WORKMASTER®

WE FIND A WAY — OR MAKE ONE!

MOTOR STARTER

S-Series

OWNER / OPERATOR MANUAL

WORKMASTER disclaims any liability for injuries, death or damages arising directly or indirectly, from the use, operation or application of this product not in accordance with the procedures, specifications and recommendations contained in this owner's manual. The user of this product is responsible to install, maintain and operate the product and parts or components manufactured or supplied by **WORKMASTER** in such a manner as to comply with all federal, state and local rules, ordinances, regulations and laws, including the Williams-Steiger Occupational Safety Act, and the American National Standards Institute Safety Code.

SYMBOLS

The following symbols are found throughout this Owner/Operator Manual to alert the reader to the relative danger that may result from non-observance.

DANGER

This indicates a situation in which a hazard is imminent and will result in a high probability of serious injury or death.

WARNING

This indicates a potentially hazardous situation, which could result in minor to moderate injury.

CAUTION

This indicates a potentially hazardous situation or unsafe practice which could result in product or property damaged.

IMPORTANT

This symbol indicates a general statement to assist the user in the operation or maintenance of the equipment.

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

WORKMASTER has chosen a precise collection of components for our line of Motor Starters. These units will provide years of reliable service, and at the same time, protect your investment in both electric motors and the operation of the plant in which they are installed, by minimizing both motor failures and nuisance tripping.

These Motor Starters are available in a wide range of voltages and amperages. Originally developed to protect rotary electric vibrators, these units can also be used to protect almost any form of industrial electric motor.

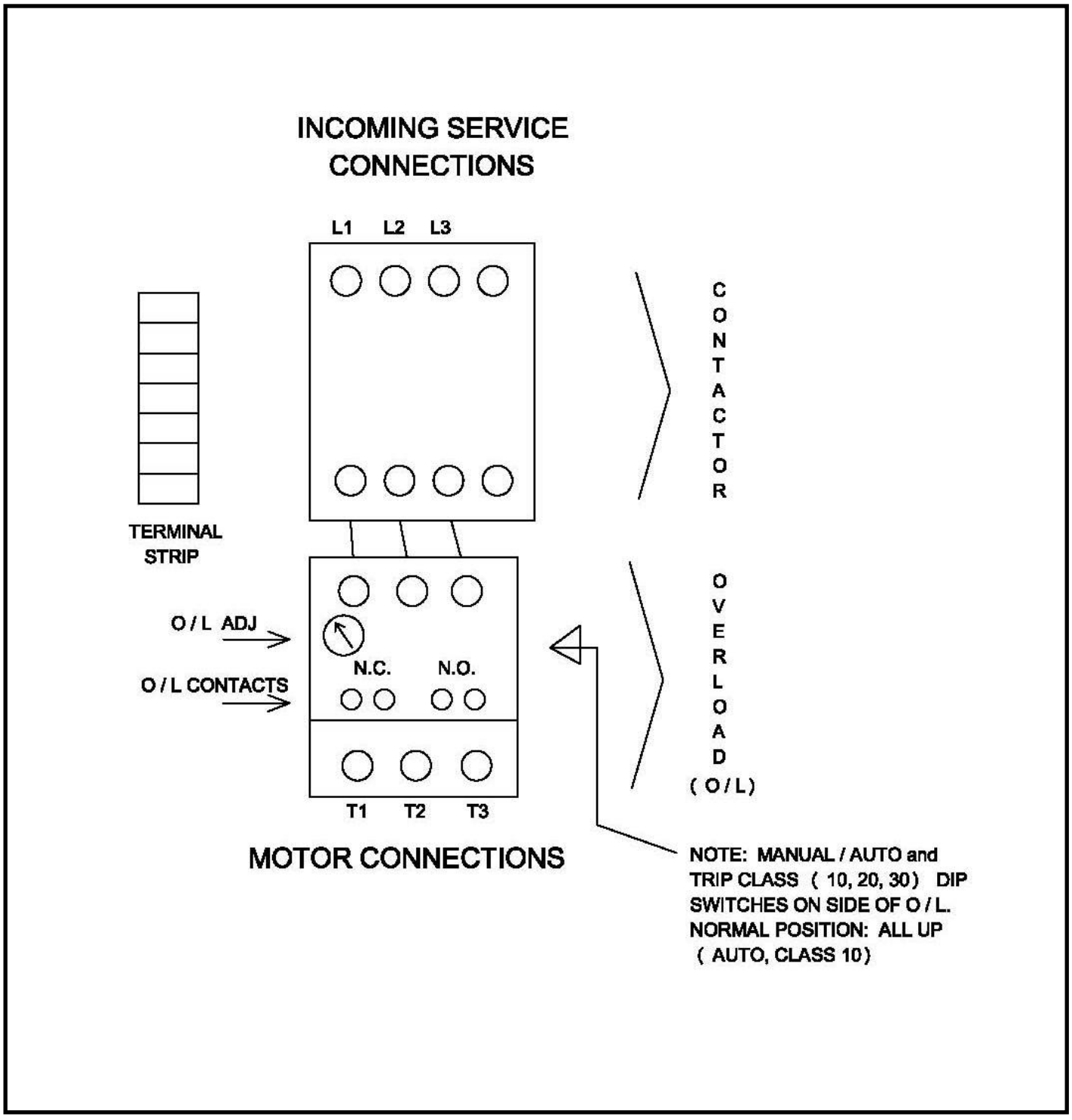
The **WORKMASTER** Motor Starter (MS) comes pre-wired in a NEMA-4 Enclosure and includes a Solid-State Overload (SS-O/L). After the MS Enclosure has been mounted, there are only two wiring connections to be made: (1) incoming electrical service; (2) outgoing feed to the motor being controlled. Standard Motor Starters are available in either 120VAC, 240 VAC, or 480 VAC. The voltage of your MS is clearly marked on both the outside of the Enclosure, and its inside panel.

Before beginning any electrical installation, make sure the incoming service has been switched off and the Locked-out/Tagged-out procedure followed. Use appropriate test equipment to verify that no voltage is present.

Make sure the incoming service voltage matches the Motor Starter's voltage.

SEE FIGURE 1 FOR MOTOR STARTER COMPONENT LAYOUT.

Figure 1: COMPONENT LAYOUT



II. SAFETY

To prevent injury to yourself or others, and/or damage to equipment, you should adhere to the following basic safety instructions.

1. Read carefully the entire Operator's Guide prior to installing or operating equipment.
2. Always follow proper precautions and use proper tools and safety equipment.
3. Be sure to receive proper training.
4. Always use the equipment and all its components in applications for which they are approved.
5. Be sure to assemble all components correctly.
6. Never use worn, defective or damaged components.
7. Practice good housekeeping always, and maintain good lighting around all equipment.
8. Perform Lock-out/Tag-out procedure on all energy sources to the equipment, mounting structure, loading and discharge systems in accordance with ANSI Standards before installation or maintenance.

III. REQUIRED MATERIALS

The following items are not supplied with your **WORKMASTER** Motor Starter but are necessary for its proper installation and operation.

- ☐ Electrical Service; 120V, 240V or 480V
- ☐ Greenlee Punch or Hole Saw
- ☐ Standard Hand Tools
- ☐ Mounting Hardware
- ☐ Incoming / outgoing cabling (See Appendix A for proper wire gauge)

IV. MOUNTING THE MS ENCLOSURE

1. Use the Enclosure's flange holes as a template, and affix the Control Box to an independent structural support, or a weld/bolt-on attachment to the support. Provide at least 18" of open, unobstructed space in front of the Enclosure.

IMPORTANT

Because locating electrical service holes in the Enclosure is site specific (dependent upon the exact routing of the conduit), the MS Enclosure is **NOT** conduit pre-punched.

2. Do not locate conduit punch-holes in the top of the Enclosure, or an upward facing surface, to prevent water from entering the MS. Waterproofing washers should be used on the conduit couplings for both incoming and outgoing lines.

CAUTION

The use of waterproofing washers will greatly reduce the risk of water entering the Enclosure and damaging the Motor Starter's components.

3. Use a GREENLEE Punch (preferred) or a hole saw (acceptable) to punch conduit service holes into the Enclosure.

4. If the surface on which the enclosure is mounted is not flat, or if heavy equipment is mounted on the door, the door may not close properly. If the top of the door strikes the flange around the body opening, metal shims placed between the mounting surface and the bottom of the mounting foot (on the hinge side) will raise the door. Make sure that all mounting bolts are tight.

V. CONNECTING SINGLE-PHASE SERVICE

1. Your **WORKMASTER** Motor Starter comes pre-wired. The only connections that need to be made are to the incoming electrical service, and the outgoing feed to the motor(s) you are controlling.

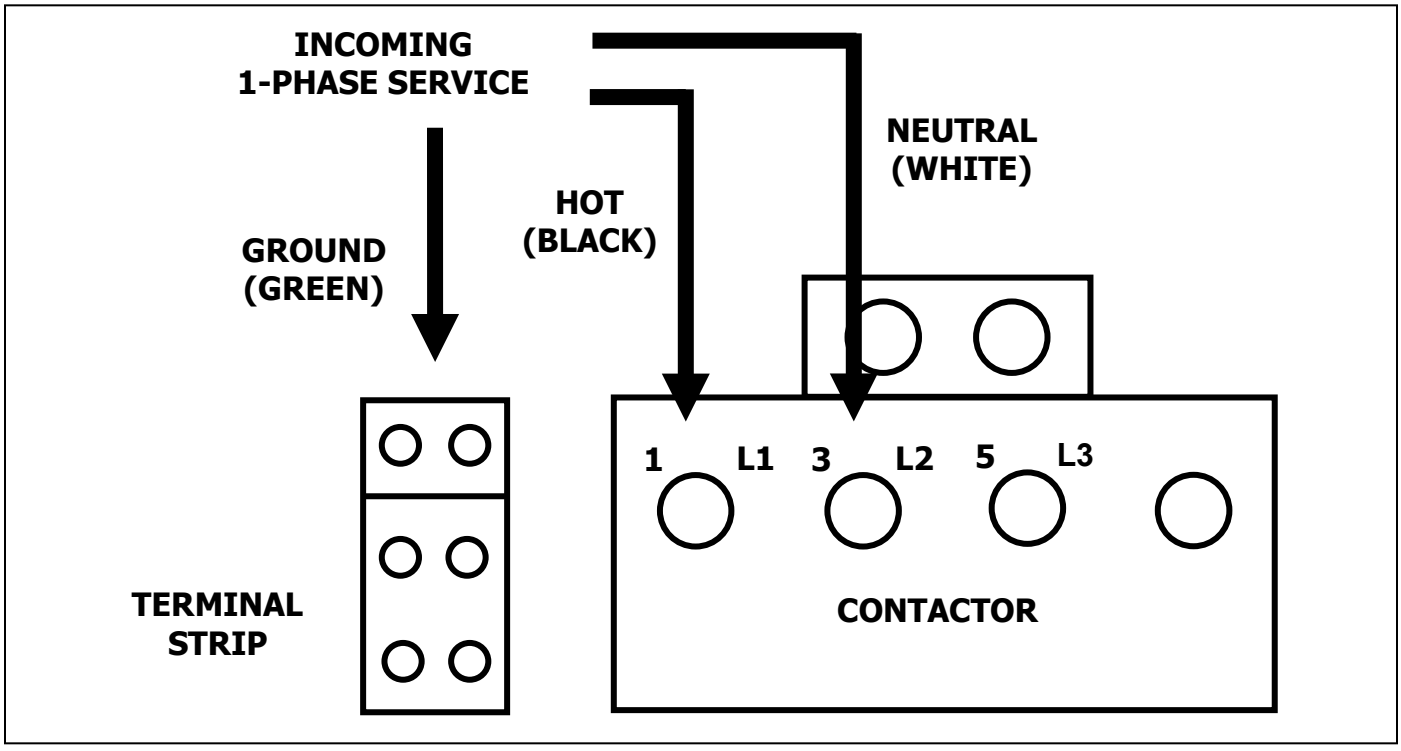
DANGER

Before beginning any electrical installation, make sure the incoming service has been both switched OFF and the Lock-out/Tag-out procedure followed. Use appropriate test equipment to verify that no voltage is present.

2. Incoming Single-Phase service requires use of all three wires, HOT (Black) to the "1 L1" Terminal and the NEUTRAL (White) to the "3 L2" Terminal (both terminals are at the top of the contactor, *as shown in* **Figure 2**, and GROUND (Green).

3. Connect the GROUND of the incoming service to the upper most, right side position of the TERMINAL STRIP. The top two terminals of the TERMINAL STRIP are for Grounding. NOTE: the wiring on the left side of the TERMINAL STRIP for the top two positions has been connected together, and is Green, *as shown in* **Figure 2**.

Figure 2: SINGLE PHASE CONNECTIONS



VI. MOTOR CAPACITORS

If the device that the Motor Starter is powering has either a START or RUN Capacitor, or both a START and RUN Capacitor, the Capacitor(s) can be installed inside the NEMA Enclosure. Sufficient space has been left to accommodate the Capacitors commonly used with single-phase rotary electric vibrators.

To accommodate the Capacitor(s), the TERMINAL STRIP's lowest position has been left empty, and can be used to connect one leg of the Capacitor(s) to the Motor's starter coil.

1. If one or two Capacitors are installed inside the Motor Starter's Enclosure, the wiring from the Enclosure to the motor should have four conductors.

2. Connect one leg of the Capacitor to the fed-through NEUTRAL, which is Terminal "6 T3" of the overload.

3. Connect the other leg of the Capacitor to the left-side of the lowest terminal on the TERMINAL STRIP.

IMPORTANT

SEE APPENDIX B
FOR WIRING DIAGRAM

VII. CONNECTING SINGLE-PHASE MOTOR

1. The incoming power connections to a single-phase motor, will be to Terminals T1 and T3 of the Overload.

2. Connect the Motor's wires to the Motor Starter's Solid-State Overload *as shown in* **Figure 3**.

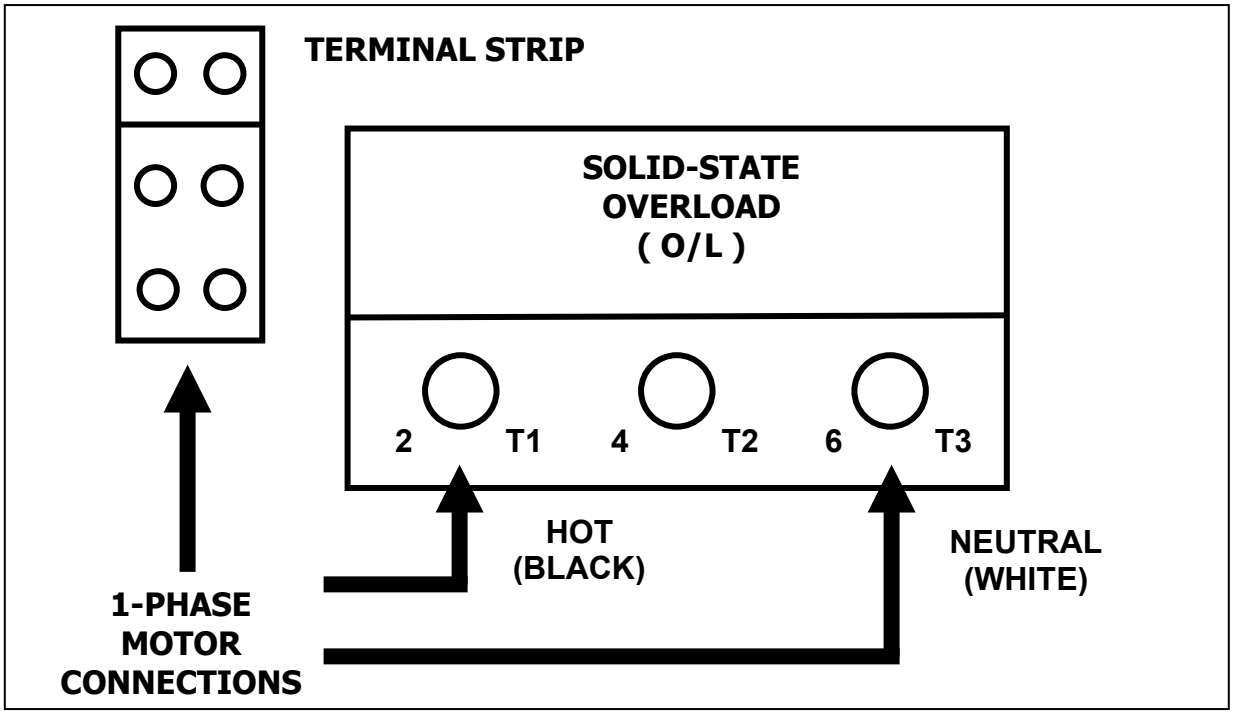
3. Connect the GROUND LEAD from the motor to the empty position on the Grounding TERMINAL STRIP (*see* Figure 4), which has been left empty. NOTE: the green wire goes to the left side of the top two TERMINAL STRIP positions. These top two terminals have been reserved for Grounding.

DANGER

Grounding the motor is mandatory. Failure to properly ground incoming service will result in severe injury or death.

4. If capacitors are installed in the Motor Starter Enclosure, use at least 4-conductor cable between the Enclosure and the motor: HOT, NEUTRAL, Starter Coil, and GROUND.

Figure 3: SINGLE-PHASE MOTOR CONNECTIONS



VIII. CONNECTING THREE-PHASE SERVICE

1. Your **WORKMASTER** Motor Starter comes pre-wired. The only connections that need to be made are to the incoming electrical service and the outgoing feed to the motor(s) you are controlling.

DANGER	Before beginning any electrical installation, make sure the incoming service has been both switched OFF and the Lock-out/Tag-out procedure followed. Use appropriate test equipment to verify that no voltage is present.

2. The incoming electrical service should consist of four wires: L1, L2 and L3 (the three HOT LEADS of 3-phase), and the GROUND LEAD (green insulation jacket).

 **IMPORTANT**	The Motor Starter's L1 and L2 connections at the top of the contactor, are pre-wired and labeled (1 to L1 ; 2 to L2). Do not remove these pre-wired connections while attaching the incoming service wires, since the factory set, pre-wired connections must remain connected as delivered for the Motor Starter to function.

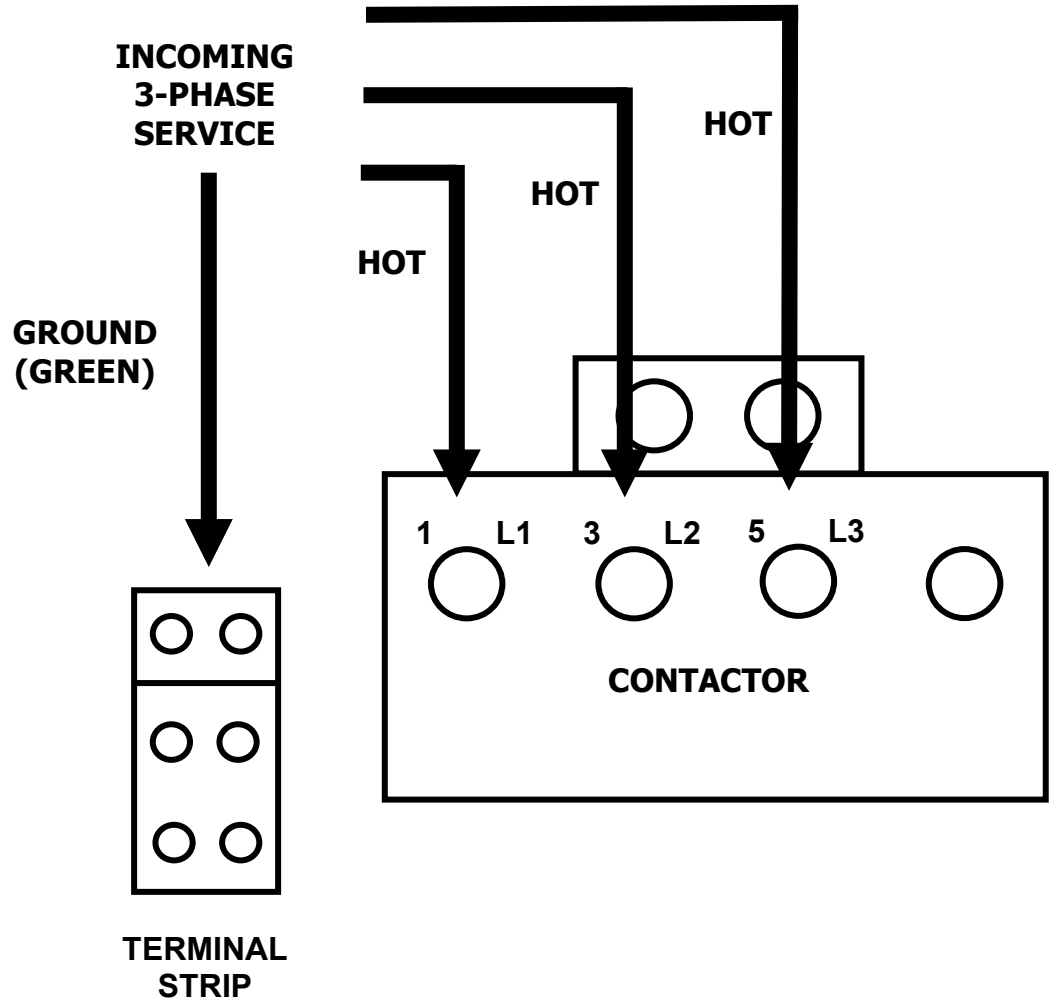
3. Connect the incoming HOT LEADS (L1, L2 and L3) to the Motor Starter's Contactor (at the top of the Enclosure),*as shown* in **Figure 5**.

4. A seven conductor, white nylon Terminal Strip has been installed to the left of the contactor *as shown in* (partial) **Figure 5**. The Green GROUND wires coming from the left side of the terminal strip, are pre-wired to both the Enclosure's GROUNDING LUG, and the BONDING LUG on the Enclosure's door. The top two open terminal positions on the right side of the TERMINAL STRIP are reserved for incoming service and motor GROUNDING. Incoming GROUND can be connected to the top position.

DANGER

Grounding the motor is mandatory. Failure to properly ground incoming service will result in severe injury or death.

Figure 5: THREE-PHASE SERVICE CONNECTIONS



IX. CONNECTING THREE-PHASE MOTOR

1. The power connections to the Motor, often referred to as T1, T2, and T3, are made to the bottom portion of the Motor Starter, which is a Solid-State Overload.

2. Connect the Motor's wires to the Motor Starter's solid-state overload *as shown in* **Figure 6**.

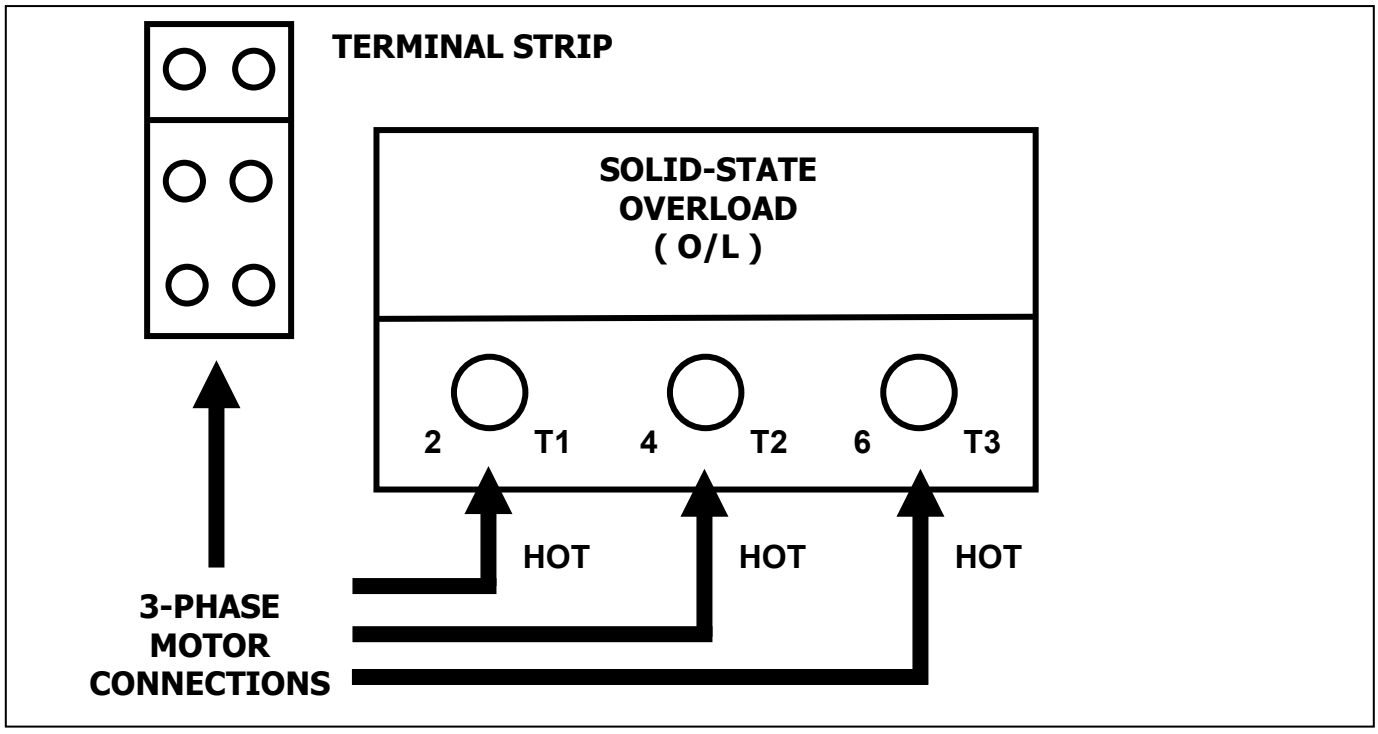
3. Connect the GROUND LEAD from the Motor to the "2nd from top" Terminal position on the right side of the TERMINAL STRIP, which is empty. NOTE that the wiring on the left of the top two Terminals is Green.

DANGER

Grounding the motor is mandatory. Failure to properly ground incoming service will result in severe injury or death.

4. The wiring between the Enclosure and the motor must be at least 4-conductor for connection to T1, T2, T3 and GROUND.

Figure 6: THREE-PHASE MOTOR CONNECTIONS



X. DIRECTION OF ROTATION

The Direction of Rotation (DOR) of an electric motor is normally application specific. To verify the DOR and to make sure it meets the application requirements, a "Bump" Test should be performed.

1. After fully connecting a motor to the Motor Starter, the motor can be momentarily energized, then turned off ("Bumped") while observing a rotating element, *ie*, motor shaft or other rotating components.

IMPORTANT

Precautions must be taken so that such a momentary rotation of the motor can be done with no compromise to safety.

2. In the event that the DOR is not correct and needs to be changed, proper safety precautions identical to the safety measures taken when installing the Motor Starter must be taken during re-wiring of all motor connections.

Deactivate all electrical service to Motor Starter prior to adjusting motor rotation. Failure to properly deactivate service will result in injury and/or product damage

3. For three-phase motors, reversing the DOR can be achieved by exchanging any two of the three wires feeding the motor.

4. For single-phase motors, the DOR cannot always be reversed. Consult the OWNER/OPERATOR MANUAL for the specific device involved to determine if the DOR can be changed.

XI. ADJUSTING THE OVERLOAD

1. The Overload Adjustment (*as shown* in **Figure 1**, labeled O/L ADJ) should be set for the amp draw of the motor being controlled (shown on motor's Nameplate). If not, or if not clear, consult the manufacturer of the motor or the device powered by the motor.

IMPORTANT

Dual voltage motors will have two different Amp draws listed: one for 240V, and the other for 480V (normally one-half the 240V Amp draw). Adjust the Overload's O/L ADJ screw to the correct Amp draw specified for the voltage being used.

2. The Motor Starter includes an Automatic Reset if overloaded. If the Amp draw exceeds the Overload's setting, the Overload will trip, and shut-off the Motor Starter.

IMPORTANT

Another condition that will cause the O/L to trip is *single phasing*, which is the loss of one of the 3-Phase feed wires to the motor. This loss, or interruption can be anywhere in the pathway of the 3-phase service. Although a *single phasing* motor has no torque, it does have excessive amp draw through the one phase that remains connected. If allowed to continue, *single phasing* a motor will cause burn out. The Solid-State Overload in this Motor Starter will detect a *single phasing* condition, and will trip the O/L.

3. After three (3) minutes the Overload will reset - but it won't restart the Motor. The Motor can only be restarted by pressing the START push button.

CAUTION

Repeated overload tripping must be investigated, and the cause(s) corrected to avoid more severe Motor damage.

4. In a Vibrator Application, the cause of the Overload tripping could be the vibrator's mount. Vibrators require a secure, rigid mount, so that the vibrational energy is transmitted, first, into the bin or hopper wall, and then, into the bulk material. Loose fasteners, or a flexible mount will cause excessive vibrator amplitude, and poor transmission of the Vibrator's energy.

IMPORTANT

A bin or hopper that is full of material is more rigid than an empty one. A vibrator running on an empty bin or hopper not only wastes energy, but also subjects both the Vibrator and the bin to abuse; the Vibrator will draw excessive amperage which will either cause the Vibrator to fail prematurely, or the bin to crack, or both.

5. A set of Normally Open (N.O.) contacts are provided on the Overload *as shown in* Figure 1. These auxiliary contacts can be used in at least two ways:

   a. To energize either a visible or audible alarm that will alert nearby personnel that the Overload has been tripped.

   b. To log the overload event into a central computer's Preventative Maintenance Program (PMP) file.

These contacts allow up to 1/2 AMP of current to pass through them.

The Overload also has a set of Normally Closed (N.C.) contacts, which will, if an overload event occurs, open and, as a result, turn the Motor Starter OFF. These auxiliary contacts are in-line with the contactor coil, and if opened by an overload event, won't allow the Motor Starter to START.

The Overload will automatically reset itself after 3-minutes. The N.O. contacts, closed by the overload event, will open at the end of the three minutes. Likewise, the N.C. contacts, opened by the overload event, will close after 3-minutes.

XII. CONNECTING MULTIPLE MOTORS

More than one Motor can be controlled from a single MS Enclosure which has only one START and one STOP button, but each motor must have its own Motor O/L. Consult your **WORKMASTER** Distributor for information on Motor Starter Systems designed for multiple motors.

WORKMASTER also offers custom built Motor Starters, which can include a broad range of options:

- Multiple starters for multiple motors;
- Different service voltages, *eg*, 575VAC;
- Different control voltage (voltage fed to contactor coil and enclosure door), eg, 12, 24, 48 or 120 volts; AC or DC.
- Different amperages;
- A recycling timer;
- Relays to allow remote START and STOP functions;
- PLC

Ask your **WORKMASTER** Distributor about your Motor Starter requirements.

APPENDIX A: WIRE GAUGE SELECTION

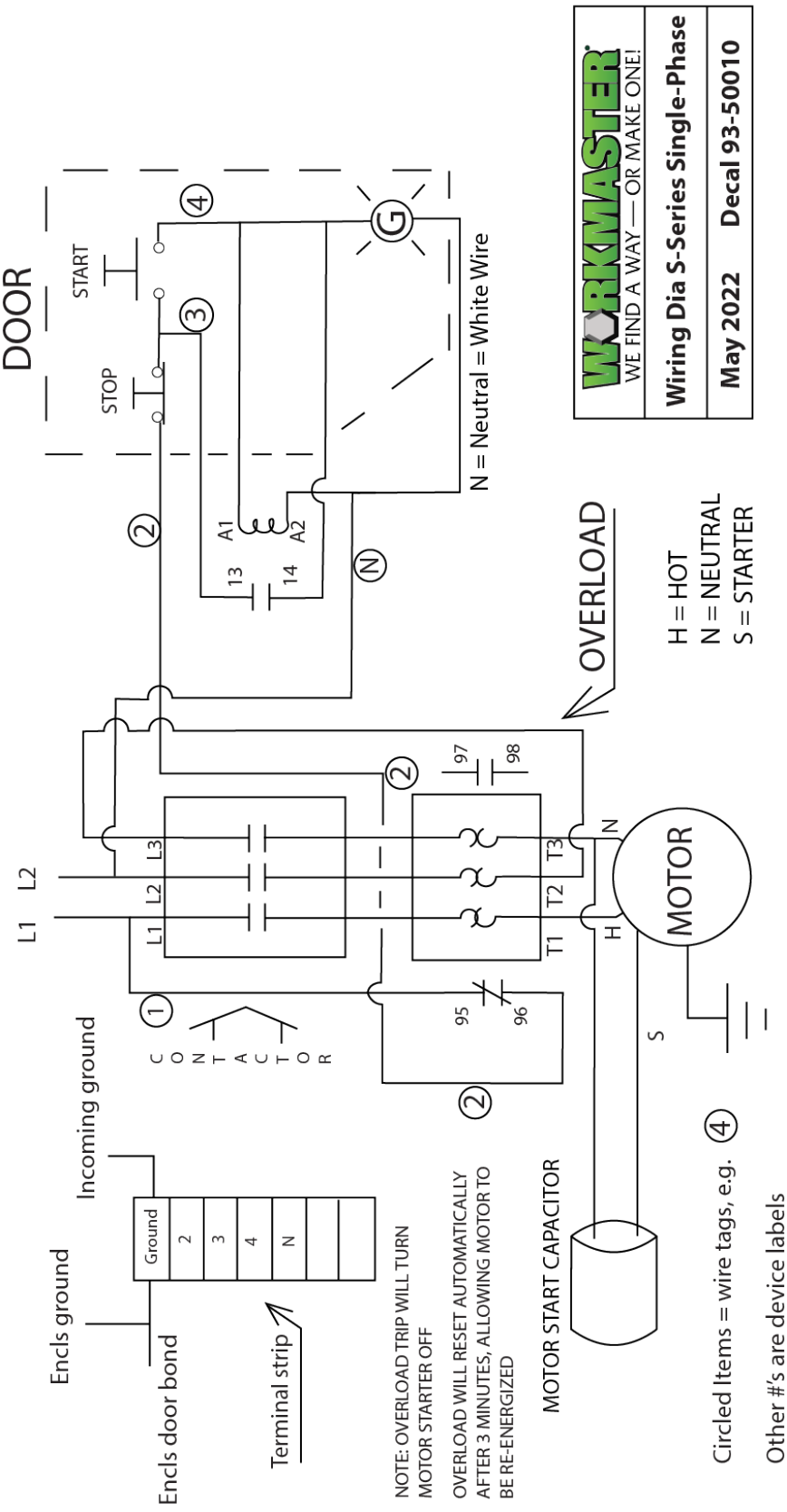
Selecting properly sized wiring for any electrical installation is critically important to a maintenance free, safe application. Undersized wiring can lead to poor performance, higher motor maintenance costs, and the potential for fire.

Here is our recommendation for selecting the appropriate gauge wiring based on the maximum amperage permitted through a circuit. The Table's data states the proper size based on the maximum Full-Load AMP (FLA) setting for the Solid-State Overload protection used in our Motor Starters. The MS 29-20090, for example, uses an overload with a max FLA of 32 AMPS; the Chart recommends that 8 Gauge wiring be used, even if the motor being powered has an FLA lower 30 AMPS.

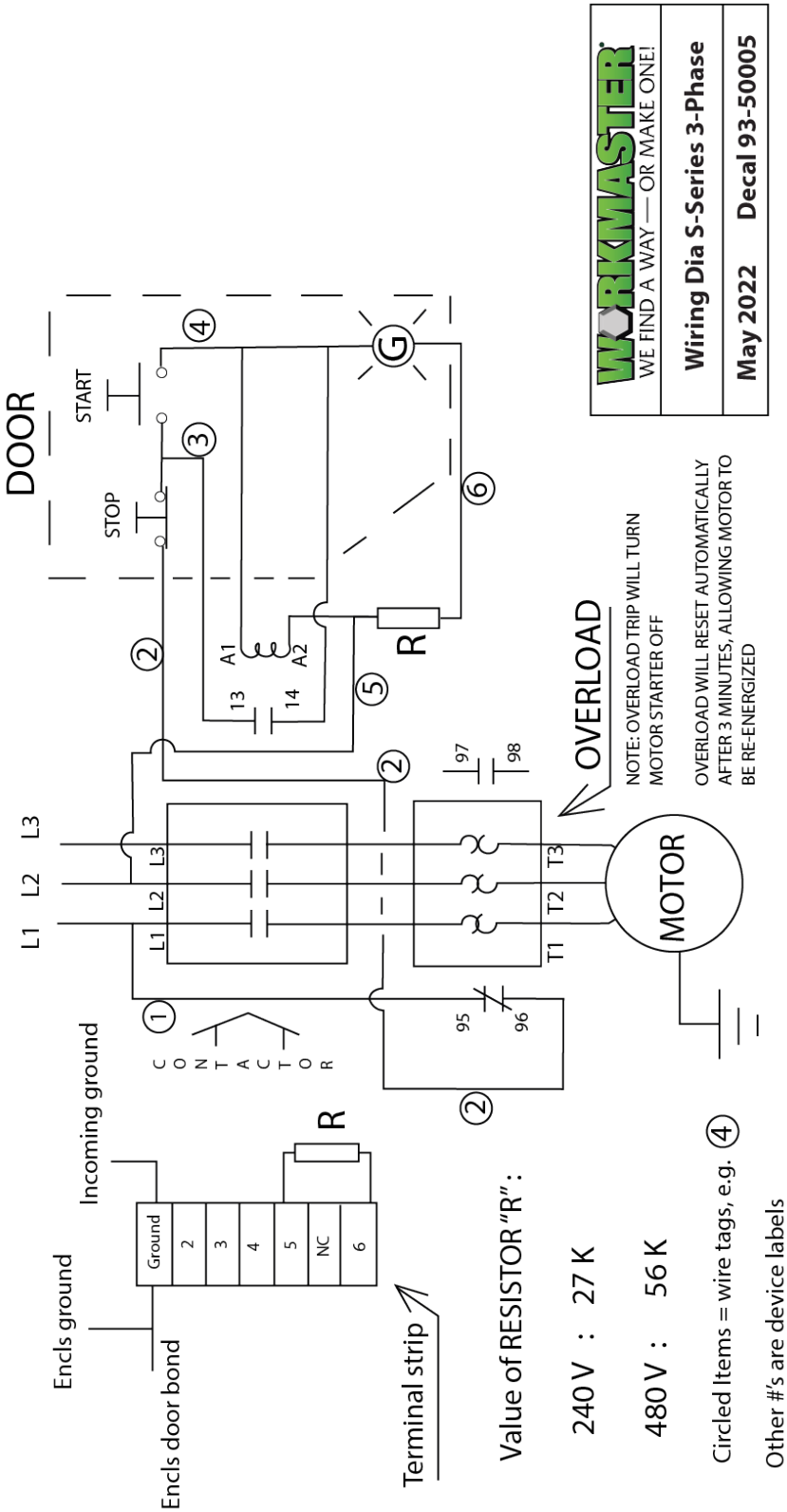
AMP* RATING	**MINIMUM WIRE GAUGE**
up to 20	12 ga
20 to 30	10 ga
30 to 40	8 ga

* If more than 3 insulated copper conductors are placed in a raceway or cable, Wire Gauge may need to be upgraded. Consult NEC Handbook.

APPENDIX B: SINGLE-PHASE WIRING DIAGRAM



APPENDIX C: THREE-PHASE WIRING DIAGRAM

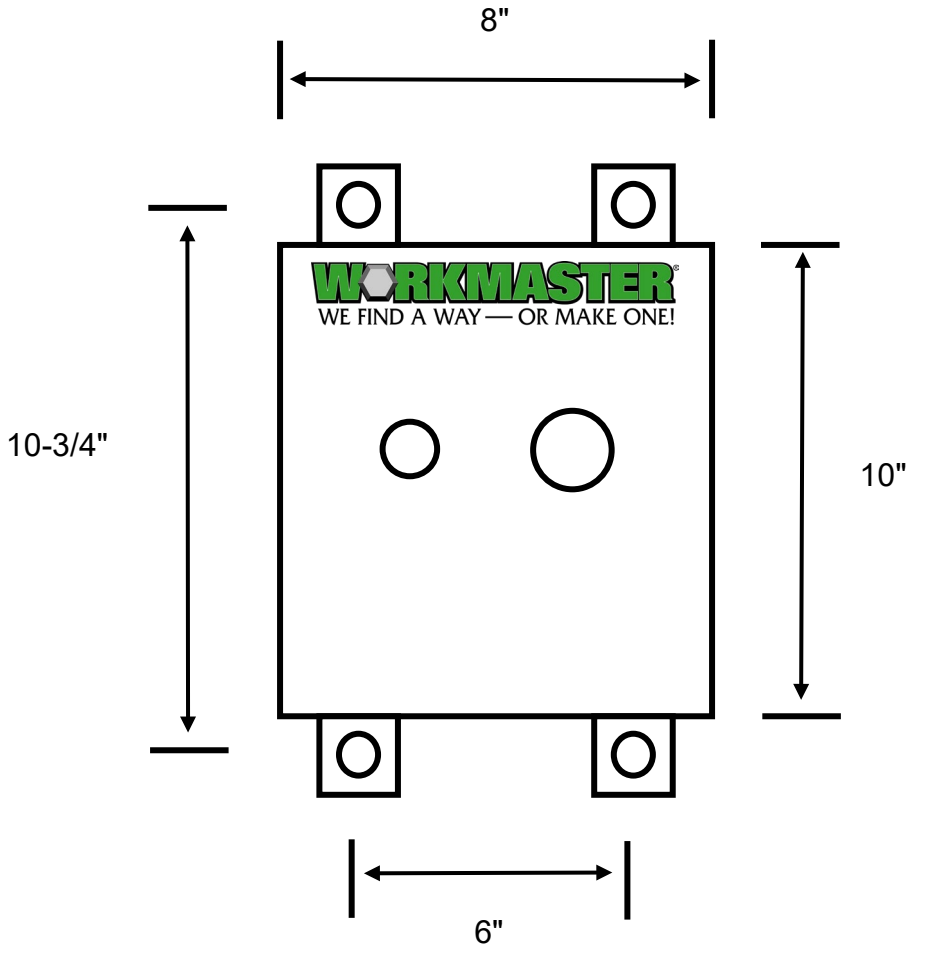


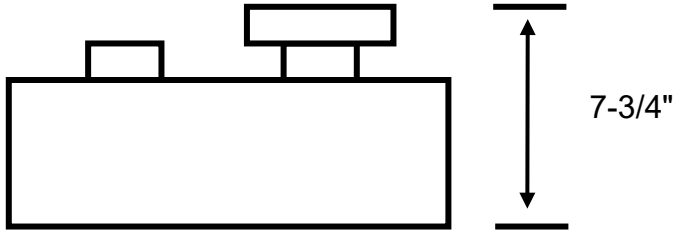
APPENDIX D: TROUBLESHOOTING GUIDE

SYMPTOM	CAUSE
Motor Starter does not turn ON	Check proper voltage fed between L1 and L2. For three-phase units, make sure Leads 1 & 2 are connected to L1 and L2. For single-phase units, make sure that Leads 1 & Neutral are connected to L1 and L2. (Leads 1 & 2 for three-phase and leads 1 & Neutral for Single-Phase, are pre-wired to the L1 and L2 contactor inputs at the factory – *they must remain connected as delivered after service voltage is connected.)* Check that voltage across contactor coil (A1 and A2) is present when START is pushed. If no voltage is present, but is present between L1 and L2, work back through circuit, using the Schematic, to see where voltage is blocked. If voltage is present, check continuity across coil. Make sure contactor is mechanically free to engage by depressing plastic plunger on contactor.
Motor Starter turns ON, but motor does not start.	For three-phase units, check voltage at input of L3 contactor. If O/L trips, make sure the motor is not locked. O/L will reset automatically after three minutes. O/L has two trip settings: AUTO and MANUAL. The O/L should be set on AUTO. For single-phase units, make sure starting capacitor is both connected and working properly. Note that capacitor connections should be between T3 (fed through Neutral for 120 VAC applications) and the motor's starting line. **DO NOT CONNECT CAPACITOR(S) TO T1 (Hot line)**. If the capacitor(s) are to be placed in the Motor Starter enclosure, the motor's starter line must be brought into the enclosure to allow proper connection.

Motor Starter turns ON, but motor does not start.	With motor wires disconnected from O/L, check for voltage at output of O/L. For single phase, check T1 and T3; For three-phase, check T1, T2 and T3. If voltage is present at these terminals when Motor Starter is ON, but motor fails to start, the problem is in motor wiring or motor itself. Check for continuity through motor leads.
Motor starts, but frequently trips O/L	Check the FLA rating on motor nameplate, and make sure O/L amp setting matches. If they match, measure the amperage going to motor, which should not exceed FLA rating. If the amperage through motor exceeds nameplate FLA, causing O/L tripping, this is normal operation. The problem is: (1) motor winding; (2) excessive load placed on motor; (3) the motor wiring (Leads between winding and starter). For a vibrator, which can have highly variable load, depending upon operating conditions, check mounting, unbalance setting, and whether vibrator is running on empty or close-to-empty bin, which will increase (perhaps beyond O/L trip level), the load on the vibrator motor. Fasteners securing vibrator to its mount must be checked for loosening several times soon after installation. Loose fasteners, low rigidity mount, and excessive unbalance all will increase the load on the motor, which decreases its life.
Motor and Motor Starter light remain ON only when START button is depressed.	"Self-latching" circuit not working. Check for continuity between N.O. auxiliary contact terminals 13 and 14 and START switch terminals (3 and 4). (*See* Schematic).
Motor and Motor Starter both turn ON, but motor is turning in wrong direction.	For three-phase motors, run direction can be changed by exchanging any two of the motor's Hot Leads. For single-phase motors, consult the owner/operator manual for that specific motor.

APPENDIX E: ENCLOSURE DIMENSIONS





NOTES

NOTES

NOTES

WORKMASTER®

WE FIND A WAY — OR MAKE ONE!

www.workmaster.net

Ph: 267.350.2809

PN: 10-00042
092024