Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT: Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).
# Table of Contents

## Important User Information
- 2

## Preface
- Introduction ....................................................... 5
- Who Should Use This Manual ................................. 5
- What Is Not in this Manual ................................. 5
- Required Supplemental Information ..................... 5
- General Precautions .............................................. 6
- Commissioning Support ........................................ 6
- Additional Resources ........................................... 6
- Contractor Scope of Work ..................................... 7

## Chapter 1
### Drive Mechanical Installation
- Introduction ....................................................... 9
- Mechanical Installation Summary .......................... 9
- Connect Shipping Splits .................................... 9
- Affix Cabinets to Floor ..................................... 13
- Install Main Cooling Fans .................................. 16
- Install Power Modules (if applicable) .................... 17
  - Power Module Lift Cart .................................. 17
  - Install Power Modules .................................... 19
- External Ducting .............................................. 20
- Air Conditioning Sizing ..................................... 22

## Chapter 2
### Drive Electrical Installation
- Introduction ....................................................... 23
- Safety and Codes .............................................. 23
- Electrical Drawings .......................................... 24
- Grounding System Requirements .......................... 24
- Power Cable Insulation Requirements .................. 25
- Power Cable Design Considerations .................... 26
- Motor Cable Sizing ............................................ 26
- Control Signal Wiring Design Considerations ........... 27
  - Control Signal Wire Shield Grounding ................ 27
- Electrical Installation Summary .......................... 28
- Connect the System Ground Cable ....................... 28
- Insulation Resistance (IR) Test of Power Cables ...... 29
- Connect Incoming Line and Outgoing Motor Power Cables .......................................................... 29
- Connect Control Power Wiring ............................ 32
  - Introduction ................................................. 32
  - Wiring Routing and Connection ......................... 32
- Connect External Control Signal Wiring ............... 34
  - Introduction ................................................. 34
  - Analog and Digital I/O Overview ....................... 34
  - Wiring Routing and Connection ......................... 34
- Connect Electrical Safety Interlock Circuit to Input Circuit Breaker ........................................... 35
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>35</td>
</tr>
<tr>
<td>MV Door Safety Interlock</td>
<td>35</td>
</tr>
<tr>
<td><strong>Chapter 3</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>37</td>
</tr>
<tr>
<td>Electrical Interconnection Summary</td>
<td>37</td>
</tr>
<tr>
<td>Power Cable Interconnection Overview</td>
<td>37</td>
</tr>
<tr>
<td>Connect Isolation Transformer Secondary Power Cables</td>
<td>38</td>
</tr>
<tr>
<td>Introduction</td>
<td>38</td>
</tr>
<tr>
<td>Cable Routing and Connection</td>
<td>40</td>
</tr>
<tr>
<td>Connect Motor and Voltage Sensing Board Cables</td>
<td>41</td>
</tr>
<tr>
<td>Introduction</td>
<td>41</td>
</tr>
<tr>
<td>Connect LV Control and Fan Wiring Bundles</td>
<td>42</td>
</tr>
<tr>
<td>Introduction</td>
<td>42</td>
</tr>
<tr>
<td>Connect Ground Bus</td>
<td>42</td>
</tr>
<tr>
<td>Introduction</td>
<td>42</td>
</tr>
<tr>
<td>Complete the Installation</td>
<td>43</td>
</tr>
<tr>
<td><strong>Appendix A</strong></td>
<td></td>
</tr>
<tr>
<td>Pre-Commissioning Responsibilities</td>
<td>45</td>
</tr>
<tr>
<td>Inspection and Verification</td>
<td>45</td>
</tr>
<tr>
<td>Pre-Commissioning Checklist</td>
<td>46</td>
</tr>
<tr>
<td><strong>Appendix B</strong></td>
<td></td>
</tr>
<tr>
<td>Torque Requirements</td>
<td>49</td>
</tr>
<tr>
<td><strong>Appendix C</strong></td>
<td></td>
</tr>
<tr>
<td>General Wire Categories</td>
<td>51</td>
</tr>
<tr>
<td><strong>Appendix D</strong></td>
<td></td>
</tr>
<tr>
<td>Power Cabling and Control Signal Wiring Details</td>
<td></td>
</tr>
<tr>
<td>Schematic Diagrams</td>
<td>53</td>
</tr>
<tr>
<td>Standard Input/Output Connection Points</td>
<td>55</td>
</tr>
<tr>
<td><strong>Appendix E</strong></td>
<td></td>
</tr>
<tr>
<td>Line and Load Cable Sizes</td>
<td>57</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>61</td>
</tr>
</tbody>
</table>
Preface

Introduction
This document provides procedural information for physically unloading, moving, and installing PowerFlex® 6000 medium voltage drives.

Who Should Use This Manual
This manual is intended for use by professional riggers, general contractors, electrical contractors, or plant operations personnel familiar with moving and siting heavy equipment. Specific experience with solid-state variable speed drive equipment is NOT required for this part of the installation process, but is mandatory for subsequent processes.

What Is Not in this Manual
This manual provides information specific for physically unloading and situating a PowerFlex 6000 drive. It does not include project-specific, or drive-specific topics such as:

- Dimensional Drawings and Electrical Drawings generated for each customer's order.
- Spare parts lists compiled for each customer's order.
- Drive-specific technical specifications.

Refer to the following documents for additional product detail or instruction relating to PowerFlex 6000 drives:

- PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping and Handling Manual, publication 6000-IN008: instructions for shipping and handling a Medium Voltage variable frequency drive and related equipment.
- PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual, publication 6000-UM002: instructions for daily recurring drive usage, HMI interface and maintenance tasks for the product's end-user.
- PowerFlex 6000 Medium Voltage Variable Frequency Drive Parameter Manual, publication 6000-TD004: detailed information on drive features, parameters, and troubleshooting faults.

Required Supplemental Information
This manual includes generic information about the drive cabinet layout orientation and generic electrical connection information.

Review the project-specific Dimensional Drawings (DDs) and Electrical Drawings (EDs) to better understand the specific drive system cabinet orientation and wiring requirements before performing any mechanical or electrical work. Paper copies of the DDs and EDs are placed in the document/hardware box in the Isolation Transformer Cabinet before shipment. Contact the local Rockwell Automation office to obtain digital copies, if required.
General Precautions

**ATTENTION:** This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference Allen-Bradley publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

**ATTENTION:** An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

**ATTENTION:** Only personnel familiar with the PowerFlex 6000 Adjustable Speed Drive (ASD) and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

Commissioning Support

After installation, Rockwell Automation is responsible for commissioning activities for the PowerFlex 6000 product line. Contact your local Rockwell Automation sales representative to arrange commissioning.

Rockwell Automation support includes, but is not limited to:

- quoting and managing product on-site start-ups
- quoting and managing field modification projects
- quoting and managing product training at Rockwell Automation facilities and on-site

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping and Handling Manual, publication 6000-IN008</td>
<td>Provides instructions for shipping and handling a Medium Voltage variable frequency drive and related equipment.</td>
</tr>
<tr>
<td>PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual, publication 6000-UM002</td>
<td>Provides instructions for daily recurring drive usage, HMI interface and maintenance tasks for the product’s end-user.</td>
</tr>
<tr>
<td>PowerFlex 6000 Medium Voltage Variable Frequency Drive Parameter Manual, publication 6000-TD004</td>
<td>Provides detailed information on drive features, parameters, and troubleshooting faults.</td>
</tr>
<tr>
<td>Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1</td>
<td>Provides general guidelines for installing a Rockwell Automation industrial system.</td>
</tr>
<tr>
<td>Product Certifications website, <a href="http://www.ab.com">http://www.ab.com</a></td>
<td>Provides declarations of conformity, certificates, and other certification details.</td>
</tr>
</tbody>
</table>
You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Contractor Scope of Work

Typical scope of work by the freight company, third-party contractor and/or customer (based on ex-works INCO terms)\(^{(1)}\):

- Load equipment on truck at a Rockwell Automation manufacturing facility and transport equipment to site
- Offload equipment from truck on-site
- Perform initial inspection\(^{(2)}\)
- Move equipment to the final installation location
- Position the cabinet sections together as shown in Dimensional Drawing and level the cabinet lineup
- Mechanically join cabinets together
- Affix the cabinets to the floor
- Install assemblies shipped loose (fan assemblies).
- Install external ductwork to exhaust heated air from control room (if required)
- Install power and control cabling and terminate cable connections to drive system:
  - Connect system ground cable
  - Insulation Resistance (IR) testing of incoming line and outgoing motor power cables
  - Connect incoming line and outgoing motor power cables
  - Connect control power wiring
  - Connect all external customer required control signal wiring
  - Connect electrical safety interlock control signal wiring circuit to input circuit breaker
  - Connecting the power cables and control wiring between cabinets that are shipped separately\(^{(3)}\)
- Complete Pre-commissioning Checklist

\(^{(1)}\) All or part of these activities could be provided by Rockwell Automation or its representatives, based on contract INCO terms and negotiated scope of supply/services agreement. Contact the local Rockwell Automation office for further information.

\(^{(2)}\) Customer should lead the initial inspection process.

\(^{(3)}\) Interconnection of power cables and low voltage control wiring bundles, between separately shipped cabinets, can be done by the contractor or Rockwell Automation. The commissioning quote from Rockwell Automation reflects this and will contain two options:
  a) the base quote, reflecting the power cable and control wiring interconnection work being done by the contractor
  b) the optional quote adder, reflecting the additional time and cost for Rockwell Automation to perform the power cable and control wiring interconnection work immediately prior to the commissioning process.
Notes:
Chapter 1

Drive Mechanical Installation

Introduction

The installation process is divided into three principal activities. The mechanical installation process described in this chapter, the electrical installation process described in Drive Electrical Installation on page 23, and the electrical interconnection process described in Drive Electrical Interconnection on page 37.

Mechanical Installation

Summary

The cabinets must be arranged as shown in the Dimensional Drawing.

Connect Shipping Splits 9
Affix Cabinets to Floor 13
Install Main Cooling Fans 16
Install Power Modules (if applicable) 17
External Ducting 20

Follow all applicable guidelines for siting the components before continuing with these installation instructions.

There may be some variation in the process depending on the type and number of drive components in your particular installation.

Connect Shipping Splits

ATTENTION: Install the drive on a level surface (+/- 1 mm per meter [ +/- 0.036 in. per 36 in.] of drive length in all directions). If necessary, use metal shims to level the cabinets before joining them; attempting to level after joining may twist or misalign the cabinets.

The PowerFlex 6000 drive is shipped in two sections, the Isolation Transformer Cabinet and Power Module/LV Control Cabinet. These two cabinets must be connected after located in its final position. The cabinets are connected together in 8 or 10 places (depending on the drive rating), half along the front edge of the cabinet and half along the rear edge of the cabinet. Access to the interior of the cabinet is required to make these connections. Access for the front connections requires only opening the doors. Access for the rear connections requires removing the back plates of the cabinet.

IMPORTANT Rear access to all cabinets is required for subsequent processes. Do not reinstall back plates until after the conclusion of the Drive Electrical Interconnection process.
1. Arrange the sections as directed in the Dimensional Drawings and move the sections together.

2. Align the cabinet side sheets together at the holes for the hardware (see step 3).

**Figure 1 - Aligning Cabinets, Type A (6/6.6 kV shown)**

**Optional Cabinets**
1. Start-up cabinet (Pre-charge cabinet)
2. Output filter cabinet
3. Bypass cabinet
4. and others

**Table 1 - Sidesheet Openings**

<table>
<thead>
<tr>
<th></th>
<th>Front Wireway</th>
<th>U Phase Motor Cable</th>
<th>V Phase Motor Cable</th>
<th>W Phase Motor Cable</th>
<th>Ground Bus Connection</th>
<th>Voltage Sensing Board Cables</th>
<th>Isolation Transformer Secondary Cables(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) The number of Isolation Transformer secondary cables is dependent on motor voltage class.

- 9 cables per motor phase (27 total) for 3/3.3 kV
- 12 cables per motor phase (36 total) for 4.16 kV
- 15 cables per motor phase (45 total) for 6 kV
- 18 cables per motor phase (54 total) for 6.6 kV
- 24 cables per motor phase (72 total) for 10kV
- 27 cables per motor phase (81 total) for 11 kV
Table 2 - Sidesheet Openings

1. Front Wireway
2. U Phase Motor Cable
3. V Phase Motor Cable
4. W Phase Motor Cable
5. Ground Bus Connection
6. Voltage Sensing Board Cables
7. Isolation Transformer Secondary Cables

(1) The number of Isolation Transformer secondary cables is dependent on motor voltage class:
- 9 cables per motor phase (27 total) for 3/3.3 kV
- 12 cables per motor phase (36 total) for 4.16 kV
- 15 cables per motor phase (45 total) for 6 kV
- 18 cables per motor phase (54 total) for 6.6 kV
- 24 cables per motor phase (72 total) for 10 kV
- 27 cables per motor phase (81 total) for 11 kV

(2) 6/6.6 kV configurations only require 18 cable hole locations per phase. Extra cable hole locations allow for added installation flexibility.
3. Secure the cabinets together using M6 or M8 hardware. See Torque Requirements on page 49 for proper torque requirements.

Open the doors to access front edge joining holes (four or five places).

**Figure 3 - Secure the Cabinets, Type A**

- Secure with M8 (or M10) hardware (10 places)
- M10x25 hex bolt
- Lock washer
- Flat washer (x2)
- M10 hex nut
- Cabinet sidesheets

**Figure 4 - Secure the Cabinets, Type B**

- Secure with M6 hardware (8 places)
- 2-socket screw M6x16
- Combination pillar
4. Remove all back plates to access rear edge joining holes (five places).

**TIP** Each back plate will have two keyhole screw holes on either side. Remove all of the other screws first. Loosen the two screws in the keyhole screw holes last and lift the back plate to remove. Do not remove these screws. Do not replace the back plates until the Drive Electrical Interconnection Process is complete (See Drive Electrical Interconnection on page 37).

To replace the back plates, the two remaining screws orient and hold the back plate in place while fastening the other screws holding the back plates to the frame of the cabinet. Tighten these screws last to complete the process.

Affix Cabinets to Floor

Typical floor drawings show minimum clearance distance, conduit openings, and mounting holes for anchor bolts\(^{(1)}\), as shown in Figure 5. Refer to customer specific dimensional drawing for outgoing motor and incoming line cable openings.

**Figure 5 - Typical Floor Drawing, Type A**

Isolation Transformer Cabinet  |  Power Module/LV Control Cabinet

Secure the cabinet to the channel steel base using M16 bolt, lock washer, two flat washers and a nut.

\(^{(1)}\) Mounting holes are represented as + in Figure 5.
Secure the cabinet to the channel steel base using M12 bolt (recommended), lock washer, two flat washers and a nut.

Figure 7 - Bolt Cabinet to Steel Base, Type A

Figure 8 - Bolt Cabinet to Steel Base, Type B
Optional: The cabinet can also be welded to the steel base once it is securely bolted, if desired.

Each weld location should be 100 mm (3.9 in.) for every 1000 mm (39.4 in.). See Mounting Requirements in the PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping and Handling Manual, publication 6000-IN008 for further information on the steel base and desired trench and mounting specifications.

Figure 9 - Welding locations

ATTENTION: Failure to correctly anchor the cabinet may result in damage to the equipment or injury to personnel.
Chapter 1  Drive Mechanical Installation

Install Main Cooling Fans

Main cooling fans are shipped in separate crates. The fans are shipped assembled in the fan housing, but must be installed after siting the drive.

**IMPORTANT**  See Mounting Clearance Distance in the PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping and Handling Manual, publication 6000-IN008 to verify that the fans have the appropriate clearance distance on top of the cabinet.

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions (HxWxD), approx.</th>
<th>Weight, approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH40</td>
<td>340 x 440 x 500 mm (13.0 x 17.3 x 19.7 in.)</td>
<td>20 kg (44.1 lb)</td>
</tr>
<tr>
<td>RH45</td>
<td>380 x 490 x 550 mm (14.6 x 19.3 x 21.7 in.)</td>
<td>25 kg (55.1 lb)</td>
</tr>
<tr>
<td>EC400</td>
<td>358 x 480 x 670 mm (14.1 x 18.9 x 26.4 in.)</td>
<td>30 kg (66 lb)</td>
</tr>
</tbody>
</table>

1. Place the fan housing on the top plate of the drive, making sure the socket is on the same side as the aviation plug.
2. Secure the fan housing using M6 hardware (six places).
   
   See Torque Requirements on page 49.
3. Connect the aviation plug located on top of the cabinet with the socket on the fan housing.

Figure 10 - Main Cooling Fan Housing, Type A
Install Power Modules (if applicable)

Power Modules are available in a wide variety of amperage ratings relating to the required motor current. Power Modules rated up to and including 350 A are mounted in the drive and ship already installed.

Power Modules rated above 350 A are shipped separately, therefore site installation and cable connection is needed. In this case, a lift cart is supplied and shipped together with the other components.

Power Module Lift Cart

**ATTENTION:** Only authorized personnel should operate the lift cart. Keep hands and feet away from the lifting mechanism. Do not stand under the lift tray when in use. Store the lift cart with the tray fully lowered.

The lift cart’s hydraulic cylinder can be operated by either a hand or foot crank. The lifting capacity is 400 kg (882 lb).
1. Check the lift tray before use to ensure the tray can be raised and lowered smoothly.

2. Rotate the Pressure Release Knob counterclockwise to ensure that the tray is in the lowest position.

3. Move the Power Module on the tray and lift the module to the appropriate height using the Foot Crank and complete the installation.

**TIP** The Foot Crank raises the lift tray faster than the Hand Crank. Use this to raise the Power Module to just below the tray assembly in the drive. Use the Hand Crank for final precise positioning.

4. Rotate the Pressure Release Knob counterclockwise to lower the tray to its original position.

5. Repeat steps 1...4 to complete the installation for all the Power Modules.

**ATTENTION:** Two people are required to handle the Power Modules.
Install Power Modules

**IMPORTANT** The Power Module should be handled carefully. After removing the packaging, inspect the Power Module to confirm there is no damage and moisture.

1. You can use the lift cart to move and position the Power Module to the appropriate location in the cabinet.

2. Push the Power Module slowly along the guide rails until it cannot be pushed in further.

3. After installing the Power Module in place, use the mounting brackets and the M6 × 16 large flat pad galvanized nickel screws to fix the four corners, as shown below.
External Ducting

The PowerFlex 6000 design can accommodate ducting exhaust air outside of the control room.

ATTENTION: The Isolation Transformer Cabinet and the Power Module/LV Control Cabinet must be ducted separately.

The following requirements are mandatory design requirements for systems that will externally duct the exhaust air and draw cleansed outside air:

- External ducting including an external filtering system must not add more than 50 Pa (0.2 in. of water) pressure drop to the PowerFlex 6000 drive airflow system. Ensure a minimum top clearance of 1500 mm (39.4 in.) above the drive top plate.

- The control room must provide slightly more make-up air, creating a pressurized room. This slight pressurization prevents unfiltered air drawing into the room.

- The drive is intended to operate in conditions with no special precautions to minimize the presence of sand or dust, but not in close proximity to sand or dust sources. IEC 721-1 defines this as being less than 0.2 mg/m³ of dust.

- If outside air does not meet this condition, filter the air to EU EN779 Class F6 or ASHRAE Standard 52.2 MERV 11. These ratings address a high percentage of the 1.0...3.0 μm particle size. Clean or change filters regularly to ensure proper flow.

- The make-up air must be between 0...40 °C (32...104°F).

- Relative humidity must be less than 95% non-condensing.

- If the ducting length is greater than 4 m, an axial fan must be installed at the air outlet. The exhaust flow of the axial fan must be greater than the total flow amount of all the centrifugal fans in this air duct.

- The ducting can be shared by more than one cabinet.

- Do not cover any medium voltage or control power wires which enter or exit from the top of the cabinet.

- The air duct outlet must slope downward to prevent water damage.

- Screens must be installed in the air duct outlet.

- An air inlet must be added to the drive room. The cross-sectional area of this inlet must meet the ventilation requirements of all drives. Screens must be installed in the air inlet.

- The air inlet and outlet must not be at the same side of the drive room.
Figure 13 - Cabinet Airflow, Type A

Figure 14 - Cabinet Airflow, Type B

(1) Top ducting shown by contractor.
Air Conditioning Sizing

If the drive is located in an enclosed space, install air conditioners for each drive. A general formula to calculate air conditioner power required:

\[
\frac{\text{DriveRating (kW)} \times (1 - \text{DriveEfficiency})}{3.5} = \text{Air Conditioning Size (tons)}
\]

**EXAMPLE**

For a 1000 kW drive with 96.5% efficiency:

\[
\frac{1000 \times (1 - 0.965)}{3.5} = 10 \text{ tons of AC required}
\]

This is for a general estimate. Refer to the actual heat loss data to calculate air conditioning sizing. Contact the local Rockwell Automation office for actual data.
Chapter 2

Drive Electrical Installation

Introduction

The installation of all external power cables and control signal wiring is covered in this chapter. General electrical safety and installation guideline topics are also included. The basic activities include connecting the system ground cable, line and motor cables, control power, and all control signal wiring from the sources to the drive. See Figure 30 and Figure 31 for an overview of these connections.

Electrical interconnections are also required between cabinets that have shipped separately. These are described in Drive Electrical Interconnection on page 37.

Safety and Codes

SHOCK HAZARD: Connecting to potentially energized industrial control equipment can be dangerous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages may exist in the cabinet even with the circuit breaker in the off position. Required practice is to disconnect and lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. If it is necessary to work in the vicinity of energized equipment, the safety related work practices outlined in Electrical Safety requirements for Employee Work places must be followed. Before attempting any work, verify the system has been locked out and tested to have no potential.

Lockout and tagout the input circuit breaker before performing any electrical connection work. After the input circuit breaker cabinet doors are opened, immediately test the outgoing connections and any components connected to medium voltage with a live-line tool (hot stick) while wearing high voltage gloves. Pay special attention to any capacitors connected to medium voltage that can retain a charge for a period of time. Only after the equipment has been verified as isolated and de-energized can subsequent work be performed. Even though the input to the drive may be open, it is still possible for hazardous voltage to be present.

Refer to national and local safety guidelines for detailed procedures on how to safely isolate the equipment from hazards.

ATTENTION: The national and local electrical codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire type, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.
Electrical Drawings

Before connecting any power cables or control signal wiring, review and understand the information contained in the project-specific Electrical Drawings.

They contain critical information such as:

- Minimum power cable insulation ratings and sizes
- Power terminal locations and designations
- Terminal block designations for all connections to external customer control signal wiring and control power supply cables.

The practice used within the PowerFlex 6000 electrical drawing is based on the IEC or NEMA standard depending on the requirements. The symbols used to identify components on the drawings are international.

Device designations used on the drawings and labeling are explained on each drawing set.

Wiring identification uses a source/destination wire number convention on point-to-point multi-conductor wiring and in situations where the system is warranted. The wire-numbering system of unique, single numbers for multi-drop and point-to-point wiring continues to be used for general control and power wiring.

Wiring that connects between the sheets or that ends at one point and starts at another point on a drawing has an arrow and drawing reference to indicate the ongoing connection. The drawing reference indicates the sheet and the X/Y coordinates of the continuation point. The reference system is explained on a sheet in each drawing set. The unique wire numbering system serves as confirmation that the correct wire is being traced from sheet-to-sheet or across a drawing. Wires in multi-conductor cables are typically identified by color rather than by number. Abbreviations used to identify the colors on the drawings are fully identified on a sheet in the drawing set.

Grounding System
Requirements

As a general guideline, the ground path must be of sufficiently low impedance and capacity that:

- the rise in potential of the drive ground point when subjected to a current of twice the rating of the supply should be no higher than 4 V over ground potential
- the current flowing into a ground fault is of sufficient magnitude to cause the protection to operate.

The general grounding point must be reliably connected with the grounding network.
Attach an external ground cable to the main ground bus, in compliance with applicable national and local electrical codes.

**IMPORTANT** The primary grounding cable must have a diameter of at least 50 mm² and meet all applicable national and local electrical codes.

Run the system ground cable separately from power and signal wiring so that faults:
- do not damage the grounding circuit
- will not interfere with or damage the protection or metering systems, or cause undue disturbance on power lines.

### Power Cable Insulation Requirements

Incoming line power cable ratings are shown on the Electrical Drawings and reflect what would typically be supplied, based on line voltage rating.

All voltage ratings for outgoing motor cables shown are line-to-ground rated power-frequency voltages and line-to-line power-frequency voltages.

**Table 5 - Cable Insulation Requirements for Outgoing Motor Cables**

<table>
<thead>
<tr>
<th>System Voltage (V, RMS)</th>
<th>Cable Insulation Rating (kV) - Motor Side</th>
<th>Line-to-Ground Rated Power Frequency Voltage U₀</th>
<th>Line-to-Line Rated Power Frequency Voltage U</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300</td>
<td>≥3.6</td>
<td>≥6</td>
<td></td>
</tr>
<tr>
<td>2400</td>
<td>≥3.6</td>
<td>≥6</td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td>≥3.6</td>
<td>≥6</td>
<td></td>
</tr>
<tr>
<td>3300</td>
<td>≥3.6</td>
<td>≥6</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>≥3.6</td>
<td>≥6</td>
<td></td>
</tr>
<tr>
<td>4160</td>
<td>≥3.6</td>
<td>≥6</td>
<td></td>
</tr>
<tr>
<td>6000</td>
<td>≥6.0</td>
<td>≥10</td>
<td></td>
</tr>
<tr>
<td>6300</td>
<td>≥6.0</td>
<td>≥10</td>
<td></td>
</tr>
<tr>
<td>6600</td>
<td>≥6.0</td>
<td>≥10</td>
<td></td>
</tr>
<tr>
<td>6900</td>
<td>≥6.0</td>
<td>≥10</td>
<td></td>
</tr>
<tr>
<td>10,000</td>
<td>≥8.7</td>
<td>≥15</td>
<td></td>
</tr>
<tr>
<td>11,000</td>
<td>≥8.7</td>
<td>≥15</td>
<td></td>
</tr>
</tbody>
</table>

Select cables of appropriate voltage classes when the incoming line grid-side voltage class is different from the outgoing line motor-side voltage class.

Standard power cable ratings commercially available can vary in different regions around the world. Cable must meet the minimum line-to-ground and line-to-line requirements.

**IMPORTANT** Follow the recommended field power cabling insulation levels to help ensure trouble-free start-up and operation. The cable insulation level must be increased over that which would be supplied for an across-the-line application with the same rated line-to-line voltage.
Power Cable Design Considerations

Use fire retardant cables for the drive input/output connections.

Shielded or unshielded cable can be used based on the criteria considered by the distribution system designer and national and local electrical codes.

If shielded power cables are used, connect the shield of the main input/output power cables with the general grounding point of the drive. Ground the drive output protective grounding connection separately, and only at the drive side.

Comply with the maximum tensile stress and the minimum curvature radius recommended by the cable manufacturer.

Do not bundle the input/output cables of the drive together.

The power cable tray must not be less than 300 mm (12 in.).

There must be no gaps where the conduit connects to the cabinet and the ground bond must be less than 0.1 ohms. Spacing between wire groups is the recommended minimum for parallel runs of approximately 61 m (200 ft) or less.

Motor Cable Sizing

Voltage drop in motor leads may adversely affect motor starting and running performance. Installation and application requirements may dictate that larger wire sizes than indicated in national and local electrical codes are used.

Wire sizes must be selected individually, observing all applicable safety and national and local electrical codes. The minimum permissible wire size does not necessarily result in the best operating economy. The minimum recommended size for the wires between the drive and the motor is the same as that used if a main voltage source connection to the motor was used. The distance between the drive and motor can affect the size of the conductors used.

Consult the Electrical Drawings and appropriate national and local electrical codes to determine correct power wiring. If assistance is needed, contact your local Rockwell Automation Sales Office.
Control Signal Wiring Design Considerations

Use shielded cables for all the analog and digital control cables.

Steel conduit or a cable tray can be used for all PowerFlex 6000 drive power or control wiring; however, use only steel conduit for all signal wiring.

ATTENTION: Steel conduit is required for all control and signal circuits when the drive is installed in European Union countries.

Wires for digital and analog signals must be routed separately.

Control cables and power cables must be routed separately; the distance between the control cable tray and the power cable tray must not be less than 300 mm.

If the control cable must pass through the power cable tray, the angle between the cable trays must be as close to 90° as possible.

Do not mix AC and DC wires in the same cable bundle.

General Wire Categories on page 51 identifies general wire categories for installing the PowerFlex 6000 drive. Each category has an associated wire group number that is used to identify the required wire. Application and signal examples, along with the recommended type of cable for each group, are provided. A matrix providing the recommended minimum spacing between different wire groups which run in the same tray or in a separate conduit is also provided.

Control Signal Wire Shield Grounding

Guidelines for Drive Signal and Safety Grounds: when using interface cables carrying signals, where the frequency does not exceed 1 MHz, for communications with the drive, follow these general guidelines:

- Ground screen mesh around the entire circumference, rather than forming a pigtail grounded only at one point.
- For coaxial cables with a single conductor surrounded by a mesh screen, ground the screen at both ends.
- When using a multi-layer screened cable (that is, a cable with both a mesh screen and a metal sheath or some form of foil), there are two alternative methods:
  - Ground the mesh screen at both ends to the metal sheath. The metal sheath or foil (known as the drain) should, unless otherwise specified, be grounded at one end only, again, as specified above, at the receiver end or the end that is physically closest to the main equipment ground bus
  - Leave the metal sheath or foil insulated from ground, and ground the other conductors and the mesh cable screen at one end only, as stated above.
Grounding provisions for control signal wiring is shown in Figure 15.

**Figure 15 - Vertical Ground Bus in LV Cabinet**

![Diagram of Vertical Ground Bus in LV Cabinet]

#### Electrical Installation Summary

<table>
<thead>
<tr>
<th>Task</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect External Cabling and Wiring</td>
<td></td>
</tr>
<tr>
<td>Connect the System Ground Cable</td>
<td>28</td>
</tr>
<tr>
<td>Insulation Resistance (IR) Test of Power Cables</td>
<td>29</td>
</tr>
<tr>
<td>Connect Incoming Line and Outgoing Motor Power Cables</td>
<td>29</td>
</tr>
<tr>
<td>Connect Control Power Wiring</td>
<td>32</td>
</tr>
<tr>
<td>Connect External Control Signal Wiring</td>
<td>34</td>
</tr>
<tr>
<td>Connect Electrical Safety Interlock Circuit to Input Circuit Breaker</td>
<td>35</td>
</tr>
</tbody>
</table>

#### Connect the System Ground Cable

The drive ground bus runs along the bottom of the drive at the front. The ground bus is accessible at the bottom of the front of each drive cabinet when the cabinet door is opened. Connect the system ground cable to the drive ground bus (Figure 16, Figure 17).
Insulation Resistance (IR)
Test of Power Cables

Before connecting the incoming line and outgoing motor power cables, follow standard industry practice to verify the integrity of the power cable insulation from the input breaker to the drive and from the drive to the motor.

Connect Incoming Line and Outgoing Motor Power Cables

The installer must ensure that all power connections are in accordance with national and local electrical codes.

Each drive is equipped with provisions for bottom power cable entry as standard. Provisions for top power cable entry can also be provided. This must be specified at the time of order.

For the location of incoming line and outgoing motor power cable connections, refer to the customer specific Dimension Drawing.

IMPORTANT:
If an optional cabinet is supplied, the system ground cable connection is in the optional cabinet. Refer to the PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual, publication 6000-UM002.
The drive is supplied with the following provisions for power cable lugs.

**Table 6 - Power Terminals**

<table>
<thead>
<tr>
<th>Incoming Line Cable Connections</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outgoing Motor Cable Connections</td>
<td>U</td>
<td>V</td>
<td>W</td>
</tr>
</tbody>
</table>

**IMPORTANT** If an optional cabinet is supplied, the incoming line and outgoing motor cable connections are in the Bypass cabinet. Refer to the PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual, publication 6000-UM002.

**Figure 18, Figure 19, and Figure 20** show typical connection points for the primary entrance/exit cable.

Connect the three-phase medium voltage inputs L1, L2, and L3 to the user-provided input three-phase AC power.

Connect three-phase medium voltage inputs U, V, and W to the user-provided three-phase asynchronous motor.

Cable clamps are provided in the cabinet to aid in routing and supporting the incoming line and outgoing motor power cables.

**Figure 18 - Isolation Transformer Cabinet, Type A (Junction cabinet not applied)**
Figure 19 - Isolation Transformer Cabinet, Type B (Junction cabinet not applied)

Figure 20 - Isolation Transformer Cabinet, Type C (Junction cabinet applied for cable connection)
Connect Control Power Wiring

Introduction

Externally supplied control power is required to operate the drive. The standard voltage supported is 220V AC/50 Hz. The other typical phase voltages of 230V AC, 110V AC, and 120V AC are also supported (50/60 Hz), but need to be specified at the time of order. A minimum of 3 kVA is required to supply the control circuit.

Wiring Routing and Connection

The opening for the control power wiring must be specified during the quotation stage. Refer to the customer specific Dimension Drawing for the location of the opening. The typical top/bottom entry design is shown below (Figure 21).

Figure 21 - Control Power Wiring Opening, Type A
The control power wiring terminates to the DTB1 terminal block strip on the left side of the LV Control cabinet (Figure 23). See Figure 30 or Figure 31 for general overview. Refer to Electrical Drawings for actual connection points.

Figure 23 - Terminal Block Strip locations
### Connect External Control Signal Wiring

#### Introduction

This section summarizes the control signal wiring from the remote DCS/PLC or discrete control to the drive. General connections are detailed in Power Cabling and Control Signal Wiring Details on page 53. Refer to the Electrical Drawings for connection information specific to the drive being installed.

#### Analog and Digital I/O Overview

Four 4...20 mA analog input signals. One may be used for DCS with rotating speed setting and three for backup. For detailed information, see Table 15 and Table 16 on page 55.

Two 4...20 mA analog output signals for indication signals such as output motor current and frequency. See Table 15 and Table 16 on page 55.

Sixteen passive dry contact inputs (internal 24V DC power supply) start/stop and reset controls. For detailed information, see Table 15 and Table 16 on page 55. These inputs are scalable depending on user requirements.

Twenty dry contact outputs: including nine active dry contact outputs with a capacity of not more than 20W for indication (backup), and 11 passive dry contact outputs powered by the drive with a capacity of 220V AC/5A for DCS status/fault indication. For detailed information, see Table 15 and Table 16 on page 55. These outputs are scalable depending on user requirements.

The drive is provided with dry contact outputs (1 N.O. with a capacity of 220V AC/5 A, valid when closed) which trigger the user-provided medium voltage circuit breaker for interlock with the user-provided medium voltage switch cabinet. For detailed information, see Table 15 and Table 16 on page 55.

Modbus RTU interface is supplied as standard (other communication interfaces including Modbus TCP, Modbus Plus, EtherNet/IP, and Profibus are provided as options). For detailed information, see Figure 31 on page 54.

#### Wiring Routing and Connection

The control signal wiring enters the drive through the same opening as the control power wiring in the LV Control Cabinet (Figure 21 or Figure 22). The wiring terminates either to the DTB1 or DTB2 terminal block strips on either side of the LV Control cabinet (Figure 23). See Figure 30 or Figure 31 for general information. Refer to Electrical Drawings for actual connection points.
Connect Electrical Safety Interlock Circuit to Input Circuit Breaker

Introduction

The electrical safety interlock circuit is part of the overall control signal wiring activity. However, it is mentioned separately in this document due to its critical importance related to the safe operation of the drive and personnel safety.

The circuits connected between the drive and the input circuit breaker:

- allow the drive to trip the input circuit breaker if a drive cabinet door is opened. This applies to the cabinet doors where medium voltage is present. The LV Control cabinet door can be opened while the drive is energized.
- allow the drive to prevent the input circuit breaker from closing when required.
- indicate to the drive when the input circuit breaker is closed.

MV Door Safety Interlock

If the MV cabinet door is opened, the Allen-Bradley Guardmaster Limit Switch (440P-CRPS11D4B) on the cabinet door will actuate. The drive will send a trip signal to the input circuit breaker to disconnect the medium voltage power supply to the drive.

**ATTENTION:** The door position interlock is a safety feature. It must not be used solely as a part of the plant operation process to ensure the drive has been disconnected from input medium voltage. Keep the medium voltage doors locked as standard practice. Always go to the input circuit breaker feeding the drive to verify if it is open. Lock out and tagout the input circuit breaker before performing any work on the drive or bypass units.
When the doors of the Power Module/LV Control Cabinet or Isolation Transformer Cabinet are not closed, when the drive is being maintained or when the control power switch is not closed, the drive will not send a signal allowing the input circuit breaker to close; this is wired as a permissive contact in the input circuit breaker’s closing circuit so that the input circuit breaker cannot close.

**Wire Routing and Connection**

The electrical safety interlock control signal wiring enters the drive through the same opening as the control power wiring in the bottom of the LV Control Cabinet ([Figure 21](enlace) or [Figure 22](enlace)).

The wiring terminates to the X1 terminal block strip on the right side of the LV Control cabinet ([Figure 23](enlace)). See [Figure 30](enlace) or [Figure 31](enlace) for general information. Refer to Electrical Drawings for actual connection points.
Chapter 3

Drive Electrical Interconnection

Introduction

The drive is shipped in two sections, the Isolation Transformer cabinet and the Power Module/LV Control cabinet. An optional cabinet may also be supplied. Drive Mechanical Installation on page 9 describes mechanically joining these cabinets together. This chapter describes the activities required to electrically connect these drive cabinets’ components together.

Electrical Interconnection Summary

<table>
<thead>
<tr>
<th>Connect Internal Cabling and Wiring</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect Isolation Transformer Secondary Power Cables</td>
<td>38</td>
</tr>
<tr>
<td>Connect Motor and Voltage Sensing Board Cables</td>
<td>41</td>
</tr>
<tr>
<td>Connect LV Control and Fan Wiring Bundles</td>
<td>42</td>
</tr>
<tr>
<td>Connect Ground Bus</td>
<td>42</td>
</tr>
</tbody>
</table>

Power Cable Interconnection Overview

Figure 25 provides a three-line drawing overview of the power cable interconnections between the power modules (PC XX) in the Power Module/LV Control cabinet and the secondary windings of the isolation transformer in the Isolation Transformer cabinet. The number of power modules is dependent solely on output (motor) voltage:

- 9 power modules for 2.3/2.4/3.0/3.3 kV
- 12 power modules for 4.0/4.16 kV
- 15 power modules for 6.0 kV
- 18 power modules for 6.6/6.9 kV
- 24 power modules for 10 kV
- 27 power modules for 11 kV

It also shows the connection point from the U, V, and W motor output phases from the power module array to the voltage sensing board cables and the motor cables.

The isolation transformer secondary windings as shown do reflect the actual orientation on the isolation transformer.

The Power Module/LV Cabinet orientation is optimized for drawing clarity. To better understand the physical orientation, the components and connections shown in the Power Module/LV Control Cabinet would be rotated 90° counter clockwise. The U phase is the top horizontal row, the V phase is the middle horizontal row, and the W phase is the bottom horizontal row.
Refer to the Electrical Drawing for actual wire number designations.

**Figure 25 - Power Cabling Overview (3.3 kV shown)**

**Connect Isolation Transformer Secondary Power Cables**

**Introduction**

The isolation transformer’s three-phase primary coils are oriented A, B, and C from left to right, as viewed from the front. The secondary windings are also divided into three principal sections from top to bottom. The upper third are to feed the power modules in the U output phase. The middle third are to feed the power modules in the V output phase. The bottom third are to feed the power modules in the W output phase (Figure 26).
The secondary windings are brought out to corresponding vertical isolated stand-offs on the body of the transformer (orientated U, V, and W from left to right as viewed from the front). See Figure 27.

Each secondary winding set will have a designated U, V, and W terminal connection. For example, (from top to bottom and left to right) the terminals from the first winding set are 1W, 1V, and 1U, the terminals from the next winding set are 2W, 2V, and 2U, and so on.

As shown in Figure 25, the first winding set (1U, 1V, and 1W) will connect to the three-phase input power connection of the first power module in the U motor phase array (PCA1), the second winding set will connect to the second power module in the U motor phase array (PCA2), and the third winding set will connect to the third power module in the U motor phase array (PCA3). The next three winding sets connect to the power modules in the V motor phase array. The remaining three winding sets connect to the power modules in the W motor phase array.

Figure 25 shows 3.0/3.3 kV configuration. The 6.0/6.6 kV and 10 kV configuration have more power modules and therefore have more corresponding isolation transformer secondary windings. The concept is the same—the top third of the winding sets feeds the power modules in the U phase, the middle third feeds the power modules in the V phase, and the bottom third feeds the power modules in the W phase.
Each three-phase secondary winding set of the isolation transformer has three individual single phase power cables connecting its output to the three-phase power input of its corresponding power module.

Drives are shipped split with an Isolation Transformer cabinet and a Power Module cabinet, and connection at the site is needed. The power cables connect to the secondary winding termination in the Isolation Transformer. All cables can be connected from the front of the cabinet.

**Cable Routing and Connection**

**Figure 27 - 6.0/6.6 kV Power Module Configuration**

Front View
Connect Motor and Voltage Sensing Board Cables

Introduction

The Voltage Sensing Board cables and the motor cables both connect to the same output point of each motor phase array (Figure 25).

The voltage sensing cables need to be connected on site. For drive ratings with power modules ≥250 A, the connection points are always on the right side of the power module cabinet.

A typical connection with connection points on the left side of the power module cabinet (for power modules ≤200 A) is shown below (Figure 28).

Figure 28 - 6.6/6.9 kV Power Module Configuration
Connect LV Control and Fan Wiring Bundles

Introduction

There are control wiring bundles that must be reconnected after the drive cabinets are connected together. These control wiring bundles are connected for the factory test and then disconnected and bundled at the shipping splits before shipment.

For exact wire numbers and terminal block designations, refer to the Electrical Drawings.

Connect Ground Bus

Introduction

A solid ground bus is located at the bottom front of each cabinet. When a shipping split is required, ground bus connectors are supplied. One is attached above the solid ground bus and one below (Figure 29).

Ground bus connection openings are provided in the cabinet sidesheets for this connection. See Table 1 on page 10 and Table 2 on page 11.

Figure 29 - Interconnection Ground
Complete the Installation

1. Inspect the interior of all cabinets carefully for hardware or tools that may have been misplaced.

2. Check and verify that no hardware or foreign material has fallen in the secondary windings in the Isolation Transformer cabinet.

3. Check that all mechanical work has been completed properly. All barriers and guards that may have been removed must be reinstalled.

4. Check that all electrical connections have been made and torqued as specified.

5. Verify the safety circuit is working properly (see page 35).

6. Reinstall all of the cabinet back plates.
Notes:
Pre-Commissioning

Pre-Commissioning Responsibilities

Rockwell Automation manages the start-up service for each installed drive at the customer’s site, but there are a number of tasks the customer or its representatives must complete before scheduling Rockwell Automation personnel for drive commissioning.

Review this information prior to commissioning the drive as a reference for drive line-up commissioning. Record the information in the data sheets provided; these are useful during future maintenance and troubleshooting exercises.

ATTENTION: Perform the pre-commissioning tasks in the order listed in this chapter. Failure to do so may result in equipment failure or personal injury.

IMPORTANT: Rockwell Automation requests a minimum of four weeks’ notice to schedule each start-up.

Inspection and Verification

Before the drive commissioning occurs, Rockwell Automation recommends that the customer arranges a pre-installation meeting to review:

a. the start-up plan
b. the start-up schedule
c. the drive(s) installation requirements
d. the pre-commissioning checklist

Customer personnel must be on-site to participate in the system start-up procedures.

See Safety and Codes on page 23.

ATTENTION: The CMOS devices used on the control circuit boards are susceptible to damage or destruction by static charges. Personnel working near static sensitive devices must be appropriately grounded.
Pre-Commissioning Checklist

Once all points of the checklist are complete, initial each check box and provide the date. Photocopy the checklist and fax the copy to the Rockwell Automation Start-up Manager, along with the planned start-up date. Upon receiving this checklist, the Project Manager will contact the site to finalize arrangements for a start-up engineer to travel to the site at your convenience.

Please print the following information:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company:</td>
<td></td>
</tr>
<tr>
<td>Phone:</td>
<td>Pages:</td>
</tr>
<tr>
<td>Fax:</td>
<td></td>
</tr>
<tr>
<td>Drive Serial Number:</td>
<td></td>
</tr>
<tr>
<td>Rockwell Automation Service Engineer Requested (YES/NO):</td>
<td></td>
</tr>
<tr>
<td>Scheduled Commissioning Date:</td>
<td></td>
</tr>
</tbody>
</table>

### Table 7 - Receiving and Unpacking:

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The drives have been checked for shipping damage upon receiving.
- After unpacking, the item(s) received are verified against the bill of materials.
- Any claims for breakage or damage, whether concealed or obvious, are made to the carrier by the customer as soon as possible after receipt of shipment.
- All packing material, wedges, or braces are removed from the drive.

### Table 8 - Installation and Mounting:

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The drive is securely fastened in an upright position, on a level surface.
- The Isolation Transformer Cabinet, Power Module Cabinet, and Bypass Cabinet (if applicable) are correctly installed.
- Lifting Angles have been removed.
- Bolts are inserted into original location on top of drive (prevent leakage of cooling air).
- All contactors and relays have been operated manually to verify free movement.
- The back plates to the cabinets have been reinstalled.

### Table 9 - Safety:

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The grounding of the drive should be in accordance with national and local electrical codes.
**Table 10 - Control Wiring:**

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All low voltage wiring entering the drive is labeled, appropriate wiring diagrams are available, and all customer interconnections are complete.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All AC and DC circuits are run in separate conduits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All wire sizes used are selected by observing all applicable safety and national and local electrical codes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remote I/O is correctly installed and configured (if applicable).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All 3-phase control wiring is within specified levels and has been verified for proper rotation, UVW.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All single-phase control wiring is within specified levels and has grounded neutrals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control lines must be shielded and grounded. Control and Power lines must run in separate conduits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The electrical safety interlock wiring to input circuit breaker is correctly installed.</td>
</tr>
</tbody>
</table>

**Table 11 - Power Wiring:**

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>The power cable connections to the drive, motor and isolation transformer adhere to national and local electrical codes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The cable terminations, if stress cones are used, adhere to the appropriate standards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appropriate cable insulation levels are adhered to, as per Rockwell Automation specifications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All shields for shielded cables must be grounded at the source end only.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If shielded cables are spliced, the shield must remain continuous and insulated from ground.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All wire sizes used are selected by observing all applicable safety and national and local electrical codes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All power connections are torqued as per Rockwell Automation specifications. Refer to Torque Requirements on page 49.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All customer power cabling has been insulation resistance (IR) tested or hi-pot tested before connecting to drive system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power wiring phase rotation has been verified per the specific electrical diagrams supplied by Rockwell Automation.</td>
</tr>
</tbody>
</table>

**Table 12 - Interconnection Wiring**

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>The power cable connection between the Isolation Transformer and Power Modules.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The motor cable connection to the three output buses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Voltage Sensing Board connections to the three output buses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All low voltage connections to the Isolation Transformer Low Voltage panel.</td>
</tr>
</tbody>
</table>
Table 13 - Drive Line-up Status

<table>
<thead>
<tr>
<th>Initials</th>
<th>Date</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>The medium voltage and low voltage power is available for startup activities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The motor is uncoupled from the driven load.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The load is available for full load testing.</td>
</tr>
</tbody>
</table>
## Torque Requirements

Proper tightening torque must be used for installation and wiring.

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Torque Class 8.8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N·m</td>
</tr>
<tr>
<td>M4</td>
<td>3.0</td>
</tr>
<tr>
<td>M5</td>
<td>5.9</td>
</tr>
<tr>
<td>M6</td>
<td>10.5</td>
</tr>
<tr>
<td>M8</td>
<td>26.0</td>
</tr>
<tr>
<td>M10</td>
<td>51.0</td>
</tr>
<tr>
<td>M12</td>
<td>89.0</td>
</tr>
<tr>
<td>M14</td>
<td>141.0</td>
</tr>
<tr>
<td>M16</td>
<td>215.0</td>
</tr>
<tr>
<td>M20</td>
<td>420.0</td>
</tr>
</tbody>
</table>
Notes:
# General Wire Categories

## General Wire Categories

<table>
<thead>
<tr>
<th>Conductors Category</th>
<th>Conductors Group</th>
<th>Machine With</th>
<th>Signal Examples</th>
<th>Recommended Cable</th>
<th>Conductors Group</th>
<th>Power Supplies mm (in.)</th>
<th>Control mm (in.)</th>
<th>To PLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supplies</td>
<td>1</td>
<td>AC power supply (TO 600V AC)</td>
<td>220V, 1Ø</td>
<td>Per IEC / NEC, Local codes and application requirements</td>
<td>Tray</td>
<td>228.6 (9.00)</td>
<td>152.4 (6.00)</td>
<td>All signal wiring must be run in separate steel conduit. A wire tray is not suitable.</td>
</tr>
<tr>
<td>Control</td>
<td>2</td>
<td>220V AC or 220V DC Logic</td>
<td>Relay Logic PLC I/O</td>
<td>Per IEC / NEC, Local codes and application requirements</td>
<td>Tray</td>
<td>228.6 (9.00)</td>
<td>152.4 (6.00)</td>
<td>The minimum spacing between conduits containing different wire groups is 76.2 mm (3 in.).</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>24V AC or 24V DC logic</td>
<td>PLC I/O</td>
<td>Per IEC / NEC, Local codes and application requirements</td>
<td>Tray</td>
<td>228.6 (9.00)</td>
<td>152.4 (6.00)</td>
<td></td>
</tr>
<tr>
<td>To PLC</td>
<td>4</td>
<td>Analog Signal DC supply</td>
<td>5...24V DC Supplies</td>
<td>Belden 8760(1) Belden 8770(2) Belden 9460(3)</td>
<td></td>
<td></td>
<td></td>
<td>All signal wiring must be run in separate steel conduit. A wire tray is not suitable.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Digital circuit (high speed)</td>
<td>Pulse train input tachometer PLC communication</td>
<td>Belden 8760(1) Belden 9460(3) Belden 9463(4)</td>
<td></td>
<td></td>
<td></td>
<td>The minimum spacing between conduits containing different wire groups is 76.2 mm (3 in.).</td>
</tr>
</tbody>
</table>

(1) 18 AWG, twisted pair, shielded
(2) 18 AWG, 3 conductor, shielded
(3) 18 AWG, twisted pair, shielded
(4) 24 AWG, twisted pair, shielded
Notes:
Schematic Diagrams

Figure 30 - Schematic Diagram of the Drive System without a Bypass Cabinet

**DANGER:**
The medium voltage drive is one component in this system which includes an input device supplied by others. The supplier of the input device is responsible for ensuring that there is safe access to the input/output drive (if used) and safe access to the drive.

Wiring locations are for design reference only; actual wiring must comply with the drawings provided with the drive.

Customer Supplied Ground

110/120/208/240 VAC, 1 phase, 50/60 Hz

Control Signal with Branch Circuit Protection (Minimum 3 kVA capacity is needed)

13.8 kV, 3 phase, 60 Hz

Upstream Circuit Breaker (Customer scope of supply)

To Motor

Control Signal

Customer Supplied Ground

110/120/220/230/240 VAC, 1 phase, 50/60 Hz. Control Signal with Branch Circuit Protection (Minimum 3 kVA capacity is needed)
Figure 31 - Terminal Strip Wiring Diagram for Drive System without a Bypass Cabinet

**NOTE:**
1. 4...20 mA shielded cable from customer input shall be grounded at the inverter side.
2. Remote DI input to drive shall be of pulse type with a duration of three seconds, shielded cable.
3. Connection marked with dotted line shall be in the customer's scope of supply.
## Standard Input/Output Connection Points

### Table 15 - Standard I/O Connections Points

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Name of I/O Connection</th>
<th>AI</th>
<th>AO</th>
<th>DI</th>
<th>DO</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Input circuit breaker closing node is allowed (917, 918)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Serially connected into the input circuit breaker’s closing circuit (the VFD provides passive normally open points, valid when closed)</td>
</tr>
<tr>
<td></td>
<td>Input circuit breaker closing node is allowed (957, 958) (Reserved)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Serially connected into the input circuit breaker’s closing circuit (the VFD provides passive normally closed points, valid when open)</td>
</tr>
<tr>
<td>2</td>
<td>Trip connection points within the VFD (919, 920)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Can be connected into input circuit breaker’s closing circuit in parallel (the VFD provides passive normally open points, valid when closed)</td>
</tr>
<tr>
<td></td>
<td>Trip connection points within the VFD (959, 960) (Reserved)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Can be connected into input circuit breaker’s closing circuit (the VFD provides passive normally closed points, valid when open)</td>
</tr>
<tr>
<td>3</td>
<td>Input circuit breaker already closed connection point (117, 119)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Circuit breaker’s auxiliary normally open connection points (valid when closed)</td>
</tr>
<tr>
<td>4</td>
<td>Input vacuum contactor close (961, 962) (Reserved)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Serially connected into the vacuum contactor close (the VFD provides passive normally open points, valid when closed)</td>
</tr>
<tr>
<td>5</td>
<td>Emergency stop status to Input vacuum contactor (967, 968) (Reserved)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Serially connected into the vacuum contactor (the VFD provides passive normally closed points, valid when open)</td>
</tr>
</tbody>
</table>

### Table 16 - I/O Connections related to Remote Distributed Control System

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Name of I/O Connection</th>
<th>AI</th>
<th>AO</th>
<th>DI</th>
<th>DO</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VFD speed regulation command (931, 931A)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided 4...20mA</td>
</tr>
<tr>
<td></td>
<td>Reserved (932, 932A)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided 4...20 mA (Reserved)</td>
</tr>
<tr>
<td></td>
<td>Reserved (934, 934A)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided 4...20 mA (Reserved)</td>
</tr>
<tr>
<td>2</td>
<td>VFD speed feedback signal (927, 928)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>VFD-provided 4...20mA</td>
</tr>
<tr>
<td>3</td>
<td>VFD current feedback signal (925, 926)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>VFD-provided 4...20mA</td>
</tr>
<tr>
<td>4</td>
<td>Alternate start command signal (431, 401) (Reserved)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (pulsed quantity, valid with 3S)</td>
</tr>
<tr>
<td></td>
<td>Remote DCS start command signal (449, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (pulsed quantity, valid with 3S)</td>
</tr>
<tr>
<td></td>
<td>Alternate command signal (432, 401) (Reserved)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally closed passive dry contact (pulsed quantity, valid with 3S)</td>
</tr>
<tr>
<td>5</td>
<td>Remote DCS stop command signal (450, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally closed passive dry contact (pulsed quantity, valid with 3S)</td>
</tr>
<tr>
<td>6</td>
<td>Reserved (433, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (pulsed quantity, valid with 3S)</td>
</tr>
<tr>
<td>7</td>
<td>Reserved (434, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (pulsed quantity, valid with 3S)</td>
</tr>
<tr>
<td>8</td>
<td>Reserved (435, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (switch quantity)</td>
</tr>
<tr>
<td></td>
<td>Reserved (436, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (switch quantity)</td>
</tr>
<tr>
<td></td>
<td>Reserved (437, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (switch quantity)</td>
</tr>
<tr>
<td></td>
<td>Reserved (438, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (switch quantity)</td>
</tr>
<tr>
<td>9</td>
<td>Remote DCS alternate (448, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact (switch quantity)</td>
</tr>
<tr>
<td>10</td>
<td>Remote DCS fault reset command (412, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact</td>
</tr>
</tbody>
</table>
### Table 16 - I/O Connections related to Remote Distributed Control System (Continued)

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Name of I/O Connection</th>
<th>AI</th>
<th>AO</th>
<th>DI</th>
<th>DO</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alternate reset command (412, 401)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>User-provided normally open passive dry contact</td>
</tr>
<tr>
<td>11</td>
<td>Emergency stop button command (1101, 1102)</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>User-provided normally closed passive dry contact (voltage class higher than 220V AC, 5 A, switch quantity)</td>
</tr>
<tr>
<td></td>
<td>Emergency stop button command (1103, 1104)</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>User-provided normally closed passive dry contact (voltage class higher than 220V AC, 5 A, switch quantity)</td>
</tr>
<tr>
<td>12</td>
<td>VFD allow closing indication (901, 902)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker closing indication (903, 904)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD alarm indication (905, 906)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD fault indication (907, 908)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD operation indication (909, 910)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD stop indication (911, 912)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD ready indication (913, 914)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>Remote control indication (915, 916)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td>13</td>
<td>VFD allow closing indication (941, 941A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>Circuit breaker closing indication (942, 942A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD alarm indication (943, 943A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD fault indication (944, 944A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD operation indication (945, 945A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD stop indication (946, 946A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally open passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>VFD ready indication (947, 947A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed passive dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
<tr>
<td></td>
<td>Remote control indication (948, 948A)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>VFD-provided normally closed active dry contact (voltage class ≤220V AC, 5 A) (used for Remote DCS)</td>
</tr>
</tbody>
</table>
Appendix E

Line and Load Cable Sizes

The data in the following tables are informative only; do not base final design criteria solely on this data. Follow national and local installation codes, industry best practices, and cable manufacturer recommendations. As cabling methods can very widely, maximum cables sizes do not account for the size of the conduit hub.

Table 17 - Line and Load Cable Sizes for IEC (In ≤200 A)

<table>
<thead>
<tr>
<th>Description (Motor V/Freq.)</th>
<th>Drive Enclosure Opening mm (in.)</th>
<th>Max. Size &amp; No. Incoming Cables: IEC(^{(1)}) (2) (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Line Cable Sizes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>300 mm(^2) 5 kV or 240 mm(^2) 8 kV/phase</td>
</tr>
<tr>
<td>3300 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>300 mm(^2) 5 kV or 240 mm(^2) 8 kV/phase</td>
</tr>
<tr>
<td>6000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>240 mm(^2) 8 kV or 185mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td>6600 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>240 mm(^2) 8 kV or 185mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td>10,000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>185 mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td>11,000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>185 mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td><strong>Maximum Load Cable Sizes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>300 mm(^2) 5 kV or 240 mm(^2) 8 kV/phase</td>
</tr>
<tr>
<td>3300 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>300 mm(^2) 5 kV or 240 mm(^2) 8 kV/phase</td>
</tr>
<tr>
<td>6000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>240 mm(^2) 8 kV or 185mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td>6600 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>240 mm(^2) 8 kV or 185mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td>10,000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>185 mm(^2) 15 kV/phase</td>
</tr>
<tr>
<td>11,000 V, 50/60 Hz</td>
<td>110 (4.33)</td>
<td>185 mm(^2) 15 kV/phase</td>
</tr>
</tbody>
</table>

(1) Cable sizes are based on overall dimensions of compact-stranded three-conductor shielded cable (common for industrial cable tray installations). Maximum sizing stated accounts for minimum rated cable insulation requirements and the next higher-rated cable (i.e., 8 kV is not commercially available in many areas of the world, therefore Rockwell Automation provides an 8 kV (minimum rating) as well as a 15 kV rating, when applicable. Enclosure openings will accommodate the thicker insulation on the higher-rated cable. IEC ratings show the equivalent to the NEMA sizes. The exact cable mm\(^2\) size shown is not commercially available in many cases; use the next smaller standard size.

(2) Minimum cable bend radius recommendations vary by national codes, cable type, and cable size. Consult local codes for guidelines and requirements. General relationship of cable diameter to bend radius is typically between 7x...12x (e.g., if the cable diameter is 1 in. [2.54 cm] the minimum bend radius could range between 7...12 in. [18.8...30.48 cm]).

(3) As cabling methods can vary widely, maximum cable sizes shown do not account for the size of the conduit hub. Verify size of conduit hub(s) against the "Drive enclosure openings" shown.
<table>
<thead>
<tr>
<th>Drive Enclosure Opening mm (in.)</th>
<th>Max. Size &amp; No. Incoming Cables: UL (1) (2) (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description (Motor V/Freq.)</td>
<td></td>
</tr>
<tr>
<td>Maximum Line Cable Sizes</td>
<td></td>
</tr>
<tr>
<td>2300/2400 V, 50/60 Hz</td>
<td>300 mm² (600 AWG) 5 kV or 240 mm² (500 AWG) 8 kV/phase</td>
</tr>
<tr>
<td>4000/4160 V, 50/60 Hz</td>
<td>300 mm² (600 AWG) 5 kV or 240 mm² (500 AWG) 8 kV/phase</td>
</tr>
<tr>
<td>6000 V, 50/60 Hz</td>
<td>240 mm² (500 AWG) 8 kV or 185 mm² (350 AWG) 15 kV/phase</td>
</tr>
<tr>
<td>6300 V, 50/60 Hz</td>
<td>240 mm² (500 AWG) 8 kV or 185 mm² (350 AWG) 15 kV/phase</td>
</tr>
<tr>
<td>6600 V, 50/60 Hz</td>
<td>240 mm² (500 AWG) 8 kV or 185 mm² (350 AWG) 15 kV/phase</td>
</tr>
<tr>
<td>Maximum Load Cable Sizes</td>
<td></td>
</tr>
<tr>
<td>2300/2400 V, 50/60 Hz</td>
<td>300 mm² (600 AWG) 5 kV or 240 mm² (500 AWG) 8 kV/phase</td>
</tr>
<tr>
<td>4000/4160 V, 50/60 Hz</td>
<td>300 mm² (600 AWG) 5 kV or 240 mm² (500 AWG) 8 kV/phase</td>
</tr>
<tr>
<td>6000 V, 50/60 Hz</td>
<td>240 mm² (500 AWG) 8 kV or 185 mm² (350 AWG) 15 kV/phase</td>
</tr>
<tr>
<td>6300 V, 50/60 Hz</td>
<td>240 mm² (500 AWG) 8 kV or 185 mm² (350 AWG) 15 kV/phase</td>
</tr>
<tr>
<td>6600 V, 50/60 Hz</td>
<td>240 mm² (500 AWG) 8 kV or 185 mm² (350 AWG) 15 kV/phase</td>
</tr>
</tbody>
</table>

(1) Cable sizes are based on overall dimensions of compact-stranded three-conductor shielded cable (common for industrial cable tray installations). Maximum sizing stated accounts for minimum rated cable insulation requirements and the next higher-rated cable (i.e., 8 kV is not commercially available in many areas of the world, therefore Rockwell Automation provides an 8 kV (minimum rating) as well as a 15 kV rating, when applicable. Enclosure openings will accommodate the thicker insulation on the higher-rated cable. IEC ratings show the equivalent to the NEMA sizes. The exact cable mm² size shown is not commercially available in many cases; use the next smaller standard size.

(2) Minimum cable bend radius recommendations vary by national codes, cable type, and cable size. Consult local codes for guidelines and requirements. General relationship of cable diameter to bend radius is typically between 7x...12x (e.g., if the cable diameter is 1 in. [2.54 cm] the minimum bend radius could range between 7...12 in. [18.8...30.48 cm]).

(3) As cabling methods can vary widely, maximum cable sizes shown do not account for the size of the conduit hub. Verify size of conduit hub(s) against the “Drive enclosure openings” shown.
### Table 19 - Line and Load Cable Sizes for IEC and UL (210 ≤ In ≤ 680 A)

<table>
<thead>
<tr>
<th>Description (Motor V/Freq.)</th>
<th>Drive Enclosure Opening mm (in.)</th>
<th>Max. Size &amp; No. Incoming Cables: UL&lt;sup&gt;(1)&lt;/sup&gt;&lt;sup&gt;(2)&lt;/sup&gt;&lt;sup&gt;(3)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Line Cable Sizes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2400 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>3000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>3300 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>4160 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>6000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>6600 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>7200 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>10,000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td><strong>Maximum Load Cable Sizes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2300/2400 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>3000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>3300 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>4000/4160 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>6000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>6300/6600 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>6900 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>10,000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
<tr>
<td>11,000 V, 50/60 Hz</td>
<td>138 x 138 (5.4 x 5.4)</td>
<td>608 mm² (1200 kcmil) 5 kV or 608 mm² (1200 kcmil) 8 kV/phase</td>
</tr>
</tbody>
</table>

(1) Cable sizes are based on overall dimensions of compact-stranded three-conductor shielded cable (common for industrial cable tray installations). Maximum sizing stated accounts for minimum rated cable insulation requirements and the next higher-rated cable (i.e., 8 kV is not commercially available in many areas of the world, therefore Rockwell Automation provides an 8 kV (minimum rating) as well as a 15 kV rating, when applicable. Enclosure openings will accommodate the thicker insulation on the higher-rated cable. IEC ratings show the equivalent to the NEMA sizes. The exact cable mm² size shown is not commercially available in many cases; use the next smaller standard size.

(2) Minimum cable bend radius recommendations vary by national codes, cable type, and cable size. Consult local codes for guidelines and requirements. General relationship of cable diameter to bend radius is typically between 7x...12x (e.g., if the cable diameter is 1 in. [2.54 cm] the minimum bend radius could range between 7...12 in. [18.8...30.48 cm]).

(3) As cabling methods can vary widely, maximum cable sizes shown do not account for the size of the conduit hub. Verify size of conduit hub(s) against the “Drive enclosure openings” shown.
Notes:
Index

A
Additional Resources 6
Air Conditioning
Calculation 22
Sizing 22
Anchor bolts 13
ASHRAE Standard 52.2 MERV 11 20
Aviation Plug 16

B
Back Plates
Remove 13

C
Cables
Cable Clamp Location 30, 31
Control Power Wiring Location 32
Electrical Safety Interlock Wire routing 36
Fan Wiring Bundles 42
General Wire Categories 51
Ground Bus 42
Incoming Line Cables 29
Insulation Resistance (IR) Test of Power Cables 29
Isolation Transformer Secondary Power Cables 38
Isolation Transformer Secondary Winding 40
Line Cable Sizes 57
Load Cable Sizes 57
Motor Cables 41
Outgoing Motor Power Cables 29
Power Cable Interconnection Overview 37
Shielded cables 26
System Ground Cable 28
Torque Requirements 49
Voltage Sensing Board 41

Commissioning Support 6
Conduit Openings 13
Contractor Scope of Work 7
Control Power Wiring
Checklist 47
Installation 32
Routing 32
Torque Requirements 49

Control Signal Wiring 27
Routing 27
Shield Grounding 27
Shielded cables 27
Torque Requirements 49

Control Signal Wiring Details
Schematic (No Bypass) 53

Cooling Fans
Dimensions 16
Hardware 16
Installation 16, 17
Model 16
Orientation 16, 17
Weight 16
Wiring Bundles 42

D
Design Considerations 27
Documentation box
Electrical Drawings 24
Drive Electrical Installation 23
Checklist 47
Cable Connections 40
Cable Insulation Rating 25
Cable Routing 40
Control Power Wiring 32
Control Power Wiring Installation 32
Control Signal Wiring Design 27
Control Signal Wiring Shield Grounding 27
Electrical Drawings 24
External Control Signal Wiring 34
Grounding System Requirements 24
Incoming Line Cables 29
Isolation Transformer Secondary Power Cables 38
Motor Cables 26
Outgoing Motor Power Cables 29
Power Terminals 30
Summary 28
Torque Requirements 49

Drive Electrical Interconnection
Checklist 47
Fan Wiring Bundles 42
Ground Bus 42
Isolation Transformer Secondary Power Cables 38
Motor cables 41
Power Cable Interconnection 37
Summary 37
Torque Requirements 49
Voltage Sensing Board 41

Drive Mechanical Installation 9
Affix Cabinet to Floor 13
Air Conditioning Sizing 22
Connect Shipping Splits 9
External Ducting 20
Install Cooling Fans 16
Install Power Modules 17
Power Module Lift Cart 17
Summary 9
Index

E
Electrical Safety Interlock 35
Electrical Drawings 24
Contents 24
Electrical Safety Interlock 35
Location 35
Wire Routing 36
EU EN779 Class F6 20
External Control Signal Wiring 34
Analog I/O 34
Digital I/O 34
Torque Requirements 49
Wiring Routing 34
External Ducting
Specifications 20

G
General Precautions 6
Safety and Codes 23
General Wire Categories 51
Ground Bus 42
LV Cabinet 28
System Ground Cable Installation 28
Grounding System
Requirements 24

H
Hardware 13
Back Plates 13
Fan Housing 16
Ground Bus 42
Power Module Power Cables 40
Secondary Winding Connections 40
Shipping Splits 12
System Ground Cable 28
Torque Requirements 49

I
IEC721-1 20
Incoming Line Power Cable Connections 30, 31
Input Connection Points 55
Input/Output Connections 30, 31
Remote Distributed Control System 55
Standard I/O Connection Points 55
Insulation Resistance (IR) Test 29
Power Cables 29
Isolation Transformer 30, 31
Location 30, 31
Isolation Transformer Cabinet 30, 31
Ground Bus 42
Layout 30, 31
Remove Back Plates 13
Secondary Power Cables 38
Secondary Winding Connections 40

J
Junction Cabinet 31
Location 31

L
Lift Cart 17
Lifting capacity 17
Operation 17
Lifting Angles
Torque Requirements 49
Line Cable Sizes 57
Drive Enclosure Opening 57
Maximum Size 57
Motor Voltage/Frequency 57
Line-to-Ground Rated Power Frequency 25
Voltage
Line-to-Line Power Frequency Maximum
Voltage 25
Load Cable Sizes 57
Drive Enclosure Opening 57
Maximum Size 57
Motor Voltage/Frequency 57
Lockout 23

M
Motor Cables
Sizing 26
Torque Requirements 49
U Phase Sidesheet opening 10, 11
V Phase Sidesheet opening 10, 11
W Phase Sidesheet opening 10, 11

O
Outgoing Motor Power Cable Connections 30, 31
Output Connection Points 55

P
Power Cable Connections 30, 31
Power Cables
Checklist 47
Design Considerations 26
Insulation Requirements 25
Interconnection Overview 37
Maximum Distance 26
Schematic (No Bypass) 53
Torque Requirements 49
Power Module Lift Cart 17
Lifting Capacity 17
Operating Procedure 17
Precautions 17

62 Rockwell Automation Publication 6000-IN006F-EN-P - March 2018
Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

<table>
<thead>
<tr>
<th>United States or Canada</th>
<th>1.440.646.3434</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside United States or Canada</td>
<td>Use the Worldwide Locator at <a href="http://www.rockwellautomation.com/rockwellautomation/support/overview.page">http://www.rockwellautomation.com/rockwellautomation/support/overview.page</a>, or contact your local Rockwell Automation representative.</td>
</tr>
</tbody>
</table>

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

<table>
<thead>
<tr>
<th>United States</th>
<th>Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside United States</td>
<td>Please contact your local Rockwell Automation representative for the return procedure.</td>
</tr>
</tbody>
</table>

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.


Medium Voltage Products, 135 Dundas Street, Cambridge, ON, N1R 5X1 Canada, Tel: (1) 519.740.4100, Fax: (1) 519.623.8930
Online: www.ab.com/mvb

Allen-Bradley, Rockwell Software, Rockwell Automation, and TechConnect are trademarks of Rockwell Automation, Inc.
Trademarks not belonging to Rockwell Automation are property of their respective companies.

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters
America: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleerlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 6000-IN006F-EN-P - March 2018
Supersedes Publication 6000-IN006E-EN-P - November 2017
Copyright © 2018 Rockwell Automation, Inc. All rights reserved. Printed in Canada.