Figure 14). 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 deceleration cycle and turn itself off.

Another common application for deceleration 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.

Figure 15: Deceleration



Operation

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

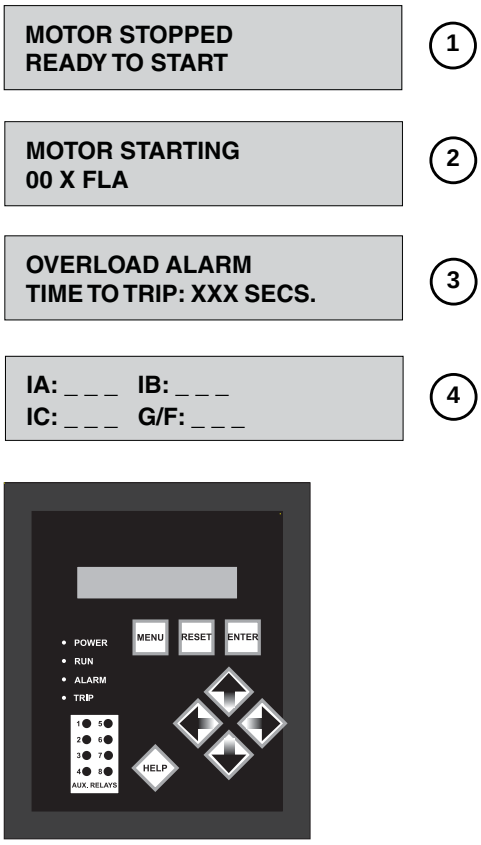
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- 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. Apply control power and make sure the POWER LED comes on and the display indicates READY TO START (Figure 16, 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 16, display 2).
   - — The RUN LED will be lit.
   - — The AUX3 LED will be lit. If the motor does not enter run mode in the set time, a trip will occur (Figure 16, display 3).
   - — The POWER, RUN, and AUX3 LEDs will be lit, indicating that the contact has energized. IA (I1), IB (I2), and IC (I3) will display the current setting for Phase A (1), Phase B (2), and Phase C (3). G/F indicates ground fault current (Figure 16, 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 document no. 46032-700-10_, section “Maintenance and Troubleshooting.”

Figure 16: Operation Displays



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 motors with minimal starting loads. For best results, program the initial starting settings to match the application. Refer to document no. 46032-700-10_, “Setpoint Page 2” in the “Programming” section to make any adjustments to:

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

If deceleration is enabled, you must also program the following parameters for deceleration time, start deceleration voltage, and stop deceleration voltage (refer to document no. 46032-700-10_, “Setpoint Page 2” in the “Programming” section).

Emergency bypass operation

Figure 17: TCB Bypass Input (Terminal TB2–Terminal Points 1 and 2)

NOTICE

HAZARD OF UNEXPECTED MOTOR START

Do not operate the emergency bypass contactor with power applied to the soft start.

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

6. Remove input power by using the isolation means (disconnector) in the controller section. To do this, open the main contactor, move the isolation means to the grounded position, and lock it out.
7. Close the emergency bypass contact (Figure 17). Refer to document no. 46032-700-10_, section “Control Connections for the Terminal and Control Board.”
8. Reclose the disconnector on the line start section. The line start section 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 starts across-the-line. When the “ON/OFF” contact is opened, the motor is disconnected from the line via the main contactor.

thyristor (SCR) heat sink ohm test

Perform the Thyristor (SCR) Heat Sink Ohm Test on each stack assembly.

Figure 18: Thyristor (SCR) Stack Assembly

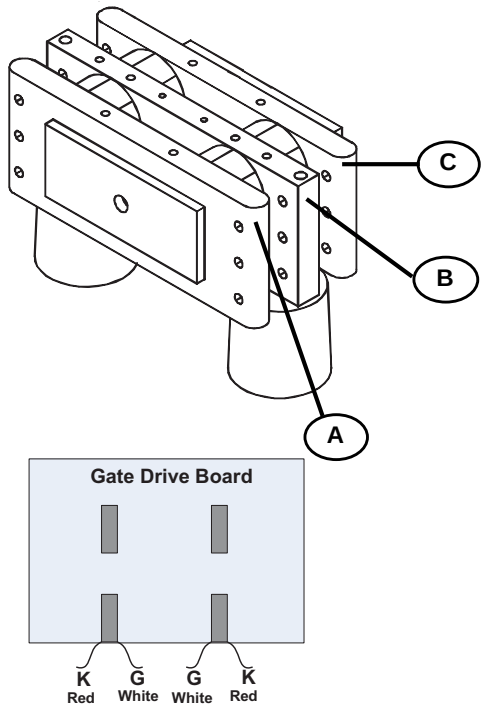


Table 3: Thyristor (SCR) Heat Sink Ohm Test

Test	Ohm Meter Reading	Result
From Position A to Position B	Greater than or equal to 10 k Ohm	Pass
	Less than 2 k Ohm	Fail
From Position B to Position C	Greater than or equal to 10 k Ohm	Pass
	Less than 2 k Ohm	Fail
Gate (G) to Cathode (K) for Each Thyristor (SCR)	8 to 50 Ohms	Pass (typical 8 to 20 Ohms)
	Less than 8 or greater than 50 Ohms	Fail

- Allow 15 minutes after shutdown for DV/DT network to discharge DC voltage.
- Voltage sharing resistors may need to be disconnected to obtain correct reading for tests between positions A, B, and C.
- If sharing resistors need to be disconnected to take resistance readings, label and remove all white wires going to the thyristor (SCR) assembly.

Starting adjustments

Some suggested settings for typical applications are below.

Table 4: Starting Adjustment Settings—Typical Applications

Application	Initial Voltage	Ramp Time	Current Limit
Pumps	30–35%	3–5 s	300–400%
Blowers	30–35%	3–5 s	350–450%
Reciprocating Compressors	35–40%	3–5 s	300–400%
Refrigeration Unit–Freon Based	25–30%	1 s	300–400%
Refrigeration Unit–Ammonia	40–50%	1 s	400–450%
Fans	40–55%	2–3 s	400–500%
Wood Shredders	50–65%	1–2 s	400–500%
Ball Mills	50–70%	1 s	400–600%*
Rod Mills	50–70%	1 s	400–600%*
Conveyors	20–25%	3–5 s	250–400%
Natural Gas Compressors	30–35%	2–3 s	300–400%
High Centrifugal Loads	50–70%	1 s	400–600%*

* Greater than 500% requires special software to provide for extended current limit.

NOTES: This table is general in nature and does not encompass all starting situations. The soft-starting operation of the Motorpact™ RVSS is dependent upon many factors not directly in control of the vendor. System impedance, ANSI motor class, and load variables must be taken into account during commissioning to optimize starting characteristics. Results may vary.

NOTE: Adjust the ramp until the current limit is reached before the soft start transfers to bypass mode. Then adjust until the motor is able to fully start without exceeding the current limit.

The Schneider group service centers are at your service for:

-engineering and technical assistance,
-commissioning,
-training,
-preventive and corrective maintenance,
-adaptation, and
-spare parts.

Contact your sales representative who will put you in touch with your nearest Schneider group service center or call us on 33 (0)4 76 57 60 60 (Grenoble, France).

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