Allen-Bradley

Kinetix 2000 Multi-axis Servo Drive

Catalog Numbers
2093-AC05-MP1, 2093-AC05-MP2, 2093-AC05-MP5

2093-AM01, 2093-AM02

2093-AMP1, 2093-AMP2, 2093-AMP5

2093-PRS1, 2093-PRS2, 2093-PRS3, 2093-PRS4, 2093-PRS5, 2093-PRS7, 2093-PRS8S

2093-ASP06

2093-PRF

User Manual

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://literature.rockwellautomation.com) 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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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.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
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
WARNING 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZ- 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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Chapter 5

Connecting the Kinetix 2000 Drive System

Appendix A

Specifications and Dimensions

Appendix B

Interconnect Diagrams

Appendix C

Upgrading Firmware

DC Common Bus Applications

Appendix D

Read this preface to familiarize yourself with the rest of the manual.

About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting your Kinetix 2000 drive, and system integration for your drive/motor combination with a Logix controller.

Who Should Use This Manual

This manual is intended for engineers or technicians directly involved in the installation and wiring of a Kinetix 2000 drive, and programmers directly involved in the operation, field maintenance, and integration of a Kinetix 2000 drive with a SERCOS interface.

If you do not have a basic understanding of the Kinetix 2000 drive, contact your local Rockwell Automation sales representative before using this product, for information on available training courses.

Conventions Used in This Manual

These conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps
- Numbered lists provide sequential steps or hierarchical information
- Acronyms for the Kinetix 2000 drive components, shown in the table below, are used throughout this manual.

Kinetix 2000 Component	Catalog Numbers	Acronym
Integrated Axis Module	2093-AC05-MP*x*	IAM
Axis Module (double width)	2093-AM0*x*	AM
Axis Module (single-width)	2093-AMP*x*	
Shunt Module	2093-ASP06	SM
Power Rail	2093-PRS*xx*	PR
Power Rail Slot Filler	2093-PRF	SF
Line Interface Module	2094-AL09, 2094-AL15S, 2094-AL25S, 2094-AL50S, 2094-AL75S, 2094-AL75S-C2	LIM

Additional Resources

The following documents contain additional information concerning related Allen-Bradley products.

Resource	Description
ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-6.5.6	For ControlFLASH information not specific to any drive family
3, 8 or 16-axis SERCOS interface Module Installation Instructions, publication 1756-IN572	ControlLogix SERCOS interface module installation instructions
Logix5000 Controllers Motion Instructions Reference Manual, publication 1756-RM007	The instructions needed to program a motion application
ControlLogix Motion Module Programming Manual, publication 1756-RM086	More detailed information on the use of ControlLogix motion features and application examples
ControlLogix Controllers User Manual, publication 1756-UM001	Information on installing, configuring, programming, and operating a ControlLogix system
CompactLogix SERCOS Interface Module Installation Instructions, publication 1768-IN005	Information on configuring and troubleshooting a CompactLogix motion module
16-axis PCI SERCOS interface Card Installation Instructions, publication 1784-IN041	SoftLogix SERCOS interface PCI card installation instructions
3, 8, or 16-axis PCI SERCOS Interface Card Installation Instructions, publication 1784-IN572	ControlLogix SERCOS interface module installation instructions
SoftLogix Motion Card Setup and Configuration Manual, publication 1784-UM003	Information on configuring and troubleshooting your SoftLogix PCI card
Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010	Information on proper handling, installing, testing, and troubleshooting fiber-optic cables
Kinetix 2000 Installation Instructions, publication 2093-IN001 (IAM and AM) 2093-IN002 (Shunt), 2093-IN003 (Power Rail), and 2093-IN004 (Slot Filler).	Information on installing the individual modules that comprise a Kinetix 2000 servo drive system
Line Interface Module Installation Instructions, publication 2094-IN005	Information on the installation and troubleshooting of your Bulletin 2094 Line Interface Module (LIM)
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise
EMC Noise Management DVD, publication GMC-SP004	
Kinetix Motion Control Selection Guide, publication GMC-SG001	Specifications, motor/servo-drive system combinations, and accessories for Kinetix motion control products
Rockwell Automation Configuration and Selection Tools website http://www.ab.com/e-tools	Online product selection and system configuration tools, including AutoCAD (DXF) drawings
Motion Analyzer, version 4.2 or later http://www.ab.com/motion/software/motion_analyzer.html	Drive and motor sizing with application analysis software
Rockwell Automation Product Certification website	For declarations of conformity (DoC) currently available from Rockwell Automation
Motion Modules in Logix5000 Control Systems User Manual, publication LOGIX-UM002	Information on configuring and troubleshooting your ControlLogix and CompactLogix SERCOS interface modules
National Electrical Code, published by National Fire Protection Association of Boston, MA.	An article on wire sizes and types for grounding electrical equipment

You can view or download publications at http://literature.rockwellautomation.com. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Start

Introduction

Use this chapter to become familiar with the Kinetix 2000 drive components. This chapter also reviews design and installation requirements for Kinetix 2000 drive systems.

About the Kinetix 2000 Drive System

The Kinetix 2000 multi-axis servo drive is designed to provide a Kinetix Integrated Motion solution for applications with output power requirements between 3...45 kW (4...49 A).

Kinetix 2000 Drive System Overview

Kinetix 2000 Component	Catalog Numbers	Description
Integrated Axis Module	2093-AC05-MP*x*	Integrated Axis Module (IAM) mounts on a Kinetix 2000 power rail, and is a 230V ac power converter and inverter. It is installed on a Kinetix 2000 power rail.
Axis Module	2093-AM*xx*	Axis Module (AM), is a shared 230V dc bus power inverter, that mounts on a Kinetix 2000 power rail. The AM must be used with an IAM.
	2093-AMP*x*	
Shunt Module	2093-ASP06	Shunt Module (SM), This module mounts on the Kinetix 2000power rail and provides additional shunting capability in regenerative applications.
Power Rail	2093-PRS*xx*	Power Rail (PR) consists of copper bus bars and a circuit board with connectors for each module. The power rail provides power and control signals from the converter section to adjacent inverters. The IAM, AM, SM, and SF modules mount to the power rail.
Power Rail Slot Filler	2093-PRF	Slot Filler (SF) is used when one or more slots on the Kinetix 2000 power rail are empty after all other power rail components are installed. One slot filler is required for each empty slot.
Logix Controller Platform	1756-L60M03SE, 1756-M*xx*SE, and 1768-M04SE modules, and the 1784-PM16SE PCI card	SERCOS interface module/PCI card serves as a link between the ControlLogix/CompactLogix/SoftLogix platform and Kinetix 2000 drive system. The communication link uses the IEC 61491 SErial Real-time COmmunication System (SERCOS) protocol over a fiber-optic cable.
RSLogix 5000 Software	9324-RLD300ENE	RSLogix 5000 software provides support for programming, commissioning, and maintaining the Logix family of controllers.
Servo Motors	MP-Series, TL-Series, and Y-Series	Compatible servo motors include the MP-Series (Low Inertia, Food Grade, and Stainless Steel) 230V motors; TL-Series motors; and Y-Series motors.
Integrated Linear Actuators	MP-Series	Compatible linear actuators include the MPAI-A*xxx* (Integrated Actuator) 230V actuators.
Cables	Motor Power, Feedback, and Brake cables	Motor power, feedback, and brake cables include integral molded, bayonet style, quick connect/quick-release connectors at the motor. Power and brake cables have flying leads on the drive end and straight connectors that connect to servo motors. Standard feedback cables have angled connectors (45°) on the drive end and straight connectors that connect to servo motors. Optional feedback cables have a straight connector on the motor end and flying leads that wire to a low-profile connector kit on the drive end.
	Fiber-optic cables	SERCOS fiber-optic cables are available in enclosure only, PVC, nylon, and glass with connectors at both ends.
Line Filters, ac	2090-XXLF-*xxxx*	Bulletin 2090-XXLF-*xxxx* single-phase and three-phase ac line filters are required to meet CE and available for use in 230V systems.
Line Interface Module	2094-AL09, 2094-AL15S, 2094-AL25S, 2094-AL50S, 2094-AL75S, 2094-AL75S-C2	Line Interface Module (LIM), contains the circuit breakers, ac line filter, power supplies, and contactor required for Kinetix 2000 operation. This module does not mount to the power rail. Alternatively, individual components may be purchased in place of a LIM.

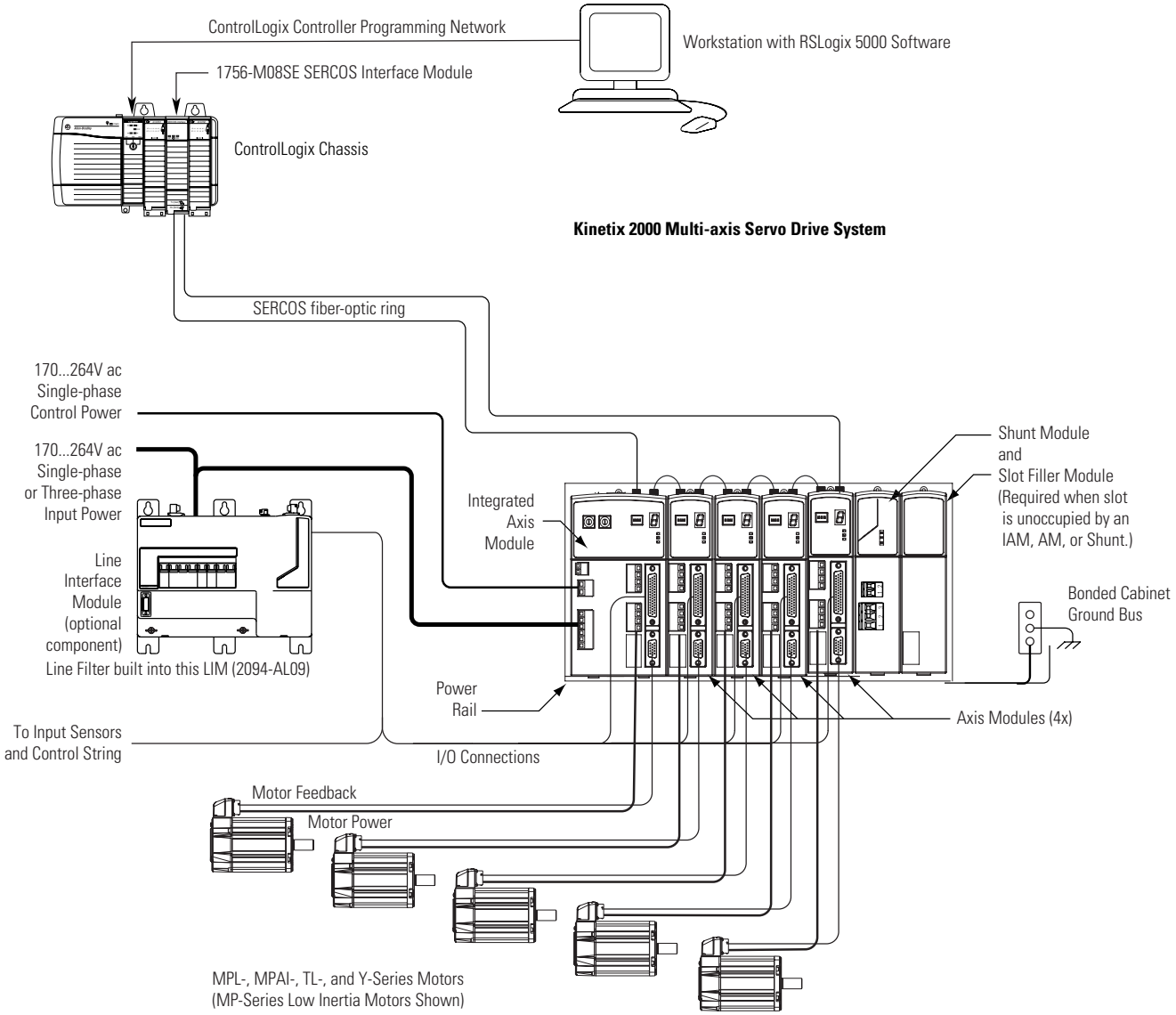
Typical Kinetix 2000 system installations include three-phase ac configurations, with and without the line interface module (LIM), and dc common bus configurations.

WARNING

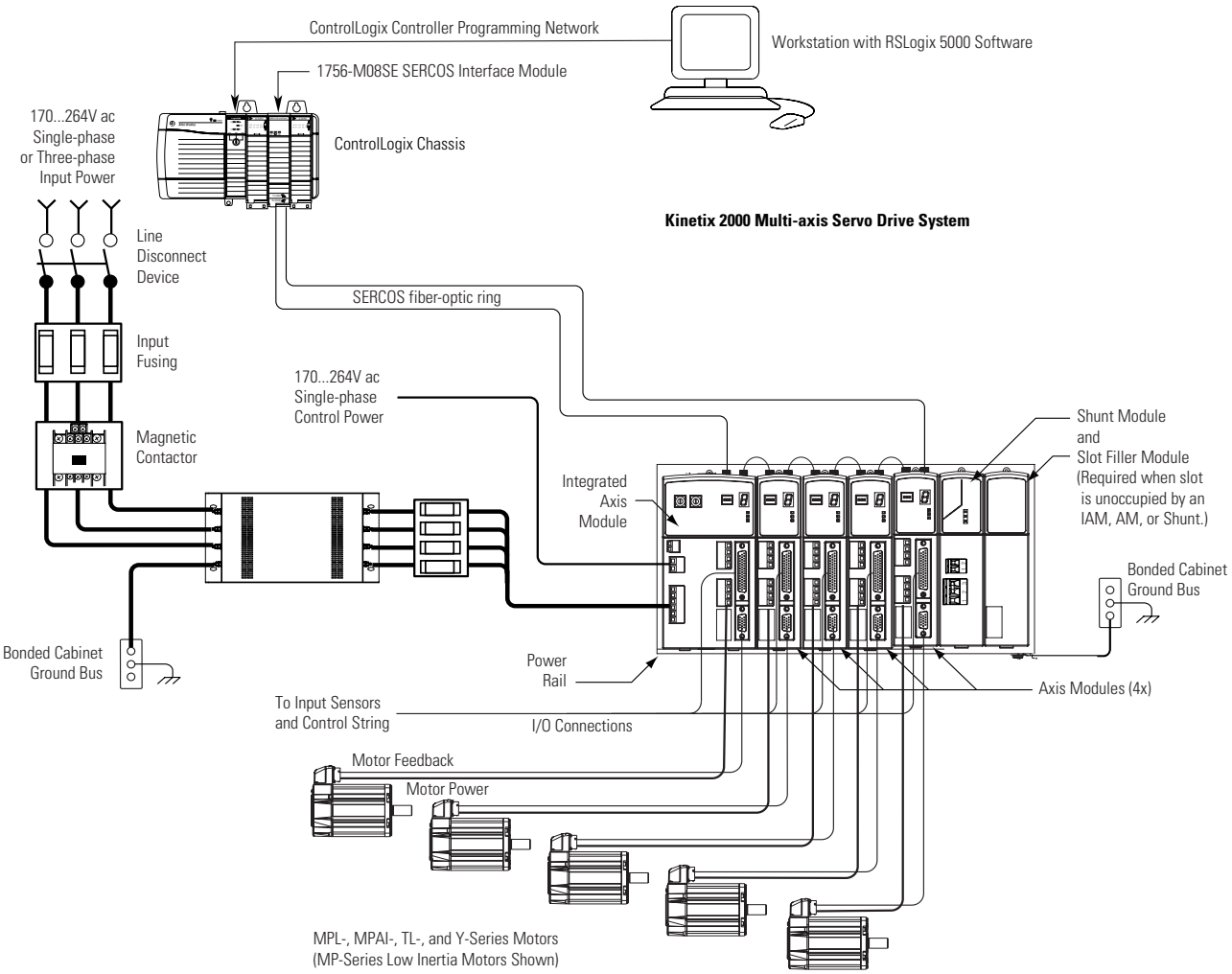
To avoid personal injury due to electrical shock, place a slot filler (catalog number 2093-PRF) in all empty slots on the power rail.

Any power rail connector without a module installed will disable the Kinetix 2000 three-phase power, however control power is still present.

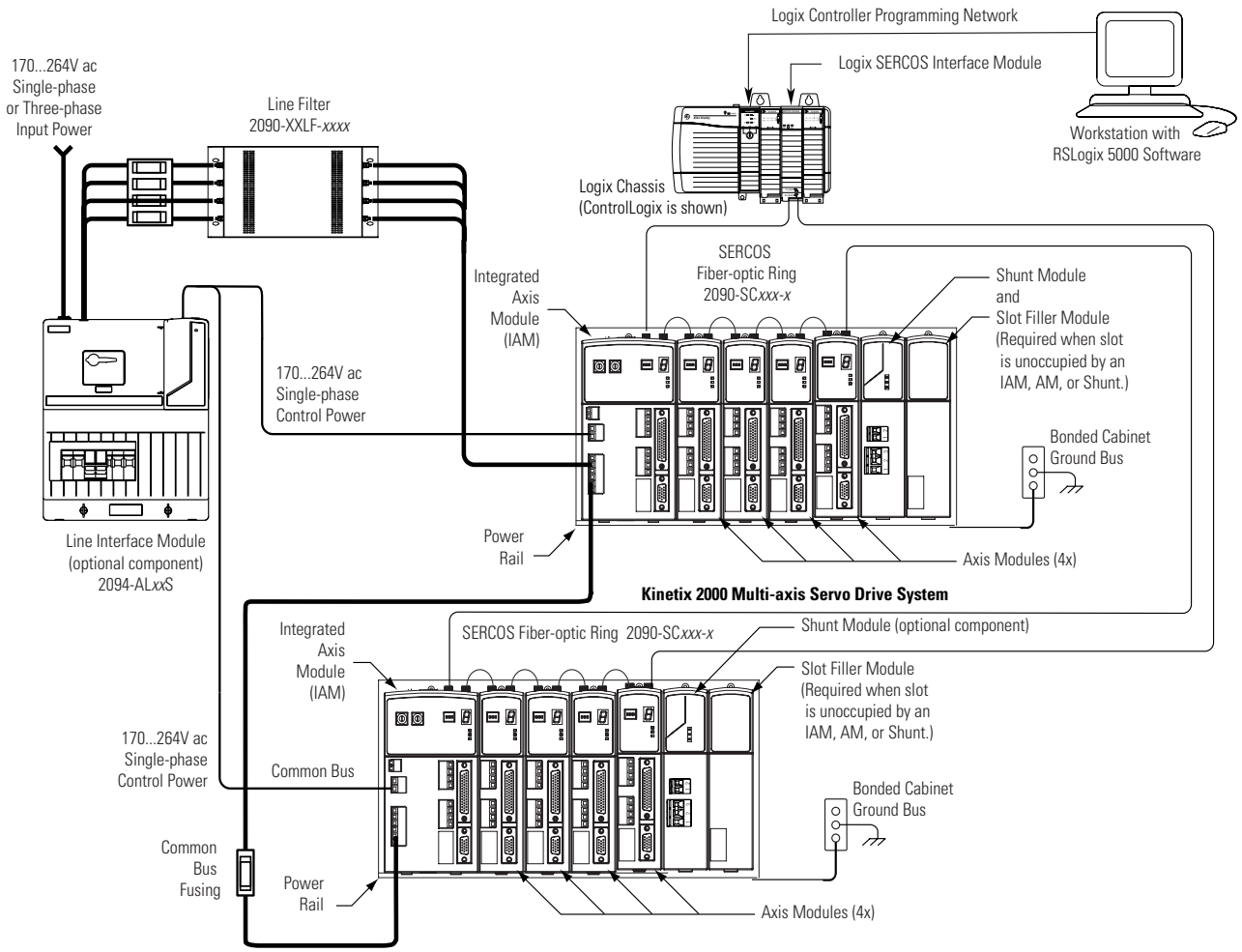
Typical Kinetix 2000 System Installation (with LIM)



Typical Kinetix 2000 System Installation (without LIM)



Typical DC Common Bus System Installation



In the example above, a leader IAM is connected to a follower IAM via the dc common bus. When planning your panel layout, you must calculate the total bus capacitance of your dc common bus system to correctly size the leader IAM to pre-charge the entire system. In RSLogix5000 software you identify the common bus follower (disabling its shunt capabilities), and in doing so require the leader IAM to control the entire common dc bus.

Refer to Appendix D, beginning on page 209, for more information.

IMPORTANT If total bus capacitance of your system exceeds the leader IAM pre-charge rating and input power is applied, the IAM seven-segment Fault Status LED indicator will display error code E90 (pre-charge timeout fault). To correct this condition, you must replace the leader IAM with a larger module or decrease the total bus capacitance by removing axis modules.

Catalog Number Explanation

Kinetix 2000 drive catalog numbers and descriptions are listed in the table below.

Kinetix 2000 Drive Catalog Numbers

Integrated Axis Modules (230V)	Catalog Number
Kinetix 2000, IAM, 230V, 3 kW [1] Converter, 1 A Inverter	2093-AC05-MP1
Kinetix 2000, IAM, 230V, 3 kW [1] Converter, 2 A Inverter	2093-AC05-MP2
Kinetix 2000, IAM, 230V, 3 kW [1] Converter, 3 A Inverter	2093-AC05-MP5
Axis Modules (230V)	
Kinetix 2000, AM, 230V, 1 A Inverter	2093-AMP1
Kinetix 2000, AM, 230V, 2 A Inverter	2093-AMP2
Kinetix 2000, AM, 230V, 3 A Inverter	2093-AMP5
Kinetix 2000, AM, 230V, 6 A Inverter	2093-AM01
Kinetix 2000, AM, 230V, 9 A Inverter	2093-AM02
Power Rails	
Kinetix 2000, Single-Axis Power Rail	2093-PRS1
Kinetix 2000, Two-Axis Power Rail	2093-PRS2
Kinetix 2000, Three-Axis Power Rail	2093-PRS3
Kinetix 2000, Four-Axis Power Rail	2093-PRS4
Kinetix 2000, Five-Axis Power Rail	2093-PRS5
Kinetix 2000, Seven-Axis Power Rail	2093-PRS7
Kinetix 2000, Eight-Axis Power Rail with Shunt or Slot Filler	2093-PRS8S
Shunt Module	
Kinetix 2000, SM, 230V, 50 W	2093-ASP06
Slot Filler	
Kinetix 2000, SF, Power Rail Slot Filler	2093-PRF

[1] Derated to 2 kW for single-phase operation.

Agency Compliance

If this product is installed within the European Union or EEC regions and has the CE mark, the following regulations apply.

ATTENTION

Meeting CE requires a grounded system, and the method of grounding the ac line filter and drive must match. Failure to do this renders the filter ineffective and may cause damage to the filter.

For grounding examples, refer to Determining Your Type of Input Power on page 63.

For more information on electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

CE Requirements (System without LIM)

To meet CE requirements when your Kinetix 2000 system does not include the line interface module (LIM), the following requirements apply.

- Install an ac line filter (2090-XXLF-*xxxx*) as close to the integrated axis module (IAM) as possible.
- Use 2090-series motor power cables or use connector kits.
- Combined motor power cable length for all axes on the same dc bus must not exceed 160 m (525 ft) with 230V systems. Drive-to-motor power cables must not exceed 30 m (98.5 ft).
- Use 2090-series motor feedback cables or use connector kits and properly terminate the feedback cable shield. Drive-to-motor feedback cables must not exceed 30 m (98.5 ft).
- Install the Kinetix 2000 system inside an enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.

Wiring instructions are available in Chapter 5 of this publication. Product catalog numbers are listed in the Kinetix Motion Control Selection Guide, publication GMC-SG001.

CE Requirements (System with LIM)

To meet CE requirements when your Kinetix 2000 system includes the line interface module (LIM), follow all the requirements as stated in CE Requirements (System without LIM), and these additional requirements as they apply to the ac line filter.

- Install the LIM (2094-AL09) as close to the integrated axis module (IAM) as possible.
- Install the LIM (2094-AL*xx*S, -or -XL75S-C*x*) with the line filter (2090-XXLF-*xxxx*) as close to the IAM as possible.

  When the LIM (2094-AL*xx*S, or -XL75S-C*x*) supports two IAMs, each IAM requires an ac line filter installed as close to the IAM as possible.

Planning the Kinetix 2000 Drive System Installation

Introduction

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 2000 drive components.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

System Design Guidelines

Use the information in this section when designing your enclosure and planning to mount your system components on the panel.

System Mounting Requirements

The following is general information for selecting an enclosure and mounting your system components within the panel.

- In order to comply with UL and CE requirements, the Kinetix 2000 system must be enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP55 such that they are not accessible to an operator or unskilled person. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The panel you install inside the enclosure for mounting your system components must be on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.

- Size the drive enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all drive components and other devices that radiate heat into the cabinet.
- Segregate input power wiring and motor power cables from control wiring and motor feedback cables as they leave the drive. Maintain this separation throughout the wire run.
- Use Rockwell Automation/Allen-Bradley shielded cable for power wiring and provide a grounded 360° clamp termination to the enclosure wall.
- Use high-frequency (HF) bonding techniques to connect the modules, enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

Refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, to better understand the concept of electrical noise reduction.

IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Transformer Selection

The integrated axis module (IAM) does not require an isolation transformer for three-phase input power. However, a transformer may be required to match the voltage requirements of the controller to the available service.

To size a transformer for the main ac power inputs, refer to the Circuit Breaker/Fuse Specifications on page 157 and Transformer Specifications for Control Power Input on page 159. Multiple power rails in a single cabinet require additional transformers or additional transformer capacity.

IMPORTANT If using an autotransformer, make sure that the phase to neutral/ground voltages do not exceed the input voltage ratings of the drive.

IMPORTANT Use a form factor of 1.5 for three-phase power (where form factor is used to compensate for transformer, drive module and motor losses, and to account for utilization in the intermittent operating area of the torque speed curve).

Example: Sizing a transformer to the voltage requirements of a 2093-AC05-MP5 Integrated Axis Module:
2093-AC05-MP5 = 3 kW continuous x 1.5 = 4.5 KVA transformer

Circuit Breaker/Fuse Selection

The Kinetix 2000 system utilizes internal short circuit output protection and is suitable for use on a circuit capable of delivering up to 100,000 Amperes, when protected by class CC, J, L, and R fuses. Circuit breakers with adequate widthstand and interrupt ratings, as defined in NEC 2002, article 110.9 and 110.10, are also permitted.

The Bulletin 140M product may be another acceptable means of protection with the Kinetix 2000 system. As with fuses and circuit breakers, you must make sure that the selected components are properly coordinated and meet applicable codes. When applying the 140M product, evaluation of the short circuit available current is critical and must be kept below the short circuit rating of the 140M product. As long as you do this review, and the conditions for use are met, the 140M product is appropriate for use with the Kinetix 2000 system.

The line interface module (LIM) contains different circuit protection based on type:

- 2094-AL09 contains supplementary protection device, 1492-CB (UL 508), and therefore class CC or J fuses with 5kA SCCR must be used on the line side of the 2094-AL09 LIM.
- 2094-AL15S, 2094-AL25S, 2094-AL50S, 2094-AL75S, and 2094-XL75S contain Bulletin 140U (UL 489) motor branch circuit protection.

Overcurrent protection must be adequately coordinated per NEC 2002, article 240.

In most cases, fuses selected to match the drive input current rating will meet the NEC requirements and provide the full drive capabilities. Dual element, time delay (slow acting) fuses should be used to avoid nuisance trips during the inrush current of power initialization.

Refer to Circuit Breaker/Fuse Specifications on page 157 for recommended circuit breakers and fuses.

Refer to Power Specifications on page 154 for input current and inrush current specifications for your IAM.

Enclosure Selection

The following example is provided to assist you in sizing an enclosure for your Kinetix 2000 system. The example system consists of the following components:

- Six-axis Kinetix 2000 servo drive system
- Line Interface Module (LIM)
- ControlLogix chassis and modules (controller)

Size the Kinetix 2000 servo drive and LIM and use the results to predict the amount of heat dissipated into the enclosure. You will also need heat

dissipation data from other equipment inside the enclosure (such as ControlLogix controller). Once the total amount of heat dissipation (in Watts) is known, the minimum enclosure size can be calculated.

Kinetix 2000 System Heat Dissipation Example

Enclosure Component	Description		Loading (1)	Heat Dissipation (1) Watts
2093-AC09-M02	Integrated axis module (IAM), 230V, three-phase	3 kW (converter section)	20%	7.0
		1 A (inverter section)	40%	33.6
2093-AM02	Axis module (AM), 230V, 9 A		60%	67.3
2093-AM02	Axis module (AM), 230V, 9 A		60%	67.3
2093-AM01	Axis module (AM),230V, 6 A		40%	46.7
2093-AM01	Axis module (AM), 230V, 6 A		40%	46.7
2093-AM01	Axis module (AM), 230V, 6 A		20%	46.7
2093-AL09	Line interface module (LIM), 230V, 6 kW, 6 A; 24V dc 3 A		100%	72.0
2093-PR6	Power rail, 230V, 6 axis		N/A	0.0
Total Kinetix 2000 system Wattage				387.3

(1) To determine heat dissipation specifications for the Kinetix 2000 components, refer to Power Dissipation Specifications on page 160.

ControlLogix System Heat Dissipation Example

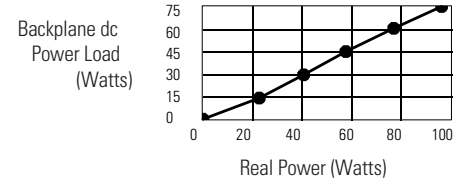
Enclosure Component	Description	Backplane Power Load (1) Watts	Heat Dissipation (1) Watts
1756-M08SE	8-axis SERCOS interface module	3.2	0
1756-L55M12	5555 ControlLogix processor	4.5	0
1756-IB16D	16 -point input module	0.84	5.8
1756-OB16D	16 -point output module	4.64	3.3
1756-ENBT	Ethernet communications module	4.0	0
Backplane total		17.18 (2)	N/A
1756-PB72	24V dc ControlLogix power supply	N/A	25 (2)
1756-A7	7-slot mounting chassis	N/A	N/A
Total ControlLogix system Wattage			34.1

(1) For ControlLogix module specifications, refer to the ControlLogix Selection Guide, publication 1756-SG001.

(2) Real power heat dissipation is determined by applying the backplane power load (17.18 W) to the graph below.

ControlLogix Real Power

1756-P B72
1756-P B75



For backplane power loading requirements of other ControlLogix power supplies, refer to the ControlLogix Selection Guide, publication 1756-SG001.

In this example, the amount of power dissipated inside the cabinet is the sum of the Kinetix 2000 system value (387 W) and the ControlLogix system value (34 W) for a total of 421 W.

With no active method of heat dissipation (such as fans or air conditioning) either of the following approximate equations can be used.

Metric	**Standard English**
$A = \frac{0.38Q}{1.8T - 1.1}$	$A = \frac{4.08Q}{T - 1.1}$
Where T is temperature difference between inside air and outside ambient (°C), Q is heat generated in enclosure (Watts), and A is enclosure surface area (m^2). The exterior surface of all six sides of an enclosure is calculated as	Where T is temperature difference between inside air and outside ambient (°F), Q is heat generated in enclosure (Watts), and A is enclosure surface area (ft^2). The exterior surface of all six sides of an enclosure is calculated as
A = 2dw + 2dh + 2wh	A = (2dw + 2dh + 2wh) / 144
Where d (depth), w (width), and h (height) are in meters.	Where d (depth), w (width), and h (height) are in inches.

The maximum ambient rating of the Kinetix 2000 system is 50 °C (122 °F) and if the maximum environmental temperature is 30 °C (86 °F) then Q=606 and T=20 in the equation below.

$$A = \frac{0.38(421)}{1.8(20) - 1.1} \approx 4.58m^2$$

In this example, the enclosure must have an exterior surface of 4.58 meters^2. If any portion of the enclosure is not able to transfer heat, it should not be included in the calculation.

Since the minimum cabinet depth to house the 230V drive (selected for this example) is 200 mm (7.9 in.), then the cabinet needs to be approximately 2000 mm (78.7 in.) high x 1000 mm (39.4 in.) wide x 200 mm (7.9 in.) deep.

$$2 \times (0.2 \times 1.0) + 2 \times (0.2 \times 1.0) + 2 \times (1.0 \times 2.0) = 4.8\ m^2$$
$$2 \times (7.9 \times 39.4) + 2 \times (7.9 \times 39.4) + 2 \times (39.4 \times 78.7) = 48\ ft.^2$$

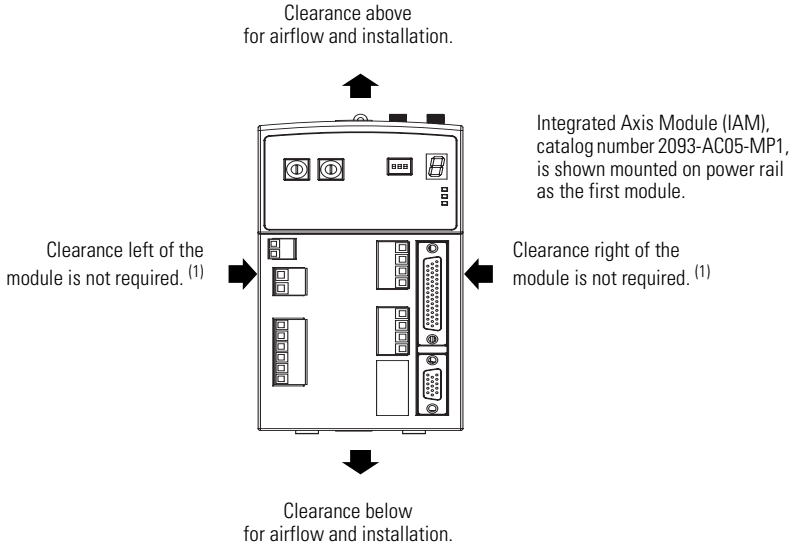
Because this cabinet size is considerably larger than what is necessary to house the system components, it may be more efficient to provide a means of cooling in a smaller cabinet. Contact your cabinet manufacturer for options available to cool your cabinet.

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 2000 system components.

IMPORTANT Mount the module in an upright position. Do not mount the module on its side.

Minimum Clearance Requirements



(1) The power rail, catalog number 2093-PRS*xx*, does not extend left of the first module or right of the last module.

Minimum Clearance Dimensions

Cat. No.	Clearance Above, Min	Clearance Below, Min	Cabinet Depth Clearance, Min (1)	
2093-AC05-MP1, 2093-AC05-MP2, 2093-AC05-MP5. 2093-AMP1, 2093-AMP2, 2093-AMP5, 2093-AM01, 2093-AM02	50.8 mm (2.0 in.)	50.8 mm (2.0 in.)	200 mm (7.9 in.)	If 15-pin connector kit, catalog number 2090-K2CK-D15M, is attached.
			235 mm (9.25 in.)	44-pin connector kit options include: • 2090-U3BK-D44xx connector kit (containing a 2090-U3BK-D44 terminal block and 2090-U3BK-D44xx cable) • 2090-U3BK-D44 terminal block and custom-built cable. • 2090-U3BK-D44 terminal block and flying lead cable.
2093-ASP06	305 mm (12.0 in.)	50.8 mm (2.0 in.)	200 mm (7.9 in.)	
2093-PRF	None	None	None	

(1) Additional clearance required to accommodate cable bend restrictions.

IMPORTANT Although clearance left and right of the power rail is not necessary for ventilation, additional clearance is required when mounted adjacent to noise sensitive equipment or clean wireways.

Refer to page 160 for power dissipation specifications.

Minimizing Electrical Noise

This section outlines best practices which minimize the possibility of noise-related failures as they apply specifically to Kinetix 2000 system installations.

For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Bonding Modules

Bonding is the practice of connecting metal chassis, assemblies, frames, shields, and enclosures to reduce the effects of electromagnetic interference (EMI).

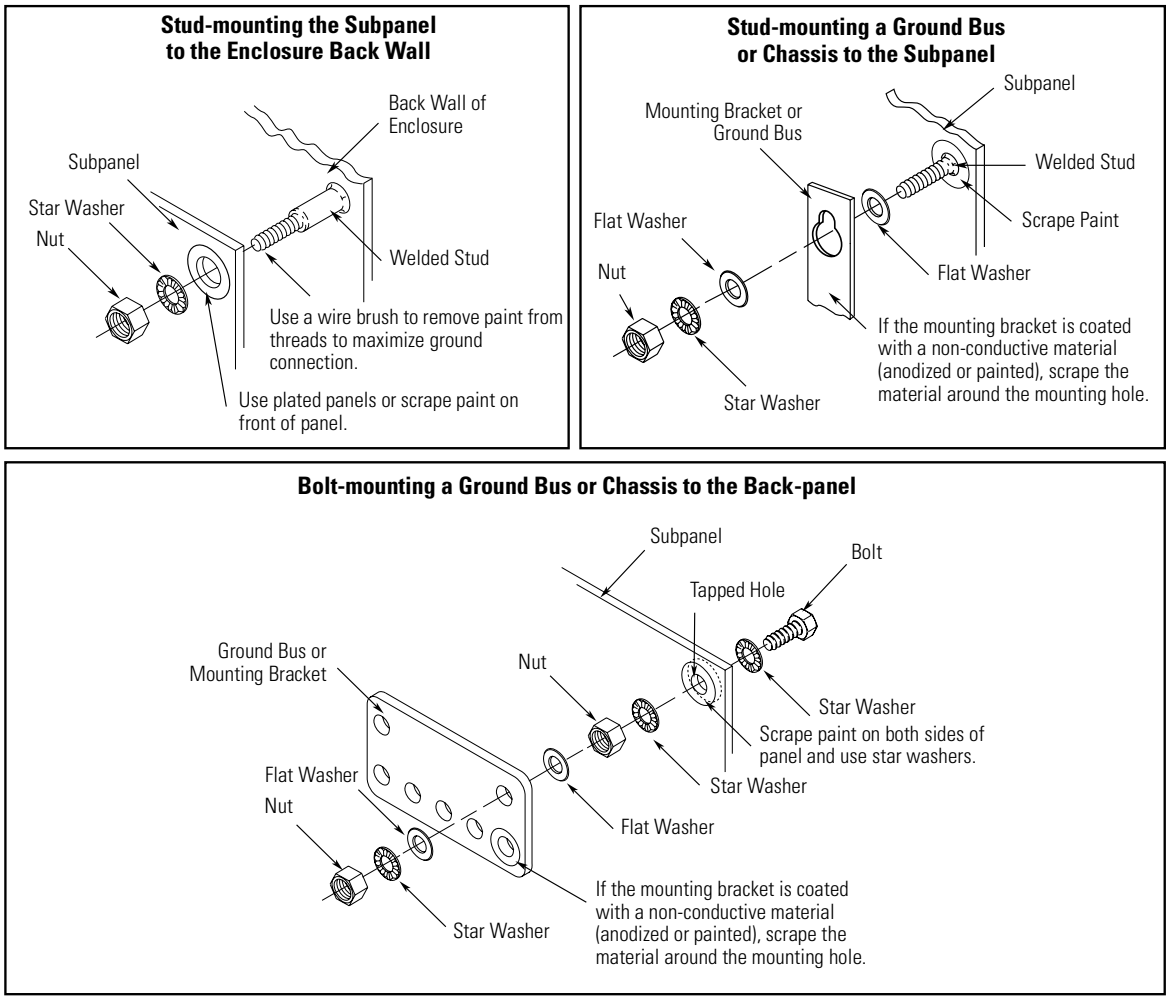
Unless specified, most paints are not conductive and act as insulators. To achieve a good bond between power rail and the subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

Improper bonding blocks the direct return path and results in high-frequency energy traveling elsewhere in the cabinet. Excessive high-frequency energy can effect the operation of other microprocessor controlled equipment.

The illustrations that follow show details of recommended bonding practices for painted panels, enclosures, and mounting brackets.

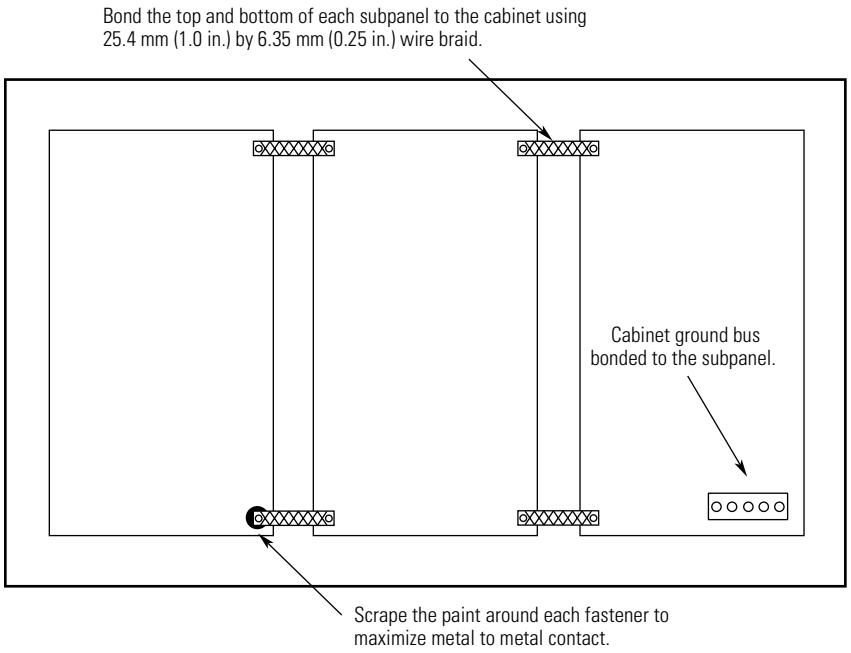
Recommended Bonding Practices for Painted Panels



Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. Subpanels that are not bonded together may not share a common low impedance path. This difference in impedance may affect networks and other devices that span multiple panels.

Multiple Subpanels and Cabinet Recommendations



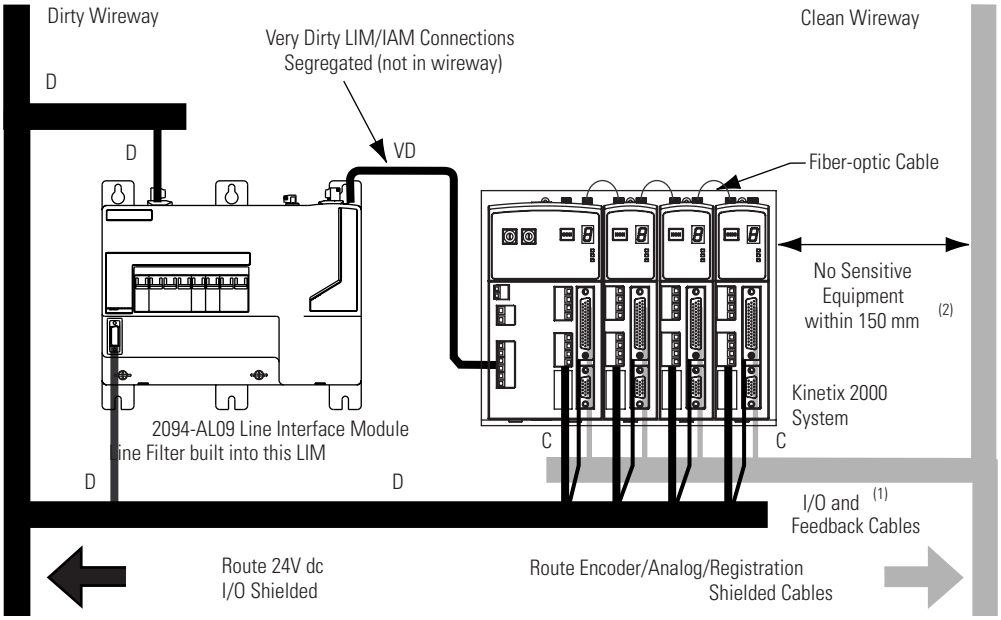
Establishing Noise Zones

Observe the following guidelines when a LIM (2094-AL09) is used in the Kinetix 2000 system and mounted left of the IAM:

This layout is preferred due to the reduced size of the very dirty zone.

- The clean zone (C) is to the right and beneath the Kinetix 2000 system (grey wireway).
- The dirty zone (D) is to the left and above the Kinetix 2000 system, and above and below the LIM (black wireway).
- The very dirty zone (VD) is limited to where the LIM VAC output jumpers over to the IAM. Shielded cable is required only if the very dirty cables enter a wireway.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM mounted left of IAM)



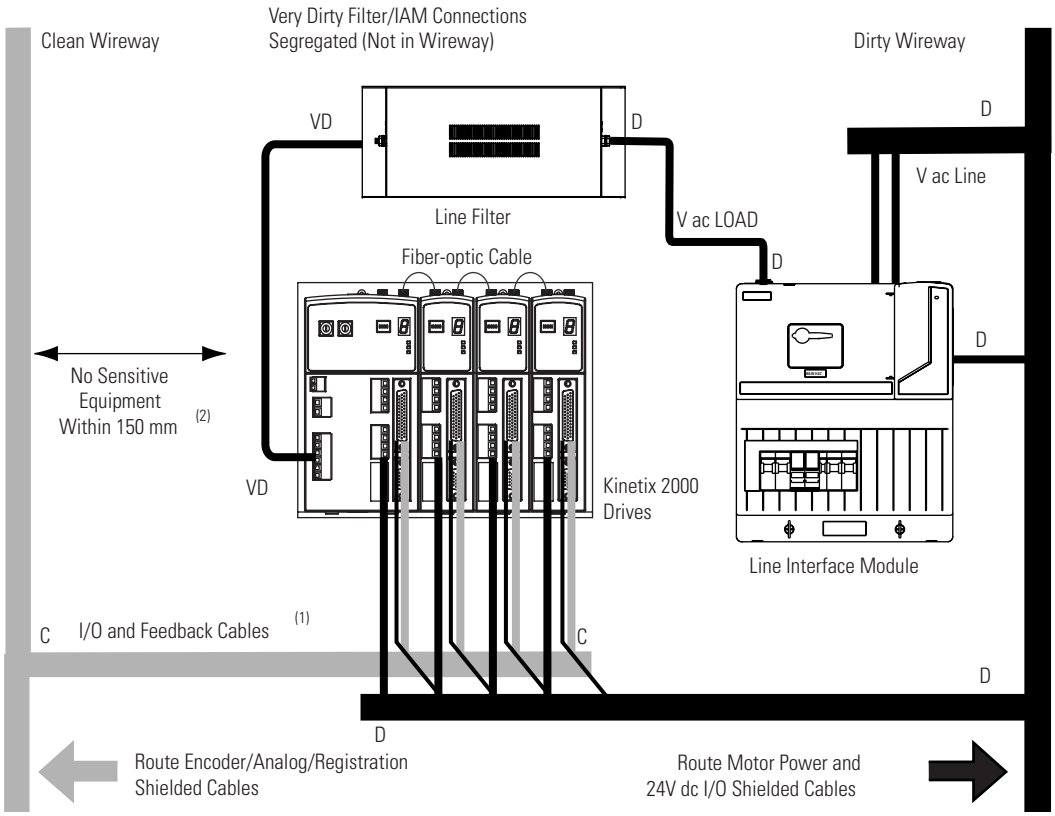
(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to Chapter 4 of the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL*xx*S, or 2094-XL75S-C*x*) is used in the Kinetix 2000 system and mounted left of the IAM with the ac (EMC) line filter mounted above the LIM:

- The clean zone (C) is to the left and below the Kinetix 2000 system (grey wireway).
- The dirty zone (D) is to the right and above the Kinetix 2000 system, and above and below the LIM (black wireway).
- The very dirty zone (VD) is from the filter output to IAM. Shielded cable is required on the EMC filter (load side) and the braided shield attached to the clamp provided.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM mounted right of IAM)



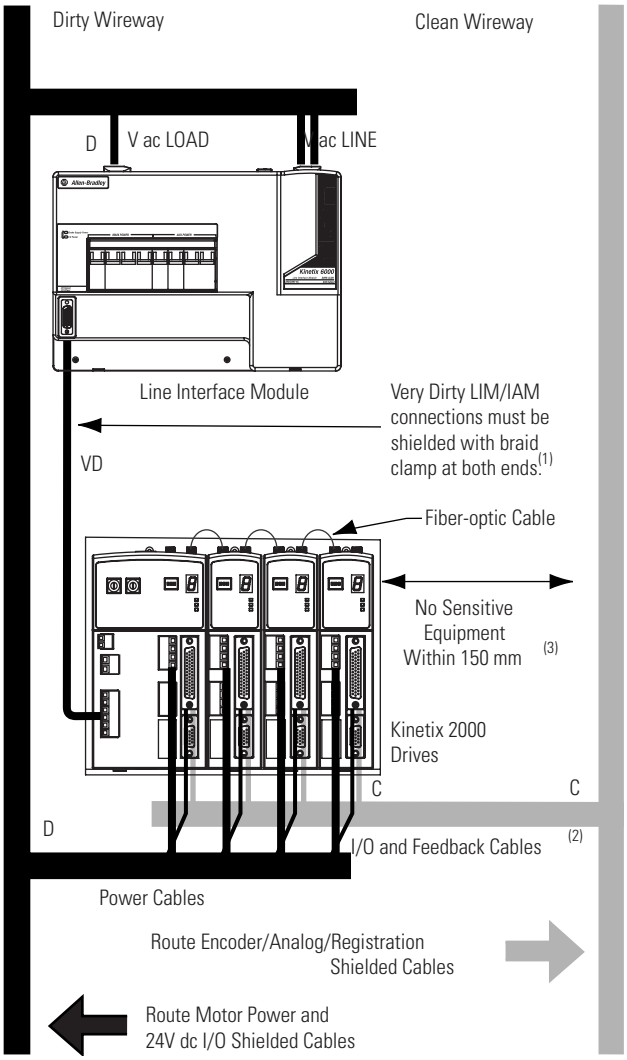
(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

(2) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to Chapter 4 of the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL09) is used in the Kinetix 2000 system and mounted above the IAM:

- The clean zone (C) is to the right and beneath the Kinetix 2000 system (grey wireway).
- The dirty zone (D) is to the left and above the Kinetix 2000 system, and above and below the LIM (black wireway).
- The LIM VAC output is very dirty (VD). Use shielded cable with a braid clamp attached at both ends of the cable to reduce the rating to dirty (D).
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (LIM mounted above IAM)



(1) For examples of shield clamp attachment, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

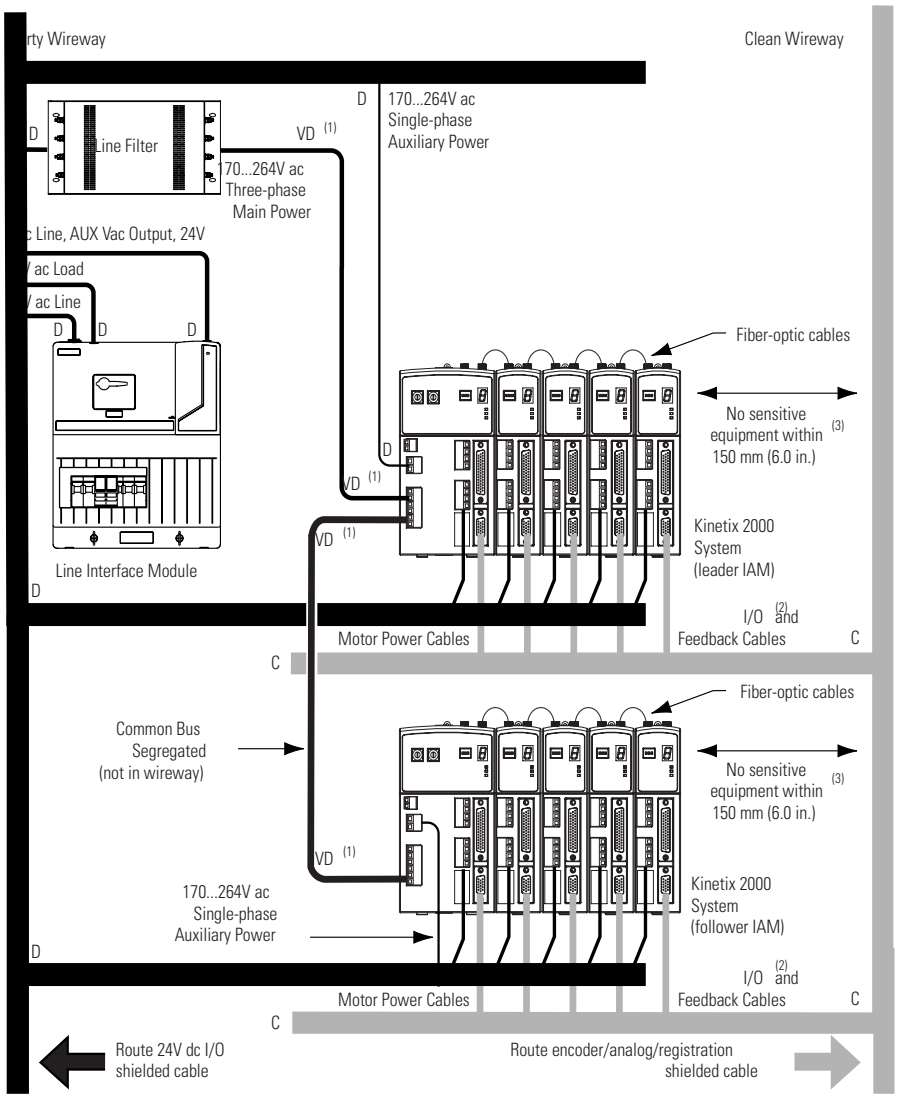
(2) If IAM/AM I/O cable contains (dirty) relay wires, route cable in dirty wireway.

(3) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to Chapter 4 of the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when a LIM (2094-AL*xx*S, or 2094-XL75S-C*x*) is used in a dc common bus configuration and the follower IAM is mounted below the leader IAM:

- The very dirty zone (VD) is from the filter output to the Leader IAM, and the entire length of the dc common bus cable. Shielded cable is required on the EMC filter (load side) and the braided shield attached to the clamp provided.
- Keep the dc common bus cable (very dirty) segregated from all other cables (not in a wireway).
- The clean zone (C) is to the right and below the Kinetix 2000 system (grey wireway).
- The dirty zone (D) is to the left of the Kinetix 2000 system, and above and below the LIM (black wireway).
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (dc common bus)



(1) Very Dirty connections must be shielded with braid clamp at both ends.For examples of shield clamp attachment, System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, publication System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

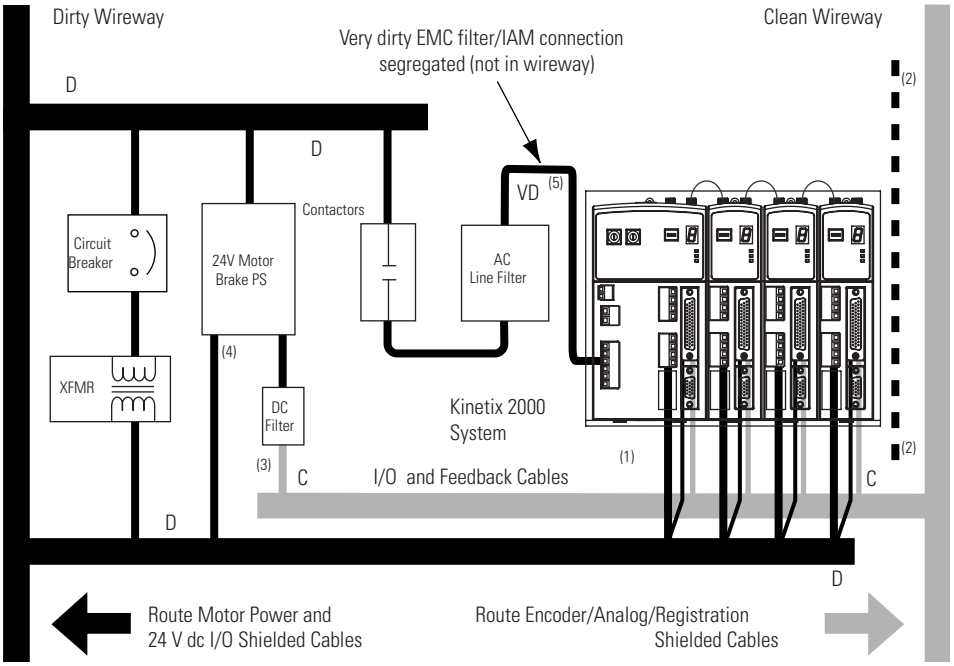
(2) If IAM/AM I/O cable contains (dirty) relay wires, route cable with LIM I/O cable in dirty wireway.

(3) When space does not permit the 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to Chapter 4 of the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

Observe the following guidelines when individual input power components are used in the Kinetix 2000 system and the LIM (2094-*x*L*xx* or 2094-*x*L*xx*S-*xx*) is not used:

- The clean zone (C) is beneath the Kinetix 2000 system and includes the I/O wiring, feedback cable, and dc filter (grey wireway).
- The dirty zone (D) is above the Kinetix 2000 system (black wireway) and includes the circuit breakers, transformer, 24V dc power supply, contactors, ac line filter, and motor power cables.
- The very dirty zone (VD) is limited to where the ac line (EMC) filter VAC output jumpers over to the IAM. Shielded cable is required only if the very dirty cables enter a wireway.
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (No LIM)



(1) If IAM/AM I/O cable contains (dirty) relay wires, route cable in dirty wireway.

(2) When space to the right of the IAM does not permit 150 mm (6.0 in.) segregation, use a grounded steel shield instead. For examples, refer to Chapter 4 of the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

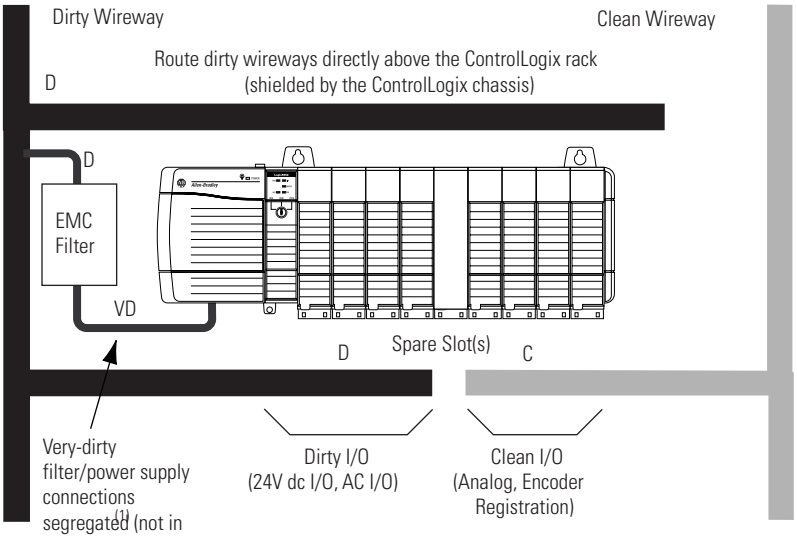
(3) This is a clean 24V dc available for any device that may require it. The 24V enters the clean wireway and exits to the right.

(4) This is a dirty 24V dc available for motor brakes and contactors. The 24V enters the dirty wireway and exits to the left.

Observe the following guidelines when installing a 1756-M*xx*SE SERCOS or other Logix interface modules:

- The clean zone (C) is beneath the less noisy modules, such as I/O, encoder, registration (grey wireway).
- The dirty zone (D) is above and below the power supply and noisy modules (black wireway).
- The SERCOS fiber-optic cables are immune to electrical noise.

Establishing Noise Zones (ControlLogix)



(1) Segregate VD wiring from D and C wiring, or use shielded cable (shield bonded to both panel at both ends) which then becomes category D.

Cable Categories for Kinetix 2000 Systems

The table below indicates the zoning requirements of cables connecting to the Kinetix 2000 drive components.

Integrated Axis Module (Converter Side)

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
CTRL 1 and 2	CPD		X			
DC-/DC+ (unshielded cable)	IPD	X				X
L1, L2, L3 (shielded cable)			X			X
L1, L2, L3 (unshielded cable)		X				
CONT EN- and CONT EN+ (M1 contactor)	CED		X			
DPI	DPI			X		X

Integrated Axis Module or Axis Module (Inverter Side)

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
U, V, W (motor power)	MP		X			X
MBRK-, MBRK+ (motor brake)	BC		X			
COM, PWR (24V dc), filtered (1)				X		
COM, PWR (24V dc), unfiltered (2)			X			
Motor feedback	MF			X		X
Auxiliary feedback	AF			X		X
Registration outputs	IOD			X		X
Others			X			
Fiber-optic	Rx and Tx	No Restrictions				

(1) This is a clean 24V dc available for any device that may require it.

(2) This is a dirty 24V dc available for motor brakes and contactors.

Line Interface Module

Wire/Cable	Connector	Zone			Method	
		Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
V ac line (main input)	IPL		X			
230V ac input	APL		X			
V ac load (shielded option)	OPL		X			X
V ac load (unshielded option)		X				
Control power output	CPL		X			
MBRK PWR, MBRK COM	P1L/PSL		X			
Status I/O	IOL		X			
Auxiliary 230V ac	P2L		X			

Noise Reduction Guidelines for Drive Accessories

When mounting an ac (EMC) line filter refer to the sections below for guidelines designed to reduce system failures caused by excessive electrical noise.

Line Filters, ac

Observe the following guidelines when mounting your ac (EMC) line filter (refer to the figure on page 33 for an example):

- Mount the line filter on the same panel as the Kinetix 2000 drive and as close to the power rail as possible.
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on page 27.
- Segregate input and output wiring as far as possible.

IMPORTANT CE test certification applies only to ac line filter and single power rail. Sharing a line filter with multiple power rails may perform satisfactorily, but the user takes legal responsibility.

Motor Brake and Thermal Switch

The thermal switch and brake are mounted inside the motor, but how you connect to the axis module depends on the motor series.

Refer to Wiring the Motor Brake (BC) Connector on page 89 for wiring guidelines. Refer to Axis Module/Motor Wiring Examples beginning on page 178 for the interconnect diagram of your drive/motor combination.

Mounting the Kinetix 2000 Drive System

Introduction

This chapter provides the system installation procedures for mounting your Kinetix 2000 drive components to the panel.

The procedures in this chapter assume you have prepared your panel and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those products.

WARNING

To avoid hazard of electrical shock, perform all mounting and wiring of IAM, AM, SM, SF, LIM, or power rail prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

Installing the 2093 Power Rail

The Kinetix 2000 power rail comes in configurations that support one integrated axis module (IAM), up to seven additional axis modules (AM), and a shunt module (SM). A slot filler (SF) must occupy any open position.

Refer to the Kinetix 2000 Power Rail Installation Instructions, publication 2093-IN004, when installing your power rail.

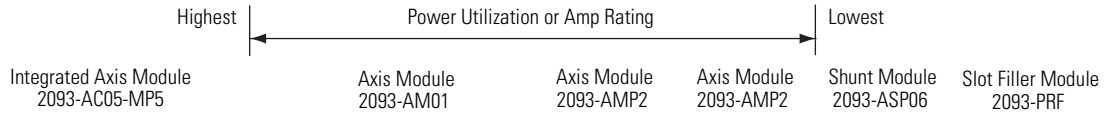
ATTENTION

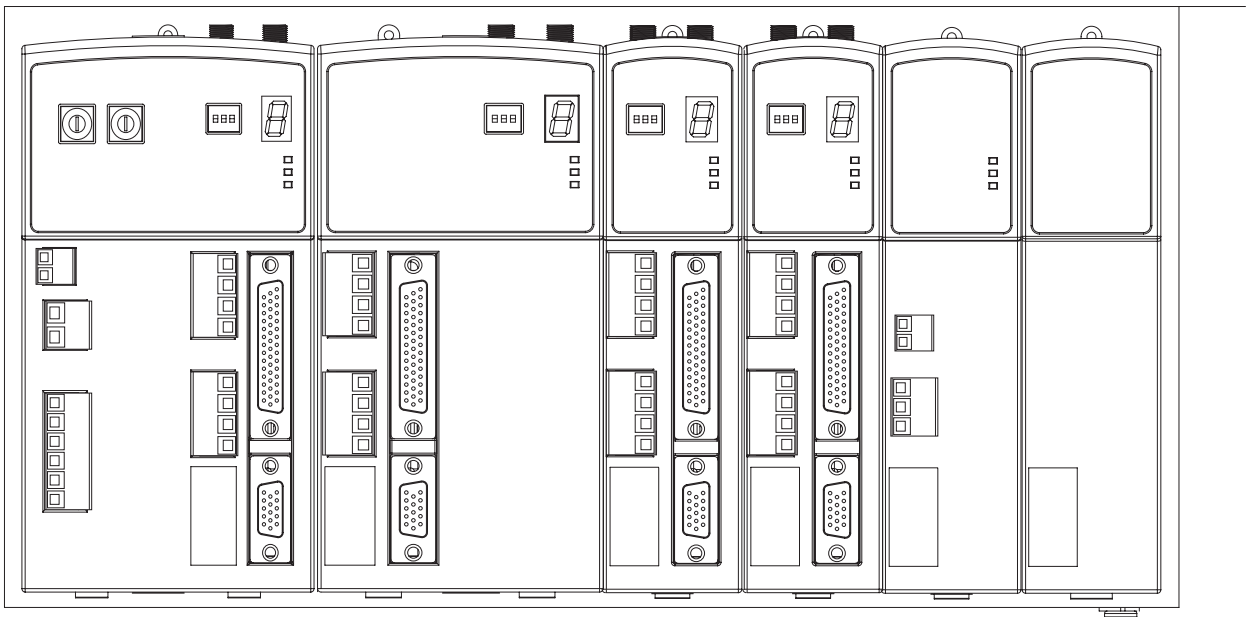
To avoid damage to the power rail during installation, do not remove the protective boots until the module for each slot is ready for mounting.

Determining Mounting Order

Mount IAM, AM, and SM modules in the order (left to right) shown in the figure. A slot filler (SF) must occupy any unoccupied slots. Mount axis modules according to power utilization (highest to lowest) from left to right starting with the highest power utilization. If power utilization is unknown, position axis modules (highest to lowest) from left to right based on Amp rating.

Module Mounting Order





Seven-axis Power Rail Module 2093-PRS7

IMPORTANT

Position the integrated axis module (IAM) in the leftmost slot of the power rail. Position your axis modules (AM), shunt module (SM), and slot fillers (SF) to the right of the IAM.

Install axis modules according to power utilization (highest to lowest) from left to right. The AM requiring the highest power utilization should be on the left.

Install the shunt module to the right of the last AM. Only slot fillers may be installed to the right of the shunt module.

Do not mount a shunt module on the power rail of a follower IAM. Common-bus follower IAMs will disable any rail mounted or external shunt modules.

SHOCK HAZARD

To avoid personal injury due to electrical shock, place a slot filler module in all empty slots on the power rail.

A unoccupied power rail connector will disable the Kinetix 2000 system, however control power will still be present.

2093-PRS8S Module Configuration

The 2093-PRS8S power rail is unique in that it has nine slots, but can accommodate only eight axis modules (IAM and AMs). The last slot must be occupied by a shunt module (SM) or a slot filler (SF), or a double-wide axis module (AM) occupying both slots 7 and 8.

The table shows valid 2093-PRS8S power rail configurations with the maximum number of axis modules. Configurations with fewer axis modules are valid when the slots to the right of the axis modules (IAM and AM) are occupied by a single shunt module (SM), or slot filler (SF) modules as described in Determining Mounting Order on page 38.

Valid 2093-PRS8S Module Positions

Slot Number								
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
IAM	AM [1]		AM		AM		AM [2]	
IAM	AM		AM		AM		AM	SM or SF [2]
IAM	AM		AM		AM	AM	AM	SM or SF [2]
IAM	AM		AM	AM	AM	AM	AM	SM or SF [2]
IAM	AM	AM	AM	AM	AM	AM	AM	SM or SF [2]

[1] Axis modules (AM) are available in double-width (2093-AM01 and 2093-AM02) and single-width (2093-AMP1, 2093-AMP2, and 2093-AMP5).

[2] Only the following modules may occupy slot 8 in the 2093-PRS8S power rail: a shunt module (2093-ASP06), a slot filler (2093-PRF), or a double-width axis module (2093-AM01 or 2093-AM02) occupying both slots 7 and 8. Refer to the Node Addressing Example 4 on page 108 for information on slot assignment and logical addressing of an axis module in slot 8.

IMPORTANT Invalid module positioning on a 2093-PRS8S power rail may result in incorrect operation.

Mount the Modules

Follow these steps to mount the IAM, AM, SM, and SF modules. All modules mount to the power rail using the same technique.

1. Determine the next available slot and module for mounting.

IMPORTANT The IAM must be positioned in the leftmost slot of the power rail. Position your axis modules, shunt module, and slot fillers to the right of the IAM.

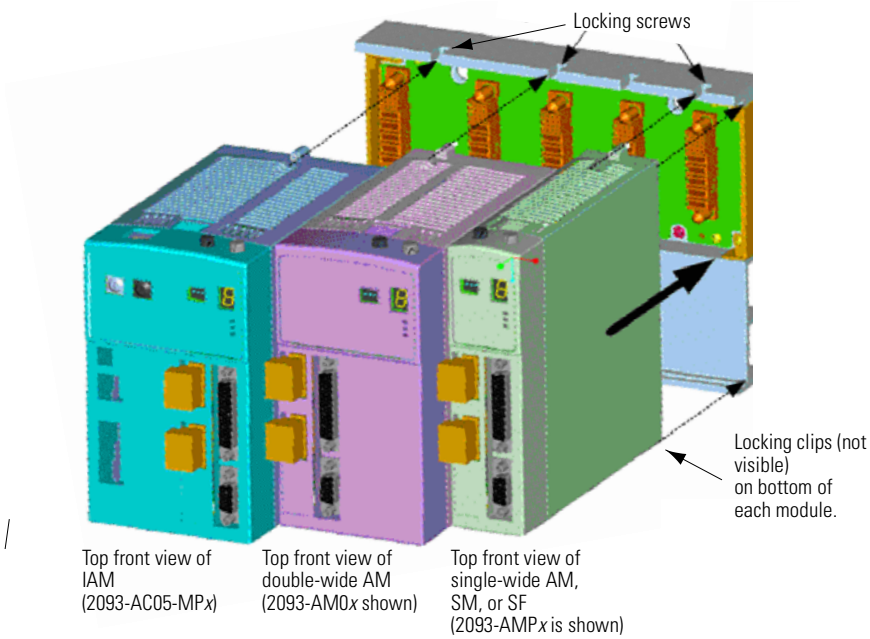
ATTENTION

To avoid damage to the pins located on the back of each module (IAM, AM, SM, and SF) and to make sure that module pins mate properly with the power rail, install modules as shown below.

The power rail must be mounted with the connectors in an upright or vertical orientation to the panel. This provides proper cooling of the modules. Do not mount modules if the power rail is not within three degrees of vertical.

2. Insert the module in the power rail slot.
   a. Align the module locking screw with its corresponding slot on the power rail.
   b. Push the module straight forward, by applying force at the top and bottom of the front cover.

The module is fully seated when each locking clip snaps into the bottom of the power rail, and the locking screw boss is flush at the top of the power rail.



3. Torque mounting screws to 0.7 Nm (6 lb-in.).

IMPORTANT There is one mounting screw on any Kinetix 2000 module (IAM, AM, SM, or SF).

4. Determine if you have additional modules to mount.

If You	Then
Have additional modules to mount	Return to step 1 and complete installation of your next AM, SM, or SF module.
Do not have additional modules to mount	Go To Mounting the Line Interface Module.

Mounting the Line Interface Module

Your Kinetix 2000 drive requires an external power source. To meet EU EMC requirements, this requires you to install a line interface module or similar discrete components (ac line filter, contactor, fusing, and transformers) that properly condition and control the input power.

Refer to Connecting the Kinetix 2000 Drive System on page 61 and the Interconnect Diagrams on page 37 for information about this specific installation.

Segregating Power and Logic Wires

Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring. For examples, refer to the Establishing Noise Zones diagrams beginning on page 29.

Kinetix 2000 Connector Data

Introduction

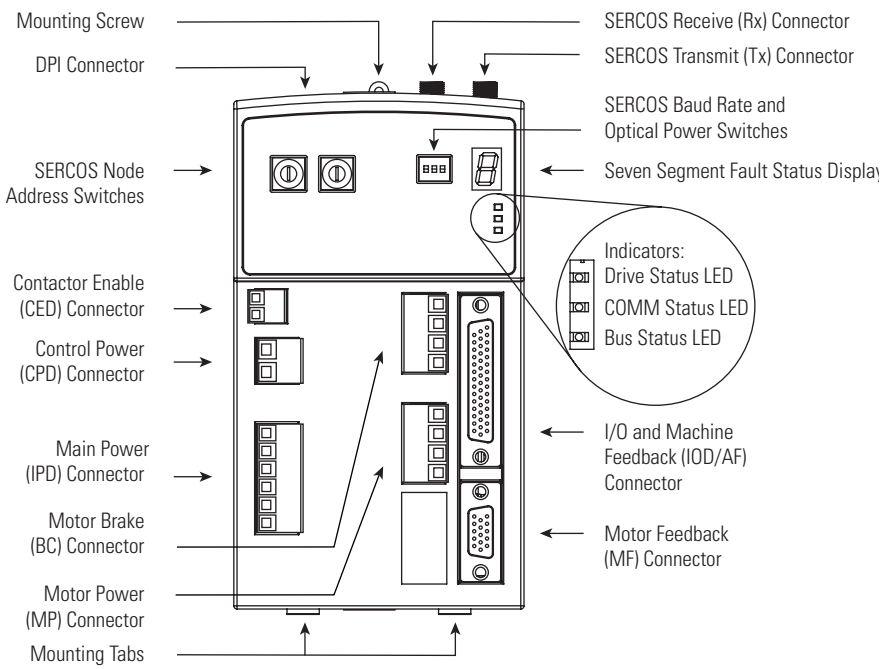
This chapter provides power, feedback, and I/O connector locations and signal descriptions for your Kinetix 2000 drive.

Locating IAM/AM Connectors and Indicators

The physical size of the modules may vary, but the location of the connectors and indicators is identical.

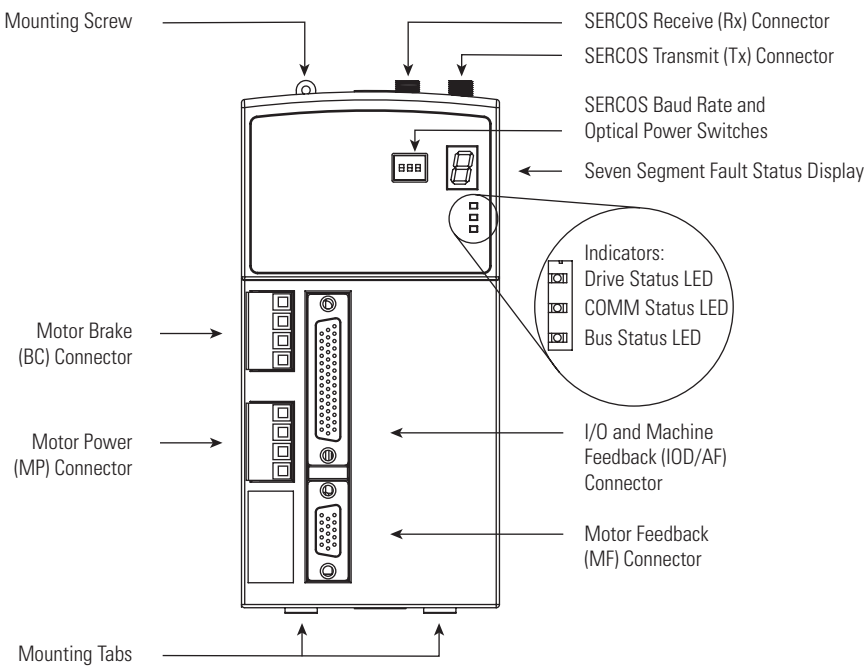
Integrated Axis Module Connectors and Indicators

Integrated Axis Module, Front View
(2093-AC05-MP*x* shown)

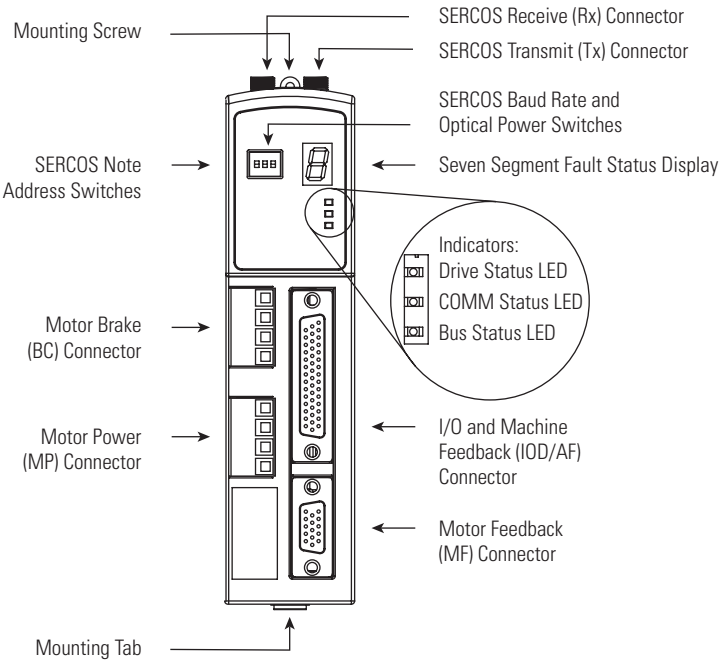


Axis Module Connectors and Indicators

Axis Module, Front View
(2093-AM*x* shown)



Axis Module, Front View
(2093-AMP*x* shown)



Integrated Axis Module/Axis Module Connectors

Designator	Description	Connector	Present on IAM or AM
BC	Motor brake	4-position plug/header	IAM/AM
CED	Contactor enable	2-position plug/header	IAM
CPD	Control input power (drive)	2-position plug/header	IAM
DPI	Drive peripheral interface (factory use only)	8-pin mini-DIN	IAM
IOD/AF	User I/O (drive) and auxiliary feedback	44-pin high-density D-shell (female)	IAM/AM
IPD	V ac input power (drive) 230V and dc bus	6-position plug/header	IAM
MF	Motor feedback	15-pin high-density D-shell (female)	IAM/AM
MP	Motor power	4-position plug/header	IAM/AM
Tx and Rx	SERCOS transmit and receive	SERCOS fiber-optic (2)	IAM/AM

Integrated Axis Module/Axis Module Switches and Indicators

Description	Type	Present on IAM or AM
SERCOS Node Address [1]	Rotary switches	IAM
SERCOS Baud Rate and Optical Power	DIP switches	IAM and AM
Fault or SERCOS Status	Seven segment LED indicator	IAM and AM
Drive Status	LED indicator	IAM and AM
Communication Status	LED indicator	IAM and AM
Bus Power Status	LED indicator	IAM and AM

(1) The node address setting for the IAM establishes the base address (n) for that power rail, and the address for the other axis modules (AMs) increment from the base address (2093-AMP*x* = n + 1, and 2093-AM0*x* = n + 2). Refer to the Node Addressing Example 4 on page 108 for information on physical and logical addressing of axis modules.

I/O Connector Pinouts

IAM/AM I/O and Auxiliary Feedback 44-pin (IOD/AF) Connector

IOD/AF Pin	Description	Signal
1	Reserved	—
2	Reserved	—
3	Reserved	—
4	Reserved	—
5	Reserved	—
6	Reserved	—
7	Reserved	—
8	Reserved	—
9	Reserved	—
10	Reserved	—
11	Reserved	—
12	Reserved	—
13	Reserved	—
14	Reserved	—
15	Reserved	—
16	Data/index positive differential input/ output	DATA+ / I+
17	Data/index negative differential input/ output	DATA- / I-
18	Encoder 5V power supply	EPWR_5V
19	Encoder common	ECOM
20	Encoder 9V power supply	EPWR_9V
21	Reserved	—
22	Registration input 2 common	24VCOM_REG2

IOD/AF Pin	Description	Signal
23	Registration input 2	REG2
24	Registration input 2 24V	24V_REG2
25	Registration input 1 common	24VCOM_REG1
26	Registration input 1	REG1
27	Registration input 1 24V	24V_REG1
28	24V common	24VCOM
29	Overtravel input negative	OT-
30	24V power output	24VPWR
31	Sine/A positive differential input	SINE+/A+
32	Sine/A negative differential input	SINE-/A-
33	Cosine/A positive differential input	COSINE+/B+
34	Cosine/A negative differential input	COSINE-/B-
35	Reserved	—
36	24V common	24VCOM
37	Overtravel input positive	OT+
38	24V power output	24VPWR
39	24V common	24VCOM
40	Home input	HOME
41	24V power output	24VPWR
42	24V common	24VCOM
43	Enable	ENABLE
44	24V power output	24VPWR

IMPORTANT Signals +24V_PWR and +24V_COM are a 24V dc source that should only be used to power inputs on the 44-pin I/O and AF connector listed above.

Auxiliary Feedback Device Pinouts

The table shows the connections made to the drive, or connector kit, for the following common auxiliary feedback devices.

- Stegmann Hiperface (SKS, SKM, SRS, SRM)
- Sine/Cosine with Marker (0.6...12V p-p)
- Differential TTL line driver (RS422) with marker

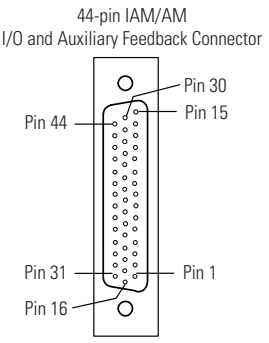
IOD/AF Pin [1]	Stegmann Hiperface [2] (SKS, SKM, SRS, SRM)	AQB Incremental	Sine/Cosine Incremental
16	DATA-	IM-	IM-
17	DATA+	IM+	IM+
18	EPWR_5V [3]	EPWR_5V	EPWR_5V [3]
19	ECOM	ECOM	ECOM
20	EPWR_9V [3]	–	EPWR_9V [3]
31	BM-	BM-	BM-
32	BM+	BM+	BM+
33	AM-	AM-	AM-
34	AM+	AM+	AM+

(1) The polarity of the feedback is defined as B leads A for positive sense.

(2) Hiperface devices support only absolute homing.

(3) Power depends on device requirement.

Pin Orientation for 44-pin I/O and Auxiliary Feedback (IOD/AF) Connector



Motor Feedback Connector Pinouts

The table shows the connections made to the drive, or connector kit, for supported feedback types.

MF Pin	Stegmann Hiperface (SKS, SKM, SRS, SRM)	Tamagawa 17-bit Serial (1)	Sine/Cosine Incremental with Hall	Sine/Cosine Incremental	AQB Incremental with Hall	AQB Incremental	Renishaw (Raptor)
1	AM+	—	AM+	AM+	AM+	AM+	AM+
2	AM-	—	AM-	AM-	AM-	AM-	AM-
3	BM+	—	BM+	BM+	BM+	BM+	BM+
4	BM-	—	BM-	BM-	BM-	BM-	BM-
5	DATA+	DATA+	IM+	IM+	IM+	IM+	IM+
6	ECOM	ECOM	ECOM	ECOM	ECOM	ECOM	ECOM
7 (2)	—	—	—	—	—	—	—
8	—	—	S3	—	S3	—	S3
9	—	—	—	—	—	—	E_OT+
10	DATA-	DATA-	IM-	IM-	IM-	IM-	IM-
11 (3)	TS	TS	TS	TS	TS	TS	TS
12	—	—	S1	—	S1	—	S1
13	—	—	S2	—	S2	—	S2
14 (4)	EPWR_5V	EPWR_5V	EPWR_5V	EPWR_5V	EPWR_5V	EPWR_5V	EPWR_5V
15	—	—	—	—	—	—	E_OT-

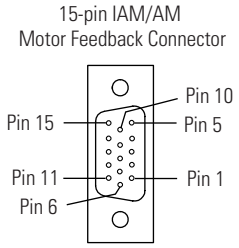
(1) 3.6V battery connections are located in the 2090-K2CK-D15M connector kit. The battery (2090-DA-BAT2) is required for this feedback type.

(2) Pin 7 is EPWR_9V connection that can be used for third party motor applications, Hiperface for example. 9V encoder power supply requirement is 9.1V dc, ±8.8% @ 350 mA total for both channels.

(3) Not applicable unless motor has integrated thermal protection.

(4) Pin 14 is EPWR_5V connection for motor applications. 5V encoder power supply requirement is 5.18V dc, ±5% @ 350 mA total for both channels.

Pin Orientation for 15-pin Motor Feedback (MF) Connector



IAM Input Connector Pinouts

These connections have removable wiring plugs. The pins are numbered consecutively from top to bottom, and keyed to prevent incorrect insertion.

Control Power Connector

CPD Pin	Description	Signal
1	Control power V ac input line 1	CTRL 1
2	Control power V ac input line 2	CTRL 2

Input Power and Common Bus Connector

IPD Pin	Description	Signal
1	Three-phase input power	L1
2		L2
3		L3
4	Chassis ground	⏚
5	An integral, unregulated power supply, consisting of ac line input, three-phase bridge rectifier, and filter capacitors	DC+
6		DC-

Contactor Enable Connector

CED Pin	Description	Signal
1	Relay-driven dry contact used in the safety string for a three-phase power contactor.	CONT EN+
2		CONT EN1-

IAM and AM Motor Power and Brake Connector Pinouts

These connections have removable wiring plugs. The pins are numbered consecutively from top to bottom, and keyed to prevent incorrect insertion.

Motor Power Connector

MP Pin	Description	Signal
1	Three-phase motor power	U
2		V
3		W
4	Chassis ground	⏚

IMPORTANT To meet CE requirements, combined motor power cable length for all axes on the same dc bus must not exceed 160 m (525 ft) with 230V systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).

Motor Brake Connector

BC Pin	Description	Signal
1	+24V brake input power (from LIM or customer supplied)	PWR
2		MBRK+
3	Motor brake connections	MBRK-
4	Motor brake common	COM

IAM/AM Signal Specifications Explained

A description of the Kinetix 2000 IAM/AM input/output (IOD), SERCOS, contactor enable (CED), brake (BC), and control power (CPD) connectors is provided on the following pages.

Digital Inputs

Two fast registration inputs and four other inputs are available for the machine interface on the integrated axis module (IAM) and axis module (AM). Each IAM and AM supplies 24V dc @ 300 mA total for the purpose of registration, home, enable, over-travel positive, and over-travel negative inputs. These are sinking inputs that require a sourcing device. A 24V power and common connection is provided for each input.

IMPORTANT To improve registration input EMC performance, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

IMPORTANT Overtravel limit input devices must be normally closed.

Digital Input Signal Specifications

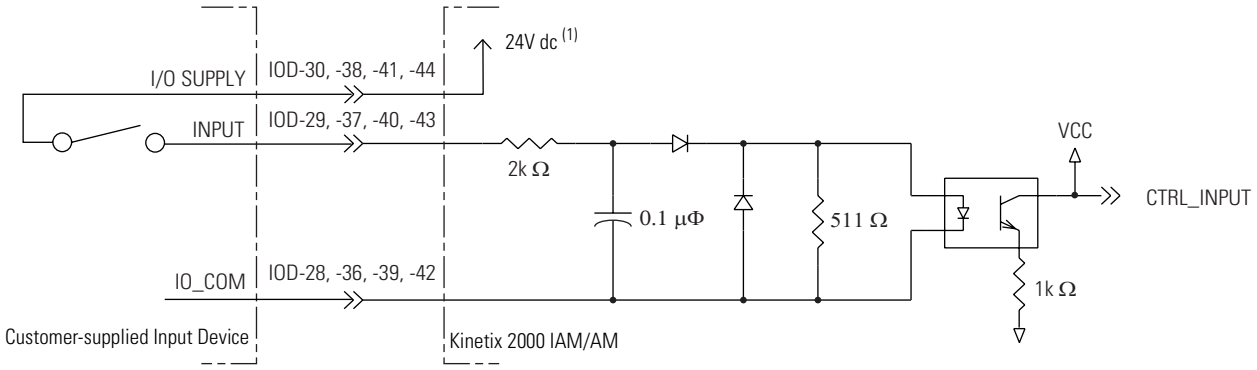
IOD/AF Pin	Signal	Description	System Reaction Time (1)	Edge/Level Sensitive
IOD/AF-43	ENABLE	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V dc input is applied to this terminal to activate each axis.	10...21 ms	Level
IOD/AF-40	HOME	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. Home switch (normally open contact) inputs for each axis require 24V dc (nominal).	10...21 ms	Level
IOD/AF-26 IOD/AF-23	REG1 REG2	Fast registration inputs are required to inform the motor interface to capture the positional information with less than 3 μs uncertainty. Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V dc input is applied to this terminal to activate each axis.	3 us	Edge
IOD/AF-37 IOD/AF-29	OT+ OT-	Overtravel detection is available as an optically isolated, single-ended active high signal. Current loading is nominally 10 mA per input. The pos/neg limit switch (normally closed contact) inputs for each axis require 24V dc (nominal).	10...21 ms	Level

(1) System reaction time is a function of the input signal, SERCOS ring time, and application code scan time.

Digital Input Specifications

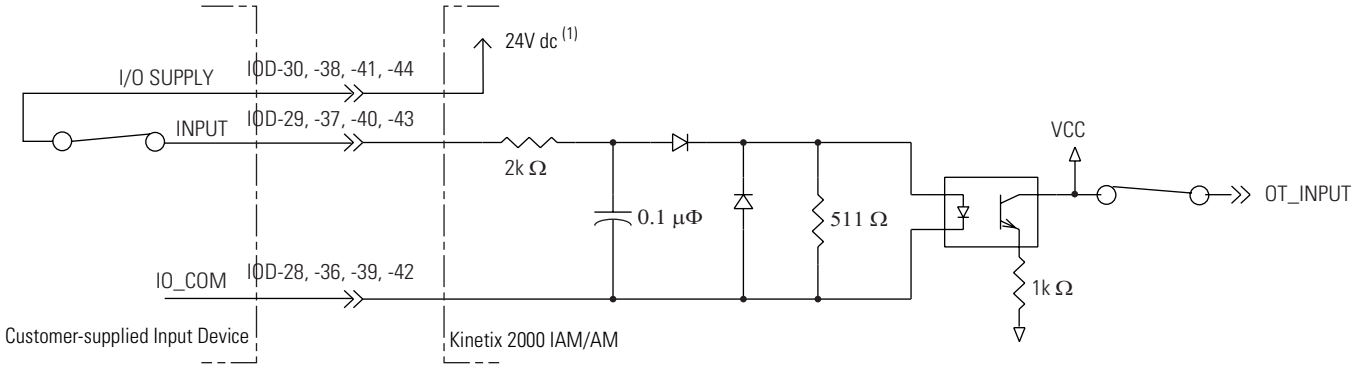
Parameter	Description		Min	Max
On-state voltage	Voltage applied to the input, with respect to IOCOM, to guarantee an on-state.	ENABLE, HOME, and OT+/OT-	10.8V	26.4V
		REG1 and REG2	21.6V	26.4V
On-state current	Current flow to guarantee an on-state.		3.0 mA	10.0 mA
Off-state voltage	Voltage applied to the input, with respect to IOCOM, to guarantee an off-state.		-1.0V	3.0V

Enable and Home Digital Input Circuits



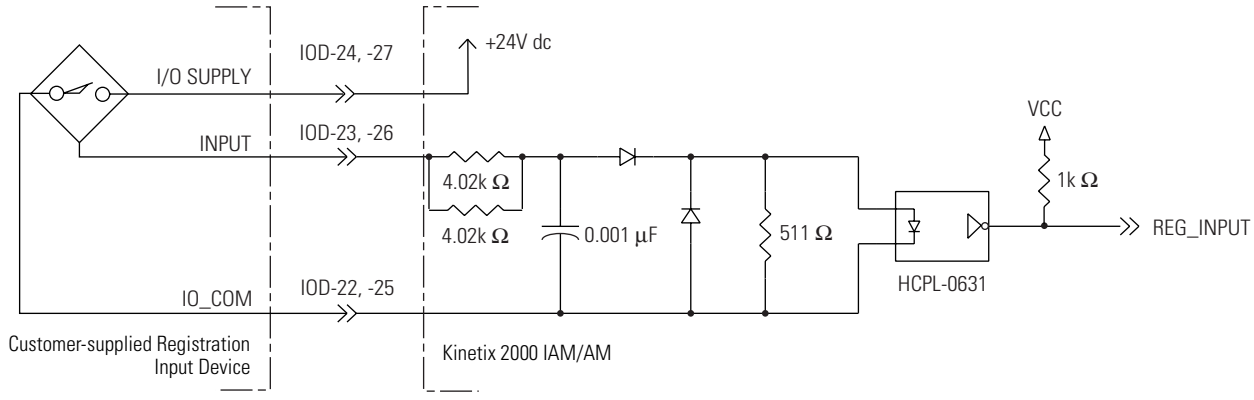
(1) 24V dc source (range) = 21.6…26.4V (supplied by drive, not to exceed 300 mA total).
Maximum current input = 10 mA

Overtravel Digital Input Circuit



(1) 24V dc source (range) = 21.6...26.4V (supplied by drive, not to exceed 300 mA total).
Maximum current input = 10 mA

Registration Digital Input Circuits



SERCOS Connections

Two fiber-optic connectors (transmit and receive) are provided on the integrated axis module (IAM) and axis module (AM).

SERCOS Communications Specifications

Attribute	Value
Data Rates	AutoDetect, 4 Mbps, and 8 Mbps
Cycle Times	0.5 ms, 1.0 ms, and 2.0 ms
Transmit Rates	Low, and High
Node Addresses	01...99 (1)

(1) Node address assignments begin with the integrated axis module (IAM).

Node addresses for axes on the same power rail are assigned by incrementing from left to right (starting with the IAM address). One SERCOS node address goes unused for each double wide AM on the power rail.

Contactor Enable Relay

Contactor enable is a relay-driven contact used in the safety control string to protect the drive electronics during certain fault conditions. It is capable of handling 120V ac or 24V dc at 1 A or less. Contactor enable is a function of the converter and is not available in the axis modules.

An active state indicates the IAM is:

- Control power is applied.
- No axis shutdown fault is detected.
- All power rail slots are occupied with a valid module.

ATTENTION

Wiring the contactor enable relay is required. To avoid personal injury or damage to the drive, wire the contactor enable relay into your safety control string so that:

- three-phase power is removed from the drive in the event of shutdown fault conditions.
- drive operation is prevented when the power rail is not fully populated.
- control power is applied to the drive prior to three-phase power.

Refer to Single-Phase Power Input (without LIM) to IAM Wiring Example on page 173 for a wiring example.

The recommended power up sequence is to apply Logix power, and then close the CE relay to apply main power to the drive electronics.

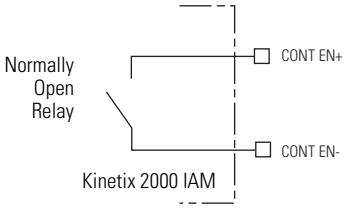
IMPORTANT All power rail slots must have the proper module installed or the Contactor Enable relay will not close.

ATTENTION

To avoid damage to the drive, wire the Contactor Enable relay in your safety control string so that three-phase power is removed from the drive in the event of certain fault conditions.

Refer to Power Wiring Examples on page 169 for wiring examples.

Contactor Enable Relay Circuit



Contactor Enable Relay Output Specifications

Parameter	Description	Min	Max
On-state current	Current flow when the relay is closed	—	1 A
On-state resistance	Contact resistance when the relay is closed	—	1 Ω
Off-state voltage	Voltage across the contacts when the relay is open	—	120V ac or 24V dc

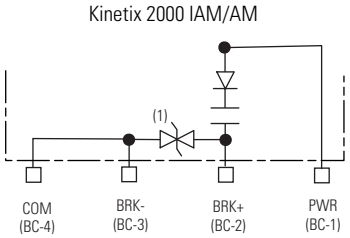
Motor Brake Relay

Two connections are required for the (customer-supplied) motor brake input power (BC-1 and BC-2) and two connections each for the motor brake output, as shown in the figure below. Connections are rated for +24V and current as shown in the table below.

An active signal releases the motor brake (BC-2 and BC-3). The brake signal on each inverter contains a suppression device. The brake turn-on delay specified in RSLogix 5000 software delays application of the motor brake activation by the time interval specified, and the brake turn-off delays release of the motor brake by the time interval specified for the signal.

Refer to Axis Module/Motor Wiring Examples beginning on page 178 and Controlling a Brake Example on page 181 for wiring examples.

Brake Relay Circuit



(1) Noise suppression device.

Brake Relay Output Specifications

Parameter	Description	IAM/AM	Max
On-state current (1)	Current flow when the relay is closed	2093-AC05-MP*x*	1.0 A
		2093-AMP*xx*	
		2093-AM*xx*	
On-state resistance	Contact resistance when the relay is closed		1 Ω
Off-state voltage	Voltage across the contacts when the relay is open		30V

(1) For motors requiring more than the maximum current specified, an external relay must be added. Refer to the Wiring Example for External Brake Relay Control of Motor Brake on page 182 for a diagram of this circuit.

Control Power Input

The integrated axis module (IAM) requires ac input power for logic circuitry.

IMPORTANT For CE certification, the control power input requires an ac line filter that provides electromagnetic compatibility (EMC). For wiring examples, refer to Power Wiring Examples beginning on page 169.

IMPORTANT Source 2093-AC05-MP*x* (230V) IAM control power from the three-phase input power (line-to-line). Supplying 230V control power from any other source requires an isolation transformer. If used, do not ground either leg of the isolation transformer output.

Refer to Transformer Specifications for Control Power Input on page 159.

Control Power Current Specifications

Attribute	Value
Input voltage	170...264V ac rms, single-phase or three-phase
Input power frequency	47...63 Hz

Control Power Current Requirements

Number of Axis Modules [1]	Current Requirements (115V ac input)	Current Requirements (230V ac input)	Max Inrush	Input VA
0	0.3 A	0.15 A	93 A	50 VA
1	0.6 A	0.30 A		99 VA
2	0.9 A	0.45 A		148 VA
3	1.2 A	0.60 A		197 VA
4	1.5 A	0.75 A		247 VA
5	1.8 A	0.90 A		296 VA
6	2.1 A	1.05 A		345 VA
7	2.4 A	1.20 A		395 VA
Shunt	2.5 A	1.25 A		410 VA
Slot Filler	–	–	–	–

(1) This number does not include the axis module (inverter section) that resides inside the integrated axis module.

Feedback Specifications Explained

The integrated axis module (IAM) and axis module (AM) can accept motor and auxiliary feedback signals from the following types of encoders:

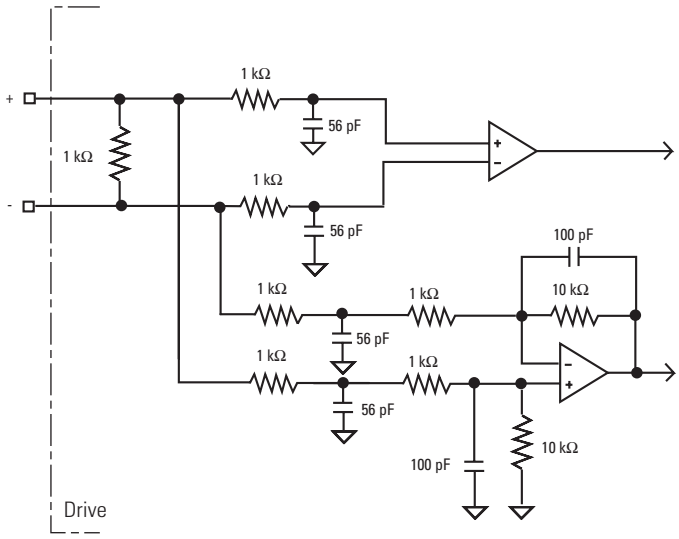
- Stegmann Hiperface (SKS, SKM, SRS, SRM)
- Tamagawa 17 bit absolute encoders (TL5669)
- Sine/Cosine w/Marker (0.6...1.2V p-p) w/ single-ended hall Commutation Tracks
- Sine/Cosine w/Marker (0.6...1.2V p-p)
- Differential TTL line driver (RS422) with Marker and single-ended Hall Commutation Tracks
- Differential TTL line driver (RS422) with Marker
- Differential TTL line driver or Sine/Cosine with Hall Effect Commutation and E-Travel inputs from Anorad Raptor linear motors. Renishaw linear encoders are provided on this product.

TIP Auto-configuration in RSLogix 5000 software of intelligent absolute, high-resolution, and incremental encoders is possible only with Allen-Bradley motors.

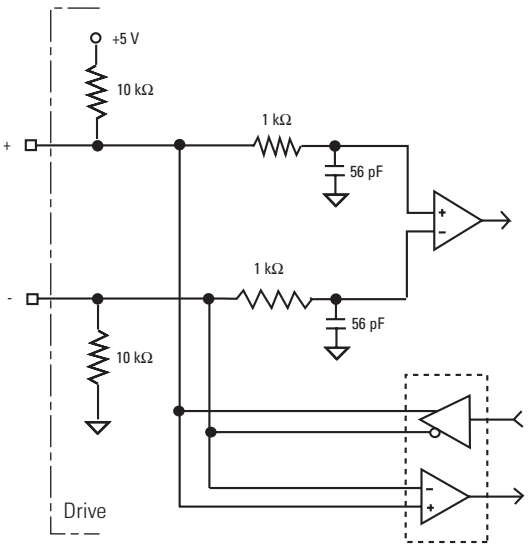
Motor and Auxiliary Feedback Specifications

AM, BM, and IM input encoder signals are filtered using analog and digital filtering. The inputs also include illegal state change detection.

AM, BM, and IM Motor Encoder Input Circuits



AM and BM Channel Inputs



IM Channel Input

Motor Encoder Feedback Specifications

Attribute	Value
Encoder types	Incremental, TTL, sine/cosine, Hiperface, and 17-bit serial
Max. input frequency	5.0 MHz (TTL input) per channel
	250 kHz (sine/cosine input)
Commutation feedback	Hall sensor

The following specifications apply to both motor and auxiliary feedback channels.

Specification	17-Bit Serial	TTL Incremental	Hiperface	Sine/Cosine
Input voltage	Differential per EIA RS 422 5.0 V U_H_2.5 V at -I_H = 20 mA U_L_2.5 V at -I_L = 20 mA		0.8...1.2 V pk-pk (1) Protocol: 1V pk-pk Sine/Cos with RS 485	0.6...1.2 V pk-pk (2)
Input frequency	—	AM, BM, IM: 5 MHz max	AM, BM: 250 kHz max	
Line count	17-bit single-turn	Max limited by input signal frequency	SRx: 1024 Sine/Cos per rev. 12-bit	Max limited by input signal frequency
Interpolation	—	4x line count	11-bit	
Termination	120 Ω			
Line loss detection	No response (all zeros) to any position request, or three consecutive bad requests cause a CRC error.	Eight consecutive sample of normalized absolute value of A or B is < 0.75, and AQB freq is < 10 kHz.	Avg ($\sin^2 + \cos^2$) > constant	
Data communications	RS 485 proprietary	RS 422	RS 485, 9600 baud	—
Support	Motor feedback channel only	5V Incremental encoder with differential AQB	—	—
Memory support: Programmed Unprogrammed	Allen-Bradley motor data	—	Allen-Bradley motor data Encoders on auxiliary channel	—
Multi-turn support Power on Power off	2^{54} rotary, $\pm2^{53}$ linear (revs) 4096 rotary, ±2047 linear (revs)	—	2^{54} rotary, $\pm2^{53}$ linear (revs) 4096 rotary, ±2047 linear (revs)	—
Single-turn support	Drive resolution equal to unwind (modulo) value without a battery.	—	Drive resolution equal to unwind (modulo) value without a battery.	—
Battery (2090-DA-BAT2)	External 3.6V, 50 mA max (3)	—	—	—
Phase shift	—	—	—	90^o ±5^o
Distance coded marker	—	—	Not supported	not supported
Hall inputs (S1, S2, S3)	—	Single-ended, TTL or open collector	—	Single-ended, TTL or open collector

(1) Voltages higher than 7V may cause product damage.

(2) Voltages higher than 24V may cause product damage.

(3) Battery to supply power for absolute encoder output from the TL-Series motors to the motor feedback connector on the drive must be installed in the Low Profile Connector Kit for Motor Feedback, catalog number 2093-K2CK-D15M. Refer to publication 2093-IN005*x*-EN-P for information on wiring and installing this connector kit.

AM, BM, and IM Input Specifications for TTL Encoders

Parameter	Description	Min	Max
AM, BM, and IM On-state input voltage	Input voltage difference between the plus (+) input and the minus (-) input that is detected as an on-state.	+1.0V	+7.0V
AM, BM, and IM Off-state input voltage	Input voltage difference between the plus (+) input and the minus (-) input that is detected as an off-state.	-1.0V	-7.0V
Common mode input voltage	Potential difference between any encoder signal and logic ground.	-7.0V	+12.0V
Current draw, dc	Current draw into the + or - input.	-30 mA	30 mA
AM, BM input signal frequency	Frequency of the AM or BM signal inputs. The count frequency is 4 times this frequency, since the circuitry counts all four transitions.	—	5.0 MHz
IM pulse width	Pulse width of the index input signal. Since the index is active for a percentage of a revolution, the speed will determine the pulse width.	125 nS	—
AM, BM phase error 2.5 MHz line frequency	Amount that the phase relationship between the AM and BM inputs can deviate from the nominal 90°.	-22.5°	+22.5°
AM, BM phase error 1 MHz line frequency	Amount that the phase relationship between the AM and BM inputs can deviate from the nominal 90°.	-45°	+45°

AM, BM, and IM Input Specifications for Sine/Cosine Encoders

Parameter	Description	Min	Max
Sine/cosine input signal frequency	Frequency of the Sine or Cosine signal inputs.	—	250 kHz
Sine/cosine input voltage	Peak-to-peak input voltages of the Sine or Cosine inputs.	0.5V (p-p)	2.0V (p-p)

Feedback Power Supply

The IAM and AM power circuit board generates +5V and +9V dc for motor and auxiliary feedback power. Short circuit protection and separate common mode filtering for each channel is included.

Motor and Auxiliary Feedback Power Specifications

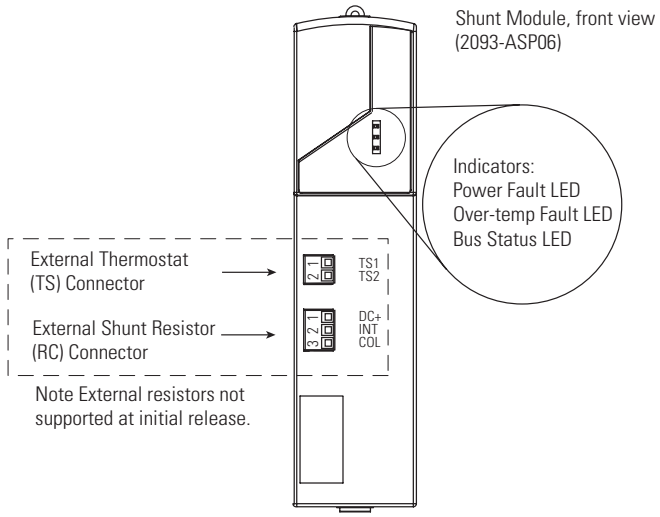
Supply	Reference	Voltage			Total Current (1)
		Min	Nominal	Max	
+5V dc	EPWR_5V	4.93	5.18	5.44	300 mA
+9V dc	EPWR_9V	8.30	9.10	9.90	350 mA

(1) Total current is for both channels, and is independent of usage by the other channel.

Locating Shunt Module Connectors and Indicators

The Kinetix 2000 shunt module (2093-ASP06) is suitable for both 230V applications.

Locating Shunt Module Connectors and Indicators



Shunt Module Connectors

Designator	Description	Connector
TS	Thermal switch connector	Two-position connector housing
RC	External shunt resistor connector	Three-position connector housing

External Thermal Switch Two-pin (TS) Connector Pinout

TS Pin	Description	Signal
1	External passive shunt module thermal switch connections (1), (2)	TS1
2		TS2

(1) Factory default bypasses the external thermal switch by placing a jumper between TS-1 and TS-2.

(2) External shunt resistor is not supported in the initial release of Kinetix 2000.

External Shunt Resistor Three-pin (RC) Connector Pinout

RC Pin	Description	Signal
1	External resistor connection (1), (2)	DC+
2	Internal shunt connection	INT
3	Collector connection	COL

(1) Factory default bypasses the external shunt resistor by placing a jumper between RC-2 and RC-3.

(2) External shunt resistor is not supported in the initial release of Kinetix 2000.

Refer to Wiring 15-pin Panel-mounted Breakout Kit on page 97 when wiring the RC and TS connectors.

Connecting the Kinetix 2000 Drive System

Introduction

This chapter provides procedures for wiring your Kinetix 2000 system components and making cable connections.

Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 2000 drive.

ATTENTION

Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep any metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry, which can result in damage to components.

SHOCK HAZARD

To avoid hazard of electrical shock, perform all mounting and wiring of IAM, AM, SM, LIM, or power rail prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

IMPORTANT

This section contains common PWM servo system wiring configurations, size, and practices that can be used in a majority of applications. National Electrical Code, local electrical codes, special operating temperatures, duty cycles, or system configurations take precedence over the values and methods provided.

Building Your Own Cables

IMPORTANT Factory-made cables are designed to minimize EMI and are recommended over hand-built cables to optimize system performance.

- Connect the cable shield to the connector shells on both ends of the cable with a complete 360° connection.
- Use a twisted pair cable whenever possible. Twist differential signals with each other and twist single-ended signals with the appropriate ground return.

Refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001 for low profile connector kit, drive-end (mating) connector kit, and motor-end connector kit catalog numbers.

Routing Power and Signal Wiring

Be aware that when you route power and signal wiring on a machine or system, radiated noise from nearby relays, transformers, and other electronic drives can be induced into motor or encoder feedback signals, input/output communications, or other sensitive low voltage signals. This can cause system faults and communication problems.

Refer to Minimizing Electrical Noise on page 26 for examples of routing high and low voltage cables in wireways, and to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for more information.

Determining Your Type of Input Power

Before wiring input power to your Kinetix 2000 system, you must determine the type of input power you are connecting to. The IAM is designed to operate in both grounded and ungrounded environments.

ATTENTION

When using a LIM with your Kinetix 2000 drive, the ac input power to the VAC LINE terminal must come from a grounded configuration. This is shown in the Grounded Three-phase Power Configuration (WYE secondary) diagram on page 64.

When not using a LIM with your Kinetix 2000 drive, ungrounded configurations are permitted, but you must set the jumper to prevent high electrostatic build-up.

Refer to Setting the Ground Jumper in Ungrounded Power Configurations on page 69 for more information.

The following three-phase power distribution configurations are supported by your Kinetix 2000 system.

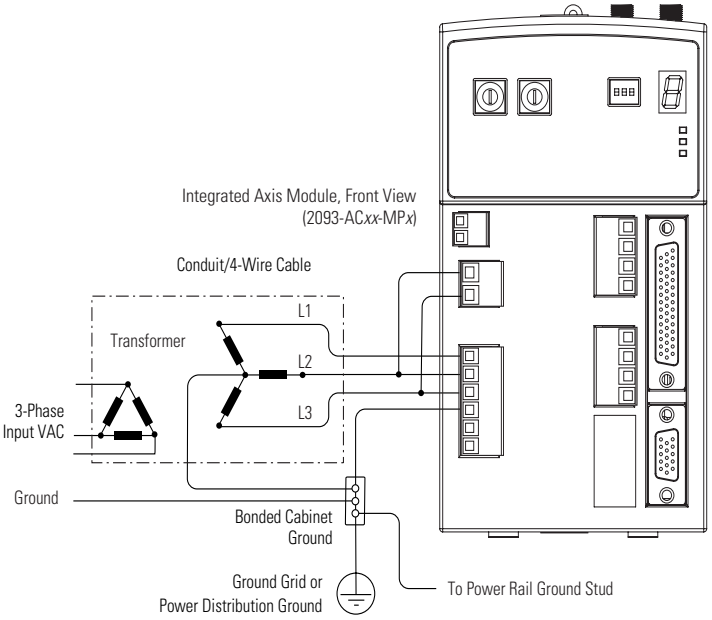
Kinetix 2000 Power Distribution Configurations

Main Power, ac	Auxiliary Control Power Supply
Grounded Wye	Line to Neutral
	Line to Line
Ungrounded Wye	Line to Neutral
	Line to Line
Grounded B Phase Wye	Line to Neutral, Except Grounded Phase
	Line to Grounded B Phase
	Line to Line
Grounded B Phase Closed Delta	Line to Grounded Phase
	Line to Ungrounded Phase
Closed Delta Ungrounded	Line to Line
Open Delta Grounded B Phase	Line to Grounded Phase
	Line to Ungrounded Phase
Open Delta Grounded	Closed Phase to Closed Phase
	Open Phase to Closed Phase

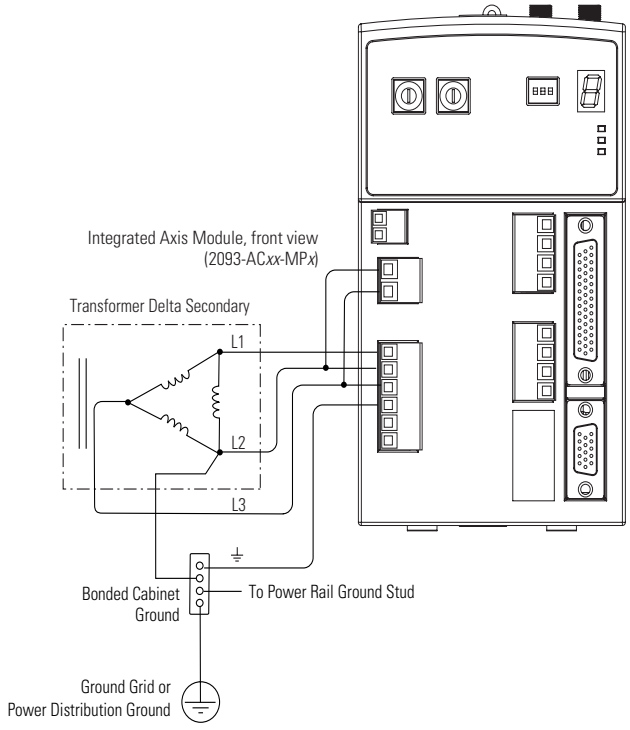
Grounded Three-phase Power Configurations

The grounded (WYE) power configuration lets you ground your three-phase power at a neutral point. This type of grounded power configuration is preferred.

Grounded Three-phase Power Configuration (WYE secondary)



Grounded Three-phase (B-phase) Power Configuration (Delta secondary)



The integrated axis module (IAM) has a factory-installed ground jumper configured for grounded power distribution.

IMPORTANT If you determine that you have grounded power distribution in your plant, you do not need to modify your IAM.

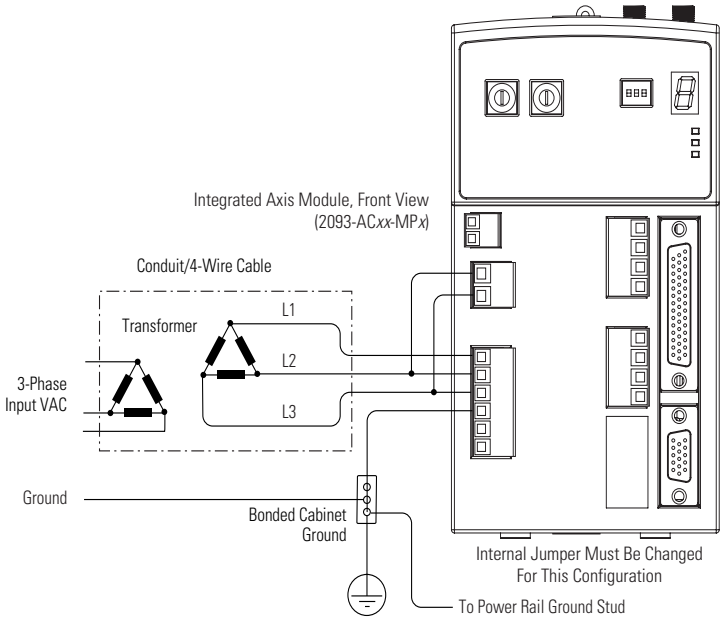
Ungrounded Three-phase Power Configurations

Ungrounded power configurations are allowed, but you must jumper across a resistor (internal to the IAM) to prevent high electrostatic build-up. The ungrounded power configuration (shown below) does not provide a neutral ground point. The IAM has a ground jumper set for grounded power distribution (default configuration).

IMPORTANT If you determine that you have ungrounded power distribution in your facility, you need to move the default jumper (configured for grounded power) to the ungrounded power position to prevent electrostatic buildup inside the IAM.

Refer to the Setting the Ground Jumper in Ungrounded Power Configurations on page 69 for more information.

Ungrounded Three-phase Power Configuration (delta secondary)

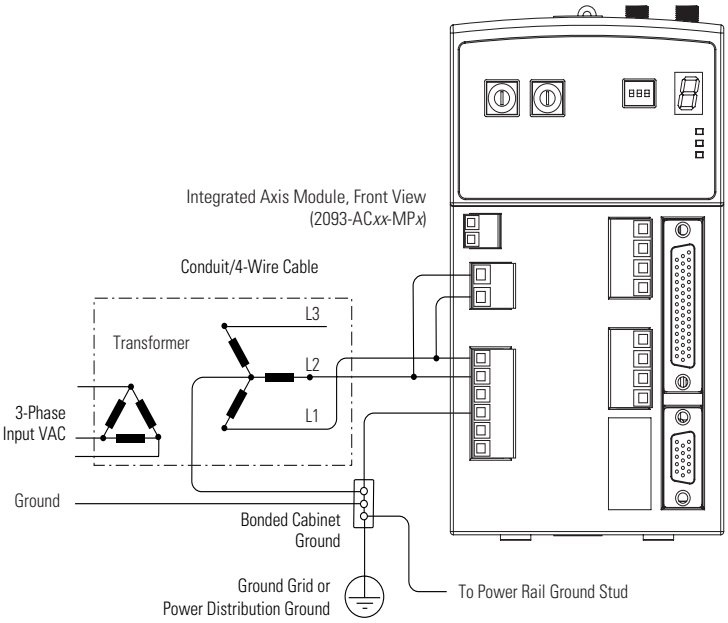


ATTENTION Ungrounded systems do not reference each phase potential to a power distribution ground. This can result in an unknown potential to earth ground.

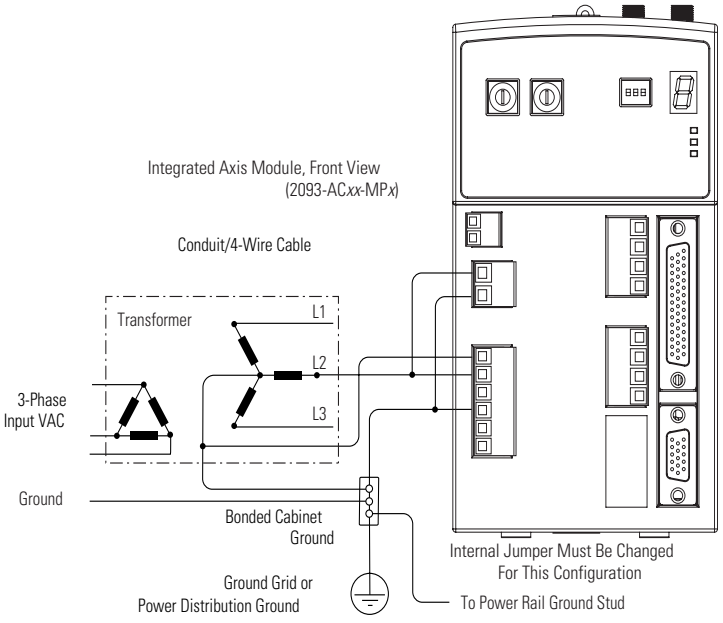
Grounded Single-phase Power Configurations

Common single-phase power configurations with both line-to-line and line-to-neutral connections are acceptable.

Single-phase Power Configuration (line-to-line)



Single-phase Power Configuration (line-to-neutral)



DC Common Bus Configurations

When an integrated axis module (IAM) is used in a dc common bus configuration, the IAM is known as a leader IAM or follower IAM. The IAM (non-common bus) and leader IAM have identical three-phase input power connections. The leader IAM is responsible for discharging the dc bus, and for providing common bus follower drives with dc bus pre-charge, bus regulation, phase-loss detection, and ground fault detection. Follower IAMs do not have three-phase input power connections, but have dc bus connections from a leader IAM.

IAM Terminology and Use

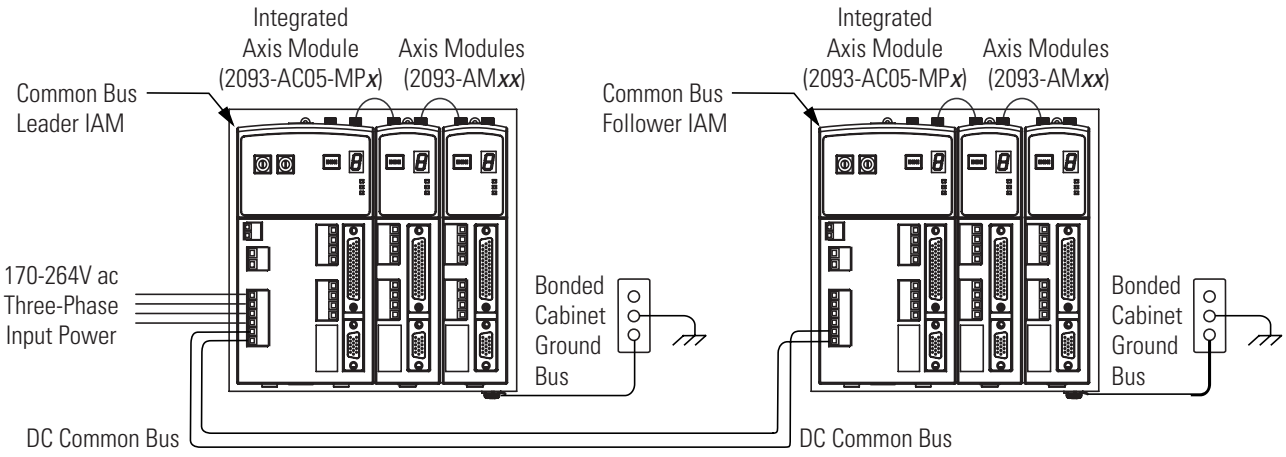
This IAM	Is Wired	And is
IAM	With three-phase input power.	Not wired in common bus mode.
Leader IAM	With three-phase input power, but has dc common bus connections to a follower IAM.	Wired in common bus mode.
Follower IAM	Without three-phase input power, but has dc common bus connections from a leader IAM.	Wired in common bus mode and configured using RSLogix 5000 software.

IMPORTANT Use Kinetix 2000 drive firmware v1.95.18 and RSLogix 5000 software, version 16 or later, for common dc bus power configurations.

The Kinetix 2000 leader IAM can operate with non-Kinetix 2000 follower drives, as can the Kinetix 2000 follower IAM operate with non-Kinetix 2000 common bus leader drives. However, non-Kinetix 2000 leader and follower drives must meet the same functional requirements as the Kinetix 2000 leader and follower IAMs.

IMPORTANT Any non-Kinetix 2000 common bus leader that does not provide pre-charge is required to add an additional external pre-charge circuit before connecting to any Kinetix 2000 common bus follower IAM.

Typical Common Bus Configuration



Common Bus Fusing Requirements

When using a Kinetix 2000 leader IAM, dc bus fuses are only required when wiring to more than one Kinetix 2000 follower IAM. When wiring multiple follower IAMs, terminal blocks are required to extend the dc common bus power to additional drives. Fuses should be installed in both lines of the dc bus between the dc bus terminal block and each follower IAM. These fuses should be rated based on the dc input current of each follower IAM.

When using a non-Kinetix 2000 common bus leader, dc bus fuses are required in both lines of the dc bus, between the common bus leader and follower IAM. These fuses should be rated based on the leader's dc output current. When using more than one follower IAM, fuses should be installed in both lines of the dc bus between the non-Kinetix 2000 common bus leader and the terminal block as well as between the dc bus terminal block and each follower IAM.

Refer to Circuit Breaker/Fuse Specifications on page 157 for recommended fuse sizes. Refer to DC Common Bus Wiring Examples on page 174 for interconnect diagrams.

Setting the Ground Jumper in Ungrounded Power Configurations

Setting the ground jumper is only necessary when using an ungrounded power configuration. Setting the jumper involves removing the IAM from the power rail, opening the IAM, and moving the jumper.

Setting the ground jumper is best done when the integrated axis module (IAM) is removed from the power rail and placed face-up on a solid surface equipped as a grounded static safe workstation.

ATTENTION

To avoid personal injury and/or equipment damage, remove the IAM from the power rail before setting the ground jumper.

To remove the IAM from the power rail, refer to Remove Modules from the Power Rail on page 150.

IMPORTANT

If you have grounded power distribution, you do not need to reposition the ground jumper.

Refer to Grounding Your System on page 71 for more information.

When using ungrounded input power in common bus configurations, use the table below to determine where to set the ground jumper.

Ground Jumper Setting

If Leader Drive is	and Follower Drive is	Then Set the Jumper in This Drive
Kinetix 2000 IAM	Kinetix 2000 IAM	Leader Drive
Kinetix 2000 IAM	non-Kinetix 2000 IAM	Leader Drive
non-Kinetix 2000 IAM	Kinetix 2000 IAM	Follower Drive if no setting exists in the leader drive.

Set Ground Jumper

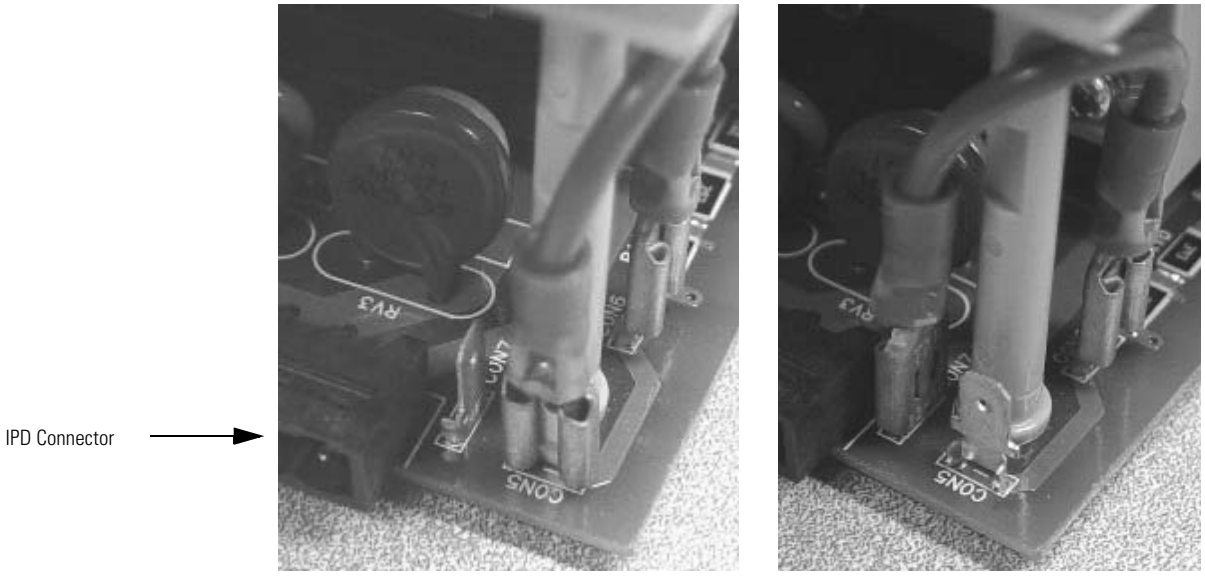
Follow these steps to set the ground jumper.

1. Remove the front panel on your IAM.

IMPORTANT

Disconnect all headers from the electrical connectors, and the SERCOS fiber optic cables on the IAM, before attempting to remove the front panel.

IAM Ground Jumper Connections



Grounded Input Power Configuration
(Factory Default)
CON5 Jumpered to CON6

Ungrounded Input Power Configuration
(Field Selected)
CON6 Jumpered to CON7

2. Move the jumper wire to connect CON6 and CON7 pins.

IMPORTANT The jumper wire and connections (CON5, CON6, and CON7) are located on the lower front of the Power Converter (leftmost) board, below the Input Power (IPD) connector.

The factory default configuration for grounded power has the jumper installed between CON5 and CON6.

3. Replace the IAM front panel.

4. Remount the IAM on the power rail.

Refer to Replace Modules on the Power Rail on page 151.

Grounding Your System

All equipment and components of a machine or process system should have a common earth ground point connected to chassis. A grounded system provides a ground path for short circuit protection. Grounding your modules and panels minimize shock hazard to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis.

ATTENTION

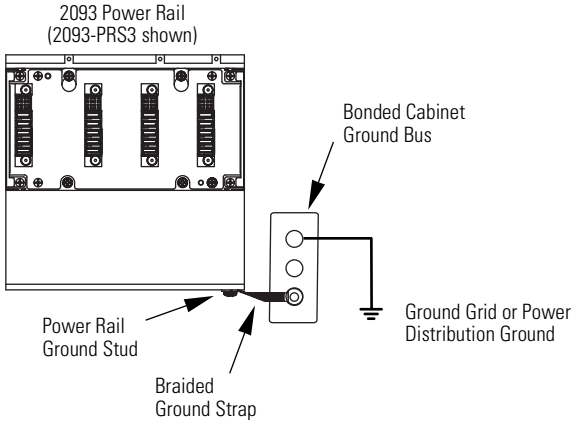
The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system.

For CE grounding requirements, refer to Agency Compliance on page 17.

Grounding Your System to the Subpanel

The 2093 power rail (2093-PRS*xx*) ships with a braided ground strap, 100 mm (3.9 in.). The ground strap connects the power rail ground stub to the bonded cabinet ground bus.

Connecting the Braided Ground Strap Examples



For power rail dimensions, refer to the Kinetix 2000 Power Rail Installation Instructions, publication 2093-IN004.

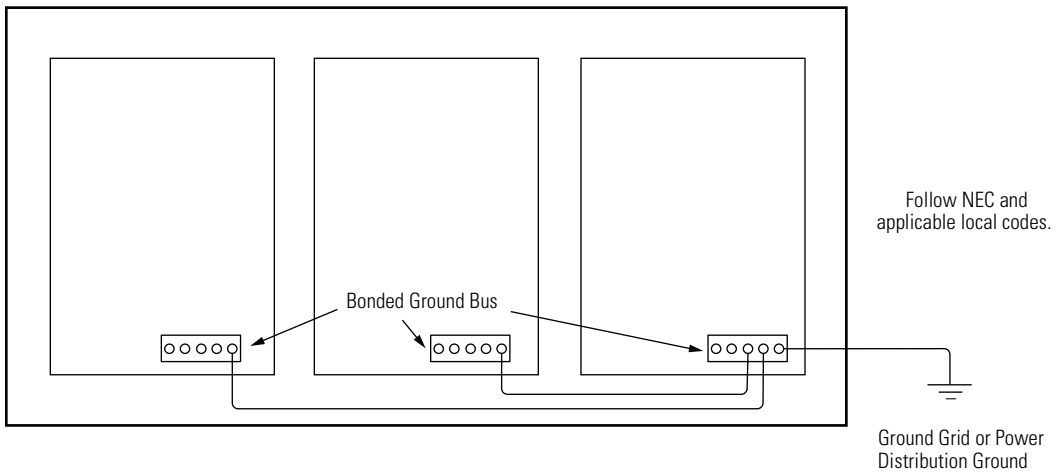
IMPORTANT

When 2094 mounting brackets may be used to mount a LIM over the ac line filter, the braided ground strap must be attached to a mounting bracket ground stud.

Grounding Multiple Subpanels

Extending the chassis ground to multiple subpanels is illustrated in the figure below. High-frequency (HF) bonding is not illustrated.

Subpanels Connected to a Single Ground Point



For HF bonding information, refer to Bonding Modules on page 26.

Power Wiring Requirements

Wire should be copper with 75 °C (167 °F) minimum rating. Phasing of main ac power is arbitrary and earth ground connection is required for safe and proper operation.

Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a 360° clamp termination.

IMPORTANT The National Electrical Code and local electrical codes take precedence over the values and methods provided.

IAM Power Wiring Requirements

Module	Catalog Number	Description	Connects to Terminals		Recommended Wire and Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
			Pin	Signal			
IAM	2093-AC05-MP*x*	Control input power	CPD-1	CTRL 1	Solid H05(07) V-U: 2.5(14) Stranded H07 V-R: 2.5(14) Flexible H05(07) V-K: 2.5(14) Flexible with ferrule:2.5(14)	7 (0.28)	0.5 (4.4)
			CPD-2	CTRL 2			
		DC bus [1] and V ac input power	IPD-1 IPD-2 IPD-3 IPD-4 IPD-5 IPD-6	L1 L2 L3 ⏚ DC+ DC-		7 (0.28)	0.5 (4.4)
		Contactor Enable	CED-1	CONT EN+	Solid H05(07) V-U: 1.5(16) Stranded H07 V-R: 1.5(16) Flexible H05(07) V-K: 1.5(16) Flexible with ferrule:1.5(16) [2]	6.5 (0.26)	0.5 (4.4)
			CED-2	CONT EN-			

[1] DC common bus connections (leader IAM to follower IAM) should be kept as short as possible.

[2] The actual gauge of the contactor enable wiring depends on the system configuration. Consult your machine builder, the NEC, and applicable local codes.

ATTENTION

To avoid personal injury and/or equipment damage, make sure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.

To avoid personal injury and/or equipment damage, make sure motor power connectors are used for connection purposes only. Do not use them to turn the unit on and off.

To avoid personal injury and/or equipment damage, make sure shielded power cables are grounded to prevent potentially high voltages on the shield.

IAM/AM Power Wiring Requirements

Module	Catalog Number	Description	Connects to Terminals		Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
			Pin	Signal			
IAM or AM	2093-AC05-MP*x*, 2093-AMP*x*, or 2093-AM0*x*	Motor power	MP-1 MP-2 MP-3 MP-4	U V W ⏚	Solid H05(07) V-U: 2.5(14) Stranded H07 V-R: 2.5(14) Flexible H05(07) V-K: 2.5(14) Flexible with ferrule: 2.5(14) (1) 6 (12) max	7 (0.28)	0.5 (4.4)
		Brake control and power	BC-1 BC-2 BC-3 BC-4	PWR MBRK+ MBRK- COM	Solid H05(07) V-U: 0.75(18) Stranded H07 V-R: 0.75(18) Flexible H05(07) V-K: 0.75(18) Flexible with ferrule: 0.75(18)		

1) The gauge of the motor power wiring is dependent on the drive and motor combination. Consult your machine builder, the NEC, and applicable local codes.

Shunt Module Power Wiring Requirements

Module	Catalog Number	Description	Connects to Terminals		Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
			Pin	Signal			
SM	2093-ASP06	DC bus to external passive shunt module, catalog number 1336-MOD-KA005 (1)	RC-1	DC+	10 (8) (2)	7 (0.28)	0.5 (4.4)
			RC-2	INT			
			RC-3	COL			
		Thermal switch (1)	TS-1	TS1	0.75 (18)		
			TS-2	TS2			

1) External shunt resistor is not supported in the initial release of Kinetix 2000 drive.

2) Requires copper wire rated for 105 °C (221 °F), 600V.

Refer to Power Specifications on page 154 for additional information, and to the Power Wiring Examples on page 169 for interconnect diagrams.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. You are required to follow static control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged.

If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, Guarding Against Electrostatic Damage or any other applicable ESD Protection Handbook.

ATTENTION

To avoid personal injury and/or equipment damage, ensure installation complies with specifications regarding wire types, conductor sizes, branch circuit protection, and disconnect devices. The National Electrical Code (NEC) and local codes outline provisions for safely installing electrical equipment.

To avoid personal injury and/or equipment damage, ensure motor power connectors are used for connection purposes only. Do not use them to turn the unit on and off.

To avoid personal injury and/or equipment damage, ensure shielded power cables are grounded to prevent potentially high voltages on the shield.

Wiring Guidelines

Use these guidelines as a reference when wiring the connectors on your Kinetix 2000 drive modules (IAM or AM) or line interface module (LIM).

IMPORTANT When tightening screws to secure the wires, refer to the tables beginning on page 73 for torque values.

When removing insulation from wires, refer to the tables beginning on page 73 for strip lengths.

Refer to page 43 for the connector locations of the Kinetix 2000 drive modules.

Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a 360° clamp termination.

Refer to Wiring the Motor Power (MP) Connector on page 85 for additional information.

IMPORTANT To achieve best system performance, run wires and cables in the wireways as established in Establishing Noise Zones on page 28.

Refer to the Line Interface Module Installation Instructions, publication 2094-IN005, for LIM power wiring requirements and connector locations. Refer to Wiring Examples beginning on page 168 for interconnect diagrams including the LIM.

Follow these steps when wiring the connectors on your Kinetix 2000 drive modules or line interface module (LIM).

1. Prepare the wires for attachment to each connector plug by removing insulation equal to the recommended strip length.

   IMPORTANT Use caution not to nick, cut, or otherwise damage strands as you remove the insulation.

2. Route the cable/wires to your Kinetix 2000 drive module or LIM.
3. Insert wires into connector plugs.

   Refer to connector pinout tables in Chapter 4 or the interconnect diagrams in Appendix B.

4. Tighten the connector screws.
5. Gently pull on each wire to be sure it does not come out of its terminal. Reinsert and tighten any loose wires.
6. Insert the connector plug into the module connector.

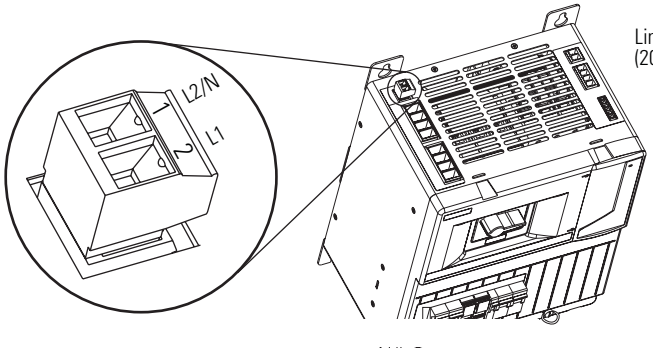
Wiring the LIM Connectors

This section provides examples and wiring tables to assist you in making connections to the line interface module (LIM) connectors.

Wiring the Auxiliary Input Power (APL) Connector

The Auxiliary Input Power (APL) connector is present only on the 2094-XL75S-C*x* models.

Line Interface Module (APL connector)



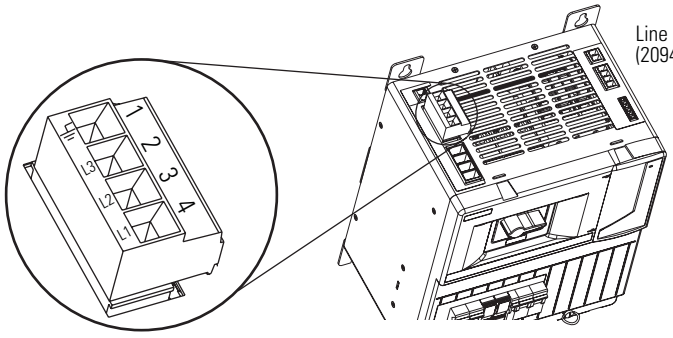
Line Interface Module, Top View
(2094-XL75S-C*x* is shown)

Auxiliary Input Power (APL) Connector

Single-phase Supply	APL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
L1	1	L1	0.2....0 (24...10)	7.0 (0.28)	0.5...0.6 (4.4...5.3)
L2	2	L2/N			

Wiring the VAC LINE (IPL) Connector

Line Interface Module (IPL connector)



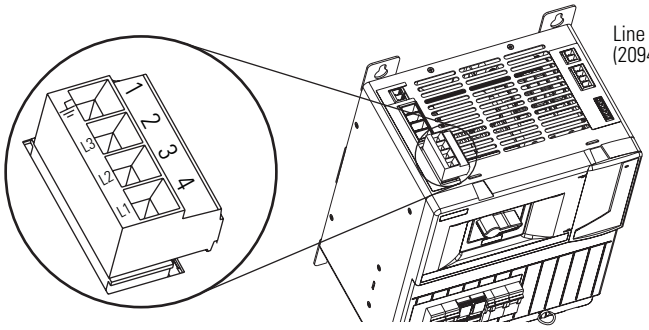
Line Interface Module, Top View
(2094-XL75S-C*x* is shown)

VAC LINE (IPL) Connector (2094-AL09, 2094-AL*xx*S, and 2094-XL75S-C*x*)

Three-phase Supply	IPL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
L1	4	L1	2.5...25 (14...4)	16.0 (0.63)	2.7 (24)
L2	3	L2			
L3	2	L3			
⏚	1	⏚			

Wiring the VAC LOAD (OPL) Connector

Line Interface Module (OPL connector)



Line Interface Module, Top View (2094-XL75S-C*x* is shown)

IMPORTANT Line interface modules (2094-AL*xx*S, and 2094-XL75S-C*x*) are capable of connecting to two IAMs, providing each IAM has its own line filter and the maximum current specification is not exceeded.

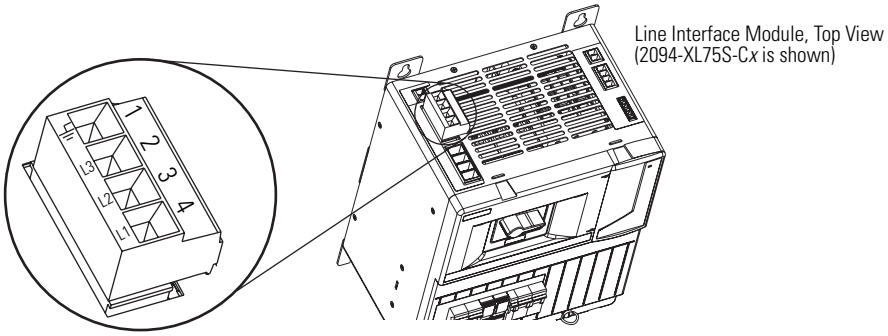
Refer to Power Wiring Examples on page 169 for an example of the LIM wired to two IAMs.

VAC LOAD (OPL) Connector (2094-AL*xx*S, or 2094-XL75S-C*x*)

Three-phase Supply	OPL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
L1	4	L1'	2.5...25 (14...4)	16.0 (0.63)	2.7 (24)
L2	3	L2'			
L3	2	L3'			
⏚	1	⏚			

Wiring the Control Power Output (CPL) Connector

Line Interface Module (CPL connector)



Line Interface Module, Top View
(2094-XL75S-C*x* is shown)

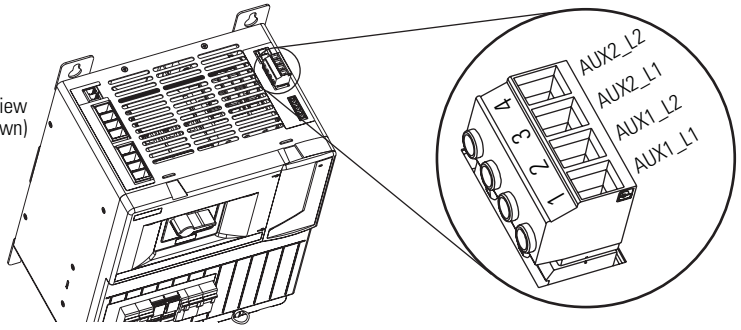
Control Power Output (CPL) Connector
2094-AL*xx*S, 2094-XL75S-C*x*

CPL Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
1	CTRL 1	0.2...4.0 (24...10)	7.0 (0.28)	0.5... 0.6 (4.4... 5.3)
2	CTRL 2			

Wiring the Auxiliary Power Output (P2L) Connector

Line Interface Module (P2L connector)

Line Interface Module, Top View
(2094-XL75S-C*x* is shown)



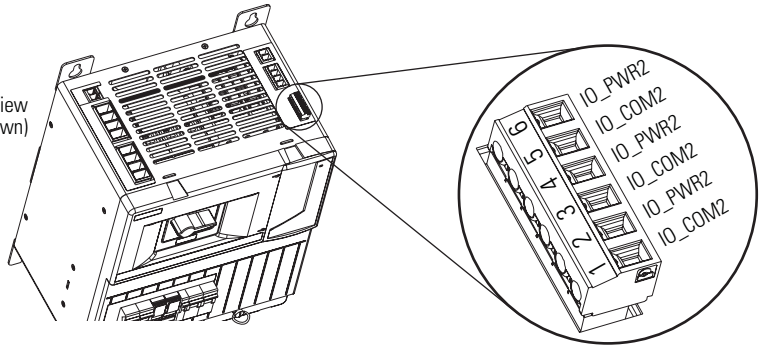
Auxiliary Power Output (P2L) Connector
2094-AL*xx*S, 2094-XL75S-C*x*

P2L Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
1	AUX1_L1	0.2...4.0 (24...10)	7.0 (0.28)	0.5... 0.6 (4.4... 5.3)
2	AUX1_L2			
3	AUX2_L1			
4	AUX2_L2			

Wiring the Brake Power Output (24V dc) Connector

Line Interface Module (24V connector)

Line Interface Module, Top View
(2094-XL75S-C*x* is shown)



Brake Power Output (24V dc) Connector
2094-AL*xx*S, 2094-XL75S-C*x*

P1L Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
1	IO_PWR2	0.08...1.5 (28...16)	7.0 (0.28)	0.5 (4.4)
2	IO_COM2			
3	IO_PWR2			
4	IO_COM2			
5	IO_PWR2			
6	IO_COM2			

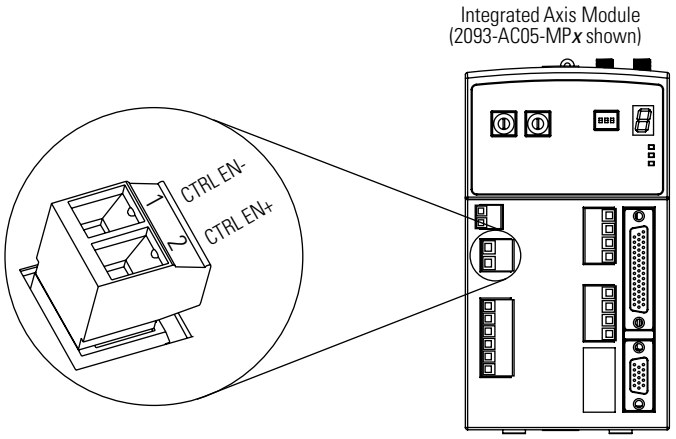
Wiring the IAM/AM Connectors

This section provides examples and wiring tables to assist you in making connections to the integrated axis module (IAM) connectors.

Wiring the Control Power (CPD) Connector

This example applies to an integrated axis module (IAM), leader IAM, or follower IAM.

Integrated Axis Module (CPD connector)



IMPORTANT LIM model (2094-AL75S) will supply up to eight axes. LIM model (2094-XL75S-C*x*) will supply up to sixteen axes.

IMPORTANT Source the 230V IAM control power from the three-phase input power (line-to-line). Supplying 230V control power from any other source requires an isolation transformer. If used, do not ground either output leg of the isolation transformer.

Refer to Control Power Input on page 55 for more information and Single-Phase Power Input (without LIM) to IAM Wiring Example beginning on page 173 for the interconnect drawing.

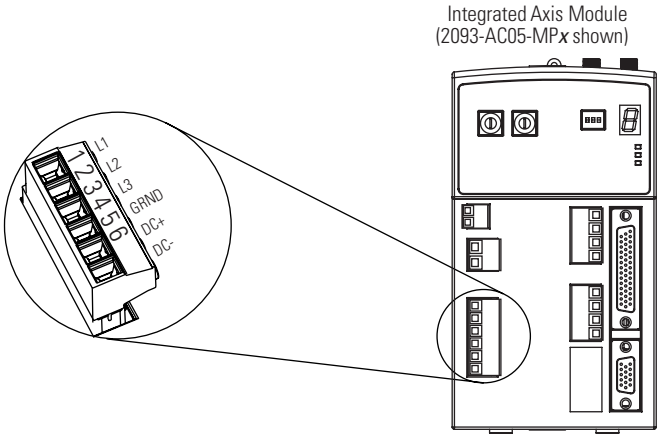
Control Power (CPD) Connector

CPL Connector (LIM) or Other Single-phase Input		CPD Connector (IAM)		Recommended Wire Size mm² (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
2094-AL*xx*S,2094-XL75S-C*x*						
CPL Pin	Signal	CPD Pin	Signal			
1	CTRL 1	1	CTRL EN-	2.5 (14)	7 (0.28)	0.5 (4.4)
2	CTRL 2	2	CTRL EN+			

Wiring the Input Power (IPD) Connector

This example applies to an integrated axis module (IAM) or leader IAM (dc common bus).

Integrated Axis Module (IPD connector)



Input Power (IPD) Connections

IPD Connector (IAM or leader IAM)		OPL Connector (LIM) or Other Three-phase Input	
		2094-AL*xx*S, or 2094-XL75S-C*x*	
IPD Pin	**Signal**	**OPL Pin**	**Signal**
1	L1	4	L1
2	L2	3	L2
3	L3	2	L3
4	⏚	1	⏚
5	DC+	N/A	
6	DC-		

Termination Specifications

Integrated Axis Module Cat. No.	Input V ac	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
2093-AC05-MP*x*	230V ac	2.5 (14)	7 (0.28)	0.5 (4.4)

This example applies to a follower IAM (dc common bus).

Input Power (IPD) Connections

IPD Connector (Follower IAM)		IPD Connector (IAM or leader IAM)	
IPD Pin	**Signal**	**IPD Pin**	**Signal**
N/A	L1	1	L1
	L2	2	L2
	L3	3	L3
	⏚	4	⏚
5	DC+	5	DC+
6	DC-	6	DC-

IMPORTANT Do not connect three-phase input power to the follower IAM.

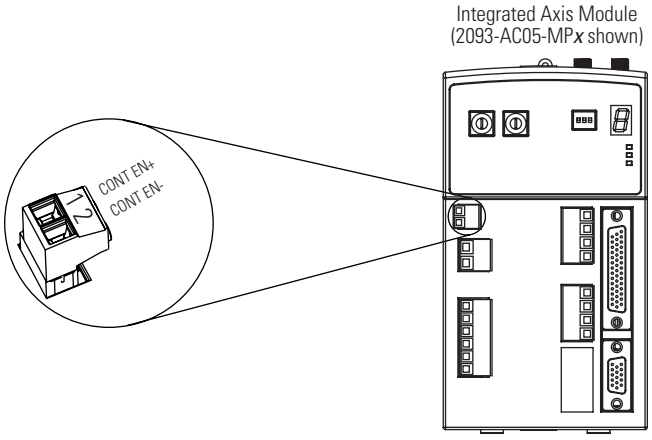
Termination Specifications

Integrated Axis Module Cat. No.	Input V ac	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
2093-AC05-MP*x*	230V ac	2.5 (14)	7 (0.28)	0.5 (4.4)

Wiring the Contactor Enable (CED) Connector

This example applies to any integrated axis module (IAM), leader IAM, or follower IAM.

Integrated Axis Module (CPD connector)



ATTENTION

Wiring the contactor enable relay is required. To avoid personal injury or damage to the drive, wire the contactor enable relay into your safety control string.

Refer to Contactor Enable Relay on page 53.

In common bus configurations, the contactor enable (CED) connections for leader and follower drives must be wired in series to the safety control string.

For interconnect diagrams, refer to Wiring Examples beginning on page 168.

Contactor Enable (CED) Connector

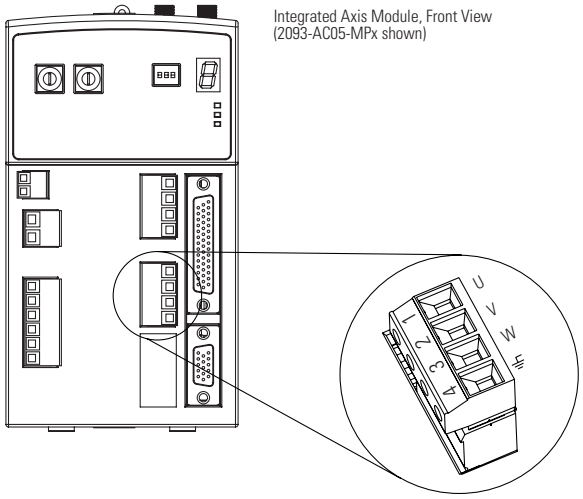
LIM I/O (IOL) Connector or Other Control String 2094-AL*xx*S, 2094-XL75S-C*x*	CED Pin	Signal	Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
IO_COM1	1	CONT EN+	2.5 (14) [1]	10 (0.38)	0.5 (4.4)
COIL_E2	2	CONT EN-			

[1] The actual gauge of the contactor enable wiring depends on the system configuration. Consult your machine builder, the NEC, and applicable local codes.

Wiring the Motor Power (MP) Connector

This example applies to axis modules (AM) and the inverter section of integrated axis modules (IAM).

Integrated Axis Module/Axis Module (MP connector)



Cable Shield Terminations

Factory supplied motor power cables for MP-Series, TL-Series, and Y-Series motors are shielded. The braided cable shield must terminate at the motor end after installation. A small portion of the cable jacket is removed to expose the shield braid. The cable is secured at the motor power (MP) connector plug.

WARNING

To avoid hazard of electrical shock, ensure shielded power cables are grounded at a minimum of one point for safety.

ATTENTION

CE requirements are met without grounding of the cable shield at the drive.

IMPORTANT

For TL-Series and Y-Series motors, also connect the 152 mm (6.0 in.) termination wire to the closest earth ground.

Refer to Pigtail Terminations on page 88 for more information.

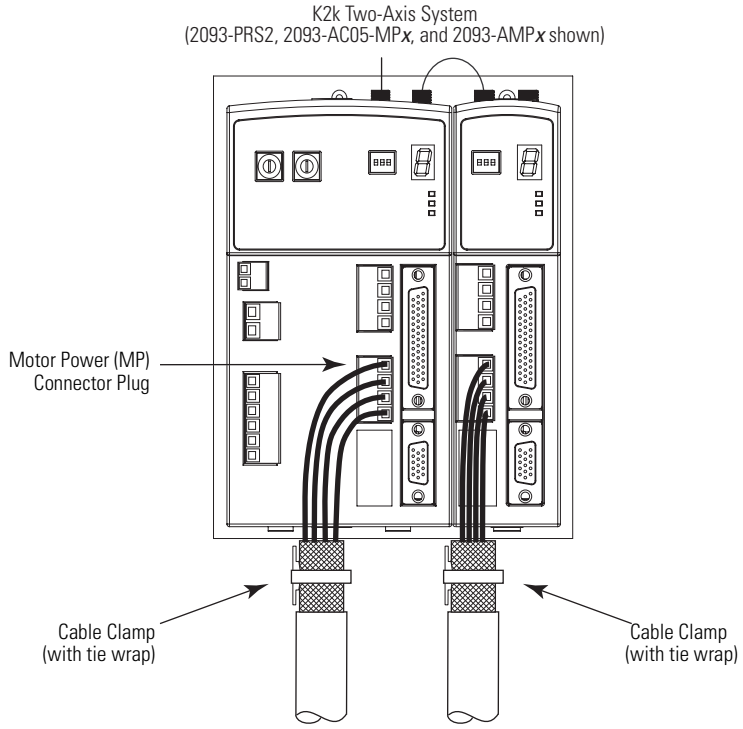
Motor Power Cables with Three-phase Wires Only

Motor	Motor Catalog Number	Motor Power Cable Catalog Number
MP-Series Low Inertia	MPL-A3*xxx*, MPL-A4*xxx*, MPL-A45*xxx*	2090-XXNPMP-*xx*S*xx*
MP-Series Integrated Gear	MPG-A*xxxx*S/M	
TL-Series	TL-A*xxxx*-H	2090-XXNPT-16S*xx*

These cables only contain the three-phase wires and the motors have a separate connector for brake connections. Thermal switch wires are included in the feedback cable.

IMPORTANT No drive-end preparation is required for these cables.

Motor Power Termination (three-phase wires only)



Motor Power Cables with Three-phase and Brake Wires

Motor	Motor Catalog Number	Motor Power Cable Catalog Number
MP-Series Low Inertia	MPL-A15*xxx* and MPL-A2*xxx* V/E	2090-XXNPMF-*xx*S*xx*
MP-Series Food Grade	MPF-A*xxxx*S/M	
MP-Series Stainless Steel	MPS-A*xxxx*S/M	
MPAI Linear Actuator	MPF-A*xxxx*S/M	
TL-Series	TL-A*xxxx*	2090-XXNPT-16Sxx
Y-Series	Y-*xxxx*	2090-XXNPY-16S*xx*

The MP-Series brake wires have a shield braid (shown below as gray) that folds back on the overall cable shield before the conductors are attached to the motor brake (BC) connector. Y-Series brake wires are not shielded.

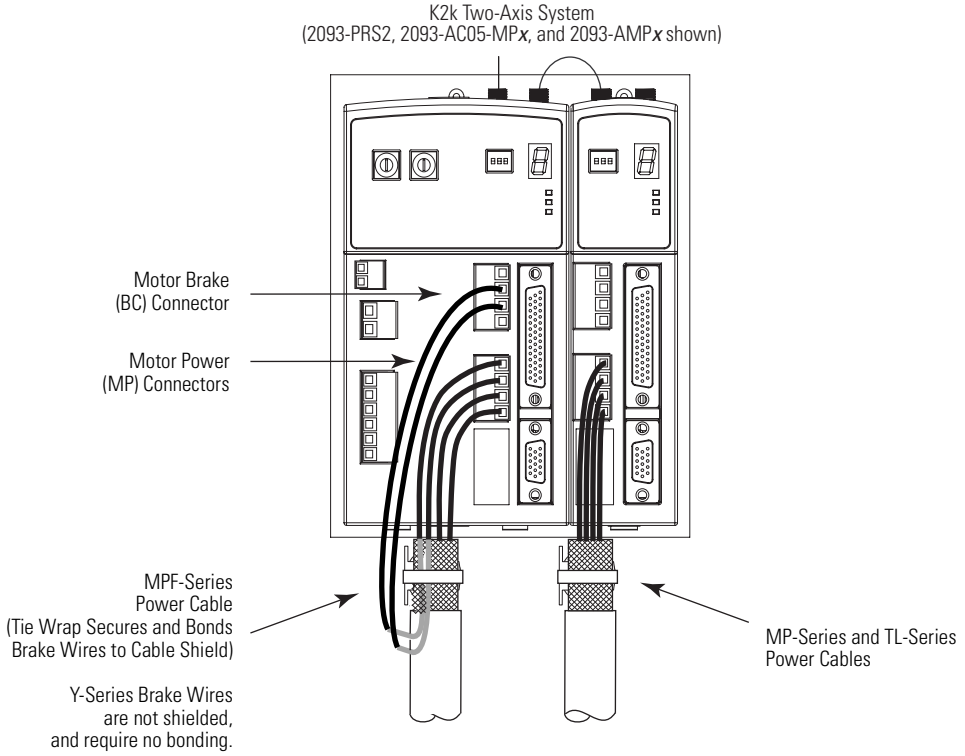
The thermal switch wires for the MP-Series motors are included in the feedback cable.

Refer to Axis Module/Motor Wiring Examples beginning on page 178 for interconnect diagrams.

IMPORTANT No drive-end preparation is required for these cables.

Refer to page 85 for drive-end cable pinouts.

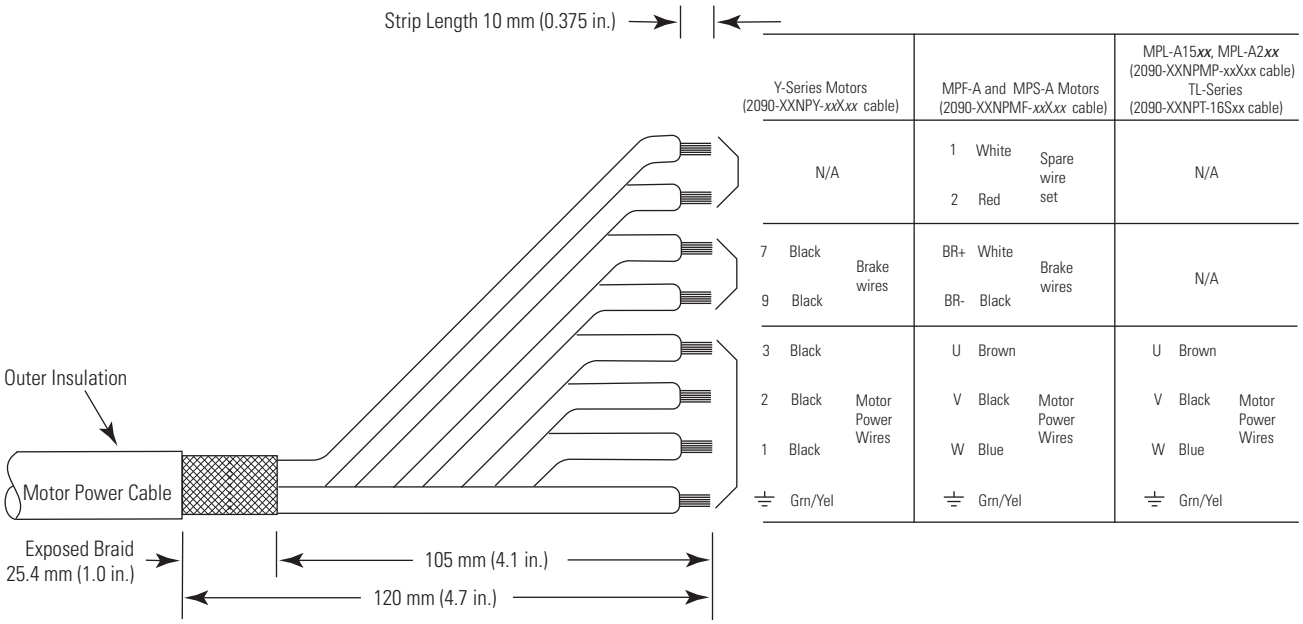
Motor Power Terminations (three-phase and brake wires)



The cable shields shown above are mounted to the power rail.

IMPORTANT Secure the cable shield with a tie wrap is recommended to improve stress relief.

Cable Pinouts (2090-XXNPMF-*xx*S*xx* and 2090-XXNPY-16S*xx*)



Refer to Axis Module/Motor Wiring Examples beginning on page 178 for interconnect diagrams.

Motor Power (MP) Connector

Servo Motor		MP Connector (IAM/AM)	
Y-Series	**MP-Series**	**MP Pin**	**Signal**
1 / Black	U / Brown	1	U
2 / Black	V / Black	2	V
3 / Black	W / Blue	3	W
Green/Yellow	⏚ Green/Yellow	4	⏚

Termination Specifications

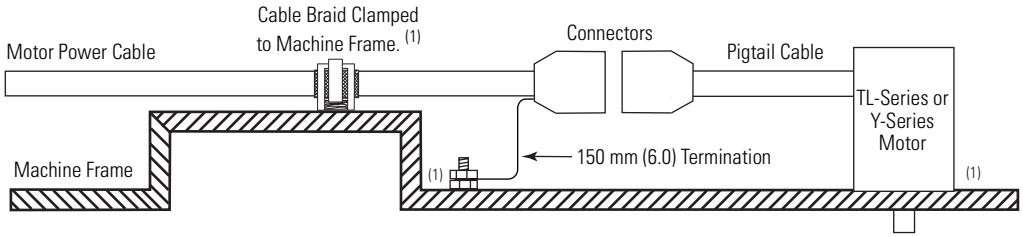
IAM/AM Cat. No.	Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
2093-AC05-MP*x*	Motor power cable depends on motor/drive combination. 4…0.14 (12…26) max	7 (0.28)	0.5 (4.4)
2093-AMP*x*			
2093-AM0*x*			

Pigtail Terminations

TL-Series and Y-Series motors have a short pigtail cable which connects to the motor, but is not shielded. The preferred method for grounding the TL-Series and Y-Series motor power cable on the motor side is to expose a section of the cable shield and clamp it directly to the machine frame. The motor power cable also has a 150 mm (6.0 in.) shield termination wire with a ring lug that

connects to the closest earth ground. The termination wire may be extended to the full length of the motor pigtail if necessary, but it is best to connect the supplied wire directly to ground without lengthening.

Pigtail Terminations

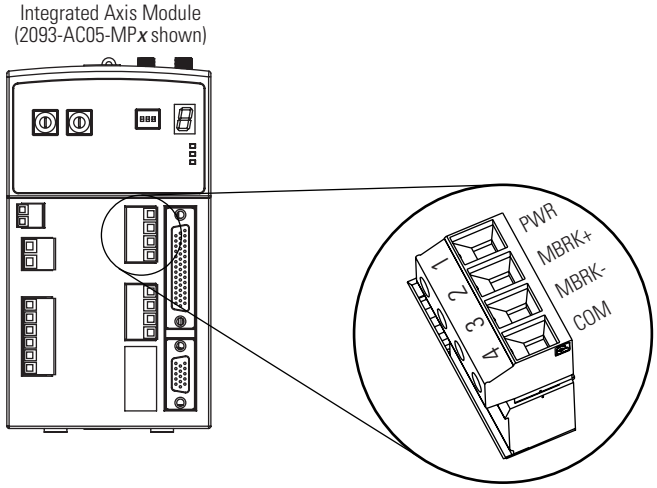


(1) Remove paint from machine frame to ensure proper HF-bond between machine frame and motor case, shield clamp, and ground stud.

Wiring the Motor Brake (BC) Connector

This example applies to axis modules (AM) and the inverter section of integrated axis modules (IAM).

Integrated Axis Module/Axis Module (BC connector)



Wiring 24V dc Brake Input Power Connections

IMPORTANT If your system includes a line interface module (LIM), you can source the 24V dc from the LIM (P1L or PSL connector).

If the number of axes and other unique 24V power loads unique to certain applications exceeds the capability of the LIM, the use of an external power supply, such as those listed below, may be necessary.

Output Power	Input Power	Power Supply
30 W	85...264V ac	1606-XLP30E
50 W		1606-XLP50E
72 W		1606-XLP72E
80 W	85...267V ac	1606-XLS80E
100 W	85...264V ac	1606-XLP100E
120 W	85...267V ac	1606-XLS120E
240 W		1606-XLS240E

Wiring the Motor Brake Connections

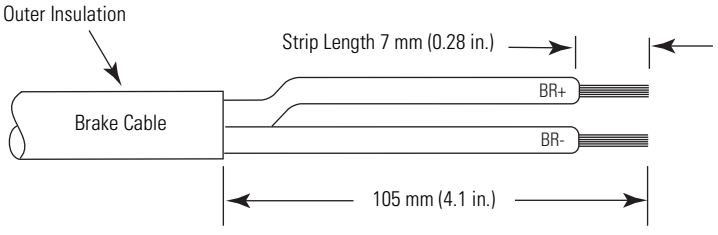
The procedure for wiring your motor brake varies slightly, depending on the motor series you are using. Refer to the table below to determine where the brake wires for your servo motor are located and for the appropriate brake cable or connector kit catalog number.

Motor Series	Brake Wires	Cable Catalog Number
MPL-A3*xxx*, MPL-A4*xxx*, MPL-A45*xxx*	The motor has a brake connector. Brake wires are in the brake cable.	2090-UXNBMP-18S*xx* brake cable
TL-A*xxxx*-H		2090-DANBT-18S*xx* brake cable
MPL-A15*xxx*, MPL-A2*xxx*, MPF-A and MPS-A	The motor does not have a brake connector. Brake wires are included in the power cable.	2090-XXNPMF-*xx*S*xx* power cable
Y-Series		2090-XXNPY-16S*xx* power cable

IMPORTANT Use surge suppression when controlling a brake coil.

Refer to the Controlling a Brake Example on page 181.

Brake Cable Preparation



Motor Brake (BC) Connector

Motor Brake Wires				BC Connector (IAM/AM)	
2090-UXNBMP-18S*xx* Brake Cable	**2090-DANBT-18S*xxx* Brake Cable**	**2090-XXNPMF-*xx*S*xx* Power Cable**	**2090-XXNPY-16S*xx* Power Cable**	**BC Pin**	**Signal**
A / BR+	1 / BR+	F/+ / BR+	7 / BR+	2	BR+
C / BR-	2 / BR-	G/- / BR-	9 / BR-	3	BR-

Termination Specifications

BC Connector (IAM/AM)		Recommended Wire Size mm^2 (AWG)	Strip Length mm (in.)	Torque Value Nm (lb-in.)
BC Pin	**Signal**			
BC-1 BC-2 BC-3 BC-4	PWR MBRK+ MBRK- COM	0.7 (28)	7 (0.28)	0.5 (4.5)

Feedback and I/O Cable Connections

Factory made cables with premolded connectors are designed to minimize EMI and are recommended over hand-built cables to improve system performance. However, other options are available for building your own feedback and I/O cables.

Options for Connecting Motor Feedback and I/O

Connection Option	Connector Kit Catalog Number	Cable	Using this Type of Cable
Premolded connectors	N/A	Motor feedback	Refer to the table below for the premolded motor feedback cable available for your motor.
Low-profile connector	2090-K2CK-D15M	Motor feedback	Refer to the table below for the flying-lead cable available for your motor.
Panel-mounted breakout kits	2090-UXBK-D15*xx*	Motor feedback	Refer to Wiring 15-pin Panel-mounted Breakout Kit on page 97.
	2090-U3BK-D44*xx*	I/O and auxiliary feedback	Refer to Wiring 44-pin Panel-mounted Breakout Kit on page 97.

Motor Feedback Cables for Specific Motor/Feedback Combinations

Motor Series	Feedback Type	Feedback Cable		Pinout
		Premolded	Flying-lead	
MPL-A*xxxx*S/M	High-resolution encoder	2090-UXNFBMP-S*xx*	2090-XXNFMP-S*xx*	Page 93
MPL-A3*xxx*-H MPL-A4*xxx*-H MPL-A45*xxx*-H MPL-A5*xxx*-H	Incremental encoder			
MPG-A*xxxx*-S/M	High-resolution encoder			
MPL-A15*xxx*-H MPL-A2*xxx*-H	Incremental encoder	N/A	2090-XXNFMF-S*xx*	Page 93
MPL-A*xxxx*-V/E	High-resolution encoder			
MPF-A*xxxx*-S/M				
MPS-A*xxxx*-S/M				
TL-A*xxxx*-H	Incremental encoder	2090-XXNFT-S*xx*	2090-XXNFLT-S*xx*	Page 93
Y-Series	Incremental encoder	2090-UXNFBY-S*xx*	2090-XXNFY-S*xx*	Page 94

Flying-lead Feedback Cable Pin-outs

2090-XXNFMP-S*xx* Feedback Cable

Motor Connector Pin	Motors with High Resolution Feedback		Motors with Incremental Encoder Feedback	Drive MF Connector Pin
	MPL-A5*xxx*-M/-S	MPL-A3*xxx*-M/-S MPL-A4*xxx*-M/-S MPL-A45*xxx*-M/-S MPG-A*xxx*-M/-S	MPL-A3*xxx*-H MPL-A4*xxx*-H MPL-A45*xxx*-H MPL-A5*xxx*-H	
A	Sine+	Sine+	AM+	1
B	Sine-	Sine-	AM-	2
C	Cos+	Cos+	BM+	3
D	Cos-	Cos-	BM-	4
E	Data+	Data+	IM+	5
F	Data-	Data-	IM-	10
K	Reserved	EPWR_5V	EPWR_5V	14
L	Reserved	ECOM	ECOM	6
N	EPWR_9V	Reserved	Reserved	7
P	ECOM	Reserved	Reserved	6
R	TS+	TS+	TS+	11
S	TS-	TS-	TS-	–
T	Reserved	Reserved	S1	12
U	Reserved	Reserved	S2	13
V	Reserved	Reserved	S3	8

2090-XXNFMF-S*xx* Feedback Cable

Motor Connector Pin	Motors with High Resolution Feedback		Motors with Incremental Encoder Feedback	Drive MF Connector Pin
	MPF-A5*xx*-M/-S	MPL-A15*xxx*-V/-E MPL-A2*xxx*-V/-E MPF/MPS-A3*xx*-M/-S MPF/MPS-A4*xx*-M/-S MPF/MPS-A45*xx*-M/-S MPS-A5*xx*-M/-S	MPL-A15*xxx*-H MPL-A2*xxx*-H	
1	Sine+	Sine+	AM+	1
2	Sine-	Sine-	AM-	2
3	Cos+	Cos+	BM+	3
4	Cos-	Cos-	BM-	4
5	Data+	Data+	IM+	5
6	Data-	Data-	IM-	10
9	Reserved	EPWR_5V	EPWR_5V	14
10	Reserved	ECOM	ECOM	6
11	EPWR_9V	Reserved	Reserved	7
12	ECOM	Reserved	Reserved	6

Motor Connector Pin	Motors with High Resolution Feedback		Motors with Incremental Encoder Feedback	Drive MF Connector Pin
	MPF-A5*xx*-M/-S	MPL-A15*xxx*-V/-E MPL-A2*xxx*-V/-E MPF/MPS-A3*xx*-M/-S MPF/MPS-A4*xx*-M/-S MPF/MPS-A45*xx*-M/-S MPS-A5*xx*-M/-S	MPL-A15*xxx*-H MPL-A2*xxx*-H	
13	TS+	TS+	TS+	11
14	TS-	TS-	TS-	–
15	Reserved	Reserved	S1	12
16	Reserved	Reserved	S2	13
17	Reserved	Reserved	S3	8

2090-XXNFY-S*xx* Feedback Cable		
Motor Connector Pin	Incremental Encoder Feedback	Drive MF Connector Pin
	Y-Series Motors	
9	AM+	1
10	AM-	2
11	BM+	3
12	BM-	4
13	IM+	5
14	IM-	10
15	S1	12
17	S2	13
19	S3	8
22	EPWR_5VM	14
23	ECOMM	6
24	Drain	Connector Housing
Reserved	Reserved	7
Reserved	Reserved	9
Reserved	Reserved	11
Reserved	Reserved	15

Wiring Feedback and I/O Connectors

These procedures assume you have mounted your Kinetix 2000 system, completed all power wiring, and are ready to connect your feedback and I/O cables.

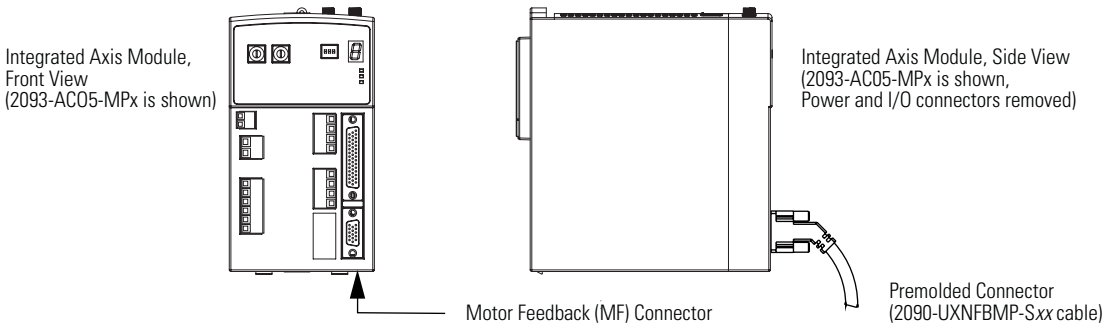
For this connection	Go To
Premolded cable	Connecting Premolded Motor Feedback Cables on page 95.
Low-profile connector	Wiring Low-profile Connector Kits on page 95.
Panel-mounted breakout board	Wiring 15-pin Panel-mounted Breakout Kit on page 97.

Connecting Premolded Motor Feedback Cables

Motor feedback cables with premolded connectors plug directly into 15-pin motor feedback (MF) connectors on either the IAM or AM (no wiring is necessary).

IMPORTANT When using Bulletin 2090 cables with premolded connectors, tighten the mounting screws (finger tight) to improve system performance.

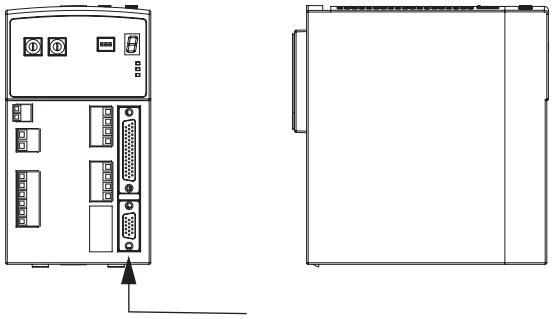
Premolded Feedback Cable Attached to MF Connector



Wiring Low-profile Connector Kits

Low-profile connector kits (2090-K2CK-D15M) are suitable for motor feedback (MF), connections on any IAM or AM.

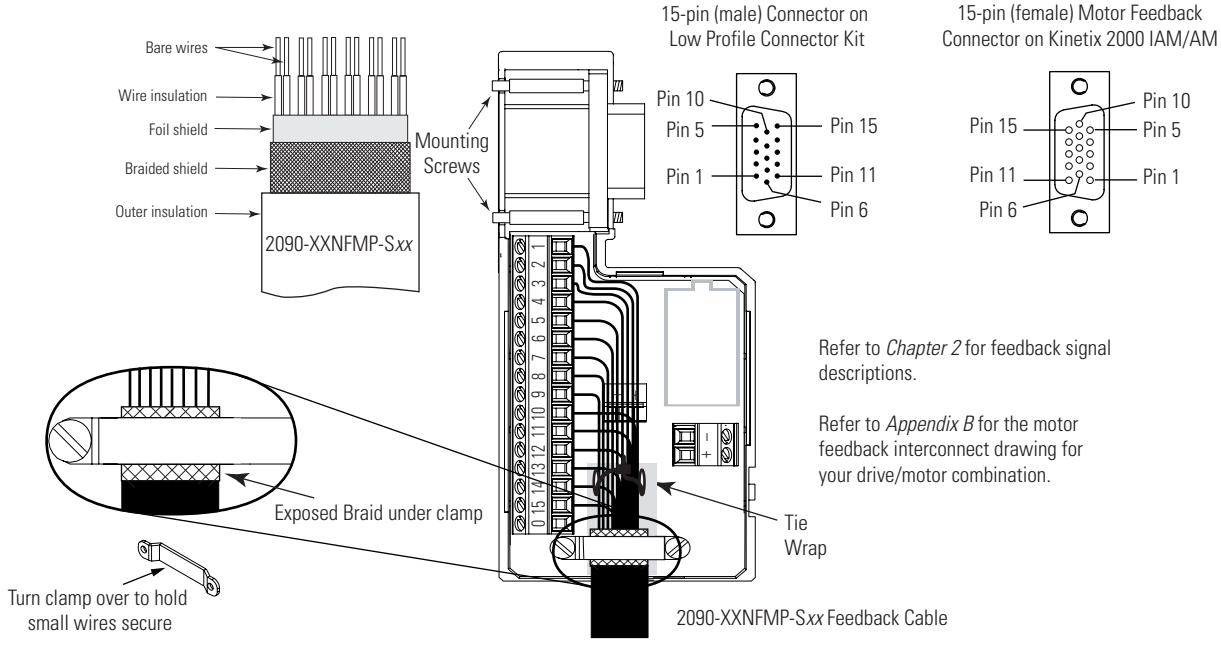
15-pin Connector Kit and Flying Lead Cable attached to MF Connector)



IMPORTANT Torque the screws on the connector cover to 0.4 Nm (3.5 lb-in.).

Tightening the cover mounting screws is essential for shield integrity.

Wiring (15-pin) Flying-lead Feedback Cable Connections
2090-XXNF*xx*-S*xx* Feedback Cable

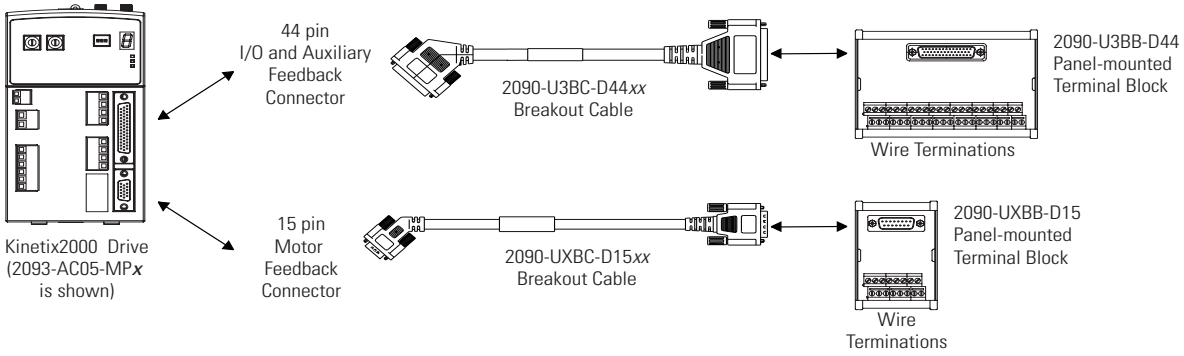


IMPORTANT Clamping the exposed area of the cable braid, and any shield or drain wires under the shield clamp is critical. Turn clamp over, if necessary, to achieve a proper ground connection.

Wiring 15-pin Panel-mounted Breakout Kit

A panel-mounted breakout kit, catalog number 2090-UXBK-D15*xx,* is available. This kit permits connection between a motor feedback device and the motor feedback (MF) connector. A cable connects between a panel-mounted terminal block and the 15-pin motor feedback (MF) connector. Wires from an external motor feedback device interface via the panel-mounted terminal block.

15-pin and 44-pin Breakout Kits for Use with Kinetix2000 Drives



Wiring 44-pin Panel-mounted Breakout Kit

A panel-mounted breakout kit, catalog number 2090-U3BK-D44, is available. This kit permits connection between external devices and the input/output and auxiliary feedback (IOD/AF) connector. A cable connects between a panel-mounted terminal block and the 44-pin I/O and auxiliary feedback (IO/AF) connector. Wires from external devices interface via the panel-mounted terminal block.

IMPORTANT The 15-pin and 44-pin breakout blocks accept wire in the range of 4…0.14 mm^2 (12…26 AWG).

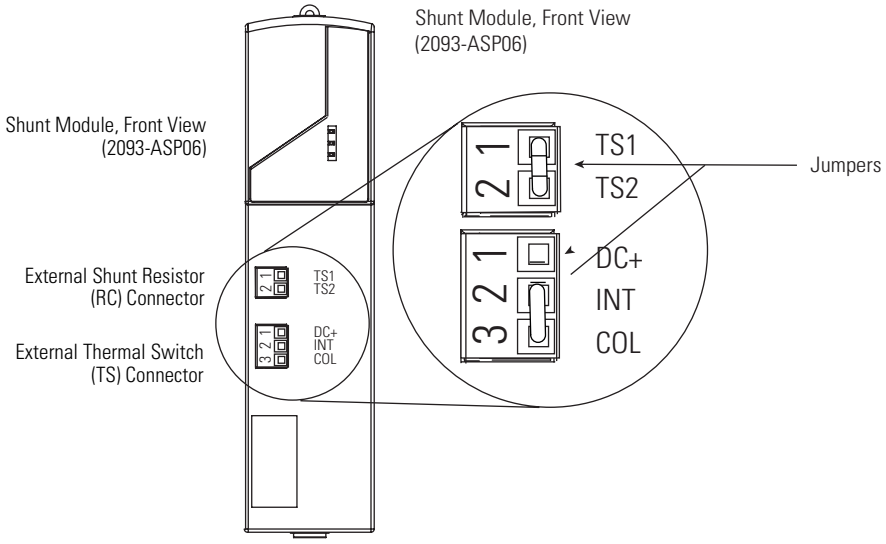
Shunt Module Connections

Follow these guidelines when wiring your shunt.

Shunt Module Wiring

With this shunt module	Cat. No.	Do this
Power rail mounted shunt module.	2093-ASP06	• Verify the internal shunt jumper is in place between RC-2 and RC-3, as shown in the figure below. • Verify the thermal switch jumper is in place between TS-1 and TS-2, as shown in the figure below.

Shunt Module Jumper Settings



(1) These jumpers are factory installed.

Connecting Your SERCOS Fiber-optic Cables

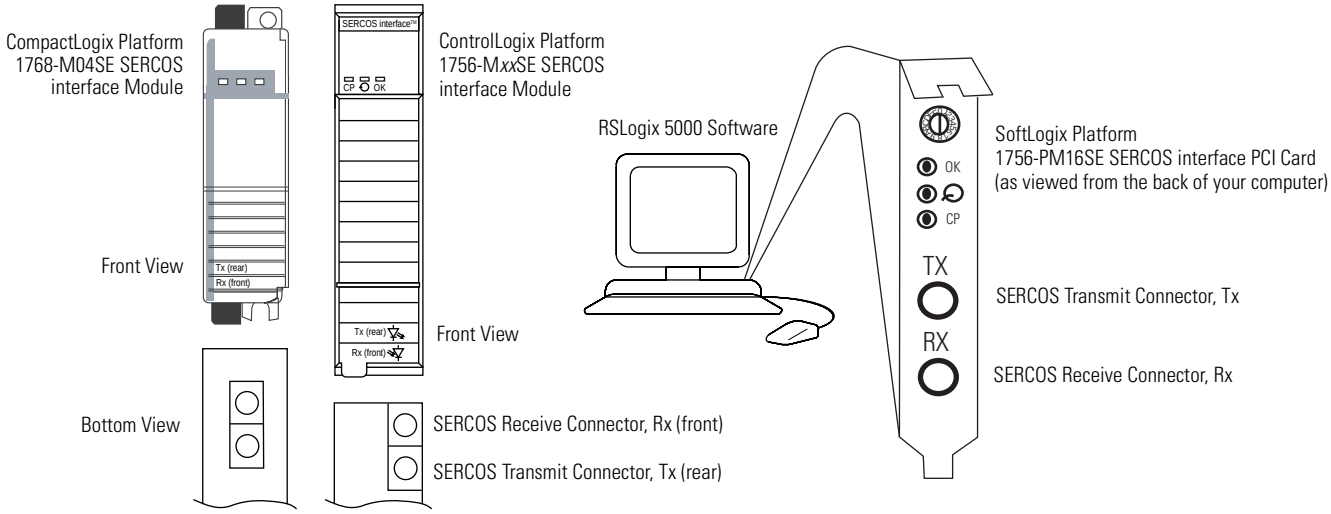
This procedure assumes you have your Logix SERCOS interface module/PCI card and Kinetix 2000 IAM/AM modules mounted and are ready to connect the fiber-optic cables.

Plastic cable is available in lengths up to 32 m (105.0 ft). Glass cable is available in lengths between 50 m (164.2 ft) and 200 m (656.7 ft).

The SERCOS fiber-optic ring is connected using the SERCOS receive (Rx) and transmit (Tx) connectors.

Refer to page 53 to locate the SERCOS connectors on your Kinetix 2000 IAM/AM, and to the figure below to locate the connectors on your SERCOS interface module or PCI card.

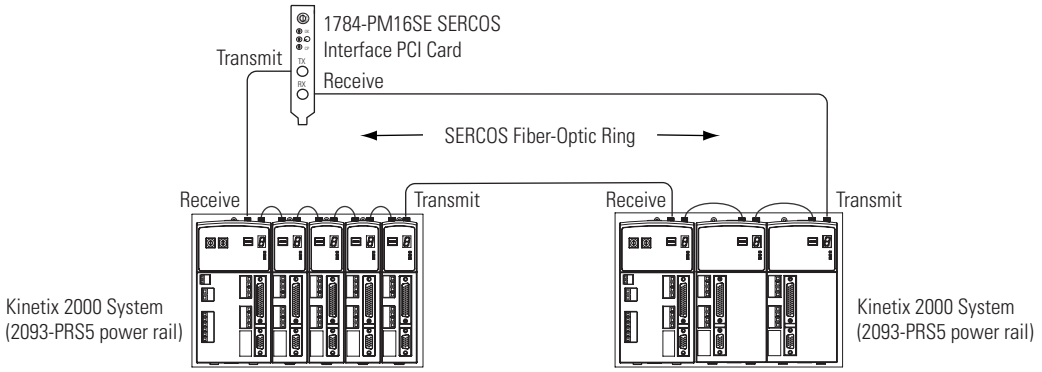
CompactLogix, ControlLogix, and SoftLogix SERCOS Connector Locations



Connect the cable from transmit on the Logix module to receive on the IAM, then transmit to receive (drive to drive), and from transmit on the last drive back to receive on the Logix module.

SoftLogix and ControlLogix platforms are used in the examples beginning below, however, all platforms connect in the same manner.

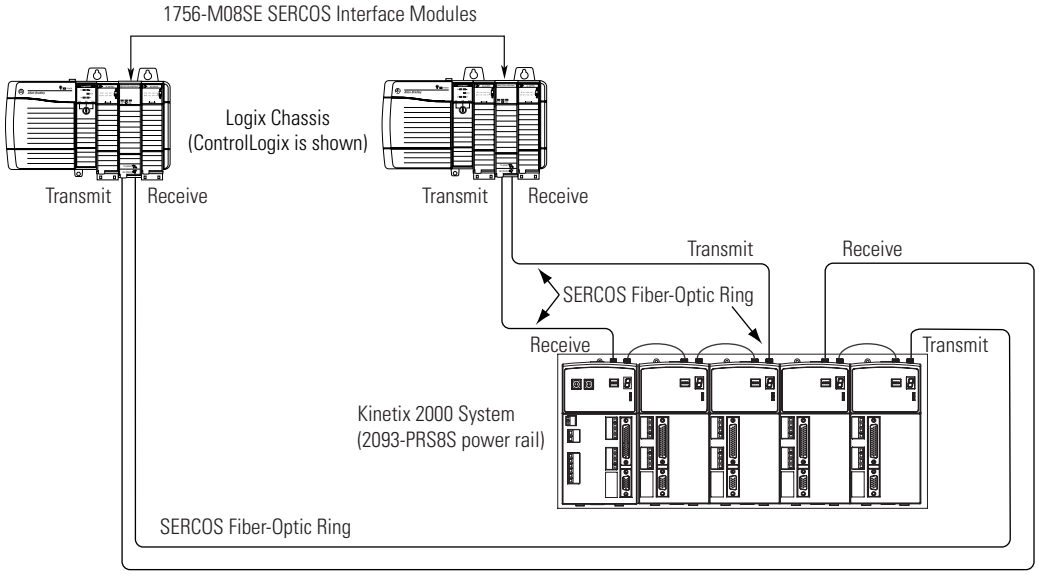
Fiber-optic Cable Example 1 (basic SERCOS ring connections)



IMPORTANT The CompactLogix platform (1768-M04SE) is limited to four axes per module.

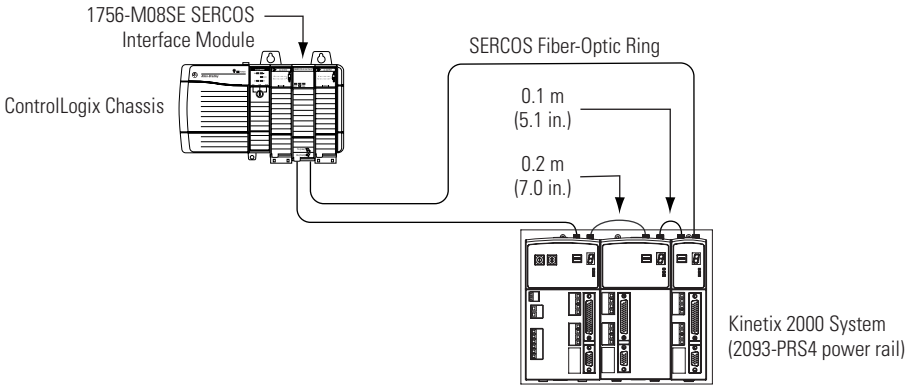
In this example, two Logix modules are installed in separate Logix chassis.

Fiber-optic Cable Example 2 (two Logix chassis)



When connecting a 2093-AC05-MP*x* integrated axis module or 2093-AM0*x* (double-wide) axis modules, use 2090-SCEP0-2, 0.2 m (7.0 in.) cables. When connecting 2093-AMP*x*, (single-wide) axis modules, use 2090-SCEP0-1, 0.1 m (5.1 in.) cables.

Fiber-optic Cable Example 3 (Double-wide Modules)



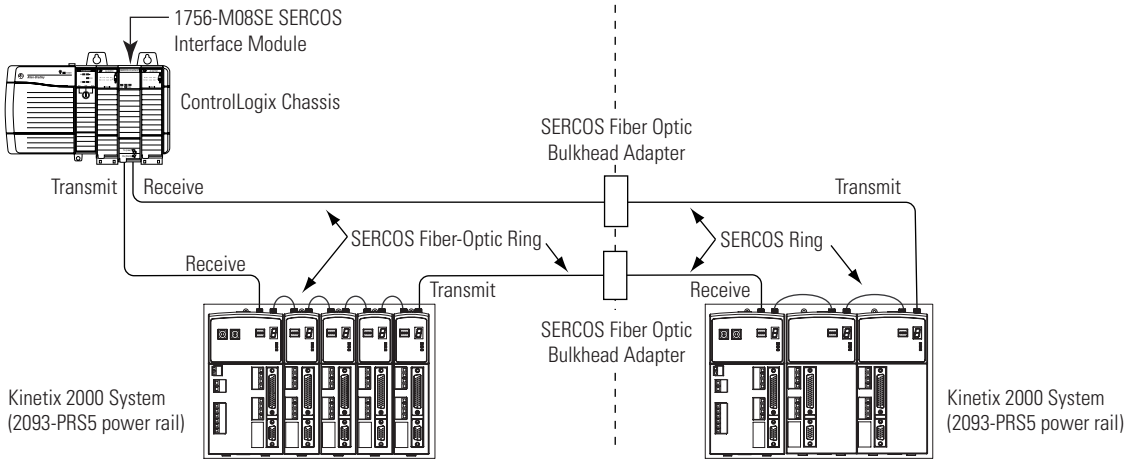
IMPORTANT Clean the fiber-optic cable connectors prior to installation. Dust in the connectors can reduce signal strength.

For more information, refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010.

In this example, the second Kinetix 2000 system is located in a separate cabinet and connected with bulkhead adapters.

IMPORTANT To avoid signal loss, do not use bulkhead adapters to connect glass cables. Use bulkhead adapters only for plastic-to-plastic cable connections.

Fiber-optic Cable Example 4 (bulkhead adapters)



SERCOS Cables

The Kinetix 2000 supports the SERCOS fiber optic cables listed in the table.

Refer to the Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010, for additional information.

SERCOS Cable Selection for Kinetix 2000 Drives

Connection	Adjacent Connection (module to the right)	Catalog Number of SERCOS Cable (1)
2093-AC05-MP1 2093-AC05-MP2 2093-AC05-MP5	2093-AMP1 2093-AMP2 2093-AMP5	2090-SCEP0-1 series B
2093-AC05-MP1 2093-AC05-MP2 2093-AC05-MP5	2093-AM01 2093-AM02	2090-SCEP0-2
2093-AMP1 2093-AMP2 2093-AMP5	2093-AMP1 2093-AMP2 2093-AMP5	2090-SCEP0-1 series B

SERCOS Cable Selection for Kinetix 2000 Drives

Connection	Adjacent Connection (module to the right)	Catalog Number of SERCOS Cable (1)
2093-AMP1 2093-AMP2 2093-AMP5	2093-AM01 2093-AM02	2090-SCEP0-2
2093-AM01 2093-AM02	2093-AM01 2093-AM02	2090-SCEP0-2
2093-AM01 2093-AM02	2093-AMP1 2093-AMP2 2093-AMP5	2090-SCEP0-1 series B

(1) Series B indicates an improved bend radius for use with Kinetix drives.

Configure and Startup the Kinetix 2000 Drive System

Introduction

This chapter provides procedures for configuring your Kinetix 2000 system components with your Logix SERCOS module.

System Configuration Requirements

Configuration of a Kinetix 2000 system requires these products as a minimum.

Product	Catalog Number	Version
RSLogix 5000 software	9324-RLD300NE	16.0 or later
RSLinx	0355-RSLETENE	2.50.00 or later
SERCOS Interface Card Firmware	1756-MxxSE	16.20 or later
	1756-L60M03SE	16.03 or later
	1768-M04SE	16.03 or later
	1784-PM16SE	not released

Configure the IAM/AM

Follow these steps to configure the IAM/AM.

1. Verify that there is no power applied to the IAM/AM and that the SERCOS fiber-optic cables are plugged into the Tx and Rx connectors.

   To verify your fiber-optic cable connections, refer to Connecting Your SERCOS Fiber-optic Cables on page 99.

To configure	Begin with
The integrated axis module (IAM)	Step 2
An axis module (AM)	Step 4

2. Set the base node address for the IAM by rotating the SERCOS Node Address switch.

IMPORTANT When two or more IAMs are connected to the same SERCOS interface module, each node address must be unique.

Refer to the node addressing examples on pages 105, 107 and 108.

Valid node addresses are 01...99. The left hand switch sets the most significant digit (MSD) and the right hand switch sets the least significant digit (LSD).

To	Turn
Increment the (MSD/LSD) node address	rotary switch. clockwise
Decrement the (MSD/LSD) node address	rotary switch counter-clockwise

The node address of the IAM determines the base node address for the power rail. Node addressing for all slot locations on the same power rail increment from left to right (from the IAM to the AMs). Refer to the node addressing examples beginning on page 105.

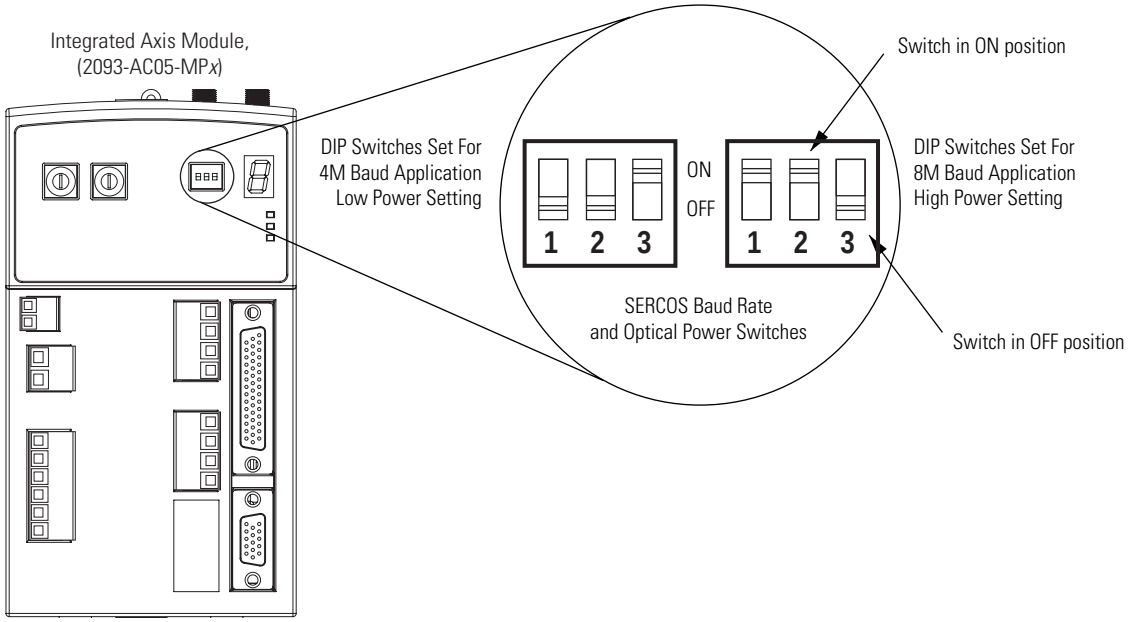
IMPORTANT The base node address setting takes effect only after the IAM is initialized or control power is cycled.

3. Set the SERCOS optical power level using DIP switch 1.

Total Fiber Ring Length	Corresponding Optical Power Switch Setting
≤14 m (46 ft)	OFF (Low)
>14 m (46 ft)	ON (High)

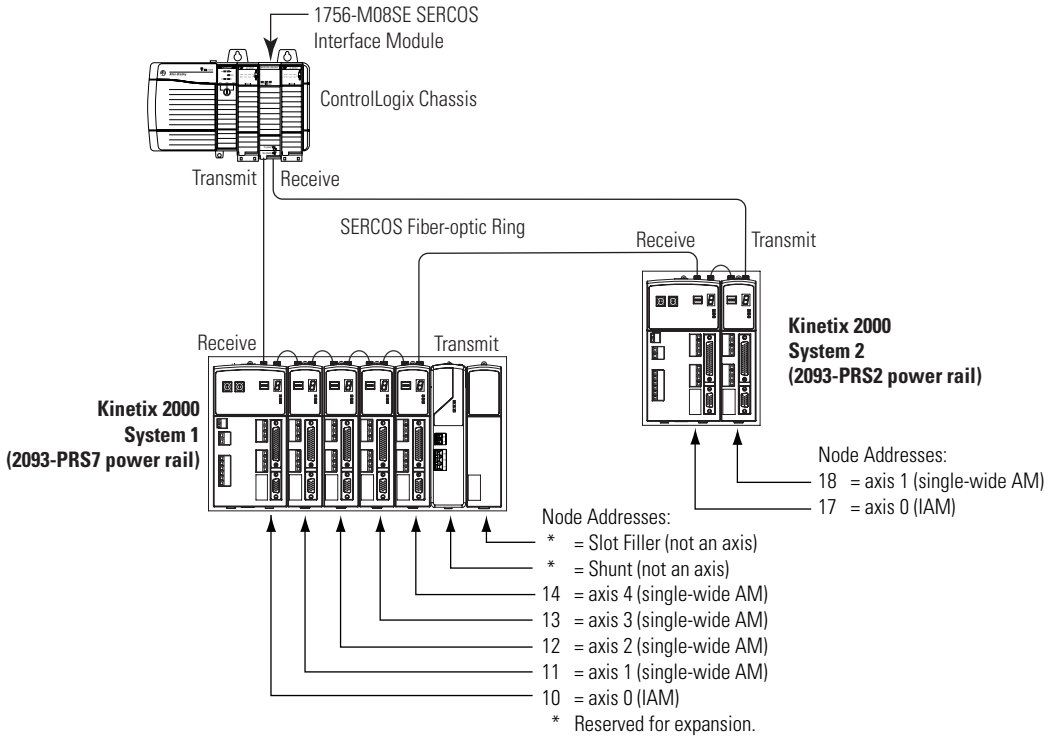
4. Set the SERCOS baud rate using DIP switches 2 and 3.

Baud Rate	Corresponding Baud Rate Switch Settings	
	Switch 2	Switch 3
4 Mbps	OFF	ON
8 Mbps	ON	OFF



5. Repeat steps 3 and 4 for each axis module.

Node Addressing Example 1



In Example 1, the Kinetix 2000 (seven-axis) system 1 power rail contains one IAM, four AMs, a shunt, and one slot filler module. In this example, the shunt module and slot filler do not use the node addresses, although having a slot assignment. The node address can be reserved by not assigning it, and this will provide for future expansion of the system.

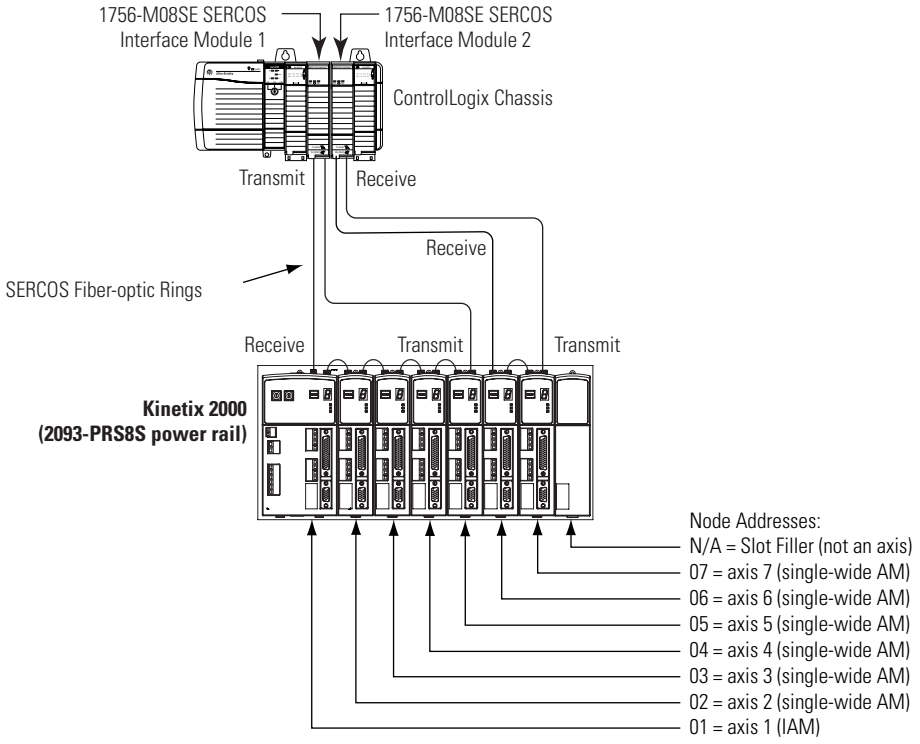
Kinetix 2000 (two-axis) system 2 power rail contains one IAM and one AM. The base node address of the IAM (system 2) must be set for an address of less than 9 or greater than 16 (greater than 16 provides expansion capability for System 1).

IMPORTANT The node address for each axis module is determined by the base node-address switch setting on the IAM.

Do not position axis modules to the right of shunt or slot filler modules. The added distance between non-adjacent axes can increase electrical noise and impedance, and requires longer fiber-optic cable lengths.

IMPORTANT Slot filler modules must be used to fill any unoccupied slot on the power rail. However, the slot fillers may also be removed and replaced by an axis or shunt module in the future.

Node Addressing Example 2



In Example 2, SERCOS interface module 1 controls axes 1...5 and interface module 2 controls axes 6...7. The slot filler (or shunt) module is not assigned a node address, because this slot cannot be occupied by an inverter (IAM or AM) module.

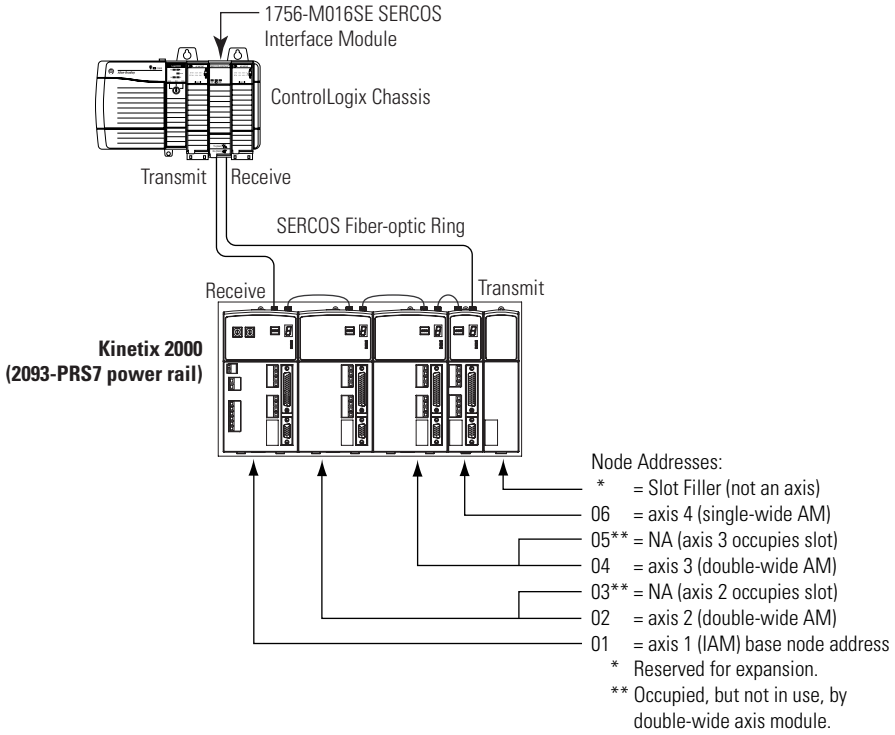
Refer to the Node Addressing Example 4 on page 108, for slot nine restrictions unique to the 2093-PRS8S power rail.

You can mount the two SERCOS interface modules the same chassis (as shown abov.e) or in two separate ControlLogix chassis. Utilizing two SERCOS

interface modules to control axes from a single Kinetix 2000 power rail reduces the cycle times.

IMPORTANT Slot Filler modules must be used to fill any unoccupied slot on the power rail. However, the slot fillers may also be removed and replaced by an axis or shunt module in the future.

Node Addressing Example 3



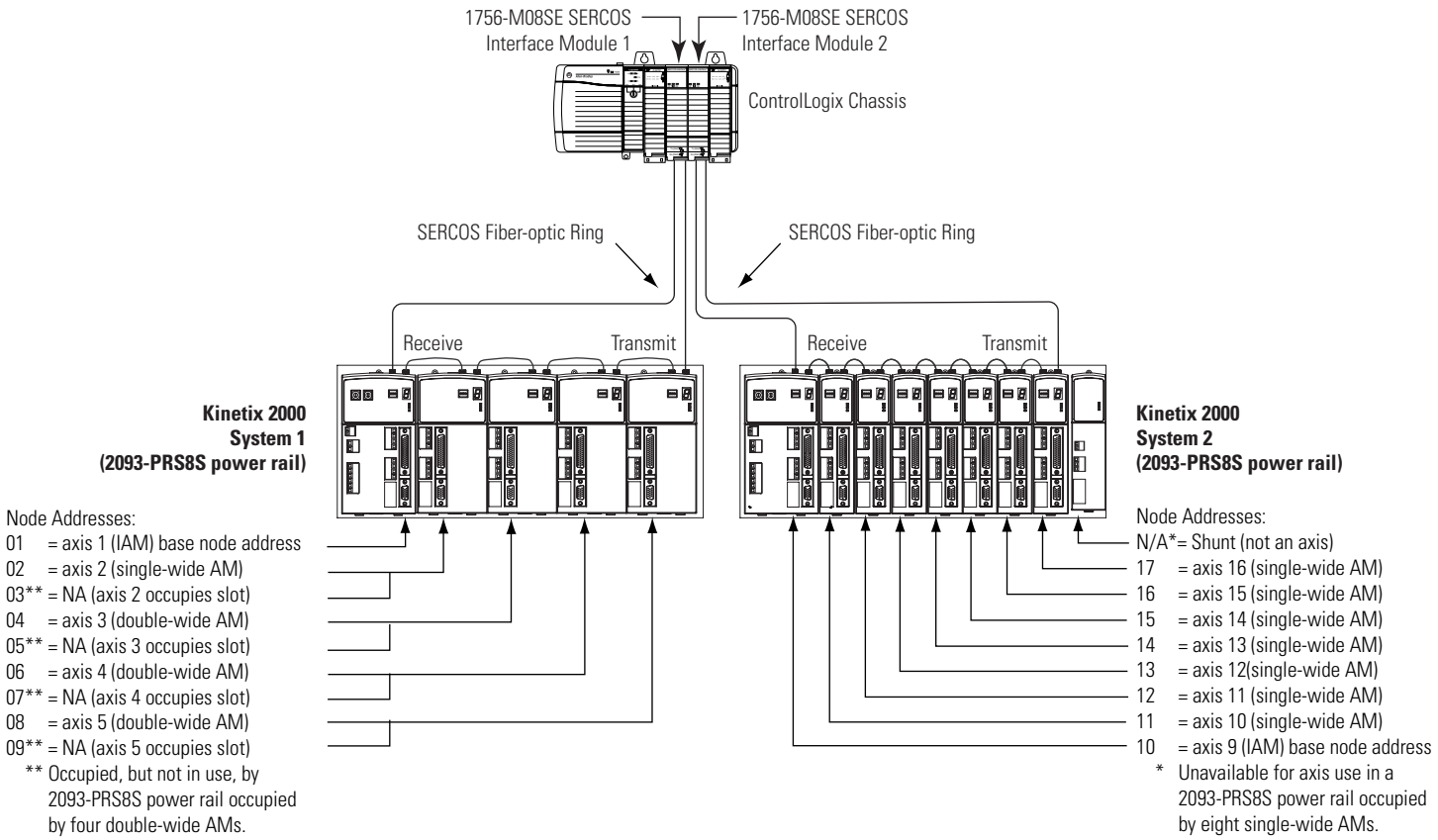
In Example 3, the Kinetix 2000 (seven-axis) power rail contains a IAM, two double-wide AMs, one single-wide AM, and one slot filler module. The slot filler module is assigned a node address, but does not use it.

The leftmost slot of the double-wide axis modules determine the node addresses that are in use (01, 02, and 04). Node addresses 03 and 05 (the rightmost slots of the double-wide axis modules) are not used. Node address 07 (the slot flitter) is not used, although it could be reserved for future expansion.

IMPORTANT Slot filler modules must be used to fill any unoccupied slot on the power rail. However, the slot fillers may also be removed and replaced by an axis or shunt module in the future.

IMPORTANT Do not position axis modules to the right of shunt or slot filler modules. The added distance between non-adjacent axes can increase electrical noise and impedance, and requires longer fiber-optic cable lengths.

Node Addressing Example 4



In Example 4, xxxxx system 1 with an eight-axis power rail contains one IAM, and four double-wide AMs. xxxxx system 2 with an eight-axis power rail contains one IAM, eight single-wide AMs, and a shunt module.

SERCOS interface module 1 controls axes 1...5, and module 2 controls axes 9...16.

The shunt module (or a slot filler) in xxxxx system 2 occupies a slot, but is not assigned a node address, since future expansion of this system is impossible.

IMPORTANT Only the following modules may occupy slot eight in the 2093-PRS8S power rail: a shunt module (2093-ASP06), a slot filler (2093-PRF), or a double-width axis module (2093-AM01 or 2093-AM02) occupying both slots seven and eight.

IMPORTANT The node address for each axis module is determined by the base node-address switch setting on the IAM.

Do not position axis modules to the right of a shunt or slot filler modules. The added distance between non-adjacent axes can increase electrical noise and impedance, and requires longer fiber-optic cable lengths.

Configure the Logix SERCOS Interface Module

This procedure assumes that you have wired your Kinetix 2000 system and have configured the baud rate and optical power switches.

IMPORTANT In order for the Kinetix 2000 drive to communicate with the SERCOS interface module (indicated by the three LED indicators on the module going solid green), your RSLogix 5000 software must be version 11.0 or later.

For greater detail on the RSLogix 5000 software as it applies to configuring the ControlLogix, CompactLogix, or SoftLogix SERCOS modules, refer to Additional Resources on page 10.

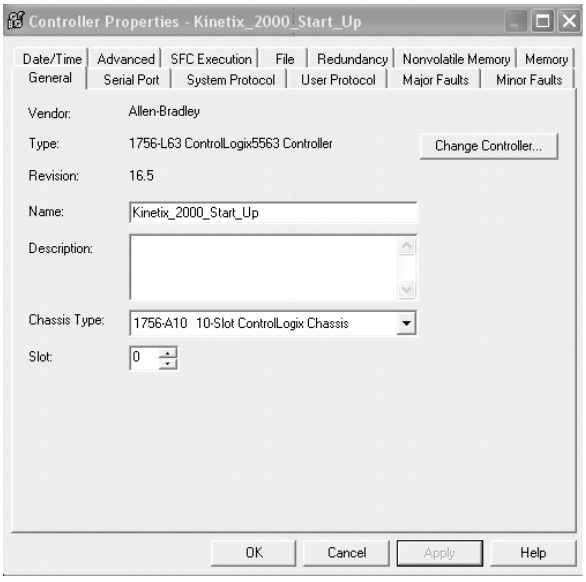
Configure the Logix Controller

Follow these steps to configure the Logix controller.

1. Apply power to your Logix chassis/personal computer containing the SERCOS interface module and open your RSLogix 5000 software.

2. Choose New from the File menu.

   A new Controller Properties dialog opens..



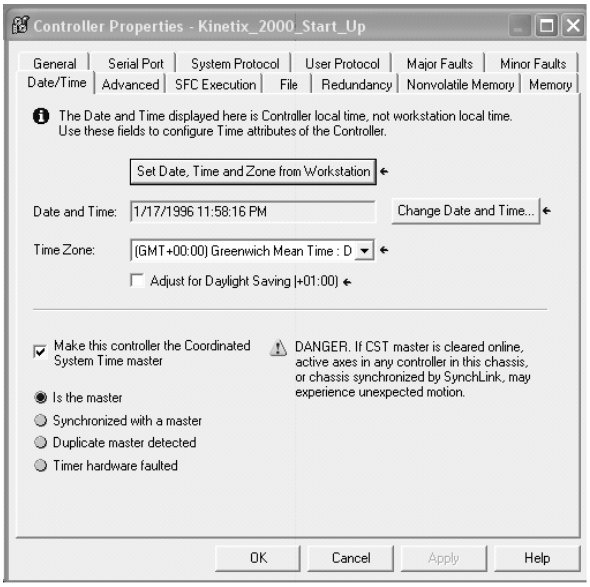
3. Configure the new controller.
   a. Select controller type.
   b. Select the version of RSLogix 5000 software.
   c. Name the file.
   d. Select the Logix chassis size.
   e. Select the slot occupied by the new controller processor.

4. Click OK.

5. From the Edit menu, choose Controller Properties.

   The Controller Properties dialog opens.

6. Select the Date and Time tab.



7. Select the checkbox Make this controller the Coordinated System Time master.

IMPORTANT Only one ControlLogix processor can be assigned as the Coordinated System Time master.

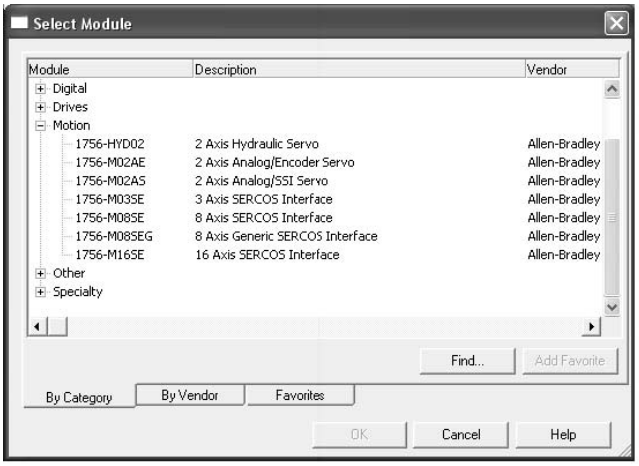
8. Click Apply, and then click OK.

Configure the SERCOS Interface Module

Follow these steps to configure the SERCOS interface module.

1. Right-click I/O Configuration in the DriveExplorer software dialog and select New Module.

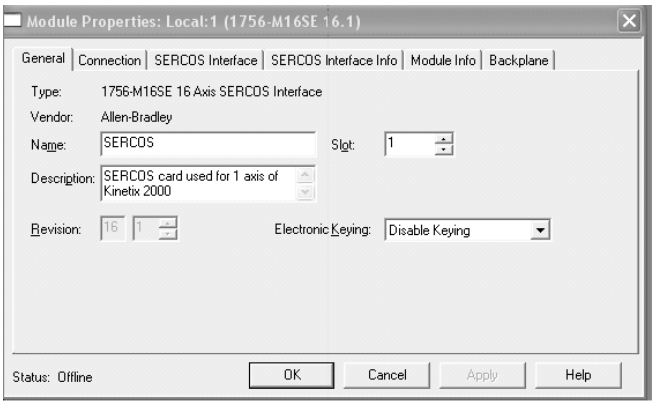
The Select Module dialog opens.



2. Expand the Motion category and select 1756-M*xx*SE, 1756-L60M03SE, 1768-M04SE, or 1784-PM16SE as appropriate for your actual hardware configuration.

3. Click OK.

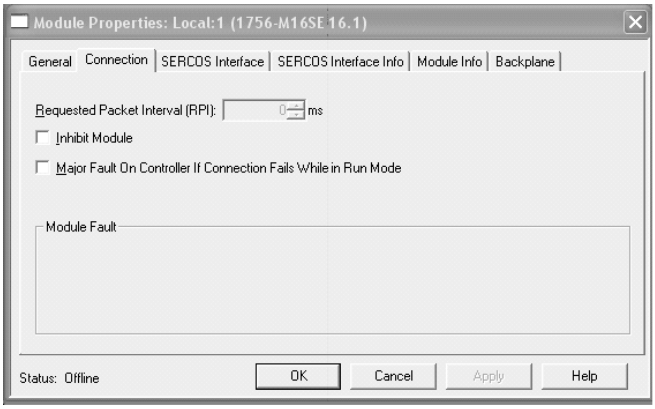
The Module Properties dialog opens. Your module appears under the General tab in the DriveExplorer software dialog.



4. Configure the new module in the General tab display.
   a. Name the module.
   b. Select the slot where your module resides (leftmost slot = 0).
   c. Select an Electronic Keying option (select Disable Keying if unsure).

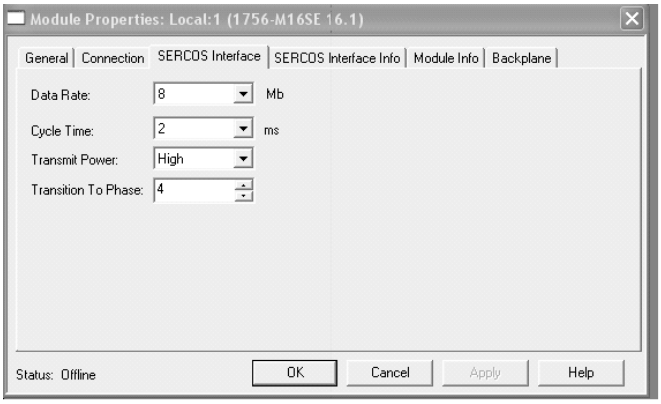
5. Click OK.

6. Select the Connection tab to verify that both Inhibit Module and Major Fault on Controller… are not selected, and that no Module Faults are detected.



7. Click OK.

8. Select the SERCOS Interface tab and reference the table below.



Logix SERCOS Module	Number of Axes per Module	Data Rate
1756-M03SE or 1756-L60M03SE	Up to 3	4 or 8 Mbps
1756-M08SE	Up to 8	
1756-M16SE or 1784-PM16SE	Up to 16	
1768-M04SE	Up to 4	

9. Verify that the Data Rate setting matches DIP switches 2 and 3 (baud rate) as set on the Kinetix 2000 axis module (IAM or AM).

Refer to page 104 for a diagram and explanation of the SERCOS optical power and data rate switch settings.

10. Set the Cycle Time according to the table below.

Data Rate	Number of Axes	Cycle Time
4 Mbps	Up to 2	0.5 ms
	Up to 4	1 ms
	Up to 8	2 ms
	No support for axes 9...16	
8 Mbps	Up to 4	0.5 ms
	Up to 8	1 ms
	Up to 16	2 ms

The number of axes per Logix SERCOS module is limited to the Number of Axes per Module listed in the table for step 8.

11. Verify that the Optical Power setting (high or low) matches DIP switch 1 as set on the Kinetix 2000 axis module (IAM or AM). The factory default setting is high.

12. Set the Transition to Phase to 4.

The Transition to Phase setting stops the ring in the phase specified (phase 4).

13. Click OK.

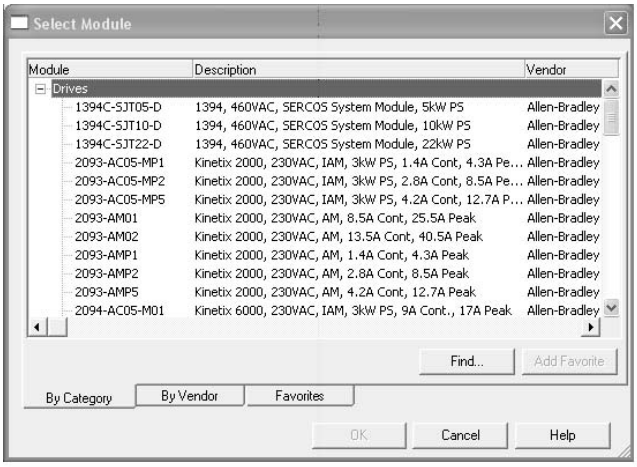
14. Repeat steps 1...13 for each SERCOS interface module.

Configure the Kinetix 2000 Modules

Follow these steps to configure the Kinetix 2000 modules.

1. Right-click the SERCOS interface module you just created and select New Module.

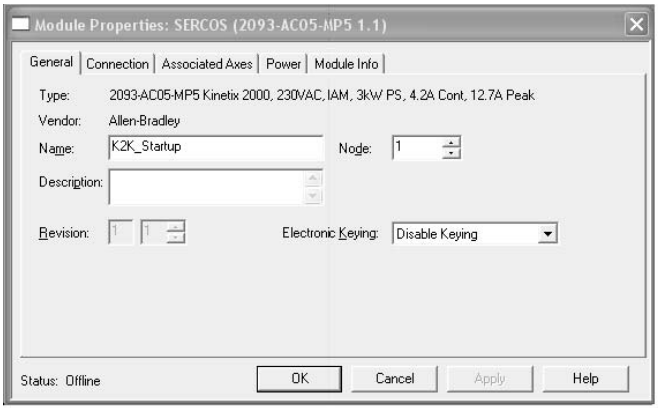
The Select Module dialog opens.



2. Expand the Drives category and select the 2093-AC05-MP*x* (IAM), 2093-AMP*x*, or 2093-AM0*x* (AM) drive appropriate for your Kinetix 2000 hardware configuration.

3. Click OK.

The Module Properties dialog opens at the General tab.



4. Name the module with a descriptive title

5. Set the Node address to match the node setting on the drive.

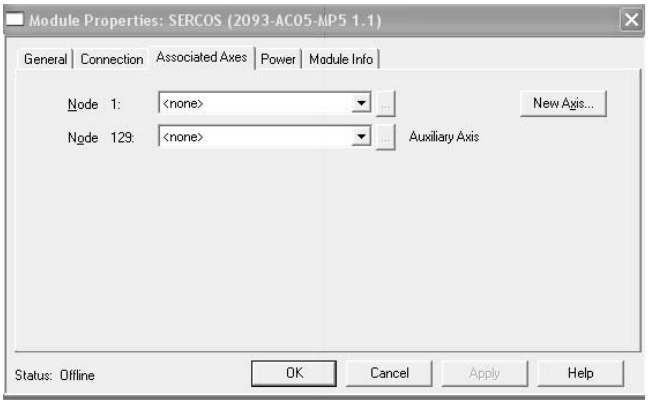
TIP Keep in mind that a double-wide axis module (2093-AM01 or 2093-AM02) requires two (2) node addresses.

Refer to Configure the IAM/AM, step 2, on page 104, and the node addressing examples on pages 105…108 for additional information on node addressing.

6. Set the Electronic Keying option to Disable Keying, unless the application requires a different setting.

7. Click OK.

8. Select the Associated Axes tab.



9. Click the New Axis button.

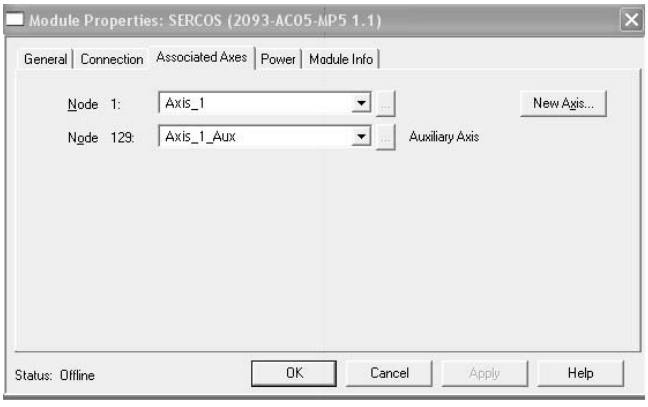
   The New Tag dialog opens.

10. Add the axis.
    1. Name the axis.
    2. Select AXIS_SERVO_DRIVE as the data type.

11. Click OK.

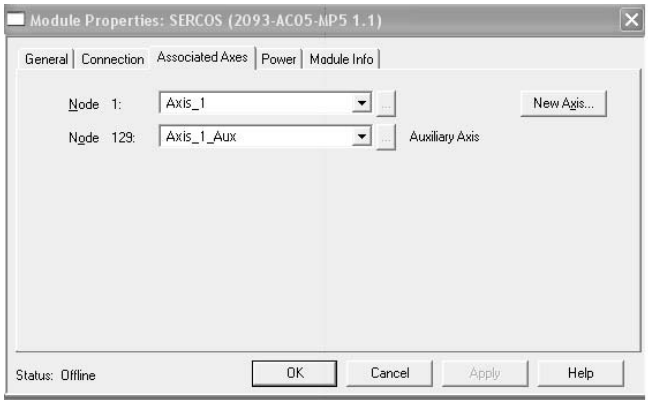
    The axis appears under the Ungrouped Axes folder in the Controller Organizer software dialog.

12. Assign your axis to the node addresses (as shown in the dialog below).



13. Repeat steps 9…11 to create an auxiliary axis (for Node x + 128).

14. Verify the axis name assigned to both the primary and auxiliary axis.

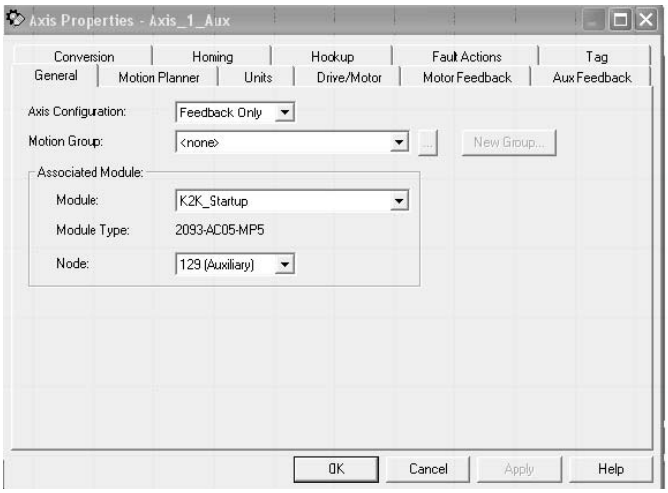


In this example, Node 1 = Axis_1, and Node 129 = Axis_1_Aux.

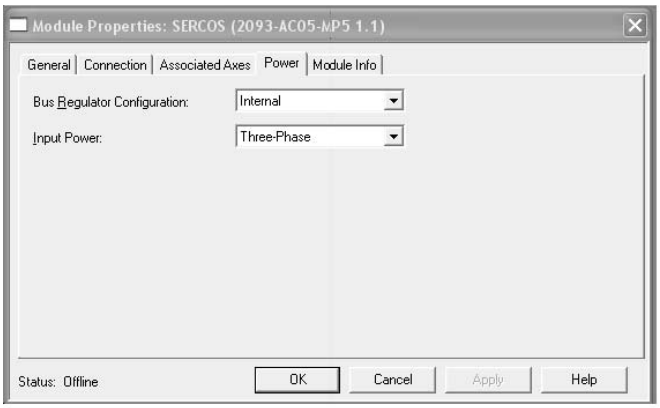
15. Click OK.

Each axis appears under the Ungrouped Axes folder in the Controller Organizer software dialog.

If an axis is be associated with the node assigned to the auxiliary axis, then the Axis Configuration on the General tab of the Axis Properties dialog is set to Feedback Only (as shown below).



16. Select the Power tab.



17. Set Input Power to either Three-Phase or Single-Phase, as appropriate for the power source.

18. Set the Bus Regulator Configuration as appropriate for your Kinetix 2000 hardware configuration.

If your IAM is	And your shunt configuration is	Then select
Configured as a Leader IAM (common bus) (1)	Internal shunts only	Internal
	Bulletin 2093 shunt module mounted on the power rail.	2093-ASP06
Configured as a Follower IAM (2)	N/A, because shunts are disabled on Follower IAM.	CommonBus Follow

(1) Drive will not accept internal shunt, 2093-ASP06, selection if dc bus voltage is present without having three-phase power applied.

(2) Drive will not accept CommonBus Follow selection if three-phase power is applied.

IMPORTANT When configured to use the 2093 shunt modules, the IAM bus regulator capacity attribute displays the shunt module or passive shunt module utilization instead of the IAM internal shunt resistor utilization.

IMPORTANT Common dc bus applications must calculate the Total Bus Capacitance and the Additional Bus Capacitance, and set the Add Bus Cap parameter (*x*:*x*:*x*599) using DriveExplorer software.

Refer to the Appendix D beginning on page 209, for more information.

19. Click OK.

20. Repeat steps 1...15 for each 2093-AMP*x*, or 2093-AM0*x* (AM) axis module.

Configure the Motion Group

Follow these steps to configure the motion group.

1. Right-click Motion Groups in the DriveExplorer software dialog and select New Motion Group.

   The New Tag dialog opens.

2. Name the new motion group.

3. Click OK.

   New group appears under the Motion Groups folder.

4. Right-click the new motion group and select Properties.

   The Motion Group Properties dialog opens.

5. Select the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.

6. Select the Attribute tab and edit the default values as appropriate for your application. The coarse update rate must be a multiple of the SERCOS ring rate.

7. Click OK.

Configure Axis Properties

Follow these steps to configure axis properties.

1. Right-click an axis in the DriveExplorer software dialog and select Properties.

2. Select the General tab, after the Axis Properties dialog opens.

3. Select the Drive/Motor tab and edit the default values as appropriate for this axis.
   a. Set the Kinetix 2000 Amplifier Catalog Number (2093-AC05-MP*x*, 2093-AMP*x*, or 2093-AM0*x*).
   b. Set the Motor Catalog Number.

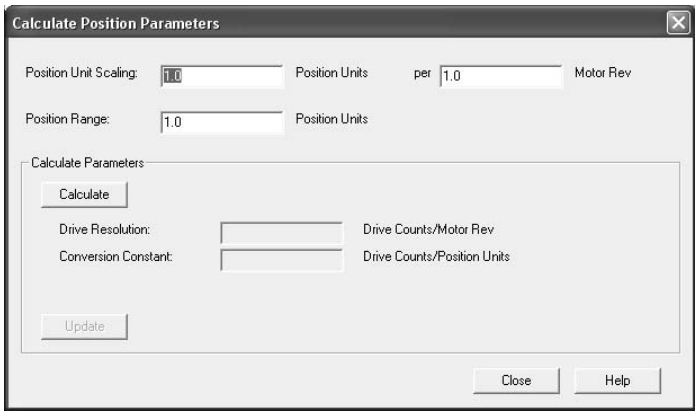
IMPORTANT If you do not know the catalog number, you may refer to the name plate on the amplifier or motor for its catalog number.

4. Clear the Drive Enable Input Checking checkbox.

   When checked (default), the drive system requires a hardware-based drive-enable input signal. De-select the checkbox to remove (clear) that requirement.

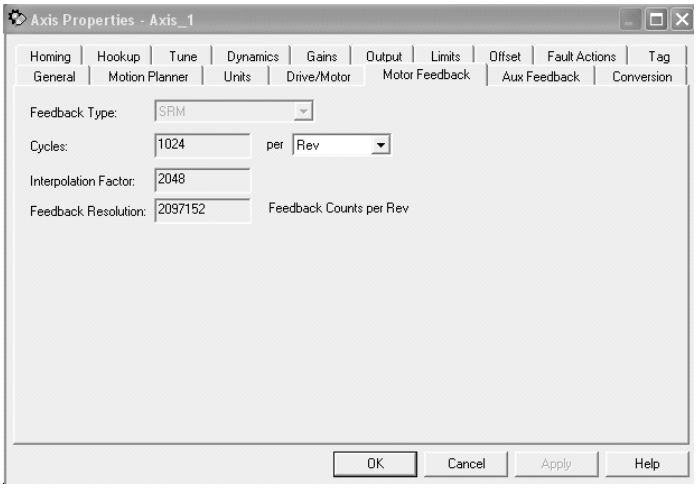
5. Verify the Drive Resolution and Drive Counts are correct.
   1. If correct, advance to step 6.

2. If incorrect, click the Calculate button to determine appropriate values for Drive Resolution and Conversion Constant. Then click Update to change the drive's resolution and counts.



3. Close the Position Parameters Calculation dialog.

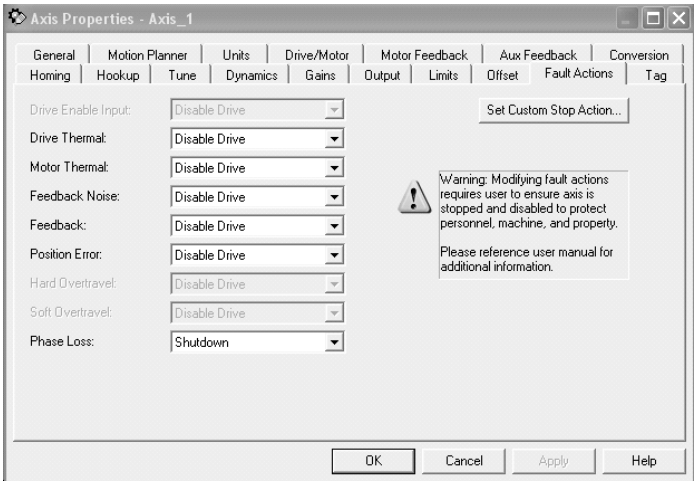
6. Select the Motor Feedback tab and verify the data shown matches the hardware configuration for this axis.



7. Select the Units tab and edit the default values as appropriate for this axis.

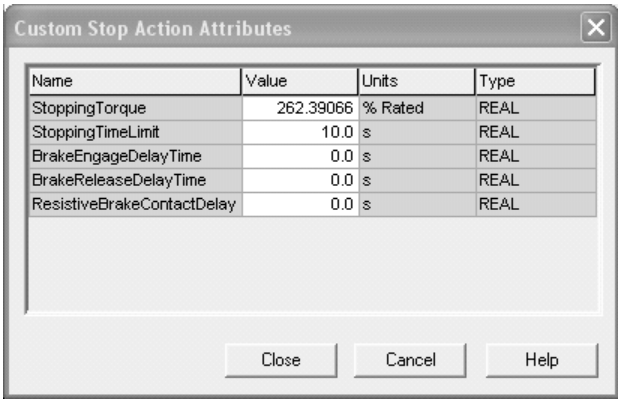
8. Select the Conversion tab and edit the default values as appropriate for this axis.

9. Select the Fault Actions tab and edit the default values if appropriate for your application. The default settings are acceptable for most applications.



10. If the motor for this axis has a brake, click the Set Custom Stop Action tab.

The Custom Stop Action Attributes dialog opens.



The Custom Stop Action Attributes window lets you set delay times for servo motors brakes.

IMPORTANT Refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001, publication Kinetix Motion Control Selection Guide, publication GMC-SG001, to set the motor brake delay times.

11. To configure the delay times.
    a. Set the Brake Engage Delay Time.
    b. Set the Brake Release Delay Time.
    c. Click Close.

12. Click OK.

13. Repeat steps 1...12 for each axis module (2093-AMP*x*, or 2093-AM0*x*) in the Kinetix 2000 system.

14. Verify your Logix program and save the file.

Download the Program

After completing the Logix configuration, you must download your program to the Logix processor.

Apply Power to the Kinetix 2000 Drive

This procedure assumes that you have wired and configured your Kinetix 2000 system (with or without the LIM) and your SERCOS interface module.

SHOCK HAZARD

To avoid hazard of electrical shock, perform all mounting and wiring of IAM, AM, SM, LIM, or power rail prior to applying power. Once power is applied, connector terminals may have voltage present even when not in use.

Refer to the Line Interface Module Installation Instructions, publication 2094-IN005, when troubleshooting the LIM status indicators, and for the location of LIM circuit breakers, connectors, and status indicators.

Follow these steps to apply power to the Kinetix 2000 system.

1. Disconnect the load to the motor.

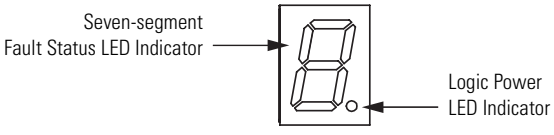
ATTENTION

To avoid personal injury or damage to equipment, disconnect the load to the motor. Make sure each motor is free of all linkages when initially applying power to the system.

2. Determine your source of control power.

If your control power	Then
Is sourced from a LIM	1. Verify that CB1, CB2, and CB3 are in the OFF position. 2. Apply three-phase input power to the LIM VAC Line connector. 3. Set CB3 to the ON position. 4. Set CB2 to the ON position. 5. Go To main Step 3.
Is not sourced from a LIM	1. Apply (170...264V ac) control power to the IAM (CPD connector). 2. Go To main Step 3.

3. Observe the IAM/AM logic power LED indicator.



If the Logic Power LED indicator is	Then
ON	Go To Step 5.
Not ON	1. Check your control power connections. 2. Go to main step 2.

4. Observe the IAM/AM Fault Status LED indicator.

The Fault Status LED indicator initially flash the SERCOS node address, then cycles through phases until final configuration (phase 4) is reached.

IAM/AM Fault Status LED Indicator	Status	Do This
Actively cycling (phase 0)	The drive is looking for a closed SERCOS ring. Wait for phase 1 or take corrective action until you reach phase 1.	Check fiber-optic connections.
Displaying a fixed 1 (phase 1)	The drive is looking for active nodes. Wait for phase 2 or take corrective action until you reach phase 2.	Check node addressing.
Displaying a fixed 2 (phase 2)	The drive is configuring nodes for communication. Wait for phase 3 or take corrective action until you reach phase 3.	Check program motor and drive configuration against installed hardware.
Displaying a fixed 3 (phase 3)	The drive is configuring device specific parameters. Wait for phase 4 or take corrective action until you reach phase 4.	Check motor catalog number against selection. (1)
Displaying a fixed 4 (phase 4)	The drive is configured and active.	Go to Step 6.
Flashing an E followed by two numbers	Drive is faulted.	Refer to Error Codes on page 134.

(1) You can get diagnostic information from the module by highlighting the module name in RSLogix 5000 software. A Pseudo Key Failure often indicates that the motor selection does not match the installed motor.

For additional troubleshooting information, refer to the appropriate SERCOS Installation Instructions referenced on page 10.

5. Determine your source of three-phase input power.

If your three-phase power	Then
Is sourced from a LIM	a. Set CB1 to the ON position. b. Verify the Hardware Enable Input signal (IOD/AF pin 43) for each axis is at 0 volts. c. Remove the connection between IOD/AF pins 43 and 44 if one exists. d. Go to main step 4.
Is not sourced from a LIM	a. Apply 170...264V (230V) ac input power to the IAM (IPD connector). b. Verify the Hardware Enable Input signal (IOD/AF pin 43) for each axis is at 0 volts. Remove the connection between IOD/AF pins 43 and 44 if one exists. c. Go to main step 4.

6. Observe the Drive, Comm, and Bus status LED indicators on the front of the IAM/AM.

Status LED Indicator	Condition	Status	Do This
Drive	Off	Normal condition	Observe the Comm Status LED indicator.
	Steady red	Drive is faulted	Refer to IAM/AM Status Indicators on page 139.

Status LED Indicator	Condition	Status	Do This
Comm	Flashing green	Establishing communication with network	Wait for steady green.
	Steady green	Communication is ready	Observe the Bus Status LED indicator.
	Off	No ring present	Refer to IAM/AM Status Indicators on page 139.
Bus	Steady green	Axis is enabled when status should be disabled	1. Verify Hardware Enable Input (IOD/AF pin 43) is open. 2. Verify MSO instruction is not commanded in RSLogix 5000 software. 3. Return to Apply Power to the Kinetix 2000 Drive on page 123.
	Flashing green [1]	Bus is up, axis is disabled (normal status)	Go to step 7.
	Off	DC bus is not present	Refer to IAM/AM Status Indicators on page 139.

[1] The follower IAM has a 2.5 second delay after dc bus voltage is applied before the Bus Status LED indicator begins flashing. This provides the common bus leader time to complete pre-charge.

7. Observe the three SERCOS LED indicators on the SERCOS module.

If SERCOS LED State is	The Status is	Do This
Flashing green and red	Establishing communication	Wait for steady green on all three LED indicators.
Steady green	Communication ready	Refer to Test and Tune the Axes.
Not flashing green or red, and not steady green	SERCOS module is faulted	Refer to the appropriate Logix manual for specific instructions and troubleshooting.

Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 2000 drive, your SERCOS interface module, and applied power to the system.

IMPORTANT Before proceeding with testing and tuning your axes, verify that the IAM and AM seven-segment and status LED indicators are as described in step 6 on page 124.

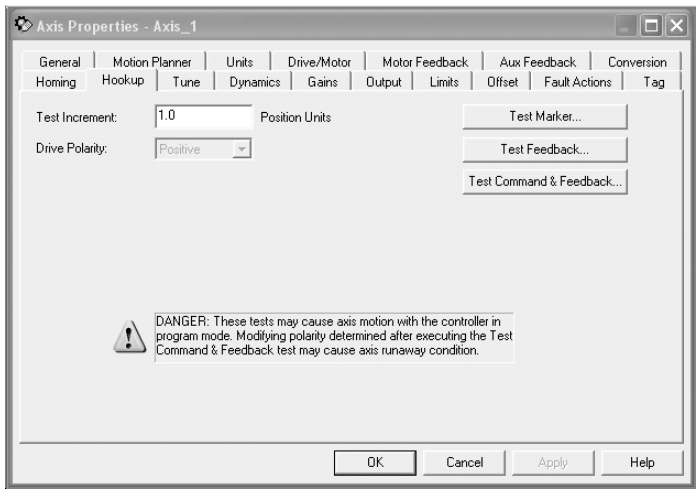
For help using RSLogix 5000 software as it applies to testing and tuning your axes with ControlLogix, CompactLogix, or SoftLogix SERCOS modules, refer to Additional Resources on page 10.

Test the Axes

Follow these steps to test the axes.

1. Verify that the load was removed from each axis.
2. Right-click an axis in your Motion Group folder in the DriveExplorer software dialog and then select Axis Properties.

   The Axis Properties dialog appears.
3. Select the Hookup tab.



4. Select 2.0 as the number of revolutions for the test (or choose another number more appropriate for your application).

This test	Verifies
Test Marker	Marker detection capability as you rotate the motor shaft.
Test Feedback	Feedback connections are wired correctly as you rotate the motor shaft.
Test Command & Feedback	Motor power and feedback connections are wired correctly as you command the motor to rotate. Also, lets you define polarity.

5. If using an external enable, apply the Hardware Enable Input signal (IOD/AF-43) for the axis you are testing.

ATTENTION

To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD/AF-43) only to the axis you are testing.

6. Click the Test button to verify connections for each of these tests

Test	Description
Marker	Requires the motor brake be manually released and the shaft must be manually rotated.
Feedback	
Test Command & Feedback	Software releases the brake, if used, and rotates the motor shaft.

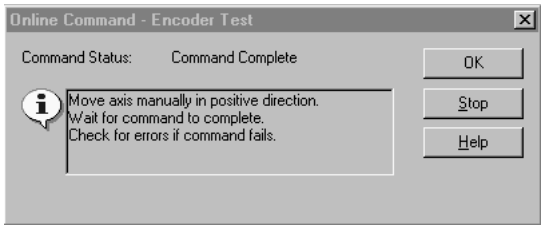
ATTENTION

Vertical applications require user intervention.

The Marker and Feedback tests require the motor brake be manually released.

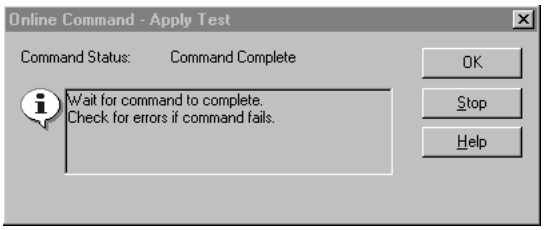
The Test Command & Feedback test releases the brake as a function of the test.

The Online Command dialog opens. Follow the on-screen test instructions. When the test completes, the Command Status changes from Executing to Command Complete.



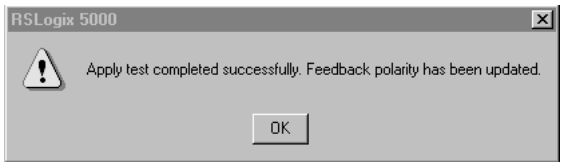
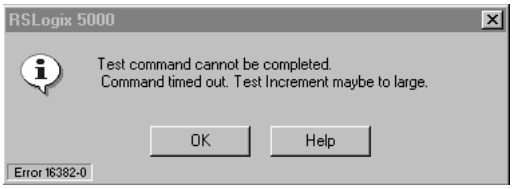
7. Click OK.

The Online Command - Apply Test dialog opens (Feedback and Command & Feedback tests only). When the test completes, the Command Status changes from Executing to Command Complete.



8. Click OK.

9. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog appears. 	1. Click OK. 2. Remove Hardware Enable Input signal (IOD/AF-43). 3. Go to the next section, Tune the Axes.
Your test failed, this dialog appears. 	1. Click OK. 2. Verify the Bus Status LED indicator turned solid green during the test. 3. Verify that the Hardware Enable Input signal (IOD/AF-43) is applied to the axis you are testing. 4. Verify conversion constant entered in the Conversion tab. 5. Return to main step 7 and run the test again.

Tune the Axes

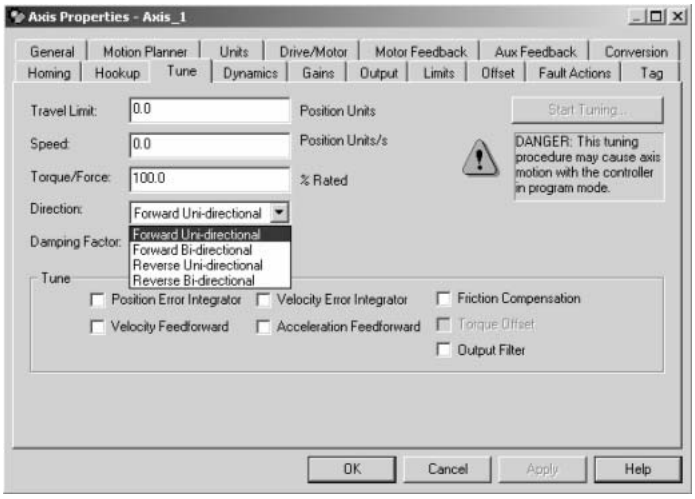
Follow these steps to tune the axes.

1. Verify the load is still removed from the axis being tuned.

ATTENTION

To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, then reattach the load and perform the tuning procedure again to provide an accurate operational response.

2. Select the Tune tab.



3. Enter values for Travel Limit and Speed.

In this example, Travel Limit = 5 and Speed = 10. The actual value for each programmed unit depends on your application.

4. Select setting for Direction (Forward Uni-directional is the default).

5. Check Tune boxes as appropriate for your application.

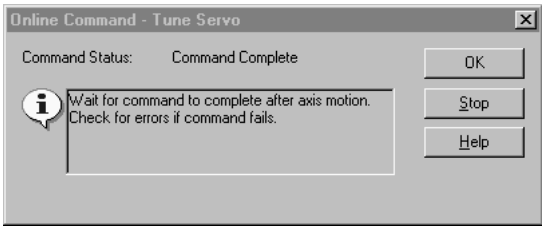
6. Apply Hardware Enable Input signal (IOD/AF-43) for the axis you are tuning.

ATTENTION

To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD/AF-43) only to the axis you are tuning.

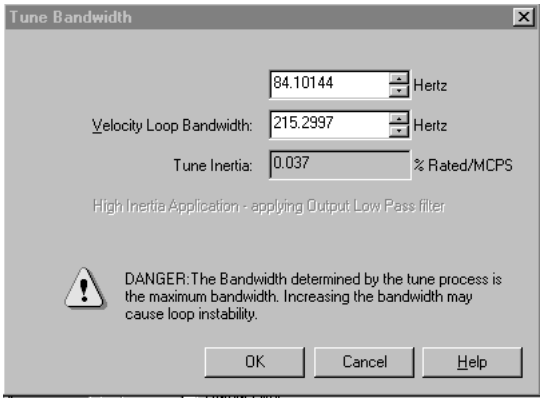
7. Select the Start Tuning button to auto-tune your axis.

The Online Command - Tune Servo dialog opens. When the test completes, the Command Status changes from Executing to Command Complete.



8. Click OK.

The Tune Bandwidth dialog opens.

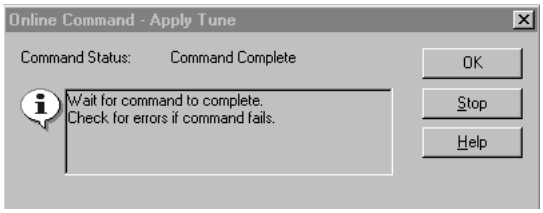


Actual bandwidth values (Hz) depend on your application and may require adjustment once motor and load are connected.

9. Record your bandwidth data for future reference.

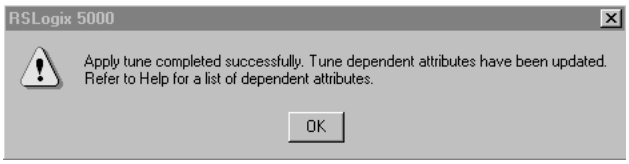
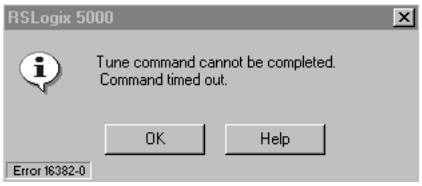
10. Click OK.

The Online Command - Apply Tune dialog opens. When the test completes, the Command Status changes from Executing to Command Complete.



11. Click OK.

12. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog appears. 	1. Click OK. 2. Go to step 13.
Your test failed, this dialog appears. 	1. Click OK. 2. Make an adjustment to motor velocity. 3. Refer to appropriate Logix motion module setup and configuration manual for more information. 4. Return to step 7 and run the test again.

13. Repeat Test and Tune the Axes for each axis.

Troubleshooting the Kinetix 2000 Drive System

Introduction

This chapter provides troubleshooting tables and for your Kinetix 2000 system components.

Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 2000 drive.

ATTENTION

Capacitors on the dc bus may retain hazardous voltages after input power has been removed. Before working on the drive, measure the dc bus voltage to verify it has reached a safe level or wait the full time interval as indicated in the warning on the front of the drive. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION

Do not attempt to defeat or override the drive fault circuits. You must determine the cause of a fault and correct it before you attempt to operate the system. Failure to correct the fault could result in personal injury and/or damage to equipment as a result of uncontrolled machine operation.

ATTENTION

Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

Interpreting Status Indicators

Use these troubleshooting tables to identify faults, potential causes, and the appropriate actions to resolve the fault. If the fault persists after attempting to troubleshoot the system, please contact your Rockwell Automation sales representative for further assistance.

Error Codes

The following list of problematic symptoms (no error code shown) and faults with assigned error codes is designed to help you resolve anomalies.

When a fault is detected, the seven-segment LED indicator will display an E followed by the flashing of the two-digit error code, one digit at a time. This is repeated until the error code is cleared.

Seven-segment LED Indicator Error Codes

Error Code	Fault Message **RSLogix** (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
		Power (PWR) indicator not ON	No ac power or auxiliary logic power.	Verify ac control power is applied to the Kinetix 2000 system.
			Internal power supply malfunction.	Call your Rockwell Automation sales representative to return module for repair.
		Motor jumps when first enabled	Motor wiring error.	• Check motor wiring. • Run Hookup test in RSLogix 5000 software.
			Incorrect motor chosen.	Verify the proper motor is selected.
		Digital I/O not working correctly	I/O power supply disconnected.	Verify connections and I/O power source.
E00	**BusUndervoltage Fault** (Blown fuse)	A blown fuse was detected on the inverter PCB	Blown fuse.	Call your Rockwell Automation sales representative to return module for repair.
E04	**MotorOvertemp Fault** (Motor Overtemp)	Motor thermal switch tripped	High ambient motor temperature and/or excessive current	• Operate within (not above) the continuous torque rating for the ambient temperature 40 °C (104 °F) maximum. • Lower ambient temperature, increase motor cooling.
			Motor wiring error.	Check motor wiring at MF connector on the IAM/AM.
			Incorrect motor selection.	Verify the proper motor has been selected.

Error Code	Fault Message **RSLogix** (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E05	**DriveOvercurrent Fault** (Power Fault)	Self-protection of the Intelligent Power Module (IPM) is indicating a major power related fault condition	Motor cables shorted.	Verify continuity of motor power cable and connector.
			Motor winding shorted internally.	Disconnect motor power cables from the motor. If the motor is difficult to turn by hand, it may need to be replaced.
			Kinetix 2000 drive temperature too high.	• Check for clogged vents or defective fan. • Make sure cooling is not restricted by insufficient space around the unit.
			Operation above continuous power rating and/or product environmental ratings.	• Verify ambient temperature is not too high. • Operate within the continuous power rating. • Reduce acceleration rates.
			Kinetix 2000drive has a short circuit, overcurrent, or failed component.	Remove all power and motor connections, and preform a continuity check from the dc bus to the U, V, and W motor outputs. If a continuity exists, check for wire fibers between terminals, or send drive in for repair.
E06	**HardOvertravel Fault** (+/- Hard Overtravel)	Axis moved beyond the physical travel limits in the positive/negative direction	Dedicated overtravel input is inactive.	• Check wiring. • Verify motion profile. • Verify axis configuration in software.
E07	**MotFeedbackFault** (Motor Feedback Loss)	The feedback wiring is open, shorted, or missing.		• Check motor encoder wiring. • Run Hookup test in RSLogix 5000 software.
E09	**BusUndervoltage Fault** (Bus Undervoltage)	With three-phase power present, the dc bus voltage is below its limit	DC bus voltage for 230V system is below 137V	• Verify voltage level of the incoming ac power. • Check ac power source for glitches or line drop. • Install an uninterruptible power supply (UPS) on your ac input.
		DC bus voltage fell below the undervoltage limit while an axis on the follower power rail was enabled		Disable follower axis before removing power.
E10	**DriveOvervoltage Fault** (Bus Overvoltage)	The dc bus voltage is above its limit	Excessive regeneration of power. When the motor is driven by an external mechanical power source, it may regenerate too much peak energy through the drive power supply. The system faults to save itself from an overload.	• Change the deceleration or motion profile. • Use a larger system (motor and Kinetix 2000 drive). • Install shunt module.
			DC bus voltage for 230V system is over 410V	Verify input is within specifications.
E11	**MotFeedbackFault** (Illegal Hall State)	State of Hall feedback inputs is incorrect	Bad connections.	• Verify the Hall wiring at the MF connector on the IAM/AM. • Verify 5V power supply to the encoder.
E16	**Softovertravel Fault** (+/- Software Overtravel)	Axis position exceeded maximum software setting.		• Verify motion profile. • Verify overtravel settings are appropriate.

Error Code	Fault Message **RSLogix** (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E18	**OverSpeedFault** (Overspeed Fault)	Motor speed has exceeded 150% of maximum rated speed. The 100% trip point is dictated by the lesser of the user velocity limits or the motor rated base speed.		• Check cables for noise. • Check tuning.
E19	**PositionErrorFault** (Follow Error)	Position error limit was exceeded.		• Increase the feed forward gain. • Increase following error limit or time. • Check position loop tuning. • Verify sizing of system. • Verify mechanical integrity of system within specification limits.
E20	**MotFeedbackFault** (Mtr Fdbk AQB)	Motor Encoder State Error	The motor encoder encountered an illegal transition.	• Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Replace the motor/encoder.
E21	**AuxFeedbackFault** (Aux Feedback Comm)	Communication was not established with an intelligent encoder.		Verify auxiliary encoder wiring.
E30	**MotFeedbackFault** (Motor Feedback Comm)	Communication was not established with an intelligent encoder.		• Verify motor selection. • Verify the motor supports automatic identification. • Verify motor encoder wiring.
E34	**GroundShortFault** (Ground Fault)	Excessive ground current in the converter was detected	Wiring error.	• Check motor power wiring. • Check input power wiring.
			Motor internal ground short.	Replace motor.
			Internal malfunction.	Disconnect motor power cable from drive and enable drive with current limit set to 0. If fault clears, then a wiring error or motor internal problem exists. If fault remains, call your sales representative.
			Grounded control power terminal (applies to 230V systems only).	• Remove ground from control power input. • Source control power from three-phase input power. Refer to the Power Wiring Examples on page 169 for more information. • Add isolation transformer for control power.
E35	**DriveUndervoltage Fault** (Pre-charge Fault)	Converter pre-charge cycle failed	Low ac input voltage.	Check input ac voltage on all phases.
			Internal malfunction.	Call your sales representative.
E36	**DriveOvertemp Fault** (System Overtemperature)	Converter thermal switch tripped	Excessive heat exists in the power circuitry.	• Reduce acceleration rates. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use larger Kinetix 2000 converter. • Check for clogged vents or defective fan. • Make sure cooling is not restricted by insufficient space around the unit.

Error Code	Fault Message **RSLogix** (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E37	**PowerPhaseLoss Fault** (Phase Loss Flt)	• One or more phases of the input ac power is missing. • Axis was enabled when main (three-phase) power was removed. • Common bus follower axis was enabled when dc bus power was removed.		• Check input ac voltage on all phases. • Disable axis before removing power.
E38	**SERCOSFault** (SERCOS Ring Flt)	The SERCOS ring is not active after being active and operational	Cable disconnected.	Check that fiber-optic cable is present and connected properly.
E39	**DriveHardFault** (Self Sense Flt)	Self-sensing Commutation Startup Error	Motion required for self-sensing startup commutation was obstructed.	• Verify that there are no impediments to motion at startup, such as hard limits. • Increase self-sensing current if high friction or load conditions exist. • Check motor or encoder wiring using wiring diagnostics.
E43	**DriveEnableInput Fault** (Drive Enable Flt)	Missing Drive Enable Input Signal	• An attempt was made to enable the axis through software while the Drive Enable hardware input was inactive. • The Drive Enable input transitioned from active to inactive while the axis was enabled.	• Disable the Drive Enable Input fault. • Verify that Drive Enable hardware input is active whenever the drive is enabled through software.
E50	**SERCOSFault** (SERCOS Same ADDR)	Duplicate node address detected on SERCOS ring.		Verify that each SERCOS drive is assigned a unique node address.
E54	**DriveHardFault** (Ifbk HW Fault)	Current feedback hardware fault detected.		Replace the module.
E60	**DriveHardFault** (Unknown Axis)	Illegal ID bits detected.		Replace the module.
E61	**AuxFeedbackFault** (Aux Fdbk AQB)	Auxiliary Encoder State Error	The auxiliary encoder encountered an illegal transition.	• Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Replace the motor/encoder.
E62	**AuxFeedbackFault** (Aux Fdbk Loss)	The feedback wiring is open, shorted, or missing.		Check the motor feedback cable connectors/wiring to the IAM/AM and motor.
E63	**AuxFeedbackNoise** (Aux Fdbk Noise)	Noise on auxiliary feedback cable	Recommended grounding, per installation instructions, has not been followed.	• Verify grounding. • Route feedback cable away from noise sources. • Refer to System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.
E64	**MotorFeedbackNoise** (Mtr Fdbk Noise)	Noise on motor feedback cable		
E65	**No Fault Message (condition indicated by on-screen message)** (Hookup Fault)	Hookup procedure failed	Motor or feedback device malfunction.	• Check motor power/feedback wiring. • Refer to on-screen message for resolution.
E66	**No Fault Message (condition indicated by on-screen message)** (Atune Flt)	Autotune procedure failed	Motor or feedback device malfunction.	• Check motor power/feedback wiring. • Refer to on-screen message for resolution. • Perform Hookup in RSLogix 5000 software. • Consult RSLogix 5000 help screen.

Error Code	Fault Message **RSLogix** (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E67	**DriveHardFault** (Task init)	Operating system failed	Software initialization fault detected due to hardware failure.	• Cycle power. • If fault persists, replace module.
E68	**DriveHardFault** (SCANport Comm)	DPI communication failed	The DPI device or cable is faulty.	Check DPI connections.
E69	**DriveHardFault** (Objects Init)	Non-volatile memory is corrupt due to control board hardware failure.		Load default parameters, save to non-volatile memory, and recycle power or reset the drive.
E70	**DriveHardFault** (NV Mem Init)	Non-volatile memory is corrupt due to control board software error.		Load default parameters, save to non-volatile memory, and recycle power or reset the drive.
E71	**DriveHardFault** (Memory Init)	RAM or Flash memory validation failure		• Cycle power. • If fault persists, replace module.
E72	**DriveOvertemp Fault** (Drive Overtemp)	Inverter thermal switch tripped	The fan on the IAM or an AM failed.	Replace the failed module.
			The cabinet ambient temperature is above rating.	Check the cabinet temperature.
			The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.	Change the command profile to reduce speed or increase time.
			The airflow access to the Kinetix 2000 system is limited or blocked.	Check airflow and re-route cables away from the Kinetix 2000 system.
E73	**Communicate** (Backplane Comm)	Power rail CAN communications failed.		Check module for proper mount.
		Power rail connection shorted or open.		Check power rail and module for foreign objects.
E74	**DriveOvercurrent Fault** (Bus OverCurrent)	DC link current exceeds rating	Motor or transmission malfunction.	• Check for proper motor sizing. • Check/replace transmission device. • Check/replace motor.
			IAM not properly sized.	• Check for proper IAM sizing. • Install larger kW rated IAM.
E75	**DriveOvervoltage Fault** (Shunt Time Out)	The IAM, AM, or SM has exceeded its shunt resistor continuous rating.		• Use a properly sized shunt or modify duty cycle of the application. • System uses internal shunt and requires external shunt for additional capacity.
E76	**DriveHardFault** (CAN Init)	DPI hardware initialization fault detected	Control board hardware failure.	• Reset System. • If fault persists, replace system module.
E78	**DriveHardFault** (SERCOS Init)	Control hardware fault detected.		• Cycle power. • If fault persists, replace module.
E79	**DriveOvervoltage Fault** (Shunt Module Flt)	Shunt module temperature fault LED indicator is steady red.		Refer to Temperature Fault LED Indicator on page 141.
		Shunt module shunt fault LED indicator is steady red.		Refer to Shunt Fault LED Indicator on page 141.
		Module missing from power rail.		• Install missing module on power rail. • Fill empty slot with slot filler module.
E80	**DriveHardFault** (CPLD Flt)	Control hardware fault detected.		Replace module.

Error Code	Fault Message RSLogix (HIM)	Problem or Symptom	Potential Cause	Possible Resolution
E81	**DriveHardFault** (Common Bus Flt)	Follower IAM detected ac input power being applied.		Remove ac input power connections from follower IAM.
E90	**DriveHardFault** (Pre-charge Timeout Flt)	Pre-charge resistor power exceeds the resistor rating.		Allow resistor to cool.
All others	RESERVED			Call your local Rockwell Automation sales representative.

IAM/AM Status Indicators

Drive Status LED Indicator

Drive Status LED Indicator	Status	Potential Cause	Possible Resolution
Off	Normal, no faults	N/A	N/A
Steady Red	Drive faulted	Seven-segment Fault Status display shows an error code	Fault exists, refer to Seven-segment LED Indicator Error Codes beginning on page 134.

Comm Status LED Indicator

Comm Status LED Indicator	Status	Potential Cause	Possible Resolution
Steady Green	Communication ready	No faults or failures.	N/A
Flashing Green	Establishing communication	System is still in the process of establishing SERCOS communication.	Wait for steady green LED indicator.
		Node address setting on the drive module does not match SERCOS controller configuration.	Verify proper node switch setting.
Off	No communication (1)	Loose fiber-optic connection.	Verify proper fiber-optic cable connections.
		Broken fiber-optic cable.	Replace fiber-optic cable.
		Receive fiber-optic cable connected to SERCOS transmit connector and vice versa.	Check proper SERCOS fiber-optic cable connections.

(1) Refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010, for more information.

Bus Status LED Indicator

Bus Status LED Indicator	Status	Condition
Steady Green	Bus power is present, axis enabled. No faults or failures.	Normal when: • 24V is applied to Hardware Enable Input (IOD/AF-43). • MSO instruction is commanded in RSLogix 5000 software.

Bus Status LED Indicator	Status	Condition
Flashing Green	Bus power is present, axis disabled. No faults or failures.	Normal when: • 24V is not applied to Hardware Enable Input (IOD/AF-43). • MSO instruction is not commanded in RSLogix 5000 software.
Off	Bus power not present.	• Normal when bus power is not applied. • Fault exists, refer to Seven-segment LED Indicator Error Codes section beginning on page 134.
	Bus power is present in follower IAM.	• Follower IAM is not configured as CommonBus Follow in RSLogix 5000 software. • After dc bus voltage is applied, a 2.5 second delay before the LED indicator begins flashing green is normal operation to provide common bus leader time to complete pre-charge.

SM Status Indicators

Each of the shunt module LED indicators provide specific troubleshooting information.

General Shunt Module Troubleshooting

Module	Status	Under These Conditions
SM	Fault is latched	Until fault condition is corrected and cleared.
	Fault is cleared	• Using RSLogix MASR, MAFR, MGSR commands or the HIM (red stop button). • Only after the dc bus is discharged (SM Bus Status LED indicator is flashing). • Drive must be configured with 2093-ASP06 or Bulletin 1336 external shunt resistor.
IAM/AM	Disabled (for dc bus regulation)	• When the 2093-ASP06 shunt module is used on a 230V system. • When a 230V system is configured with a Bulletin 1336 external shunt resistor. • When configured in Common Bus Follower mode.
	Enabled to discharge the dc bus	Drive (IAM or leader IAM) three-phase power is removed.
	Disabled from discharging the dc bus	When configured in common bus follower mode.

IMPORTANT Under some fault conditions, two reset commands may be required to clear drive and SM faults.

Bus Status LED Indicator

Bus Status LED Indicator	Status	Potential Cause	Possible Resolution
Flashing	Normal condition when control power is applied and bus voltage is less than 60V dc.		N/A
Steady Green	Normal condition when control power is applied and bus voltage is greater than 60V dc.		N/A
Off	Control power is not present.	Internal power supply failure.	Replace shunt module.

Temperature Fault LED Indicator

Temp Fault LED Indicator	Status	Potential Cause	Possible Resolution
Off	Normal condition		N/A
Steady Red	SM internal temperature exceeds operating temperature specification	Shunt module fan failed	Replace shunt module.
		Shunt module temperature exceeds rating	• Allow shunt module to cool. • Reset faults. • Verify IAM bus regulator configuration.
	External over temperature condition	External temperature switch is open	• Allow shunt module to cool. • Reset faults. • Verify IAM bus regulator configuration.
		TS jumper is not present	Install jumper.

Shunt Fault LED Indicator

Shunt Fault LED Indicator	Status	Potential Cause	Possible Resolution
Off	Normal condition		N/A
Steady Red	Shorted internal or external shunt resistor	Mis-wired shunt jumper or other short on RC connector	• Correct mis-wire (shorted) condition. • If problem persists, replace shunt module.
		Mis-wired (shorted) external shunt wiring	

All SM Status LED Indicators

SM Status LED Indicator	Status	Potential Cause	Possible Resolution
• Bus Status • Temperature Fault • Shunt Fault	All three SM status LED indicators flash simultaneously	Shunt module hardware failure	• Cycle power. • If problem persists, replace shunt module.

Contactor Enable Status

Use this table for troubleshooting faults associated with the Contactor Enable signal (CED-1 and CED-2).

Contactor Enable Relay (CED-1 and CED-2)	Status	Potential Cause	Possible Action or Resolution
Closed	Ready for application of Main power.	Contactor Enable closes independently of the SERCOS ring status, as a result of the conditions below being verified.	CPR or CTRL power may be applied,
Open	Not ready for main power	CTRL power not applied.	Verify 170-260V ac, single-phase power is applied to CPR-1 and CPR-2.
			• Verify control power indicator is ON. • If control power indicator is OFF, control board may be defective. Control Power indicator is a dot on the lower-right of the seven segment LED display. Refer to diagram on page 123 for location.
		Axis Shutdown fault, such as E10 or overvoltage condition. For example, E19 (position error) does not cause this.	User Logix Axis_Servo_Drive Axis Fault and other tags to determine what caused the fault. Correct the problem(s) and clear the fault.
		Power rail has open slot or module is not fully seated.	• Verify that all power rail slots are occupied by a valid module. • Verify that all modules are mounted and secured to the power rail. Refer to module mounting instructions beginning on page 40.
		Connector pins on the power rail backplane or a module are bent (SYS_OK, or other pins).	Remove power and dismount each module (IAM, AM, SM, or SF). Verify the connector pins on each module are not bent or misaligned, and power tabs are evenly spaced.

Troubleshooting General System Problems

Use the tables below for troubleshooting general system faults.

Condition	Potential Cause	Possible Resolution
Axis or system is unstable.	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in torque mode.	Check to see what primary operation mode was programmed.
	Motor tuning limits are set too high.	Run Tune in RSLogix 5000 software.
	Position loop gain or position controller accel/decel rate is improperly set.	Run Tune in RSLogix 5000 software.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	• Check setups. • Run Tune in RSLogix 5000 software.
	Mechanical resonance	Notch filter or output filter may be required. Refer to Axis Properties dialog, Output tab in RSLogix 5000 software.
You cannot obtain the motor acceleration/deceleration that you want.	Torque Limit limits are set too low.	Verify that current limits are set properly.
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in RSLogix 5000 software again.
	The system inertia is excessive.	• Check motor size vs. application need. • Review servo system sizing.
	The system friction torque is excessive.	Check motor size vs. application need.
	Available current is insufficient to supply the correct accel/decel rate.	• Check motor size vs. application need. • Review servo system sizing.
	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.
Motor does not respond to a velocity command.	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	Enable signal has not been applied or the enable wiring is incorrect.	• Check the controller. • Check the wiring.
	The motor wiring is open.	Check the wiring.
	The motor thermal switch has tripped.	• Check for a fault. • Check the wiring.
	The motor has malfunctioned.	Repair or replace the motor.
	The coupling between motor and machine has broken (i.e., the motor moves, but the load/machine doesn't).	Check and correct the mechanics.
	Primary operation mode is set incorrectly.	Check and properly set the limit.
	Velocity or current limits are set incorrectly.	Check and properly set the limits.

Condition	Potential Cause	Possible Resolution
Presence of noise on command or motor feedback signal wires.	Recommended grounding per installation instructions have not been followed.	• Verify grounding. • Route wire away from noise sources. • Refer to System Design for Control of Electrical Noise, publication GMC-RM001.
	Line frequency may be present.	• Verify grounding. • Route wire away from noise sources.
	Variable frequency may be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls etc. The frequency may be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	• Decouple the motor for verification. • Check and improve the performance of the gearbox, ballscrew, or other mechanical connections.
No rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	• Check brake wiring and function. • Return the motor for repair.
	The motor is not connect to the load.	Check coupling.
Motor overheating	The duty cycle is excessive.	Change the command profile to reduce accel/decel or increase time.
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.
Abnormal noise	Motor tuning limits are set too high.	Run Tune in RSLogix 5000 software again.
	Loose parts are present in the motor.	• Remove the loose parts. • Return motor for repair. • Replace motor.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return motor for repair.
	Mechanical resonance	Notch filter may be required. Refer to Axis Properties dialog, Output tab in RSLogix 5000 software.
Erratic operation - Motor locks into position, runs without control or with reduced torque.	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.
	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.
	Sine, Cosine, Rotor lead sets of resolver feedback are reversed.	Check and correct motor feedback wiring.

Logix/Drive Fault Behavior

This section provides the drive fault actions and indicates whether the fault action is programmable.

Drive Fault Action Definitions

Drive Fault Action	Definition
Shutdown	The drive disables and the contactor enable relay opens. Uncontrolled stop, motor coasts to a stop.
Disable Drive	The drive is disabled. Uncontrolled Stop, motor coasts to a stop.
Stop Motion	Logix configuration for velocity loop Kp/Ki is followed. When zero speed is reached or stopping time is exceeded, the drive is disabled. Stopping time and stopping torque are user defined parameters in RSLogix 5000 software.
Status Only	Drive continues to operate. Status is provided by seven-segment Fault Status LED indicator, Drive Status LED indicator, and DPI (if used).

Logix/Drive Fault Behavior

Fault Message RSLogix (HIM)	Error Code	Description	Drive Fault Action	RSLogix Programmable Fault Action?
BusUndervoltageFault (Blown fuse)	E00	A blown fuse was detected in the inverter pcb.	SHUTDOWN	N
MotorOvertempFault (Motor Overtemp)	E04	The motor thermal switch was tripped. Firmware I^2t protection does not generate a fault, rather it dynamically folds back current when 110% of motor rating is reached. Setting the Motor Thermal fault action to Status Only will bypass this function.	STOP	Y
DriveOvercurrentFault (Power Fault)	E05	An instantaneous over-current was detected in the inverter power section.	SHUTDOWN	N
HardOvertravelFault (+/- Hard Overtravel)	E06	Axis moved beyond the physical travel limits in the positive/negative direction. This fault can be configured for status only.	STOP	Y
MotFeedbackFault (Motor Feedback Loss)	E07	The feedback wiring is open, shorted, or missing.	DISABLE	N
BusUndervoltageFault (Bus Under Voltage)	E09	With three-phase power applied, the dc bus voltage is below limits. The trip point is 137V dc for 230V drives. DC bus voltage is below limits when any axis on common bus follower power rail was enabled.	SHUTDOWN	N
DriveOvervoltageFault (Bus Overvoltage)	E10	The dc bus voltage is above limits. The trip point is 410V dc for 230V drives respectively.	SHUTDOWN	N
MotFeedbackFault (Illegal Hall State)	E11	State of Hall feedback inputs in incorrect.	DISABLE	N
SoftovertravelFault (+/- Software Overtravel)	E16	Axis position exceeded maximum software setting in the positive/ negative direction. This fault can be configured for status only.	STOP	Y
OverSpeedFault (Overspeed Fault)	E18	Axis speed has reached 150% of the maximum rated setting. The 100% trip point is dictated by the lesser of the user velocity limits or the motor rated base speed.	DISABLE	N
PositionErrorFault (Follow Error)	E19	Axis position error limit has been exceeded. This fault can be configured for status only.	STOP	Y

Fault Message RSLogix (HIM)	**Error Code**	**Description**	**Drive Fault Action**	**RSLogix Programmable Fault Action?**
MotFeedbackFault (Mtr Fdbk AQB)	E20	Motor encoder has encountered an illegal state transition.	DISABLE	N
AuxFeedbackFault (Aux Feedback Comm)	E21	Communication was not established with an intelligent (Stegmann) encoder on the Auxiliary feedback port.	STOP	N
MotFeedbackFault (Motor Feedback Comm)	E30	Communication was not established with an intelligent (Stegmann) encoder on the Motor feedback port.	STOP	N
GroundShortFault (Ground Fault)	E34	Excessive ground current in the converter was detected.	SHUTDOWN	N
DriveUndervoltageFault (Precharge Fault)	E35	The converter pre-charge cycle has failed.	SHUTDOWN	N
DriveOvertempFault (System Overtemperature)	E36	Converter internal temperature limit exceeded.	SHUTDOWN	N
PowerPhaseLossFault (Phase Loss Flt)	E37	• One or more phases of the ac input power is missing. • Axis was enabled when main (three-phase) power was removed. • Common bus follower axis was enabled when dc bus power was removed.	SHUTDOWN/ STOP	N
SERCOSFault (SERCOS Ring Flt)	E38	The SERCOS ring is not active after being active and operational.	STOP	N
DriveHardFault (Self Sense Flt)	E39	Self-sensing commutation fault detected.	DISABLE	N
DriveEnableInputFault (Drive Enable Flt)	E43	Generated when Enable input switches off when drive is enabled.	STOP	Y
SERCOSFault (SERCOS Same ADDR)	E50	Duplicate node address detected on SERCOS ring.	STOP	N
DriveHardFault (Ifbk HW Fault)	E54	Current feedback hardware fault detected.	SHUTDOWN	N
DriveHardFault (Unknown Axis)	E60	Invalid module type identified by firmware when applying power.	SHUTDOWN	N
AuxFeedbackFault (Aux Fdbk AQB)	E61	Auxiliary encoder has encountered an illegal state transition.	DISABLE	N
AuxFeedbackFault (Aux Fdbk Loss)	E62	The feedback wiring is open, shorted, or missing.	DISABLE	N
AuxFeedbackNoise (Aux Fdbk Noise)	E63	Presence of noise on auxiliary feedback cable.	DISABLE	Y
MotorFeedbackNoise (Mtr Fdbk Noise)	E64	Presence of noise on motor feedback cable.		
No Fault Message (condition indicated by on-screen message) (Hookup Fault)	E65	Hookup procedure failed.	DISABLE	N
No Fault Message (condition indicated by on-screen message) (Atune Flt)	E66	Autotune procedure failed.	DISABLE	N

Fault Message RSLogix (HIM)	**Error Code**	**Description**	**Drive Fault Action**	**RSLogix Programmable Fault Action?**
DriveHardFault (Task init)	E67	Operating system failed.	SHUTDOWN	N
DriveHardFault (SCANport Comm)	E68	DPI communication failed.	STOP	N
DriveHardFault (Objects Init)	E69	Non-volatile memory attribute out of range.	SHUTDOWN	N
DriveHardFault (NV Mem Init)	E70	Non-volatile memory corrupted.	SHUTDOWN	N
DriveHardFault (Memory Init)	E71	RAM or flash memory validation failure.	SHUTDOWN	N
DriveOvertempFault (Drive Overtemp)	E72	Inverter temperature limit exceeded. Firmware I^2t protection does not generate a fault, rather it dynamically folds back current when 110% of drive rating is reached.	SHUTDOWN	Y
Communicate (Backplane Comm)	E73	Power rail backplane CAN communications failed.	STOP	N
DriveOvercurrentFault (Bus OverCurrent)	E74	The converter has exceeded its converter rating.	SHUTDOWN	N
DriveOvervoltageFault (Shunt Time Out)	E75	The IAM, AM, or SM has exceeded its shunt resistor continuous rating. SHUTDOWN for IAM, DISABLE for AM. IAM also provides fault handling for shunt module.	SHUTDOWN	N
DriveHardFault (Can Init)	E76	Either DPI or backplane CAN initialization failure.	SHUTDOWN	N
DriveHardFault (Module Mismatch)	E77	Generated by IAM if the power rating of an AM on the same power rail does not match with IAM input power rating.	SHUTDOWN	N
DriveHardFault SERCOS Init	E78	Control hardware fault detected.	SHUTDOWN	N
DriveOvervoltageFault (Shunt Module Flt)	E79	Power rail mounted shunt module fault. Displayed on IAM seven-segment Fault Status LED indicator.	SHUTDOWN	N
HardwareFault (CPLD Flt)	E80	Control hardware fault detected.	SHUTDOWN	N
HardwareFault (Common Bus Flt)	E81	Common bus follower IAM detected ac input power being applied.	SHUTDOWN	N
HardwareFault (Pre-charge Timeout Flt)	E90	Pre-charge resistor power exceeds the resistor rating.	SHUTDOWN	N
RESERVED	All Others			

Removing and Replacing the Kinetix 2000 Drive Modules

Introduction

This chapter provides remove and replace procedures for your Kinetix 2000 system components.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. You are required to follow static control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged.

If you are not familiar with static control procedures, refer to Allen-Bradley publication 8000-4.5.2, Guarding Against Electrostatic Damage, or any other applicable ESD Protection Handbook.

Before You Begin

You will need the following tools available before you begin removal and replacement procedures:

- A flat-blade screwdriver
- A small flat-blade screwdriver, 3.5 mm (0.14 in.)
- Voltmeter

Remove Modules from the Power Rail

Follow these steps to remove modules from the power rail.

1. Verify that all control and input power has been removed from the system. Zero (0) V ac should be measured between these points on the IAM:

   - IPD-1, IPD-2, and IPD-3 (L1, L2, L3) for main input power.
   - CPD-1 and CPD-2 ((CTRL-1 and CTRL-2) for control input power.

ATTENTION

To avoid shock hazard or personal injury, verify that all power has been removed before proceeding. This system may have multiple sources of power. More than one disconnect switch may be required to de-energize the system.

1. Allow five minutes for the dc bus to completely discharge before proceeding. Zero (0) V dc should be measured between these points on the IAM:

   - IPD-5 and IPD-6 (DC+ and DC-) for common bus output power.

ATTENTION

This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. You should only attempt the procedures in this document if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

2. Label and remove all connectors from the module (IAM, AM, or SM) you are removing.

   To identify each connector, refer to page 43 (IAM/AM) or page 60 (SM). A slot filler module has no connectors that are user accessible.

3. Loosen the mounting screw (top of each module).

4. Grasp the module with one hand while unlocking the bottom clips with the other, and pull the module straight out of the power rail.

Replace Modules on the Power Rail

Follow these steps to replace modules on the power rail.

1. Align the locking screw with the corresponding slot in the power rail.
2. Push the module straight in while applying the force at the top and bottom of the front cover.
3. The module is fully seated when each clip on the bottom snaps into the groove and the screw boss is flush with the top of the power rail.

TIP The IAM and double-wide AM have two power rail connectors with integrated guide pins, the single-wide AM has one. All other modules have one connector.

4. Torque the locking screw to 2.26 Nm (20 lb-in.).
5. Reconnect the module connectors.
6. Reapply power to the system.
7. Verify that the system is operating properly.

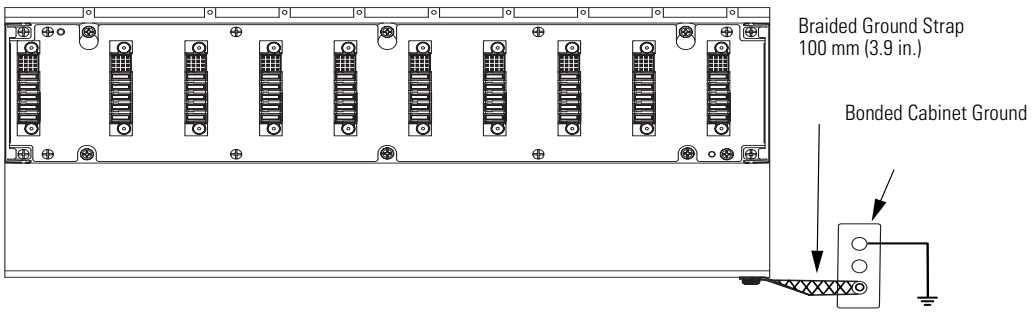
TIP Because IAM and AM parameters reside in the RSLogix 5000 software, you do not need to perform any tuning or setup procedures.

Remove the Power Rail

This procedure assumes you have removed all modules from the power rail.

Follow these steps to remove the power rail.

1. Disconnect the braided grounding strap from the grounding stud located on the right side of the power rail.



2. Loosen the mounting bolts.
3. Remove the mounting bolts along the bottom of the power rail.
4. Lift the power rail up and off of the top mounting bolts.

Replace the Power Rail

This procedure assumes you do not need to change the location of the power rail on the panel, because you intend to reuse the mounting bolts in their existing locations to mount a new power rail.

IMPORTANT If you need to change the location of the power rail, or if you are installing a power rail designed for additional or fewer modules than you removed, refer to Kinetix 2000 Power Rail Installation Instructions, publication 2093-IN004.

ATTENTION To avoid damage to the power rail during installation, do not remove the protective boots until the module for each slot is ready for mounting.

Follow these steps to replace the power rail.

1. Align the replacement power rail over the existing mounting bolts.

IMPORTANT To improve the bond between the power rail and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

2. Tighten the mounting bolts.
3. Re-attach the braided grounding strap to the power rail grounding stud (refer to page 151).

Specifications and Dimensions

Introduction

This appendix provides product specifications and mounting dimensions for your Kinetix 2000 system components.

Power Specifications

This section contains power specifications for your IAM or AM components.

Converter Power Specifications

The following tables list power specifications for the converter section that resides within an integrated axis module.

IAM Converter (three-phase and single-phase) Power Specifications

Attribute	2093-AC05-MP*x* Three-phase Input (230V nom)	2093-AC05-MP*x* Single-phase Input (230V nom)
Input voltage, ac	170...264V rms	
Input frequency, ac	47...63 Hz	
Input current, ac main [1] Nom (rms) Max inrush (0-pk)	 11.66 A 34.0 A	 10.95 A 34.0 A
Input voltage, dc (common bus follower)	240...375V dc	
Input current, dc (common bus follower)	9.76 A	6.42 A
Control power ac input voltage	170...264V rms single-phase (230V nom)	
Control power ac input current Nom (@ 230V ac) rms Max inrush (0-pk)	 1.25 A 93.0 A [2]	
Bus output voltage, nom	325V dc	
Line loss ride through	20 ms	
Continuous output current to bus (A_{dc})	9.67 A	6.42 A
Intermittent output current to bus (A_{dc}) [3]	19.34 A	12.84 A
Bus overvoltage	425V dc	
Bus undervoltage	137.5V dc	
Internal shunt Continuous power Peak power	 15 W 3000 W	
Internal shunt resistor	50 Ω	
Shunt on	405V	
Shunt off	375V	
Continuous power output to bus	3.0 kW	2.0 kW
Peak power output	6.0 kW	4.0 kW
Efficiency	95%	
Converter inductance	N/A	
Converter capacitance	540 µF	
Converter leakage current (max)	2.0 mA	

(1) All 2093-AC05 integrated axis modules are limited to two contactor cycles per minute (with up to four axis modules), or one contactor cycle per minute (with five to eight axis modules).

(2) Maximum inrush duration is less than 1/2 line cycle.

(3) Intermittent output current duration equals 250 ms.

Inverter Power Specifications

The following tables list power specifications for the inverter section that resides within an integrated axis module or an axis module.

IAM Inverter Power Specifications

Attribute	2093-AC05-MP1	2093-AC05-MP2	2093-AC05-MP5
Bandwidth Velocity Loop [1] Current Loop	 500 Hz 860 Hz		
PWM frequency	8 kHz		
Nominal input voltage	325V dc		
Continuous current (rms)	1.0 A	2.0 A	3.0 A
Continuous current (0-pk)	1.41 A	2.83 A	4.24 A
Peak current (rms)	3.0 A	6.0 A	9.0 A
Peak current (0-pk)	4.20 A	8.48 A	12.7 A
Peak output current time, max	3 s from 0% drive utilization (0% soak)		
Continuous power out, nom	0.3 kW	0.6 kW	0.9 kW
Efficiency	98%		
Capacitance	200 µF		
Capacitive energy absorption	7.5 J		
Inverter PCB leakage current	1 mA		

[1] Bandwidth values in the velocity loop vary based on tuning parameters and mechanical components.

AM Inverter Power Specifications

Specification	2093-AMP1	2093-AMP2	2093-AMP5	2093-AM01	2093-AM02
Bandwidth [1] Velocity Loop Current Loop	 500 Hz 860 Hz				
PWM frequency	8 kHz				
Nominal input voltage	325V dc				
Continuous current (rms)	1.0 A	2.0 A	3.0 A	6.0 A	9.5 A
Continuous current (0-pk)	1.41 A	2.83 A	4.24 A	8.48 A	13.4 A
Peak current (rms)	3.0 A	6.0 A	9.0 A	18.0 A	28.5 A
Peak current (0-pk)	4.20 A	8.48 A	12.7 A	25.5 A	40.3 A
Peak output current time (max)	3 s from 0% drive utilization (0% soak)				
Continuous power out (nom)	0.3 kW	0.6 kW	0.9 kW	1.9 kW	3.0 kW
Efficiency	98%				
Capacitance	200 µF			540 µF	
Capacitive energy absorption	7.5 J			20 J	
Inverter PCB leakage current	1 mA				

[1] Bandwidth values vary based on tuning parameters and mechanical components.

Auxiliary Control Power Specifications

This section lists auxiliary control power requirements for a Kinetix 2000 system comprised of an IAM, up to seven AMs, a Shunt Module, or a Slot Filler.

Auxiliary Control Power Specifications

Number of AMs (2093-AMPx or 2093-AMx)	**Current Requirements** (115V ac)	**Current Requirements** (230V ac)	**Max Inrush**	**Input VA**
0	0.3 A	0.15 A	93 A	50 VA
1	0.6 A	0.30 A		99 VA
2	0.9 A	0.45 A		148 VA
3	1.2 A	0.60 A		197 VA
4	1.5 A	0.75 A		247 VA
5	1.8 A	0.90 A		296 VA
6	2.1 A	1.05 A		345 VA
7	2.4 A	1.20 A		395 VA
Shunt Module (2093-ASP06)	2.5 A	1.25 A		410 VA
Slot Filler (2093-PRF)	—	—	—	—

Shunt Module Power Specifications

The table below lists the power specifications for the 2093-ASP06 Shunt Module (SM).

SM Power Specifications

Kinetix 2000 Drives	Shunt Module Catalog Number	Specifications						Fuse Replacement
		Drive Voltage V ac	Resistance Ω	Peak Power kW	Peak Current A	Continuous Power W	Capacitance µF	
2093-AC05-MP1	2093-ASP06 (1)	230	15.0	10.9	27.0	50	164	N/A (no internal fuse)
2093-AC05-MP2								
2093-AC05-MP5								

(1) 1Contact your Allen-Bradley sales representative for availability of external shunt modules.

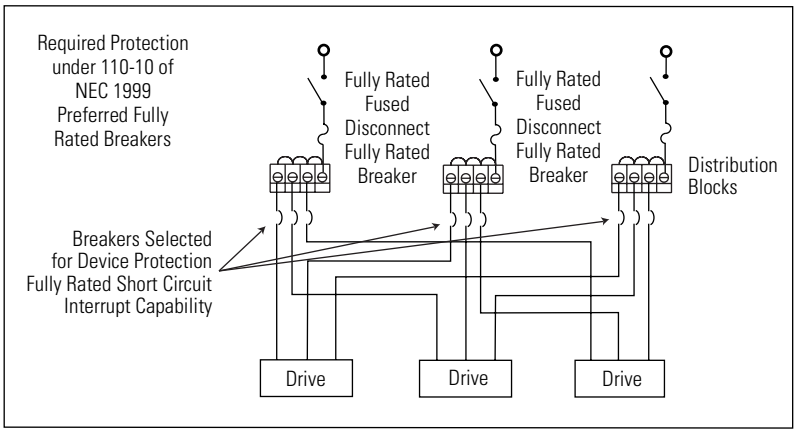
Circuit Breaker/Fuse Specifications

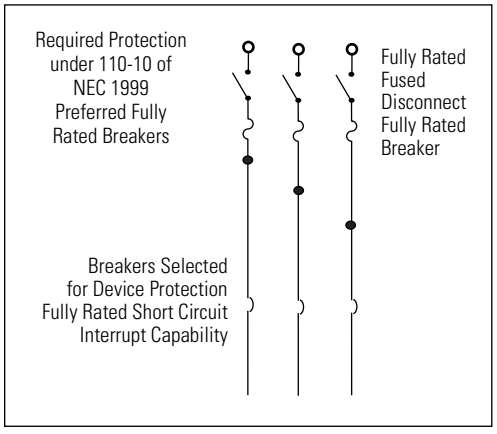
While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses. A Kinetix 2000 system needs to be protected by a device having a short circuit interrupt current rating of the service capacity provided or a maximum of 100,000 A.

If an upstream circuit protection device is rated for the overload current and short circuit rating, a supplementary circuit protection device (such as the 1492 product) can be used as the only Kinetix 2000 branch-circuit protection device. The upstream fully rated device let-through must be less than or equal to the 10 kA interrupt rating of the 1492 circuit protection device.

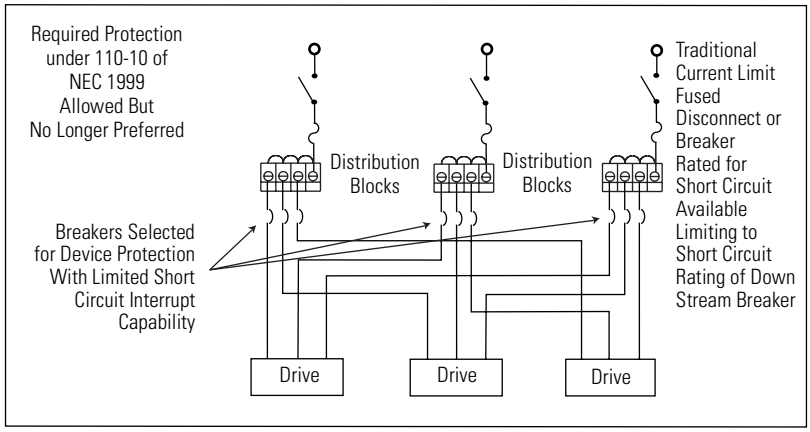
The wiring interconnection in the figures below provide examples of the needed protection and follows UL and NEC codes. Full compliance is dependent on final wiring design and installation.

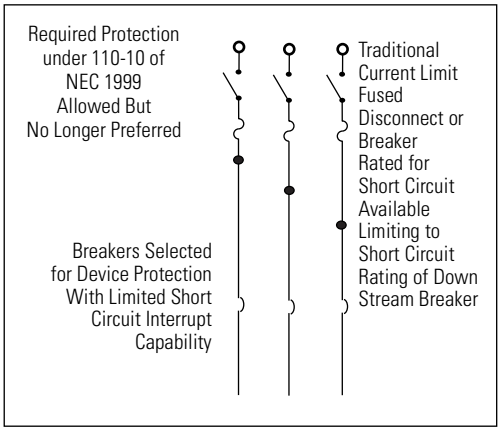
Circuit Protection under NEC 1999 110-10 (preferred fully rated devices)





Circuit Protection under NEC 1999 110-10 (allowed but no longer preferred)





Use class CC, J, L, or R fuses, with current rating as indicated in the table below. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with integrated axis modules (2093-AC05-MP*x*) when the Line Interface Module (LIM) is not used.

IMPORTANT Line interface modules (2094-AL*xx*S and 2094-XL75S-C*x*) provide branch circuit protection to the IAM.

Line interface module 2094-AL09 contains a supplementary protection device, 1492-CB (UL 508), and therefore class CC or J fuses with 5kA SCCR must be used on the line side.

Follow all applicable NEC and local codes.

Main and Control Input Power Fuse Specifications

Catalog Number	Main Input Power				Control Input Power	
	Main Input	Fuse	Circuit Breaker 1492 Series (1)	Circuit Breaker 140M Series (1)	Fuse (2)	Circuit Breaker 1492 Series (1)
2093-AC05-MP1	170...264V ac three-phase	KTK-R-20 (20A)	1492-CB3H300	140M-F8E-C16	FNQ-R-10 (10A) or KTK-R-5 (5A)	1492-CB2H060
2093-AC05-MP2						
2093-AC05-MP5						
2093-AC05-MP1	170...264V ac single-phase			N/A		
2093-AC05-MP2						
2093-AC05-MP5						

(1) When using Bulletin 1492 or 140M circuit protection devices, the maximum short circuit current available from the source is limited to 5000 A.

(2) Fuse selection for control power is appropriate for an eight-axis system with the specified IAM.

ATTENTION Bulletin 1492 and 140M circuit breakers should not be used on the output of an ac drive as an isolating disconnect switch or motor overload device. These devices are designed to operate on sine wave voltage and the drive's PWM waveform does not permit proper operation. As a result, damage will occur to the device.

DC Common Bus Fuse Specifications

Catalog Number	DC Common Bus (1)	
	Bussman Fuse	Ferraz Shawmut Fuse
2093-AC05-MP1	N/A	A50P20-1
2093-AC05-MP2		
2093-AC05-MP5		

(1) Fusing of dc common bus is independent of main input power configuration.

Contactor Ratings

The table below lists the recommended contactor ratings for integrated axis modules installed without a line interface module.

Catalog Number	Main Input Power	AC Coil Contactor	DC Coil Contactor
2093-AC05-MP1	170...264V ac single-phase	N/A	N/A
2093-AC05-MP2			
2093-AC05-MP5			
2093-AC05-MP1	170...264V ac three-phase	100-C23x10	100-C23Zx10
2093-AC05-MP2			
2093-AC05-MP5			

Transformer Specifications for Control Power Input

Attribute	Value (23V system)
Input volt-amperes	500VA
Input voltage	230V ac
Output voltage	200...240V ac

Power Dissipation Specifications

Use the following table to size an enclosure and calculate required ventilation for your Kinetix 2000 system.

Kinetix 2000 Modules		Usage as a Percentage of Rated Power Output (Watts)				
		20%	40%	60%	80%	100%
Converter (IAM) [1]						
2093-AC05-MP1	Three-phase	7.0	10.5	14.0	17.4	20.9
2093-AC05-MP2						
2093-AC09-MP5						
2093-AC05-MP1	Single-phase	5.8	8.0	10.3	12.6	14.8
2093-AC05-MP2						
2093-AC09-MP5						
Inverter (IAM and AM) [1]						
2093-AC05-MP1 and 2093-AMP1		31.6	33.6	35.6	37.6	39.6
2093-AC05-MP2 and 2093-AMP2		33.0	36.4	39.8	43.3	46.8
2093-AC05-MP5 and 2093-AMP5		36.2	42.9	49.8	56.8	63.9
2093-AM01		38. 3	46.7	55. 3	64. 1	73. 1
2093-AM02		44. 3	55.6	67. 3	79.2	91.4
Shunt module (SM)						
2093-ASP06		35.8	45.8	55.8	65.8	75.8
Power Rail						
2093-PRS*xx*		0	0	0	0	0
Connector Kit						
2093-K2CK-D15M		0	0	0	0	0

[1] Internal shunt power is not included in the calculations and must be added based on utilization.

General Specifications

This section contains general specifications for your Kinetix 2000 system components.

Maximum Feedback Cable Lengths

Kinetix 2000drive/motor/feedback combinations are limited to the maximum cable length shown in the tables below. These tables assume the use of recommended cables.

IMPORTANT Operating a Kinetix 2000 drive at maximum temperature with maximum cable length may necessitate derating of the drive.

MP-Series, Y-Series, and TL-Series Motors/Actuators

MPL-A (230V) Motors [1]		MPG-A, MPF-A, and MPS-A (230V) Motors [2]	MPAI-A (230V) Linear Actuators [3]	Y-Series (230V) Motors [4]	TL-Series (230V) Motors [5]	
Absolute High-resolution m (ft)	**Incremental** m (ft)	**Absolute High-resolution** m (ft)	**Absolute High-resolution** m (ft)	**Incremental** m (ft)	**Absolute High-resolution** m (ft)	**Incremental** m (ft)
30 (98.4)	30 (98.4)	30 (98.4)	30 (98.4)	30 (98.4)	30 (98.4)	30 (98.4)

1 Refers to MPL-A*xxxx*S/M and E/V (single-turn or multi-turn) low-inertia motors with absolute high-resolution feedback.
Refers to MPL-A*xxxx*H low-inertia motors with 2000-line incremental feedback.

2 Refers to MPG-A*xxxx*S/M (single-turn or multi-turn) integrated rotary actuators with absolute high-resolution feedback.
Refers to MPF-A*xxxx*S/M (single-turn or multi-turn) food-grade motors with absolute high-resolution feedback.
Refers to MPS-A*xxxx*S/M (single-turn or multi-turn) stainless-steel motors with absolute high-resolution feedback.

3 Refers to MPAI-A*xxxx*V/M (multi-turn) integrated linear actuators with absolute high-resolution feedback.

4 Refers to Y-Series motors with incremental (optical encoder) feedback.

5 Refers to TL-A*xxxx*-B low-inertia motors with absolute high-resolution feedback.
Refers to TL-A*xxxx*-H low-inertia motors with incremental feedback.

Environmental Specifications

Attribute	Operational Range	Storage Range (non-operating)
Ambient Temperature	0...50 °C (32...122 °F)	-40...85 °C (-40...185 °F)
Relative Humidity	5...95% noncondensing	5...95% noncondensing
Altitude	1000 m (3281 ft) 3000 m (9843 ft) with derating (1)	3000 m (9843 ft) during transport
Environmental Rating	IP2X (EN60529) For use only in a Pollution Degree 2 Environment (UL508c, section 2.7) Open Device (UL508c, section 2.5)	
Vibration	5...55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55...500 Hz @ 2.0 g peak constant acceleration	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	
Conformal Coating	IB31: DSP and SERCOS pins, anti-dust and anti-humidity 1B73LSE: Power Rail connector pins, Converter, Inverter, Shunt, Power Rail, and Slot Filler PCB assemblies, clear UL creepage and clearance issue.	

(1) Peak current output is derated by 15% for each 1000 m over 1000 m (3281 ft).

Weight Specifications

Kinetix 2000 Module	Catalog Number	Description, Approx. kg (lb)
IAM	2093-AC05-MP1	1.32 (2.9)
	2093-AC05-MP2	
	2093-AC05-MP5	
AM	2093-AMP1	0.67 (1.5)
	2093-AMP2	
	2093-AMP5	
	2093-AM01	0.95 (2.1)
	2093-AM02	
SM	2093-ASP06	0.59 (1.3)

Kinetix 2000 Module	Catalog Number	Description, Approx. kg (lb)
Power Rails (Slim)	2093-PRS1	0.27 (0.6)
	2093-PRS2	0.38 (0.8)
	2093-PRS3	0.51 (1.1)
	2093-PRS4	0.64 (1.4)
	2093-PRS5	0.77 (1.7)
	2093-PRS7	1.03 (2.3)
	2093-PRS8S	1.28 (2.8)
Slot Filler Module	2093-PRF	0.15 (0.3)

Certifications

Certification [1] (when product is marked)	Standards
c-UL-us	UL Listed to U.S. and Canadian safety standards (UL 508 C File E226834).
CE	European Union 89/336/EEC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 73/23/EEC Low Voltage Directive compliant with: • EN 60204-1:1997 - Safety of Machinery - Electrical Equipment of Machines. • EN 50178:1997 - Electronic Equipment for use in Power Installations.
Functional Safety	• EN 60204-1:1997 - Safety of Machinery - Electrical Equipment of Machines. • IEC 61508: Part 1-7:2000 - Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems. • EN954-1:1996 - Safety of machinery. Safety related parts of control systems. Part 1: General principles for design.

(1) Refer to http://www.rockwellautomation.com/products/certification for Declarations of Conformity Certificates.

Line Filter Specifications

Line filters are required to meet the conducted emissions requirements. Three-phase and single-phase versions of the filters are available to meet the input power configuration.

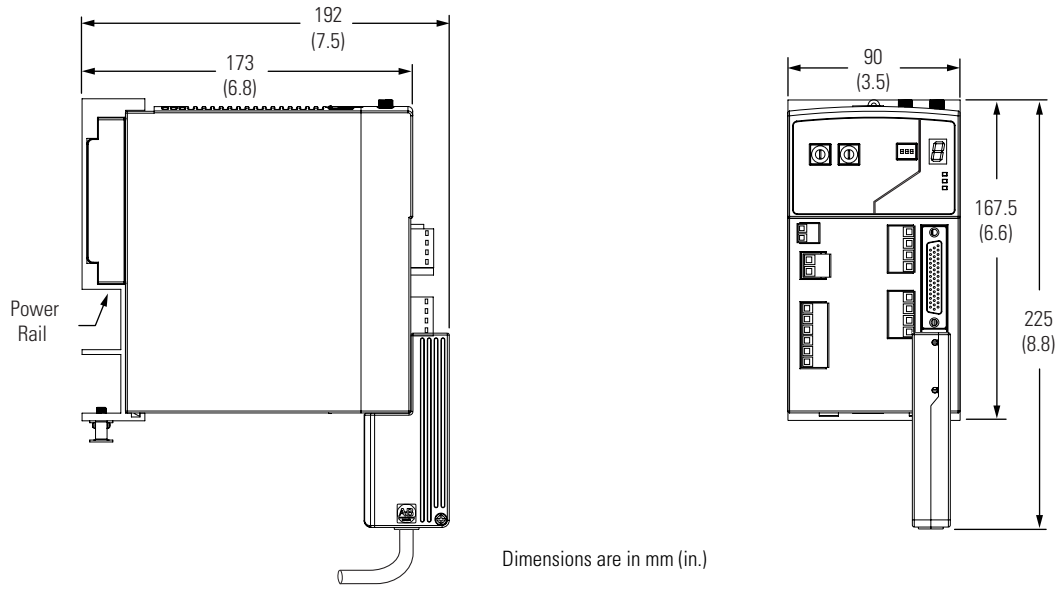
Line Filter Selection

Catalog Number	Main Input Power	Line Filter, ac	Recommended Wire Size
2093-AC05-MP1	170...264V ac three-phase	2090-XXLF-TC316 (Tesch NF310-16)	4 mm^2 (10 AWG)
2093-AC05-MP2			
2093-AC05-MP5			
2093-AC05-MP1	170...264V ac single-phase	2090-XXLF-TC116 (Tesch NF210-16)	
2093-AC05-MP2			
2093-AC05-MP5			

Product Dimensions

This section contains product dimensions for your Kinetix 2000 system components.

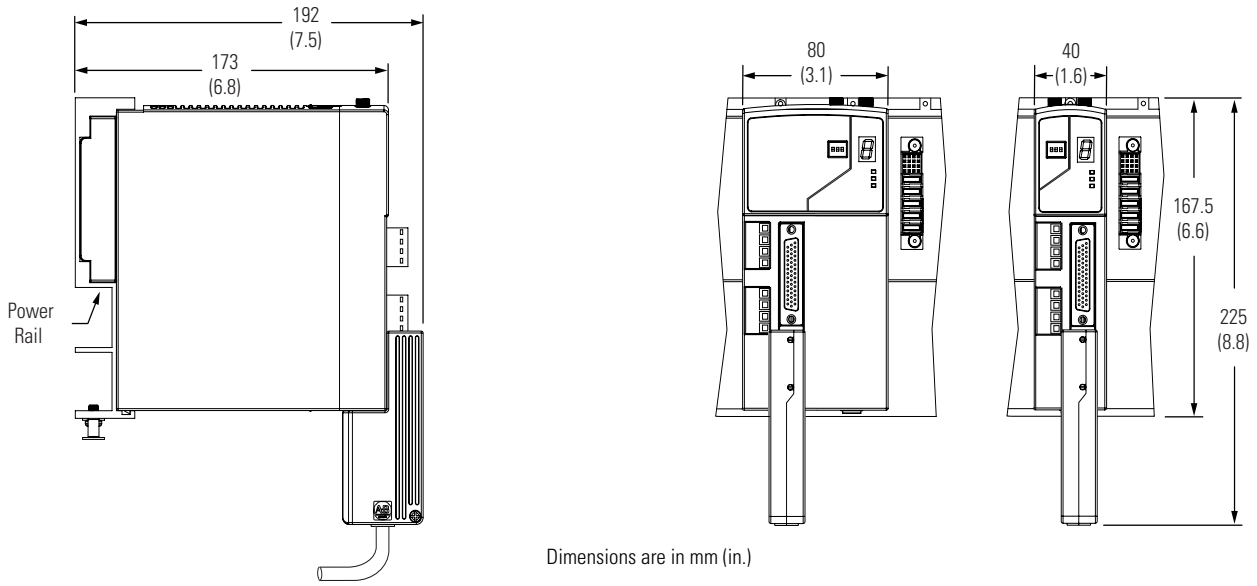
Integrated Axis Module Dimensions
2093-AC05-MP1, 2093-AC05-MP2, 2093-AC05-MP5



Dimensions are in mm (in.)

Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

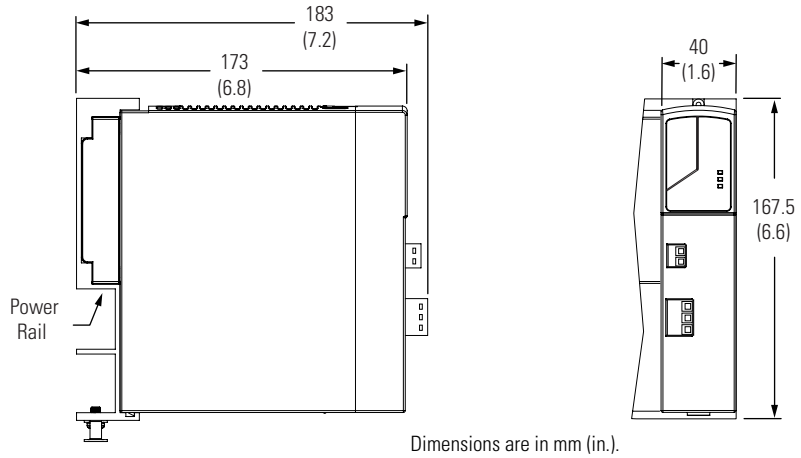
Axis Module Dimensions
2093-AM01, 2093-AM02 (double-wide), and 2093-AMP1, 2093-AMP2, 2093-AMP5 (single-wide)



Dimensions are in mm (in.)

Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

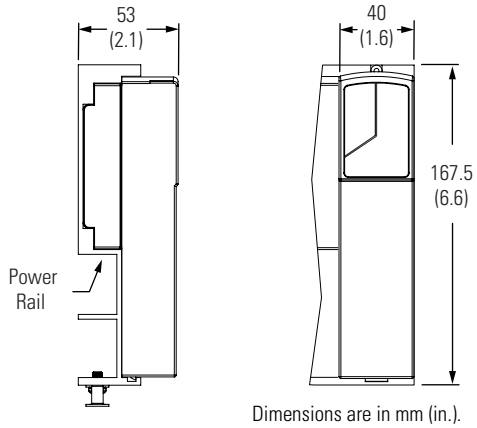
Shunt Module Dimensions
2093-ASP06



Dimensions are in mm (in.).

Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

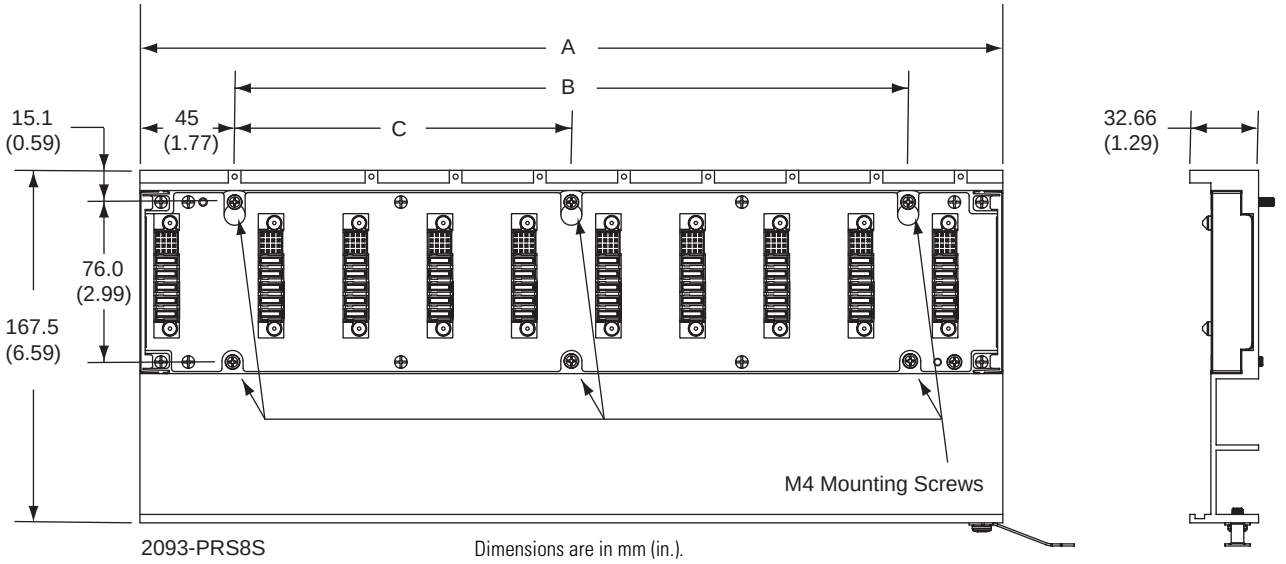
Slot Filler Dimensions
2093-PRF



Dimensions are in mm (in.).

Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

Power Rail Dimensions
2093-PRS1, 2093-PRS2, 2093-PRS3, 2093-PRS4, 2093-PRS5, 2093-PRS7, 2093-PRS8S



2093-PRS8S

Dimensions are in mm (in.).

Catalog Number	Description	Dimension A mm (in.)	Dimension B mm (in.)	Dimension C mm (in.)
2093-PRS1	1 axis power rail	90 (3.54)	N/A	N/A
2093-PRS2	2 axis power rail	130 (5.12)	40 (1.57)	N/A
2093-PRS3	3 axis power rail	170 (6.69)	80 (3.15)	N/A
2093-PRS4	4 axis power rail	210 (8.26)	120 (4.72)	N/A
2093-PRS5	5 axis power rail	250 (9.84)	160 (6.30)	N/A
2093-PRS7	7 axis power rail	330 (12.99)	240 (9.45)	120 (4.72)
2093-PRS8S	8 axis power rail	410 (16.14)	320 (12.60)	160 (6.30)

Interconnect Diagrams

Introduction

This appendix provides wiring examples and system block diagrams for your Kinetix 2000 system components.

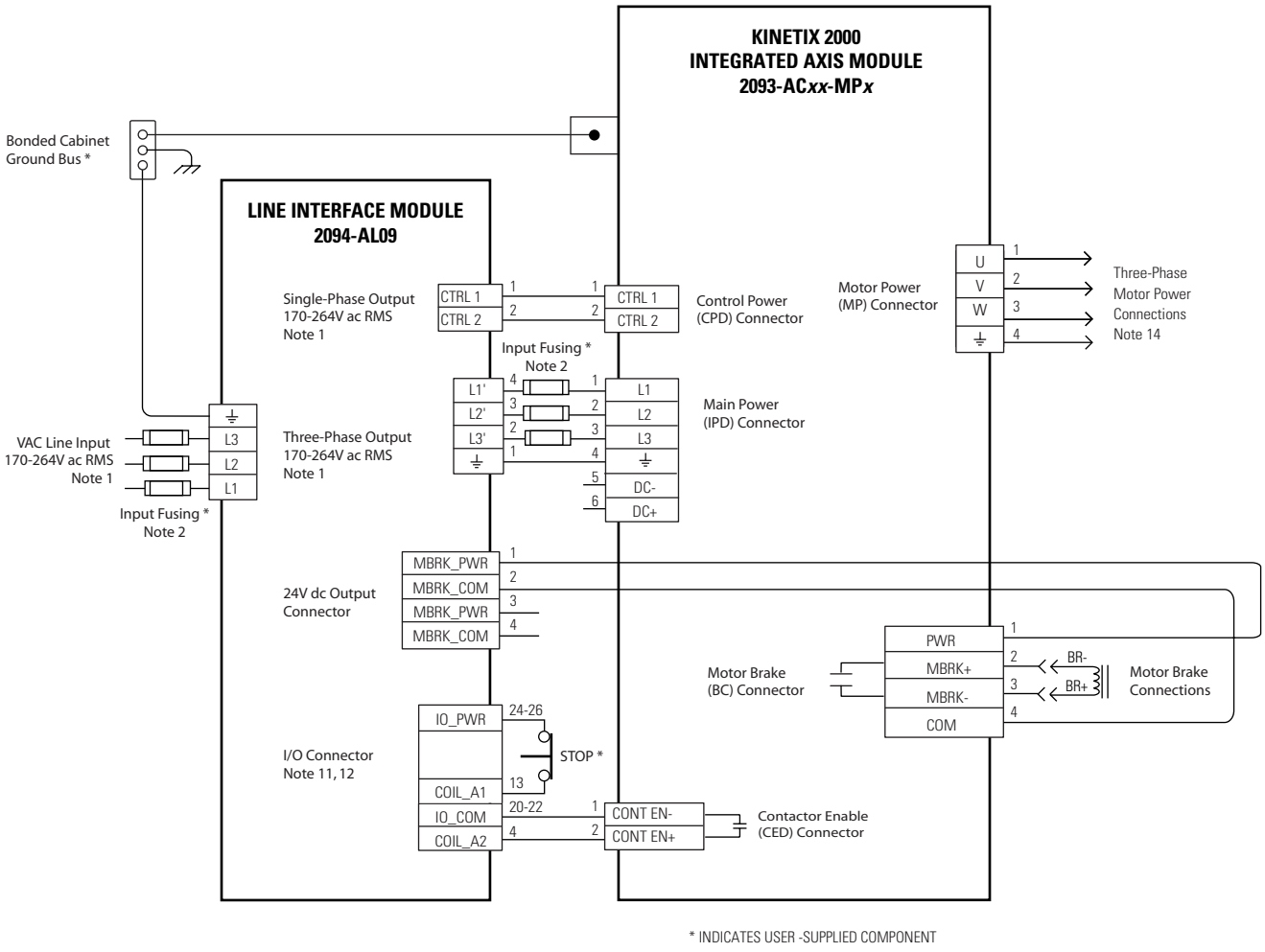
Wiring Examples

This appendix provides wiring examples to assist you in wiring the Kinetix 2000 system. The notes below apply to the wiring examples on the pages that follow.

Note	Information
1	For power wiring specifications, refer to Power Wiring Requirements on page 73.
2	For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Specifications on page 157.
3	Place ac (EMC) line filters as close to the drive as possible and do not route very dirty wires in wireway. If routing in wireway is unavoidable, use shielded cable with shields grounded to the drive chassis and filter case. For line filter specifications, refer to the Line Filter Specifications on page 163.
4	Terminal block is required to make connections.
5	Source 2093-AC05-MP*x* (230V) IAM control power from the three-phase input power (line-to-line). Supplying 230V control power from any other source requires an isolation transformer. If used, do not ground either leg of the isolation transformer output.
6	LIM model 2094-AL*xx*S supplies a maximum of eight axes. LIM models 2094-XL75S-C*x* can supply a maximum of sixteen axes. For common bus systems with more than sixteen axes, multiple LIMs (or control power transformers) are required.
7	LIM models 2094-AL*xx*S, and 2094-XL75S-C*x* are capable of connecting to two IAMs, providing each IAM has its own line filter and the maximum current specification is not exceeded.
8	Contactor coil (M1) needs integrated surge suppressors for ac coil operation. Refer to the Contactor Ratings on page 159 for more information.
9	Drive Enable input must be opened when main power is removed, or a drive fault will occur. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.
10	Default configuration for jumper is for grounded power at user site. Ungrounded sites must jumper the bleeder resistor to prevent high electrostatic buildup. Refer to Determining Your Type of Input Power on page 63 for more information.
11	**ATTENTION**  Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN 1050 and EN 954 estimation and safety performance categories. For more information, refer to Understanding the Machinery Directive, publication SHB-900.
12	**ATTENTION**  Wiring the contactor enable relay is required. To avoid personal injury or damage to the drive, wire the contactor enable relay into your safety control string. The recommended minimum wire size for wiring the safety circuit to the contactor enable connector is 1.5 mm^2 (16 AWG). Refer to the Contactor Enable Relay on page 53, for more information.
13	The Kinetix 2000 axis module referenced is either an individual axis module (2093-AMPx or 2093-AMx) or the resident integrated axis module (2093-AC05-MP*x*).
14	For motor cable specifications, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001.
15	Wire colors are for flying lead cable (2090-XXNF*xx*-S*xx*) and may vary from the premolded connector cable (2090-UXNFB*xx*-S*xx*).
16	Y-Series feedback cables have a drain wire that must be folded back under the low-profile connector clamp.
17	MPL-A3*xx*, MPL-A4*xx*, MPL-A45*xx*, and MPG-A*xxx* encoders use the +5V dc supply.
18	MPL-A15*xx*, MPL-A2*xx*, MPF-A3*xx*, MPF-A4*xx*, MPF-A45*xx*, and MPS-A*xxx* encoders use the +5V dc supply.
19	Single-phase powering of the Kinetix 2000 is shown connected to L1 and L2, but any two line inputs may be used.
20	Single-phase powering of a Kinetix 2000 IAM (2093-AC05-MPx) requires setting the input power in RSLogix5000 (Power tab in I/O Configuration) to single-phase input power.
21	Common bus applications require configuring of the additional bus capacitance for the IAM leader (2093-AC05-MPx) as described in Appendix D.
22	Common bus applications require setting the IAM follower (2093-AC05-MPx) I/O configuration, Power tab, Bus Regulator configuration to Common Bus Follower.

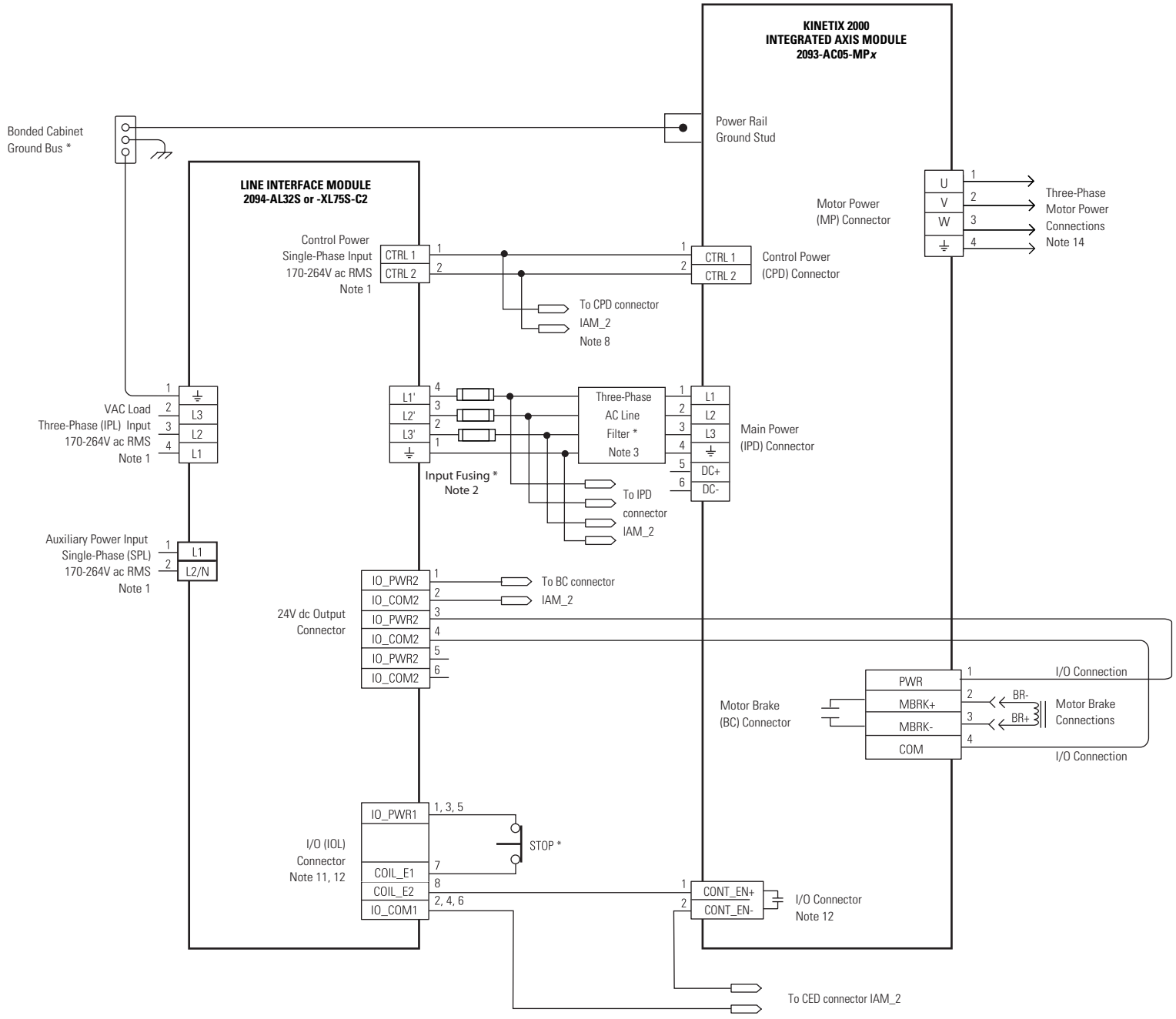
Power Wiring Examples

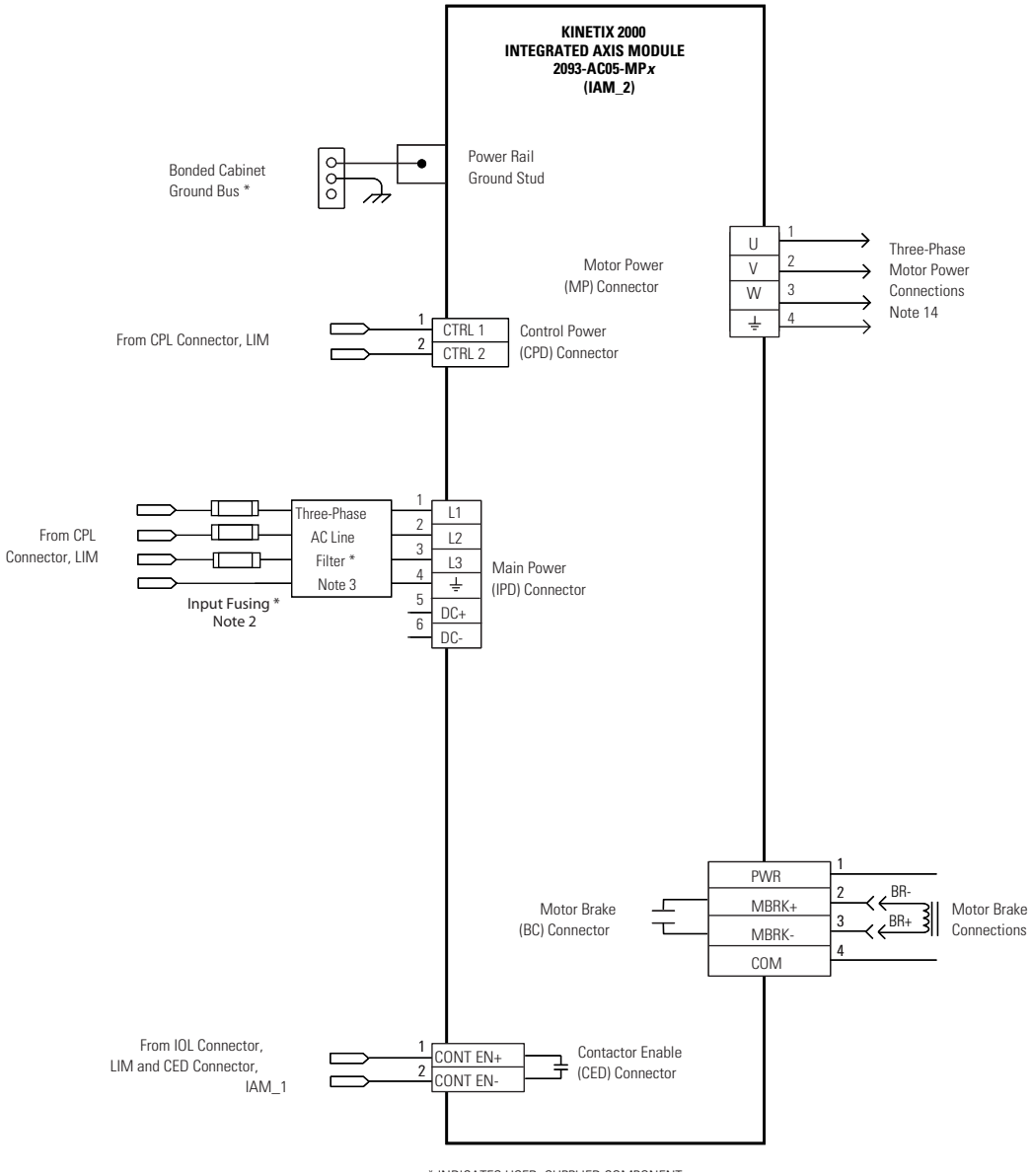
Single IAM Wiring Example with LIM 2094-AL09



* INDICATES USER -SUPPLIED COMPONENT

Multiple IAM Wiring Example with LIM 2094-AL*xx*S or 2094-XL75S-C2




KINETIX 2000
INTEGRATED AXIS MODULE
2093-AC05-MPx
(IAM_2)
Bonded Cabinet
Ground Bus *
Power Rail
Ground Stud
Motor Power
(MP) Connector
U
V
W
1
2
3
4
Three-Phase
Motor Power
Connections
Note 14
From CPL Connector, LIM
CTRL 1
CTRL 2
Control Power
(CPD) Connector
From CPL
Connector, LIM
Three-Phase
AC Line
Filter *
Note 3
L1
L2
L3
DC+
DC-
Main Power
(IPD) Connector
Input Fusing *
Note 2
Motor Brake
(BC) Connector
PWR
MBRK+
MBRK-
COM
BR-
BR+
Motor Brake
Connections
From IOL Connector,
LIM and CED Connector,
IAM_1
CONT EN+
CONT EN-
Contactor Enable
(CED) Connector

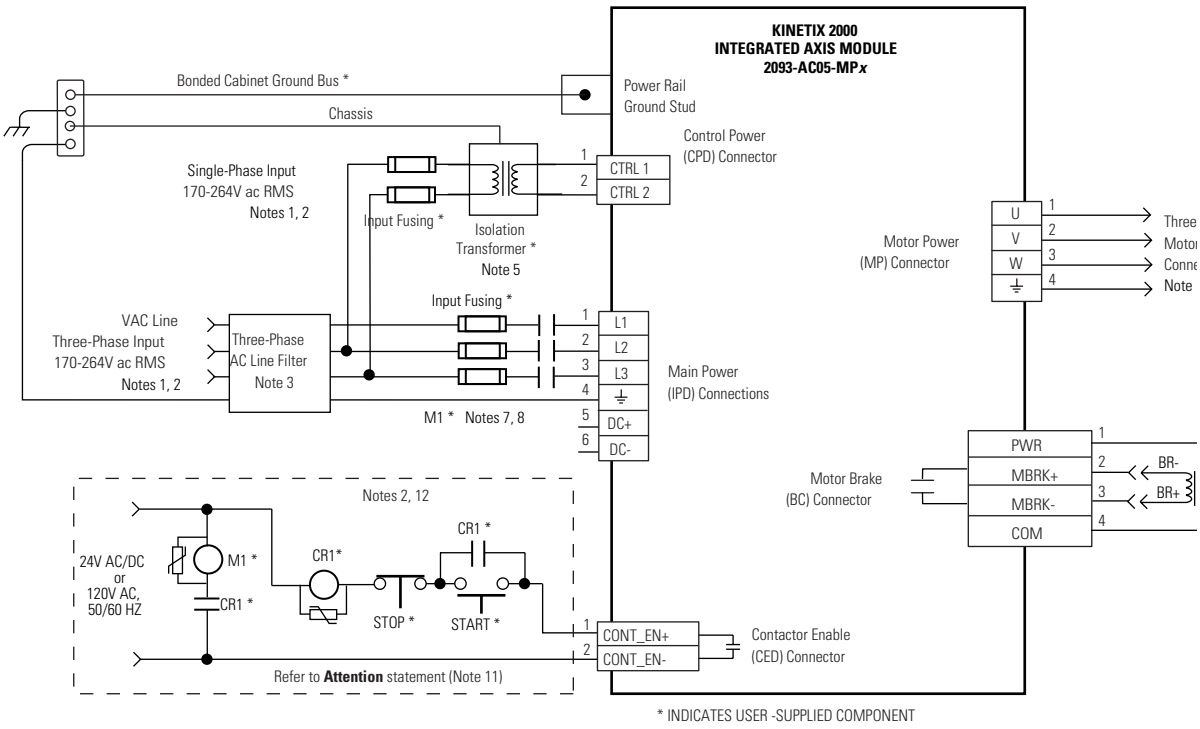
The configuration on this page does not include a LIM. You must supply input power components. The single-phase and three-phase line filters are wired downstream of fusing and the M1 contactor.

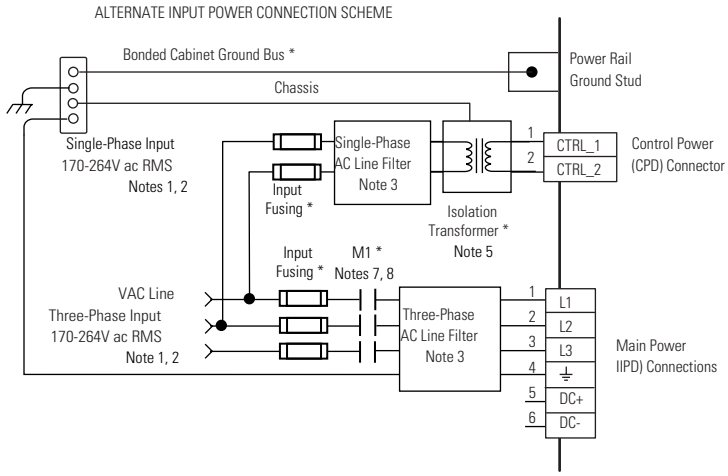
ATTENTION

Wiring the contactor enable (CED) relay is required. To avoid injury or damage to the drive, wire the contactor enable relay into your safety control string.

Refer to Contactor Enable Relay on page 53, for more information.

Three-Phase Power Input (without LIM) to IAM Wiring Example





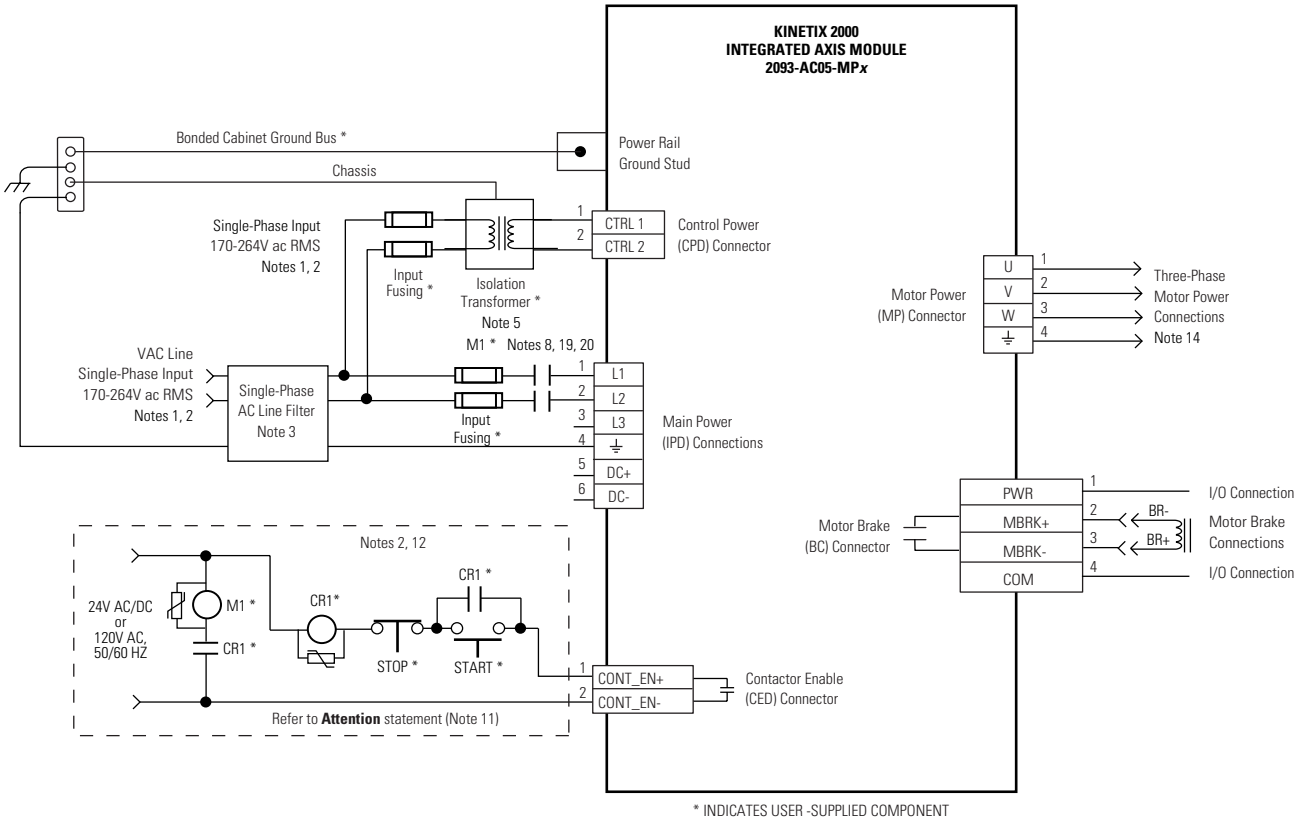
The configuration on this page does not include a LIM. You must supply input power components. The single-phase and three-phase line filters are wired downstream of fusing and the M1 contactor.

ATTENTION

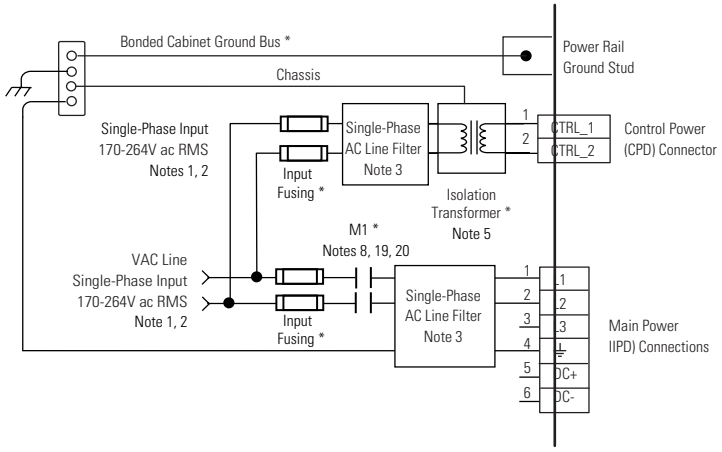
Wiring the contactor enable (CED) relay is required. To avoid injury or damage to the drive, wire the contactor enable relay into your safety control string.

Refer to Contactor Enable Relay on page 53, for more information.

Single-Phase Power Input (without LIM) to IAM Wiring Example

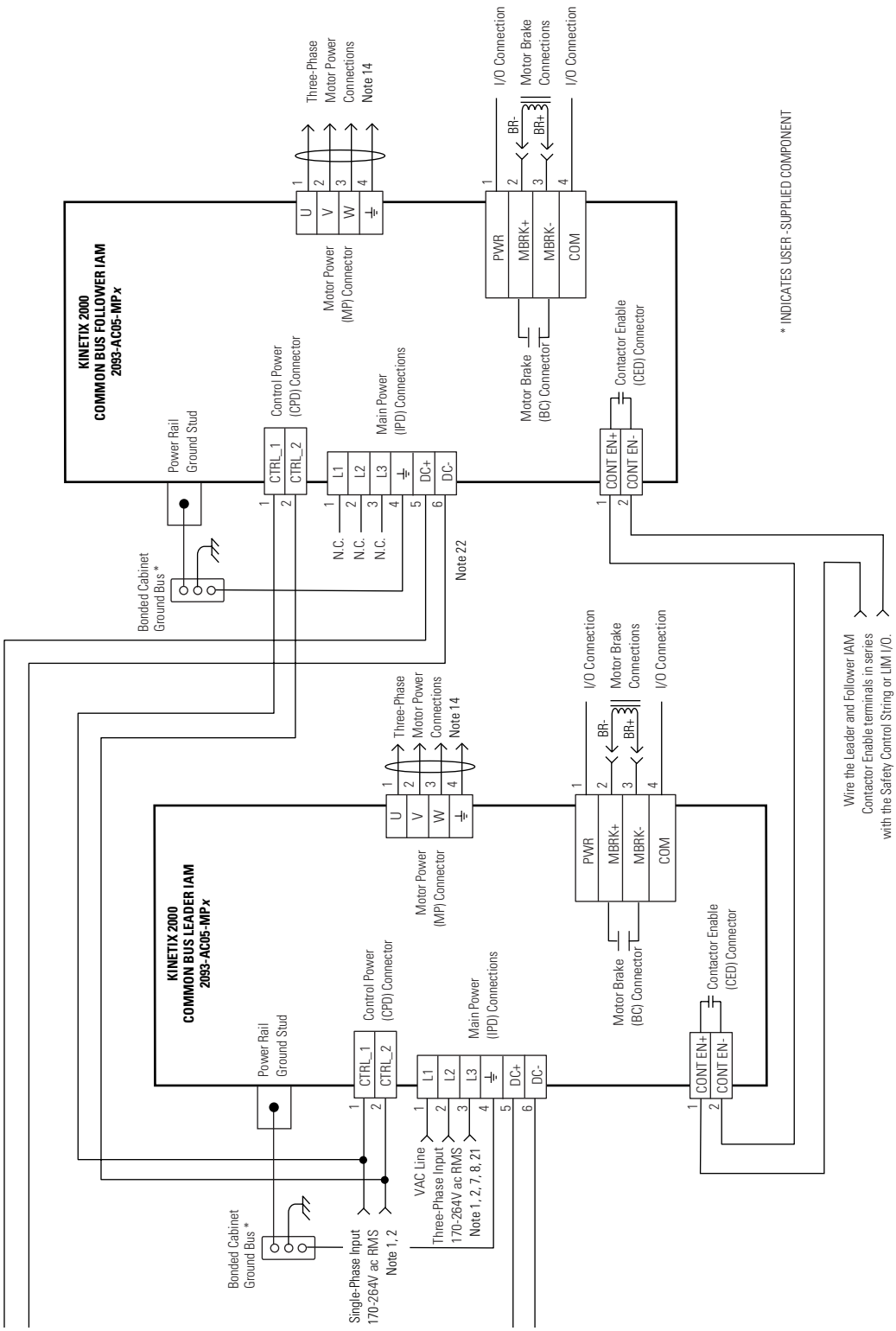


ALTERNATE INPUT POWER CONNECTION SCHEME

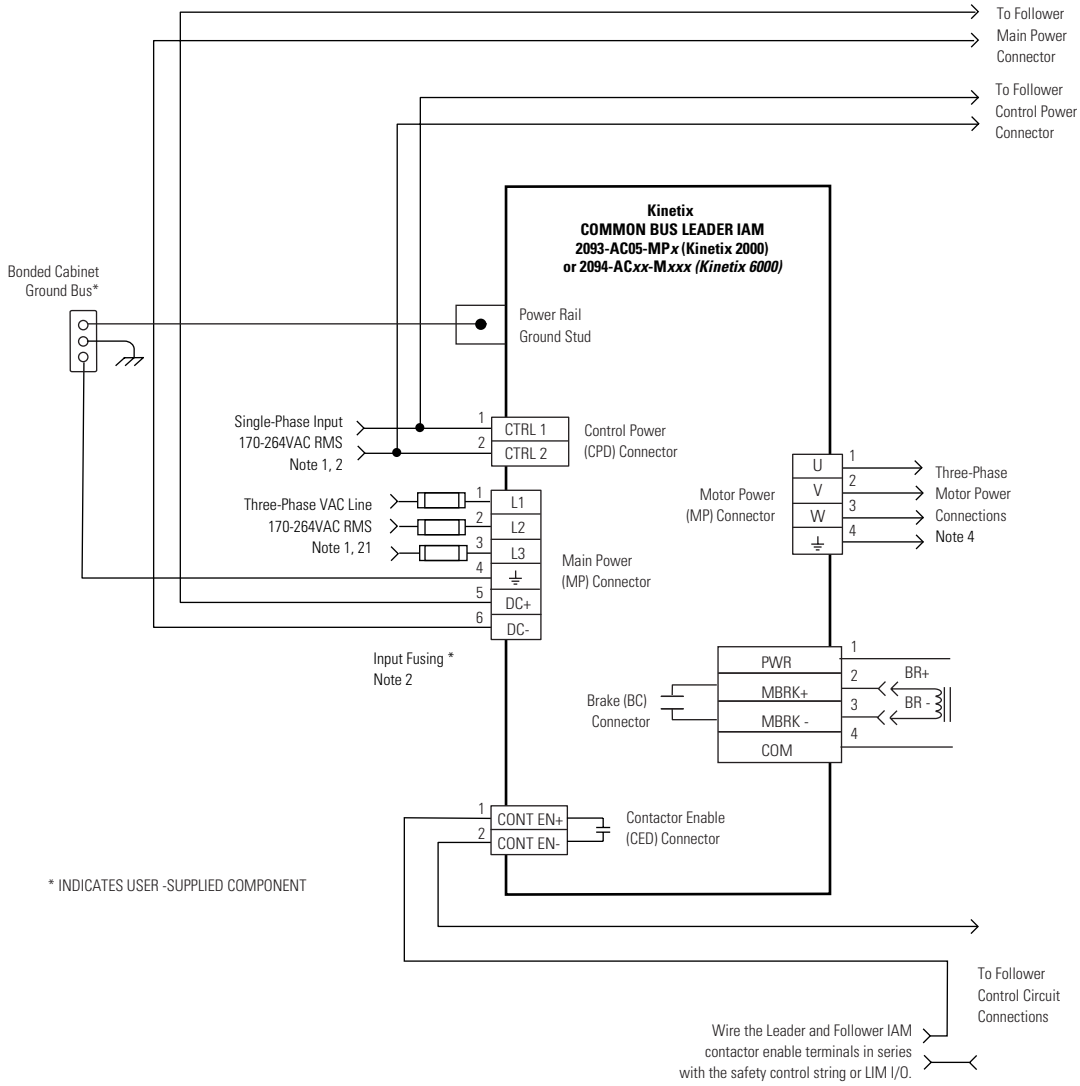


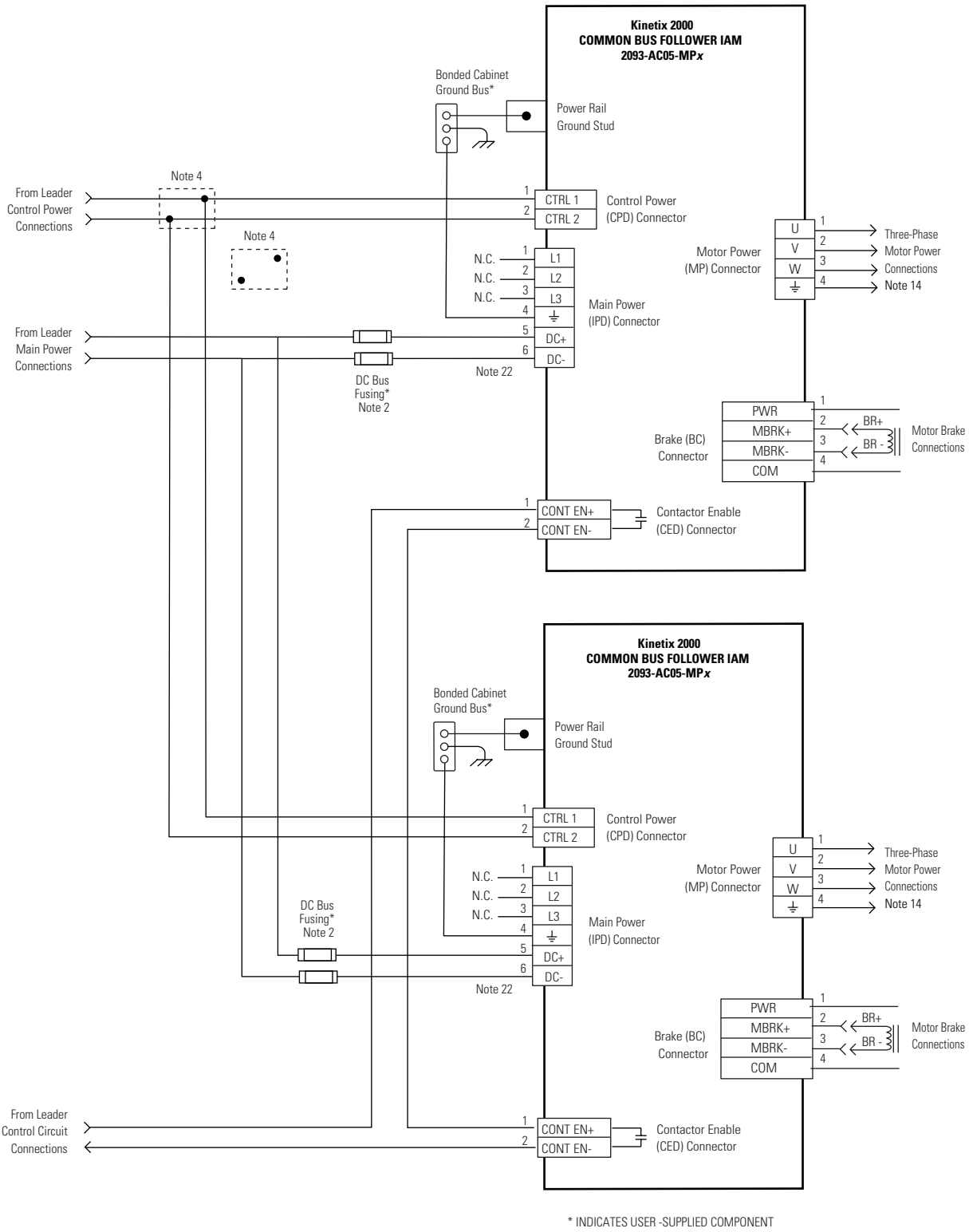
DC Common Bus Wiring Examples

Leader IAM Wiring Example with Single Follower IAM



Leader IAM Wiring Example with Multiple Follower IAM

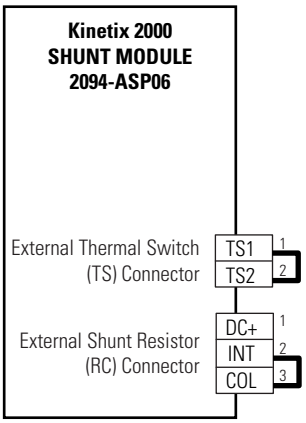




* INDICATES USER -SUPPLIED COMPONENT

Shunt Module Wiring Examples

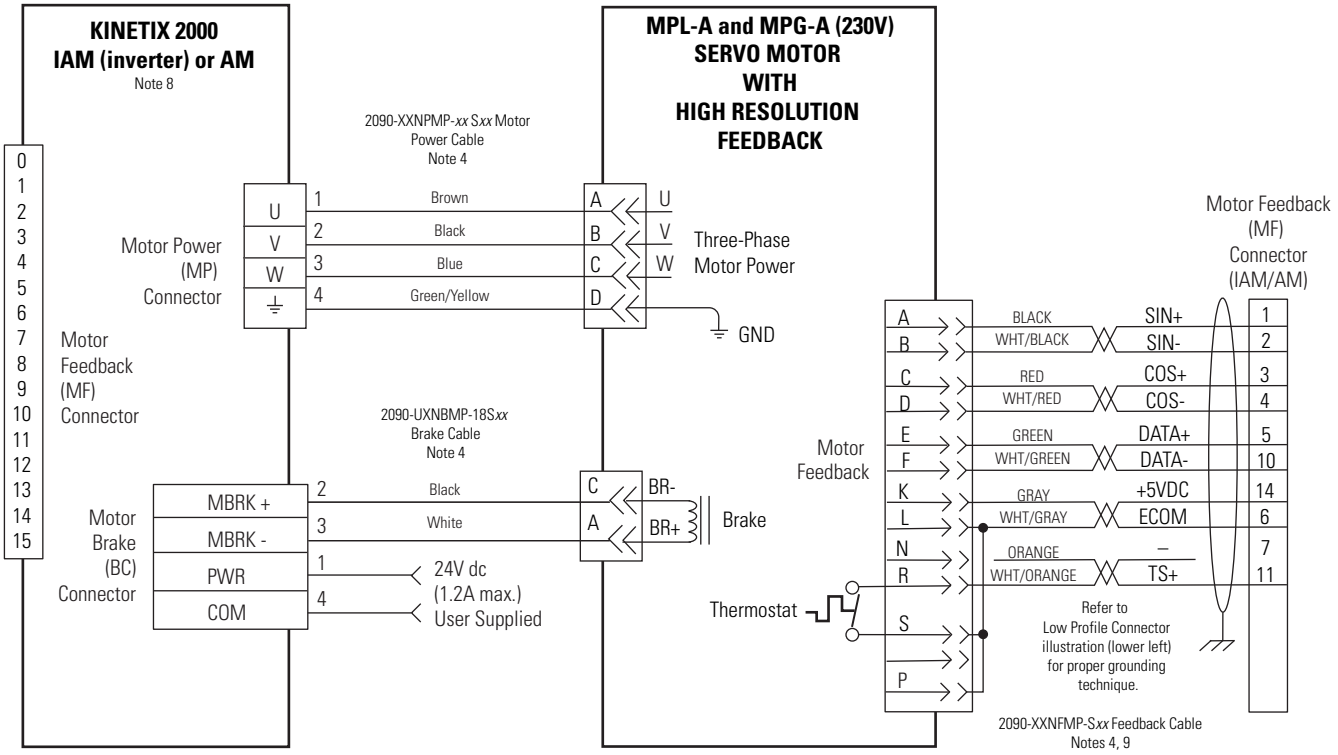
Shunt Module Wired for Internal Operation (default configuration)

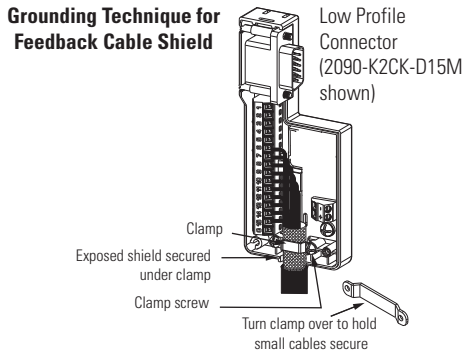


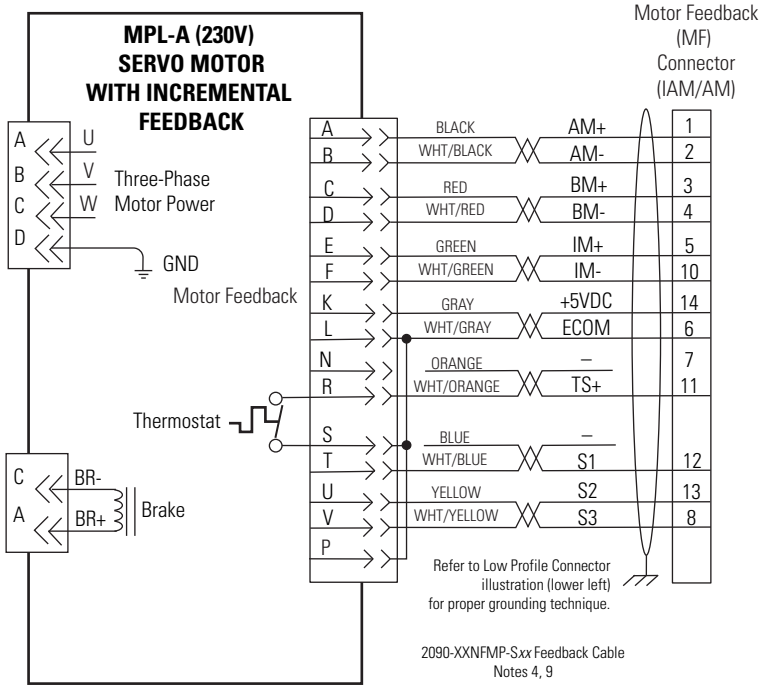
2094-ASP06 is jumpered for internal shunt.

Axis Module/Motor Wiring Examples

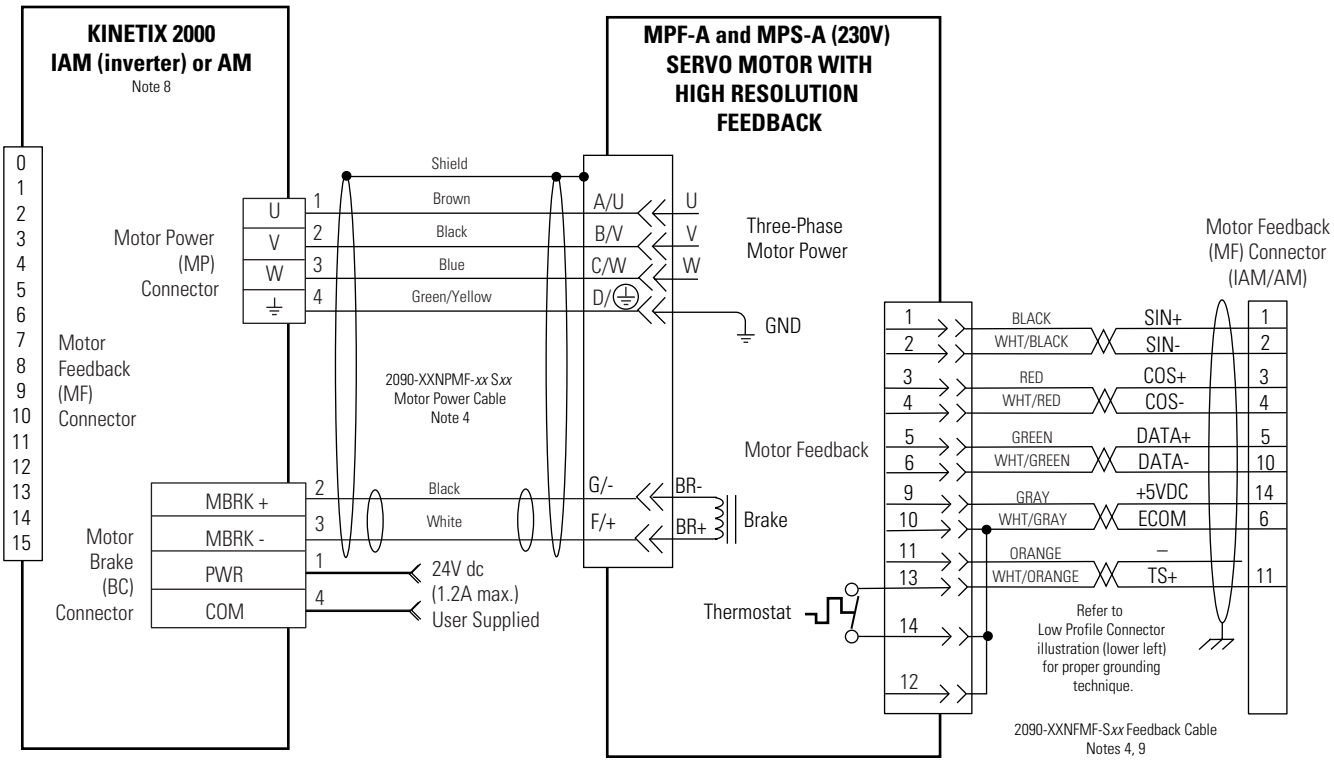
Wiring Example for MP-Series Low Inertia and Gear Motor (MPL-A and MPG-A) with 230V Axis Module (IAM or AM)



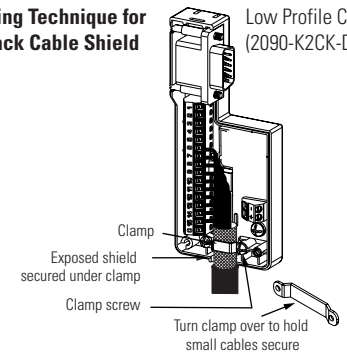




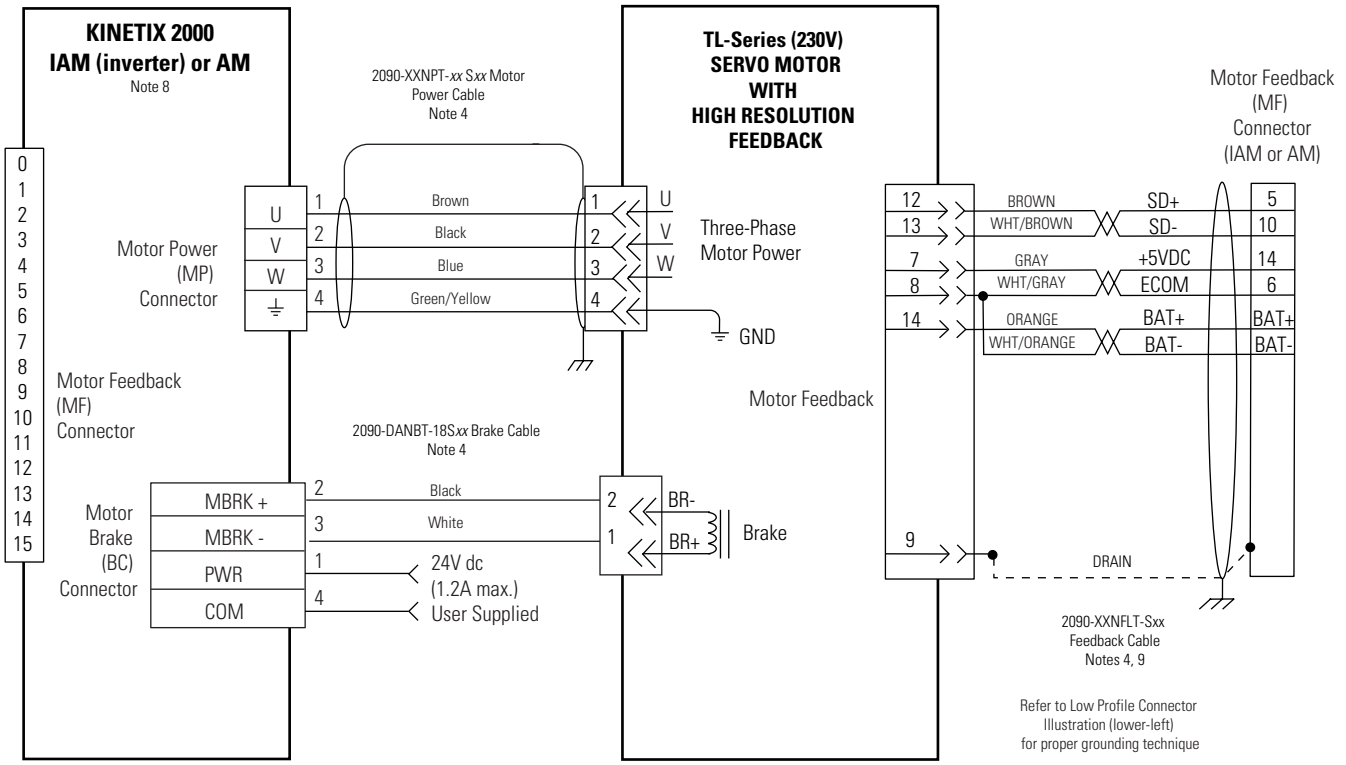
Wiring Example for MP-Series Food Grade and Stainless Steel Motor (MPF-A and MPS-A) with 230V Axis Module (IAM or AM)



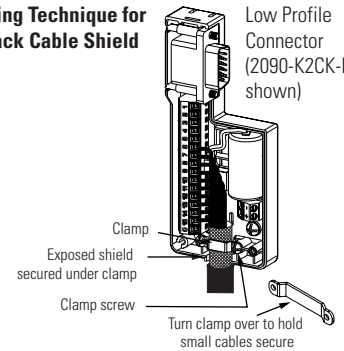
Grounding Technique for Feedback Cable Shield

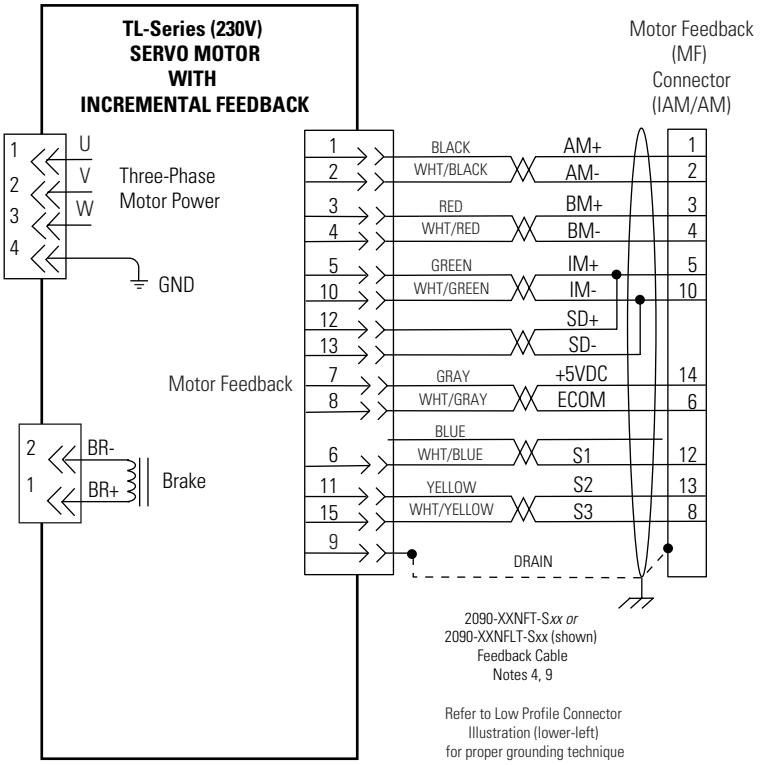


Wiring Example for TL-Series Motor with 230V Axis Module (IAM or AM)

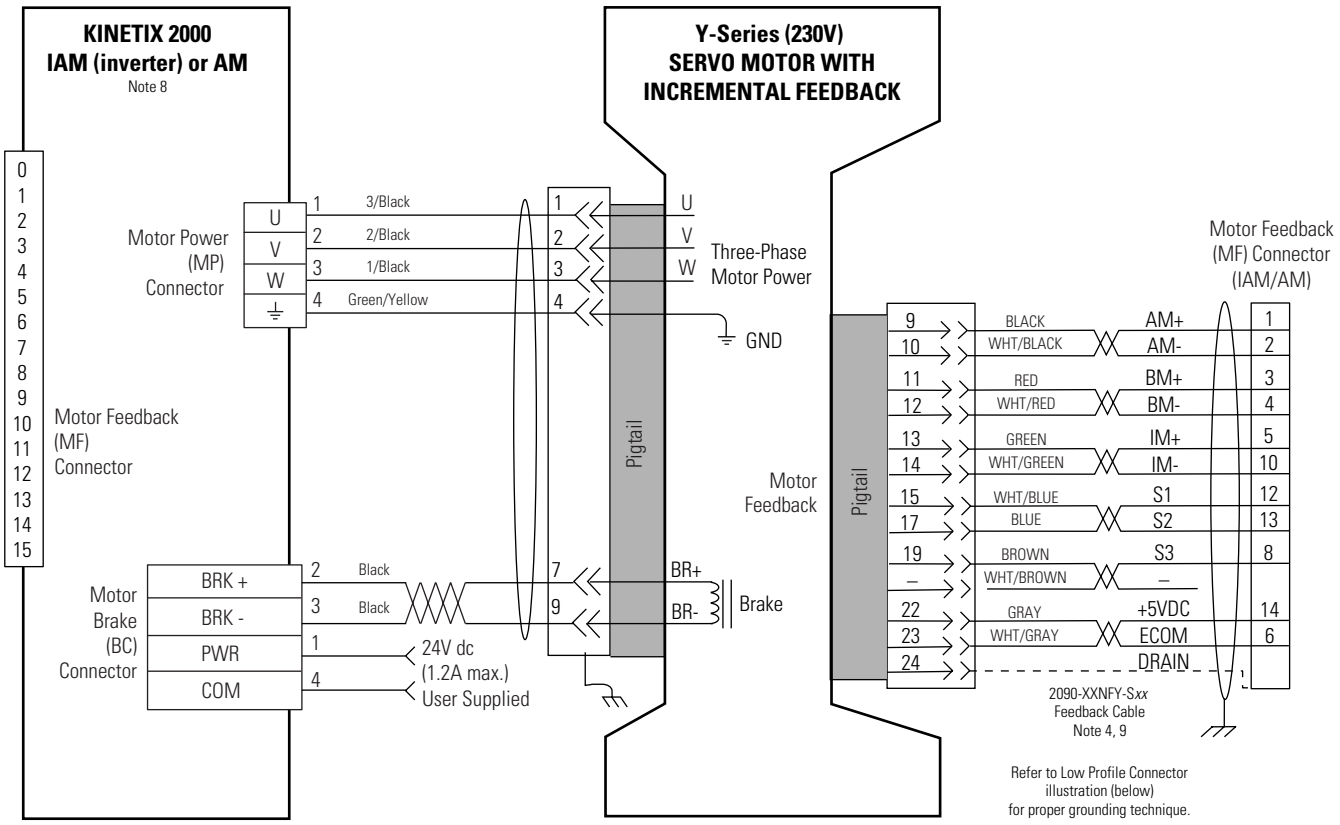


Grounding Technique for Feedback Cable Shield





AM (230V) Wiring Example with Y-Series Motor



Controlling a Brake Example

The relay output of the Kinetix 2000 drive MBRK± signals (BC-2 and BC-3) is suitable for directly controlling a motor brake, subject to the relay voltage limit of 30V dc, and the relay current limit as shown in the table below.

Brake Relay Current Limit

Kinetix 2000 IAM/AM	Brake Current Rating, Max
2093-AC05-M*xx*, 2093-AMP*x*, 2093-AM0*x*	1.0A

IMPORTANT For brake requirements outside of these limits, an external relay must be used.

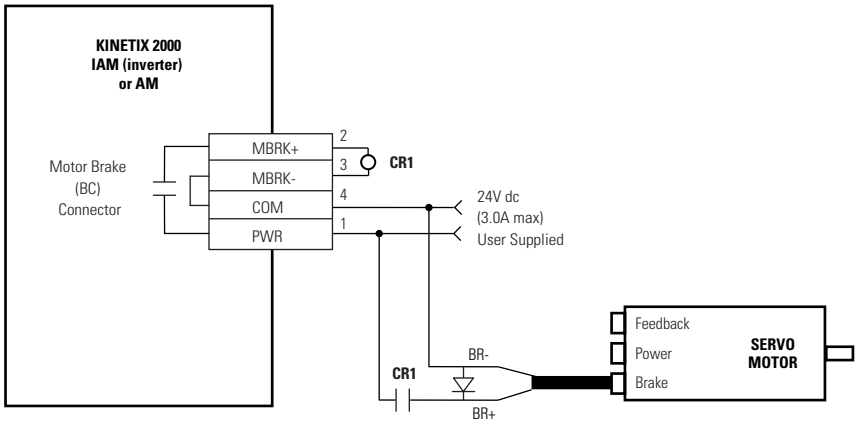
Coil Currents Rated at < 1.0 A

Compatible Brake Motors	Coil Current
MPL-x15xx	0.48 A
MPL-*x2xx*	0.51 A
MPL/MPF/MPS-*x*310, -*x*320, -*x*330	0.50 A
MPL-*x*420, MPL-*x*430, MPL-*x*4520, MPL-*x*4530, MPL-*x*4540	0.64 A
MPF-*x*430, MPF-*x*4530, MPF-*x*4540	
MPG-*x*004	0.33 A
MPG-*x*010	0.45 A
MPG-*x*025	
MPG-*x*050	0.50 A
MPG-*x*110	1.0 A

Compatible Brake Motors	Coil Current
TL-A110P-H, TL-A120P-H, and TL-A130P-H	0.208 A
TL-A220P-H and TL-A230P-H	0.375 A
TL-A2530P-H and TL-A2540P-H	0.396 A
TL-A410P-H	0.746 A
Y-1002 and Y-1003	0.26 A
Y-2006 and Y-2012	0.31 A
Y-3023	0.37 A

This example shows a motor brake configuration using the MBRK± signals and an external relay to control a motor brake that exceeds the internal relay rating of a Kinetix 2000 drive. A properly rated flyback diode must be placed across the brake coil when using external relay to control the brake.

Wiring Example for External Brake Relay Control of Motor Brake

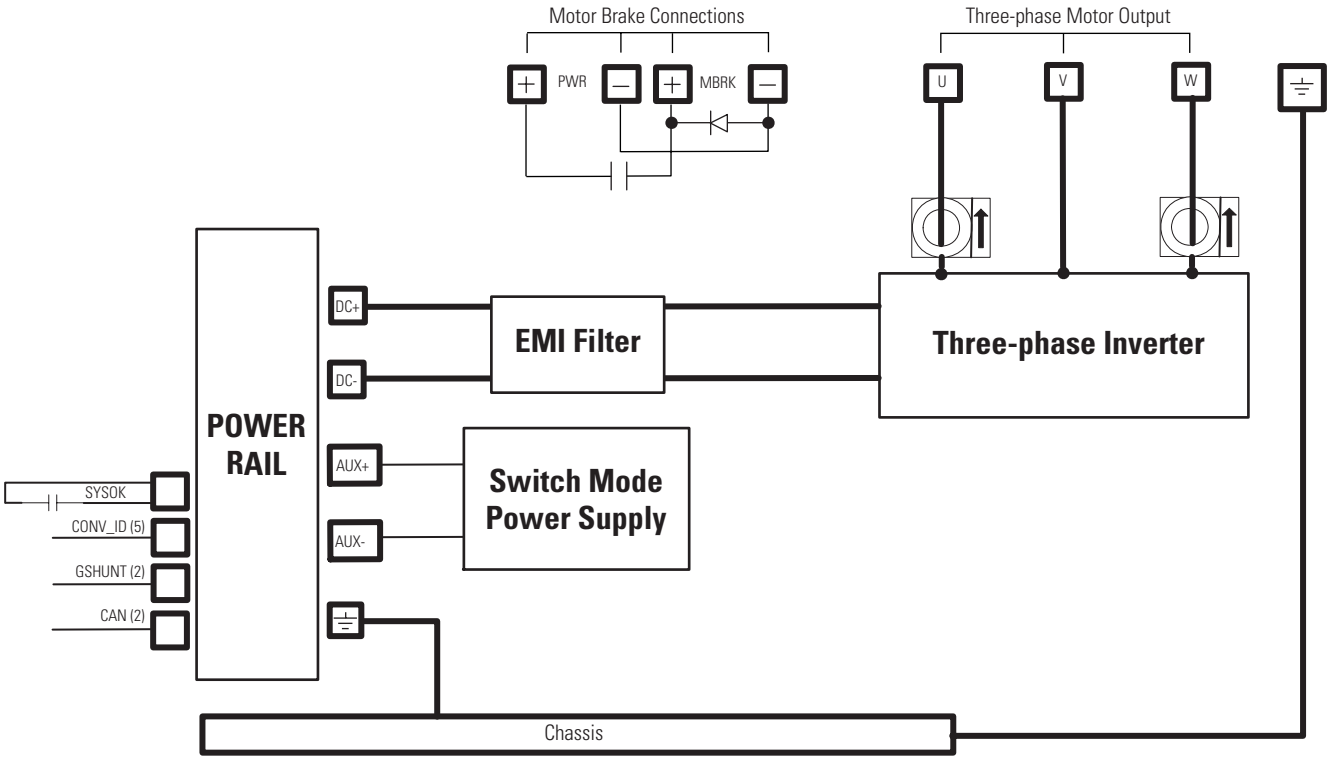


System Block Diagrams

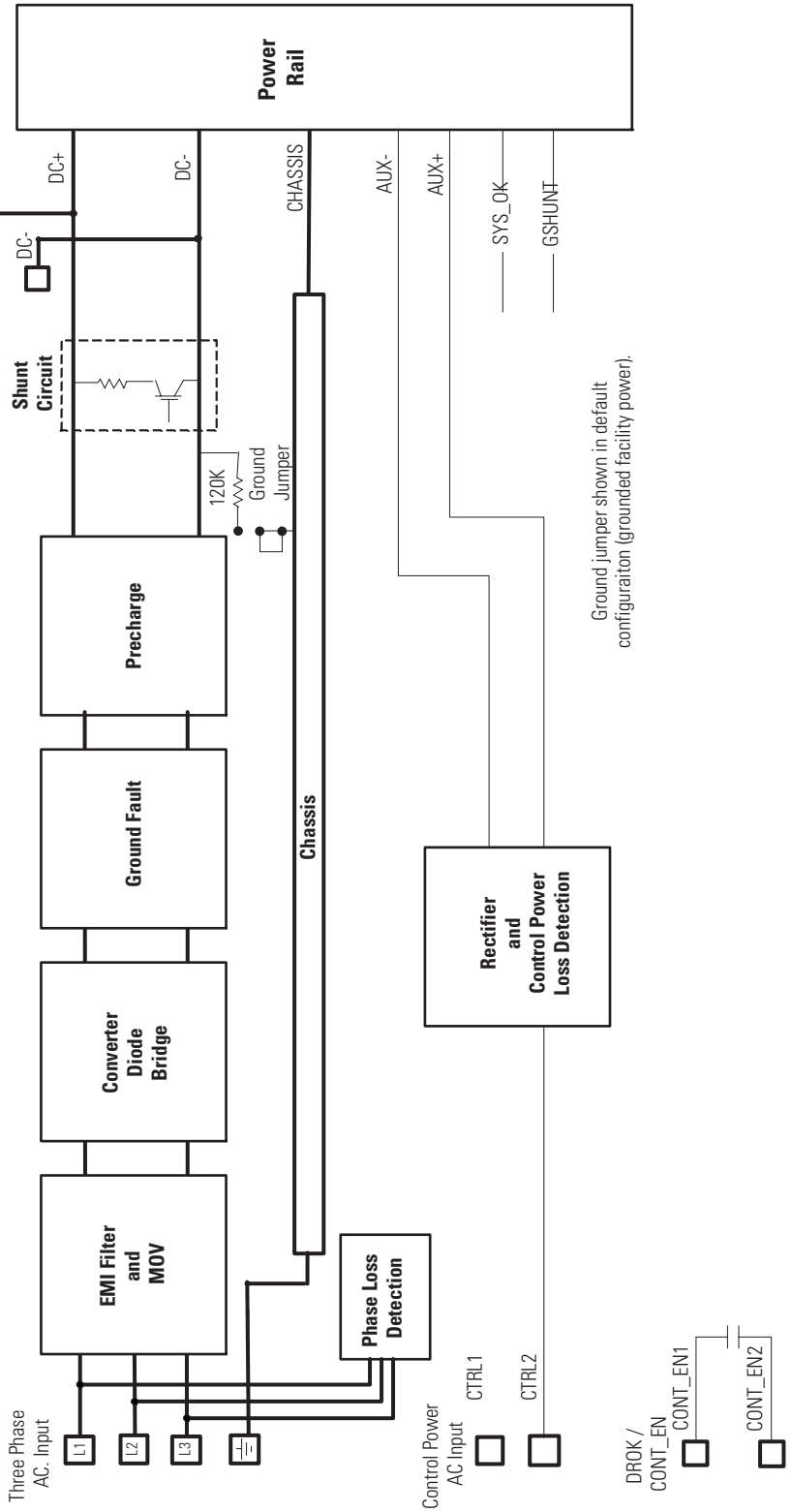
This section provides block diagrams of the Kinetix 2000 modules. For block diagrams of the line interface module (LIM) refer to the Line Interface Module Installation Instructions, publication 2094-IN005.

Refer to Additional Resources on page 10 for the documentation available for those products.

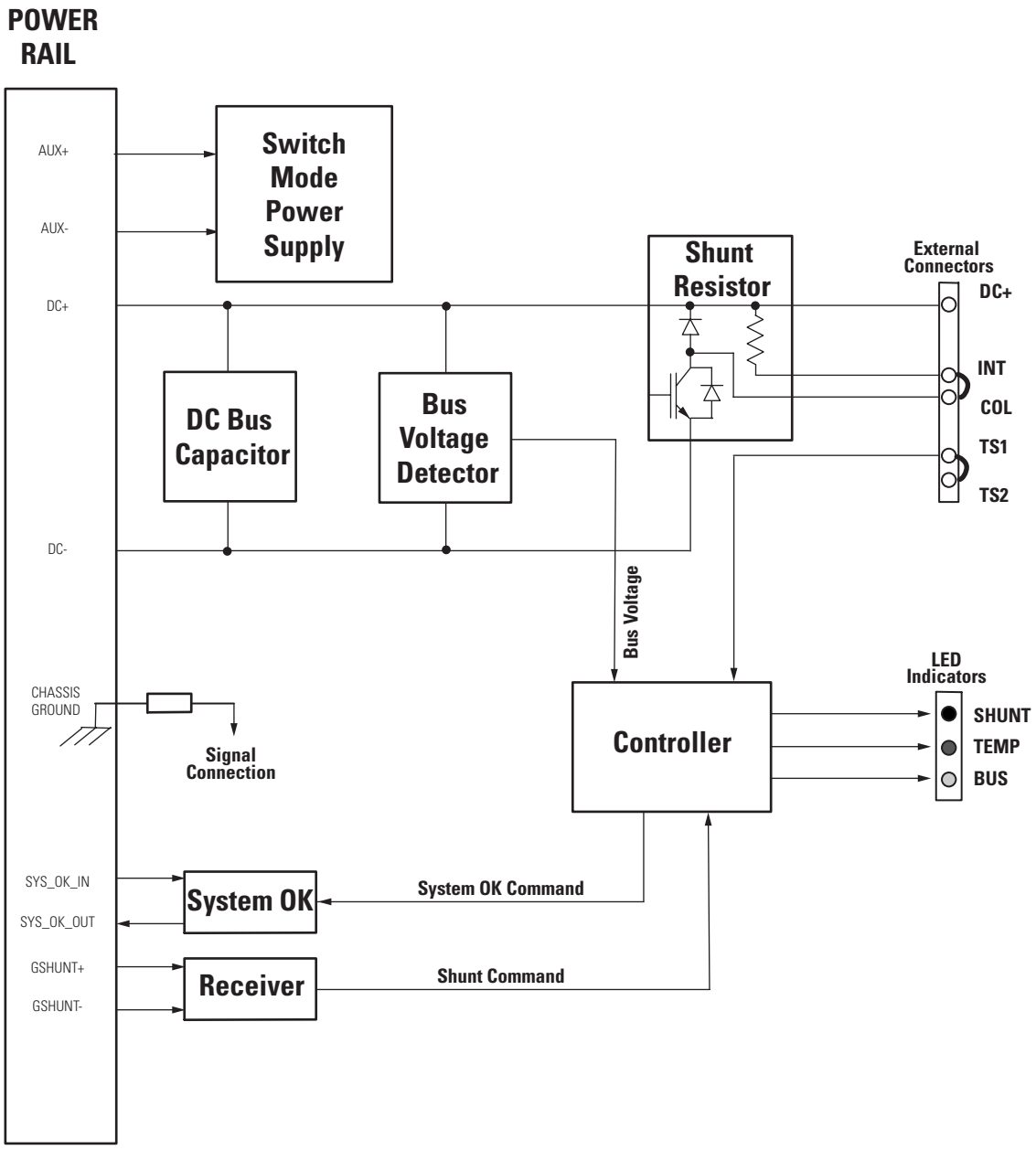
IAM/AM (inverter) Block Diagram



IAM (converter) Block Diagram



Shunt Module Block Diagram



Upgrading Firmware

Introduction

This appendix provides procedures for upgrading firmware. The procedure requires you to complete two steps:

- Use Drive Explorer or Drive Executive to setup the Kinetix 2000 axes to be flashed.
- Use Hyperterminal to flash the firmware in the selected drives.

Before You Begin

Obtain the following software and information before you begin.

Description	Catalog Number	Firmware Revision
DriveExplorer software	9306-4EXP02ENE	5.02 or later
Drive Executive software		v4.01 or later
RSLinx [1]		2.50.00 or later
Firmware Upgrade file for your Kinetix 2000 IAM/AM [2]		—
Anacanda Serial to DPI Adapter [3]	1203-SSS (Series B)	3.004 or later
Personal computer with Hyperterminal software	—	—

[1] RSLinx is required by Drive Executive software, but it is not required by DriveExplorer software.

[2] The correct MSI ControlFlash for Hyperterminal use is a binary file ending in _a. If unable to locate the file, contact technical support at 440-646-5800 to receive the file email.

[3] The Serial to DPI Adapter, catalog number 1203-SSS (Series B), contains: 1203-SFC cable from PC serial to Anacanda, 1202-Cxx cable from Anacanda to DPI port, and an Anacanda body.

IMPORTANT Control power (230V ac, single phase) must be present at CPD-1 and CPD-2 prior to flashing your drive.

The seven-segment Fault Status display on the IAM (inverter) or AM to upgrade must display a fixed 2, 3, or 4 before beginning this procedure. This indicates the IAM/AM is recognized on the SERCOS ring.

ATTENTION

To avoid personal injury or damage to equipment during the firmware upgrade, do not apply main ac (three-phase or single-phase) or common bus dc input power to the drive. This prevents unpredictable motor activity from occurring.

Only single-phase control power should be applied to the drive when upgrading the firmware.

Selecting Software Tools to Upgrade the Kinetix 2000 Drive Firmware

In this section you have a choice of software tools to use when upgrading drive firmware. Either Drive Explorer or Drive Executive may be used to setup the Kinetix 2000 axes to be flashed. Hyperterminal is used to flash the drive selected through Drive Explorer or Drive Executive.

Drive Executive allows you to create a file, and to reuse that file. This is a important difference between Drive Executive and DriveExplorer., as file reuse, rather than creation, proves useful when reviewing, troubleshooting, or evaluating files.

Using Drive Explorer to Setup the Kinetix 2000 Drives to Flash

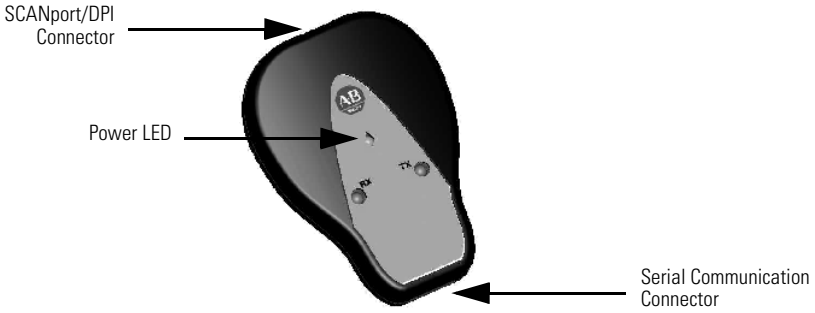
Follow these steps to use Drive Explorer v5.02. to identify the Kinetix 2000 axes to be flashed.

1. Connect the 1203-SSS serial cable between the appropriate COM port on your personal computer and the serial communication port on the Anacanda.

2. Connect the 1203-SSS SCANport cable between the SCANport on the Anacanda and the DPI connector on the top of the IAM.

   The drive sources power to the 1203-SSS communication device when Control power is applied to the drive.

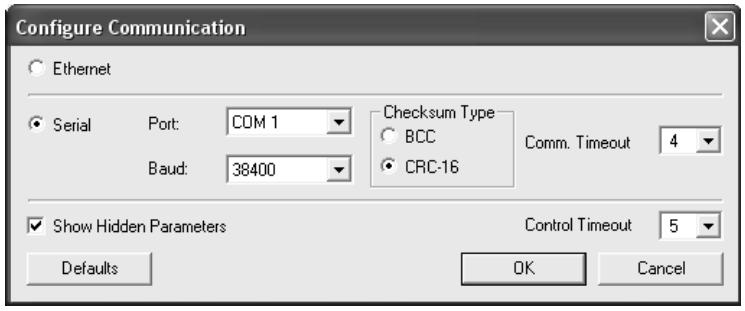
3. Observe the LED indicator to verify that the 1203-SSS has power.



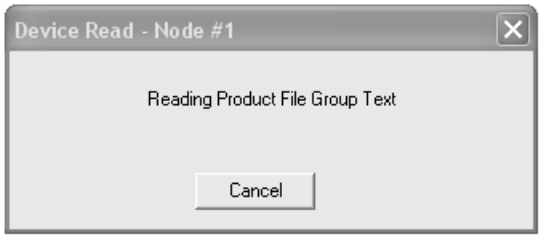
4. Verify RSLinx software is closed, as it may conflict with DriveExplorer.

5. Open the DriveExplorer software.

6. Select Connect and Configure Communications from the Explore menu to configure the communication between your computer, DriveExplorer, and the 1203-SSS SCANport. The diagram shows the appropriate settings.

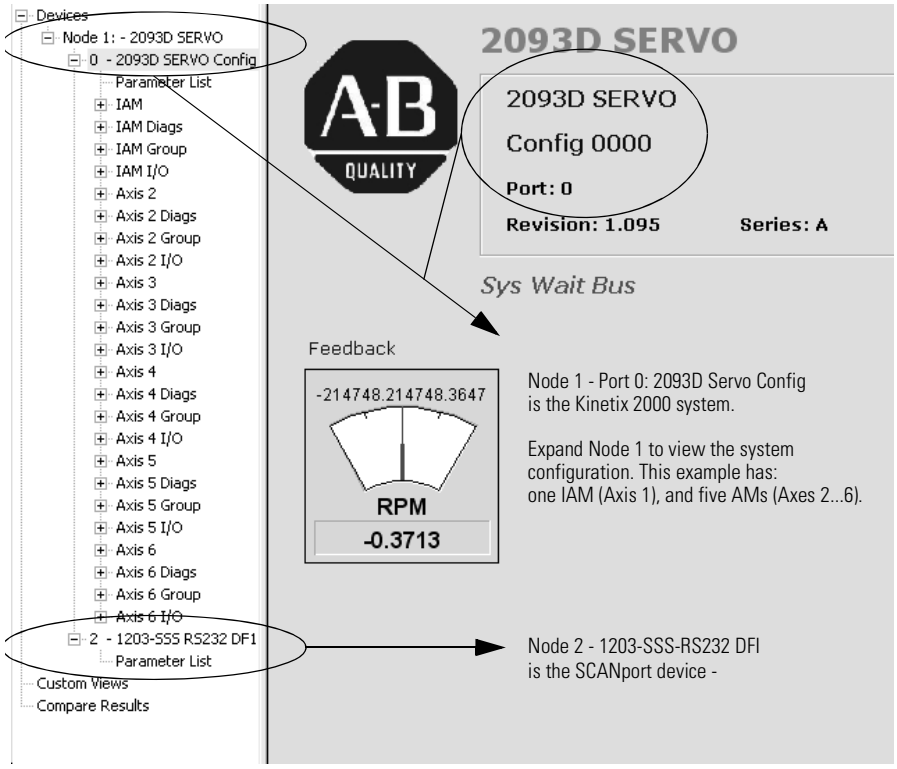


7. When communication is established, DriveExplorer displays the following message, and then begins to map your Kinetix 2000 system.



8. Successful uploading of your Kinetix 2000 system parameters results in a Kinetix 2000 system display.

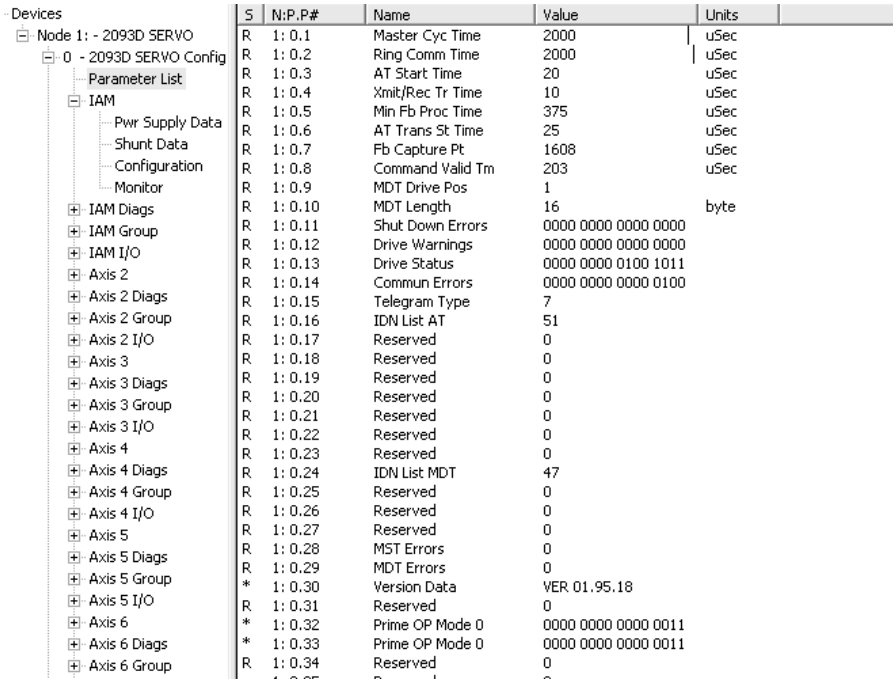
9. Expand Node 1: 2093D SERVO to examine the Kinetix 2000 system configuration.



10. Double-click on Node 2 - 1203-SSS-RS232 DFI to examine the SCANport device configuration.

11. Click on Node 1: 2093D SERVO to return to the Kinetix 2000 system configuration display.

12. Double-click on Parameter List to display the parameter functions.



S	N:P.P#	Name	Value	Units
R	1: 0.1	Master Cyc Time	2000	uSec
R	1: 0.2	Ring Comm Time	2000	uSec
R	1: 0.3	AT Start Time	20	uSec
R	1: 0.4	Xmit/Rec Tr Time	10	uSec
R	1: 0.5	Min Fb Proc Time	375	uSec
R	1: 0.6	AT Trans St Time	25	uSec
R	1: 0.7	Fb Capture Pt	1608	uSec
R	1: 0.8	Command Valid Tm	203	uSec
R	1: 0.9	MDT Drive Pos	1	
R	1: 0.10	MDT Length	16	byte
R	1: 0.11	Shut Down Errors	0000 0000 0000 0000	
R	1: 0.12	Drive Warnings	0000 0000 0000 0000	
R	1: 0.13	Drive Status	0000 0000 0100 1011	
R	1: 0.14	Commun Errors	0000 0000 0000 0100	
R	1: 0.15	Telegram Type	7	
R	1: 0.16	IDN List AT	51	
R	1: 0.17	Reserved	0	
R	1: 0.18	Reserved	0	
R	1: 0.19	Reserved	0	
R	1: 0.20	Reserved	0	
R	1: 0.21	Reserved	0	
R	1: 0.22	Reserved	0	
R	1: 0.23	Reserved	0	
R	1: 0.24	IDN List MDT	47	
R	1: 0.25	Reserved	0	
R	1: 0.26	Reserved	0	
R	1: 0.27	Reserved	0	
R	1: 0.28	MST Errors	0	
R	1: 0.29	MDT Errors	0	
*	1: 0.30	Version Data	VER 01.95.18	
R	1: 0.31	Reserved	0	
*	1: 0.32	Prime OP Mode 0	0000 0000 0000 0011	
*	1: 0.33	Prime OP Mode 0	0000 0000 0000 0011	
R	1: 0.34	Reserved	0	

Each parameter includes these functions.

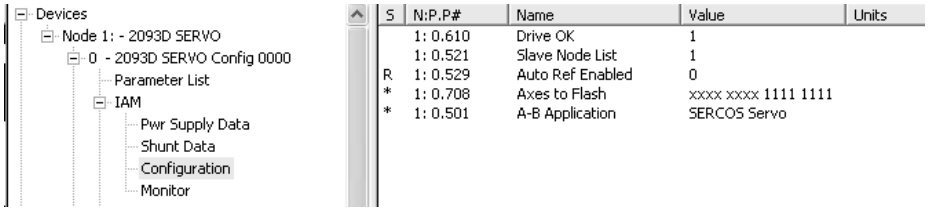
Column	Description of Contents	
S	Status R = * =	 Read only Editable
N:P,P#	N = P = P# =	The node number of the device on the network The port number (0 if a device) The parameter number associated with a specific programming parameter Parameter number progression is: 0... 999 = Axis 1 (IAM) 1000...1999 = Axis 2 2000...2999 = Axis 3 3000...3999 = Axis 4 4000...4999 = Axis 5 5000...5999 = Axis 6 6000...6999 = Axis 7 7000...7999 = Axis 8
Name	The item name	
Value	The present value of the item	
Units	The unit of measurement for the item	

For example, scrolling down to Parameter 30 (* 1:0.30 Version Data VER 01.95.18) indicates this is the IAM inverter, with version 01.95.18 (version 01.95, build 18). It is the first axis in the 2093 system or the IAM. To view

Axis 2, parameter 30, move to 1:0.1030. To view parameter 31 for Axis 2 move to 1:0.1031.

	1: 0.27	Reserved	0
	1: 0.28	MST Errors	0
	1: 0.29	MDT Errors	0
	1: 0.30	Version Data	VER 01.95.18
	1: 0.31	Reserved	0
	1: 0.32	Prime OP Mode 0	0000 0000 0000 0011
	1: 0.33	Prime OP Mode 0	0000 0000 0000 0011
	1: 0.34	Reserved	0

13. Go to the IAM in the Device Workspace, and select Configuration. Parameter 708 is the Axes to Flash when using Hypterminal.

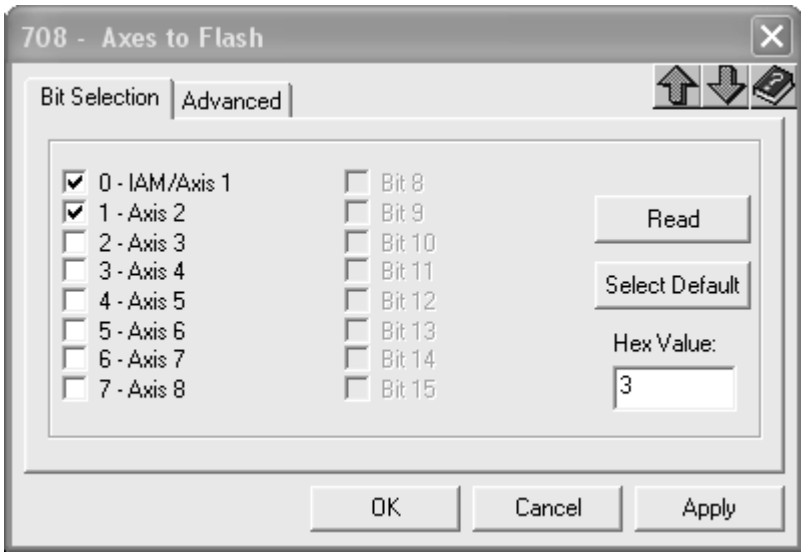


TIP

Check the firmware level of each axis on the power rail. You should always have the same firmware level for each axis module in the system.

Parameter 708 is used to flash any axis on the 2093 power rail.

14. Double-click on parameter 708 to open the Axes to Flash window.



Drive Explorer does not do the flashing, but it allows you to determine which drives to setup for flashing with Hyperterminal. The Axes to Flash window shown indicates Axes 1 and 2 are selected for flashing.

15. Select Apply, and then OK after you have selected all axes to flash.

16. Close Drive Explorer.

Using Drive Executive to Setup the Kinetix 2000 Drives to Flash

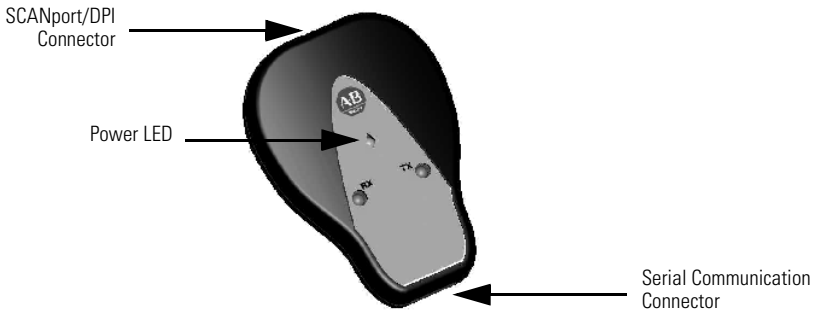
Follow these steps to use Drive Executive v4.01. to identify the Kinetix 2000 axes to be flashed.

1. Connect the 1203-SSS serial cable between the appropriate COM port on your personal computer and the serial communication port on the Anacanda.

2. Connect the 1203-SSS SCANport cable between the SCANport on the Anacanda and the DPI connector on the top of the IAM.

   The drive sources power to the 1203-SSS communication device when Control power is applied to the drive.

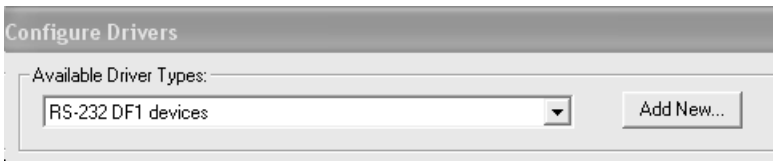
3. Observe the LED indicator to verify that the 1203-SSS has power.



4. Open RSLinx software.

IMPORTANT Drive Executive must exchange information via RSLinx. This requires serial communication between the DPI port on the Kinetix 2000 drive and your personal computer. Ethernet, or other communication standards are not compatible.

5. In RSLinx, configure a communication driver to interface between your pc and the DPI port on the Kinetix 2000 IAM.
   1. Select Add New.



   2. Name the device RS-232 DF1 devices as shown.
   3. Select OK.

6. Configure the RS232 DF1 Device as shown.

The baud rate for a 1203-SSS device is often written on the back label. If the baud rate is not found, you should attempt to connect by entering different baud rates.

- Select the correct baud rate for the device. The diagram shows 38,400 as the correct baud rate.
- Verify the correct Comm Port is selected for your pc. No conflicting programs should be using this port at this time. For example, RSLinx should not be open at this time.
- The SCANport must be listed as the Device, and the octal Station Number is 01.

7. Select Auto-Configure.

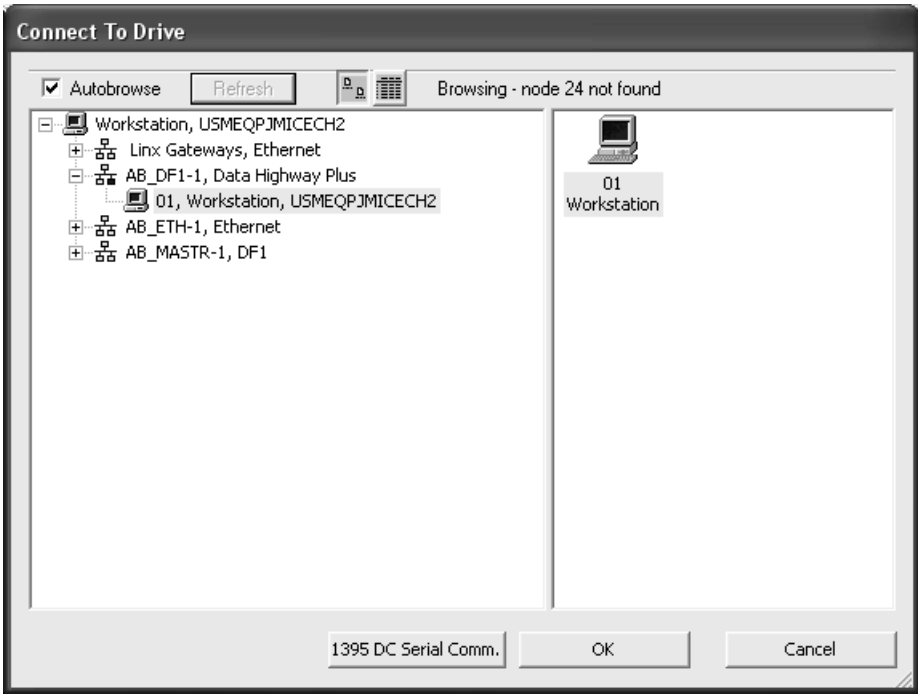
8. A successful connection results in the following display.

If unsuccessful, look at all of the settings, device and baud rate and properly select. Be sure RSLinx is occupying the appropriate COMM only.

9. Click OK, to ignore the note that auto configuration appears successful, but RSLinx could not identify the device.

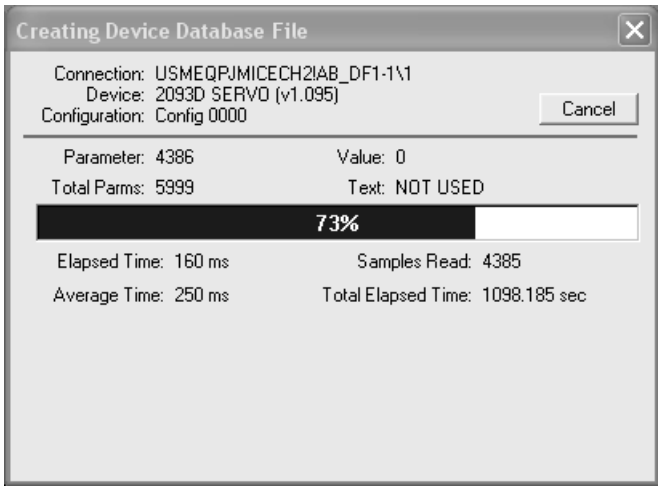
10. A second Caution will appear, that also should be ignored by clicking OK.

11. Open RSWho in RSLinx to verify the new driver is recognized.

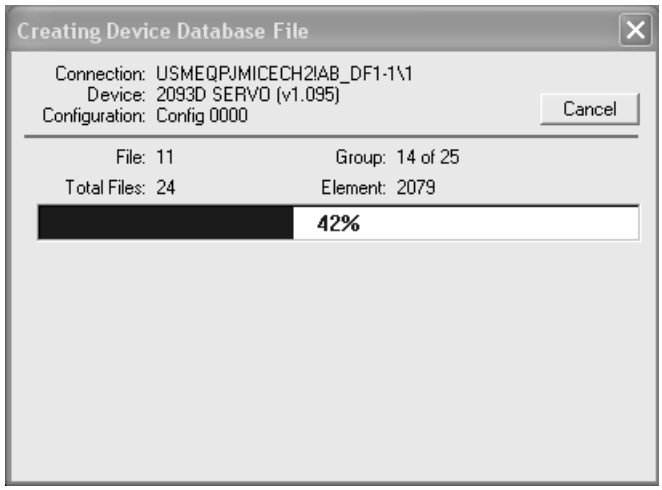


12. Open Drive Executive, advance to Drive Selection, and select Connect to Drive.

13. Select the workstation (01 in the preceding diagram) and click OK.



Drive Executive should connect with the drive and begin to upload the Kinetix 2000 parameters.



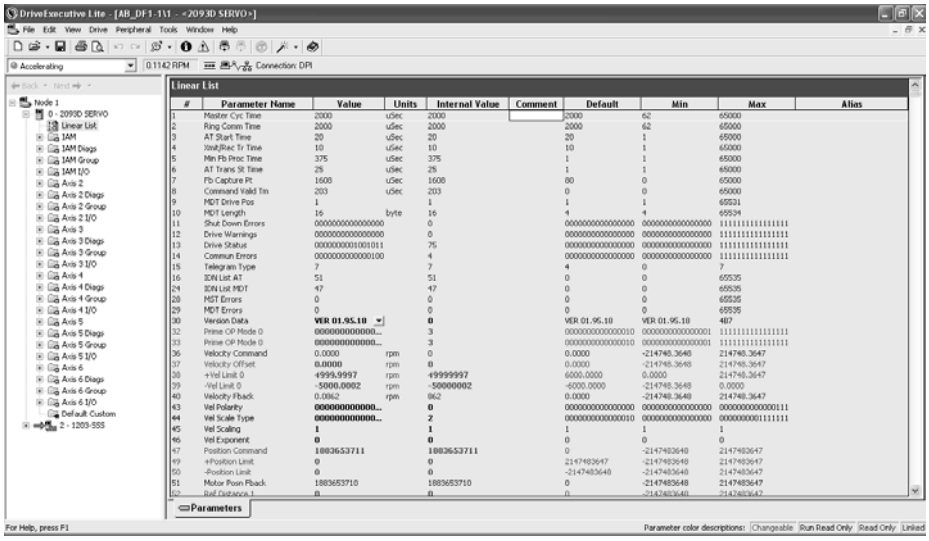
A parameter upload initially occurs, followed by a file group upload. Each upload displays in a separate screen.

TIP

Upload time varies. It is based on the number of axes on the power rail and the baud rate of the 1203-SSS.

For example, a baud rate of 38400 requires approximately 25 minutes to upload a six-axis Kinetix 2000 system.

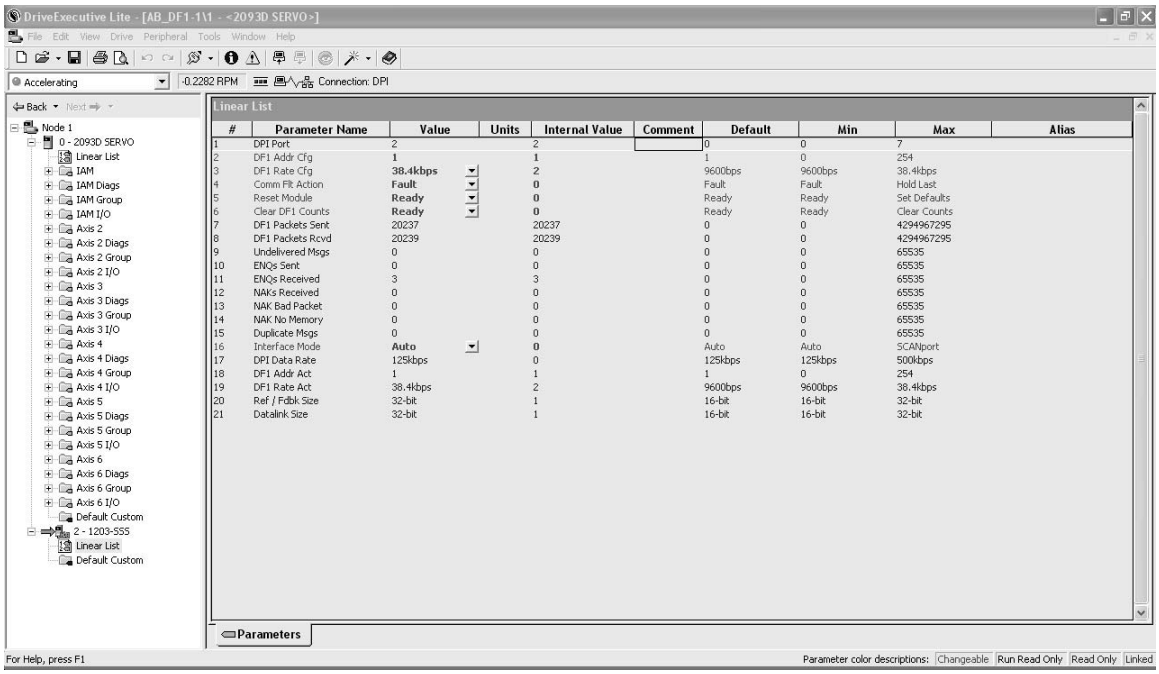
14. Successful uploading of the Kinetix 2000 parameters results in the following screen.



15. Expand node x: 2093 SERVO in the device workspace, and double click on the Linear List. Linear List contains one IAM and five other axes. The same parameters as Drive Explorer, but in a slightly different format.

IMPORTANT The parameters in Drive Executive are read/write, and may be saved as an extension dno file.

16. Expand 1203-SSS in the device workspace. Double-click on the Linear List to view the 1203-SSS or Anacanda listing both baud rate and revisions.



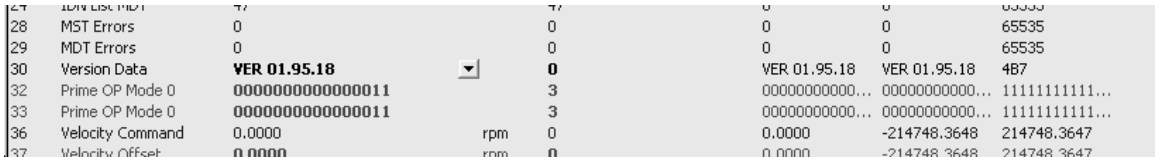
Go to Help in Drive Executive to scan for information such as Linear List or Parameter listing. Breakdown of the functions listed are as follows: Each parameter includes these functions.

Column	Description of Contents
#	Parameter number
Parameter Name	Short name of the parameter
Value	Current value of the parameter
Units	Units describes the measurement units for this parameter. For example, Volts and Amps.
Internal Value	Internal values are unscaled values used by the device and by controllers that communicate with the device. The information in this field provides the scaling information to calculate the internal value from a scaled value.
Source Parameter	Displays the source parameter, if any.
Comment	Displays comments previously entered.
Min	The minimum value is the lowest possible value for this parameter.
Max	The maximum value is the highest possible value for this parameter.
Alias	Displays an alias, or alternative name, previously entered.
The following columns do not appear by default, but can be made available through View Options.	
Internal Default	The default value expressed in internal units.
Internal Min	The minimum value expressed in internal units.
Internal Max	The maximum value expressed in internal units.

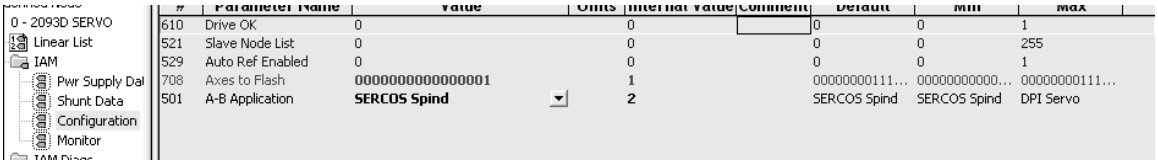
Drive Executive parameters are identical to those in Drive Explorer, but the format is different. You only see the parameter number, parameter name, related data.

Parameter number progression is:
0... 999 = Axis 1 (IAM)
1000...1999 = Axis 2
2000...2999 = Axis 3
3000...3999 = Axis 4
4000...4999 = Axis 5
5000...5999 = Axis 6
6000...6999 = Axis 7
7000...7999 = Axis 8

For example, scrolling down to parameter 30. In this example 30 or the IAM inverter version data of VER01.95.18(Version 01.95, build 18). This is the first axis in the 2093 system or the IAM. If Axis 2 were to be reviewed, move to 1030. To view parameter 31 for Axis 2 move to 2031.



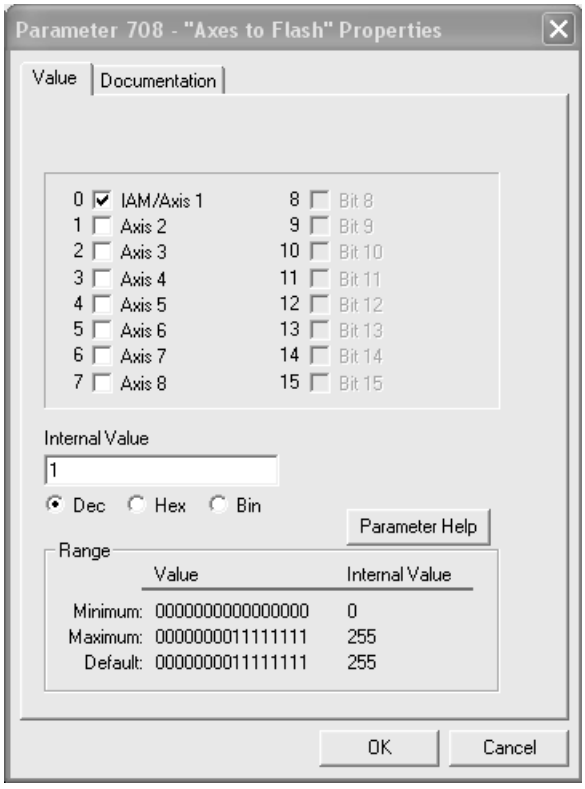
17. Go to the IAM in the Device Workspace and select Configuration. Parameter 708 has the Axes to Flash when using Hypterminal.



18. Double-click on parameter 708 or Axes to Flash to open the Parameter 708 "Axes to Flash Properties" dialog.

TIP Check the firmware level of each axis on the power rail. You should always have the same firmware level for each module type.

Parameter 708 is used to flash any axis on the 2093 power rail.



19. Select the axes to flash, and then click OK.

Drive Executive does not flash the axes, but it allows you to select one or more drives that are to be flashed with Hyperterminal.

20. Close Drive Executive.

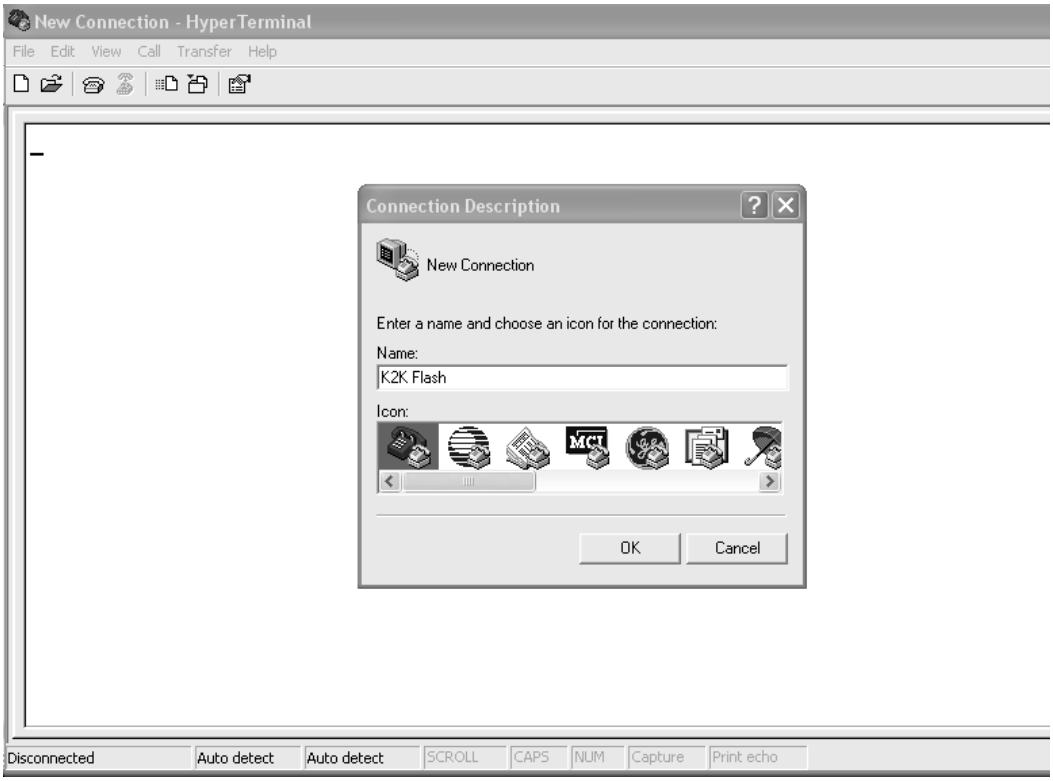
A prompt will ask whether you want to save the uploaded parameters. If you choose Save, an extension dno is applied to the file, that allows you to reuse this Drive Executive file.

Using Hyperterminal to FLASH the Kinetix 2000 Drive

This section provides instructions on how to perform a HyperTerminal session. Typically Hyperterminal is located in the directory path Programs\Accessories\Communications\Hyperterminal.

1. Start Hyperterminal.

2. A new dialog opens.

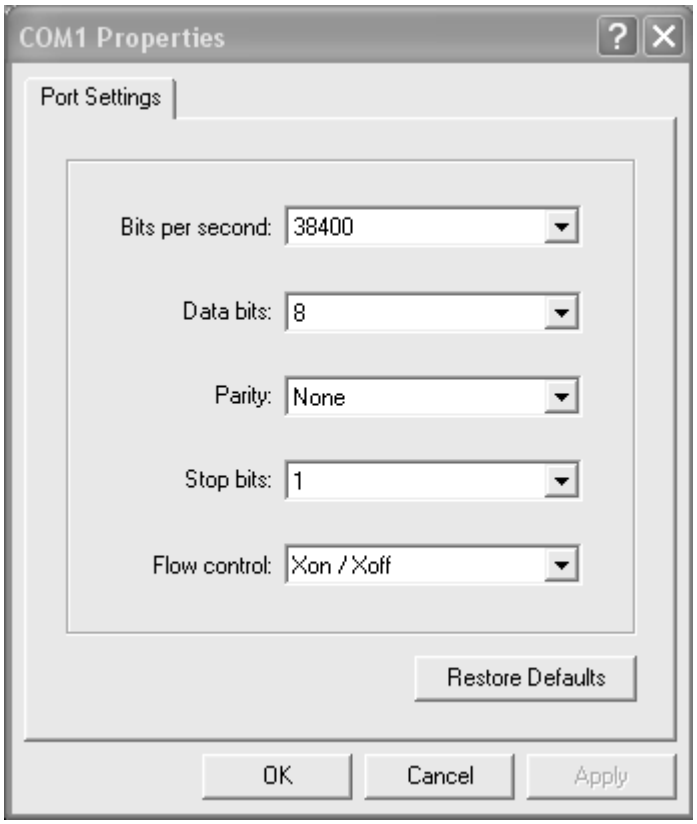


3. Type a new Hypterminal name and choose the first icon for the connection.

4. Select OK, and the following dialog opens.

5. Select the appropriate COM port. Be sure the port is not tied to another program or in use by other software. For example, if you just used Drive Executive, RSLinx may be open.

6. Select OK to open the next dialog box.



7. Set up the port setting as shown in screen above.

You may notice that the baud rate is the same setting as used with Drive Explorer or Drive Executive and is tied to the baud rate of the 1203-SSS device.

8. Select OK.

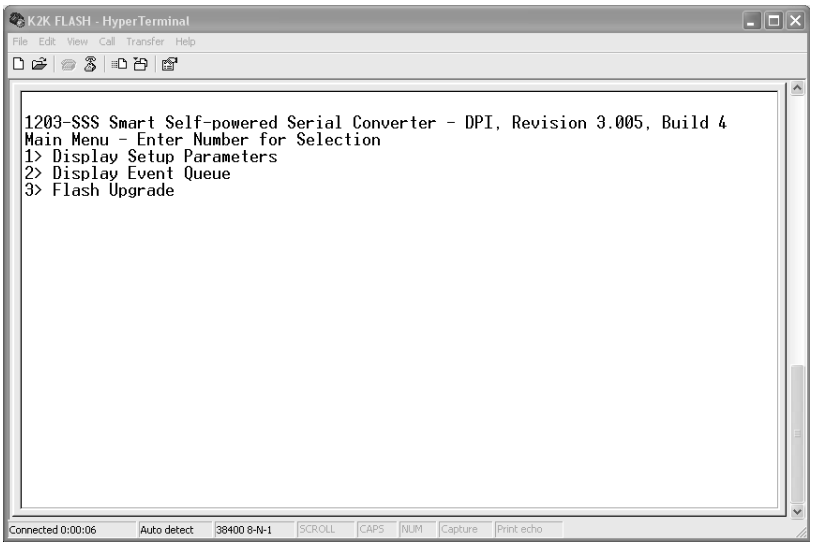
This completes the configuration of your Hyperterminal session.

Flashing Kinetix 2000 Firmware with Hyperterminal

This procedure assumes you have identified which axis modules require flashing, have set the Axes to Flash parameters, and have configured a Hyperterminal session.

IMPORTANT You must also know where to find your firmware update (extension _a or binary) file.

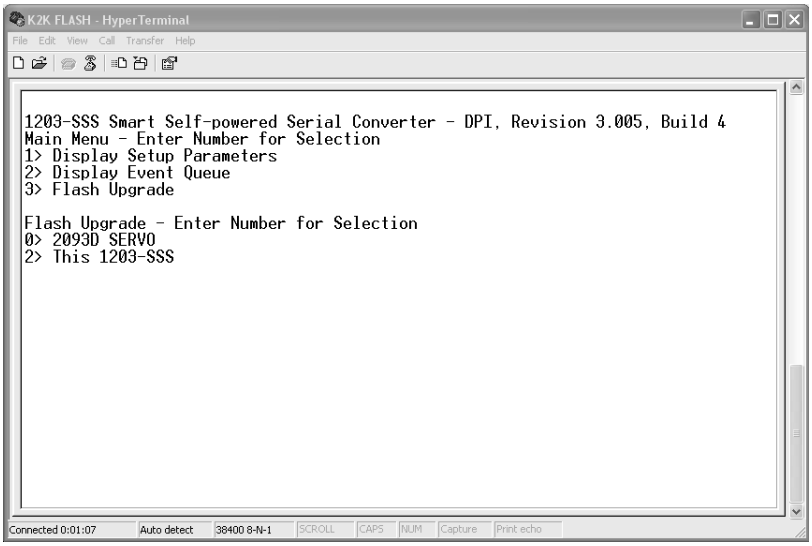
1. Press Enter to open the Hyperterminal main menu.



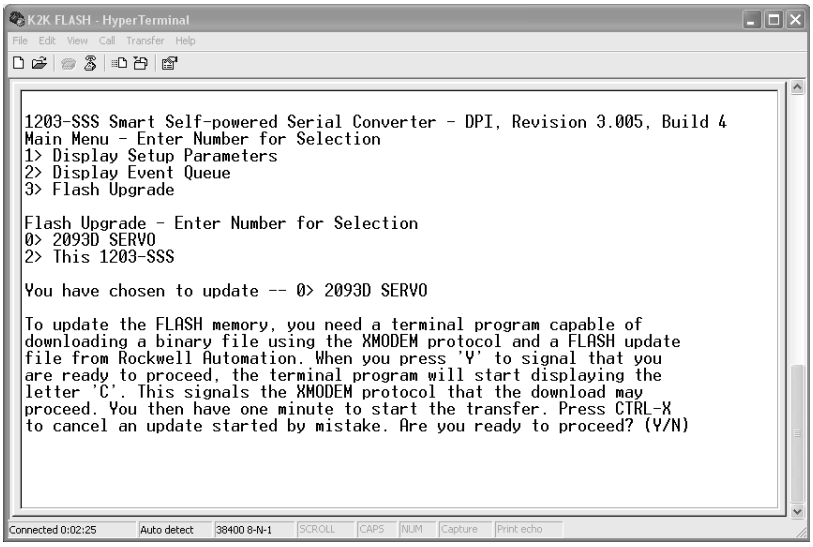
If you have difficulty opening a Hypterminal session, verify you have:

- the port setting the same as in the previous section.
- the 1203-SSS connected.
- the baud rate setting the same as in the previous section.

2. Enter 3) to select Flash Upgrade. The following dialog opens.



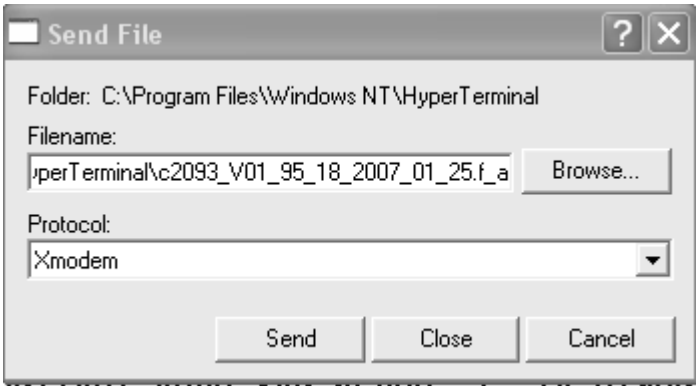
3. Enter 0), as the 2093 SERVO (Kinetix 2000) was identified earlier. The following dialog appears.



4. Select Y, when you are ready to perform the function and have found the firmware file. The screen to the right of the (Y/N) will fill with the character C to indicate it is waiting to download.

IMPORTANT As displayed in the dialog above, you have 1 minute to start the transfer. If you do not start the file transfer within this time, you must repeat the previous sequence fromstep 1.

5. From the Transfer menu, select Send File.

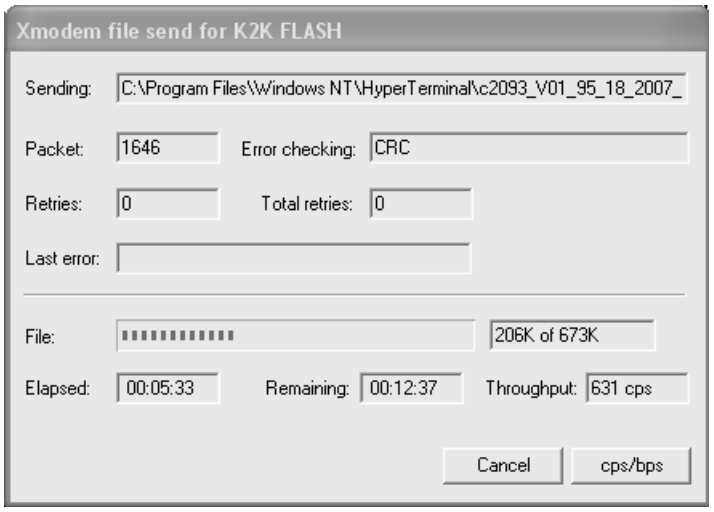


6. Browse for your firmware upgrade file. For Hyperterminal, the file must be a binary or extension a. (Only SERCOS ControlFLASH has the extension nvs.).

7. Select Xmodem as the transfer Protocol.

8. Click Send to start the flash upgrade.

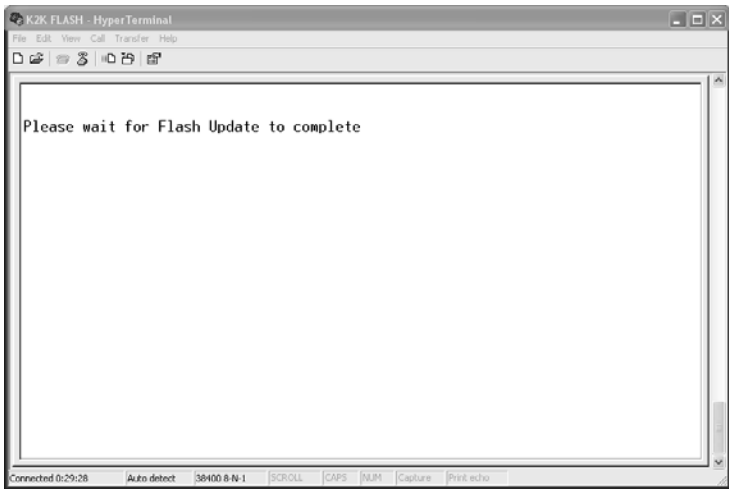
The following dialog opens. It is followed by additional dialogs that detail the progress of the flash upgrade.



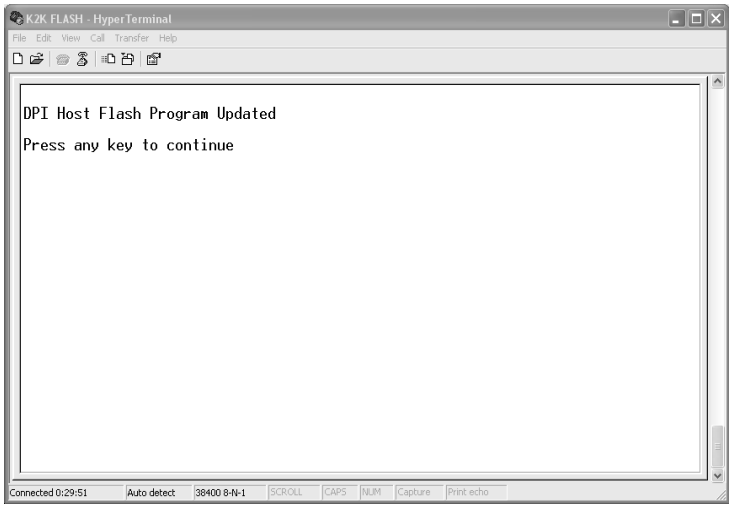
ATTENTION

To avoid unrecoverable drive module faults, do not interrupt control power to the IAM, power to the 1203-SSS SCANport adapter, or power to your computer while the flash upgrade is in progress.

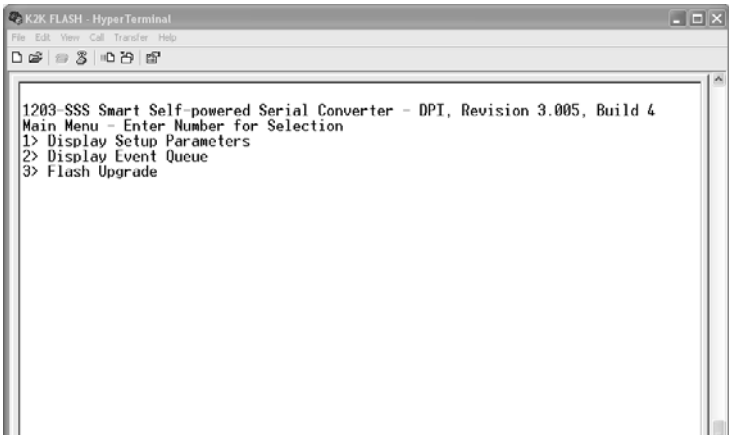
When the firmware flashing has started this dialog opens.



When the firmware flashing completes this dialog opens.



9. Press Enter, on the keyboard, to return to step 1.



10. Close the Hyperterminal session.

11. Return to Drive Explorer or Drive Executive to verify that parameter 30 for each axis module upgraded to the new firmware revision.

DC Common Bus Applications

Introduction

This appendix provides integration procedures specific to the Kinetix 2000 multi-axis servo-drive systems configured for dc common bus. The procedure involves calculating capacitance values and setting the Add Bus Cap parameter using DriveExplorer software.

Before You Begin

These procedures assume you have mounted and wired your Kinetix 2000 dc common bus system.

Before you set the Additional Bus Capacitance (Add Bus Cap) parameter in DriveExplorer software, you need to calculate the following values:

- Total bus capacitance, and
- Additional bus capacitance.

Calculating Total Bus Capacitance

Total bus capacitance is the sum of all capacitance values for your Kinetix 2000 common bus modules. Specifically, this includes the capacitance values for each of these modules.

- Leader IAM (converter and inverter)
- Each AM and SM (if present) on the leader IAM power rail
- Each follower IAM (converter and inverter)
- Each AM on the follower IAM power rails

Refer to Kinetix 2000 Capacitance Values on page 211 for IAM/AM/SM capacitance values.

IMPORTANT If total bus capacitance exceeds the leader IAM maximum value, a pre-charge time-out fault is triggered, and error code E90 is displayed.

This fault disables the drive.

If the Leader IAM (230V) is	the Total Bus Capacitance must not exceed
2093-AC05-MP1	3420 µF
2093-AC05-MP2	
2093-AC05-MP5	

IMPORTANT If your total bus capacitance value exceeds the value in the table above, you must decrease the total bus capacitance by removing axis modules.

Calculating Additional Bus Capacitance

Additional bus capacitance is the sum of all follower IAM and AM capacitance values for your Kinetix 2000 common bus modules. Specifically, this includes the capacitance values for each of these modules:

- Each follower IAM (converter and inverter)
- Each AM on the follower IAM power rails

Enter the additional bus capacitance values in step 6 of Setting the Additional Bus Capacitance Parameter.

Kinetix 2000 Capacitance Values

Use the tables below when calculating total bus capacitance and additional bus capacitance for your Kinetix 2000 common bus application.

IAM and AM (230V) Modules

IAM Converter (230V)	Capacitance µF
2093-AC05-MP1	540
2093-AC05-MP2	
2093-AC05-MP5	

IAM or AM Inverter (230V)	Capacitance µF
2093-AC05-MP1 or 2093-AMP1	200
2093-AC05-MP2 or 2093-AMP2	
2093-AC05-MP5 or 2093-AMP5	
2093-AM01	540
2093-AM02	

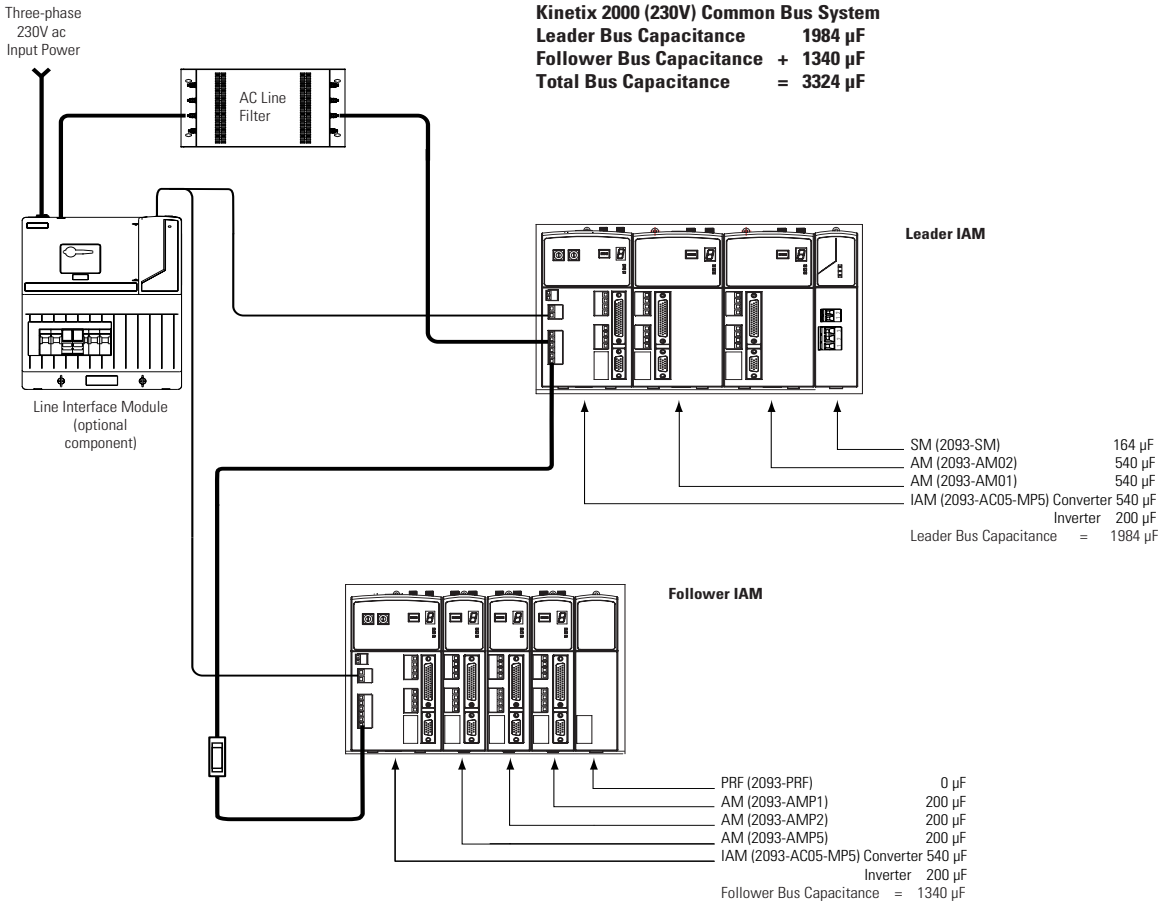
SM (230V) Module

SM (230V)	Capacitance µF
2093-ASP06	164

Common Bus Capacitance Example

In the example below, the sum of the leader IAM power rail modules capacitance and the follower IAM power rail modules capacitance (1984 µF and 1340 µF) equals 3324 µF total bus capacitance. This configuration does not exceed the maximum total bus capacitance of 3420 µF for a common bus Kinetix 2000 system.

Calculating Common Bus Capacitance



Setting the Additional Bus Capacitance Parameter

In this procedure you will set the Add Bus Cap parameter using DriveExplorer software.

The following hardware and software tools are required to provide the necessary communication link between your personal computer and the Kinetix 2000 drive system running DriveExplorer software.

Description	Catalog Numbers	Version
DriveExplorer software (1) (2)	9306-4EXP02ENE	5.02 or later
Anacanda Serial to DPI Adapter (2) (3)	1203-SSS (Series B)	3.004 or later
RSLogix 5000 Software	9324-RLD300NE	16.0 or later

(1) Refer to DriveExplorer Getting Results Manual, publication 9306-GR001, for instructions.

(2) Additional information regarding these communication and software tools is available at http://www.ab.com/support/abdrives.

(3) Refer to 1203-SSS (series B) FRN 3.*xxx* User Manual, publication 20COMM-UM001, for instructions.

ATTENTION

To avoid personal injury or equipment damage, at least one end of a SERCOS fiber-optic cable must be disconnected from the drive. This ensures that motion will not occur while changes are being made to the Add Bus Cap parameter.

Remove SERCOS Communication

Follow these steps to remove (break) SERCOS communications.

1. Remove three-phase and control power from the Kinetix 2000 drive system.
2. Remove one of the SERCOS fiber-optic cables.

   Fiber-optic cable connections (Tx and Rx) are located on the top of each IAM/AM.
3. Reapply three-phase and control power.

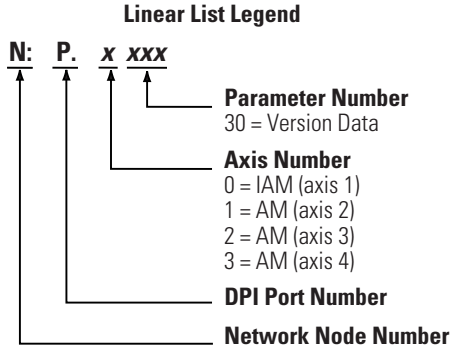
Set the Additional Bus Capacitance Parameter

Follow these steps to set the Additional Bus Capacitance parameter.

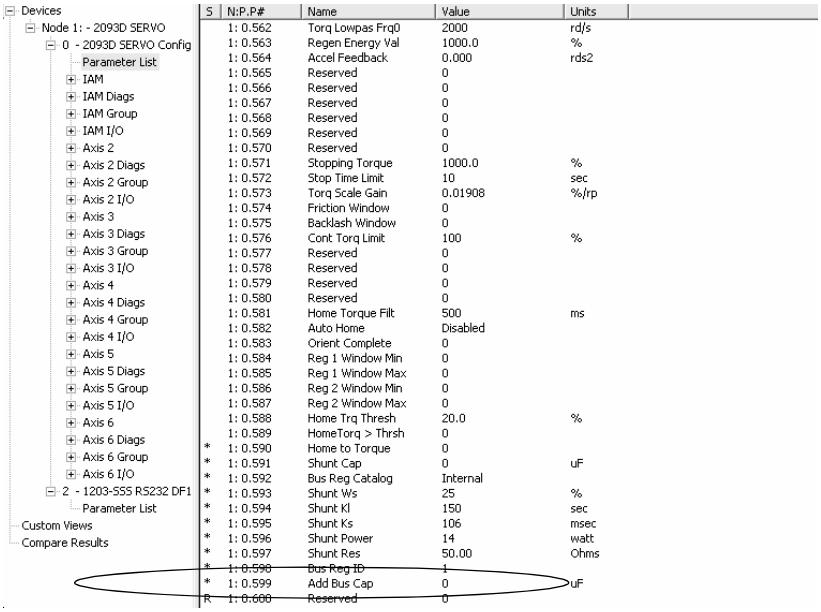
1. Start your DriveExplorer software.
2. From the menu bar choose Explore\Connect\Local or enter Ctrl-L from the keyboard.

DriveExplorer software will read your system.

3. Observe the Linear List of parameters as grouped by Node, Port, and Axis hierarchy as shown below.

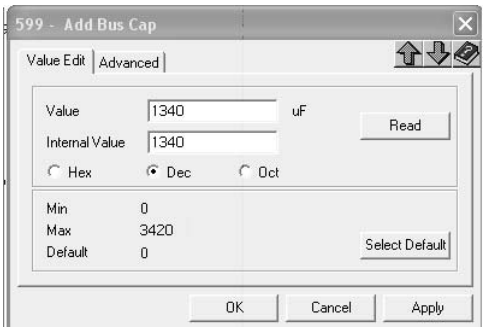


4. Select the appropriate Devices\Node\Product\ path and navigate to the *N:P:x*599 Add Bus Cap parameter as shown.



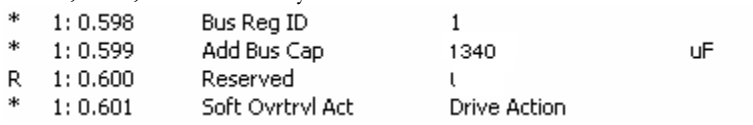
5. Double-click the *N:P:x*599 Add Bus Cap parameter.

The command dialog for parameter *x*599 - Add Bus Cap opens.



6. Select the Value Edit tab and enter the Add Bus Cap Value (μF).

7. Click OK, and verify the correct Add Bus Cap value is displayed in the Node, Port, Axis hierarchy.

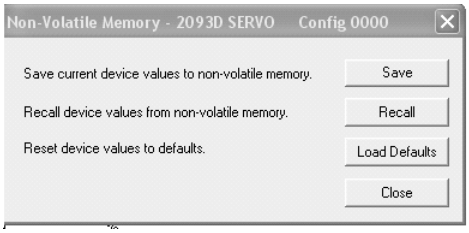


Save the Add Bus Cap Parameter to Non-volatile Memory

Follow these steps to save the Add Bus Cap parameter to non-volatile memory.

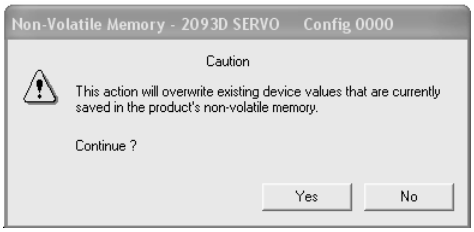
1. From the menu bar choose Actions\Non-volatile Memory.

   The following message dialog opens.



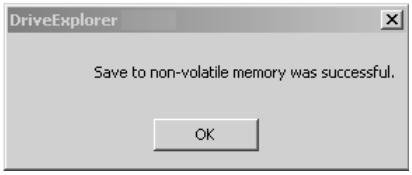
2. Click Save.

   The changes are saved to non-volatile memory and the following cautionary message dialog opens.



3. Click Yes.

   The save to non-volatile memory is complete and the following confirmation message dialog opens.



4. Click OK.

5. Close the DriveExplorer software.

Reconnect SERCOS Communication

Follow these steps to reconnect SERCOS communication.

1. Remove three-phase and control power from the Kinetix 2000 drive system.
2. Replace the SERCOS fiber-optic cable removed earlier.

   Fiber-optic cable connections (Tx and Rx) are located on the top of each IAM/AM.
3. Reapply three-phase and control power.

Numerics

A

B

C

D

K

L

M

N

O

P

R

S

T

U

W

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, 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://support.rockwellautomation.com.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running.

United States	1.440.646.3223 Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell 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, it may need to be returned.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for return procedure.

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Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 2093-UM001A-EN-P — March 2007

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