Application Guidelines

Allen-Bradley

PowerFlex® AC Drives in Common Bus Configurations

Allen-Bradley • Rockwell Software

Rockwell Automation

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.

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

This manual contains new and updated information.

New and Updated Information

This table contains the changes made to this revision.

Topic	Page
In Chapter 1: • Revised paragraph in the subsection "PowerFlex 750-Series Frame 5…7 Drives." • Added new subsection "PowerFlex 750-Series Frame 5…7 DC Input "Common Bus Drives."	 23 25
In Chapter 2: • Revised footnote 5 below "Supported Products" table to say "PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected." • Revised the "PowerFlex 750-Series: Frames 5…7" row and added a new Kinetix BM09…BM12 row in the table below Figure 20. • Updated PowerFlex SCR Bus Supply Normal Duty and Heavy Duty tables.	 29 31 34
In Chapter 3: • Revised footnote 6 below "Supported Products" table to say "Frame 5…7 DC input version drives with precharge must be selected." • Revised the "PowerFlex 750-Series: Frames 5…7" and Kinetix BM09…BM12 rows in the tables below Figures 22 and 25. • Updated PowerFlex SCR Bus Supply Normal Duty and Heavy Duty tables.	 37 39 & 42 46
In Chapter 4: • Revised footnote 4 below "Supported Products" table to say "A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives." • Revised the "PowerFlex 750-Series: Frames 5…7" row in the table below Figure 26. • Revised the "PowerFlex 750-Series: Frames 2…7" row in the tables below Figures 27 and 28.	 49 50 51 & 52
In Chapter 5: • Revised footnote 4 below "Supported Products" table to say "A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives." • Revised the "PowerFlex 750-Series: Frames 5…7" row in the tables below Figures 30 and 31.	 57 59 & 60
In Chapter 6, revised footnote 3 below "Supported Products" table and footnote 4 in the table below Figure 33 to say "A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives."	65 & 66
In Chapter 7, revised footnote 3 below "Supported Products" table and footnote 4 in the table below Figure 35 to say "A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives."	69 & 72
In Chapter 8: • Revised footnote 4 below "Supported Products" table to say "PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected." • Revised the "PowerFlex 750-Series: Frames 5…7" row and added a new Kinetix BM09…BM12 row in the tables below Figures 36 and 37.	 75 76 & 77
In Chapter 9: • Revised footnote 3 below "Supported Products" table to say "PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected." • Revised the "PowerFlex 750-Series: Frames 5…7" row in the table below Figure 38.	 83 84
In Chapter 10: • Revised footnote 4 below "Supported Products" table to say "PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected." • Revised the "PowerFlex 750-Series: Frames 5…7" row and added a new Kinetix BM09…BM12 row in the table below Figure 40.	 89 90

Topic	Page
In Chapter 11: • Revised footnote 4 below "Supported Products" table to say "A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives." • Revised the "PowerFlex 750-Series: Frames 5…7" row in the table below Figure 41.	93 94
In Chapter 12: • Revised footnote 4 below "Supported Products" table to say "A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives." • Revised the "PowerFlex 750-Series: Frames 5…7" row in the table below Figure 42.	97 98
In Appendix A, added last column "Maximum External DC Bus Capacitance (µF)" to Tables 6 and 14.	105 & 112

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Introduction

An increasing number of drive systems in a wide range of applications and power ranges are being configured today in common bus configurations. These common bus drive system configurations provide significant advantages such as, design flexibility, higher efficiency, and cost savings.

It is the objective of this publication to provide the necessary guidelines, considerations, and limitations for the proper application of PowerFlex drives used in common bus configurations.

For Allen-Bradley common bus standard products, refer to the *Common DC Bus Selection Guide* (Publication DRIVES-SG001).

Definitions of Common Bus Configurations

Common DC Bus — Non-Regenerative

Three-phase diode or SCR bridge front-end. A single-direction power flow, full-wave bridge converts 3-phase AC voltage to a fixed DC bus voltage. One or more drives are connected via the DC bus.

Common DC Bus — Non-Regenerative with Braking Chopper

Same as Non-Regenerative with an added resistive braking module to dissipate excess regenerative DC bus energy.

Shared AC/DC Bus

Stand alone drives fed by a common 3-phase voltage source with the DC bus of each drive connected together.

Shared AC/DC Bus — with Braking Chopper

Same as Shared AC/DC Bus with an added resistive braking module to dissipate excess regenerative DC bus energy.

Shared DC Bus (Piggy Back)

One stand-alone drive is used as the common converter section for multiple shared DC bus drives. The incoming AC power is fed to the drive used as the common converter only. The drive used as the common converter sources DC power to the smaller drive(s) via the DC link connections.

Shared DC Bus (Piggy Back) — with Braking Chopper

Same as Shared DC Bus with an added resistive braking module to dissipate excess regenerative DC bus energy.

Regenerative Bus Supply (Active Front End)

PWM controlled IGBT converter allows regeneration to the AC line. One or more drives are connected to the DC bus.

Regenerative Braking

A regenerative brake allows regeneration to the AC line. In this configuration, the drive has a connection to the AC line and draws the majority of the motoring power.

Shared Regenerative Braking

Similar to the Regenerative Braking Configuration, except multiple drives are connected to a single regenerative unit. Steering diodes are used to control flow of current.

Parallel Regenerative Braking

Similar to the Regenerative Braking Configuration, except multiple regenerative units are connected to a single drive.

Reference Materials

The following publications provide useful information when planning and installing common bus products:

For:	Refer to:	Publication
1336-WA / -WB / -WC Brake Chopper Module	Installation Instructions	1336-5.65
1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Braking	Installation Instructions	1336-5.64
AK DBU Dynamic Braking Unit	AK DBU Dynamic Braking Unit 600/690 VAC User Manual	AKDBU-UM001
20S SCR Bus Supply	PowerFlex SCR Bus Supply User Manual	20S-UM001
20T Diode Bus Supply	PowerFlex Diode Bus Supply User Manual	20T-UM001
PowerFlex® 40P Drive	PowerFlex 40P User Manual PowerFlex 40P Quick Start	22D-UM001 22D-QS001
PowerFlex® 700/700VC Series A Drive PowerFlex® 700VC Series B Drive	PowerFlex 700 Series A User Manual PowerFlex 700 Series B User Manual PowerFlex 70/700 Reference Manual PowerFlex 70EC/700VC Reference Manual PowerFlex 700 Technical Data PowerFlex Dynamic Braking Resistor Calculator	20B-UM001 20B-UM002 PFLEX-RM001 PFLEX-RM004 20B-TD001 PFLEX-AT001
PowerFlex® 700H Drive	PowerFlex 700H Installation Instructions PowerFlex 700H Programming Manual PowerFlex 700H Technical Data	PFLEX-IN006 20C-PM001 20C-TD001
PowerFlex® 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 I Control Technical Data 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 PowerFlex 700S with Phase II Control Technical Data PowerFlex Dynamic Braking Resistor Calculator	20D-IN024 PFLEX-IN006 20D-UM001 PFLEX-RM002 20D-TD001 20D-IN024 PFLEX-IN006 20D-PM001 PFLEX-RM003 20D-TD002 PFLEX-AT001
PowerFlex® 700L Drive	PowerFlex 700L Liquid-Cooled Drive User Manual PowerFlex 700L Active Converter Power Module User Manual For Vector Control, see PowerFlex 700 Series B User Manual For Phase II Control, see PowerFlex 700S w/Phase II Control Programming Manual	20L-UM001 PFLEX-UM002 20B-UM002 20D-PM001
PowerFlex® 750-Series Drive	PowerFlex 750-Series Drive Installation Instructions PowerFlex 750-Series Drive Programming Manual PowerFlex 750-Series Drive Technical Data	750-IN001 750-PM001 750-TD001
PowerFlex® 700AFE	PowerFlex 700AFE User Manual	20Y-UM001
1336 REGEN Drive	Line Regeneration Package User Manual	1336 REGEN-5.0
1321 Line Reactor & Isolation Transformers	Line Reactor and Isolation Transformer Technical Data	1321-TD001
Kinetix 7000 Servo Drive	Kinetix 7000 Installation Instructions Kinetix 7000 User Manual	2099-IN003 2099-UM001
Kinetix 6000 Multi-Axis Servo Drive	Kinetix 6000 Installation Instructions Kinetix 6000 User Manual	2094-IN001 2094-UM001
Kintetix 6200/6500 Modular Multi-Axis Servo Drives	Kinetix 6200 and Kinetix 6500 Installation Instructions Kinetix 6200 and Kinetix 6500 User Manual	2094-IN012 2094-UM002

Publications can be obtained online at http://www.rockwellautomation.com/literature.

Technical Support (SupportPlus™)

For consultation on high performance drive applications, the SupportPlus program is offered. SupportPlus uses expert-level Rockwell Automation system engineers to support the user's engineering team. SupportPlus engineers will work with the end user to lay out the appropriate architecture, configure drives, recommend programming techniques, and provide application assistance on the most effective ways to implement the control solution.

Description	Catalog No.
One-Hour Design Consultation	TS-SP1HR
Two-Hour Design Consultation	TS-SP2HR
On-Site Power Analysis	TS-PASIOS

For more information, please visit
http://www.ab.com/support/abdrives/files/supportplus.pdf

General Considerations

DC Bus Wiring Guidelines

Drive Line-up

Generally, it is desirable to have the drive line-up match the machine layout. However, if there is a mix of drive frame sizes used in the line-up, the general system layout should have the largest drives located closest to the rectifier source. The rectifier source need not be at the left end of the system line-up. Many times it is advantageous to put the rectifier in the middle of the line-up, minimizing the distances to the farthest loads. This is needed to minimize the energy stored in the parasitic inductance of the bus structure and thus lower peak bus voltages during transient operation.

The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives. This is needed to maintain low inductance.

DC Bus Connections

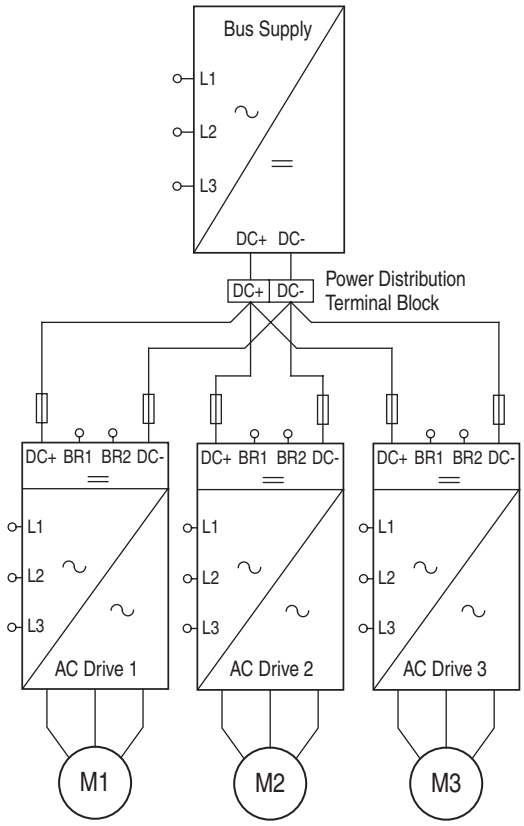
General

The interconnection of drives to the DC bus, and the inductance levels between the drives, should be kept to a minimum for reliable system operation.

Bus Bar vs. Cable

- DC Bus Bar is recommended.
- When DC Bus Bar cannot be used, use the following guidelines for DC Bus cables:
  - Keep the cable lengths as short as possible.
  - Twist cable where possible, approximately 1 twist per foot.
  - Use cable rated for the equivalent AC voltage rating. The peak AC voltage is equivalent to the DC voltage. For example, the peak AC voltage on a 480V AC system no load is 480 x 1.414 = 679 Volts peak. The 679 Volts peak corresponds to 679 Volts DC at no load.
  - The DC bus connections should not be “daisy chained.” Configuration of the DC bus connections should be in a "star" configuration to allow for proper fusing.

Figure 1 - Star Configuration of Common Bus Connections



Braking Chopper

Connection of the brake unit should be closest to the largest drive. If all are the same rating, then closest to the drive that regenerates the most.

The maximum wire length between the brake chopper and the highest power drive and between parallel brake choppers must be observed. Refer to the respective braking product documentation (Reference Materials on page 15) for details.

In certain configurations, an RC snubber circuit is required when using a 1336-W* Brake Chopper. The RC snubber circuit is required to prevent the DC bus voltage from exceeding the 1200V maximum Brake Chopper IGBT voltage. The 1336-W* Brake Chopper power-up delay time is 80 milliseconds. During this time, the IGBT will not turn on. The RC snubber circuit must always be connected to the DC bus (located close to the braking chopper) to absorb the power-on voltage overshoot. For RC snubber circuit specifications, refer to RC Snubber Circuit on page 123.

An RC snubber can also mitigate inductive voltage spike at brake off transitions.

Precharge

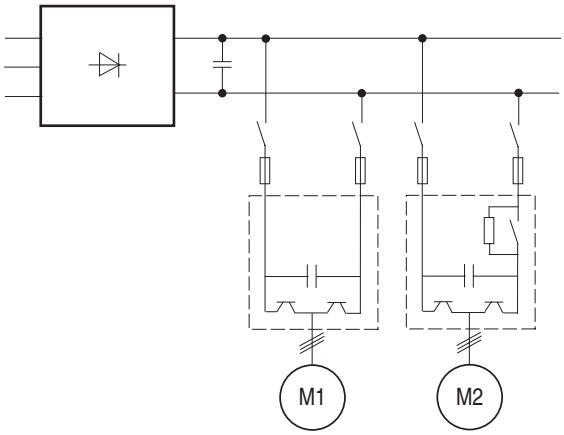
Precharge is the process through which the DC bus voltage of a drive is gradually increased. During this increase in DC bus voltage, the DC bus filtering capacitors are charged in a controller manner. The precharge assembly may be part of the drive's design or provided and controlled externally by the user.

ATTENTION: An external source of power may be present. To avoid an electrical shock hazard, verify the AC power supply has been removed prior to performing any maintenance.

If an external voltage source is being used to power the logic boards of the drives, precaution must be taken to control the precharge sequence. It is recommended that the "Precharge Enable" digital input for common bus operation on the drive be used. The logic input can be coordinated through a PLC or system level control for precharge sequencing. This will allow for various horsepower drives charging time constants to settle out before the precharge is closed. Generally, a 3 second delay after power application is acceptable.

When multiple drives are connected through disconnects to a common DC bus, it is generally necessary to provide an input to the drive that enables the precharge to close. Often this input is controlled by an auxiliary contact on the drive disconnect switch.

Figure 2 - Common DC Bus Example



The bus capacitors in the individual drives act as a low impedance voltage source. Extra care is needed when connecting individual drives to an energized bus.

ATTENTION: Kinetix servo drives have no method for the user to control the precharge sequence. Kinetix servo drives must never be connected to an energized DC bus. Severe drive and/or equipment damage will result due to an uncontrolled precharge of the Kinetix drives.

If "Precharge Enable" is selected as a digital input, it must be energized to allow the initial bus precharge to complete (with PowerFlex 700-Series and PowerFlex 40P drives). If it is de-energized, it is treated as a coast to stop command AND it

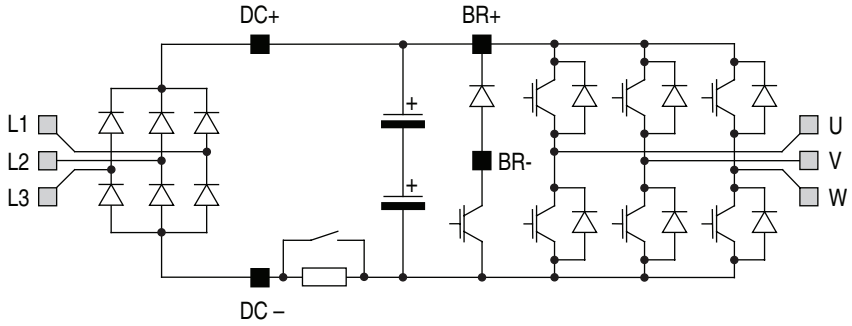
forces the drive to the initial bus precharge state. Fuse failure is probable unless coordination of precharge circuits in individual drives is considered.

PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware version 2.001 or later (Standard and Vector Control) for use in common bus configurations. When Kinetix 6000 drives are used in common bus configurations with PowerFlex drives, they must have firmware version 1.92 or later. Kinetix 6200/6500 drives with any firmware version can be used.

PowerFlex 40P 0.5…5 HP AC Drives

For PowerFlex 40P 0.5...5 HP AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the negative DC bus, between the diode bridge and the bus capacitors. The resistor has a relay contact connected in parallel that will close, bypassing the precharge resistor when the bus precharge level has been reached. The precharge function will work the same for either AC or DC input power.

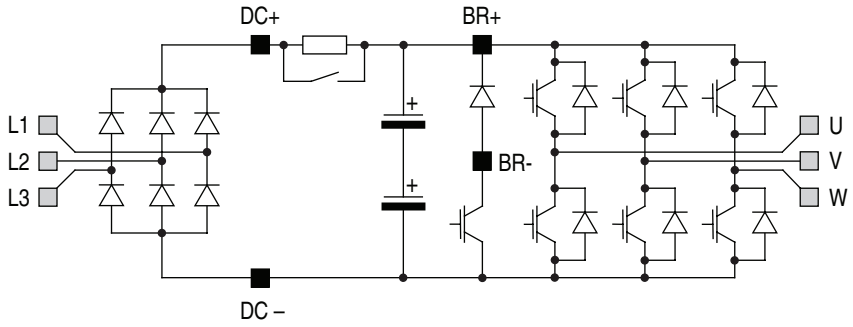
Figure 3 - PowerFlex 40P 0.5…5 HP Drives AC and DC Input Schematic



PowerFlex 40P 7.5…10 HP AC Drives

For PowerFlex 40P 7.5...10 HP AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus, between the diode bridge and the bus capacitors. The resistor has a relay contact connected in parallel that will close, bypassing the precharge resistor when the bus precharge level has been reached. The precharge function will work the same for either AC or DC input power.

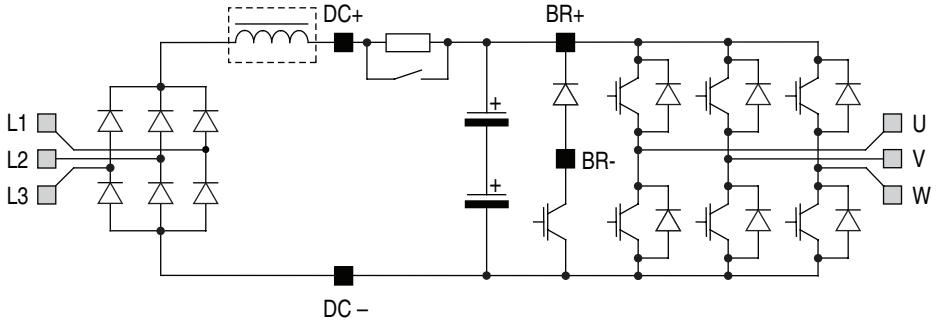
Figure 4 - PowerFlex 40P 7.5…10 HP Drives AC and DC Input Schematic



PowerFlex 40P 15 HP AC Drives

For PowerFlex 40P 15 HP AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus, between the DC link inductor and the bus capacitors. The resistor has a relay contact connected in parallel that will close, bypassing the precharge resistor when the bus precharge level has been reached. The precharge function will work the same for either AC or DC input power.

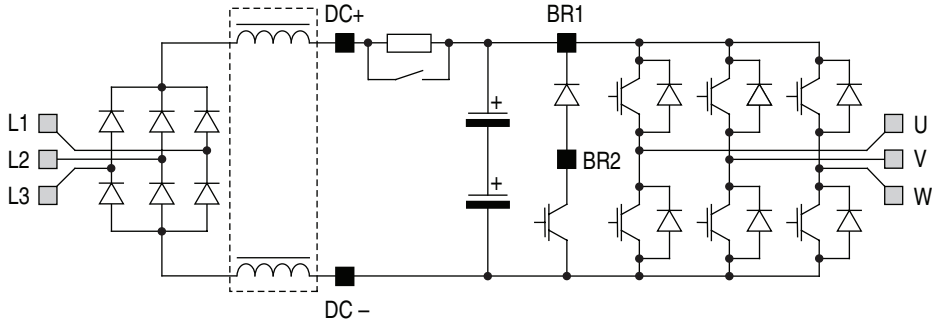
Figure 5 - PowerFlex 40P 15 HP Drives AC and DC Input Schematic



PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0…4, and PowerFlex 750-Series Frame 2…4 AC Drives

For PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0...4, and PowerFlex 750-Series Frame 2...4 AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus, between the DC link and the bus capacitors. The resistor has a relay contact connected in parallel that will close, bypassing the precharge resistor when the bus precharge level has been reached. The precharge function will work the same for either AC or DC input power.

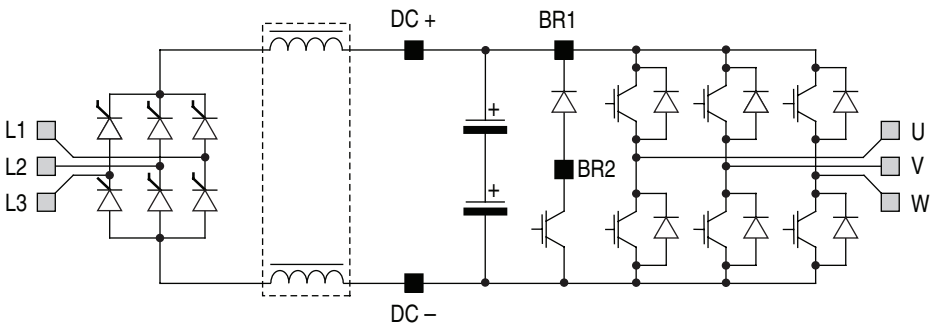
Figure 6 - PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0…4, and PowerFlex 750-Series Frame 2…4 Drives AC and DC Input Schematic



PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…10 AC Input "Stand-Alone Drives"

For PowerFlex 700/700S Frame 5 and 6, and PowerFlex Frame 7...10 drives (AC Input), the precharge function is implemented with an SCR rectifier such that the SCRs are phase advanced to limit the inrush current into the bus capacitor(s). This phase-advanced precharge is not controlled by the drive and should normally be completed by the minimum precharge time required by the drive. The drive will not complete precharge until the bus voltage is stable and above the under voltage level.

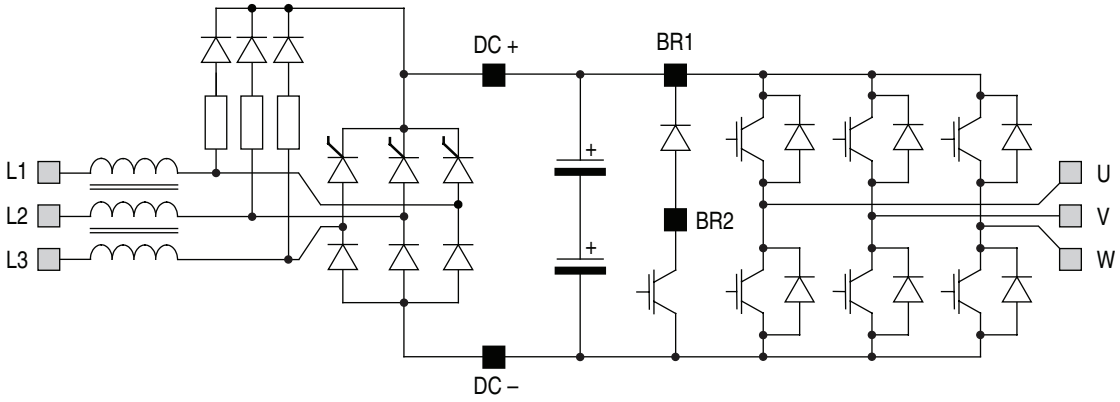
Figure 7 - PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…10 Drives AC Input Schematic



PowerFlex 700H/700S Frame 9…14 AC Input "Stand-Alone Drives"

During the precharge phase of PowerFlex 700H/700S Frame 9...14 drives, the three SCR switches of the front end rectifier are open and the bus capacitors are charged through the resistors and diodes from the AC side of the bridge.

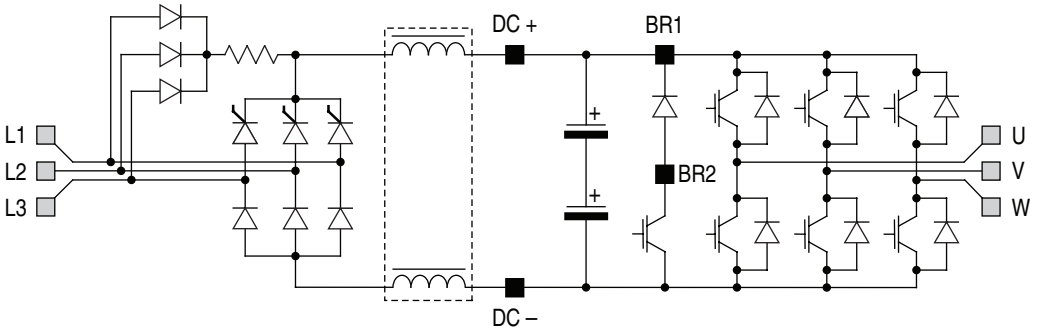
Figure 8 - PowerFlex 700H/700S Frame 9…14 Drives AC Input Schematic



PowerFlex 750-Series Frame 5…7 AC Drives

When ordered as an AC input drive, DC terminals are not provided. During precharge, the SCRs of the front end rectifier are open and the bus capacitors are charged through the diodes and resistors from the AC input.

Figure 9 - PowerFlex 750-Series Frame 5…7 Drives AC Input Schematic



PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…10 DC Input "Common Bus Drives"

There are two versions of these DC Input or common bus drives. One version has a resistor in series with the positive DC bus, ahead of the bus capacitors. An SCR is connected in parallel and when gated on, it will bypass the resistor. PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7...9 drives are available with this internal precharge. PowerFlex 700 Frame 10 drives do not have an internal precharge option. The second version does not have any precharge hardware and is intended for applications where the precharge hardware and control is provided by the user. PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 10 drives are available without internal precharge. Drives with the resistor and SCR bypass (internal) have the same precharge control as PowerFlex 700/700S Frame 0...4 drives.

Figure 10 - PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…9 Drives DC Input Schematic (Voltage Rating Catalog Codes N, P, R, T, and W)

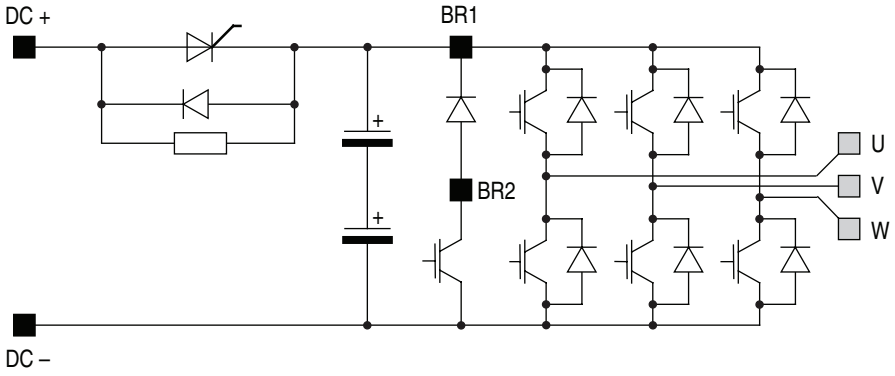
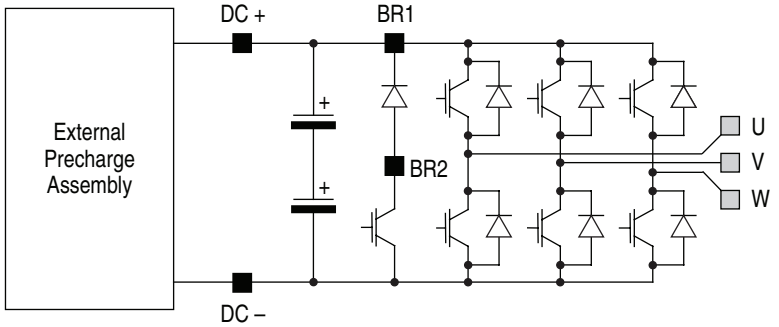


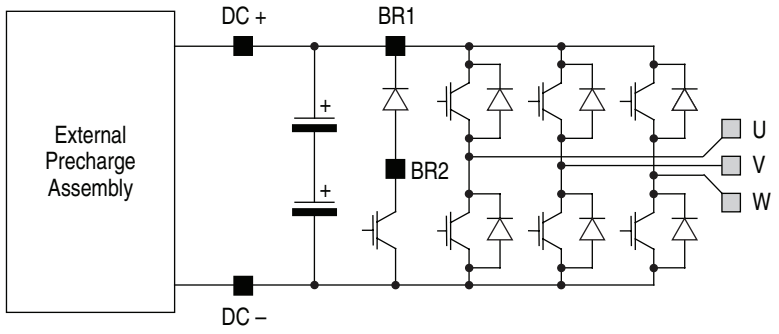
Figure 11 - PowerFlex 700/700S Frame 5 and 6, and PowerFlex Frame 10 Drives DC Input Schematic (Voltage Rating Catalog Codes H, J, K, and M)



PowerFlex 700H/700S Frame 9…14 DC Input "Common Bus Drives"

PowerFlex 700H/700S Frame 9...14 drives (DC Input) do not include internal precharge. Precharge must be provided by an external precharge assembly.

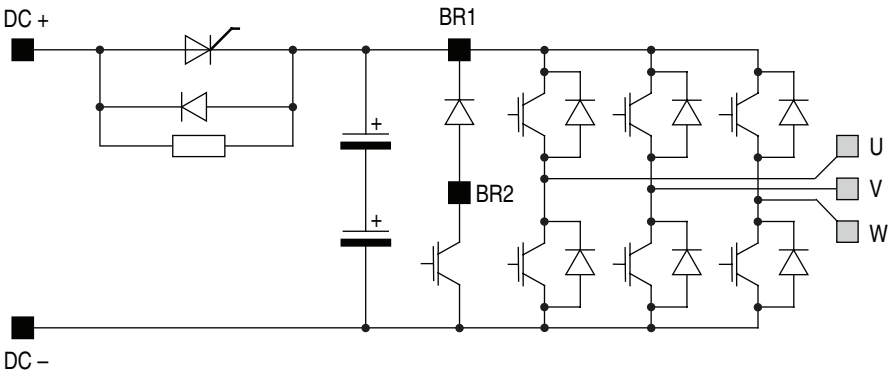
Figure 12 - PowerFlex 700H/700S Frame 9…14 Drives DC Input Schematic (Voltage Rating Catalog Codes H, J, K, and M)



PowerFlex 750-Series Frame 5…7 DC Input "Common Bus Drives"

The precharge has a resistor in series with the positive DC bus, ahead of the bus capacitors. An SCR is connected in parallel and when gated on, it will bypass the resistor.

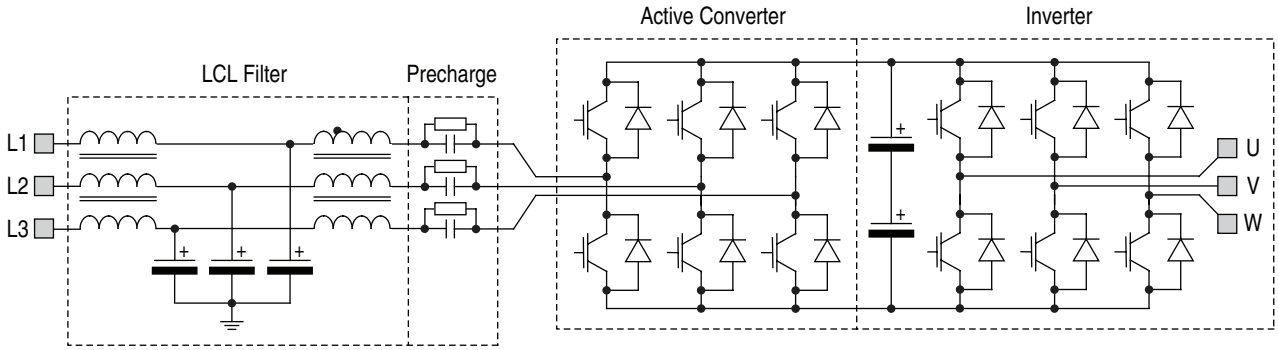
Figure 13 - PowerFlex 750-Series Frame 5…7 (Input Type Catalog Code 4)



PowerFlex 700L Frame 2, 3A, and 3B AC Input "Stand-Alone Drives"

PowerFlex 700L Frame 2, 3A, and 3B AC input drives are regenerative drives with an active converter and input filter. The precharge circuit is connected between the input filter and the active converter. This is a 3-phase precharge with resistors in parallel with AC contactors. When the precharge is complete, the AC contactors close to bypass the resistors.

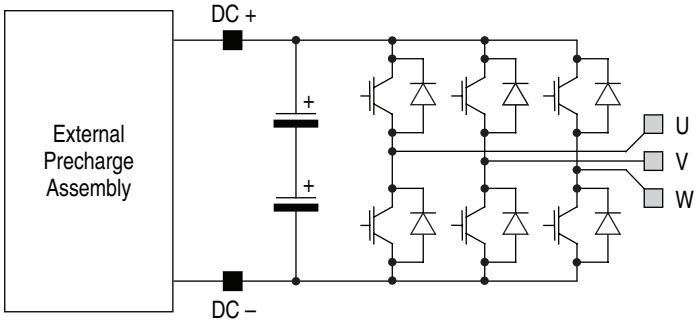
Figure 14 - PowerFlex 700L Frame 2, 3A, and 3B Drives AC Input Schematic (Equipment Type Catalog Code A)



PowerFlex 700L Frame 3A and 3B DC Input "Common Bus Drives"

PowerFlex 700L Frame 3A and 3B drives (DC Input) do not include internal precharge. Precharge must be provided by an external precharge assembly.

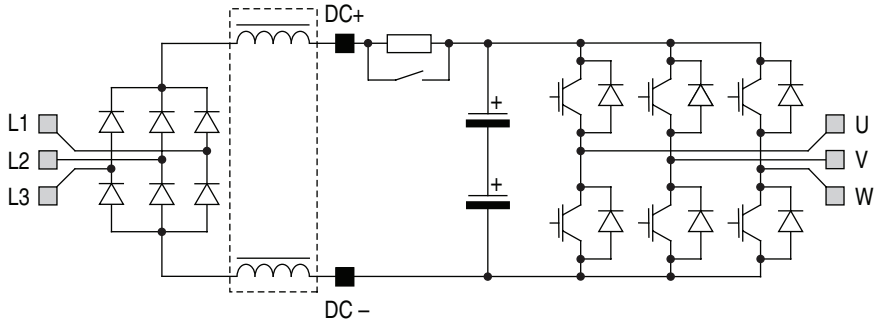
Figure 15 - PowerFlex 700L Frame 3A and 3B Drives DC Input Schematic (Equipment Type Catalog Codes K and L)



Kinetix 7000 Catalog Numbers BM06…BM08 Servo Drives

For Kinetix 7000, catalog numbers BM06...BM08, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus between the DC link and the bus capacitors. The resistor has a relay contact connected in parallel that will close, bypassing the precharge resistor when the bus precharge level has been reached. The precharge function will work the same for either AC or DC power.

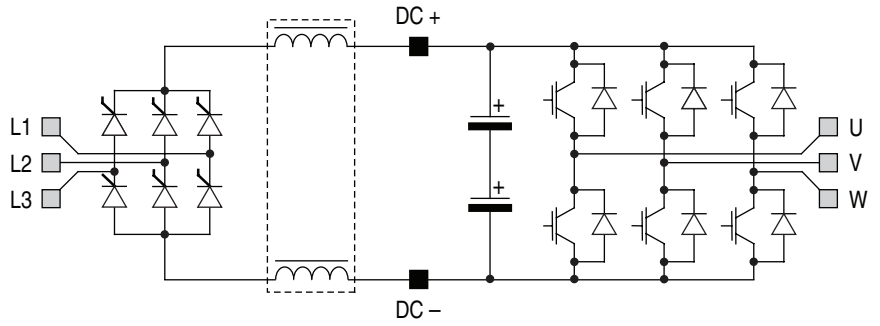
Figure 16 - Kinetix 7000 BM06…BM08 Servo Drives Schematic



Kinetix 7000 Catalog Numbers BM09…BM12 Servo Drives

For Kinetix 7000, catalog numbers BM09...BM12, the precharge hardware is implemented with an SCR rectifier such that the SCR's are phase advanced to limit the inrush current into the bus capacitor(s). This phase-advanced precharge is not controlled by the drive and should normally be completed by the minimum precharge time required by the drive. The drive will not complete precharge until the bus voltage is stable and above the undervoltage level.

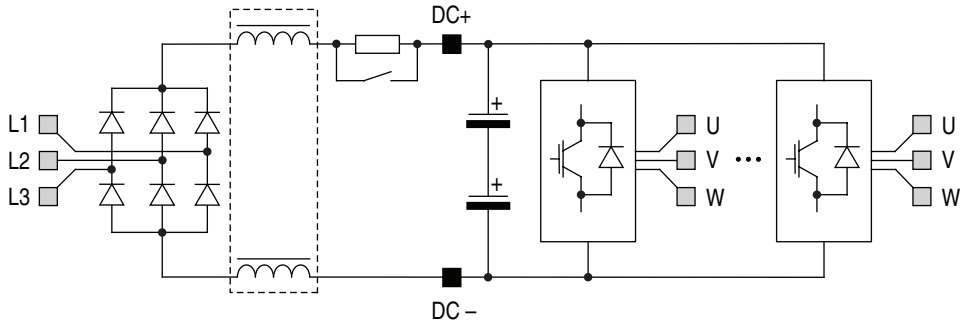
Figure 17 - Kinetix 7000 BM09…BM12 Servo Drives Schematic



Kinetix 6000 Bxxx-Series and Kinetix 6200/6500 Multi-Axis Servo Drives

The Kinetix 6000 series and Kinetix 6200/6500 series is a packaged, highly configurable, common bus product with one converter module and multiple inverter modules mounted on a shared backplane. Precharge hardware, which consists of a resistor in series with a DC link inductor and the positive rail of the DC bus, is mounted in the converter module. In all recommended common bus configurations with PowerFlex drives, the converter is not used; therefore, three phase AC power should never be connected to the converter in mixed PowerFlex/Kinetix 6000 common bus configurations. An internal shunt module (braking chopper) is built into each inverter module. To be used in a common bus system with PowerFlex drives, the Kinetix system must be set to the common-bus follower condition with the shunt modules disabled.

Figure 18 - Kinetix 6000 Bxxx-Series and Kinetix 6200/6500 Multi-Axis Servo Drives System Schematic



Common DC Bus Configuration — Non-Regenerative

System Characteristics

This system is characterized by a diode or an SCR rectifier front end which converts the 3-phase AC line voltage into a non-filtered DC bus voltage. No provisions exist for line regeneration or power dissipation of any recovered energy from the motor/load system.

Supported Products

At the time of publication, the following non-regenerative DC Bus Supplies and PowerFlex drives are supported:

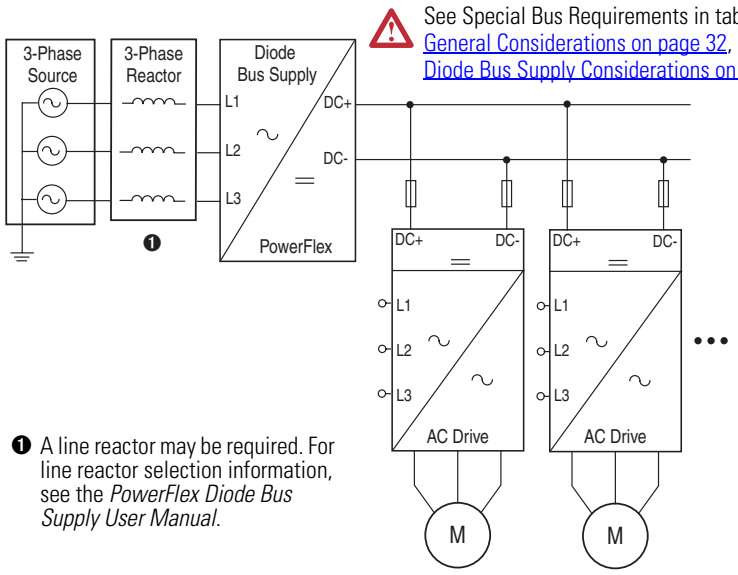
DC Bus Supply Products	Supported Drives
PowerFlex Diode Bus Supply 20T	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…4
	PowerFlex 700S: Frames 1…4 (2)
	PowerFlex 750-Series: Frames 2…4
	Kinetix 7000: BM06…BM08
PowerFlex SCR Bus Supply 20S	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): All frame sizes (3)
	PowerFlex 700S: All frame sizes (3)
	PowerFlex 700H: All frame sizes (3)
	PowerFlex 700L: Frames 3A (4) and 3B (3)
	PowerFlex 750-Series: Frames 2…7 (5)
	Kinetix 7000: All power ratings
	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations (6)

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) There is no Frame 0 for PowerFlex 700S drives.
(3) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(4) Frame 3A dual inverter drives only.
(5) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.
(6) Kinetix 6000 configurations require firmware version 1.92 or later.

Typical System Configuration

PowerFlex Diode Bus Supply

Figure 19 - Diode Bus Supply with Stand-Alone AC Drives Connected in Common Bus Configuration

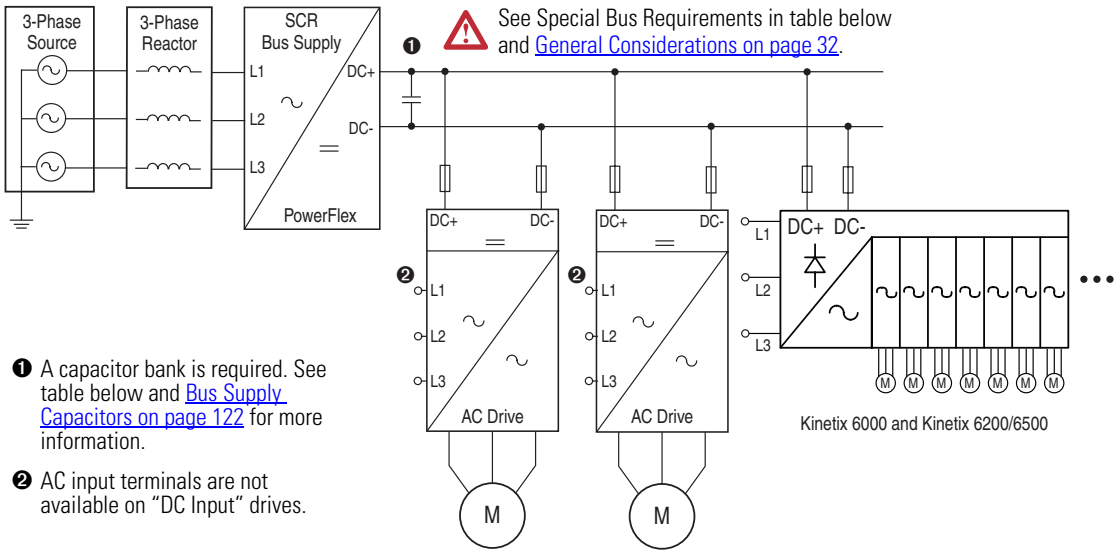


❶ A line reactor may be required. For line reactor selection information, see the *PowerFlex Diode Bus Supply User Manual*.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 750-Series: Frames 2…4	None
	Kinetix 7000: BM06…BM08	None
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700S/750-Series drives and Kinetix 7000 drives.

PowerFlex SCR Bus Supply

Figure 20 - SCR Bus Supply with Stand-Alone AC Drives and Kinetix 6000 Drive System in a Common Bus Configuration



❶ A capacitor bank is required. See table below and Bus Supply Capacitors on page 122 for more information.

❷ AC input terminals are not available on "DC Input" drives.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 700: Frames 7…10 PowerFlex 700H/700S: Frames 9…14 PowerFlex 700L: Frames 3A (1) and 3B	• Additional bus capacitance may be required; see General Considerations on page 32. • External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 750-Series: Frames 2…4	None
	PowerFlex 750-Series: Frames 5…7	DC input version with precharge must be selected.
	Kinetix 7000: BM06…BM08	None
	Kinetix 7000: BM09…BM12	External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
Kinetix 6000 and Kinetix 6200/6500	Kinetix 6000: Bxxx-Series (460V only) Kinetix 6200/6500 Multi-Axis Servo Drives (460V only)	• No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 33. • Drives must be placed in a common bus follower configuration.

(1) Frame 3A dual inverter drives only.

General Considerations

ATTENTION: The incorrect use or configuration of third party assemblies may result in reduced system reliability and drive damage.

1. All system components (Bus Supply, PowerFlex and Kinetix Drives, and Braking Unit) must be selected for the same AC-line voltage.
2. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives. This is needed to maintain low inductance.
3. Every precaution should be taken to minimize the distance between drives and wire lengths. The mixture of different frame size drives in this arrangement can cause high ripple current in the smaller frame drives. In this case, the larger power drives should be placed physically closer to the bus supply. This will help current sharing among the various drives on the bus.
4. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to "PreCharge En." This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drive(s) must have internal or externally-supplied precharge.

Drive	Parameter		Digital Input
	Number	Setting	
PowerFlex 40P	A051…A054	"29" (PreCharge En)	1…4
PowerFlex 700	361…366	"30" (PreCharge En)	1…6
PowerFlex 700L with vector control			
PowerFlex 700S	825…830	"30" (PreCharge En)	1…6
PowerFlex 700L with 700S control			
PowerFlex 700H	361…366	"30" (PreCharge En)	1…6
PowerFlex 750-Series	189 [DI Precharge]	See Drive Programming Manual for programming information.	

ATTENTION: The Kinetix family of drives have no external means of controlling the precharge; therefore, a DC disconnect should not be used.

5. If an AC drive from column A is mixed with an AC drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 122 for details.

Column A Drives	Column B Drives
PowerFlex 700/700S: Frames 0…5 PowerFlex 750-Series: Frames 2…7 Kinetix 6000 and Kinetix 6200/6500 Kinetix 7000	PowerFlex 700/700S: Frame 6 PowerFlex 700: Frames 8…10 PowerFlex 700H/700S: Frame 9 and up PowerFlex 700L: All Frames

6. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware version 2.001 or later (Standard and Vector Control).
7. For further assistance with this Common Bus configuration, contact the Rockwell Automation Support Plus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

PowerFlex Diode Bus Supply Considerations

The Diode Bus Supply should only be used with PowerFlex 700/700S Frame 0...4 drives, PowerFlex 750-Series Frame 2...4 drives, Kinetix 7000 BM06...BM08 drives or PowerFlex 40P drives (all power ratings). This is because the Diode Bus Supply does not include precharge. The precharge function must be provided by the drives.

ATTENTION: Never connect Kinetix 7000 BM09…BM12 drives, Kinetix 6000-Series drives or Kinetix 6200/6500 drives to a PowerFlex Diode Bus Supply in common bus configuration because there will be no controlled, current-limited precharge of the DC bus capacitors, resulting in drive damage.

PowerFlex SCR Bus Supply Considerations

ATTENTION: The SCR Bus Supply includes precharge. The use of drives with precharge is not required IF AND ONLY IF power is removed and reconnected to the entire system, AND IF individual drives do not require to be isolated and reconnected to an energized bus via a disconnect switch. Failure to follow this recommendation will result in drive damage.

1. In order to commission and test the SCR Bus Supply, a minimum capacitance is required. See Bus Supply Capacitors on page 122 for details.
2. AC line reactors for di/dt limitation and current sharing must be externally mounted for each PowerFlex SCR Bus Supply. See the PowerFlex SCR Bus Supply User Manual for line reactor information.

Sizing

To avoid overloading the Bus Supply, the following requirements apply:

- 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 continuous DC Bus output current rating of the Bus Supply.
- For the DC Input Current values of the drives, please refer to the tables in Appendix A. In addition, the guidelines provided in the *PowerFlex 700 User Manual*, *PowerFlex 700S/700H Installation Manual*, or *PowerFlex 750-Series Drive Technical Data* also apply.
- For Kinetix product ratings, refer to the *Kinetix Motion Control Selection Guide* and the *Kinetix 6000 and 7000 User Manuals and Installation Instructions*.

PowerFlex Diode Bus Supply

Examples for Maximum Loading of the Diode Bus Supply:

a) Normal Duty ND

DC Input Rating of Connected Drives				Diode Bus Supply	
DC Voltage	ND Power	ND Currents	ND Current Sum	Rated Cont. DC Output Amps	AC Input Voltage
540V	30 + 22 = 52 kW	61.9 + 47.5	109.4	120A	400V
650V	2 x 40 = 80 HP	2 x 55.7	111.4	120A	480V

b) Heavy Duty HD

DC Input Rating of Connected Drives				Diode Bus Supply	
DC Voltage	HD Power	HD Currents	HD Current Sum	Rated Cont. DC Output Amps	AC Input Voltage
540V	37 + 2 x 1.5 = 40 kW	95.1 + 2 x 5.3	105.7	120A	400V

Total the DC Input currents for all drives connected to the DC bus. This total must be less than 120A.

PowerFlex SCR Bus Supply

Examples for Maximum Loading of the SCR Bus Supply:

a) Normal Duty ND, 110%, 1 minute; 150%, 3 seconds

Drive Rating		Drive Output Current		Drive DC Input Current		SCR Bus Supply (1)	
DC Voltage	ND Power	ND Output Currents	ND Output Current Sum	ND DC Input Currents	ND DC Input Current Sum	Maximum DC Output Amps	AC Input Voltage
540V	3 x 110 kW 1 x 45 kW	3 x 205 = 615A 1 x 85 = 85A	700A	3 x 226 = 678A 1 x 95 = 95A	773A	1000A	400V
650V	3 x 60 HP 1 x 30 HP	3 x 77 = 231A 1 x 40 = 40A	271A	3 x 84.5 = 253.5A 1 x 42.9 = 42.9A	297A	400A	480V

(1) No overload capability.

b) Heavy Duty HD, 150%, 1 minute; 200%, 3 seconds

Drive Rating		Drive Output Current		Drive DC Input Current		SCR Bus Supply (1)	
DC Voltage	HD Power	HD Output Currents	HD Output Current Sum	HD DC Input Currents	HD DC Input Current Sum	Maximum DC Output Amps	AC Input Voltage
540V	3 x 90 kW	3 x 170 = 510A	510A	3 x 192.3 = 577A	577A	600A	400V

(1) No overload capability.

Fusing

DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

PowerFlex Diode Bus Supply

See the *PowerFlex Diode Bus Supply User Manual* for recommended AC input fusing.

PowerFlex SCR Bus Supply

The PowerFlex SCR Bus Supply has built-in AC line and DC bus fuses (on 400A and 600A units). The 1000A unit has six in-path fuses which simultaneously protect AC and DC paths. All units are equipped with fuse trip indicator switches. See the *PowerFlex SCR Bus Supply User Manual* for fusing information.

Notes:

Common DC Bus Configuration — Non-Regenerative with Braking DC Bus Regulation

System Characteristics

This system is characterized by a diode or SCR rectifier front end which converts the 3-phase AC line voltage into a non-filtered DC bus voltage. This system uses a Braking Chopper, Dynamic Brake Unit, or the drive's internal IGBT with a braking resistor for power dissipation of excess regenerative energy.

Supported Products

At the time of publication, these non-regenerative DC Bus Supplies and drives are supported:

DC Bus Supply Products (1)	Supported Drives
PowerFlex Diode Bus Supply 20T	PowerFlex 40P: All power ratings
	PowerFlex 700 (2) / PowerFlex 700 Series B (2): Frames 0…4
	PowerFlex 700S: Frames 1…4 (3)
	PowerFlex 750-Series: Frames 2…4
	Kinetix 7000: BM06…BM08
PowerFlex SCR Bus Supply 20S	PowerFlex 40P: All power ratings
	PowerFlex 700 (2) / PowerFlex 700 Series B (2): All frame sizes (4)
	PowerFlex 700S: All frame sizes (4)
	PowerFlex 700H: All frame sizes (4)
	PowerFlex 700L: Frame 3A (5) and 3B (4)
	PowerFlex 750-Series: Frames 2…7 (6)
	Kinetix 7000: All power ratings
	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations (7)

(1) For Bus Supply product details, see Chapter 2.
(2) These drives require firmware version 2.001 or later (Standard and Vector Control).
(3) There is no Frame 0 for PowerFlex 700S drives.
(4) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(5) Frame 3A dual inverter drives only.
(6) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.
(7) Kinetix 6000 configurations require firmware version 1.92 or later.

At the time of publication, these braking module products are available:

- 1336-WA / -WB / -WC Brake Chopper Module
- 1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Brake Unit
- AK DBU Dynamic Braking Unit

For information on these products, see Reference Materials on page 15.

Note – When applicable and within the power limitation, the drive's internal IGBT can also be used:

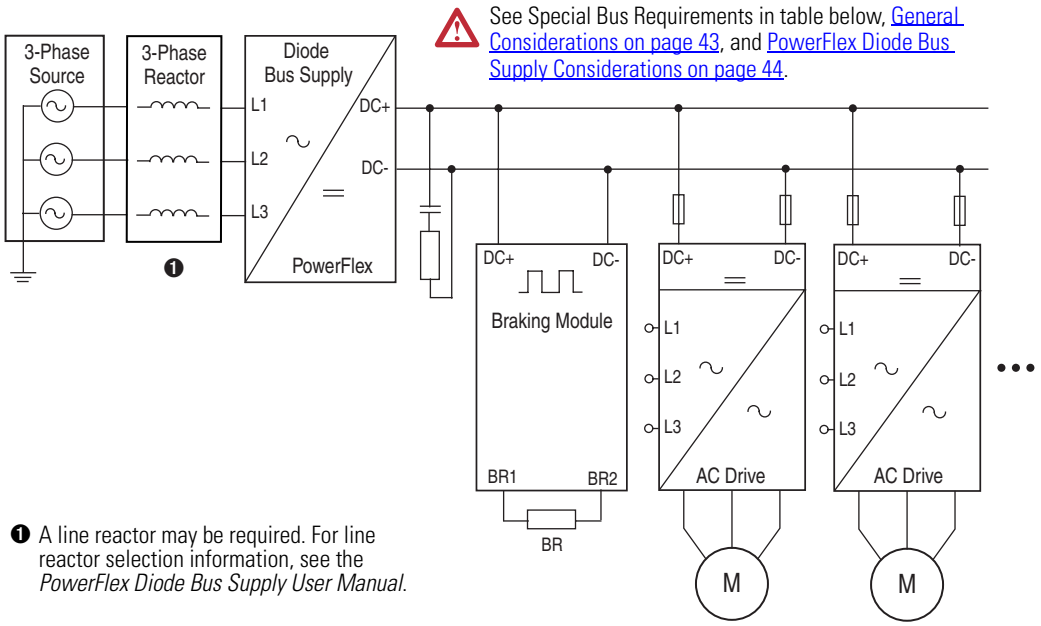
Drive	Internal Brake IGBT
PowerFlex 40P	Standard on all power ratings
PowerFlex 700	Standard on Frames 0…3; optional on Frames 4…6
PowerFlex 700S	Standard on Frames 1…3; optional on Frames 4…9 only
PowerFlex 700H	Optional on Frame 9 only
PowerFlex 750-Series	Standard on Frames 2…5; optional on Frames 6 and 7
Kinetix 7000	No internal brake IGBT
Kinetix 6000 and Kinetix 6200/6500	Internal bus regulation cannot be used

ATTENTION: The internal IGBT in a Kinetix 6000 Multi-Axis Servo Drive is disabled in "Common Bus Follower" mode.

Typical System Configurations

1336-Series Brake Chopper Modules

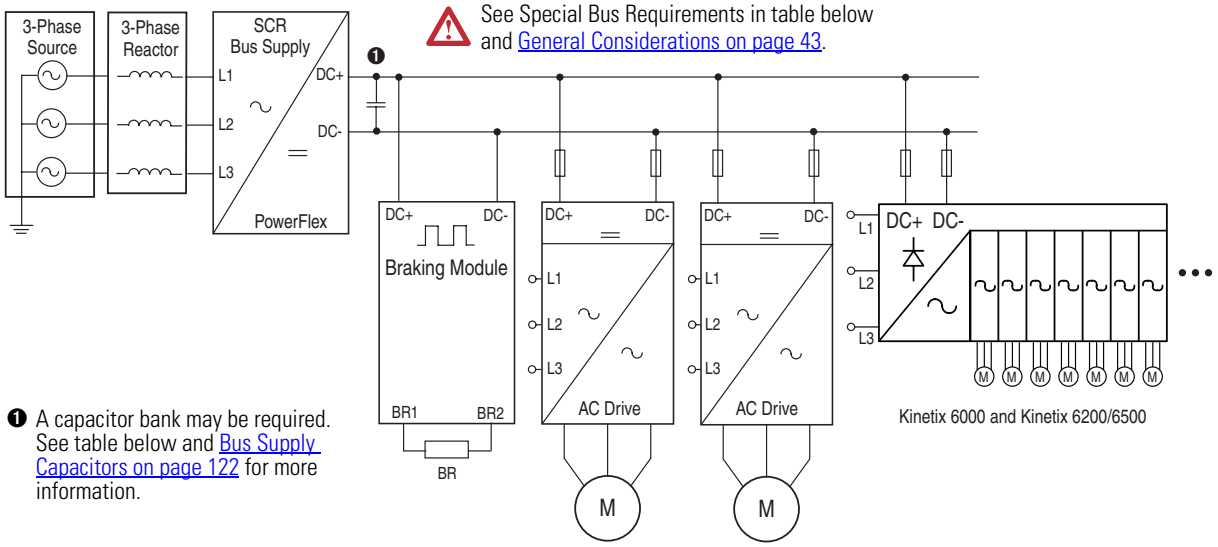
Figure 21 - Diode Bus Supply with Stand-Alone AC Drives and 1336-W* Brake Chopper



❶ A line reactor may be required. For line reactor selection information, see the *PowerFlex Diode Bus Supply User Manual*.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	An RC snubber is required to limit DC bus voltage overshoot at power-on. See RC Snubber Circuit on page 123 for more information.
	PowerFlex 750-Series: Frames 2…4	
	Kinetix 7000: BM06…BM08	
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700S/750-Series drives and Kinetix 7000 drives.

Figure 22 - SCR Bus Supply with Stand-Alone AC Drives, Kinetix 6000 Drive System, and 1336-W* or 1336-MOD-K* Braking Module



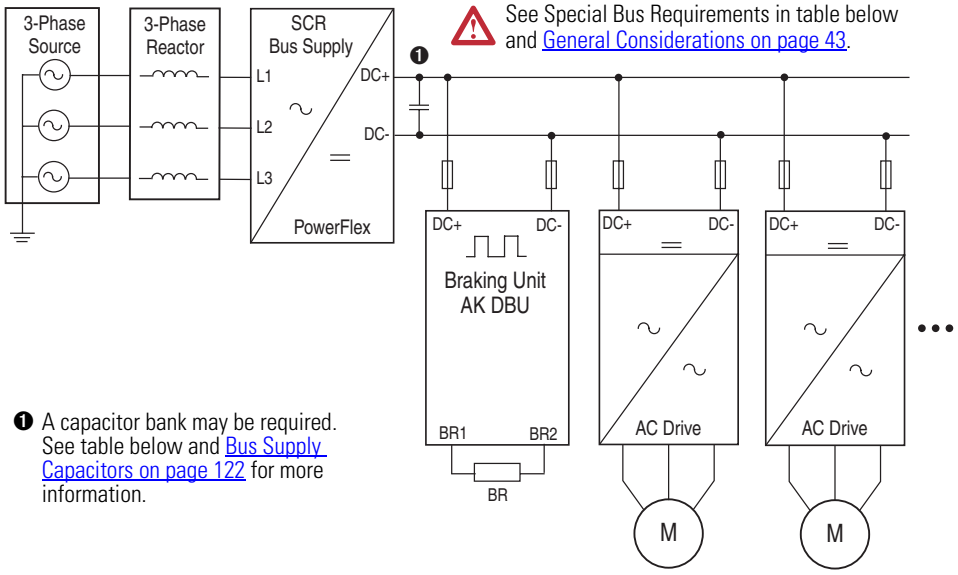
❶ A capacitor bank may be required. See table below and Bus Supply Capacitors on page 122 for more information.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configurations.
	PowerFlex 700: Frames 7…10	• Additional bus capacitance may be required; see General Considerations on page 43. • External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 700H/700S: Frames 9…14	
	PowerFlex 700L: Frames 3A (1) and 3B	
	PowerFlex 750-Series: Frames 2…4	None
	PowerFlex 750-Series: Frames 5…7	DC input version with precharge must be selected.
	Kinetix 7000: BM06…BM08	None
	Kinetix 7000: BM09…BM12	External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
Kinetix 6000 and Kinetix 6200/6500	Kinetix 6000 (460V only): Bxxx-Series Kinetix 6200/6500 Multi-Axis Servo Drives (460V only)	• No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 44. • Drives must be placed in a common bus follower configuration.
Braking Module	1336-W*	See PowerFlex SCR Bus Supply Considerations on page 44. If the instantaneous Brake Chopper current is larger than 150% of the DC input rating of the largest drive, a capacitor bank is required.
	1336-MOD-K*	

(1) Frame 3A dual inverter drives only.

AK DBU Dynamic Braking Unit (600-690V AC only)

Figure 23 - SCR Bus Supply with DC Input AC Drives (600-690V AC only) and AK DBU Braking Unit

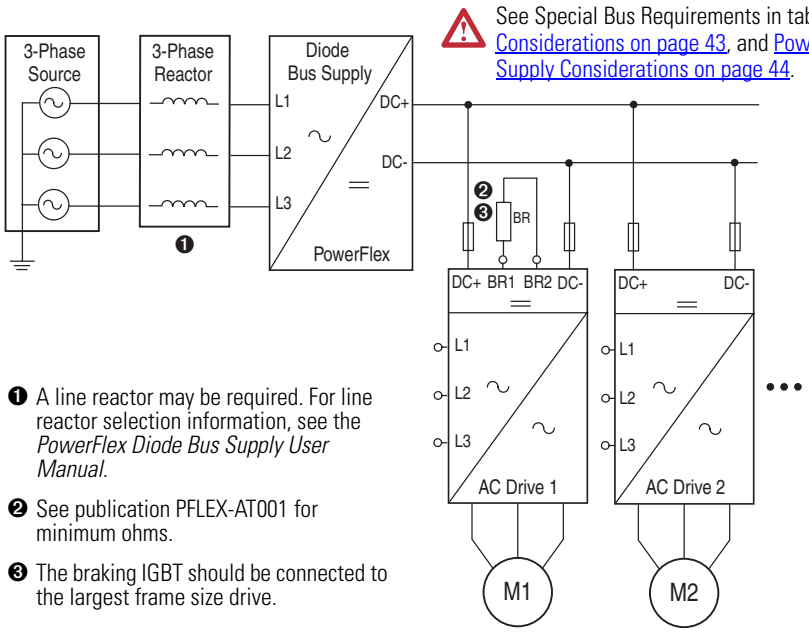


Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 5 and 6 (600…690V only)	• No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 44. • DC input "Common Bus" drives are required—not AC stand-alone configurations.
	PowerFlex 700H/700S: Frames 9…14 (600…690V only)	• Additional bus capacitance is required. See General Considerations on page 43.
	PowerFlex 700L: Frames 3A (1) and 3B	• External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.

(1) Frame 3A dual inverter drives only.

Drive Internal Brake IGBT

Figure 24 - Diode Bus Supply with Stand-Alone AC Drives with Internal Brake IGBT



See Special Bus Requirements in table below, General Considerations on page 43, and PowerFlex Diode Bus Supply Considerations on page 44.

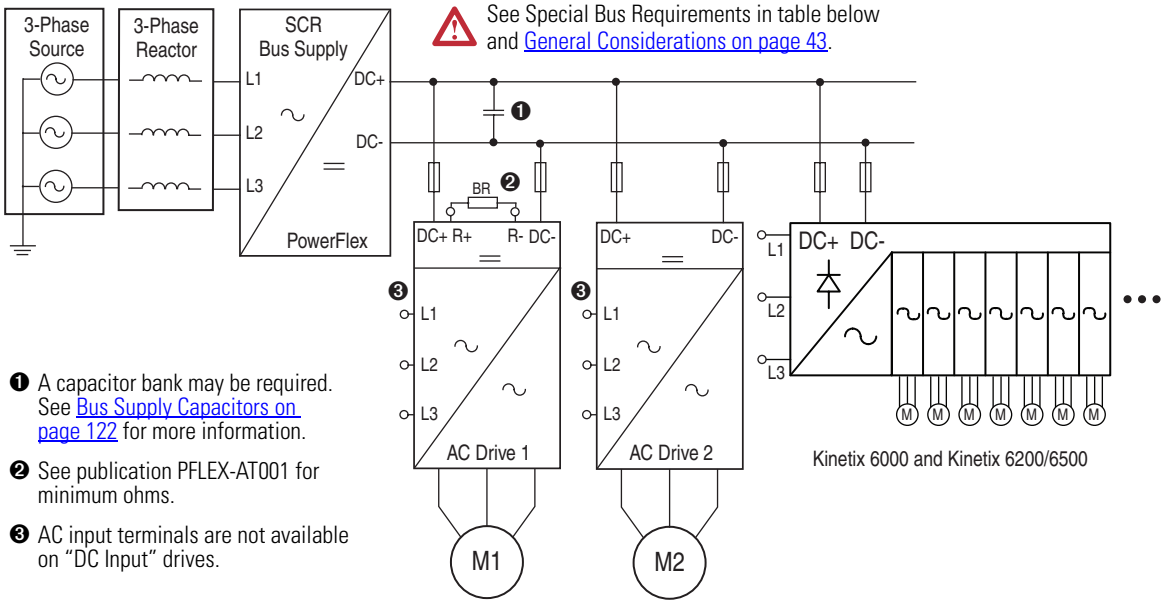
❶ A line reactor may be required. For line reactor selection information, see the *PowerFlex Diode Bus Supply User Manual*.

❷ See publication PFLEX-AT001 for minimum ohms.

❸ The braking IGBT should be connected to the largest frame size drive.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 750-Series: Frames 2…4	None
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700S drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700S drives.
AC Drive 2	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 750-Series: Frames 2…4	None
	Kinetix 7000: BM06…BM08	None
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 750-Series drives and Kinetix 7000 drives.

Figure 25 - SCR Bus Supply with Stand-Alone AC Drives with Internal Brake IGBT, and Kinetix 6000 Drive System



❶ A capacitor bank may be required. See Bus Supply Capacitors on page 122 for more information.

❷ See publication PFLEX-AT001 for minimum ohms.

❸ AC input terminals are not available on "DC Input" drives.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1	PowerFlex 700H/700S: Frame 9	• Additional bus capacitance may be required; see General Considerations on page 43. • External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
AC Drive 2	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configurations.
	PowerFlex 750-Series: Frames 2…4	None
	PowerFlex 750-Series: Frames 5…7	DC input version with precharge must be selected.
	Kinetix 7000: BM06…BM08	None
	Kinetix 7000: BM09…BM12	External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
Kinetix 6000 and Kinetix 6200/6500	Kinetix 6000: Bxxx-Series (460V only) Kinetix 6200/6500 Multi-Axis Servo Drives (460V only)	• No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 44. • Drives must be placed in a common bus follower configuration.

General Considerations

ATTENTION: The incorrect use or configuration of third party assemblies may result in reduced system reliability and drive damage.

1. All system components (Bus Supply, PowerFlex and Kinetix Drives, and Braking Unit) must be selected for the same AC-line voltage.
2. A low inductance type DC bus should be used.
3. The braking chopper must be located next to the bus supply and the highest power drive.
4. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives. This is needed to maintain low inductance.
5. The maximum wire length between the brake chopper and the highest power drive and between parallel brake choppers must be observed. Refer to the respective braking product documentation (Reference Materials on page 15) for details.
6. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to "PreCharge En." This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drive(s) must have internal or externally-supplied precharge.

Drive	Parameter		Digital Input
	Number	Setting	
PowerFlex 40P	A051…A054	"29" (PreCharge En)	1…4
PowerFlex 700	361…366	"30" (PreCharge En)	1…6
PowerFlex 700L with vector control			
PowerFlex 700S	825…830	"30" (PreCharge En)	1…6
PowerFlex 700L with 700S control			
PowerFlex 700H	361…366	"30" (PreCharge En)	1…6
PowerFlex 750-Series	189 [DI Precharge]	See Drive Programming Manual for programming information.	

ATTENTION: The Kinetix family of drives have no external means of controlling the precharge; therefore, a DC disconnect should not be used.

7. If an AC drive from column A is mixed with an AC drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 122 for details.

Column A Drives	Column B Drives
PowerFlex 700/700S: Frames 0…5 PowerFlex 750-Series: Frames 2…7 Kinetix 6000 and Kinetix 6200/6500 Kinetix 7000	PowerFlex 700/700S: Frame 6 PowerFlex 700: Frames 8…10 PowerFlex 700H/700S: Frame 9 and up PowerFlex 700L: All Frames

8. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware version 2.001 or later (Standard and Vector Control).
9. For further assistance with this Common Bus configuration, contact Rockwell Automation Support Plus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

PowerFlex Diode Bus Supply Considerations

The Diode Bus Supply should only be used with PowerFlex 700/700S Frame 0...4 drives, PowerFlex 750-Series Frame 2...4 drives, Kinetix 7000 BM06...BM08 drives, or PowerFlex 40P drives (all power ratings). This is because the Diode Bus Supply does not include precharge. The precharge function must be provided by the drives.

ATTENTION: Never connect Kinetix 7000 BM09…BM12 drives, Kinetix 6000-Series drives or Kinetix 6200/6500 drives to a PowerFlex Diode Bus Supply in common bus configuration because there will be no controlled, current-limited precharge of the DC bus capacitors, resulting in drive damage.

When using a PowerFlex **Diode Bus Supply** with the **1336-W* Brake Chopper**, this additional recommendation should also be followed:

An RC snubber circuit is required to prevent the DC bus voltage from exceeding the 1200V maximum Brake Chopper IGBT voltage. The 1336-W* Brake Chopper power-up delay time is 80 milliseconds. During this time, the IGBT will not turn-on.

The RC snubber circuit must always be connected to the DC bus (located close to the braking chopper) to absorb the power-on voltage overshoot. See RC Snubber Circuit on page 123 for details.

PowerFlex SCR Bus Supply Considerations

ATTENTION: The SCR Bus Supply includes precharge. The use of drives with precharge is not required IF AND ONLY IF power is removed and reconnected to the entire system, AND IF individual drives do not require to be isolated and reconnected to an energized bus via a disconnect switch. Failure to follow this recommendation will result in drive damage.

1. In order to commission and test the SCR Bus Supply, a minimum capacitance is required. See Bus Supply Capacitors on page 122 for details.
2. AC line reactors for di/dt limitation and current sharing must be externally mounted for each PowerFlex SCR Bus Supply. See the *PowerFlex SCR Bus Supply User Manual* for line reactor information.

When using a PowerFlex **SCR Bus Supply** with the **1336-W*** or **AK DBU Braking Unit**, this additional recommendation should also be followed:

If the instantaneous Brake Chopper current is larger than 150% of the DC input rating of the largest drive, a capacitor bank is required and should be located as close as possible to the brake chopper and the rectifier source.

– **Exception 1:** The capacitor is not required if at least one drive without internal precharge (Frames 5 and up, DC input only, Catalog Codes H and J), is always connected to the common DC bus.

– **Exception 2:** If a PowerFlex 700H/700S Frame 9 and up drive is interconnected with PowerFlex 700/700S Frame 0...6 drives or PowerFlex 750-Series Frame 2...7 drives, and a capacitor bank with appropriate capacitance is already used. See the subsection Connecting High Power Drives and Low Power Drives on the DC Bus on page 122 for details.

Sizing

1336-W* Brake Chopper

See the *1336-W* Brake Chopper Module Installation Instructions* for peak ratings and minimum resistance values.

1336-MOD-* Heavy Duty Dynamic Brake Unit

See the *1336-MOD-KA / -KB / -KC Installation Instructions* for ratings.

AK DBU Dynamic Braking Unit

See the *AK DBU Dynamic Breaking Unit User Manual* for information.

Drive Internal Brake IGBT

See the *PowerFlex Dynamic Braking Resistor Calculator* for minimum resistance values.

Bus Supplies

To avoid overloading the Bus Supply, the following requirements apply:

- 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 continuous DC Bus output current rating of the Bus Supply.

- For the DC Input Current values of the drives, please refer to the tables in Appendix A. In addition, the guidelines provided in the *PowerFlex 700 User Manual*, *PowerFlex 700S/700H Installation Manual* or *PowerFlex 750-Series Drive Technical Data* also apply.

PowerFlex Diode Bus Supply

Examples for Maximum Loading of the Diode Bus Supply:

a) Normal Duty ND

DC Input Rating of Connected Drives				Diode Bus Supply	
DC Voltage	**ND Power**	**ND Currents**	**ND Current Sum**	**Rated Cont. DC Output Amps**	**AC Input Voltage**
540V	30 + 22 = 52 kW	61.9 + 47.5	109.4	120A	400V
650V	2 x 40 = 80 HP	2 x 55.7	111.4	120A	480V

b) Heavy Duty HD

DC Input Rating of Connected Drives				Diode Bus Supply	
DC Voltage	**HD Power**	**HD Currents**	**HD Current Sum**	**Rated Cont. DC Output Amps**	**AC Input Voltage**
540V	37 + 2 x 1.5 = 40 kW	95.1 + 2 x 5.3	105.7	120A	400V

Total the DC Input currents for all drives connected to the DC bus. This total must be less than 120A.

PowerFlex SCR Bus Supply

Examples for Maximum Loading of the SCR Bus Supply:

a) Normal Duty ND, 110%, 1 minute; 150%, 3 seconds

Drive Rating		Drive Output Current		Drive DC Input Current		SCR Bus Supply (1)	
DC Voltage	**ND Power**	**ND Output Currents**	**ND Output Current Sum**	**ND DC Input Currents**	**ND DC Input Current Sum**	**Maximum DC Output Amps**	**AC Input Voltage**
540V	3 x 110 kW 1 x 45 kW	3 x 205 = 615A 1 x 85 = 85A	700A	3 x 226 = 678A 1 x 95 = 95A	773A	1000A	400V
650V	3 x 60 HP 1 x 30 HP	3 x 77 = 231A 1 x 40 = 40A	271A	3 x 84.5 = 253.5A 1 x 42.9 = 42.9A	297A	400A	480V

(1) No overload capability.

b) Heavy Duty HD, 150%, 1 minute; 200%, 3 seconds

Drive Rating		Drive Output Current		Drive DC Input Current		SCR Bus Supply (1)	
DC Voltage	**HD Power**	**HD Output Currents**	**HD Output Current Sum**	**HD DC Input Currents**	**HD DC Input Current Sum**	**Maximum DC Output Amps**	**AC Input Voltage**
540V	3 x 90 kW	3 x 170 = 510A	510A	3 x 192.3 = 577A	577A	600A	400V

(1) No overload capability.

Fusing

DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

1336-W* Brake Chopper

The 1336-WA / -WB / -WC Brake Chopper Modules are internally fused to protect brake components. See the *1336-W* Brake Chopper Module Installation Instructions* for fusing information.

1336-MOD-* Heavy Duty Dynamic Brake Unit

The 1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Brake Units are internally fused to protect bake components. See the *1336-MOD-KA / -KB / -KC Installation Instructions* for fusing information.

AK DBU Dynamic Braking Unit

DC fuses for the AK DBU Braking Unit must be supplied by the customer. See the *AK DBU Dynamic Breaking Unit User Manual* for information.

PowerFlex Diode Bus Supply

See the *PowerFlex Diode Bus Supply User Manual* for recommended AC input fusing.

PowerFlex SCR Bus Supply

The PowerFlex SCR Bus Supply has built-in AC line and DC bus fuses (on 400A and 600A units). The 1000A unit has six in-path fuses which simultaneously protect AC and DC paths. All units are equipped with fuse trip indicator switches. See the *PowerFlex SCR Bus Supply User Manual* for fusing information.

Notes:

Shared AC/DC Bus Configuration

System Characteristics

IMPORTANT Although there are guidelines to help with AC input current sharing between drives for this configuration, current sharing cannot be ensured. Therefore, the configurations shown in Chapter 2 or Chapter 6 are preferred.

This system is characterized by the use of stand-alone drives fed by a common 3-phase voltage source and the DC bus of each drive connected together.

Supported Products

At the time of publication, these drives can be used on a shared AC/DC bus configuration:

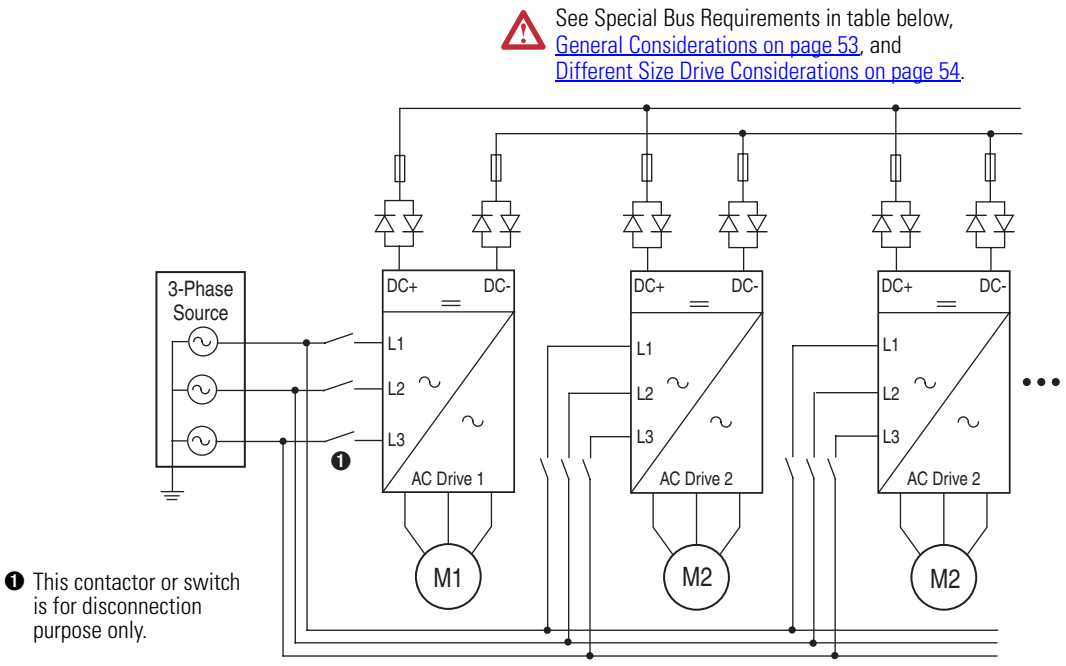
Supported Drives
PowerFlex 40P: All power ratings
PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2)
PowerFlex 700S: Frames 1…6 (2) (3)
PowerFlex 750-Series: Frames 2…7 (4)
Kinetix 7000: BM06…BM12

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5 and 6, and PowerFlex 700S Frame 5 and 6 DC input drives are required when not connected to the AC source.
(3) There is no Frame 0 for PowerFlex 700S drives.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

Typical System Configurations

AC Drives of Different Sizes

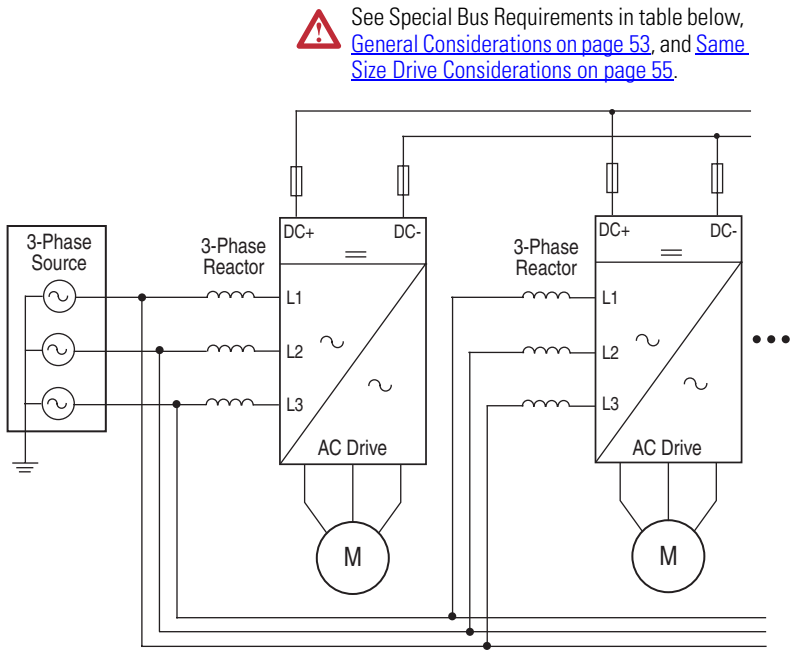
Figure 26 - Different Size Stand-Alone AC Drives in a Shared AC/DC Bus Configuration



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1	PowerFlex 700/700S: Frames 5 and 6	Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information.
	Kinetix 7000: BM09…BM12	
	PowerFlex 750-Series: Frames 5…7	• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information. • A DC input terminal kit must be ordered for Frames 6 and 7.
AC Drive 2	PowerFlex 700/700S: Frames 0…4	• An individual or common contactor is required if AC bus is shared with PowerFlex 700/700S Frame 5 and 6 drives, or Kinetix 7000 BM09…BM12 drives. • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information.
	PowerFlex 750-Series: Frames 2…4	
	Kinetix 7000: BM06…BM08	

Same Size AC Drives

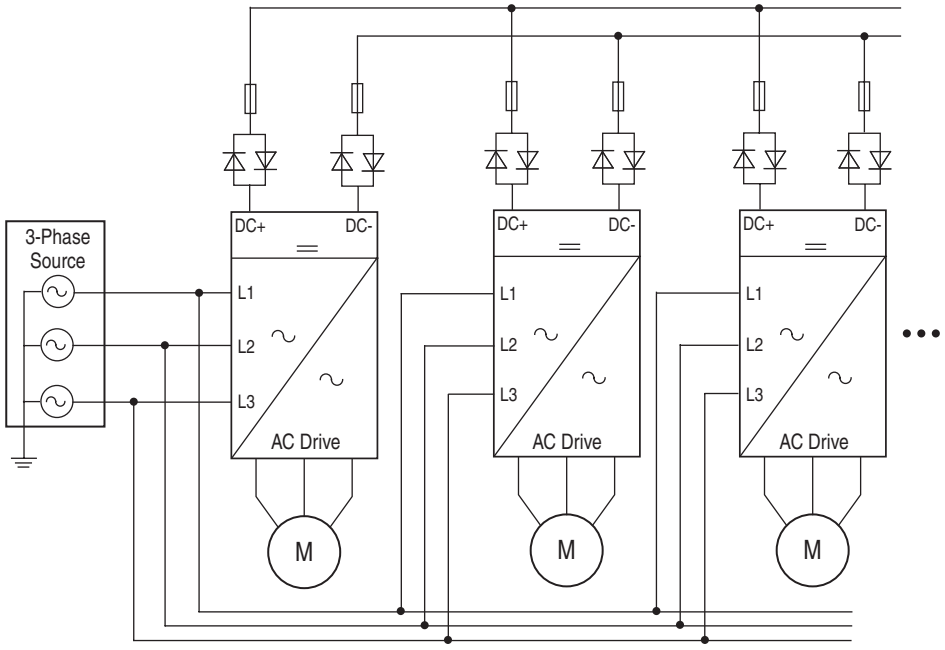
Figure 27 - Same Size Stand-Alone AC Drives in a Shared AC/DC Bus Configuration with AC Input Reactors for Proportional Current Sharing



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…6 Kinetix 7000: BM06…BM12	• 3-Phase line reactors are required for proportional current sharing. See *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001) for additional information. • The same size and the same product line must be used.
	PowerFlex 750-Series: Frames 2…7	• 3-Phase line reactors are required for proportional current sharing. See *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001) for additional information. • The same size and the same product line must be used. • A DC input terminal kit must be ordered for Frames 6 and 7.

Figure 28 - Same Size Stand-Alone AC Drives in a Shared AC/DC Bus Configuration with Back-to-Back Diodes for Proportional Current Sharing

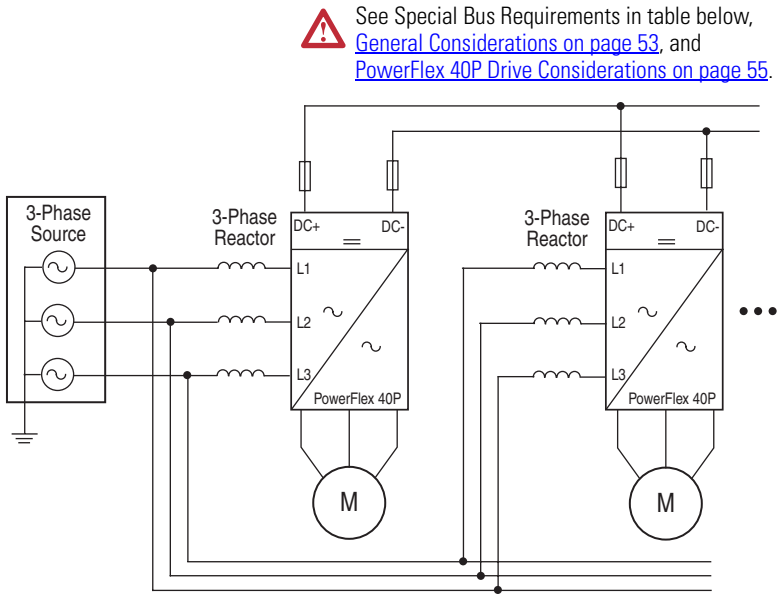
See Special Bus Requirements in table below, General Considerations on page 53, and Same Size Drive Considerations on page 55.



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…6 Kinetix 7000: BM06…BM12	• Back-to-back diodes are required for proportional current sharing. • The same size and the same product line must be used.
	PowerFlex 750-Series: Frames 2…7	• Back-to-back diodes are required for proportional current sharing. • The same size and the same product line must be used. • A DC input terminal kit must be ordered for Frames 6 and 7.

PowerFlex 40P Drives

Figure 29 - PowerFlex 40P Drives in a Shared AC/DC Bus Configuration with AC Input Reactors for Proportional Current Sharing



Dwg. Designation	Supported Drives	Special Bus Requirements
PowerFlex 40P	PowerFlex 40P: All power ratings	See PowerFlex 40P Drive Considerations on page 55.

General Considerations

ATTENTION: The incorrect use or configuration of third party assemblies may result in reduced system reliability and drive damage.

1. Minimizing bus inductance is imperative. Drives should be mounted physically as close to each other as possible with all power wiring "tied" together to minimize loop area.
2. If AC power is removed from one drive in a shared AC/DC bus, that drive can still be energized through the DC bus of another drive. Therefore, AC power to all of the drives in a shared AC/DC bus should be provided through a common disconnect switch or circuit breaker.
3. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware version 2.001 or later (Standard and Vector Control).

Different Size Drive Considerations

When the Shared AC/DC Bus line-up is composed of different frame size drives, two system phases must be taken into account. These are the precharge and loading phases of the drives within this configuration.

Precharge

Due to the difference in the precharge circuitry between PowerFlex 700/700S Frame 0...4 drives and PowerFlex 750-Series Frame 2...4 drives when compared to PowerFlex 700/700S Frame 5 and 6 drives or PowerFlex 750-Series Frame 5...7 drives, the following considerations must be followed:

- An individual or a common contactor on the AC-side must be used for PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 2...4 drives. If PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 2...4 drives are not kept isolated from the AC power during precharge, the PowerFlex 700/700S Frame 5 and 6 drives or PowerFlex 750-Series Frame 5...7 drives will precharge through the diode front end of the PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 2...4 drives. This may result in diode front end or precharge resistor damage. See Figure 26 on page 50.

- Kinetix 7000 BM06...BM08 drives have the same precharge as PowerFlex 700/700S Frame 0...4 drives and PowerFlex 750-Series Frame 2...4 drives. Similarly, Kinetix 7000 BM09...BM12 drives have the same precharge as PowerFlex 700 Frame 5 drives. Therefore, Kinetix 7000 BM06...BM08 drives must also be isolated from AC power during precharging of PowerFlex 700/700S Frame 5 and 6 drives, PowerFlex 750-Series Frame 5...7 drives, and Kinetix 7000 BM09...BM12 drives to prevent diode front end damage.

Loading

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive may exceed its current rating. To prevent this condition, these considerations must be followed:

1. **Diodes** - Back-to-back (dual pack) diodes with fuses must be used in the DC link of each drive to allow for proportional sharing of input current by the converter section of each drive. **Failure to do so may result in drive damage**. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for recommended part numbers.
2. The wiring and interconnection distances to the Common AC Bus should be minimized to prevent large variations of the input impedances between the drive inverters.

Same Size Drive Considerations

1. Individual line reactors for each drive or back-to-back diodes must be used for proportional current sharing. For line reactor information, refer to *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001). For recommended diodes, see Back-to-Back Diodes (Shared AC/DC Configurations) on page 121.
2. The wiring and interconnection distances to the Common AC Bus should be minimized to prevent large variations of the input impedances between the drive inverters.

PowerFlex 40P Drive Considerations

When using PowerFlex 40P drives in a shared bus configuration, the loading must be taken into account.

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive may exceed its current rating. To prevent this condition, the following considerations must be followed:

1. Individual line reactors for each drive must be used for proportional current sharing. For line reactor information, refer to *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001).
2. The wiring and interconnection distances to the Common AC Bus should be minimized to prevent large variations of the input impedances between the drive inverters.
3. Only multiple same size and type of drives on a shared AC/DC bus are recommended in the system configuration shown in Figure 29 on page 53. PowerFlex 40P drives should NOT be combined with PowerFlex 700/700S/750-Series drives on the same shared AC/DC bus.

Sizing

Each drive should be sized for the motor load connected to it.

Fusing

Drives should NOT be “daisy chained.” Configuration of shared DC bus should be in a “star” configuration to allow for proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the case of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common DC Bus drive fusing.

Notes:

Shared AC/DC Bus Configuration — with Braking DC Bus Regulation

System Characteristics

IMPORTANT Although there are guidelines to help with AC input current sharing between drives for this configuration, current sharing cannot be ensured. Therefore, the configurations shown in Chapter 3 or Chapter 7 are preferred.

This system is characterized by the use of stand-alone drives fed by a common 3-phase voltage source and the DC bus of each drive connected together. In addition, a Braking Chopper, Dynamic Braking Unit, or the drive's internal IGBT with a braking resistor for power dissipation of regenerative energy is also used.

Supported Products

At the time of publication, these products are supported:

Products	Supported Drives
1336-WA / -WB / -WC Brake Chopper Module	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2)
	PowerFlex 700S: Frames 1…6 (2) (3)
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12
1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Brake Unit	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2)
	PowerFlex 700S: Frames 1…6 (2) (3)
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12
AK DBU Dynamic Braking Unit	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2)
	PowerFlex 700S: Frames 1…6 (2) (3)
	PowerFlex 750-Series: Frames 2…7 (4)

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5 and 6 and PowerFlex 700S Frame 5 and 6 DC input drives are required when not connected to the AC source.
(3) There is no Frame 0 for PowerFlex 700S drives.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

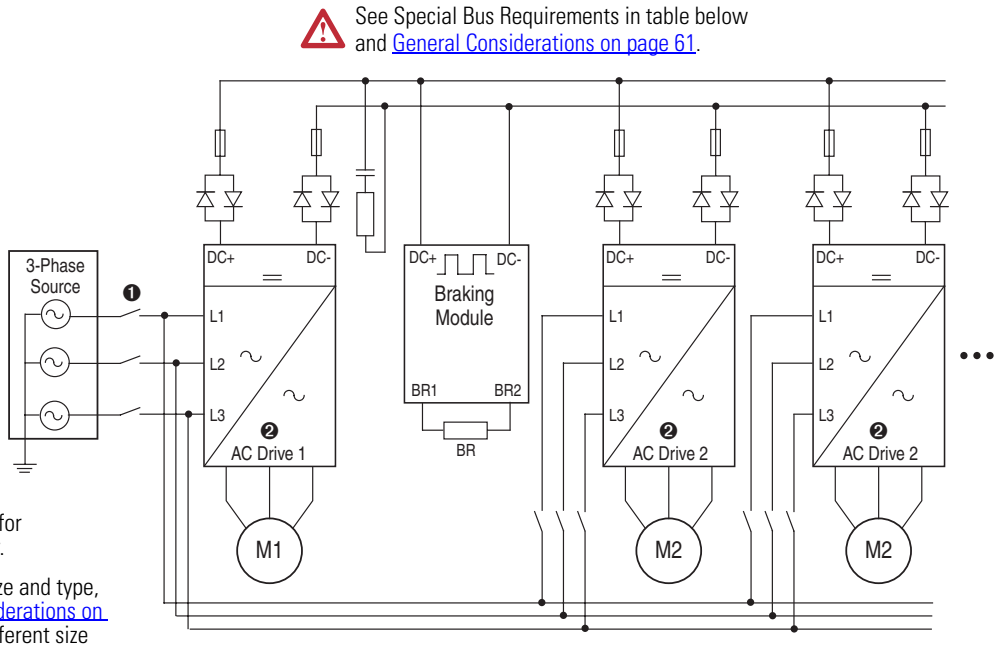
Note – When applicable, the drive's internal IGBT can also be used:

Drive	Internal Brake IGBT
PowerFlex 40P	Standard on all power ratings
PowerFlex 700	Standard on Frames 0…3; optional on Frames 4…6
PowerFlex 700S	Standard on Frames 1…3; optional on Frames 4…9 only
PowerFlex 750-Series	Standard on Frames 2…5; optional on Frames 6 and 7
Kinetix 7000	No internal brake IGBT
Kinetix 6000 and Kinetix 6200/6500	Internal bus regulation cannot be used.

ATTENTION: The internal IGBT in a Kinetix 6000 Multi-Axis Servo Drive is disabled in "Common Bus Follower" mode.

Typical System Configurations

Figure 30 - Stand-Alone AC Drives with a Braking Module in a Shared AC/DC Bus Configuration

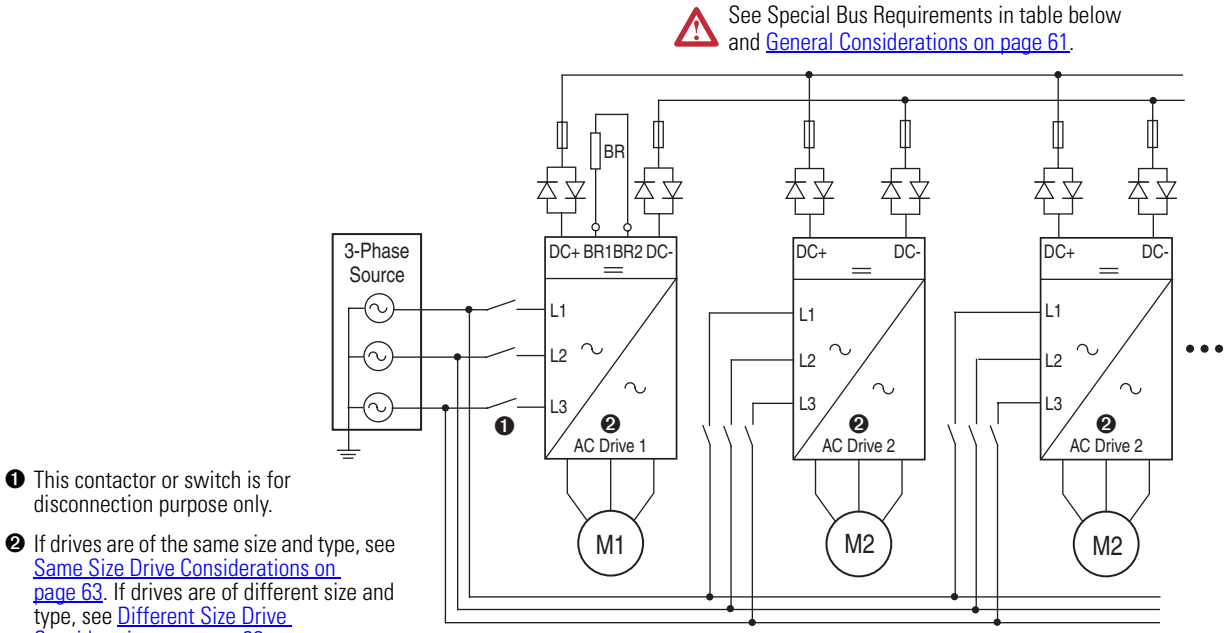


❶ This contactor or switch is for disconnection purpose only.

❷ If drives are of the same size and type, see Same Size Drive Considerations on page 63. If drives are of different size and type, see Different Size Drive Considerations on page 62.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1	PowerFlex 700/700S: Frames 5 and 6	Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information.
	Kinetix 7000: BM09…BM12	
	PowerFlex 750-Series: Frames 5…7	• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information. • A DC input terminal kit must be ordered for Frames 6 and 7.
AC Drive 2	PowerFlex 700/700S: Frames 0…4	• An individual or common contactor is required if the AC bus is shared with PowerFlex 700/700S Frame 5 and 6 drives or Kinetix 7000 BM09…BM12 drives. • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information.
	PowerFlex 750-Series: Frames 2…4	
	Kinetix 7000: BM06…BM08	
Braking Module	1336-W* Braking Chopper Module	An RC Snubber is required to limit DC bus voltage overshoot at power-on. See RC Snubber Circuit on page 123 for more information.
	1336-MOD-K* Heavy Duty Dynamic Brake Unit	None
	AK DBU Dynamic Braking Unit	This unit cannot be used on 460V systems; only on systems where AC input voltage is 600/690V AC.

Figure 31 - Stand-Alone AC Drives with an Internal Brake IGBT in a Shared AC/DC Bus Configuration



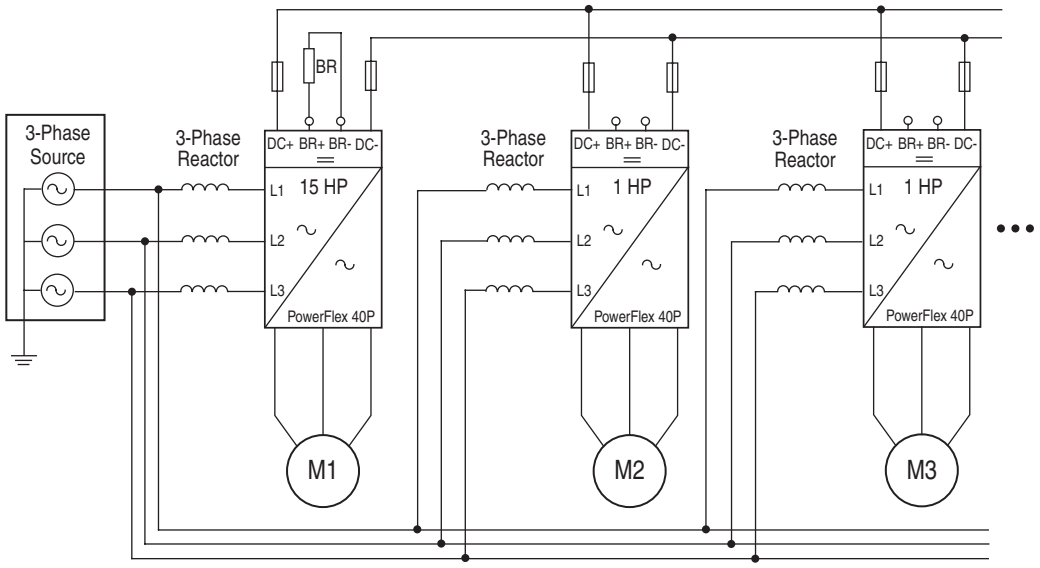
❶ This contactor or switch is for disconnection purpose only.

❷ If drives are of the same size and type, see Same Size Drive Considerations on page 63. If drives are of different size and type, see Different Size Drive Considerations on page 62.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1	PowerFlex 700/700S: Frames 5 and 6 Kinetix 7000: BM09…BM12	• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information. • A Kinetix 7000 BM09…BM12 drive does not have an internal brake IGBT so it cannot be used to internally regulate the DC bus.
	PowerFlex 750-Series: Frames 5…7	• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information. • A DC input terminal kit must be ordered for Frames 6 and 7.
AC Drive 2	PowerFlex 700/700S: Frames 0…4 PowerFlex 750-Series: Frames 2…4 Kinetix 7000: BM06…BM08	• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for more information. • An individual or common contactor is required if AC bus is shared with PowerFlex 700/700S Frame 5 or 6 drives. • A Kinetix 7000 BM06…BM08 drive does not have an internal brake IGBT so it cannot be used to internally regulate the DC bus.

Figure 32 - Stand-Alone PowerFlex 40P Drives (all Power Ratings) with Internal Brake IGBT in a Shared AC/DC Bus Configuration

See PowerFlex 40P Drive Considerations on page 63.



Dwg. Designation	Supported Drives	Special Bus Requirements
PowerFlex 40P	PowerFlex 40P: All power ratings	See PowerFlex 40P Drive Considerations on page 63.

General Considerations

ATTENTION: The incorrect use or configuration of third party assemblies may result in reduced system reliability and drive damage.

1. Connection of the brake unit should be closest to the largest drive. If all are the same rating, then closest to the drive that regenerates the most. Minimizing DC bus inductance is imperative. Drives should be mounted physically as close to each other as possible with all power wiring "tied" together to minimize loop area. If minimizing the physical distance between the units is not possible, a capacitor bank will be required and should be located physically close to the braking unit.
2. An RC Snubber circuit must be used in a shared AC/DC Bus Configuration when a PowerFlex 700/700S Frame 0...4 drive, PowerFlex 750-Series Frame 2...7 drive, Kinetix 7000 BM06...BM08 drive or PowerFlex 40 drive is used with a 1336-W* Brake Chopper. See RC Snubber Circuit on page 123 for more information.
3. If AC power is removed from one drive in a shared AC/DC bus, that drive can still be energized through the DC bus of another drive. Therefore, AC power to all of the drives in a shared AC/DC bus should be provided through a common disconnect switch or circuit breaker.
4. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware version 2.001 or later (Standard and Vector Control).

Different Size Drive Considerations

When the Shared AC/DC Bus line-up is composed of different frame size drives, two system phases must be taken into account. These are the precharge and loading phases of the drives within this configuration.

Precharge

Due to the difference in the precharge circuitry between PowerFlex 700/700S Frame 0...4 drives and PowerFlex 750-Series Frame 2...4 drives when compared to PowerFlex 700/700S Frame 5 and 6 drives or PowerFlex 750-Series Frame 5...7 drives, the following considerations must be followed:

- An individual or a common contactor on the AC-side must be used for PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 2...4 drives. If PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 2...4 drives are not kept isolated from the AC power during precharge, the PowerFlex 700/700S Frame 5 and 6 drives or PowerFlex 750-Series Frame 5...7 drives will precharge through the diode front end of the PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 2...4 drives. This may result in diode front end damage. See Figure 30 on page 59 and Figure 32 on page 61.

- Kinetix 7000 BM06...BM08 drives have the same precharge as PowerFlex 700/700S Frame 0...4 drives and PowerFlex 750-Series Frame 2...4 drives. Similarly, Kinetix 7000 BM09...BM12 drives have the same precharge as PowerFlex 700 Frame 5 drives. Therefore, Kinetix 7000 BM06...BM08 drives must also be isolated from AC power during precharging of PowerFlex 700/700S Frame 5 and 6 drives, PowerFlex 750-Series Frame 5...7 drives, and Kinetix 7000 BM09...BM12 drives to prevent diode front end damage.

Loading

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive may exceed its current rating. To prevent this condition, comply with the following considerations:

1. **Diodes** - Back-to-back (dual pack) diodes with fuses must be used in the DC link of each drive to allow for proportional sharing of input current by the converter section of each drive. **Failure to do so may result in drive damage**. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 121 for recommended part numbers.
2. The wiring and interconnection distances to the AC input connections should be minimized to prevent large variations of the input impedances between the drives.

3. If a 3-phase line reactor is used, the Common AC must be drawn from the load side of the reactor (see Figure 30 on page 59).

Same Size Drive Considerations

1. Individual line reactors for each drive or back-to-back diodes must be used for proportional current sharing. For line reactor information, refer to *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001). For recommended diodes, see Back-to-Back Diodes (Shared AC/DC Configurations) on page 121.
2. The wiring and interconnection distances to the Common AC Bus should be minimized to prevent large variations of the input impedances between the drive inverters.

PowerFlex 40P Drive Considerations

When using PowerFlex 40P drives in a shared bus configuration, the loading must be taken into account.

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive may exceed its current rating. To prevent this condition, comply with the following considerations:

1. Individual line reactors for each drive must be used for proportional current sharing. For line reactor information, refer to *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001).
2. The wiring and interconnection distances to the Common AC Bus should be minimized to prevent large variations of the input impedances between the drive inverters.
3. Only multiple same size and type of drives on a shared AC/DC bus are recommended in the system configuration shown in Figure 32 on page 61. PowerFlex 40P drives should NOT be combined with PowerFlex 700/700S/750-Series drives on the same shared AC/DC bus.

Sizing

Each drive should be sized for the motor load connected to it.

Fusing

Drives should NOT be “daisy chained.” Configuration of shared DC bus should be in a “star” configuration to allow for proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the case of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common Bus DC drive fusing.

Notes:

Shared DC Bus Configuration (Piggy Back)

System Characteristics

This system is characterized by the use of one stand-alone drive as the converter and additional common DC bus drives used in a shared DC bus configuration.

Supported Products

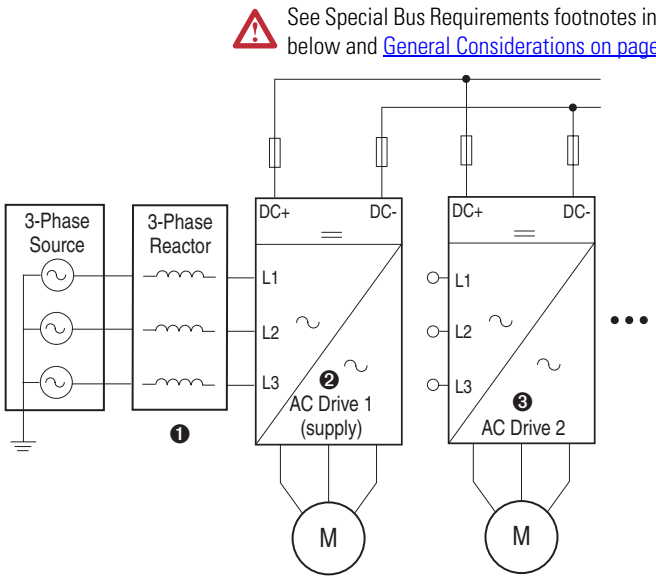
At the time of publication, these drives are supported when used on a shared DC bus configuration:

Supported Drives
PowerFlex 40P: All power ratings
PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2)
PowerFlex 700S: All frame sizes (2)
PowerFlex 700H: All frame sizes (2)
PowerFlex 700L: All frame sizes (2)
PowerFlex 750-Series: Frames 2…7 (3)
Kinetix 7000: BM06…BM12
Kinetix 6000 and Kinetix 6200/6500: B-Series Configurations

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(3) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

Typical System Configurations

Figure 33 - Stand-Alone AC Drives in a Shared DC Bus Configuration



❶ A 3-Phase line reactor is only required for special line considerations. See *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001) for additional information.

❷ Supply drive must be sized to source current to all connected drives during all modes of operation that are encountered.

❸ AC input terminals are not available on "DC Input" drives.

Drive Compatibility Matrix

			AC Drive 1 (Supply)										
			PowerFlex								Kinetix		
			40P	700/700S Frames 0…4	700/700S Frames 5…6	700 Frames 7…10	700H/700S Frames 9…14	700L Frames 2, 3A, and 3B	750-Series Frames 2…4	750-Series Frames 5…7	BM06…BM08	BM09…BM12	6000 & 6200/ 6500 (460V)
AC Drive 2	PowerFlex	40P	Yes (1)										
		700/700S Frames 0…4		Yes	Yes	Yes	Yes (3)	Yes (3)			Yes	Yes	
		700/700S Frames 5…6			Yes (2)	Yes (2)	Yes (2) (3)	Yes (2) (3)				Yes (2)	
		700 Frames 7…10				Yes (2)							
		750-Series Frames 2…4							Yes	Yes (4)			
		750-Series Frames 5…7								Yes (4)			
		700H/700S Frames 9…14					Yes (2) (3)						
		700L Frames 3A and 3B						Yes (2) (3)					
	Kinetix	BM06…BM08		Yes	Yes		Yes (3)				Yes	Yes	
		BM09…BM12			Yes		Yes (3)					Yes	
		6000 and 6200/ 6500 (460V)			Yes		Yes (3)					Yes	

Special Bus Requirements

(1) See PowerFlex 40P Drive Considerations on page 67.

(2) DC input "Common Bus" drives are required when not connected to an AC source.

(3) Total capacitance of externally connected drives must not exceed the maximum allowable external capacitance of the supply drive or the precharge resistors will overheat. The maximum allowable external capacitance for each drive is listed in related tables in Appendix A.must be ordered

(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

General Considerations

ATTENTION: The incorrect use or configuration of third party assemblies may result in reduced system reliability and drive damage.

1. Minimizing bus inductance is imperative. Drives should be mounted physically as close to each other as possible with all power wiring "tied" together to minimize loop area.
2. For further assistance with this Common Bus configuration, contact Rockwell Automation Support Plus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

PowerFlex 40P Drive Considerations

PowerFlex 40P drives should NOT be used on the same DC bus supply as PowerFlex 700/700S/700H/700L/750-Series drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700S/700H/700L/750-Series drives.

Sizing

The total motoring load should not exceed the rated load for the drive sourcing the DC power. Each DC-fed drive should be sized for the motor load connected to it.

Fusing

Drives should NOT be "daisy chained." Configuration of shared DC bus should be in a "star" configuration to allow for proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the case of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common DC Bus drive fusing.

Notes:

Shared DC Bus Configuration (Piggy Back) — with Braking Chopper

System Characteristics

This system is characterized by the use of one stand-alone drive as the converter and additional common DC bus drives used in a shared DC bus configuration. In addition, a Braking Chopper, Dynamic Braking Unit, or the drive's internal IGBT with a braking resistor for power dissipation of regenerative energy is also used.

Supported Products

At the time of publication, these products are supported:

Products	Supported Drives
1336-WA / -WB / -WC Brake Chopper Module	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2)
	PowerFlex 700S: All frame sizes (2)
	PowerFlex 700H: All frame sizes (2)
	PowerFlex 700L: All frame sizes (2)
	PowerFlex 750-Series: Frames 2…7 (3)
	Kinetix 7000: BM06…BM12
	Kinetix 6000 and Kinetix 6200/6500 – All 460V configurations (4)
1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Brake Unit	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2)
	PowerFlex 700S: All frame sizes (2)
	PowerFlex 700H: All frame sizes (2)
	PowerFlex 700L: All frame sizes (2)
	PowerFlex 750-Series: Frames 2…7 (3)
	Kinetix 7000: BM06…BM12
	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations (4)
AK DBU Dynamic Braking Unit	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2)
	PowerFlex 700S: All frame sizes (2)
	PowerFlex 700H: All frame sizes (2)
	PowerFlex 700L: All frame sizes (2)
	PowerFlex 750-Series: Frames 2…7 (3)

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(3) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.
(4) Kinetix 6000 configurations require firmware version 1.92 or later.

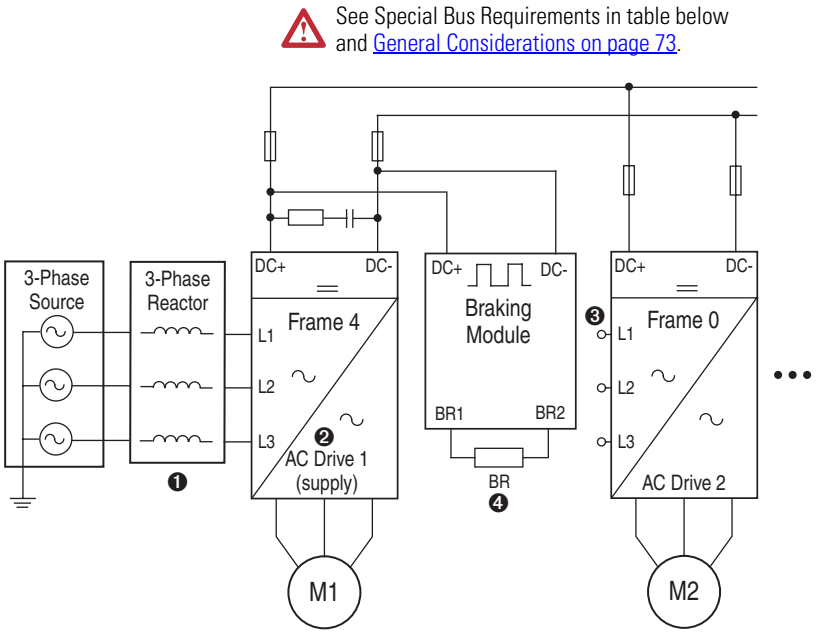
Note – When applicable, the drive's internal IGBT can also be used:

Drive	Internal Brake IGBT
PowerFlex 40P	Standard on all power ratings
PowerFlex 700	Standard on Frames 0…3; optional on Frames 4…6
PowerFlex 700S	Standard on Frames 1…3; optional on Frames 4…9 only
PowerFlex 700H	Optional in Frame 9 only
PowerFlex 750-Series	Standard on Frames 2…5; optional on Frames 6 and 7
Kinetix 7000	No internal brake IGBT
Kinetix 6000 and Kinetix 6200/6500	Internal bus regulation cannot be used

ATTENTION: The internal IGBT in a Kinetix 6000 Multi-Axis Servo Drive is disabled in "Common Bus Follower" mode.

Typical System Configurations

Figure 34 - AC Drives with a Braking Module in a Shared DC Bus Configuration



❶ A 3-Phase line reactor is only required for special line considerations. See *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001) for additional information.

❷ Supply drive must be able to source current to all connected drives during all modes of operation that are encountered.

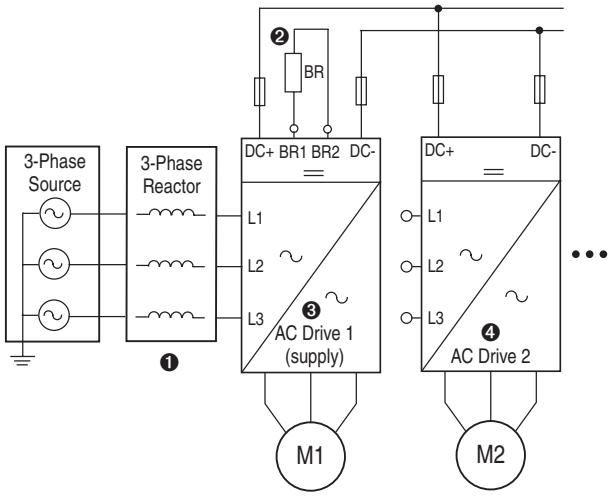
❸ AC input terminals are not available on "DC Input" drives.

❹ The brake module must be connected closest to the supply drive. The brake and resistor must be sized no bigger than the capacity of the supply drive.

Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1 (supply)	See the Drive Compatibility Matrix on page 72 for supported drives and special bus requirements.	
AC Drive 2		
Braking Module	1336-W* Braking Chopper Module	An RC Snubber is required when supply drive is a PowerFlex 700/700S Frame 0…4, PowerFlex 750-Series Frame 2…4 drive, or a Kinetix 7000 BM06…BM08 drive. See RC Snubber Circuit on page 123 for more information.
	1336-MOD-K* Heavy Duty Dynamic Brake Unit	None
	AK DBU Dynamic Braking Unit	This unit cannot be used on 460V systems; only on systems where AC input voltage is 600/690V AC.

Figure 35 - AC Drives Using an Internal Braking IGBT in a Shared DC Bus Configuration

See Special Bus Requirements footnotes in table below and General Considerations on page 73.



❶ A 3-Phase line reactor is only required for special line considerations. See *Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives* (Publication DRIVES-UM001) for additional information.

❷ Only drives listed in the table on page 70 have internal brake IGBTs. See publication PFLEX-AT001 for minimum resistance.

❸ Supply drive must be able to source current to all connected drives during all modes of operation that are encountered.

❹ AC input terminals are not available on "DC Input" drives.

Drive Compatibility Matrix

AC Drive 2		AC Drive 1 (Supply)										
		PowerFlex								Kinetix		
		40P	700/700S Frames 0…4	700/700S Frames 5…6	700 Frames 7…10	700H/700S Frames 9…14	700L Frames 2, 3A, and 3B	750-Series Frames 2…4	750-Series Frames 5…7	BM06…BM08	BM09…BM12	6000 & 6200/ 6500 (460V)
PowerFlex	40P	Yes (1)										
PowerFlex	700/700S Frames 0…4		Yes	Yes	Yes	Yes (3)	Yes (3)			Yes	Yes	
PowerFlex	700/700S Frames 5…6			Yes (2)	Yes (2)	Yes (2) (3)	Yes (2) (3)				Yes (2)	
PowerFlex	700 Frames 7…10				Yes (2)							
PowerFlex	750-Series Frames 2…4							Yes	Yes (4)			
PowerFlex	750-Series Frames 5…7								Yes (4)			
PowerFlex	700H/700S Frames 9…14					Yes (2) (3)						
PowerFlex	700L Frames 3A and 3B						Yes (2) (3)					
Kinetix	BM06…BM08		Yes	Yes		Yes (3)				Yes	Yes	
Kinetix	BM09…BM12			Yes		Yes (3)					Yes	
Kinetix	6000 and 6200/ 6500 (460V)			Yes		Yes (3)					Yes	

Special Bus Requirements

(1) See PowerFlex 40P Drive Considerations on page 73.

(2) DC input "Common Bus" drives are required when not connected to an AC source.

(3) Total capacitance of externally connected drives must not exceed the maximum allowable external capacitance of the supply drive or the precharge resistors will overheat. The maximum allowable external capacitance for each drive is listed in related tables in Appendix A.

(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

General Considerations

ATTENTION: The incorrect use or configuration of third party assemblies may result in reduced system reliability and drive damage.

1. The brake unit must be connected to the terminals of the drive used as the converter. The brake module and resistor should be sized no bigger than the capacity of the supply drive. This allows the drives to regenerate power to the large drive capacitor bank at current limit values if necessary. The large drive can then dump large amounts of peak power to a properly sized brake unit without stressing the small drives.
2. Minimizing bus inductance is imperative. Drives should be mounted physically as close to each other as possible with all power wiring "tied" together to minimize loop area.
3. An R-C Snubber circuit must be used in a Shared DC Bus configuration when the main drive is a PowerFlex 700/700S Frame 0...4, PowerFlex 750-Series Frame 2...4, or PowerFlex 40P drive and a 1336-W* Brake Chopper is used. See RC Snubber Circuit on page 123 for more information.
4. For further assistance with this Common Bus configuration, contact Rockwell Automation Support Plus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

PowerFlex 40P Drive Considerations

PowerFlex 40P drives should NOT be used on the same DC bus supply as PowerFlex 700/700S/700H/700L/750-Series drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700S/700H/700L/750-Series drives.

Sizing

The total motoring load should not exceed the rated load for the drive sourcing the DC power. Each DC-fed drive should be sized for the motor load connected to it.

Fusing

Drives should NOT be “daisy chained.” Configuration of shared DC bus should be in a “star” configuration to allow for proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the case of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common DC Bus drive fusing.

Notes:

Regenerative Bus Supply (Active Front End) Configuration

System Characteristics

This system is characterized by a PWM-controlled IGBT converter for full regeneration of power to the AC line. The regenerative bus supply puts energy back onto the distribution system instead of wasting energy with resistor braking technology. This configuration provides low AC line harmonics and can be used to meet IEEE-519 when used with the appropriate filtering.

Supported Products

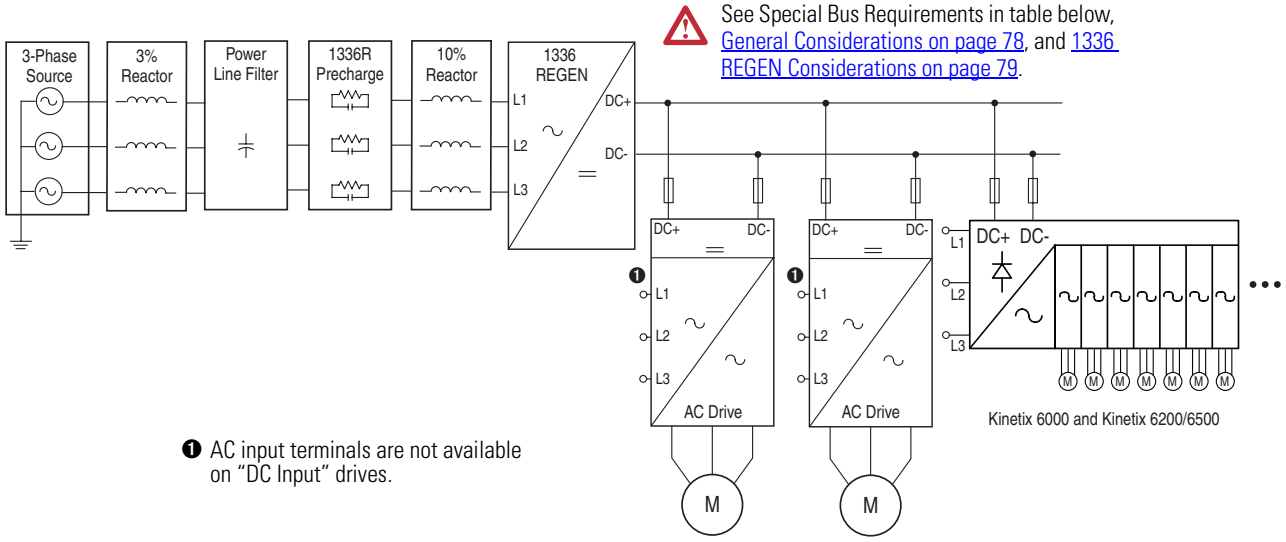
At the time of publication, these products are supported:

Products	Supported Drives
1336 REGEN (1)	PowerFlex 40P: All 400/480V AC power ratings
	PowerFlex 700 (2) / PowerFlex 700 Series B (2): 400/480V AC Frames 0…6 (3)
	PowerFlex 700S: 400/480V AC Frames 1…6 (3)
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12
	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations
PowerFlex 700AFE	PowerFlex 40P: All power ratings
	PowerFlex 700 (2) / PowerFlex 700 Series B (2): All frame sizes (3)
	PowerFlex 700S: All frame sizes (3)
	PowerFlex 700H: All frame sizes (3)
	PowerFlex 700L: Frames 3A (5) and 3B (3)
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12
	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations

(1) The 1336 REGEN is not CE compliant.
(2) These drives require firmware version 2.001 or later (Standard and Vector Control).
(3) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(4) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.
(5) Frame 3A dual inverter drives only.

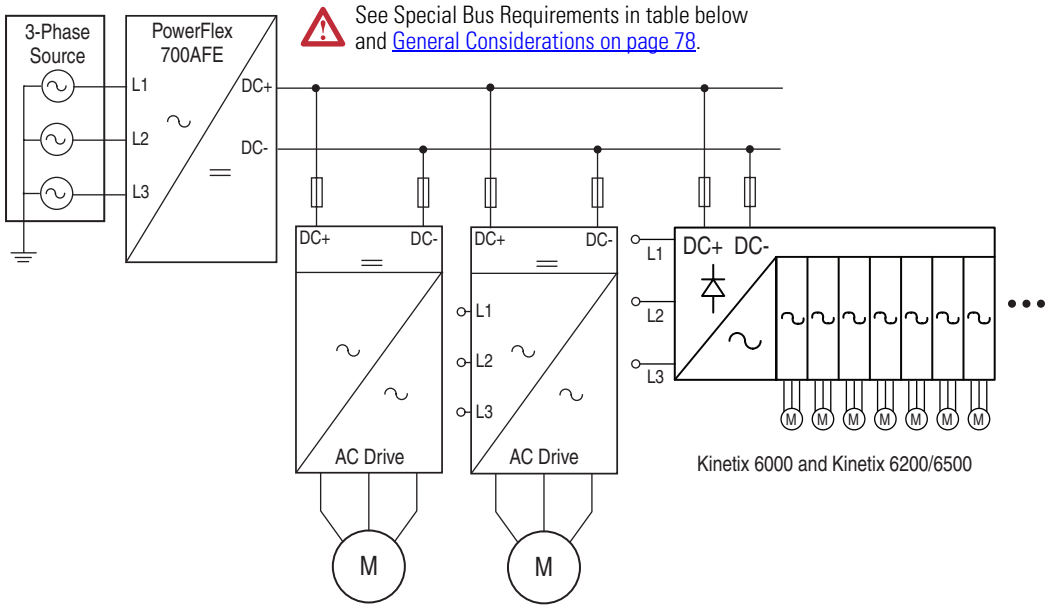
Typical System Configurations

Figure 36 - 1336 REGEN DC Bus Supply with AC Drives and Kinetix 6000 Drive System



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 750-Series: Frames 2…4	None
	PowerFlex 750-Series: Frames 5…7	DC input version with precharge must be selected.
	Kinetix 7000: BM06…BM08	None
	Kinetix 7000: BM09…BM12	External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700H/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700H/700S/750-Series drives and Kinetix 7000 drives.
Kinetix 6000 and Kinetix 6200/6500	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations	Drives must be placed in a common bus follower configuration.

Figure 37 - PowerFlex 700AFE with AC Drives and Kinetix 6000 Drive System



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 700: Frames 7…10	• Additional bus capacitance may be required; see General Considerations on page 78. • External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 700H/700S: Frames 9…13	
	PowerFlex 750-Series: Frames 2…4	None
	PowerFlex 750-Series: Frames 5…7	DC input version with precharge must be selected.
	Kinetix 7000: BM06…BM08	None
	Kinetix 7000: BM09…BM12	External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700H/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700H/700S/750-Series drives and Kinetix 7000 drives.
Kinetix 6000 and Kinetix 6200/6500	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations	Drives must be placed in a common bus follower configuration.

General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's User Manual for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus should be used. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives.
4. If an AC drive from column A is mixed with an AC drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 122 for details.

Column A Drives	Column B Drives
PowerFlex 700/700S: Frames 0…5 PowerFlex 750-Series: Frames 2…7 Kinetix 6000 and Kinetix 6200/6500 Kinetix 7000	PowerFlex 700/700S: Frame 6 PowerFlex 700: Frames 8…10 PowerFlex 700H/700S: Frame 9 and up PowerFlex 700L: All Frames

5. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to "Precharge Enable." This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drive(s) must have internal or externally-supplied precharge.

Drive	Parameter		Digital Input
	Number	Setting	
PowerFlex 40P	A051…A054	"29" (PreCharge En)	1…4
PowerFlex 700	361…366	"30" (PreCharge En)	1…6
PowerFlex 700L with vector control			
PowerFlex 700S	825…830	"30" (PreCharge En)	1…6
PowerFlex 700L with 700S control			
PowerFlex 700H	361…366	"30" (PreCharge En)	1…6
PowerFlex 750-Series	189 [DI Precharge]	See Drive Programming Manual for programming information.	

1336 REGEN Considerations

1. The 1336 REGEN Parameter 1- [Operational Mode] must be set to "DC Bus Supply Mode."
2. The 3% reactor and power line filter are separately ordered items, but both are required when the supplying transformer impedance is more than 10% of the 10% line reactor impedance. See Appendix B for Power Line Filter part numbers. See the *1336 REGEN User Manual* for 3% reactor part numbers.
   - Together with the 10% reactor, these components form a LCL (inductance, capacitance, inductance) type filter.
   - Example calculation of 10% Reactor Impedance vs. Transformer Impedance:

     Transformer is 200 KVA, 480V AC, 5% Impedance.

     180A Regen is used.

     Transformer Impedance in mH = $(Xpu \times VAC^2) / (2 \times Pi \times f \times KVA \times 1000)$

     $= (0.05 \times 480^2) / (2 \times 3.14159 \times 60 \times 200 \times 1000) = 0.153$ mH

     0.153 / 0.430 = 0.36 = 36%, which is higher than 10%, therefore a power line filter is required.
   - 10% Reactor Per Phase Inductances

1321-3LRA048	1.6 mH
1321-3LRA078	1.0 mH
1321-3LRA180	0.430 mH

Sizing

1. Convert all motor powers to kW (kW = HP x 0.746).
2. Determine the total power and input current required during acceleration:(1)

   For Motoring Loads: $P_{DRIVE} = P_{MOTOR} / \text{Motor Efficiency}$

   For Regenerating Loads: $P_{DRIVE} = P_{MOTOR} * \text{Motor Efficiency}$

   $$P_{ACCEL} = P_{DRIVE1} + P_{DRIVE2} + \ldots$$

   Calculate the input current required on the regenerative unit during acceleration, taking advantage of the 110% for 1 minute overload rating of the regenerative unit:

   $$I_{INPUT} = P_{ACCEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.1),$$

   where P_{ACCEL} is in kW, and V_{LL} = RMS line-to-line AC input voltage.

(1) P_{MOTOR} is the motor power required for the application. The P_{MOTOR} could be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

3. Determine the total power and input current required during steady state run operation: (1)

   For Motoring Loads: $P_{DRIVE} = P_{MOTOR}$ / Motor Efficiency

   For Regenerating Loads: $P_{DRIVE} = P_{MOTOR}$ * Motor Efficiency

   $$P_{RUN} = P_{DRIVE1} + P_{DRIVE2} + ...$$

   Calculate the steady state input current required on the regenerative unit:

   $$I_{INPUT} = P_{RUN} \times 1000 / (\sqrt{3} \times V_{LL}),$$

   where P_{RUN} is in kW, and V_{LL} = RMS line-to-line AC input voltage.

4. Determine the total power and input current required during deceleration:(1)

   For Motoring Loads: $P_{DRIVE} = P_{MOTOR}$ / Motor Efficiency

   For Regenerating Loads: $P_{DRIVE} = P_{MOTOR}$ * Motor Efficiency

   $$P_{DECEL} = P_{DRIVE1} + P_{DRIVE2} + ...$$

   Calculate the input current required on the regenerative unit during deceleration, taking advantage of the 110% for 1 minute overload rating of the regenerative unit:

   $$I_{INPUT} = P_{DECEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.1),$$

   where P_{DECEL} is in kW, and V_{LL} = RMS line-to-line AC input voltage.

5. Compare the absolute values of the input current required for the regenerative unit during acceleration, deceleration, and steady state. Select the regenerative unit with the input current rating that meets or exceeds the worst case input current.

Example Calculation:

A machine contains 3 drives that are to be powered with a regenerative bus supply. The following motor powers were determined:

Roll Name	Accel Power (HP)	Run Power (HP)	Decel Power (HP)
Feed Roll (DRIVE1)	-10	-15	-30
Leveler (DRIVE2)	75	50	-75
Winder (DRIVE3)	20	12	-30

Motor efficiencies were were estimated at 85%. Line voltage is 480V AC.

Step 1

All motor powers were converted to kW:

Roll Name	Accel Power (kW)	Run Power (kW)	Decel Power (kW)
Feed Roll (DRIVE1)	-7.5	-11.2	-22.4
Leveler (DRIVE2)	55.9	37.3	-55.9
Winder (DRIVE3)	14.9	8.9	-22.4

Step 2

Drive power was calculated for each roll during acceleration:

P_{DRIVE1} = -7.5 x 0.85 = -6.4 kW
P_{DRIVE2} = 55.9 / 0.85 = 65.8 kW
P_{DRIVE3} = 14.9 / 0.85 = 17.5 kW

Total power during acceleration:

P_{ACCEL} = (-6.4) + (65.8) + (17.5) = 76.9 kW

Input current during acceleration:

I_{INPUT} = 76.9 x 1000 / (√ 3 x 480 x 1.5) = 61.7 Amps

Step 3

Drive power was calculated for each roll during steady state run conditions:

P_{DRIVE1} = -11.2 x 0.85 = -9.5 kW
P_{DRIVE2} = 37.3 / 0.85 = 43.9 kW
P_{DRIVE3} = 8.9 / 0.85 = 10.5 kW

Total power during steady state run conditions:

P_{ACCEL} = (-9.5) + (43.9) + (10.5) = 44.9 kW

Input current during steady state run conditions:

I_{INPUT} = 44.9 x 1000 / (√ 3 x 480) = 54 Amps

Step 4

Drive power was calculated for each roll during deceleration:

P_{DRIVE1} = -22.4 x 0.85 = -19.0 kW
P_{DRIVE2} = -55.9 x 0.85 = -47.5 kW
P_{DRIVE3} = -22.4 x 0.85 = -19.0 kW

Total power during deceleration:

P_{ACCEL} = (-19.0) + (-47.5) + (-19.0) = -85.5 kW

Input current during deceleration:

I_{INPUT} = -85.5 x 1000 / (√ 3 x 480 x 1.5) = -68.6 Amps

Step 5

Comparing the absolute values of the input current required during acceleration, deceleration, and steady state, 68.6 Amps is the largest value. Select a regenerative unit with a current rating of 68.6 Amps or more.

Fusing

DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

AC Input 1336 REGEN

See the *1336 REGEN User Manual* for recommended AC input fusing of the 1336 REGEN.

PowerFlex 700AFE

See the *PowerFlex 700AFE User Manual* for recommended fusing.

Notes:

Paralleling Regenerative Bus Supplies (Active Front Ends) Configuration

System Characteristics

The power of the AFE input group can be increased by connecting several groups in parallel. Paralleling refers to AFE units connected on the same input transformer and the same DC bus.

Paralleling is typically used when the power range of a single frame size is not enough, or when redundancy is needed.

Supported Products

At the time of publication, these regenerative Bus Supplies and PowerFlex drives are supported:

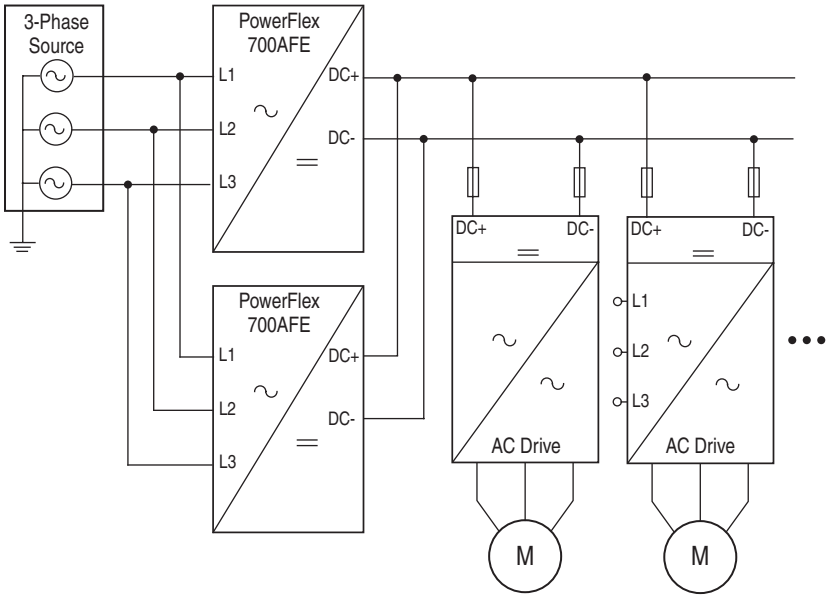
Product	AC Input Voltage (VAC)	AFE Voltage Class (VAC)	Supported Drives	DC Bus OverVoltage Trip
PowerFlex 700AFE	400/460	400/480	480V AC PowerFlex 700 (1) / PowerFlex 700 Series B (1): All Frames (2)	810V DC
			480V AC PowerFlex 700S: Frames 1…6 (2)	810V DC
			480V AC PowerFlex 700S: Frames 9 and up (2)	910V DC
			480V AC PowerFlex 700H: All Frames (2)	911V DC
			480V AC PowerFlex 750-Series: Frames 2…7 (3)	810V DC
	480	400/480	480V AC PowerFlex 700H/700S: Frames 9 and up (2)	911V DC
			600V AC (4) PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…4	1013V DC
			600/690V AC (4) PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 5 and 6 (2)	1162V DC
	600	600/690	600/690V AC PowerFlex 700/700S: Frames 5 and 6 (2)	1162V DC
			690V AC PowerFlex 700H/700S: Frames 9 and up (2)	1200V DC
	690	600/690	690V AC PowerFlex 700H/700S: Frames 9 and up (2)	1200V DC

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, and PowerFlex 700H Frame 9…14 DC input drives are required when not connected to the AC source.
(3) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.
(4) These drives can be operated on parallel AFEs that are powered by 480V AC input.

When the PowerFlex 700AFE is paralleled, the DC bus voltage at regeneration is 5% higher than with a single AFE due to the 5% droop.

Typical System Configuration

Figure 38 - Parallel PowerFlex AFEs with AC Drives



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	See Supported Products on page 83 for supported voltages.
	PowerFlex 750-Series: Frames 2…4	
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration. • See Supported Products on page 83 for supported voltages.
	PowerFlex 700: Frames 7…10	• Additional bus capacitance may be required. See General Considerations on page 87. • External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration. • See Supported Products on page 83 for supported voltages.
	PowerFlex 700H/700S: Frames 9…14	
	PowerFlex 750-Series: Frames 5…7	• DC input version with precharge must be selected. • See Supported Products on page 83 for supported voltages.

PowerFlex 700AFE Considerations

- No communication between the units is required—they work independently.
- AFE units of different power sizes can be connected in parallel.
- A maximum of six (6) AFEs can be paralleled. However, this may be limited by the capacity of the DC bus bar.
- Each AFE must have its own LCL filter.
- Each AFE must have its own short-circuit protection on AC and DC sides. See Appendix A for fusing information. When paralleling, attention must be paid to the sufficient short-circuit capacity of the system.
- The AFE units must be derated by 5% of their power rating.
- Configure the following parameters for parallel operation:
  - Set Parameter 42 - [Modulation Type] to "3."
  - Set Parameter 82 - [Ground I Lvl] to 100%.
  - Set Parameter 85 - [Droop] to 5% for current sharing of the AFEs.
  - Set Parameter 86 - [PWM Synch] to "1" to reduce circulating currents between AFEs connected to the same DC bus and fed from the same power source.
- If one of the paralleled AFEs is to be isolated from the AC and DC voltages, the AC input and DC output must be isolated. The AC input can be isolated using a circuit breaker or a disconnect switch. Contactors are not suitable for isolating the AC input because they cannot be locked in the safe position. The DC output can be isolated using a disconnect. A load isolation switch or safety isolation switch can be used to isolate the precharging circuit from the AC input.
- With standard IP21 Rittal cabinet AFEs, each AFE must use a separate precharging circuit, precharging control switch, DC bus output fusing, and main contactor.

  Each AFE controls its own precharging and main circuit breaker. Therefore, it is possible to disconnect the AFE when other parallel AFEs are running.
- An AFE can be connected while other parallel AFE units are running. When connecting the AFE to the DC bus, follow these steps:

  a. The isolated AFE must first be precharged.
  b. When that is done, the AFE control should close the main circuit breaker.
  c. Then close the DC disconnect to connect the AFE to the DC bus.

  When disconnecting the AFE from the DC bus, follow these steps:

d. Stop the inverters and AFEs connected to the same DC bus from modulating. The AFE load must be zero before being disconnected to reduce the load on the main circuit breaker.

e. Open the main circuit breaker of the AFE.

f. Open the DC disconnect switch.

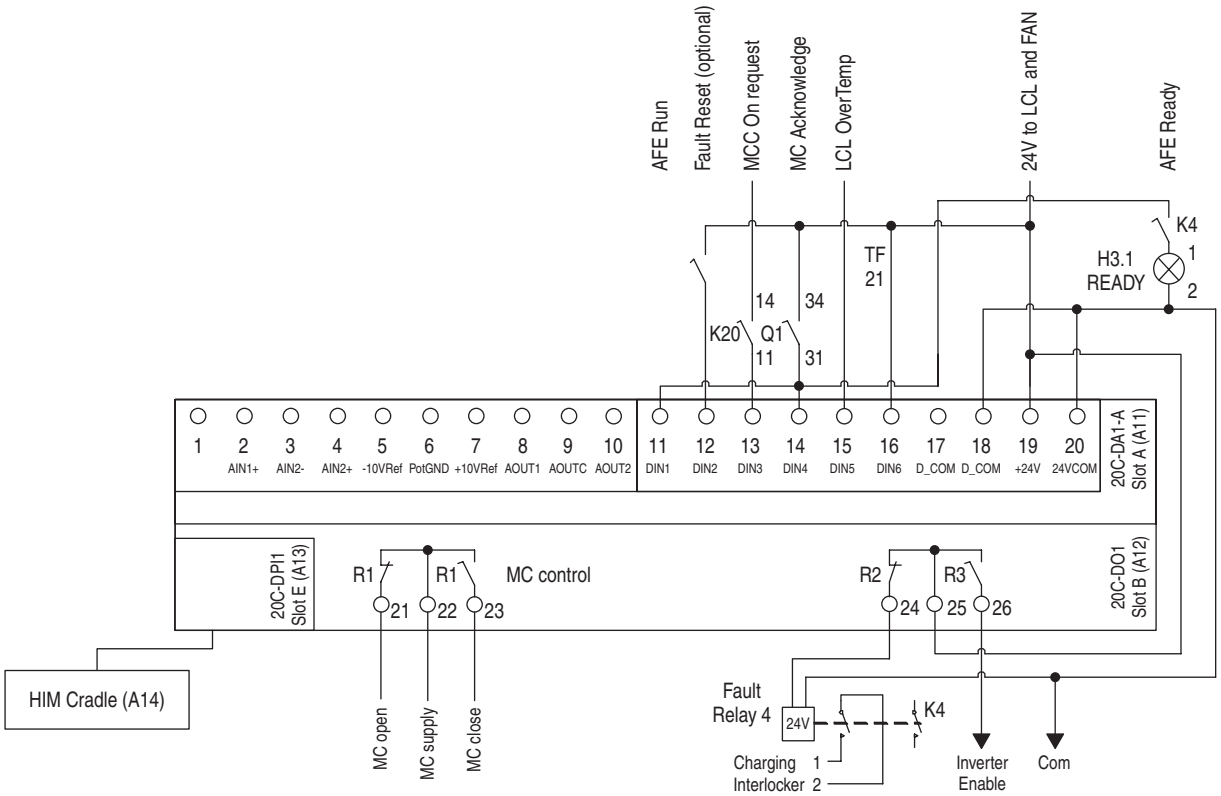
g. The other AFE units can be restarted.

- Figure 38 on page 84 shows an example of paralleling two Frame 10 PowerFlex 700AFEs in their standard IP21 Rittal cabinets, where each AFE has its own precharging circuit, precharging control, and fusing on the DC bus output and main contactor.

  In this case, turn the disconnects (Q0) of all AFEs to the ON position, and set all of the REM-MAN-AUTO selector switches on the door to the AUTO position to enable automatic operation.

When turning on the main power, the two AFEs precharge automatically. After charging, the motor-controlled main circuit breakers (Q1) will be closed and the AFEs start the modulation. The control signal "Inverter Enable" shown in Figure 39 can be used to interlock the drives connected to the DC bus.

Figure 39 - PowerFlex 700AFE Factory Installed Wiring Diagram



General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's User Manual for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus should be used. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives.
4. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to "Precharge Enable." This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drive(s) must have internal or externally-supplied precharge.

Drive	Parameter		Digital Input
	Number	Setting	
PowerFlex 40P	A051…A054	"29" (PreCharge En)	1…4
PowerFlex 700	361…366	"30" (PreCharge En)	1…6
PowerFlex 700L with vector control			
PowerFlex 700S	825…830	"30" (PreCharge En)	1…6
PowerFlex 700L with 700S control			
PowerFlex 700H	361…366	"30" (PreCharge En)	1…6
PowerFlex 750-Series	189 [DI Precharge]	See Drive Programming Manual for programming information.	

5. If an AC drive from column A is mixed with an AC drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 122 for details.

Column A Drives	Column B Drives
PowerFlex 700/700S: Frames 0…5 PowerFlex 750-Series: Frames 2…7 Kinetix 6000 and Kinetix 6200/6500 Kinetix 7000	PowerFlex 700/700S: Frame 6 PowerFlex 700: Frames 8…10 PowerFlex 700H/700S: Frame 9 and up PowerFlex 700L: All Frames

Sizing

See Chapter 8 for sizing information. In addition, when paralleling PowerFlex 700AFE units, they must be derated by 5% of their power rating.

Fusing

DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

PowerFlex 700AFE

See the *PowerFlex 700AFE User Manual* for recommended fusing.

Paralleling an AFE with One or More PowerFlex SCR Bus Supplies

System Characteristics

A single AFE can be paralleled with one or more PowerFlex SCR Bus Supplies for applications that require partial regeneration capacity.

Supported Products

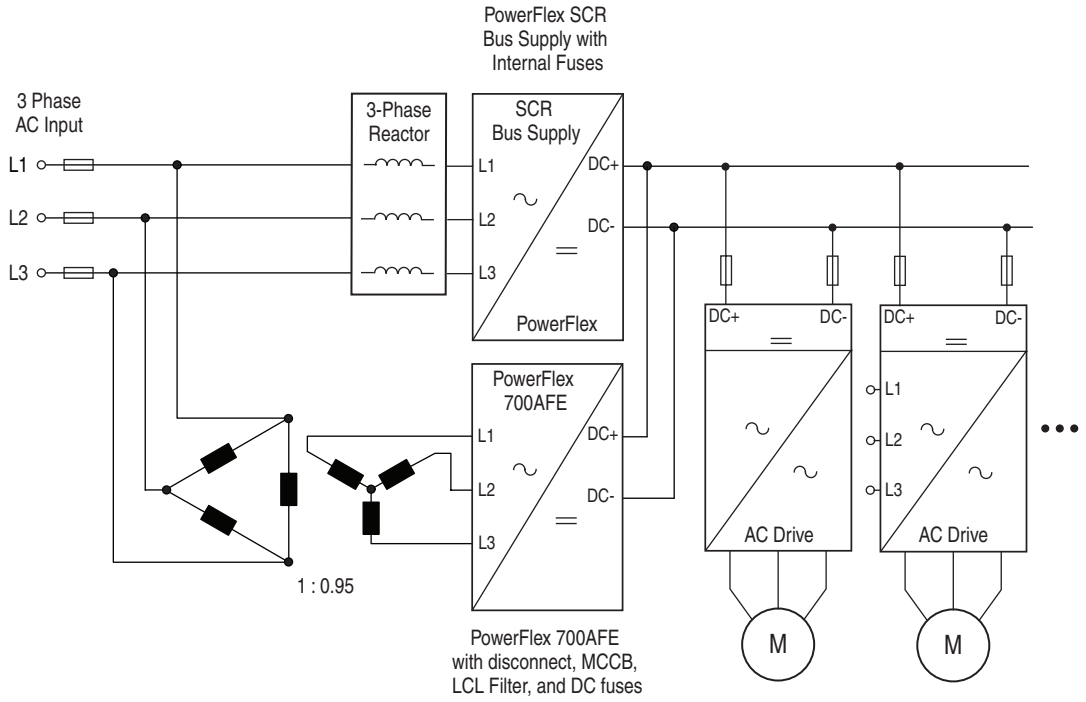
At the time of publication, these products are supported:

Products	Supported Drives
PowerFlex 700AFE in parallel with PowerFlex SCR Bus Supply	PowerFlex 40P: All power ratings
	PowerFlex 700 (1) / PowerFlex 700 Series B (1): All frame sizes (2)
	PowerFlex 700S: All frame sizes (2)
	PowerFlex 700H: All frame sizes (2)
	PowerFlex 700L: Frames 3A (3) and 3B (2)
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12
	Kinetix 6000 and Kinetix 6200/6500: All 460V configurations

(1) These drives require firmware version 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(3) Frame 3A dual inverter drives only.
(4) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.

Typical System Configuration

Figure 40 - AFE in Parallel with PowerFlex SCR Bus Supply with AC Drives



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…4	None
	PowerFlex 750-Series: Frames 2…4	
	PowerFlex 700/700S: Frames 5 and 6	• Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 700: Frames 7…10	• Additional bus capacitance may be required. See General Considerations on page 91. • External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. • DC input "common bus" drives are required—not AC stand-alone configuration.
	PowerFlex 700H/700S: Frames 9 …14	
	PowerFlex 700L: Frames 3A (1) and 3B	
	PowerFlex 750-Series: Frames 5…7	DC input version with precharge must be selected.
	Kinetix 7000: BM06…BM08	None
	Kinetix 7000: BM09…BM12	External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
	PowerFlex 40P: All power ratings	**Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700H/700S drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700H/700S drives and Kinetix 7000 drives.

(1) Frame 3A dual inverter drives only.

PowerFlex 700AFE and PowerFlex SCR Bus Supply Considerations

- An isolating delta Y transformer with the secondary center tap ungrounded must be used on the input of the AFE (see Figure 40 on page 90). This is to minimize circulating currents and avoid nuisance ground faults in the AFE.
- The transformer kVA should be equal to or greater than the AFE input kVA.
- The system impedance should be less than 10%.
- The isolating transformer on the input of the AFE must be tapped 5% below the input voltage for the PowerFlex SCR Bus Supply. This is to provide proper sharing of the load between the AFE and SCR Bus Supply during motoring operation.
- An input reactor must be used on the input of each PowerFlex SCR Bus Supply. See the *PowerFlex SCR Bus Supply User Manual* for details.
- Allow the PowerFlex SCR Bus Supply to precharge the DC bus of the system before allowing the AFE to complete precharge and close its MCCB. See the *PowerFlex SCR Bus Supply User Manual* for details on setting up the precharge rate.
- Parameter 75 - [Motor Power Lmt] of the AFE must be set to 10% to limit the motoring current that the AFE can supply and avoid overload faults on the AFE.

General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's User Manual for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus should be used. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives.
4. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to “Precharge Enable.” This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive

to an energized DC bus. Under this condition, the drive(s) must have internal or externally-supplied precharge.

Drive	Parameter		Digital Input
	Number	Setting	
PowerFlex 40P	A051…A054	"29" (PreCharge En)	1…4
PowerFlex 700	361…366	"30" (PreCharge En)	1…6
PowerFlex 700L with vector control			
PowerFlex 700S	825…830	"30" (PreCharge En)	1…6
PowerFlex 700L with 700S control			
PowerFlex 700H	361…366	"30" (PreCharge En)	1…6
PowerFlex 750-Series	189 [DI Precharge]	See Drive Programming Manual for programming information.	

5. If an AC drive from column A is mixed with an AC drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 122 for details.

Column A Drives	Column B Drives
PowerFlex 700/700S: Frames 0…5 PowerFlex 750-Series: Frames 2…7 Kinetix 6000 and Kinetix 6200/6500 Kinetix 7000	PowerFlex 700/700S: Frame 6 PowerFlex 700: Frames 8…10 PowerFlex 700H/700S: Frame 9 and up PowerFlex 700L: All Frames

Sizing

See Chapter 8 for sizing the AFE. See Chapter 2 for sizing the SCR Bus Supply. In addition, the AFE should be sized for the regenerative power only, and the SCR Bus Supply should be sized to handle all of the motoring power because the AFE will be programmed for a 10% [Motor Power Lmt].

Fusing

DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

PowerFlex SCR Bus Supply

The PowerFlex SCR Bus Supply has built-in AC line and DC bus fuses (on 400A and 600A units). The 1000A unit has six in-path fuses which simultaneously protect AC and DC paths. All units are equipped with fuse trip indicator switches. See the *PowerFlex SCR Bus Supply User Manual* for fusing information.

PowerFlex 700AFE

See the *PowerFlex 700AFE User Manual* for recommended fusing.

Regenerative Braking Configuration

System Characteristics

In the regenerative braking configuration the drive has a connection to the AC line and draws the majority of the motoring power. This allows the regenerative brake to be sized for the regenerative power only. The regenerative brake puts energy back onto the distribution system instead of wasting energy with resistor braking technology.

Supported Products

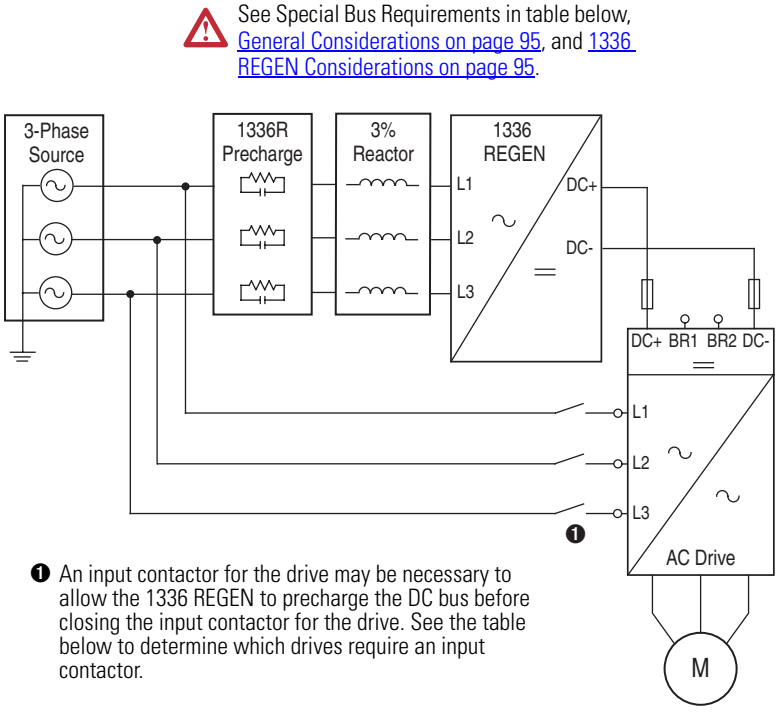
At the time of publication, these products are supported:

Products	Supported Drives
1336 REGEN (1)	PowerFlex 40P: All 400/480V AC power ratings
	PowerFlex 700 (2) / PowerFlex 700 Series B (2): All 400/480V AC frame sizes (3)
	PowerFlex 700S: All 400/480V AC frame sizes (3)
	PowerFlex 700H: All 400/480V AC frame sizes (3)
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12

(1) The 1336 REGEN is not CE compliant.
(2) These drives require firmware version 2.001 or later (Standard and Vector Control).
(3) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, and PowerFlex 700H Frame 9…14 DC input drives are required when not connected to the AC source.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

Typical System Configurations

Figure 41 - 1336 REGEN Brake with an AC Drive



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive	PowerFlex 700/700S: Frames 0…2	See item 2 in 1336 REGEN Considerations on page 95.
	PowerFlex 700/700S: Frames 3 and 4	See item 3 in 1336 REGEN Considerations on page 95.
	PowerFlex 700/700S: Frames 5 and 6	None
	PowerFlex 700: Frames 7…10	
	PowerFlex 700/700S: Frames 9…14	
	PowerFlex 750-Series: Frames 2…4	See item 2 in 1336 REGEN Considerations on page 95.
	PowerFlex 750-Series: Frames 5…7	A DC input terminal kit must be ordered for Frames 6 and 7.
	PowerFlex 40P: All power ratings	• See item 2 in 1336 REGEN Considerations on page 95. • **Important:** Do not use PowerFlex 40P drives on the same DC bus supply with PowerFlex 700/700H/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700H/700S/750-Series drives and Kinetix 7000 drives.
	Kinetix 7000: BM06…BM12	See item 2 in 1336 REGEN Considerations on page 95.

General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's User Manual for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus should be used. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives.

1336 REGEN Considerations

1. The 1336 REGEN Parameter 1- [Operational Mode] must be set to "Regen Brake Mode" (default).
2. When using a PowerFlex 40P drive, PowerFlex 700/700S Frame 0...2 drive, PowerFlex 750-Series Frame 2...4 drive or Kinetix 7000 BM06...BM12 drive with a 1336 REGEN in the Regenerative Brake Configuration, an AC input contactor must be provided for the drive. The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drive.
3. When using a PowerFlex 700/700S Frame 3 or 4 drive with a 1336 REGEN in the Regenerative Brake Configuration, one of the following methods must be used:
   - Provide an AC input contactor for the drive. The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drive.
   - An alternative to using an AC contactor on the PowerFlex 700/700S Frame 3 or 4 drive is to connect to BR1 instead of DC+. This method can be used only with Frame 3 or 4 on a 48A or 78A 1336R.

Sizing

1. Convert all motor powers to kW (kW = HP x 0.746).
2. Determine the total power required during deceleration: (1)

$$P_{DECEL} = P_{MOTOR} * \text{Motor Efficiency}$$

Calculate the input current required on the regenerative unit during deceleration, taking advantage of the 150% for 1 minute overload rating of the regenerative unit:

$$I_{INPUT} = P_{DECEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.5),$$

where P_{DECEL} is in kW, and V_{LL} = RMS line-to-line AC input voltage.

(1) P_{MOTOR} is the motor power required for the application. The P_{MOTOR} could be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

3. Determine the total power required during steady state run operation, if the steady state power is regenerative: (1)

$$P_{RUN} = P_{MOTOR} * \text{Motor Efficiency}$$

Calculate the steady state input current required on the regenerative unit:

$$I_{INPUT} = P_{RUN} \times 1000 / (\sqrt{3} \times V_{LL}),$$

where P_{RUN} is in kW, and V_{LL} = RMS line-to-line AC input voltage.

4. Compare the input current required for the regenerative unit during deceleration, and steady state. Select the regenerative unit with the input current rating that meets or exceeds the worst case regenerative input current.

Fusing

AC Input Drives

See the drive's User Manual for AC input fusing of the drives.

AC Input 1336 REGEN

See the *1336 REGEN User Manual* for recommended AC input fusing of the 1336 REGEN.

DC Output 1336 REGEN

The DC fusing is sized per the 1336 REGEN rating in this configuration because the regenerative unit is sized to handle regenerative current only. See the *1336 REGEN User Manual* for recommended DC output fusing of the 1336 REGEN.

Shared Regenerative Braking Configuration

System Characteristics

The shared regenerative braking configuration is used when regeneration is needed for stopping or slowing down multiple drives. The regenerative brake puts energy back onto the distribution system instead of wasting energy with resistor braking technology. Steering diodes only allow regenerative current to flow to the regenerative module so that one drive cannot source power to the other drives.

Supported Products

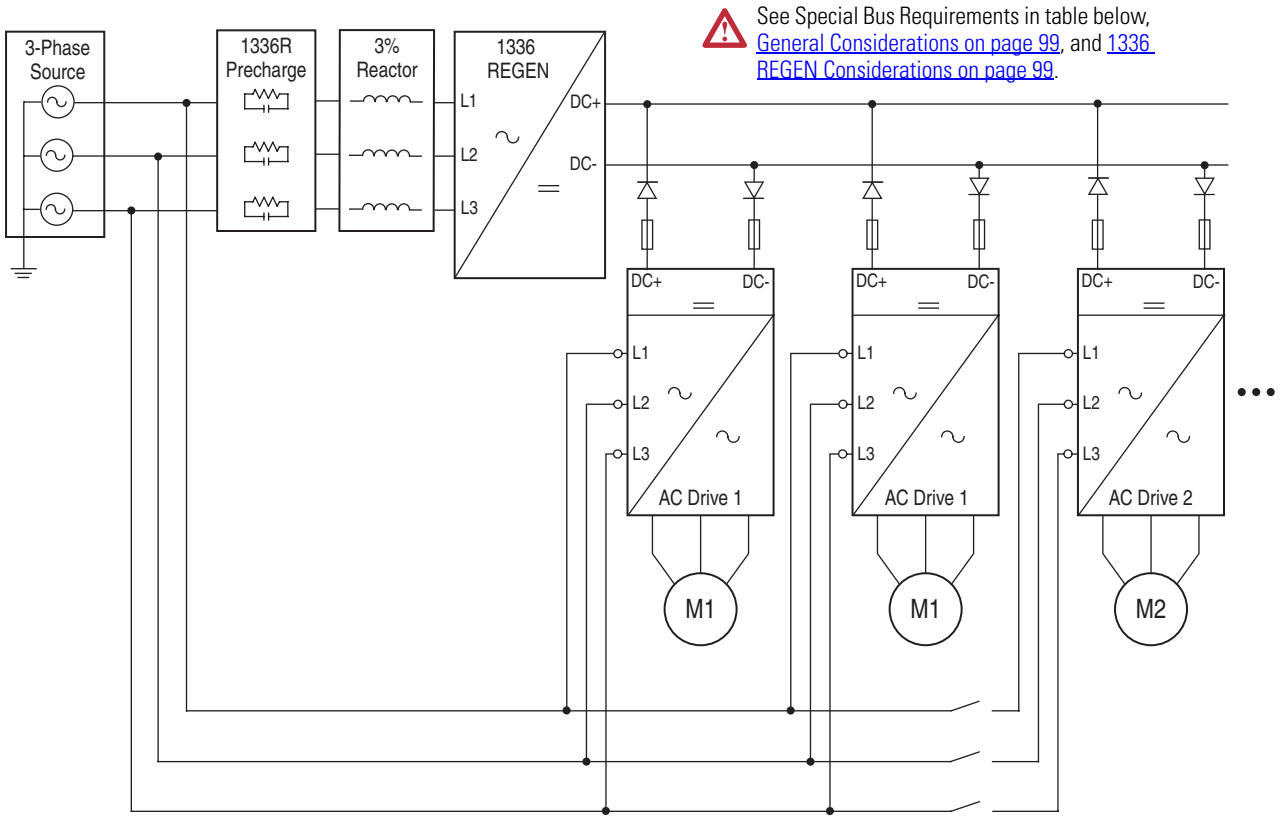
At the time of publication, these products are supported:

Products	Supported Drives
1336 REGEN (1)	PowerFlex 40P: All 400/480V AC power ratings
	PowerFlex 700 (2) / PowerFlex 700 Series B (2): All 400/480V AC frame sizes (3)
	PowerFlex 700S: All 400/480V AC frame sizes
	PowerFlex 700H: All 400/480V AC frame sizes
	PowerFlex 750-Series: Frames 2…7 (4)
	Kinetix 7000: BM06…BM12
	Kinetix 7000: All 460V configurations

(1) The 1336 REGEN is not CE compliant.
(2) These drives require firmware version 2.001 or later (Standard and Vector Control).
(3) PowerFlex 700 Frame 5…10 DC input drives are required when not connected to the AC source.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

Typical System Configurations

Figure 42 - Shared 1336 REGEN Brake with AC Drives



Dwg. Designation	Supported Drives	Special Bus Requirements
AC Drive 1	PowerFlex 700/700S: Frames 5 and 6	Steering diodes must be used in a shared regeneration configuration to prevent imbalanced AC current sharing between the drives.
	PowerFlex 700: Frames 7…10	
	PowerFlex 700H: Frames 9…14	
	Kinetix 7000: BM09…BM12	
	PowerFlex 750-Series: Frames 5…7	• Steering diodes must be used in a shared regeneration configuration to prevent imbalanced AC current sharing between the drives. • A DC input terminal kit must be ordered for Frames 6 and 7.
AC Drive 2	PowerFlex 700/700S: Frames 0…4	• When using these drives with a 1336 REGEN in the Shared Regenerative Brake Configuration, an AC input contactor must be provided for these drives. The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drives. • Steering diodes must be used in a shared regeneration configuration to prevent imbalanced AC current sharing between the drives.
	PowerFlex 750-Series: Frames 2…4	
	Kinetix 7000: BM06…BM08	

General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's User Manual for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus should be used. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives.

1336 REGEN Considerations

1. The 1336 REGEN Parameter 1- [Operational Mode] must be set to "Regen Brake Mode" (default).
2. When using any of the following drives/drive systems with a 1336 REGEN in the Regenerative Brake Configuration, an AC input contactor must be provided for these drives:

PowerFlex 40P: All 400/480V AC power ratings
PowerFlex 700/700S: All 400/480V AC frame sizes
PowerFlex 750-Series: Frames 2…7
Kinetix 7000: BM06…BM12
Kinetix 7000: All 460V configurations

   The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drives.
3. Steering diodes must be used in a shared regeneration configuration to ensure AC current sharing between the drives. Bonitron (www.bonitron.com) sells diode sharing modules for connecting multiple drives to one regenerative brake (see Table 23 on page 122).

PowerFlex 40P Drive Considerations

PowerFlex 40P drives should NOT be used on the same DC bus supply as PowerFlex 700/700S/700H/750-Series drives. This is due to the difference in capacitance/amps of the PowerFlex 40P drives compared to the PowerFlex 700/700S/700H/750-Series drives.

Sizing

1. Convert all motor powers to kW (kW = HP x 0.746).
2. Determine the total power required during deceleration: (1)

   $$P_{DECEL} = P_{MOTOR} * \text{Motor Efficiency}$$

   Calculate the input current required on the regenerative unit during deceleration, taking advantage of the 150% for 1 minute overload rating of the regenerative unit:

   $$I_{INPUT} = P_{DECEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.5),$$

   where P_{DECEL} is in kW, and V_{LL} = RMS line-to-line AC input voltage.
3. Determine the total power required during steady state run operation, if the steady state power is regenerative: (1)

   $$P_{RUN} = P_{MOTOR} * \text{Motor Efficiency}$$

   Calculate the steady state input current required on the regenerative unit:

   $$I_{INPUT} = P_{RUN} \times 1000 / (\sqrt{3} \times V_{LL}),$$

   where P_{RUN} is in kW, and V_{LL} = RMS line-to-line AC input voltage.
4. Compare the input current required for the regenerative unit during deceleration, and steady state. Select the regenerative unit with the input current rating that meets or exceeds the worst case regenerative input current.

Fusing

AC Input Drives

See the drive's User Manual for AC input fusing of the drives.

DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

AC Input 1336 REGEN

See the *1336 REGEN User Manual* for recommended AC input fusing of the 1336 REGEN.

(1) P_{MOTOR} is the motor power required for the application. The P_{MOTOR} could be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

PowerFlex Drive Ratings, Recommended DC Bus Fuses, and Drive DC Bus Capacitance

The tables on the following pages provide drive ratings (including DC input currents), recommended DC input fuses (Manufacturer Catalog No.), and internal drive DC bus capacitance. The sizes listed are the recommended sizes based on 40 °C. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

325 Volt DC Input Fuses

Table 1 - PowerFlex 40P Drives

Drive Cat. No. 22D...	HP Rating	DC Input Amps	Non-Time Delay Fuse (1)		Drive DC Bus Capacitance (µF)
			Amps	Catalog No.	
B2P3	0.5	2.1	6	Bussmann JKS-6 (2)	270
B5P0	1	4.5	10	Bussmann JKS-10 (2)	560
B8P0	2	8.1	20	Ferraz Shawmut HSJ20 (3)	940
B012	3	12.1	25	Ferraz Shawmut HSJ25 (3)	1,120
B017	5	18.3	40	Ferraz Shawmut HSJ40 (3)	2,000
B024	7.5	25.4	50	Ferraz Shawmut HSJ50 (3)	2,800
B033	10	35.4	70	Ferraz Shawmut HSJ70 (3)	3,920

(1) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects:* Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses:* Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(2) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 2 - PowerFlex 700/700S Drives — Frames 0…6

Drive Cat. No. 20B… / 20D…	Frame	HP Rating		DC Input Rating	Non-Time Delay Fuse [2]		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.	
B2P2	0	0.5	0.33	2.0	6	Bussmann JKS-6 [3]	440
B4P2	0/1	1	0.75	3.8	8	Bussmann JKS-8 [3]	440
B6P8	1	2	1.5	6.9	15	Ferraz Shawmut HSJ15 [4]	1,120
B9P6	1	3	2	9.7	20	Ferraz Shawmut HSJ20 [4]	1,120
B015	1	5	3	16	30	Ferraz Shawmut HSJ30 [4]	2,000
B022	1	7.5	5	23.3	45	Ferraz Shawmut HSJ45 [4]	2,000
B028	2	10	7.5	30	60	Ferraz Shawmut HSJ60 [4]	3,000
B042	3	15	10	45	90	Ferraz Shawmut HSJ90 [4]	4,800
B052	3	20	15	55	100	Ferraz Shawmut HSJ100 [4]	4,800
B070	4	25	20	75.3	150	Ferraz Shawmut HSJ150 [4]	7,000
B080	4	30	25	85.8	175	Ferraz Shawmut HSJ175 [4]	7,000
N104 [1]	5	40	30	114.1	225	Ferraz Shawmut HSJ225 [4]	9,000
N130 [1]	5	50	40	142.6	250	Ferraz Shawmut HSJ250 [4]	12,000
N154 [1]	6	60	50	169	300	Ferraz Shawmut HSJ300 [4]	13,800
N192 [1]	6	75	60	210.6	400	Ferraz Shawmut HSJ400 [4]	16,800
N260 [1]	6	100	75	272.1	400	Ferraz Shawmut HSJ400 [4]	16,800

(1) Catalog number corresponds to drives with precharge only.

(2) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses:* Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

540 Volt DC Input Fuses

Table 3 - PowerFlex 40P Drives

Drive Cat. No. 22D…	kW Rating	DC Input Amps	Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)
			Amps	Catalog No.	
D1P4	0.4	1.4	3	Bussmann JKS-3 [1]	90
D2P3	0.75	2.2	6	Bussmann JKS-6 [1]	135
D4P0	1.5	4.1	10	Bussmann JKS-10 [1]	235
D6P0	2.2	6.4	15	Ferraz Shawmut HSJ15 [2]	280
D010	4	11.6	25	Ferraz Shawmut HSJ25 [2]	600
D012	5.5	13.4	25	Ferraz Shawmut HSJ25 [2]	705
D017	7.5	19.4	40	Ferraz Shawmut HSJ40 [2]	940
D024	11	28.0	50	Ferraz Shawmut HSJ50 [2]	1,120

(1) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 4 - PowerFlex 700/700S Drives — Frames 0…6

Drive Cat. No. 20B… / 20D…	Frame	kW Rating		DC Input Rating	Non-Time Delay Fuse[2]		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.	
C1P3	0	0.37	0.25	1.3	3	Bussmann JKS-3 [3]	110
C2P1	0/1	0.75	0.55	2.1	6	Bussmann JKS-6 [3]	110
C3P5	0/1	1.5	1.1	3.7	8	Bussmann JKS-8 [3]	165
C5P0	0/1	2.2	1.5	5.3	10	Bussmann JKS-10 [3]	280
C8P7	0/1	4	3.0	9.3	15	Ferraz Shawmut HSJ15 [4]	330
C011	0/1	5.5	4	12.6	20	Ferraz Shawmut HSJ20 [4]	560
C015	1	7.5	5.5	16.8	25	Ferraz Shawmut HSJ25 [4]	680
C022	1	11	7.5	24	40	Ferraz Shawmut HSJ40 [4]	1,000
C030	2	15	11	33.2	50	Ferraz Shawmut HSJ50 [4]	1,200
C037	2	18.5	15	40.9	70	Ferraz Shawmut HSJ70 [4]	1,500
C043	3	22	18.5	47.5	90	Ferraz Shawmut HSJ90 [4]	1,800
C056	3	30	22	61.9	100	Ferraz Shawmut HSJ100 [4]	2,400
C072	3	37	30	80.5	125	Ferraz Shawmut HSJ125 [4]	3,000
C085	4	45	37	95.1	150	Ferraz Shawmut HSJ150 [4]	3,500
H105 [1]	5	55	–	120.2	175	Ferraz Shawmut HSJ175 [4]	4,500
		–	45	95.1	175	Ferraz Shawmut HSJ175 [4]	
H125 [1]	5	55	–	120.2	200	Ferraz Shawmut HSJ200 [4]	6,000
		–	45	95.1	200	Ferraz Shawmut HSJ200 [4]	
H140 [1]	5	75	–	159	250	Ferraz Shawmut HSJ250 [4]	6,000
		–	55	120.2	250	Ferraz Shawmut HSJ250 [4]	
H170 [1]	6	90	–	192	350	Ferraz Shawmut HSJ350 [4]	6,900
		–	75	159	350	Ferraz Shawmut HSJ350 [4]	
H205 [1]	6	110	–	226	350	Ferraz Shawmut HSJ350 [4]	8,400
		–	90	192	350	Ferraz Shawmut HSJ350 [4]	
H260 [1]	6	132	–	298	400	Ferraz Shawmut HSJ400 [4]	8,400
		–	110	226	400	Ferraz Shawmut HSJ400 [4]	

(1) Also applies to "P" voltage class. Fuses must be applied in the (+) leg and (-) leg of the DC Common Bus.

(2) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes;Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 5 - PowerFlex 700 Drives — Frames 7…10

Drive Cat. No. 20B…	Frame	kW Rating		DC Input Rating		Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	kW	Amps	Catalog No.	
P292	7	160	–	342	185	630	Bussmann 170M6608 (3)	15,000
		–	150	309	166	630	Bussmann 170M6608 (3)	
P325	7	180	–	381	206	800	Bussmann 170M6612 (3)	15,000
		–	180	381	206	800	Bussmann 170M6612 (3)	
P365	8	200	–	428	231	800	Bussmann 170M6612 (3)	20,700
		–	180	381	206	800	Bussmann 170M6612 (3)	
P415	8	240	–	487	262	800	Bussmann 170M6612 (3)	20,700
		–	200	428	231	800	Bussmann 170M6612 (3)	
P481	8	280	–	564	304	900	Bussmann 170M6613 (3)	20,700
		–	240	487	262	900	Bussmann 170M6613 (3)	
P535	8	300	–	627	338	1000	Bussmann 170M6614 (3)	20,700
		–	280	564	304	1000	Bussmann 170M6614 (3)	
P600	8	350	–	703	379	1200 (1)	Bussmann 170M6616 (3)	20,700
		–	300	627	338	1200 (1)	Bussmann 170M6616 (3)	
P730	9	400	–	855	461	1400 (2)	Bussmann 170M6617 (3)	20,700
		–	350	703	379	1400	Bussmann 170M6617 (3)	
H875 No Precharge	10	500	–	1025	553	2 x 800	Bussmann 170M6612 (3)	29,900
		–	400	820	443	2 x 800	Bussmann 170M6612 (3)	

(1) Two 630A Bussmann 170M6608 fuses can also be used.
(2) Two 700A Bussmann 170M6611 fuses can also be used.
(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

Table 6 - PowerFlex 750-Series Drives — Frames 2…7

Drive Cat. No. 20F…/20G…	Frame	kW Rating		DC Input Rating		Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	kW	Amps	Catalog No.		
C015	2	7.5	—	17.0	9.2	25	HSJ25 (1)	705	176
		—	5.5	12.6	6.8	20	HSJ20 (1)		
C022	2	11	—	24.6	13.3	40	HSJ40 (1)	1000	250
		—	7.5	17.0	9.2	25	HSJ25 (1)		
C030	3	15	—	33.6	18.1	50	HSJ50 (1)	1230	308
		—	11	24.6	13.3	40	HSJ40 (1)		
C037	3	18.5	—	41.4	22.3	70	HSJ70 (1)	1500	375
		—	15	33.6	18.1	50	HSJ50 (1)		
C043	3	22	—	48.1	26.0	90	HSJ90 (1)	1800	450
		—	18.5	41.4	22.3	70	HSJ70 (1)		
C060	4	30	—	67.1	36.2	100	HSJ100 (1)	2400	600
		—	22	48.1	26.0	90	HSJ90 (1)		
C072	4	37	—	82.4	44.5	125	HSJ125 (1)	3000	750
		—	30	67.1	36.2	100	HSJ100 (1)		
C085	5	45	—	97.3	52.5	150	HSJ150 (1)	3600	900
		—	37	82.4	44.5	125	HSJ125 (1)		
C104	5	55	—	120.2	64.9	175	HSJ175 (1)	4500	1125
		—	45	97.3	52.5	150	HSJ150 (1)		
C140	6	75	—	160.3	86.5	250	HSJ250 (1)	4600	1150
		—	55	120.2	64.9	175	HSJ175 (1)		
C170	6	90	—	194.6	105.1	350	HSJ350 (1)	9200	2300
		—	75	160.3	86.5	250	HSJ250 (1)		
C205	6	110	—	234.7	126.7	350	HSJ350 (1)	9200	2300
		—	90	194.6	105.1	350	HSJ350 (1)		
C260	6	132	—	297.7	160.7	400	HSJ400 (1)	9200	2300
		—	110	234.7	126.7	350	HSJ350 (1)		
C302	7	160	—	345.7	186.7	630	Bussman 170M6608 (2)	13,800	3450
		—	132	297.7	160.7	400	HSJ400 (1)		
C367	7	200	—	420.2	226.9	800	Bussman 170M6612 (2)	13,800	3450
		—	160	345.7	186.7	630	Bussman 170M6608 (2)		
C456	7	250	—	522.0	281.9	900	Bussman 170M6613 (2)	18,400	4600
		—	200	420.2	226.9	800	Bussman 170M6612 (2)		

(1) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

(2) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

Table 7 - PowerFlex 700H/700S Drives – Frames 9…14

Drive Cat. No. 20C… / 20D…	Frame	kW Rating		DC Input Rating	Bussmann Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
H261	9	132	–	307	500	170M6608 (1)	6,600	0
		–	110	241	500	170M6608 (1)		
H300	9	160	–	353	630	170M6610 (1)	6,600	0
		–	132	288	630	170M6610 (1)		
H385	10	200	–	453	700	170M6611 (1)	9,900	26,400
		–	160	353	700	170M6611 (1)		
H460	10	250	–	541	900	170M6613 (1)	9,900	26,400
		–	200	453	900	170M6613 (1)		
H500	10	250	–	589	500 (2 per phase)	170M6608 (1)	9,900	26,400
		–	250	494	500 (2 per phase)	170M6608 (1)		
H590	11	315	–	695	550 (2 per phase)	170M6609 (1)	14,850	21,450
		–	250	612	550 (2 per phase)	170M6609 (1)		
H650	11	355	–	765	630 (2 per phase)	170M6610 (1)	14,850	21,450
		–	315	695	630 (2 per phase)	170M6610 (1)		
H730	11	400	–	859	700 (2 per phase)	170M6611 (1)	14,850	21,450
		–	355	765	700 (2 per phase)	170M6611 (1)		
H820	12	450	–	965	700 (2 per phase)	170M6611 (1)	19,800	16,500
		–	400	859	700 (2 per phase)	170M6611 (1)		
H920	12	500	–	1083	550 (3 per phase)	170M6609 (1)	19,800	16,500
		–	450	965	550 (3 per phase)	170M6609 (1)		
H1K0	12	560	–	1213	630 (3 per phase)	170M6610 (1)	19,800	16,500
		–	500	1083	630 (3 per phase)	170M6610 (1)		
H1K1	13	630	–	1354	2400	170M7107 (1)	29,700 (2)	0
		–	560	1213	2400	170M7107 (1)		
H1K3	13	710	–	1530	2400	170M7107 (1)	29,700 (2)	0
		–	630	1354	2400	170M7107 (1)		
H1K4	13	800	–	1707	2400	170M7107 (1)	29,700 (2)	0
		–	710	1413	2400	170M7107 (1)		
H1K7	14	1000	–	2084	–	170M8610 (1)	50,400 (3)	0
		–	900	1883	–	170M8610 (1)		
H2K1	14	1200	–	2531	–	170M8610 (1)	50,400 (3)	0
		–	1100	2284	–	170M8610 (1)		
H2K7	14	1600	–	3178	–	170M8610 (1)	50,400 (3)	0
		–	1300	2708	–	170M8610 (1)		

(1) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) This listed capacitance is for Frame 13 Series B DC fed drives. For Frame 13 Series A DC fed drives, the capacitance is 50,400 µF. For Frame 13 Series B AC fed drives, the capacitance is 36,300 µF.

(3) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 72,600 µF.

Table 8 - PowerFlex 700L Drives — Frames 2, 3A, and 3B

Drive Cat. No. 20L…	Frame	kW Rating		DC Input Rating	Bussmann Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
C360	2	200	150	N/A (1)	N/A (1)	N/A (1)	13,500	21,850
C650	3A	370	270	1250 (2)	2000	170M6621 (3) (4)	16,200	19,150 (6)
C1K2	3B	715	525	1250	2000	170M6621 (3) (4)	34,400 (5)	38,301 (6)

(1) The PowerFlex 700L Frame 2 is not available as a DC input inverter.
(2) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.
(3) Two 1000A Bussmann 170M6614 fuses per phase can also be used.
(4) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(5) This 34,400 µF is the drive DC bus capacitance for a complete Frame 3B drive. For a Frame 3B common bus inverter, the bus capacitance is 16,200 µF.
(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

650 Volt DC Input Fuses

Table 9 - PowerFlex 40P Drives

Drive Cat. No. 22D…	HP Rating	DC Input Amps	Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)
			Amps	Catalog No.	
D1P4	0.5	1.3	3	Bussmann JKS-3 (1)	90
D2P3	1	2.1	6	Bussmann JKS-6 (1)	135
D4P0	2	3.6	8	Bussmann JKS-8 (1)	235
D6P0	3	5.4	15	Ferraz Shawmut HSJ15 (2)	280
D010	5	10.6	25	Ferraz Shawmut HSJ25 (2)	600
D012	7.5	12.1	25	Ferraz Shawmut HSJ25 (2)	705
D017	10	17.8	40	Ferraz Shawmut HSJ40 (2)	940
D024	15	25.4	50	Ferraz Shawmut HSJ50 (2)	1,120

(1) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 10 - PowerFlex 700/700S Drives — Frames 0…6

Drive Cat. No. 20B… / 20D…	Frame	HP Rating		DC Input Ratings	Non-Time Delay Fuse [2]		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.	
D1P1	0	0.5	0.33	1.0	3	Bussmann JKS-3 [3]	110
D2P1	0/1	1	0.75	1.9	6	Bussmann JKS-6 [3]	110
D3P4	0/1	2	1.5	3.0	6	Bussmann JKS-6 [3]	165
D5P0	0/1	3	2	4.5	10	Bussmann JKS-10 [3]	280
D8P0	0/1	5	3	8.1	15	Ferraz Shawmut HSJ15 [4]	330
D011	0/1	7.5	5	11.1	20	Ferraz Shawmut HSJ20 [4]	560
D014	1	10	7.5	14.6	30	Ferraz Shawmut HSJ30 [4]	680
D022	1	15	10	23.3	40	Ferraz Shawmut HSJ40 [4]	1,000
D027	2	20	15	28.9	50	Ferraz Shawmut HSJ50 [4]	1,200
D034	2	25	20	36.4	60	Ferraz Shawmut HSJ60 [4]	1,500
D040	3	30	25	42.9	80	Ferraz Shawmut HSJ80 [4]	1,800
D052	3	40	30	55.7	90	Ferraz Shawmut HSJ90 [4]	2,400
D065	3	50	40	69.6	100	Ferraz Shawmut HSJ100 [4]	3,000
D077	4	60	50	84.5	150	Ferraz Shawmut HSJ150 [4]	3,500
J096 [1]	5	75	–	105.3	175	Ferraz Shawmut HSJ175 [4]	4,500
		–	60	84.5	175	Ferraz Shawmut HSJ175 [4]	
J125 [1]	5	100	–	137.1	200	Ferraz Shawmut HSJ200 [4]	6,000
		–	75	105.3	200	Ferraz Shawmut HSJ200 [4]	
J140 [1]	5	100	–	137	250	Ferraz Shawmut HSJ250 [4]	6,000
		–	75	105.3	250	Ferraz Shawmut HSJ250 [4]	
J156 [1]	6	125	–	171	300	Ferraz Shawmut HSJ300 [4]	6,900
		–	100	137.1	300	Ferraz Shawmut HSJ300 [4]	
J180 [1]	6	150	–	198	400	Ferraz Shawmut HSJ400 [4]	8,400
		–	125	171.2	400	Ferraz Shawmut HSJ400 [4]	
J248 [1]	6	200	–	272	400	Ferraz Shawmut HSJ400 [4]	8,400
		–	150	198	400	Ferraz Shawmut HSJ400 [4]	

(1) Also applies to "R" voltage class. Fuses must be applied in the (+) leg and (-) leg of the DC Common Bus.

(2) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes;Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 11 - PowerFlex 700 Drives — Frames 7…10

Drive Cat. No. 20B…	Frame	kW Rating		DC Input Rating		Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	kW	Amps	Catalog No.	
R292	7	250	–	328	212	630	Bussmann 170M6608 (3)	15,000
		–	200	296	191	630	Bussmann 170M6608 (3)	
R325	7	250	–	365	236	800	Bussmann 170M6612 (3)	15,000
		–	250	365	236	800	Bussmann 170M6612 (3)	
R365	8	300	–	410	265	800	Bussmann 170M6612 (3)	20,700
		–	250	365	236	800	Bussmann 170M6612 (3)	
R415	8	350	–	466	302	800	Bussmann 170M6612 (3)	20,700
		–	300	410	265	800	Bussmann 170M6612 (3)	
R481	8	400	–	540	350	900	Bussmann 170M6613 (3)	20,700
		–	350	466	302	900	Bussmann 170M6613 (3)	
R535	8	450	–	601	389	1000	Bussmann 170M6614 (3)	20,700
		–	400	540	350	1000	Bussmann 170M6614 (3)	
R600	8	500	–	674	436	1200 (1)	Bussmann 170M6616 (3)	20,700
		–	450	601	389	1200 (1)	Bussmann 170M6616 (3)	
R730	9	600	–	820	533	1400 (2)	Bussmann 170M6617 (3)	20,700
		–	500	674	436	1400	Bussmann 170M6617 (3)	
J875 No precharge	10	700	–	983	636	2 x 800	Bussmann 170M6612 (3)	29,900
		–	600	786	509	2 x 800	Bussmann 170M6612 (3)	

(1) Two 630A Bussmann 170M6608 fuses can also be used.
(2) Two 700A Bussmann 170M6611 fuses can also be used.
(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

Table 12 - PowerFlex 700H/700S Drives — Frames 9…14

Drive Cat. No. 20C… / 20D…	Frame	HP Rating		DC Input Rating	Bussmann Style Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
J261	9	200	–	294	500	170M6608 (1)	6,600	0
		–	150	231	500	170M6608 (1)		
J300	9	250	–	338	630	170M6610 (1)	6,600	0
		–	200	294	630	170M6610 (1)		
J385	10	300	–	434	700	170M6611 (1)	9,900	26,400
		–	250	338	700	170M6611 (1)		
J460	10	350	–	519	900	170M6613 (1)	9,900	26,400
		–	300	434	900	170M6613 (1)		
J500	10	450	–	564	500 (2 per phase)	170M6608 (1)	9,900	26,400
		–	350	474	500 (2 per phase)	170M6608 (1)		
J590	11	500	–	666	550 (2 per phase)	170M6609 (1)	14,850	21,450
		–	450	587	550 (2 per phase)	170M6609 (1)		
J650	11	500	–	733	630 (2 per phase)	170M6610 (1)	14,850	21,450
		–	500	666	630 (2 per phase)	170M6610 (1)		
J730	11	600	–	824	700 (2 per phase)	170M6611 (1)	14,850	21,450
		–	500	733	700 (2 per phase)	170M6611 (1)		
J820	12	700	–	925	700 (2 per phase)	170M6611 (1)	19,800	16,500
		–	600	824	700 (2 per phase)	170M6611 (1)		
J920	12	800	–	1038	550 (3 per phase)	170M6609 (1)	19,800	16,500
		–	700	925	550 (3 per phase)	170M6609 (1)		
J1K0	12	900	–	1162	630 (3 per phase)	170M6610 (1)	19,800	16,500
		–	800	1038	630 (3 per phase)	170M6610 (1)		
J1K1	13	1000	–	1297	2400	170M7107 (1)	29,700 (2)	0
		–	900	1162	2400	170M7107 (1)		
J1K3	13	1200	–	1467	2400	170M7107 (1)	29,700 (2)	0
		–	1000	1297	2400	170M7107 (1)		
J1K4	13	1250	–	1636	2400	170M7107 (1)	29,700 (2)	0
		–	1000	1354	2400	170M7107 (1)		
J1K7	14	1500	–	1997	–	170M8610 (1)	50,400 (3)	0
		–	1400	1805	–	170M8610 (1)		
J2K1	14	1900	–	2425	–	170M8610 (1)	50,400 (3)	0
		–	1700	2189	–	170M8610 (1)		
J2K7	14	2300	–	3046	–	170M8610 (1)	50,400 (3)	0
		–	2000	2595	–	170M8610 (1)		

(1) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) This listed capacitance is for Frame 13 Series B DC fed drives. For Frame 13 Series A DC fed drives, the capacitance is 50,400 µF. For Frame 13 Series B AC fed drives, the capacitance is 36,300 µF.

(3) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 72,600 µF.

Table 13 - PowerFlex 700L Drives — Frames 2, 3A, and 3B

Drive Cat. No. 20L…	Frame	HP Rating		DC Input Rating	Bussmann Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
D360	2	300	235	N/A (1)	N/A (1)	N/A (1)	13,500	11,049
D650	3A	600	440	1250 (2)	2000	170M6621 (3) (4)	16,200	8,349 (6)
D1K2	3B	1150	845	1250	2000	170M6621 (3) (4)	34,400 (5)	16,698 (6)

(1) The PowerFlex 700L Frame 2 is not available as a DC input inverter.
(2) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.
(3) Two 1000A Bussmann 170M6614 fuses per phase can also be used.
(4) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(5) This 34,400 µF is the drive DC bus capacitance for a complete Frame 3B drive. The Frame 3B DC input inverter bus capacitance is 16,200 µF.
(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

Table 14 - PowerFlex 750-Series Drives — Frames 2…7

Drive Cat. No. 20F…/20G…	Frame	HP Rating		DC Input Rating		Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	kW	Amps	Catalog No.		
D014	2	10	—	14.7	9.5	30	HSJ30 (1)	705	176
		—	7.5	11.1	7.2	20	HSJ20 (1)		
D022	2	15	—	23.3	15.1	40	HSJ40 (1)	1000	250
		—	10	14.7	9.5	30	HSJ30 (1)		
D027	3	20	—	28.9	18.8	50	HSJ50 (1)	1230	308
		—	15	23.3	15.1	40	HSJ40 (1)		
D034	3	25	—	36.4	23.6	60	HSJ60 (1)	1500	375
		—	20	28.9	18.8	50	HSJ50 (1)		
D040	3	30	—	42.9	27.8	80	HSJ80 (1)	1800	450
		—	25	36.4	23.6	60	HSJ60 (1)		
D052	4	40	—	55.7	36.1	90	HSJ90 (1)	2400	600
		—	30	42.9	27.8	80	HSJ80 (1)		
D065	4	50	—	69.7	45.1	100	HSJ100 (1)	3000	750
		—	40	55.7	36.1	90	HSJ90 (1)		
D077	5	60	—	84.5	54.7	150	HSJ150 (1)	3600	900
		—	50	69.7	45.1	100	HSJ100 (1)		
D096	5	75	—	105.3	68.3	175	HSJ175 (1)	4500	1125
		—	60	84.5	54.7	150	HSJ150 (1)		
D125	6	100	—	137.1	88.9	200	HSJ200 (1)	4600	1150
		—	75	105.3	68.3	175	HSJ175 (1)		
D156	6	125	—	171.2	110.9	300	HSJ300 (1)	9200	2300
		—	100	137.1	88.9	200	HSJ200 (1)		
D186	6	150	—	204.1	132.2	400	HSJ400 (1)	9200	2300
		—	125	171.2	110.9	300	HSJ300 (1)		
D248	6	200	—	272.1	176.3	400	HSJ400 (1)	9200	2300
		—	150	204.1	132.2	400	HSJ400 (1)		
D302	7	250	—	331.3	214.7	630	Bussman 170M6608 (2)	13,800	3450
		—	200	272.1	176.3	400	HSJ400 (1)		
D361	7	300	—	396.1	256.6	800	Bussman 170M6612 (2)	13,800	3450
		—	250	331.3	214.7	630	Bussman 170M6608 (2)		
D415	7	350	—	455.3	295.0	900	Bussman 170M6613 (2)	18,400	4600
		—	300	396.1	256.6	800	Bussman 170M6612 (2)		

(1) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

(2) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

810 Volt DC Input Fuses

Table 15 - PowerFlex 40P Drives

Drive Cat. No. 22D…	HP Rating	DC Input Amps	Non-Time Delay Fuse		Drive DC Bus Capacitance (µF)
			Amps	Catalog No.	
E1P7	1	1.5	6	Bussmann JKS-6 (1)	75
E3P0	2	2.7	6	Bussmann JKS-6 (1)	110
E4P2	3	3.8	10	Bussmann JKS-10 (1)	135
E6P6	5	6.7	15	Ferraz Shawmut HSJ15 (2)	280
E9P9	7.5	10.0	20	Ferraz Shawmut HSJ20 (2)	330
E012	10	12.8	25	Ferraz Shawmut HSJ25 (2)	440
E019	15	20.1	40	Ferraz Shawmut HSJ40 (2)	440

(1) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 16 - PowerFlex 700/700S Drives — Frames 1…6

Drive Cat. No. 20B… / 20D…	Frame	HP Rating		DC Input Rating	Non-Time Delay Fuse(1)		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.	
E1P7	0/1	1	0.75	1.5	3	Bussmann JKS-3 (2)	195
E2P7	0/1	2	1.5	2.4	6	Bussmann JKS-6 (2)	195
E3P9	0/1	3	2	3.5	6	Bussmann JKS-6 (2)	195
E6P1	0/1	5	3	6.2	10	Bussmann JKS-10 (2)	390
E9P0	0/1	7.5	5	9.1	15	Ferraz Shawmut HSJ15 (3)	390
E011	1	10	7.5	11.5	20	Ferraz Shawmut HSJ20 (3)	560
E017	1	15	10	18	30	Ferraz Shawmut HSJ30 (3)	560
E022	2	20	15	23.6	40	Ferraz Shawmut HSJ40 (3)	1,000
E027	2	25	20	29	50	Ferraz Shawmut HSJ50 (3)	1,200
E032	3	30	25	34.3	60	Ferraz Shawmut HSJ60 (3)	1,400
E041	3	40	30	43.9	70	Ferraz Shawmut HSJ70 (3)	1,800
E052	3	50	40	55.7	90	Ferraz Shawmut HSJ90 (3)	2,400
E062	4	60	50	68.0	125	Ferraz Shawmut HSJ125 (3)	2,400
T099	5	100	–	108.6	150	Ferraz Shawmut HSJ150 (3)	3,500
		–	75	84.5	150	Ferraz Shawmut HSJ150 (3)	
T144	6	150	–	158	200	Ferraz Shawmut HSJ200 (3)	5,000
		–	125	137.1	200	Ferraz Shawmut HSJ200 (3)	

(1) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes;Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(2) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 17 - PowerFlex 700H/700S Drives — Frames 9…14

Drive Cat. No. 20C… / 20D…	Frame	HP Rating		DC Input Rating	Bussmann Style Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
K170	9	150	–	192	400	170M5608 (2)	3,600	0
		–	150	162	400	170M5608 (2)		
K208	9	200	–	235	450	170M5609 (2)	3,600	0
		–	150	192	450	170M5609 (2)		
K261	10	250	–	294	450	170M5609 (2)	7,467	19,333
		–	200	235	450	170M5609 (2)		
K325	10	350	–	367	550	170M6609 (2)	7,467	19,333
		–	250	294	550	170M6609 (2)		
K385	10	400	–	434	700	170M6611 (2)	7,467	19,333
		–	350	367	700	170M6611 (2)		
K416	10	450	–	469	800	170M6612 (2)	7,467	19,333
		–	350	367	800	170M6612 (2)		
K460	11	500	–	519	450 (2 per phase)	170M5609 (2)	11,200	15,600
		–	400	434	450 (2 per phase)	170M5609 (2)		
K502	11	500	–	566	500 (2 per phase)	170M6608 (2)	11,200	15,600
		–	500	519	500 (2 per phase)	170M6608 (2)		
K590	11	600	–	666	500 (2 per phase)	170M6608 (2)	11,200	15,600
		–	500	566	500 (2 per phase)	170M6608 (2)		
K650	12	700	–	733	500 (2 per phase)	170M6608 (2)	14,933	11,867
		–	650	666	500 (2 per phase)	170M6608 (2)		
K750	12	800	–	846	630 (2 per phase)	170M6610 (2)	14,933	11,867
		–	700	733	630 (2 per phase)	170M6610 (2)		
K820 (1)	12	900	–	925	630 (2 per phase)	170M6610 (2)	14,933	11,867
		–	700	733	630 (2 per phase)	170M6610 (2)		
K920	13	1000	–	1038	2400	170M7107 (2)	22,400 (3)	0
		–	900	925	2400	170M7107 (2)		
K1K0	13	1100	–	1162	2400	170M7107 (2)	22,400 (3)	0
		–	1000	1038	2400	170M7107 (2)		
K1K1	13	1300	–	1331	2400	170M7107 (2)	22,400 (3)	0
		–	1100	1162	2400	170M7107 (2)		
K1K5	14	1600	–	1692	-	170M8610 (2)	44,800 (4)	0
		–	1400	1467	-	170M8610 (2)		
K1K9	14	2000	–	2143	-	170M8610 (2)	44,800 (4)	0
		–	1600	1692	-	170M8610 (2)		
K2K2	14	2400	–	2538	-	170M8610 (2)	44,800 (4)	0
		–	2000	2143	-	170M8610 (2)		

(1) 20DK820 drives (ND) are only capable of producing 95% of starting torque under 10 Hz.

(2) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) This listed capacitance is for Frame 13 DC fed drives. For Frame 13 AC fed drives, the capacitance is 26,800 µF.

(4) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 53,600 µF.

Table 18 - PowerFlex 700L Drives — Frames 3A and 3B

Drive Cat. No. 20L…	Frame	HP Rating		DC Input Rating	Bussmann Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
E425	3A	465	345	850 (1)	1400	170M6701 (2) (3)	10,800	4,911 (6)
E800	3B	870	640	800	1250	170M6700 (3) (4)	21,600 (5)	9,823 (6)
E1K1	3B	1275	935	1175	900 (2 per phase)	170M6697 (3)	21,600 (5)	9,823 (6)

(1) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.
(2) Two 700A Bussmann 170M6695 fuses per phase can also be used.
(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(4) Two 630A Bussmann 170M6694 fuses per phase can also be used.
(5) This 21,600 µF is the drive DC bus capacitance for a complete Frame 3B drive. The Frame 3B DC input inverter bus capacitance is 10,800 µF.
(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

932 Volt DC Input Fuses

Table 19 - PowerFlex 700/700S Drives — Frames 5 and 6

Drive Cat. No. 20B… / 20D…	Frame	kW Rating		DC Input Rating	Non-Time Delay Fuse(1)		Drive DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.	
W098	5	90	–	92.3	160	Ferraz Shawmut HSJ160 (2)	3,500
		–	75	92.3	160	Ferraz Shawmut HSJ160 (2)	
W142	6	132	–	162.2	250	Ferraz Shawmut HSJ250 (2)	5,000
		–	110	134.9	250	Ferraz Shawmut HSJ250 (2)	

(1) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes;Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.
(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, etc. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

Table 20 - PowerFlex 700H/700S Drives — Frames 9…14

Drive Cat. No. 20C… / 20D…	Frame	kW Rating		DC Input Rating	Bussmann Style Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
M170	9	160	–	200	315	170M3746 (2)	3,600	0
		–	132	170	315	170M3746 (2)		
M208	9	200	–	245	400	170M5742 (2)	3,600	0
		–	160	200	400	170M5742 (2)		
M261	10	250	–	307	500	170M5744 (2)	7,467	19,333
		–	200	245	500	170M5744 (2)		
M325	10	315	–	383	630	170M5746 (2)	7,467	19,333
		–	250	307	630	170M5746 (2)		
M385	10	355	–	453	700	170M6745 (2)	7,467	19,333
		–	315	383	700	170M6745 (2)		
M416	10	400	–	490	700	170M6745 (2)	7,467	19,333
		–	315	383	700	170M6745 (2)		
M460	11	450	–	542	450 (2 per phase)	170M5743 (2)	11,200	15,600
		–	355	453	450 (2 per phase)	170M5743 (2)		
M502	11	500	–	591	500 (2 per phase)	170M5744 (2)	11,200	15,600
		–	400	542	500 (2 per phase)	170M5744 (2)		
M590	11	560	–	695	500 (2 per phase)	170M5744 (2)	11,200	15,600
		–	500	591	500 (2 per phase)	170M5744 (2)		
M650	12	630	–	765	550 (2 per phase)	170M5745 (2)	14,933	11,867
		–	560	695	550 (2 per phase)	170M5745 (2)		
M750	12	710	–	883	630 (2 per phase)	170M5746 (2)	14,933	11,867
		–	630	765	630 (2 per phase)	170M5746 (2)		
M820 (1)	12	800	–	965	630 (2 per phase)	170M5746 (2)	14,933	11,867
		–	630	765	630 (2 per phase)	170M5746 (2)		
M920	13	900	–	1038	2400	170M7107 (2)	22,400 (3)	0
		–	800	925	2400	170M7107 (2)		
M1K0	13	1000	–	1162	2400	170M7107 (2)	22,400 (3)	0
		–	900	1038	2400	170M7107 (2)		
M1K1	13	1100	–	1331	2400	170M7107 (2)	22,400 (3)	0
		–	1000	1162	2400	170M7107 (2)		
M1K5	14	1500	–	1766	–	170M8610 (2)	44,800 (4)	0
		–	1300	1530	–	170M8610 (2)		
M1K9	14	1800	–	2237	–	170M8610 (2)	44,800 (4)	0
		–	1500	1766	–	170M8610 (2)		
M2K2	14	2000	–	2649	–	170M8610 (2)	44,800 (4)	0
		–	1800	2237	–	170M8610 (2)		

(1) 20DM820 drives (ND) are only capable of producing 95% of starting torque under 10 Hz.

(2) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) This listed capacitance is for Frame 13 DC fed drives. For Frame 13 AC fed drives, the capacitance is 26,800 µF

(4) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 53,600 µF.

Table 21 - PowerFlex 700L Drives — Frames 3A and 3B

Drive Cat. No. 20L…	Frame	kW Rating		DC Input Rating	Bussmann Fuse		Drive DC Bus Capacitance (µF)	Maximum External DC Bus Capacitance (µF)
		ND	HD	Amps	Amps	Catalog No.		
F380	3A	355	260	760 (1)	1250	170M6700 (2) (3)	10,800	1,080 (6)
F705	3B	657	485	705	1100	170M6699 (3) (4)	21,600 (5)	2,160 (6)
F1K0	3B	980	720	1050	800 (2 per phase)	170M6696 (3)	21,600 (5)	2,160 (6)

(1) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.
(2) Two 630A Bussmann 170M6694 fuses per phase can also be used.
(3) See Fuse Certification and Test Data on page 117 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(4) Two 550A Bussmann 170M6693 fuses per phase can also be used.
(5) This 21,600 µF is the drive DC bus capacitance for a complete Frame 3B drive. The Frame 3B DC input inverter bus capacitance is 10,800 µF.
(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

Fuse Certification and Test Data

The following are copies of self-certification letters and test data for JKS and 170M fuses recommended in the previous tables in this Appendix for DC input fusing.

Configuration A indicates one fuse in the (+) leg and one fuse in the (-) leg of the DC bus.

JKS Fuses

Cooper Bussmann
P. O. Box 14460
St. Louis, MO 63178-4460

January 25, 2002

Sr. Project Engineer
Rockwell Automation
6400 West Enterprise Drive
P.O. Box 760
Mequon, WI 53092

Subject: DC Testing for JKS Fuses

Dear Mr.

Per Rockwell Automation's request, Bussmann has completed the DC testing for the JKS fuses and is please to present the attached information indicating successful "Self Certification DC Rating" on all subject fuses.

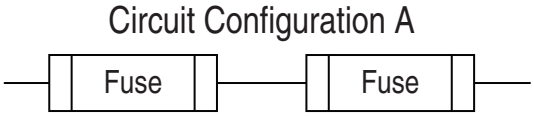
Bussmann tested fuses to the following parameters specified by Rockwell Automation:

Short Circuit Current	=	65 KA
Voltage	=	810V DC
Time Constant	≥	0.4 msec

Additional tests were performed for acceptability.

Short Circuit Current	≅	30 times fuse amperage
Voltage	=	810V DC
Time Constant	≥	0.4 msec.

The attached table identifies the fuses tested, the actual circuit parameters and the circuit configuration. In the attached table, the Interrupting Amps column specifies the fuses minimum and maximum amps the fuse will safely clear at 810V DC.



By way of this correspondence, Cooper Bussmann self-certifies the above fuses in end-user applications to the above parameters and the attached data sheet.

Should you have any questions regarding this correspondence, please contact me at the listed address and numbers below.

Regards,

Strategic OEM Accounts Manager
Cooper Bussmann

Cooper Bussmann JKS
DC Fuse Test for Rockwell Automation

Fuse	Results	Circuit Parameters				
		Interrupting Amps		Volts DC	Time Constant	Circuit Configuration
		Min	Max			
JKS-(3A-15A)	Acceptable	—	69.6 KA	810	2.78 ms	Configuration A
JKS-(3A-15A)	Acceptable	375 A	—	810	0.55 ms	Configuration A
JKS-(20A-30A)	Acceptable	—	69.6 KA	816	2.78 ms	Configuration A
JKS-(20A-30A)	Acceptable	920 A	—	812	0.4 ms	Configuration A
JKS-(35A-60A)	Acceptable	—	69.6 KA	816	2.78 ms	Configuration A
JKS-(35A-60A)	Acceptable	1820 A	—	812	0.5 ms	Configuration A
JKS-(70A-100A)	Acceptable	—	69.6 KA	816	2.78 ms	Configuration A
JKS-(70A-100A)	Acceptable	2950 A	—	812	0.86 ms	Configuration A
JKS-(110A-200A)	Acceptable	—	69.6 KA	816	2.78 ms	Configuration A
JKS-(110A-200A)	Acceptable	5960 A	—	810	3.34 ms	Configuration A
JKS-(225A-400A)	Acceptable	—	69.6 KA	816	2.78 ms	Configuration A
JKS-(225A-400A)	Acceptable	11.5 KA	—	812	2.92 ms	Configuration A
JKS-(450A-600A)	Acceptable	—	69.6 KA	816	2.78 ms	Configuration A
JKS-(450A-600A)	Acceptable	15.5 KA	—	810	0.4 ms	Configuration A

170M Fuses

Cooper Bussmann
P. O. Box 14460
St. Louis, MO 63178-4460

May 15, 2002

Sr. Project Engineer
Rockwell Automation
6400 West Enterprise Drive
P.O. Box 760
Mequon, WI 53092

Subject: DC Testing for 170M Fuses

Dear Mr.

Per Rockwell Automation's request, Bussmann has completed the DC testing for the 170M fuses and is please to present the attached information indicating successful "Self Certification DC Rating" on all subject fuses.

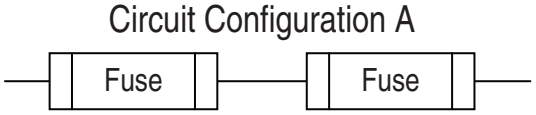
Bussmann tested fuses to the following parameters specified by Rockwell Automation:

Short Circuit Current	=	65 KA and 100 KA
Voltage	=	810V DC
Time Constant	≥	0.4 msec

Additional tests were performed for acceptability.

Short Circuit Current	≅	30 times fuse amperage as minimum current interrupting rating or as tested
Voltage	=	810V DC
Time Constant	≥	0.4 msec.

The attached table identifies the fuses tested, the actual circuit parameters and the circuit configuration. In the attached table, the Interrupting Amps column specifies the fuses minimum and maximum amps the fuse will safely clear at 810V DC.



By way of this correspondence, Cooper Bussmann self-certifies the above fuses in end-user applications to the above parameters and the attached data sheet.

Should you have any questions regarding this correspondence, please contact me at the listed address and numbers below.

Regards,

Strategic OEM Accounts Manager
Cooper Bussmann

Cooper Bussmann 170M
DC Fuse Test for Rockwell Automation

Fuse	Results	Circuit Parameters				
		Interrupting Amps		Volts DC	Time Constant	Circuit Configuration
		Min	Max			
170M6646	Acceptable	—	69.8 KA	812	2 ms	Configuration A
170M6646	Acceptable	10.2 KA	—	812	1.66 ms	Configuration A
170M6650	Acceptable	—	69.6 KA	812	2 ms	Configuration A
170M6650	Acceptable	21.1 KA	—	812	1.2 ms	Configuration A
170M7510		—	65 KA	810	2 ms	
170M7510		20 KA	—	810	2 ms	
170M6792		—	65 KA	810	2 ms	
170M6792		19 KA	—	810	2 ms	
170M6793		—	65 KA	810	2 ms	
170M6793		23 KA	—	810	2 ms	
170M6794		—	65 KA	810	2 ms	
170M6794		27.5 KA	—	810	2 ms	
170M6828		—	65 KA	810	2 ms	
170M6828		37 KA	—	810	2 ms	
170M6934	Acceptable	—	105.4 KA	810	1.8 ms	Configuration A
170M6934	Acceptable	45.2 KA	—	810	1.12 ms	Configuration A
170M7560		—	100 KA	810	2 ms	
170M7560		60 KA	—	810	2 ms	

Power Component Accessories

Back-to-Back Diodes (Shared AC/DC Configurations)

Considerations

Consider the following when selecting the Back-to-Back diodes:

- Back-to-Back diodes should be sized 125% of the drive's DC input Amps.
- Thermal impedance of panel to air.
- Ambient temperature
- Any thermal compound present between diodes and panel affecting thermal drop between diodes and panel
- Consult diode vendor for proper diode installation.

The listed Back-to-Back Diodes in Table 22 are offered by Semikron at: www.semikron.com

Table 22 - Back-to-Back Diodes for Shared AC/DC Bus Configurations

SEMIPACK			
Type	I_{FAF} @ T_{case} sin 180		Diode Size
	Amp	°C	
SKKD 15	15	82	0
SKKD 26	31	82	1
SKKD 46	45	87	1
SKKD 81	80	85	1
SKKD 100	100	85	1
SKKD 162	195	85	2
SKKD 260	260	85	3
SKKD 380	380	100	3
SKKD 700	700	100	5

Diode Sharing Modules

Consider the following when selecting Diode Sharing Modules for the Shared Regenerative Braking Configuration discussed in Chapter 12. The listed Diode Sharing Modules in Table 23 are offered by Bonitron at: www.bonitron.com

Table 23 - Bonitron M3345D Diode Sharing Modules

Nominal Drive HP		Maximum Regen Amps	Drive DC Bus Amps	Max. # of Drives	Model Number
230V AC	460V AC				
1.5	3	30	4	6	M3345D-04F6
3	5	30	10	3	M3345D-10H3
3	5	60	10	6	M3345D-10J6
10	20	90	30	3	M3345D-30H3
10	20	90	30	6	M3345D-30J6
20	40	90	60	3	M3345D-60L3
20	40	90	60	4	M3345D-60P4
20	40	90	60	6	M3345D-60P6
30	60	90	90	2	M3345D-90N2
30	60	90	90	3	M3345D-90N3
20	40	90	60	2	M3345D-60L2
50	100	120	200	2	M3345D-200P2

HF Filter (SCR Bus Supply)

When the 20S-RFC filter is used, the HF emission limits for class A, group 2* (EN55011) in the second environment (industrial supply network) according to the product standard EN61800-3 are met, and the Bus Supply fulfills CE conformity.

Description	Catalog No.
HF Filter, 690V	20S-RFC

Bus Supply Capacitors

SCR Bus Supply Minimum Capacitance

In order to commission and test the SCR bus supply, a minimum capacitance is required. If this minimum capacitance is not present, the bus supply internal fault detection circuit will interpret the condition as a DC bus short and stop pulse firing. This minimum capacitance may be provided by a drive as long as it remains connected to the DC bus, or by a capacitor bank of at least 110 µF per SCR Bus Supply.

Connecting High Power Drives and Low Power Drives on the DC Bus

The PowerFlex 700/700S Frame 0 through 5 drives (up to 205 Amp) include DC bus capacitors that are proportional to the drive power rating. When used in a

Common DC bus configuration, these capacitors are directly connected in parallel resulting in the DC bus ripple being shared proportionally to the power rating of the drives. PowerFlex 700/700S Frame 6 (248 Amp), PowerFlex 700 Frames 7...10, PowerFlex 700H/700S Frame 9 and up, and PowerFlex 700L drives have approximately half of the capacitance per Amp and, therefore, will absorb less of the common DC bus ripple current. When this combination is present, the use of a capacitor bank will be required. The additional required capacitance can be determined using this formula:

Additional Capacitance = 40 µF x DC Input Amps - Drive DC Bus Capacitance

The capacitor banks should be connected closest to the PowerFlex 700/700S Frame 6, PowerFlex 700 Frames 7...10, PowerFlex 700H/700S Frame 9 and up, or PowerFlex 700L drive for which the capacitor bank is being used.

RC Snubber Circuit

The specifications for the snubber are:

R = 10 ohm, 100 W, low inductance (less than 50 µH)
C = 20 µF, 2000V

Contact Bonitron for an RC snubber circuit at: www.bonitron.com

1336 REGEN Power Line Filters

Description	Part Number
460V, 48A, Open Style	1321-VB048FLT-AN
460V, 78A, Open Style	1321-VB078FLT-AN
460V, 180A, Open Style	1321-VB180FLT-AN

A 3% reactor is also required for use with the 1336 REGEN Power Line Filter. See the *1336 REGEN User Manual* for reactor selection.

Notes:

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, Online: 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 Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, 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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