User Manual



Kinetix 6000 Multi-axis Servo Drives

Catalog Numbers 2094-ACxx-Mxx-S, 2094-BCxx-Mxx-S, 2094-AMxx-S, 2094-BMxx-S 2094-ACxx-Mxx, 2094-BCxx-Mxx, 2094-AMxx, 2094-BMxx, 2094-BSP2, 2094-PRF, 2094-SEPM-B24-S





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 <u>SGI-1.1</u> available from your local Rockwell Automation sales office or online at <u>http://www.rockwellautomation.com/literature/</u>) 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.



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This manual contains new and updated information.

New and Updated Information

This table contains the changes made to this revision.

Торіс	Page
Studio 5000 [™] Logix Designer application is the rebranding of RSLogix [™] 5000 software. General references to RSLogix 5000 software have been replaced by the Logix Designer application. References to specific RSLogix 5000 software versions did not change.	12
Updated references to safe-off (SO) as safe torque-off (STO), per EN61800-5-2.	Throughout this manual
Updated references to series A and B drives. The 230V drive modules previously labeled as series A are now series A and C. The 460V drives previously labeled as series B are now series B and C.	Throughout this manual
Added LDAT-Series linear thrusters to system overview table.	16
Added LDAT-Series linear thrusters to typical system installation diagrams.	1718
Updated System Mounting Requirements for enclosure rating from IP2x to IP54.	26
Added AC line filter selection table.	27
Updated safe torque-off (STO) connector pinout table with series C descriptions for safety enable inputs.	60
Updated motor/resistive brake circuitry diagram and text with changes for the new solid-state relay.	71
Added the LDAT-Series linear thruster interconnect diagram with Kinetix® 6000 drive.	207
Added the Configure the Load Observer Feature appendix.	235

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About This Publication	This manual provides detailed installation instructions for mounting, wiring, and troubleshooting Kinetix 6000 drives; and system integration for your drive and motor/actuator combination with a Logix controller. For information on wiring and troubleshooting your Kinetix 6000 servo drive with the safe torque-off feature, refer to the Kinetix Safe Torque-off Feature Safety Reference Manual, publication <u>GMC-RM002</u> .		
Audience	This manual is intended for engineers or technicians directly involved in the installation and wiring of the Kinetix 6000 drives; and programmers directly involved in the operation, field maintenance, and integration of these drives with a sercos interface module. If you do not have a basic understanding of the Kinetix 6000 drives, contact your local Rockwell Automation sales representative for information on available training courses.		
Conventions Used in This Manual	 The conventions starting below 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 6000 drive modules are shown in the table below and are used throughout this manual. 		
	Kinetix 6000 Drive Modules	Cat. No.	Acronym
	Integrated Axis Module	2094- <i>xCxx</i> -M <i>xx-x</i>	IAM
	Axis Module	2094- <i>x</i> M <i>xx-x</i>	AM
	Line Interface Module	2094- <i>x</i> L <i>xx</i> and 2094- <i>x</i> L <i>xx</i> S- <i>xx</i>	LIM
	Resistive Brake Module	2090-XB <i>xx-xx</i>	RBM
	Kinetix 6000M Drive Modules	Cat. No.	Acronym
	Integrated Drive-Motor	MDF-SBxxxxx	IDM

IMPORTANT Throughout this publication, when the IAM or AM module catalog number is followed by -*x*, for example 2094-BMP5-*x*, the variable (*x*) indicates that the drive module may or may not include the safe torque-off feature.

2094-SEPM-B24-S

IDM Power Interface Module

IPIM

Studio 5000 Environment

The Studio 5000 Engineering and Design Environment combines engineering and design elements into a common environment. The first element in the Studio 5000 environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix 5000 software and will continue to be the product to program Logix5000 controllers for discrete, process, batch, motion, safety, and drive-based solutions.



The Studio 5000 environment is the foundation for the future of Rockwell Automation[®] engineering design tools and capabilities. It is the one place for design engineers to develop all the elements of their control system.

Additional Resources

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

Table 1 - Additional Resources

Resource	Description
Line Interface Module Installation Instructions, publication 2094-IN005	Provides information on the installation and troubleshooting of Bulletin 2094 line interface modules (LIM).
2094 Mounting Bracket Installation Instructions, publication 2094-IN008	Provides information on the installation of Bulletin 2094 mounting brackets.
Resistive Brake Module Installation Instructions, publication 2090-IN009	Provides information on the installation and wiring of Bulletin 2090 Resistive Brake Modules.
Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010	Provides information on proper handling, installing, testing, and troubleshooting fiber- optic cables.
External Shunt Modules Installation Instructions, publication 2090-IN004	Provides information on mounting and wiring the Bulletin 1394 shunt modules with Bulletin 2094 servo drive systems.
System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>	Provides information, examples, and techniques designed to minimize system failures
EMC Noise Management DVD, publication GMC-SP004	caused by electrical noise.
Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003	Provides information on installing, configuring, startup, troubleshooting, and applications for your Kinetix 6000M integrated drive-motor (IDM) system.
Kinetix Safe Torque-off Feature Safety Reference Manual, publication <u>GMC-RM002</u>	Provides information on wiring and troubleshooting your Kinetix 6000 servo drives with the safe torque-off feature.

Table 1 - Additional Resources (continued)

Resource	Description
Kinetix Motion Control Selection Guide, publication <u>GMC-SG001</u>	Provides overview of Kinetix servo drives, motors, actuators, and motion accessories designed to help make initial decisions for the motion control products best suited for your system requirements.
Kinetix 6000 and Kinetix 6200/6500 Drive Systems Design Guide, publication <u>GMC-RM003</u>	Provides information to determine and select the required (drive specific) drive module, power accessory, connector kit, motor cable, and interface cable catalog numbers for your drive and motor/actuator motion control system. Includes system performance specifications and torque/speed curves (rotary motion) and force/velocity curves (linear motion) for your motion application.
Kinetix Rotary Motion Specifications Technical Data, publication <u>GMC-TD001</u>	Provides product specifications for MP-Series™ (Bulletin MPL, MPM, MPF, MPS), Kinetix 6000M (Bulletin MDF), TL-Series™, RDD-Series™, and HPK-Series™ rotary motors.
Kinetix Linear Motion Specifications Technical Data, publication <u>GMC-TD002</u>	Provides product specifications for Bulletin MPAS and MPMA linear stages, Bulletin MPAR, MPAI, and TLAR electric cylinders, and LDC-Series™ and LDL-Series™ linear motors.
Kinetix Servo Drives Specifications Technical Data, publication <u>GMC-TD003</u>	Provides product specifications for Kinetix Integrated Motion over the EtherNet/IP network, Integrated Motion over sercos interface, EtherNet/IP networking, and component servo drive families.
Kinetix Motion Accessories Specifications Technical Data, publication <u>GMC-TD004</u>	Provides product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items.
Download Motion Analyzer software from: <u>http://www.ab.rockwellautomation.com/motion-control/motion-analyzer-software</u>	Comprehensive motion application sizing tool used for analysis, optimization, selection, and validation of your Kinetix Motion Control system.
Rockwell Automation Configuration and Selection Tools, website http://www.ab.com	Provides online product selection and system configuration tools, including AutoCad (DXF) drawings.
Rockwell Automation Product Certification, website <u>http://www.rockwellautomation.com/products/certification</u>	For declarations of conformity (DoC) currently available from Rockwell Automation.
Sercos and Analog Motion Configuration User Manual, publication MOTION-UM001	Provides information on configuring and troubleshooting your ControlLogix®, CompactLogix™, and SoftLogix™ sercos interface modules.
Motion Coordinate System User Manual, publication MOTION-UM002	Provides information to create a motion coordinate system with sercos or analog motion modules.
Integrated Motion on the EtherNet/IP Network Configuration and Startup User Manual, publication MOTION-UM003	Provides information on configuring and troubleshooting your ControlLogix and CompactLogix EtherNet/IP network modules.
SoftLogix Motion Card Setup and Configuration Manual, publication <u>1784-UM003</u>	Provides information on configuring and troubleshooting SoftLogix PCI cards.
ControlFLASH Firmware Upgrade Kit User Manual, publication <u>1756-QS105</u>	For ControlFLASH™ information not specific to any drive family.
National Electrical Code, published by the National Fire Protection Association of Boston, MA	An article on wire sizes and types for grounding electrical equipment.
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations.

You can view or download publications at

http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

Start

Use this chapter to become familiar with the design and installation requirements for Kinetix 6000 drive systems.

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IAM/AM Module Series Changes

Series B drives included the peak current enhancement and applied to only the 460V (series A) IAM and AM modules. The peak current ratings of the Kinetix 6000 (460V) drives are configured at the factory as 150% of continuous current. However, you can program 460V AM modules and the equivalent IAM (inverter) modules, for up to 250% of continuous inverter current.

Table 2 - Kinetix 6000 Enhanced Peak Performance Series (Change
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IAM Module	AM Module Cat. No.	Peak Current Rating		
Cat. No.		Series A (inverter)	Series B and C (inverter)	
2094-BC01-MP5-S	2094-BMP5-S	150%	250%	
2094-BC01-M01-S	2094-BM01-S	150%	250%	
2094-BC02-M02-S	2094-BM02-S	150%	250%	
2094-BC04-M03-S	2094-BM03-S	150%	250%	
2094-BC07-M05-S	2094-BM05-S	150%	200%	

IMPORTANT Before your drive can deliver enhanced peak performance, you must enable the peak enhancement feature by configuring your drive with DriveExplorer[™] software or the Logix Designer application.

Refer to <u>Appendix F</u> on <u>page 255</u> to recalculate torque and acceleration or deceleration limit values, and paste them into the appropriate Axis Properties dialog box in the Logix Designer application.

For more information on setting axis properties, refer to Configure Axis Properties on page 149.

In series C drives, a mechanical relay for the brake circuit and another for the safe torque-off inputs are replaced by solid-state relays and apply to the 230V (series A) and 460V (series B) IAM and AM modules. All wiring is consistent with previous series releases.

About the Kinetix 6000 Drive Systems

The Kinetix 6000 multi-axis servo drives are designed to provide a Kinetix Integrated Motion solution for your drive/motor/actuator applications.

System Component	Cat. No.	Description
Integrated Axis	2094- <i>xCxx</i> -M <i>xx</i> -S ^{(1) (2)}	Integrated Axis Modules (IAM) with the safe torque-off feature with 200V or 400V-class AC input power. Contains an inverter and converter section. The peak enhancement feature is available on 400V-class (series B and C) IAM modules.
Module	2094- <i>x</i> Cxx-Mxx	Integrated Axis Modules (IAM), with 200V or 400V-class AC input power (does not include the safe torque-off or peak-enhanced feature). Contains an inverter and converter section.
Avic Modulo	2094- <i>x</i> M <i>xx</i> -S ^{(1) (2)}	Axis Modules (AM) with safe torque-off are shared DC-bus inverters and rated for 200 or 400V-class operation. The AM module must be used with an IAM module. The peak enhancement feature is available on 400V-class (series B and C) AM modules.
AXIS MOUULE	2094- <i>x</i> M <i>xx</i>	Axis Modules (AM) are shared DC-bus inverters rated for 200V or 400V-class input power (does not include the safe torque-off or peak-enhanced feature). The AM module must be used with an IAM module.
Shunt Module	2094-BSP2	The Bulletin 2094 shunt module mounts to the power rail and provides additional shunting in regenerative applications.
Kinetix 6000M IDM System	2094-SEPM-B24-S Bulletin MDF	The Kinetix 6000M integrated drive-motor (IDM) system consists of the IDM power interface module (IPIM) and up to 16 (Bulletin MDF) IDM units. The IPIM module mounts on the Bulletin 2094 power rail and provides power and communication to the IDM units. The IPIM module also monitors power output and provides overload protection.
Power Rail	2094-PRS <i>x</i> 2094-PR <i>x</i>	The Bulletin 2094 power rail 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 and AM power modules, shunt module, slot-filler modules mount to the power rail.
Slot-filler Module	2094-PRF	The Bulletin 2094 slot-filler module is used when one or more slots on the power rail are empty after all the other power rail modules are installed. One slot-filler module is required for each empty slot.
Logix5000™	1756-MxxSE modules 1768-M04SE module 1784-PM16SE PCI card	The sercos interface module/PCI card serves as a link between the ControlLogix/CompactLogix/SoftLogix controllers and the Kinetix 6000 drive system. The communication link uses the IEC 61491 SErial Real-time COmmunication System (sercos) protocol over a fiber-optic cable.
Controllers	1756-ENxTx modules CompactLogix 5370 controllers	The Kinetix 6000M IPIM module connects to the EtherNet/IP network for monitoring, diagnostics, and firmware upgrades.
Studio 5000 Environment	9324-RLD300xxE	The Logix Designer application provides support for programming, commissioning, and maintaining the Logix5000 family of controllers.
Rotary Servo Motors	MP-Series, TL-Series, RDD-Series, 1326AB, F-Series	Compatible rotary motors include the MP-Series (Bulletin MPL, MPM, MPF, and MPS) 200V and 400V-class motors; RDD-Series; TL-Series; 1326AB (M2L/S2L) and 1326AB (resolver); and F-Series motors.
Linear Motors	LDC-Series, LDL-Series	Compatible motors include LDC-Series iron core (200V and 400V-class) and LDL-Series ironless (200V-class) linear motors.
Linear Actuators	MP-Series	Compatible actuators include MP-Series (200V and 400V-class) Bulletin MPAS single-axis and Bulletin MPMA multi-axis integrated linear stages, and MP-Series (200V and 400V-class) Bulletin MPAR and MPAI electric cylinders.
Actuators	LDAT-Series	LDAT-Series integrated linear actuators are compatible with 200V and 400V-class drive systems.
	2090-Series motor/actuator cables	Bulletin 2090 motor/actuator cables are available with bayonet, threaded, and SpeedTec connectors. Power/brake cables have flying leads on the drive end and straight connectors that connect to servo motors. Feedback cables have flying leads that wire to low-profile connector kits on the drive end and straight connectors on the motor end.
Cables	Kinetix 6000M integrated drive-motor cables	Bulletin 2090 integrated drive-motor (IDM) hybrid and network cables connect between the 2094 IPIM module and the Kinetix 6000M IDM units. Bulletin 889D and 879D cables connect between digital input connectors and sensors.
	Communication	Bulletin 2090 sercos fiber-optic cables are available as enclosure only, PVC, nylon, and glass with connectors at both ends.
	communication	Ethernet cables are available in standard lengths for Kinetix 6000M IPIM modules. Shielded cable is recommended.
AC Line Filters	2090-XXLF <i>-xxxx</i>	Bulletin 2090-XXLF-xxxx three-phase AC line filters are required to meet CE in all 200V and 400V-class drive systems.
Line Interface Modules	2094-xLxx 2094-xLxxS 2094-XL75S-Cx	Line interface modules (LIM) include the circuit breakers, AC line filter (catalog numbers 2094-AL09 and 2094-BL02 only), power supplies, and safety contactor required for Kinetix 6000 operation. The LIM module does not mount to the power rail. You can purchase individual components separately in place of the LIM module.
External Shunt Modules	1394-SR <i>xxxx</i>	You can use Bulletin 1394 external passive shunt modules when the IAM/AM module internal shunt and power rail mounted 2094-BSP2 shunt module capability is exceeded.
Resistive Brake Module	2090-XB <i>xx-xx</i>	Resistive Brake Modules (RBM) include a safety contactor for use in a control circuit. Contactors and resistors reside in this module such that the motor leads can be disconnected from the drive with the permanent magnet motor brought to an immediate stop. This module does not mount to the power rail.

Table 3 - Kinetix 6000 Drive System Overview

(1) Refer to the Kinetix Safe Torque-off Feature Safety Reference Manual, publication <u>GMC-RM002</u>, for more information.

(2) Refer to Peak Enhancement Specifications on page 73 for more information on drive performance in the Peak-enhanced mode.

Typical Hardware Configurations

Typical Kinetix 6000 system installations include three-phase AC configurations, with and without the line interface module (LIM), and DC common-bus configurations.



SHOCK HAZARD: To avoid personal injury due to electrical shock, place a 2094-PRF slot-filler module in all empty slots on the power rail. Any power rail connector without a module installed disables the Bulletin 2094 system; however, control power is still present.



Figure 1 - Typical Kinetix 6000 System Installation (with LIM)

(1) RDD-Series direct-drive motors require the 2090-K6CK-KENDAT low-profile feedback module.



Figure 2 - Typical Kinetix 6000 System Installation (without LIM)

This configuration illustrates the Kinetix 6000M integrated drive-motor (IDM) system with IDM power interface module (IPIM) installed on the Bulletin 2094 power rail. The IPIM module is included in the drive-to-drive fiber-optic cable installation along with the axis modules.



Figure 3 - Typical Kinetix 6000M Integrated Drive-Motor System Installation

For more information on Kinetix 6000M integrated drive-motor system installation, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.



Figure 4 - Typical (400V-class) DC Common Bus System Installation

In the example above, the leader IAM module is connected to the follower IAM module via the DC common-bus. The follower system also includes the Kinetix 6000M integrated drive-motor (IDM) power interface module (IPIM) that supports up to 16 IDM units.

When planning your panel layout, you must calculate the total bus capacitance of your DC common-bus system to be sure that the leader IAM module is sized sufficiently to pre-charge the entire system. Refer to <u>Appendix C</u>, beginning on page 225, for more information.

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

Typical Communication Configurations

In this example, drive-to-drive sercos cables and catalog numbers are shown when Kinetix 6000, Kinetix 6000M, and Kinetix 6200 drive modules exist on the same power rail.

The Kinetix 6200 control modules use sercos interface for configuring the Logix5000 module and the EtherNet/IP network for diagnostics and configuring safety functions. An Ethernet cable is connected to each control module during safety configuration. For more information on Ethernet cables, refer to the Industrial Ethernet Media Brochure, publication <u>1585-BR001</u>.





2094-BMxx-S Single-wide AM Module _____

Catalog Number Explanation

Kinetix 6000 (Bulletin 2094) drive catalog numbers and descriptions are listed in the tables below.

IMPORTANT Throughout this publication, when the IAM or AM module catalog number is followed by *-x*, for example 2094-BMP5*-x*, the variable (*x*) indicates that the drive module may or may not include the safe torque-off feature.

Integrated Axis Modules (230V)	Cat. No. (with safe torque-off feature)	Cat. No. (without safe torque-off feature)
Kinetix 6000, IAM, 200V-class, 3 kW converter, 5 A inverter	2094-AC05-MP5-S	2094-AC05-MP5
Kinetix 6000, IAM, 200V-class, 3 kW converter, 9 A inverter	2094-AC05-M01-S	2094-AC05-M01
Kinetix 6000, IAM, 200V-class, 6 kW converter, 15 A inverter	2094-AC09-M02-S	2094-AC09-M02
Kinetix 6000, IAM, 200V-class, 11 kW converter, 24 A inverter	2094-AC16-M03-S	2094-AC16-M03
Kinetix 6000, IAM, 200V-class, 23 kW converter, 49 A inverter	2094-AC32-M05-S	2094-AC32-M05
Integrated Axis Modules (460V)		
Kinetix 6000, IAM, 400V-class, 6 kW converter, 4 A inverter	2094-BC01-MP5-S ⁽¹⁾	2094-BC01-MP5
Kinetix 6000, IAM, 400V-class, 6 kW converter, 9 A inverter	2094-BC01-M01-S ⁽¹⁾	2094-BC01-M01
Kinetix 6000, IAM, 400V-class, 15 kW converter, 15 A inverter	2094-BC02-M02-S ⁽¹⁾	2094-BC02-M02
Kinetix 6000, IAM, 400V-class, 28 kW converter, 30 A inverter	2094-BC04-M03-S ⁽¹⁾	2094-BC04-M03
Kinetix 6000, IAM, 400V-class, 45 kW converter, 49 A inverter	2094-BC07-M05-S ⁽²⁾	2094-BC07-M05
Axis Modules (230V)		
Kinetix 6000, AM, 200V-class, 5 A	2094-AMP5-S	2094-AMP5
Kinetix 6000, AM, 200V-class, 9 A	2094-AM01-S	2094-AM01
Kinetix 6000, AM, 200V-class, 15 A	2094-AM02-S	2094-AM02
Kinetix 6000, AM, 200V-class, 24 A	2094-AM03-S	2094-AM03
Kinetix 6000, AM, 200V-class, 49 A	2094-AM05-S	2094-AM05
Axis Modules (460V)		
Kinetix 6000, AM, 400V-class, 4 A	2094-BMP5-S ⁽¹⁾	2094-BMP5
Kinetix 6000, AM, 400V-class, 9 A	2094-BM01-S ⁽¹⁾	2094-BM01
Kinetix 6000, AM, 400V-class, 15 A	2094-BM02-S ⁽¹⁾	2094-BM02
Kinetix 6000, AM, 400V-class, 30 A	2094-BM03-S ⁽¹⁾	2094-BM03
Kinetix 6000, AM, 400V-class, 49 A	2094-BM05-S ⁽²⁾	2094-BM05

Table 4 - Kinetix 6000 Drive Catalog Numbers

(1) You can configure the peak inverter current rating of this 460V (series B and C) IAM or AM module for 250% of continuous inverter current.

(2) You can configure the peak inverter current rating of this 460V (series B and C) IAM or AM module for 200% of continuous inverter current. Refer to <u>Peak Enhancement</u>. <u>Specifications</u> on <u>page 73</u>, for more information on drive performance in the peak-enhanced mode.

Table 5 - Kinetix 6000 Drive Component Catalog Numbers

Drive Components	Cat. No.
Integrated power interface (IPIM) module, 400V-class, 15 kW, 24 A (rms)	2094-SEPM-B24-S
Kinetix 6000 shunt module, 200/400V-class, 200 W	2094-BSP2
Kinetix 6000 slot-filler module, 200/400V-class	2094-PRF

Kinetix Drive Component Compatibility

The 2094-BCxx-Mxx-M and 2094-BMxx-M power modules contain the same power structure as the 2094-BCxx-Mxx-S and 2094-BMxx-S drive modules. Because of this, the 2094-BSP2 shunt module, 2094-PRF slot-filler module, and 2094-PRSx power rails are supported by both drive families.

In addition, 2094-BMxx-M AM power modules with sercos interface are supported on power rails with a 2094-BCxx-Mxx-S IAM drive module. Conversely, 2094-BMxx-S AM drive modules are supported on power rails with a 2094-BCxx-Mxx-M IAM power module with sercos interface.

IMPORTANTKinetix 6500 EtherNet/IP control modules (catalog numbers
2094-EN02D-M01-Sx) are not compatible with IAM/AM modules on the same
Bulletin 2094 power rail with Kinetix 6000 or Kinetix 6200 sercos drives.

	Control Module	2094- <i>xMxx</i> -S Kinetix 6000 AM Module	2094-BMxx-M AM Power Modules	
IAM Module			2094-SE02F-M00-S <i>x</i> Kinetix 6200 Control Module	2094-EN02D-M01-Sx Kinetix 6500 Control Module
2094- <i>xCxx</i> -M <i>xx</i> -S	N/A			
2094-BCxx-Mxx-M	2094-SE02F-M00-Sx sercos interface	Fully compatible	Fully compatible	Not compatible
(IAM power module)	2094-EN02D-M01-Sx EtherNet/IP network	Not compatible	Not compatible	Fully compatible

Table 6 - IAM and AM Module/Network Compatibility

For additional information on the 2094-BC*xx*-M*xx*-M (IAM) and 2094-BM*xx*-M (AM) modules, refer to the Kinetix 6200 and Kinetix 6500 Multi-axis Servo Drives User Manual, publication <u>2094-UM002</u>.

Kinetix 6000M Integrated Drive-Motor System Compatibility

Bulletin 2094 power rails with Kinetix 6000 (series B and C) or Kinetix 6200 drives are compatible with Kinetix 6000M integrated drive-motor (IDM) systems. The IDM power interface module (IPIM) mounts to the power rail and connects to as many as 16 IDM units.

Table 7 - IPIM Module Compatibility

IAM Module Control Module		2094-SEPM-B24-S IDM Power Interface Module (IPIM)	
2094-BC <i>xx-Mxx-</i> S (series B and C)	N/A	Fully compatible	
2094-BC <i>xx</i> -M <i>xx</i> -M	2094-SE02F-M00-Sx sercos interface		
(IAM power module)	2094-EN02D-M01-Sx EtherNet/IP network	Not compatible	

For more information on Kinetix 6000M integrated drive-motor system installation, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

Agency Compliance

If this product is installed within the European Union 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 can cause damage to the filter. For grounding examples, refer to Grounded Power Configurations on <u>page 83</u>.

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

CE Requirements (system without LIM module)

To meet CE requirements when your Kinetix 6000 system does not include the LIM module, these requirements apply.

- Install 2090-XXLF-*xxxx* AC line filters for three-phase input power and single-phase control power as close to the IAM module as possible.
- Use 2090 series motor power cables or use connector kits and terminate the cable shields to the chassis clamp provided.
- Combined motor power cable lengths for all Kinetix 6000 axes and hybrid cable lengths for all IDM units on the same DC bus must not exceed 240 m (787 ft) with 400V-class systems or 160 m (525 ft) with 200V-class systems. Drive-to-motor power cables must not exceed 90 m (295.5 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 90 m (295.5 ft).
- Install the Kinetix 6000 system inside an enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.

Refer to <u>Appendix A</u> on <u>page 185</u> for interconnect diagrams, including input power wiring and drive/motor interconnect diagrams.

CE Requirements (system with LIM module)

To meet CE requirements when your Kinetix 6000 system includes the LIM module, follow all the requirements as stated in <u>CE Requirements (system</u> <u>without LIM module</u>) and these additional requirements as they apply to the AC line filter.

- Install the LIM module (catalog numbers 2094-AL09 or 2094-BL02) as close to the IAM module as possible.
- Install the LIM module (catalog numbers 2094-ALxxS, 2094-BLxxS, or 2094-XL75S-Cx) with line filter (catalog number 2090-XXLF-xxxx) as close to the IAM module as possible.

When the LIM module (catalog numbers 2094-AL*xx*S, 2094-BL*xx*S, or 2094-XL75S-C*x*) supports two IAM modules, each IAM module requires an AC line filter installed as close to the IAM module as possible.

Planning the Kinetix 6000 Drive System Installation

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 6000 drive components.

Торіс	Page
System Design Guidelines	26
Electrical Noise Reduction	34



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.

For on-line product selection and system configuration tools, including AutoCAD (DXF) drawings of the product, refer to <u>http://www.rockwellautomation.com/en/e-tools</u>.

System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 6000 drive system must be enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP54 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.
- Combined motor power cable lengths for all axes and hybrid cable lengths for all IDM units on the same DC bus must not exceed 240 m (787 ft) with 400V-class systems or 160 m (525 ft) with 200V-class systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).

IMPORTANTSystem performance was tested at these cable length specifications.
These limitations also apply when meeting CE requirements.

- Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a grounded 360° clamp termination.
- 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 <u>GMC-RM001</u>, to better understand the concept of electrical noise reduction.

Transformer Selection

The IAM module does not require an isolation transformer for three-phase input power. However, a transformer can 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 Kinetix 6000 power specifications in the Kinetix Servo Drives Technical Data, publication <u>GMC-TD003</u>.

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).

For example, to size a transformer to the voltage requirements of a 2094-BC01-M01-S integrated axis module: 2094-BC01-M01-S = 6 kW continuous x 1.5 = 9.0 KVA transformer

AC Line Filter Selection

These AC line filters are available for your servo drive input power.

Drive Cat. No.	Voltage	Current A @ 50 ℃ (122 °F)	Weight, approx kg (lb)	AC Line Filter Cat. No.
2094-AC05-MP5-S				
2094-AC05-M01-S		30	2.7 (5.9)	2090-XXLF-X330B
2094-AC09-M02-S	500V AC 50/60 Hz			
2094-AC16-M03-S		75	5.2 (11.4)	2090-XXLF-375
2094-AC32-M05-S		100	9.5 (20.9)	2090-XXLF-3100
2094-BC01-MP5-S	500V AC 50/60 Hz			
2094-BC01-M01-S		30	2.7 (5.9)	2090-XXLF-X330B
2094-BC02-M02-S				
2094-BC04-M03-S		75	5.2 (11.4)	2090-XXLF-375B
2094-BC07-M05-S		100	9.5 (20.9)	2090-XXLF-3100

Refer to the Kinetix Motion Accessories Specifications Technical Data, publication <u>GMC-TD004</u>, for additional AC line filter specifications.

Circuit Breaker/Fuse Options

The 2094-*x*C*xx*-M*xx*-S and 2094-*x*M*xx*-S drive modules and the Kinetix 6000M integrated drive-motor system (2094-SEPM-B24-S IPIM module and MDF-SB*xxxxx* IDM units) use internal solid-state motor short-circuit protection and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 200,000 A. Fuses or circuit breakers, with adequate withstand and interrupt ratings, as defined in NEC or applicable local codes, are permitted.

The 2094-AL09 and 2094-BL02 LIM modules contain supplementary protection devices and, when protected by suitable branch circuit protection, are rated for use on a circuit capable of delivering up to 5000 A. When these modules are used, protection on the line side of the LIM module is required. Fuses must be class J or CC only.

The 2094-ALxxS, 2094-BLxxS, and 2094-XL75S-Cx LIM modules contain branch circuit rated devices suitable for use on a circuit capable of delivering up to 65,000 A (400V-class) or 100,000 A (200V-class).

Refer to the Line Interface Module Installation Instructions, publication <u>2094-IN005</u>, for power specifications and more information on using the LIM module.

The Bulletin 140M and 140U products are another acceptable means of protection. As with fuses and circuit breakers, you must make sure that the selected components are properly coordinated and meet applicable codes including any requirements for branch circuit protection. When applying the 140M/140U product, evaluation of the short circuit available current is critical and must be kept below the short circuit current rating of the 140M/140U product.

In most cases, class CC, J, L, and R fuses selected to match the drive input current rating meets the NEC requirements or applicable local codes, and provide the full drive capabilities. Use dual element, time delay (slow-acting) fuses to avoid nuisance trips during the inrush current of power initialization.

Circuit Breaker and 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.

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

The following fuse examples and Allen-Bradley[®] circuit breakers are recommended for use with 2094-*x*C*xx*-M*xx*-S IAM modules when the Line Interface Module (LIM) is not used.

IMPORTANT LIM Modules (catalog numbers 2094-ALxxS, 2094-BLxxS, and 2094-XL75S-Cx) provide branch circuit protection to the IAM module. Follow all applicable NEC and local codes.

	V AC Input Power			Control I	nput Power	DC Common Bus Fuse	
IAM Module Cat. No.		Allen-Bradley Circuit Breaker				_	
	Bussmann Fuse	Disconnect	Magnetic Contactor	Bussmann Fuse ⁽¹⁾	Circuit Breaker	Bussmann Fuse	Ferraz Shawmut Fuse
2094-AC05-MP5-S		1402 5020200	140M FOE C16			N/A	A50P20-1
2094-AC05-M01-S	– KTK-K-ZU (ZU A)	1492-3230300	140101-F0E-C10		1492-SP2D060 1492-SP2D200		
2094-AC09-M02-S	KTK-R-30 (30 A)	1492-SP3D400	140M-F8E-C20	FNQ-R-10 (10 A)		FWH-35B	A50P35-4
2094-AC16-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50			FWH-60B	A50P60-4
2094-AC32-M05-S	LPJ-80SP (80 A)	N/A	140U-H6C3-C90	-		FWH-125B	A50P125-4
2094-BC01-MP5-S		1402 5020200	140M FRE (22				
2094-BC01-M01-S	KIK-N-20 (20 A)	1492-5P3D300 140M	140101-F8E-C32	FNQ-R-10 (10 A) or FNO-R-7 5 (7 5 A)		FWJ-20A14F	DCT20-2
2094-BC02-M02-S	KTK-R-30 (30 A)	1492-SP3D400	140M-F8E-C45		1492-SP2D060 or 1492-SP1D150	FWJ-40A	A70QS40-4
2094-BC04-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50			FWJ-70A	A70QS70-4
2094-BC07-M05-S	LPJ-80SP (80 A)	N/A	140U-H6C3-C90	1		FWJ-125A	A70QS125-4

Table 9 - Kinetix 6000 Circuit Breaker and Fuse Selection

(1) Use FNQ-R-7.5 fuse for higher single-cycle inrush current capability. This is recommended when the continuous control power current exceeds 3.0 A.

(2) Use 1492-SP1D150 circuit breaker for higher single-cycle inrush current capability. This is recommended when the continuous control power current exceeds 3.0 A.

Refer to the Kinetix Servo Drives Technical Data, publication <u>GMC-TD003</u>, for additional power specifications for your IAM module.

2094-BM02-x 2094-BM02-x 2094-BM01-x

2094-BM01-x

2094-BM01-x

2094-BL25S

2094-PRS6

2090-XB33-32

Total Kinetix 6000 system wattage

Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Bulletin 2094 drive system. The example system consists of these components:

- 6-axis Bulletin 2094 servo drive system
- Line Interface Module (LIM)
- ControlLogix chassis and modules (controller) ٠

Size the Bulletin 2094 servo drive and LIM module and use the results to predict the amount of heat dissipated into the enclosure. You also need heat dissipation data from other equipment inside the enclosure (such as the ControlLogix controller). Once the total amount of heat dissipation (in watts) is known, you can calculate the minimum enclosure size.

40%

40%

20%

100%

N/A

N/A

73

73

57

43

0

30 578

Enclosure Component	Description		Loading ⁽¹⁾	Heat Dissipation ⁽¹⁾ watts
2094-BC02-M02- <i>x</i>	Integrated axis module (IAM),	15 kW (converter section)	20%	44
	400/460V	15 A (inverter section)	40%	72
2094-BM02- <i>x</i>	Axis module (AM), 400/460V, 15 A	s module (AM), 400/460V, 15 A		93
2094-BM02-x	Axis module (AM), 400/460V, 15 A		60%	93

Table 10 - Bulletin 2094 System Heat Dissipation Example

(1) To determine heat dissipation specifications for your drive system components, refer to Table 12 on page 32.

Power rail, 460V, 6 axis

Axis module (AM), 400/460V, 9 A

Axis module (AM), 400/460V, 9 A

Axis module (AM), 400/460V, 9 A

Resistive brake module (RBM), 33 A, 32 Ω

Line interface module (LIM), 400/460V, 25 A; 24V DC 20 A

Enclosure Component	Description	Backplane Power Load ⁽¹⁾ watts	Heat Dissipation ⁽¹⁾ watts		
1756-M08SE	8-axis sercos interface module	3.2	0		
1756-L5563	L63 ControlLogix processor	4.5	0		
1756-IB16D	16 -point input module	0.84	5.8		
1756-0B16D	16 -point output module	4.64	3.3		
1756-EN <i>x</i> T <i>x</i>	EtherNet/IP communication 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	Total ControlLogix system wattage				

(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 (17.18W) to the graph below.

Figure 6 - ControlLogix Real Power



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

In this example, the amount of power dissipated inside the cabinet is the sum of the Bulletin 2094 system value (578 W) and the ControlLogix system value (34 W) for a total of 612 W.

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

Metric	Standard English
$A = \frac{0.38Q}{1.8T - 1.1}$	$A = \frac{4.080}{T - 1.1}$
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.

Total system watts dissipated (Q) was calculated at 612 W. The maximum ambient rating of the Bulletin 2094 system is 50 °C (122 °F) and if the maximum environmental temperature is 30 °C (86 °F), then T=20 in the equation below.

$$A = \frac{0.38 (612)}{1.8 (20) - 1.1} = 6.66 \text{ m}^2$$

In this example, the enclosure must have an exterior surface of 6.66 m^2 . If any portion of the enclosure is not able to transfer heat, do not include that portion in the calculation.

Because the minimum cabinet depth to house the 460V drive (selected for this example) is 302 mm (11.9 in.), then the cabinet needs to be approximately 2500 mm (high) x 950 mm (wide) x 302 mm (deep).

$$2 \times (0.3 \times 0.95) + 2 \times (0.3 \times 2.5) + 2 \times (0.95 \times 2.5) = 6.82 \text{ m}^2$$

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

Bulletin 2094 Drive Modules ⁽¹⁾	Usage as % of Rated Power Output (watts)					
	20%	40%	60%	80%	100%	
IAM (converter) module ⁽²⁾					l	
2094-AC05-MP5-S	8	11	15	19	24	
2094-AC05-M01-S	9	12	16	20	25	
2094-AC09-M02-S	14	20	28	36	46	
2094-AC16-M03-S	19	30	43	58	74	
2094-AC32-M05-S	41	68	100	136	176	
2094-BC01-MP5-S	10	21	25	20	34	
2094-BC01-M01-S	18	21	25	29	33	
2094-BC02-M02-S	36	44	54	64	75	
2094-BC04-M03-S	50	67	87	110	135	
2094-BC07-M05-SS	71	101	137	179	226	
IAM (inverter) module or AM module ⁽²⁾						
2094-AC05-MP5-S or 2094-AMP5-S	28	32	37	41	46	
2094-AC05-M01-S or 2094-AM01-S	31	38	46	54	62	
2094-AC09-M02-S or 2094-AM02-S	34	45	57	70	84	
2094-AC16-M03-S or 2094-AM03-S	48	68	91	116	144	
2094-AC32-M05-S or 2094-AM05-S	104	156	212	274	342	
2094-BC01-MP5-S or 2094-BMP5-S	46	54	61	69	77	
2094-BC01-M01-S or 2094-BM01-S	57	73	90	108	126	
2094-BC02-M02-S or 2094-BM02-S	53	72	93	116	142	
2094-BC04-M03-S or 2094-BM03-S	94	130	169	211	255	
2094-BC07-M05-S or 2094-BM05-S	121	183	252	326	407	
Shunt module - 2094-BSP2	68	121	174	227	280	
IPIM module - 2094-SEPM-B24-S	To calculate pow Manual, publica	To calculate power dissipation for IPIM modules on your 2094 power rail, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.				

Tab	le '	12	- F	Power	Dissi	pation	Spe	cifica	ations
-----	------	----	-----	-------	-------	--------	-----	--------	--------

(1) Power dissipation for the Bulletin 2094 control modules, catalog numbers 2094-SE02F-M00-Sx and 2094-EN02D-M01-Sx, is included in the IAM and AM power module specifications.

(2) Internal shunt power is not included in the calculations and must be added based on utilization.

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Bulletin 2094 system components.

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

<u>Figure 7</u> illustrates minimum clearance requirements for proper airflow and installation:

- Additional clearance is required for the cables and wires connected to the top and front of the drive.
- Additional clearance left and right of the power rail is required when the drive is mounted adjacent to noise sensitive equipment or clean wireways.



Figure 7 - Minimum Clearance Requirements

(1) The power rail (slim), catalog number 2094-PRSx, extends left and right of the first and last module 5.0 mm (0.20 in.). The Bulletin 2094-PRx power rail extends approximately 25.4 mm (1.0 in.) left of the IAM module and right of the last module mounted on the rail.

	-	-	
Drive Cat. No.	Series	F	
2094-AC05-M <i>xx-x</i> 2094-AC09-M02- <i>x</i>		227	
2094-AMP5- <i>x,</i> 2094-AM01- <i>x,</i> 2094-AM02- <i>x</i>	A and C	(9.3) in.	
2094-AC16-M03- <i>x</i> 2094-AC32-M05- <i>x</i>	AandC	420 mm	
2094-AM03- <i>x,</i> 2094-AM05- <i>x</i>	A dia C	(16.5) in.	
2094-BC01-M <i>xx-x</i> 2094-BC02-M02- <i>x</i>			
2094-BMP5- <i>x,</i> 2094-BM01- <i>x,</i> 2094-BM02- <i>x</i>	A, B, and C	287 mm (11.3) in.	
2094-SEPM-B24-S 2094-BSP2	A		
2094-BC04-M03- <i>x</i> 2094-BM03- <i>x</i>	A, B, and C	374 mm	
2094-BC07-M05-x 2094-BM05-x	B and C	(14.7) in.	
2094-BC07-M05- <i>x</i> 2094-BM05- <i>x</i>	A and C	436 mm (17.2) in.	

Table 13 - Minimum Cabinet Depth

Drive Cat. No.	Cabinet Depth, min ⁽¹⁾	Drive Cat. No.	Cabinet Depth, min ⁽¹⁾
2094-AC05-Mxx-x, 2094-AC09-M02-x, 2094-AMP5-x, 2094-AM01-x, 2094-AM02-x	198 mm (7.8 in.)	2094-AC16-M03-x, 2094-AC32-M05-x, 2094-AM03-x, 2094-AM05-x	198 mm (7.8 in.)
2094-BC01-Mxx-x, 2094-BC02-M02-x, 2094-BMP5-x, 2094-BM01-x, 2094-BM02-x	272 mm (10.7 in.)	2094-BC04-M03-x, 2094-BC07-M05-x, 2094-BM03-x, 2094-BM05-x	272 mm (10.7 in.)
2094-BSP2	272 mm (10.7 in.)	2094-SEPM-B24-S	263 mm (10.3 in.)

(1) Minimum cabinet depth is based on the use of 2090-K6CK-xxxx low-profile connector kits. Other means of making feedback connections can require additional clearance.

Electrical Noise Reduction

This section outlines best practices that minimize the possibility of noise-related failures as they apply specifically to Kinetix 6000 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 <u>GMC-RM001</u>.

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 highfrequency energy.

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

Improper bonding of metal surfaces blocks the direct return path and allows high-frequency energy to travel elsewhere in the cabinet. Excessive highfrequency energy can effect the operation of other microprocessor controlled equipment. These illustrations show details of recommended bonding practices for painted panels, enclosures, and mounting brackets.



Figure 8 - 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. If subpanels are not bonded together, and do not share a common low impedance path, the difference in impedance can affect networks and other devices that span multiple panels:

- Bond the top and bottom of each subpanel to the cabinet by using 25.4 mm (1.0 in.) by 6.35 mm (0.25 in.) wire braid. As a rule, the wider and shorter the braid is, the better the bond.
- Scrape the paint from around each fastener to maximize metal-to-metal contact.

Figure 9 - Multiple Subpanels and Cabinet Recommendations


Establishing Noise Zones

Observe these guidelines when the 2094-ALxxS, 2094-BLxxS, or 2094-XL75S-Cx LIM module is used in the Bulletin 2094 system and mounted left of the IAM module with the AC (EMC) line filter mounted above the LIM module:

- The clean zone (C) is to the right and beneath the Bulletin 2094 system (gray wireway).
- The dirty zone (D) is to the left and above the Bulletin 2094 system, and above and below the LIM module (black wireway).
- The very dirty zone (VD) is from the filter output to IAM module. 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, but due to their delicate nature, route them in the clean zone.



Figure 10 - Noise Zones (LIM mounted left of IAM module)

- (1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.

Observe these guidelines when the 2094-ALxxS, 2094-BLxxS, or 2094-XL75S-Cx LIM module is used in the Bulletin 2094 system and mounted right of the IAM module with the AC (EMC) line filter mounted behind the IAM module:

- The clean zone (C) is to the left and beneath the Bulletin 2094 system (gray wireway).
- The dirty zone (D) is to the right and above the Bulletin 2094 system, and above and below the LIM module (black wireway).
- The very dirty zone (VD) is from the filter output to IAM module. 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, but due to their delicate nature, route them in the clean zone.



Figure 11 - Noise Zones (LIM with EMC filter behind IAM module)

- (1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.

Observe these guidelines when the 2094-ALxxS, 2094-BLxxS, or 2094-XL75S-Cx LIM module is used in the Bulletin 2094 system and mounted right of the drive with the AC (EMC) line filter mounted behind the LIM module:

- The clean zone (C) is to the left and beneath the Bulletin 2094 system (gray wireway).
- The dirty zone (D) is to the right and above the Bulletin 2094 system, and above and below the LIM module (black wireway).
- The very dirty zone (VD) is from the filter output to drive. Shielded cable is required on the EMC filter (load side) and the braided shield attached to the clamp (when provided).
- The sercos fiber-optic cables are immune to electrical noise, but due to their delicate nature, route them in the clean zone.



Figure 12 - Noise Zones (EMC filter behind LIM module)

- (1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.
- (3) Only the 2094-ALxxS and 2094-XL75S-Cx LIM modules are compatible with the 2094 mounting brackets. The 2094-BLxxS, 2094-AL09, and 2094-BL02 LIM modules are not compatible.

Keep the DC common-bus cable (very dirty) segregated from all other cables (not in a wireway) when the 2094-ALxxS, 2094-BLxxS, or 2094-XL75S-Cx LIM module is used in a DC common-bus configuration and the follower IAM module is mounted below the leader IAM module.



Figure 13 - Noise Zones (DC common bus)

- (1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.

Observe these guidelines when the 2094-AL09 or 2094-BL02 LIM module is used in the Bulletin 2094 system and mounted left of the IAM module:

- The clean zone (C) is to the right and beneath the Bulletin 2094 system (gray wireway).
- The dirty zone (D) is to the left and above the Bulletin 2094 system, and above and below the LIM module (black wireway).
- The very dirty zone (VD) is limited to where the LIM module VAC output jumpers over to the IAM module. Shielded cable is required only if the very dirty cables enter a wireway.
- The sercos fiber-optic cables are immune to electrical noise, but due to their delicate nature, route them in the clean zone.

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



Figure 14 - Noise Zones (LIM mounted left of IAM module)

- (1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.

Observe these guidelines when the 2094-AL09 or 2094-BL02 LIM module is used in the Bulletin 2094 system and mounted above the IAM module:

- The clean zone (C) is to the right and beneath the Bulletin 2094 system (gray wireway).
- The dirty zone (D) is to the left and above the Bulletin 2094 system, and above and below the LIM module (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, but due to their delicate nature, route them in the clean zone.

Figure 15 - Noise Zones (LIM mounted above IAM module)



- For examples of shield clamp attachment, refer to the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.
- (2) If drive system 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.

Observe these guidelines when your system includes the 2094-SEPM-B24-S IPIM module. In this example, a 2094-BL02 LIM module is used in the Bulletin 2094 system and mounted left of the IAM module:

- Establish clean (C) and dirty zones (D) similar to other Bulletin 2094 drive systems.
- The sercos fiber-optic cables are immune to electrical noise, but due to their delicate nature, route them in the clean zone.
- IPIM digital input wires are noise sensitive and belong with the fiber-optic cables in the clean zone.
- Ethernet cables are noise sensitive and belong in the clean zone, however, they are connected only when programming the IPIM module.
- IDM network cables, although noise sensitive by nature, are shielded and can be routed with the hybrid cables outside of the enclosure.
- The Bulletin 2090 hybrid cable is dirty and belongs in the dirty zone.

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





- (1) If drive system I/O cable contains (dirty) relay wires, route cable with LIM module 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.

Observe these guidelines when individual input power components are used in the Bulletin 2094 system and the Bulletin 2094 LIM module is not used:

- The clean zone (C) is beneath the Bulletin 2094 system and includes the I/O wiring, feedback cable, and DC filter (gray wireway).
- The dirty zone (D) is above the Bulletin 2094 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 module. Shielded cable is required only if the very dirty cables enter a wireway.
- The sercos fiber-optic cables are immune to electrical noise, but due to their delicate nature, route them in the clean zone.

Figure 17 - Noise Zones (without LIM module)



- (1) If drive system 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 the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.
- (3) This is a clean 24V DC available for any device that requires 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 these guidelines when installing your Logix5000 sercos interface module:

- The clean zone (C) is beneath the less noisy modules (I/O, analog, encoder, registration, an so forth (gray 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, but due to their delicate nature, route them in the clean zone.

Figure 18 - Noise Zones (ControlLogix chassis)



Cable Categories for Kinetix 6000 Systems

These tables indicate the zoning requirements of cables connecting to the Kinetix 6000 drive components.

Table 14 - IAM Module (converter side)

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

			Zone	Zone		Method	
Wire/Cable	Connector	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable	
U, V, W (motor power)	MP		Х			Х	
MBRK-, MBRK+ (motor brake)			Х				
MBRK-, MBRK+ (motor brake) 1326AB motors with resolver feedback			Х		Х		
DBRK-, DBRK+ (resistive brake)	BC		Х				
COM, PWR (24V DC), filtered ⁽¹⁾				Х			
COM, PWR (24V DC), unfiltered ⁽²⁾			Х				
COM, PWR (24V DC), safety enable, and feedback signals for safe torque-off feature	ST0		Х				
Motor feedback	MF			Х		Х	
Auxiliary feedback	AF			Х		Х	
Registration and analog outputs				Х		Х	
Others	עטו		Х				
Fiber-optic	Rx and Tx	No restric	tions	•	•	•	

Table 15 - AM Module or Axis Module (inverter side)

(1) This is a clean 24V DC available for any device that requires it.

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

Table 16 - Line Interface Module (LIM)

		Zone			Method	
Wire/Cable	Connector	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
VAC line (main input)	IPL		Х			
Aux power input	APL		Х			
VAC load (shielded option)	ODI		Х			Х
VAC load (unshielded option)	UFL	Х				
Control power output	CPL		Х			
MBRK PWR, MBRK COM	P1L/PSL		Х			
Status I/O	IOL		Х			
Aux power output	P2L		Х			

Table 17 - Shunt Module

		Zone			Method	
Wire/Cable	Connector	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
COL, DC+ (shielded option)	RC RC		Х			Х
COL, DC+ (unshielded option)		Х				
Thermal switch	TS		Х			Х
Fan (if present)	N/A		Х			

Wire/Cable		Zone			Method	
	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable	
Hybrid DC bus power, control power, inter-module communication, and safe torque-off ⁽¹⁾		Х			Х	
Enable input			Х		Х	
Fiber-optic	No restriction	No restrictions				
Ethernet network			Х		Х	
IDM network ⁽¹⁾			Х		Х	

Table 18 - IDM Power Interface Module (IPIM)

(1) There is no option for making your own hybrid power or IDM network cables.

Table 19	Resistive	Brake Module	(RBM)
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Wire/Cable	Connections	Zone			Method	
	connections	Very Dirty	Dirty	Clean	Ferrite Sleeve	Shielded Cable
Resistive brake module coil power	TB3-6 and TB3-7		Х			
Resistive brake module I/O	TB1-1TB1-5 and TB3-8		Х			
Resistive brake module drive and motor power	TB1 and TB2		Х			Х
230V power	TB4		Х			

Noise Reduction Guidelines for Drive Accessories

Refer to this section when mounting an AC (EMC) line filter or external shunt module for guidelines designed to reduce system failures caused by excessive electrical noise.

AC Line Filters

Observe these guidelines when mounting your AC (EMC) line filter (refer to the figure on page 44 for an example):

- Mount the AC line filter on the same panel as the Kinetix 6000 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 35.
- 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 can perform satisfactorily, but the user takes legal responsibility.

External Shunt Modules

Observe these guidelines when mounting your external shunt module outside the enclosure:

- Mount circuit components and wiring in the very dirty zone or in an external shielded enclosure. Run shunt power and fan wiring inside metal conduit to minimize the effects of EMI and RFI.
- Mount resistors (other than metal-clad) in a shielded and ventilated enclosure outside the cabinet.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Route thermal switch and fan wires separate from shunt power.

Figure 19 - External Shunt Module Outside the Enclosure



When mounting your shunt module inside the enclosure, follow these additional guidelines:

- Mount metal-clad modules anywhere in the dirty zone, but as close to the Bulletin 2094 drive system as possible.
- Route shunt power wires with motor power cables.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt power cables from other sensitive, low voltage signal cables.



Figure 20 - External Shunt Module Inside the Enclosure

Resistive Brake Modules

Observe these guidelines when mounting your RBM module:

- Mount circuit components and wiring in the dirty zone or in an external shielded enclosure. If mounting the RBM module in a separate ventilated shielded enclosure, run wiring inside metal conduit to minimize the effects of EMI and RFI.
- Keep unshielded wiring as short as possible. Keep wiring as flat to the cabinet as possible.
- Route RBM module power and I/O cables separate from other sensitive low voltage signal cables.



Figure 21 - Noise Zones (RBM mounted above AM module)

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 Wire the Motor/Resistive Brake (BC) Connector on page 111 for wiring guidelines. Refer to Axis Module/Rotary Motor Wiring Examples beginning on page 196 for the interconnect diagram of your drive/motor combination.

Motor Brake and Thermal Switch

Mounting the Kinetix 6000 Drive System

This chapter provides the system installation procedures for mounting your Kinetix 6000 drive components on the Bulletin 2094 power rail.

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Before You Begin	51
Determine Mounting Order	52
Mount Modules on the Power Rail	54

This procedure assumes you have prepared your panel, mounted your Bulletin 2094 power rail, 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.



SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2094 power rail and drive modules prior to applying power. Once power is applied, connector terminals can 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.

Before You Begin

Before you begin, consider your Bulletin 2094 power rail installation and using 2094 mounting brackets.

Using the 2094 Mounting Brackets

You can use Bulletin 2094 mounting brackets to mount the power rail or LIM module over the AC line filter. Refer to the 2094 Mounting Brackets Installation Instructions, publication <u>2094-IN008</u>, when using mounting brackets with your Kinetix 6000 drive system.

Installing the 2094 Power Rail

The Bulletin 2094 power rail comes in lengths to support one IAM module and up to seven additional AM/IPIM modules, or up to six additional AM/IPIM modules and one shunt module. The connector pins for each slot are covered by a protective cover. The cover is designed to protect the pins from damage and make sure that no foreign objects lodge between the pins during installation. Refer to the Kinetix 6000 Power Rail Installation Instructions, publication <u>2094-IN003</u>, when installing your power rail.



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

The Kinetix 6000M integrated drive-motor (IDM) system is supported by Bulletin 2094 (400V-class) power rail configurations. You can mount up to four IDM power interface (IPIM) modules on the Bulletin 2094 power rail. Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for more information.

rder Mount IAM, AM/IPIM, shunt, and slot-filler modules in the order (left to right) as shown in <u>Figure 22</u>. Mount axis modules and the IPIM module according to power utilization (highest to lowest) from left to right starting with the highest power utilization.

Power utilization is the average power (kW) consumed by a servo axis. If Motion Analyzer software was used to size the axis, the calculated axis power required can be used for the power utilization value. If Motion Analyzer software was not used, you can use the continuous power value (kW) for each module to determine mounting order.

Table 20 - Kinetix 6000 (200V-class) Axis Modules

Attribute	2094-AMP5-S	2094-AM01-S	2094-AM02-S	2094-AM03-S	2094-AM05-S
Continuous Power Output, nom	1.2 kW	1.9 kW	3.4 kW	5.5 kW	11.0 kW

Table 21 - Kinetix 6000 (400V-class) Axis Modules

Attribute	2094-BMP5-S	2094-BM01-S	2094-BM02-S	2094-BM03-S	2094-BM05-S
Continuous Power Output, nom	1.8 kW	3.9 kW	6.6 kW	13.5 kW	22.0 kW

Table 22 - Kinetix 6000M (400V-class) IPIM Module

Attribute	2094-SEPM-B24-S
Continuous Power Output, nom	15.0 kW

Determine Mounting Order



Figure 22 - Module Mounting Order Example

IMPORTANTThe IAM module must be positioned in the leftmost slot of the power rail.
Position your AM/IPIM modules, shunt module, and slot-filler modules to the
right of the IAM module.
The shunt module must be installed to the right of the last AM/IPIM module.
Only slot-filler modules can be installed to the right of the shunt module.
Do not mount the shunt module on power rails with a follower IAM module.
Common-bus follower IAM modules disable the internal, rail mounted, and
external shunt modules.



SHOCK HAZARD: To avoid personal injury due to electrical shock, place a 2094-PRF slot-filler module in all empty slots on the power rail. Any power rail connector without a module installed disables the Bulletin 2094 system; however, control power is still present.

Mount Modules on the Power Rail

Follow these steps to mount the IAM, AM, IPIM, shunt, and slot-filler modules.

- **TIP** All modules mount to the power rail by using the same technique; however, only the IAM module is used in the examples.
- 1. Remove the protective covers from the power rail connectors.

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

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



ATTENTION: To avoid damage to the pins on the back of each IAM, AM, IPIM, shunt, and slot-filler module and to make sure that module pins mate properly with the power rail, hang modules as shown in <u>step 3</u> through <u>step 6</u>.

The power rail must be mounted vertically on the panel before hanging modules on the power rail. Do not mount modules if the power rail is horizontal.

3. Hang the mounting bracket from the slot on the power rail.





4. Pivot module downward and align the guide pins on the power rail with the guide pin holes in the back of the module.

TIP

The IAM module can have two or three power rail connectors and guide pins, the AM module can have one or two, all other modules have one.

5. Gently push the module against the power rail connectors and into the final mounting position.



Kinetix 6000 IAM, AM, IPIM, Shunt, or Slot-filler Module (IAM module is shown) 6. Use 2.26 N \bullet m (20 lb \bullet in) torque to tighten the mounting screws.



Repeat <u>step 1</u> through <u>step 6</u> for each AM, IPIM, shunt, or slot-filler module in your Bulletin 2094 drive system

Connector Data and Feature Descriptions

This chapter illustrates drive connectors and indicators, including connector pinouts, and provides descriptions for Kinetix 6000 drive features.

Торіс	Page
2094 IAM/AM Module Connector Data	58
Control Signal Specifications	67
Power and Relay Specifications	71
Feedback Specifications	77

For the Kinetix 6000M integrated drive-motor (IDM) unit and IDM power interface module (IPIM) connector locations and signal descriptions, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication 2094-UM003.

2094 IAM/AM Module Connector Data

Use these illustrations to identify the connectors and indicators for the IAM/AM modules. Sercos interface and Ethernet network connectors for the Kinetix 6000M IPIM module are also shown. For the remainder of the IPIM module features and indicators, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

Although the physical size of the 400V-class module is larger than the 200V-class module, the location of the features and indicators is identical.

Figure 23 - Integrated Axis Module Features and Indicators



ltem	Description
1	Safe torque-off (STO) connector
2	Contactor enable (CED) connector
3	DC bus/AC input power (IPD) connector
4	Control power (CPD) connector
5	Motor cable shield clamp
6	Motor power (MP) connector
7	Motor/resistive brake (BC) connector
8	Sercos communication rate and optical power switches
9	Sercos transmit (Tx) connector
10	DPI connector

ltem	Description
11	Sercos receive (Rx) connector
12	Mounting screw
13	I/O (IOD) connector
14	Sercos node address switch
15	Seven-segment fault status indicator
16	Drive status indicator
17	COMM status indicator
18	Bus status indicator
19	Motor feedback (MF) connector
20	Auxiliary feedback (AF) connector

-11

15

16

Figure 24 - Axis Module Features and Indicators



ltem	Description	ltem	Description
1	Safe torque-off (STO) connector	9	Mounting screw
2	Motor cable shield clamp	10	I/O (IOD) connector
3	Motor power (MP) connector	11	Seven-segment fault status indicator
4	Motor/resistive brake (BC) connector	12	Drive status indicator
5	Sercos communication rate and optical power switches	13	COMM status indicator
6	Sercos transmit (Tx) connector ⁽¹⁾	14	Bus status indicator
7	Sercos receive (Rx) connector ⁽¹⁾	15	Motor feedback (MF) connector
8	Ethernet (PORT1 and PORT 2) connectors (2)	16	Auxiliary feedback (AF) connector

(1) The Rx and Tx sercos connectors on the Kinetix 6000M IPIM module are in the same position as on the Kinetix 6000 AM modules. For the remainder of the IPIM module features and indicators, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication 2094-UM003.

(2) The Kinetix 6000M IPIM module has two Ethernet ports. These ports are used only for connecting to the EtherNet/IP network for Logix5000 programming.

Table 23 - Kinetix 6000 IAM/AM Module Connectors

Designator	Description	Connector	Module
IOD	User I/O (drive)	26-pin high-density D-shell (female)	IAM/AM
MF	Motor feedback	15-pin high-density D-shell (female)	IAM/AM
AF	Auxiliary feedback	15-pin high-density D-shell (male)	IAM/AM
CPD	Control input power (drive)	2-position plug/header	IAM
IPD	VAC input power (drive) and DC bus	6-position plug/header	IAM
CED	Contactor enable	2-position plug/header	IAM
MP	Motor power	4-position plug/header	IAM/AM
ВС	Motor/Resistive brake	6-position plug/header	IAM/AM
ST0	Safe torque-off	9-position plug/header	IAM/AM
Tx and Rx	Sercos transmit and receive	Sercos fiber-optic (2)	IAM/AM
DPI	DPI	DPI	IAM

Safe Torque-off Connector Pinout

Each 2094-xCxx-Mxx-S IAM module and 2094-xMxx-S AM module ships with the (9-pin) wiring-plug header and motion-allowed jumper installed in the safe torque-off (STO) connector. With the motion-allowed jumper installed, the safe torque-off feature is not used.

Figure 25 - Motion-allowed Jumper



Headers in this table extend the safe torque-off (STO) connector signals for use in wiring single and multiple safe torque-off drive configurations, or to defeat (not use) the safe torque-off feature.

Table 24 - IAM/AM Safe	Torque-off 9-pin	(STO) Connector
------------------------	------------------	-----------------

Safe Torque-off (STO) Connector Pin	Applies to These STO Connector Headers	nnector Headers Description	
1		One side of the normally-closed monitoring contact of relay 2	FDBK2+
2		Other side of the normally-closed monitoring contact of relay 2	FDBK2-
3	 Wiring plug header used in single-drive applications First-drive wiring header (catalog number 2090-XNSM-W) used in multiple-drive applications 	One side of the normally-closed monitoring contact of relay 1	FDBK1+
4		Other side of the normally-closed monitoring contact of relay 1	FDBK1-
5		Safety enable 2 input	SAFETY ENABLE2+
6		Return for safety enable power (both inputs)	SAFETY ENABLE-
7		Safety enable 1 input	SAFETY ENABLE1+
8	Wiring plug header	Power for continuous enable of the safety function, 500 mA max	24V+
9	Motion-allowed jumper	Power return used for continuous enable of safety function	24V_COM

IMPORTANT

Pins STO-8 and STO-9 (24V+) are used by only the motion-allowed jumper. When wiring to the wiring-plug header, the 24V supply must come from an external source.

Refer to the Kinetix Safe Torque-off Feature Safety Reference Manual, publication GMC-RM002, for more information on wiring safe torque-off headers.

I/O Connector Pinout

IOD Pin	Description	Signal	IOD Pin	Description	Signal
1	Hardware enable 24V DC power supply	+24V_PWR	14	High speed registration 1 input	REG1
2	Hardware enable input	ENABLE	15	Common for registration	REG_COM
3	Common	+24V_COM	16	24V registration power	REG_24V
4	Home switch 24V DC power supply	+24V_PWR	17	High speed registration 2 input	REG2
5	Home switch input	HOME	18	Common for registration	REG_COM
6	Common	+24V_COM	19	Reserved	-
7	Positive overtravel 24V DC power supply	+24V_PWR	20	Reserved	-
8	Positive overtravel limit switch input	+T0	21	Reserved	-
9	Common	+24V_COM	22	Reserved	-
10	Negative overtravel 24V DC power supply	+24V_PWR	23	Analog output 0	DACO
11	Negative overtravel limit switch input	OT-	24	Analog output common	DAC_COM
12	Common	+24V_COM	25	Analog output 1	DAC1
13	24V registration power	REG_24V	26	Analog output common	DAC_COM

Table 25 - IAM/AM I/O 26-pin (IOD) Connector

IMPORTANT Signals +24V_PWR and +24V_COM are a 24V DC source you can use only for the inputs listed above.

Figure 26 - Pin Orientation for 26-pin I/O (IOD) Connector



Motor Feedback Connector Pinout

Table 26 - Stegmann Hiperface (SRS/SRM)

MF Pin	Description	Signal
1	Sine differential input+	SIN+
2	Sine differential input-	SIN-
3	Cosine differential input+	COS+
4	Cosine differential input-	COS-
5	Hiperface data channel	DATA+
6	Common	ECOM
7	Encoder power (+9V)	EPWR_9V ⁽²⁾
8	Reserved	-

MF Pin	Description	Signal
9	Reserved	-
10	Hiperface data channel	DATA-
11	Motor thermal switch (normally closed) ⁽¹⁾	TS+
12	Reserved	-
13	Reserved	-
14	Encoder power (+5V)	EPWR_5V ⁽²⁾
15	Reserved	-

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

Common (TS-) signal for thermal switch is tied to MF-6 (ECOM) in Bulletin 2090 cables.

(2) Encoder power supply uses either 5V or 9V DC based on encoder/motor used.

MF Pin	Description	Signal	MF Pin	Description	Signal
1	AM+ / Sine differential input+	AM+/SIN+	9	Reserved	-
2	AM- / Sine differential input-	AM- / SIN-	10	Index pulse-	IM-
3	BM+ / Cosine differential input+	BM+/COS+	11	Motor thermal switch (normally closed) ⁽¹⁾	TS+
4	BM- / Cosine differential input-	BM- / COS-	12	Single-ended 5V hall effect commutation	S1
5	Index pulse+	IM+	13	Single-ended 5V hall effect commutation	S2
6	Common	ECOM	14	Encoder power (+5V)	EPWR_5V ⁽²⁾
7	Encoder power (+9V)	EPWR_9V ⁽²⁾	15	Reserved	-
8	Single-ended 5V hall effect commutation	\$3			

Table 27 - TTL or Sine/Cosine with Index Pulse and Hall Commutation

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

Common (TS-) signal for thermal switch is tied to MF-6 (ECOM) in Bulletin 2090 cables.

(2) Encoder power supply uses either 5V or 9V DC based on encoder/motor used.

Table 28 - Resolver Transmitter (transformation ratio = 0.25)

MF Pin	Description	Signal
1	Sine differential input+	S2
2	Sine differential input-	S4
3	Cosine differential input+	S1
4	Cosine differential input-	S3
5	Resolver excitation	R1
6	Common	ECOM
7	Reserved	-
8	Reserved	-

MF Pin	Description	Signal
9	Reserved	-
10	Resolver excitation	R2
11	Motor thermal switch (normally closed) ^{(1) (2)}	TS+
12	Reserved	-
13	Reserved	-
14	Reserved	-
15	Reserved	-

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

Common (TS-) signal for thermal switch is tied to MF-6 (ECOM) in Bulletin 2090 cables.

(2) If using 1326AB (resolver-based) motors, use 2090-K6CK-D15MF Low-profile Connector Kits that connect the filtered thermal switch (pins 16 and 17) to MF-11 and MF-6.

Kinetix 6000 drives do not support Heidenhain EnDat high-resolution feedback; however, you can use the 2090-K6CK-KENDAT feedback module to convert Heidenhain EnDat high-resolution feedback to Stegmann Hiperface. Pin numbers in the table below refer to pins in the feedback module.

IMPORTANT Only 2094-*x*C*xx*-M*xx*-S and 2094-*x*M*xx*-S drives with firmware revision 1.116 or later support the use of 2090-K6CK-KENDAT feedback modules for Heidenhain EnDat feedback.

Table 29 - Heidenhain EnDat

Pin	Description	Signal	Pin
1	Sine differential input+	SIN+	8
2	Sine differential input-	SIN-	9
3	Cosine differential input+	COS+	10
4	Cosine differential input-	COS-	11
5	Encoder power (+5V)	EPWR_5V	12
6	Common	ECOM	13
7	Serial data clock signal +	CLK+	

Pin	Description	Signal
8	Serial data clock signal -	CLK-
9	Serial data differential signal+	DATA+
10	Serial data differential signal -	DATA-
11	Motor thermal switch+ ⁽¹⁾	TS+
12	Motor thermal switch- ⁽²⁾	TS-
13	Reserved	-

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

(2) When used with Allen-Bradley motors and Bulletin 2090 cables, pin 12 is reserved.

IMPORTANT Combined motor-power cable length for all axes on the same DC bus must not exceed 240 m (787 ft) with 460V systems or 160 m (525 ft) with 230V systems. Drive-to-motor power cables must not exceed 90 m (295.5 ft).

System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

Figure 27 - Pin Orientation for 15-pin Motor Feedback (MF) Connector



Auxiliary Feedback Connector Pinout

For TTL devices, the position count increases when A leads B. For sinusoidal devices, the position count increases when cosine leads sine.

Table 30 - Stegmann Hiperface (SRS and SRM only)

AF Pin	Description	Signal
1	Sine differential input+	SIN+
2	Sine differential input-	SIN-
3	Cosine differential input+	COS+
4	Cosine differential input-	COS-
5	Hiperface data channel	DATA+
6	Common	ECOM
7	Encoder power (+9V)	EPWR_9V ⁽¹⁾
8	Reserved	-

AF Pin	Description	Signal
9	Reserved	-
10	Hiperface data channel	DATA-
11	Reserved	-
12	Reserved	-
13	Reserved	-
14	Encoder power (+5V)	EPWR_5V ⁽¹⁾
15	Reserved	-

(1) Encoder power supply uses either 5V or 9V DC based on encoder/motor used.

AF Pin	Description	Signal
1	A+ / Sine differential input+	A+/SIN+
2	A- / Sine differential input-	A-/SIN-
3	B+ / Cosine differential input+	B+/COS+
4	B- / Cosine differential input-	B- / COS-
5	Index pulse+	l+
6	Common	ECOM
7	Encoder power (+9V)	EPWR_9V ⁽¹⁾
8	Reserved	-

Table 31 - TTL or Sine/Cosine with Index Pulse

AF Pin	Description	Signal
9	Reserved	-
10	Index pulse-	-
11	Reserved	_
12	Reserved	-
13	Reserved	-
14	Encoder power (+5V)	EPWR_5V ⁽¹⁾
15	Reserved	-

(1) Encoder power supply uses either 5V or 9V DC based on encoder/motor used.

Figure 28 - Pin Orientation for 15-pin Auxiliary Feedback (AF) Connector



IAM Input Connector Pinout

Table 32 - Control Power Connector

CPD Pin	Description	Signal
1	Control nower VAC input	CTRL 2
2		CTRL 1

Table 33 - DC Bus and Input Power Connector

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

Table 34 - 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 EN+

IAM and AM Motor Power and Brake Connector Pinout

Table 35 - Motor Power Connector

MP Pin	Description	Signal
4	Chassis ground	<u> </u>
3		W
2	Three-phase motor power	V
1		U

IMPORTANTCombined motor-power cable length for all axes on the same DC bus must not
exceed 240 m (787 ft) with 460V systems or 160 m (525 ft) with 230V systems.
Drive-to-motor power cables must not exceed 90 m (295.5 ft).

System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

Table 36 - Motor Brake/Resistive Brake Connector

BC Pin	Description	Signal
6	Motor brake connections	MBRK-
5		MBRK+
4	Motor brake common	СОМ
3	+24V brake input power (from LIM module or customer supplied)	PWR
2	RBM module connections (from RBM module and safety string)	DBRK-
1		DBRK+

Control Signal Specifications

This section provides a description of the Kinetix 6000 drive I/O (IOD), communication, contactor enable (CED), brake (BC), and control power (CPD) connectors.

Digital Inputs

Two fast registration inputs and four other inputs are available for the machine interface on the IAM module and AM module. Each IAM and AM module supplies 24V DC @ 250 mA 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 DC 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 <u>GMC-RM001</u>.

IMPORTANT Over-travel limit input devices must be normally closed.

Table 37	- Understanding	Digital Inputs
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IOD Pin	Signal	Description	Capture Time	Edge/Level Sensitive
IOD-2	ENABLE	Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V DC input is applied to this terminal to enable each axis.	20 ms	Level
IOD-5	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).	20 ms	Level
IOD-14 IOD-17	REG1 REG2	Fast registration inputs are required to inform the motor interface to capture the positional information with less than 3 μ s uncertainty. Optically isolated, single-ended active high signal. Current loading is nominally 10 mA. A 24V DC input is applied to this terminal to enable each axis.	500 ns	Edge
IOD-8 IOD-11	0T+ 0T-	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).	30 ms	Level

Table 38 - Digital Input Specifications

Parameter	Description	Min	Max	
On-state voltage	Voltage applied to the input, with respect to	ENABLE, HOME, and OT+/OT-	10.8V	26.4V
	IOCOM, to guarantee an on-state.	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



Figure 29 - Enable, Home, and Overtravel Digital Input Circuits

24V DC source (range) = 21.6V - 26.4V (supplied by drive, not to exceed 250 mA total).
 Maximum current input = 10 mA.





Sercos Communication Specifications

The Rx and Tx sercos connectors are provided on the Kinetix 6000 IAM and AM module for communication with the Logix5000 controller.

Attribute	Value
Data rates	4 and 8 Mbps, selectable via DIP switch $^{(1)}$
Light intensity	Low power or high power, selectable via DIP switch
Cyclic update period	500 μs, min
Node addresses	0199 ⁽²⁾

(1) The Kinetix 6000M IDM system supports only 8 Mbps and is hardwired for this setting.

(2) Node address assignments begin with the IAM module. Node addresses for additional axes on the same power rail are assigned by incrementing from left to right (starting with the IAM module address).

Each IDM unit has it's own node address switches and can be set to any valid address. However, node addresses for the IAM and AM modules on the power rail and for IDM units must be unique.

Analog Outputs

The IAM and AM modules include two analog outputs (IOD-23 and IOD-25) that you can configure through software to represent drive variables.

Figure 31 - Analog Output Circuit



IMPORTANT Output values can vary during powerup until the specified power supply voltage is reached.

Table 39 - Analog Output Specifications

Parameter	Description	Min	Max	
Resolution	Number of states that the output signal is divided into, which is 2 ^(to the number of bits) .		-	±11 bits
Output current	Current capability of the output.	0	+2 mA	
Output signal range		2094- <i>xCxx</i> -M <i>xx</i> and 2094- <i>xMxx</i> drives	0	+5V
	Range of the output voltage.	2094- <i>xCxx</i> -Mxx-S and 2094- <i>x</i> Mxx-S drives	0	+10V
Offset error	Deviation when the output is expected to be at 0V.		-	1 mV
Bandwidth	Frequency response of the analog output		DC	7.2k Hz (3 db)

Table 40 - Linear Scaling Specifications

Drive Cat. No.	Speed rpm	Value V DC	Torque %
	10,000	5.0	1000
2094- <i>x</i> Cxx-Mxx or 2094-xMxx	0	2.5	0
	-10,000	0	-1000
	10,000	10.0	1000
2094- <i>xCxx</i> -Mxx-S or 2094- <i>x</i> Mxx-S	0	5.0	0
	-10,000	0	-1000

For configuration/set up of the analog outputs, refer to Configure Drive Parameters and System Variables beginning on <u>page 160</u>.

Contactor Enable Relay

Contactor enable is a relay-driven contact used in the protective 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 drive is operational and does not have a fault.



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 IAM Module (without LIM module) on page 190 for a wiring example.

IMPORTANT All power rail slots must have a module installed or the contactor enable relay does not close.

Figure 32 - Contactor Enable Relay Circuit



Table 41 - Contactor Enable Relay Output Specifications

Attribute	Value	Min	Max
On-state current	Current flow when the relay is closed	-	1 A
On-state resistance	Contact resistance when the relay is closed	-	1Ω
Off-state voltage	Voltage across the contacts when the relay is open	-	120V AC or 24V DC

Power and Relay Specifications

This section provides a description of the Kinetix 6000 brake relay (BC), input power (IPD), motor power (MP), and control power (CPD) connectors.

Motor/Resistive Brake Relay

Series C brake circuits use solid-state relays. Series A and B drive modules used mechanical relays. The solid-state brake driver circuit provides the following:

- Brake thermal overload protection
- Brake current overload protection
- Brake short circuit protection

Two connections are required for the (customer-supplied) motor/resistive brake input power (BC-3 and BC-4) and two connections each for the motor and resistive brake output, as shown in Figure 33. Wiring is consistent with all series releases. Connections are rated for +24V and current as shown in Table 42.

An active signal releases the motor brake (BC-5 and BC-6). The brake signal turn-on and turn-off delays are specified by the brake active delay and brake inactive delay (configurable in the Logix Designer application). Refer to the Axis Module/Rotary Motor Wiring Examples beginning on <u>page 196</u> and the Controlling a Brake Example on <u>page 211</u> for wiring examples.

The resistive brake relay (BC-1 and BC-2) controls the resistive brake module (RBM) contactor. The RBM module is wired between the drive and motor by using an internal contactor to switch the motor between the drive and a resistive load. The RBM module contact delay is the time it takes to fully close the contactor across the motor power input lines, and must be configured in the software. Refer to RBM Module Interconnect Diagrams beginning on page 265 for wiring examples.





Attributo	Description	IAM/AM Modulo	Brake Current Value, max			
Attribute	Description		Series A	Series B	Series C	
On-state current ⁽¹⁾		2094-AC05-Mxx,-x 2094-AC09-M02-x, 2094-AMP5-x, 2094-AM01-x, 2094-AM02-x	104	N/A	-	
	Current flow when the relay is closed	2094-BC01-Mxx-x, 2094-BC02-M02-x, 2094-BMP5-x, 2094-BM01-x, 2094-BM02-x	1.0 A	3.0 A		
		2094-AC16-M03- <i>x</i> , 2094-AC32-M05- <i>x</i> , 2094-AM03- <i>x</i> , 2094-AM05- <i>x</i>	1.3 A	N/A	5.0 A	
		2094-BC04-M03-x, 2094-BC07-M05-x, 2094-BM03-x, 2094-BM05-x	3.0 A 3.0 A			
On-state resistance	Contact resistance when the relay is closed		1Ω			
Off-state voltage	Voltage across the contacts when the relay is open		30V			

Table 42 - Brake Relay Output Specifications

(1) For motors requiring more than the maximum current specified, a relay must be added.

Input Power Cycle Capability

The power cycle capability is inversely proportional to the system capacitance (including DC bus follower), but cannot exceed 2 contactor cycles per minute with up to 4 axes or 1 contactor cycle per minute with 5...8 axes.

The cycle capability also depends on the converter power rating and the total system capacitance. Refer to Appendix C on <u>page 225</u> to calculate total system capacitance.

Table 43 - Maximum Input Power Cycling Specifications (230V)

Attribute	2094-AC05-MP5-S	2094-AC05-M01-S	2094-AC09-M02-S	2094-AC16-M03-S	2094-AC32-M05-S
Main AC input power cycling (cycles per minute for 10,000 µf)	0.69		4.30		

Table 44 - Maximum Input Power Cycling Specifications (460V)

Attribute	2094-BC01-MP5-S	2094-BC01-M01-S	2094-BC02-M02-S	2094-BC04-M03-S	2094-BC07-M05-S
Main AC input power cycling (cycles per minute for 10,000 μf)	0.12		0.52	2.15	4.30

For example, in a 4 axis system with a 2094-BC02-M02-S IAM module and 2,000 μ F total capacitance, the calculated capability is 0.52 x 10,000/2000 = 2.6 cycles per minute. However, this value is reduced to 2.0 by the 4 axes per system limitation.
Peak Enhancement Specifications

Drives that support the Peak-enhanced mode have the capability of increasing the maximum inverter peak current to achieve greater overload performance.

IMPORTANT The peak enhancement feature requires the use of RSLogix 5000 software or the Logix Designer application, and drive firmware as specified in <u>Table 45</u>.

Table 45 - Peak Enhancement Software and Firmware Requirements

IAM Module Cat. No.	AM Module Cat. No.	RSLogix 5000 Software Version	Kinetix 6000 Drive Firmware Revision
2094-BC01-MP5-S	2094-BMP5-S	16 or later	1.111 or later
2094-BC01-M01-S	2094-BM01-S	16 or later	1.111 or later
2094-BC02-M02-S	2094-BM02-S	16 or later	1.111 or later
2094-BC04-M03-S	2094-BM03-S	17 or later	1.117 or later
2094-BC07-M05-S	2094-BM05-S	17 or later	1.117 or later

Table 46	- Kinetix 6000	Inverter Peak	Overload Support
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Kinetix 6000 Drives Cat. No.	Module	Safe Torque- off Drive	Series A	Series B and C		
2094-BC <i>xx</i> -M <i>xx</i>	IAM	Non Safe	Standard	N/A		
2094-BM <i>xx</i>	AM	Torque-off	Standard			
2094-BC <i>xx</i> -M <i>xx</i> -S	IAM	Safe	Standard	Standard or		
2094-BM <i>xx</i> -S	AM	Torque-off	Stanuaru	Peak Enhanced ⁽¹⁾		

 Standard mode is enabled by default to preserve backward compatibility, but you can enable the Peak-enhanced mode to achieve increased peak current performance.

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IAM/AM Module	Peak Inverte	r Current Rating	Peak Converter Current Rating		
Cat. No.	Standard	Peak Enhanced	Series A	Series B and C	
2094-BC01-MP5-S	150%	250%	200%	250%	
2094-BC01-M01-S	150%	250%	200%	250%	
2094-BC02-M02-S	150%	250%	200%	250%	
2094-BC04-M03-S	150%	250%	200%	250%	
2094-BC07-M05-S	150%	200%	200%	300%	
2094-BMP5-S	150%	250%	N/A	N/A	
2094-BM01-S	150%	250%	N/A	N/A	
2094-BM02-S	150%	250%	N/A	N/A	
2094-BM03-S	150%	250%	N/A	N/A	
2094-BM05-S	150%	200%	N/A	N/A	

Figure 34 - Load Duty-cycle Profile Example



Table 48 - Peak Duty Cycle Definition of Terms

Term	Definition ⁽¹⁾
Continuous Current Rating (I _{Cont})	The maximum value of current that can be output continuously.
Peak Current Rating (I _{PKmax})	The maximum value of peak current that the drive can output. This rating is valid only for overload times less than $T_{\rm PKmax}.$
Duty Cycle (D)	The ratio of time at peak to the Application Period and is defined as: $D = \frac{T_{PK}}{T} \times 100\%$
Time at Peak (T _{PK})	The time at peak current (I_{PK}) for a given loading profile. Must be less than or equal to $T_{PKmax}.$
Peak Current (I _{PK})	The level of peak current for a given loading profile. I_{PK} must be less than or equal to the Peak Current Rating (T_{PKMAX}) of the drive.
Base Current (I _{Base})	The level of current between the pulses of peak current for a given loading profile. ${\sf I}_{\sf Base}$ must be less than or equal to the continuous current rating (${\sf I}_{\sf Cont}$) of the drive.
Loading Profile	The loading profile is comprised of I _{PK} , I _{Base} , T _{PK} , and D (or T) values and completely specify the operation of the drive in an overload situation. These values are collectively defined as the Loading Profile of the drive.
Application Period (T)	The sum of the times at I_{PK} (T_{PK}) and I_{Base} .

(1) All current values are specified as RMS.



Figure 35 - Peak Inverter Overload (T_{PK} < 2.0 s)

% Base Current (I_{Base}/I_{Cont})

(1) Base current (I_{Base}) and peak current (I_{PK}) are a percentage of the continuous drive current rating (I_{Cont}).



Figure 36 - Peak Inverter Overload (T_{PK} < 2.0 s)

(1) Base current (I_{Base}) and peak current (I_{PK}) are a percentage of the continuous drive current rating (I_{Cont}).

Control Power

The IAM module requires AC input power for logic circuitry.

IMPORTANT	The control power input requires an AC (EMC) line filter for CE certification. For wiring examples, refer to the Power Wiring Examples on <u>page 187</u> .
IMPORTANT	Control power isolation, via a step-down transformer, is required for all 460V applications. Source the 2094-ACxx-Mxx-x (230V) IAM module control power from the three-phase input power (line-to-line). Supplying control power from any other source requires an isolation transformer. Do not ground the transformer secondary to avoid ground fault conflicts with IAM module. The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder.

Table 49 - Control Power Input Power Specifications

Attribute	Value
Input voltage	95264V AC rms, single-phase
Input power frequency	4763 Hz
Control power AC input current Nom @ 220/230V AC rms Nom @ 110/115V AC rms Max inrush (0-pk)	6 A 6 A 98 A ⁽¹⁾

(1) For eight axis systems with 230V AC control input voltage and 50 °C (122°F) ambient temperature the maximum inrush duration is less than 1/2 line cycle. Use this equation to calculate maximum inrush current for systems with different axis count and control input voltage.

 $I_{PK} = 0.043 \text{ x} (V_{IN}) + 6.72 \text{ x} (\# \text{ of axes}) + 0.000333 \text{ x} (V_{IN}^2) - 0.816 \text{ x} (\# \text{ of axes})^2 + 0.0358 \text{ x} (\# \text{ of axes x} V_{IN})$

Ta	blo	e 5	0	- (on	trol	P	ower	Cur	rent	R	leq	lui	re	m	en	t	5
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	110/115\	/ AC Input	220/230V AC Input			
Modules on Power Rail	Input CurrentInput VAAVA		Input Current A	Input VA VA		
IAM module only	0.56	67	0.36	85		
IAM and 1 AM module	0.99	119	0.64	153		
IAM and 2 AM module	1.43	172	0.92	220		
IAM and 3 AM module	1.87	224	1.20	287		
IAM and 4 AM module	2.31	277	1.48	354		
IAM and 5 AM module	2.74	329	1.75	421		
IAM and 6 AM module	3.18	382	2.03	488		
IAM and 7 AM module	3.62	434	2.31	555		
IDM power interface module (IPIM)	For specifications and an example for calculating the IPIM module current requirements, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.					

For Kinetix 6000M systems, calculate the sum of the control power current requirements for each IPIM module on the power rail and add that value with the appropriate value from <u>Table 50</u> for the number of axes on the power rail.

Feedback Specifications

The IAM and AM modules can accept motor and auxiliary feedback signals from these types of encoders:

- Stegmann Hiperface
- TTL or Sine/Cosine with index pulse and Hall commutation
- Resolver Transmitter TR = 0.25 (motor feedback only)

Motor feedback from Heidenhain EnDat high-resolution encoders is also accepted, but only when using drive firmware revision 1.116 and the 2090-K6CK-KENDAT low-profile feedback module for EnDat to Hiperface conversion.

Absolute Position Feature

The drive's absolute position feature tracks the position of the motor, within the multi-turn retention limits, while the drive is powered off. The absolute position feature is available with only these multi-turn encoders.

Table 51 - Absolute Position Designator Examples

Encoder Type	Motor Cat. No. Designator	Motor Cat. No. Example
Steamann Hinerface	-M	MPL-B310P-M
Stegmann inpenace	-V	MPL-B230P-V
Heidenhain EnDat	-7	RDB-B21519-7

Figure 37 - Absolute Position Retention Limit



Motor Feedback Specifications

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

Figure 38 - AM, BM, and IM Motor Encoder Input Circuits



Table 52 - Motor Encoder Feedback Specifications

Attribute	Value
Encoder types	Incremental, A quad B, sine/cosine, intelligent, resolver, and absolute
Maximum input froquoncy	500 kHz (TTL input) per channel
Maximum input nequency	250 kHz (sine/cosine input)
Commutation feedback	Hall sensor

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
DC current draw	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, because the circuitry counts all four transitions.	-	500 kHz
IM pulse width	Pulse width of the index input signal. Because the index is active for a percentage of a revolution, the speed determines 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°

Tabl	e 53	- AM,	BM,	and I	M In	put S	pecific	ations	for TTL	. Encod	ers
------	------	-------	-----	-------	------	-------	---------	--------	---------	---------	-----

Table 54 - 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.	0.8V (p-p)	1.2V (p-p)

Table 55 - Specifications for Heidenhain EnDat Encoders

Command Set	Order Designation	Description
EnDat 2.2	EnDat 01	1V p-p Sin/Cos, <2 MHz clock frequency

Feedback Power Supply Specifications

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.

Supply	Poforonco	Voltage			Current mA	
Suppry	helefence	Min	Nominal	Max	Min	Max
+5V DC	EPWR_5V	4.9	5.25	5.4	0	400
+9V DC	EPWR_9V	8.3	9.1	9.9	0	275

Auxiliary Position Feedback Encoders

Allen-Bradley Bulletin 842HR, 844D, 845H, and 845T encoders are the preferred encoders for auxiliary feedback connections.

Cat. No.	Description	
842HR-MJDZ115FWYD (multi-turn) 842HR-SJDZ115FWYD (single-turn)	Size 25, sine/cosine, square flange, 3/8 in. shaft, 5V or 9V DC, digital RS-485 interface, M23 17-pin connector	
844D-B5CC1FW		
844D-B5CC1CS	Size 20, incremental, square flange, 3/8 in. shaft, 5V DC, 5V DLD output. radial connector	
844D-B5CC1DR		
845H-SJDN14FWY2	Size 25, incremental, square flange, 3/8 in. shaft, 5V DC, 5V DLD output. radial connector	
845H-SJDN14CSY2		
845H-SJDN14DRY2		
845T-DN13EFW	HS35, hollow shaft incremental, 5/8 in. shaft, tether 3/8 in. bolt on,	
845T-DN13ECS	5V DC, 5V DLD output, 10 pin connector	

Refer to the Kinetix Motion Accessories Technical Data, publication <u>GMC-TD004</u>, for more information on these Allen-Bradley encoders.

Connecting the Kinetix 6000 Drive System

This chapter provides procedures for wiring your Kinetix 6000 system components and making cable connections.

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Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 6000 drive modules.



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 the Bulletin 2094 power rail and drive modules prior to applying power. Once power is applied, connector terminals can 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.
	Building your own cables is not an option for the hybrid and network cables used in Kinetix 6000M integrated drive-motor systems.

Follow these guidelines when building cables for compatible motors and actuators:

- Connect the cable shield to the connector shells on both ends of the cable with a complete 360° connection.
- Use 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 Accessories Technical Data, publication <u>GMC-TD004</u>, for low-profile connector kit, drive-end (mating) connector kit, and motor-end connector kit catalog numbers.

Routing the Power and Signal Cables

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 communication, or other sensitive low voltage signals. This can cause system faults and communication anomalies.

Refer to Electrical Noise Reduction on <u>page 34</u> for examples of routing high and low voltage cables in wireways. Refer to the System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>, for more information.

Determine the Input Power Configuration

Before wiring input power to your Kinetix 6000 system, you must determine the type of input power you are connecting to. The IAM module is designed to operate in both grounded and ungrounded environments.

ATTENTION: When using a LIM module with your IAM module, the VAC LINE input power must come from a grounded configuration (refer to Figure 39). When not using a LIM module with your IAM module, ungrounded configurations are permitted, but you must set the jumper to the ungrounded position for proper drive operation. Refer to Setting the Ground Jumper in Ungrounded Power Configurations on page 87 for more information.

Grounded 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.





Refer to <u>Power Wiring Examples</u> beginning on <u>page 187</u> for input power interconnect diagrams with and without the LIM module.



Figure 40 - Grounded (B-Phase) Power Configuration (Delta Secondary)

The IAM module 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 module.

Refer to Appendix A on <u>page 187</u>, for input-power interconnect diagrams with and without the LIM module.

Ungrounded and High-impedance Grounded Power Configurations

Ungrounded and high-impedance grounded power configurations are allowed, but you must jumper across a 120 k Ω resistor (internal to the IAM module). The ungrounded power configuration (shown below) does not provide a neutral ground point. The IAM module has a ground jumper set for grounded power distribution (default configuration).

IMPORTANT	If you determine that you have ungrounded or high-impedance grounded power distribution in your facility, you need to move the default jumper (configured for grounded power) to the ungrounded power position inside the IAM module.
	Refer to Setting the Ground Jumper in Ungrounded Power Configurations on page <u>87</u> for more information.

Figure 41 - Ungrounded Power Configuration





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

Refer to Appendix A on <u>page 187</u>, for input-power interconnect diagrams with and without the LIM module.

DC Common Bus Configurations

When the IAM module is used in a DC common-bus configuration, the IAM module is known as a leader IAM or follower IAM module. The IAM (noncommon bus) and leader IAM module have identical three-phase input power connections. The leader IAM module 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 IAM modules do not have three-phase input power connections, but have DC bus connections from a leader IAM module.

This Module	ls 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 module.	Wired in Common-bus mode.
Follower IAM	Without three-phase input power, but has DC common-bus connections from a leader IAM module.	Wired in Common-bus mode and configured by using the Logix Designer application.

Table 56 - IAM Module Terminology and Use

IMPORTANT Use Kinetix 6000 drive firmware revision 1.85 and the Logix Designer Application or RSLogix 5000 software, version 15 or later, for common-bus power configurations.

The Kinetix 6000 leader IAM module can operate with non-Kinetix 6000 follower drives, as can the Kinetix 6000 follower IAM module operate with non-Kinetix 6000 common-bus leader drives. However, non-Kinetix 6000 leader and follower drives must meet the same functional requirements as the Kinetix 6000 leader and follower IAM modules.

IMPORTANT Any non-Kinetix 6000 common-bus leader IAM module that does not provide pre-charge is required to add an additional external pre-charge circuit before connecting to any Kinetix 6000 common-bus follower IAM module.



Figure 42 - Typical DC Common-bus Configuration

Common Bus Fusing Requirements

When using a Kinetix 6000 leader IAM module, DC-bus fuses are required only when wiring to more than one Kinetix 6000 follower IAM module. When wiring multiple follower IAM modules, terminal blocks are required to extend the DC common-bus power to additional drives. Install fuses in both lines of the DC bus between the DC bus terminal block and each follower IAM module. Base these fuse ratings on the DC input current of each follower IAM module.
When using a non-Kinetix 6000 common-bus leader drive, DC bus fuses are required in both lines of the DC bus, between the common-bus leader drive and follower IAM module. Base these fuse ratings on the common-bus leader drive DC output current. When using more than one follower IAM module, install fuses in both lines of the DC bus between the non-Kinetix 6000 common-bus leader and the terminal block as well as between the DC bus terminal block and each follower IAM module.
Refer to Circuit Breaker/Fuse Options on <u>page 28</u> , for recommended circuit breaker/fuse sizes. Refer to DC Common Bus Wiring Examples on <u>page 191</u> for interconnect diagrams.

Setting the Ground Jumper in Ungrounded Power Configurations Setting the ground jumper is necessary only when using an ungrounded or highimpedance grounded power configuration. Setting the jumper involves removing the IAM module from the power rail, opening the IAM module, and moving the jumper.

IMPORTANT If you have grounded power distribution, you do not need to set the ground jumper. Go to Grounding the Kinetix 6000 Drive System on page 93.

Setting the ground jumper is best done when the IAM module 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 damage to equipment, remove the IAM module from the power rail before setting the ground jumper.

By setting the ground jumper for ungrounded power configurations, you no longer maintain line-to-neutral voltage protection.

To remove the IAM module from the power rail, refer to Remove Kinetix 6000 Drive Modules on page 180.



ATTENTION: This drive contains electrostatic discharge (ESD) 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 Guarding Against Electrostatic Damage, publication <u>8000-4.5.2</u>, or any other applicable ESD awareness handbook.

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

Table 57 - Ground Jumper to Set

Leader Drive	Follower Drive	Set the Jumper in This Drive
Kinetix 6000 IAM module	Kinetix 6000 IAM module	Leader drive
Kinetix 6000 IAM module	Non-Kinetix 6000 drive	Leader drive
Non-Kinetix 6000 drive	Kinetix 6000 IAM module	Follower drive (if no setting exists in the leader drive)

Set the Ground Jumper

Follow these steps to set the ground jumper for ungrounded power.

1. Remove the top and bottom front-panel screws.

Refer to the figures beginning on <u>page 90</u> (230V IAM module) or <u>page 91</u> (460V IAM module) for an illustration of your actual hardware.

2. Swing the front panel open to the right, as shown, and locate the ground jumper.

IMPORTANT	Do not attempt to remove the front panel from the IAM module. The
	front panel status indicators and switches are also connected to the
	IAM module with a ribbon cable. The ribbon cable acts like a hinge and
	lets you swing the front panel open to access the ground jumper.

3. Move the ground jumper.

IAM Modulo (corios A)	Configuration		
IAM MOUULE (SELIES A)	Grounded (default)	Ungrounded	
2094-AC <i>xx</i> -M <i>xx-x</i> (230V) ⁽¹⁾	P15 and P16	P15 and P17	
2094-BC01-MP5- <i>x</i> (460V)			
2094-BC01-M01-x (460V)	P13 and P14	P13 and P12	
2094-BC02-M02-x (460V)			
2094-BC04-M03-x (460V)	D14 and D12	P14 and P12	
2094-BC07-M05-x (460V)		r 14 aliu r 12	

(1) Applies to series A and C (230V) drives.

IAM Modulo (corios P and C)	Configuration			
TAM MOULIE (SETIES D'allu C)	Grounded (default)	Ungrounded		
2094-BC01-MP5-S (460V)				
2094-BC01-M01-S (460V)				
2094-BC02-M02-S (460V)	P16 and P17	P18 and P19		
2094-BC04-M03-S (460V)				
2094-BC07-M05-S (460V)				

- Replace the IAM module front panel and two screws. Apply 1.6 N•m (14 lb•in) torque.
- 5. Mount the IAM module back on the power rail.

Refer to Replace Kinetix 6000 Drive Modules on page 181.



Figure 43 - Setting the Ground Jumper (230V Series A and C IAM modules)



Figure 44 - Setting the Ground Jumper (460V Series A IAM modules)



Figure 45 - Setting the Ground Jumper (460V Series B and C IAM modules)

Grounding the Kinetix 6000 Drive System

All equipment and components of a machine or process system must 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 24.

Ground the Power Rail to the System Subpanel

The 2094-PR*x* and 2094-PRS*x* power rail ships with a braided ground strap, 100 mm (3.9 in.), that connects to the bonded cabinet ground bus. Connect the other end to either the power rail ground stud or mounting bracket ground stud, if mounting brackets are used.



Figure 46 - Connecting the Braided Ground Strap Examples

For power rail dimensions, refer to the Kinetix 6000 Power Rail Installation Instructions, publication <u>2094-IN003</u>.

For mounting bracket dimensions, refer to the 2094 Mounting Brackets Installation Instructions, publication <u>2094-IN008</u>.

IMPORTANT When 2094 mounting brackets are used to mount the power rail or LIM module over the AC line filter, the braided ground strap must be removed from the power rail and attached to a mounting bracket ground stud.

Ground Multiple Subpanels

In this figure, the chassis ground is extended to multiple subpanels.

Figure 47 - Subpanels Connected to a Single Ground Point



High-frequency (HF) bonding is not illustrated. For HF bonding information, refer to Bonding Multiple Subpanels on page <u>36</u>.

Power Wiring Requirements

Wire must 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.

For IPIM module power wiring requirements, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

Refer to Power Wiring Examples on page 187 for interconnect diagrams.

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

Kinetix 6000 Drive	Description	Connects to Terminals		Recommended	Strip Length	Torque Value
Cat. No.	Description	Pin	Signal	mm ² (AWG)	mm (in.)	N•m (lb•in)
2094-AC05-M <i>xx-x</i>		IPD-1	DC-	62.5 (1014)	10	0.50.6
2094-AC09-M02- <i>x</i>	DC bus ⁽¹⁾ and	IPD-2 IPD-3		64 (1012)	(0.38)	(4.45.3)
2094-AC16-M03- <i>x</i>	VAC input power	IPD-5 IPD-6	L2 L1	3010 (38)	16	2.43.0 (21.626.5)
2094-AC32-M05- <i>x</i>				30 (3)	(0.03)	
2094-BC01-M <i>xx-x</i> 2094-BC02-M02- <i>x</i>	- DC bus ⁽¹⁾ and VAC input power	IPD-1 IPD-2	1 DC- 2 DC+	102.5 (814)	10 (0.38)	1.21.5 (10.613.2)
2094-BC04-M03- <i>x</i>		IPD-3 IPD-4 IPD-5	$\begin{array}{c} \underline{-}\\ \underline{L3}\\ \underline{L2}\end{array}$	106 (810)	16	2.43.0 (21.626.5)
2094-BC07-M05- <i>x</i>		IPD-6	L1	30 (3)	(0.05)	
2004 2022 Мис. 2	Controllinguite annua	CPD-1	CTRL 2	42.5		0.50.6
	control input power	CPD-2	CTRL 1	(1214)	10	(4.45.3)
2027-2027-19122-2	Contactor Enable	CED-1	CONT EN-	42.5	(0.38)	0.50.6
	Contactor Enable	CED-2	CONT EN+	(1214) ⁽²⁾		(4.45.3)

Table 58 - IAM Power Wiring Requirements

(1) Keep DC common-bus connections (leader IAM to follower IAM module) 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.

ATTENTION: 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.

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

Kinetix 6000 Drive		Connect	s to Terminals	Recommended	Strip Length	Torque Value	
Cat. No.	Description	Pin	Signal	mm ² (AWG)	mm (in.)	N•m (lb•in)	
2094-AC05-Mxx-x, 2094-AC09-M02-x, 2094-BC01-Mxx-x, 2094-BC02-M02-x, 2094-AMP5-x, 2094-AM01-x, 2094-AM02-x, 2094-BMP5-x, 2094-BM01-x, 2094-BM02-x		MP-4 MP-3	<u> </u>	Motor power cable depends on motor/ drive combination. 61.5 (1016)	10 (0.38)	0.50.6 (4.45.3)	
2094-AC16-M03- <i>x,</i> 2094-AC32-M05- <i>x,</i> 2094-BC04-M03- <i>x,</i> 2094-AM03- <i>x,</i> 2094-AM05- <i>x,</i> 2094-BM03- <i>x</i>	MP-2 MP-1	MP-2 MP-1	P-2 V P-1 U	101.5 (816)	10 (0.38)	1.21.5 (10.613.2)	
2094-BC07-M05- <i>x,</i> 2094-BM05- <i>x</i>				302.5 (314)	16 (0.63)	2.43.0 (21.626.5)	
IAM or AM (230 or 460V) 2094- <i>xCxx-Mxx-x</i> and 2094- <i>xMxx-x</i>	Brake power	BC-6 BC-5 BC-4 BC-3 BC-2 BC-1	MBRK- MBRK+ COM PWR DBRK- DBRK+	0.75 (18)	10 (0.38)	0.220.25 (1.92.2)	
IAM or AM (230 or 460V) 2094- <i>x</i> Cxx-Mxx-S and 2094- <i>x</i> Mxx-S	Safe torque-off	ST0-1 ST0-2 ST0-3 ST0-4 ST0-5 ST0-6 ST0-7 ST0-8 ST0-9	FDBK2+ FDBK2- FDBK1+ FDBK1- SAFETY ENABLE2+ SAFETY ENABLE- SAFETY ENABLE1+ 24V + 24V_COM	0.75 (18) (stranded wire with ferrule) 1.5 (16) (solid wire)	7.0 (0.275)	0.235 (2.0)	

Table 59 - IAM/AM Power Wiring Requirements

Table 60 - Shunt Module Power Wiring Requirements

	D	Connects t	o Terminals	Recommended Wire Size mm ² (AWG)	Torque Value N∙m (Ib∙in)
Drive Module Cat. No.	Description	Pin	Signal		
2094-BSP2 Shunt module (200/400V-class)	1394-SRxxxx External passive shunt module Thermal switch	RC-1	DC+	10 (8) ⁽¹⁾	1.21.5 (10.613.2)
		RC-2	INT		
		RC-3	COL		
		TS-1	TS1	0.75 (18) 0. (1	0.220.25
		TS-2	TS2		(1.92.2)

(1) 105 °C (221 °F), 600V.

Power Wiring Guidelines

Use these guidelines as a reference when wiring the power connectors on your IAM and AM drive modules.

For IPIM module power wiring guidelines, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

IMPORTANT	For connector locations of the Kinetix 6000 drive modules, refer to 2094 IAM/ AM Module Connector Data on <u>page 58</u> .
	When tightening screws to secure the wires, refer to the tables beginning on page <u>95</u> for torque values.
	When removing insulation from wires, refer to the tables beginning on <u>page 95</u> for strip lengths.
IMPORTANT	To improve system performance, run wires and cables in the wireways as

Follow these steps when wiring the connectors on your IAM and AM drive

established in Establishing Noise Zones on page 37.

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 IAM and AM drive modules.
- 3. Insert wires into connector plugs.

modules.

Refer to connector pinout tables in <u>Chapter 4</u> or the interconnect diagrams in <u>Appendix A</u>.

- 4. Tighten the connector screws.
- 5. Gently pull on each wire to make 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 IAM/AM Module Connectors

This section provides examples and wiring tables to assist you in making connections to the IAM and AM modules.

Wire the Control Power (CPD) Connector

This example applies to any IAM, leader IAM, or follower IAM module.

Figure 48 - IAM Module (CPD connector)



Table 61 - Control Power (CPD) Connector

CPL Connector (LIM module) or Other Single-phase Input			CPD Connector		De commende d					
2094-ALxxS, 2094-BLxxS, or 2094-XL75S-Cx LIM Module		2094-AL09 and LIM Module	2094-BL02	(IAM module)		(IAM module)		Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N∙m (lb∙in)
CPL Pin	Signal	CPL Pin	Signal	CPD Pin	Signal					
1	CTRL 1	2	L1	1	CTRL 2	25(14)	10 (0.28)	0.50.6		
2	CTRL 2	1	L2/N	2	CTRL 1	2.3 (14)	(06.0)	(4.45.3)		

Wire the Input Power (IPD) Connector

This example applies to any IAM module or common-bus leader IAM module.



ATTENTION: Make sure the input power connections are correct when wiring the IPD connector plug and that the plug is fully engaged in the module connector. Incorrect wiring/polarity or loose wiring can cause explosion or damage to equipment.

Figure 49 - IAM Module (IPD connector)



Table 62 - Input Power (IPD) Connections

OPL Conne	ector (LIM module)		mastar		
2094 LIM N	2094-AL09 2094-ALxxS, 2094 LIM Module 2094-XL7SS-Cx L1		094-BL <i>xx</i> S, or x LIM Modules	(IAM or leader	r IAM module)
OPL Pin	Signal	OPL Pin	Signal	IPD Pin	Signal
1	L1′	4	L1′	6	L1
2	L2′	3	L2′	5	L2
3	L3′	2	L3′	4	L3
4	Ŧ	1	<u> </u>	3	<u> </u>
N/A				2	DC+
N/A			1	DC-	

Table 63 - Termination Specifications

IAM Module Cat. No.	Input VAC	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N∙m (Ib∙in)
2094-AC05-M <i>xx-x</i>		2.5 (14)	10 (0 38)	0.50.6
2094-AC09-M02- <i>x</i>	2201/ 10	4.0 (12)	10 (0.30)	(4.45.3)
2094-AC16-M03 <i>-x</i>	230V AC	10 (8)	16 (0.63)	2.43.0
2094-AC32-M05-x		30 (3)	10 (0.03)	(21.626.5)
2094-BC01-M <i>xx-x</i> 2094-BC02-M02- <i>x</i>		2.5 (14)	10 (0.38)	1.21.5 (10.613.2)
2094-BC04-M03-x	460V AC	6 (10)	16 (0.63)	2.43.0
2094-BC07-M05-x		30 (3)		(21.626.5)

This example applies to a common-bus follower IAM module.



ATTENTION: Make sure the common-bus power connections are correct when wiring the IPD connector plug and that the plug is fully engaged in the module connector. Incorrect wiring/polarity or loose wiring can cause explosion or damage to equipment.

Figure 50 - IAM Module (IPD connector)



Table 64 - Input Power (IPD) Connections

IPD Connector (IAM or follower IAM module)				
IPD Pin	Signal			
6	N.C.			
5	N.C.			
4	N.C.			
3	Ť			
2	DC+			
1	DC-			

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

Table 65 - Termination Specifications

IAM Module Cat. No.	Input VAC	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N∙m (Ib∙in)
2094-AC05-M <i>xx-x</i>		2.5 (14)	10 (0.38)	0.50.6 (4.45.3)
2094-AC09-M02- <i>x</i>	230V AC	4.0 (12)		
2094-AC16-M03-x		10 (8)	16 (0.63)	2.43.0 (21.626.5)
2094-AC32-M05- <i>x</i>		30 (3)		
2094-BC01-M <i>xx-x</i> 2094-BC02-M02- <i>x</i>	460V AC	2.5 (14)	10 (0.38)	1.21.5 (10.613.2)
2094-BC04-M03 <i>-x</i>		6 (10)	16 (0.62)	2.43.0 (21.626.5)
2094-BC07-M05- <i>x</i>		30 (3)	10 (0.03)	

Wire the Contactor Enable (CED) Connector

This example applies to any IAM, common-bus leader IAM, or common-bus follower IAM module.

Figure 51 - IAM Module (CED 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 <u>page 70</u>.

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

For interconnect diagrams, refer to Interconnect Diagram Notes beginning on page 186.

LIM Module I/O (IOL) Connector or Other Control String				Recommended	Strip Length mm (in.)	Torque Value N∙m (Ib∙in)
2094-AL <i>xx</i> S, 2094-BL <i>xx</i> S, or 2094-XL75S-Cx LIM Modules	2094-AL09 and 2094-BL02 LIM Modules	4-AL09 and 2094-BL02 I Modules		Wire Size mm ² (AWG)		
I0_COM1	10_COM	1	CONT EN-	2 5 (14) (1)	10 (0 38)	0.50.6
COIL_E2	COIL_A2	2	CONT EN+	2.5 (17)	10 (0.50)	(4.45.3)

Table 66 - Contactor Enable (CED) Connector

(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 Safe Torque-off (STO) Connector

This example applies to any IAM or AM module equipped with the torque-off (STO) connector.

Figure 52 - IAM/AM Module (STO connector)



Each IAM and AM module ships with the (9-pin) wiring-plug header and motion-allowed jumper installed in the safe torque-off connector. With the motion-allowed jumper installed, the safe torque-off feature is not used.

Pinouts for the torque-off (STO) connector are shown on page 60.

IMPORTANT	Pins STO-8 and STO-9 (24V+) are used by only the motion-allowed jumper.
	When wiring to the wiring-plug header, the 24V supply must come from an
	external source.

Table 67 - Safe Torque-off (STO) Connector

STO Pin	Signal	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N∙m (Ib∙in)
1	FDBK2+			
2	FDBK2-			
3	FDBK1+	0.75 (18)		
4	FDBK1-	(stranded wire with		
5	SAFETY ENABLE2+	lerrule)	7.0 (0.275)	0.235 (2.0)
6	SAFETY ENABLE-	1.5 (16)		
7	SAFETY ENABLE1+	(solid wire)		
8	24V +			
9	24V_COM			

To wire the safe torque-off connector in single axis or multi-axis configurations, refer to the Kinetix Safe Torque-off Feature Safety Reference Manual, publication <u>GMC-RM002</u>.

Wire the Motor Power (MP) Connector

Connections to the motor power (MP) connector include rotary motors, linear motors, and motor driven actuators.



ATTENTION: Make sure the motor power connections are correct when wiring the MP connector plug and that the plug is fully engaged in the module connector. Incorrect wiring/polarity or loose wiring can cause explosion or damage to equipment.

This example applies to AM modules and the inverter section of IAM modules.





Cable Shield Terminations

Factory-supplied Bulletin 2090 motor power cables for motors and acutators are shielded, and the braided cable shield must terminate at the drive during installation. A small portion of the cable jacket must be removed to expose the shield braid. The exposed area must be clamped (with the clamp provided) on top of the IAM or AM modules and the power wires terminated in the motor power (MP) connector plug.



SHOCK HAZARD: To avoid hazard of electrical shock, make sure shielded power cables are grounded at a minimum of one point for safety.

IMPORTANT	For TL-Series motors, also connect the 152 mm (6.0 in.) termination wire to the closest earth ground.
	Refer to Pigtail Terminations on page 104 for more information.

Pigtail Terminations

TL-Series motors have a short pigtail cable that connects to the motor, but is not shielded. The preferred method for grounding the TL-Series 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. Use this method in addition to the cable clamp. The termination wire can 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.

Figure 54 - Pigtail Terminations



 Remove paint from machine frame to be sure of proper HF-bond between machine frame and motor case, shield clamp, and ground stud.

MP-Series (Bulletin MPL) Motor Connectors

Bulletin MPL motors equipped with circular DIN connectors (specified by 4 or 7 in the catalog number) are not compatible with cables designed for motors equipped with bayonet connectors (specified by 2 in the catalog number). The motors with bayonet connectors are being discontinued.

Motor Cat. No. /SpeedTec DIN Connectors	Motor Cat. No. /Threaded DIN Connectors	Motor Cat. No. /Bayonet Connectors
MPL-A/B15 <i>xxx-xx7x</i> AA MPL-A/B2 <i>xxx-xx7x</i> AA	MPL-A/B15 <i>xxx-xx</i> 4xAA MPL-A/B2 <i>xxx-xx</i> 4xAA	N/A
MPL-A/B3xxx-xx7xAA, MPL-A/B4xxx-xx7xAA, MPL-A/B45xxx-xx7xAA, MPL-A/B5xxx-xx7xAA	N/A	MPL-A/B3xxx-xx2xAA, MPL-A/B4xxx-xx2xAA, MPL-A/B45xxx-xx2xAA, MPL-A/B5xxx-xx2xAA
MPL-B6xxx-xx7xAA, MPL-B8xxx-xx7xAA, MPL-B9xxx-xx7xAA	N/A	MPL-B6 <i>xxx-xx</i> 2xAA, MPL-B8 <i>xxx-xx</i> 2xAA, MPL-B9 <i>xxx-xx</i> 2xAA

Bayonet connectors can be mounted facing the motor shaft or end plate and provide a separate connector for power, feedback, and brake connections. Circular DIN connectors rotate up to 180° and combine power and brake wires in the same connector, eliminating the brake connector.

Power and Brake

Motor Connector

Figure 55 - Bayonet and Circular DIN Motor Connectors



Feedback / Power / Brake Motor Connectors



Feedback / Power Motor Connectors **Circular DIN Connectors**



Feedback Motor Connector

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Motor Power Wiring Examples

The procedure for wiring motor power varies slightly, depending on the motor family. The cables compatible with your motor or actuator depend on the connectors installed on the motor or actuator. Refer to MP-Series (Bulletin MPL) Motor Connectors on <u>page 105</u> for more information on circular DIN and bayonet connectors.

Table 69 - Motor Power Cable Compatibility - Bayonet Connectors

Motor/Actuator	Connector Type	Motor/Actuator Cat. No.	Motor Power Cables (with brake wires)	Motor Power Cables (without brake wires)
MP-Series (Bulletin MPL)	Bayonet	MPL-A/B3xxx-xx2xAA, MPL-A/B4xxx-xx2xAA, MPL-A/B45xxx-xx2xAA, MPL-A/B5xxx-xx2xAA, MPL-B6xxx-xx2xAA, MPL-B8xxx-xx2xAA, MPL-B960B-xx2xAA, MPL-B960C-xx2xAA, MPL-B980B-xx2xAA, and MPL-B980C-xx2xAA	N/A	2090-XXxPMP-xxSxx ⁽¹⁾
	-	MPL-B960D-xx2xAA, MPL-B980D-xx2xAA		2090-MCNPMP-6S <i>xx</i>
1326AB (M2L/S2L)		1326AB-Bxxxx-M2L/S2L		2090-XXxPMP-xxSxx ⁽¹⁾
F-Series		F-xxxx		2090-XXNPHF-xxSxx
1326AB (resolver)	P-LOK	1326AB-Bxxxx-21	1326-CPx1T-L-xxx (continuous-flex)	N/A

(1) For Bulletin MPL or 1326AB motors equipped with bayonet connectors. These cables are available as standard (catalog number 2090-XXNPMP-xxSxx) and continuous-flex (catalog number 2090-XXTPMP-xxSxx).

Motor/Actuator	Connector Type	Motor/Actuator Cat. No.	Motor Power Cables (with brake wires)	Motor Power Cables (without brake wires)
MP-Series (Bulletin MPL)		MPL-A/B15xxx-xx4xAA, MPL-A/B2xxx-xx4xAA	2090-XXNPMF- <i>xxSxx</i> (standard) or 2090-CPBM4DF- <i>xx</i> AFxx (continuous-flex)	2090-CPWM4DF-xxAFxx (continuous-flex)
MP-Series (Bulletin MPS)	Circular (threaded) DIN	MPS-A/Bxxxx		
MP-Series (Bulletin MPAS)		MPAS-A/Bxxxx		
MP-Series (Bulletin MPAR)		MPAR-A/B1xxx and MPAR-A/B2xxx (series A)		
TL-Series (Bulletin TLY)	Circular Plastic	TLY-Axxxx-H	2090-CPBM6DF-16AAxx (standard)	2090-CPWM6DF-16AAxx (standard)

Table 71 - Motor Power Cable Compatibility - SpeedTec DIN Connectors

Motor/Actuator	Connector Type	Motor/Actuator Cat. No.	Motor Power Cables ⁽¹⁾ (with brake wires)	Motor Power Cables ⁽¹⁾ (without brake wires)
MP-Series (Bulletin MPL)		MPL-A/B15xxx-xx7xAA, MPL-A/B2xxx-xx7xAA, MPL-A/B3xxx-xx7xAA, MPL-A/B4xxx-xx7xAA, MPL-A/B45xxx-xx7xAA, MPL-A/B5xxx-xx7xAA, MPL-B6xxx-xx7xAA, MPL-B8xxx-xx7xAA MPL-B9xxx-xx7xAA		
MP-Series (Bulletin MPM)		MPM-A/Bxxxx		
MP-Series (Bulletin MPF)	Circular (SpeedTec) DIN	MPF-A/Bxxxx	2090-CPBM7DE-xxAAxx (standard) or	2090-CPWM7DF- <i>xx</i> AA <i>xx</i> (standard) or
RDD-Series		RDD-Bxxxx	2090-CPBM7DF-xxAFxx (continuous-flex)	2090-CPWM7DF-xxAFxx (continuous flow)
LDC-Series		LDC-Cxxxx		(continuous-nex)
MP-Series (Bulletin MPAI)		MPAI-A/Bxxxx		
MP-Series (Bulletin MPAR)		MPAR-A/B3xxx, MPAR-A/B1xxx and MPAR-A/B2xxx (series B)		
LDL-Series	1	LDL-xxxxxxx		

(1) You must remove the motor-side o-ring when using 2090-CPxM7DF-xxAxxx cables.

These cables contain only the three-phase power wires. The motors/actuators either have no brake or a separate connector for brake connections. Thermal switch wires are included in the feedback cable.

Refer to Axis Module/Rotary Motor Wiring Examples beginning on page 196 for interconnect diagrams.



Figure 56 - Motor Power Terminations (cables without brake wires)

The cable shield clamp shown above is mounted to an IAM module. Cables attach to the clamp on each AM module in the same way.

These cables contain three-phase power wires and brake wires. The brake wires have a shield braid (shown below as gray) that folds back under the cable clamp before the conductors are attached to the motor brake (BC) connector. Thermal switch wires are included in the feedback cable.

Refer to Axis Module/Rotary Motor Wiring Examples beginning on page 196 for interconnect diagrams.



Figure 57 - Motor Power Terminations (cables with brake wires)

The cable shield clamp shown above is mounted to an IAM module. Cables attach to the clamp on each AM module in the same way.
The 1326AB (resolver) power cables (catalog number 1326-CPx1T-L-xxx) contain the three-phase wires, brake wires, and thermal switch wires. To improve the EMC performance of your system, route the wires as shown.

Refer to Axis Module/Rotary Motor Wiring Examples beginning on page 196 for interconnect diagrams.

Figure 58 - Motor Power Terminations (1326-CPx1T-L-xxx cable)



The cable shield clamp shown above is mounted to an IAM module. Cables attach to the clamp on each AM module in the same way.

IMPORTANT	We recommend securing the cable shield in the clamp with a tie wrap to
	improve stress relief.

Cable shield and lead preparation is provided with most Allen-Bradley cable assemblies. Follow these guidelines if your motor power cable shield and wires require preparation.

Figure 59 - Cable Shield and Lead Preparation



Refer to Axis Module/Rotary Motor Wiring Examples beginning on page 196 for interconnect diagrams.

Table 72 - Motor Power (MP) Connector

Servo Motor		MP Connector (IAM/AM module)	
1326AB (resolver)	All Other Motors	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	÷

Table 73 - Termination Specifications

IAM/AM Module Cat. No.	Recommended Wire Size mm ² (AWG)	Strip Length mm (in.)	Torque Value N∙m (Ib∙in)
2094-AC05-Mxx-x, 2094-AMP5-x, 2094-AM01-x, 2094-AC09-M02-x, 2094-AM02-x, 2094-BC01-Mxx-x, 2094-BMP5-x, 2094-BM01-x 2094-BC02-M02-x, 2094-BM02-x	Motor power cable depends on motor/ drive combination. 6 (10) max	10 (0.38)	0.50.6 (4.45.3)
2094-AC16-M03-x, 2094-AM03-x 2094-AC32-M05-x, 2094-AM05-x	10 (8) max	10 (0.38)	1.21.5 (10.613.2)
2094-BC04-M03- <i>x</i> , 2094-BM03- <i>x</i>	10 (8) max	10 (0.38)	1.21.5 (10.613.2)
2094-BC07-M05- <i>x</i> , 2094-BM05- <i>x</i>	30 (3) max	16 (0.63)	2.43.0 (21.626.5)

Wire the Motor/Resistive Brake (BC) Connector

This example applies to AM modules and the inverter section of IAM modules.

Figure 60 - IAM/AM Module (BC connector)



24V DC Brake Input Power Connections

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

Table 74 - Motor/Resistive Brake (BC) Connector

2094-ALxxS, 2094-BLxxS, 2094-XL75S-Cx LIM Modules		2094-AL09 and 2094-BL02 LIM Modules		BC Connector (IAM/AM modules)	
P1L Pin	Signal	PSL Pin	Signal	BC Pin	Signal
1	IO_PWR2	1	MBRK PWR	3	PWR
2	10_COM2	2	MBRK COM	4	СОМ

RBM Module Connections

Table 75 - Motor/Resistive Brake (BC) Connector

RBM Module I/O Connections		BC Con (IAM/AM	nector modules)
TB3 Pin	Signal	MP Pin	Signal ⁽¹⁾
6	COIL_A1	1	DBRK+
7	COIL_A2	2	DBRK-

(1) Firmware revision 1.071 or later is required to use the DBRK outputs on the Kinetix 6000 IAM/AM module.

Motor Brake Connections

The procedure for wiring your motor brake varies slightly, depending on the motor family. The cables compatible with your motor or actuator depend on the connectors installed on the motor or actuator. Refer to MP-Series (Bulletin MPL) Motor Connectors on <u>page 105</u> for more information on circular DIN and bayonet connectors.

Table 76 - Motor Brake Cable Compatibility - Bayonet Connectors

Motor Series	Connector Type	Brake Wires	Cable Cat. No.		
MPL-A/B3xxx-xx2xAA, MPL-A/B4xxx-xx2xAA, MPL-A/B45xxx-xx2xAA, MPL-A/B5xxx-xx2xAA, MPL-B6xxx-xx2xAA, MPL-B8xxx-xx2xAA, MPL-B9xxx-xx2xAA	Bavonet	The motor has a brake connector. Brake wires are in the brake cable	2090-UXxBMP-18Sxx brake cable ⁽¹⁾		
1326AB (M2L/S2L)	buyonet				
F-Series		The motor has a brake	Straight brake connector kit 9101-0330		
1326AB (resolver)	P-LOK	the brake cable.	1326-CPx1T-L-xxx power cable		

(1) For Bulletin MPL and 1326AB motors equipped with bayonet connectors. These cables are available as standard (catalog number 2090-UXNBMP-185xx) and continuous-flex (catalog number 2090-UXTBMP-185xx).

Table 77 - Motor Brake Cable Compatibility - Threaded DIN and Circular Plastic Connectors

Motor Series	Connector Type	Brake Wires	Cable Cat. No.	
MPL-A/B15xxx-xx4xAA, MPL-A/B2xxx-xx4xAA		The motor/actuator does not		
MPS-A/Bxxx, MPAS-A/Bxxx, MPMA-A/Bxxx, MPAR-A/B1xxx, MPAR-A/B2xxx (series A)	Circular (threaded) DIN	have a brake connector. Brake wires are included in the power cable.	2090-XXNPMF-xxSxx (standard) or 2090-CPBM4DF-xxAFxx (continuous-flex)	
TLY-Axxxx-H	Circular Plastic		2090-CPBM6DF-16AAxx power cable	

Table 78 - Motor Brake Cable Compatibility - SpeedTec DIN Connectors

Motor Series	Connector Type	Brake Wires	Cable Cat. No. ⁽¹⁾	
MPL-A/B15xxx-xx7xAA, MPL-A/B2xxx-xx7xAA				
MPL-A/B3xxx-xx7xAA, MPL-A/B4xxx-xx7xAA, MPL-A/B45xxx-xx7xAA, MPL-A/B5xxx-xx7xAA, MPL-B6xxx-xx7xAA, MPL-B8xxx-xx7xAA MPL-B9xxx-xx7xAA	Circular (SpeedTec) DIN	The motor/actuator does not have a brake connector. Brake wires are included in the power cable.	2090-CPBM7DF-xxAAxx (standard) or	
MPM-A/Bxxx, MPF-A/Bxxx	(Speedlee) Div		2090-CPBM70F-xxAFxx (continuous-ilex)	
MPAR-A/B1xxx, MPAR-A/B2xxx (series B), MPAR-A/B3xxx, MPAI-A/Bxxx				

(1) You must remove the motor-side o-ring when using 2090-CFBM7*xx*-*xx*A*xxx* cables.

IMPORTANT Use surge suppression when controlling a brake coil. Refer to Controlling a Brake Example on page 211.

Figure 61 - Brake Cable Preparation



Table 79 - Motor/Resistive brake (bc) Connecto	Table 79 -	Motor/R	esistive	Brake	(BC)	Connecto
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Motor Brake Wires					nector module)
2090-UXxBMP-18Sxx Brake Cable	2090-XXNPMF-xxSxx 2090-CPBMxDF-xxAFxx Power Cable	2090-CPBM6DF-16AAxx Power Cable	1326-CP <i>x</i> 1T-L- <i>xxx</i> Power Cable	BC Pin	Signal
A / BR+	F/+ / BR+/MBRK+	7 / MBRK+	6/B1	5	MBRK+
C/BR-	G/-/BR-/MBRK-	9 / MBRK-	4 / B2	6	MBRK-

BC Conne	ctor (IAM/AM module)	Recommended	Strip Length	Torque Value
BC Pin	Signal	mm ² (AWG)	mm (in.)	N•m (lb•in)
BC-6 BC-5 BC-4 BC-3 BC-2 BC-1	MBRK- MBRK+ COM PWR DBRK- DBRK+	0.75 (18)	10 (0.38)	0.220.25 (1.92.2)

Apply the Motor Cable Shield Clamp

This procedure assumes you have completed wiring your motor power (MP) connector and are ready to apply the cable shield clamp.

TIP Your drive can be equipped with either the pivot-open or slide-open cable clamp.

Follow these steps to apply the motor cable shield clamp.

1. Depress the spring loaded clamp.

The pivot-open cable clamp was designed to replace the slide-open cable clamp. Pivot-open clamp features include:

- Screwdriver not required for depressing the spring
- Tie wrap not required or recommended

Pry clamp back with thumb. Pry clamp back with thumb. Pivot-open Cable Clamp Screwdriver Tip in Slot Slide-open Cable Clamp

- **2.** Position the exposed portion of the cable braid directly in line with the clamp.
- 3. Release the spring, making sure the cable and cable braid are held secure by the clamp.
- 4. Attach tie wrap (slide-open clamp only) around cable and clamp for additional strain relief.



5. Repeat step 1 through step 4 for each IAM, AM, or IPIM module.

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.

Connection Option	Connector Kit Cat. No.	Cable	Using this Type of Cable
Premolded connector	N/A	Motor feedback	Refer to <u>Table 82</u> and <u>Table 83</u> for the flying-lead cable
low profile connector kit	2090-K6CK-D15M	Motor feedback	available for your motor.
Low-prome connector kit	2090-K6CK-D26M	I/O interface	User-supplied flying-lead cable.
l en file er en et er lite	2090-K6CK-D15F	Auxiliary feedback	User-supplied flying-lead cable.
Low-prome connector kit	2090-K6CK-D15MF		1326-CCUT-L-xxx flying-lead feedback cable.
Low-profile feedback module	2090-K6CK-KENDAT	Motor feedback	Refer to <u>Table 82Table 84</u> for the flying-lead cable available for your motor.
Panel-mounted breakout board kit	2090-UXBK-D15 <i>xx</i> ⁽¹⁾	Motor feedback	Refer to <u>Table 82Table 84</u> for the flying-lead cable available for your motor.

Table 81 - Options for Connecting Motor Feedback and I/O

(1) Not compatible with 1326-CCUT-L-xxx cable.

The procedure for wiring your motor feedback varies slightly, depending on the motor family. The cables compatible with your motor or actuator depend on the connectors installed on the motor or actuator. Refer to MP-Series (Bulletin MPL) Motor Connectors on <u>page 105</u> for more information on circular DIN and bayonet connectors.

Table 82 - Motor Feedback Cable Com	patibility - Ba	yonet Connectors
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Motor/Actuator	Connector	Foodback Typo	Feedback Cable	ick Cable
Motol/Actuatol	Туре	reeuback type	Premolded	Flying-lead
MPL-A/Bxxxx-S/Mx2xAA		High-resolution encoder		
MPL-A3 <i>xxx</i> -Hx2xAA MPL-A4 <i>xxx</i> -Hx2xAA MPL-A45 <i>xxx</i> -Hx2xAA		Incremental encoder	2090-UXNFBMP-S <i>xx</i>	2090-XX <i>x</i> FMP-S <i>xx</i> ⁽¹⁾
MPL-B3 <i>xxx</i> -Rx2xAA MPL-B4 <i>xxx</i> -Rx2xAA MPL-B45 <i>xxx</i> -Rx2xAA	Bayonet	Motor resolver	N/A	2090-CDNFDMP-Sxx
1326AB-Bxxxx-M2L/S2L		High-resolution encoder	2090-UXNFBMP-S <i>xx</i>	2090-XXxFMP-Sxx ⁽¹⁾
1326AB-Bxxxx-21		Motor resolver	N/A	1326-CCUT-L <i>-xxx</i>
F-Series		Incremental encoder	2090-UXNFBHF-Sxx	2090-XXNFHF-S <i>xx</i>

(1) For Bulletin MPL and 1326AB (M2L/S2L) motors equipped with bayonet connectors. These cables are available as standard (catalog number 2090-XXNFMP-Sxx) and continuous-flex (catalog number 2090-XXTFMP-Sxx).

Refer to Flying-lead Feedback Cable Pinouts beginning on <u>page 117</u> for the motor-to-drive feedback cable pinout used in your application.

Refer to MP-Series (Bulletin MPL) Motor Connectors on page 105 for more information on circular DIN and bayonet connectors.

Motor/Actuator	Connector Feedback Type		Feedback Cable ⁽¹⁾	
Motor/Actuator	Туре	recuback type	Premolded	Flying-lead
MPL-A/B15xxx-V/Ex4xAA MPL-A/B2xxx-V/Ex4xAA	Circular (threaded) DIN	High-resolution encoder		
MPL-A/B15xxx-Hx4xAA MPL-A/B2xxx-Hx4xAA		Incremental encoder	N/A	2090-XXNFMF-Sxx (standard) or 2090-CFBM4DF-CDAFxx (continuous-flex)
MPS-A/Bxxxx-S/M		DIN	1//	
MPAS-A/Bxxxxx-V/A		High-resolution encoder		
MPAR-A/B1xxxx-V and MPAR-A/B2xxxx-V (series A)				
TLY-Axxxx-H	Circular Plastic	Incremental encoder	2090-CFBM6DD-CCAAxx	2090-CFBM6DF-CBAAxx

Table 83 - Motor Feedback Cable Compatibility - Threaded DIN/Plastic Connectors

(1) You must remove the motor-side o-ring when using 2090-CFBM7xx-xxAxxx cables.

Table 84 - Motor Feedback Cable Compatibility - SpeedTec DIN Connectors

Madaa / Astronom	Connector Feedback Type	Feedback Cable ⁽¹⁾		
Motor/Actuator	Туре	reedback Type	Premolded	Flying-lead
MPL-A/B15xxx-V/Ex7xAA MPL-A/B2xxx-V/Ex7xAA		High-resolution encoder		
MPL-A/B15 <i>xxx</i> -Hx7xAA MPL-A/B2xxx-Hx7xAA		Incremental encoder		2090-CFBM7DF-CEAA <i>xx</i>
MPL-A/B3xxx-S/Mx7xAA, MPL-A/B4xxx-S/Mx7xAA, MPL-A/B45xxx-S/Mx7xAA, MPL-A/B5xxx-S/Mx7xAA, MPL-B6xxx-S/Mx7xAA, MPL-B8xxx-S/Mx7xAA MPL-B8xxx-S/Mx7xAA	Circular (SpeedTec) DIN	High-resolution encoder	(standard) or 2090-CFBM7DD-CEAFxx (continuous-flex)	(standard) or 2090-CFBM7DF-CEAF <i>xx</i> (continuous-flex)
MPL-A/B3xxx-Hx7xAA ⁽²⁾ MPL-A/B4xxx-Hx7xAA ⁽²⁾ MPL-A/B45xxx-Hx7xAA ⁽²⁾ LDAT-Sxxxxx-xBx ⁽²⁾		Incremental encoder	N/A	2090-XXNFMF-Sxx (standard) or 2090-CFBM7DF-CDAFxx (continuous-flex)
MPL-B3 <i>xxx</i> -Rx7xAA MPL-B4 <i>xxx</i> -Rx7xAA MPL-B45 <i>xxx</i> -Rx7xAA	Circular (SpeedTec) DIN	Motor resolver	N/A	2090-CFBM7DF-CEAAxx (standard) or 2090-CFBM7DF-CEAFxx
MPM-A/Bxxxxx-2				(continuous-flex)
MPF-A/Bxxxx-S/M				
MPM-A/Bxxxxx-S/M			2090-CFBM7DD-CEAAxx	2090-CFBM7DF-CEAAxx
MPAR-A/B1xxxx-V and MPAR-A/B2xxxx-V (series B) MPAR-A/B3xxxx-M	Circular (SpeedTec) DIN	High-resolution encoder	(standard) or 2090-CFBM7DD-CEAF <i>xx</i> (continuous-flex)	(standard) or 2090-CFBM7DF-CEAF <i>xx</i> (continuous-flex)
MPAI-A/BxxxxxM3				
RDB-Bxxxx-7/3				2090-XXNFMF-Sxx
LDC-Cxxxx or LDL-xxxxx ⁽²⁾		Sin/Cos encoder or TTL encoder	N/A	(standard) or 2090-CFBM7DF-CDAF <i>xx</i> (continuous-flex)

(1) You must remove the motor-side o-ring when using 2090-CFBM7*xx*-*xx*A*xxx* cables.

(2) These motors/linear thrusters are equipped with SpeedTec DIN connectors, however, the feedback option requires the additional conductors supplied with the cables listed.

Refer to Flying-lead Feedback Cable Pinouts beginning on page 117 for the motor-to-drive feedback cable pinout used in your application.

Flying-lead Feedback Cable Pinouts

Bayonet Connector Pin	High-resolution Feedback		Incremental Feedback	
Rotary Motors	MPL-B3xxxMPL-B9xxx-M/Sx2xAA MPL-A5xxx-M/Sx2xAA 1326AB-Bxxx-M2L/S2L	MPL-A3xxx-M/Sx2xAA MPL-A4xxx-M/Sx2xAA MPL-A45xxx-M/Sx2xAA	MPL-A3xxx-Hx2xAA MPL-A4xxx-Hx2xAA MPL-A45xxx-Hx2xAA	Connector Pin
A	Sin+	Sin+	AM+	1
В	Sin-	Sin-	AM-	2
C	Cos+	Cos+	BM+	3
D	Cos-	Cos-	BM-	4
E	Data+	Data+	IM+	5
F	Data-	Data-	IM-	10
К	Reserved	EPWR_5V	EPWR_5V	14
L	Reserved	ECOM	ECOM	6
Ν	EPWR_9V	Reserved	Reserved	7
Р	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

Table 85 - 2090-XXxFMP-Sxx Feedback Cable ⁽¹⁾

(1) These cables are available as standard (catalog number 2090-XXNFMP-Sxx) and continuous-flex (catalog number 2090-XXTFMP-Sxx).

Table 86 - 2090-CFBM7DF-CEAAxx Feedback Cable

Motor DIN Connector Pin	Resolver Feedback MPL-B <i>xxxx</i> -Rx7xAA MPM- <i>xxxxxx</i> -2	Drive MF Connector Pin
1	S2	1
2	S4	2
3	S1	3
4	53	4
5	R1	5
6	R2	10
11	EPWR_9V	7
12	ECOM	6
13	TS+	11
14	TS-	6

Table 87 - 2090-CDNFDMP-Sxx Feedback Cable

Motor Bayonet Connector Pin	Resolver Feedback MPL-B <i>xxxx</i> -Rx2xAA	Drive MF Connector Pin
A	S2	1
В	S4	2
С	S1	3
D	\$3	4
G	R1	5
Н	R2	10
Ν	EPWR_9V	7
Р	ECOM	6
R	TS+	11
S	TS-	6

Circular DIN Connector Pin	High-resolut	ion Feedback	Incremental Feedback	
Rotary Motors	MPL-B15xxxMPL-B2xxx-V/Ex4/7xAA MPF/MPS-Bxxx-M/S MPF-A5xxx-M/S MPL-B3xxx MPL-B9xxy-M/Sx7xAA	MPL-A15xxxMPL-A2xxx-V/Ex4/7xAA MPF/MPS-A3xx-M/S MPF/MPS-A4xx-M/S MPF/MPS-A45xx-M/S MPS-A5xxx-M/S MPS-A5xxx-M/S	MPL-A15xxx-Hx4/7xAA MPL-A2xxx-Hx4/7xAA MPL-B15xxx-Hx4/7xAA MPL-B2xxx-Hx4/7xAA	Drive MF
	MPL-A5xxx-M/Sx7xAA MPM-A165xxxMPM-A215xxx MPM-Bxxxxx-M/S	MDB-BXXXXX-S/7 MPL-A3xXX-M/Sx7xAA MPL-A4xXX-M/Sx7xAA MPL-A45xXX-M/Sx7xAA MPM-A115xXXMPM-A130xXX-M/S	MPL-A3xxx-Hx7xAA MPL-A4xxx-Hx7xAA MPL-A45xxx-Hx7xAA	Connector Pin
Linear Motors	N/A	LDC-Cxxxx and LDL-xxxx	LDC-Cxxxx and LDL-xxxx	
Linear Actuators	MPAS-Bxxxxx-VxxSxA MPAR-Bxxxx, MPAI-Bxxxx	MPAS-Axxxxx-VxxSxA MPAR-Axxxx, MPAI-Axxxx	MPAS-A/Bxxxxx-ALMx2C LDAT-Sxxxxxx-xBx	
1	Sin+	Sin+	AM+	1
2	Sin-	Sin-	AM-	2
3	Cos+	Cos+	BM+	3
4	Cos-	Cos-	BM-	4
5	Data+	Data+	IM+	5
6	Data-	Data-	IM-	10
7	Reserved	CLK+ ⁽¹⁾	Reserved	9
8	Reserved	CLK- ⁽¹⁾	Reserved	15
9	Reserved	EPWR_5V	EPWR_5V	14
10	Reserved	ECOM	ECOM	6
11	EPWR_9V	Reserved	Reserved	7
12	ECOM	Reserved	Reserved	6
13	TS+	TS+	TS+	11
14	TS-	TS-	TS-	-
15	Reserved	Reserved	S1	12
16	Reserved	Reserved	S2	13
17	Reserved	Reserved	53	8

Table 88 - 2090-XXNFMF-Sxx or 2090-CFBMxDF-xxAxxx Feedback Cables

(1) Applies to RDB-Bxxxxx-3/7 direct-drive motors only.

Table 89 - 2090-CFBM6DF-CBAAxx Feedback Cable

Rotary Motor	Incremental Feedback	Drive MF Connector Pin	
Connector Pin	TLY-Axxxx-H		
9	AM+	1	
10	AM-	2	
11	BM+	3	
12	BM-	4	
13	IM+	5	
14	IM-	10	

Rotary Motor	Incremental Feedback	Drive MF	
Connector Pin	TLY-Axxxx-H	Connector Pin	
15	S1	12	
17	S2	13	
19	\$3	8	
22	EPWR_5V	14	
23	ECOM	6	
24	Shield	Connector housing	

Rotary Motor	Incremental Feedback	Drive MF
Connector Pin	F-Series Motors	Connector Pin
A	AM+	1
В	AM-	2
C	BM+	3
D	BM-	4
E	IM+	5
F	IM-	10
G	Reserved	-
Н	Reserved	-
J	EPWR_5VM	14
К	EPWR_5VM	14
L	ECOMM	6
М	ECOMM	6
Ν	S2	13
Р	S3	8
R	TS+	11
S	TS-	6
T	S1	12

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Table 91 - 1326-CCUT-L-xxx Feedback Cable

Rotary Motor Connector Pin	Resolver Feedback 1326AB-B <i>xxxx</i> -21	Drive MF Connector Pin ⁽¹⁾
Α	R1	5
В	R2	10
C	-	-
D	S1	3
E	S3	4
F	-	-
G	S2	1
Н	S4	2

Table 92 - 1326-CPx1T-L-xxx Power Cable

Rotary Motor Connector Pin	Thermal Switch Connections 1326AB-B <i>xxxx</i> -21	Drive MF Connector Pin ⁽²⁾
5	TS+	16
9	TS-	17
-	Shield	S

(1) For termination of individual drain wires, use Low Profile connector kit (catalog number 2090-K6CK-D15MF) and reference figure on page 124.

(2) Thermal switch wires (5 and 9) are in the motor power cable (catalog number1326-CPx1T-L-xxx). Use Low Profile connector kit (catalog number 2090-K6CK-D15MF) and reference figure on page 124.

Wiring the Feedback and I/O **Connectors**

These procedures assume you have mounted your Kinetix 6000 system, completed all power wiring, and are ready to connect your feedback and I/O cables.

For This Connection	Go to
Premolded cable	Connect Premolded Motor Feedback Cables on page 120.
Panel-mounted breakout board	Connect Panel-mounted Breakout Board Kits on page 121.
Low-profile connector	Wire Low-profile Connector Kits on page 122.

Connect 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 modules (no wiring is necessary).

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



Figure 62 - IAM/AM Module (MF connector)

Connect Panel-mounted Breakout Board Kits

The 2090-UXBK-D15*xx* panel-mounted breakout board kit includes a DIN-rail breakout board and cable. The cable connects between the breakout board and the motor feedback (MF) connector. Wires from your flying-lead motor feedback cable connect to the terminals.





IMPORTANT The panel-mounted breakout board kit (2090-UXBK-D15*xx*) is not compatible with 1326-CCUT-L-*xxx* cable.

Wire Low-profile Connector Kits

The 2090-K6CK-*xxxx* low-profile connector kits are suitable for terminating flying-lead motor feedback, auxiliary feedback, and I/O connections. They also apply to I/O connections on the 2094-AL09 and 2094-BL02 LIM modules.

Table 93 -	Low-profile	Connector	Kits
------------	-------------	-----------	------

Connector Kit Cat. No.	Description	Cable Compatibility
2090-K6CK-KENDAT	Low-profile feedback module for EnDat to Hiperface conversion (15-pin, male, D-sub). Use with any Kinetix 6000 IAM/AM module and Bulletin RDB direct-drive motor with EnDat high-resolution feedback.	2090-XXNFMF-S <i>xx,</i> 2090-CFBM7DF-CDAF <i>xx</i>
2090-K6CK-D15M	Low-profile connector kit for motor feedback (15-pin, male, D-sub). Use with any Kinetix 6000 IAM/AM module and compatible motors with incremental or high-resolution feedback.	2090-XXxFMP-Sxx, 2090-XXNFMF-Sxx, 2090-XXNFHF-Sxx, 2090-CFBMxDF-CxAxxx
2090-K6CK-D15M	Low-profile connector kit for motor feedback (15-pin, male, D-sub). Use with Kinetix 6000 IAM/AM module and MPL-B <i>xxxx</i> -R (resolver feedback) motors.	2090-CDNFDMP-Sxx 2090-CFBM7DF-CEAAxx 2090-CFBM7DF-CEAFxx
2090-K6CK-D15MF	Low-profile connector kit for motor feedback (15-pin, male, D-sub) with filter. Use with Kinetix 6000 IAM/AM module and 1326ABxxxx-21 (resolver feedback) motors.	1326-CCUT-L- <i>xxx</i>
2090-K6CK-D15F	Low-profile connector kit for auxiliary feedback (15-pin, female, D-sub). Use with any Kinetix 6000 IAM/AM module for auxiliary feedback applications.	Customer Supplied
2090-K6CK-D26M	Low-profile connector kit for I/O (26-pin, male, D-sub). Use with any Kinetix 6000 IAM/AM module or 2094-AL09 and 2094-BL02 LIM module for making I/O connections.	Customer supplied

Figure 64 - IAM/AM Module (IOD/MF/AF connectors)





Figure 65 - Wiring (15-pin) Flying-lead Feedback Cable Connections 2090-K6CK-D15M and 2090-K6CK-D15F Connector Kit



Figure 67 - Wiring (15-pin) Flying-lead Feedback Cable Connections 2090-K6CK-D15MF Connector Kit

Clamping the exposed braid under the shield clamp is critical. Turn clamp over, if necessary, to be sure of a proper ground.





External Shunt Module Connections

Follow these guidelines when wiring your external active or passive shunt module.

IMPORTANTWhen tightening screws to secure the wires, refer to the tables beginning on
page 95 for torque values.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in <u>Chapter 2</u>.

Figure 69 - Shunt Module Wiring

Use This Shunt Module	Cat. No.	With This Drive Module	Do This
Power rail mounted shunt module.	2094-BSP2	N/A	 Verify the internal shunt jumper is in place between RC-2 and RC-3 (refer to Figure 70). Verify the thermal switch jumper is in place between TS-1 and TS-2 (refer to Figure 70).
External passive shunt module connected to the power rail shunt module.	1394-SRxxxx	2094-BSP2 Shunt module	 Remove the internal shunt jumper between RC-2 and RC-3. Remove the thermal switch jumper between TS-1 and TS-2 (if your shunt module includes a thermal switch). Refer to External Shunt Modules on page 48 for noise zone considerations. Refer to Shunt Module Wiring Examples on page 195. Refer to the installation instructions provided with your Bulletin 1394 shunt module, publication 2090-IN004.

Figure 70 - Shunt Module Jumper Settings



(1) These are the default jumper settings.

IPIM Module Connections

An overview of the Kinetix 6000M integrated drive-motor (IDM) system connections are shown here.

- Refer to Chapter 2 on page 25, for noise zone considerations.
- Refer to Appendix A, on <u>page 210</u>, for an interconnect diagram featuring the Kinetix 6000M integrated drive-motor (IDM) system.
- Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for more information when wiring your IPIM module.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in <u>Chapter 2</u>.



RBM Module Connections

Follow these guidelines when wiring your Bulletin 2090 Resistive Brake Module (RBM).

IMPORTANT To be sure of system performance, run wires and cables in the wireways as established in <u>Chapter 2</u>.

If your application requires an RBM module and you are wiring to a Kinetix 6000 IAM/AM module, then refer to the following:

- Cable Categories for Kinetix 6000 Systems on <u>page 45</u> to establish noise zones when mounting the RBM module on your panel.
- Resistive brake module to Kinetix 6000 drive interface cable (catalog number 2090-XXNRB-*xx*F0P*x*).
- The example diagram below and others in Appendix G, beginning on page 265.
- The installation instructions provided with your RBM module, publication <u>2090-IN009</u>.





Sercos Fiber-optic Cable Connections

This procedure assumes you have your Logix5000 sercos interface module/PCI card and Kinetix 6000 IAM/AM modules mounted and are ready to connect the fiber-optic cables.

The sercos fiber-optic ring is connected by using the sercos receive (Rx) and transmit (Tx) connectors. Refer to page 58 to locate the sercos connectors on your Kinetix 6000 IAM/AM module and IPIM module. Refer to the figure below to locate the connectors on your Logix5000 sercos interface module or PCI card.

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).

Figure 73 - CompactLogix, ControlLogix, and SoftLogix Sercos Connectors



Connect the cable from transmit on the Logix5000 module to receive on the IAM/AM or IPIM module, then transmit to receive (drive to drive), and from transmit on the last drive back to receive on the Logix5000 module.



ATTENTION: To avoid damage to the sercos Rx and Tx connectors, use only finger-tight torque when attaching the fiber-optic cables to the Kinetix 6000 IAM/AM modules and IPIM module. Do not use a wrench or any other mechanical assistance.

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

SoftLogix and ControlLogix controllers are used in the following examples; however, CompactLogix controllers connect in the same manner.



Figure 74 - Fiber-optic Cable Example - SoftLogix Controller





Figure 75 - Fiber-optic Cable Example - Two Logix5000 Controllers

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 <u>2090-IN010</u>.

When connecting 2094-BM03-*x* and 2094-BM05-*x* (double-wide) axis modules, use 2090-SCEP0-2, 0.2 m (7.0 in.) cables. When connecting 2094-AM*xx*-*x*, 2094-BMP5-*x*, 2094-BM01-*x*, and 2094-BM02-*x* (single-wide) axis modules, use 2090-SCEP0-1, 0.1 m (5.1 in.) cables.

Figure 76 - Fiber-optic Cable Example - Logix5000 Controller with Double-wide Drive Modules



In this example, the second Kinetix 6000 system is mounted in a separate cabinet and connected with bulkhead adapters.

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

Figure 77 - Fiber-optic Cable Example - Logix5000 Controller with Bulkhead Adapters



Kinetix 6000M Integrated Drive-Motor Sercos Connections

The Kinetix 6000 sercos ring includes the Kinetix 6000M integrated drive-motor (IDM) units and IDM power interface modules (IPIM). Fiber-optic connections are made from drive-to-drive and drive-to-IPIM module. IDM network connections continue from the IPIM module to the IDM units.

Because the Kinetix 6000M (IPIM) module has fiber-optic cable connectors positioned identical to the Kinetix 6000 (2094-BMxx-S) drives, the IPIM module uses the same fiber-optic cable lengths as the drive modules.

Figure 78 - Fiber-optic Cable Example - Logix5000 Controller with Kinetix 6000M (IPIM) Module



In this example, all the drive modules and the IPIM module are on the same sercos ring. The ring begins and ends at the 1756-M16SE sercos module. IDM units (not shown for simplicity) connected to the IPIM module, are also part of this sercos ring.

For more Kinetix 6000 IDM system examples including the IDM units, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication 2094-UM003.

Ethernet Cable Connections

This procedure assumes you have your ControlLogix or CompactLogix EtherNet/IP module and Bulletin 2094 control modules mounted and are ready to connect the Ethernet network cables.

The EtherNet/IP network is connected by using the PORT 1 and/or PORT 2 connectors.

Table 94 - EtherNet/IP Connector Location

Drive Family	Cat. No.	EtherNet/IP Network	Refer to
Kinetix 6000M	2094-SEPM-B24-S	Monitoring, diagnostics, and firmware upgrades	<u>page 59</u>



Figure 79 - ControlLogix and CompactLogix Ethernet Port Locations

Configure and Start the Kinetix 6000 Drive System

This chapter provides procedures for configuring your Kinetix 6000 system components with your Logix sercos module.

Торіс	Page
Configure the Kinetix 6000M Integrated Drive-Motor System	133
Configure the Drive Modules	134
Configure the Logix5000 Sercos interface Module	140
Apply Power to the Kinetix 6000 Drive	153
Test and Tune the Axes	155
Configure Drive Parameters and System Variables	160

TIP

Before you begin, make sure you know the catalog number for each drive component, the Logix5000 module, and the servo motor/actuator in your motion control application.

00M Configuration for the Kinetix 6000M integrated drive-motor (IDM) system follows a procedure similar to what is described in this chapter. You'll assign each IDM unit a node address and configure the IDM system in the Logix Designer application.

The IPIM module does not require configuration for your IDM units to be configured in the sercos ring. However, you can include the IPIM module in your project by connecting it to a configured Ethernet module in the Logix5000 chassis and adding it under the Ethernet module in the I/O configuration tree. An Add-On Profile is also needed to use the IPIM module in the project, but as a result you can view IPIM module status information in the configuration software and use it in your application program. The Ethernet connection is also used to upgrade the IPIM module firmware by using ControlFLASH software.

For system configuration and startup procedures specific to the IDM system, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

Configure the Kinetix 6000M Integrated Drive-Motor System

Configure the Drive Modules

Follow these steps to configure the integrated axis module (IAM) and axis modules (AM).

IMPORTANTIf you have one or more IDM power interface modules (IPIM) on your power
rail, refer to the Kinetix 6000M Integrated Drive-Motor System User
Manual, publication 2094-UM003, for system configuration information
specific to the Kinetix 6000M IDM system.

1. Verify that no power is applied to the IAM and AM modules and that the communication cables are plugged into the appropriate connectors.

To verify communication, refer to Sercos Fiber-optic Cable Connections on page 128.

To Configure	Begin With
The IAM module	step 2
Any AM module	step 4
Kinetix 6000M IDM system ⁽¹⁾	Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.

(1) Sercos fiber-optic cable connections for the Kinetix 6000M integrated drive-motor (IDM) system are on page 131.

2. Set the base node address for the IAM module by setting the Node Address switches.

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

То	Press
Increment the (MSD/LSD) node address	The plus (+) switch.
Decrement the (MSD/LSD) node address	The minus (-) switch.



Setting the base node address on the IAM module determines the node address for the IAM (inverter) module. Node addressing for all slot locations on the same power rail increment (from the IAM inverter) left to right.

3. Cycle control power to initialize the IAM module.

IMPORTANT	The base node address setting takes effect only after the IAM module is
	initialized.

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

Refer to the node addressing examples beginning on page 136.

4. Set the sercos communication rate with DIP switches 2 and 3.

For This Communication Rate	Set Switch 2	Set Switch 3
4 Mbps	OFF	ON
8 Mbps ⁽¹⁾	ON	OFF

(1) The Kinetix 6000M IDM system supports only 8 Mbps and is hardwired for this setting.

5. Set the sercos optical power level to High with DIP switch 1.

For This Optical Power Level	Set Switch 1
Low	OFF
High	ON



6. Repeat step 4 and step 5 for each 2094-xMxx-x AM module.



Figure 80 - Node Addressing Example 1

In Example 1, the Kinetix 6000 (6-axis) drive system 1 power rail contains one IAM module, three AM modules, one shunt module, and one slot-filler module. The shunt module and slot-filler modules are not assigned a sercos node address, but the system identifies them with a slot location.

Kinetix 6000 (2-axis) drive system 2 power rail contains one IAM module and one AM module. The base node address of the (system 2) IAM module must be set for an address of \geq 007.

IMPORTANT	The node address for each axis module is determined by the base node-address switch setting on the IAM module.
	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, you can replace slot-filler modules with AM modules or the 2094- BSP2 shunt module (maximum one 2094-BSP2 shunt module per power rail).



Figure 81 - Node Addressing Example 2

In this example, sercos interface module 1 controls axes 1...4 and module 2 controls axes 5...7. The slot-filler module is not assigned a sercos node address, but the system identifies it with a slot location.

You can mount the two sercos interface modules in two separate ControlLogix chassis (as shown) or you can mount them in the same chassis.

IMPORTANT	The node address for each axis module is determined by the base node-address switch setting on the IAM module.
	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, you can replace slot-filler modules with AM modules or the 2094- BSP2 shunt module (maximum one 2094-BSP2 shunt module per power rail).



Figure 82 - Node Addressing Example 3

In this example, the Kinetix 6000 (8-axis) power rail contains a double-wide IAM module, two double-wide AM modules, one single-wide AM module, and one slot-filler module. The slot-filler module is not assigned a sercos node address, but the system identifies it with a slot location.

The leftmost slot of a double-wide module determines the node address. So, in the example above, node addresses 02, 04, and 06 (the rightmost slots of the double-wide modules) are not used.

IMPORTANT	The node address for each axis module is determined by the base node-address switch setting on the IAM module.
	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, you can replace slot-filler modules with AM modules or the 2094- BSP2 shunt module (maximum one 2094-BSP2 shunt module per power rail).



Figure 83 - Node Addressing Example 4

In this example, the Kinetix 6000 (5-axis) power rail contains two single-wide axis modules and one IDM system. Neither the slot-filler or IPIM module is assigned a sercos node address, but the system identifies them with a slot location.

Node addressing on the power rail is no different than the previous examples. Node address 02 and 05 are available for any of the IDM units, but to avoid confusion, the node addressing for the IDM units was started at 20. Unlike the axis modules, each IDM unit has switches that determine its node address. In this example, the IDM unit node addressing is sequential, but it doesn't have to be.

IMPORTANT	Creating a duplicate node address between the axis modules mounted on the power rail and the IDM system (in the same sercos ring) generates error code E50. Each node address on the sercos ring must be unique within the range of 0199. Axes on the same power rail as the IPIM module do not have to be in the same sercos ring as the IDM units.
IMPORTANT	Slot-filler modules must be used to fill any unoccupied slot on the power rail. However, you can replace slot-filler modules with AM modules or the 2094- BSP2 shunt module (maximum one 2094-BSP2 shunt module per power rail).

Configure the Logix5000 Sercos interface Module

This procedure assumes that you have wired your Kinetix 6000 system and have configured the communication rate and optical power switches.

For help with using the Logix Designer application as it applies to configuring the ControlLogix, CompactLogix, or SoftLogix sercos modules, refer to Additional Resources on page 12.

Configure the Logix5000 Controller

Follow these steps to configure the Logix5000 controller.

- 1. Apply power to your Logix5000 chassis containing the sercos interface module/PCI card and open your Logix Designer application.
- 2. From the File menu, choose New.

The New Controller dialog box opens.

New Controller			×
Vendor:	Allen-Bradley		
Туре:	1756-L63 ControlLogix5563 Controller	OK	
Revision:	18 💌	Cancel	
	Redundancy Enabled	Help	
Name:	UM_SERCOS		
Description:			
	<u>_</u>		
Chassis Type:	1756-A4 4-Slot ControlLogix Chassis		
Slot	0 Safety Partner Slot: <none></none>		
Create In:	C:\RSLogix 5000\Projects	Browse	

- 3. Configure the new controller.
 - a. From the Type pull-down menu, choose the controller type.
 - b. From the Revision pull-down menu, choose the revision.
 - c. Type the file Name.
 - d. From the Chassis Type pull-down menu, choose the chassis.
 - e. Enter the Logix5000 processor slot.
- 4. Click OK.
- 5. From the Edit menu, choose Controller Properties.

General S	erial Port	0 · D ·	and a second state of the		AT STATEMENT AND	
	ACCOUNTS AND	System Protocol L	lser Protocol 📗 Maj	or Faults	Minor Faults	Date/Time
(i) The Date Use these	and Time of fields to construct the fields to construct the field state of the field stat	displayed here is Contro onfigure Time attributes ate. Time and Zone fro	iller local time, not we of the Controller.	vrkstation I	ocal time.	
Date and Tim	e:	- 18) 		ihange Dia	ite and Time 🗲	
Time Zone:			•			
	Adj	ust for Daylight Saving I	+00:00) 🖕			
Time Synch	ronize -	A				
🗹 Enable Tir	ne Synchro	nization	DANGER. If tin disabled online controller in this	ne synchro , active ax s chassis, ;	nization is tes in any or any other	
O Is the syst	em time ma	ster	synchronized d unexpected ma	evice, may ation. Safe	y experience aty controllers may	,
Ols a synch	ronized time	e slave	fault if no other time master exists in the			
	us i maste	r detected	.cca. ondooro.			
O No CST	ersnip disat	Died		6		
UNUCSI II	105(8)			Ļ	Advanced	

The Controller Properties dialog box opens.

- **6.** Click the Date/Time tab.
- 7. Check Enable Time Synchronization.

This assigns the controller as the Grandmaster clock. The motion modules set their clocks to the module you assign as the Grandmaster.

IMPORTANT You can assign only one module in the Logix5000 chassis as the Grandmaster clock.

8. Click OK.

Configure the Logix5000 Module

Follow these steps to configure the Logix5000 module.

 Right-click I/O Configuration in the Controller Organizer and choose New Module.

The Select Module dialog box opens.

lodule	Description	Vendor
🗄 🗉 Digital		
🕂 - Drives		
🚊 Motion		
- 1756-HYD02	2 Axis Hydraulic Servo	Allen-Bradley
- 1756-M02AE	2 Axis Analog/Encoder Servo	Allen-Bradley
- 1756-M02AS	2 Axis Analog/SSI Servo	Allen-Bradley
- 1756-M03SE	3 Axis SERCOS Interface	Allen-Bradley
- 1756-M08SE	8 Axis SERCOS Interface Allen-Bradley	
- 1756-M08SEG	8 Axis Generic SERCOS Interface Allen-Bradley	
1756-M16SE	16 Axis SERCOS Interface	Allen-Bradley
🕂 Other		
🗄 Specialty		
		Þ
		Find Add Favorite
By Category By	Vendor Favorites	

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.

In this example, the 1756-M16SE module is selected.

3. Click OK.

The New Module dialog box opens.

New Module				x
Type: Vendor:	1756-M16SE 16 Axis SERCOS Allen-Bradley	Interface		
Name:	UM_SERCOS	Slot:	3 -	
Description:		*		
Revision:	18 1	Electronic Keying:	Compatible Keying	•
🔽 Open Mo	dule Properties		OK Cancel	Help

- 4. Configure the new module.
 - a. Type the module Name.
 - b. Enter the Logix5000 sercos module slot (leftmost slot = 0).
 - c. Check Open Module Properties.
- 5. Click OK.

Your new module appears under the I/O Configuration folder in the Controller Organizer and the Module Properties dialog box opens.

🗖 Module Propertie	s: Local:1 (1756-M16SE)	×
General Connection	SERCOS Interface SERCOS Interface Info Module Info Backplane	
Data Rate:	Auto Detect 💌 Mb	
Cycle Time:	2 ms	
Transmit Power:	High 💌	
Transition To Phase:	4 .	
Status: Offline	OK Cancel Apply Help	

6. Click the sercos Interface tab and reference the table below.

Logix5000 Sercos Module	Number of Axes	Data Rate
1756-M03SE or 1756-L60M03SE	Up to 3	
1756-M08SE	Up to 8	A or 8 Mbps
1756-M16SE or 1784-PM16SE	Up to 16	cquin o io r
1768-M04SE	Up to 4	

- 7. Verify that the Data Rate setting matches DIP switches 2 and 3 (communication rate), as set on the IAM and AM module, or choose the Auto Detect setting.
- **8.** From the Cycle Time pull-down menu, choose 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 916	
8 Mbps ⁽¹⁾	Up to 4	0.5 ms
	Up to 8	1 ms
	Up to 16	2 ms

(1) The Kinetix 6000M IDM system supports only 8 Mbps and is hardwired for this setting.

TIP

The number of axes/module is limited to the number of axes as shown in step 6.

9. From the Transmit Power pull-down menu, choose High.

The default setting is High, however this setting is dependent on the cable length (distance to next receiver) and cable type (glass or plastic).

10. Enter the Transition to Phase setting.

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

- 11. Click OK.
- 12. Repeat <u>step 1</u> through <u>step 11</u> for each Logix5000 module.

Configure the Kinetix 6000 Drive Modules

Follow these steps to configure the Kinetix 6000 drive modules.

1. Right-click the Logix5000 module you just created and choose New Module.

The Select Module dialog box opens.

Select Module		X		
Module	Description	Vendor		
2093-AMP2	Kinetix 2000, 230VAC, AM, 2.8A Cont, 8.5A Peak	Allen-I 🔨		
2093-AMP5	Kinetix 2000, 230VAC, AM, 4.2A Cont, 12.7A Peak	Allen-I		
2094-AC05-M01	Kinetix 6000, 230VAC, IAM, 3kW PS, 9A Cont., 17A Peak	Allen-I		
2094-AC05-MP5	Kinetix 6000, 230VAC, IAM, 3kW PS, 5A Cont., 10A Peak	Allen-I		
2094-AC09-M02	Kinetix 6000, 230VAC, IAM, 6kW PS, 15A Cont., 30A Peak	Allen-I		
	Kinetix 6000, 230VAC, IAM, 15kW PS, 24A Cont., 49A P	Allen-I		
2094-AC32-M05	Kinetix 6000, 230VAC, IAM, 23kW PS, 49A Cont., 98A P	Allen-I		
2094-AM01	Kinetix 6000, 230VAC, AM, 9A Cont., 17A Peak	Allen-I		
2094-AM02	Kinetix 6000, 230VAC, AM, 15A Cont., 30A Peak			
2094-AM03	Kinetix 6000, 230VAC, AM, 24A Cont., 49A Peak			
2094-AM05	Kinetix 6000, 230VAC, AM, 49A Cont., 98A Peak			
2094-AMP5	Kinetix 6000, 230VAC, AM, 5A Cont., 10A Peak			
2094-BC01-M01	Kinetix 6000, 460VAC, IAM, 6kW PS, 9A Cont., 13A Peak	Allen-I 🔽		
4				
Find Add Favorite				
By Category By Vendor Favorites				
	OK Cancel H	elp		

2. Expand the Drives category and select drive components appropriate for your actual hardware configuration.

IMPORTANT In order for the Kinetix 6000 drive to communicate with the sercos interface module (indicated by three solid-green status indicators on the sercos module), you must be using RSLogix 5000 software, version 11.00 or later, or the Logix Designer application.

3. Click OK.

The New Module dialog box opens.

New Modul	e	×
Type: Vendor: Name:	2094-AC16-M03 Kinetix 6000, 230VAC, IAM, 15kW PS, 24A Cont., 49A Peak Allen-Bradley	
Description		
Revision:	1 1 Electronic Keying: Compatible Keying	
🔽 Open Mo	dule Properties OK Cancel Help	
- 4. Configure the new module.
 - a. Type the module Name.
 - b. Enter the Node address.

Set the node address in the software to match the node setting on the drive. Refer to Configure the Drive Modules, <u>step 2</u>, on <u>page 134</u>.

- c. Check Open Module Properties.
- 5. Click OK.
- 6. Click the Associated Axes tab.

Module Properties: UM_SERCOS (2094)					
General Connection	Associated Axes Power Module Info				
<u>N</u> ode 1:	<none></none>				
N <u>o</u> de 129:	<none> Auxiliary Axis</none>				
Status: Offline	OK Cancel Apply Help				

7. Click New Axis.

The New Tag dialog box opens.

New Tag		×
Name:	Axis_1	OK
Description:		Cancel
		Help
	Ţ	
Usage:	<normal></normal>	[
Туре:	Base Connection]
Alias For:	· · · · · · · · · · · · · · · · · · ·	[
Data Type:	AXIS_SERVO_DRIVE	
Scope:	UM_SERCOS	
External Access:	Read/Write	
Style:	<u> </u>	
Constant		
🗌 Open AXI:	S_SERVO_DRIVE Configuration	

8. Type the axis Name.

AXIS_SERVO_DRIVE is the default Data Type.

9. Click OK.

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

10. Assign your axis to Node 1.

🔲 Module Propertie	es: UM_SERCOS (2094)	×
General Connection	Associated Axes* Power Module Info	
<u>N</u> ode 1:	Axis_1 New Agis	
N <u>o</u> de 129:	<none> Auxiliary Axis</none>	
Status: Offline	OK Cancel Apply Help	

11. Click Apply.

TIP

With drive firmware revision 1.80 or later, and the Logix Designer application or RSLogix 5000 software, version 13 or later, it is possible to configure the Auxiliary Axis feedback port as a Feedback Only axis. With this feature, you can configure each IAM inverter or AM module to appear as two axes/nodes on the sercos ring. The base node is the servo axis using the motor feedback, and the base node (plus 128) is a feedback-only axis that uses the auxiliary feedback port.

Auxiliary feedback is not supported by the Kinetix 6000M IDM units.

🗖 Module Propertie	s: SE_MOD (2094)	×
General Connection	Associated Axes Power Module Info	
<u>N</u> ode 1:	Axis_1 New Agis	
N <u>o</u> de 129:	Axis_1_Aux	
Status: Offline	OK Cancel Apply Help	

The Auxiliary Axis (Node 129) is configured identical to Node 1 by clicking New Axis and creating a new tag.

- 12. Click Apply if you made changes.
- 13. Click the Power tab.

Module Properties: SE_MO	D (2094)			×
General Connection Associate	d Axes* Power Module Info	o		
Bus Regulator Configuration:	<none></none>	•		
Additional Bus Capacitance:	0	uF		
Status: Offline	ОК	Cancel	Apply	Help

14. From the Bus Regulator Catalog Number pull-down menu, choose the shunt option appropriate for your actual hardware configuration.

If your IAM module is	And your hardware configuration includes this shunt option	Then choose
	Internal shunt resistors only	Internal or <none></none>
Configured as an IAM modulo or	Bulletin 2094 (rail mounted) shunt module	2094-BSP2
common-bus leader IAM module ⁽¹⁾	Bulletin 1394 passive shunt module (connected to the 2094-BSP2 shunt module)	1394-SR <i>xxxx</i>
	External active shunt module	Internal or <none></none>
Configured as a common-bus follower IAM module ⁽²⁾	N/A. Shunts are disabled on follower IAM module	CommonBus Follow

(1) Drive does not accept Internal, <none>, 2094-BSP2, or 1394-SRxxxx selection if DC bus voltage is present without having three-phase power applied.

(2) Drive does not accept CommonBus Follow selection if three-phase power or DC bus power is applied.



To avoid damage to your Bulletin 1394 external shunt module when wired to the 2094-BSP2 shunt module, verify that the proper 230V or 460V fuse is installed prior to applying power.

Refer to Kinetix Motion Accessories Specifications Technical Data, publication <u>GMC-TD004</u>, for more information.

IMPORTANT	When configured to use the Bulletin 1394 or 2094 shunt modules, the IAM bus
	regulator capacity attribute displays the utilization of total shunt power
	available (as a percent) based on the power rail configuration.
	Refer to Kinetix Motion Accessories Specifications Technical Data, publication
	GMC-TD004, for shunt power specification and examples.

15. Calculate additional bus capacitance, if this applies to your application, and enter the value here (version 20.00 or later), or refer to <u>Appendix E</u> on <u>page 249</u> to set the Add Bus Cap parameter.

The Additional Bus Capacitance field applies only to the IAM module.

IMPORTANT	DC common-bus applications must calculate Total Bus Capacitance and Additional Bus Capacitance and set the Add Bus Cap parameter in the leader IAM module. However, you can set the parameter as shown in <u>step 15</u> or by using DriveExplorer software or the Logix Designer application, as shown in <u>Appendix E</u> .
	Refer to <u>Appendix C</u> beginning on <u>page 225</u> , for more information on making the calculations. Refer to <u>Appendix E</u> beginning on <u>page 249</u> , for more information on setting the Add Bus Cap parameter.

16. Click OK.

 Repeat step 1 through step 10 for each Bulletin 2094 AM module and each IDM unit.

Configure the Motion Group

Follow these steps to configure the motion group.

1. Right-click Motion Groups in the Controller Organizer and choose New Motion Group.

The New Tag dialog box opens.

New Tag		x
Name:	UM_Motion	OK
Description:	A	Cancel
		Help
	Ŧ	
Usage:	<normal></normal>	
Туре:	Base Connection	
Alias For:		
Data Type:	MOTION_GROUP	
Scope:	🖸 UM_SERCOS 🗨	
External Access:	Read/Write	
Style:		
Constant		
🔲 Open MO1	FION_GROUP Configuration	

- 2. Type the new motion group Name.
- 3. Click OK.

The new motion group appears under the Motion Groups folder.

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

The Motion Group Properties dialog box opens.

6	Motion Group Properties -	UM_Motion	- 🗆 🗙
	Axis Assignment Attribute Tag	1	
	Unassigned:	Assigned: Axis_1	_
	Add>	< Remove	
	ОК	Cancel Apply	Help

- 5. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.
- **6.** Click the Attribute tab and edit the default values as appropriate for your application.
- 7. Click OK.

Configure Axis Properties

The peak current ratings of the Kinetix 6000 AM modules (series A, B, and C) are configured at the factory as 150% of continuous current. You can program 460V (series B and C) AM modules and the equivalent IAM (inverter) modules, for up to 250% of continuous inverter current.

Refer to $\underline{\text{Appendix F}}$ on $\underline{\text{page 255}}$ to recalculate torque and acceleration or deceleration limit values, and paste them into the appropriate Axis Properties dialog box in the Logix Designer application.

Follow these steps to configure Axis properties for motor feedback.

1. Right-click an axis in the Controller Organizer and choose Properties.

The Axis Properties dialog box opens.

Amplifier Catalog Number	2094-AC16-M03				
Notor Catalog Number:	<none></none>		Change Cata	log	
.oop Configuration:	Position Servo	×		<u></u>	
Drive Resolution:	200000	Drive Counts per	Motor Rev	•	Calculate
Drive Enable Input Ch	necking			1	
🕅 Drive Enable	Input Fault				
Real Time Axis Informati	on				
Attribute 1:	<none></none>	•			
Attribute 2	[

- 2. Click the Drive/Motor tab.
- 3. Click Change Catalog.

The Change Catalog Number dialog box opens.

Change Catalog Num	nber	E	×
Catalog Number:			
MPL-A330P-M		ОК	
MPL-A320P-H MPL-A320P-M		Cancel	
MPL-A320P-S MPL-A330P-H		Help	
MPL-A330P-M MPL-A430P-S MPL-A420P-H MPL-A420P-M MPL-A420P-S MPL-A430H-H		■	_
Filters Voltage <all></all>	Family <all></all>	Feedback Type	

- Select the motor catalog number appropriate for your application.
 To verify the motor catalog number, refer to the motor name plate.
- 5. Click OK.

6. On the Drive/Motor tab, check Drive Enable Input Checking.

When checked (default), means a hard drive-enable input signal is required. Uncheck to remove that requirement.

- 7. Click Apply.
- **8.** Click the Motor Feedback tab and verify the Feedback Type shown is appropriate for your actual hardware configuration.
- **9.** Click the Units tab and edit default values as appropriate for your application.
- **10.** Click the Conversion tab and edit default values as appropriate for your application.

Ø	Axis Properties - Axis_1
	Homing Hookup Tune Dynamics Gains Output Limits Offset FaultActions Tag General Motion Planner Units Drive/Motor* Motor Feedback* Aux Feedback Conversion*
	Positioning Mode: Rotary
	Conversion Constant: 200000.0 Drive Counts/1.0 Position Units Based on 200000 Counts/Motor Rev
	Position Unwind: 200000 Drive Counts/Unwind Based on 200000 Counts/Motor Rev
	OK Cancel Apply Help

In this example, Rotary is chosen from the Positioning Mode pull-down menu.

- **11.** Click Apply if you made changes.
- **12.** Click the Fault Actions tab.

🗛 Axis Properties - Axis_1					
General Motion Plar Homing Hookup	ner Units Tune Dynar	Drive/Motor [*] Motor F mics Gains Output	eedback A Limits Offs	ux Feedback et Fault Acti	Conversion ions Tag
Drive Enable Input:	Disable Drive	~	Set	Custom Stop Ac	tion)
Drive Thermal:	Disable Drive	-			
Motor Thermal:	Disable Drive	Custom Stop Action Attri	butes		×
Feedback Noise:	Status Only	Name	Value	Units	Туре
Feedback:	Shutdown	StoppingTorque	291.2458	% Rated	REAL
Position Error:	Disable Drive	BrakeEngageDelayTime	0.0	s	REAL
Hard Overtravel:	Disable Drive	BrakeReleaseDelayTime ResistiveBrakeContactDelay	0.0	s	REAL
Soft Overtravel:	Disable Drive		0.0	•	
Phase Loss:	Shutdown	L	Close	Cancel	Help
·		OK	Cancel	Apply	Help

13. Click Set Custom Stop Action.

The Custom Stop Action Attributes dialog box opens and lets you set delay times for servo motors and RBM modules.

- 14. Configure the delay times.
 - a. Type the Brake Engage Delay Time.
 - b. Type the Brake Release Delay Time.
 - c. Set the Resistive Brake Contact Delay time (0 1000 ms range).
 - TIPFor recommended motor brake response times, refer to the Kinetix Rotary
Motion Technical Data, publication GMC-TD001.
The recommended delay time for 2090-XB33-xx and 2090-XB120-xx RBM
modules is 71 ms.
 - d. Click Close to close the Custom Stop Action Attributes dialog box.
- **15.** Click Apply.
- 16. Repeat step 1 through step 15 for each Bulletin 2094 AM module.

Follow these steps to configure Auxiliary Axis properties.

IMPORTANT Auxiliary feedback is not supported by the Kinetix 6000M IDM units.

1. Right-click an auxiliary axis in the Controller Organizer and choose Properties.

The Axis Properties dialog box opens on the General tab.

If an axis is associated to the auxiliary axis node, set the Axis Configuration on the General tab of the Axis Properties dialog box to Feedback Only.

Axis Properties - Axi	s_1_Aux 📃 🗖
Homing General Motion Plan	Hookup Fault Actions Tag ner Units Drive/Motor Motor Feedback Aux Feedback Conversion
Axis Configuration:	Feedback Only
Motion Group:	UM_Motion New Liroup
Module: Module Tupe:	
Node:	129 (Auxiliary)

2. Click the Drive/Motor tab.

The Drive/Motor tab displays the amplifier being used and the Loop Configuration is Aux Feedback Only. This is the only choice if the amplifier is using the primary node for Servo (motor) configuration.

😵 Axis Properties - Ax	is_1_Aux					_ 🗆 🗙
Homing General Motion Plar	Hool	kup Drive/Motor	Fault A	Actions dback	Aux Feedback	Tag Conversion
Amplifier Catalog Number:	2094-AC16-M03			•		
Motor Latalog Number:	<none></none>				Change Catalog	
Loop Configuration:	Aux Feedback C	inly		-		
Drive Resolution:	200000	Drive Counts /	Aux Rev	•	Calculate	
🔽 Drive Enable Input Ch	ecking					
🔲 Drive Enable	Input Fault					
Real Time Axis Informati	on					
Attribute 1:	<none></none>			•		
Attribute 2:	<none></none>			•		
			ОК	Cancel	Apply	Help

3. Click the Aux Feedback tab.

🍄 Axis Properties - A	xis_1_Aux			
Homing	∏ Hoo	okup Fault Actions	1	Tag
General Motion P	lanner Units	Drive/Motor Motor Feedback	Aux Feedback	Conversion
Feedback Type:	SRM	•		
Cycles:	1024	per Rev 💌		
Interpolation Factor:	2048			
Feedback Resolution:	2097152	Feedback Counts per Rev		
Feedback Ratio:	1.0	Aux. Rev/Motor Rev		
		OK Cancel	Apply	Help

IMPORTANT The Aux Feedback tab must be configured for the auxiliary feedback type being used. In this example, an SRM feedback device is being used.

- **4.** From the Feedback Type pull-down menu, choose the feedback type appropriate for your auxiliary feedback motor.
- 5. Click OK.
- 6. Verify your Logix5000 program and save the file.

Download the Program

After completing the Logix5000 configuration you must download your program to the Logix5000 processor.

Apply Power to the Kinetix 6000 Drive

This procedure assumes that you have wired and configured your Kinetix 6000 system (with or without the LIM module) and your sercos interface module.



ATTENTION: Capacitors on the DC bus can 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.

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

Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for connector locations and when troubleshooting the IPIM module and IDM unit status indicators.

Follow these steps to apply power to the Kinetix 6000 drive 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
ls sourced from a LIM module	 Verify that CB1, CB2, and CB3 are in the OFF position. Apply three-phase input power to the LIM module VAC Line connector. Set CB3 to the ON position. Set CB2 to the ON position. Go to main <u>step 3.</u>
ls not sourced from a LIM module	 Apply (95264V AC) control power to the IAM module (CPD connector). Go to main <u>step 3.</u>

3. Observe the IAM/AM module logic power status indicator.



If the Logic Power Indicator is ⁽¹⁾	Then
ON	Go to <u>step 4</u> .
Not ON	 Check your control power connections. Go back to main <u>step 2</u>.

(1) If your 2094 drive system includes a Kinetix 6000M IDM system, observe the drive status indicator and verify that it is on.

lf Your Three-phase Power	Then
ls sourced from a LIM module	 Set CB1 to the ON position. Verify the Hardware Enable Input signal (IOD-2) for each axis is at 0 volts. Remove the connection between IOD-1 and IOD-2 if one exists. ⁽¹⁾ Go to main <u>step 5</u>.
ls not sourced from a LIM module	 Apply 195265V AC (230V) or 324528V AC (460V) input power to the IAM module (IPD connector). Verify the Hardware Enable Input signal (IOD-2) for each axis is at 0 volts. Remove the connection between IOD-1 and IOD-2 if one exists. ⁽¹⁾ Go to main <u>step 5</u>.

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

(1) The hardware enable input for IDM units is on the IPIM module.

5. Observe the IAM/AM module fault status indicator.

The status indicator first flashes the sercos node address, then cycles through ring phases until final configuration (phase 4) is reached.

IAM/AM Fault Status 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 <u>step 6</u> .
Flashing an E followed by two numbers	Drive is faulted.	Go to Kinetix 6000 Drive System Error Codes on page 165.

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

6. Observe the status indicators on the front of the IAM/AM module.

Refer to troubleshooting tables for the Drive, Comm, and Bus status indicators in IAM/AM Module Status Indicators on <u>page 170</u>. Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for IPIM module and IDM unit status indicator troubleshooting tables.

7. Observe the three sercos indicators on the Logix5000 sercos module.

Three Sercos Indicators	Status	Do This
Flashing green and red	Establishing communication	Wait for steady green on all three indicators.
Steady green	Communication ready	Go to Test and Tune the Axes on page 155.
Not flashing green and red/ not steady green	Sercos module is faulted	Go to the appropriate Logix5000 manual for specific instructions and troubleshooting.

Test and Tune the Axes

These procedures assume that you have configured your Kinetix 6000 drive, your Logix5000 sercos interface module, and applied power to the system.

For help with using the Logix Designer application, as it applies to testing and tuning your axes with ControlLogix, CompactLogix, or SoftLogix sercos modules, refer to Additional Resources on page 12.

Test the Axes

Follow these steps to test the axes.

- 1. Verify the load was removed from each axis.
- 2. Right-click an axis in your Motion Group folder and choose Properties.

The Axis Properties dialog box opens.

🏷 Axis Properties - Axis_1	_ 🗆 X
Dynamics Gains Output Limits Offset Fault Actions General Units Conversion Drive Motor/Feedback Homing Hookup*	Tag Tune
<u>I</u> est Increment: 2.0 Revs Test <u>M</u> arker	
Drive Polarity: Positive Test Eeedback.	
Test Command & Feed	lback
DANGER: These tests may cause axis motion with the controller in program mode. Modifying polarity determined after executing the Test Command & Feedback test may cause axis runaway condition.	
OK Cancel Apply	Help

- 3. Click the Hookup tab.
- 4. Type 2.0 as the number of revolutions for the test or another number more appropriate for your application.

This Test	Performs this Test
Test Marker ⁽¹⁾	Verifies marker detection capability as you rotate the motor shaft.
Test Feedback ⁽¹⁾	Verifies feedback connections are wired correctly as you rotate the motor shaft. Also, lets you define polarity.
Test Command & Feedback	Verifies motor power and feedback connections are wired correctly as you command the motor to rotate. Also, lets you define polarity.

(1) If testing motor with brake, energize the brake circuit to release the brake prior to test.

5. Apply Hardware Enable Input signal (IOD-2) for the axis you are testing.



ATTENTION: To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD-2) only to the axis you are testing.

IMPORTANT Hardware Enable input for IDM units is on the IPIM module.

6. Click the desired test (Marker/Feedback/Command & Feedback) to verify connections.

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

Online Command - Encoder Test	×
Command Status: Command Complete	OK
Move axis manually in positive direction. Wait for command to complete.	<u>S</u> top
Check for errors if command fails.	<u>H</u> elp
,	

7. Click OK.

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

Online Command - Apply Test	×
Command Status: Command Complete	ОК
Wait for command to complete. Check for errors if command fails.	<u>S</u> top
4	<u>H</u> elp
-	

- 8. Click OK.
- **9.** Determine if your test completed successfully.

lf	Then
Your test completes successfully, this dialog box opens.	 Click OK. Remove Hardware Enable Input ⁽¹⁾ signal (IOD-2). Go to Tune the Axes on page 157.
Your test failed, this dialog box opens. RSLogix 5000 Test command cannot be completed. Command timed out. Test Increment maybe to large. OK Help Error 16382-0	 Click OK. Verify the Bus status indicator turned solid green during the test. Verify that the Hardware Enable Input ⁽¹⁾ signal (IOD-2) is applied to the axis you are testing. Verify conversion constant entered in the Conversion tab. Return to main step 6 and run the test again.

(1) The hardware enable input for IDM units is on the IPIM module.

Tune the Axes

The load observer feature (available with drive firmware revision 1.124 or later) can provide good performance without having to tune your axis. Using load observer with auto-tuned gains can maximize system performance. Refer to Appendix D beginning on page 235 for more load observer information.

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 re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click the Tune tab.



3. Type values for Travel Limit and Speed.

In this example, Travel Limit = 5 and Speed = 10. The actual value of programmed units depend on your application.

4. From the Direction pull-down menu, choose a setting.

Forward Uni-directional is default.

- 5. Check Tune boxes as appropriate for your application.
- 6. Apply Hardware Enable Input signal (IOD-2) for the axis you are tuning.



ATTENTION: To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD-2) only to the axis you are tuning.

IMPORTANT Hardware Enable input for IDM units is on the IPIM module.

7. Click Start Tuning to auto-tune your axis.

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

Online Command - Tune Servo	×
Command Status: Command Complete	OK
Wait for command to complete after axis motion. Check for errors if command fails.	<u>S</u> top
7	<u>H</u> elp
,	

8. Click OK.

The Tune Bandwidth dialog box opens.

Tune Results			x
Position Loop Bandwidth:	24.202887	Hertz	
Load Inertia Ratio:	0.0	Load Inertia/Motor Inertia	
DANGER:TI the maximum cause loop i	he Bandwidth determin n bandwidth. Increasin nstability.	ed by the tune process is g the bandwidth may	
	OK	Cancel Help	

Actual bandwidth values (Hz) depend on your application and can 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 box opens. When the test completes, the Command Status changes from Executing to Command Complete.

Online Command - Apply Tune	×
Command Status: Command Complete	OK
Wait for command to complete. Check for errors if command fails.	<u>S</u> top
*	<u>H</u> elp
,	

11. Click OK.

lf	Then
Your test completes successfully, this dialog box opens. RSLogix 5000 Apply tune completed successfully. Tune dependent attributes have been updated. Refer to Help for a list of dependent attributes. OK	 Click OK. Remove the Hardware Enable Input ⁽¹⁾ signal (IOD-2) applied earlier. Go to <u>step 13</u>.
Your test failed, this dialog box opens.	 Click OK. Make an adjustment to motor velocity.
RSLogix 5000 Image: Tune command cannot be completed. Command timed out.	 Refer to the appropriate Logix5000 motion module user manual for more information. Return to <u>step 7</u> and run the test again.
Error 16382-0	

12. Determine if your test completed successfully.

(1) The hardware enable input for IDM units is on the IPIM module.

13. Repeat <u>Test and Tune the Axes</u> for each axis.

Configure Drive Parameters and System Variables

This section provides information for accessing and changing parameters not accessible through the Logix Designer application.

IMPORTANTDrive parameters for the Kinetix 6000M IDM system are not accessible
through the HIM module or DriveExplorer software.

Tools for Changing Parameters

Most parameters are accessible through the Logix Designer application. Alternatives include the DPI compatible Human Interface Module (HIM) and DriveExplorer software.

Table 95 - Software For Changing Parameters

Method	Description	Cat. No.	Firmware Revision
Software (1)	DriveExplorer software ⁽²⁾	9306-4EXP02ENE	2.01 or later
Jontware	Serial to SCANport adapter	1203-SSS (Series B)	3.004 or later
HIM module ⁽³⁾	Full numeric LCD HIM	20-HIM-A3	N/A

 Refer to Set the Additional Bus Capacitance Parameter on page 229, for more information on changing parameter values by using DriveExplorer software and 1203-SSS adapter.

(2) Refer to DriveExplorer Getting Results Manual, publication <u>9306-GR001</u>, for instructions.

(3) Compatible catalog numbers include all 20-HIM-Ax.

Change Parameters with DriveExplorer Software

To navigate with DriveExplorer software, refer to the example dialog box below. In this example, the IAM I/O group folder is open, the Analog Outputs parameter group is selected, and the parameter elements are displayed in the box to the right.

IMPORTANTParameters are read-only when the sercos ring is active. You must break the
sercos ring to change parameters.
To save changes, perform a nonvolatile save (NVS) prior to cycling power.

Figure 84 - DriveExplorer Software Example

🞯 DriveExplorer Beta			
<u>File Edit Explore Actions H</u> elp			
D 🛎 E X 🖻 B 😂 🔊 🖸 4	₽₽		
Devices Over the second seco	N:P.P# * 1: 0.681 * 1: 0.682 R 1: 0.982 * 1: 0.683 1: 0.683 1: 0.684 1: 0.983 1: 0.983	Name AnaOut Ch1 Selec AnaOut Ch1 Gain AnaOut Ch1 Value AnaOut Ch2 Selec AnaOut Ch2 Gain AnaOut Ch2 Value	Value 40 0.0060 0.0000 84 0.1000 0.0000

Change Parameters with the HIM Module

When using the HIM module to monitor or change parameters, use the up and down arrows (\land and \lor) to arrive at selections. Refer to the instructions that came with your HIM module for more information.

Follow these steps to monitor or change parameters with the HIM module.

- 1. Select parameter, and press ↓.
- 2. Select I/O AM1 Group (for IAM module), and press ↓.
- 3. Select Analog Outputs, and press ↓.
 - a. Analog Output 1 is displayed, and press 4.
 - b. For Analog Output 2 use arrows to select, and press 4.
- 4. Press Sel.
- **5.** Enter parameter number, and press \downarrow .

Monitor System Variables with Analog Test Points

There are two analog output test points accessible from the IOD 26-pin connector on the IAM and AM module.

Table 96 - IAM/AM I/O 26-pin (IOD) Connector

IOD Pin	Description	Signal
23	Analog output 0	DACO
24	Analog output common	DAC_COM
25	Analog output 1	DAC1
26	Analog output common	DAC_COM

Figure 85 - Pin Orientation for 26-pin I/O (IOD) Connector



Refer to Analog Outputs on page 69 for signal specifications.

Parameters begin with a variable to identify a specific axis by slot number, as follows:

- IAM module = 0 for parameters 0...999
- 1st AM module = 1 for parameters 1000...1999
- 2nd AM module = 2 for parameters 2000...2999 and so on
- 7th AM module = 7 for parameter 7000...7999

Table 97 - Monitor System Variables

Analog	Controlling Parameter		Scale Parameter	
Output	Parameter Number ⁽¹⁾	Default Value ⁽¹⁾	Parameter Number ⁽¹⁾	Default Value
1	<i>x</i> 681	<i>xx</i> 40	<i>x</i> 682	0.0060
2	<i>x</i> 683	<i>xx</i> 84	<i>x</i> 684	0.1000

(1) x = slot number

The value entered in Scale Parameter scales the analog output so that you can get a full scale reading of the specific parameter for the dynamic range or values you are testing.

For linear scaling specifications, refer to the table on page 69.

Table 98 - Monitor Dynamic System Variables

Attribute	Parameter Number ⁽¹⁾
Velocity feedback	<i>xx</i> 40
Velocity commanded	<i>x</i> x36
Torque feedback	xx84
Torque commanded	<i>xx</i> 80

(1) x =slot number.

Troubleshooting the Kinetix 6000 Drive System

This chapter provides troubleshooting tables for your Kinetix 6000 system components.

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Safety Precautions	163
Interpret Status Indicators	164
General System Anomalies	173
Logix5000/Drive Fault Behavior	175

Safety Precautions

Observe these safety precautions when troubleshooting your Kinetix 6000 drive.



ATTENTION: Capacitors on the DC bus can 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.

Interpret Status Indicators

Refer to 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.

Kinetix 6000M IDM System Error Codes

The IAM module reports a single, generic IPIM Fault whenever a fault occurs on any IPIM in the same backplane as the IAM module. All IPIM faults result in an open contactor. The Logix5000 Axis Tag for this fault is IPIMFault.

The IPIM module is not a sercos device, so the IAM module reports any IPIM faults to the Logix5000 motion subsystem. IPIM faults are reset by performing a fault reset on the IAM module. Issuing a fault reset command to the IAM module also generates a fault reset to all the IPIM modules in the same backplane as the IAM. Detailed information about the IPIM fault status can be obtained by messaging to the IAM module.

Connecting the IPIM module into the Logix5000 environment as an EtherNet/ IP device does not disable fault reporting through the IAM module. Only the IAM fault reporting lets the Logix5000 motion sub-system take action based on the IPIM module fault status. IPIM faults are also reported over the Ethernet connection. However, IPIM faults must be reset by applying a fault reset instruction to the IAM module. The integration of the IPIM module into the Logix5000 environment through the EtherNet/IP network provides additional capabilities you can choose to take advantage of in your program.

Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for more information on troubleshooting the IDM drive-motor system.

Kinetix 6000 Drive System 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 status indicator displays 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.

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
No Error Code Displayed		Power (PWR) indicator not ON	No AC power or auxiliary logic power.	Verify AC control power is applied to the Kinetix 6000 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 the Logix Designer application.
			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.
	MotorOvertemp Fault (Motor Overtemp)	Motor thermal switch tripped	 High motor ambient 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
E04				cooling.
			Motor wiring error.	Check motor wiring at MF connector on the IAM/AM module.
			Incorrect motor selection.	Verify the proper motor has been selected.
		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.
	DriveOvercurrent Fault (Power Fault)		Motor winding shorted internally.	Disconnect motor power cables from the motor. If the motor is difficult to turn by hand, consider replacing the motor.
F05			Kinetix 6000 drive temperature too high.	 Check for clogged vents or defective fan. Make sure cooling is not restricted by insufficient space around the unit.
205			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 6000 drive 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 the Logix Designer application.

Table 99 - Seven-segment Status Indicator Error Codes

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E09	BusUndervoltage Fault (Bus Undervoltage)	With three-phase power present, the DC bus voltage is below limits.	 DC bus voltage for 460V system is below 275V 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 limits.	Excessive regeneration of power. When the motor is driven by an external mechanical power source, it can 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 6000 drive). Install shunt module.
			 DC bus voltage for 460V system is over 820V 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.	Improper connections.	 Verify the Hall wiring at the MF connector on the IAM/AM module. 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.
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.

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
			Wiring error.	 Check motor power wiring. Check input power wiring.
E34			Motor internal ground short.	Replace motor.
	GroundShortFault (Ground Fault)	Excessive ground current in the converter was detected.	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 anomaly 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 page 190). Add isolation transformer for control power.
F25	DriveUndervoltage Fault	Converter pre-charge cycle	Low AC input voltage.	Check input AC voltage on all phases.
E33	(Pre-charge Fault)	failed.	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 IAM converter module. Check for clogged vents or defective fan. Make sure cooling is not restricted by insufficient space around the unit.
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 Start-up Error	Motion required for self-sensing start-up 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 by 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.
E49	DriveHardFault (Safe-off HW Flt)	Safe torque-off function mismatch. Drive does not allow motion.	 Loose wiring at STO connector. Cable/header not seated properly in STO connector. Safe torque-off circuit missing +24V DC. 	 Verify wire terminations, cable/header connections, and +24V. Reset error and run proof test. If error persists, return the drive to Rockwell Automation.
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

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
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, sho	orted, or missing.	Check the motor feedback cable connectors/wiring to the IAM/AM module and servo motor.
E63	AuxFeedbackNoise (Aux Fdbk Noise)	Noise on auxiliary feedback cable.	Recommended grounding, per installation	 Verify grounding. Route feedback cable away from noise sources.
E64	MotorFeedbackNoise (Mtr Fdbk Noise)	Noise on motor feedback cable.	instructions, has not been followed.	 Refer to System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u>.
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 FIt)	Autotune procedure failed	Motor or feedback device malfunction.	 Check motor power/feedback wiring. Refer to on-screen message for resolution. Perform Hookup in the Logix Designer application. Consult application help screen.
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)	Nonvolatile memory is corrupt due to control board hardware failure.		Load default parameters, save to nonvolatile memory, and recycle power or reset the drive.
E70	DriveHardFault (NV Mem Init)	Nonvolatile memory is corrupt due to control board software error.		Load default parameters, save to nonvolatile memory, and recycle power or reset the drive.
E71	DriveHardFault (Memory Init)	RAM or nonvolatile memory validation failure		Cycle power.If fault persists, replace module.
			The IAM or an AM module fan failed.	Replace the failed module.
	DriveOvertemp Fault (Drive Overtemp)	Inverter thermal switch tripped	The cabinet ambient temperature is above rating.	Check the cabinet temperature.
E72			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 6000 system is limited or blocked.	Check airflow and re-route cables away from the Kinetix 6000 system.
F73	Communicate	Power rail CAN communication f	failed.	Check module for proper mount.
L/J	(Backplane Comm)	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 module not sized properly.	Check for proper IAM module sizing.Install larger kW rated IAM module.
E75	DriveOvervoltage Fault (Shunt Time Out)	The IAM/AM module, or shunt module 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.

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E76	DriveHardFault (CAN Init)	DPI hardware initialization fault detected.	Control board hardware failure.	 Reset System. If fault persists, replace system module.
E77	DriveHardFault (Module Mismatch)	Either 230V AM module is instal AM module is installed on powe	led on power rail with 460V IAM module, or 460V r rail with 230V IAM module.	Replace mismatched module.
E78	DriveHardFault (Sercos Init)	Control hardware fault detected.		Cycle power.If fault persists, replace module.
E79 DriveOvervoltage Fault (Shunt Module Flt)	Over-temperature fault indicator on Bulletin 2094 shunt module is steady red.		Refer to Temperature Fault Status Indicator on page 172.	
	DriveOvervoltage Fault (Shunt Module Flt)	Shunt-fault indicator on Bulletin 2094 shunt module is steady red.		Refer to Shunt Fault Status Indicator on page 172.
		Bulletin 2094 shunt module is 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.
E81	DriveHardFault (Common Bus Flt)	Follower IAM module detected AC input power being applied.		Remove AC input power connections from follower IAM module.
E90	DriveHardFault (Pre-charge Timeout Flt)	Pre-charge resistor power exceeds the resistor rating.		Wait for resistor to cool.
E95	IPIMFault (IPIM Module Flt)	A fault has occurred in one or more IPIM modules on the power rail.		Refer to the troubleshooting chapter in the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u> .

Table 99 - Seven-segment Status Indicator Error Codes (continued)

IAM/AM Module Status Indicators

Table 100 - Drive Status Indicator

Drive Status Indicator	Drive Status	Possible Resolution
Off	Normal, no faults	N/A
Steady red	Drive faulted	Refer to seven-segment error code and Kinetix 6000 Drive System Error Codes troubleshooting on page 165.

Comm Status Indicator Drive Status Potential Cause Possible Resolution Loose fiber-optic connection. Verify proper fiber-optic cable connections. Broken fiber-optic cable. Replace fiber-optic cable. No communication $^{\left(1\right) }$ 0ff Receive fiber-optic cable connected to sercos transmit Check proper sercos fiber-optic cable connections. connector and vice versa. System is still in the process of establishing sercos Wait for steady green indicator. communication. Flashing green Establishing communication Node address setting on the drive module does not match sercos controller configuration. Verify proper node switch setting. Steady green Communication ready No faults or failures. N/A

Table 101 - Comm Status Indicator

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

Table 102 - Bus Status Indicator

Bus Status Indicator	Bus Status	Condition
Off	No power or DC bus is not present.	 Normal when bus power is not applied. Fault exists, refer to seven-segment error code and Kinetix 6000 Drive System Error Codes troubleshooting on page 165.
	Bus power is present in follower IAM.	 Follower IAM module is not configured as CommonBus Follow in the Logix Designer application. After DC bus voltage is applied, a 2.5 second delay before the indicator begins flashing green is normal operation to provide the common-bus leader module time to complete pre-charge.
Flashing green	Bus power is present, axis disabled. No faults.	 Normal when: 24V is not applied to Hardware Enable Input (IOD-2). MSO instruction is not commanded in the Logix Designer application.
Steady green	Bus power is present, axis enabled. No faults.	 Normal when: 24V is applied to Hardware Enable Input (IOD-2). MSO instruction is commanded in the Logix Designer application.

Shunt Module Status Indicators

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

Table 103 - General Shunt Module Troubleshooting

Module	Status	Under These Conditions	
Shunt	Fault is latched.	Until fault condition is corrected and cleared.	
	Fault is cleared.	 Using MASR, MAFR, MGSR instructions or the HIM (red stop button). Only after the DC bus is discharged (bus status indicator is flashing). Drive must be configured with 2094-BSP2 shunt module or Bulletin 1394 external shunt module. 	
IAM/AM	Disabled (for DC bus regulation).	 When the 2094-BSP2 shunt module is used on a 230V system. When either 230V or 460V system is configured with a Bulletin 1394 external shunt module. When configured in Common-bus Follower mode. 	
	Enabled to discharge the DC bus.	Drive (IAM or leader IAM module) 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 can be required to clear drive and shunt module faults.

Bus Status Indicator	Status	Potential Cause	Possible Resolution
Flashing	Normal condition when control power is appli	N/A	
Steady Green	Normal condition when control power is appli	N/A	
Off	Control power is not present.	Internal power supply failure.	Replace shunt module.

Table 104 - Bus Status Indicator

Table 105 - Temperature Fault Status Indicator

Over-Temp Fault Indicator	Status	Potential Cause	Possible Resolution
Off	Normal condition.		N/A
Steady Red	Church march the instance of	Shunt module fan failed.	Replace shunt module.
	temperature exceeds operating temperature specification.	Shunt module temperature exceeds rating.	 Wait for shunt module to cool. Reset faults. Verify IAM module bus regulator configuration.
	External over temperature condition.	External temperature switch is open.	 Wait for shunt module to cool. Reset faults. Verify IAM module bus regulator configuration.
		TS jumper is not present.	Install jumper.

Table 106 - Shunt Fault Status Indicator

Shunt Fault Indicator	Status Potential Cause		Possible Resolution	
Off	Normal condition		N/A	
Steady Red	Shorted internal or external shunt	Mis-wired shunt jumper or other short on RC connector.	Correct mis-wire (shorted) condition.	
	10313101.	Mis-wired (shorted) external shunt wiring.	• If anomaly persists, replace shart module.	

Table 107 - All Shunt Module Status Indicators

Shunt Module Status Indicator	Status	Potential Cause	Possible Resolution
Bus StatusOver-Temp FaultShunt Fault	All three status indicators flash simultaneously.	Shunt module hardware failure.	Cycle power.If anomaly persists, replace shunt module.

General System Anomalies

These anomalies do not always result in a fault code, but can require troubleshooting to improve performance.

Condition	Potential Cause	Possible Resolution
	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 the Logix Designer application.
	Position loop gain or position controller acceleration or deceleration rate is improperly set.	Run Tune in the Logix Designer application.
Axis or system is unstable.	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 the Logix Designer application.
	Mechanical resonance.	Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
	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 the Logix Designer application again.
You cannot obtain the motor	The system inertia is excessive.	Check motor size versus application need.Review servo system sizing.
acceleration/deceleration that you want.	The system friction torque is excessive.	Check motor size versus application need.
	Available current is insufficient to supply the correct acceleration or deceleration rate.	Check motor size versus 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.
	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.
Motor does not respond to a velocity command.	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 (for example, the motor moves, but the load/machine does not).	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.

Table 108 - General System Anomalies

Table 108 - General System Anomalies (continued)

Condition	Potential Cause	Possible Resolution	
	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 <u>GMC-RM001</u>. 	
Presence of noise on command or motor feedback signal wires.	Line frequency present.	Verify grounding.Route wire away from noise sources.	
	Variable frequency can be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls, for example. The frequency can be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	 Decouple the motor for verification. Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism. 	
	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.	
No rotation	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 deceleration or increase time.		
	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.	
	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.	
	Loose parts are present in the motor.	Remove the loose parts.Return motor for repair.Replace motor.	
Abnormal noise	Through bolts or coupling is loose.	Tighten bolts.	
	The bearings are worn.	Return motor for repair.	
	Mechanical resonance.	Notch filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).	
Erratic operation - Motor	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.	
locks into position, runs without control or with	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.	
reduced torque.	Sine, Cosine, Rotor lead sets of resolver feedback are reversed.	Check and correct motor feedback wiring.	

Logix5000/Drive Fault Behavior

These fault actions are configurable from the Axis Properties dialog box, Fault Actions tab in the Logix Designer application.

Drive Fault Action	Definition
Shutdown	The drive disables the axis as defined in Logix5000/Drive Fault Behavior, Table 110. In addition, the axis in Logix enters the Shutdown state, which disables any axes that are using this axis as a camming or gearing master. In addition, the AxisHomedStatus tag for the faulted axis is cleared. Shutdown is the most severe action to a fault and it is usually reserved for faults that could endanger the machine or operator if power is not removed as quickly as possible.
Disable Drive	The drive disables the axis as defined in Logix5000/Drive Fault Behavior, Table 110.
Stop Motion	The axis decelerates at the maximum deceleration rate (set in the Logix Designer application>Axis Properties>Dynamics tab). Once the axis has come to a stop, the servo loops remain enabled but no further motion can be generated until the fault is reset. This is the gentlest stopping mechanism in response to a fault. It is usually used for less severe faults.
Status Only	The drive continues to operate. Status is provided by the seven-segment fault status indicator, drive status indicator, and DPI (if used). The application program must handle any motion faults. In general, use this setting in applications where the standard fault actions are not appropriate.

Table 109 - Drive Fault Action Definitions

Only selected faults are programmable. In the Logix5000/Drive Fault Behavior table on page 176, the controlling attribute is given for programmable fault actions. All faults that are not configurable have a fault action of Shutdown.

Figure 86 - Axis Properties - Fault Actions Tab

	ѷ Axis Properties - A	xis_1			
	General Motion Plar Homing Hookup	nner Units Dri Tune Dynamics	ve/Motor MotorFeed Gains Output Lim	back Aux Feedback iits Offset Fault Action	Conversion s* Tag
	Drive Enable Input:	Disable Drive	_	Set Custom Stop	Action
e for Motor fault (E04).	Motor Thermal:	Stop Motion	· ·		
	Feedback Noise:	Disable Drive	•		
	Feedback:	Disable Drive	•		
	Position Error:	Disable Drive	•		
	Hard Overtravel :	Disable Drive	T		
	Soft Overtravel :	Disable Drive	T		
			OK Ca	ancel Apply	Help

Drive Fault Action/Attribute for Motor Overtemp fault (E04)

Table 110 - Logix5000/Drive Fault Behavior

Logix5000 Fault Message (HIM Message)	Error Code	Description	Drive Fault Action/ Attribute	Logix Designer Programmable Fault Action?
BusUndervoltageFault (Blown fuse)	E00	A blown fuse was detected in the inverter pcb.	Coast/Disable (open contactor enable relay)	No
MotorOvertempFault (Motor Overtemp)	E04 ⁽¹⁾	The motor thermal switch was tripped. Firmware I ² t 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 or Stop Motion bypasses the foldback behavior and allows the fault to occur.	N/A	Yes Motor Thermal
DriveOvercurrentFault (Power Fault)	E05	An instantaneous over-current was detected in the inverter power section.	Coast/Disable (open contactor enable relay)	No
HardOvertravelFault (+/- Hard Overtravel)	E06	Axis moved beyond the physical travel limits in the positive/negative direction. This fault can be configured for status only.	Decel/Disable	Yes Hard Overtravel
MotFeedbackFault (Motor Feedback Loss)	E07	The feedback wiring is open, shorted or missing.	Coast/Disable	No
BusUndervoltageFault	F09	With 3-phase present, the DC bus voltage is below limits. The trip point is 275V and 137V DC for 460V/230V drives respectively.	Coast/Disable (open	No
(Bus Under Voltage)	207	DC bus voltage is below limits when any axis on common-bus follower power rail was enabled.	contactor enable relay)	NO
DriveOvervoltageFault (Bus Overvoltage)	E10	The DC bus voltage is above limits. The trip point is 820V and 410V DC for 460V/230V drives respectively.	Coast/Disable (open contactor enable relay)	No
MotFeedbackFault (Illegal Hall State)	E11	State of Hall feedback inputs in incorrect.	Coast/Disable	No
SoftovertravelFault (+/- Software Overtravel)	E16	Axis position exceeded maximum software setting in the positive/negative direction. This fault can be configured for status only.	Decel/Disable	Yes Soft Overtravel
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.	Coast/Disable	No
PositionErrorFault (Follow Error)	E19	Axis position error limit has been exceeded. This fault can be configured for status only.	Decel/Disable	Yes Position Error
MotFeedbackFault (Mtr Fdbk AQB)	E20	Motor encoder has encountered an illegal state transition.	Coast/Disable	No
AuxFeedbackFault (Aux Feedback Comm)	E21	Communication was not established with an intelligent (Stegmann) encoder on the Auxiliary feedback port.	Decel/Disable	No
MotFeedbackFault (Motor Feedback Comm)	E30	Communication was not established with an intelligent (Stegmann) encoder on the Motor feedback port.	Decel/Disable	No
GroundShortFault (Ground Fault)	E34	Excessive ground current in the converter was detected.	Coast/Disable (open contactor enable relay)	No
DriveUndervoltageFault (Precharge Fault)	E35	The converter pre-charge cycle has failed.	Coast/Disable (open contactor enable relay)	No
DriveOvertempFault (System Overtemperature)	E36 ⁽²⁾	Converter internal temperature limit exceeded.	Coast/Disable (open contactor enable relay)	No
		One or two phases of the input AC power are missing.	Coast/Disable (open contactor enable relay)	
PowerPhaseLossFault (Phase Loss Flt)	E37	 All phases of the input AC power are missing. Axis was enabled when main (three-phase) power was removed. Common-bus follower axis was enabled when DC bus power was removed. 	Decel/Disable	No

Table 110 - Logix5000/Drive Fault Behavior (continued)

Logix5000 Fault Message (HIM Message)	Error Code	Description	Drive Fault Action/ Attribute	Logix Designer Programmable Fault Action?
SercosFault (Sercos Ring Flt)	E38	The sercos ring is not active after being active and operational.	Decel/Disable	No
DriveHardFault (Self Sense Flt)	E39	Self-sensing commutation fault detected.	Coast/Disable	No
DriveEnableInputFault (Drive Enable Flt)	E43	Generated when Enable input switches off when drive is enabled.	Decel/Disable	Yes Drive Enable Input
DriveHardFault (Safe-Off HW Flt)	E49	Safe torque-off function mismatch. Drive does not allow motion. Refer to the Kinetix Safe Torque-off Feature Safety Reference Manual, publication <u>GMC-RM002</u> , for more information. Applies to 2094- <i>x</i> Cxx-Mxx-S IAM and 2094- <i>x</i> Mxx-S AM modules with safe torque-off feature.	Coast/Disable (open contactor enable relay)	No
SercosFault (Sercos Same ADDR)	E50	Duplicate node address detected on sercos ring.	Decel/Disable	No
DriveHardFault (Ifbk HW Fault)	E54	Current feedback hardware fault detected.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Unknown Axis)	E60	Invalid module type identified by firmware when applying power.	Coast/Disable (open contactor enable relay)	No
AuxFeedbackFault (Aux Fdbk AQB)	E61	Auxiliary encoder has encountered an illegal state transition.	Coast/Disable	No
AuxFeedbackFault (Aux Fdbk Loss)	E62	The feedback wiring is open, shorted or missing.	Coast/Disable	No
AuxFeedbackNoise (Aux Fdbk Noise)	E63	Presence of noise on auxiliary feedback cable.	Coact/Disable	Yes
MotorFeedbackNoise (Mtr Fdbk Noise)	E64	Presence of noise on motor feedback cable.	COASI/DISADIC	Feedback Noise
No Fault Message (condition indicated by on-screen message) (Hookup Fault)	E65	Hookup procedure failed.	Coast/Disable	No
No Fault Message (condition indicated by on-screen message) (Atune Flt)	E66	Autotune procedure failed.	Coast/Disable	No
DriveHardFault (Task init)	E67	Operating system failed.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (SCANport Comm)	E68	DPI communication failed.	Decel/Disable	No
DriveHardFault (Objects Init)	E69	Nonvolatile memory attribute out of range.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (NV Mem Init)	E70	Nonvolatile memory corrupted.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Memory Init)	E71	RAM or nonvolatile memory validation failure.	Coast/Disable (open contactor enable relay)	No

Table 110 - Logix5000/Drive Fault Behavior (continued)

Logix5000 Fault Message (HIM Message)	Error Code	Description	Drive Fault Action/ Attribute	Logix Designer Programmable Fault Action?
DriveOvertempFault (Drive Overtemp)	E72	Inverter temperature limit exceeded. Firmware I ² t protection does not generate a fault, rather it dynamically folds back current when 110% of drive rating is reached. Setting the Drive Thermal fault action to Status Only or Stop Motion bypasses the foldback behavior and allows the fault to occur.	N/A	Yes Drive Thermal
Communicate (Backplane Comm)	E73	Power rail backplane CAN communication failed.	Decel/Disable	No
DriveOvercurrentFault (Bus OverCurrent)	E74	The converter has exceeded its converter rating.	Coast/Disable (open contactor enable relay)	No
DriveOvervoltageFault (Shunt Time Out)	E75	The IAM/AM module or shunt module has exceeded its shunt resistor continuous rating. SHUTDOWN for IAM module, DISABLE for AM module. IAM module provides fault handling for shunt module.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Can Init)	E76	Either DPI or backplane CAN initialization failure.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Module Mismatch)	E77	Generated by IAM module if the power rating of an AM module on the same power rail does not match with IAM module input power rating.	Coast/Disable (open contactor enable relay)	No
DriveHardFault Sercos Init	E78	Control hardware fault detected.	Coast/Disable (open contactor enable relay)	No
DriveOvervoltageFault (Shunt Module Flt)	E79	Power rail mounted shunt module fault. Displayed on IAM module seven-segment fault status indicator.	Coast/Disable (open contactor enable relay)	No
HardwareFault (CPLD Flt)	E80	Control hardware fault detected.	Coast/Disable (open contactor enable relay)	No
HardwareFault (Common Bus Flt)	E81	Common-bus follower IAM module detected AC input power being applied.	Coast/Disable (open contactor enable relay)	No
HardwareFault (Pre-charge Timeout Flt)	E90	Pre-charge resistor power exceeds the resistor rating.	Coast/Disable (open contactor enable relay)	No
IPIMFault (IPIM Module Flt)	E95	A fault has occurred in one or more IPIM modules on the power rail.	Coast/Disable (open contactor enable relay)	No

(1) The Logix5000 Motor Thermal Fault Action is tied to the motor thermostat fault. If this is set to Shutdown or Disable (in controller), the drive folds back the current when the l²T calculation indicates that the motor temperature has exceeded 10% of its rated temperature. If it is set to Stop Motion or Status Only, the drive does not fold back the current. The l²T calculation never generates a fault.

(2) The Logix5000 Drive Thermal Fault Action is tied to the drive thermostat fault. The drive always folds back the current when the I²T calculation indicates that the drive has exceeded 110% of its rating. The I²T calculation never generates a fault.

Removing and Replacing the Kinetix 6000 Drive Modules

This chapter provides remove and replace procedures for your Kinetix 6000 system components.

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ATTENTION: This drive contains electrostatic discharge (ESD) 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 Guarding Against Electrostatic Damage, publication 8000-4.5.2, or any other applicable ESD awareness handbook.

Before You Begin

These tools are required before you begin removal and replacement procedures:

- Flat-blade screwdriver, 3.5 mm (0.14 in.)
- Voltmeter

Remove Kinetix 6000 Drive Modules

Follow these steps to remove the IAM, AM, and IPIM modules from the Bulletin 2094 power rail.

1. Verify that all control and input power has been removed from the system.



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

2. Wait five minutes for the DC bus to discharge completely before proceeding.



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. Do not attempt the procedures in this document unless you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

3. Label and remove all connectors from the IAM/AM module you are removing.

To identify each connector, refer to page 58.

4. Remove the motor cable from the cable shield clamp, as shown in these examples.



- 5. Loosen the mounting screw (bottom center of each module).
- 6. Grasp the top and bottom of the module with both hands and gently pull the module away from the connectors enough to clear the guide pins (module pivots on top bracket).
7. Lift the bracket out of the power rail slot and remove the module from the power rail.



TIP

This procedure also applies to Bulletin 2094-BSP2 shunt module, 2094-PRF slot-filler module, and 2094-SEPM-B24-S IPIM module.

Follow these steps to replace drives from the Bulletin 2094 power rail.

1. Determine your drive module replacement.

If you are	Then
Replacing a drive module on an existing power rail	Go to <u>step 3</u> .
Replacing a drive module on a new power rail	Go to <u>step 2</u> .

- **2.** Prepare to mount your replacement drive module by removing the protective covers from the power rail connectors.
- 3. Hang the mounting bracket from the slot on the power rail.

IMPORTANT Power rails must be in vertical orientation before replacing drive modules for pins to seat properly.

- **4.** Align the guide pins on the power rail with the guide pin holes in the back of the drive module (refer to the figure above).
 - TIP The IAM module can have two or three power rail connectors and guide pins, the AM module can have one or two, all other modules have only one connector and one guide pin.
- 5. Use 2.26 N•m (20 lb•in) torque to tighten the mounting screw.
- 6. Reconnect the module connectors.
- 7. Reapply power to the system.

Replace Kinetix 6000 Drive Modules

8. Verify that the system is operating properly.

TIP Because parameter settings reside in the Logix Designer application, you do not need to perform any tuning or set-up 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 on the right side of the power rail.



- 2. Loosen the mounting bolts (removing the bolts is not necessary).
- 3. Lift the power rail up and off of the mounting bolts.

Replace the Power Rail

This procedure assumes you do not need to change the location of the power rail on the panel and you intend to reuse the mounting bolts of the power rail you just removed.

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 6000 Power Rail Installation Instructions, publication <u>2094-IN003</u>.



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. Reattach the braided grounding strap to the power rail grounding stud (refer to page 182).

Notes:

Interconnect Diagrams

This appendix provides wiring examples and system block diagrams for your Kinetix 6000 system components.

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Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 6000 drive system. These notes apply to the wiring examples on the following pages.

Note	Information			
1	For power wiring specifications, refer to Power Wiring Requirements on page 95.			
2	For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Options on page 28.			
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 AC line filter specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>GMC-TD004</u> .			
4	Terminal block is required to make connections.			
5	2094-BCxx-Mxx-x (460V) IAM modules require a step down transformer for single-phase control power input. Source the 2094-ACxx-Mxx-x (230V) IAM module control power from the three-phase input power (line-to-line) with neither leg of the transformer secondary bonded to ground or neutral potential. Supplying control power from any other source requires an isolation transformer. The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder.			
6	2094-ALxxS and 2094-BLxxS and 2094-XL75S-C2 LIM modules can supply input power for up to eight axes. 2094-XL75S-C1 LIM modules can supply input power for up to sixteen axes. For common-bus systems with more than sixteen axes, multiple LIM modules (or control power transformers) are required. For Kinetix 6000M systems, the control power current needs to be calculated and the LIM module needs to be sized.			
7	2094-ALxxS, 2094-BLxxS, and 2094-XL75S-Cx LIM modules are capable of connecting to two IAM modules, providing each IAM module 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 Kinetix Servo Drives Technical Data, publication GMC-TD003.			
9	Drive Enable input must be opened when main power is removed, or a drive fault occurs. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.			
10	Cable shield clamp must be used to meet CE requirements. No external connection to ground is required.			
11	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 Determine the Input Power Configuration on page 83 for more information.			
12	Leave jumper between PR2 and PR3 as shown to use the internal pre-charge resistor. Remove jumper when external pre-charge/circuit is required. For more information, refer to the 8720MC Regenerative Power Supply Installation Manual, publication <u>8720MC-RM001</u> .			
13	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 <u>SHB-900</u> .			
14	ATTENTION: Wiring the contactor enable relay is required. Refer to Contactor Enable Relay on <u>page 70</u> , for more information. The recommended minimum wire size for wiring the safety circuit to the contactor enable connector is 1.5 mm ² (16 AWG).			
15	The Bulletin 2094 axis module referenced is either an individual axis module (catalog number 2094- <i>xMxx-x</i>) or the same axis module that resides within an integrated axis module (catalog number 2094- <i>xCxx</i> -Mxx-x).			
16	For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>GMC-TD004</u> .			
17	Wire colors are for flying-lead cable and can vary from the premolded cable connectors.			
18	Motor power cables (2090-XXNPMF-xxSxx and 2090-CPBM6DF-16AAxx) have a drain wire that must be folded back under the cable shield clamp.			
19	MPL-A15xxMPL-A45xx, MPM-A115xxMPM-A130xx, MPF-A3xxMPF-A45xx, MPS-Axxx, MPAR-Axxx, and MPAS-Axxx, encoders use the +5V DC supply.			
20	MPL-Bxx, MPL-A5xx, MPM-Bxx, MPM-A165xx MPM-A215xx, MPF-Bxx, MPF-A5xx, MPS-Bxxx, MPAR-Bxxx, and MPAS-Bxxx encoders use the +9V DC supply.			
21	Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and GND or A, B, C, and D respectively.			

Power Wiring Examples

These examples apply to power wiring configurations with and without the Bulletin 2094 line interface module (LIM), DC common bus wiring, and shunt module wiring.



Figure 87 - Single IAM Module with 2094-AL09 or 2094-BL02 LIM Module



Figure 88 - Multiple IAM Module with LIM Module



Figure 89 - Multiple IAM Module with LIM Module (continued)

This configuration does not include a LIM module. 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 70 for more information.



Figure 90 - IAM Module (without LIM module)

DC Common Bus Wiring Examples







Figure 92 - Leader IAM Module with Multiple Follower IAM Modules



Figure 93 - Leader IAM Module with Multiple Follower IAM Modules (continued)



Figure 94 - 8720MC-RPS Leader Drive with Single Follower IAM Module

Shunt Module Wiring Examples

Refer to Kinetix Motion Accessories Technical Data, publication <u>GMC-TD004</u> for the Bulletin 1394 external shunt module catalog numbers available for the Kinetix 6000 drive systems.

Figure 95 - Shunt Module Wired for Internal Operation (default configuration)



Refer to the Kinetix 6000 Shunt Module Installation Instructions, publication 2094-IN004, for additional installation information.

Figure 96 - Shunt Module with External Passive Shunt



IMPORTANT Only passive shunts with a thermal switch are wired to the TS connector on the Kinetix 6000 shunt module. If your external passive shunt does not have a thermal switch, leave the jumper (default configuration) in place on the TS connector.

Refer to the External Shunt Module Installation Instructions, publication <u>2090-</u><u>IN004</u>, for additional installation information.

Axis Module/Rotary Motor Wiring Examples

These examples apply to Kinetix 6000 drives with Allen-Bradley rotary motors.

IMPORTANT The Bulletin MPL motor wiring examples on this page apply to motors equipped with bayonet connectors.







IMPORTANT The Bulletin MPL motor wiring examples on this page apply to motors equipped with circular DIN (threaded) connectors.



Figure 99 - AM Module with MP-Series (Bulletin MPL-A/B and MPS-A/B) Motors

IMPORTANT The Bulletin MPL motor wiring examples on this page apply to motors equipped with circular DIN (SpeedTec) connectors.



Figure 100 - AM Module with MP-Series Motors (Bulletin MPL-A/B, MPM-A/B, and MPF-A/B)

IMPORTANT

The Bulletin MPL motor wiring examples on this page apply to motors equipped with circular DIN (SpeedTec) connectors.





Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.



Figure 102 - AM Module with RDD-Series Direct Drive Motors

Refer to Low Profile EnDat Feedback Module Installation Instructions, publication 2090-IN020, for connector kit specifications.



Figure 103 - AM Module (230V) Wiring Example with TL-Series Motors (Bulletin TLY-A)





Figure 104 - AM Module (460V) Wiring Examples with 1326AB Motors

(1) When wiring the thermal switch on 1326AB (resolver-based) motors requires the use of the 2090-K6CK-D15MF Low-profile connector kit and wire extension to the power connector. Pins 16, 17, and S are filtered to prevent noise transmission back to the drive. Refer to page 124 for wiring instructions and a diagram.



Figure 105 - AM Module (230V) Wiring Example with F-Series Motors

Axis Module/Linear Motor/ Actuator Wiring Examples

These examples apply to Kinetix 6000 drives with Allen-Bradley linear motors and actuators.



Figure 106 - AM Module with MP-Series Integrated Linear Stages

Note 16



Figure 107 - AM Module with MP-Series Electric Cylinders



MP-Series Electric Cylinder Cat. No.	Frame	Power Cable Cat. No.	Feedback Cable Cat. No.	
MPAR-A/B1xxx (series A)	32	2090-XXNPMF-16Sxx (standard) or	2090-XXNFMF-Sxx (standard) or	
MPAR-A/B2xxx (series A)	40	2090-CPxM4DF-16AFxx (continuous-flex)	2090-CFBM4DF-CDAFxx (continuous-flex)	
MPAR-A/B1xxx (series B)	32			
MPAR-A/B2xxx (series B)	40			
MPAR-A/B3 <i>xxx</i>	63			
MPAI-A/B2 <i>xxxx</i>	64	2090-CPxM7DF-16AAxx (standard) or 2090-CPxM7DF-16AFxx (continuous-flex)	2090-CFBM7DF-CEAA <i>xx</i> (standard) or 2090-CFBM7DF-CEAF <i>xx</i> (continuous-flex)	
MPAI-A/B3xxxx	83			
MPAI-A/B4xxxx	110			
MPAI-B5 <i>xxxx</i>	144			
MPAI-A5 <i>xxxx</i>	144	2090-CPxM7DF-14AAxx (standard) or 2090-CPxM7DF-14AFxx (continuous-flex)	2090-CFBM7DF-CEAAxx (standard) or 2090-CFBM7DF-CEAFxx (continuous-flex)	



Figure 108 - AM Module with LDAT-Series Linear Thrusters



Figure 109 - AM Module with LDC-Series or LDL-Series Linear Motors (cable connectors)



Figure 110 - AM Module with LDC-Series or LDL-Series Linear Motors (flying-lead cables)

Kinetix 6000M Integrated Drive-Motor Wiring Example

This example applies to Kinetix 6000 drives with Kinetix 6000M IDM systems.



Figure 111 - IPIM Module with IDM Unit

Controlling a Brake Example

The relay output of the Kinetix 6000 (MBRK \pm BC-5 and BC-6) is suitable for directly controlling a motor brake, subject to the relay voltage limit of 30V DC, and the relay current limit as shown below.

Table 112 - Brake Relay Current Limit

Kinatiy 6000 IAM/AM Madula	Brake Current Value, max		
Killetix 0000 IAM/AM Module	Series A	Series B	Series C
2094-AC05-Mxx-x, 2094-AC09-M02-x, 2094-AMP5-x, 2094-AM01-x, 2094-AM02-x	104	N/A	
2094-BC01-Mxx-x, 2094-BC02-M02-x, 2094-BMP5-x, 2094-BM01-x, 2094-BM02-x	1.0 A	3.0 A	301
2094-AC16-M03-x, 2094-AC32-M05-x, 2094-AM03-x, 2094-AM05-x	1.3 A	N/A	J.0 K
2094-BC04-M03- <i>x</i> , 2094-BC07-M05- <i>x</i> , 2094-BM03- <i>x</i> , 2094-BM05- <i>x</i>	3.0 A	3.0 A	

Table 113 - Coil Currents Rated at <1.0 A

Compatible Brake Motors/Actuators ⁽¹⁾	Coil Current	Compatible Brake Motors	Coil Current
MPL- <i>x</i> 1510, MPL- <i>x</i> 1520, MPL- <i>x</i> 1530	0.430.53 A	TLY-A110T-H, TLY-A120T-H, and TLY-A130T-H	0.180.22 A
MPL- <i>x</i> 210, MPL- <i>x</i> 220, MPL- <i>x</i> 230	0.460.56 A	TLY-A220T-H and TLY-A230T-H	0.3330.407 A
MPL/MPF-x310, MPL/MPF-x320, MPL/MPF-x330	0.45 0.55 A	TLY-A2530P-H, TLY-A2540P-H, and TLY-A310M-H	0.3510.429 A
MPS- <i>x</i> 330, MPM- <i>x</i> 115, MDF-SB1003	0.430.33 A	1326AB-B4 <i>xxx</i>	0.88 A
MPL-x420, MPL-x430, MPL-x4520, MPL-x4530, MPL-x4540, MPL-x4560		F-4030, F-4050, and F-4075	0.69 A
MPF-x430, MPF-x4530, MPF-x4540	0.5760.704 A		
MPS-x4540, MPM-x130, MDF-SB1153, MDF-SB1304			

Table 114 - Coil Currents Rated at >1.0 A and \leq 1.3 A

Compatible Brake Motors ⁽¹⁾	Coil Current	Compatible Brake Motors	Coil Current
MPL- <i>x</i> B520, MPL- <i>x</i> B540, MPL- <i>x</i> 560, MPL- <i>x</i> 580	1.05 1.28 A	F-6100, F-6200, and F-6300	1.30 A
MPF-x540, MPS-B560, MPM-x165	1.051.20 A	1326AB-B5xxx, and 1326AB-B7xxx	1.20 A

(1) Use of the variable *x* indicates this specification applies to 230V and 460V motors.

Table 115 - Coil Currents Rated at >1.3 A and \leq 3.0 A

Compatible Brake Motors	Coil Current
MPL-B640, MPL-B660, MPL-B680	1.912.19 A
MPL-B860, MPL-B880	2.052.50 A
MPM-x215	1.842.25 A
MPL-B960, MPL-B980	N/A

IMPORTANT Because the coil current for MPL-B960 and MPL-B980 motors is rated 3.85...4.70 A, an external relay must be used.

System Block Diagrams

This section provides block diagrams of the Kinetix 6000 drive modules. For block diagrams of the LIM module and RBM module, refer to Additional Resources on page 12 for the documentation available for those products.

Figure 112 - IAM/AM Module (inverter) Block Diagram







Figure 114 - Shunt Module Block Diagram

Upgrading the Drive Firmware

This appendix provides procedures for upgrading firmware by using either ControlFLASH software.

Торіс	Page
Upgrade Kinetix 6000M System Firmware	215
Upgrade Drive Firmware with ControlFLASH Software	216

Upgrading firmware for the Kinetix 6000M integrated drive-motor (IDM) system is done by using ControlFLASH software. The procedure for upgrading the IDM units uses the sercos interface, similar to the axis modules. However, upgrading firmware on the IPIM module is accomplished over the EtherNet/IP network.

IMPORTANT	DriveExplorer software does not apply to Kinetix 6000M firmware
	upgrades.

For the firmware upgrade procedure specific to the IDM system, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

Upgrade Kinetix 6000M System Firmware

Upgrade Drive Firmware with ControlFLASH Software

Upgrading axis module firmware by using ControlFLASH software involves configuring your controller communication, selecting the drive to upgrade, and upgrading the firmware.

Before You Begin

You need the following software and information before you begin.

Description	Cat. No.	Firmware Revision or Software Version
RSLogix 5000 software or	RSLogix 5000 software	15. <i>x</i> or later
the Logix Designer application	Logix Designer application	21.x or later
Controll agiv corres module	1756-M <i>xx</i> SE	15.32 or later
ControlLogix sercos module	1756-L60M03SE	15.4 or later
CompactLogix sercos module	1768-M04SE	15.35 or later
SoftLogix sercos PCI card	1784-PM16SE	15.33 or later
RSLinx [®] software	2.50 or later	
ControlFLASH software kit ⁽¹⁾		4.00.09 or later
Catalog number of the targeted IAM/AM n	odule you want to ungrade	4

Catalog number of the targeted IAM/AM module you want to upg

Network path to the targeted IAM/AM module.

 Download the ControlFLASH kit from <u>http://support.rockwellautomation.com/controlflash</u>. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.

For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit User Manual, publication <u>1756-UM105</u>.

IMPORTANT Control power must be present at CPD-1 and CPD-2 prior to upgrading your target drive.

The seven-segment status indicator on the target IAM (inverter) module or AM module must be displaying a fixed 2, 3, or 4 before beginning this procedure.



ATTENTION: To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase AC or common-bus DC input power to the drive.
Configure Logix5000 Communication

This procedure assumes that your communication method to the Logix5000 controller is using the Ethernet protocol. It is also assumed that your Logix5000 Ethernet module has already been configured.

For more information, refer to the ControlLogix System User Manual, publication <u>1756-UM001</u>.

Follow these steps to configure Logix5000 communication.

- 1. Open your RSLinx Classic software.
- 2. From the Communications pull-down menu, choose Configure Drivers.

Available Driver Types:		
Ethernet devices	Add New	
Configured Drivers:		
Name and Description	Status	
		Configure.
		Startup
		Start
		Stop
		Delete

The Configure Drivers dialog box opens.

- 3. From the Available Drive Types pull-down menu, choose Ethernet devices.
- 4. Click Add New.

The Add New RSLinx Classic Driver dialog box opens.

5. Type the new driver name.

Choose a name for the new driver. (15 characters maximum)	OK
	Cancel

6. Click OK.

The Configure driver dialog box opens.

nfigure d	river: AB_ETH-1	?
tation Mapp	ing	
Station	Host Name	Add New
	and the second sec	
0	10.91.36.82	10 0000000

7. Type the IP address of your Logix5000 Ethernet module.

The IP address shown is an example. Yours will be different.

8. Click OK.

The new Ethernet driver appears under Configured Drivers.

Configure Drivers		<u>?</u> ×
Available Driver Types:		Close
Ethernet devices	▼ Add New	
		Help
Configured Drivers:		
Name and Description	Status	
AB_ETH-1 A-B Ethernet RUNNING	Bunning	Configure
LocalSubhet A-B Ethemet RUNNING	Running	Startun
		Start
		Stop
		Delete

- 9. Click Close.
- **10.** Minimize the RSLinx application dialog box.

Upgrade Firmware

Follow these steps to select the drive module to upgrade.

1. Open your ControlFLASH software.

You can access the ControlFLASH software by either of these methods:

- From the Tools menu in the Logix Designer application, choose ControlFLASH.
- Choose Start>Programs>FLASH Programming Tools> ControlFLASH.

The Welcome to ControlFLASH dialog box opens.

Control	Welcome update to following begin up 1. The Ca 2. The Ne (c 3. The Ne 4. The Fin	e to ControlFLASH ool. ControlFLASH information from dating a device. Italog Number of twork Number potional). etwork Path to the mware Revision f	H, the firmware I needs the you before it can the target device. ion parameters a target device. or this update.	
	View I	Log Next >	Cancel	Help

2. Click Next.

The Catalog Number dialog box opens.

Catalog Number
Control 2094-BC01-MP5 2094-BC01-MP5 2094-AM02 2094-AM05 2094-AM05 2094-BC01-MP5 2094-AM05 2094-BC01-MP5 2094-AM05 2094-BC01-M01 2094-AM05 2094-BC01-M01 2094-BM05 2094-BM01 2094-BM01 2094-BM05 2094-BM05 2094-BM05 2094-BM05
< Back Next > Cancel Help

3. Select your drive module.

In this example, the 2094-BC01-MP5 IAM module is selected.

4. Click Next.

The Select Device to Update dialog box opens.



- 5. Expand your Ethernet node, Logix5000 backplane, and EtherNet/IP network module.
- 6. Select the servo drive to upgrade.
- 7. Click OK.

The Firmware Revision dialog box opens.

Firmware Revision	
Control FLASH	Catalog Number: 2094-BC01-MP5 Serial Number: 0000000 Current Revision: 1.88 Select the new revision for this update: RevisiRestricti 1.89 Show All Restrictions
	Current Folder: c:\progra~1\contro~1
	< Back Next > Cancel Help

- 8. Select the firmware revision to upgrade.
- 9. Click Next.

The Summary dialog box opens.



- 10. Confirm the drive catalog number and firmware revision.
- 11. Click Finish.

This ControlFLASH warning dialog box opens.

Summary Control FLASH	DANGER: The target module is about to be update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all eafeth critical functions are not controlFLASH
	Yes No More Info
	< Back Finish Cancel Help

12. Click Yes (only if you are ready).

This ControlFLASH warning dialog box opens.



13. Acknowledge the warning and click OK.

The Progress dialog box opens and upgrading begins.

Progress		
Catalog Number: Serial Number:	2094-BC01-MP5 00000000	
Current Revision: New Revision:	1.88 1.89	
Transmitting block	: 2751 of 5377	
	Cancel	

The drive module seven-segment

status indicator changes from the fixed 2, 3, or 4 to F, which indicates that upgrading is in progress.

After the upgrade information is sent to the drive, the drive resets and performs diagnostic checking.

14. Wait for the Progress dialog box to time out.

Progress	
Catalog Number: Serial Number:	2094-BC01-MP5 00000000
Current Revision: New Revision:	1.88 1.89
Transmitting block	5377 of 5377
	Cancel

15. The Update Status dialog box opens and indicates success or failure as described below.

Upgrading Status	lf
Success	 Update complete appears in a GREEN Status dialog box. Go to <u>step 16</u>.
Failure	 Update failure appears in a RED Status dialog box. Refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication <u>1756-QS105</u>, for troubleshooting information.

Update Status	x
Catalog Number: 2094-8C01-MP5 Serial Number: 00000000	ОК
Current Revision: 1.88 New Revision: 1.89	View Log
Status: Update complete. Please verify this new	Help
firmware update before using the target device in its intended application.	Repeat

16. Click OK.

Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

- **TIP** Verifying the firmware upgrade is optional.
- **1.** Open your RSLinx software.
- 2. From the Communications pull-down menu, choose RSWho.



- **3.** Expand your Ethernet node, Logix5000 backplane, and EtherNet/IP network module.
- 4. Right-click the drive module and choose Device Properties.

۰.

L	he	L)ev	nce	ŀ	rop	oerti	es c	11a.	log	box	op	ens.
---	----	---	-----	-----	---	-----	-------	------	------	-----	-----	----	------

-

\B_ETH-2\10.91.3	6.169\Backplane\5\SERCOS int <mark>?</mark> 🕽			
Device Name:	2094-BC01-MP5			
Vendor:	Allen-Bradley Company			
Product Type:	115			
Product Code:	93			
Revision:	1.89			
Serial Number: 00000000				
Faults:				
	- 1 1			
	Close Help			

- 5. Verify the new firmware revision level.
- 6. Click Close.

-

Notes:

DC Common Bus Applications

This appendix provides integration procedures specific to Kinetix 6000 multiaxis drive systems configured for DC common bus. The procedure involves calculating capacitance values and setting the Additional Bus Capacitance parameter by using DriveExplorer software.

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Calculate Total Bus Capacitance	226
Calculate Additional Bus Capacitance	227
Bulletin 2094 Drive Capacitance Values	227
Common Bus Capacitance Example	228
Set the Additional Bus Capacitance Parameter	229

To set the Additional Bus Capacitance parameter by using the Logix Designer application, refer to <u>Appendix E</u> beginning on <u>page 249</u>.

Calculating capacitance, as it applies to the Bulletin 2094 shunt module and Kinetix 6000M IPIM module, is also included in this appendix.

These procedures assume you have mounted and wired your Kinetix 6000 DC common-bus system.

Before you set the Additional Bus Capacitance (Add Bus Cap) parameter in DriveExplorer software or the Logix Designer application, you need to calculate these values:

• Total bus capacitance

Before You Begin

• Additional bus capacitance

Calculate Total Bus Capacitance

Total bus capacitance is the sum of all capacitance values for your Bulletin 2094 common-bus modules. Specifically, this includes the capacitance values for each of these modules:

- Leader IAM (converter and inverter) module
- Each AM and shunt module (if present) on the leader IAM power rail
- Each IPIM module (if present) on the leader IAM power rail
- Each follower IAM (converter and inverter) module
- Each AM module on the follower IAM power rail
- Each IPIM module (if present) on the follower IAM power rail

Refer to Bulletin 2094 Drive Capacitance Values on page 227 for IAM, AM, IPIM, and shunt module capacitance values.

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

Table 116 - Maximum IAM Module Bus Capacitance

Leader IAM (200V-class) Module	Bus Capacitance, max μF	Leader IAM (400V-class) Modules	Bus Capacitance, max μF
2094-AC05-MP5- <i>x</i>	7145	2094-BC01-MP5- <i>x</i>	4585
2094-AC05-M01-x		2094-BC01-M01- <i>x</i>	600
2094-AC09-M02-x	15,295	2094-BC02-M02- <i>x</i>	8955
2094-AC16-M03-x	34,400	2094-BC04-M03- <i>x</i>	8955
2094-AC32-M05- <i>x</i>	62,825	2094-BC07-M05- <i>x</i>	17,915

IMPORTANT If your total bus capacitance value exceeds the value in the table above, you must increase the size of the leader IAM module or decrease the total bus capacitance by removing other modules on the power rail.

Calculate Additional Bus Capacitance

Bulletin 2094 Drive

Capacitance Values

Additional bus capacitance is the sum of all follower IAM, AM, and IPIM module capacitance values for your Bulletin 2094 common-bus modules. Specifically, this includes the capacitance values for each of these modules:

- Each follower IAM (converter and inverter) module
- Each AM module on the follower IAM module power rail
- Each IPIM module on the follower IAM module power rail

Enter the additional bus capacitance value in Set the Additional Bus Capacitance Parameter beginning on page 230.

Use these tables when calculating total bus capacitance and additional bus capacitance for your Bulletin 2094 common-bus application.

Table 117 - IAM/AM (200V-class) Modules

IAM Converter (200V-class)	Capacitance μF	
2094-AC05-MP5- <i>x</i>	270	
2094-AC05-M01- <i>x</i>	270	
2094-AC09-M02-x	540	
2094-AC16-M03-x	1320	
2094-AC32-M05- <i>x</i>	1980	

AM Inverter (200V-class)	Capacitance μF
2094-AMP5- <i>x</i>	390
2094-AM01- <i>x</i>	660
2094-AM02 <i>-x</i>	780
2094-AM03 <i>-x</i>	1320
2094-AM05 <i>-x</i>	2640

Table 118 - IAM/AM (400V-class) Modules

IAM Converter (400V-class)	Capacitance μF		
2094-BC01-MP5- <i>x</i>	110		
2094-BC01-M01- <i>x</i>	110		
2094-BC02-M02- <i>x</i>	220		
2094-BC04-M03- <i>x</i>	940		
2094-BC07-M05-x	1410		

AM Inverter (400V-class)	Capacitance μF
2094-BMP5- <i>x</i>	75
2094-BM01- <i>x</i>	150
2094-BM02- <i>x</i>	270
2094-BM03- <i>x</i>	840
2094-BM05- <i>x</i>	1175

Table 119 - Shunt Module (200/400V-class)

Shunt Module	Capacitance	
(200/400V-class)	μF	
2094-BSP2	470	

Table 120 - IPIM Module (400V-class)

IPIM Module (400V-class)	Capacitance μF	
2094-SEPM-B24-S	840	

Common Bus Capacitance Example

In this example, the sum of the leader IAM power rail modules capacitance (6530 $\mu F)$ and the follower IAM power rail modules capacitance (5280 $\mu F)$ equals 11,810 μF total bus capacitance.

The sum of the follower IAM module power rail equals 5280 μF additional bus capacitance.

Figure 115 - Calculating Common Bus Capacitance



Set the Additional Bus Capacitance Parameter

In this section you set the Add Bus Cap parameter by using DriveExplorer software.

- **TIP**You can also set the Add Bus Cap parameter by changing IDN parameter
values. Refer to <u>Appendix E</u> on <u>page 249</u> for more information.
- **TIP** You can use this procedure to change other parameters too, the Analog Output parameters, for example.

The following hardware and software tools are required to provide the necessary communication link between your personal computer and the Kinetix 6000 drive system running DriveExplorer software.

Table 121 - Kinetix 6000 System Requirements

Description	Cat. No.	Version	
DriveExplorer software ^{(1) (2)}	9306-4EXP02ENE	2.01 or later	
Serial to SCANport adapter ^{(2) (3)}	1203-SSS (Series B) 3.004 or later		
Studio 5000 Logix Designer application	03.27-BI D300vvE	21.0 or later	
RSLogix 5000 software	- 9324-NED30000	15.0 or later	

(1) Refer to DriveExplorer Getting Results Manual, publication <u>9306-GR001</u>, 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 20C0MM-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 makes sure that motion does not occur while changes are being made to the Add Bus Cap parameter.

Remove Sercos Communication

Follow these steps to remove (break) sercos communication.

- 1. Remove three-phase and control power from the Kinetix 6000 drive system.
- 2. Remove one of the sercos fiber-optic cables.

Fiber-optic cable connections (Tx and Rx) are on the top of each IAM and AM module.

3. Re-apply 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 Explore menu, choose Connect>Local or press CTRL+L.

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. Choose Devices>Node>Product and navigate to the parameter *x:x:x*599 as shown below.

📴 DriveExplorer					
<u>File E</u> dit E <u>x</u> plore <u>A</u> ctions <u>H</u> elp					
D 🛎 🖬 🖇 🖻 🖨 🔊 • Tế 🔒	₽₽ ≖				
🖃 Devices	S N:P.P#	Name	Value	Units	~
Node 1: - 2094D SERVO	1: 0.593	Shunt Ws	10	%	
- 0 - 2094D SERVO Config 0000	1: 0.594	Shunt Kl	111	sec	
H- TAM	1:0.595	Shunt Ks	130	msec	
E IOM Diago	1:0.596	Shunt Power	200	watt	
	1: 0.597	Shunt Res	28.75	Ohms	
H - IAM Group	1: 0.598	Bus Reg ID	1		
	1: 0.599	Add Bus Cap	0	uF)	_
- 2 - 1203-SSS RS232 DF1	1:0.600	Reserved	0		_
🚊 Custom Views	1: 0.601	Soft Ovrtrvl Act	Drive Action		
New Custom View	* 1:0.602	Pos Err Flt Act	Drive Action		
Compare Results	* 1:0.603	Hard Ovrtrvl Act	Drive Action		
	* 1:0.604	Fdbk Nse Flt Act	Status Only		
P	I* 1±0.605	Dr Therm Elt Act	Drive Action		×
For Help, press F1				Local DPI	

5. Double-click the *x*:*x*:*x*599 Add Bus Cap parameter.

599 - Add	Bus Cap			
Value <u>E</u> dit	Ad <u>v</u> anced			
Value	1780		uF	
Internal	Value 1780			Head
C Hex	• Dec	: O Oct		
Min	0			
Max	65535			
Default	0			Select <u>D</u> efault
		ОК	Cancel	Apply

The command dialog box for parameter x599 - Add Bus Cap opens.

- 6. Click the Value Edit tab and enter the Add Bus Cap Value (μ F).
- 7. Click OK.

The Add Bus Cap value is changed, but not saved in nonvolatile memory.

Save the Add Bus Cap Parameter to Nonvolatile Memory

Follow these steps to save the Add Bus Cap parameter to nonvolatile memory.

1. From the Actions menu, choose Nonvolatile Memory.

This message dialog box opens.

Non-Volatile Memory - 2094D SERVO Config 000	D X
Save current device values to non-volatile memory.	Save
Recall device values from non-volatile memory.	Recall
Reset device values to defaults.	Load Defaults
Close	

2. Click Save.

The changes are saved to nonvolatile memory and this cautionary message dialog box opens.

Non-¥ola	tile Memory - 2094D SERVO	Config 0000
	Caution This action will overwrite existing saved in the product's	device values that are currently non-volatile memory.
	Continue	?
	Yes	No

3. Click Yes.

The save to nonvolatile memory is complete and this confirmation message dialog box opens.

DriveExplorer X
Save to non-volatile memory was successful.
ОК

- 4. Click OK.
- 5. Close the DriveExplorer software.

Verify the Parameter Changes

Follow these steps to verify your parameter change was successful.

TIP Verifying the parameter change is optional.

- 1. Open your DriveExplorer software.
- 2. Cycle the drive control power.
- **3.** Reconnect the drive to your DriveExplorer software and read the Add Bus Cap value just like you did in Set the Additional Bus Capacitance Parameter on page 230.

599 - Add Bus (Cap			×
Value <u>E</u> dit Ad <u>v</u> ar	nced			<u>ᠿ₽</u>
Value Internal Value	<mark>1780</mark> 1780		uF	<u>R</u> ead
C Hex		C Oct		
Min	0			
Max	65535			
Default	0			Select Default
		ОК	Cancel	Apply

4. Verify the new parameter value.

In this example, the new value is 1780 μ F.

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 6000 drive system.
- 2. Replace the sercos fiber-optic cable removed earlier.

Fiber-optic cable connections (Tx and Rx) are on the top of each IAM and AM module.

3. Re-apply three-phase and control power.

Notes:

Configure the Load Observer Feature

The load observer feature is a control loop inside the drive that estimates the mechanical load on the motor and compensates for it, thereby forcing the motor to behave as if it is unloaded and relatively easy to control. As a result, load observer automatically compensates for disturbances and load dynamics, such as sudden inertia/torque changes, compliance, backlash, and resonances.

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Setting Gains with Sercos IDN Write Messages	246
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Benefits

You can use load observer with out-of-box controller gains, where the load is unknown and thus the Load Inertia Ratio = 0, or with auto-tuned controller gains, where the Load Inertia Ratio is known or calculated by performing an auto-tune procedure.

When used with out-of-box controller gains, load observer does the following.

- Provides relatively high-performance motion control without tuning
- Automatically compensates for load resonances and machine wear over time

When used with auto-tuned controller gains, load observer does the following.

- Increases controller bandwidth
- Reduces tracking errors, so line speeds can be increased
- Provides tighter control of moving parts, reducing wear and saving material costs

How it Works

Load observer acts on the acceleration signal within the control loops and monitors the Acceleration Reference and the Actual Position Feedback. Load observer models an ideal unloaded motor and generates a load Torque Estimate, in torque units, that represents any deviation in response of the actual motor and mechanics from the ideal model. This deviation represents the reaction torque placed on the motor shaft by the load mechanics. It is estimated in real time and compensated by closed loop operation.



Figure 116 - Load Observer and Control Loop Signals Relationship Block Diagram

Load observer also generates a Velocity Estimate signal that you can apply to the velocity loop. The Velocity Estimate has less delay than the Velocity Feedback signal derived from the actual feedback device. It also helps to reduce high frequency output noise caused by load observer's aggressive action on the acceleration reference. Together, load observer with the Velocity Estimate setting provides the best overall performance.

Configuration

You can configure the load observer feature in a variety of ways by writing to a set of configuration IDN parameters. The overall behavior of load observer is controlled by Load Observer Configuration (IDN P-431). This parameter is used to select the load observer mode. It can be set to the following values.

Mode	Value	Description	
Disabled (default)	0	Load Observer is inactive	
Load Observer Only	1	Provides a Torque Estimate only	This setting is a filtered acceleration feedback with the addition of integral action below the observer bandwidth that is active in the acceleration forward path. This greatly increases the disturbance rejection properties (stiffness) over the acceleration feedback setting. However, it is also fairly aggressive and the observer bandwidth must be decreased significantly for stable operation.
Load Observer with Velocity Estimate	2	Standard Operation: Provides Torque and Velocity Estimates	This setting combines the best of the Load Observer Only and Velocity Estimate Only settings. Separately, load observer removes error, but is too aggressive, and the velocity estimate setting provides a smooth response, but creates error. Together, they remove error and provide a smooth response. Load observer performs well in situations that require adapting to changing inertia and velocity integrator anti-windup.
Velocity Estimate Only	3	Provides a Velocity Estimate only	This setting creates a filtered velocity feedback signal that is void of phase lag. Less phase lag (delay around the loop) allows for higher performance. However, the signal is modeled at frequencies above the observer bandwidth, producing error in velocity feedback. This generates a fictitiously lower velocity error since velocity error equals velocity command minus velocity feedback. Nevertheless, the steady state error disappears when used in position mode with either the position integrator or the observer integrator.
Acceleration Feedback	4	Provides acceleration feedback by disconnecting Acceleration Reference to load observer	This setting creates a filtered acceleration feedback signal. This setting is fairly aggressive and the observer bandwidth must be decreased significantly for stable operation. The Load Observer Only setting is similar, but without the additional phase lag (delay) created by necessary filtering.

For the remaining IDN parameter descriptions, refer to Figure 117.





Load observer gains that require user interaction are Load Observer Bandwidth (Kop) and Load Observer Integral Bandwidth (Koi). They are set by IDN P-432 and IDN P-433, respectively. Guidelines for setting these gains are provided in the following sections. In general, Kop acts like a velocity integrator without windup and Koi acts a like a position integrator without windup.

Load observer gains that do not require user interaction are Load Observer Feedback Gain (Kof) and the Load Observer Input Gain (Kou). They are automatically set internally based on the Load Observer Configuration. However, when in Acceleration Feedback mode, Kof can also be set manually by IDN P-434 with typical values between zero and one.

Table 123 - Load Observer Gain Parameters

IDN	Name	Units	Format	Value, min	Value, max
P:0:432	Load Observer Bandwidth (Kop)	Rad/s			12,500 (1)
P:0:433	Load Observer Integral Bandwidth (Koi)	Rad/s	16 bit unsigned int	0	65,535 ⁽²⁾
P:0:434	Load Observer Feedback Gain (Kof)	-	-		200

(1) This value applies to drive firmware revision 1.124.

(2) This value applies to drive firmware revisions later than 1.124.

The Acceleration Estimate and Torque Estimate signals are read by using IDN-435 and P-436, respectively. Definitions for these IDN parameters are given in the following table.

Table 124 - Load Observer Output Signals

IDN	Name	Units	Format	Value, min	Value, max
P:0:435	Load Observer Acceleration Estimate	Acceleration	32bit signed int	-2 ³¹	2 ³¹ -1
P:0:436	Load Observer Torque Estimate	Torque	16 bit signed int	-2 ¹⁵	2 ¹⁵ -1

When load observer and the torque low-pass filter are both enabled, and the lowpass filter bandwidth is less than 5 times the load observer bandwidth, their interaction can interfere with each other, causing instability. The low-pass filter is always limited to a bandwidth under 389 Hz in drive firmware prior to revision 1.116. As a result, an IDN parameter was added in drive firmware revision 1.116 to override the torque low-pass filter bandwidth limiting. The filter is also bypassed if the override IDN is set to one and the torque low-pass filter bandwidth is set to zero.

IDN P:0:065	Bandwidth in the Logix Designer Application	Actual Bandwidth in Drive	Drive Firmware Notes
0	=0	389 Hz	Operation before revision
0	> 0	Limited to \leq 389 Hz	1.116
1	= 0	Filter bypassed	Operation with revision
	>0	Limited to \leq 10,430 Hz	1.116 or later

Table 125 - Torque Low-pass Filter Bandwidth

Refer to <u>Appendix E</u> on <u>page 249</u> for more information on changing IDN parameter values with read/write messages in the Logix Designer application.

Out-of-Box Gain Settings

This method of setting controller gains works for unknown loads or when an auto-tune is not performed. It produces a relatively high level of performance in 90% of motion applications. Most of the time, there is no need to perform an auto-tune procedure or further optimize gain settings. As a result, it has become the default out-of-box setting for Kinetix drives using integrated motion on the EtherNet/IP network.

Follow these steps to configure the drive for high performance right out of the box.

1. Create a new axis with type AXIS_SERVO_DRIVE.

If you need more information to create a new axis, refer to Configure the Kinetix 6000 Drive Modules on <u>page 144</u>.

2. Click the Drive/Motor tab in the Axis Properties dialog box and add a motor.

Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Acti	ons	Tag
General	Motion P	lanner	Units	Drive/Motor	Motor	Feedback	Aux F	eedback	Cor	nversion
Amplifier 0	atalog Numb	er: 2094	-AM01			~				
Motor Cat	alog Number:	MPL	A310P-M				Change	Catalog		
Loop Con	figuration:	Positi	ion Servo			~				
Drive Res	olution:	2000	00 D	rive Counts /	Motor Rev	~	Calcu	late		

If you need more information to add a motor, refer to Configure Axis Properties on page 149.

3. Click the Gains tab in the Axis Properties dialog box.

The current Velocity Proportional Gain value is used to recalculate other gain values.

General	Mo	otion Pla	anner	Units	Drive/Motor	Motor Fe	edback	Aux F	eedback	Cor	version
Homing	Hool	kup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Act	ions	Tag
Position	Gains				1				المستعلم المستعد		1
Propor	tional:	298.66	512	1/s					ranuai Auju	20	J
Integra	əl:	0.0		1/ms-s				Sel	t Custom Ga	ains	J
Velocity	Gains				-Fe	eedforward G	ains				
Propor	tional:	764.57	727	1/s		Velocity:	0.0		%		
Integra	əlt	0.0		1/ms-s		Acceleration	0.0		%		
Integrator	Hold:	Enable	ed	*							

- **4.** Make the following calculations:
 - a. Load Observer Bandwidth: Kop = Velocity Proportional Gain x 2.56
 - b. Velocity Loop Bandwidth: Kvp = Kop/4
 - c. Position Loop Bandwidth: Kpp = Kvp/4

- 5. Configure these settings and values on the Gains tab.
 - a. Position Proportional Gain = Kpp
 - b. Velocity Proportional Gain = Kvp
 - c. Velocity Feedforward Gain = 100%
 - d. Integrator Hold = Disabled

General	Mo	tion Plan	nner	Units	Drive/Motor	Motor F	eedback	Aux F	eedback	Co	nversion
Homing	Hook	up	Tune	Dynamics	Gains*	Output	Limits	Offset	Fault Ac	tions	Tag
Position G Proportio	à ains onal:	122.33	1E	1/s					Manual Adju	ist	
Integral:		0.0		1/ms-s				Se	t Custom G	ains	J
Velocity G	ains				-Fe	eedforward G	ains				
Proportio	onal:	489.32	65	1/s		Velocity:	100.0] %		
Integral:		0.0		1/ms-s		Acceleration	. 0.0] %		
Integrator H	lold:	Disable	d	~							

- 6. Configure these IDN parameter values.
 - a. IDN P-431 = 2 (load observer with velocity estimate)
 - b. IDN P-432 = Kop
 - c. IDN P-433 = 0
 - d. IDN P-065 = 1

File Edit Explore Actions Help		* & Ø		
Devices	S N:P.P#	Name	Value	Units
- Node 1: - 2094D SERVO	1:0.930	Reserved	0	
- 0 - 2094D SERVO Config 0000	1:0.931	Load Obs Config	With Vel Est	
Parameter List	1:0.932	Load Obs Bw	1957	rd/s
TANA	1:0.933	Load Obs Int Bw	0	rd/s

- 7. Click the Output tab in the Axis Properties dialog box and verify these settings.
 - a. Load Inertia Ratio = 0
 - b. Enable Low-pass Output Filter = Unchecked

General	Motion F	lanner L	Jnits	Drive/Motor	Motor	Feedback	Aux F	eedback	Conversion
Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Act	ons Tag
Motor Ine	Motor Inertia: 0.000044			Kg·m^2				Manual Adju	st
Load Iner	Load Inertia Ratio:			Load Inertia/	Motor Inerti	a			
Torqu	Torque/Force Scaling:		0.0174	0.01749257		Position Unit	ts/s^2)		
Syster	m Acceleratio	n:	5716.7	713	(Position U	Inits/s^2) at	100% Rate	ed	
Enable	e Notch Filter	Frequency							
Notch	Notch Filter Frequency: 0.0			Hertz					
Enable	Enable Low-pass Output Filter								
Low-p	ass Output F	ilter Bandwidtł	η. 0.0		Hertz				

8. Refer to Compensate for High Frequency Resonances on page 247, to tune-out resonant frequencies.

Auto-tune Gain Settings

This procedure explains how to configure the load observer feature after running Auto-tune. This method also works for any existing gain set where the Load Inertia Ratio is known or manually calculated, for example, the Load Inertia Ratio > 0.

1. Click the Tune tab in the Axis Properties dialog box and perform Autotune.

For variable inertia loads, perform Auto-tune at the point of lowest mechanical inertia. If you manually calculate the Load Inertia Ratio, use the minimum load inertia.

2. Click the Output tab in the Axis Properties dialog box and verify that the Load Inertia Ratio > 0.

General	Motion F	lanner	Units	Drive/Motor	Motor	Feedback	Aux F	eedback	Com	ersion
Homing	Hookup	Tune Dynamics		s Gains	Output	Limits	Offset	Fault Act	ions	Tag
Motor Iner	Motor Inertia: 0.00004 Load Inertia Ratio: 15:155		0044 Kg·m^2		Motor Inertia	a		Manual Adju	st	
Torque	Torque/Force Scaling:		0.2826076		% Rated/(F	Position Unit	s/s^2)			
System	System Acceleration:		353.8	4753	(Position U	nits/s^2) at	100% Rate	ed		

3. Click the Gains tab in the Axis Properties dialog box.

The current Position and Velocity gain values are used to recalculate other gain values.

General	M	otion Pl	anner	Units	Drive/Motor	Motor Fe	edback	Aux F	eedback	Co	nversion
Homing	Hoo	kup	Tune	Dynamics	Gains*	Output	Limits	Offset	Fault Ac	tions	Tag
Position Proport	Gains ional:	151.9	9413	1/s				1	fanual Adju	ist]
Integra	ŧ	5.775	6	1/ms-s				Se	t Custom G	ains	J
Velocity	Gains				D CF	eedforward G	ains				
Proport	ional:	389.1	05	1/s		Velocity:	100		%		
		0.0		1/ms-s		Acceleration	0.0		%		

- **4.** Determine if the mechanical load connected to the motor is rigid or compliant.
 - Rigid systems typically involve high-performance load mechanics that are tightly coupled directly to the motor shaft.

Refer to Rigid Mechanical Loads on page 242, for rigid applications.

• Everything else is compliant, including systems with belts and pulleys, long shafts, short shafts with heavy loads, and couplings and gearboxes with backlash and/or lost motion.

Refer to Compliant Mechanical Loads on <u>page 242</u>, for compliant applications.

Rigid Mechanical Loads

Follow these steps if the load is rigid or the load observer feature is being added to a previously working set of gains with a Load Inertia Ratio > 0.

1. Calculate the Load Observer Bandwidth.

Load Observer Bandwidth: Kop = Velocity Proportional Gain

- If the Low-pass Output Filter is enabled, verify that the Low-pass Output Filter Bandwidth is ≥ the Velocity Proportional Gain x 2/(2pi).
- 3. Configure these IDN parameter values.
 - a. IDN P-431 = 2 (Load Observer with Velocity Estimate)
 - b. IDN P-432 = Kop
 - c. IDN P-433 = 0
 - d. IDN P-065 = 1

Eile Edit Explore Actions Help				
) 🖗 🖗 📼	* 8 0		
Devices	S N:P.P#	Name	Value	Units
- Node 1: - 2094D SERVO	1:0.930	Reserved	0	
- 0 - 2094D SERVO Config 0000	1:0.931	Load Obs Config	With Vel Est	
Parameter List	1:0.932	Load Obs Bw	389	rd/s
TANA	1:0.933	Load Obs Int Bw	0	rd/s

4. Refer to Compensate for High Frequency Resonances on <u>page 247</u>, to tune-out resonant frequencies.

Compliant Mechanical Loads

Follow these steps if the load is compliant.

- 1. Make the following calculations:
 - a. Position Loop Bandwidth:
 Kpp = Position Proportional Gain/(Load Inertia Ratio + 1)
 - b. Position Integral Bandwidth:

Kpi = Position Integral Gain/(Load Inertia Ratio + 1)²

- c. Velocity Loop Bandwidth: Kvp = Velocity Proportional Gain/(Load Inertia Ratio + 1)
- d. Velocity Integral Bandwidth: Kvi = Velocity Integral Gain/(Load Inertia Ratio + 1)²
- e. Load Observer Bandwidth: Kop = Kvp

- Drive/Motor Aux Feedback General Motion Planner Units Motor Feedback Conversion Homing Hookup Tune Dynamics Gains Output Limits Offset Fault Actions Tag Position Gains Manual Adjust. Proportional: 9.408 1/s Set Custom Gains. Integral: 0.0221 1/ms-s Velocity Gains Feedforward Gains 22.0844 Proportional: 1/s 100.0 % Velocity: 1/ms-s 0.0 Integral: Acceleration: 0.0 % Integrator Hold: Disabled ~
- 2. Configure these settings and values on the Gains tab.

- a. Set the Position Proportional Gain = Kpp
- b. Position Integral gain = Kpi
- c. Velocity Proportional Gain = Kvp
- d. Velocity Integral Gain = Kvi
- **3.** If the Low-pass Output Filter is enabled, verify that the Low-pass Output Filter Bandwidth ≥ Velocity Proportional Gain x 5/(2pi).

The compliant setting reduces all of the gains by a factor of the Load Inertia Ratio +1 and then calculates the Load Observer Bandwidth. Typically, this reduction is too conservative, making the loop response too sluggish and the error too large, however, it does provide stability.

To manually increase the gains by some factor to optimize the response, refer to Manual Tuning for Further Optimization on page 244.

- 4. Configure these IDN parameter values.
 - a. IDN P-431 = 2 (Load Observer with Velocity Estimate)
 - b. IDN P-432 = Kop
 - c. IDN P-433 = 0
 - d. IDN P-065 = 1



5. Refer to Compensate for High Frequency Resonances on page 247, to tune-out resonant frequencies.

Tuning Mode Summary

This table summarizes the primary difference between the two tuning modes.

Table 126 - Tuning Mode Comparison

Tuning Mode	Description
Out-of-box or unknown load Load Inertia Ratio = 0	Load Observer Bandwidth Kop $=$ 4 times the new Velocity Proportional Gain, Kvp
Auto-tuning or known load Load Inertia Ratio > 0	Load Observer Bandwidth = Velocity Proportional Gain

Manual Tuning for Further Optimization

The out-of-box and auto-tune rigid methods achieve relatively high performance. However, the manual tuning method can help to optimize performance for the auto-tune compliant method, or if every ounce of performance is required. It involves incrementally increasing controller gains to the point of marginal stability, then backing them off by a given percentage. Typical ranges for various gains are also given to provide guidelines.

Follow these steps to manually tune your drive.

- 1. Select a factor (N) that you can incrementally increase the gains by in an iterative process, for example, 1.5>N>2.
- **2.** Create a trend to monitor Torque Reference.
- 3. Manually tune the velocity loop.
 - a. Make note of the Position and Feedforward Gains.

You must change them temporarily to isolate the velocity loop and later restore them to the original values.

- b. Isolate the velocity loop.
 - Zero out the Position Proportional Gain, Position Integral Gain, and Acceleration Feedforward Gain
 - Set the Velocity Feedforward = 100
- c. While Jogging the axis and monitoring the Torque Reference trend, incrementally increase the following gains simultaneously and stop when the Torque Reference begins to become oscillatory or unstable:
 - Low-pass Output Filter Bandwidth = Low-pass Output Filter Bandwidth x N
 - Load Observer Proportional Gain = Load Observer Proportional Gain x N
 - Load Observer Integral Gain = Load Observer Integral Gain x N
 - Velocity Proportional Gain = Velocity Proportional Gain x N
 - Velocity Integral Gain = Velocity Integral Gain $x N^2$

- d. Decrease the gains by using the previous equations with N = 0.5. A typical range of values for various integral gains are given:
 - 0 ≤ Load Observer Integral Gain ≤ Load Observer Proportional Gain/4
 - $0 \leq$ Velocity Integral Gain \leq Velocity Proportional Gain²/4000
- e. If the Low-pass Output Filter is enabled, a typical range of values for the Low-pass Output Filter Bandwidth are given:
 - Rigid: Low-pass Output Filter Bandwidth ≥ Velocity Proportional Gain x 2/(2pi)
 - Compliant: Low-pass Output Filter Bandwidth ≥ Velocity Proportional Gain x 5/(2pi)
- 4. Manually tune the position loop.
 - a. Restore the Position and Feedforward Gains to the original values to reenable the position loop.
 - b. While Jogging the axis and monitoring the Torque Reference trend, incrementally increase the following gains simultaneously and stop when the Torque Reference begins to become oscillatory or unstable:
 - Position Proportional Gain = Position Proportional Gain x N
 - Position Integral Gain = Position Integral Gain $x N^2$
 - c. Decrease the gains by using the previous equations with an N = 0.5. A typical range of values for the Position Integral Gain is given: $0 \le Position Integral Gain \le Position Proportional Gain^2/4000$

Setting Gains with Sercos IDN Write Messages

Write the Load Observer Configuration attribute and the Load Observer gains each time the drive gets initialized after applying power.

The Sercos IDN write instruction is accomplished by using RSLogix 5000 software or the Logix Designer application. Refer to <u>Appendix E</u> on <u>page 249</u> for more information on changing IDN parameter values by using this method.

1. Upon initialization of the drive, read the INT value of the configuration of the drive at Sercos IDN P:0:431.

Configuration*	Communication Ta	ag				
Message Type	SERCOS	IDN Read		•		
Service Type: Identification	Data	<u> </u>	➡ De	stination:	Drive_Read_Value	•
Number: Element:	7:Operation Value	T 401	•			
Data Type:	INT		•			
) Enable ()	Enable Waiting	⊖ Start	O Done	Do	ne Length: 0	
) Error Code: Error Path: Error Text:	Extende	ed Error Code:			Timed Out 🔦	

2. If the value is not what you want, latch it and write the new value back to the drive at the same address, again as type INT.

Configuration (Communication Ta	ag			
Message Type	SERCOS	IDN Write		•	
Service Type: Identification Number:	Data P • 0	🗼 431	Source Source Lengt	re: Drive_Write	_Value 🚽 (Bytes)
Element:	7:Operation Value	e	•	New Tag	
Data Type:	[INT		•]		
) Enable)) Error Code:	Enable Waiting Extend) Start ed Error Code:	O Done	Done Length: 0	
Error Path: Error Text:					
		ОК	Cancel	Apply	Help

3. Verify the change with another sercos IDN Read Message from IDN P:0:431.



Compensate for High Frequency Resonances

Approximately 15% of all motion applications exhibit a high-frequency resonance that is apparent by an audible high-frequency squealing of the load mechanics.

Follow these steps to identify and reduce the presence of high-frequency resonances.

- 1. Perform the following move sequence by using Motion Direct Commands:
 - a. Enable the axis with an MSO
 - b. Slowly jog the axis with an MAJ
 - c. Stop the axis with an MAS
 - d. Disable the axis with a MSO

IMPORTANT	Sometimes an audible resonance is heard before the axis is jogged,
	making the MAJ and MAS unnecessary.

- **2.** Determine if an audible high-frequency resonance exists in your motion application.
 - If an audible high frequency resonance is not present during the move sequence, skip the remaining steps and tuning is complete.
 - If an audible high frequency resonance is present during the move sequence, use an FFT smart phone or tablet application to identify the dominant resonant frequencies.



3. Click the Output tab in the Axis Properties dialog box.

General	Motion F	Planner	Units	Drive/Motor	Motor	Feedback	Aux F	eedback	Cor	nversion
Homing	Hookup	Tune	Dynamics	Gains*	Output [×]	Limits	Offset	Fault Ac	tions	Tag
Motor Inertia: 0.000044			Kg⋅m^2			1	fanual Adju	ıst		
Load Inertia Ratio: 0.0				Load Inertia/	'Motor Inerti	a				
Torque/Force Scaling:			0.0174	49257 % Rated/(Position Units/s^2)						
System Acceleration:			5716.7	6.713 (Position Units/s ²) at 100% Rated						
🔽 Enable	Notch Filter	Frequency								
Notch Filter Frequency:		627.3	Hertz							
Enable	e Low-pass O	utput Filter								
Low-p	ass Output F	ilter Bandwid	h: 0.0		Hertz					

- a. Check Enable Notch Filter Frequency and set the Notch Filter Frequency to the resonant frequency with the largest amplitude.
- b. If multiple resonances have nearly the same amplitude, set the Notch Filter Frequency to the lowest resonant frequency.
- c. If the problem persists, also check Enable Low-pass Output Filter and set the Low-pass Output Filter Frequency to the next largest resonant frequency.
- d. Click OK.

Changing the Default IDN Parameter Values

This appendix provides a procedure, specific to the Kinetix 6000 (sercos) drive systems, for changing IDN parameter values to non-default values when your application does not match the default configuration. The procedure also applies when one or more Kinetix 6000M IDM systems are present.

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Change IDN Parameter Values	250

Before You Begin

The Logix5000 processor contains a motion planner that sends real-time and non real-time data to the drive. This drive communication is performed via a set of sercos interface telegrams. Each telegram has an identification or Ident (IDN) number. All parametric data, such as scaling and loop gains, and real-time loop closure information is configured this way.

Table 127 - IDN Instruction Format in the IEC Standard Document

	Name						
	Function/Description						
IDN Number	Length in bytes	Minimum input value/ Maximum input value	Scaling/resolution	Units			

There are default parameters in the Logix5000-to-Kinetix 6000 drive product structure you can reconfigure when the default configuration does not match the Integrated Architecture[™] machine configuration.

By using this procedure, you can change the Additional Bus Capacitance value in common-bus configurations.

TIP You can also set the Additional Bus Capacitance parameter by using DriveExplorer software (refer to <u>Appendix C</u>), the Logix Designer application, or RSLogix 5000 software, version 20.00 or later, from I/O configuration>Sercos module>Drive module properties>Power tab (refer to <u>Chapter 6</u>).

Use this flowchart to determine if changing your default configuration is required.



Figure 118 - Configuration Flowchart

Change IDN Parameter Values

In this section you follow the Configuration Flowchart on page 250 to determine if you need to use the sercos IDN Write instruction in the Logix Designer application to change the IDN parameter values.

Read the Present IDN Parameter Value

Follow these steps to read the present IDN value.

- 1. Start your Logix Designer application program.
- 2. Configure a Message Configuration (MSG) instruction to read your present IDN parameter values.

In this example, the Message Configuration (MSG) instruction is set to read the additional bus capacitance of your leader IAM power module.

Message Config	juration - Read_#	\dd_Bus_Cap					×
Configuration	Communication T	ag					_
Message Type	SERCOSI	DN Read		•			
Service Type: Identification Number: Element: Data Type:	Data P V ··· 0 7:Operation Value INT	<u>*</u> 99	V De	stination:	Present_Add New Tag	_Bus_C	
O Enable C) Enable Waiting	🔾 Start	🔾 Done	Dor	ne Length: 0		
 Error Code: Error Path: Error Text: 	Extende	ed Error Code:			Timed Out 🗲		
		OK	Cance		Apply	Help	

- a. From the Message Type pull-down menu, choose sercos IDN Read.
- b. From the Identification Number pull-down menus, choose P-0-99.
- 3. Click New Tag.
- 4. The New Tag dialog box opens.

New Tag			×
Name:	Read_Value		ОК
Description:		~	Cancel
			Help
		~	
Usage:	<pre><normal></normal></pre>	-	
Туре:	Base Connectio	on	
Alias For:		~	
Data Type:	[INT		
Scope:	🔁 K6K_Compatibility	•	
Style:	Decimal	•	
🗖 Open Cor	ifiguration		

5. Type the name of your Destination tag.

In this example, the tag name is Read_Value.

6. Click OK.

In this example, the MSG instruction reads the P-0-99 IDN value and places it in the destination as specified by the new tag.

7. Click the Communication tab.

8. Click Browse.

Message Configuration	- Read_Add_Bus_Cap	×
Configuration Communic	cation Tag	
Path: BC02	Browse	
BC02	Message Path Browser	×
Communication Meth	Path: BC02 BC02	
Connected		IX
 Error Code: Error Path: Error Text: 	<u> </u>	
	OK Cancel Help	

- 9. Select the Bulletin 2094 module to read the MSG instruction.
- 10. Click OK.

Calculate the New IDN Value

Changing the additional bus capacitance value requires calculations. Determine the sum of all capacitance values for the follower IAM module, each AM module, and each IPIM module on the follower IAM power rail.

Refer to Calculate Additional Bus Capacitance on <u>page 227</u> for more information.
Write the New IDN Parameter Value

Follow these steps to write the new IDN parameter value.

1. Configure a Message Configuration (MSG) instruction to write the IDN parameter value required for your application.

In this example, the Message Configuration (MSG) instruction is set to write the additional bus capacitance of your leader IAM power module.

Message Configuration - Change_/	\dd_Bus_Cap_Val			×
Configuration Communication Tag				
Message Type: SERCOS IDI	N Write	•		
Service Data	•	Source:	New_Bus_Cap	_Value 🗸
Identification P 🔽 0 Number:	· · · 99 ·	Source Length:	1 🗦	(Bytes)
Element: 7:Operation Value	•		New Tag	
Data Type: INT	•			
◯ Enable ◯ Enable Waiting	⊖ Start ⊃ E	ione Doi	ne Length: 0	
O Error Code: Extended Error Path: Error Text:	Error Code:		Timed Out 🗲	
	ОК	Cancel	Apply	Help

- a. From the Message Type pull-down menu, choose sercos IDN Write.
- b. From the Identification Number pull-down menus, choose P-0-99.
- 2. Click New Tag.
- 3. The New Tag dialog box opens.

New Tag			×
Name:	Write_Value		ОК
Description:		~	Cancel
	8710 - 1750 Jan		Help
		<u>-</u>	
Usage:	<normab< td=""><td>-</td><td></td></normab<>	-	
Туре:	Base Connecti	on	
Alias For:		*	
Data Type:	INT		
Scope:	1 K6K_Compatibility	-	
Style:	Decimal	•	
🗖 Open Cor	figuration		

4. Type the name of your Source tag.

In this example, the tag name is Write_Value.

5. Click OK.

In this example, the new tag creates a source value (that you entered) that the MSG instruction uses to overwrite the existing P-0-099 IDN value.

6. Click the Communication tab.

The Communication tab opens.

Configuration Communication Tag Path: BC02 Browse BC02 Message Path Browser X Communication Message Path Browser Message Path Browser Communication Message Path Browser Message Path Browser BC02 Message Path Browser Message Path Browser Communication Message Path Browser Message Path Browser Communication Message Path Browser Message Path Browser Communication Message Path Browser Message Path Browser Message Path Browser Message Path Browser Message Path Browser Message Path Browser Message Path Browser Message Path Browser <th>Message Configuration</th> <th>- Read_Add_Bus_Cap</th> <th>×</th>	Message Configuration	- Read_Add_Bus_Cap	×
Path: BC02 Browse BC02 Communication Meth Path: BC02 C CP C DH+ BC02 BC02 BC02 C CP Vith BC02 BC02 BC02 C CP Connected I/O Configuration I/O Configuration Image: Display the image of the imag	Configuration Communi	cation Tag	
Communication Meth C CP C DH+ C CP Vith Source ID Connected C Enable C Enable C Enror Code: Error Path: Error Text: ■ Path: BCO2	Path: BC02 BC02	Browse	×
C Enable Error Text:	Communication Meth C CIP C DH+ C CIP With Source ID	Path: BC02	
IK Cancel Help	O Enable O Enable O Error Code: Error Path: Error Text:		

- 7. Click Browse.
- 8. Select your Bulletin 2094 module.
- 9. Click OK.

The MSG instruction writes the new IDN value to your drive.

- **TIP** To verify your sercos IDN Write instruction was successful, you can perform another sercos IDN Read instruction for the IDN in question.
- 10. Click OK to close the Message Configuration dialog box.

Enhanced Peak Performance

This appendix provides procedures and information, specific to the Kinetix 6000 drive systems, for enabling the peak enhancement feature in each drive.

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Before You Begin

The peak current ratings of the Kinetix 6000 460V drives (series A, B, and C) are configured at the factory as 150% of continuous current. However, you can program 460V (series B and C) AM modules and the equivalent IAM (inverter) modules, for up to 250% of continuous inverter current.

To achieve the enhanced peak performance, you must determine the values of maximum acceleration, deceleration, and torque. This feature is present only in the Kinetix 6000 (series B and C) drives listed in <u>Table 128</u>.

Table	128 -	Kinetix	6000	Series	Change
-------	-------	---------	------	--------	--------

IAM Module	AM Module	Peak Current Rating					
Cat. No.	Cat. No.	Series A (inverter)	Series B and C (inverter)				
2094-BC01-MP5-S	2094-BMP5-S	150%	250%				
2094-BC01-M01-S	2094-BM01-S	150%	250%				
2094-BC02-M02-S	2094-BM02-S	150%	250%				
2094-BC04-M03-S	2094-BM03-S	150%	250%				
2094-BC07-M05-S	2094-BM05-S	150%	200%				

The default values that populate the AXIS_SERVO_DRIVE properties in the Logix Designer application are calculated for each motor and drive, but assume 150% peak torque in those calculations. For the drive to command more current, you must enter new values for some of those parameters, including the following:

- TorqueLimitBipolar
- TorqueLimitPositive
- TorqueLimitNegative
- MaximumAcceleration
- MaximumDeceleration
- AccelerationLimitBipolar
- AccelerationLimitPositive
- AccelerationLimitNegative

You can access these parameters offline in the Logix Designer application Axis Properties tabs or online as sent to the drive in an SSV instruction.

To calculate the new values, you also need to determine these values:

- Drive electrical data (Motion Analyzer solution page, under Drive tab)
- Motor electrical data (Motion Analyzer solution page, under Motor tab)
- TorqueScaling (the Logix Designer application, Axis Properties, Output tab)

Figure 119 - Drive and Motor Data in Motion Analyzer Software



IMPORTANT The default unit in Motion Analyzer software for drive and motor current is A (0-pk). Because the example formula is in A (RMS), you must change the units in the Drive and Motor tabs to A (RMS).

Pause your mouse over A (0-pk) and use the pull-down menu to change the units to A (RMS). Refer to Figure 119 for an example.

Enhanced Peak Example

In this example, the following motor and drive combination is used:

- Drive = 2094-BC02-M02-S
- Motor = MPL-B540K

Table 129 - Example Definitions

Description	Symbol	IDN	Example
Motor continuous current (A _{rms})	I _{mtr, cont}	S:0:0111	14.49525
Motor peak current (A _{rms})	I _{mtr, pk}	S:0:0109	42.42641
Drive continuous current (A _{rms})	I _{dr, cont}	S:0:0112	10.3379
Drive near current (Λ_{-})	1	5-0-0110	150%: 15.5069
Drive peak current (Arms)	'dr, pk	5.0.0110	250%: 25.8094

Figure 120 - Example Torque Formula

Torque_{max} =
$$\frac{\min(I_{mtr, pk}, I_{dr, pk})}{I_{mtr, cont}} = \frac{\min(42.4 \text{ A}_{rms}, 25.8 \text{ A}_{rms})}{14.5 \text{ A}_{rms}} = 178.1\%$$

1. Navigate to Axis Properties and click the Limits tab.

	🍄 Axis Properties - Axis					
	General Motion Planner Homing Hookup Tune	Units Dynamics	Drive/Motor Motor Gains Output	Feedback Limits	Aux Feedback Conversio Offset Fault Actions Tag	n
	Hard Travel Limits				Manual Adjust	
	Maximum Positive:	0.0	Position Units			
	Maximum Negative:	0.0	Position Units			
	Position Error Tolerance:	0.87722665	Position Units			
Default Peak Torque Limit Value	Position Lock Tolerance:	0.01	Position Units			
	Peak Torque/Force Limit:	106.344826	% Rated			
	Continuous Torque/Force Limit:	100.0	% Rated			
		0.0				
			OK	Cancel	Apply Help	

- Overwrite the existing Peak Torque Limit (TorqueLimitBipolar) value. In this example, the calculated value is 178.1.
- 3. Click Set Custom Limits.

	Provenue				
	Name	Value	Units	Туре	
	VelocityThreshold	0.0	Position Units/s	REAL	
	VelocityWindow	1.0	Position Units/s	REAL	
	VelocityStandstill/Vindow	1.0	Position Units/s	REAL	
	AccelerationLimitPositive	4468.53	Position Units/s	REAL	
imit Values —	AccelerationLimitNegative	-4468.53	Position Units/s	REAL	
	TorqueLimitPositive	106.344826	% Rated	REAL	
	TorqueLimitNegative	-106.344826	% Rated	REAL	
	TorqueThreshold	0.0	% Rated	REAL	
		Close	Cancel		alo

4. Overwrite the existing TorqueLimitPositive and TorqueLimitNegative values.

In this example, the calculated values are 178.1 and -178.1 (respectively).

The calculated value for Torque_{max} is the maximum value for the following:

- TorqueLimitBipolar
- TorqueLimitPositive (+)
- TorqueLimitNegative (-)

If you want to limit the torque, adjust the calculated values to a value closer to zero. The values shown are the default values for 150% peak torque with this motor and drive pair.

- **TIP** For more information on system configuration with your Logix5000 controller and the Logix Designer application, refer to <u>page 133</u>.
- 5. Click the Output tab.

	🍄 Axis Pro	perties -	Axis							
	General Homing	Motion F Hookup	Planner L Tune	Inits Dynamics	Drive/Motor Gains	Motor Output	Feedback Limits	Aux Fee Offset	edback Fault Action	Conversion s Tag
Default LoadInertiaRatio Value	Motor Iner	ia:	0.00147		Kg·m^2			Ma	inual Adjust	
	Load Inertia Ratio:				Load Inertia/I	a				
	Torque	/Force Scal	ing:	0.0475	97233	% Rated/(Position Unit	s/s^2]		
Default TorqueScaling Value	System	I Acceleratio	n:	2100.9	1624	(Position U	Jnits/s^2) at	100% Rated		
	Enable	Notch Filter	Frequency	-21						
	Notch Filter Frequency:					Hertz				· · · ·
	Enable Low-pass Output Filter Low-pass Output Filter Bandwidth: 0.0 Hertz									
						ОК	Canc			Help

The TorqueScaling and LoadInertiaRatio values are populated after an autotune. If an autotune is not possible, model the system in Motion Analyzer software and enter that value for the LoadInertiaRatio. The default value for the LoadInertiaRatio is 0.0, however for this example, a ratio of 10.20:1 is used (load inertia = 0.015 Kg-m^2).

IMPORTANTTo obtain more accurate results, performing Autotune in the Logix
Designer application is recommended.

To calculate the maximum acceleration and deceleration from $\text{Torque}_{\text{max}}$, use this equation.

Accel_{max} = Torque_{max} •
$$\frac{100}{\text{TorqueScaling}}$$

TIP

If autotune cannot be performed, enter the data for the LoadInertiaRatio, DriveResolution, and ConversionConstant as shown in step 5 through step 9.

- 6. Change the Load Inertia Ratio value to 10.2.
- 7. Click Apply.

The TorqueScaling values update.

	🍄 Axis Pro	perties -	Axis							
	General	Motion F	lanner	Units	Drive/Motor	Motor	Feedback	Aux Fe	edback	Conversion
	Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Action	is Tag
Modified Load Inertia Ratio Value	Motor Iner	tia:	0.00147		Kg·m^2			M	anual Adjust	
	Load Inert	ia Ratio:	10.2		Load Inertia/N	Motor Inertia				
	Torque	e/Force Sca	ling:	0.5330	8904	% Rated/(F	Position Unit	s/s^2]		
New TorqueScaling value	Syster	n Acceleratio	n:	187.58	592	(Position U	nits/s^2) at	100% Rated	ł	
used in this example.	Enable	Notch Filter	Frequency							
	Notch	Filter Freque	ncy:	0.0		Hertz				- <u>-</u>
	Enable	Low-pass O	utput Filter							
	Low-p	ass Output F	ilter Bandwid	th: 0.0		Hertz				1.1.1
	4					OK) Canc	el	Apply	Help

8. Click the Drive/Motor tab.

	Homing Hookup	Tune Dynamic	s Gains	Output	Limits	Offset	Fault Actions	Tag				
	General Motion Plan	nner Units	Drive/Motor	Motor F	eedback	Aux F	eedback I	Conversion				
	Amplifier Catalog Number:	2094-BC02-M02			-							
DriveResolution value	Motor Catalog Number:	MPL-8540K-M			Change	Catalog						
	Loop Configuration:	Position Servo										
in this example.	Drive Resolution:	200000	Drive Counts /	Motor Rev		Calcu	ilate					
	Drive Enable Input Che	ecking										
	🗌 Drive Enable	Drive Enable Input Fault										
	Real Time Axis Informati	on										
	Attribute 1:	<none></none>	~									
	Attribute 2:	<none></none>			~							

The values for DriveResolution and ConversionConstant start out populated with default values, but can be changed for your specific needs. If you plan to change those values, enter the new values into the dialog boxes. Otherwise, use the defaults.

9. Click the Conversion tab.

	🥸 Axis Pro	operties -	Axis							
	Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Act	ions Tag
	General	Motion	Planner	Units	Drive/Motor	Moto	r Feedback	Aux F	eedback	Conversion
ConversionConstant value used in this example.	Positionin	g Mode:	Linear	~						
	Conversio	n Constant:	200000.	0	Drive Counts/1 Based on 2000	1.0 Position 300 Counts	n Units s/Motor Rev)		
	Position U	nwind:	200000		Drive Counts/L Based on 2000	Jnwind 300 Counts	s/Motor Rev			
	L					OK	Canc	el	Apply	Help

Enhanced Peak Example Calculation

Based on the values shown, this is the sample calculation.

Accel_{max} = 1.781 •
$$\frac{100}{0.53308904} = 334.09 \text{ PU/s}^2$$

To provide safe headroom, this value needs to be reduced by 15% before being written to the controller. This is the sample calculation.

MaximumAcceleration = MaximumDeceleration = $0.85 \cdot \text{Accel}_{\text{max}} = 283.98 \text{ PU/s}^2$

1. Click the Dynamics tab.

	🍄 Axis Pro	operties - Axis							
	General	Motion Planne	r Units	Drive/Motor	Motor	Feedback	Aux F	eedback	Conversion
	Homing	Hookup Tu	ne Dynamics	s Gains	Output	Limits	Offset	Fault Action	ns Tag
Default Acceleration and Deceleration Values	Maximum	Speed:	56.666668	Position Units/s Manu			Manual	Adjust	
	Maximum Acceleration:		1899.1252	Position L	Position Units/s ²				
	Maximum	Deceleration:	1899.1252	Position Units/s ²					
	Maximum Acceleration Jerk:		63647.234	Position L	Position Units/s ³ = 100% of Max Accel Time		Calculate)		
	Maximum	Deceleration Jerk:	63647.234	Position L	Inits/s^3	= 100	% of Max D	ecel Time	Calculate)
					ОК	Canc	cel 🛛	Apply	Help

2. Overwrite the existing Maximum Acceleration and Maximum Deceleration values.

In this example, the calculated values are 283.98 for each.

- **3.** Click Calculate for the Maximum Acceleration Jerk and Maximum Deceleration Jerk fields to automatically calculate new values.
- 4. Adjust the new jerk values for your specific application needs.

Setting the values for AccelerationLimitBipolar, AccelerationLimitPositive, and AccelerationLimitNegative requires one more calculation by using this formula.

AccelerationLimitBipolar = AccelerationLimitPositive = -AccelerationLimitNegative AccelerationLimitBipolar = $\frac{2 \cdot MaximumAcceleration}{0.85}$ = 668.18 PU/s²

5. Click the Limits tab.

- Custom Limits Attributes Name Value Units Туре Default AccelerationLimitBipolar Value VelocityLimitBipolar 33.333336 Position Units/s REA AccelerationLimitBipolar 8732.302 Position Units/s REAL /elocityLimitPositive 33.333336 Position Units/s REAL VelocityLimitNegative -33.333336 Position Units/s REAL VelocityThreshold 0.0 Position Units/s REAL 1.0 Position Units/s REAL VelocityWindow Default AccelerationLimitPositive and 1.0 Position Units/s REAL 8732.302 Position Units/s REAL VelocityStandstill/Vindow AccelerationLimitNegative Values AccelerationLimitPositive -8732.302 Position Units/s REAL AccelerationLimitNegative Close Cancel Help
- **6.** Click Set Custom Limits.

7. Overwrite the existing AccelerationLimitBipolar value.

In this example, the calculated value is 668.18.

8. Overwrite the existing AccelerationLimitPositive and AccelerationLimitNegative values.

In this example, the calculated values are +668.18 and -668.18 (respectively).

9. Repeat this process for each IAM and AM module in your system.

Change the Drive Parameter

Before the drive is capable of accepting a command for the new peak current ratings, you need to change a drive parameter. This needs to be done only once, and there are two methods to perform the task.

IMPORTANT The sercos IDN method that uses the Logix Designer application supports automatic drive replacement (ADR).

Sercos IDN Write Instruction

The sercos IDN write instruction is accomplished by using the Logix Designer application. Refer to <u>Appendix E</u> on <u>page 249</u> for more information on changing IDN parameter values by using this method.

1. On initialization of the drive, read the INT value of the configuration of the drive at sercos IDN P:0:7.

Configuration	Communication	ſag		-1
Message Type	sercos	IDN Read	<u>.</u>	<u> </u>
Service Type:	Data		✓ Destin	ation: Drive_Read_Data
Number:	P <u>▼</u> … 0	± 7	Ē	New Lag
Element:	7:0peration Value	e	-	
Data Type:	INT		-	
🔾 Enable 🛛 🔇) Enable Waiting	Start	Done	Done Length: 0
 Enable Error Code: Error Path: Error Text:) Enable Waiting Extend	Start led Error Code:	Done	Done Length: 0 └── Timed Out ◆

2. If the value of bit zero is zero, latch it and write the new value back to the drive at the same address, again as type INT.

lessage Confi	guration - IDN_	Write			D
Message Type	Communication	ag IDN Write	Ŀ	•	
Service Type: Identification Number: Element:	Data P • ··· 0	<u>+</u> - 7	✓ Source Source Length	Drive_Write_I	Data 💌 (Bytes)
Data Type:	INT		-	Ξ.	-
🔾 Enable 🛛 🔾) Enable Waiting	Start	Done	Done Length: 0	
Error Code: Error Path: Error Text:	Extend	ed Error Code:		Timed Out 🗲	
		ОК	Cancel	Apply	Help

3. Verify change with another sercos IDN Read Message from IDN P:0:7 and examine bit zero.



Refer to this Logix Designer application example.

DriveExplorer Software

To use DriveExplorer software to change IDN parameter values, you must also have the 1203-SSS Serial to SCANport adapter. Refer to <u>Appendix C</u> on <u>page 225</u> for more information on changing IDN parameter values by using this method.

- 1. Connect a 1203-SSS Serial to SCANport adaptor to the drive by using DriveExplorer software.
- 2. Change parameter P507 [Drv Peak Rating] from 150% to 250% (or 200% if applicable).
- 3. Save device values to nonvolatile memory.

Notes:

RBM Module Interconnect Diagrams

This appendix provides Bulletin 2090 Resistive Brake Module (RBM) interconnect diagrams specific to Kinetix 6000 multi-axis servo-drive systems with and without the safe torque-off feature.

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Kinetix 6000 drives with the safe torque-off feature have the -S designation at the end of the catalog number. For example, the 2094-AM01-S AM module includes safe torque-off and the 2094-AM01 AM module does not.

Before You Begin

These procedures assume you have installed your RBM module with the Kinetix 6000 servo-drive system. For RBM module installation instructions, refer to the Resistive Brake Module Installation Instructions, publication 2090-IN009.

IMPORTANT Drive firmware revision 1.071 or later is required to use the RBM module with Kinetix 6000 drives.



ATTENTION: User the interconnection diagrams as a general recommendation on how the safety control circuit can be implemented. Actual applications can vary due to requirements based on the machine builders risk assessment. The machine builder must perform a risk assessment and determine a category level of safety that must be applied to the machine.

For Kinetix 6000 drive systems, you can set the delay time for your RBM module in the Logix Designer application. Refer to Configure Axis Properties on page 149.

RBM Module Wiring Examples

This example diagram shows 2094-*x*C*xx*-M*xx*-S and 2094-*x*M*xx*-S drives (with safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module.

Figure 121 - RBM Wiring Example



RBM Wiring Example (continued)



Note Note 3 3	ATTENTION: The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder. Information Cable shield clamp must be used to meet CE requirements. No external connection to ground required. For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>GMC-TD004</u> . The BRKTMPO signal can be wired to a ControlLogix input as overtemp warning in user program. Firmware revision 1.071 or later is required to use the DBRK outputs on the Kinetix 6000 IAM or AM module. Set the safety relay time delay beyond the time required to stop and disable
9	Drive Enable Input Checking must be selected when configuring Axis Properties in the Logix Designer application.

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This example diagram shows 2094-*x*C*xx*-M*xx* and 2094-*x*M*xx* drives (without safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module.







RBM Wiring Example, Category 2 Configuration per ISO 13849-1 (continued)

This example diagram shows 2094-*x*C*xx*-M*xx* and 2094-*x*M*xx* drives (without safe torque-off) and 2094-AL09 and 2094-BL02 LIM modules wired with the Bulletin 2090 RBM module.

Figure 123 - RBM Wiring Example, Category 2 Configuration per ISO 13849-1





RBM Wiring Example, Category 2 Configuration per ISO 13849-1 (continued)

This example diagram shows 2094-*x*C*xx*-M*xx* drives (without safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module. The example continues on page 273.



Figure 124 - RBM Wiring Example, Category 3 Configuration per ISO 13849-1



RBM Wiring Example, Category 3 Configuration per ISO 13849-1 (continued)

This example diagram shows 2094-*x*C*xx*-M*xx* drives (without safe torque-off) and 2094-AL09 and 2094-BL02 LIM modules wired with the Bulletin 2090 RBM module.







RBM Wiring Example, Category 3 Configuration per ISO 13849-1 (continued)

Notes:

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