

# PowerFlex Diode Bus Supply



User Manual



## Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at <http://www.rockwellautomation.com/literature>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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.

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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.

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

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**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 consequences.

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**Shock Hazard** labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

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**Burn Hazard** labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

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## Summary of Changes

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The information below summarizes the changes made to this manual since its last release (September 2006):

Description of Changes	Page
Reformatted document from half size (5.5 x 8.5 in.) to full size (8.5 x 11 in.)	Throughout manual
In Chapter 1: <ul style="list-style-type: none"><li>Revised the subsection "Ambient Operating Temperatures" to include more information.</li><li>At the beginning of the section "Power Wiring," added a recommendation to keep all wired connections identical in size and length to maintain balanced impedance.</li><li>In the section "Disconnecting MOVs and RFI Filter Capacitors," added new Table 1.E, Recommended MOV Configurations.</li></ul>	<a href="#">1-2</a> <a href="#">1-6</a> <a href="#">1-10</a>
In Chapter 2: <ul style="list-style-type: none"><li>In the subsection "Before Applying Power to the Diode Bus Supply," added new steps 2 and 5.</li><li>In Table 2.A, Possible Faults and Corrective Actions, added a corrective action and revised others.</li></ul>	<a href="#">2-2</a> <a href="#">2-3</a>
In Appendix A: <ul style="list-style-type: none"><li>In the section "Line Reactors," added introductory information.</li><li>Added the new section "Spare Parts."</li></ul>	<a href="#">A-5</a> <a href="#">A-5</a>
Added the new Appendix B, History of Changes."	<a href="#">B-1</a>

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## Overview

The purpose of this manual is to provide you with the basic information needed to install, start up, and troubleshoot the PowerFlex™ Diode Bus Supply.

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### Who Should Use this Manual?

This manual is intended for personnel that are qualified to install, program, and operate adjustable frequency AC drives and their use in common DC bus systems.

### Reference Documentation      General Drive Information

Title	Publication
Wiring and Grounding Guidelines for PWM AC Drives	DRIVES-IN001
AC Drives in Common Bus Configurations	DRIVES-AT002
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1
A Global Reference Guide for Reading Schematic Diagrams	0100-2.10
Guarding Against Electrostatic Damage	8000-4.5.2
1321 Power Conditioning Products Technical Data	1321-TD001

### Specific Drive Information

For detailed drive information, including specifications, refer to the following PowerFlex 70, PowerFlex 700, PowerFlex 700H, PowerFlex 700S, and PowerFlex 750-Series drive publications.

For	See	Publication
PowerFlex® 70/70EC Drive	PowerFlex 70 User Manual	20A-UM001
	PowerFlex 70/700 Reference Manual	PFLEX-RM001
	PowerFlex 70EC/700VC Reference Manual	PFLEX-RM004
PowerFlex® 700/700VC Series A Drive PowerFlex® 700VC Series B Drive	PowerFlex 700 Series A User Manual	20B-UM001
	PowerFlex 700 Series B User Manual	20B-UM002
	PowerFlex 70/700 Reference Manual	PFLEX-RM001
	PowerFlex 70EC/700VC Reference Manual	PFLEX-RM004

For	See	Publication
PowerFlex <sup>®</sup> 700H Drive	PowerFlex 700H Installation Instructions PowerFlex 700H Programming Manual	PFLEX-IN006 20C-PM001
PowerFlex <sup>®</sup> 700S Drive	PowerFlex 700S with Phase I Control Installation Manual (Frames 1...6) PowerFlex 700S with Phase I Control Installation Manual (Frames 9 and 10) PowerFlex 700S with Phase I Control User Manual (All Frame Sizes) PowerFlex 700S with Phase I Control Reference Manual PowerFlex 700S with Phase II Control Installation Manual (Frames 1...6) PowerFlex 700S with Phase II Control Installation Manual (Frames 9...14) PowerFlex 700S with Phase II Control Programming Manual (All Frame Sizes) PowerFlex 700S with Phase II Control Reference Manual	20D-IN024 PFLEX-IN006 20D-UM001 PFLEX-RM002 20D-IN024 PFLEX-IN006 20D-PM006 PFLEX-RM003
PowerFlex <sup>®</sup> 750-Series AC Drive	PowerFlex 750-Series Drive Installation Instructions PowerFlex 750-Series Drive Programming Manual PowerFlex 750-Series Reference Manual	750-IN001 750-PM001 750-RM002

Documentation can be obtained online at <http://literature.rockwellautomation.com>. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

To find your local Rockwell Automation distributor or sales representative, visit [www.rockwellautomation.com/locations](http://www.rockwellautomation.com/locations).

For information such as firmware updates or answers to drive-related questions, go to the Drives Service & Support web site at [www.ab.com/support/abdrives](http://www.ab.com/support/abdrives) and click on the “Downloads” or “Knowledgebase” link.

## Rockwell Automation Support

Use the contacts below for PowerFlex Diode Bus Supply technical support.

Online	By E-mail	By Telephone
<a href="http://www.ab.com/support/abdrives">www.ab.com/support/abdrives</a>	<a href="mailto:support@drives.ra.rockwell.com">support@drives.ra.rockwell.com</a>	262-512-8176

## Conventions Used in This Manual

- In this manual we may refer to the PowerFlex Diode Bus Supply as Diode Bus Supply or Bus Supply.
- The following words may be used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not Recommended



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## General Precautions



**ATTENTION:** The Diode Bus Supply contains electrostatic discharge (ESD) 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, see *Guarding Against Electrostatic Damage*, publication [8000-4.5.2](#), or any other applicable ESD protection handbook.



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



**ATTENTION:** Only qualified personnel familiar with adjustable frequency AC drives 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.



**ATTENTION:** Only connect Rockwell Automation common DC bus drives with built-in precharge circuitry to the common DC bus output terminals of the Diode Bus Supply within the load rating guidelines. See [Specific Drive Information](#) earlier in this Preface for available drives.



**ATTENTION:** To avoid an electric shock hazard, verify that the voltage on the DC bus terminals (which are connected to the DC bus capacitors of the Inverter) has discharged before performing any work on the Diode Bus Supply. Measure the DC bus voltage at the +DC and -DC output terminals. The voltage must be zero.



**ATTENTION:** National Codes and standards (NEC, VDE, BSI, and so forth) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

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**Catalog Number  
Explanation**

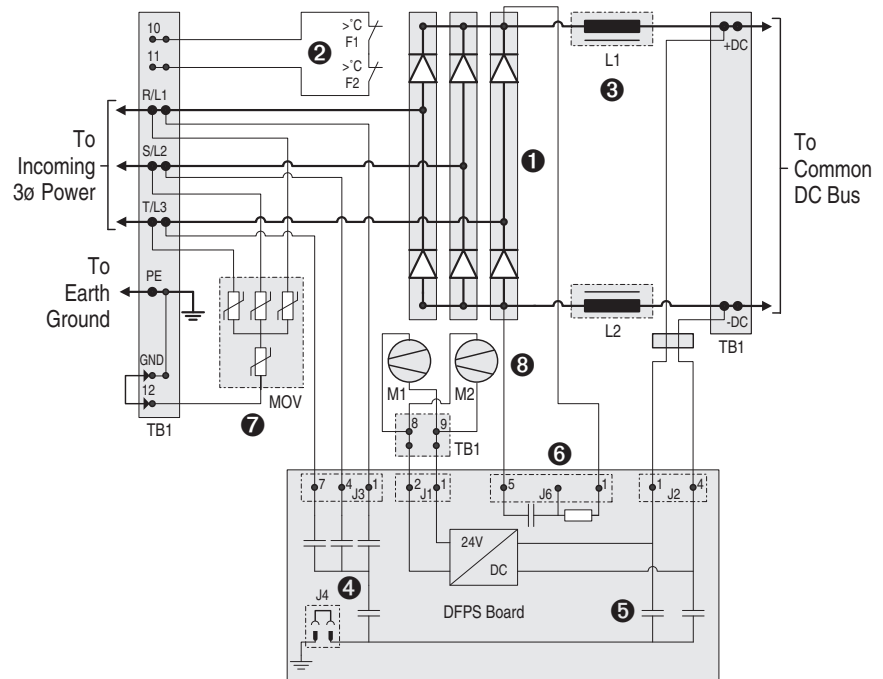
		<i>Position Number</i>			
1-3	4	5-7	8	9	
<b>20T</b>	<b>D</b>	<b>120</b>	<b>A</b>	<b>E</b>	
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	
<i>a</i>					
<b>Product</b>					
<b>Code</b>			<b>Type</b>		
20T			PowerFlex Diode Bus Supply		
<i>b</i>					
<b>Voltage Rating</b>					
<b>Code</b>	<b>Input Voltage</b>	<b>Phase</b>	<b>DC Output</b>		
D	240/480V AC	3	325...650V DC		
E	500/600V AC	3	675...810V DC		
<i>c</i>					
<b>Current Rating</b>					
<b>Code</b>	<b>Output</b>	<b>Frame <sup>(1)</sup></b>			
120	120.0 Amp	2			
<i>d</i>					
<b>Enclosure</b>					
<b>Code</b>			<b>Rating</b>		
A			NEMA Type 1 / IP20		
<i>e</i>					
<b>Documentation &amp; Shipping Carton</b>					
<b>Code</b>	<b>User Manual</b>	<b>Carton</b>			
E	English	Yes			

<sup>(1)</sup> PowerFlex 700 drive equivalent frame size.

## Description and Schematic Diagram

The Diode Bus Supply is a single-direction power converter for the front end of common DC bus drive systems. It converts the incoming 3-phase AC line voltage to a common DC bus voltage.

**Figure P.1 Diode Bus Supply Schematic Diagram**



The primary electrical components for the Diode Bus Supply are listed below.

Item	Description
❶	<b>Six-Pulse, Full-Wave, 3-Phase Diode Bridge Rectifier Unit</b> directly connected to the three line input terminals.
❷	<b>Bus Supply Overtemperature Sensors</b> , located in the heat sink, are used for thermal protection of the diode-bridge rectifier.
❸	<b>DC Chokes</b> (L1, L2) to reduce conducted HF-emissions. They also reduce line harmonics and peak currents in the AC line and the bridge circuit.
❹	<b>Input Filter Capacitors</b> connected to the three input phases to reduce conducted HF-emissions.
❺	<b>Common Mode Capacitors</b> connected to the DC bus to reduce conducted HF-emissions.
❻	<b>DC Bus Snubber Circuit</b> for dampening and limiting overvoltages.
❼	<b>MOV Circuit</b> connected to the three input phases.
❽	<b>Cooling Fans</b> connected to the 24V DC supply on the Power Supply (DFPS Board).

**NOTE:** Components ❸, ❹, and ❺ compose a Radio Frequency Interference Filter (RFI), which meets the EMC requirements of Product Standard 61800-3 for industrial environments.

**Notes:**

## Installation/Wiring

This chapter provides information on the installation and wiring of the PowerFlex Diode Bus Supply.

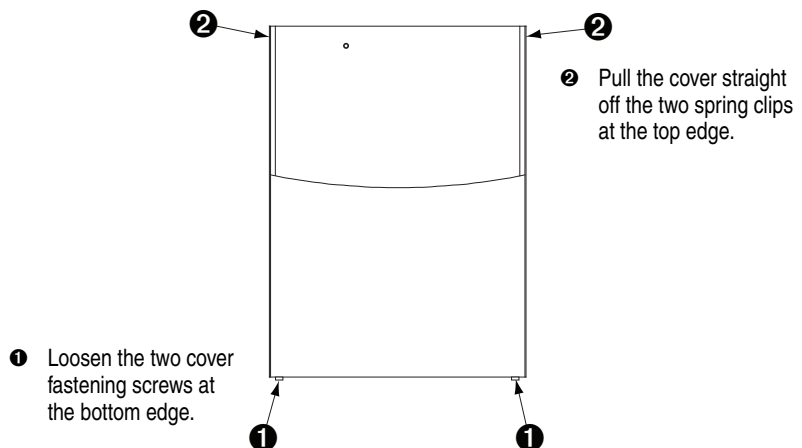
Topic	Page
<a href="#">Opening the Cover</a>	<a href="#">1-1</a>
<a href="#">Minimum Mounting Clearances</a>	<a href="#">1-2</a>
<a href="#">AC Supply Source Considerations</a>	<a href="#">1-3</a>
<a href="#">General Grounding Requirements</a>	<a href="#">1-4</a>
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<a href="#">Paralleling Diode Bus Supplies</a>	<a href="#">1-11</a>
<a href="#">CE Conformity</a>	<a href="#">1-12</a>

Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

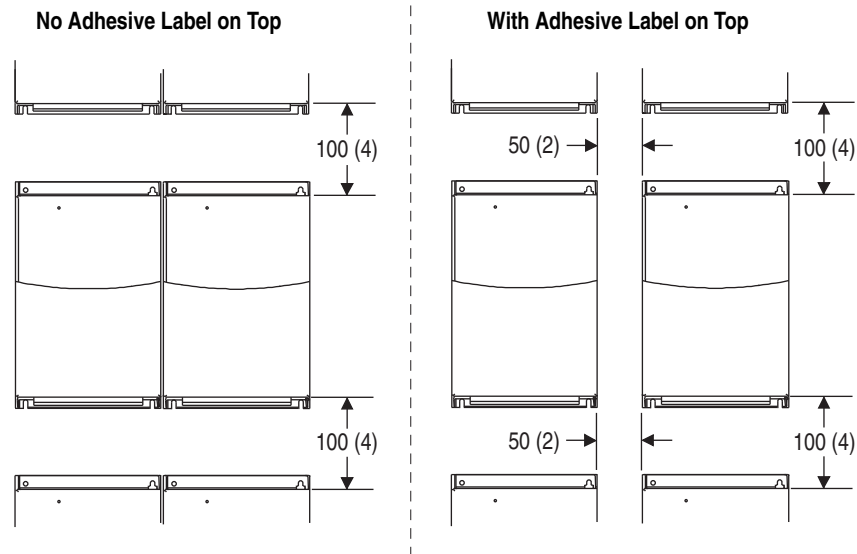


**ATTENTION:** The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this product or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

### Opening the Cover



## Minimum Mounting Clearances



Dimensions are in millimeters and (inches).

See [Appendix A](#) for detailed dimension information.

## Ambient Operating Temperatures

The Diode Bus Supply is designed to operate at 0...40 °C (32...104 °F) ambient without derating. Remove the label from the top to operate the Diode Bus Supply in ambients 41 °C up to 50 °C (104 °F up to 122 °F).

**Important:** Removing the adhesive label changes the enclosure rating from NEMA Type 1 Enclosed to Open Type. This also changes the side-to-side mounting clearance requirement.

Ensure that proper cooling is provided to the Diode Bus Supply to stay under the 40 °C rated specification. Add exhaust fans to the front or top of the enclosure bay and provide a filtered opening at the bottom of the cabinet bay.

The Diode Bus Supply watt loss (from specification section) is 500 W at 120 A. The three-phase AC line reactor watt losses are listed in the 1321 Power Conditioning Products Technical Data, publication [1321-TD001](#).

It is recommended that the system integrator completes a thermal evaluation to ensure adequate cooling to maintain proper operating conditions for each cabinet or bay.

## AC Supply Source Considerations

The Diode Bus Supply is suitable for use on a circuit capable of delivering a short circuit rating up to a maximum of 200,000 rms symmetrical amperes, and a maximum of 600 volts.



**ATTENTION:** To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in [Appendix A](#).

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If a Residual Current Detector (RCD) is used as a system ground fault monitor, only Type B (adjustable) devices should be used to avoid nuisance tripping.

## Input Power Conditioning

Certain events on the power system supplying a bus supply can cause component damage or shortened product life. These conditions include:

- The power system has power factor correction capacitors switched in and out of the system, either by the user or by the power company.
- The power source has intermittent voltage spikes in excess of 6000 volts. These spikes could be caused by other equipment on the line or by events such as lightning strikes.
- The power source has frequent interruptions.
- The nearest supply transformer is larger than 1000 kVA.

If any or all of these conditions exist, it is recommended that the user install a minimum amount of impedance between the Diode Bus Supply and the source. This impedance could come from the supply transformer itself, the cable between the transformer and Diode Bus Supply, or an additional transformer or reactor.

## Unbalanced or Non-Solid Grounded Distribution Systems

Where the potential exists for abnormally high phase-to-ground voltages (in excess of 125% of nominal), or the supply system is non-solid grounded, see the Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication [DRIVES-IN001](#).



**ATTENTION:** The Diode Bus Supply contains protective MOVs, and input filter and common mode capacitors that are referenced to ground. These devices should be disconnected from ground if the Diode Bus Supply is installed on any non-solid grounded power distribution system (IT-network). For jumper locations, see [Figure 1.2 on page 1-7](#).

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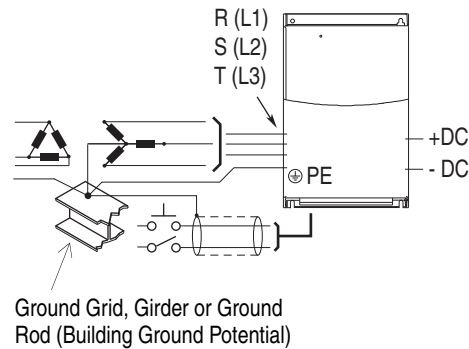
## General Grounding Requirements

### Safety Ground Terminal - PE

The **Safety Ground terminal (PE) must be connected to the building grounding scheme.** Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. This is the safety ground for the Diode Bus Supply. The integrity of all ground connections should be periodically checked.

For installations within a cabinet, a single safety ground point or ground bus bar connected directly to building steel (girder, joist), a floor ground rod, bus bar or building ground grid should be used. All circuits including the AC input ground conductor should be grounded independently and directly to this point/bar.

**Figure 1.1 Typical Grounding**



### RFI Filter Grounding

Using an external RFI filter may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked. See the instructions supplied with the filter.



## Maximum Loading

To avoid overloading the Diode Bus Supply, the following requirement applies:

The DC Input current sum (Normal Duty or Heavy Duty rating at 40 °C/ 104 °F) of the connected drive(s) must not exceed the Bus Supply continuous DC Bus output current rating of 120 amps at 40 °C/104 °F.

For the DC Input Current values of the drives, see tables in the respective drive documentation.

[Table 1.A](#) and [Table 1.B](#) provide guidance on the nominal operation of the Diode Bus Supply. No overload capability is built into the tables.

When an overload is being utilized in connected drives or products, that overload current must be accounted for in the calculation to properly size the Diode Bus Supply.



**TIP:** When paralleling two Diode Bus Supplies, see [Paralleling Diode Bus Supplies on page 1-11](#) for details.

**Table 1.A Normal Duty ND**

Drive Rating		Drive DC Input Current		Diode Bus Supply <sup>(1)</sup>	
DC Voltage	ND Power	ND DC Input Currents	ND DC Input Current Sum	Maximum DC Output Amps	AC Input Voltage
540V	30 + 22 = 52 kW	61.9 + 47.5	109.4 A	120 A	400V
650V	2 x 40 = 80 Hp	2 x 55.7	111.4 A	120 A	480V

<sup>(1)</sup> No overload capability.

**Table 1.B Heavy Duty HD**

Drive Rating		Drive DC Input Current		Diode Bus Supply <sup>(1)</sup>	
DC Voltage	HD Power	HD DC Input Currents	HD DC Input Current Sum	Maximum DC Output Amps	AC Input Voltage
540V	37 + 2 x 1.5 = 40 kW	95.1 + 2 x 5.3	105.7 A	120 A	400V

<sup>(1)</sup> No overload capability.

## AC Input Fusing

The Diode Bus Supply can be installed with delay type AC input line fuses. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations.



**ATTENTION:** The PowerFlex Diode Bus Supply does not provide branch short circuit protection. Specifications for the recommended fusing to provide protection against short circuits are provided in [Table A.A on page A-4](#).

## Power Wiring



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**ATTENTION:** National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

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To maintain balanced impedance, and thus balance current in the Diode Bus Supply, it is recommended to keep all wired connections identical in size and length. This includes the AC line connection to three-phase AC line reactors and from the three-phase AC line reactors to the Diode Bus Supply.

### Cable Types Acceptable for 200...600 Volt Installations

A variety of cable types are acceptable for Diode Bus Supply installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (33 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than or equal to 15 mils (0.4 mm/0.015 in.). UL installations in 50 °C (122 °F) ambient must use 600V, 90 °C (194 °F) wire. UL installations in 40 °C (104 °F) ambient should use 600V, 75 °C (168 °F) wire.

THHN, THWN or similar wire is acceptable for Diode Bus Supply installation in dry environments provided adequate free air space and/or conduit fill rate limits are provided. **Do not use THHN or similarly coated wire in wet areas.**

### EMC Compliance

Refer to [CE Conformity on page 1-12](#) for details.

### Cable Trays and Conduit

If cable trays or large conduits are to be used, refer to guidelines in the Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication [DRIVES-IN001](#).



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**ATTENTION:** To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” motor leads.

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## DC Bus Wiring Guidelines

For DC Bus wiring guidelines, refer to AC Drives in Common Bus Configurations, publication [DRIVES-AT002](#).

## Bus Supply Terminals

Figure 1.2 Terminal and Jumper Locations

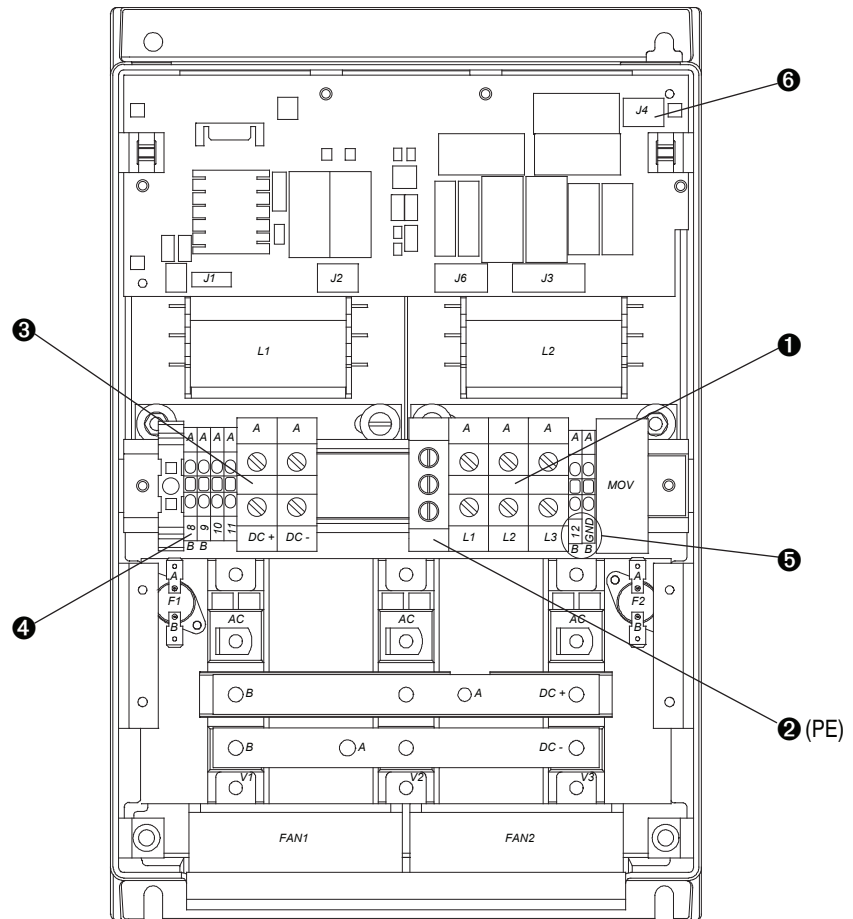
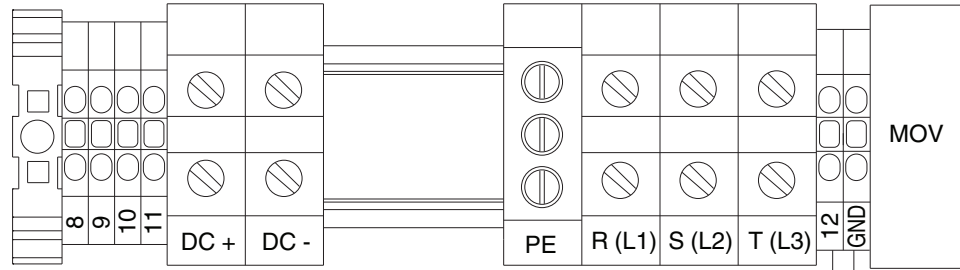


Table 1.C Terminal Specifications and Jumper Information

Item	Description	Wire Size Range <sup>(1)</sup>		Torque
		Maximum	Minimum	
①	AC Line Input L1, L2, L3			
②	PE (Protective Earth) Terminal	35 mm <sup>2</sup> (2 AWG)	0.75 mm <sup>2</sup> (18 AWG)	3.3 N•m (20 lb•in)
③	DC Bus Terminals (DC+, DC-)			
④	Control Terminals 8...11			
⑤	Control Terminals 12 and GND (MOV neutral disconnect; see <a href="#">page 1-10</a> )	2.5 mm <sup>2</sup> (14 AWG)	0.25 mm <sup>2</sup> (22 AWG)	0.8 N•m (7 lb•in)
⑥	Jumper J4, see <a href="#">Disconnecting MOVs and RFI Filter Capacitors on page 1-10</a>			

<sup>(1)</sup> Maximum/minimum sizes that the terminals will accept - these are not recommendations.

**Figure 1.3 Power and Control Terminals**



Terminal	Description	Notes
<b>Power Connections</b>		
DC +	DC Bus (+)	DC Bus Connection (+)
DC -	DC Bus (-)	DC Bus Connection (-)
PE	PE Ground	Safety Ground
R	R (L1)	AC Line Input Power
S	S (L2)	AC Line Input Power
T	T (L3)	AC Line Input Power
<b>Control Connections</b>		
8	24V Fan Supply	Internal connection to extend fan supply leads (must be disconnected in case of fan replacement)
9		
10	NC Contact Output (F1, F2)	Opens with power stack overtemperature. (See <a href="#">Appendix A</a> for contact ratings.)
11		
12	Jumper MOVs to Ground	Disconnect MOV neutral point and ground by removing this jumper. (See <a href="#">page 1-10</a> for details.)
GND		

## Control Wiring

Important points to remember about control wiring:

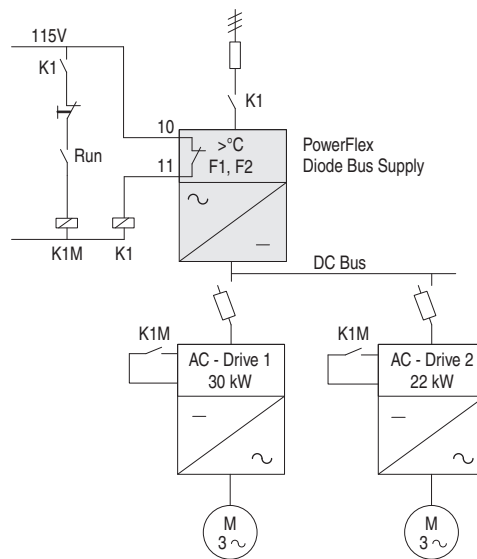
- Use Copper wire only. Wire gauge requirements and recommendations are based on 75 °C (168 °F). Do not reduce wire gauge when using higher temperature wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control wires outside the cabinet should be separated from power wires by at least 0.3 meters (1 foot).

## Drive Run Interlock

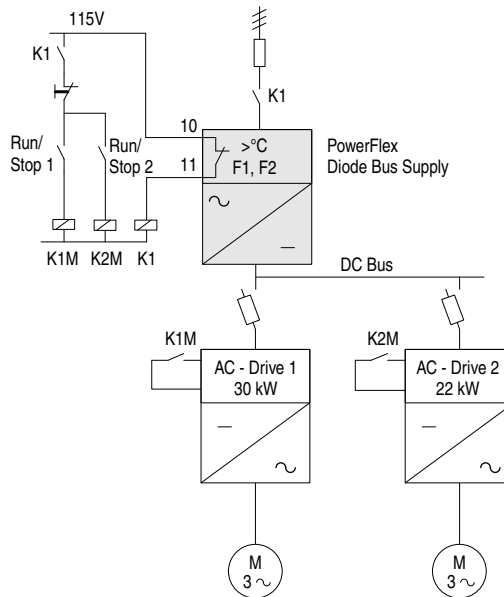
To protect the Diode Bus Supply from overtemperature, the normally closed contacts (Bus Supply Overtemperature - terminals 10 and 11) should be wired to either the AC line input contactor for the Diode Bus Supply or the Run interlock circuit (enable input) of each connected drive. This ensures that the drives are stopped in case of Bus Supply Overtemperature.

## Control Wiring Examples

**Figure 1.4 Multiple Drives, Running Simultaneously**



**Figure 1.5 Multiple Drives, Running Independently (2-wire control)**



**NOTE:** See [Appendix A](#) for Output Contact ratings.

## Disconnecting MOVs and RFI Filter Capacitors

The Diode Bus Supply contains protective MOVs, and input filter and common mode capacitors that are referenced to ground. To prevent damage, the MOVs should be **disconnected from ground if the Bus Supply is installed on any non-solid grounded distribution system** where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices from ground, remove the jumpers shown in [Table 1.D](#). Jumpers can be removed by carefully pulling the jumper straight out. Solid and non-solid grounded systems are defined in [Table 1.E](#).

**Table 1.D Jumper Removal**

Item	Jumper <sup>(1)</sup>	Jumper Location (see <a href="#">Figure 1.2</a> )	Removes Component (see <a href="#">Figure 1.6</a> )
5	12 and GND	Control Terminals	MOV neutral from Ground
6	J4	On DFPS Board	Capacitors from Ground

<sup>(1)</sup> **Important:** Do not remove jumpers if the distribution system is grounded.

**Table 1.E Recommended MOV Configurations**

Power Source Type <sup>(1)</sup>	MOV/Input Filter Capacitors <sup>(2)</sup>	Benefits of Correct Power Source Type Configuration
Solid Grounded <ul style="list-style-type: none"> <li>AC fed, solidly grounded</li> <li>DC fed from passive rectifier which has an AC source and solid ground</li> </ul>	Connected	<ul style="list-style-type: none"> <li>UL compliance</li> <li>Reduced electrical noise</li> <li>Most stable operation</li> <li>EMC compliance</li> <li>Reduced voltage stress on components and motor bearings</li> </ul>
Non-Solid Grounded <ul style="list-style-type: none"> <li>AC fed ungrounded</li> <li>Impedance grounded</li> <li>High resistive ground</li> <li>B phase ground</li> <li>Regenerative unit (common DC bus supply and brake)</li> <li>DC fed from an active converter</li> </ul>	Disconnected	<ul style="list-style-type: none"> <li>Helps avoid severe equipment damage when ground fault occurs</li> </ul>

<sup>(1)</sup> It is highly recommended to accurately determine the power source type and then configure appropriately.

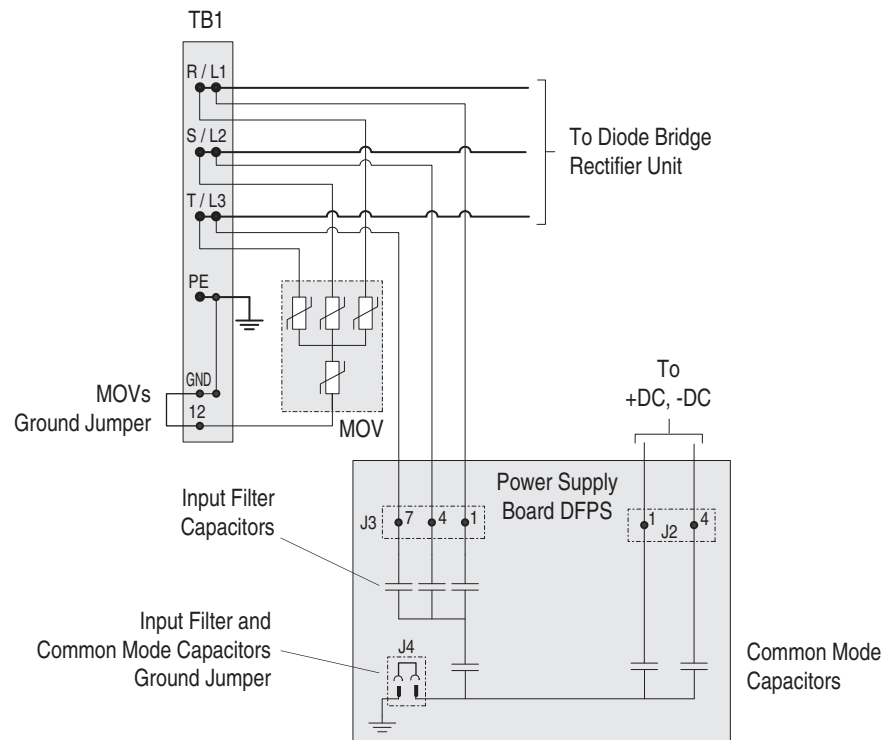
<sup>(2)</sup> When MOVs are disconnected, the power system must have its own transient protection to ensure known and controlled voltages.

For more information on non-solid grounded system installation, see [Wiring and Grounding Guidelines for Pulse Width Modulated \(PWM\) AC Drives](#), publication [DRIVES-IN001](#).



**ATTENTION:** To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before removing/ installing jumpers. Measure the DC bus voltage at the +DC and – DC output terminals. The voltage must be zero.

**Figure 1.6 Removing the Phase-to-Ground Jumpers for the MOV, Input Filter, and Common Mode Capacitors**



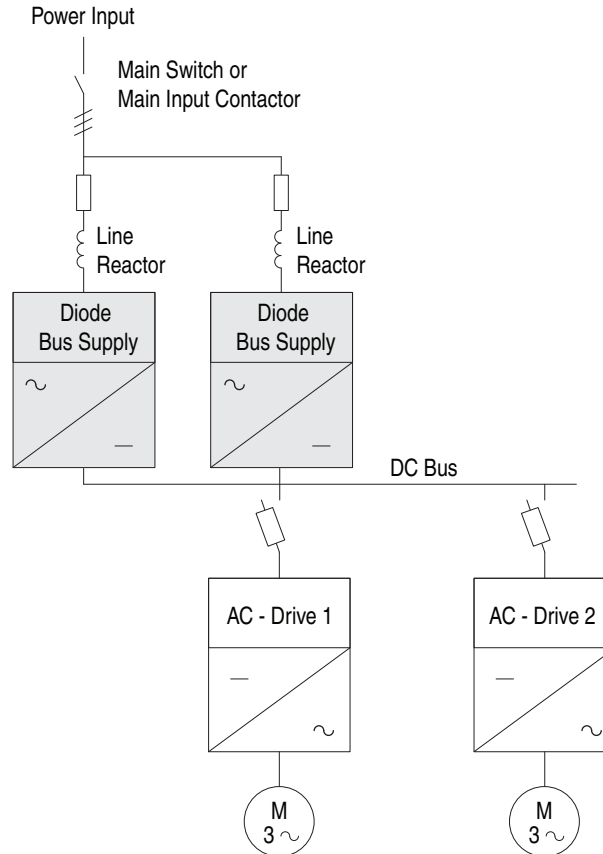
## Paralleling Diode Bus Supplies

Up to two Diode Bus Supplies can be paralleled for operation. To parallel Diode Bus Supplies, an AC line reactor must be used at the input of each Bus Supply (see [Figure 1.7](#)). One-percent reactors (catalog number 1321-3R130-A) can be used, unless 3% reactors (catalog number 1321-3R130-B) are required based on the maximum transformer size listed in [Line Reactors on page A-5](#).

When paralleling Diode Bus Supplies, follow these guidelines:

- A maximum of (2) two Diode Bus Supplies can be paralleled.
- Each Diode Bus Supply must be derated by 3%. This results in a DC Bus continuous output current rating of 233 Amps ( $0.97 \times 2 \times 120$ ).
- It is recommended to use AC line fuses with an open fuse indicator. See [AC Input Fusing on page A-4](#) for details on recommended fusing.

**Important:** It is recommended to keep all wired connections identical in size and length. This includes the AC line connection to the three-phase AC line reactors and from the three-phase AC line reactors to the Diode Bus Supply.

**Figure 1.7 Parallel Diode Bus Supply Wiring Diagram**

## CE Conformity

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The Diode Bus Supply complies with the EN standards listed below when installed according to the User Manual.

CE Declarations of Conformity are available online at <http://www.ab.com/certification/ce/docs>

### Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

### EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.



## Harmonic Emissions

Electronic converters such as the Diode Bus Supply can cause conducted low frequency disturbances (harmonic emissions) to the supply network. The mandatory three-phase AC line reactors will substantially reduce harmonic currents produced by the Bus Supply. However, the magnitude of the harmonic currents and resulting harmonic voltages depends upon the network impedence at the point where the unit is connected to the network. Presently, there are no mandatory harmonic emission limits related to CE compliance for equipment connected to private power networks. Upon request, Rockwell Automation can provide information regarding harmonic emissions from the Diode Bus Supply.

## General Notes

- If the adhesive label is removed from the top of the Diode Bus Supply, it must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The DC bus cable to the drive(s) should be kept as short as possible to avoid electromagnetic emission and capacitive currents. Therefore the drive(s) should be located in the same cabinet as the Diode Bus Supply or next to the cabinet with the Diode Bus Supply. If the connection leads between DC bus and drive(s) are leaving the cabinet, shielded cables must be used.
- Use of line filters in non-solid grounded systems is not recommended.
- The Diode Bus Supply with its inherent high frequency filtering satisfies CE EMC emission limits for the industrial environment. If used in a residential or domestic environment, it may cause radio interference. The user is required to take measures to prevent interference, in addition to the essential requirements for CE compliance listed below, if necessary.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.

## Essential Requirements for CE Compliance

Conditions 1...5 listed below **must be** satisfied for the Diode Bus Supply to meet the requirements of **EN61800-3**.

1. The Diode Bus Supply and drive must be PowerFlex type and CE compatible.
2. The externally mounted Line Reactor must be connected to the line input as shown in [Figure 1.7 on page 1-12](#).

3. Review important precaution/attention statements throughout this document before installing the drive(s).
4. Ground as described in [General Grounding Requirements on page 1-4](#).
5. Control wiring and DC bus wiring leaving the cabinet must be a braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.

For additional conditions, see the respective drive Reference Manual and installation guidelines (see [Specific Drive Information on page P-1](#)).

# Start Up/Troubleshooting

This chapter provides the necessary information for the start up and troubleshooting of the Diode Bus Supply.

Topic	Page
<a href="#">Start-Up</a>	<a href="#">2-2</a>
<a href="#">Power On LED</a>	<a href="#">2-3</a>
<a href="#">Troubleshooting</a>	<a href="#">2-3</a>



**ATTENTION:** Power must be applied to the Diode Bus Supply and the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **do not proceed. Remove power** including user-supplied control voltages. User-supplied voltages may exist even when main AC power is not applied to the Diode Bus Supply. Correct the malfunction before continuing.

---

## Start-Up

### Before Applying Power to the Diode Bus Supply

- 1. Confirm that all inputs and outputs are connected to the correct terminals and are properly torqued.
- 2. Using an ohmmeter or other continuity testing device, verify that shorts do not exist between Source 1 and Source 2.

Source 1	Source 2	Checkmark Below if No Short Exists
L1	L2	
L1	L3	
L2	L3	
L1	PE	
L2	PE	
L3	PE	
L1	DC+ Bus	
L2	DC+ Bus	
L3	DC+ Bus	
L1	DC- Bus	
L2	DC- Bus	
L3	DC- Bus	
DC+ Bus	DC- Bus	
DC+ Bus	PE	
DC Bus	PE	

- 3. Verify that AC line power at the disconnect device is within the rated value of the Diode Bus Supply. See [Appendix A](#).
- 4. Verify that the Bus Supply Overtemperature is correctly wired.  
  
This normally closed contact output can be used to set alarms and to stop the drive(s). Verify that they have been wired correctly according to the user’s specification. See [Control Wiring Examples on page 1-9](#).
- 5. Verify that the jumper between control terminals 12 and GND and jumper P4 (on DFPS circuit board) are present on grounded supply lines (default) or removed on non-solid grounded supply lines. See [Disconnecting MOVs and RFI Filter Capacitors on page 1-10](#) for more information.

### Applying AC Power to the Diode Bus Supply

- 1. Apply AC power to the Diode Bus Supply.  
  
The green Power On LED should be on if power is applied to terminals L1 (R), L2 (S), and L3 (T).
- 2. If the green Power On LED is off at this point, see [Table 2.A](#).

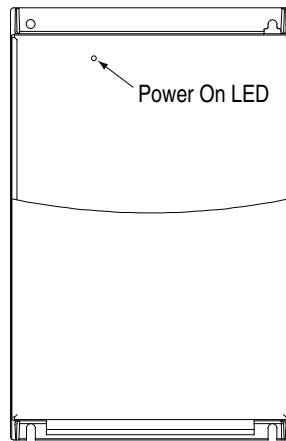
## Power On LED

The green Power On LED is visible through the front panel and will illuminated if power is applied.



**ATTENTION:** The Power On LED is only operational when the unit is energized. Servicing energized equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of the controlled equipment. Follow safety-related practices of NFPA 70E, Electrical Safety For Employee Workplaces. **DO NOT** work alone on energized equipment!

**Figure 2.1** Power On LED



## Troubleshooting

**Table 2.A** Possible Faults and Corrective Actions

Fault	Cause	Corrective Action
Heat sink Overtemperature	Heat sink temperature exceeds maximum rating	1. Verify that maximum ambient temperature has not been exceeded.
		2. Check Overtemperature Switch (N.C. contacts) at control terminals 10 and 11.
DC Output Voltage Loss	Loss of DC Bus power and loss of 24V power	3. Check fan for correct operation.
		4. Check for excess load on the Diode Bus Supply.
DC Output Voltage Loss	Loss of 24V power only (used for fan power only)	5. Check for minimum mounting clearance around the Diode Bus Supply.
		6. Contact your local Rockwell Automation sales office.
DC Output Voltage Loss	Loss of DC Bus power and loss of 24V power	1. Check 3-phase AC incoming power for undervoltage or phase loss.
		2. Check Diode Bus Supply input circuit breaker or fuses.
DC Output Voltage Loss	Loss of 24V power only (used for fan power only)	3. Contact your local Rockwell Automation sales office.
		1. Check fans for correct operation.
DC Output Voltage Loss	Loss of DC Bus power and loss of 24V power	2. Check Overtemperature switches.
		3. Contact your local Rockwell Automation sales office.

**Notes:**



## Supplemental Information

This appendix provides electrical, environmental, functional, and physical specifications for the Diode Bus Supply, and selection tables for AC input devices.

Topic	Page
<a href="#">Specifications</a>	<a href="#">A-1</a>
<a href="#">Dimensions</a>	<a href="#">A-3</a>
<a href="#">AC Input Fusing</a>	<a href="#">A-4</a>
<a href="#">Line Reactors</a>	<a href="#">A-5</a>
<a href="#">Spare Parts</a>	<a href="#">A-5</a>

### Specifications

Category	Specification	
Input/Output Ratings	AC Input Voltage Range:	<b>200...480V Unit</b> <b>500...600V Unit</b>
	Nominal AC Input Voltage:	<b>240V</b> <b>400V</b> <b>480V</b> <b>500V</b> <b>600V</b>
	Nominal DC Bus Voltage:	325V    540V    648V    675V    810V
	Continuous rms AC Input Current:	105A    105A    105A    105A    105A
	Continuous DC Bus Current: <sup>(1)</sup>	120A    120A    120A    120A    120A
	Voltage Tolerance:	-10% minimum, +10% maximum
	Frequency Tolerance:	47...63 Hz.
	Displacement Power Factor:	0.92 lagging (entire speed range)
	Efficiency:	99.5% at rated amps, nominal line volts
	Line Transients:	up to 6000 volts peak per IEEE C62.41-1991
	Heat Dissipation:	500 W
	Max. Short Circuit Current Rating: (using recommended fuse or circuit breaker type)	Maximum short circuit current rating to match specified fuse/circuit breaker capability
	Control Output	Heat Sink Temperature Sensor:
Contact Output Rating (Max.):		Resistive Rating: 15A at 125V AC, 10A at 250V AC, 7A at 24V DC Inductive Rating: 10A at 125V AC, 6A at 250V AC

Category	Specification	
<b>Approvals and Standards Compliance</b>	NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. NEMA 250 - Enclosures for Electrical Equipment IEC 146 - International Electrical Code	
	 UL us	UL and cUL Listed to UL508C and CAN/CSA-C2.2 No. 14-M91
		Marked for all applicable European Directives: <ul style="list-style-type: none"> <li>• EMC Directive (89/336/EEC)</li> <li>• Emissions: EN 61800-3 Adjustable Speed electrical power drive systems Part 3</li> <li>• Immunity: EN 61800-3 Second Environment, Restricted Distribution</li> <li>• Low Voltage Directive (73/23/EEC)</li> <li>• EN 50178 Electronic Equipment for Use in Power Installations</li> </ul>
<b>Environment</b>	Altitude:	1000 m (3300 ft.) max. without derating. Above 1000 m, the derating for the output current is 1% per 100 m (330 ft.).
	Ambient Operating Temperature without Derating: <sup>(2)</sup> Open Type / IP00: NEMA Type 1 / IP20:	0...50 °C (32...122 °F) 0...40 °C (32...104 °F)
	Storage Temperature (all const.):	-40...70 °C (-40...158 °F)
	Relative Humidity:	5 to 95% non-condensing
	Shock:	15G peak for 11 ms duration (± 1.0 ms)
	Vibration:	0.152 mm (0.006 in.) displacement, 1G peak
<b>Compatible AC Drives</b>	Permitted DC Input (Common Bus) Drives that Can Be Connected to Diode Bus Supply:	PowerFlex DC Input (Common Bus) drives with built-in precharge circuit (see <a href="#">Specific Drive Information on page P-1</a> )

<sup>(1)</sup> When paralleling Diode Bus Supplies (two maximum) for operation, the DC bus output current is derated by 3% for each Bus Supply. For more details, see [Paralleling Diode Bus Supplies on page 1-11](#).

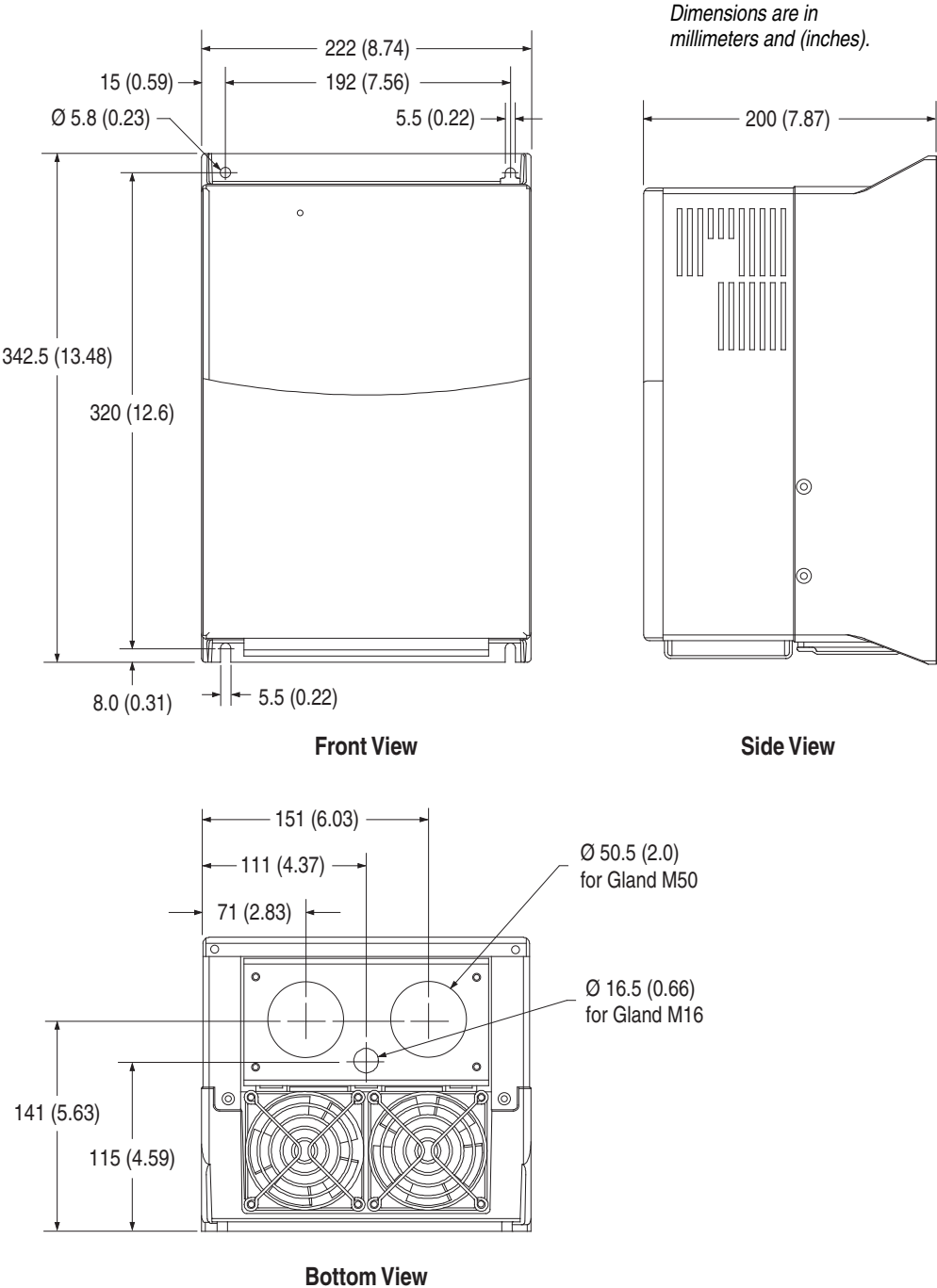
<sup>(2)</sup> See [page 1-2](#) for enclosure type conversion information.



### Dimensions

The overall and mounting dimensions for the Diode Bus Supply are shown in [Figure A.1](#).

**Figure A.1 Diode Bus Supply Dimensions (equivalent to PowerFlex 700 Frame 2 Drive)**



**Approximate Shipping Weight:** 23 kg (50.7 lb.)

## AC Input Fusing

[Table A.A](#) below provides output ampere ratings for the Diode Bus Supply (including continuous, 1 minute, and 3 seconds) and recommended AC line input fusing information. The short circuit protection fuses are acceptable for UL and IEC requirements. Sizes listed are recommended sizes based on 40 °C (104 °F) and the U.S. NEC. Other country, state or local codes may require different ratings.

### Fuse Types

Refer to the recommended types listed below.

- IEC – BS88 (British Standard) Parts 1 & 2 <sup>(1)</sup>, EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class RK1 or J must be used. <sup>(2)</sup>

**Table A.A AC Input Current Ratings and Recommended Input Fusing**

Bus Supply Catalog Number	Input Ratings		Output Amps			Dual Element Time Delay Fuse Amps	
	Amps	kVA	Cont.	1 Min.	3 Sec.		
<b>240 Volt / 60 Hz AC Input</b>							
20TD120	105	44	120	180	240	125 IEC - gG or 150 UL - Class RK1 or J	
<b>400 Volt / 50 Hz AC Input</b>							
20TD120	105	73	120	180	240		
<b>480 Volt / 60 Hz AC Input</b>							
20TD120	105	87	120	180	240		
<b>500 Volt / 50 Hz AC Input</b>							
20TE120	105	91	120	180	240		
<b>600 Volt / 60 Hz AC Input</b>							
20TE120	105	109	120	180	240		

<sup>(1)</sup> Typical designations include, but may not be limited to, the following: Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, and GH.

<sup>(2)</sup> For 600V, (Ferraz Shawmut) Class J: AJT150 (with open fuse indicator),  
Class RK1: A6D150R  
(Bussman) Class J: LPJ-150SP,  
Class RK1: LPS-RK-150SP or equivalent

## Line Reactors

A minimum reactance is required to limit peak currents in the AC line and the diode bridge circuit. This can be accomplished either by a matched supply transformer or by adding line reactors to ensure the requested minimum voltage drop over the total line impedance. The preferred method is to install a minimum 3% line reactor, which will also reduce line harmonics.

Use [Table A.B](#) to select a line reactor based on the sum of the drive's connected DC Amps and the supply transformer rating.

For more details on the 1321-Series line reactors, see 1321 Power Conditioning Products Technical Data, publication [1321-TD001](#).

**Table A.B Line Reactor Selection**

Drives	Maximum Power Transformer Size <sup>(1)</sup>		Line Reactor		
	Sum of DC Amps	1000 kVA 5.5% 31 $\mu$ H	1400 kVA 6% 24 $\mu$ H	Watts	Induct. [ $\mu$ H]
<b>400V, 50 Hz</b>					
Up to 120	Yes	—	180	200	1321-3R130-B
<b>480V, 60 Hz</b>					
Up to 120	Yes	—	180	200	1321-3R130-B
<b>600V, 60 Hz</b>					
Up to 120	Yes	Yes	180	200	1321-3R130-B

<sup>(1)</sup> The inductance value of the supply transformers includes 2.5  $\mu$ H for 10 m feeder cable.

<sup>(2)</sup> The number in the catalog string represents the fundamental AC current rating of the reactor.

## Spare Parts

The Diode Bus Supply is not factory or field repairable, therefore no spare parts exist for this product.

**Notes:**

## History of Changes

Topic	Page
<a href="#">20T-UM001C-EN-P, September 2006</a>	B-1

This appendix summarizes the revisions to this manual, starting with revision C. Reference this appendix if you need information to determine what changes have been made across multiple revisions. This may be especially useful if you are deciding to upgrade your hardware or software based on information added with previous revisions of this manual.

### 20T-UM001C-EN-P, September 2006

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#### Change

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In Chapter 1:

- In the section “AC Supply Source Considerations,” revised information in the “Input Power Conditioning” subsection.
- In the section “Power Wiring,” added a new “DC Bus Wiring Guidelines” subsection that refers to the AC Drives In Common Bus Guidelines, publication DRIVES-AT002.
- Added the new section “Parallel Bus Supplies.”

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In Appendix A, added the new section “Line Reactors.”

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# 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 manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit <http://www.rockwellautomation.com/support/>.

For U.S. Allen-Bradley Drives Technical Support — Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: [support@drives.ra.rockwell.com](mailto:support@drives.ra.rockwell.com), Online: [www.ab.com/support/abdrives](http://www.ab.com/support/abdrives)

## 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.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the <a href="#">Worldwide Locator</a> at <a href="http://www.rockwellautomation.com/support/americas/phone_en.html">http://www.rockwellautomation.com/support/americas/phone_en.html</a> , or contact your local Rockwell Automation representative.

## New Product Satisfaction Return

Rockwell Automation tests all of its products to 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.

United States	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.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

## 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/>.

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