ACROSS-THE-LINE MOTOR STARTER

USER MANUAL

208 V – 460 V | 5 – 100 HP | MOTOR PROTECTION
MOTOR STARTER | NEMA 3R OUTDOOR ENCLOSURE

SAFETY MESSAGES AND WARNINGS

To ensure safe and reliable operation of Phase Technologies Motor Starters, it is important to carefully read and understand this manual and to read and observe all warning labels attached to the Motor Starter before installing the equipment. Please follow all instructions exactly and always keep this manual with the equipment for quick and easy reference.

Definitions of Warning Signs and Symbols

CAUTION: Indicates a potentially hazardous situation that could result in injury or damage to the product.

WARNING: Indicates a potentially hazardous situation that could result in serious injury or death.

HIGH VOLTAGE: Indicates high voltage. The voltage associated with the procedures or operations referenced could result in serious injury or death. Use caution and follow instructions carefully.

READ THESE WARNINGS BEFORE INSTALLING OR OPERATING EQUIPMENT!

WARNING: Risk of electric shock. De-energize the unit by disconnecting all incoming sources of power before servicing the equipment.

HIGH VOLTAGE: This equipment is connected to line voltages that can create a potentially hazardous situation. Electric shock could result in serious injury or death. This device should be installed and serviced only by trained, licensed, and qualified personnel. Follow instructions carefully and observe all warnings.

WARNING: Installation of this equipment must comply with the National Electrical Code (NEC) and all applicable local codes. Failure to observe and comply with these codes could result in risk of electric shock, fire, or damage to the equipment.

CAUTION: DO NOT apply voltage to the Aux 1 Input terminals. Use dry contacts only.

WARNING: Suitable for use in a circuit capable of delivering not more than 15 kA RMS symmetrical amperes.

WARNING: Wire used in the motor circuit and all field wiring terminals must be rated at least 75°C and sized properly for Class 1 circuits.

WARNING: Input power connections should be made by a qualified electrician into a voltage source, with adequate current carrying capacity. Branch circuit protection to the Motor Starter should be provided by appropriately sized fuses or circuit breaker. Circuit breaker and fuse ratings for each model are listed in **Table 4**.

WARNING: These devices are equipped with integral solid-state short circuit protection and branch circuit protection. All installations must comply with the National Electrical Code and any additional local codes.

CAUTION: Use 600 V vinyl-sheathed wire or equivalent. The voltage drop of the leads needs to be considered in determining wire size. Voltage drop is dependent on wire length and gauge.

CAUTION: Wires fastened to the terminals shall be secured by tightening the terminal screws to a torque value listed in **Table 4**.

CAUTION: The maximum wire gauge for the input and output terminals are listed in **Table 4**.

CAUTION: Never allow bare wire to contact the metal surfaces.

CAUTION: Never connect AC main power to the output terminals T1, T2, and T3.

WARNING: Under certain conditions, the motor may automatically restart after a fault has stopped it. Make sure power to the device has been disconnected before approaching or servicing the equipment. Otherwise, serious injury may occur.

CAUTION: Use caution when applying power to the main input terminals of the unit. If the starter is in Auto mode and the controlling device is closed, the starter will initialize in AUTO mode and the motor load may start as soon as the starter is energized.

CAUTION: The AC motor load must be connected directly to the output terminals of the Motor Starter. Do not install relays, disconnect switches, or wire nuts between the Motor Starter and the motor load.

CAUTION: Before the motor is connected to the output terminals, check all output lines for line-to-ground faults using a megger.

CAUTION: Operating the system in MANUAL mode on the door switch overrides remote signals from any control circuits.

TABLE OF CONTENTS

1 INTRODUCTION

Phase Technologies Motor Starter panels are designed to start and stop three-phase AC motors by applying full line voltage directly to the motor terminals at the moment of startup. When a start command is issued, the internal contactor closes and connects the motor windings directly across the supply, delivering immediate full torque for reliable starting under load. The contactor is sized for AC3 motor starting duty up to the full rating of the device, ensuring dependable performance across the panel's entire current range.

An Auto Input is also provided, allowing an external dry-contact device to control motor operation. When the external contact is closed, the motor will run; when open, the motor will stop — enabling seamless integration with devices such as overpressure or emergency stop switches, liquid level transducers, or any other dry-contact control signal. The following block diagrams show the basic operation of Phase Technologies Motor Starters.

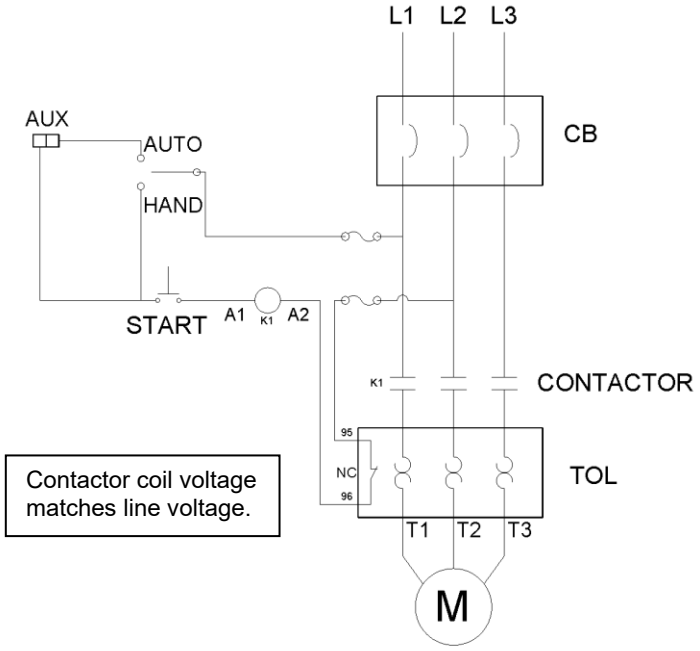

Figure 1 – Frame 1 Block Diagram

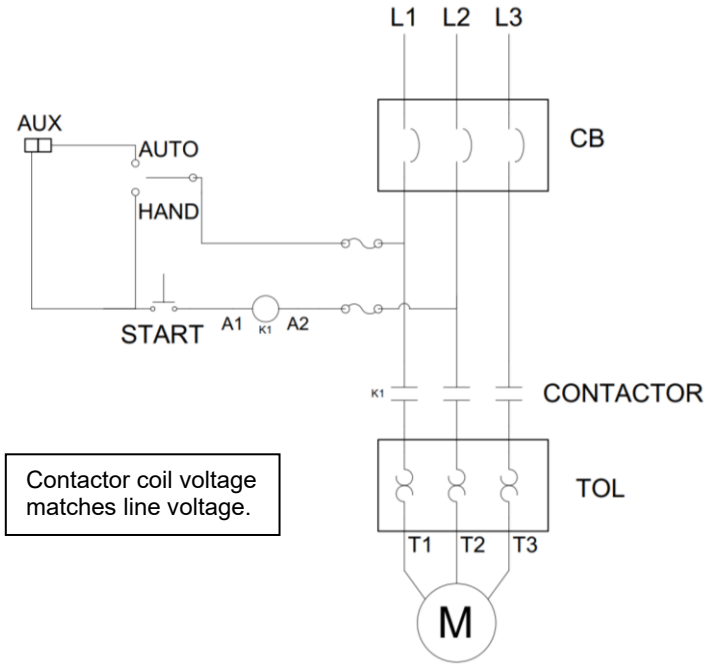

Figure 2 – Frame 2 Block Diagram

This manual contains instructions on selecting, installing, commissioning, and maintaining Phase Technologies Motor Starters.

2 MODELS AND RATINGS

2.1 Specifications

Table 1 – Motor Starter Specifications

Specs	
Operating Temperature	-20°C – 55°C (-4°F – 131°F)
Storage Temperature	-40°C – 60°C (-40°F – 140°F)
Enclosure	NEMA Type 3R
Input Frequency	50/60 Hz (3-phase)
Output Frequency	Equal to Input
Starts/Hour	10
Short Circuit Current Rating	See **Table 2** below
Certification	UL 508A

2.2 Model Ratings

Table 2 – Motor Starter Ratings

	Motor Starting						
Model Number	**UL**	**IEC (AC3)**	**Input/Output Voltage (VAC)**	**Max Current (A)**	**Overload Range (A)**	**Short Circuit Current Rating (kA)**	**Frame Size**
MS005R-B	5	17 A	230	17	11 – 17	20	1
MS007R-B	7.5	26 A		26	18 – 26	15	
MS010R-B	10	32 A		32	22 – 32	25	
MS015R-B	15	50 A		50	34 – 50	25	
MS020R-B	20	63 A		63	45 – 63	50	
MS030R-B	30	85 A		85	63 – 85	65	2
MS040R-B	40	130 A		130	85 – 125	65	
MS050R-B	50	150 A		150	110 – 150	65	
MS405R-B	5	10 A	460	10	6 – 10	50	1
MS407R-B	7.5	13 A		13	9 – 13	50	
MS410R-B	10	17 A		17	11 – 17	20	
MS415R-B	15	26 A		26	18 – 26	15	
MS420R-B	20	32 A		32	22 – 32	25	
MS430R-B	30	50 A		50	34 – 50	25	
MS440R-B	40	63 A		63	45 – 63	50	
MS450R-B	50	75 A		75	55 – 75	50	
MS460R-B	60	85 A		85	63 – 85	35	2
MS475R-B	75	125 A		125	85 – 125	35	
MS4100R-B	100	150 A		150	110 - 150	35	

2.3 Model Nomenclature

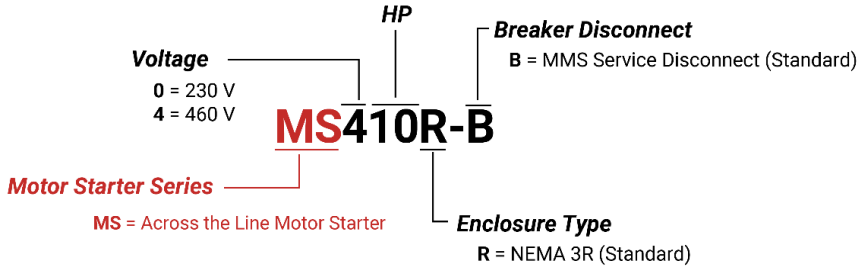

Figure 3 – Motor Starter Nomenclature

2.4 Dimensional Drawings

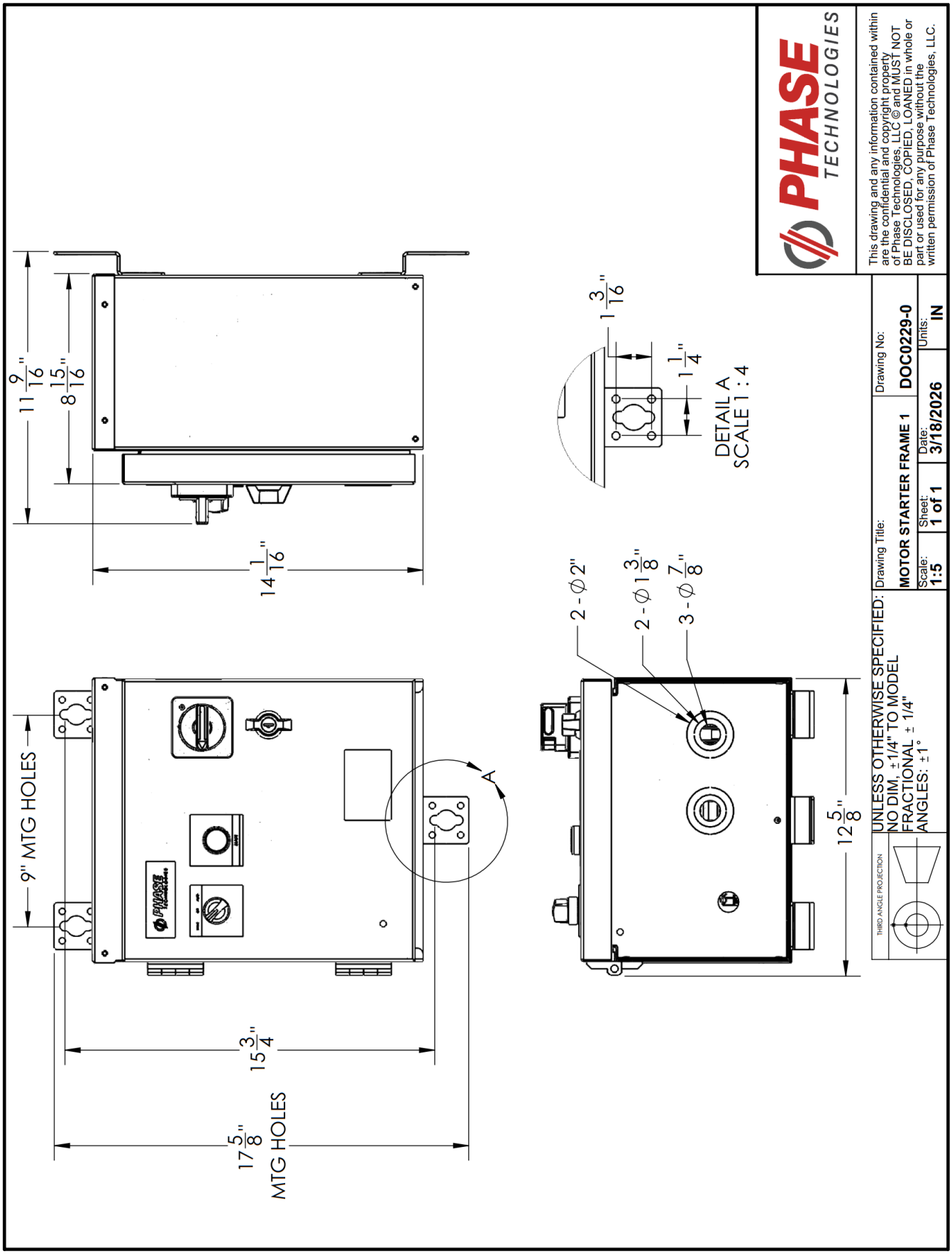

Figure 4 – Frame 1 Enclosure Drawing

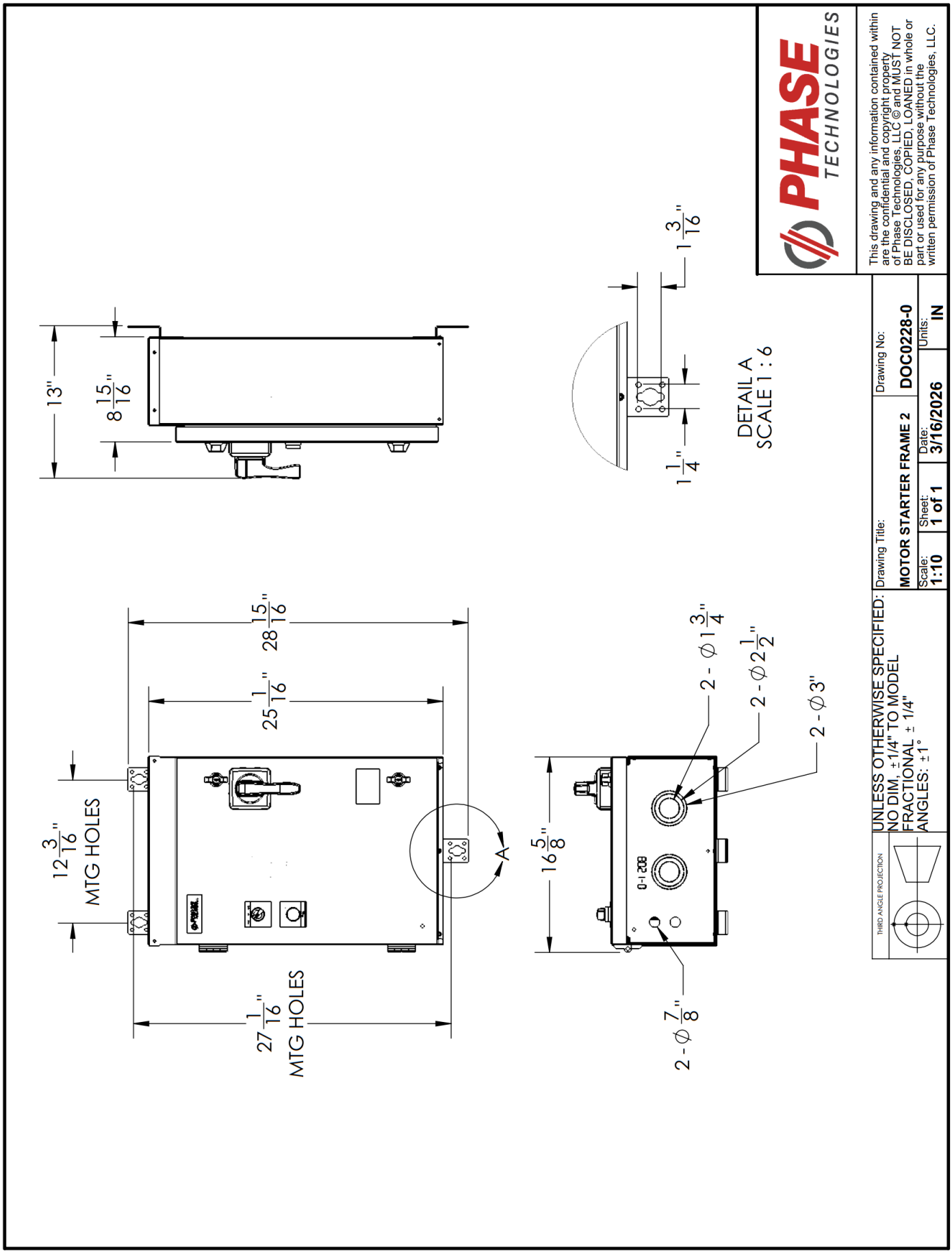

Figure 5 – Frame 2 Enclosure Drawing

3 INSTALLATION

3.1 Mounting

The Motor Starter must be mounted in an upright position with adequate clearance for maintenance. The mounting surface must be sturdy, non-flammable, and capable of bearing the weight of the unit. Fasten the unit to the mounting surface using screws or bolts of an appropriate size through the holes in the mounting brackets.

3.2 Ambient Temperature Rating

Phase Technologies Motor Starters are intended for use in ambient temperatures up to 55˚C (131°F).

3.3 General Wiring Considerations

Installations must comply with all NEC and local electrical code requirements. Circuit breaker and/or fuse size, listed in **Table 4**, are maximum allowable sizes, not recommended sizes. The NEC dictates that circuit breakers must be rated at least 25% higher than the input current rating.

Table 3 – Power Terminal Descriptions

Terminal Name	Description
L1, L2, L3 (Line)	Input power terminals
T1, T2, T3 (Load)	3-Phase output power terminals
GND	Earth safety ground

3.4 Installing Power Cables

⚠ **CAUTION:** In 3R panels, continuous metal conduit should be used on all power cables, both line and load side. The conduit must be securely grounded to the enclosure of the Motor Starter and the motor case. If any conduit holes remain unused, they must be covered with a 3R hole plug to maintain the NEMA 3R rating. Control wires should be routed in a separate conduit.

Table 4 – Motor Starter Input Circuit Breaker and Fuse Ratings (Inverse Time Circuit Breaker)

<table>
<tr><th rowspan="2">Model</th><th colspan="2">Input</th><th colspan="2">Output</th><th rowspan="2">Maximum Circuit Breaker / Fuse Rating Class J</th></tr>
<tr><th>Wire Size Range</th><th>Torque (lb-in)</th><th>Wire Size Range</th><th>Torque (lb-in)</th></tr>
<tr><td>MS005R-B</td><td rowspan="2">18 – 10 AWG</td><td rowspan="2">7 – 22</td><td>16 – 8 AWG</td><td>10</td><td>50</td></tr>
<tr><td>MS007R-B</td><td rowspan="2">12 – 8 AWG</td><td rowspan="2">35</td><td>70</td></tr>
<tr><td>MS010R-B</td><td rowspan="2">18 – 2 AWG</td><td rowspan="2">7 – 22</td><td>80</td></tr>
<tr><td>MS015R-B</td><td rowspan="2">8 – 2 AWG</td><td rowspan="2">45</td><td>125</td></tr>
<tr><td>MS020R-B</td><td>12 – 2/0 AWG</td><td>35 – 53</td><td>175</td></tr>
<tr><td>MS030R-B</td><td>8 – 2/0 AWG</td><td>134</td><td>8 – 1/0 AWG</td><td>53</td><td>225</td></tr>
<tr><td>MS040R-B</td><td>Aluminum: 3/0 – 4/0
Copper: 1/0 – 2/0</td><td>283</td><td rowspan="2">3 AWG – 250 kcmil</td><td rowspan="2">88</td><td>350</td></tr>
<tr><td>MS050R-B</td><td>Aluminum: 250 – 350 kcmil
Copper: 3/0 – 4/0</td><td>Aluminum: 390
Copper: 283</td><td>400</td></tr>
<tr><td>MS405R-B</td><td rowspan="4">18 – 10 AWG</td><td rowspan="4">7 – 22</td><td rowspan="3">16 – 8 AWG</td><td rowspan="3">10</td><td>25</td></tr>
<tr><td>MS407R-B</td><td>35</td></tr>
<tr><td>MS410R-B</td><td>45</td></tr>
<tr><td>MS415R-B</td><td rowspan="2">12 – 8 AWG</td><td rowspan="2">35</td><td>70</td></tr>
<tr><td>MS420R-B</td><td rowspan="2">18 – 2 AWG</td><td rowspan="2">7 – 22</td><td>80</td></tr>
<tr><td>MS430R-B</td><td rowspan="3">8 – 2 AWG</td><td rowspan="3">45</td><td>125</td></tr>
<tr><td>MS440R-B</td><td rowspan="2">12 – 2/0 AWG</td><td rowspan="2">35 – 53</td><td>175</td></tr>
<tr><td>MS450R-B</td><td>200</td></tr>
<tr><td>MS460R-B</td><td>8 – 2/0 AWG</td><td>137</td><td>8 – 1/0 AWG</td><td>53</td><td>225</td></tr>
<tr><td>MS475R-B</td><td>Aluminum: 3/0 – 4/0 AWG
Copper: 1/0 – 2/0 AWG</td><td>283</td><td rowspan="2">3 AWG – 250 kcmil</td><td rowspan="2">88</td><td>350</td></tr>
<tr><td>MS4100R-B</td><td>Aluminum: 250 AWG – 350 kcmil
Copper: 3/0 – 4/0</td><td>Aluminum: 390
Copper: 283</td><td>400</td></tr>
</table>

4 Operation

This section describes how to configure the overload protection and operate the motor starter using the Hand-Off-Auto (HOA) selector switch and the latching Start/Stop push button.

4.1 Setting Overload Amperage

The motor starter is equipped with a thermal overload relay that must be set to match the full-load amperage (FLA) of the connected motor. Setting the overload current correctly protects the motor from damage due to sustained overcurrent conditions.

To set the overload current:

1. Locate the overload adjustment dial on the overload relay.
2. Refer to the motor nameplate for the motor's FLA rating.
3. Rotate the adjustment dial to align the motor's FLA value with the indicator mark.
4. Once set, verify the adjustment has not shifted before each commissioning.

Note: Never set the overload current higher than the motor's nameplate FLA to prevent nuisance tripping. If nuisance tripping occurs, investigate the cause rather than increasing the overload setpoint.

a. Frame 1 Overload Adjustment Dial b. Frame 2 Overload Adjustment Dial

Figure 6 – Overload Adjustment Dial Locations

4.2 Aux 1 Input Terminals

Phase Technologies Motor Starters are equipped with Aux 1 and COM input terminals that allow remote ON/OFF control when a dry contact (voltage-free) closure device is connected. When the connected device closes Aux 1 to COM, the motor will start. When the connected device opens, the motor will stop.

⚠**CAUTION:** DO NOT apply voltage to the Aux 1 and COM input terminals. Use dry contacts only.

To connect a control device, remove the orange jumper wire and replace with the control device wires. Any device that provides a dry contact closure can be used for basic control. Common examples include: 40-60 pressure switch, float switch, overpressure shutdown switch, programmable-logic controller (PLC), timer relays.

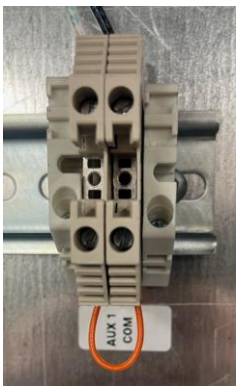

Figure 7 – Aux 1 Input Terminals

4.3 Hand Operation

Hand mode allows the operator to run the motor directly from the starter panel, independent of any external control signal. In Hand mode, the Aux 1 Input circuit is **ignored** — the state of any connected external control device has no effect on starter operation.

To operate the starter in Hand mode:

1. Turn the HOA selector switch to the **HAND** position.
2. Verify the motor and connected equipment are clear and safe to start.
3. Press the latching Start/Stop push button to the latched (IN) position. The starter will energize and the motor will run.
4. To stop the motor, depress the push button again to release it to the unlatched (OUT) position. The starter will de-energize and the motor will stop.

Note: The latching push button must be in the latched position for the motor to run in any mode. Releasing the push button will always stop the motor, regardless of the HOA switch position.

4.4 Auto Operation

Auto mode allows the motor starter to be controlled by an external signal connected to the Aux 1 Input terminals. This is the normal operating mode for applications where the motor is started and stopped automatically by a process control device such as a float switch, pressure switch, thermostat, PLC output, or similar.

In Auto mode, the motor will only run when **all** the following conditions are met:

- The **HOA selector switch** is in the **AUTO** position, **and**
- The **Aux 1 Input circuit is closed** (external control device is calling for the motor to run), **and**
- The **latching Start/Stop push button** is in the latched (IN) position.

To operate the starter in Auto mode:

1. Verify that the external control device is properly wired to the Aux 1 Input terminals and is functioning correctly.
2. Turn the HOA selector switch to the **AUTO** position.
3. Press the latching Start/Stop push button to the latched (IN) position. This arms the starter for automatic operation.
4. The motor will start automatically when the Aux 1 Input circuit closes and will stop when the Aux 1 Input circuit opens.

To take the motor out of service while in Auto mode, depress the Start/Stop push button to the unlatched (OUT) position. The motor will stop immediately and will not restart — even if the Aux 1 Input circuit remains closed — until the push button is latched in again.

Note: When returning the starter to Auto operation after a manual stop, ensure it is safe for the motor to restart automatically before re-latching the push button. If the Aux 1 Input circuit is already closed when the push button is latched, the motor will start immediately.

4.5 Overload Reset – Frame 1

When the Motor Starter trips due to an overload or fault condition, the disconnect handle will move to an intermediate position between **ON** and **OFF**. The handle will not sit fully in either the ON or OFF position when the device has tripped.

To reset the device, turn the HOA selector switch to the OFF position and ensure the Start/Stop push button is in the unlatched (OUT) position. Move the disconnect handle to the OFF position, then return it to the ON position. The device is now reset and ready for operation.

4.6 Overload Reset – Frame 2

Frame 2 motor starters are equipped with a **Thermal Overload Relay (TOL)**, which provides adjustable overload protection for the motor. Unlike the MMS device used in Frame 1, the TOL relay is a dedicated protection device that works in conjunction with the starter contactor. When the TOL relay trips, it opens the contactor control circuit, de-energizing the starter and stopping the motor.

When the TOL relay trips, the red TRIP indicator button on the face of the relay will protrude or become visible, indicating a tripped state. The motor will have stopped and will not restart until the relay is manually reset.

⚠**CAUTION:** Always allow a minimum cooling period of 5 minutes after tripping before attempting to reset the TOL. These TOL relays are thermally operated and the bimetallic element must cool sufficiently before the relay can be successfully reset. Attempting to reset before the cooling period has elapsed may be unsuccessful.

To reset the device, turn the HOA selector switch to the OFF position and ensure the Start/Stop push button is in the unlatched (OUT) position. Move the disconnect handle to the OFF position, then open the panel. Locate the RESET button on the face of the TOL and press firmly. A click and retraction of the TRIP indicator confirm a successful reset.

5 WARRANTY POLICY

LIMITED WARRANTY

Phase Technologies Motor Starters are warranted against defects in material and workmanship for a period of one year. This warranty covers both parts and labor (at Phase Technologies) for two years from the date of purchase by the original owner. Phase Technologies will repair or replace (at our option), at no charge, any part(s) found to be faulty during the warranty period specified. The warranty repairs must be performed by/at a Phase Technologies Authorized Service Center or at Phase Technologies LLC, Rapid City, SD.

Obligations of the Original Owner

1. The original Bill of Sale must be presented to obtain "in-warranty" service.
2. Transportation to Phase Technologies or an Authorized Service Center is the responsibility of the original purchaser. Return transportation is provided by Phase Technologies.
3. Installations must comply with all national and local electrical codes.

Exclusions of the Warranty

This warranty does not cover any of the following: accident, misuse, fire, flood, and other acts of God, nor any contingencies beyond the control of Phase Technologies, LLC, including water damage, incorrect line voltage, improper installation, missing or altered serial numbers, and service performed by an unauthorized facility. Phase Technologies' liability for any damage caused in association with the use of Phase Technologies' equipment shall be limited to the repair or replacement only of Phase Technologies' equipment. No person, agent, distributor, dealer, or company is authorized to modify, alter, or change the design of this merchandise without express written approval of Phase Technologies, LLC.

Forum Selection

Any suit, claim, or cause of action arising from this document or any Phase Technologies product, will be governed by the laws of the State of South Dakota. It is agreed that jurisdiction and venue for all disputes will be the federal or state courts of South Dakota.

INSTALLATIONS MUST COMPLY WITH ALL NATIONAL AND LOCAL ELECTRICAL CODE REQUIREMENTS.