

Kinetix 5700 Servo Drives

Catalog Numbers 2198-P031, 2198-P070, 2198-P141, 2198-P208, 2198-S086-ERS3, 2198-S130-ERS3, 2198-S160-ERS3, 2198-D006-ERS3, 2198-D012-ERS3, 2198-D020-ERS3, 2198-D032-ERS3, 2198-D057-ERS3, 2198-S086-ERS4, 2198-S130-ERS4, 2198-S160-ERS4, 2198-D006-ERS4, 2198-D012-ERS4, 2198-D020-ERS4, 2198-D032-ERS4, 2198-D057-ERS4, 2198T-W25K-ER, 2198-CAPMOD-2240, 2198-CAPMOD-DCBUS-IO



Important User Information

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

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

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

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

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

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



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



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

IMPORTANT

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

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



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



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



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

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Notes:

This manual provides detailed installation instructions for mounting and wiring your Kinetix® 5700 power supplies, single-axis inverters, dual-axis inverters, and capacitor modules. Also included is system configuration with the Studio 5000 Logix Designer® application, integration of your drive modules with a Logix 5000™ controller, system startup, and troubleshooting.

Also provided in this manual are installation instructions for mounting and wiring input power for your iTRAK® power supply. For wiring iTRAK digital inputs, outputs to the motor modules, and startup, troubleshooting, and commissioning with the AOI, see the iTRAK System User Manual, publication [2198T-UM001](#).

This manual is intended for engineers or technicians directly involved in the installation and wiring of the Kinetix 5700 drive modules, and programmers directly involved in the operation, field maintenance, and integration of these modules with the EtherNet/IP™ communication module or controller.

If you do not have a basic understanding of Kinetix 5700 drive modules, contact your local Rockwell Automation sales representative for information on available training courses.

Summary of Changes

This manual contains new and updated information as indicated in the following table.

| Topic | Page |
|---|------------|
| Added features that apply to 2198-xxxx-ERS3 (series B) drives. <ul style="list-style-type: none"> In many instances, 2198-xxxx-ERS3 (series B) drives share features of 2198-xxxx-ERS4 drives and this was added to the text In many instances, it was necessary to distinguish 2198-xxxx-ERS3 (series A) drive operation from series B and this was added to the text Updated single-axis and dual-axis inverter line drawings with locking-leaver I/O (IOD) and safety (STO) connectors that are included with 2198-xxxx-ERS3 (series B) and 2198-xxxx-ERS4 drives | Throughout |
| Added Kinetix® 5700 Servo Drives Series Change to describe new features that are available with 2198-xxxx-ERS3 (series B) drives. | 15 |
| Updated AC Line Filters installation guidelines. | 45 |
| Corrected the DC-bus power supply IOD-4 description and signal name. | 69, 101 |
| Added information for IEC 61800-3 category C3/C4 compliance with regard to the use of AC line filters on AC input power. | 93...98 |
| Added bullet statements and other text to describe features of 2198-xxxx-ERS3 (series B) drives, including when to use Compatible Module and Exact Match electronic keying options in the Module Definition. | 158 |
| Updated Table 88 with safety functions specific to 2198-xxxx-ERS3 (series A) drives and 2198-xxxx-ERS3 (series B) drives. | 159 |
| Updated content regarding fault code NODE FLT 06 fault behavior. | 230, 234 |
| Added Replacing 2198-xxxx-ERS3 (series A) Drives with Series B Drives with text, dialog boxes, and a flowchart to describe when to use Compatible Module and Exact Match electronic keying options in the Module Definition. | 240 |
| Added Table 137 to help describe changes in the safe torque-off tag names. | 264 |
| Updated Table 138 and Table 139 to reflect safe torque-off tag name changes. | 264, 265 |
| Added Figure 117 , Figure 118 , and Figure 119 to show how tag name changes can appear in your application program. | 265 |
| Added information about changes in drive firmware revision 9.001 and later (2198-xxxx-ERS4 and 2198-xxxx-ERS3 series B drives) that provides for the use of MDS instructions with Speed Limited Adjustable Torque (SLAT) operation. | 350...355 |

Conventions Used in This Manual

These conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps
- Numbered lists provide sequential steps or hierarchical information
- When catalog number 2198-xxxx-ERS3 appears in this publication without series designation, the topic applies to series A and B drives

IMPORTANT Throughout this publication, when the Kinetix 5700 inverter catalog number ends in -ERSx, for example 2198-D057-ERSx, the variable (x) indicates that the inverter (using this example) can be 2198-D057-ERS3 or 2198-D057-ERS4.

Additional Resources

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

Table 1 - Additional Resources

| Resource | Description |
|---|---|
| Kinetix Rotary Motion Specifications Technical Data, publication KNX-TD001 | Product specifications for Kinetix VP (Bulletin VPL, VPC, VPF, and VPS), MP-Series™ (Bulletin MPL, MPM, MPF, and MPS), and HPK-Series™ rotary motors. |
| Kinetix Linear Motion Specifications Technical Data, publication KNX-TD002 | Product specifications for Bulletin MPAS and MPMA linear stages, Bulletin MPAR and MPAL electric cylinders, LDAT-Series linear thrusters, and LDC-Series™ linear motors. |
| Kinetix Servo Drives Specifications Technical Data, publication KNX-TD003 | 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 KNX-TD004 | Product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items. |
| Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication 2198-RM001 | Provides a description of integrated stopping functions and safe monitoring functions with a GuardLogix® controller and Kinetix 5700 servo drives. |
| Kinetix 5000 AC Line Filter Installation Instructions, publication 2198-IN003 | Information on installing and wiring the Kinetix 5500 and Kinetix 5700 AC line filters. |
| Kinetix 5700 Capacitor Modules Installation Instructions, publication 2198-IN008 | Information on installing and wiring the Kinetix 5700 capacitor modules. |
| Kinetix 5700 Shunt Passive Modules Installation Instructions, publication 2198-IN011 | Information on installing and wiring Kinetix 5700 passive shunts. |
| iTRAK System User Manual, publication 2198T-UM001 | Information on installing the Kinetix 5700 iTRAK power supply with an iTRAK system and programming the iTRAK system. |
| 1321 Power Conditioning Products Technical Data, publication 1321-TD001 | Information on typical use cases, specifications, terminations, and dimensions of Bulletin 1321 line reactors. |
| 8720MC Regenerative Power Supply Installation Manual, publication 8720MC-RM001 | Information on installing, wiring, and startup for the 8720MC regenerative power supply with 380 . . . 460V AC operation. |
| System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001 | Information, examples, and techniques designed to minimize system failures caused by electrical noise. |
| Kinetix Motion Control Selection Guide, publication KNX-SG001 | 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 5700 Drive Systems Design Guide, publication KNX-RM010 | System design guide to select the required (drive specific) drive module, power accessory, feedback connector kit, and motor cable catalog numbers for your Kinetix 5700 drive system. |
| Rockwell Automation Product Selection website http://www.rockwellautomation.com/global/support/selection.page | Online product selection and system configuration tools, including AutoCAD (DXF) drawings. |
| Motion Analyzer System Sizing and Selection Tool website https://motionanalyzer.rockwellautomation.com/ | Comprehensive motion application sizing tool used for analysis, optimization, selection, and validation of your Kinetix Motion Control system. |

Table 1 - Additional Resources (continued)

| Resource | Description |
|---|---|
| Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page | Provides declarations of conformity, certificates, and other certification details. |
| Vertical Load and Holding Brake Management Application Technique, publication MOTION-AT003 | Information on vertical loads and how the servo motor holding-brake option can be used to help keep a load from falling. |
| Motion System Tuning Application Technique, publication MOTION-AT005 | Information on tuning a Kinetix drive system. |
| Integrated Motion on the EtherNet/IP Network Configuration and Startup User Manual, publication MOTION-UM003 | Information on configuring and troubleshooting your ControlLogix® and CompactLogix™ EtherNet/IP network modules. |
| Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003 | Information on the AXIS_CIP_DRIVE attributes and the Studio 5000 Logix Designer application Control Modes and Methods. |
| GuardLogix 5570 Controllers User Manual, publication 1756-UM022 | Information on designing, installing, programming, or troubleshooting control systems that use GuardLogix controllers. |
| GuardLogix 5580 Controllers User Manual, publication 1756-UM543 | |
| Compact GuardLogix 5370 Controllers User Manual, publication 1769-UM022 | Information on designing, installing, programming, or troubleshooting control systems that use Compact GuardLogix controllers. |
| Compact GuardLogix 5380 Controllers User Manual, publication 5069-UM001 | |
| GuardLogix 5570 and Compact GuardLogix 5370 Controller Systems Safety Reference Manual, publication 1756-RM099 | Information for development, operation, or maintenance of a GuardLogix or Compact GuardLogix controller-based safety system that uses the Studio 5000 Logix Designer application. |
| GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Safety Reference Manual, publication 1756-RM012 | |
| ControlFLASH Firmware Upgrade Software User Manual, publication 1756-UM105 | For ControlFLASH™ information not specific to any drive family. |
| Rockwell Automation Industrial Automation Glossary, publication AG-7.1 | A glossary of industrial automation terms and abbreviations. |
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 | Provides general guidelines for installing a Rockwell Automation industrial system. |

You can view or download publications at <http://www.rockwellautomation.com/global/literature-library/overview.page>. 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® 5700 drive systems.

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Kinetix 5700 Servo Drives Series Change

Single-axis and dual-axis inverters, catalog numbers 2198-xxxx-ERS3 (series B), include an enhancement that is not included in series A drives, but that is included in 2198-xxxx-ERS4 drives.

- The drive-based (Monitored SS1 and Timed SS1) stopping functions and controller-based monitoring functions apply to the 2198-xxxx-ERS4 drives
- The drive-based Timed SS1 stopping function and STO with configurable delay applies to the 2198-xxxx-ERS3 (series B) drives
- When catalog number 2198-xxxx-ERS3 appears in this publication without series designation, the topic applies to series A and B drives

Table 2 - Integrated Functional Safety Support

| Integrated Safety Over the EtherNet/IP Network | Safety Function | Dual-axis Inverters Cat. No. | Single-axis Inverters Cat. No. | Minimum Controller ⁽¹⁾ Required |
|--|--|---|---|---|
| Drive-based stopping functions | Timed Safe Stop 1 (SS1) | 2198-Dxxx-ERS3 (series B) 2198-Dxxx-ERS4 | 2198-Sxxx-ERS3 (series B) 2198-Sxxx-ERS4 | <ul style="list-style-type: none"> • GuardLogix® 5580 • CompactLogix™ 5380 |
| | Monitored Safe Stop 1 (SS1) | | | |
| Controller-based stopping functions | <ul style="list-style-type: none"> • Monitored Safe Stop 1 (SS1) • Safe Stop 2 (SS2) | | | |
| Controller-based monitoring functions | <ul style="list-style-type: none"> • Safe Operational Stop (SOS) • Safely Limited Speed (SLS) • Safety Limited Position (SLP) • Safe Direction (SDI) | 2198-Dxxx-ERS4 | 2198-Sxxx-ERS4 | |
| Safety feedback function | Safety Feedback Interface (SFX) | | | |
| Integrated STO mode | Safe Torque-off (STO) | 2198-Dxxx-ERS4 | 2198-Sxxx-ERS4 | <ul style="list-style-type: none"> • ControlLogix® 5570 • CompactLogix 5370 |
| | | 2198-Dxxx-ERS3 | 2198-Sxxx-ERS3 | |

(1) Where a ControlLogix or CompactLogix (non-safety) controller is specified, a GuardLogix or Compact GuardLogix controller is backwards compatible. Also, GuardLogix 5580 and Compact GuardLogix 5380 controllers are backwards compatible with GuardLogix 5570 and Compact GuardLogix 5370 controllers.

About the Kinetix 5700 Servo Drive System

The Kinetix 5700 drive modules are zero-stacked and use the shared-bus connection system to extend power from one drive module to another. Systems are designed to support Integrated Motion over the EtherNet/IP™ network.

Table 3 - Kinetix 5700 Drive System Overview

| Drive System Component | Cat. No. | Description |
|---------------------------------------|---|--|
| Kinetix 5700 DC-bus Power Supply | 2198-Pxxx | Converter power supply with 400V-class (three-phase) AC input. Typical systems consist of 1...3 modules. Additional modules increase power output to Bulletin 2198 single-axis and dual-axis inverters. |
| Kinetix 5700 Single-axis Servo Drives | 2198-Sxxx-ERS3 | Single-axis inverters with current ratings up to 85 A rms. Drives feature TÜV Rheinland certified safe torque-off function with hardwired and integrated safety connection options, PL e and SIL 3 safety ratings, and support DSL and Hiperface encoder feedback. 2198-Sxxx-ERS3 (series B) drives also support Timed SS1 drive-based stopping functions. |
| | 2198-Sxxx-ERS4 | Single-axis inverters with the same power structure and encoder feedback support as -ERS3 inverters, plus support for Monitored SS1 and Timed SS1 drive-based stopping functions. Also, support for controller-based safe stop and safe monitor functions over the EtherNet/IP network. |
| Kinetix 5700 Dual-axis Servo Drives | 2198-Dxxx-ERS3 | Dual-axis inverters with current ratings up to 23 A rms. Drives feature TÜV Rheinland certified safe torque-off function with hardwired and integrated safety connection options, PL e and SIL 3 safety ratings, and support DSL and Hiperface encoder feedback. 2198-Dxxx-ERS3 (series B) drives also support Timed SS1 drive-based stopping functions. |
| | 2198-Dxxx-ERS4 | Dual-axis inverters with the same power structure and encoder feedback support as -ERS3 inverters, plus support for Monitored SS1 and Timed SS1 drive-based stopping functions. Also, support for controller-based safe stop and safe monitor functions over the EtherNet/IP network. |
| Kinetix 5700 iTRAK Power Supply | 2198T-W25K-ER | DC-DC converter that generates DC-bus power for iTRAK® systems. |
| Kinetix 5700 Capacitor Module | 2198-CAPMOD-2240 | Use for energy storage and to extend the DC-bus voltage to another inverter cluster. Modules are zero-stacked with servo drives and use the shared-bus connection system to extend the external DC-bus in applications up to 100A. |
| Kinetix 5700 Extension Module | 2198-CAPMOD-DCBUS-IO | The extension module, paired with a capacitor module, is used to extend the DC-bus voltage to another inverter cluster in the Kinetix 5700 drive system. |
| Regenerative Power Supply | 8720MC-RPSxxx | Sinusoidal PWM converter that can control the increase of DC-bus voltage and perform continuous power generation for one or more servo drives in multi-axis DC common-bus configurations. |
| Line Reactors | 1321-3R80-B 1321-3RA80-B | Bulletin 1321 line reactors help keep equipment running longer by absorbing many of the power line disturbances that can shut down your power supply. |
| Shared-bus Connector Kits | 2198-TCON-24VDCIN36 2198-xxxx-P-T 2198-BARCON-xxDCAC100 | 24V input wiring connectors, T-connectors, and bus-bars for the Kinetix 5700 drive system 24V shared-bus connection system (optional). |
| | 2198T-W25K-P-IN 2198T-W25K-P-T | 24V input wiring connector, T-connector, and bus-bar for the iTRAK motor module 24V shared-bus connection system (optional). |
| | 2198-BARCON-xxDC200 2198-KITCON-ENDCAP200 | DC-bus links (55, 85, and 100 mm) and end caps for the DC-bus shared-bus connection system (required and included with each respective drive module). |
| DSL Feedback Connector Kit | 2198-KITCON-DSL | Replacement DSL motor feedback connector kit with 2-pin connector plug and grounding plate inside the connector housing. Supports 400V-class Kinetix VP rotary motors. Included with 2090-CSxM1DE motor cables. Must be purchased separately when used with 2090-CSxM1DG motor cables. |
| Universal Feedback Connector Kit | 2198-K57CK-D15M | Universal feedback connector kit for motor and auxiliary feedback connections with the 15-pin connector plug and grounding plate inside the connector housing. Supports 400V-class MP-Series™ and HPK-Series™ rotary motors, MP-Series linear actuators, LDAT-Series linear thrusters, and LDC-Series™ linear motors. |
| Hiperface to DSL Converter Kit | 2198-H2DCK (series B or later) | Provides Hiperface-to-DSL feedback conversion for use with compatible 400V-class motors and actuators. |
| Kinetix 5700 System Mounting Toolkit | 2198-K5700-MOUNTKIT | Use to position the drive modules and identify drill-holes for mounting your Kinetix 5700 servo drive system. |
| Kinetix 5700 Cable Clamp Spacer Kit | 2198-K5700-CLAMPSPACER | Replacement cable clamp spacers for 2198-Dxxx-ERSx dual-axis inverters. |
| Encoder Output Module | 2198-ABQE | The Allen-Bradley® encoder output module is a DIN-rail mounted EtherNet/IP network-based standalone module capable of outputting encoder pulses to a customer-supplied peripheral device (cameras, for example, used in line-scan vision systems). |

Table 3 - Kinetix 5700 Drive System Overview (continued)

| Drive System Component | Cat. No. | Description |
|-------------------------------------|--|---|
| Connector Sets | 2198-KITCON-P070 | Replacement connector set for DC-bus power supplies (55 mm). |
| | 2198-KITCON-P208 | Replacement connector set for DC-bus power supplies (85 mm). |
| | 2198-KITCON-S160 (series A) 2198-KITCON-S160-L (series B) | Replacement connector set for single-axis inverters (85 and 100 mm). Use 2198-KITCON-S160-L connector set with 2198-Sxxx-ERS3 (series B) and 2198-Sxxx-ERS4 drives. |
| | 2198-KITCON-D032 (series A) 2198-KITCON-D032-L (series B) | Replacement connector set for dual-axis inverters (55 mm). Use 2198-KITCON-D032-L connector set with 2198-Dxxx-ERS3 (series B) and 2198-Dxxx-ERS4 drives. |
| | 2198-KITCON-D057 (series A) 2198-KITCON-D057-L (series B) | Replacement connector set for dual-axis inverter (85 mm). Use 2198-KITCON-D057-L connector set with 2198-Dxxx-ERS3 (series B) and 2198-Dxxx-ERS4 drives. |
| | 2198-KITCON-CAPMOD2240 | Replacement connector set for capacitor module. |
| | 2198T-W25K-KITCON | Replacement connector set for iTRAK power supply. |
| Logix 5000™ Controller Platform | Bulletin 1769 Bulletin 5069 | Integrated Motion on the EtherNet/IP network in CompactLogix 5370 and CompactLogix 5380 controllers and Integrated Safety in Compact GuardLogix 5370 and Compact GuardLogix 5380 controllers. Linear, device-level ring (DLR), and star topology is supported. |
| | 1756-EN2T module 1756-EN2TR module 1756-EN3TR module | EtherNet/IP network communication modules for use with ControlLogix 5570, ControlLogix 5580, GuardLogix 5570, and GuardLogix 5580 controllers. Linear, device-level ring (DLR), and star topology is supported. |
| Studio 5000® Environment | N/A | Studio 5000 Logix Designer® application, version 26.00 or later, provides support for programming, commissioning, and maintaining the CompactLogix, ControlLogix, and GuardLogix controller families. |
| Rotary Servo Motors | Kinetix VP | Compatible motors include 400V-class Bulletin VPL, VPC, VPF, and VPS servo motors. |
| | MP-Series | Compatible motors include 400V-class Bulletin MPL, MPM, MPF, and MPS servo motors. |
| | HPK-Series | Compatible motors include 460V and 400V-class HPK-Series asynchronous servo motors. |
| Linear Actuators | MP-Series, LDAT-Series | Compatible actuators include 400V-class Bulletin MPAS, MPAR, MPAL linear actuators and LDAT-Series linear thrusters. |
| Linear Motors | LDC-Series | Compatible motors include LDC-Series iron-core (400V-class) linear motors. |
| Induction Motors | N/A | Induction motors with open-loop frequency control and closed-loop control are supported. |
| Cables | 2090-CSxM1DE-xxAxxx | Bulletin 2090 single cable for motor power, feedback, and 24V DC brake power with Kinetix VP motors. Feedback conductors are wired to the 2198-KITCON-DSL feedback connector kit. |
| | 2090-CSxM1DG-xxAxxx | Bulletin 2090 single cable for motor power, feedback, and 24V DC brake power with Kinetix VP motors. 2090-CSxM1DG cables have flying-lead feedback conductors for connection to a customer-supplied 2198-KITCON-DSL feedback connector kit. |
| | 2090-CFBM7DF-CEAxxx | Bulletin 2090 motor feedback cables for MP-Series motors and actuators with Stegmann Hiperface encoders. |
| | 2090-CPxM7DF-xxAxxx | Bulletin 2090 motor power/brake cables for MP-Series motors and actuators. |
| | 2090-XXNFMF-Sxx 2090-CFBM7DF-CDAFxx | Bulletin 2090 standard and continuous-flex feedback cables that include additional conductors for use with incremental and EnDat encoders. |
| | 2198T-CHBFLS8-12AAxx | Bulletin 2198T power cables for iTRAK power supply to iTRAK motor modules. |
| | 1585J-M8CBJM-x | Ethernet cables are available in standard lengths. Shielded cable is required to meet EMC specifications. |
| AC Line Filters | 2198-DB20-F, 2198-DB42-F, 2198-DB80-F, 2198-DB290-F | Bulletin 2198 three-phase AC line filters are required to meet CE and available for use in all Kinetix 5700 drive systems. |
| 24V DC Power Supply | 1606-XLxxx | Bulletin 1606 24V DC power supply for control circuitry, digital inputs, safety, and motor brake. |
| External Passive Shunt Resistors | 2198-R014, 2198-R031, 2198-R127, 2198-R004 | Bulletin 2198 external passive shunt resistors for use when the DC-bus power supply internal shunt capability is exceeded. |
| External Active Shunt Resistors | N/A | External active shunts from Rockwell Automation Encompass™ Partner Powerohm Resistors, Inc. are available for connecting to Bulletin 2198 DC-bus power supplies. See External Active-shunt Connections on page 134 for catalog numbers. |

Drive Hardware and Input Power Configurations

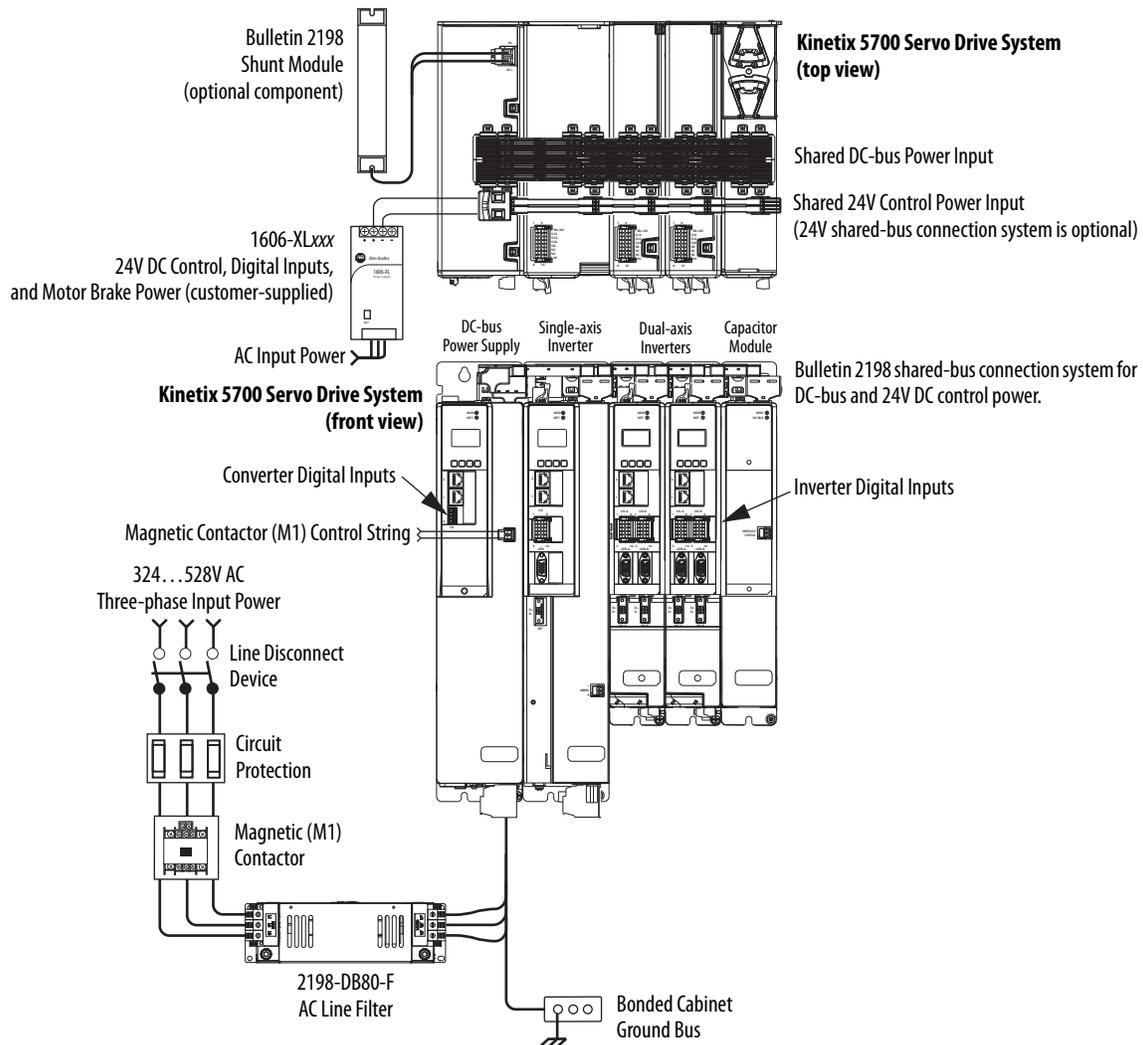
Kinetix 5700 servo drive systems have three-phase input power supplied by a single DC-bus (converter) power supply. However, for additional output power (kW) you can install two or three 2198-P208 power supplies or an 8720MC-RPS regenerative power supply. In addition, you can extend the DC-bus to another inverter cluster with capacitor modules.

DC-bus Power Supply Configuration

In this multi-axis example, AC input power is fed to the DC-bus (converter) power supply. One single-axis (inverter) module and two dual-axis (inverter) modules support five axes of motion.

Digital inputs are wired to sensors and the control circuitry at the IOD connectors. The contactor-enable relay protects the DC-bus power supply in the event of shutdown fault conditions.

Figure 1 - Typical Shared DC-bus Installation

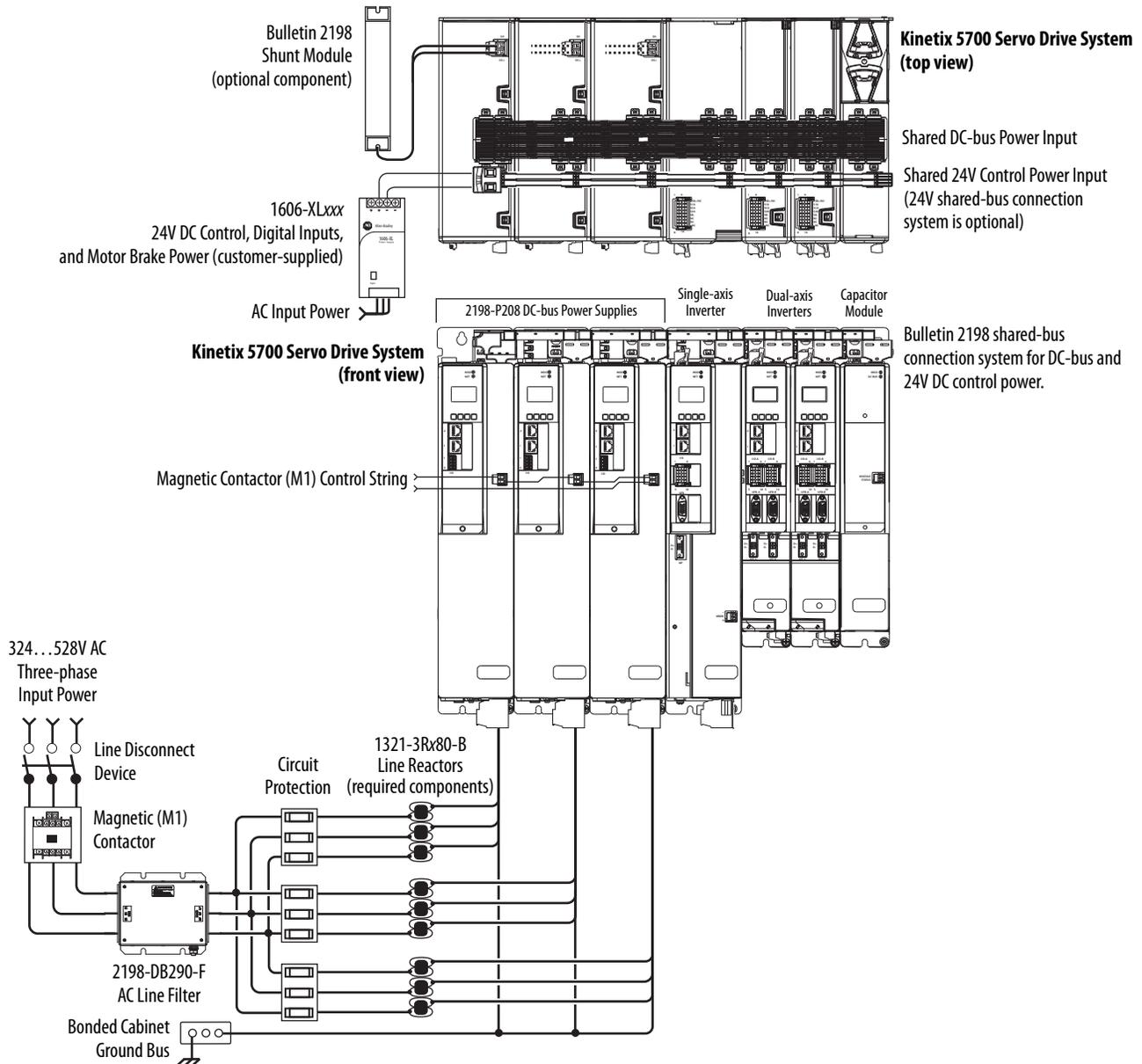


Multiple DC-Bus Power Supply Configuration

In this example, three DC-bus (converter) power supplies all receive AC input power and feed the inverter modules for increased output power.

Contactor-enable relays from each of the DC-bus power supplies are wired in series to protect the DC-bus power supply in the event of shutdown fault conditions.

Figure 2 - Multiple DC-bus Power Supply Installation



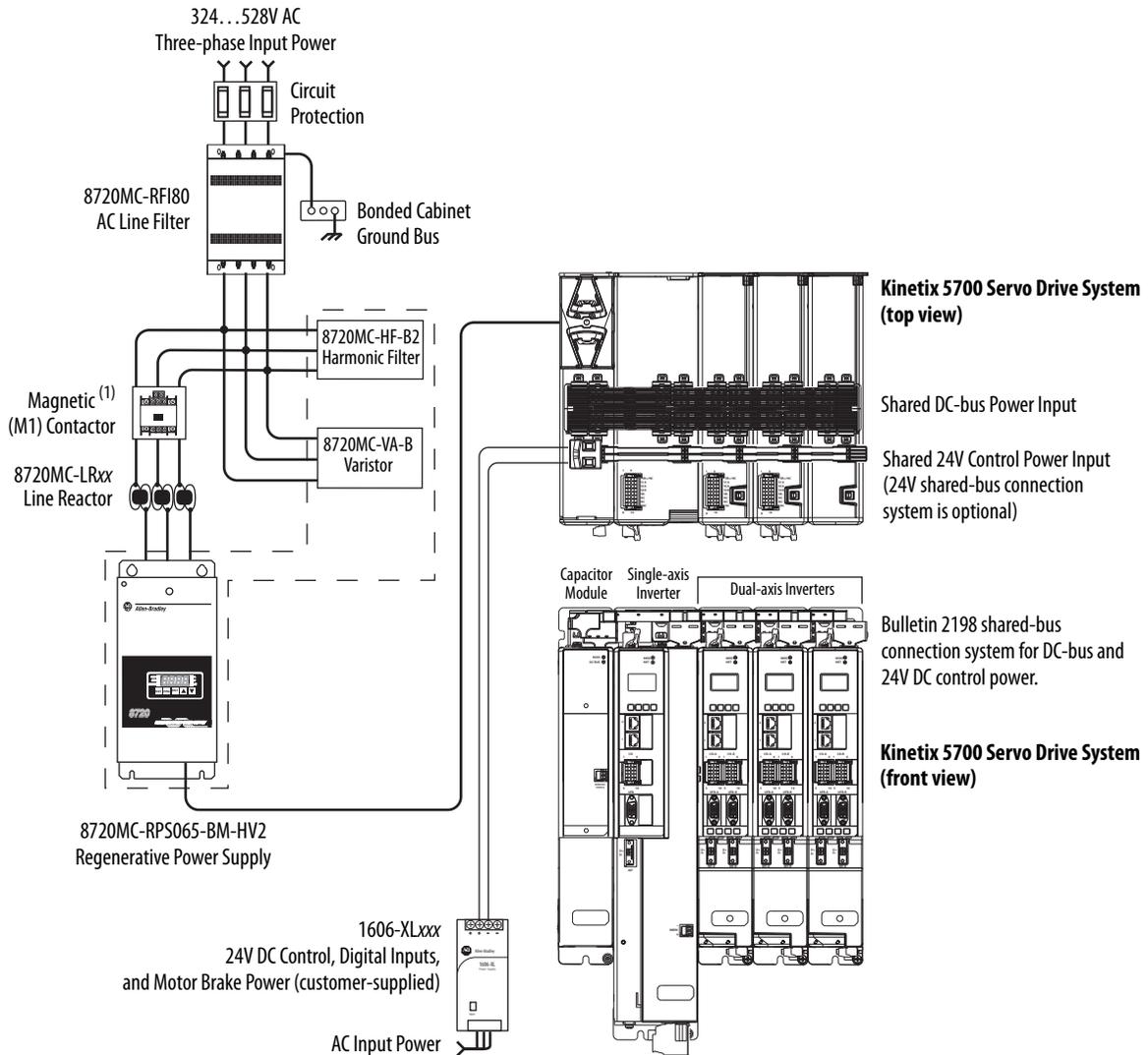
IMPORTANT When two or three DC-bus power supplies are wired together in the same drive cluster, they must all be catalog number 2198-P208.

8720MC-RPS Power Supply Configuration

In this example, three-phase AC input power is fed to the Bulletin 8720MC regenerative power supply. The 8720MC-RPS DC-bus voltage supplies the Kinetix 5700 DC-bus via the capacitor module. If the 8720MC-RPS190 is used, the 2198-CAPMOD-DCBUS-IO extension module is required. DC-bus full-regeneration is possible with this configuration.

IMPORTANT The 8720MC-RPS power supply is not compatible with the iTRAK power supply.

Figure 3 - 8720MC-RPS Power Supply Installations

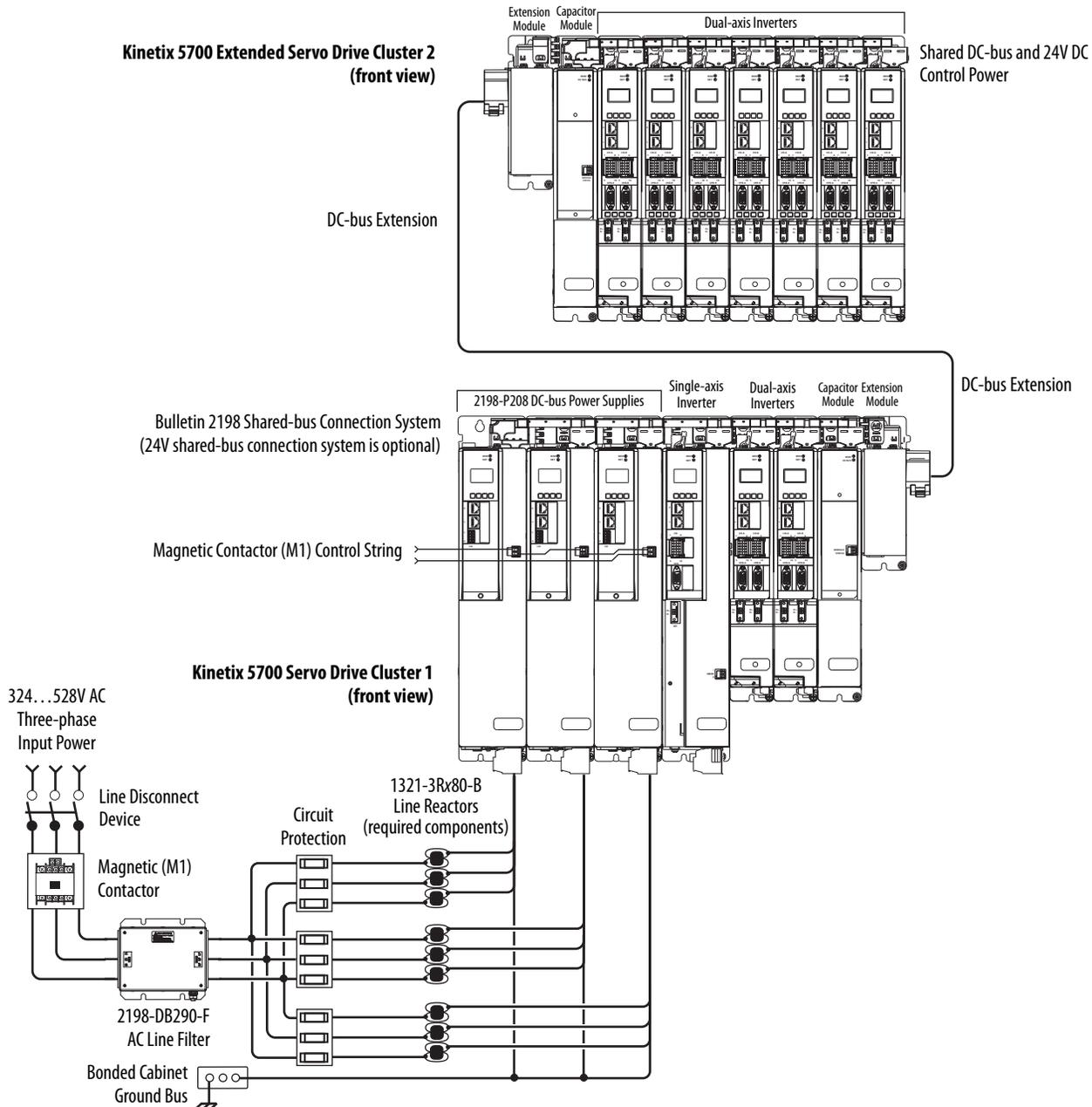


(1) This M1 contactor is controlled by the 8720MC regenerative power supply.

Extended DC-bus Configuration

In this example, two drive clusters in the same cabinet are connected by the same 450...750V DC bus voltage. Kinetix 5700 capacitor modules provide connection points for the DC bus at the end of cluster 1 and the beginning of cluster 2. The extension module is needed only when the DC-bus system current exceeds 100 A and can support up to 200 A maximum external DC-bus current.

Figure 4 - Extended DC-bus Installation



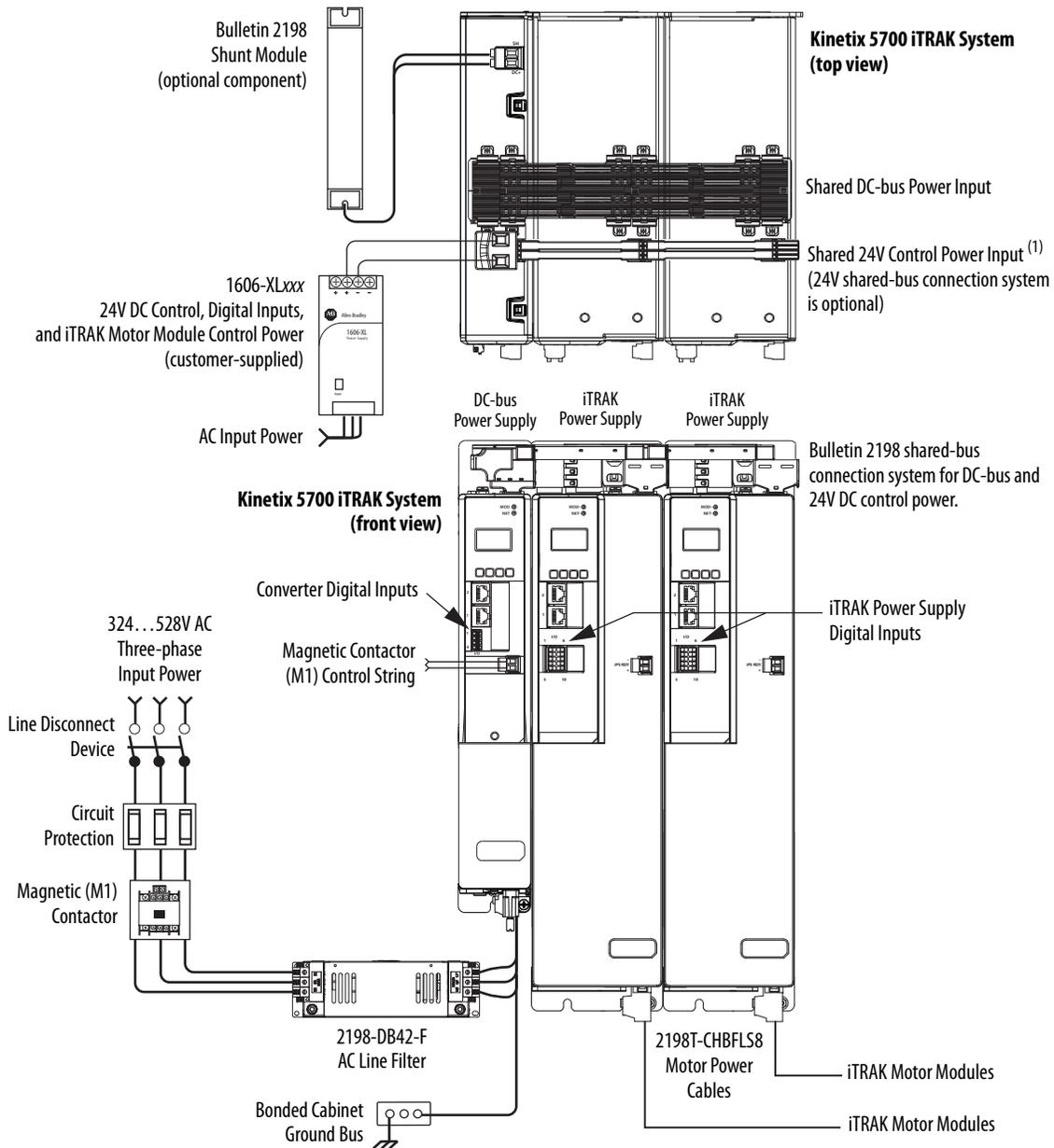
IMPORTANT When two or three DC-bus power supplies are wired together in the same drive cluster, they must all be catalog number 2198-P208.

iTRAK Power Supply Configuration

In this example, AC input power is fed to the DC-bus (converter) power supply. Two iTRAK power supplies support up to 40 iTRAK motor modules, depending on cable lengths and iTRAK motor-module power consumption.

Digital inputs are wired to sensors and the control circuitry at the IOD connectors. The contactor-enable relay protects the DC-bus power supply in the event of shutdown fault conditions.

Figure 5 - Typical iTRAK Power Supply Installation



(1) If total control power current exceeds 16 A, a second input connector (catalog number 2198T-W25K-P-IN) can be added to the leftmost iTRAK power supply.

Motor and Auxiliary Feedback Configurations

Feedback connections are made at the 2-pin motor feedback (MF) connector and the 15-pin universal feedback (UFB) connector. These examples illustrate how you can use the Bulletin 2198 connector kits for making these connections. To see motor power and brake connections, refer to [Chapter 5](#) on [page 91](#).

Figure 6 - Feedback Configuration Example

2198-Dxxx-ERSx or 2198-Sxxx-ERSx Inverters (2198-Dxxx-ERS4 dual-axis inverter is shown)

15-pin Universal Feedback (UFB) Connectors

2-pin Motor Feedback (MF) Connectors

2090-CSBM1DG Single Motor Cables

2090-CSBM1DE Single Motor Cables

2198-KITCON-DSL Connector Kit

- Accepts DSL motor feedback from VPC-Bxxxx-Q and (Bulletin VPL, VPF, VPS) rotary motors
- Feedback-only or load feedback (DSL)

Kinetix VP Rotary Motors (Bulletin VPL, VPF, VPS) and Catalog Number VPC-Bxxxx-Q

2198-K57CK-D15M Universal Connector Kit

Accepts multiple encoder feedback types:

- Hiperface high-resolution absolute multi-turn and single-turn encoders
 - VPC-Bxxxx-S rotary motors
 - MP-Series (Bulletin MPL, MPM, MPF, MPS) rotary motors
 - HPK-Series asynchronous rotary motors
 - MP-Series (Bulletin MPAS, MPAR, MPAI) linear actuators
 - LDAT-Series linear thrusters, LDC-Series linear motors
- Heidenhain EnDat high-resolution absolute encoders
 - RDD-Series direct-drive motors
 - VPC-Bxxxx-Y rotary motors
- Feedback-only, master feedback, or load feedback (absolute single-turn/multi-turn Hiperface)
- Feedback-only, master feedback, or load feedback (incremental)

Kinetix VP Rotary Motors Catalog Numbers VPC-Bxxxx-S and VPC-Bxxxx-Y

MP-Series Rotary Motors (MPL-Bxxxx motor is shown)

2198-H2DCK Converter Kit

Converts 15-pin Hiperface feedback into 2-pin DSL feedback for:

- VPC-Bxxxx-S rotary motors
- MP-Series rotary motors and linear actuators
- HPK-Series asynchronous rotary motors
- LDAT-Series linear thrusters
- Feedback-only, master feedback, or load feedback (absolute single-turn/multi-turn Hiperface)

Bulletin 2090 Motor Power and Feedback Cables

LDC-Series Linear Motors

LDAT-Series Linear Thrusters

RDD-Series Direct Drive Rotary Motors

MP-Series Linear Actuators (MPAS-B9xxx ballscrew linear stage is shown)

HPK-Series Asynchronous Rotary Motors and Induction Rotary Motors (closed-loop control)

MP-Series Linear Actuators (MPAI-B3xxx heavy-duty electric cylinder is shown)

Typical Communication Configurations

The Kinetix 5700 drives support any Ethernet topology including linear, ring, and star by using ControlLogix, GuardLogix, or CompactLogix controllers.

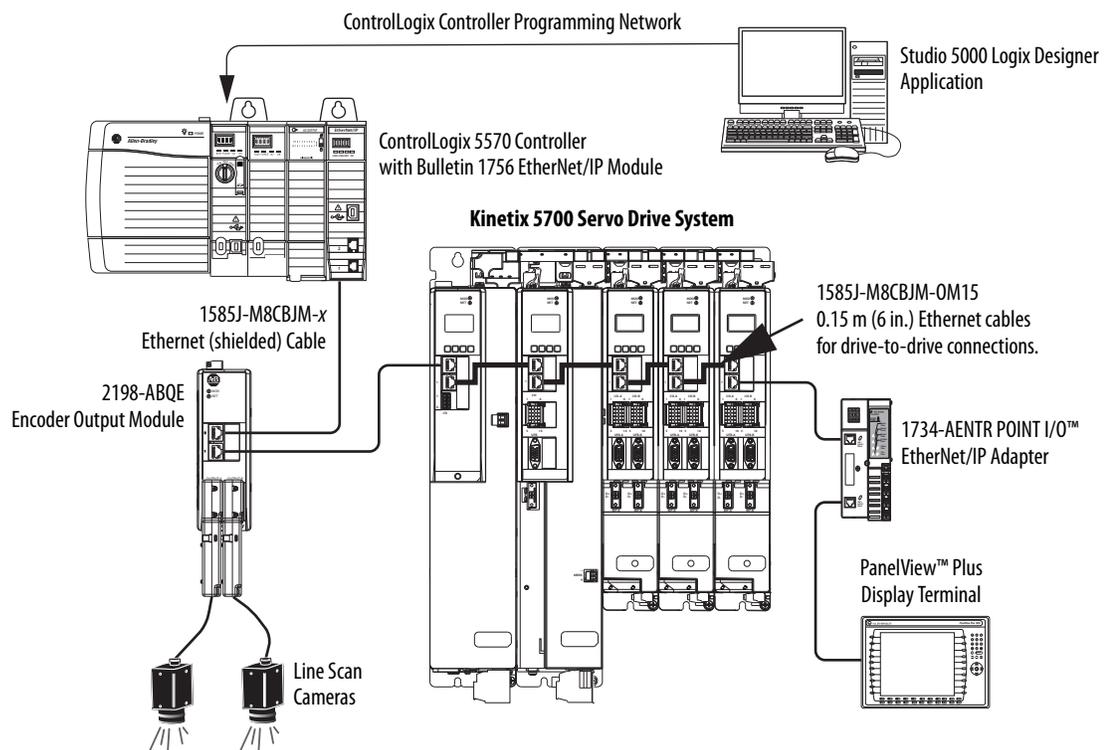
These examples feature the ControlLogix 5570 programmable automation controllers with support for integrated motion and integrated safety over the EtherNet/IP network. Other Allen-Bradley controllers are also compatible with the Kinetix 5700 servo drives.

Refer to ControlLogix Communication Module Specifications Technical Data, publication [1756-TD003](#), for more information on ControlLogix 1756-EN2T, 1756-EN2TR, and 1756-EN3TR communication modules.

Linear Topology

In this example, all devices are connected by using linear topology. The Kinetix 5700 drive modules include dual-port connectivity, however, if any device becomes disconnected, all devices downstream of that device lose communication. Devices without dual ports must include the 1783-ETAP module or be connected at the end of the line.

Figure 7 - Kinetix 5700 Linear Communication Installation

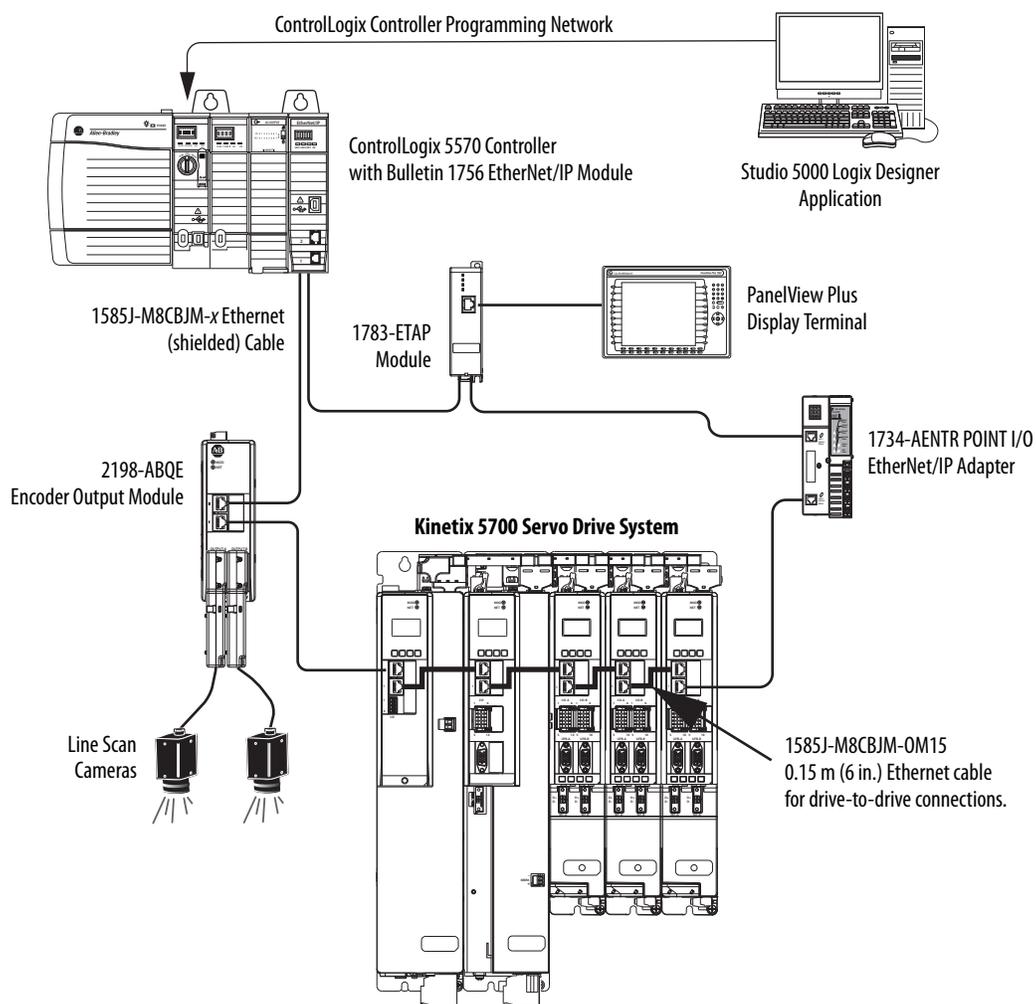


Ring Topology

In this example, the devices are connected by using ring topology. If only one device in the ring is disconnected, the rest of the devices continue to communicate. For ring topology to work correctly, a device level ring (DLR) supervisor is required (for example, the Bulletin 1783 ETAP device). DLR is an ODVA standard. For more information, refer to the EtherNet/IP Embedded Switch Technology Application Guide, publication [ENET-AP005](#).

Devices without dual ports, for example the display terminal, require a 1783-ETAP module to complete the network ring.

Figure 8 - Kinetix 5700 Ring Communication Installation

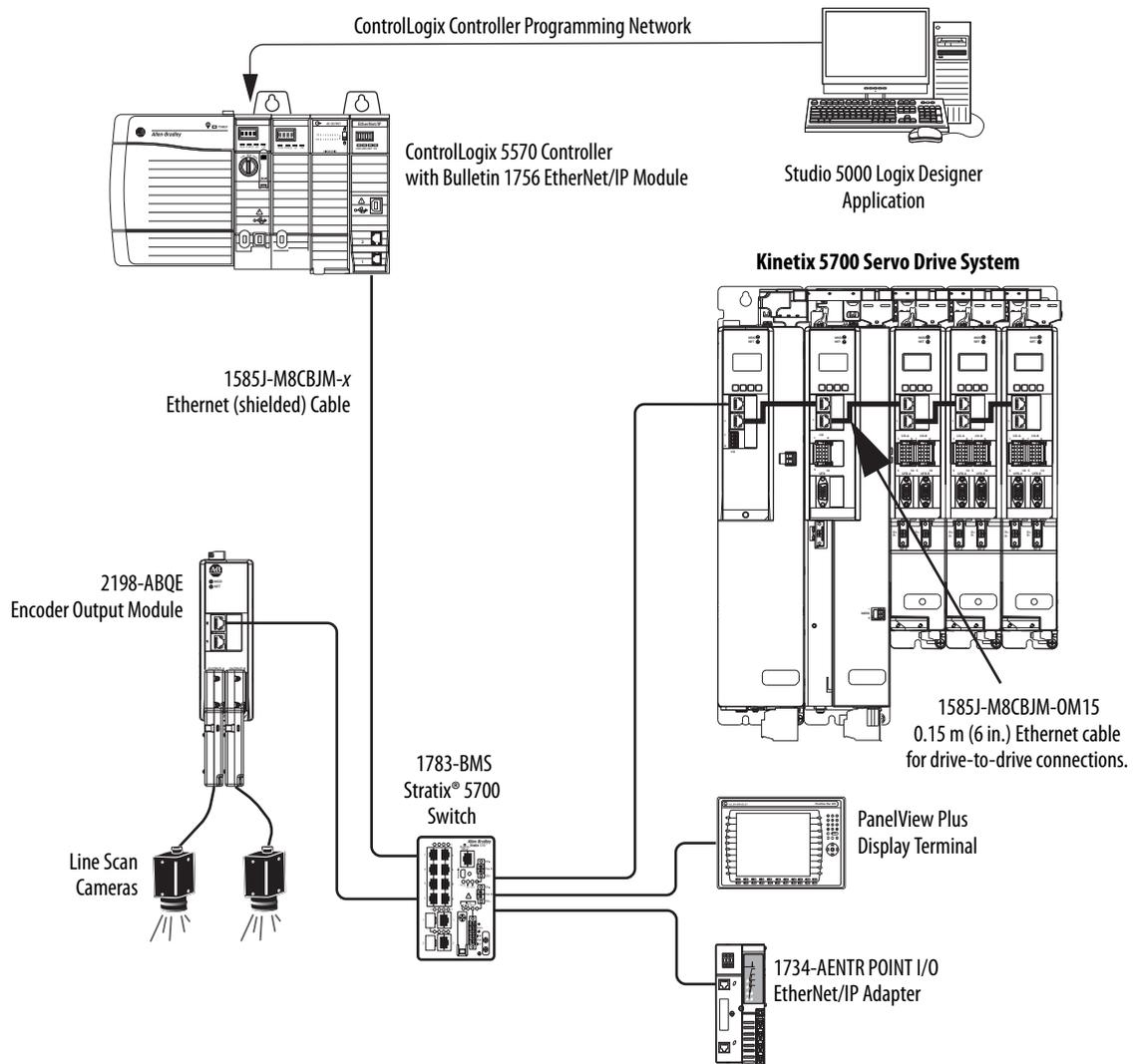


Star Topology

In this example, the devices are connected by using star topology. Each device is connected directly to the switch.

Kinetix 5700 drive modules have dual ports, so linear topology is maintained from one module to another, but the Kinetix 5700 system and other devices operate independently. The loss of one device does not impact the operation of other devices.

Figure 9 - Kinetix 5700 Star Communication Installation



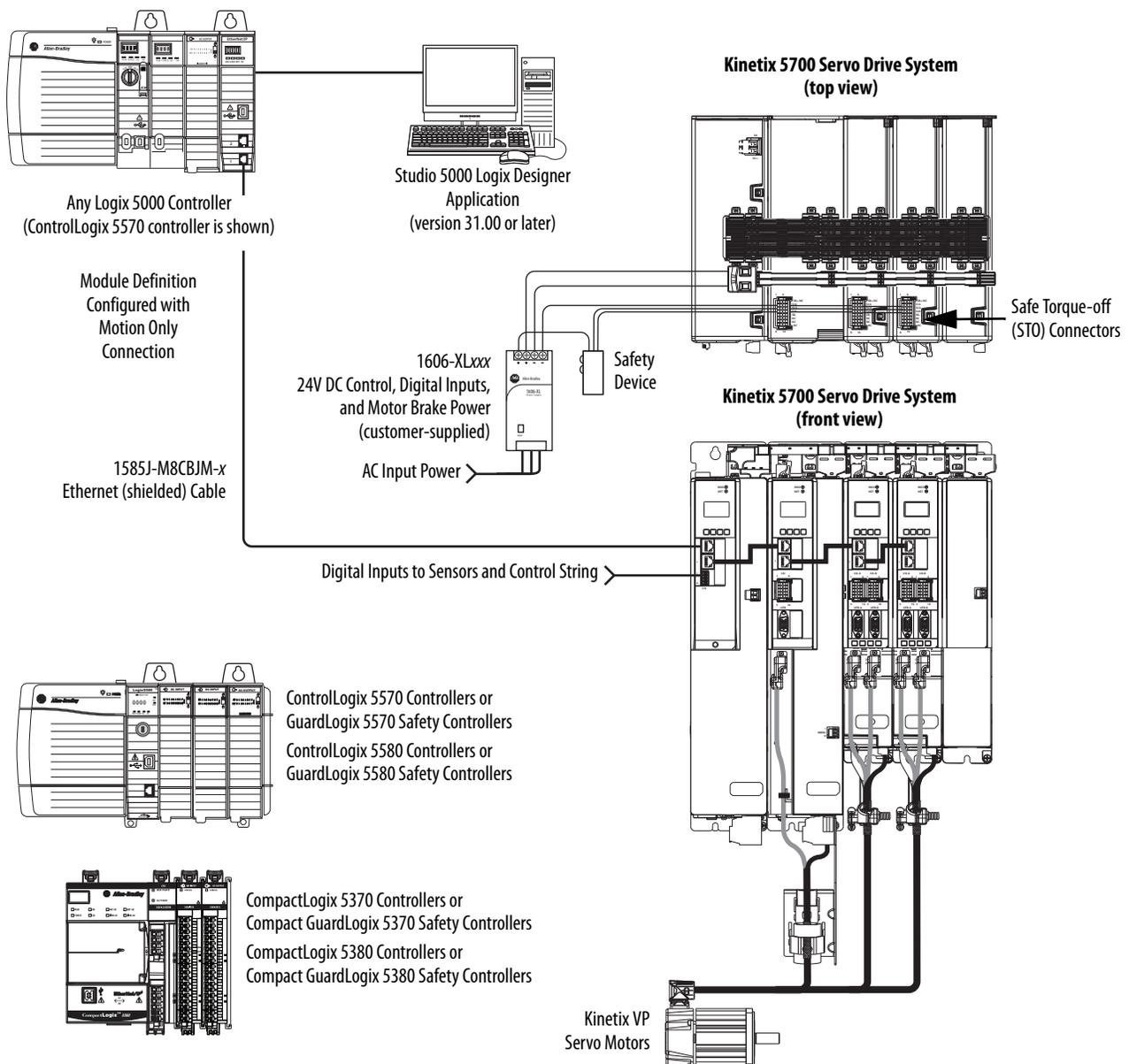
Functional Safety Configurations

Kinetix 5700 servo drives are capable of safe torque-off (STO) and safe stop 1 (SS1) drive-based safety functions via hardwired connections or integrated over the EtherNet/IP network. In addition, safely limited speed (SLS) and other controller-based safety instructions are also possible. These examples illustrate the functional safety configuration options.

Hardwired Configuration

Kinetix 5700 servo drives use the safe torque-off (STO) connector for wiring external safety-devices and cascading hardwired safety-connections from one drive to another.

Figure 10 - Safe Torque-off (hardwired) Configuration



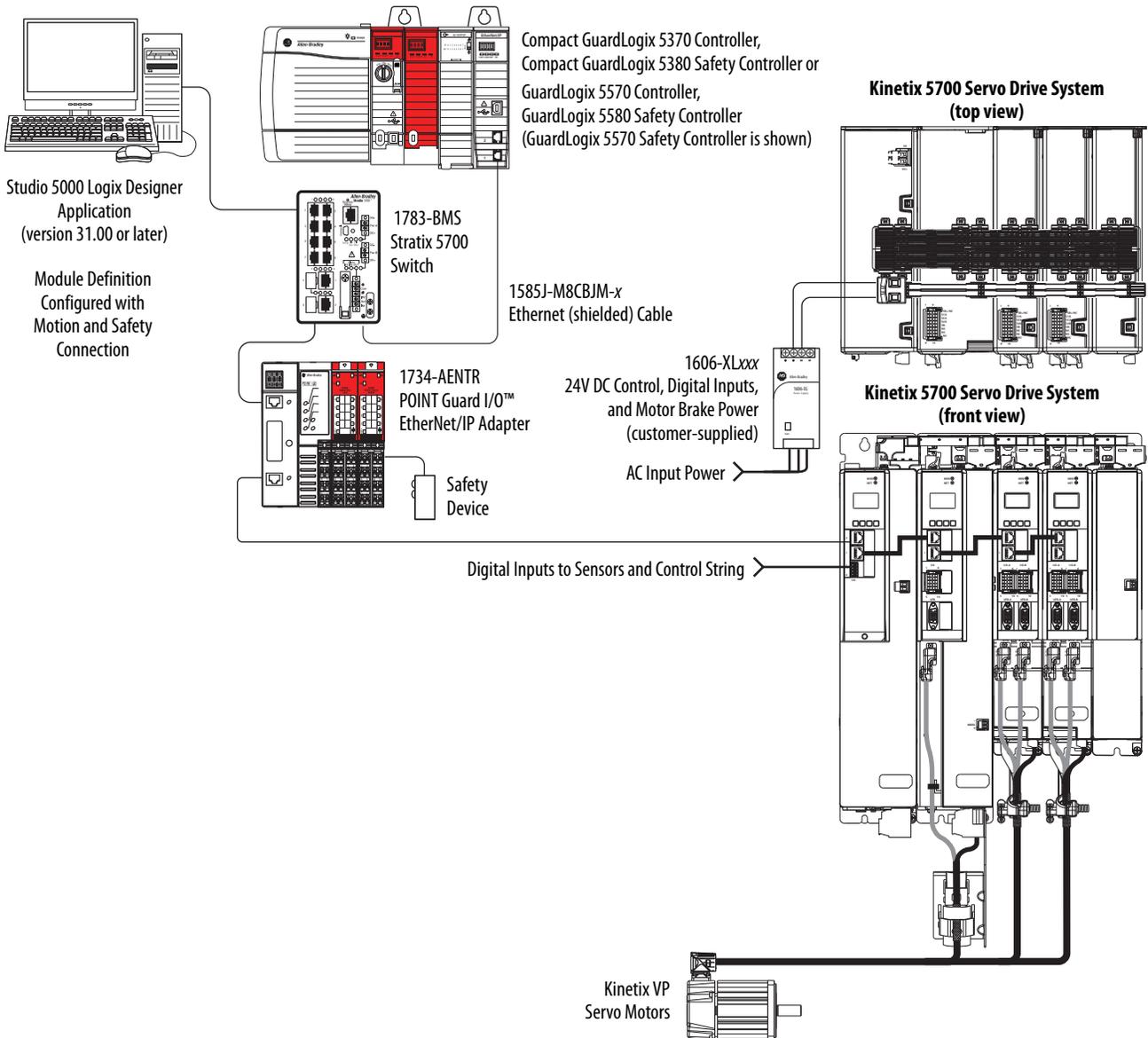
Integrated Safety Configurations

The GuardLogix or Compact GuardLogix safety controller issues the safe torque-off (STO) or safe stop (SS1) command over the EtherNet/IP network and the Kinetix 5700 servo drive executes the command.

In this example, a single GuardLogix safety controller makes the Motion and Safety connections.

IMPORTANT If only one controller is used in an application with Motion and Safety connections, it must be a GuardLogix or Compact GuardLogix safety controller. For more information, see the [Integrated Functional Safety Support](#) table on [page 15](#).

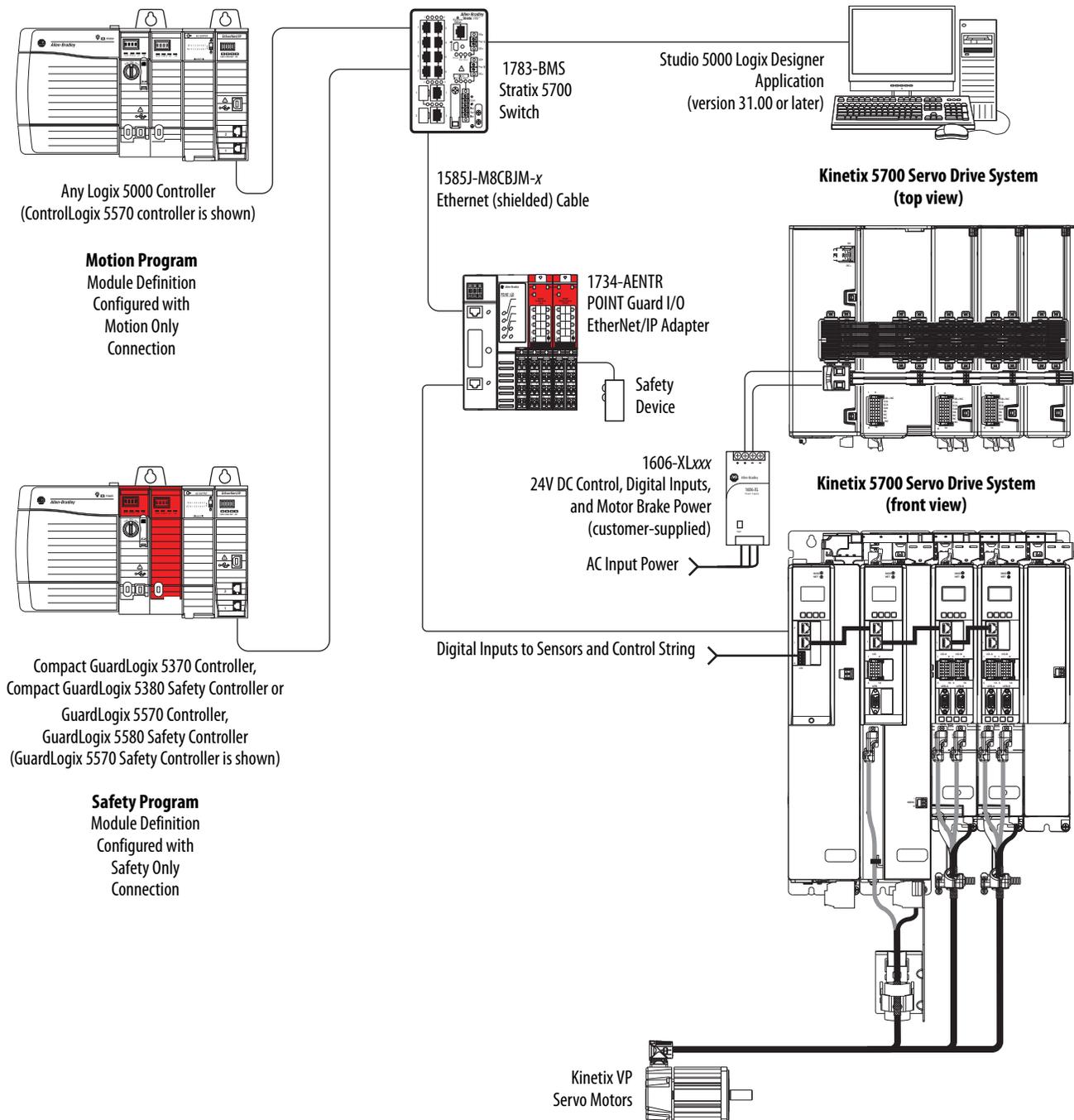
Figure 11 - Motion and Safety Configuration (single controller)



In this example, a non-safety controller makes the Motion-only connection and a separate GuardLogix safety controller makes the Safety-only connection.

IMPORTANT If two controllers are used in an application with Motion Only and Safety Only connections, the Safety Only connection must be a GuardLogix or Compact GuardLogix safety controller and the Motion Only connection must be any Logix 5000 controller. For more information, see the [Integrated Functional Safety Support](#) table on [page 15](#).

Figure 12 - Motion and Safety Configuration (multi-controller)



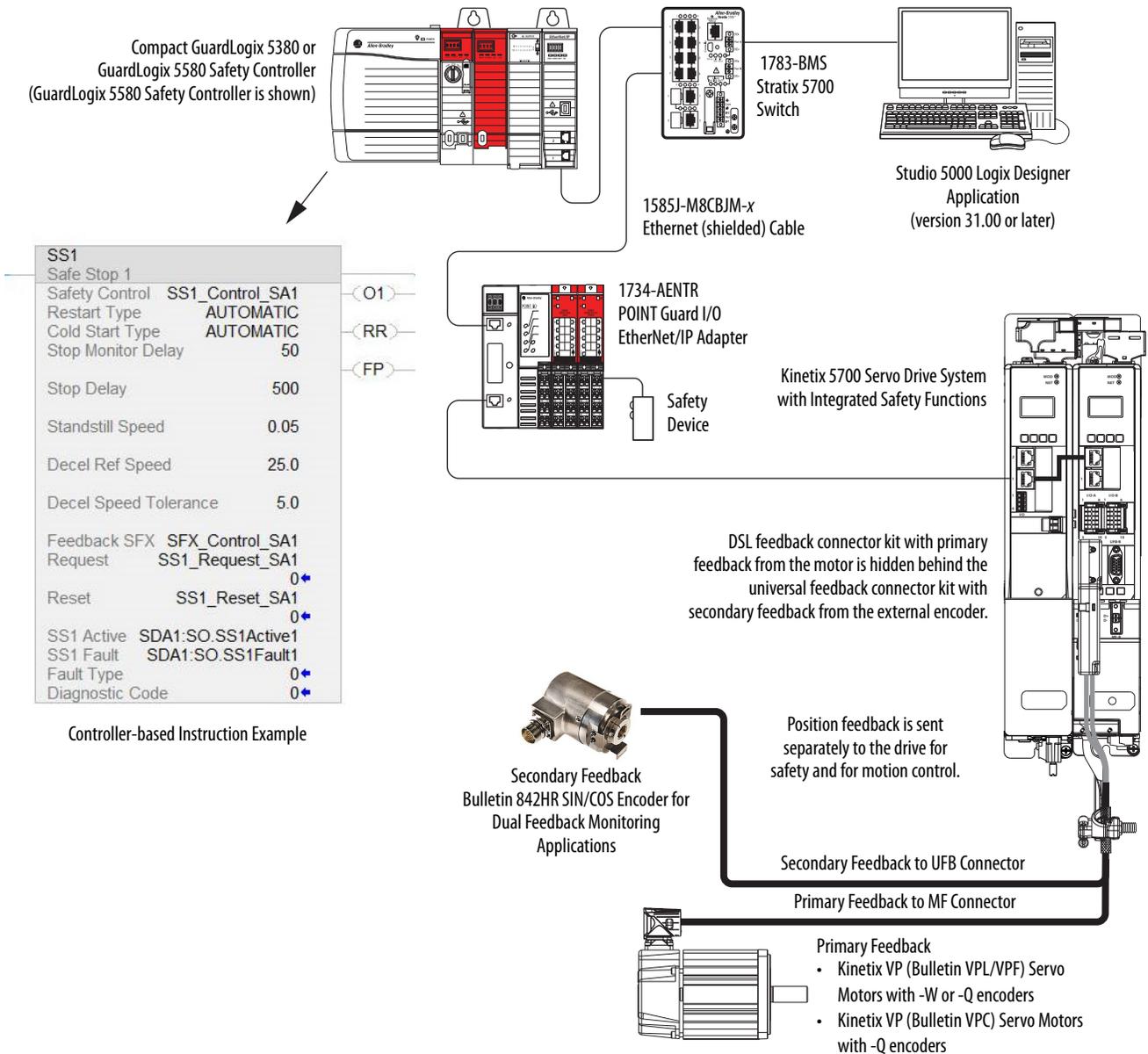
Safe Stop and Safe Monitor Configurations

Kinetix 5700 servo drives are capable of safe stop and safe monitor functions via drive-based and controller-based integrated safety over the EtherNet/IP network.

IMPORTANT For applications with safe stop and safe monitor safety functions, the GuardLogix 5580 or Compact GuardLogix 5380 controllers must be used. For more information, see the [Integrated Functional Safety Support](#) table on [page 15](#).

In this example, the SS1 stopping function is used in a motion and safety controller-based configuration with dual-feedback monitoring.

Figure 13 - Safe Motion-monitoring Configuration



Catalog Number Explanation

Kinetix 5700 drive module catalog numbers and performance descriptions.

Table 4 - Kinetix 5700 Drive Module Catalog Numbers

| Kinetix 5700 Drive Modules | Cat. No. | Module Width mm | Input Voltage | Continuous Output Power kW | Continuous Output Current to Bus A _{DC rms} | Continuous Output Current A 0-pk |
|----------------------------|--|--|-----------------------------------|-------------------------------|---|-------------------------------------|
| DC-bus Power Supply | 2198-P031 2198-P070 | 55 | 324...528V AC rms, three-phase | 7 17 | 10.5 25.5 | N/A |
| | 2198-P141 2198-P208 | 85 | | 31 46 | 46.9 69.2 | |
| Single-axis Inverters | 2198-S086-ERS3 2198-S130-ERS3 | 2198-S086-ERS4 2198-S130-ERS4 | 85 | N/A | 29.7 44.9 | 60.8 91.9 |
| | 2198-S160-ERS3 | 2198-S160-ERS4 | | | | |
| Dual-axis Inverters | 2198-D006-ERS3 2198-D012-ERS3 2198-D020-ERS3 2198-D032-ERS3 | 2198-D006-ERS4 2198-D012-ERS4 2198-D020-ERS4 2198-D032-ERS4 | 55 | N/A | 1.7 3.4 5.5 8.9 | N/A |
| | 2198-D057-ERS3 | 2198-D057-ERS4 | | | | |
| iTRAK Power Supply | 2198T-W25K-ER | 100 | N/A | N/A | N/A | 2x12.5 |

Table 5 - Capacitor Module Catalog Numbers

| Capacitor Modules Cat. No. | System Current, max | Rated Voltage | Capacitance |
|--|---------------------|--------------------|-------------|
| 2198-CAPMOD-2240 | 100 A | 458...747V DC, nom | 2240 µF |
| 2198-CAPMOD-DCBUS-IO (extension module) | 200 A | | N/A |

Table 6 - Shared-bus Connector Kit Catalog Numbers

| Shared-bus Connector Kits Cat. No. | Drive Module Cat. No. | Application | Description |
|---------------------------------------|--|-----------------------------------|---|
| 2198-TCON-24VDCIN36 ⁽¹⁾ | 2198-P070, 2198-P141, 2198-P208 2198-CAPMOD-2240 | 24V DC input power to control bus | 24V DC input wiring connector |
| 2198-H040-P-T | 2198-D006-ERSx, 2198-D012-ERSx 2198-D020-ERSx, 2198-D032-ERSx 2198-CAPMOD-2240 | Control power sharing | Control power T-connector with bus bars, 55 mm |
| 2198-H070-P-T | 2198-D057-ERSx 2198-S086-ERSx 2198-S130-ERSx | Control power sharing | Control power T-connector with bus bars, 85 mm |
| 2198-S160-P-T | 2198-S160-ERSx | Control power sharing | Control power T-connector with bus bars, 100 mm |
| 2198T-W25K-P-IN ⁽²⁾ | 2198T-W25K-ER | 24V DC input power to control bus | 24V DC input wiring connector |
| 2198T-W25K-P-T | | Control power sharing | Control power T-connector with bus bars, 100 mm |

(1) The DC-bus power supply or capacitor module is the typical use. However, the input wiring connector can be inserted into any drive module (mid-stream in the drive system) to begin a new 24V control bus when the maximum current value is reached.

(2) Use this connector with only iTRAK power supplies when the current capacity of the 2198-TCON-24VDCIN36 input wiring connector is exceeded.

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 module 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 [page 93](#).

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

To meet CE requirements, these requirements apply:

- Install an AC line filter (catalog number 2198-DB xx -F) for input power as close to the 2198-P xxx DC-bus power supply as possible.
- Bond DC-bus power supplies, inverter modules, capacitor modules, and line filter grounding screws by using a braided ground strap as shown in [Figure 62 on page 99](#).
- Use Bulletin 2090 single motor cables with Kinetix VP servo motors. Use Bulletin 2090 motor power/brake and feedback cables for other compatible Allen-Bradley motors and actuators.
- Use Bulletin 2198T power cables with iTRAK systems.
- Combined motor power cable length for all axes on the same DC bus must not exceed 400 m (1312 ft). Drive-to-motor feedback cables must not exceed 90 m (295 ft), depending on the feedback type.
- Motor cable length for iTRAK power supply to iTRAK motor modules must at least 3 m (9.8 ft), not to exceed 30 m (98.4 ft).
- Install the Kinetix 5700 system inside an approved enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.
- Segregate input power wiring from control wiring and motor cables.

Refer to Appendix A on [page 279](#) for input power wiring and drive/motor interconnect diagrams.

Plan the Kinetix 5700 Drive System Installation

This chapter describes system installation guidelines used in preparation for mounting your Kinetix® 5700 drive system components.

| Topic | Page |
|----------------------------|------|
| System Design Guidelines | 34 |
| Electrical Noise Reduction | 40 |



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 metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry and result in damage to the 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 <https://www.rockwellautomation.com/global/support/selection.page>.

System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 5700 drive systems 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 in accordance with pollution degree 2 (EN 61800-5-1) because the product is rated to protection class IP20 (EN 60529).
- Size the system enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all system components.
- Combined motor power cable length for all axes on the same DC bus must not exceed 400 m (1312 ft). Drive-to-motor cables must not exceed 90 m (295 ft), depending on the feedback type.

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

- Ethernet cable must be shielded and cables connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).
- Registration and digital input cables greater than 30 m (98.4 ft) must be shielded.
- Segregate input power wiring from control wiring and motor cables.
- 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.

Bond DC-bus power supply, inverter module, iTRAK® power supply, capacitor module, and line filter grounding screws by using a braided ground strap as shown in [Figure 62 on page 99](#).

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

Transformer Selection

The power supplies do not require an isolation transformer for three-phase input power. However, a transformer can be required to match the voltage requirements of the power supply to the available service.

To size a transformer for the main AC power inputs, refer to the Kinetix 5700 power specifications in the Kinetix Servo Drives Technical Data, publication [KNX-TD003](#).

IMPORTANT When using an autotransformer, make sure that the phase to neutral/ground voltage does not exceed the input voltage ratings of the power supply.

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

IMPORTANT A line reactor must be used if the source transformer is greater than 150 KVA, max and 3% impedance, min.

EXAMPLE Sizing a transformer to the voltage requirements of this power supply:
2198-P141: $31\text{kW} \times 1.5 = 46.5\text{ KVA}$ transformer.

IMPORTANT When using an iTRAK power supply, connect the DC-bus power supply to only grounded-wye power distribution.

Circuit Breaker/Fuse Selection

The Kinetix 5700 power supplies 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) and 65,000 A (circuit breakers).

Refer to [Power Wiring Examples](#), on [page 281](#), for the wiring diagram.



ATTENTION: Do not use circuit protection devices on the output of an AC drive as an isolating disconnect switch or motor overload device. These devices are designed to operate on sine wave voltage and the drive's PWM waveform does not allow it to operate properly. As a result, damage to the device occurs.

Input Power UL/CSA Circuit-protection Specifications

| Kinetix 5700 Drives | | UL/CSA Applications ⁽¹⁾ | | | |
|------------------------------|---------------------------------|------------------------------------|--------------------------------------|--|-------------------------|
| DC-bus Power Supply Cat. No. | Drive Voltage (three-phase) nom | Bussmann Fuses Cat. No. | Miniature CB ⁽²⁾ Cat. No. | Motor Protection CB, Self Protected CMC Cat. No. | Molded Case CB Cat. No. |
| 2198-P031 | 324...528V AC | LPJ-15SP (15A) | 1489-M3D250 | 140M-D8E-C25 | 140G-G6C3-C25 |
| 2198-P070 | | LPJ-40SP (40A) | N/A | 140M-F8E-C45 | 140G-G6C3-C50 |
| 2198-P141 | | LPJ-70SP (70A) | N/A | N/A | 140G-G6C3-C90 |
| 2198-P208 | | LPJ-100SP (100A) | N/A | N/A | 140G-G6C3-D12 |

(1) For applications requiring CSA certification, fuses (Bussmann catalog number 170M1760) must be added to the DC link between the two drive clusters when circuit breakers are used for branch circuit protection. The DC bus fuses are not required when AC line fuses are used for branch circuit protection.

(2) These Bulletin 140M circuit breakers, when used as self-protected (Type E) devices, and Bulletin 1489 circuit breakers can be used on only WYE power systems (480Y/277V).

Input Power IEC (non-UL/CSA) Circuit-protection Specifications

| Kinetix 5700 Drives | | IEC (non-UL/CSA) Applications | | | | |
|------------------------------|---------------------------------|-------------------------------|-----------------------|---------------|------------------------------|-------------------------|
| DC-bus Power Supply Cat. No. | Drive Voltage (three-phase) nom | DIN gG Fuses Amps, max | Miniature CB Cat. No. | | Motor Protection CB Cat. No. | Molded Case CB Cat. No. |
| 2198-P031 | 324...528V AC | 16 | 1489-M3D250 | N/A | 140M-D8E-C25 | 140G-G6C3-C25 |
| 2198-P070 | | 40 | N/A | 1492-SPM3D400 | 140M-F8E-C45 | 140G-G6C3-C50 |
| 2198-P141 | | 75 | N/A | 1492-SPM3D630 | 140MG-H8E-C60 | 140G-G6C3-C90 |
| 2198-P208 | | 110 | N/A | N/A | 140MG-H8E-D10 | 140G-G6C3-D12 |

Contactor Specifications

The DC-bus power supply contactor enable relay (CED connector) is rated at 24V DC or 110/220V AC at 1.0 A, max.

Table 7 - Input Power Contactor Specifications

| DC-bus Power Supply Cat. No. | Contactor ^{(1) (2)} Cat. No. | Intermediate Relay ⁽³⁾ Cat. No. |
|------------------------------|---------------------------------------|--|
| 2198-P031 | 100-C16EJ10 | N/A |
| 2198-P070 | 100-C37EJ10 | |
| 2198-P141 | 100-C72DJ10 | 700-HB32Z24 (relay) 700-HN153 (socket) |
| 2198-P208 | 100-C97DJ10 | |
| 2198-P208 (2 in parallel) | 100-D180EZJ10 | |
| 2198-P208 (3 in parallel) | 100-D300EZJ10 | |

(1) Auxiliary contact configuration (10) is for 1 N.O. 0 N.C. Other configurations are available.

(2) Requires integrated diode with the contactor coil.

(3) These DC-bus power supplies require an additional intermediate relay used with the contactor.

Refer to the Kinetix Servo Drives Technical Data, publication [KNX-TD003](#), for additional power specifications for your DC-bus power supply.

Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Kinetix 5700 drive system. You need heat dissipation data from all components planned for your enclosure to calculate the enclosure size (refer to [Table 8](#)).

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

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

If the maximum ambient rating of the Kinetix 5700 drive system is 50 °C (122 °F) and if the maximum environmental temperature is 20 °C (68 °F), then T=30. In this example, the total heat dissipation is 416 W (sum of all components in enclosure). So, in the equation below, T=30 and Q=416.

$$A = \frac{0.38(416)}{1.8(30) - 1.1} = 2.99 \text{ m}^2$$

In this example, the enclosure must have an exterior surface of at least 2.99 m². If any portion of the enclosure is not able to transfer heat, do not include that value in the calculation.

Because the minimum cabinet depth to house the Kinetix 5700 system (selected for this example) is 300 mm (11.8 in.), the cabinet needs to be approximately 1500 x 700 x 300 mm (59.0 x 27.6 x 11.8 in.) HxWxD.

$$1.5 \times (0.300 \times 0.70) + 1.5 \times (0.300 \times 2.0) + 1.5 \times (0.70 \times 2.0) = 3.31 \text{ m}^2$$

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

Table 8 - Power Dissipation Specifications

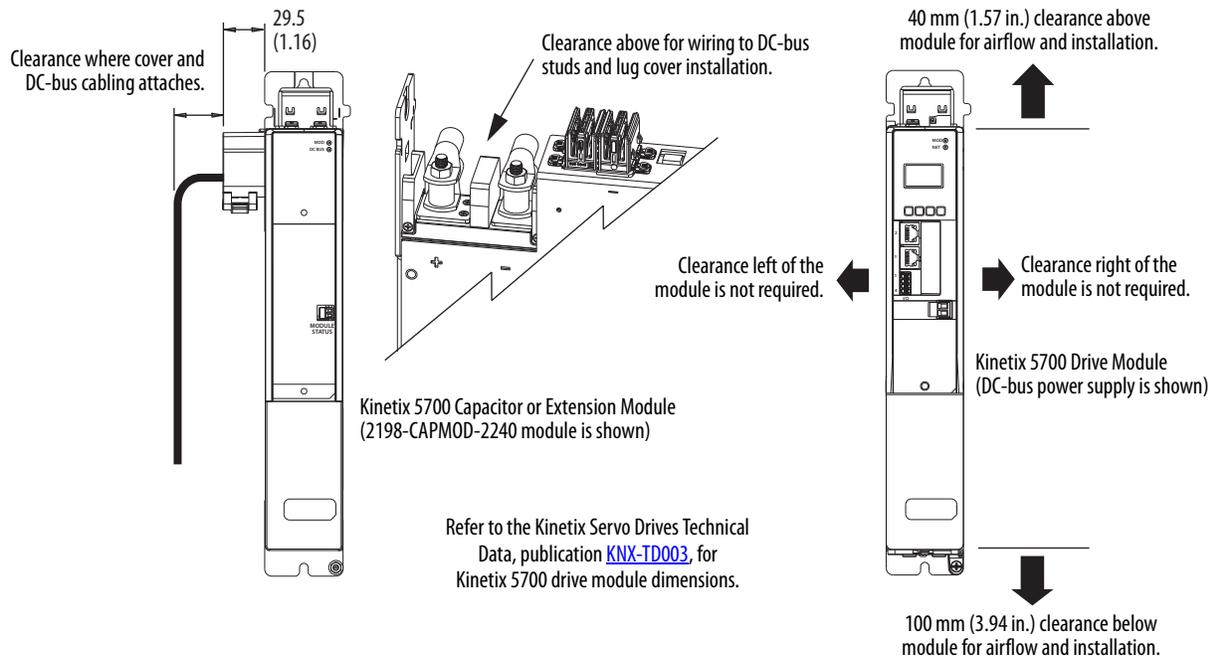
| DC-bus Power Supply Cat. No. | Usage as % of Rated Power Output (watts) | | | | |
|--------------------------------------|---|-----|-----|-----|------|
| | 20% | 40% | 60% | 80% | 100% |
| 2198-P031 | 97 | 101 | 105 | 109 | 113 |
| 2198-P070 | 108 | 119 | 130 | 140 | 151 |
| 2198-P141 | 249 | 267 | 286 | 304 | 323 |
| 2198-P208 | 265 | 294 | 323 | 352 | 380 |
| Dual-axis Inverter Cat. No. | | | | | |
| 2198-D006-ERSx | 17 | 29 | 41 | 53 | 65 |
| 2198-D012-ERSx | 34 | 58 | 82 | 106 | 130 |
| 2198-D020-ERSx | 52 | 84 | 116 | 148 | 180 |
| 2198-D032-ERSx | 100 | 155 | 210 | 265 | 320 |
| 2198-D057-ERSx | 252 | 354 | 456 | 558 | 660 |
| Single-axis Inverter Cat. No. | | | | | |
| 2198-S086-ERSx | 190 | 255 | 325 | 400 | 475 |
| 2198-S130-ERSx | 225 | 340 | 460 | 590 | 725 |
| 2198-S160-ERSx | 270 | 420 | 570 | 760 | 950 |
| iTRAK Power Supply Cat. No. | | | | | |
| 2198T-W25K-ER | 206 | 272 | 338 | 404 | 470 |
| Capacitor Module Cat. No. | | | | | |
| 2198-CAPMOD-2240 | 28 | 34 | 42 | 51 | 62 |
| 2198-CAPMOD-DCBUS-IO | 1.1 | 1.4 | 1.6 | 2.1 | 2.5 |

Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 5700 drive system:

- Additional clearance is required for cables and wires or the shared-bus connection system connected to the top of the drive modules.
 - Capacitor modules require extra clearance above for wiring DC-bus stud connections and installing the cover.
- Additional clearance is required if other devices are installed above and/or below the drive module and have clearance requirements of their own.
 - Capacitor modules require extra clearance to route DC-bus wiring into or away from the drive system.
- Additional clearance left and right of the drive module is required when mounted adjacent to noise sensitive equipment or clean wire ways.
- The recommended minimum cabinet depth is 300 mm (11.81 in.).

Figure 14 - Minimum Clearance Requirements



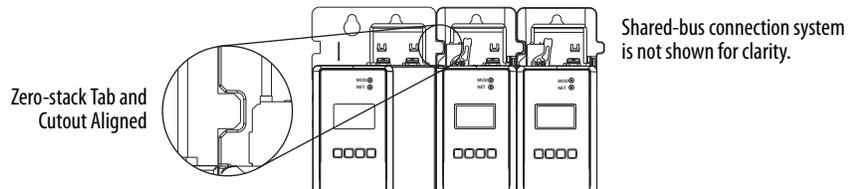
IMPORTANT Mount the drive module in an upright position as shown. Do not mount the module on its side.

| Kinetix 5700 Drive Modules | Drive Module Cat. No. | Clearance Above, min mm (in.) | Clearance Below, ⁽¹⁾ min mm (in.) |
|----------------------------|--|----------------------------------|--|
| DC-bus power supply | 2198-P031 2198-P070 2198-P141 2198-P208 | 40 (1.57) | 100 (3.94) |
| Single-axis inverters | 2198-S086-ERSx 2198-S130-ERSx 2198-S160-ERSx | 40 (1.57) | 100 (3.94) |
| Dual-axis inverters | 2198-D006-ERSx 2198-D012-ERSx 2198-D020-ERSx 2198-D032-ERSx 2198-D057-ERSx | 40 (1.57) | 100 (3.94) |
| iTRAK power supply | 2198T-W25K-ER | 40 (1.57) | 100 (3.94) |
| Capacitor module | 2198-CAPMOD-2240 | 115 (4.53) | 100 (3.94) |
| Extension module | 2198-CAPMOD-DCBUS-IO | | |

(1) Additional clearance can be required depending on the actual wiring harness being installed.

In multi-axis shared-bus configurations, drive modules must be spaced by aligning the zero-stack tab and cutout.

Figure 15 - Multi-axis Shared-bus Clearance Requirements



Electrical Noise Reduction

This section outlines best practices that minimize the possibility of noise-related failures as they apply specifically to Kinetix 5700 system installations. For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

Bonding Modules

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

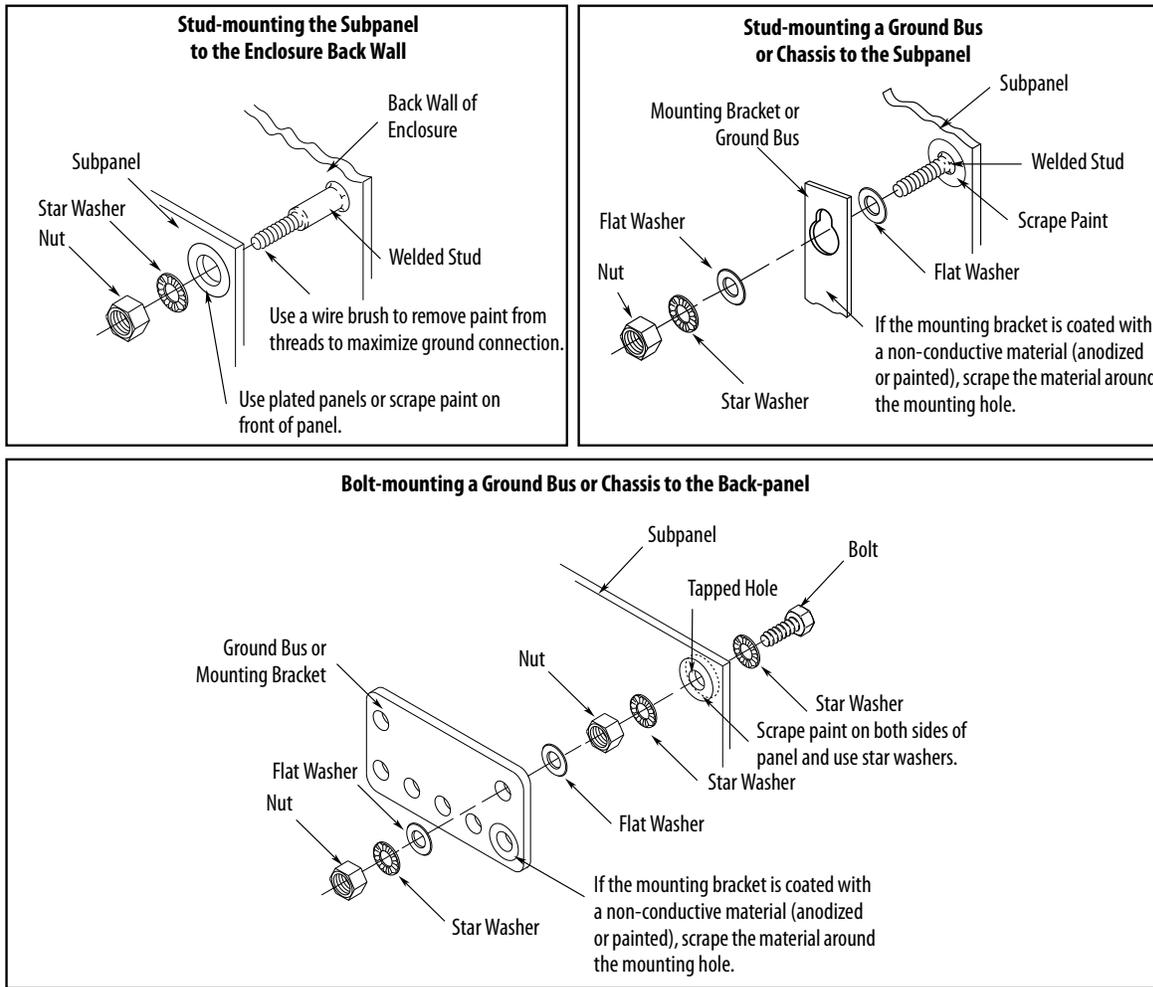
Unless specified, most paints are not conductive and act as insulators. To achieve a good bond between the drive module and subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

IMPORTANT To improve the bond between the drive module 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 high-frequency 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 16 - Recommended Bonding Practices for Painted Panels

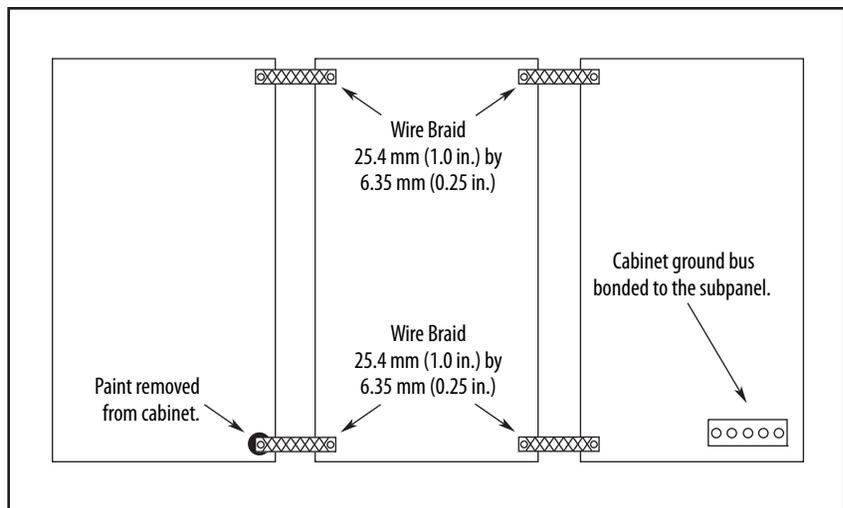


Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. Subpanels that are not bonded together do not necessarily share a common low impedance path. This 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 17 - Multiple Subpanels and Cabinet Recommendations

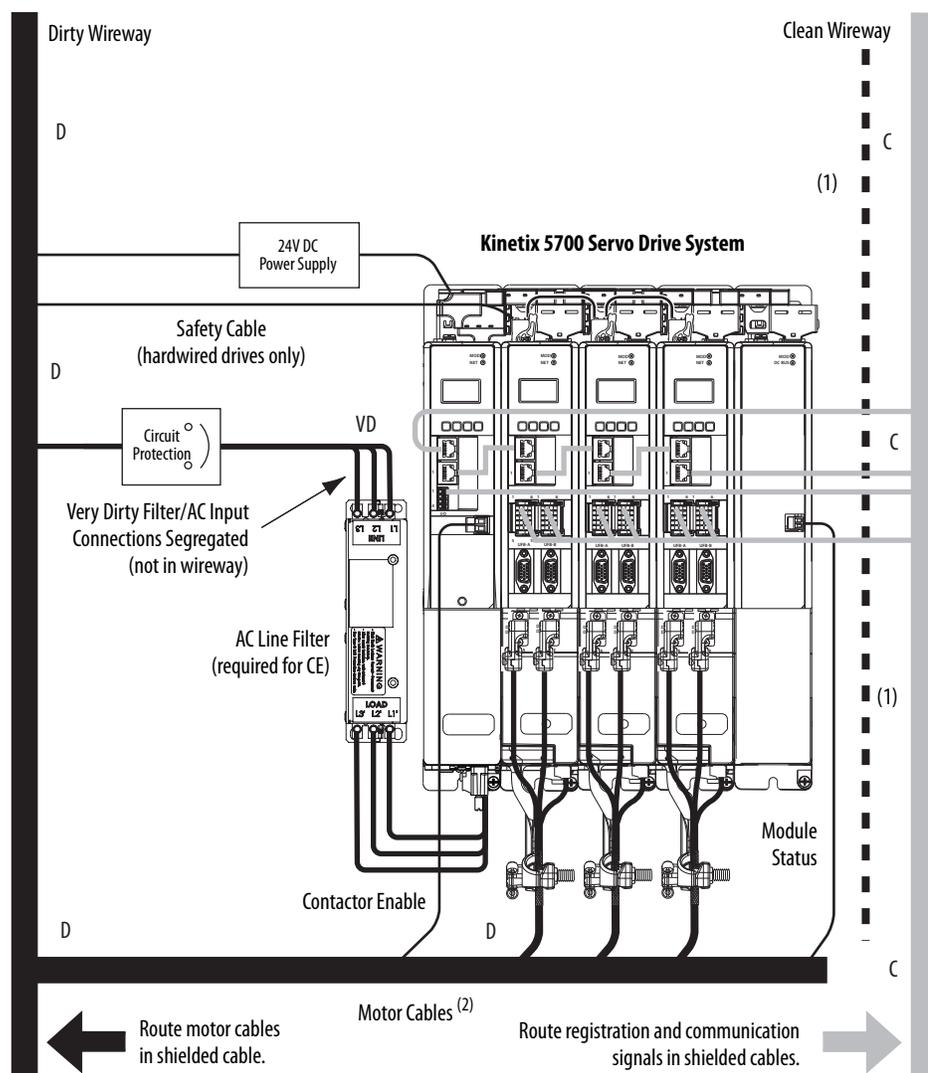


Establishing Noise Zones

Observe these guidelines when routing cables used in the Kinetix 5700 system:

- The clean zone (C) is right of the drive system and includes the digital inputs wiring and Ethernet cable (gray wireway).
- The dirty zone (D) is left and below the drive system (black wireways) and includes the circuit breakers, 24V DC power supply, safety, and motor cables.
- The very dirty zone (VD) is limited to where the AC line (EMC) filter VAC output jumpers over to the DC-bus power supply. Shielded cable is required only if the very dirty cables enter a wireway.

Figure 18 - Noise Zones



(1) When space to the right of the module 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 [GMC-RM001](#).

(2) When the 2198-H2DCK feedback converter kit or 2198-K57CK-D15M universal feedback kit is used, feedback cable routes in the clean wireway.

Cable Categories for Kinetix 5700 Systems

These tables indicate the zoning requirements of cables connecting to the Kinetix 5700 drive system components.

Table 9 - DC-bus Power Supplies

| Wire/Cable | Connector | Zone | | | Method | |
|---|----------------|------------------------------------|-------|-------|----------------|----------------|
| | | Very Dirty | Dirty | Clean | Ferrite Sleeve | Shielded Cable |
| L1, L2, L3 (shielded cable) | IPD | | X | | | X |
| L1, L2, L3 (unshielded cable) | | X | | | | |
| DC-/DC+ (DC bus) | DC | Bus-bar only, no wiring connector. | | | | |
| DC+/SH (shunt) | RC | | X | | | |
| CONT EN- and CONT EN+ (M1 contactor) | CED | | X | | | |
| 24V DC | CP | | X | | | |
| Registration input, greater than 30 m (98.4 ft) | IOD | | | X | | X |
| Registration input, less than 30 m (98.4 ft) | | | | X | | |
| Ethernet (shielded cable) | PORT1 PORT2 | | | X | | X |

Table 10 - Dual-axis and Single-axis Inverters

| Wire/Cable | Connector | Zone | | | Method | |
|---|----------------------|------------------------------------|-------|-------|----------------|----------------|
| | | Very Dirty | Dirty | Clean | Ferrite Sleeve | Shielded Cable |
| DC-/DC+ (DC bus) | DC | Bus-bar only, no wiring connector. | | | | |
| U, V, W (motor power) | Kinetix VP motors | MP | X | | | X |
| Motor feedback | | MF | X | | | X |
| Motor brake | | BC | X | | | X |
| U, V, W (motor power) | MP-Series™ motors | MP | X | | | X |
| Motor feedback | | MF or UFB | | X | | X |
| Motor brake | | BC | X | | | X |
| 24V DC | CP | | X | | | |
| Safety enable for safe torque-off (hardwired) | STO | | X | | | |
| Registration input, greater than 30 m (98.4 ft) | IOD | | | X | | X |
| Registration input, less than 30 m (98.4 ft) | | | | X | | |
| Ethernet | PORT1 PORT2 | | | X | | X |

Table 11 - iTRAK Power Supply

| Wire/Cable | Connector | Zone | | | Method | |
|---|----------------|------------------------------------|-------|-------|----------------|----------------|
| | | Very Dirty | Dirty | Clean | Ferrite Sleeve | Shielded Cable |
| DC-/DC+ (DC bus) | DC | Bus-bar only, no wiring connector. | | | | |
| iTRAK DC-bus output A and B | IDC | | X | | | X |
| 24V DC control input power | CP | | X | | | X |
| iTRAK 24V DC control output power A and B | ICP | | | | | |
| iTRAK digital inputs | IOD | | | X | | |
| iTRAK ready output | IR | | | X | | |
| Ethernet | PORT1 PORT2 | | | X | | X |

Table 12 - Capacitor Module

| Wire/Cable | Connector | Zone | | | Method | |
|------------------------------|-----------|------------------------------------|-------|-------|----------------|----------------|
| | | Very Dirty | Dirty | Clean | Ferrite Sleeve | Shielded Cable |
| DC-/DC+ (DC bus) | DC | Bus-bar only, no wiring connector. | | | | |
| DC-/DC+ (shielded extension) | M8 Stud | | X | | | |
| 24V DC | CP | | X | | | |
| Module status | MS | | X | | | |

Table 13 - Extension Module

| Wire/Cable | Connector | Zone | | | Method | |
|------------------------------|-----------|------------------------------------|-------|-------|----------------|----------------|
| | | Very Dirty | Dirty | Clean | Ferrite Sleeve | Shielded Cable |
| DC-/DC+ (DC bus) | DC | Bus-bar only, no wiring connector. | | | | |
| DC-/DC+ (shielded extension) | M8 Stud | | X | | | |

Noise Reduction Guidelines for Drive System Accessories

Refer to this section when mounting an AC (EMC) line filter or external shunt resistor 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 43](#) for an example):

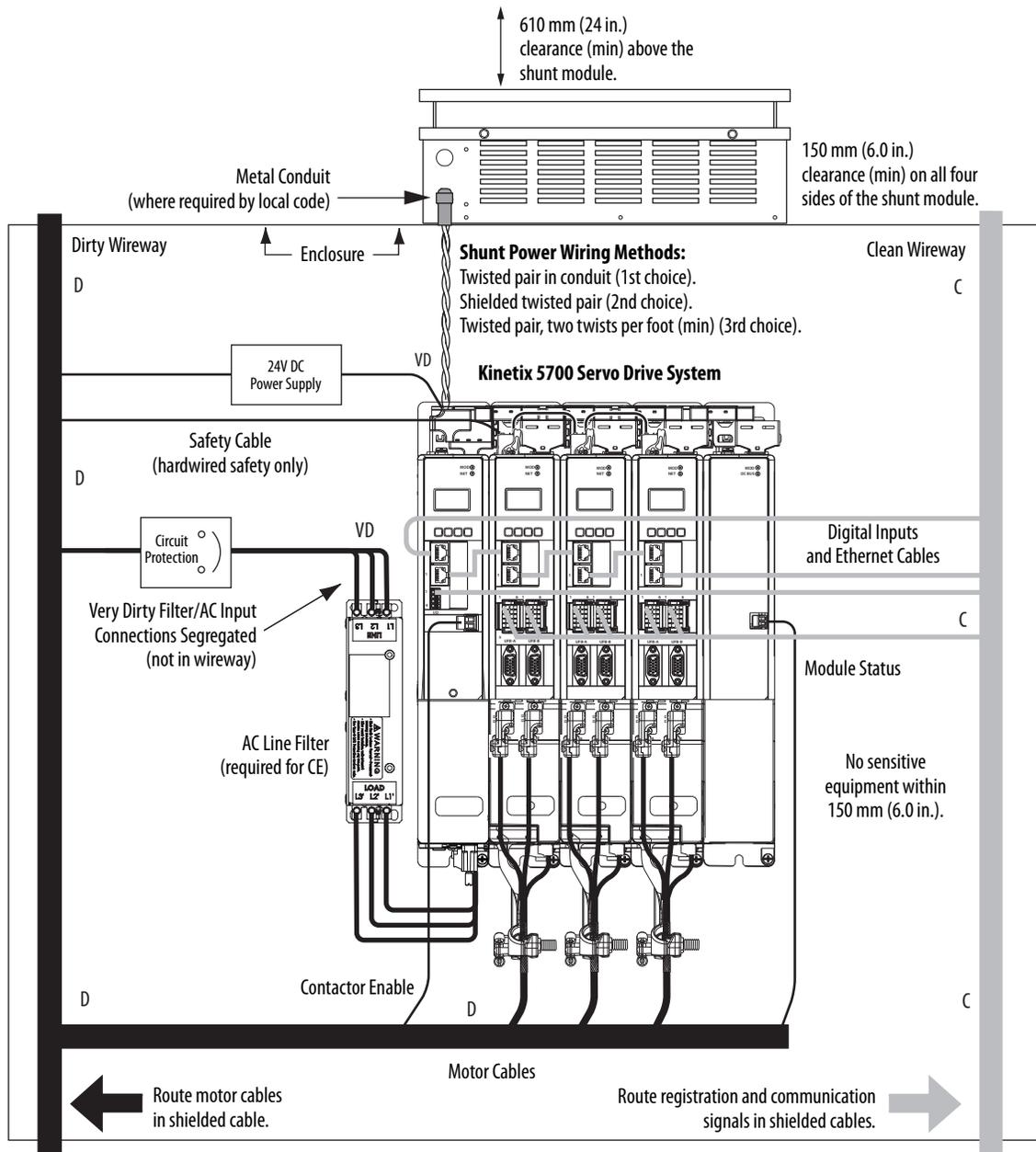
- If your facility has grounded WYE power distribution, as shown in [Figure 56](#) on [page 93](#), mount the AC line filter on the same panel as the Kinetix 5700 power supply and as close to the power supply as possible.
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on [page 41](#).
- Segregate input and output wiring as far apart as possible.

External Passive Shunt Modules

Observe these guidelines when mounting your 2198-R014, 2198-R031, or 2198-R127 external passive shunt modules:

- Mount the shunt module outside of the drive system enclosure.
- Mount the shunt module so that wiring routes in the very dirty zone inside the drive system enclosure.
- Keep unshielded wiring as short as possible, not to exceed 3 m (9.8 ft). Keep shunt wiring as flat to the cabinet as possible.

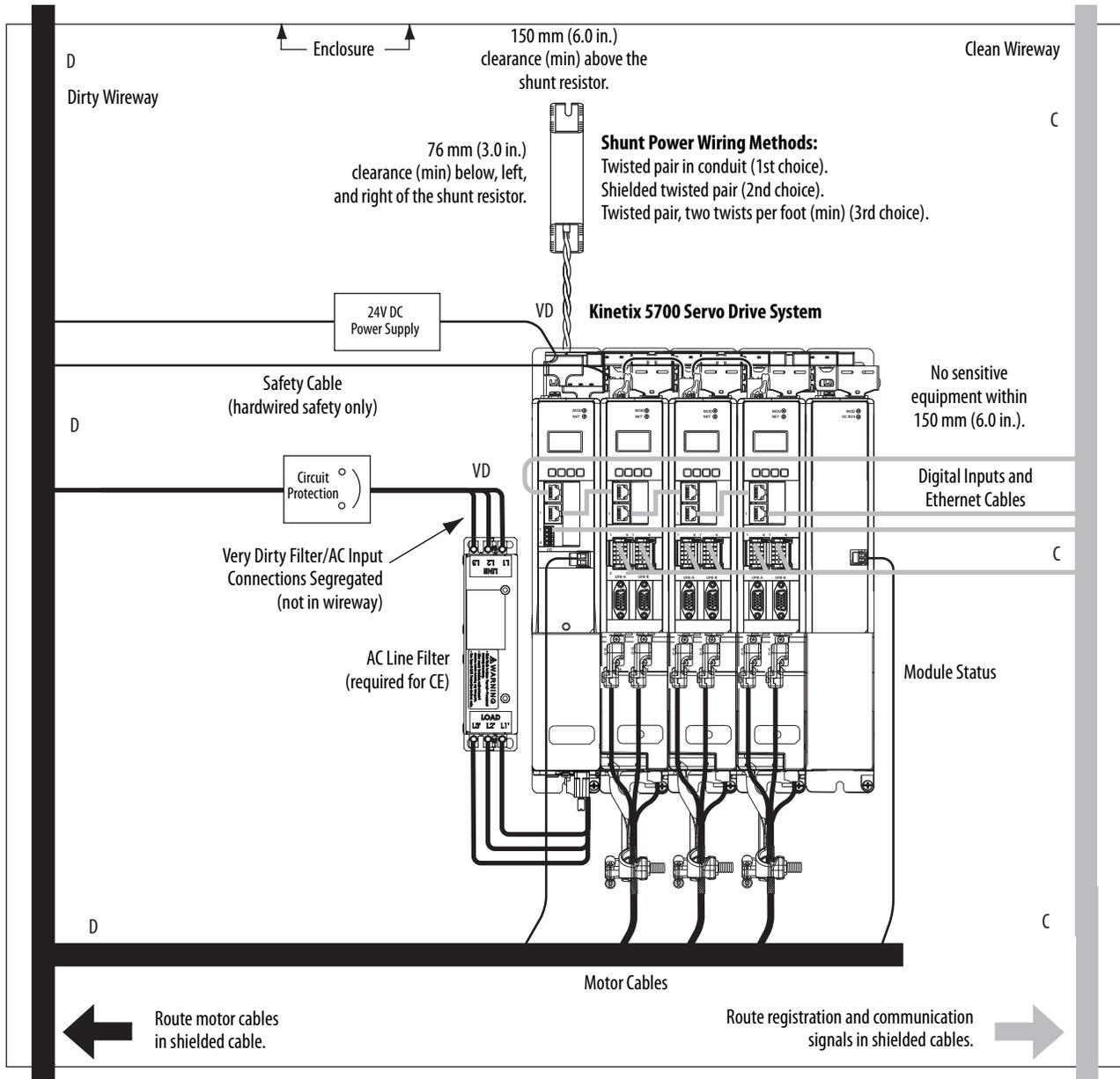
Figure 19 - External Shunt Module Mounted On Top of the Drive System Enclosure



Observe these guidelines when mounting your 2198-R004 external passive shunt resistor:

- Mount the shunt resistors anywhere in the dirty zone, but as close to the Kinetix 5700 power supply as possible.
- Route the shunt power wires with other very dirty wires.
- Keep unshielded wiring as short as possible, not to exceed 3 m (9.8 ft). 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 Resistor Mounted Inside the Drive System Enclosure



Notes:

Mount the Kinetix 5700 Drive System

This chapter provides the system installation procedures for mounting your Kinetix® 5700 drive system to the system panel.

| Topic | Page |
|---------------------------------------|------|
| Determine Mounting Order | 50 |
| Drill-hole Patterns | 56 |
| Mount Your Kinetix 5700 Drive Modules | 61 |

This procedure assumes that you have prepared your panel and understand how to bond your system. For installation instructions regarding equipment and accessories not included here, refer to the instructions that came with those products.



SHOCK HAZARD: To avoid the hazard of electrical shock, perform all mounting and wiring of the Kinetix 5700 drive system before 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 metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry and result in damage to the components.

Determine Mounting Order

Mount the DC-bus power supply, single-axis inverters, and dual-axis inverters in the order (left to right) as shown in [Figure 21](#). Mount inverter modules and iTRAK® power supplies according to power rating (highest to lowest) from left to right starting with the highest power rating.

IMPORTANT The DC-bus power supplies (1...3 modules) must be positioned on the far left. Position your single-axis inverter modules to the right of the DC-bus power supplies and the dual-axis inverter modules on the far right.

Table 14 - Kinetix 5700 Single-axis Inverter Modules

| Attribute | 2198-S086-ERSx | 2198-S130-ERSx | 2198-S160-ERSx |
|------------------------------|----------------|----------------|----------------|
| Continuous Power Output, nom | 29.7 kW | 44.9 kW | 60.1 kW |

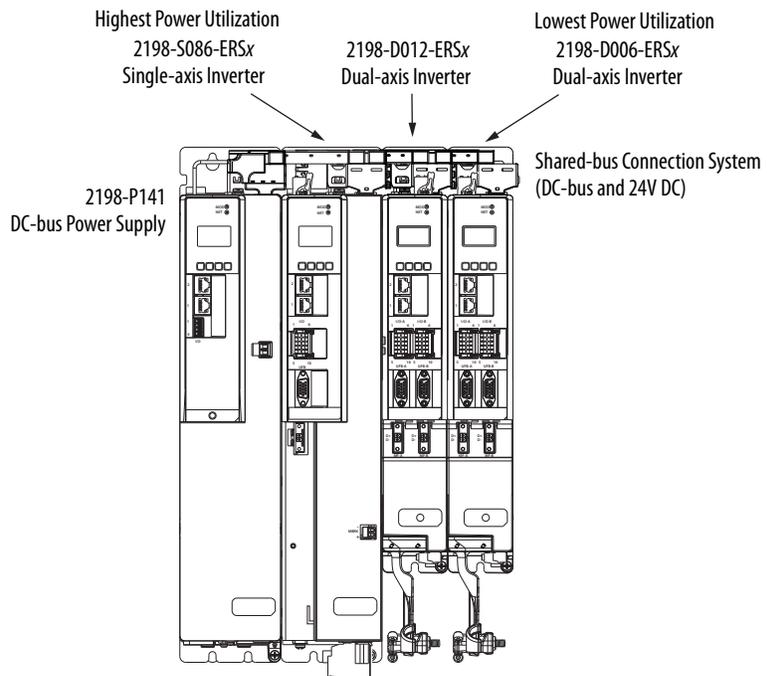
Table 15 - Kinetix 5700 Dual-axis Inverter Modules

| Attribute | 2198-D006-ERSx | 2198-D012-ERSx | 2198-D020-ERSx | 2198-D032-ERSx | 2198-D057-ERSx |
|------------------------------|----------------|----------------|----------------|----------------|----------------|
| Continuous Power Output, nom | 1.7 kW | 3.4 kW | 5.5 kW | 8.9 kW | 15.9 kW |

Table 16 - iTRAK Power Supply

| Attribute | 2198T-W25K-ER |
|------------------------------|---------------|
| Continuous Power Output, nom | 4.1 kW |

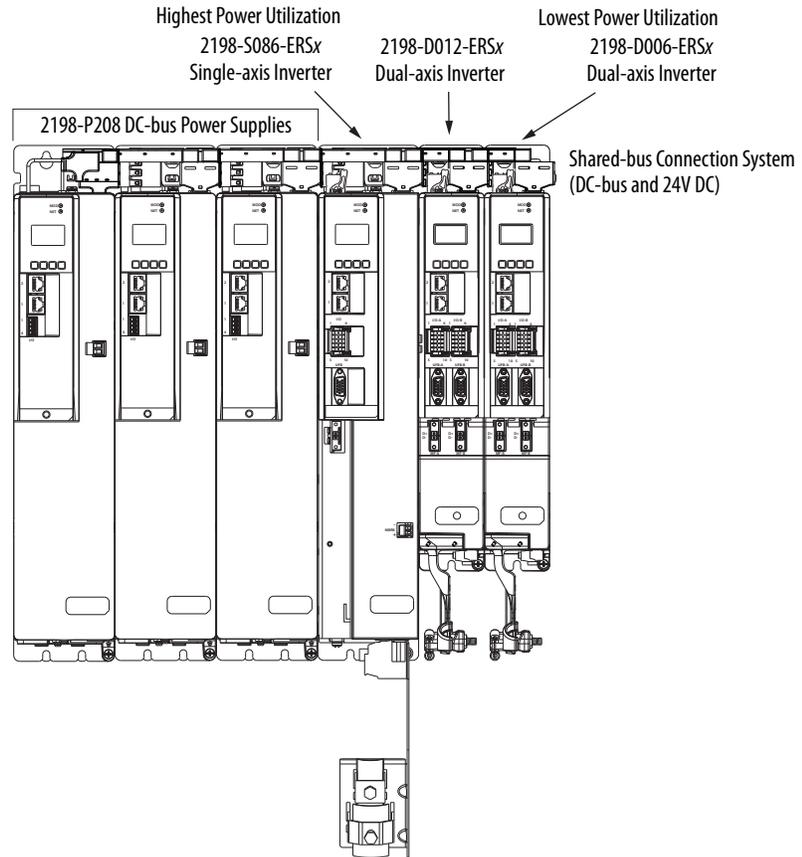
Figure 21 - System Mounting Order Example (single DC-bus power supply)



IMPORTANT The maximum number of inverter modules depends on the maximum system capacitance of the power supply and the total system capacitance of all Kinetix 5700 system capacitance values. When there are two or three DC-bus power supplies, they must be catalog number 2198-P208.

Refer to Appendix C on [page 319](#) for more system sizing information.

Figure 22 - System Mounting Order Example (multiple DC-bus power supplies)



Mounting Capacitor Modules

Mount the 2198-CAPMOD-2240 capacitor module on the far right or far left of any system cluster, depending on the input power configuration. More than one capacitor module can be used in a cluster, if needed. Each additional module adds to the total system capacitance and increased energy storage.

The 2198-CAPMOD-DCBUS-IO extension module is always mounted next to a capacitor module and always on the outside of the system cluster (either first or last). An extension module is needed if the external DC-bus current is greater than 100 A, up to a maximum of 200 A.

IMPORTANT Capacitor modules always mount on the far right or far left of the system cluster.
 Extension modules always mount next to a capacitor module, in systems up to 200 A.

Table 17 - Capacitor Module Positioning

| Cat. No. | Position | Description |
|------------------|-----------|---|
| 2198-CAPMOD-2240 | Far right | When the DC-bus power supply is used for input power. |
| | Far left | When a regenerative bus supply (RPS unit) is used for input power. |
| | | When the capacitor module is used to extend the DC-bus voltage to a second set of inverters, downstream from the first. |

Figure 23 - Regenerative Power Supply Example (100 A, max)

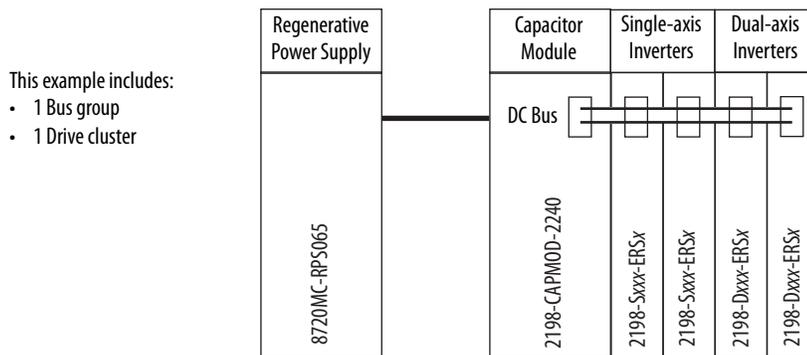


Figure 24 - DC-bus Power Supply Example/Second System (100 A, max)

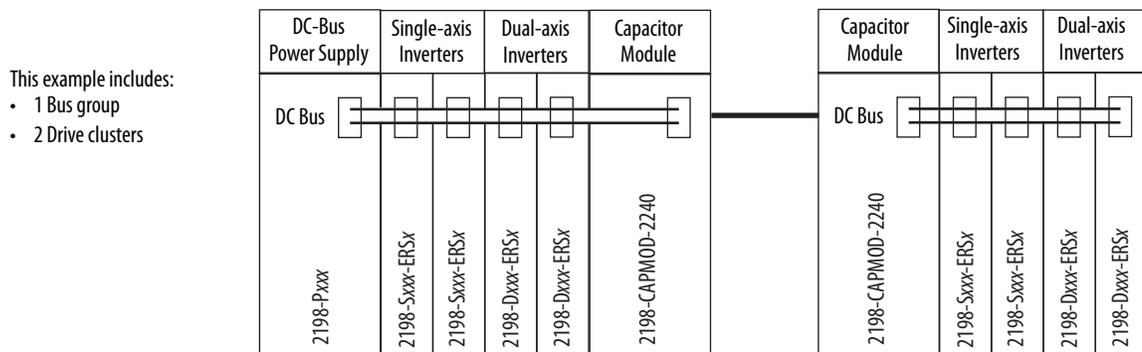


Figure 25 - DC-bus Power Supply Example/Multiple Capacitor Modules (200 A, max)

- This example includes:
- 1 Bus group
 - 1 Drive cluster

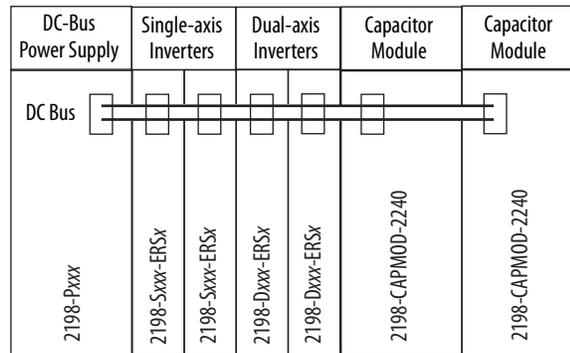


Figure 26 - Regenerative Power Supply Example Power (200 A, max)

- This example includes:
- 1 Bus group
 - 1 Drive cluster

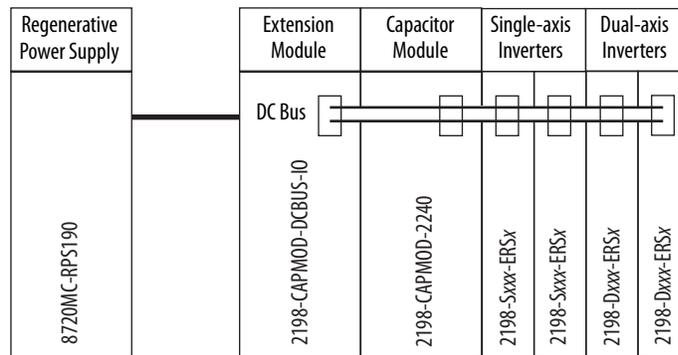
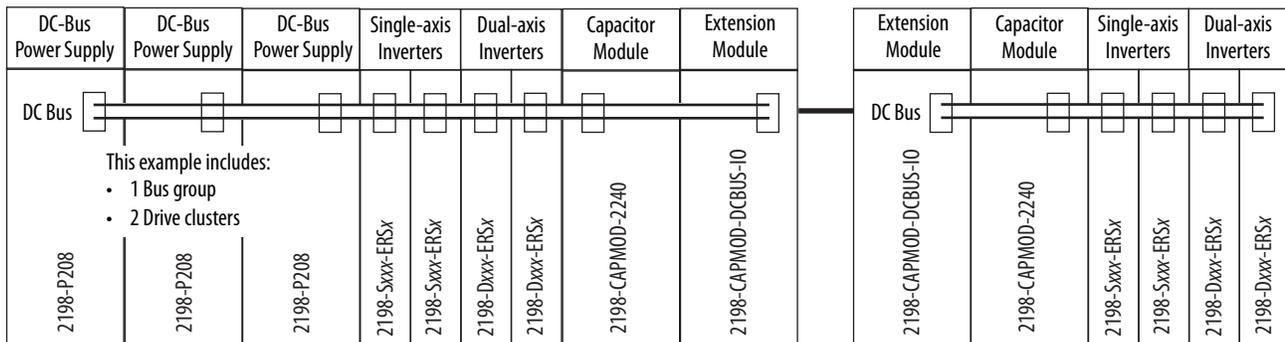


Figure 27 - Multiple DC-bus Power Supply Example/Second System (200 A, max)

- This example includes:
- 1 Bus group
 - 2 Drive clusters



IMPORTANT The systems that are shown are typical. The maximum number of inverter modules depends on the maximum system capacitance of the power supply. When there are two or three DC-bus power supplies, they must be catalog number 2198-P208.

Refer to Appendix C on [page 319](#) for more system sizing information.

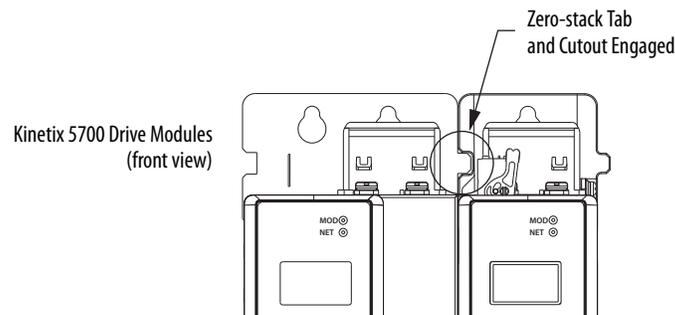
IMPORTANT The 8720MC-RPS power supply is not compatible with the iTRAK power supply.

Zero-stack Tab and Cutout

Engaging the zero-stack tab and cutout from one drive module to another makes efficient use of panel space, especially for high axis-count installations.

IMPORTANT Engaging the zero-stack tab and cutout from module-to-module is required for any input power configuration. This is done to make sure that the DC-bus connectors are spaced properly to accept the shared-bus connection system.

Figure 28 - Zero-stack Tab and Cutout Example



For Kinetix 5700 system sizing examples, refer to Appendix C on [page 319](#).

Shared-bus Connection System

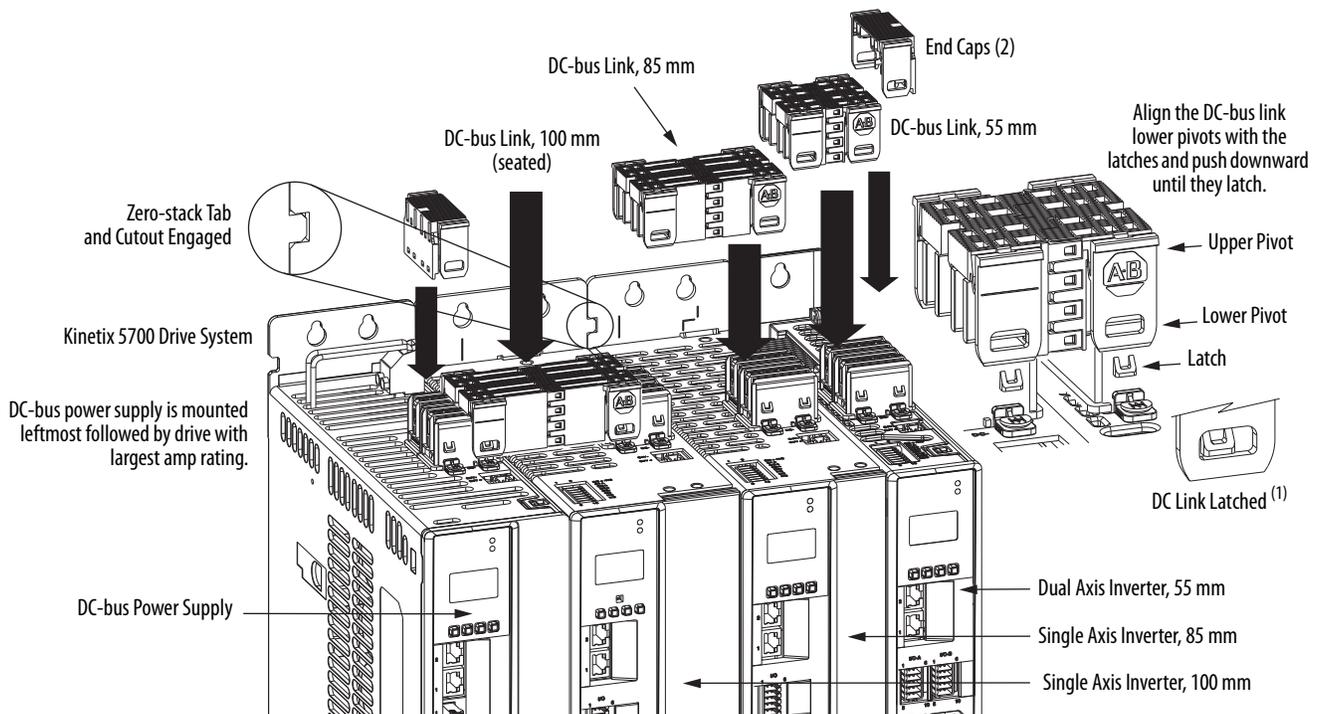
The shared-bus connection system is used to extend the DC-bus power and 24V control power from one drive module to another.

IMPORTANT The zero-stack tab and cutout must be engaged between adjacent drive modules for the shared-bus connection system to fit properly.

DC-bus Connection System

The DC-bus connection system is required and comprised of these two components:

- DC-bus links that are inserted between drive modules to extend the DC-bus from one drive module to another.
- DC-bus end-caps that are inserted into the first and last drive modules to cover the exposed DC-bus connector on both ends of the bus.

Figure 29 - DC-bus Connector Example

(1) DC-bus links latch on both sides when inserted into the DC-bus connectors. To remove the DC-bus link, depress both sets of upper pivots to unlatch the lower pivots and hold the DC-bus link firmly while pulling upward.

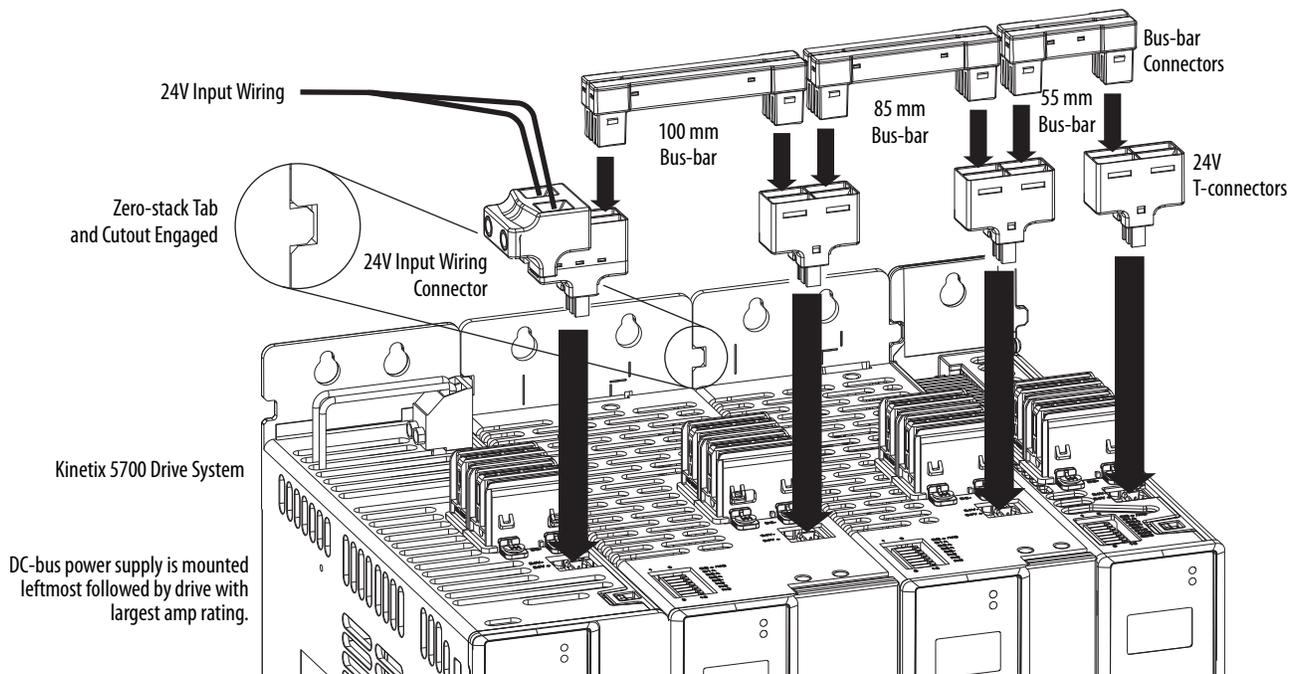
24V Input Power Connection System

The 24V input power connection system is optional and comprised of three components:

- The 24V input wiring connector that plugs into the DC-bus power supply or first module supplied by the 24V external power receives 24V DC input wiring.
- 24V DC T-connectors that plug into the drive modules downstream from the power supply or first module supplied by the 24V external power where the 24V control power is shared.
- Bus bars that connect between drive modules to extend the 24V control power from one drive module to another.

IMPORTANT The maximum current rating for the 24V input power connection system is 52 A. If needed, you can insert another 2198-TCON-24VDCIN36 control power input wiring connector at any point in the drive cluster.

Figure 30 - 24V Connector Example



The three components assemble from left to right across the drive system.

1. Attach wiring to 24V input wiring connector.
2. Insert input wiring connector and T-connectors into the appropriate drive module connectors.
3. Insert bus-bars to connect between wiring connector and T-connectors.

Drill-hole Patterns

This section provides drill-hole patterns for Kinetix 5700 drive modules that are mounted in zero-stack (shared-bus) configurations. Properly spaced drill-holes are essential for engaging the zero-stack tab and cutout from module-to-module so that the DC-bus connectors are spaced properly to accept the DC-bus links.

Also available to assist you in mounting drive modules is the 2198-K5700-MOUNTKIT system mounting toolkit.

Follow these guidelines when mounting your drive modules.

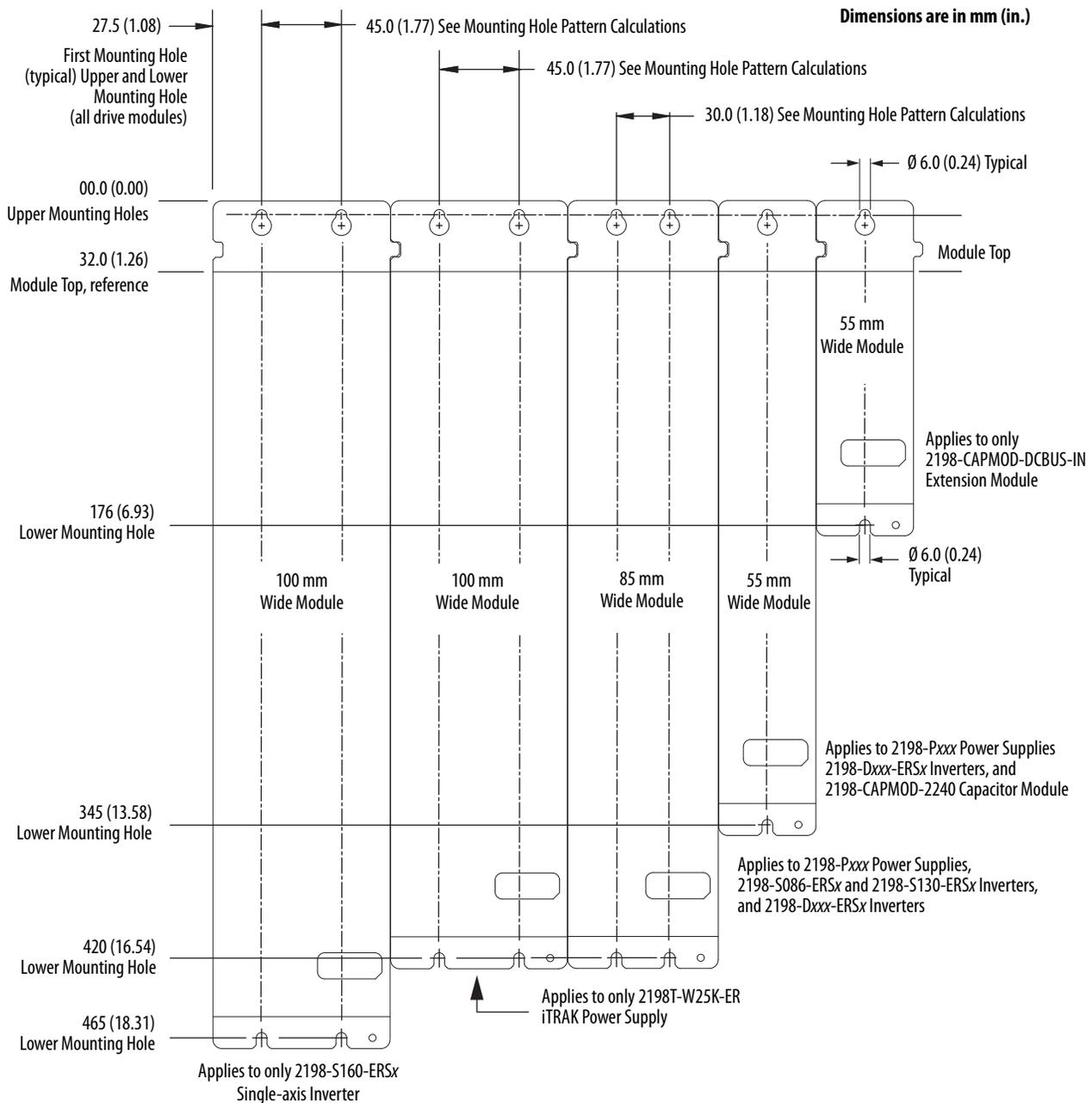
- The DC-bus power supply (or supplies) is/are always mounted in the far left position.
- Inverter modules with the highest power rating are always mounted to the left of any inverter module with a lower power rating.

Drill-hole Pattern Calculations

Follow these steps to calculate the left-to-right hole pattern for any Kinetix 5700 drive module configuration by using [Figure 31](#).

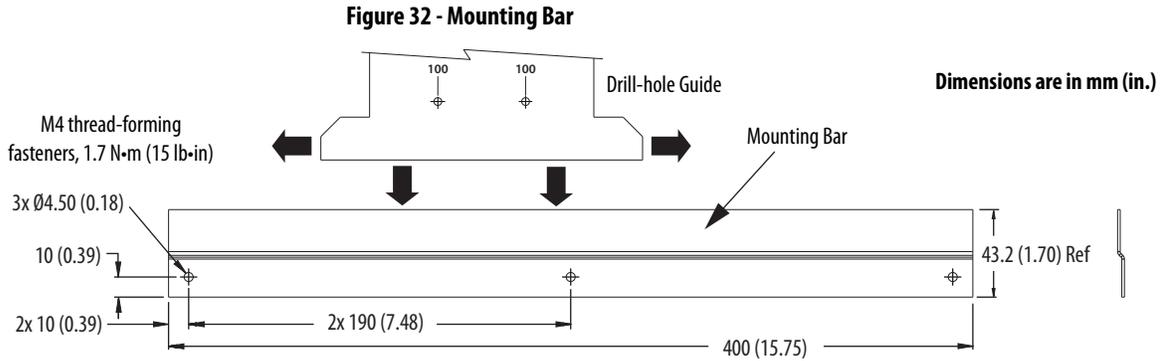
1. The first hole location is zero.
2. The second hole location is module width minus 55 mm.
3. The next hole location is 55 mm.
4. Repeat [step 2](#) and [step 3](#) for the remaining holes.

Figure 31 - Kinetix 5700 Mounting Hole Patterns



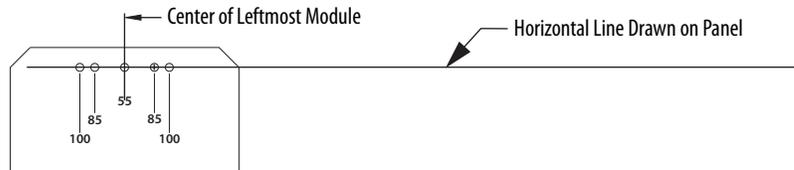
Drill-hole Patterns by Using the System Mounting Toolkit

The mounting bar must be mounted horizontally on the system panel. The drill-hole guide inserts behind the mounting bar and slides left and right. Holes and slots in the drill-hole guide let you establish the location of each Kinetix 5700 drive module.



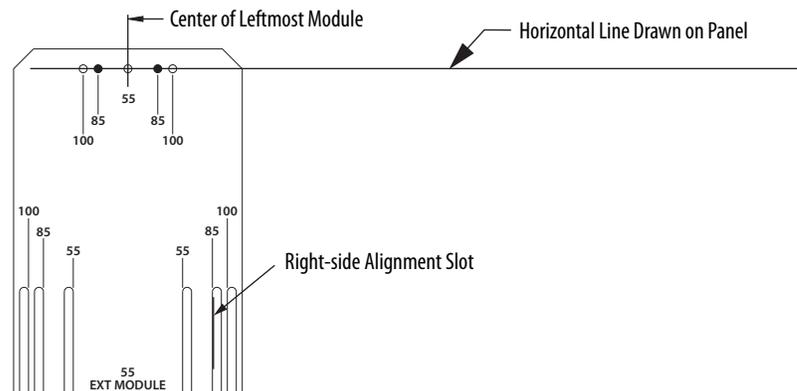
Follow these steps to locate the drill-holes by using the system mounting toolkit.

1. Draw a horizontal line on the panel where you would like to position the upper module-width holes (refer to [Figure 33](#)).
2. Drill three 3.6 mm (0.14 in.) holes 506 mm (19.9 in.) below the line you drew in [step 1](#) for attaching the mounting bar to the panel.
3. Attach the mounting bar to the panel by using the two M4 fasteners.
4. Determine (left to right) the leftmost module position and draw a vertical line where you would like the center of that leftmost module.

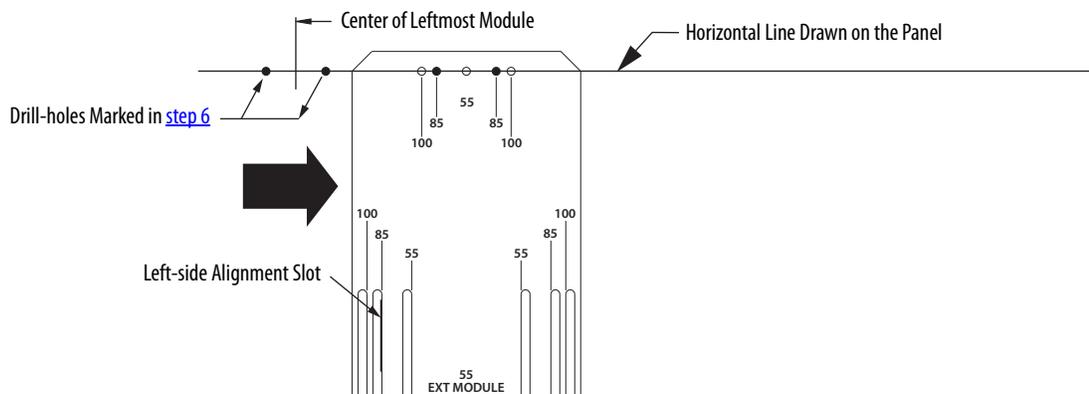


5. Slide the drill-hole guide into the mounting bar and adjust left-to-right until the 55 mm upper module-width hole is aligned with the vertical line you drew in [step 4](#).
6. Mark the upper and lower module-width holes appropriate for the drive-width of the module being mounted.

In this example, the leftmost module is 85 mm wide.



7. Draw a line along the left edge of the right-side alignment slot appropriate for the drive-width of module being mounted.
8. Slide the drill-hole guide to the right until the line you drew in [step 7](#) is just visible in the left-side alignment slot appropriate for the drive-width of next module being mounted.



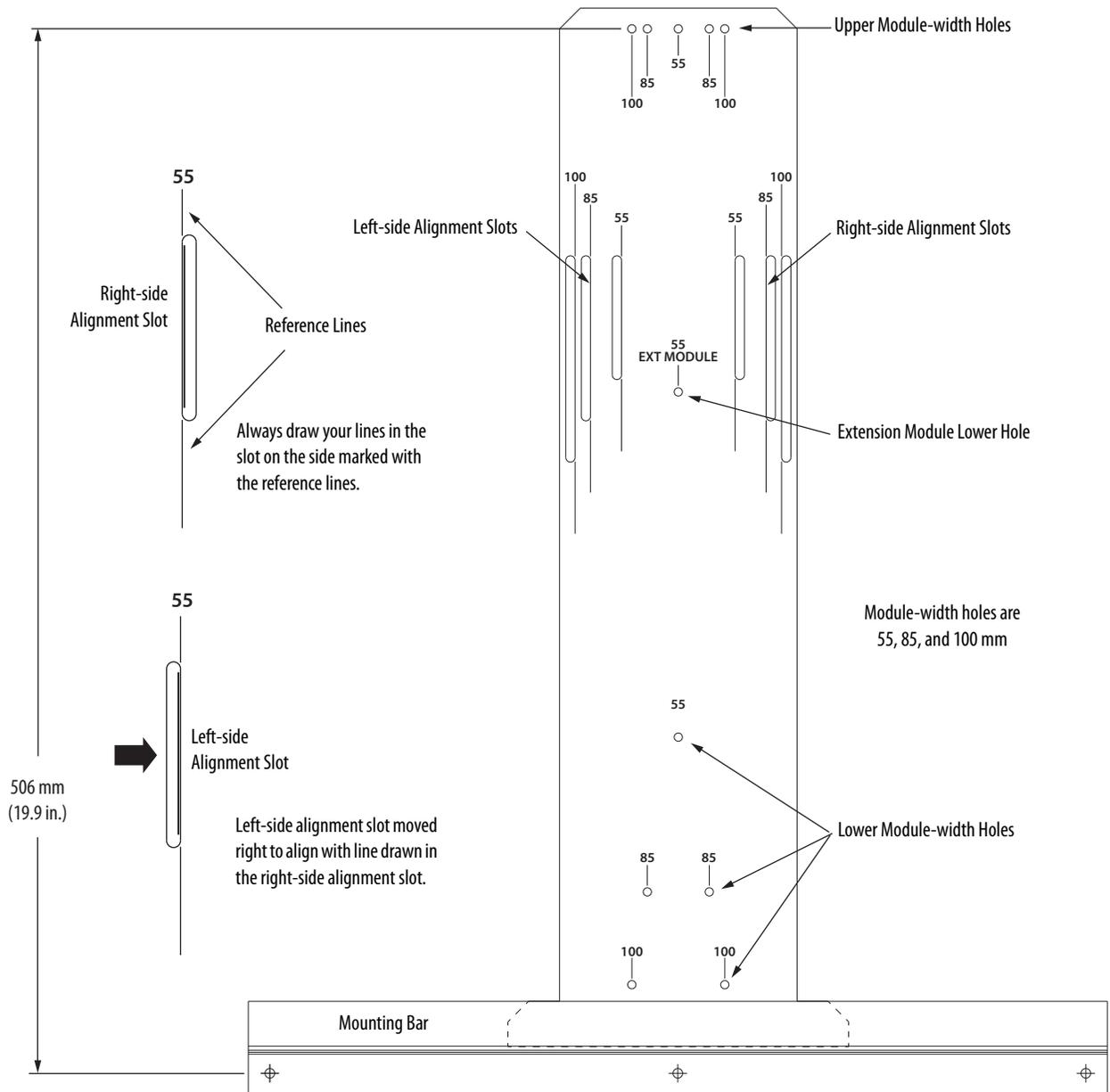
In this example, the next module is also 85 mm wide.

9. Repeat [step 6](#) through [step 8](#) for each module in your drive system.

TIP When drive systems are wider than the mounting bar, you can remove the screws and shift the mounting bar left or right, reusing two of the original holes and drilling another (repeat as needed).

10. Remove the mounting bar from the panel when you are finished.

Figure 33 - Kinetix 5700 System Mounting Toolkit



Mount Your Kinetix 5700 Drive Modules

This procedure assumes that you have prepared your panel and understand how to bond your system. For installation instructions regarding other equipment and accessories, refer to the instructions that came with those products.

Follow these steps to mount your Kinetix 5700 drive modules to the panel.

1. Lay out the hole pattern for each drive module in the enclosure.

See [Establishing Noise Zones](#) on [page 43](#) for panel layout recommendations.

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

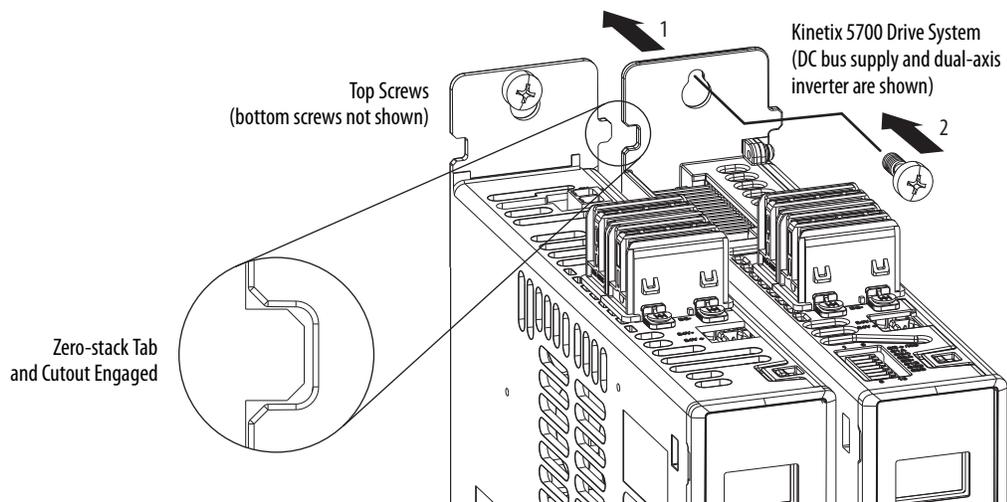
2. Drill holes in the panel for mounting your drive system.

Refer to [Drill-hole Patterns](#) beginning on [page 56](#).

3. Loosely attach the mounting hardware to the panel.

The recommended mounting hardware is M5 (#10-32) steel bolts. Observe bonding techniques as described in [Bonding Modules](#) on [page 40](#).

4. Attach the DC-bus supply (or supplies) to the cabinet panel in the leftmost position.



5. Attach additional drive modules to the right of the previous module by using the same method, but also making sure that the zero-stack tabs and cutouts are engaged.

Zero-stack mounting is required for all configurations. See the [Zero-stack Tab and Cutout Example](#) on [page 54](#).

6. Tighten all mounting fasteners.

Apply 4.0 N•m (35.4 lb•in) maximum torque to each fastener.

Notes:

Connector Data and Feature Descriptions

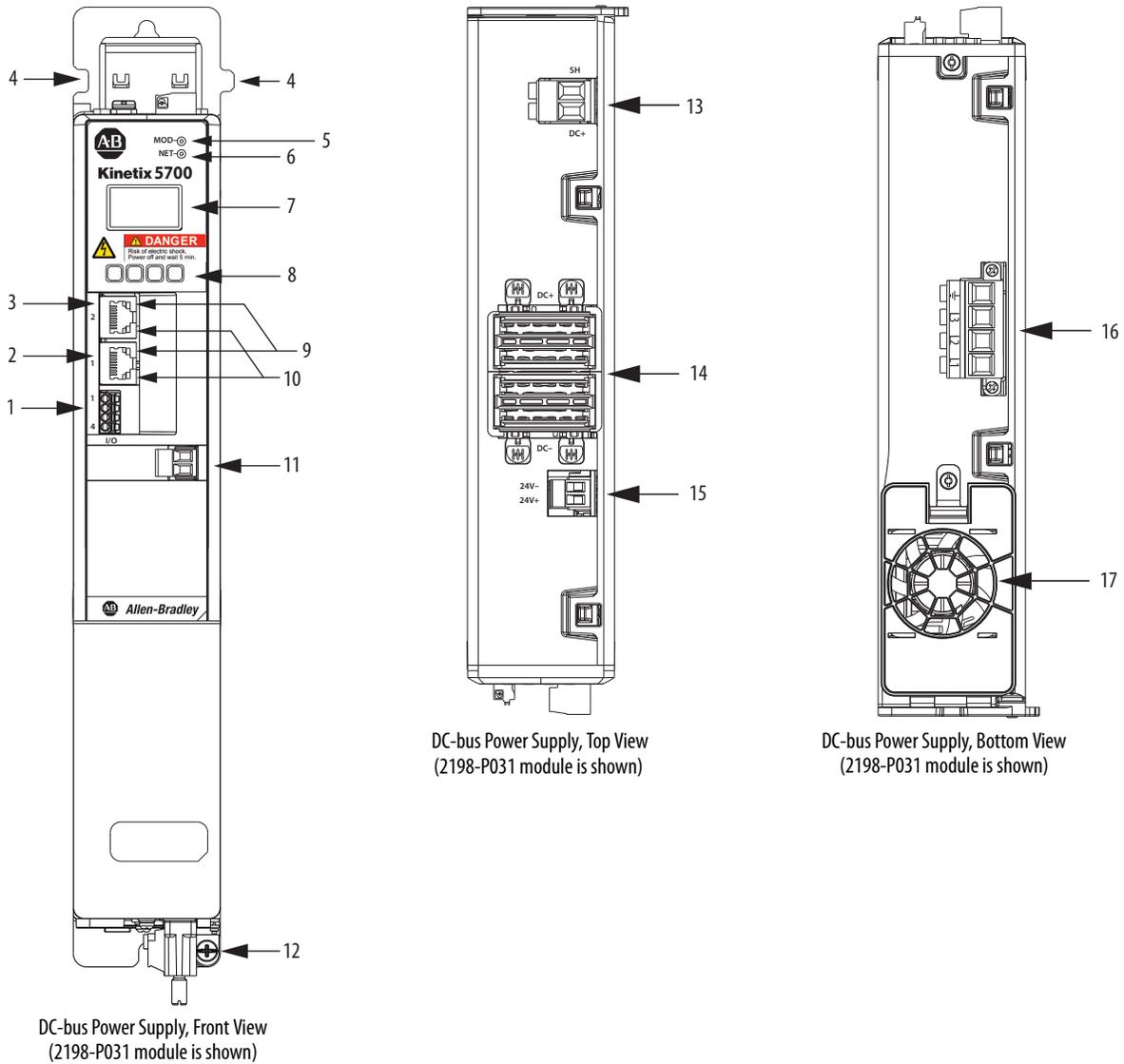
This chapter illustrates connectors and indicators for the Kinetix® 5700 drive system components, including the DC-bus power supply, single-axis inverter, and dual-axis inverter modules. Also included in this chapter are connector pinouts and descriptions for Kinetix 5700 system components.

| Topic | Page |
|--|-------------|
| Kinetix 5700 Connector Data | 64 |
| Understand Control Signal Specifications | 74 |
| Feedback Specifications | 79 |
| Functional Safety Features | 90 |

Kinetix 5700 Connector Data

Use these illustrations to identify the connectors and indicators for the Kinetix 5700 drive modules.

Figure 34 - DC-bus Power Supply Features and Indicators

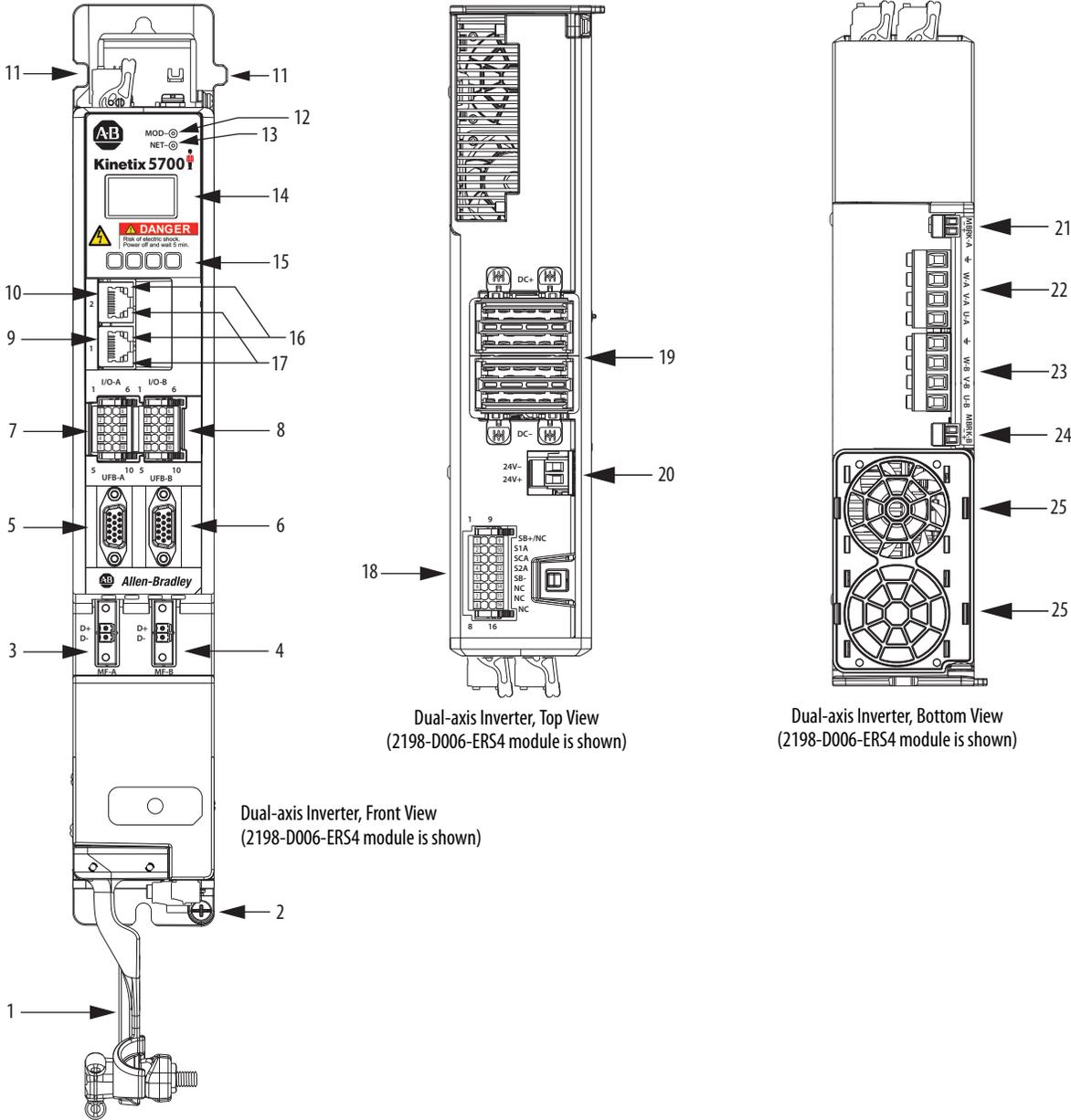


| Item | Description |
|------|---------------------------------|
| 1 | Digital inputs (IOD) connector |
| 2 | Ethernet (PORT1) RJ45 connector |
| 3 | Ethernet (PORT2) RJ45 connector |
| 4 | Zero-stack mounting tab/cutout |
| 5 | Module status indicator |
| 6 | Network status indicator |

| Item | Description |
|------|----------------------------------|
| 7 | LCD display |
| 8 | Navigation pushbuttons |
| 9 | Link speed status indicators |
| 10 | Link/Activity status indicators |
| 11 | Contacter-enable (CED) connector |
| 12 | Ground terminal |

| Item | Description |
|------|--|
| 13 | Shunt resistor (RC) connector |
| 14 | DC bus (DC) connector |
| 15 | 24V control input power (CP) connector |
| 16 | AC Input power (IPD) connector |
| 17 | Cooling fan |

Figure 35 - Dual-axis Inverter Features and Indicators

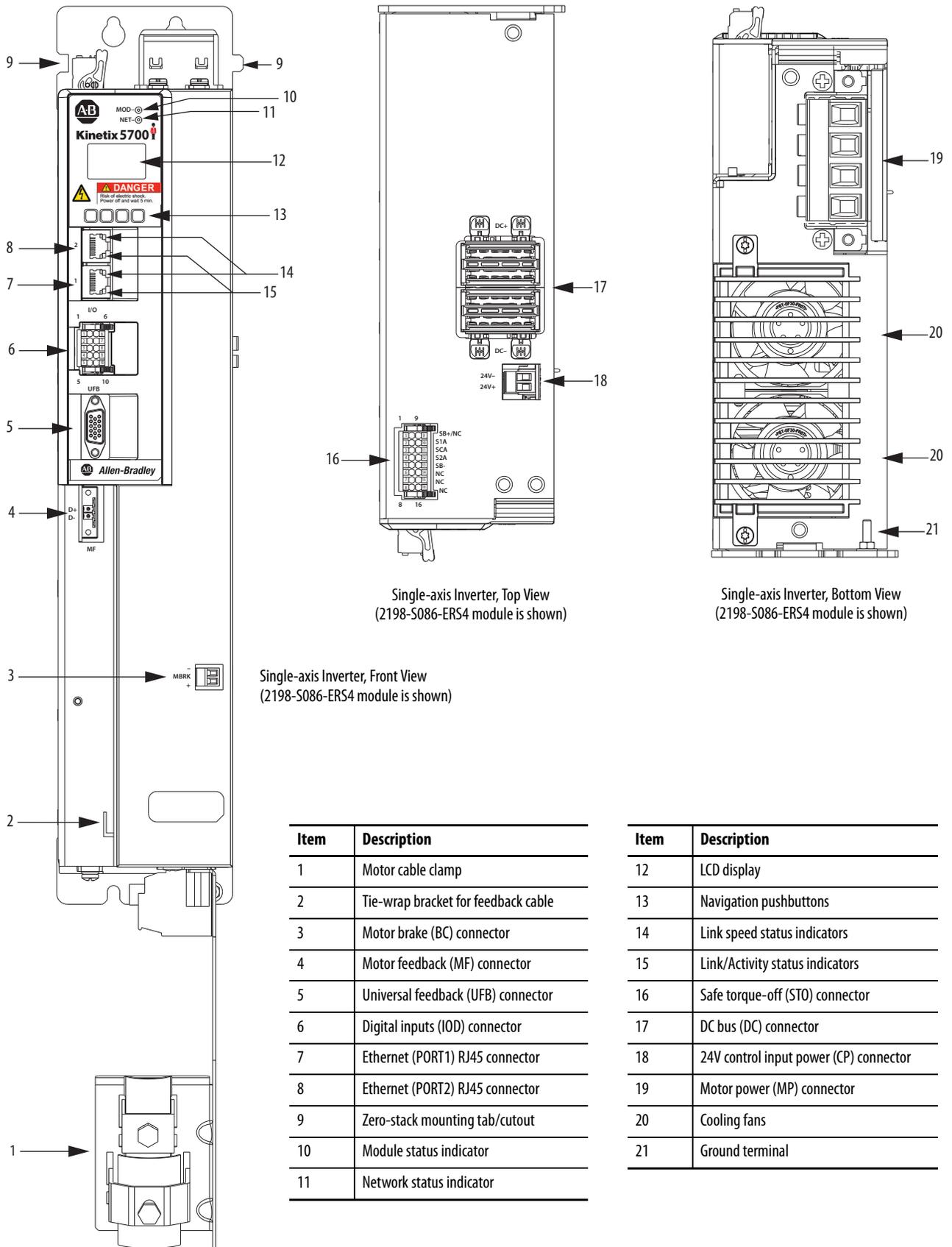


| Item | Description |
|------|--|
| 1 | Motor cable clamp with spacers |
| 2 | Ground terminal |
| 3 | Motor feedback (MF) connector - A |
| 4 | Motor feedback (MF) connector - B |
| 5 | Universal feedback (UFB) connector - A |
| 6 | Universal feedback (UFB) connector - B |
| 7 | Digital inputs (IOD) connector - A |
| 8 | Digital inputs (IOD) connector - B |
| 9 | Ethernet (PORT1) RJ45 connector |

| Item | Description |
|------|---------------------------------|
| 10 | Ethernet (PORT2) RJ45 connector |
| 11 | Zero-stack mounting tab/cutout |
| 12 | Module status indicator |
| 13 | Network status indicator |
| 14 | LCD display |
| 15 | Navigation pushbuttons |
| 16 | Link speed status indicators |
| 17 | Link/Activity status indicators |
| 18 | Safe torque-off (STO) connector |

| Item | Description |
|------|--|
| 19 | DC bus (DC) connector |
| 20 | 24V control input power (CP) connector |
| 21 | Motor brake (BC) connector - A |
| 22 | Motor power (MP) connector - A |
| 23 | Motor power (MP) connector - B |
| 24 | Motor brake (BC) connector - B |
| 25 | Cooling fan |

Figure 36 - Single-axis Inverter Features and Indicators



Single-axis Inverter, Front View
(2198-S086-ERS4 module is shown)

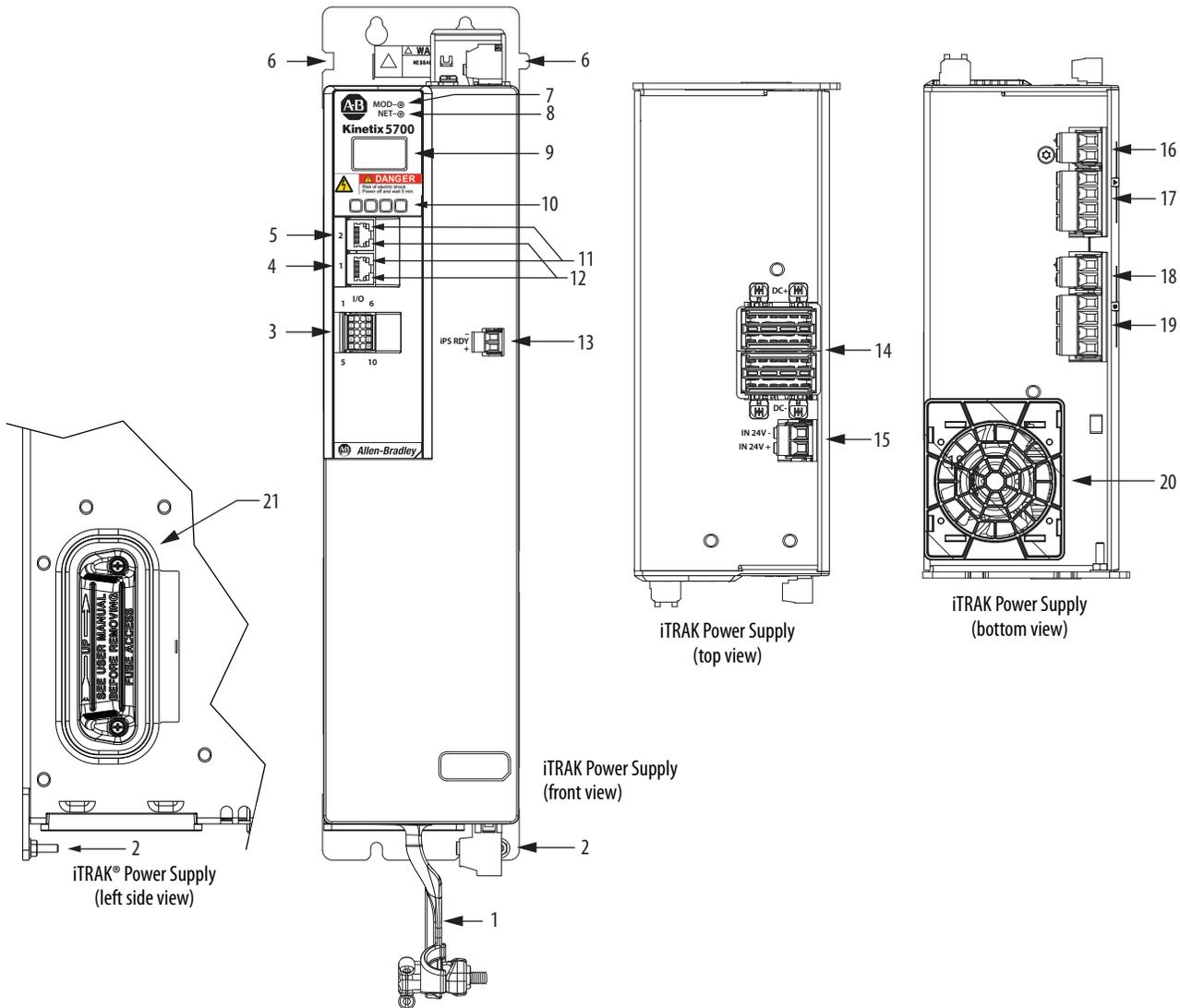
Single-axis Inverter, Top View
(2198-S086-ERS4 module is shown)

Single-axis Inverter, Bottom View
(2198-S086-ERS4 module is shown)

| Item | Description |
|------|-------------------------------------|
| 1 | Motor cable clamp |
| 2 | Tie-wrap bracket for feedback cable |
| 3 | Motor brake (BC) connector |
| 4 | Motor feedback (MF) connector |
| 5 | Universal feedback (UFB) connector |
| 6 | Digital inputs (IOD) connector |
| 7 | Ethernet (PORT1) RJ45 connector |
| 8 | Ethernet (PORT2) RJ45 connector |
| 9 | Zero-stack mounting tab/cutout |
| 10 | Module status indicator |
| 11 | Network status indicator |

| Item | Description |
|------|--|
| 12 | LCD display |
| 13 | Navigation pushbuttons |
| 14 | Link speed status indicators |
| 15 | Link/Activity status indicators |
| 16 | Safe torque-off (STO) connector |
| 17 | DC bus (DC) connector |
| 18 | 24V control input power (CP) connector |
| 19 | Motor power (MP) connector |
| 20 | Cooling fans |
| 21 | Ground terminal |

Figure 37 - iTRAK Power Supply Features and Indicators



| Item | Description |
|------|---------------------------------|
| 1 | Power bus cable clamp |
| 2 | Ground lug |
| 3 | Digital inputs (IOD) connector |
| 4 | Ethernet (PORT1) RJ45 connector |
| 5 | Ethernet (PORT2) RJ45 connector |
| 6 | Zero-stack mounting tab/cutout |
| 7 | Module status indicator |

| Item | Description |
|------|---|
| 8 | Network status indicator |
| 9 | LCD display |
| 10 | Navigation push buttons |
| 11 | Link speed status indicators |
| 12 | Link/Activity status indicators |
| 13 | iTRAK power-supply ready (IR) connector |
| 14 | DC bus input (DC) connector |

| Item | Description |
|------|--|
| 15 | 24V control input power (CP) connector |
| 16 | 24V control output power (ICP) connector -A |
| 17 | DC bus output (IDC) connector - A |
| 18 | 24V control output power (ICP) connector - B |
| 19 | DC bus output (IDC) connector - B |
| 20 | Cooling fan |
| 21 | Power supply internal fuse |

IMPORTANT See the iTRAK System User Manual, publication [2198T-UM001](#), for IOD, IR, IDC, and ICP connector pinouts, and internal fuse information.

Safe Torque-off Connector Pinout

The hardwired safe torque-off (STO) connector pinouts apply to single-axis and dual-axis inverters. For feature descriptions and wiring information, refer to [Chapter 9](#) beginning on [page 255](#).

Input Power Connector Pinouts

The AC input power (IPD) and contactor-enable (CED) connector pinouts apply to DC-bus power supply. The 24V input power (CP) connector pinout applies to DC-bus power supply, single-axis inverter, dual-axis inverter, and iTRAK power supply.

Table 18 - AC Input Power Connector

| IPD Pin | Description | Signal |
|---|-------------------------|---|
|  | Chassis ground |  |
| L3 | Three-phase input power | L3 |
| L2 | | L2 |
| L1 | | L1 |

Table 19 - 24V Input Power Connector

| CP Pin | Description | Signal |
|--------|-------------------------------------|--------|
| 1 | 24V power supply, customer supplied | 24V+ |
| 2 | 24V common | 24V- |

Table 20 - Contactor Enable Connector

| CED Pin | Description | Signal |
|---------|--|----------|
| EN+ | Relay-driven contact used in the control string for a three-phase power contactor. | CONT EN+ |
| EN- | | CONT EN- |

DC Bus and Shunt Resistor Connector Pinouts

The DC-bus (DC) connector pinout applies to DC-bus power supply, single-axis inverter, dual-axis inverter, and iTRAK power supply. The shunt resistor (RC) pinout applies to the DC-bus power supply.

Table 21 - DC Bus Power Connector

| DC Pin | Description | Signal |
|---------|--------------------|--------|
| Bus bar | DC bus connections | DC- |
| | | DC+ |

Table 22 - Shunt Resistor Connector

| RC Pin | Description | Signal |
|--------|-------------------|--------|
| 1 | Shunt connections | SH |
| 2 | | DC+ |

Digital Inputs Connector Pinouts

The DC-bus power supply has two configurable digital inputs and four configurable functions to choose from in the Logix Designer application.

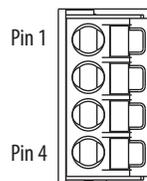
Table 23 - DC-bus Supply Digital Input Pinouts

| IOD Pin | Description | Signal |
|---------|---|--------|
| 1 | 24V current sinking fast input #1 | IN1 |
| 2 | I/O common for customer-supplied 24V supply | COM |
| 3 | 24V current sinking fast input #2 | IN2 |
| 4 | I/O cable shield termination | SHLD |

Table 24 - DC-bus Supply Configurable Functions

| Default Configuration | Description |
|---|-------------------------|
| Digital input1= Enable Digital input2 = Unassigned | Unassigned |
| | Enable |
| | Bus capacitor OK |
| | Shunt thermal switch OK |

Figure 38 - Pin Orientation for 4-pin Digital Inputs (IOD) Connector



Single-axis and dual-axis inverters have four configurable digital inputs with fast response times and ten configurable functions to choose from in the Logix Designer application.

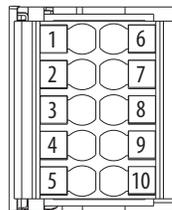
Table 25 - Inverter Digital Input Pinouts

| IOD Pin | Description | Signal |
|---------|---|--------|
| 1 | 24V current sinking fast input #1 | IN1 |
| 2 | I/O common for customer-supplied 24V supply | COM |
| 3 | 24V current sinking fast input #2 | IN2 |
| 4 | I/O common for customer-supplied 24V supply | COM |
| 5 | Chassis ground | SHLD |
| 6 | 24V current sinking fast input #3 | IN3 |
| 7 | I/O common for customer-supplied 24V supply | COM |
| 8 | 24V current sinking fast input #4 | IN4 |
| 9 | I/O common for customer-supplied 24V supply | COM |
| 10 | Chassis ground | SHLD |

Table 26 - Inverter Configurable Functions

| Default Configuration | Description |
|---|-------------------------|
| Digital input1= Enable Digital input2 = Home Digital input3 = Registration 1 Digital input4 = Registration 2 | Unassigned |
| | Enable |
| | Home |
| | Registration 1 |
| | Registration 2 |
| | Positive overtravel |
| | Negative overtravel |
| | Regeneration OK |
| | Bus capacitor OK |
| | Shunt thermal switch OK |

Figure 39 - Pin Orientation for 10-pin Digital Inputs (IOD) Connector

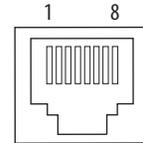


Ethernet Communication Connector Pinout

The Ethernet connector pinout applies to the DC-bus power supply, single-axis inverter, dual-axis inverter, and iTRAK power supply.

Table 27 - Ethernet Connector Pinout

| Pin | Description | Signal |
|-----|-------------|--------|
| 1 | Transmit+ | TD+ |
| 2 | Transmit- | TD- |
| 3 | Receive+ | RD+ |
| 4 | Reserved | - |
| 5 | Reserved | - |
| 6 | Receive- | RD- |
| 7 | Reserved | - |
| 8 | Reserved | - |



Motor Power, Brake, and Feedback Connector Pinouts

These connector pinouts apply to the single-axis and dual-axis inverter.

Table 28 - Motor Power Connector

| MP Pin | Description | Signal | Color |
|---------|-------------------------|---------|-------|
| U | Three-phase motor power | U | Brown |
| V | | V | Black |
| W | | W | Blue |
| \perp | Chassis ground | \perp | Green |



ATTENTION: To avoid damage to the Kinetix 5700 DC-bus power supply and inverter, make sure the motor power signals are wired correctly. Refer to [Figure 71](#) and [Figure 72](#) beginning on [page 112](#) for connector wiring examples.

IMPORTANT Drive-to-motor power cables must not exceed 90 m (295 ft), depending on feedback type.
System performance was tested at this cable length. These limitations also apply when meeting CE requirements.

Table 29 - Motor Brake Connector

| BC Pin | Description | Signal |
|--------|-------------------------|--------|
| 1 | Motor brake connections | MBRK+ |
| 2 | | MBRK- |

Motor Feedback Connector Pinouts

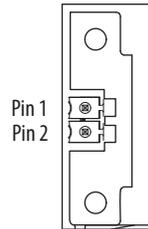
These connector pinouts apply to the single-axis and dual-axis inverter.

Table 30 - DSL Feedback Connector

| MF Pin | Description | Signal |
|--------|---|--------|
| 1 | Bidirectional data and power for digital encoder interface | D+ |
| 2 | | D- |
| SHIELD | Cable shield and grounding plate (internal to 2198-KITCON-DSL connector kit) termination point. | SHIELD |
| | Cable shield and shield clamp (internal to 2198-H2DCK converter kit) termination point | |

IMPORTANT Drive-to-motor power cables must not exceed 90 m (295 ft), depending on feedback type.
System performance was tested at these cable length specifications. These limitations also apply when meeting CE requirements.

Figure 40 - Pin Orientation for 2-pin DSL Feedback (MF) Connector



Universal Feedback Connector Pinouts

These connector pinouts apply to the single-axis and dual-axis inverter.

Table 31 - Stegmann Hiperface and TTL Sine/Cosine Universal Feedback Connector

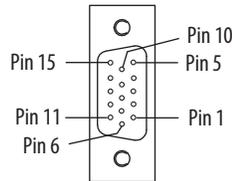
| UFB Pin | Description | Signal |
|---------|--|---------------------------|
| 1 | Sine differential input + A differential input + | MTR_SIN+ MTR_AM+ |
| 2 | Sine differential input- A differential input- | MTR_SIN- MTR_AM- |
| 3 | Cosine differential input + B differential input + | MTR_COS+ MTR_BM+ |
| 4 | Cosine differential input - B differential input - | MTR_COS- MTR_BM- |
| 5 | Data differential input/output + Index differential input + | MTR_DATA+ MTR_IM+ |
| 6 | Encoder common | MTR_ECOM |
| 7 | Encoder 9V power output | MTR_EPWR9V ⁽¹⁾ |
| 8 | Hall commutation S3 input | MTR_S3 |

| UFB Pin | Description | Signal |
|---------|--|---------------------------|
| 9 | Clock output + | MTR_CLK+ |
| 10 | Data differential input/output - Index differential input - | MTR_DATA- MTR_IM- |
| 11 | Motor thermostat (normally closed) ⁽²⁾ | MTR_TS |
| 12 | Hall commutation S1 input | MTR_S1 |
| 13 | Hall commutation S2 input | MTR_S2 |
| 14 | Encoder 5V power output | MTR_EPWR5V ⁽¹⁾ |
| 15 | Clock output - | MTR_CLK- |

(1) Determine which power supply your encoder requires and connect to only the specified supply. Do not make connections to both supplies.

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

Figure 41 - Pin Orientation for 15-pin Universal Feedback (UFB) Connector



Understand Control Signal Specifications

This section provides a description of the Kinetix 5700 digital inputs, Ethernet communication, power and relay specifications, encoder feedback specifications, and safe torque-off features.

Digital Inputs

Digital inputs are available for the machine interface on the IOD connector. Two for the DC-bus power supply, four for the single-axis inverter, and four per axis for the dual-axis inverters. Digital inputs require a 24V DC @ 15 mA supply. These are sinking inputs that require a sourcing device. A common connection is provided on the IOD connector for each of the digital inputs.

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

Table 32 - Understand Digital Input Functions

| Functions | Description ⁽²⁾ |
|--|--|
| Enable | A 24V DC input is applied to this terminal as a condition to enable each module. |
| Home | An active state indicates to a homing sequence that the referencing sensor has been seen. Typically, a transition of this signal is used to establish a reference position for the machine axis. |
| Registration 1 | An inactive-to-active transition (also known as a positive transition) or active-to-inactive transition (also known as a negative transition) is used to latch position values for use in registration moves. |
| Registration 2 | |
| Positive overtravel Negative overtravel | The positive/negative limit switch (normally closed contact) inputs for each axis require 24V DC (nominal). |
| Regeneration OK ⁽¹⁾ | In the active state the inverters can be enabled. An inactive state indicates that the Bulletin 8720MC-RPS unit is not ready to supply DC-bus power. The inverters cannot be enabled. When a bus group is supplied by an 8720MC-RPS unit, one inverter in the bus group must be configured in the Logix Designer application as Shared-DC Non-CIP Motion™ Converter and assigned to Regenerative OK. This signal is wired from RDY on the 8720MC-RPS unit and indicates to the Kinetix 5700 drive system that the 8720MC-RPS unit is ready to supply power. Enabled inverters enumerate a Bus Power Sharing fault if the Regeneration OK input goes inactive. |
| Shunt thermal switch OK | When the 2198-R014, 2198-R031, or 2198-R127 external shunt resistor is wired to the DC-bus power supply, this input must be configured in the Logix Designer application to monitor the status of the external shunt module thermal switch and assigned to Shunt thermal switch OK. This function does not apply to the 2198-R004 shunt resistor. You can also use this input to monitor the status of an active shunt module in the system that is connected via the capacitor module or an extension module. |
| Bus capacitor OK | You can configure this input in the Logix Designer application and wire the module status (MS) relay output from the 2198-CAPMOD-2240 capacitor module to indicate to the inverter that a major fault is present on the capacitor module. |

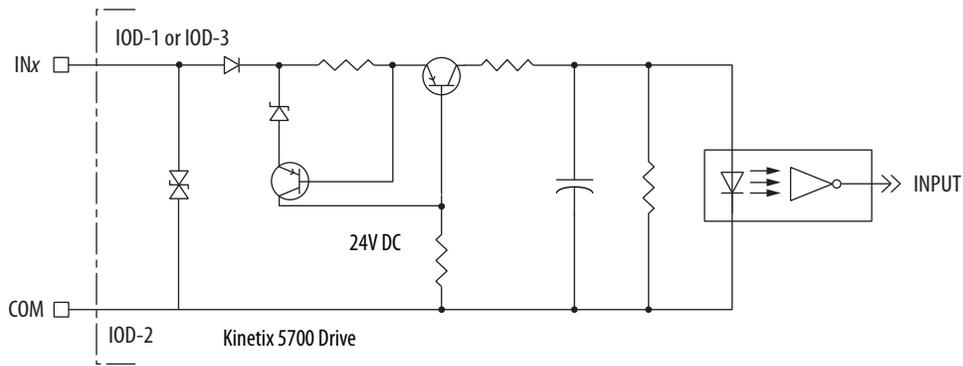
(1) For more information on configuring a Shared-bus Non-CIP Motion Converter, refer to [step 1](#) on [page 161](#). For more information on wiring the 8720MC-RPS unit, refer to [Figure 136](#) on [page 287](#).

(2) The function is always inactive unless assigned to a digital input in the Logix Designer application. For more information on configuring a Regeneration OK, Shunt thermal switch OK, or Bus capacitor OK, refer to [step 11](#) on [page 153](#).

Table 33 - Digital Input Specifications

| Attribute | Value |
|--|--|
| Type | Optically isolated, active high, single-ended, current sinking (EN 61131-2 Type 1) |
| Input current (with 24V applied) | 12 mA, typical |
| On-state input voltage | 15...30V @ 15 mA, max |
| Off-state input voltage | -1.0...5.0V |
| Pulse reject filtering (registration functions) | 12.0 μs |
| Pulse reject filtering (home input function) debounce filter | 20 ms, nom |
| Propagation delay (registration functions) | 0 (delay compensated) |
| Registration accuracy | ±3 μs |
| Registration repeatability | 700 ns |
| Windowed registration invalid-to-valid event delay | 125 μs, min |

Figure 42 - Digital Input Circuitry



Ethernet Communication Specifications

The PORT1 and PORT2 (RJ45) Ethernet connectors are provided for communication with the Logix 5000™ controller.

| Attribute | Value |
|--|---|
| Communication | The drive auto-negotiates speed and duplex modes. These modes can be forced through the Logix Designer application. 100BASE-TX, full duplex is recommended for maximum performance. |
| Cyclic update period | 1.0 ms, min |
| Embedded switch features | Three-port, cut-through, time correction on IEEE-1588 packets, limited filtering, quality of service with four priority levels |
| Auto MDI/MDIX crossover detection/correction | Yes |
| Port-to-port time synchronization variation | 100 ns, max |
| Cabling | CAT5e shielded, 100 m (328 ft) max |

Contactor Enable Relay

The contactor-enable circuitry includes a relay-driven contact within the 2198-Pxxx DC-bus power supply. The relay protects the Kinetix 5700 drive system in the event of overloads or other fault conditions.

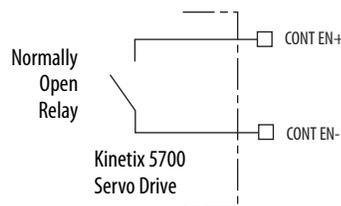
An AC three-phase mains contactor must be wired in series between the branch circuit protection and the DC-bus power supply. In addition, the AC three-phase contactor control string must be wired in series with the contactor-enable relay at the contactor-enable (CED) connector. Refer to [Power Wiring Examples](#) on [page 281](#) for wiring examples.



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

- three-phase power is removed and the DC-bus power supply is protected under various fault conditions.
- three-phase power is never applied to the Kinetix 5700 drive system before control power is applied.

Figure 43 - Contactor-enable Relay Circuit



Surge suppression (diode, varistor module, RC module, or DC electronic interface) is required across the auxiliary and main contactor coils.

Table 34 - 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 | – | 1 Ω |
| Off-state voltage | Voltage across the contacts when the relay is open | – | 240V DC |

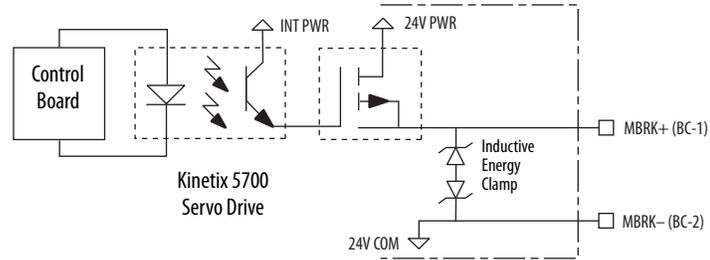
Motor Brake Circuit

The brake option is a spring-set holding brake that releases when voltage is applied to the brake coil in the motor. The customer-supplied 24V power supply drives the brake output through a solid-state relay. The dual-axis inverters have separate brake circuits for each axis. The solid-state brake driver circuit provides the following:

- Brake current-overload protection
- Brake over-voltage protection

Two connections (BC-1 and BC-2) are required for the motor brake output (refer to [Figure 44](#)). Connections are rated for 2.0 A @ +24V (dual-axis inverters) and 5.0 A @ +24V (single-axis inverters).

Figure 44 - Motor Brake Circuit



IMPORTANT Motor holding-brake switching frequency must not exceed 10 cycles/min.

Control of the solid-state relay to release the motor brake is configurable in the Logix Designer application (refer to [Configure SPM Motor Closed-loop Control Axis Properties](#) on [page 184](#)). An active signal releases the motor brake. Turn-on and turn-off delays are specified by the MechanicalBrakeEngageDelay and MechanicalBrakeReleaseDelay settings.

IMPORTANT Holding brakes that are available on Allen-Bradley® rotary motors are designed to hold a motor shaft at 0 rpm for up to the rated brake-holding torque, not to stop the rotation of the motor shaft, or be used as a safety device.

You must command the servo drive to 0 rpm and engage the brake only after verifying that the motor shaft is at 0 rpm.

These steps provide one method you can use to control a brake.

1. Wire the mechanical brake according to the appropriate interconnect diagram in Appendix A beginning on [page 294](#).
2. Enter the MechanicalBrakeEngageDelay and Mechanical BrakeReleaseDelay times in the Logix Designer application.
Refer to Axis Properties>Parameter List. The delay times must be from the appropriate motor family brake specifications table in the Kinetix Rotary Motion Specifications Technical Data, publication [KNX-TD001](#).
3. Use the drive stop-action default setting (Current Decel & Disable).
Refer to Axis Properties>Actions>Stop Action in the Logix Designer application.
4. Use the motion instruction Motion Axis Stop (MAS) to decelerate the servo motor to 0 rpm.
5. Use the motion instruction Motion Servo Off (MSF) to engage the brake and disable drive.

Control Power

The Kinetix 5700 drive modules require 24V DC (21.6...26.4V) input power for control circuitry.

IMPORTANT SELV or PELV rated power supplies must be used to energize external safety devices connected to the Kinetix 5700 safety inputs.

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 35 - Control Power Current Specifications

| Drive Module | Drive Module Cat. No. | 24V Current Per Module (non-brake motor) A _{DC} | 24V Current, max (with maximum brake current) A _{DC} | 24V Inrush Current ⁽⁵⁾ A |
|-----------------------------------|-----------------------|---|--|--|
| DC-bus Power Supplies | 2198-P031 | 0.8 | N/A | 4.0 |
| | 2198-P070 | | | |
| | 2198-P141 | 1.9 | | |
| | 2198-P208 | | | |
| Dual-axis Inverters | 2198-D006-ERSx | 1.4 ⁽²⁾ | 5.5 ⁽³⁾ | 4.0 |
| | 2198-D012-ERSx | | | |
| | 2198-D020-ERSx | 1.7 ⁽²⁾ | 7.7 ⁽³⁾ | |
| | 2198-D032-ERSx | | | |
| | 2198-D057-ERSx | | | |
| Single-axis Inverters | 2198-S086-ERSx | 4.6 | 9.6 ⁽⁴⁾ | 4.0 |
| | 2198-S130-ERSx | | | |
| | 2198-S160-ERSx | | | |
| iTRAK Power Supply ⁽¹⁾ | 2198T-W25K-ER | 1.3 | N/A | 2.2 |
| Capacitor Modules | 2198-CAPMOD-2240 | 0.5 | N/A | N/A |
| | 2198-CAPMOD-DCBUS-IO | N/A | | |

(1) These values represent only the iTRAK power supply. They do not include the iTRAK motor modules that are connected to the iTRAK power supply and also draw current from this 24V control power input. For more information regarding 24V control power requirements, see the iTRAK System User Manual, publication [2198T-UM001](#).

(2) Values are base current per module.

(3) Values assume two brake motors, each drawing the maximum rating of 2 A, are attached to each module.

(4) Values assume the maximum rated brake current of 5 A.

(5) Inrush current duration is less than 30 ms.

Feedback Specifications

The Kinetix 5700 drives accept motor feedback signals from Stegmann Hiperface digital-servo-link (DSL) encoders on the motor feedback (MF) connector and Hiperface, incremental, and EnDat encoders on the universal feedback (UFB) connector.

IMPORTANT Auto-configuration in the Logix Designer application of intelligent absolute, high-resolution encoders, incremental, and EnDat encoders is possible with only Allen-Bradley motors.

The MF and UFB connectors can be used in the following applications:

- Motor feedback
- Auxiliary feedback-only axis
- Dual-loop control applications

Encoder Feedback Supported on the DSL Feedback Connector

The Kinetix 5700 drives support Kinetix VP motors with Stegmann Hiperface digital-servo-link (DSL) encoders by using the 2-pin (MF) feedback connector.

Other Allen-Bradley motors and actuators with Stegmann Hiperface single-turn or multi-turn high-resolution absolute encoders are also accepted. However, to connect these devices to the MF connector, you must also use the 2198-H2DCK Hiperface-to-DSL (series B or later) converter kit for Hiperface-to-DSL feedback conversion. Alternatively, you can use the universal (UFB) feedback connector for those motors and actuators.

Encoder Feedback Supported on the UFB Feedback Connector

The Kinetix 5700 drives also support multiple types of feedback devices by using the 15-pin (UFB) universal feedback connector and sharing connector pins in many cases. Use the 2198-K57CK-D15M universal feedback connector kit for terminating the feedback conductors.

Table 36 - Universal Feedback General Specifications

| Attribute | Motor Feedback | Auxiliary Feedback |
|--|--|--|
| Feedback device support | <ul style="list-style-type: none"> • Stegmann Hiperface • Generic TTL Incremental • Generic Sine/Cosine Incremental • Heidenhain EnDat Sin/Cos ⁽¹⁾ • Heidenhain EnDat Digital ⁽²⁾ | <ul style="list-style-type: none"> • Stegmann Hiperface • Generic TTL Incremental • Generic Sine/Cosine Incremental • Heidenhain EnDat Sin/Cos • Heidenhain EnDat Digital |
| Power supply voltage (MTR_EPWR5V) Power supply current (MTR_EPWR5V) | 5.27...5.50V 300 mA, max | |
| Power supply voltage (MTR_EPWR9V) Power supply current (MTR_EPWR9V) | 8.30...9.90V 150 mA, max | |
| Thermostat | Single-ended, under 500 Ω = no fault, over 10 k Ω = fault | Single-ended, under 500 Ω = no fault, over 10 k Ω = fault |

(1) EnDat sine/cosine encoders support only RDD-Series direct-drive motors (Bulletin RDB).

(2) EnDat digital encoders support only third-party motors.

Table 37 - Universal Feedback Signals by Device Type

| UFB Pin | Stegmann Hiperface | Generic TTL Incremental | Generic Sine/Cosine Incremental | Heidenhain EnDat Sine/Cosine | Heidenhain EnDat Digital |
|---------|---------------------------|-------------------------|---------------------------------|------------------------------|---------------------------|
| 1 | MTR_SIN+ | MTR_AM+ | MTR_SIN+ | ENDAT_B+ | – |
| 2 | MTR_SIN– | MTR_AM– | MTR_SIN– | ENDAT_B– | – |
| 3 | MTR_COS+ | MTR_BM+ | MTR_COS+ | ENDAT_A+ | – |
| 4 | MTR_COS– | MTR_BM– | MTR_COS– | ENDAT_A– | – |
| 5 | MTR_DATA+ | MTR_IM+ | MTR_IM+ | MTR_DATA+ | MTR_DATA+ |
| 6 | MTR_ECOM | MTR_ECOM | MTR_ECOM | MTR_ECOM | MTR_ECOM |
| 7 | MTR_EPWR9V ⁽¹⁾ | – | – | MTR_EPWR9V ⁽¹⁾ | MTR_EPWR9V ⁽¹⁾ |
| 8 | – | MTR_S3 | MTR_S3 | – | – |
| 9 | – | – | – | MTR_CLK+ | MTR_CLK+ |
| 10 | MTR_DATA– | MTR_IM– | MTR_IM– | MTR_DATA– | MTR_DATA– |
| 11 | MTR_TS | MTR_TS | MTR_TS | MTR_TS | MTR_TS |
| 12 | – | MTR_S1 | MTR_S1 | – | – |
| 13 | – | MTR_S2 | MTR_S2 | – | – |
| 14 | MTR_EPWR5V ⁽¹⁾ | MTR_EPWR5V | MTR_EPWR5V | MTR_EPWR5V ⁽¹⁾ | MTR_EPWR5V ⁽¹⁾ |
| 15 | – | – | – | MTR_CLK– | MTR_CLK– |

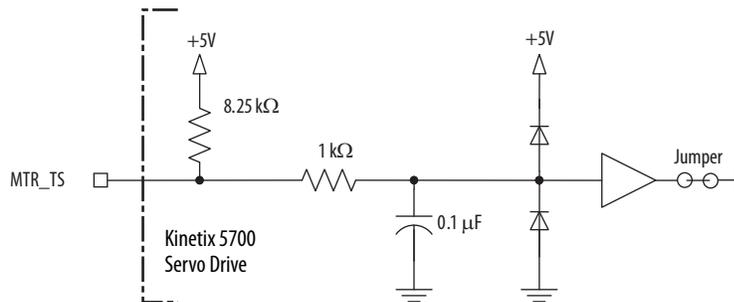
(1) Determine which power supply your encoder requires and connect to only the specified supply. Do not make connections to both supplies.



ATTENTION: To avoid damage to components, determine which power supply your encoder requires and connect to either the 5V or 9V supply, but not both.

This is the motor thermostat interface schematic. Although the thermostat signal is shown for all feedback types, some motors may not support this feature because it is not part of the feedback device.

Figure 45 - Motor Thermostat Interface



Stegmann Hiperface Feedback

Figure 46 - Stegmann Hiperface Interface, MTR_SIN and MTR_COS Signals

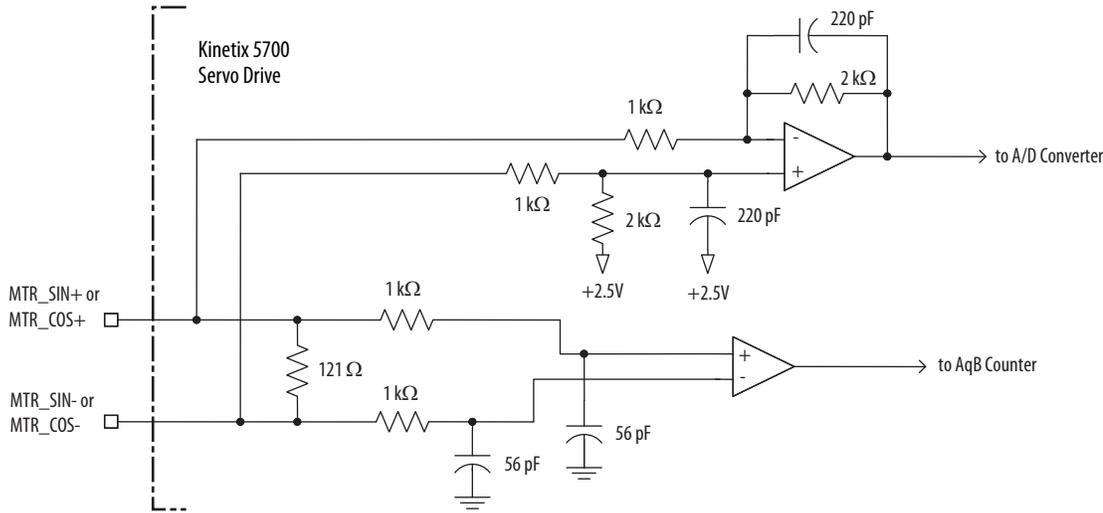
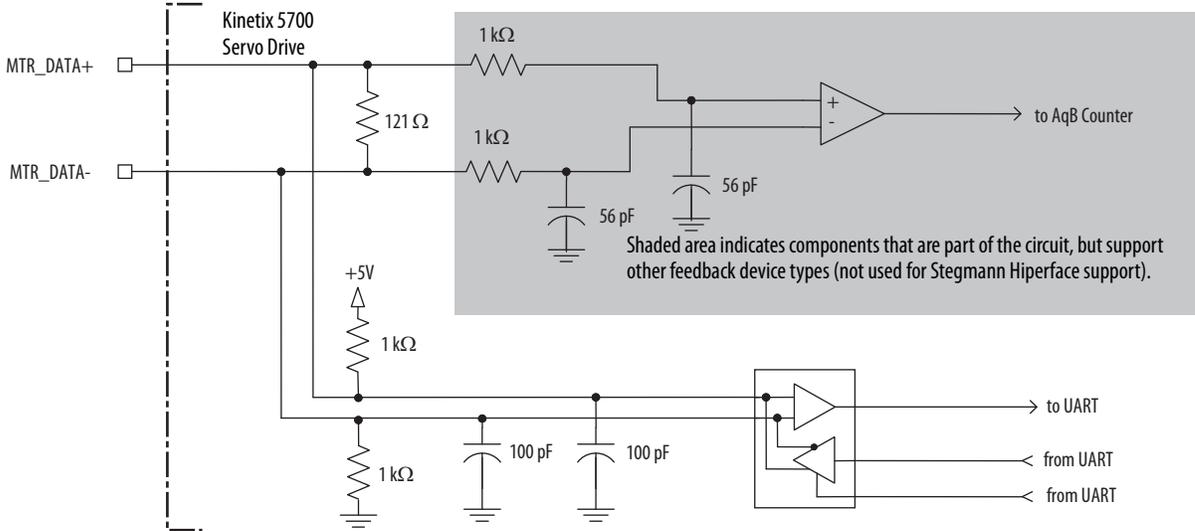


Figure 47 - Stegmann Hiperface Interface, MTR_DATA Signals



Generic TTL Feedback

Table 38 - Generic TTL Incremental Specifications

| Attribute | Value |
|---|---|
| TTL incremental encoder support | 5V, differential A quad B |
| Quadrature interpolation | 4 counts / square wave period |
| Differential input voltage (MTR_AM, MTR_BM, and MTR_IM) | 5V DC, differential line driver (DLD) output compatible |
| DC current draw (MTR_AM, MTR_BM, and MTR_IM) | 30 mA, max |
| Input signal frequency (MTR_AM, MTR_BM, and MTR_IM) | 5.0 MHz, max |
| Edge separation (MTR_AM and MTR_BM) | 42 ns min, between any two edges |
| Commutation verification | Commutation angle verification performed at the first Hall signal transition and periodically verifies thereafter |
| Hall inputs (MTR_S1, MTR_S2, and MTR_S3) | Single-ended, TTL, open collector, or none |

Figure 48 - Generic TTL Incremental, MTR_AM and MTR_BM Signals

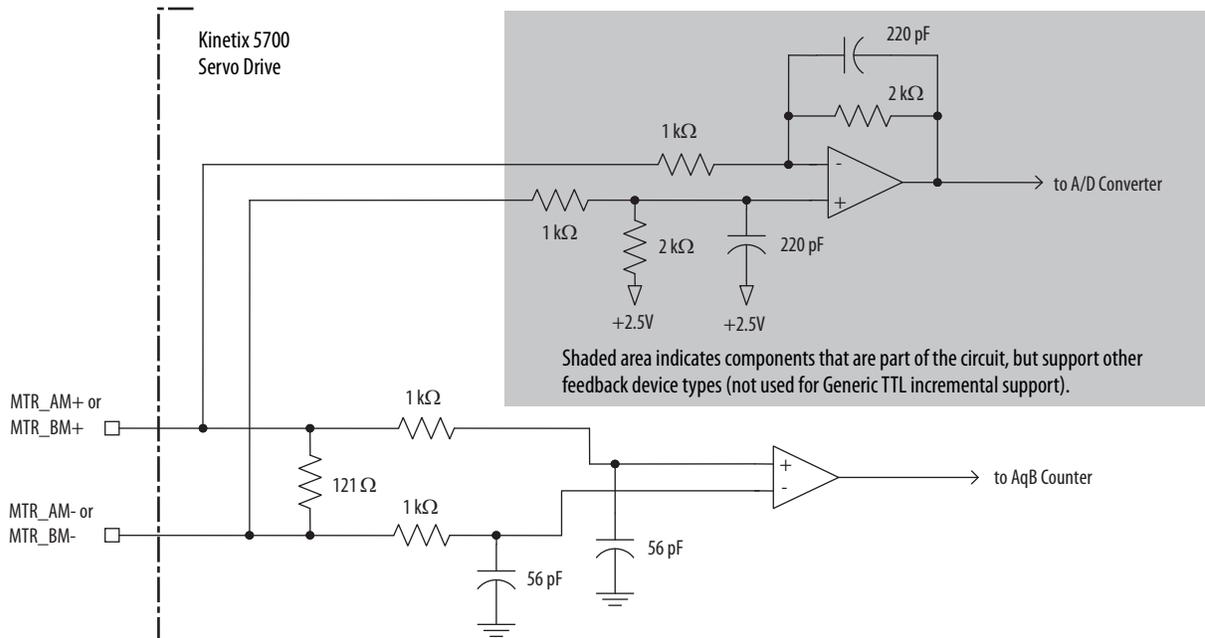


Figure 49 - Generic TTL Interface, MTR_IM Signals

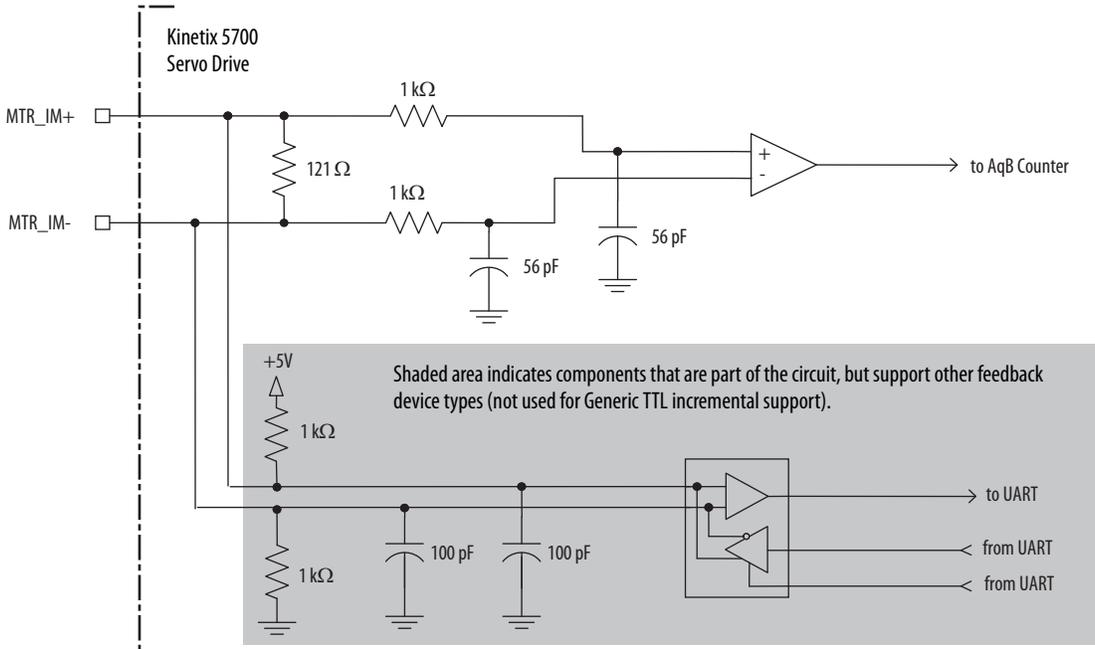
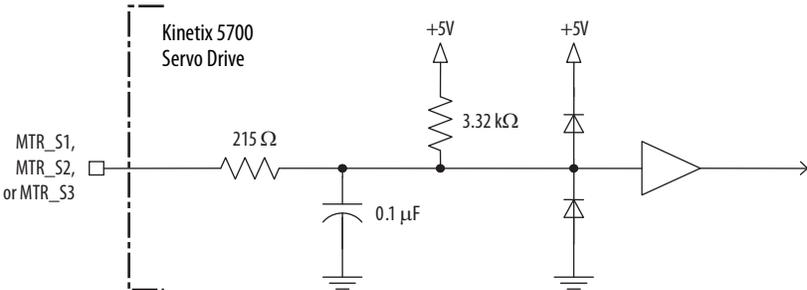


Figure 50 - Generic TTL Interface, MTR_S1, MTR_S2, or MTR_S3 Signals



Generic Sine/Cosine Feedback

Table 39 - Generic Sine/Cosine Incremental Specifications

| Attribute | Value |
|---|---|
| Sine/Cosine interpolation | 2048 counts/sine wave period |
| Input frequency (MTR_SIN and MTR_COS) | 250 kHz, max |
| Differential input voltage (MTR_SIN and MTR_COS) | 0.6...1.2V, p-p |
| Commutation verification | Commutation angle verification performed at the first Hall signal transition and periodically verifies thereafter |
| Hall inputs (MTR_S1, MTR_S2, and MTR_S3) | Single-ended, TTL, open collector, or none |

Refer to [page 82](#) for the generic sine/cosine interface schematic. It is identical to the Stegmann Hiperface (MTR_AM and MTR_BM) signal schematic.

Refer to [page 83](#) for the Hall (MTR_S1, MTR_S2, and MTR_S3) signal schematic.

Refer to [Encoder Phasing Definitions](#) on [page 88](#) for encoder phasing alignment diagrams.

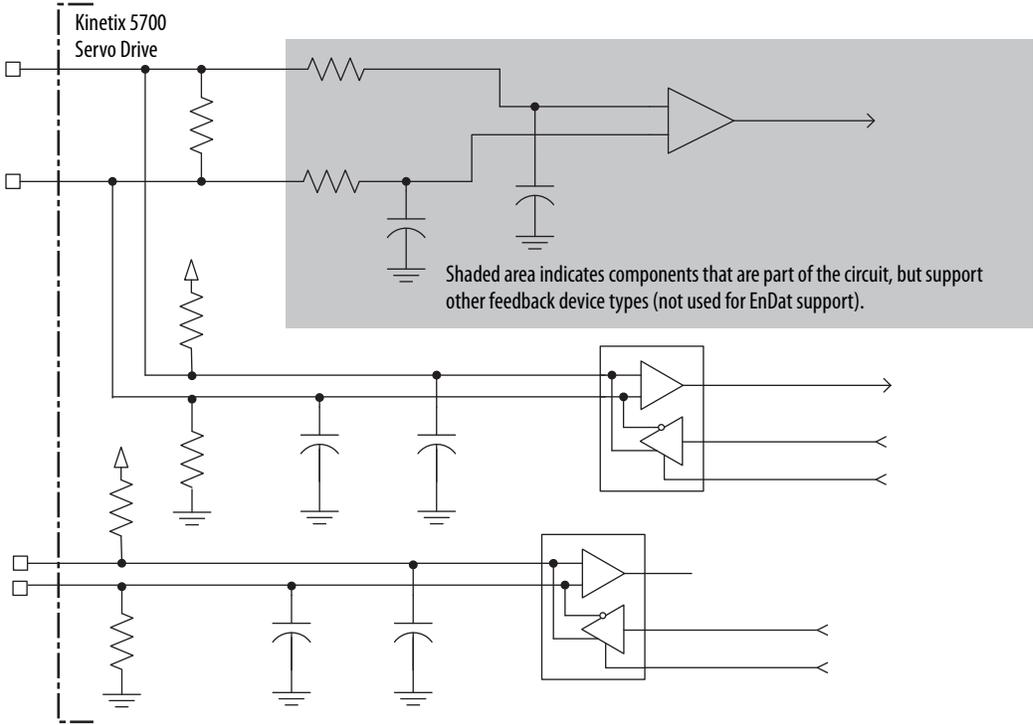
EnDat Sine/Cosine Feedback

Table 40 - EnDat Sine/Cosine Interface Specifications

| Attribute | Value |
|--|---|
| Protocol | EnDat Sine/Cosine |
| EnDat Sine/Cosine data communication | 2 Mbps, synchronous |
| Sine/Cosine interpolation | 2048 counts/sine wave period |
| Input frequency (MTR_SIN and MTR_COS) | 250 kHz, max |
| Differential input voltage (MTR_SIN and MTR_COS) | 0.6...1.2V, p-p |
| Incremental position verification | Position compare between incremental accumulator and serial data performed every 50 ms or less. |

Refer to [page 81](#) for the EnDat sine/cosine interface schematic. It is identical to the Stegmann Hiperface (MTR_SIN and MTR_COS) schematic.

Figure 51 - EnDat Sin/Cos and EnDat Digital Interface Schematic for Serial Communication



EnDat Digital Feedback

Table 41 - EnDat Digital Interface Specifications

| Attribute | Value |
|----------------------------------|---------------------|
| EnDat Digital data communication | 4 Mbps, synchronous |

Table 42 - Support Requirements for EnDat Encoders

| Requirement | EnDat Sine/Cosine | EnDat Digital |
|-------------------------|--|---|
| Supported models | LC 483 ECI 119 ⁽¹⁾ ECN 113 ECN 1313/EQN 1325 ECN 413/EQN 425 ROQ 425 | LIC 4000 ECI 119 ⁽¹⁾ ROQ 437 ECN 1123/ EQN 1135 ECN 1325 / EQN 1337 ECI 1319/EQI 1331 ECI 1118/EQI 1130 ECN 125 |
| Position initialization | Digital | |
| Position tracking | Uses sine/cosine signals | Digital |
| Data frequency | 100 kHz | 4.125 MHz |
| Sine/cosine frequency | 0...250 kHz | — |

(1) ECI119 can be procured from Heidenhain as either EnDat Sin/Cos or EnDat Digital.

IMPORTANT To properly support system EnDat feedback, the keying configuration in drive Module Properties of the Logix Designer application must be selected to use Kinetix 5700 drive firmware revision 5.0 or later.

IMPORTANT Unprogrammed Smart feedback devices (Hiperface Sin/Cos, Hiperface DSL, EnDat Sin/Cos, and EnDat Digital) are not supported. Unprogrammed as load or feedback-only feedback types are supported. Contact your local distributor or Rockwell Automation representative for support options.

Auxiliary Feedback Specifications

The Kinetix 5700 inverters support multiple types of feedback devices by using the 15-pin (UFB) connector and sharing connector pins in many cases. Refer to [Configure Feedback-only Axis Properties](#) on [page 169](#) to use these in your application.

Table 43 - Auxiliary Feedback Signals by Device Type

| UFB Pin | Stegmann Hiperface | Generic TTL Incremental | Generic Sine/Cosine Incremental | Heidenhain EnDat Sin/Cos | Heidenhain EnDat Digital |
|---------|---------------------------|-------------------------|---------------------------------|---------------------------|---------------------------|
| 1 | AUX_SIN+ | AUX_AM+ | AUX_SIN+ | ENDAT_B+ | – |
| 2 | AUX_SIN- | AUX_AM- | AUX_SIN- | ENDAT_B- | – |
| 3 | AUX_COS+ | AUX_BM+ | AUX_COS+ | ENDAT_A+ | – |
| 4 | AUX_COS- | AUX_BM- | AUX_COS- | ENDAT_A- | – |
| 5 | AUX_DATA+ | AUX_IM+ | AUX_IM+ | AUX_DATA+ | AUX_DATA+ |
| 6 | AUX_ECOM | AUX_ECOM | AUX_ECOM | AUX_ECOM | AUX_ECOM |
| 7 | AUX_EPWR9V ⁽¹⁾ | – | – | AUX_EPWR9V ⁽¹⁾ | AUX_EPWR9V ⁽¹⁾ |
| 9 | – | – | – | AUX_CLK+ | AUX_CLK+ |
| 10 | AUX_DATA- | AUX_IM- | AUX_IM- | AUX_DATA- | AUX_DATA- |
| 14 | AUX_EPWR5V ⁽¹⁾ | AUX_EPWR5V | AUX_EPWR5V | AUX_EPWR5V ⁽¹⁾ | AUX_EPWR5V ⁽¹⁾ |
| 15 | – | – | – | AUX_CLK- | AUX_CLK- |

(1) Determine which power supply your encoder requires and connect to only the specified supply. Do not make connections to both supplies.



ATTENTION: To avoid damage to components, determine which power supply your encoder requires and connect to either the 5V or 9V supply, but not both.

Specifications for the auxiliary feedback channel are identical to the motor feedback channel, except for specifications related to commutation and blob programming.

The 9.0V and 5.0V power supplies for auxiliary feedback devices are shared with the motor feedback channel, and the total current capability is outlined in the table on [page 79](#).

Allen-Bradley Bulletin 842HR, 844D, 847H, and 847T encoders are the preferred encoders for auxiliary feedback connections.

Table 44 - Allen-Bradley Auxiliary Feedback Encoders

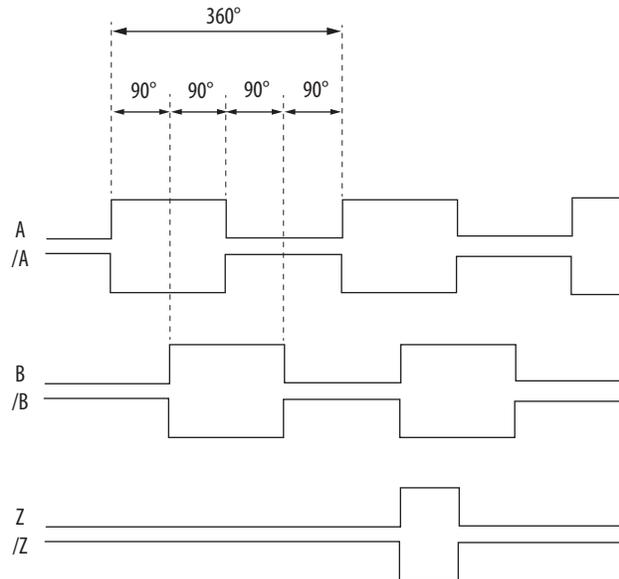
| Cat. No. | Description |
|---|---|
| 842HR-MJZ115FWYD (multi-turn) 842HR-SJZ115FWYD (single-turn) | Size 25, sine/cosine (serial), square flange, 3/8 in. solid shaft with flat, 5...12V DC, digital RS-485 interface, M23, 17-pin connector |
| 844D-B5CC1FW 844D-B5CC1CS 844D-B5CC1DR | HS35, hollow-shaft incremental encoders, rear (through-shaft), 5/8 inch, tether, 3/8 in. bolt on a 2.5...4.0 in. diameter, 10-pin connector, 5V DC in, 5V DC DLD out |
| 847H-DN1A-RH01024 847H-DN1A-RH02048 847H-DN1A-RH05000 | Size 25, incremental encoder, standard square flange, 3/8 inch diameter shaft with flat, 4.5...5.5V line driver, TTL (B-Leads-A, CW, Z gated with BN), MS connector, 10-pin |
| 847T-DN1A-RH01024 847T-DN1A-RH02048 | Size 20, incremental encoder, standard square flange, 3/8 inch diameter shaft with flat, 4.5...5.5V line driver, TTL (B-Leads-A, CW, Z gated with BN), MS connector, 10-pin |

Refer to the Kinetix Motion Accessories Technical Data, publication [KNX-TD004](#), for more information on these Allen-Bradley encoders.

Encoder Phasing Definitions

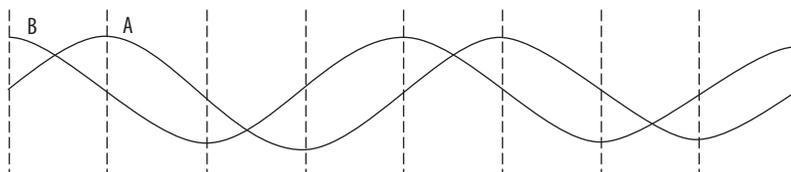
For TTL encoders, the drive position increases when A leads B. Clockwise motor rotation is assumed, when looking at the shaft.

Figure 52 - TTL Encoder Phasing



For Sin/Cos encoders (Stegmann Hiperface and Heidenhain EnDat), the drive position increases when Cosine (B) leads Sine (A). Clockwise motor rotation is assumed, when looking at the shaft.

Figure 53 - Sine/Cosine Encoder Phasing



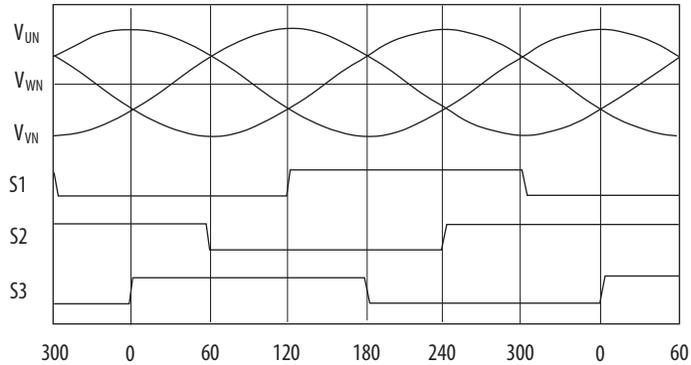
IMPORTANT The Sine/Cosine encoder signal phasing is different than the TTL encoder signal phasing.

IMPORTANT When using a Sine/Cosine feedback device, the drive cannot synthesize a marker signal, so a physical marker signal is required for the home-to-marker sequence (and the marker hookup test) to complete.

When using absolute feedback devices (for example, Stegmann Hiperface) the drive synthesizes a marker signal because these devices don't have a marker signal required for the home-to-marker sequence (and the marker hookup test) to complete.

The drive UFB feedback connector uses Hall signals to initialize the commutation angle for permanent magnet motor commutation.

Figure 54 - Hall Encoder Phasing



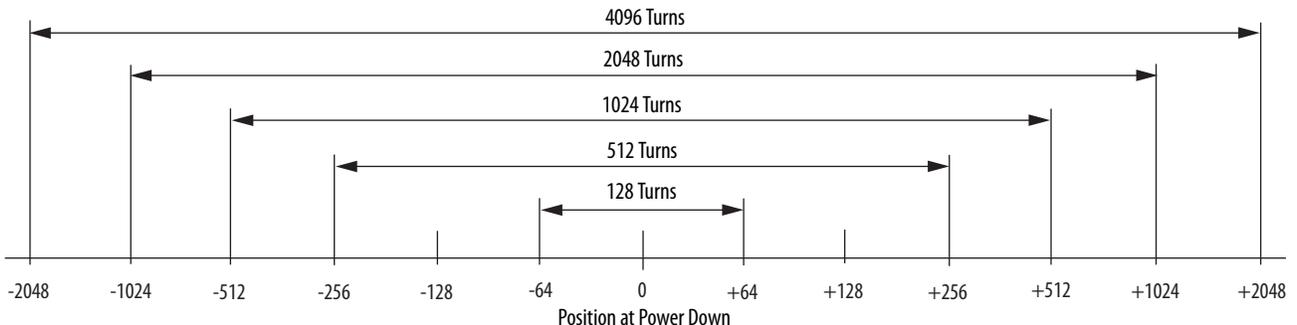
Absolute Position Feature

The 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 multi-turn encoders.

Table 45 - Absolute Position Retention Limits

| Encoder Type | Cat. No. Designator | Motor/Actuator Cat. No. | Retention Limits | |
|-------------------------------------|---------------------|--|------------------|-----------------|
| | | | Turns (rotary) | mm (in.) linear |
| Stegmann Hiperface (DSL) | -P | VPL-Bxxxxx-P, VPF-Bxxxxx-P, VPS-Bxxxxx-P | 4096 (±2048) | N/A |
| | -W | VPL-Bxxxxx-W, VPF-Bxxxxx-W | 4096 (±2048) | N/A |
| | -Q | VPL-Bxxxxx-Q, VPF-Bxxxxx-Q, VPC-Bxxxxx-Q | 512 (±256) | N/A |
| Stegmann Hiperface | -M | MPL-Bxxxxx-M, MPM-Bxxxxx-M, MPF-Bxxxxx-M, MPS-Bxxxxx-M, MPAR-B3xxxx-M, MPAL-BxxxxxM | 2048 (±1024) | N/A |
| | -V | MPL-Bxxxxx-V, MPAS-Bxxxxx1-V05, MPAS-Bxxxxx2-V20, MPAR-B1xxxx-V, MPAR-B2xxxx-V, MPAL-BxxxxxV | 4096 (±2048) | N/A |
| Stegmann Hiperface (magnetic scale) | -xDx | LDAT-Sxxxxxx-xDx | N/A | 960 (37.8) |
| Heidenhain EnDat | -7 | RDB-Bxxxxxx-7 | 1024 (±512) | N/A |
| | -Y | VPC-Bxxxxx-Y | 128 (±64) | N/A |

Figure 55 - Absolute Position Limits (measured in turns)



Functional Safety Features

Kinetix 5700 drives have the capability to safely turn off the inverter power transistors in response to a monitored digital input, in accordance with Stop Category 0 behavior. Hardwired and integrated safety options are available on all Kinetix 5700 servo drives.

Hardwired STO Mode

Hardwired safe torque-off (STO) mode supports parallel input terminals for cascading to adjacent drives over duplex wiring. For applications that do not require the safety function you must install jumper wires to bypass the safe torque-off feature. This applies to 2198-xxxx-ERS3 and 2198-xxxx-ERS4 inverters.

Refer to [Hardwired Safe Torque-off](#) on [page 252](#) for the STO connector pinout, installation, and wiring information.

Integrated Mode

For 2198-xxxx-ERS3 inverters in integrated STO mode, when any GuardLogix® or Compact GuardLogix safety controller issues the safe torque-off (STO) command over the EtherNet/IP™ network and the Kinetix 5700 drives execute the STO commands.

Refer to [Integrated Safe Torque-off](#) on [page 261](#) for integrated safety drive specifications, configuring motion and safety connections, direct motion commands, and the STO bypass feature.

For 2189-xxxx-ERS4 inverters in integrated mode, the GuardLogix 5580 or Compact GuardLogix 5380 safety controller activates the Monitored SS1 stopping function or any of the Drive Safety instructions providing controller-based safety functions over the EtherNet/IP network.

For 2189-xxxx-ERS4 and 2189-xxxx-ERS3 (series B) drives, Timed SS1 and STO are drive-based safety functions that are activated by the GuardLogix 5580 or Compact GuardLogix 5380 controller over the EtherNet/IP network.

Refer to the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication [2198-RM001](#), for a description and configuration examples of the integrated stopping functions in the Studio 5000 Logix Designer® application.

Connect the Kinetix 5700 Drive System

This chapter provides procedures for wiring your Kinetix® 5700 system components and making cable connections.

| Topic | Page |
|---|-------------|
| Basic Wiring Requirements | 92 |
| Determine the Input Power Configuration | 93 |
| Ground Screw/Jumper Settings | 96 |
| Grounding the Drive System | 98 |
| Wiring Requirements | 101 |
| Wiring Guidelines | 104 |
| Wiring the Power Connectors | 104 |
| Wiring the Digital Input Connectors | 108 |
| Wiring Single Cables | 111 |
| Wiring Power/Brake and Feedback Cables | 117 |
| Capacitor Module Connections | 131 |
| External Passive-shunt Connections | 133 |
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| Ethernet Cable Connections | 136 |

Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 5700 DC-bus power supplies, servo drives, the iTRAK® power supply, and accessories.



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 metal debris from falling into it. Metal debris or other foreign matter can become lodged in the circuitry and result in damage to components.



SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2198 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.

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 devices can be induced into I/O communication, or other sensitive low voltage signals. This can cause system faults and communication anomalies.

The Bulletin 2090 single motor cable contains the power, brake, and feedback wires, but is properly shielded to protect the noise-sensitive feedback signals.

Refer to [Electrical Noise Reduction](#) on [page 40](#) for examples of routing high and low voltage cables in wireways. Refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#), for more information.

Determine the Input Power Configuration

Before wiring input power to your DC-bus power supply, you must determine the type of input power within your facility. The drive modules are designed to operate in both grounded and ungrounded environments.

IMPORTANT For IEC 61800-3 category C3 compliance, use the appropriate 2198-DBxx-F line filter with a grounded WYE configuration only. The use of the line filter in an ungrounded, corner-grounded, or impedance-grounded configuration can affect the line filter components and can result in equipment damage.

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.

Figure 56 - Grounded Power Configuration (WYE Secondary)

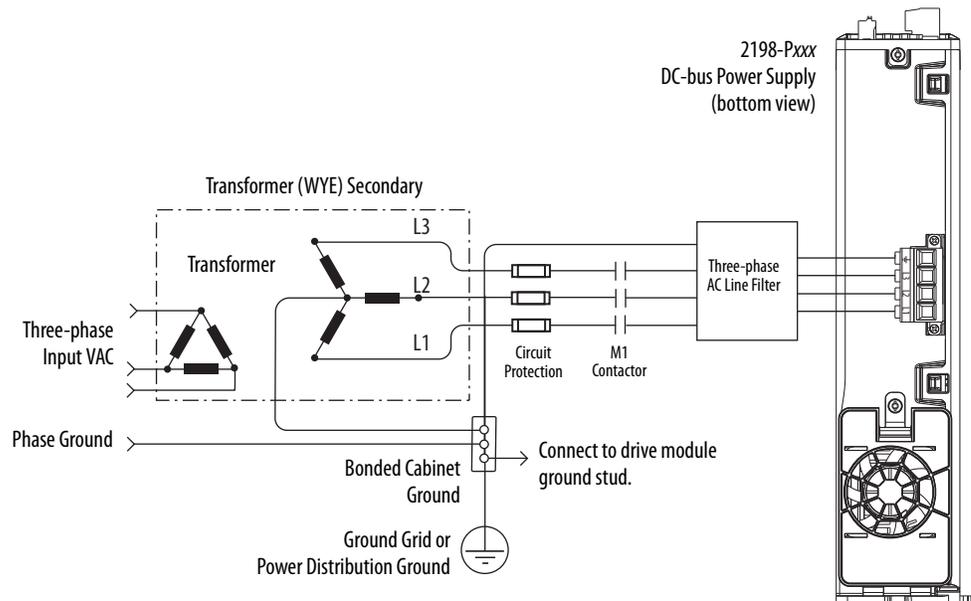


Figure 57 - Impedance-grounded Power Configuration (WYE Secondary)

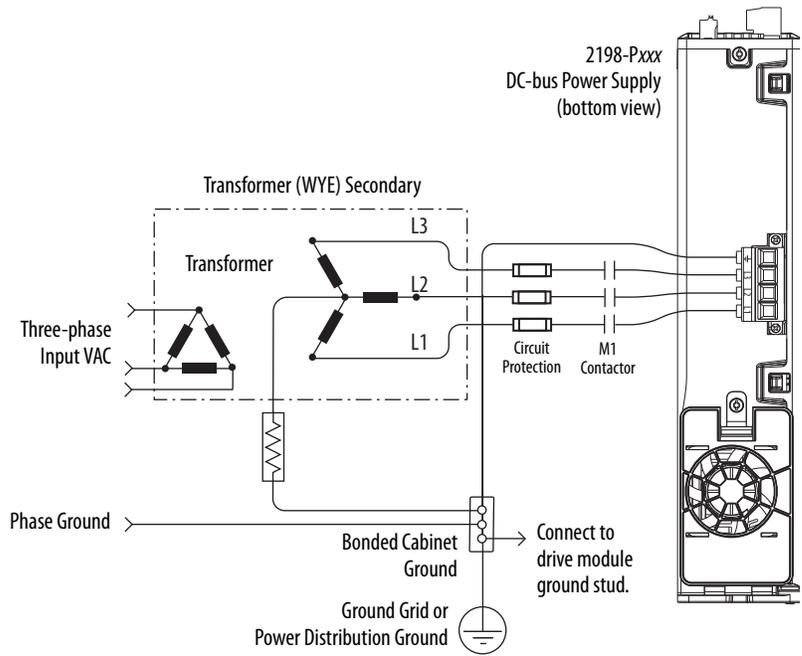
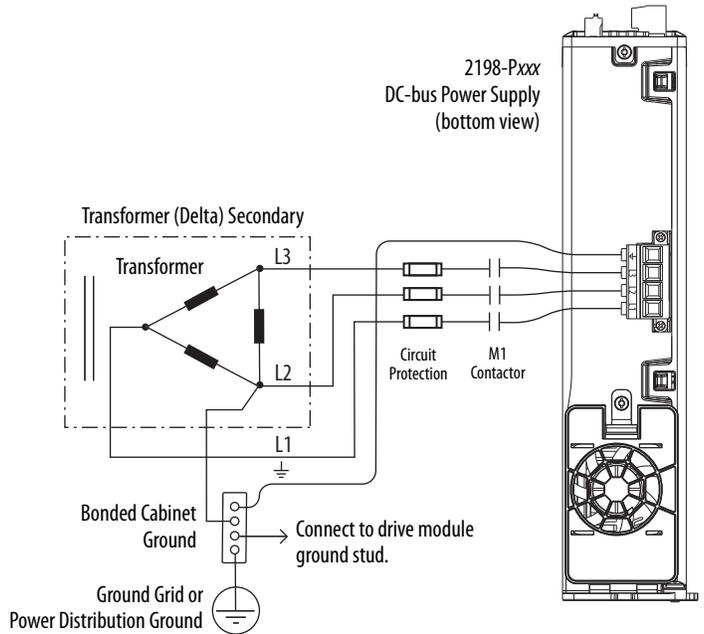


Figure 58 - Corner-grounded Power Configuration (Delta Secondary)



Refer to [Power Wiring Examples](#) beginning on [page 281](#) for input power interconnect diagrams.

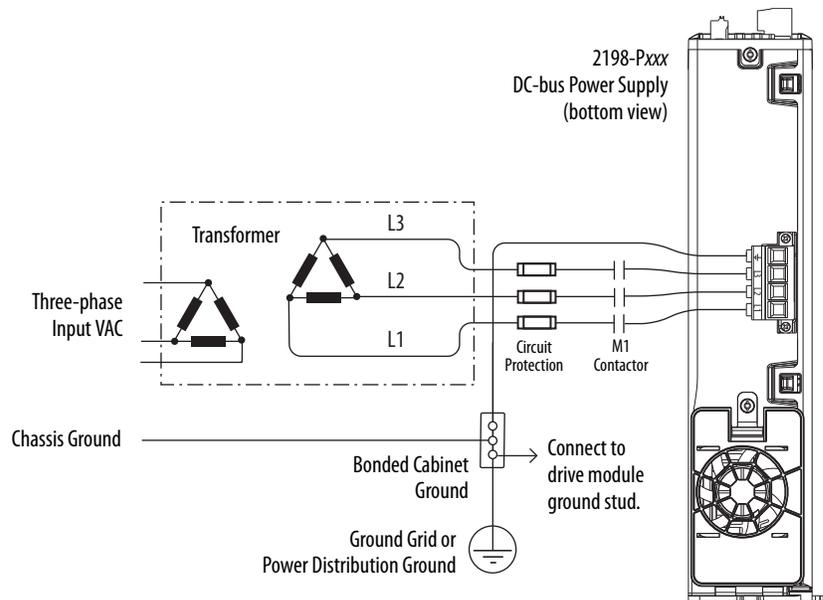
Ungrounded Power Configurations

The ungrounded power configuration ([Figure 59](#)), corner-grounded ([Figure 58](#)), and impedance-grounded ([Figure 57](#)) power configurations do not provide a neutral ground point.

IMPORTANT If you determine that you have ungrounded, corner-grounded, or impedance-grounded power distribution in your facility, you must remove the ground screw in each of your DC-bus power supplies, iTRAK power supplies, and dual-axis inverters, and the ground jumper in each of your single-axis inverters.

Refer to [Ground Screw/Jumper Settings](#) on [page 96](#) for more information.

Figure 59 - 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 [Power Wiring Examples](#) beginning on [page 281](#) for input power interconnect diagrams.

Ground Screw/Jumper Settings

The 2198-Pxxx DC-bus power supply and 2198T-W25K-ER iTRAK power supply have a factory-installed ground screw for grounded power distribution.

IMPORTANT If you determine that you have grounded power distribution in your facility, do not remove the ground screw from the DC-bus power supply or iTRAK power supply. Remove the ground screw when using ungrounded, corner-grounded, or impedance-grounded power, the Bulletin 8720MC regenerative power supply, or any active converter.



ATTENTION: The DC-bus power supply that supplies DC-bus voltage to the iTRAK power supply must have a grounded-wye power configuration.

The 2198-Dxxx-ERS3 (series A) dual-axis inverters also have a factory-installed ground screw for grounded power distribution.

The 2198-Sxxx-ERS3 (series A) single-axis inverters have a factory-installed ground jumper for grounded power distribution.

IMPORTANT If you determine that you have grounded power distribution in your facility, do not remove the ground screw/jumper from the 2198-xxx-ERS3 (series A) inverters. Remove the ground screw/jumper when using ungrounded, corner-grounded, or impedance-grounded power, the Bulletin 8720MC regenerative power supply, or any active converter.

Included with the 2198-Dxxx-ERS4 and 2198-Dxxx-ERS3 (series B) dual-axis inverter connector set is a ground screw. Install the ground screw for grounded (wye) power configurations.

Included with the 2198-Sxxx-ERS4 and 2198-Sxxx-ERS3 (series B) single-axis inverter connector set is a ground jumper. Install the ground jumper for grounded (wye) power configurations.

IMPORTANT If you have grounded-wye power distribution and a 2198-Pxxx DC-bus power supply, install the ground screw/jumper in 2198-xxx-ERS4 and 2198-xxx-ERS3 (series B) inverters. EMC performance can be affected if the ground screw/jumper is not installed. However, do not install the ground screw/jumper when using ungrounded, corner-grounded, or impedance-grounded power, the Bulletin 8720MC regenerative power supply, or any active converter.

Remove/Install the Ground Screw/Jumper

We recommend that you remove or install the ground screw/jumper when the drive module is removed from the panel and placed on its side on a solid work surface.

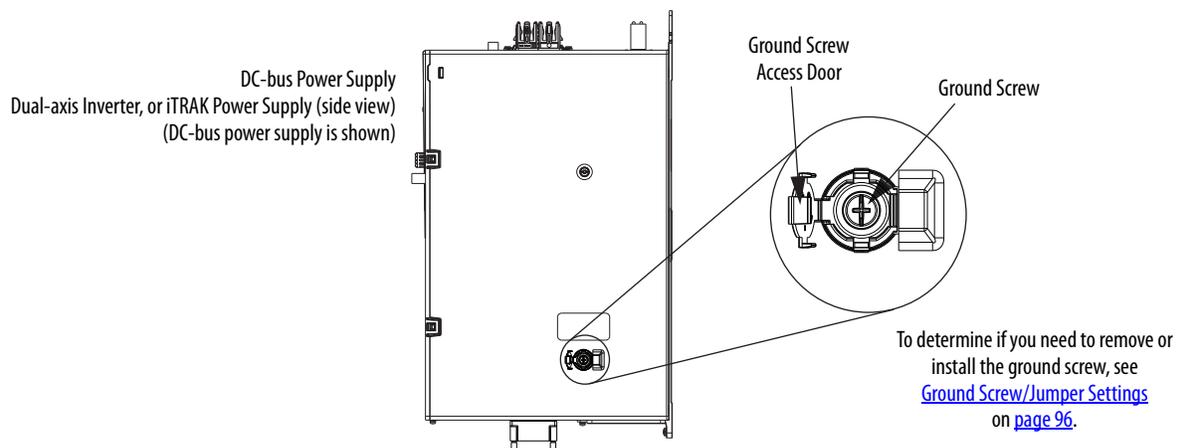
IMPORTANT To determine if you need to remove or install the ground screw/jumper, see [Ground Screw/Jumper Settings](#) on [page 96](#).



ATTENTION: When the ground screw/jumper is not installed the unit no longer maintains line-to-neutral voltage protection, and the risk of equipment damage exists.

To access or install the ground screw on DC-bus power supplies, dual-axis inverters, and the iTRAK power supply, open the small plastic door on the right side of the module.

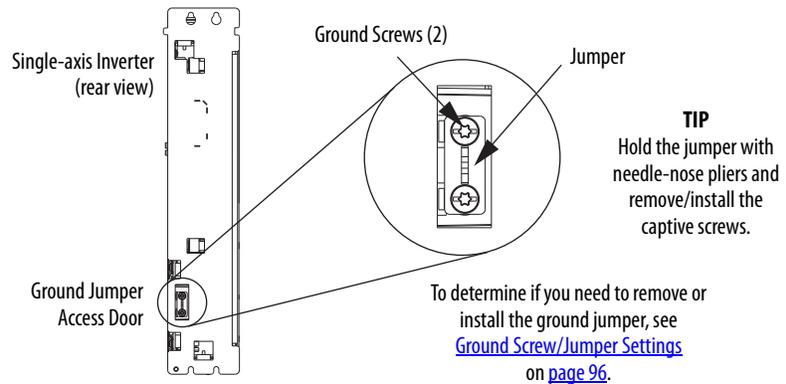
Figure 60 - Remove/Install the Ground Screw



ATTENTION: To avoid personal injury, the ground screw/jumper access door must be kept closed when power is applied. If power was present and then removed, wait at least 5 minutes for the DC-bus voltage to dissipate and verify that no DC-bus voltage exists before accessing the ground screw/jumper. This applies to the DC-bus power supply, dual-axis inverters, and single-axis inverters.

Single-axis inverters have a ground jumper access door on the back of the unit. Two captive screws secure the jumper.

Figure 61 - Remove the Single-axis Inverter Grounding Jumper



ATTENTION: Risk of equipment damage exists. The module ground configuration must be accurately determined. See [Ground Screw/Jumper Settings](#) on page 96.

Table 46 - Grounding Screw/Jumper Configurations

| Ground Configuration | Example Diagram | Grounding Screw/Jumper Configuration | Benefits of Correct Configuration |
|--|--|--------------------------------------|--|
| Grounded (wye) | Figure 56 on page 93 | Installed ⁽¹⁾ | <ul style="list-style-type: none"> Meets IEC 61800-3 category C3 compliance Reduced electrical noise Most stable operation Reduced voltage stress on components and motor bearings |
| <ul style="list-style-type: none"> AC-fed ungrounded Corner grounded Impedance grounded | Figure 59 on page 95 Figure 58 on page 94 Figure 57 on page 94 | Removed ⁽²⁾ | <ul style="list-style-type: none"> Meets IEC 61800-3 category C4 compliance Helps avoid severe equipment damage when ground faults occurs Reduced leakage current |
| DC-bus from active converter | Figure 136 on page 287 | | |

(1) Default setting for DC-bus and iTRAK power supplies and 2198-xxxx-ERS3 (series A) inverters.

(2) Default setting for 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) inverters.

Grounding the Drive System

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

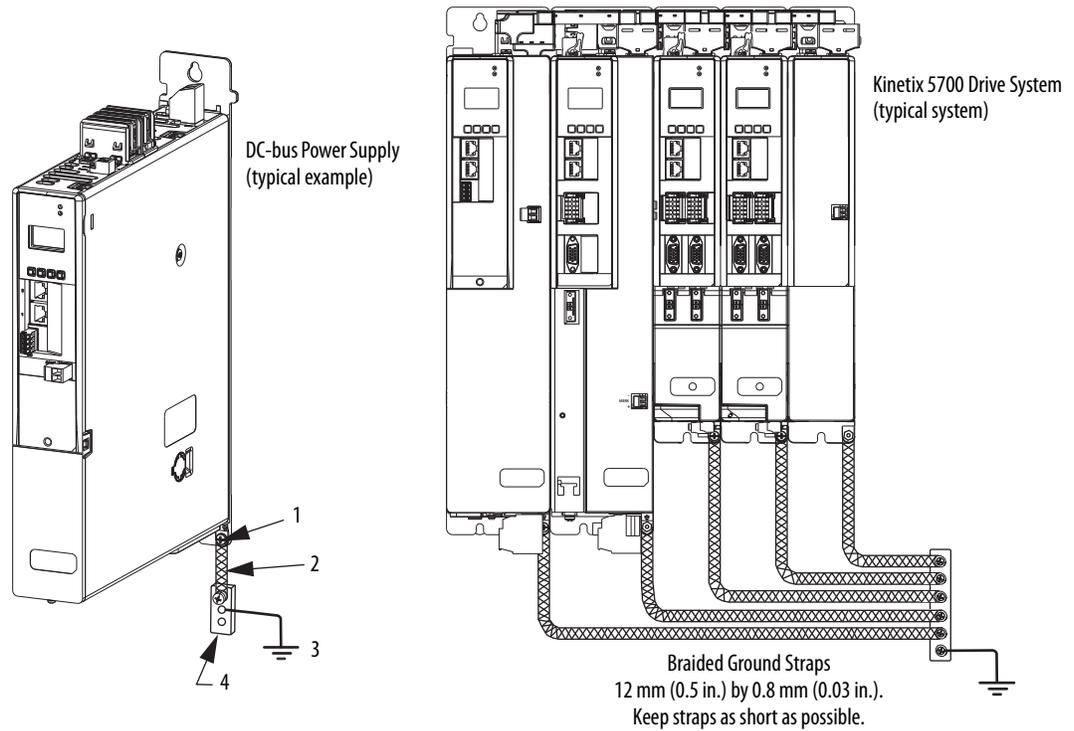


ATTENTION: The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system. For CE grounding requirements, refer to [Agency Compliance](#) on page 32.

Ground the System Subpanel

Ground Kinetix 5700 power supplies, inverters, and capacitor modules to a bonded cabinet ground bus with a braided ground strap. Keep the braided ground strap as short as possible for optimum bonding.

Figure 62 - Connect the Ground Terminal



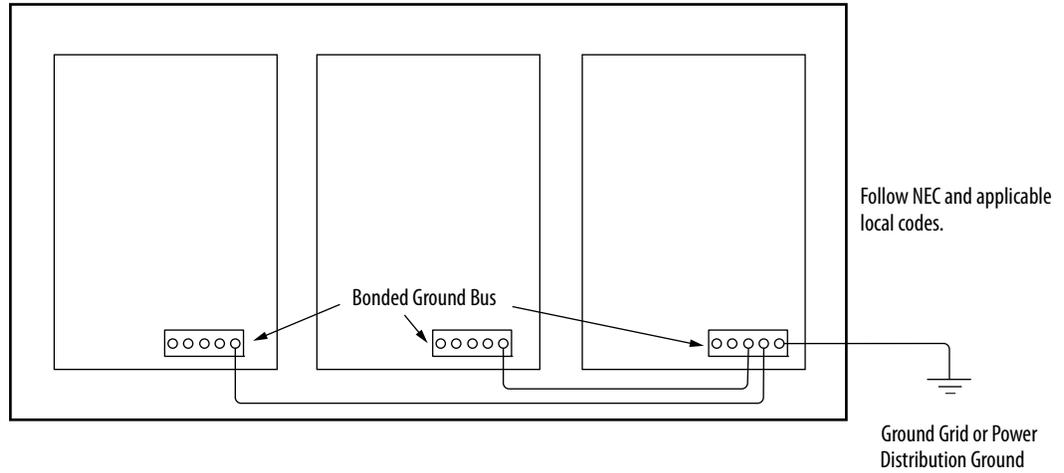
| Item | Description |
|------|--|
| 1 | Ground screw (green) 2.0 N•m (17.7 lb•in), max |
| 2 | Braided ground strap (customer supplied) |
| 3 | Ground grid or power distribution ground |
| 4 | Bonded cabinet ground bus (customer supplied) |

Refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#), for more information.

Ground Multiple Subpanels

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

Figure 63 - 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 42](#).

Wiring Requirements

Wires 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.

Refer to [Power Wiring Examples](#) on [page 281](#) for interconnect diagrams.

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

Table 47 - DC-bus Power Supply Wiring Requirements

| DC-bus Power Supply Cat. No. | Description | Connects to Terminals | | Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|------------------------------|--|---|---|------------------------------------|--------------------------|-----------------------------|
| | | Pin | Signal | | | |
| 2198-P031 2198-P070 | Mains input power |  |  | 6...10 (10...8) | 10.0 (0.39) | 0.5...0.8 (4.4...7.1) |
| 2198-P141 2198-P208 | | L2 L1 | L2 L1 | 10...35 (8...2) | 20.0 (0.79) | 2.5...4.5 (22...40) |
| 2198-Pxxx | PELV/SELV 24V power (connector plug) | CP-1 CP-2 | 24V+ 24V- | 0.5...2.5 (20...14) | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) |
| | DC Bus power | Bus bar | DC- DC+ | N/A ⁽¹⁾ | N/A ⁽¹⁾ | N/A ⁽¹⁾ |
| | Contactor enable | EN- EN+ | CONT EN- CONT EN+ | 0.14...2.5 (26...12) | 7.0 (0.28) | 0.4...0.5 (3.5...4.4) |
| | Shunt resistor | RC-1 RC-2 | SH DC+ | 1.5...6 (16...10) | 12.0 (0.47) | 0.5...0.6 (4.5...5.3) |
| | Digital inputs | IOD-1 IOD-2 IOD-3 IOD-4 | IN1 COM IN2 SHLD | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽²⁾ |

(1) Shared DC-bus power connections are always made from one drive module to another over the bus-bar connection system. These terminals do not receive discrete wires.

(2) This connector uses spring tension to hold wires in place.

Table 48 - iTRAK Power Supply Wiring Requirements

| iTRAK Power Supply Cat. No. | Description | Connects to Terminals | | Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|-----------------------------|--|-----------------------|--------------|---|----------------------------|---|
| | | Pin | Signal | | | |
| 2198T-W25K-ER | DC-bus input power | Bus bar | DC- DC+ | N/A ⁽¹⁾ | N/A ⁽¹⁾ | N/A ⁽¹⁾ |
| | SELV/PELV rated 24V power (connector plug) | CP-1 CP-2 | 24V+ 24V- | 1.5...4 ⁽²⁾ (16...12) 6 ⁽²⁾ (10) | 10.0 (0.39) 10.0 (0.39) | 0.5...0.6 (4.4...5.3) 0.7...0.8 ⁽³⁾ (6.1...7.0) |

(1) Shared DC-bus power connections are always made from power supply to power supply over the bus-bar connection system. These terminals do not receive discrete wires.

(2) Use sufficient wire size to support the complete control power load, including the Kinetix 5700 drive modules and pass-through current for the attached motor modules.

(3) Depending on 24V current demand, 6 mm² (10 AWG) wire can be required. When 6 mm² (10 AWG) wire is used, these torque specifications apply.

TIP For iTRAK power supply wiring requirements not shown here, see the iTRAK System User Manual, publication [2198T-UM001](#).

Table 49 - Single-axis Inverter Wiring Requirements

| Single-axis Inverter Cat. No. | Description | Connects to Terminals | | Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) | |
|----------------------------------|--|---|---|--|--------------------------|-----------------------------|--------------------|
| | | Pin | Signal | | | | |
| 2198-S086-ERSx 2198-S130-ERSx | Motor power | U V W ⏚ | U V W ⏚ | Motor power cable depends on motor/ drive combination. 6...25 ⁽¹⁾ (10...4) | 20.0 (0.79) | 2.5...4.5 (22...40) | |
| 2198-S160-ERSx | | | | 10...35 ⁽¹⁾ (8...2) | | | |
| 2198-Sxxx-ERSx | PELV/SELV 24V power (connector plug) | CP-1 CP-2 | 24V+ 24V- | 0.5...2.5 (20...14) | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) | |
| | Brake power | BC-1 BC-2 | MBRK+ MBRK- | N/A ⁽²⁾ | | | |
| | DC Bus power | Bus bar | DC- DC+ | N/A ⁽³⁾ | N/A ⁽³⁾ | N/A ⁽³⁾ | |
| | Safety | STO-1 STO-2 STO-3 STO-4 STO-5 STO-6 STO-7 STO-8 | STO-9 STO-10 STO-11 STO-12 STO-13 STO-14 STO-15 STO-16 | SB+/NC S1A SCA S2A SB- NC NC NC | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽⁴⁾ |
| | Digital inputs | IOD-1 IOD-2 IOD-3 IOD-4 IOD-5 IOD-6 IOD-7 IOD-8 IOD-9 IOD-10 | IN1 COM IN2 COM SHLD IN3 COM IN4 COM SHLD | | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽⁴⁾ |

- (1) Building your own cables or using third-party cables for Kinetix VP (Bulletin VPL, VPF, VPS, and VPC-Bxxxx-Q) motors is not an option. Use 2090-CSxM1DE single motor cables. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-TD004](#), for cable specifications.
- (2) Motor brake wires are included in the Bulletin 2090 motor cable.
- (3) Shared DC-bus power connections are always made from one drive module to another over the bus-bar connection system. These terminals do not receive discrete wires.
- (4) This connector uses spring tension to hold wires in place.

Table 50 - Dual-axis Inverter Wiring Requirements

| Dual-axis Inverter Cat. No. | Description | Connects to Terminals | | Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) | |
|--|--------------------------------------|---|---|---|-------------------------|----------------------------|--------------------|
| | | Pin | Signal | | | | |
| 2198-D006-ERSx 2198-D012-ERSx 2198-D020-ERSx 2198-D032-ERSx | Motor power (axis A and B) | U V W ⏏ | U V W ⏏ | Motor power cable depends on motor/drive combination. 0.75...2.5 ⁽¹⁾ (18...14) | 10.0 (0.39) | 0.5...0.6 (4.4...5.3) | |
| 2198-D057-ERSx | | | | 2.5...6 ⁽¹⁾ (14...10) | | | |
| 2198-Dxxx-ERSx | PELV/SELV 24V power (connector plug) | CP-1 CP-2 | 24V+ 24V- | 0.5...2.5 (20...14) | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) | |
| | Brake power (axis A and B) | BC-1 BC-2 | MBRK+ MBRK- | N/A ⁽²⁾ | | | |
| | DC Bus power | Bus bar | DC- DC+ | N/A ⁽³⁾ | N/A ⁽³⁾ | N/A ⁽³⁾ | |
| | Safety | STO-1 STO-2 STO-3 STO-4 STO-5 STO-6 STO-7 STO-8 | STO-9 STO-10 STO-11 STO-12 STO-13 STO-14 STO-15 STO-16 | SB+ /NC S1A SCA S2A SB- S1B SCB S2B | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽⁴⁾ |
| | Digital inputs | IOD-1 IOD-2 IOD-3 IOD-4 IOD-5 IOD-6 IOD-7 IOD-8 IOD-9 IOD-10 | IN1 COM IN2 COM SHLD IN3 COM IN4 COM SHLD | | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽⁴⁾ |

- (1) Building your own cables or using third-party cables for Kinetix VP (Bulletin VPL, VPE, VPS, and VPC-Bxxxx-Q) motors is not an option. Use 2090-CSxM1DE single motor cables. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-TD004](#), for cable specifications.
- (2) Motor brake wires are included in the Bulletin 2090 motor cable.
- (3) Shared DC-bus power connections are always made from one drive module to another over the bus-bar connection system. These terminals do not receive discrete wires.
- (4) This connector uses spring tension to hold wires in place.



ATTENTION: To avoid personal injury and/or equipment damage, observe the following:

- 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.
- Use motor power connectors for connection purposes only. Do not use them to turn the motor on and off.
- Ground shielded power cables to prevent potentially high voltages on the shield.

Wiring Guidelines

Use these guidelines as a reference when wiring the power connectors on your Kinetix 5700 drive modules.

IMPORTANT For connector locations of the Kinetix 5700 drive modules, refer to [Kinetix 5700 Connector Data](#) on [page 64](#).
When removing insulation from wires and tightening screws to secure the wires, refer to the table on [page 101](#) for strip lengths and torque values.

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Establishing Noise Zones](#) on [page 43](#).

Follow these steps when wiring the connectors for your Kinetix 5700 drive modules.

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

Some cables come prepared with wires appropriately stripped.

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

2. Route the cable/wires to your Kinetix 5700 drive module connector.
3. Insert wires into connector plugs.

Refer to the connector pinout tables in [Chapter 4](#) or the interconnect diagrams in [Appendix A](#).

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 drive module connector.

Wiring the Power Connectors

This section provides examples and guidelines to assist you in making connections to the input power connectors.

Refer to [Power Wiring Examples](#) on [page 281](#) for an interconnect diagram.

Wire the 24V Control Power Input Connector

The 24V power (CP) connector requires 24V DC input for the control circuitry. The connector plug ships with the drive module and shared-bus connector kits are purchased separately.

Figure 64 - CP Connector Wiring - Connector Plug

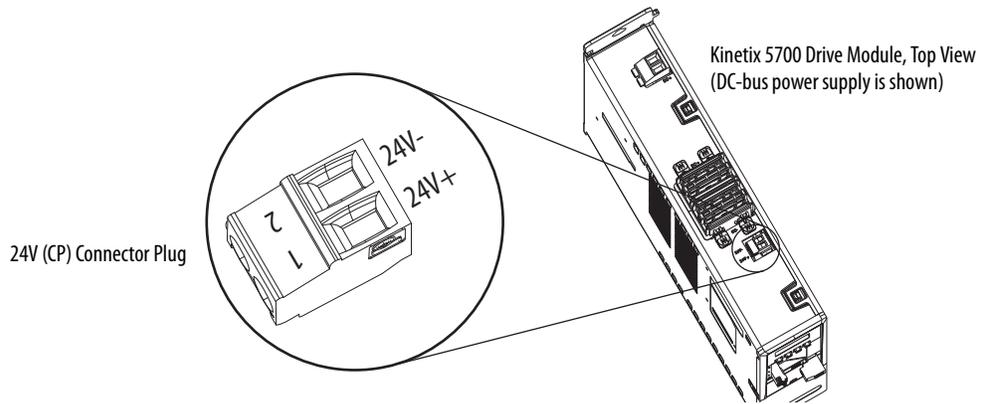


Table 51 - CP Connector Plug Wiring Specifications

| Drive Module Cat. No. | CP Pin | Signal | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|---|--------|--------|---|-----------------------|---|
| 2198-Pxxx 2198-Dxxx-ERSx 2198-Sxxx-ERSx 2198-CAPMOD-2240 | CP-1 | 24V+ | 0.5...2.5 (20...14) | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) |
| | CP-2 | 24V- | | | |
| 2198T-W25K-ER | CP-1 | 24V+ | 1.5...4 ⁽¹⁾ (16...12) | 10.0 (0.39) | 0.5...0.6 (4.4...5.3) |
| | CP-2 | 24V- | 6 ⁽¹⁾ (10) | 10.0 (0.39) | 0.7...0.8 ⁽²⁾ (6.1...7.0) |

- (1) Use sufficient wire size to support the complete control power load, including the Kinetix 5700 drive modules and pass-through current for the attached motor modules.
- (2) Depending on 24V current demand, 6 mm² (10 AWG) wire can be required. When 6 mm² (10 AWG) wire is used, these torque specifications apply.

Figure 65 - CP Connector Wiring - Shared Bus

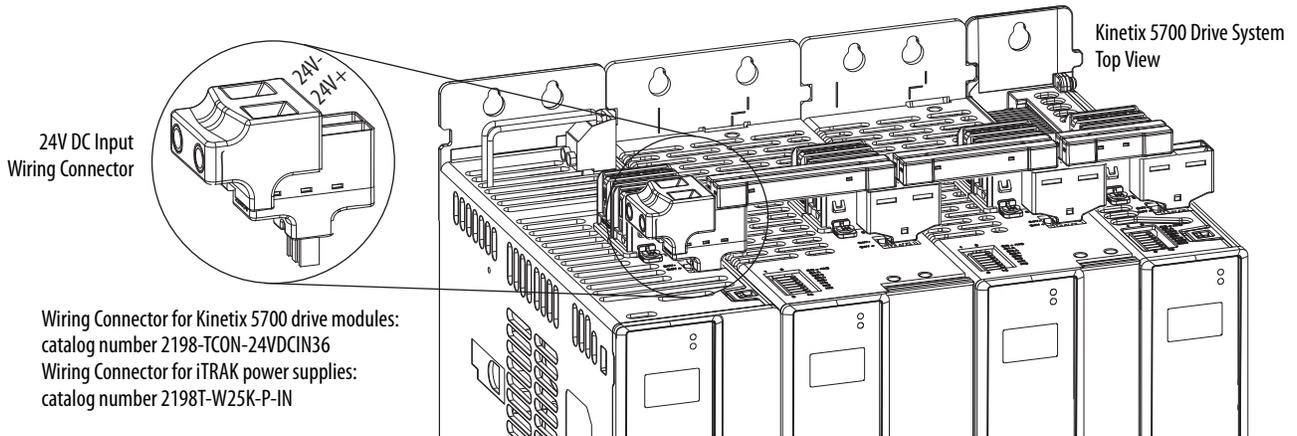


Table 52 - CP Shared-bus Wiring Specifications

| Drive Module Cat. No. | CP Pin | Signal | Input Current, max A rms | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|---|--------|--------|--------------------------|---|-----------------------|----------------------------|
| 2198-Pxxx 2198-Dxxx-ERSx 2198-Sxxx-ERSx 2198-CAPMOD-2240 2198T-W25K-ER ⁽¹⁾ | CP-1 | 24V+ | 52 | 10 (6) | 11.0 (0.43) | 1.7...1.8 (15.0...15.9) |
| | CP-2 | 24V- | | | | |

- (1) The iTRAK Power Supply, catalog number 2198T-W25K-ER, uses a different input wiring connector, with the same wiring specifications.

Wire the Input Power Connector

The input power (IPD) connector applies to only the DC-bus power supply and requires 324...528V AC (three-phase) for mains input power.



ATTENTION: Make sure the input power connections are correct when wiring the IPD connector plug. Insert the plug into the module connector and tighten screws to 0.8 N•m (7.1 lb•in). Incorrect wiring/polarity or loose wiring can cause damage to equipment.

Figure 66 - IPD Connector Wiring - Connector Plug

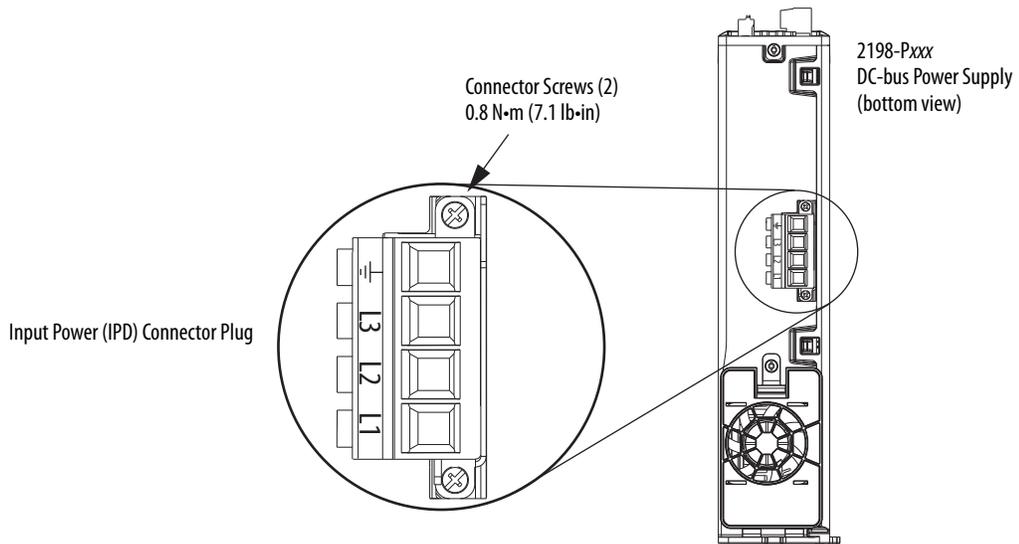


Table 53 - Input Power (IPD) Connector Plug Specifications

| DC-bus Power Supply Cat. No. | Pin | Signal | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|------------------------------|---------|---------|---|-----------------------|--------------------------|
| 2198-P031 2198-P070 | ⏏ L3 | ⏏ L3 | 6...10 (10...8) | 10.0 (0.39) | 0.8 (7.1) |
| 2198-P141 2198-P208 | L2 | L2 | 10...35 (8...2) | 20.0 (0.79) | |
| | L1 | L1 | | | |

Wire the Contactor Enable Connector

The contactor-enable (CED) connector applies to only the DC-bus power supply.



ATTENTION: Wiring the contactor-enable relay is required. To avoid personal injury or damage to the Kinetix 5700 drive system, wire the contactor-enable relay into your control string so that:

- three-phase power is removed and the DC-bus power supply is protected under various fault conditions.
- three-phase power is never applied to the Kinetix 5700 drive system before control power is applied.

Figure 67 - CED Connector Wiring - Connector Plug

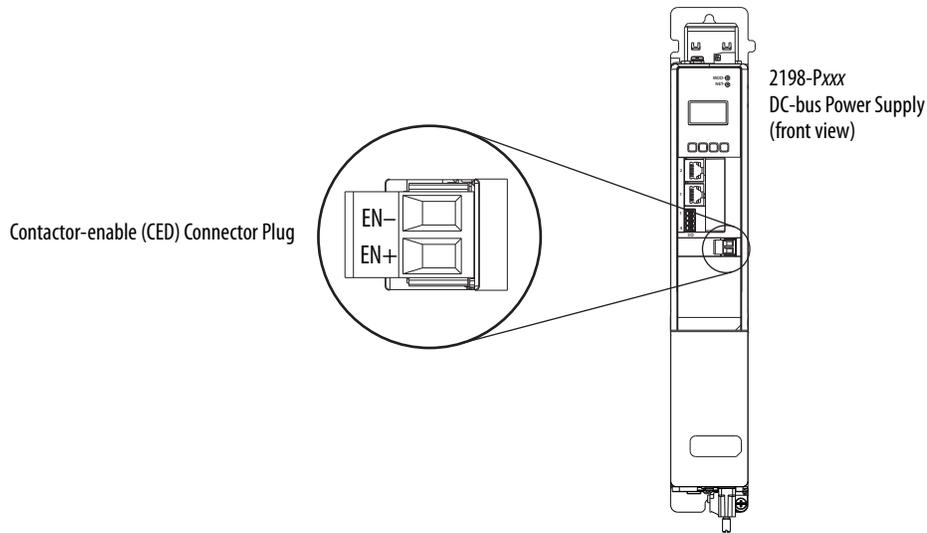


Table 54 - Contactor-enable (CED) Connector Plug Specifications

| DC-bus Power Supply Cat. No. | Pin | Signal | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|--|------------|----------------------|---|-----------------------|--------------------------|
| 2198-P031 2198-P070 2198-P141 2198-P208 | EN- EN+ | CONT EN- CONT EN+ | 0.14...2.5 (26...12) | 7.0 (0.28) | 0.4...0.5 (3.5...4.4) |

Wiring the Digital Input Connectors

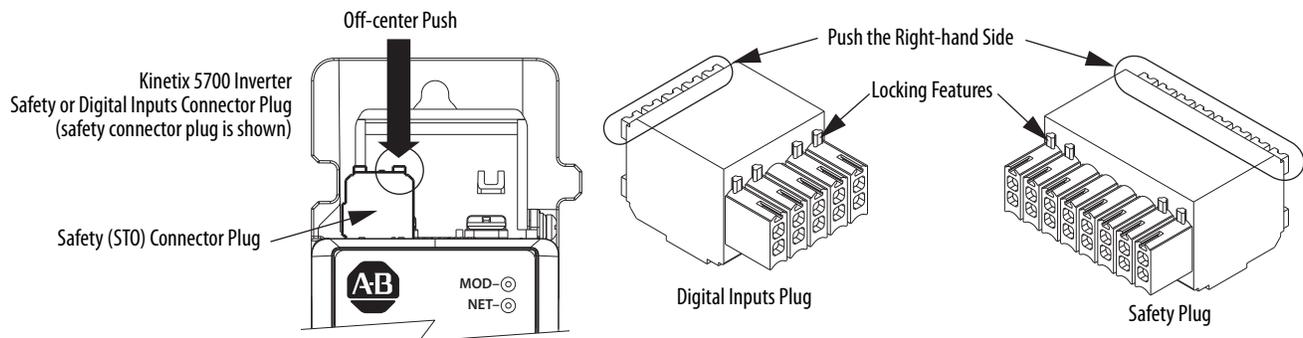
This section provides guidelines to assist you in making digital input connections. The digital inputs (IOD) and safety (STO) connector plugs for all 2198-xxxx-ERS3 and 2198-xxxx-ERS4 drives require special attention to help keep the plugs seated properly during normal operation.

2198-xxxx-ERS3 (series A) Connector Plugs

The right side of the safety and digital-input connector plugs require an off-center push when inserting them into their respective connectors. This applies to 2198-xxxx-ERS3 (series A) single-axis and dual-axis inverters.

IMPORTANT An off-center push is required to engage the locking features on the bottom of the safety and digital-input connector plugs and seat properly with the drive (STO and IOD) connectors. Failure to do this can result in the connector plugs pulling out of the drive connector during normal operation.

Figure 68 - 2198-xxxx-ERS3 (series A) Connector Plugs

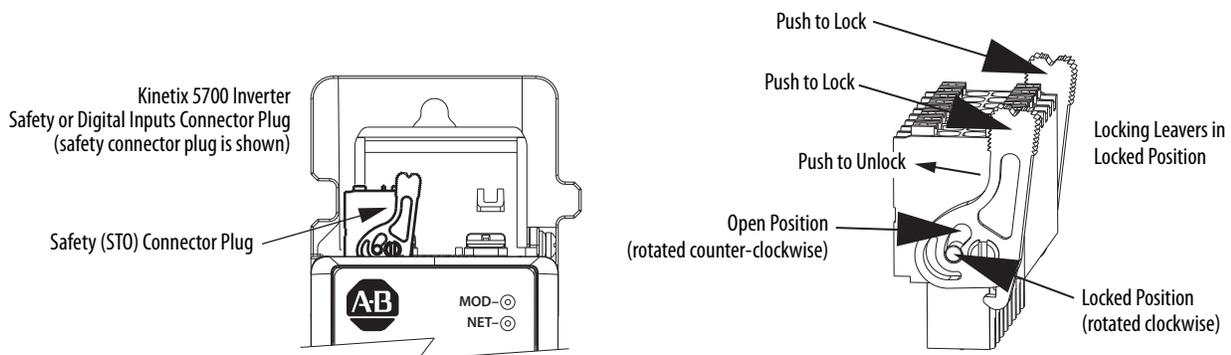


2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) Connector Plugs

The safety and digital-input connector plugs have two locking levers that you push in a clockwise direction as you insert the plugs into the drive connector. This is the locked position. Rotate the levers counter-clockwise (open position) to release the connector plugs. This applies to 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) single-axis and dual-axis inverters.

IMPORTANT Push the locking levers clockwise into the locked position as you insert the (STO and IOD) connector plugs. Failure to do this can result in the connector plugs pulling out of the drive connector during normal operation.

Figure 69 - 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) Connector Plugs



Wire the Safe Torque-off Connector

For the hardwired safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to Chapter 9 beginning on [page 243](#).

Wire the Digital Inputs Connector

The digital inputs (IOD) connector applies to the DC-bus power supply, single-axis inverter, and dual-axis inverters and use spring tension to hold wires in place.

Figure 70 - IOD Connector Wiring

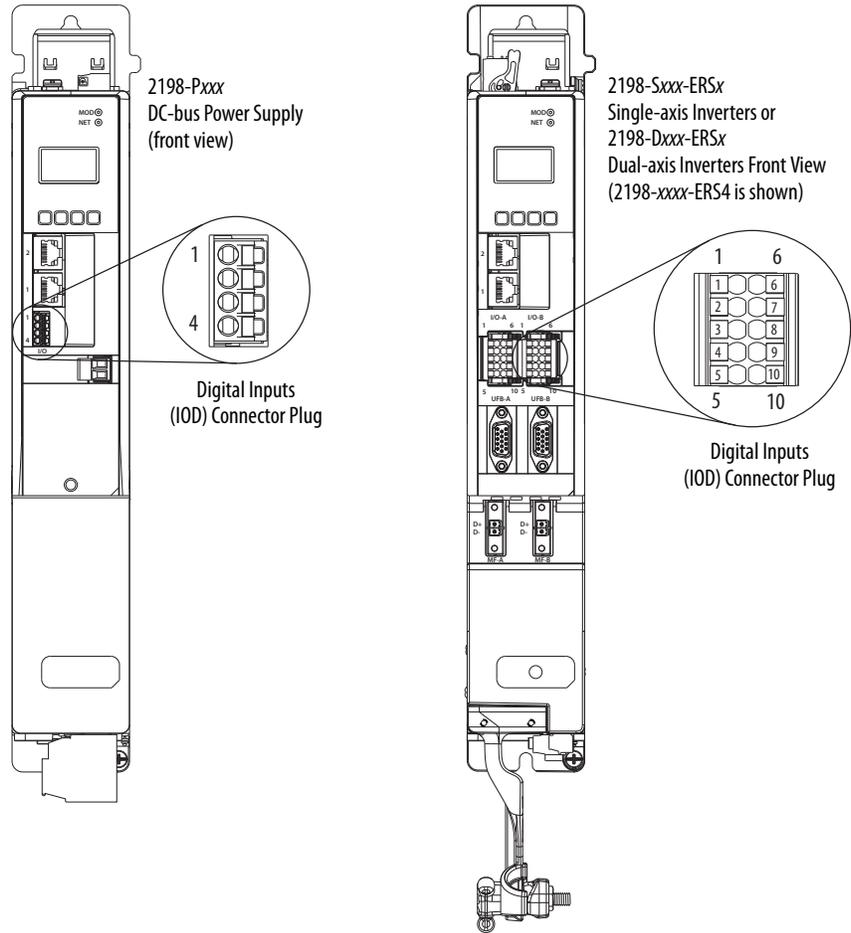


Table 55 - Digital Inputs (IOD) Connector Specifications

| Drive Module Cat. No. | IOD Pin | Signal | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|---|---|--|---|-----------------------|--------------------------|
| 2198-Pxxx | IOD-1 IOD-2 IOD-3 IOD-4 | IN1 COM IN2 SHLD | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽¹⁾ |
| 2198-Dxxx-ERSx and 2198-Sxxx-ERSx | IOD-1 IOD-2 IOD-3 IOD-4 IOD-5 IOD-6 IOD-7 IOD-8 IOD-9 IOD-10 | IN1 COM IN2 COM SHLD IN3 COM IN4 COM SHLD | 0.14...1.5 (26...16) | 10.0 (0.39) | N/A ⁽¹⁾ |

(1) This connector uses spring tension to hold wires in place.

Wiring Single Cables

Kinetix 5700 inverters and most Kinetix VP motor combinations use single motor-cable technology with motor power, feedback, and brake wires (when specified) housed in a single cable. Feedback wires are shielded separately and provide a shield braid for grounding in the connector kit.

IMPORTANT Due to the unique characteristics of single cable technology, designed for and tested with Kinetix 5700 inverters and Kinetix VP (Bulletin VPL, VPF, VPS, and VPC-Bxxxx-Q) motors, you cannot build your own cables or use third-party cables.

Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-TD004](#), for cable specifications.

Table 56 - Single Cable Catalog Numbers

| Motor Cat. No. | Feedback Kit Cat. No. | Motor Cable Cat. No. (with brake wires) | Motor Cable Cat. No. (without brake wires) | Feedback Connections |
|--|-----------------------|---|--|--|
| VPL-Bxxxx VPF-Bxxxx VPS-Bxxxx VPC-Bxxxx-Q | 2198-KITCON-DSL | 2090-CSBM1DE-xxAAxx (standard) cables 2090-CSBM1DE-xxAFxx (continuous-flex) cables | 2090-CSWM1DE-xxAAxx (standard) cables | 2198-KITCON-DSL kit is pre-wired to feedback conductors |
| | | 2090-CSBM1DG-xxAAxx (standard) cables 2090-CSBM1DG-xxAFxx (continuous-flex) cables | 2090-CSWM1DG-xxAAxx (standard) cables | Flying-lead feedback conductors. 2198-KITCON-DSL connector kit is purchased separately |

Table 57 - Kinetix VP Rotary Motor Compatibility

| Drive Module Cat. No. ⁽¹⁾ | Bulletin VPL | Bulletin VPF | Bulletin VPS | VPC-Bxxxx-Q Motors ⁽²⁾ |
|--------------------------------------|--------------|--------------|--------------|-----------------------------------|
| 2198-Dxxx-ERSx | X | X | X | X |
| 2198-S086-ERSx 2198-S130-ERSx | – | – | – | |

(1) For motor compatibility with 2198-S160-ERSx drives, see [Wiring Power/Brake and Feedback Cables](#) on [page 117](#).

(2) Due to the motor power conductor size, VPC-B3004A-Q and VPC-B3004D-Q motors do not support single cable technology. See [Wiring Power/Brake and Feedback Cables](#) on [page 117](#).

Maximum Cable Lengths

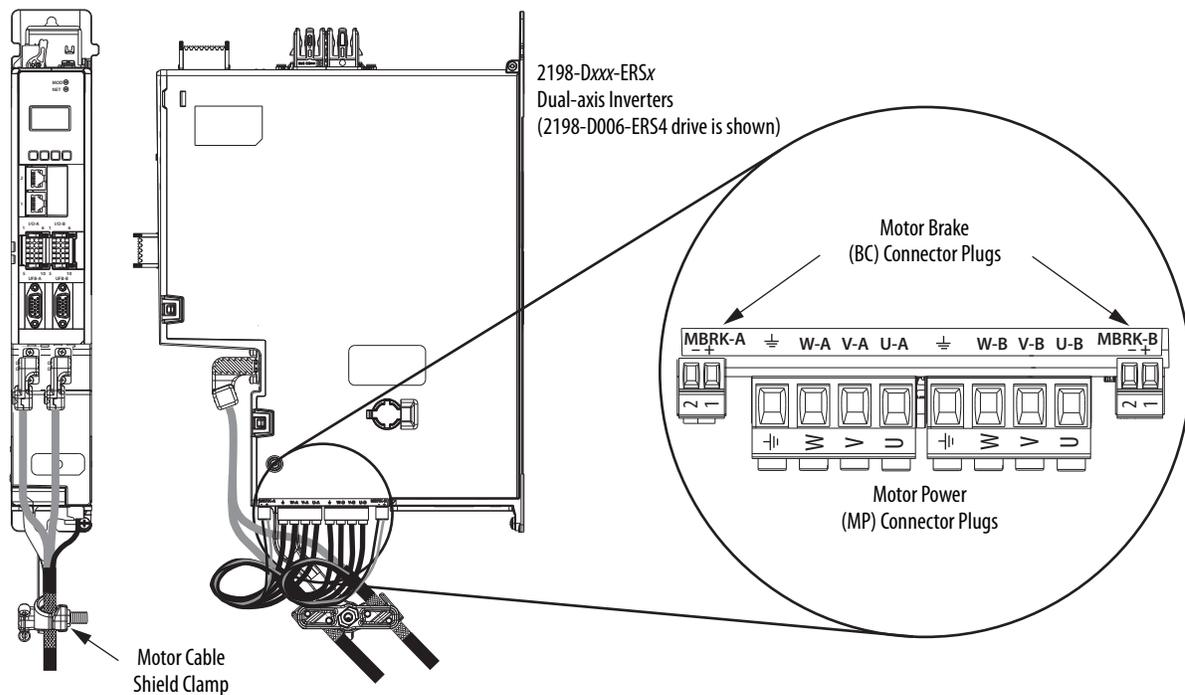
Combined motor power cable length for all axes on the same DC bus must not exceed 400 m (1312 ft). The maximum drive-to-motor cable length for Kinetix 5700 drives and motor/actuator combinations with 2090-CSxM1Dx cables is 90 m (295 ft).

Motor Power and Brake Connections

Motor power connections are made at the MP connector on the bottom of the dual-axis and single-axis inverters. Motor brake connections are made at the BC connector. On dual-axis inverters, the BC connectors are on either side of the MP connectors on the bottom of the drive. On single-axis inverters, the BC connector is on the front of the drive.

On 2198-Sxxx-ERSx single-axis inverters, the motor power connector and shield clamp are mounted to a separate bracket that plugs into the bottom of the drive and has mounting screws to hold it secure.

Figure 71 - MP and BC Connector Wiring (dual-axis inverters)



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 damage to equipment.

Table 58 - Motor Power (MP) Connector Specifications (dual-axis inverters)

| Dual-axis Inverter Cat. No. | Pin | Signal/Wire Color | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|--|------------------|--|---|-----------------------|--------------------------|
| 2198-D006-ERSx 2198-D012-ERSx 2198-D020-ERSx 2198-D032-ERSx | U V W ⊥ | U Brown V Black W Blue ⊥ Green/Yellow | Motor power cable depends on motor/ drive combination. 0.75...2.5 ⁽¹⁾ (18...14) | 10.0 (0.39) | 0.5...0.6 (4.4...5.3) |
| 2198-D057-ERSx | | | 2.5...6 ⁽¹⁾ (14...10) | 10.0 (0.39) | 0.5...0.8 (4.4...7.1) |

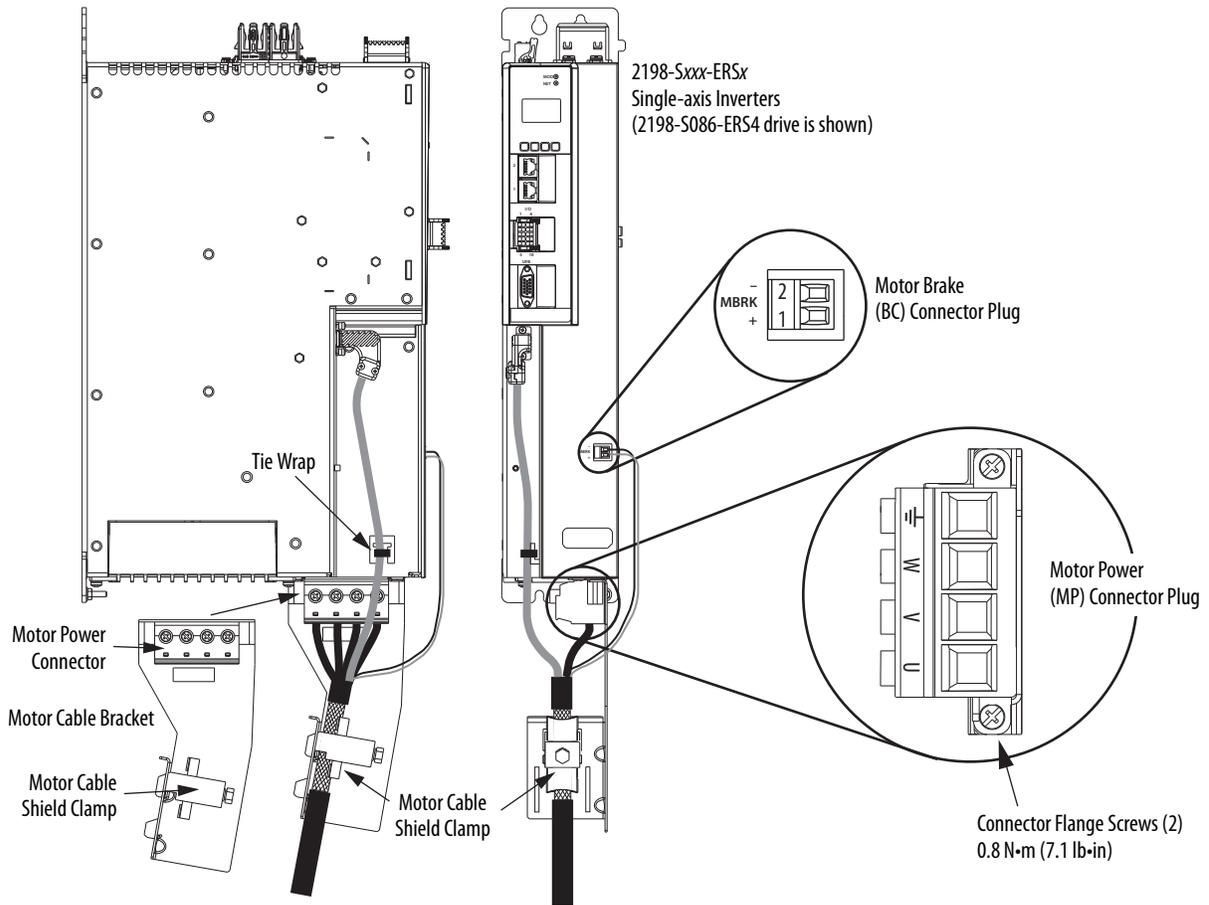
(1) Building your own cables or using third-party cables is not an option. Use 2090-CSxM1DE/DG single motor cables. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-TD004](#), for cable specifications.

Table 59 - Motor Brake (BC) Connector Specifications

| Drive Module Cat. No. | Pin | Signal/Wire Color | Recommended Wire Size (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|--|--------------|----------------------------|-----------------------------|-----------------------|----------------------------|
| 2198-Dxxx-ERSx 2198-S086-ERSx 2198-S130-ERSx | BC-1 BC-2 | MBRK+/Black MBRK-/White | N/A ⁽¹⁾ | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) |

(1) Motor brake wires are part of the 2090-CSBM1DE/DG motor cable.

Figure 72 - MP and BC Connector Wiring (single-axis inverters)



You can attach the motor power wires to the motor power connector, plug in the motor feedback and brake connectors, and then connect the bracket to the drive.



WARNING: Make sure the motor power connections are correct when wiring the MP connector plug. Insert the plug into the module connector and tighten flange screws to 0.8 N·m (7.1 lb·in). Incorrect wiring/polarity or loose wiring can cause an explosion or damage to equipment.

Table 60 - Motor Power (MP) Connector Specifications (single-axis inverters)

| Drive Module Cat. No. | Pin | Signal/Wire Color | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Terminal Torque Value N·m (lb·in) | Flange Torque Value, max N·m (lb·in) |
|----------------------------------|------------------|--|--|-----------------------|-----------------------------------|--------------------------------------|
| 2198-S086-ERSx 2198-S130-ERSx | U V W ⊥ | U Brown V Black W Blue ⊥ Green/Yellow | Motor power cable depends on motor/drive combination. 6...16 ⁽¹⁾ (10...6) | 20.0 (0.79) | 2.5...4.5 (22...40) | 0.8 (7.1) |

(1) Building your own cables or using third-party cables for Kinetix VP motors is not an option. Use 2090-CSxM1DE/DG single motor cables. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-TD004](#), for cable specifications.

Motor Feedback Connections

Single motor-cable feedback connections are made by using the 2198-KITCON-DSL feedback connector kit.

- 2090-CSxM1DE cables include the connector kit pre-wired to the feedback conductors.
- 2090-CSxM1DG cables have flying-lead feedback conductors. The 2198-KITCON-DSL feedback connector kit must be purchased separately and installed.

Figure 73 - MF Connector Wiring

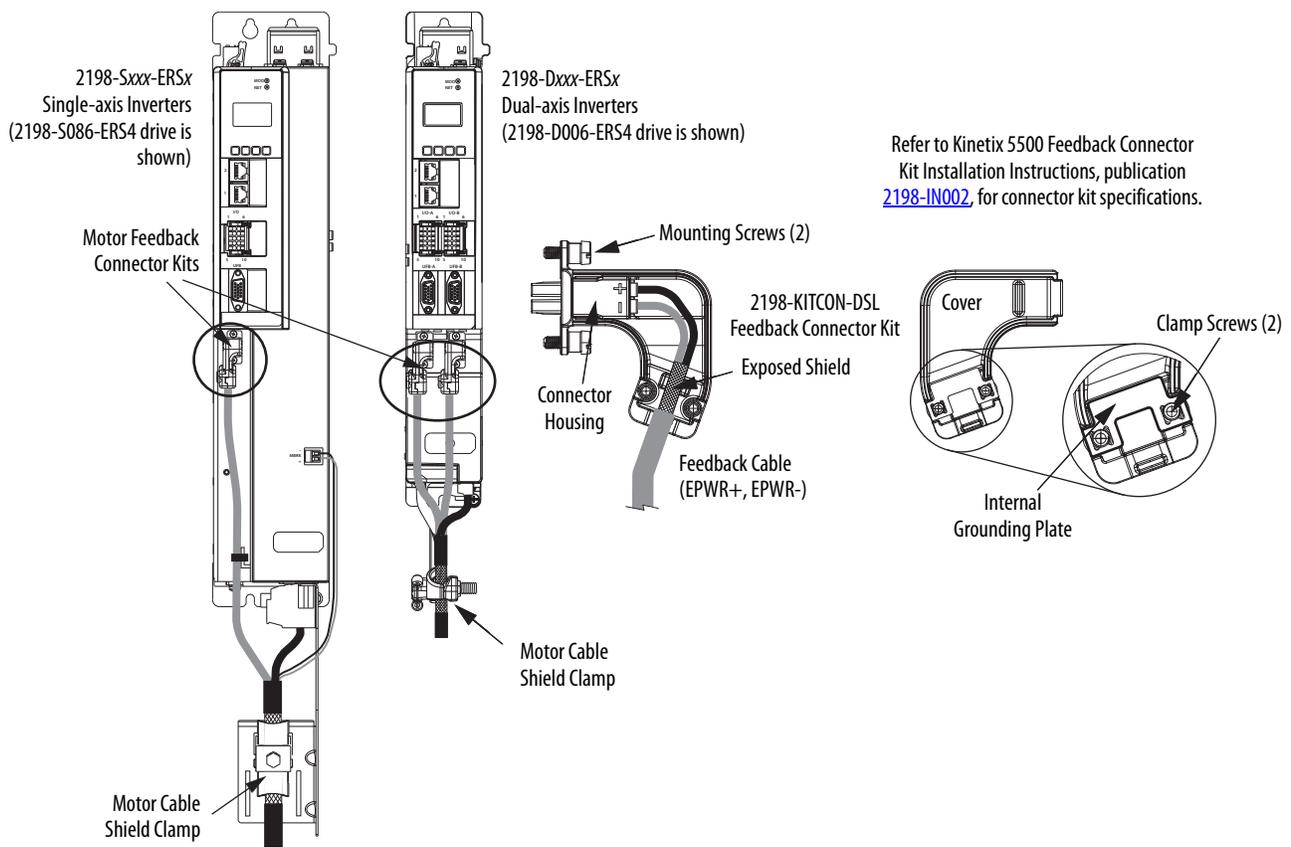


Table 61 - Motor Feedback (MF) Connector Specifications

| Drive Module Cat. No. | Pin | Signal/Wire Color | Wire Size AWG | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|--|------|-------------------|---------------|-----------------------|--------------------------|
| 2198-Dxxx-ERSx 2198-S086-ERSx 2198-S130-ERSx | MF-1 | D+/Blue | 22 | 10.0 (0.39) | 0.4 (3.5) |
| | MF-2 | D-/White/Blue | | | |

Apply the Single Motor Cable Shield Clamp

Factory-supplied 2090-Series single motor cables are shielded, and the braided cable shield must terminate at the drive during installation. A small portion of the cable jacket has been removed to expose the shield braid. The exposed area must be clamped (with the clamp provided) at the bottom front of the drive.



SHOCK HAZARD: To avoid hazard of electrical shock, make sure shielded power cables are grounded according to recommendations.

These procedures assume you have completed wiring your motor power, brake, and feedback connectors and are ready to apply the cable shield clamp.

Dual-axis Inverter Shield Clamp Installation

Follow these steps to apply the dual-axis inverter cable shield clamp.

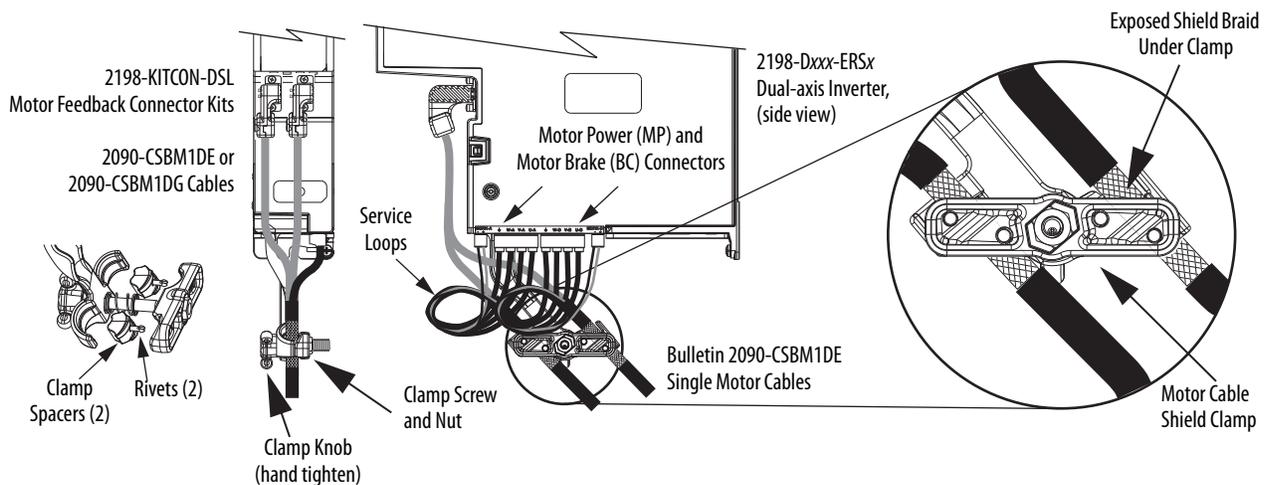
1. Loosen the clamp knob and determine if you need the clamp spacers.

Clamp spacers are included with the dual-axis inverters for cable diameters that are too small for a tight fit within the drive clamp alone.

The spacers are held captive by nylon rivets. Remove the rivets and spacers when your cable shield is of sufficient diameter for the clamp to hold the cable secure.

IMPORTANT Clamp spacers are needed with 2090-CSBM1DG (18 and 14 AWG) cables. Spacers are not needed for 2090-CSBM1DG (10 AWG) cables, all 2090-CSBM1DE cables, and can be removed.

Figure 74 - Dual-axis Inverter Shield Clamp Installation



2. Position the exposed portion of each cable braid directly in line with the clamp.
3. Hand tighten the clamp knob.

Make sure the cable clamp tightens around the cable shield and provides a good bond between the cable shield and the drive chassis.

Only finger-tight torque on the clamp knob is required. The cable should not move within the clamp under its own weight or when slight pressure is applied by hand.

IMPORTANT If the power/brake cable shield on the dual-axis inverter has a loose fit inside the shield clamp, use a clamp spacer to reduce the clamp diameter. When the clamp knob is tightened, the result must be a high-frequency bond between the cable shield and the drive chassis.

Make sure the clamp is aligned with the shield braid and not heat shrink.

4. Repeat [step 1](#) through [step 3](#) for each dual-axis inverter.

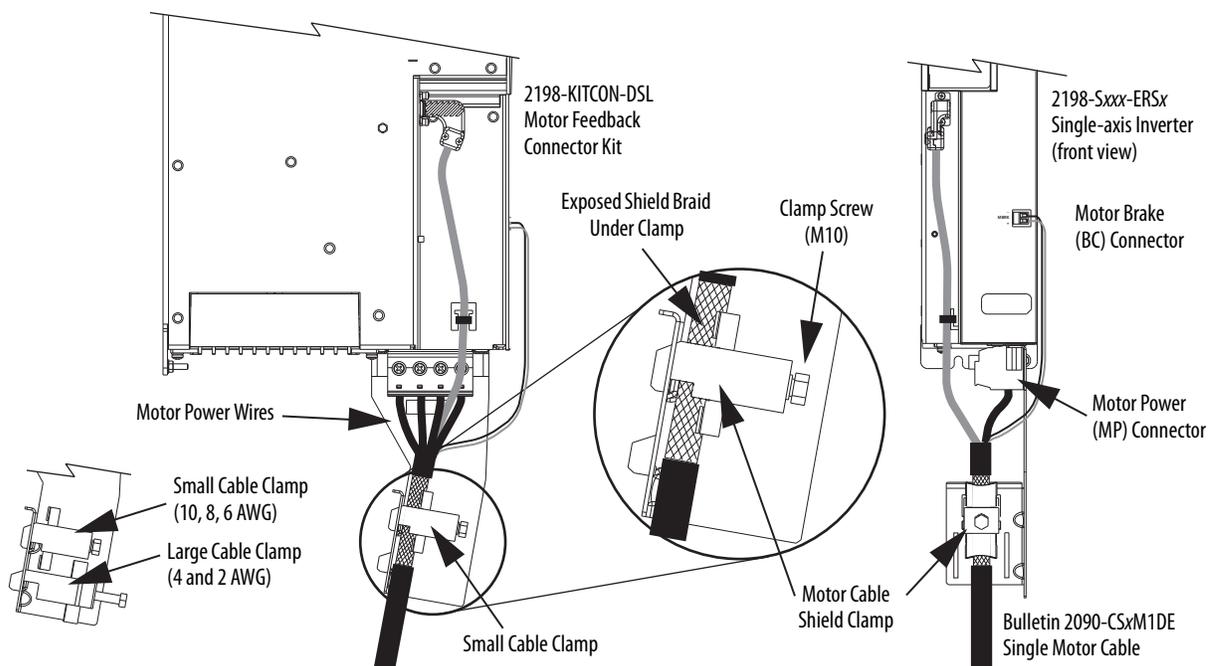
Single-axis Inverter Shield Clamp Installation

Single-axis inverters include a two-position cable-shield clamp. With 10 AWG 2090-CSxM1DE and 2090-CSxM1DG cables, only the small (upper) clamp is used. Replacement clamps are also available.

Follow these steps to apply the single-axis inverter motor-cable shield clamp.

1. Remove the larger (lower position) clamp.
2. Loosen the clamp screw.

Figure 75 - Cable Installation



- Position the exposed portion of the cable braid directly in line with the clamp.

IMPORTANT Make sure the clamp is aligned with the shield braid and not the heat shrink.

- Tighten the clamp screw.

Make sure the cable clamp tightens around the overall cable shield and provides a good bond between the cable shield and the drive chassis.

Torque value 5.6 N•m (50 lb•in), max.

- Repeat [step 1](#) through [step 4](#) for each drive in multi-axis configurations.

Wiring Power/Brake and Feedback Cables

Kinetix 5700 drives are also compatible with many other Allen-Bradley® motors and actuators that have separate power/brake and feedback cables. Follow these guidelines when 2090-CPxM7DF (power/brake) cables and 2090-CFBM7DF (feedback) cables are used in a new installation or reused in an existing installation with Kinetix 5700 servo drives.

Motor Power and Brake Cables

The motors and actuators in [Table 62](#) have separate power/brake and feedback cables. The motor power/brake cable attaches to the cable clamp on the drive and the power/brake conductors attach to the MP and BC connectors, respectively.

Table 62 - Motor Power Cable Compatibility

| Motor/Actuator Cat. No. | Motor Power Cables ⁽¹⁾ (with brake wires) | Motor Power Cables ⁽¹⁾ (without brake wires) |
|---|--|--|
| MPL-B15xxx-xx7xAA, MPL-B2xxx-xx7xA MPL-B3xxx-xx7xAA...MPL-B9xxx-xx7xAA | 2090-CPBM7DF-xxAAxx (standard) or 2090-CPBM7DF-xxAFxx (continuous-flex) | 2090-CPWM7DF-xxAAxx (standard) or 2090-CPWM7DF-xxAFxx (continuous-flex) |
| MPM-Bxxxx, MPF-Bxxxx, MPS-Bxxxx | | |
| MPAS-Bxxxx1-V05SxA, MPAS-Bxxxx2-V20SxA MPAI-Bxxxx, MPAR-B3xxx (series B) MPAR-B1xxx and MPAR-B2xxx (series B and C) | | |
| VPC-Bxxxx-S VPC-Bxxxx-Y | | |
| RDB-Bxxxx-7/3 | | |
| MPAS-Bxxxx-ALMx2C LDAT-Sxxxxx-xDx LDAT-Sxxxxx-xBx LDC-xxxxxx-xHTxx | N/A | |
| HPK-Bxxxx, HPK-Exxxx | Customer-supplied | |

(1) Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-ID004](#), for cable specifications.

Table 63 - Legacy Motor Power Cables

| Motor Cable | Description | Cat. No. |
|-----------------|-----------------------|---------------------|
| Standard | Power/brake, threaded | 2090-XXNPMF-xxSxx |
| | Power-only, bayonet | 2090-XXNPMP-xxSxx |
| Continuous-flex | Power/brake, threaded | 2090-CPBM4DF-xxAFxx |
| | Power-only, threaded | 2090-CPWM4DF-xxAFxx |
| | Power-only, bayonet | 2090-XXTPMP-xxSxx |

Table 64 - Induction Motor Power Cable Specifications

| Cable Manufacturer | Cable Series | Voltage Rating | Temperature Rating |
|--------------------|--------------|----------------|--------------------|
| Belden | 29500-29507 | 600V | 90 °C (194 °F) |
| Lapp Group | ÖLFEX VFD XL | | |
| SAB | VFD XLPE TR | | |

Motor Power and Brake Connections

Motor power connections are made at the MP connector on the bottom of the dual-axis and single-axis inverters. Motor brake connections are made at the BC connector. On dual-axis inverters, the BC connectors are on either side of the MP connectors on the bottom of the drive. On single-axis inverters, the BC connector is on the front of the drive.

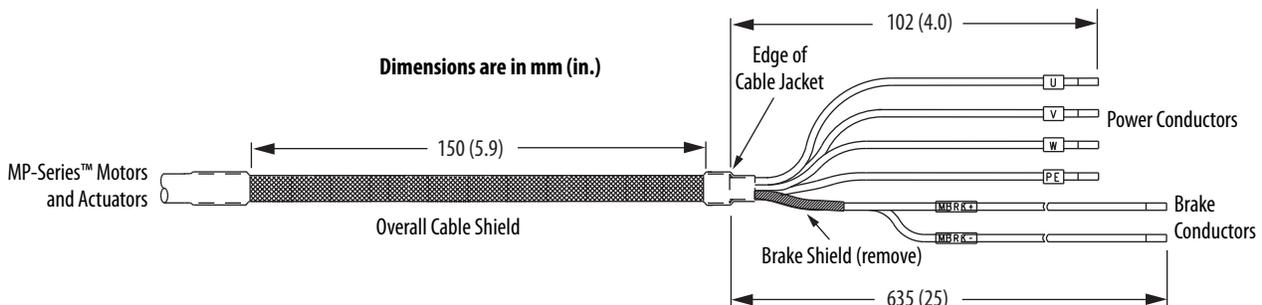
On single-axis inverters, the motor power connector and shield clamp are mounted to a separate bracket that plugs into the bottom of the drive and has mounting screws to hold it secure.

Refer to [Table 58](#), [Table 59](#), and [Table 60](#) beginning on [page 112](#) for the MP and BC connector specifications.

Motor Power/Brake Cable Series Change

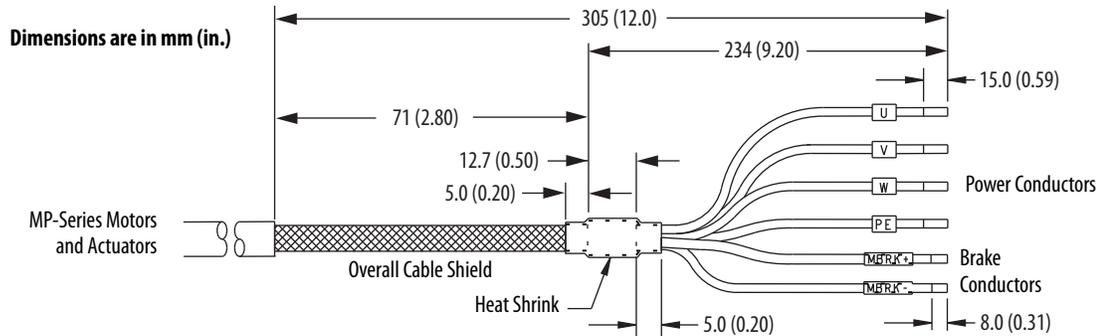
Motor power and brake conductors on 2090-CPBM7DF (series A) cables have the following dimensions from the factory. If your cable is reused from an existing application, the actual conductor lengths could be slightly different.

Figure 76 - 2090-CPBM7DF (series A) Power/brake Cable Dimensions



Motor power and brake conductors on 2090-CPBM7DF (series B) 12 and 10 AWG standard, non-flex cables provide (drive end) shield braid and conductor preparation designed for compatibility with multiple Kinetix servo-drive families, including Kinetix 5700 drives.

Figure 77 - 2090-CPBM7DF (series B, 10 or 12 AWG) Power/brake Cable Dimensions



Maximum Cable Lengths

Combined motor power cable length for all axes on the same DC bus must not exceed 400 m (1312 ft). The maximum drive-to-motor cable length for Kinetix 5700 drives and motor/actuator combinations with 2090-CxxM7DF cables is 90 m (295 ft), depending on the feedback type.

Table 65 - Drive-to-Motor Feedback Cable Length

| Feedback Type | Cable Length, max m (ft) |
|------------------------------------|-----------------------------|
| Single-turn or multi-turn absolute | 90 (295) |
| Incremental | 30 (98) |
| Heidenhain EnDat | 90 m (295) |

Dual-axis Inverter Power/Brake Cable Installation

Dual-axis inverters are compatible with several Allen-Bradley motor families that require 16, 14, 12, and 10 AWG power/brake cables. Refer to [Table 66](#) for the proper procedure designed for your 2090-CPxM7DF cable.



SHOCK HAZARD: To avoid hazard of electrical shock, make sure shielded power cables are grounded according to recommendations.

Table 66 - Cable Preparation for 2090-CPxM7DF Cables

| Cable Power Conductor Size AWG | Go to: |
|-----------------------------------|--|
| 16 and 14 | Cable Preparation for 16 and 14 AWG Cables |
| 12 and 10 | Cable Preparation for 12 and 10 AWG Cables |

Cable Preparation for 16 and 14 AWG Cables

For dual-axis inverters, the 2090-CPBM7DF power conductor length, 102 mm (4.0 in.), is sufficiently long to reach the MP connector plug and provides adequate stress relief. However, you must remove additional insulation from the power conductors to achieve a strip length of 10 mm (0.39 in.).

The brake conductor length, 635 mm (25 in.), is much longer than necessary. We recommend that you measure 188 mm (7.4 in.) from the edge of the cable jacket (that is covered by heat shrink) and trim off the rest.

Refer to [Figure 78](#) and on [page 122](#) for a typical installation example. For strip lengths and torque values, refer to [Table 58](#) and [Table 59](#) on [page 112](#).

Cable Preparation for 12 and 10 AWG Cables

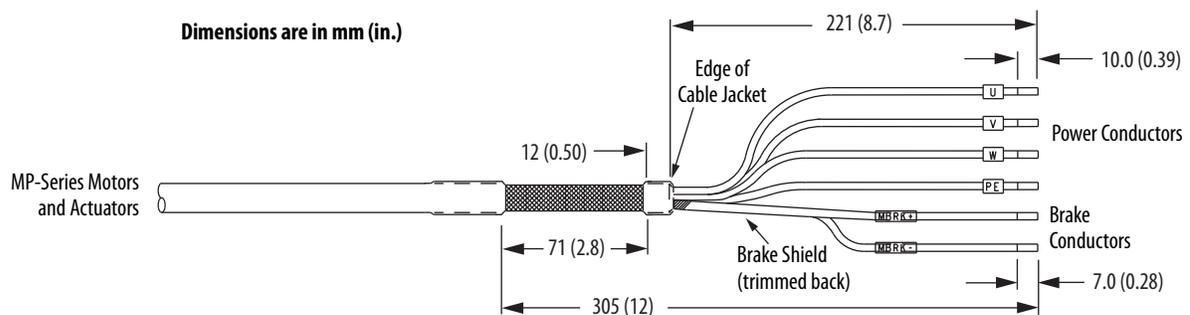
2090-CPBM7DF (series B) 12 and 10 AWG cables are designed for use with Kinetix 5700 dual-axis inverters and do not require any modifications.

For dual-axis inverters, 2090-CPBM7DF (series A) 12 and 10 AWG conductors are too short and stiff to reach the MP connector plug and provide adequate stress relief.

Follow these steps to prepare your existing (series A) 12 and 10 AWG cables.

1. Remove any heat shrink or small sections of cable jacket from your existing cable.
2. Remove additional cable jacket and shield braid from your cable following the diagram below.

Include a new 12 mm (0.5 in.) section of cable jacket and slide it down to the end of the shield braid.



3. Apply heat shrink to the small section of cable jacket.

Refer to [Figure 79](#) for typical installation examples for series A and series B cables. For strip lengths and torque values, refer to [Table 58](#) and [Table 59](#) on [page 112](#).

Dual-axis Inverter Shield Clamp Installation

Follow these steps to apply the dual-axis inverter cable shield clamp.

1. Loosen the clamp knob and determine if you need the clamp spacers.

The power/brake cable shield attaches to the dual-axis inverter cable clamp. Clamp spacers are included with the dual-axis inverters for cable diameters that are too small for a tight fit within the drive clamp alone.

The spacers are held captive by nylon rivets. Remove the rivets and spacers when your cable shield is of sufficient diameter for the clamp to hold the cable secure.

IMPORTANT Most all 2090-CPxM7DF power/brake cables require the spacers. Only 10 AWG cables with brake conductors have a diameter large enough to fit in the clamp without the spacers.

2. Position the exposed portion of each cable braid directly in line with the clamp.
3. Hand tighten the clamp knob.

Make sure the cable clamp tightens around the cable shield and provides a good bond between the cable shield and the drive chassis.

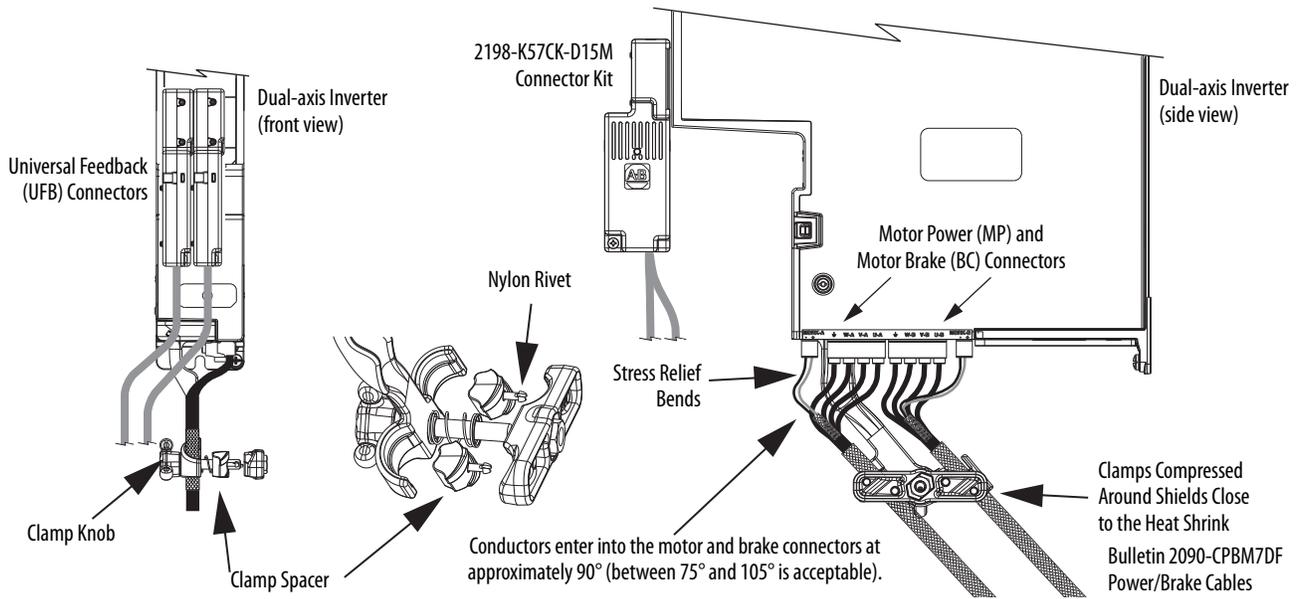
Only finger-tight torque on the clamp knob is required. The cable should not move within the clamp under its own weight or when slight pressure is applied by hand.

IMPORTANT If the power/brake cable shield on the dual-axis inverter has a loose fit inside the shield clamp, use a clamp spacer to reduce the clamp diameter. When the clamp knob is tightened, the result must be a high-frequency bond between the cable shield and the drive chassis.

Make sure the clamp is aligned with the shield braid and not heat shrink.

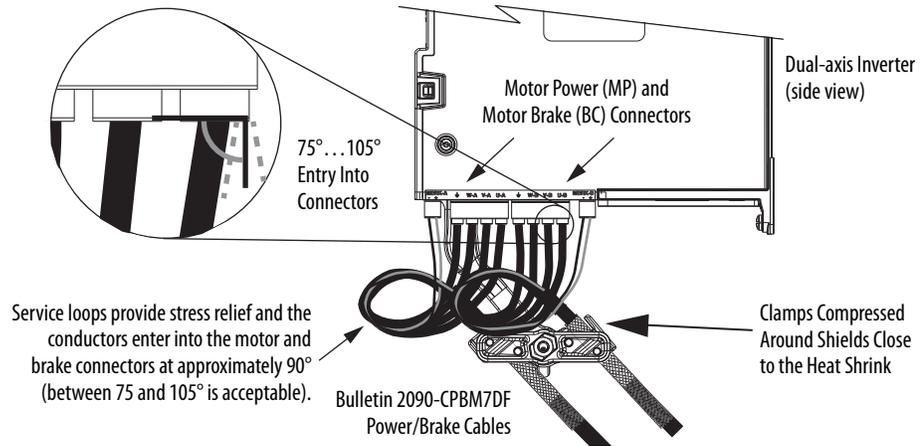
See [Figure 78](#) and [Figure 79](#) on [page 122](#) for examples.

Figure 78 - Dual-axis Inverter Cable Installation (16 and 14 AWG cable)



12 and 10 AWG (series A) cables, prepared as shown on [page 120](#), and series B cables have longer conductors that support service loops.

Figure 79 - Dual-axis Inverter Cable Installation (series A and B, 12 and 10 AWG cable)



IMPORTANT Avoid sharp bends in the power and brake conductors. You must route the power and brake conductors from where they exit the clamp and enter the motor and brake connectors so that stress-relief bends or service loops are formed.

4. Repeat [step 1](#) through [step 3](#) for each dual-axis inverter.

Single-axis Inverter Power/Brake Cable Installation

Single-axis inverters include a two-position cable-shield clamp for 2090-CPBM7DF cables with 10, 8, 6, 4, and 2 AWG power conductors.

2090-CPBM7DF (series B) 10 AWG cables are designed for use with Kinetix 5700 single-axis inverters and do not require any modifications.



SHOCK HAZARD: To avoid hazard of electrical shock, make sure shielded power cables are grounded according to recommendations.

For single-axis inverters, the 2090-CPBM7DF (series A) cable power conductors, 102 mm (4.0 in.), require adjustment only when the smaller (upper position) clamp is used. The upper position is for smaller cables (10, 8, and 6 AWG). The lower position is for larger cables (4 and 2 AWG). We recommend that you measure from the edge of the cable jacket (that is covered with heat shrink) and trim the power conductors as shown in [Table 67](#).

Table 67 - Power Conductor Trimmed Length

| Power Conductor Size AWG | Power Conductor Length mm (in.) |
|-----------------------------|------------------------------------|
| 6 and 8 | 75 (2.9) |
| 10 | No trimming required |
| 2 and 4 | 85 (3.3) |

The (series A) 2090-CPBM7DF brake conductor length, 635 mm (25 in.) is longer than necessary. Measure from the edge of the heat shrink and trim the brake conductors as shown in [Table 68](#).

Table 68 - Brake Conductor Trimmed Length

| Power Conductor Size AWG | Brake Conductor Length mm (in.) |
|-----------------------------|------------------------------------|
| 6, 8, 10 | 315 (12.4) |
| 2 and 4 | 375 (14.7) |

See [Figure 80](#) on [page 124](#) for a typical series-A installation example. For strip lengths and torque values, see [Table 59](#) and [Table 60](#) on [page 112](#).

Single-axis Inverter Shield Clamp Installation

Follow these steps to apply the single-axis inverter motor-cable shield clamp.

1. Remove the larger (lower position) clamp or small (upper position) clamp, depending on the power conductor size used in your application.

IMPORTANT Make sure to use the proper size clamp depending on cable diameter.

2. Loosen the clamp screw.
3. Position the exposed portion of the cable braid directly in line with the clamp.

IMPORTANT Make sure the clamp is aligned with the shield braid and not heat shrink.

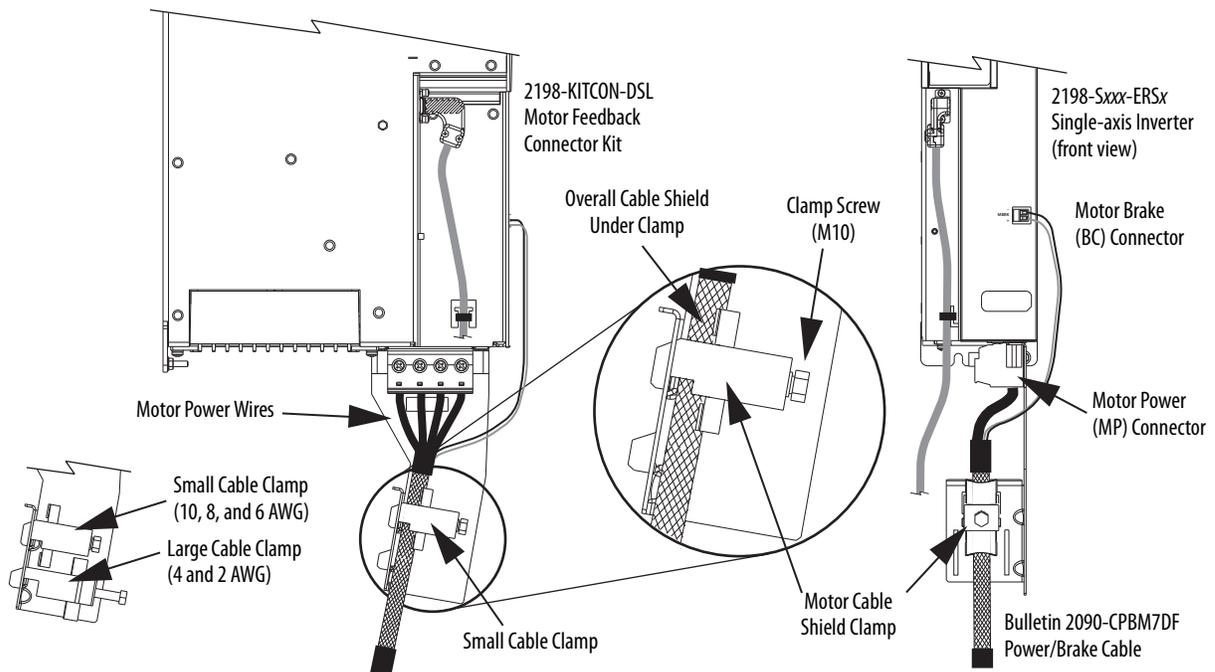
4. Tighten the clamp screw.

Make sure the cable clamp tightens around the overall cable shield and provides a good bond between the cable shield and the drive chassis.

Torque value 5.6 N•m (50 lb•in), max.

In [Figure 80](#), 10 AWG (series A) cables are prepared per [Table 67](#) and [Table 68](#) on [page 123](#), and series B cables do not require preparation.

Figure 80 - Single-axis Inverter Cable Installation (series A and B, 10 AWG cables)



5. Repeat [step 1](#) through [step 4](#) for each drive in multi-axis configurations.

Motor Feedback Connections

You can connect motor feedback to the 2-pin motor feedback (MF) connector or the 15-pin universal feedback (UFB) connector with the associated feedback connector kit.

Table 69 - Feedback Connector Kit Options

| Connector Kit Cat. No. | Kinetix 5700 Drive Feedback Connectors | Encoder Feedback Type | Description |
|--------------------------------|--|---|---|
| 2198-H2DCK (series B or later) | Motor feedback (MF) | Single-turn or multi-turn absolute | Converts the 15-pin Hiperface feedback signals from the encoder to 2-pin DSL feedback signals at the drive. |
| 2198-K57CK-D15M | Universal feedback (UFB) | Single-turn/ multi-turn absolute, incremental, or EnDat | Feedback signals pass straight through encoder to drive for motor feedback or auxiliary feedback. |

Feedback cables attach to the connector kit and are wired to the connector inside the connector kit. Bulletin 2090 feedback cables require preparation to make sure the shield clamp attaches properly and conductors route smoothly to the connector terminals.

All of the current and legacy feedback cables listed below are compatible with the 2198-H2DCK converter kit and 2198-K57CK-D15M connector kit.

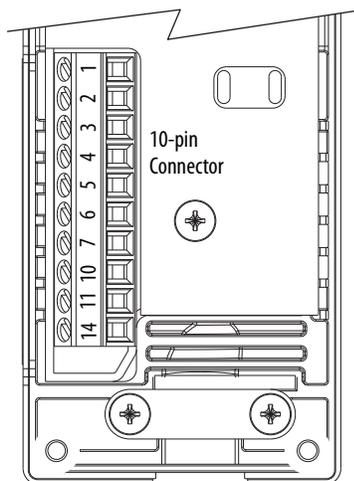
Table 70 - Compatible Motors and Actuators

| Motor/Actuator Families | Single-turn or Multi-turn Absolute Encoders | | Incremental Encoders | | |
|---|---|--|--|---|-----|
| | Motor/Actuator Cat. No. | Feedback Cable Cat. No. | Motor/Actuator Cat. No. | Feedback Cable Cat. No. | |
| MP-Series low-inertia motors (Bulletin MPL) | MPL-B15xxx... MPL-B2xxx-V/E MPL-B3xxx... MPL-B9xxx-M/S | 2090-CFBM7DF-CEAAxx 2090-CFBM7DD-CEAAxx 2090-CFBM7DF-CERAxx (standard) or 2090-CFBM7DF-CEAFxx 2090-CFBM7DD-CEAFxx 2090-CFBM7DF-CDAFxx (continuous-flex) | MPL-B15xxx... MPL-B2xxx-H MPL-B3xxx... MPL-B45xxx-H | 2090-XXNFMF-Sxx (standard) 2090-CFBM7DF-CDAFxx (continuous-flex) | |
| MP-Series medium-inertia motors (Bulletin MPM) | MPM-Bxxxx-M/S | | N/A | | |
| MP-Series food-grade motors (Bulletin MPF) | MPF-Bxxxx-M/S | | N/A | | |
| MP-Series stainless-steel motors (Bulletin MPS) | MPS-Bxxxx-M/S | | N/A | | |
| Kinetix VP continuous-duty motors (Bulletin VPC) | VPC-Bxxxx-S VPC-Bxxxx-Y | | N/A | | |
| HPK-Series™ asynchronous servo motors | HPK-Bxxxx-M/S | | N/A | | |
| MP-Series integrated linear stages (Bulletin MPAS/MPMA) | MPAS-Bxxxx-VxxSxA (ballscrew) | | MPAS-Bxxxx-ALMx2C (direct drive) | | |
| MP-Series electric cylinders (Bulletin MPAR) | MPAR-Bxxxx | | N/A | | |
| MP-Series heavy-duty electric cylinders (Bulletin MPAI) | MPAI-Bxxxx | | N/A | | |
| LDAT-Series integrated linear thrusters | LDAT-Sxxxxx-xDx | | LDAT-Sxxxxx-xBx | | |
| LDC-Series™ iron-core linear motors | N/A | | LDC-xxxxx-xHTxx | | |
| RDD-Series direct-drive motors (Bulletin RDB) | RDB-Bxxxx-7/3 | | 2090-XXNFMF-Sxx 2090-CFBM7DF-CDAFxx | | N/A |

Table 71 - Legacy Motor Feedback Cables

| Motor Cable | Description | Cable Cat. No. |
|-----------------|----------------------------|-------------------------------------|
| Standard | Encoder feedback, threaded | 2090-XXNFMF-Sxx 2090-UXNFBMF-Sxx |
| | Encoder feedback, bayonet | 2090-UXNFBMP-Sxx 2090-XXNFMP-Sxx |
| Continuous-flex | Encoder feedback, bayonet | 2090-XTFMP-Sxx |
| | Encoder feedback, threaded | 2090-CFBM4DF-CDAFxx |

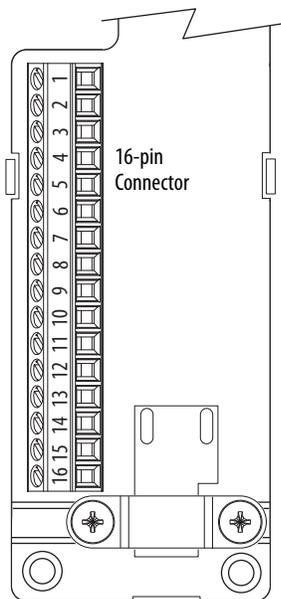
Figure 81 - 2198-H2DCK Converter Kit Pinout



| Terminal | Signal | Wire Color | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|----------|------------------------|--------------|--------------------------|-----------------------------|
| 1 | SIN+ | Black | 5.0 (0.2) | 0.22...0.25 (1.9...2.2) |
| 2 | SIN- | White/Black | | |
| 3 | COS+ | Red | | |
| 4 | COS- | White/Red | | |
| 5 | DATA+ | Green | | |
| 6 | ECOM ⁽¹⁾ | White/Gray | | |
| 7 | EPWR_9V ⁽²⁾ | Orange | | |
| 10 | DATA- | White/Green | | |
| 11 | TS | White/Orange | | |
| 14 | EPWR_5V ⁽²⁾ | Gray | | |

- (1) The ECOM and TS- connections are tied together and connect to the cable shield.
- (2) The converter kit generates 9V and 5V from a 12V supply coming from the drive. The 9V supply is used by 9V encoders in 460V motors and actuators.

Figure 82 - 2198-K57CK-D15M Connector Kit Pinout



| Terminal | Signal | Wire Color | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|----------|---------------------|--------------|--------------------------|-----------------------------|
| 1 | SIN+ AM+ | Black | 5.0 (0.2) | 0.22...0.25 (1.9...2.2) |
| 2 | SIN- AM- | White/Black | | |
| 3 | COS+ BM+ | Red | | |
| 4 | COS- BM- | White/Red | | |
| 5 | DATA+ IM+ | Green | | |
| 6 | ECOM ⁽¹⁾ | White/Gray | | |
| 7 | EPWR_9V | Orange | | |
| 8 | S3 | White/Yellow | | |
| 9 | CLK+ | Brown | | |
| 10 | DATA- IM- | White/Green | | |
| 11 | TS | White/Orange | | |
| 12 | S1 | White/Blue | | |
| 13 | S2 | Yellow | | |
| 14 | EPWR_5V | Gray | | |
| 15 | CLK- | White/Brown | | |
| 16 | Drain | N/A | | |

- (1) The ECOM and TS- connections are tied together and connect to the cable shield.

Motor Feedback Cable Preparation

Observe the lead preparation guidelines for each of the connector kits.

IMPORTANT This length of wire is needed to provide a service loop for the longest wires terminated at the terminal block. However, most wires need to be trimmed shorter, depending on the terminal they are assigned to.

Figure 83 - Lead Preparation for 2198-H2DCK Converter Kit

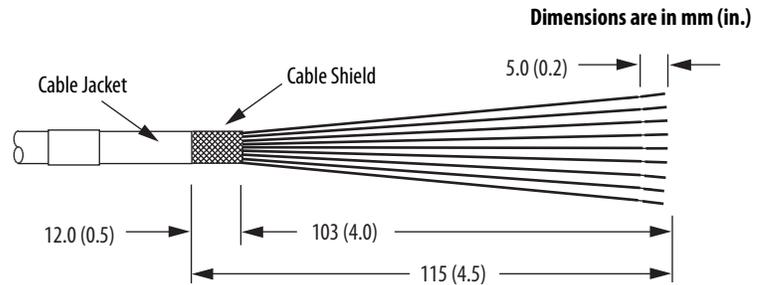
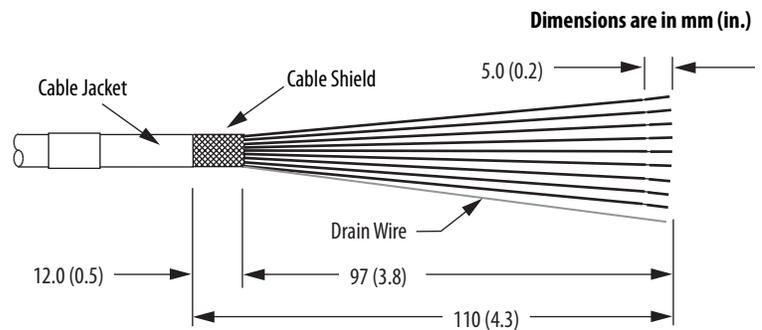


Figure 84 - Lead Preparation for 2198-K57CK-D15M Connector Kit



IMPORTANT For the 2198- K57CK-D15M universal connector kit, if your 2090-Series motor cable does not include a drain wire, you must create one from the overall shield during wire preparation and connect it to pin 16.

Apply the Converter Kit/Connector Kit Shield Clamp

Follow these steps to apply the shield clamp.

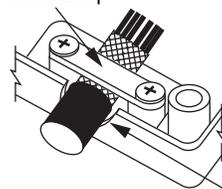
1. Apply the shield clamp to the 12 mm (0.5 in.) of exposed cable shield.

IMPORTANT Cable preparation and positioning/wiring that provides a high-frequency bond between the shield braid/drain wire and ground is required to optimize system performance.

Also, make sure that the cable is positioned where the cover clamps onto the jacket for added stress relief.

- a. For the 2198- H2DCK converter kit, the shield clamp achieves a high-frequency bond between the shield braid and ground. Apply 0.30 N•m (2.6 lb•in) torque to the clamp screws.

Shield Clamp



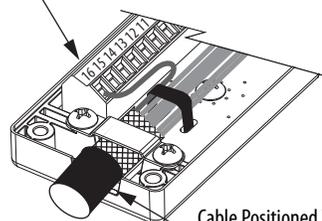
Cable Positioned Where Cover Clamps Onto the Cable Jacket

- b. For the 2198- K57CK-D15M connector kit, you must attach the drain wire to pin 16 to achieve a high-frequency bond.

IMPORTANT If your 2090-Series motor cable does not include a drain wire, you must create one from the overall shield braid.

Apply 0.34 N•m (3.0 lb•in) torque to the clamp screws.

Drain Wire



Cable Positioned Where Cover Clamps Onto the Cable Jacket

2. Route and insert each wire to its assigned terminal.

Include a service loop, as shown on [page 130](#), and refer to the connector pinout on [page 126](#).

3. Tighten each terminal screw.

Apply 0.22...0.25 N•m (1.9...2.2 lb•in) torque to each screw.

4. Gently pull on each wire to make sure it does not come out of its terminal; reinsert and tighten any loose wires.

5. Attach the tie wrap for added stress relief.

Table 72 - 2090-CFBM7DF-CEAxxx Feedback Cables

| Rotary Motors | MPL-B15xxx...MPL-B2xxx-V/Ex4/7xAA MPL-B3xxx...MPL-B9xxx-M/Sx7xAA MPF-Bxxx-M/S, MPS-Bxxx-M/S MPM-Bxxxxx-M/S, VPC-Bxxxxx-S HPK-Bxxxxx-M/S, HPK-Exxxxx-M/S | 2198-H2DCK Converter Kit Pin | 2198-K57CK-D15M Connector Kit Pin | Rotary Motors | VPC-Bxxxxx-Y | 2198-K57CK-D15M Connector Kit Pin |
|---------------|---|------------------------------|-----------------------------------|---------------|--------------|-----------------------------------|
| | Linear Actuators | | | | | |
| 1 | SIN+ | 1 | 1 | 1 | – | 1 |
| 2 | SIN– | 2 | 2 | 2 | – | 2 |
| 3 | COS+ | 3 | 3 | 3 | CLK+ | 9 |
| 4 | COS– | 4 | 4 | 4 | CLK– | 15 |
| 5 | DATA+ | 5 | 5 | 5 | DATA+ | 5 |
| 6 | DATA– | 10 | 10 | 6 | DATA– | 10 |
| 9 | EPWR_5V | – | 14 | 9 | EPWR_9V | 7 |
| 10 | ECOM | 6 ⁽¹⁾ | 6 ⁽¹⁾ | 10 | ECOM | 6 ⁽¹⁾ |
| 11 | EPWR_9V | 7 | 7 | 11 | – | – |
| 12 | ECOM | 6 | 6 | 12 | ECOM | 6 |
| 13 | TS | 11 | 11 | 13 | TS | 11 |

(1) The ECOM and TS- connections are tied together and connect to the cable shield.

Table 73 - 2090-XXNFMF-Sxx or 2090-CFBM7DF-CDAxxx Feedback Cables

| Rotary Motors | MPL-B15xxx...MPL-B2xxx-Hx4/7xAA MPL-B3xxx...MPL-B45xxx-Hx4/7xAA | RDB-Bxxxx-7/3 | 2198-K57CK-D15M Connector Kit Pin |
|---------------|--|---------------|-----------------------------------|
| | Linear Actuators | | |
| 1 | AM+ | SIN+ | 1 |
| 2 | AM– | SIN– | 2 |
| 3 | BM+ | COS+ | 3 |
| 4 | BM– | COS– | 4 |
| 5 | IM+ | DATA+ | 5 |
| 6 | IM– | DATA– | 10 |
| 9 | EPWR_5V | EPWR_5V | 14 |
| 10 | ECOM | ECOM | 6 ⁽¹⁾ |
| 12 | ECOM | ECOM | 6 |
| 13 | TS | TS | 11 |

(1) The ECOM and TS- connections are tied together and connect to the cable shield.

A mounting bracket is included with the 2198-H2DCK converter kit to secure the kit to the drive. Install the mounting bracket in the bottom mounting position on the kit, and the kit mounting holes on the drive.

Figure 85 - Wiring the 2198-H2DCK Feedback Converter Kit

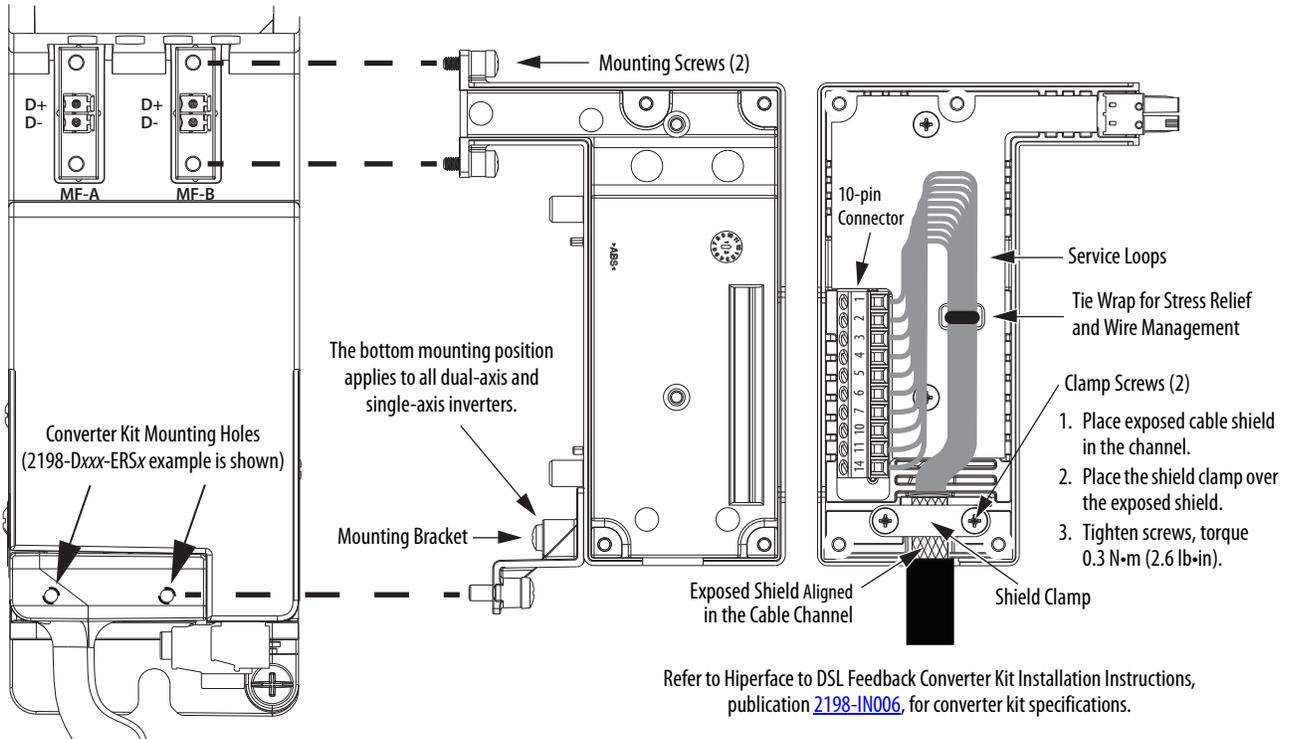
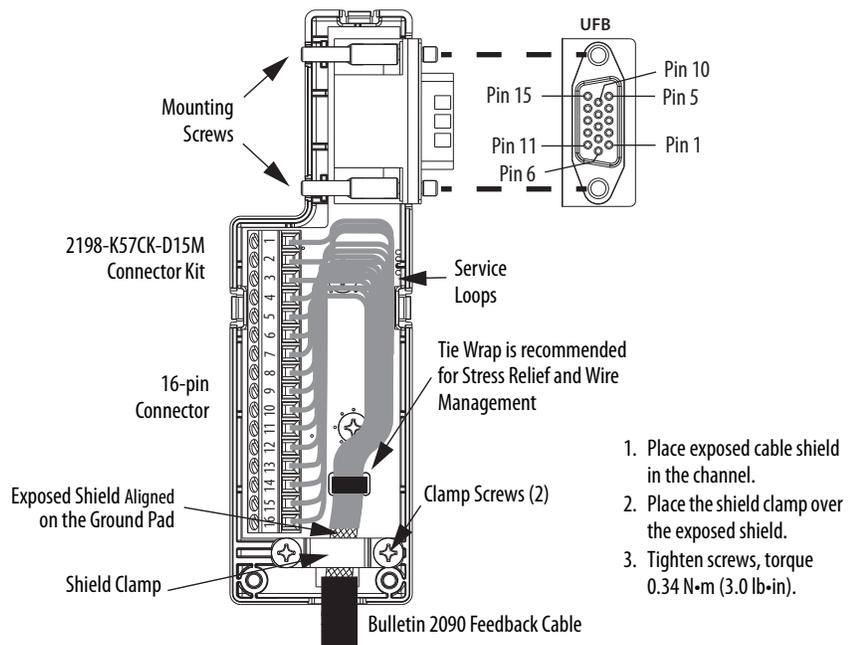


Figure 86 - Wiring the 2198-K57CK-D15M Feedback Connector Kit



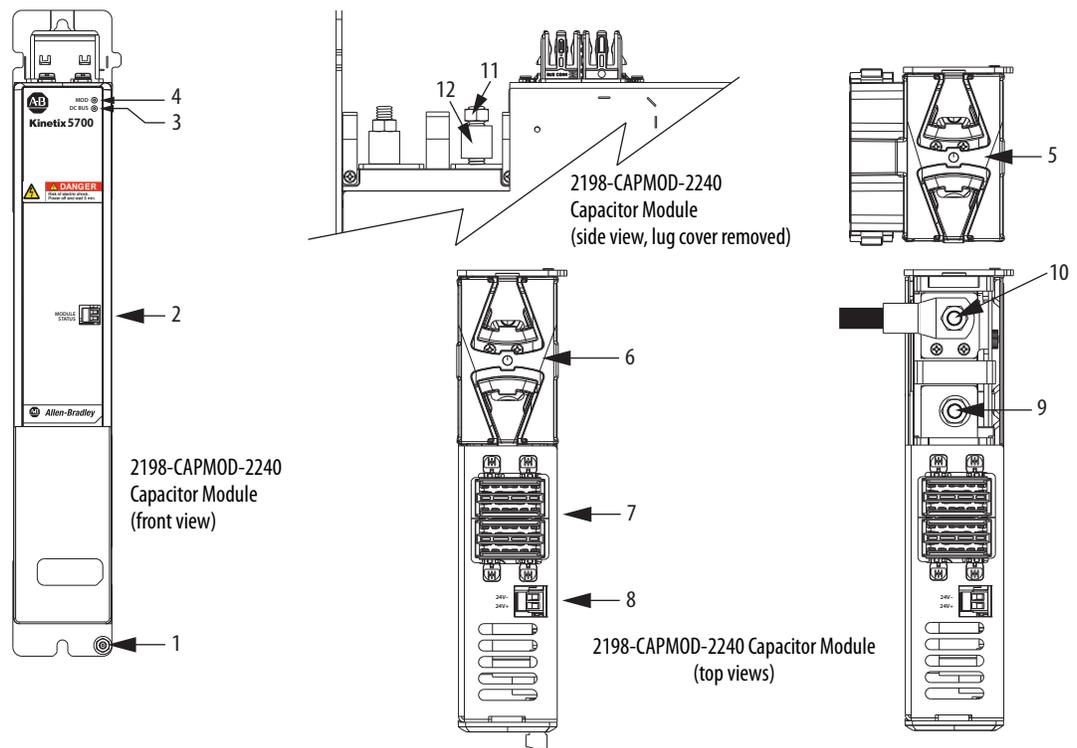
Capacitor Module Connections

Follow these guidelines when wiring the 2198-CAPMOD-2240 capacitor module and 2198-CAPMOD-DCBUS-IO extension module:

- Wire module status (MS) relay output connections to digital input Bus Capacitor OK or the Logix 5000™ controller (optional).
- Refer to [Kinetix 5700 Capacitor Module](#) wiring example on [page 285](#).
- Refer to [Kinetix 5700 Capacitor Module Status Indicators](#) on [page 224](#) for troubleshooting the module status indicators and relay output.
- Refer to the installation instructions provided with your Kinetix 5700 capacitor module, publication [2198-IN008](#).

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Chapter 2](#). Connections to the DC bus must be made with the shared-bus connection system.

Figure 87 - Capacitor Module Features and Indicators

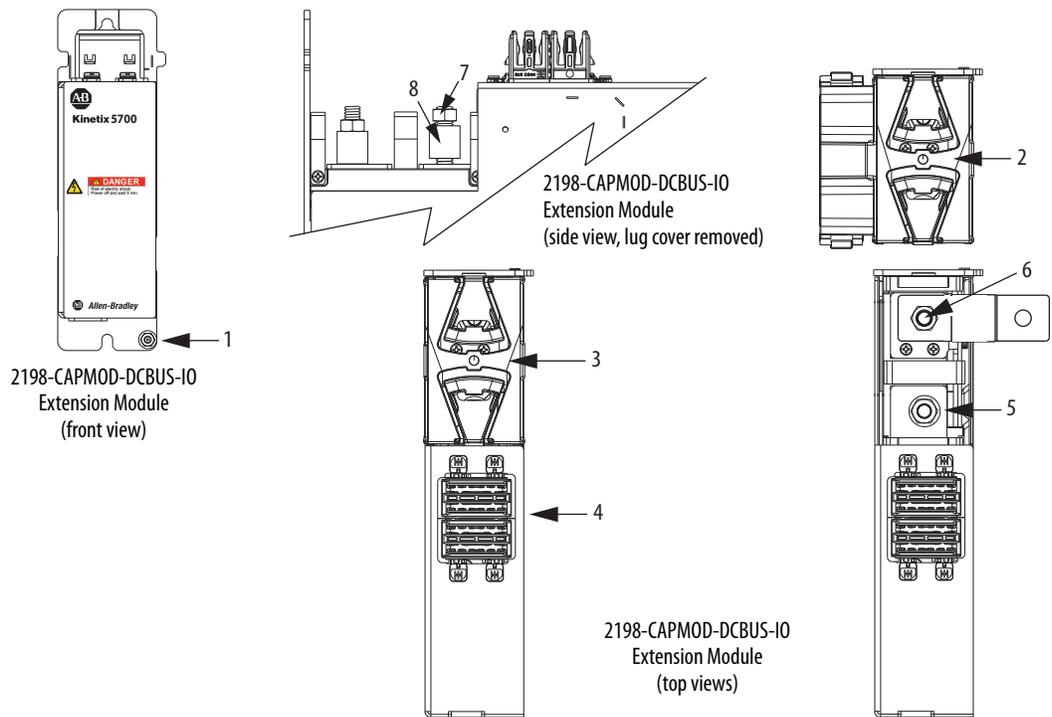


| Item | Description |
|------|--|
| 1 | Ground stud |
| 2 | Module status (MS) connector |
| 3 | DC-bus status indicator |
| 4 | Module status indicator |
| 5 | Stud/lug cover with wires ⁽¹⁾ |
| 6 | Stud cover without wires |

| Item | Description |
|------|--|
| 7 | DC-bus (DC) connector |
| 8 | 24V control input power (CP) connector |
| 9 | DC- M8 stud (external DC-bus) |
| 10 | DC+ M8 stud (external DC-bus), shown with wire lug |
| 11 | M8 hex nut |
| 12 | Lug spacer |

(1) This example shows the lug cover oriented for wires exiting to the left (capacitor module is on the far left of the drive configuration). Rotate lug cover 180° when wires exit to the right (capacitor module is on the far right of the drive configuration).

Figure 88 - Extension Module Features and Indicators



| Item | Description |
|------|--|
| 1 | Ground lug |
| 2 | Stud/lug cover with wires ⁽¹⁾ |
| 3 | Stud cover without wires |
| 4 | DC-bus (DC) connector |

| Item | Description |
|------|---|
| 5 | DC- M8 stud (external DC-bus) |
| 6 | DC+ M8 stud (external DC-bus), shown with flexible bus-bar (2x) |
| 7 | M8 hex nut |
| 8 | Lug spacer |

(1) This example shows the lug cover oriented for wires exiting to the left (extension module is on the far left of drive configuration). Rotate lug cover 180° when wires exit to the right (extension module is on the far right of drive configuration).

Table 74 - Capacitor Module Connector Specifications

| Connector Description | Pin | Signal | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|-------------------------------|--------------|------------------|---|-----------------------|----------------------------|
| Module Status | MS-1 MS-2 | RELAY+ RELAY- | 0.14...1.5 (28...16) | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) |
| PELV/SELV 24V power (plug) | CP-1 CP-2 | 24V+ 24V- | 0.5...2.5 (20...14) | 7.0 (0.28) | 0.22...0.25 (1.9...2.2) |
| DC-bus power | Bus-bar | DC- DC+ | N/A ⁽¹⁾ | N/A ⁽¹⁾ | N/A ⁽¹⁾ |
| DC-bus studs | Bus-bar | | N/A | N/A | 18 (156) |
| | Lugs | | 53.5 (1/0) 100 A 85.0 (3/0) 200 A | N/A ⁽²⁾ | |

(1) DC bus connections are always made from one drive module to another over the shared-bus connection system. These terminals do not receive discrete wires.

(2) Strip length for the DC-bus studs depend on the customer-supplied lugs.

External Passive-shunt Connections

Follow these guidelines when wiring your 2198-Rxxx passive shunt:

- Refer to [External Passive Shunt Modules](#) on [page 46](#) for noise zone considerations.
- Refer to [Passive Shunt Resistor Wiring Examples](#) on [page 293](#).
- Refer to the installation instructions provided with your Bulletin 2198 shunt module, publication [2198-IN011](#).

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Chapter 2](#).

Figure 89 - RC Connector Wiring

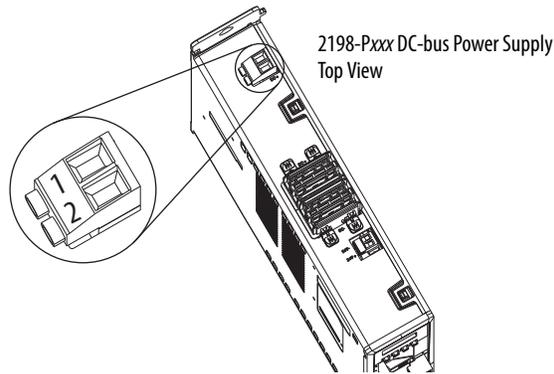


Table 75 - Shunt Resistor (RC) Connector Specifications

| DC-bus Power Supply Cat. No. | Pin | Signal | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|------------------------------|--------------|-----------|---|-----------------------|--------------------------|
| 2198-Pxxx | RC-1 RC-2 | SH DC+ | 1.5...6 (16...10) | 12.0 (0.47) | 0.5...0.6 (4.4...5.3) |

IMPORTANT You must disconnect the internal shunt wires at the RC connector before connecting the Bulletin 2198 shunt resistor wires.

Table 76 - Shunt Resistor Compatibility

| DC-bus Power Supply Cat. No. | Kinetix 5700 Shunt Module ⁽¹⁾ Cat. No. | | | |
|------------------------------|--|-----------|-----------|-----------|
| | 2198-R127 | 2198-R031 | 2198-R014 | 2198-R004 |
| 2198-P031 | N/A | N/A | X | X |
| 2198-P070 | N/A | N/A | X | X |
| 2198-P141 | X | X | X | X |
| 2198-P208 | X | X | X | X |

(1) Shunt resistor selection is based on the needs of your actual hardware configuration.

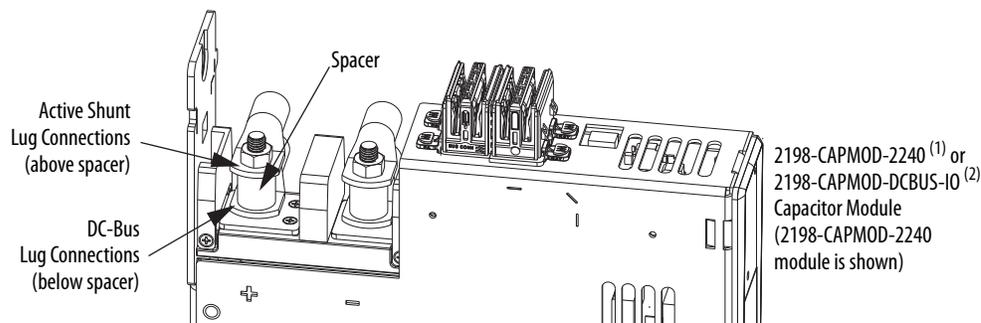
External Active-shunt Connections

Active shunts are available from the Rockwell Automation® Encompass™ Partner Powerohm Resistors, Inc.

| Rockwell Automation Encompass Partners | Contact Information |
|--|---|
| Powerohm Resistors, Inc. | 5713 13th Street Katy, Texas 77493 Tel: (800) 838-4694 http://www.powerohm.com |

Active shunts wire to the DC-bus studs. The capacitor modules are equipped with spacers that slide onto the M8 studs. When the system configuration includes external DC-bus and active shunt connections, external DC-bus connections are made below the spacer and active shunt connections are made above the spacer.

Figure 90 - Active Shunt Connections



- (1) A 2198-CAPMOD-2240 capacitor module is needed in systems with the external DC-bus current up to 100 A.
- (2) A 2198-CAPMOD-DCBUS-10 extension module is needed if the external DC-bus current is greater than 100 A, up to a maximum of 200 A. See [Mounting Capacitor Modules](#) on [page 52](#) for example configurations that include these capacitor modules.

Table 77 - Active Shunts Compatible with Kinetix 5700 Drive Systems

| Rockwell Automation Encompass Partners | Powerohm Cat. No. (1) | Power Rating kW | Current Rating Amps |
|--|-----------------------|-----------------|---------------------|
| Powerohm Resistors, Inc. | PKB005 | 1.5 | N/A |
| | PKB010 | 2.0 | N/A |
| | PKB050 | 7.0 | N/A |
| | PWB035 | 22.7 | 35 |
| | PWB110 | 71.5 | 110 |

(1) PKBxxx active shunt modules use built-in internal brake resistors. PWBxxx active shunt modules require appropriately sized external brake resistors.



ATTENTION: Do not use Powerohm active-shunt modules at input line voltages that exceed 500V AC. Active-shunt thermal-overload shutdown can occur if input line voltage exceeds 500V AC.

Bulletin VPC Motors and the Extended Speed Feature

The extended speed feature is implemented in the Logix Designer application to prevent accidental motor operation at unsafe speeds. See [Field Weakening Mode](#) on [page 367](#) for a description of this feature.



WARNING: Bulletin VPC motor operation at speeds exceeding the bus-overvoltage speed limit can result in personal injury and/or damage to the drive. To avoid equipment damage and personal injury, an active shunt must be configured in the Logix Designer application to protect the DC-bus system from an overvoltage condition.

IMPORTANT Refer to Motion Analyzer software to verify drive/shunt system sizing. Access the tool at <https://motionanalyzer.rockwellautomation.com>.

Powerohm Bulletin PKB and PWB active-shunt modules are required for DC-bus system protection when Bulletin VPC motors are expected to operate in the extended speed region at speeds exceeding the bus-overvoltage speed limit.

Considerations for Powerohm Shunt Installation

Refer to the Powerohm documentation included with your Bulletin PKB or PWB shunt module to install, wire, and configure the module.

- To avoid nuisance thermal overload trips, configure Bulletin PKB and PWB active-shunt modules to the highest shunt turn-on voltage setting. The recommended setting for Line Voltage Level Jumper is JP5.
- Configure Bulletin PKB and PWB active-shunt modules in Internal (automatic) mode. Unless an external enable signal is provided, configure the Brake Enable Jumper in Internal (automatic) mode (JP6 is in the downward position).

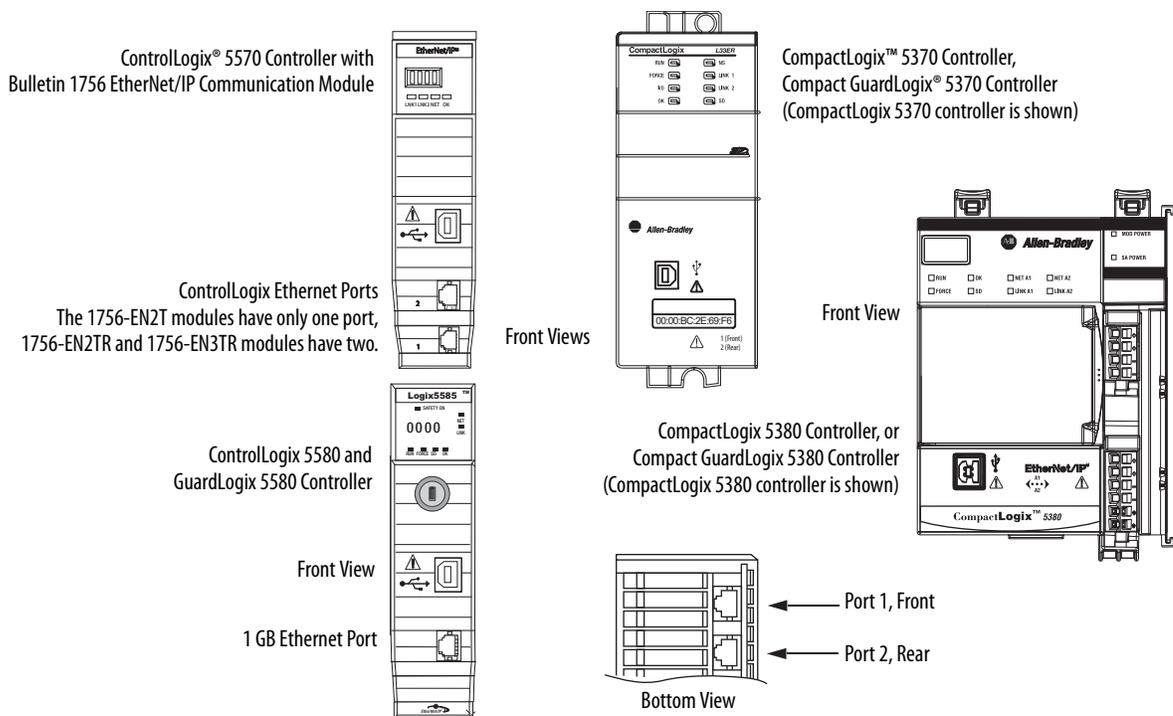
Ethernet Cable Connections

This procedure assumes that you have your Logix 5000 controller and Kinetix 5700 modules mounted and are ready to connect the network cables.

The EtherNet/IP™ network is connected by using the PORT 1 and PORT 2 connectors. Refer to [page 64](#) to locate the Ethernet connectors on your drive module. Refer to [Figure 91](#) to locate the connectors on your Logix 5000 controller.

Shielded Ethernet cable is required and available in several standard lengths. Ethernet cable lengths connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft). Refer to the Kinetix Motion Accessories Specifications Technical Data, publication [KNX-TD004](#), for more information.

Figure 91 - ControlLogix and CompactLogix Ethernet Port Locations



The Logix 5000 controllers accept linear, ring (DLR), and star network configurations. Refer to [Typical Communication Configurations](#) on [page 24](#) for linear, ring, and star configuration examples.

IMPORTANT When using an external Ethernet switch for routing traffic between the controller and the drive, switches with IEEE-1588 time synchronization capabilities (boundary or transparent clock) must be used to make sure switch delays are compensated.

IMPORTANT The iTRAK power supply requires an Ethernet connection for firmware upgrades by using ControlFLASH™ software. Although Ethernet is not required during normal operation, it can also be used to access real-time data, for example, event logging.

Configure and Start the Kinetix 5700 Drive System

This chapter provides procedures for configuring your Kinetix® 5700 drive system with a Logix 5000™ controller by using the Logix Designer application.

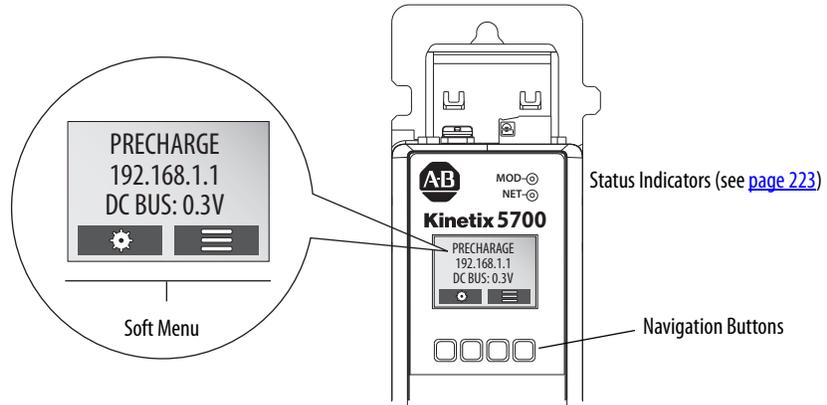
| Topic | Page |
|---|------|
| Understand the Kinetix 5700 Display | 138 |
| Configure the Drive | 146 |
| Studio 5000 Logix Designer | 146 |
| Configure the Kinetix 5700 Drive Modules | 151 |
| Configure the Motion Group | 167 |
| Configure Vertical Load Control Axis Properties | 168 |
| Configure Feedback-only Axis Properties | 169 |
| Configure Induction-motor Frequency-control Axis Properties | 171 |
| Configure IPM Motor Closed-loop Control Axis Properties | 180 |
| Configure SPM Motor Closed-loop Control Axis Properties | 184 |
| Configure Induction-motor Closed-loop Control Axis Properties | 188 |
| Configure Feedback Properties | 195 |
| Download the Program | 200 |
| Apply Power to the Kinetix 5700 Drive System | 201 |
| Understand Bus-sharing Group Configuration | 202 |
| Test and Tune the Axes | 205 |

TIP Before you begin, make sure that you know the catalog number for each drive module, the Logix module and /or controller, and the motor used in your motion control application.

Understand the Kinetix 5700 Display

The Kinetix 5700 drives have two status indicators and an LCD status display. The indicators and display are used to monitor the system status, set network parameters, and troubleshoot faults. Four navigation buttons, directly below the display, are used to select items from a soft menu.

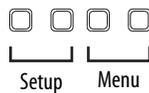
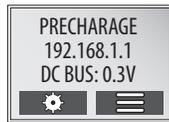
Figure 92 - Kinetix 5700 Drive LCD Display and Status Indicators



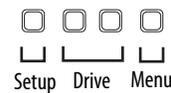
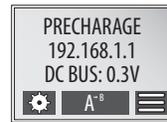
This is the Home screen.

- The setup selections are tied to the Setup (left-side) buttons and the menu selections are tied to the Menu (right-side) buttons.
- For dual-axis inverters, the Drive (center) buttons toggle the display between drive A and B (A is the default drive).

DC-bus Power Supplies and Single-axis Inverters

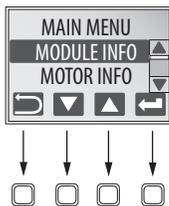


Dual-axis Inverters



The soft menu provides a changing selection that corresponds to the current screen. Use the navigation buttons to perform the following.

Each soft menu item is executed by pressing the navigation button directly below the item, as shown in this example.



| | |
|--|---|
| | Press to go back. Pressing enough times results in the Home screen. |
| | Pressing either arrow moves the selection to the next (or previous) item. When changing values, pressing the up arrow increments the highlighted value. Values rollover after reaching the end of the list. |
| | Press to select values to change, moving from right to left. Values rollover when reaching the end of the list. |
| | Press to select a menu item. |
| | Press to return to the Home screen. |
| | Press to display the fault help (possible solutions in troubleshooting tables). ⁽¹⁾ |

(1) Refer to [Fault Codes](#) beginning on [page 214](#) to review the troubleshooting tables.

Menu Screens

The menu screens provide information about the drives, motors, diagnostics, and the fault log. Parameters cannot be updated in the menu screens. Press one of the menu buttons to access the menu.

You can use the soft menu items and navigation buttons to view the information.

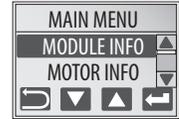


Table 78 - Navigating the Inverter Menu

| Menu/Sub Menu Selections | Attributes | Description | Example Values | |
|-------------------------------------|----------------------------------|---|---|-------------------|
| Drive Info | Catalog number | | 2198-xxxx-ERS4 | |
| | Firmware revision | | FW REV: 1.1.450167 | |
| | Hardware revision | | HW REV: 1.1 | |
| | Serial number | | SERIAL#: xxxxxxxxxxxx | |
| Motor Info | Model number | | MODEL: VPL-B1306F | |
| | Serial number | | SERIAL#: xxxxxxxxxxxx | |
| Diagnostics> Drive Diagnostics | Bus diagnostics | | BUS VOLT: 0.0V | |
| | | | BUS CUR: 0.0A | |
| | Inverter diagnostics | | INV UTIL: 0.0% | |
| | | | INV TEMP: 31.7C | |
| Diagnostics> Motor Diagnostics | Motor speed | | SPEED:0.0 RPM | |
| | Motor current | | MTR CUR:0.0A RMS | |
| | Motor utilization | | MTR UTIL:0.0% | |
| | Motor temperature | | MTR TEMP:0.00C | |
| Diagnostics> Encoder Diagnostics | Serial number | | SERIAL#xxxxxxxxxxx | |
| | Resolution | | RESOLUTION: 262144 | |
| | Number of turns | | NO OF TURNS: 1 | |
| | Encoder temperature | | ENC TEMP:33.7C | |
| | Supply voltage | | SUPP VOLT:11.3V | |
| | Link quality | The link quality attribute indicates how noisy a communication link is and also indicates if there is a communication link already established at the drive end. The LINK QUAL value must always be 100%. Persistent values below 100% indicates a poor feedback ground connection. | | LINK QUAL: 100.0% |
| | Remote signal strength indicator | Similar to Link Quality, RSSI reports the quality of link as seen at the motor end by the encoder. Maintain the RSSI value between 80 and 100%. Persistent values below 80% indicates a poor feedback ground connection. | | RSSI: 100.0% |
| | Accumulated position errors | This is an aggregated number of errors in the primary position feedback channel of DSL feedback. | | POS ERRORS: 1 |
| | Channel position errors | This is an aggregated number of errors on a secondary communication channel of the DSL feedback. | | CHNL ERRORS: 5 |
| Diagnostics> Safety Inputs | Hardwired input status | | 1 2 OFF OFF 1 2 ON ON | |
| Diagnostics> Safety Diagnostics | Safety state | This attribute indicates the state of the safety supervisor object (refer to Safety Supervisor State on page 250). | | |
| | Input connections | This attribute indicates the number of safety controllers that have an input connection established. The input connection provides the controller with the drive's safety status. The drive supports up to three input connections. | SAFETY STATE:CONFIGURING INPUT CONNECTIONS:1 OUTPUT CONNECTIONS:1 | |
| | Output connections | This attribute indicates the number of safety controllers that have an output connection established. The output connection provides a controller with the ability to control the drive's STO function. The drive allows only one output connection. | SAFETY STATE:RUNNING INPUT CONNECTIONS:1 OUTPUT CONNECTIONS:1 | |

Table 78 - Navigating the Inverter Menu (continued)

| Menu/Sub Menu Selections | Attributes | Description | Example Values |
|--------------------------|---------------|--|--|
| Fault Log | Fault text | Fault code as listed in Fault Codes beginning on page 214 . | FLT S20 - CONV OVERLOAD FL |
| | Fault details | The problem as reported in Fault Codes on page 214 . | The converter thermal model indicates that the temperature has exceeded the factory set capacity rating of 110%. |
| | Fault help | The Possible Solution as reported in Fault Codes on page 214 . | <ul style="list-style-type: none"> Reduce the number of drives in the same bus group Reduce duty-cycle of commanded motion |

Table 79 - Navigating the DC-bus Power Supply Menu

| Menu/Sub Menu Selections | Attributes | Description | Example Values |
|--|-----------------------|--|---|
| Module Info | Catalog number | | 2198-Pxxx |
| | Firmware revision | | FW REV: 1.1.450167 |
| | Hardware revision | | HW REV: 1.1 |
| | Serial number | | SERIAL#: xxxxxxxxxxxx |
| Diagnostics> Converter Diagnostics | Bus diagnostics | | BUS VOLT: 0.0V BUS CUR: 0.0A |
| | Converter diagnostics | | CONV UTIL: 0.7% CONV TEMP: 31.7C |
| | Shunt utilization | | SHUNT UTIL: 0.0% |
| Fault Log | Fault text | Fault code as listed in Fault Codes beginning on page 214 . | FLT S45 - FDBK COMM FL |
| | Fault details | The problem as reported in Fault Codes on page 214 . | The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a factory set limit |
| | Fault help | The Possible Solution as reported in Fault Codes on page 214 . | Check motor feedback cable and connector |

Table 80 - Navigating the iTRAK Power Supply Menu

| Menu/Sub Menu Selections | Attributes | Description | Example Values |
|--|----------------------|--|--|
| Module Info | Catalog number | | 2198T-W25K-ER |
| | Firmware revision | | FW: 6.1.7100254 |
| | Hardware revision | | HW REV: 1.1 |
| | Serial number | | SERIAL#: xxxxxxxxxxxx |
| Diagnostics> Converter Diagnostics | Bus diagnostics | | BUS VOLT: 0.0V |
| | Output 1 diagnostics | | OUT1 VOLT: 0.0V |
| | | | OUT1 AMPS: 0.0A |
| | | | OUT1 PWR: 0.0kW |
| | | | OUT1 UTIL: 0.0% |
| | Output 2 diagnostics | | OUT2 VOLT: 0.0V |
| | | | OUT2 AMPS: 0.0A |
| | | OUT2 PWR: 0.0kW | |
| | | OUT2 UTIL: 0.0% | |
| Converter diagnostics | | TOTAL PWR: 0.0kW | |
| Fault Log | Fault text | Fault code as listed in Fault Codes beginning on page 214 . | FLT S38 - FUSE BLOWN |
| | Fault details | The problem as reported in Fault Codes on page 214 . | The internal DC-bus power fuse is blown |
| | Fault help | The Possible Solution as reported in Fault Codes on page 214 . | Return drive for repair if fault continues |

Setup Screens

The setup screens provide the means of changing drive settings, for example, the IP address. Press one of the setup buttons to access the setup screens.

You can use the soft menu items and navigation buttons to view the information and make changes.



Press  to validate your changes:

- If the change is invalid, the value doesn't change.
- If the change is valid, an asterisk appears next to the changed attribute.



IMPORTANT You must cycle control power to make network configuration changes persistent. In this example, the IP address was changed. The change takes affect and the asterisk disappears after control power is cycled. Display configuration changes take effect immediately.

Table 81 - Navigating the Inverter Settings Menu

| Settings Menu Selections | Sub Menu Selections | Attributes | Default | Description | |
|--------------------------|-----------------------------------|--|-------------------------|---|---------------------------------|
| Protected Mode | Reset | ENABLED DISABLED | ENABLED | When Enabled (default), identity object or safety resets are not possible when a controller connection is open. | |
| | Network Config | ENABLED DISABLED | ENABLED | When Enabled (default), network configuration changes are not possible when a controller connection is open. | |
| | Flash Update | ENABLED DISABLED | ENABLED | When Enabled (default), firmware updates are not possible when a controller connection is open. | |
| | Device Config | ENABLED DISABLED | ENABLED | When Enabled (default), only attribute writes are possible when a controller connection is open. | |
| Network | ->Static IP ⁽¹⁾ | IP address | 192.168.1.1 | Indicates current IP address | |
| | | Subnet mask | 255.255.255.000 | Indicates current subnet mask | |
| | | Gateway | 192.168.001.001 | Indicates current gateway | |
| | DHCP | On | | | Turns DHCP on |
| | | Off | | | Turns DHCP off |
| Display | Backlight Timeout | 30 sec... NEVER (NEVER=no timeout period, the backlight is always on) | -> 3 min ⁽¹⁾ | Sets backlight timeout period of the display | |
| | Cyclic Data Select ⁽²⁾ | ->DC BUS ⁽¹⁾ | | | DC bus voltage |
| | | INV UTIL | | | Inverter utilization in percent |
| | | INV TEMP | | | Inverter temperature in °C |
| | | MOTOR UTIL | | | Motor utilization in percent |
| | | SPEED | | | RPM |
| | | OUT PWR | | | Output power in watts |
| | | OUT FREQ | | | Output frequency in hertz |
| | OUT CUR | | | Output current in amps | |
| | Set Contrast | -10...+10 | 0 | | Contrast setting of the display |
| Safety | Reset Ownership | Are you sure? | | Resets safety ownership (reset fails after 30 seconds) | |
| Web | Enabled | | | Enables the web server | |
| | ->Disabled | | | Disables the web server | |

(1) An arrow (->) appears in front of the chosen attribute indicating that this attribute is currently configured. This is also the factory default setting.

(2) The DC bus voltage is one of several cyclic data attributes. You can select any of the Cyclic Data Select attributes to be displayed on the Home screen.

Table 82 - Navigating the DC-bus Power Supply Settings Menu

| Settings Menu Selections | Sub Menu Selections | Attributes | Default | Description |
|--------------------------|-----------------------------------|---|-------------------------|---|
| Protected Mode | Reset | ENABLED DISABLED | ENABLED | When Enabled (default), identity object or safety resets are not possible when a controller connection is open. |
| | Network Config | ENABLED DISABLED | ENABLED | When Enabled (default), network configuration changes are not possible when a controller connection is open. |
| | Flash Update | ENABLED DISABLED | ENABLED | When Enabled (default), firmware updates are not possible when a controller connection is open. |
| | Device Config | ENABLED DISABLED | ENABLED | When Enabled (default), only attribute writes are possible when a controller connection is open. |
| Network | ->Static IP ⁽¹⁾ | IP address | 192.168.1.1 | Indicates current IP address |
| | | Subnet mask | 255.255.255.000 | Indicates current subnet mask |
| | | Gateway | 192.168.001.001 | Indicates current gateway |
| | DHCP | On | | Turns DHCP on |
| | | Off | | Turns DHCP off |
| Display | Backlight Timeout | 30 sec. . . NEVER (NEVER=no timeout period, the backlight is always on) | -> 3 min ⁽¹⁾ | Sets backlight timeout period of the display |
| | Cyclic Data Select ⁽²⁾ | ->DC BUS ⁽¹⁾ | | DC bus voltage |
| | | CONV UTIL | | Converter utilization in percent |
| | | CONV TEMP | | Converter temperature in °C |
| | | SHUNT UTIL | | Shunt utilization in percent |
| | | OUT PWR | | Output power in watts |
| | | DC BUS CUR | | Output current in amps |
| | Set Contrast | -10 . . . +10 | 0 | Contrast setting of the display |

(1) An arrow (->) appears in front of the chosen attribute indicating that this attribute is currently configured. This is also the factory default setting.

(2) The DC bus voltage is one of several cyclic data attributes. You can select any of the Cyclic Data Select attributes to be displayed on the Home screen.

Table 83 - Navigating the iTRAK Power Supply Settings Menu

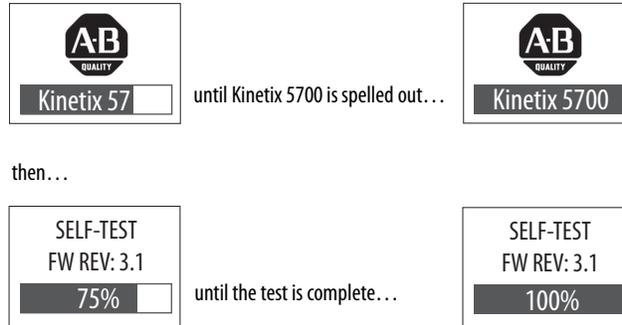
| Settings Menu Selections | Sub Menu Selections | Attributes | Default | Description |
|--------------------------|-----------------------------------|--|---------------------------------|--|
| Network | ->Static IP ⁽¹⁾ | IP address | 192.168.1.1 | Indicates current IP address |
| | | Subnet mask | 255.255.255.000 | Indicates current subnet mask |
| | | Gateway | 192.168.001.254 | Indicates current gateway |
| | DHCP | On | | Turns DHCP on |
| | | Off | | Turns DHCP off |
| Display | Backlight Timeout | 30 sec . . . NEVER (NEVER=no timeout period, the backlight is always on) | -> 3 min ⁽¹⁾ | Sets backlight timeout period of the display |
| | Cyclic Data Select ⁽²⁾ | -> BUS VOLT ⁽¹⁾ | | DC bus voltage in volts |
| | | OUT1 VOLT | | Output 1 voltage in volts |
| | | OUT1 AMPS | | Output 1 current in amps |
| | | OUT1 PWR | | Output 1 power in kilowatts |
| | | OUT1 UTIL | | Output 1 utilization in percent |
| | | OUT2 VOLT | | Output 2 voltage in volts |
| | | OUT2 AMP | | Output 2 current in amps |
| | | OUT2 PWR | | Output 2 power in kilowatts |
| | | OUT2 UTIL | | Output 2 utilization in percent |
| | | TOTAL PWR | | Total power in kilowatts |
| Set Contrast | -10 . . . +10 | 0 | Contrast setting of the display | |
| Web | Enabled | | | Enables the web server |
| | ->Disabled | | | Disables the web server |

(1) An arrow (->) appears in front of the chosen attribute indicating that this attribute is currently configured. This is also the factory default setting.

(2) The DC bus voltage is one of several cyclic data attributes. You can select any of the Cyclic Data Select attributes to be displayed on the Home screen.

Startup Sequence

On initial powerup, the drive performs a self test. Upon successful completion, the drive firmware revision is displayed.



Next, the axis state, the IP address, and the default cyclic data attribute (in this example DC bus voltage) appears. In addition, the setup and menu soft keys are displayed. This is the Home screen.



In this example PRECHARGE is the axis state attribute. [Table 84](#) lists the other axis states and their descriptions.

Table 84 - Axis States on the Home Screen

| Axis State | Description |
|-----------------|--|
| STANDBY | The drive is waiting to receive configuration information from the controller. |
| CONNECTING | The drive is trying to establish communication with the EtherNet/IP™ controller. |
| CONFIGURING | The drive is receiving configuration information from the controller. |
| SYNCING | The drive is waiting for a successful Group Sync service. |
| STOPPED | The drive has DC bus ready, but the control loops are not enabled. |
| PRECHARGE | The drive is ready for mains input power. |
| STARTING | The drive is enabled and checking various conditions before entering the RUNNING or TESTING state. For example, the drive checks the Brake Release delay time during the STARTING state. |
| RUNNING | <ul style="list-style-type: none"> The drive is enabled, configured with an active control mode, and actively tracking a command. The drive is configured for No Control and is fully operational. |
| TESTING | The drive is actively executing a test procedure, for example, a hookup test. |
| STOPPING | The drive is decelerating to a stop as the result of a disable. |
| ABORTING | The drive is decelerating to a stop as the result of a fault or an abort request. |
| MAJOR FAULTED | The drive is faulted due to an existing or past fault condition. |
| START INHIBITED | The drive has an active condition that inhibits it from being enabled. |
| SHUTDOWN | The drive has been shut down. |

Configure the Drive

You can include the drive in your Studio 5000 Logix Designer® application by adding it to a configured EtherNet/IP module or controller under the I/O configuration tree. After setting network parameters, you can view the drive status information in Studio 5000® environment and use it in your Logix Designer application.

Set the Network Parameters

You must program network parameters by using the LCD display.

1. From the LCD display, select SETUP>NETWORK and choose between STATIC IP and DHCP.

The default setting is STATIC IP.

2. If STATIC IP, then press  to configure the following parameters:
 - IP address
 - Gateway
 - Subnet mask

Settings are stored in nonvolatile memory. IP addressing can also be changed through the Module Configuration dialog box in RSLinx® software. Changes to the IP addressing take effect after power is cycled. The drive is factory programmed to static IP address of 192.168.1.1.

Refer to [Setup Screens](#) on [page 141](#) for help setting the network parameters.

Studio 5000 Logix Designer

For help using the Studio 5000 Logix Designer application as it applies to configuring the ControlLogix® or CompactLogix™ controllers, refer to [Additional Resources](#) on [page 12](#).

Kinetix 5700 Add-On Profile

The Logix Designer application, version 31.00 or later, makes possible the configuration of additional Allen-Bradley® motors, actuators, and drive features not available in previous versions.

IMPORTANT To configure additional motors, actuators, and drive features with your Kinetix 5700 servo drive, you must have drive firmware 4.001 or later. Refer to [Table 85](#) to determine if you need to install the Kinetix 5700 Add-on Profile.

Table 85 - AOP Installation Requirement

| Drive Cat. No. | Drive Firmware Revision | Logix Designer Application Version | Kinetix 5700 AOP Needed? |
|---|-------------------------------|------------------------------------|--------------------------|
| 2198-xxxx-ERS3 (series A) | 4.001 | 26.00 or 27.00 | Yes |
| | | 28.00 or later | No |
| | 5.001 | 26.00, 27.00, 28.00 | Yes |
| | | 29.00 or later | No |
| 7.001 or later ⁽¹⁾ | 29.00 or later | No | |
| 2198-xxxx-ERS3 (series B) 2198-xxxx-ERS4 | 9.001 or later ⁽²⁾ | 31.00 or later | No |

- (1) Drive firmware 7.001 enhancements are available only with the Studio 5000 Logix Designer, version 29.00 or later, firmware update. The AOP for firmware 7.001 is not available for download.
- (2) Drive firmware 9.001 enhancements are available only with the Studio 5000 Logix Designer, version 31.00 or later, firmware update. The AOP for firmware 9.001 is not available for download.

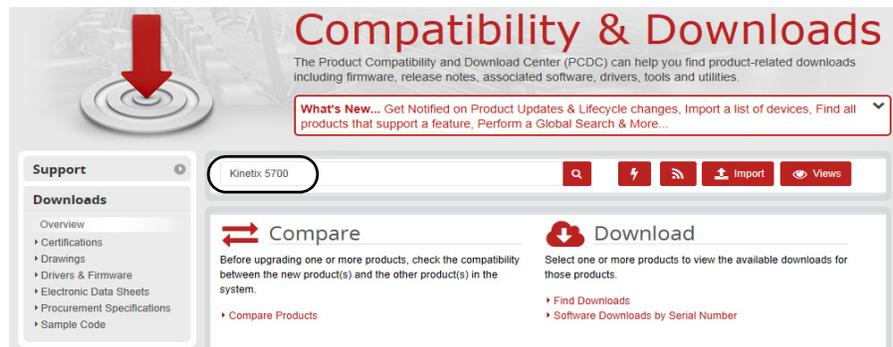
Install the Kinetix 5700 Add-On Profile

Download Add-On profiles (AOP) from the Product Compatibility Download Center (PCDC) website:

<http://compatibility.rockwellautomation.com/Pages/home.aspx>.

Follow these steps to download the Kinetix 5700 Add-On profile.

1. Go to the Product Compatibility Download Center.
The Compatibility & Downloads webpage appears.
2. Enter Kinetix 5700 in the Search PCDC window.



3. Click the appropriate firmware revision and follow prompts to download.
4. Extract the AOP zip file and run Setup.

Configure the Logix 5000 Controller

These procedures assume that you have wired your Kinetix 5700 drive system. In this example, the GuardLogix® 5580 safety controller and Compact GuardLogix 5380 controller dialog boxes are shown.

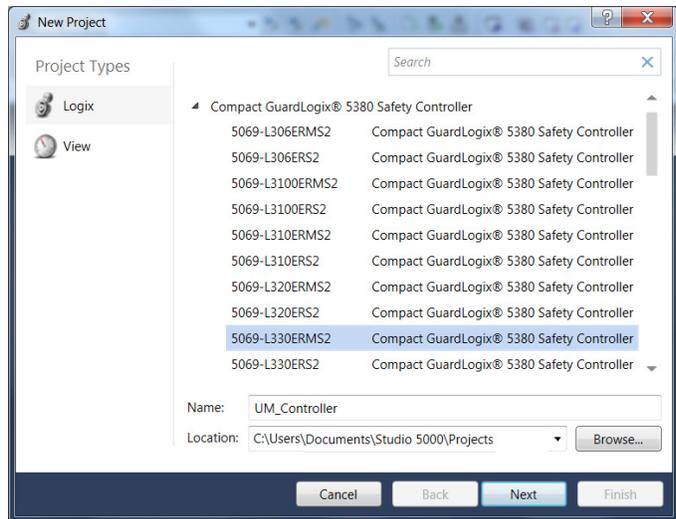
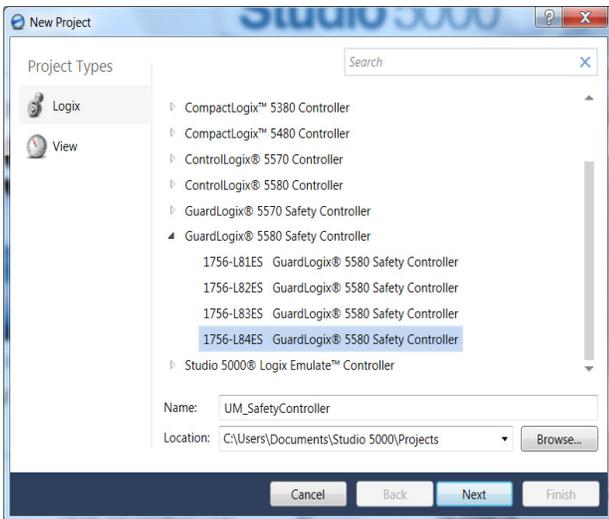
Follow these steps to configure the controller.

1. Apply power to your controller and open your Logix Designer application.



2. From the Create menu, choose New Project.

The New Project dialog box appears.



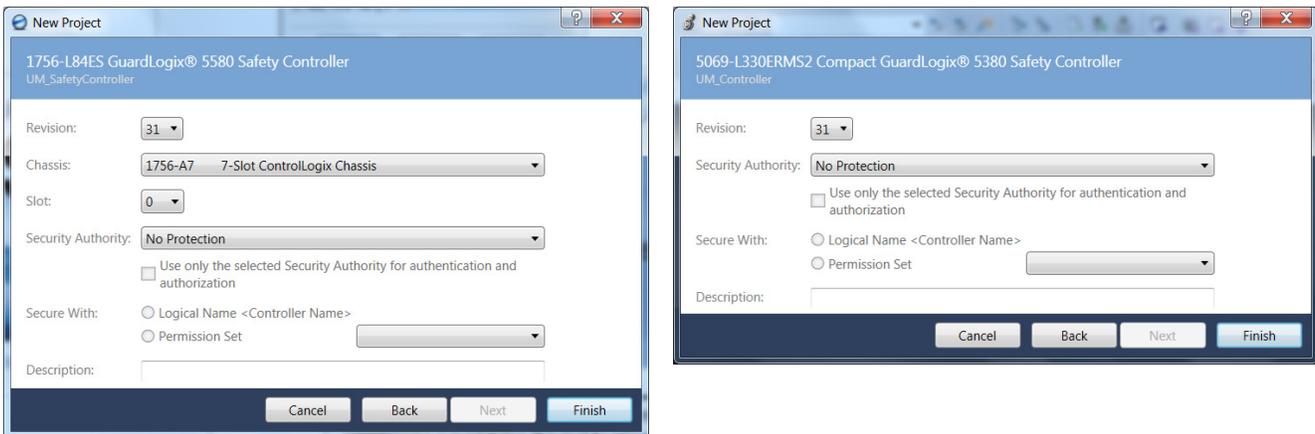
IMPORTANT If you are configuring a safety application, you must use a GuardLogix or Compact GuardLogix safety controller. If you are configuring a 2198-xxxx-ERS4 inverter in a safety application, you must use a GuardLogix 5580 or Compact GuardLogix 5380 safety controller.

In this example, the typical dialog boxes for ControlLogix and GuardLogix 5580 controllers and CompactLogix 5380 controllers with embedded Ethernet are shown.

Follow these steps to configure your Logix 5000 controller.

1. Expand the Logix 5000 controller family and select your controller.
2. Type the file Name.
3. Click Next.

The New Project dialog box appears.



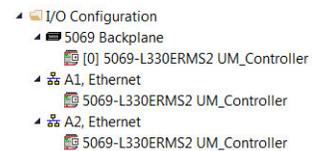
4. From the Revision pull-down menu, choose your software revision.

IMPORTANT To configure Kinetix 5700 drive systems, you must be using the Logix Designer application, version 26.00 or later.

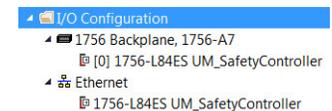
5. Click Finish.

The new controller appears in the Controller Organizer under the I/O Configuration folder.

Controller Organizer with Compact GuardLogix 5380 controller.



Controller Organizer with GuardLogix 5580 controller.

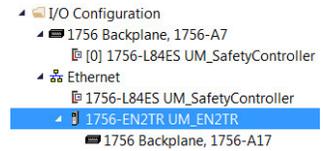


IMPORTANT If your project includes a ControlLogix or GuardLogix controller, you need to add an EtherNet/IP communication module to your Bulletin 1756 chassis and configure it for use in your application. Refer to the EtherNet/IP Network Configuration User Manual, publication, [ENET-UM001](#) for more information.

6. Configure the Logix 5000 controller.

Your new Logix 5000 controller appears under the I/O Configuration folder in the Controller Organizer.

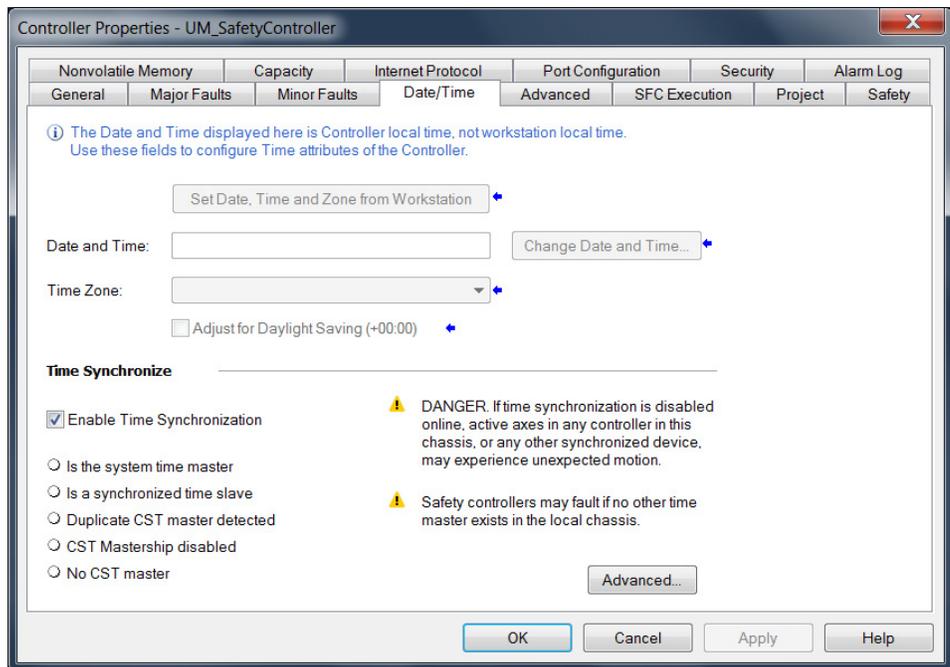
In this example, a GuardLogix 5580 controller with 1756-EN2TR communication module is used.



7. From the Edit menu, choose Controller Properties.

The Controller Properties dialog box appears.

8. Click the Date/Time tab.



9. Check Enable Time Synchronization.

The motion modules set their clocks to the module you assign as the Grandmaster.

IMPORTANT Check Enable Time Synchronization for all controllers that participate in CIP Sync™. The overall CIP Sync network automatically promotes a Grandmaster clock, unless the priority is set in Advanced.

10. Click OK.

Configure the Kinetix 5700 Drive Modules

IMPORTANT To configure Kinetix 5700 drive systems, you must be using the Logix Designer application, version 26.00 or later.

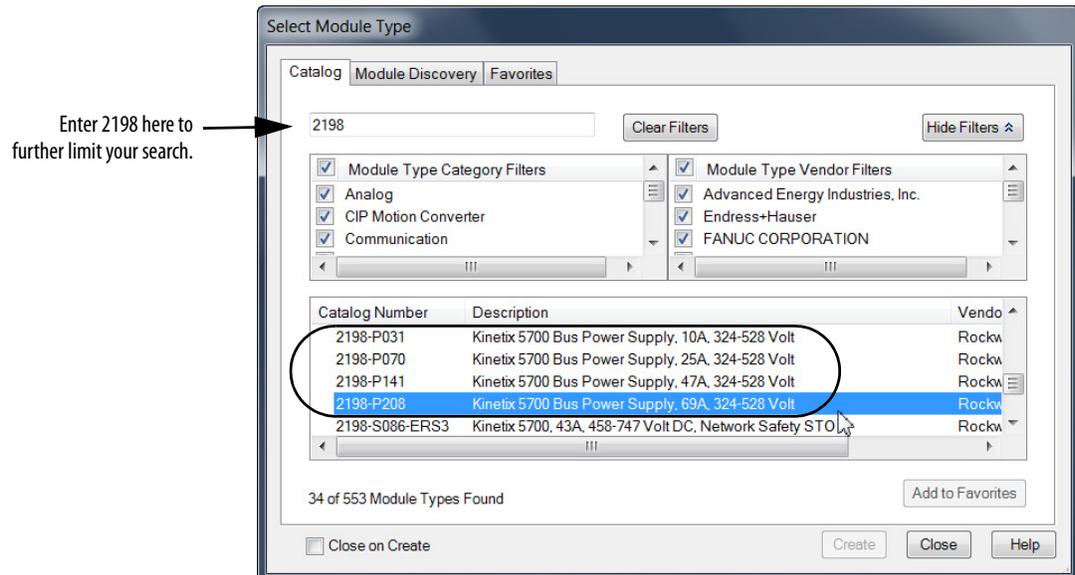
IMPORTANT The iTRAK® power supply is not configured in the Logix Designer application. For more information, see the iTRAK System User Manual, publication [2198T-UM001](#).

Configure the DC-bus Power Supply

Follow these steps to configure the DC-bus power supply.

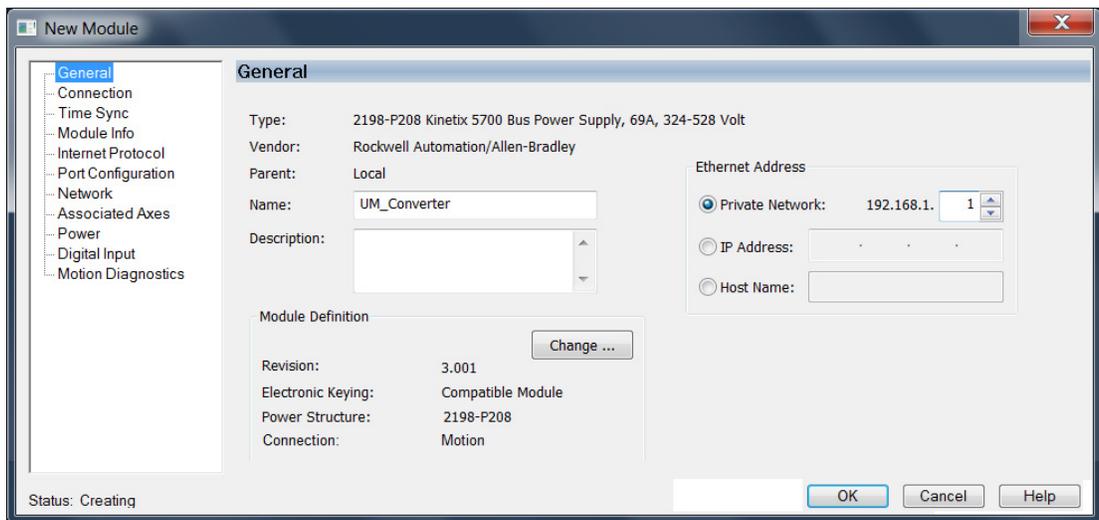
1. Below the controller you just created, right-click Ethernet and choose New Module.

The Select Module Type dialog box appears.

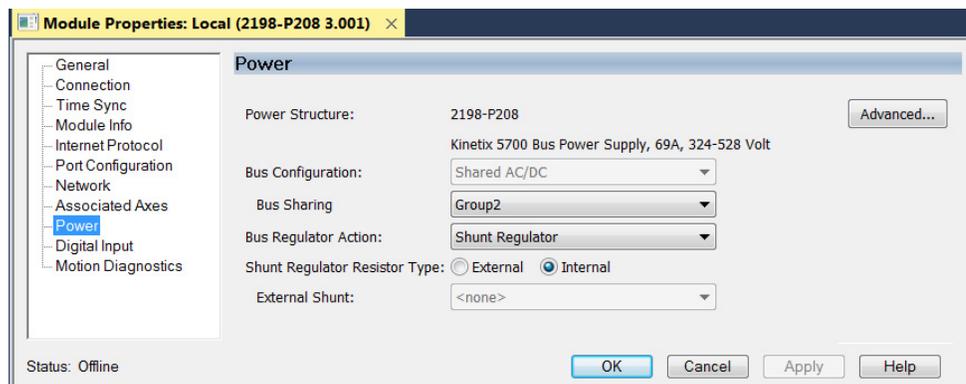


2. By using the filters, check Motion and Allen-Bradley, and select your 2198-Pxxx DC-bus power supply as appropriate for your hardware configuration.
3. Click Create.

The New Module dialog box appears.



4. Configure the new drive.
 - a. Type the drive Name.
 - b. Select an Ethernet Address option.
In this example, the Private Network address is selected.
 - c. Enter the address of your 2198-Pxxx DC-bus power supply.
In this example, the last octet of the address is 1.
5. Click the Power category.



IMPORTANT The Logix Designer application enforces shared-bus configuration rules for Kinetix 5700 drives.

6. From the pull-down menus, choose the power options appropriate for your hardware configuration.

| Attribute | Menu | Description |
|----------------------------------|--|--|
| Bus Configuration | Shared AC/DC ⁽¹⁾ | Applies to 2198-Pxxx DC-bus power supply (converter) modules. |
| Bus Sharing Group ⁽²⁾ | <ul style="list-style-type: none"> • Group1 • Group2 • Group3... | Applies to any bus-sharing configuration. |
| Bus Regulator Action | Disabled | Disables the internal shunt resistor and external shunt option. |
| | Shunt Regulator | Enables the internal and external shunt options. |
| Shunt Regulator Resistor Type | Internal | Enables the internal shunt (external shunt option is disabled). |
| | External | Enables the external shunt (internal shunt option is disabled). |
| External Shunt ⁽³⁾ | <ul style="list-style-type: none"> • None • 2198-R004, 2198-R014 • 2198-R031, 2198-R127 | Selects external shunt option. Only the shunt catalog number intended for the specific DC-bus power supply is shown. |

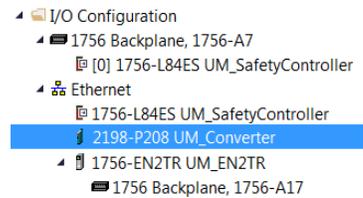
- (1) Shared AC/DC bus configuration is the default selection for DC-bus power supplies.
- (2) For more information on bus-sharing groups, refer to [Understand Bus-sharing Group Configuration](#) on page 202.
- (3) Refer to the Kinetix Servo Drives Specifications Technical Data, publication [KNX-TD003](#), for more information on the Bulletin 2198 external passive shunt resistors.



ATTENTION: To avoid damage to equipment all modules physically connected to the same shared-bus connection system must be part of the same Bus Sharing Group in the Logix Designer application.

7. Click OK to close the New Module dialog box.

8. Your 2198-Pxxx DC-bus power supply appears in the Controller Organizer under the Ethernet network in the I/O Configuration folder.



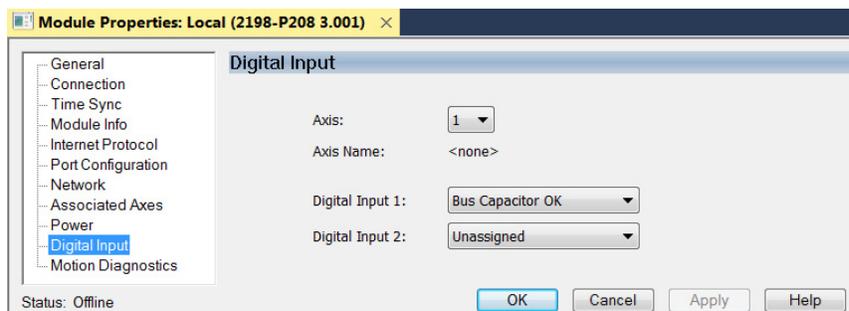
9. Click Close to close the Select Module Type dialog box.

10. Right-click the DC-bus power supply you just created in the Controller Organizer and choose Properties.

The Module Properties dialog box appears.

TIP To configure the remaining DC-bus power supply properties, you must close the New Module dialog box and reopen it as the Module Properties dialog box.

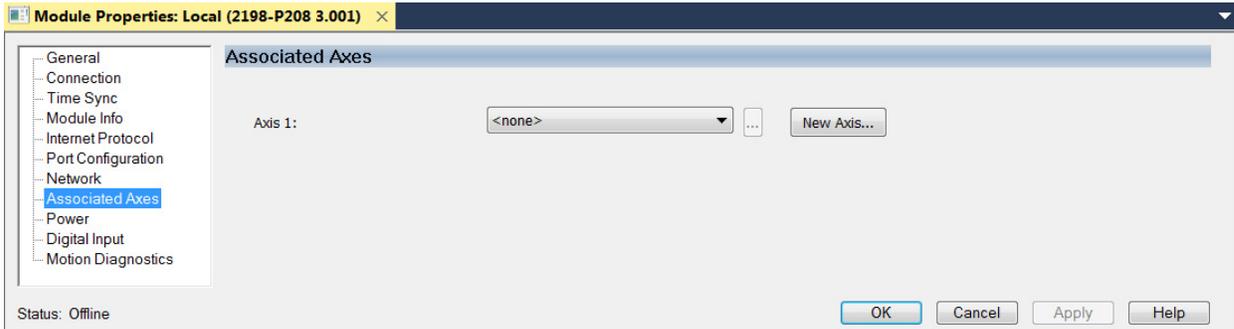
11. Click the Digital Input category.



- From the Digital Input pull-down menu choose Bus Capacitor OK or Shunt Thermal Switch OK to monitor your capacitor module status or the shunt thermal switch, respectively, depending on your application needs.

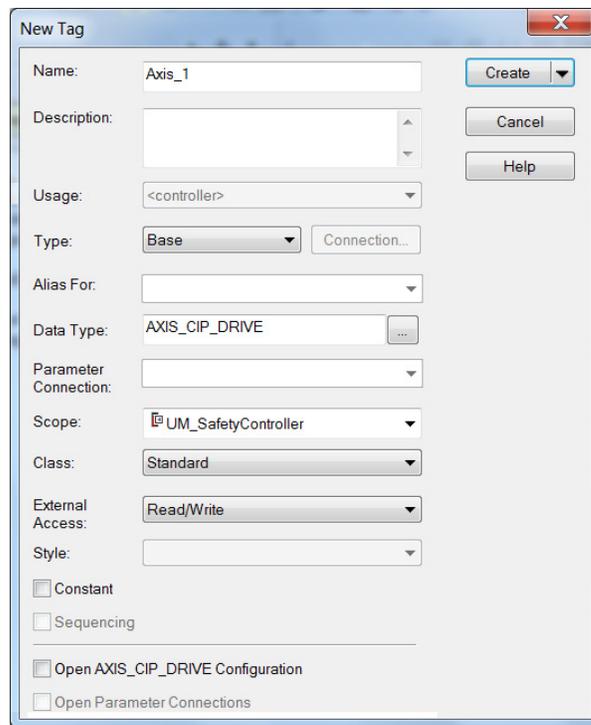
In this example, Bus Capacitor OK is chosen.

- Click the Associated Axes category.



- Click New Axis.

The New Tag dialog box appears.

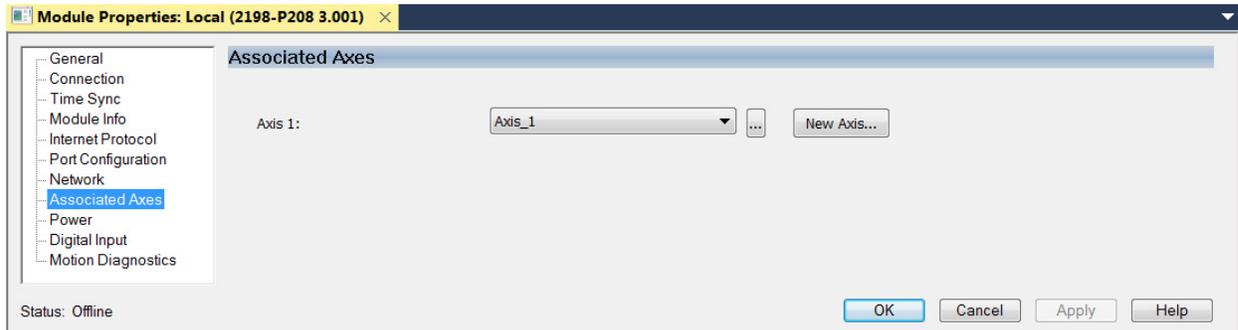


- Type the axis Name.

AXIS_CIP_DRIVE is the default Data Type.

- Click Create.

The axis (Axis_1 in this example) appears in the Controller Organizer under Motion Groups> Ungrouped Axes and is assigned as Axis 1.



17. Click Apply.
18. Repeat [step 1](#) through [step 17](#) if you have more than one 2198-P208 DC-bus power supply.

Configure the Inverter Drives

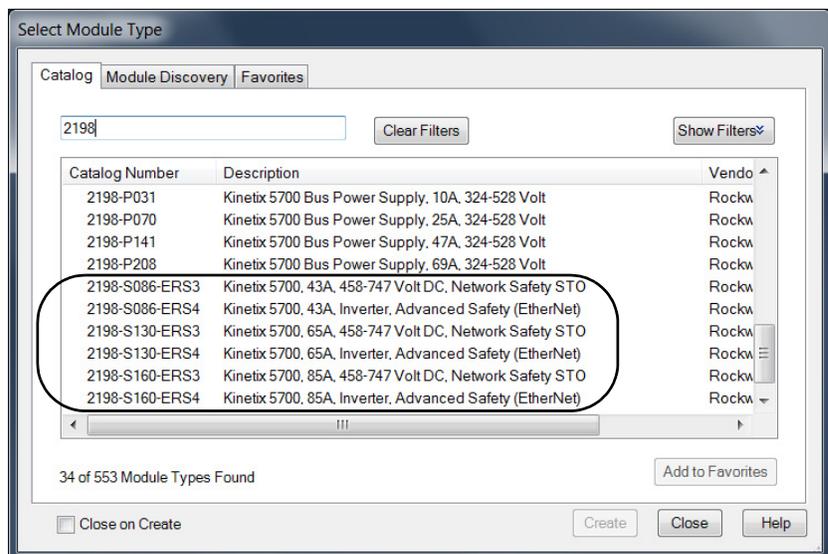
This procedure applies to single-axis and dual-axis inverters with hardwired or integrated safety connections. In this example, a 2198-D006-ERS4 dual-axis inverter is configured.

Follow these steps to configure Kinetix 5700 inverter drives.

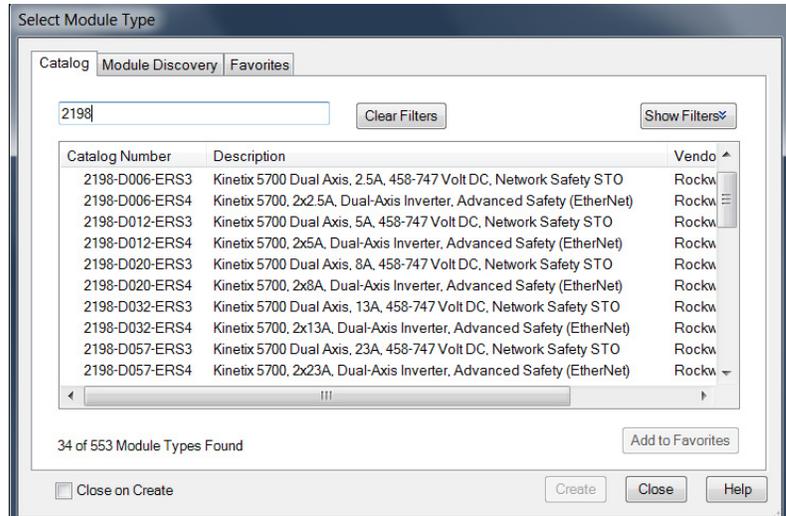
1. Above the DC-bus power supply (converter) you just created, right-click Ethernet and choose New Module.

The Select Module Type dialog box appears.

This example shows the 2198-Sxxx-ERSx single-axis inverters you can choose from.

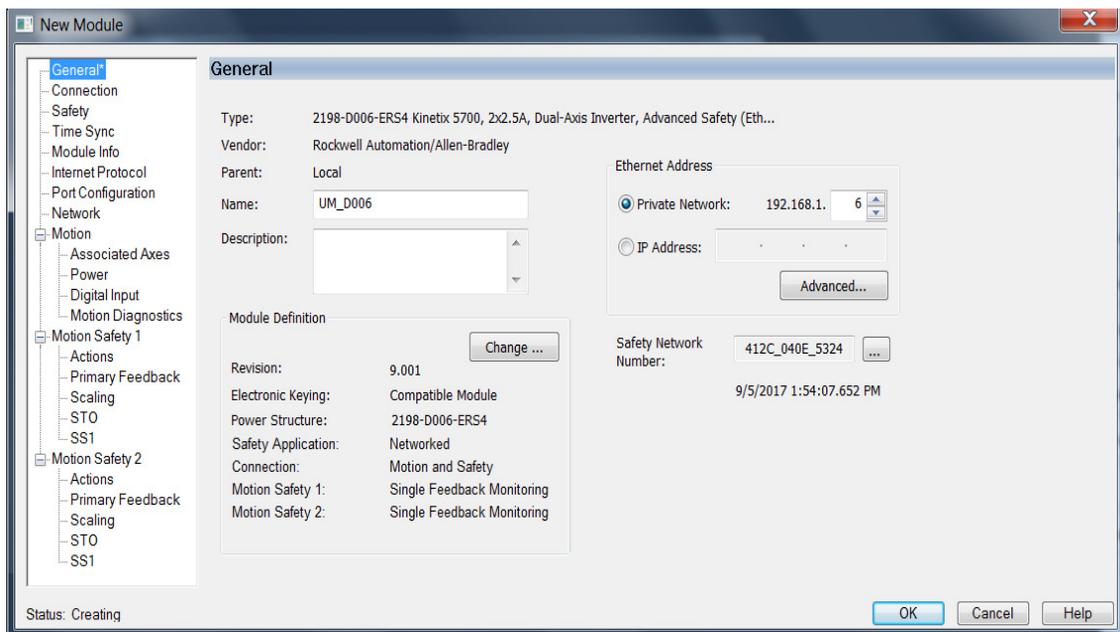


This example shows the 2198-Dxxx-ERSx dual-axis inverters you can choose from.



2. Enter 2198 to narrow your choices and select your 2198-xxxx-ERS3 or 2198-xxxx-ERS4 inverter as appropriate for your hardware configuration.
3. Click Create.

The New Module dialog box appears.



4. Configure the new drive.
 - a. Type the drive Name.
 - b. Select an Ethernet Address option.
In this example, the Private Network address is selected.
 - c. Enter the address of your 2198-xxxx-ERSx inverter.
In this example, the last octet of the address is 6.
 - d. Click Advanced if using network address translation with safety connection to add drive module configured IP address.

The fields to configure in the Module Definition dialog box are dependent on your drive, Logix Designer version, and drive firmware revision. Use the following table to navigate to the series of steps intended for your drive system.

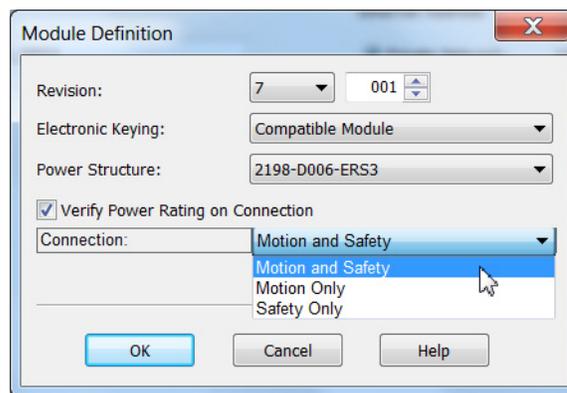
Table 86 - How to Navigate Module Definition

| For Drive Cat. No. | Logix Designer Version | Drive Firmware Revision | Go to: |
|---|------------------------|-------------------------|---|
| 2198-xxxx-ERS3 (series A) | 30 or earlier | 7 or earlier | Configure Module Definition for 2198-xxxx-ERS3 (series A) Drives on page 157 |
| 2198-xxxx-ERS3 (series B) 2198-xxxx-ERS4 | 31 or later | 9 or later | Configure Module Definition for 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) Drives on page 158 |

Configure Module Definition for 2198-xxxx-ERS3 (series A) Drives

1. Under Module Definition click Change.

The Module Definition dialog box appears.



Depending on the Module Definition revision selection, alternate product features and feedback types can be selected.

2. From the Connection pull-down menu, choose the Connection mode for your motion application.

TIP When 'Safety' appears in the Connection mode, integrated safety is implied.

IMPORTANT If the STO bypass jumper wires were applied during machine commissioning or maintenance, they must be removed before the drive will operate in Integrated (Networked) safety mode.

Table 87 - Module Connection Definitions

| Connection Mode | Safety Options | Description |
|-------------------|---|---|
| Motion and Safety | Integrated mode | Motion connections and integrated STO are managed by this controller. |
| Motion Only | <ul style="list-style-type: none"> • Hardwired STO mode • Integrated mode if there is a secondary safety controller | <ul style="list-style-type: none"> • Motion connections are managed by this controller. • Hardwired STO is controlled by the hardwired safety inputs or Integrated is managed by another controller that has a Safety-only connection to the drive. |
| Safety Only | Integrated mode | <ul style="list-style-type: none"> • Integrated STO is managed by this controller. • Motion connections are managed by another controller that has a Motion-only connection to the drive. |

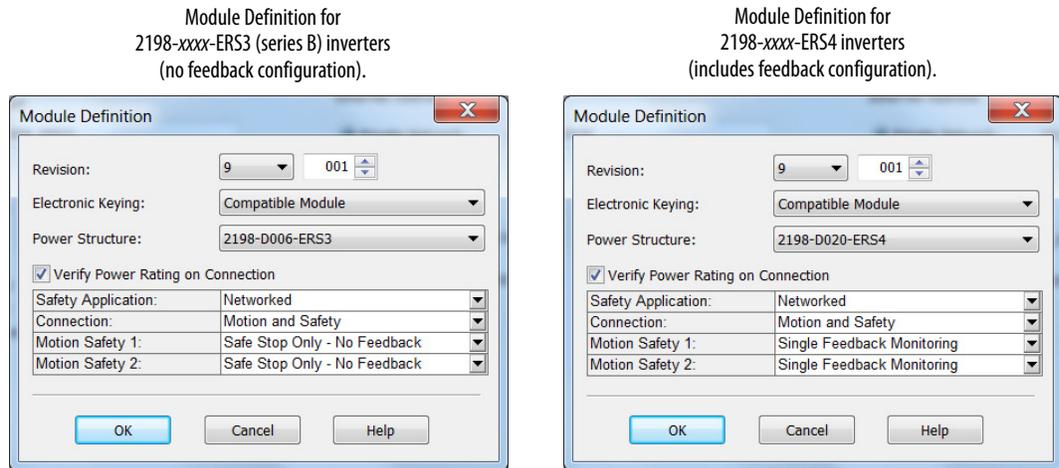
The Safety Network Number (SNN) field populates automatically when the Connection mode includes an integrated Motion and Safety or Safety-only connection. For a detailed explanation of the safety network number, refer to the appropriate GuardLogix controller publication as defined in [Additional Resources](#) on [page 12](#).

3. Click OK to close the Module Definition dialog box.
4. Click Apply.
5. Go to [Configure the Power and Safety Categories](#) on [page 161](#).

Configure Module Definition for 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) Drives

1. Under Module Definition click Change.

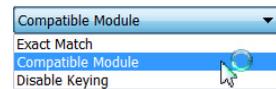
The Module Definition dialog box appears.



Depending on the Module Definition revision selection, alternate product features and feedback types can be selected.

- 2198-xxxx-ERS4 drives appear in only drive firmware revision 9.001 or later
- With drive firmware revision 9.001 or later, 2198-xxxx-ERS3 (series B) drives support Timed SS1 function and STO function with configurable delay
- 2198-xxxx-ERS3 drives do not support feedback monitoring

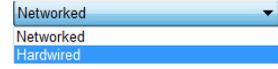
2. If you are replacing a 2198-xxxx-ERS3 (series A) drive with a 2198-xxxx-ERS3, series B drive, determine your Electronic Keying option from the pull-down menu (Compatible Module is the default setting). See [Replacing 2198-xxxx-ERS3 \(series A\) Drives with Series B Drives](#) on [page 240](#) for more information.



| Drive Cat. No. | Studio 5000 Logix Designer | Electronic Keying |
|--|----------------------------|--|
| 2198-xxxx-ERS3 (replacing series A with series B) | Version 30 or earlier | Compatible Module |
| | Version 31 or later | Exact Match (recommended) ⁽¹⁾ |

(1) See the Logix 5000 Controllers I/O and Tag Data Programming Manual, publication [1756-PM004](#), for more information on Electronic Keying settings.

3. From the Safety Application pull-down menu, choose between Hardwired for Hardwired STO mode or Networked for an integrated safety application (see [Table 88](#) on [page 159](#) for definitions).



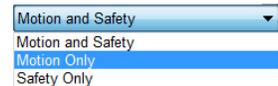
IMPORTANT If the STO bypass jumper wires were applied during machine commissioning or maintenance, they must be removed before the drive will operate in Integrated (Networked) safety mode.

Table 88 - Safety Application Definitions

| Safety Application Mode ⁽¹⁾ | Safety Functions | Minimum Drive Module Required ⁽³⁾ | Drive Module Connection Options | Minimum Controller Required ⁽⁴⁾ |
|--|--|--|---|--|
| Hardwired | Safe Torque-off (STO) | 2198-xxxx-ERS3 (series A) | Motion Only | |
| Networked (integrated) | Safe Torque-off (STO) | 2198-xxxx-ERS3 (series A) | <ul style="list-style-type: none"> Motion and Safety Motion Only Safety Only | <ul style="list-style-type: none"> ControlLogix 5570 CompactLogix 5370 |
| | Timed SS1 | 2198-xxxx-ERS3 (series B) | <ul style="list-style-type: none"> Motion and Safety Motion Only Safety Only | <ul style="list-style-type: none"> GuardLogix 5580 CompactLogix 5380 |
| | <ul style="list-style-type: none"> Timed SS1 Monitored SS1 Controller-based safety functions ⁽²⁾ | 2198-xxxx-ERS4 | <ul style="list-style-type: none"> Motion and Safety Motion Only Safety Only | |

(1) For 2198-Dxxx-ERS4 (dual-axis) inverters, you must configure axes 1 and 3 as either Networked or Hardwired, they cannot be mixed.
 (2) See the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication [2198-RM001](#), for more information on these Drive Safety instructions.
 (3) Where a 2198-xxxx-ERS3 drive is specified, a 2198-xxxx-ERS4 drive is backwards compatible.
 Where a 2198-xxxx-ERS3 (series A) drive is specified, a 2198-xxxx-ERS3 (series B) drive is backwards compatible.
 (4) Where a ControlLogix or CompactLogix (non-safety) controller is specified, a GuardLogix or Compact GuardLogix controller is backwards compatible. Also, GuardLogix 5580 and Compact GuardLogix 5380 controllers are backwards compatible with GuardLogix 5570 and Compact GuardLogix 5370 controllers.

4. From the Connection pull-down menu, choose the Connection mode for your motion application (see [Table 89](#) for definitions).

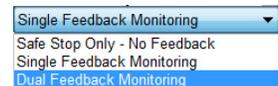


TIP When 'Safety' appears in the Connection mode, integrated safety is implied.

Table 89 - Module Connection Definitions

| Connection Mode | Safety Options | Description |
|-------------------|---|---|
| Motion and Safety | Integrated mode | Motion connections and integrated STO are managed by this controller. |
| Motion Only | <ul style="list-style-type: none"> Hardwired STO mode Integrated mode if there is a secondary safety controller | <ul style="list-style-type: none"> Motion connections are managed by this controller. Hardwired STO is controlled by the hardwired safety inputs or Integrated is managed by another controller that has a Safety-only connection to the drive. |
| Safety Only | Integrated mode | <ul style="list-style-type: none"> Integrated STO is managed by this controller. Motion connections are managed by another controller that has a Motion-only connection to the drive. |

5. From the Motion Safety *x* pull-down menu, choose the integrated safety type (see [Table 90](#) on [page 160](#) for definitions).



‘Motion Safety’ applies to 2198-Sxxx-ERS4 (single-axis) inverters.
 ‘Motion Safety 1’ and ‘Motion Safety 2’ applies to 2198-Dxxx-ERS4 (dual-axis) inverters.

Motion Safety and Motion Safety 1 align with Axis 1 configured in Associated Axes. Motion Safety 2 aligns with Axis 3 configured in Associated Axes.

Table 90 - Motion Safety Definitions

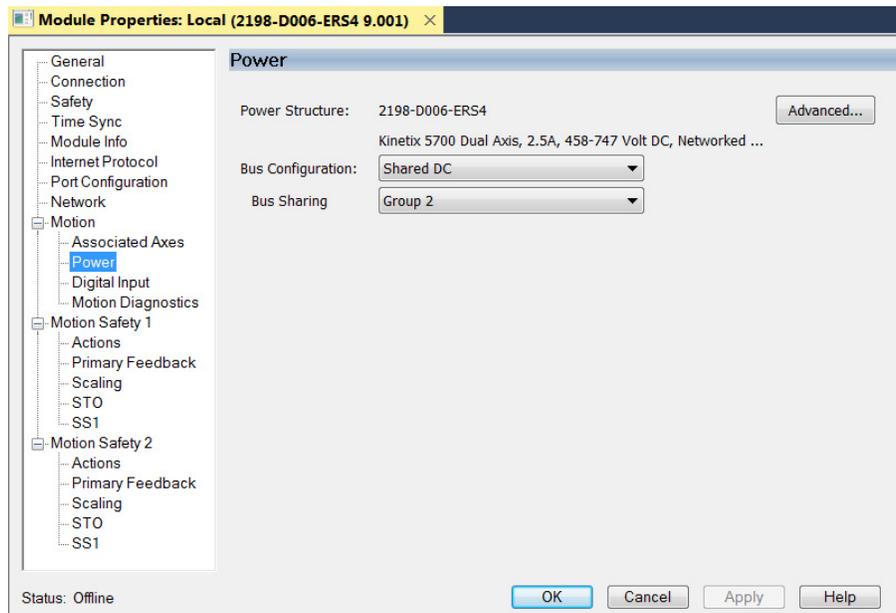
| Motion Safety Mode | Safety Application Mode | Module Connection Options | Description |
|------------------------------|-------------------------|--|---|
| STO Only | Networked | <ul style="list-style-type: none"> • Motion and Safety • Safety Only | 2198-xxxx-ERS3 (series A and B): STO function only. |
| Safe Stop Only - No Feedback | | | <ul style="list-style-type: none"> • 2198-xxxx-ERS4: STO function and Timed SS1 Safe Stop functions are available. • 2198-xxxx-ERS3 (series B): STO function and Timed SS1 Safe Stop functions are available. |
| Single Feedback Monitoring | | | Primary feedback is used in the safety object for safe monitoring. The feedback can be a SIL rated Hiperface DSL encoder, for example, a VPL-B1003P-Q or W motor used in the DSL Feedback port. This can also be a Sine/Cosine or EnDat device, for example, an MPL-B310P-M motor used in the Universal Feedback port. See the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication 2198-RM001 , to evaluate SIL levels possible with a single feedback device. |
| Dual Feedback Monitoring | | | In addition to primary feedback, an external feedback device is used to improve SIL levels. For example, the Bulletin 842HR type encoder can be used in the Universal Feedback port as a Sine/Cosine device. See the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication 2198-RM001 , to evaluate SIL levels possible with two feedback devices. |

The Safety Network Number (SNN) field populates automatically when the Connection mode includes an integrated Motion and Safety or Safety-only connection. For a detailed explanation of the safety network number, refer to the appropriate GuardLogix controller publication as defined in [Additional Resources](#) on [page 12](#).

6. Click OK to close the Module Definition dialog box.
7. Click Apply.

Configure the Power and Safety Categories

1. Click the Power category.



IMPORTANT The Logix Designer application enforces shared-bus configuration rules for Kinetix 5700 drives.

2. From the pull-down menus, choose the power options appropriate for your hardware configuration.

| Attribute | Menu | Description |
|--------------------------------------|---|--|
| Bus Configuration | Shared DC ⁽²⁾ | Applies to 2198-Sxxx-ERSx and 2198-Dxxx-ERSx inverter drives. |
| | Shared DC - Non-CIP Motion Converter ⁽³⁾ | Applies to the designated inverter in drive systems powered by the 8720MC-RPS regenerative power supply. |
| Bus Sharing Group ^{(1) (3)} | <ul style="list-style-type: none"> • Group1 • Group2 • Group3... | Applies to any bus-sharing configuration. |

(1) For more information on bus-sharing groups, refer to [Understand Bus-sharing Group Configuration](#) on page 202.

(2) Shared DC bus configuration is the default selection for single-axis and dual-axis inverters.

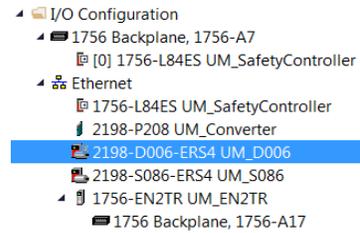
(3) Because the 8720MC-RPS unit is not an EtherNet/IP network device the Logix 5000 controller does not communicate with it. The designated inverter, configured as the Shared DC - Non-CIP Motion Converter, monitors the 8720MC-RPS unit status through a digital input (Regen OK) and communicates with the other inverters to signal when the DC-bus voltage is present.



ATTENTION: To avoid damage to equipment all modules physically connected to the same shared-bus connection system must be part of the same Bus Sharing Group in the Logix Designer application.

3. Click OK to close the Module Properties dialog box.
4. Click Close to close the Select Module Type dialog box.

Your 2198-xxxx-ERS4 inverter appears in the Controller Organizer under the Ethernet network in the I/O Configuration folder.

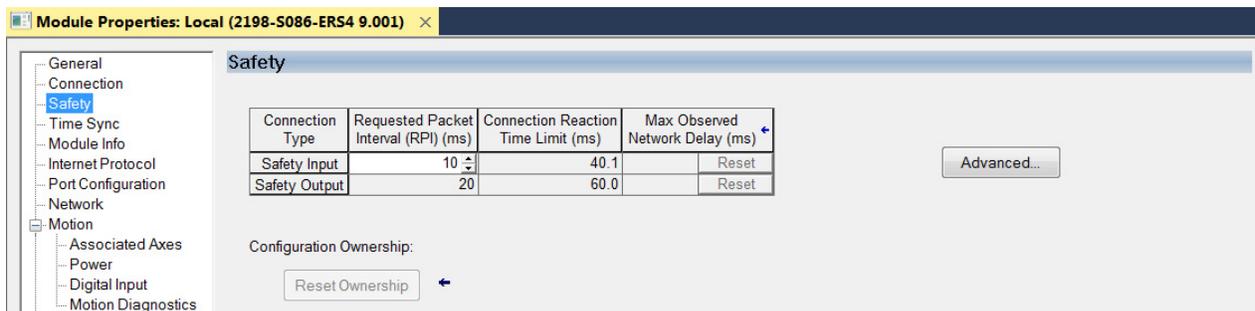


- Right-click the drive you just created in the Controller Organizer and choose Properties.

The Module Properties dialog box appears.

| If | Then |
|---|---|
| Your application includes integrated safety | Go to step 6 on page 162 . |
| Your application includes hardwired safety or has no safety connections | Go to Continue Inverter Configuration on page 163 . |

- Click the Safety category.



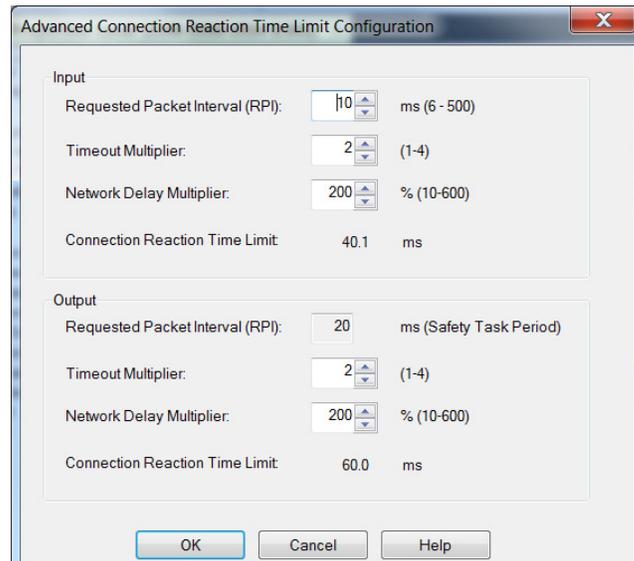
- The connection between the owner and the 2198-xxxx-ERSx inverter is based on the following:

- Servo drive safety network number
- GuardLogix slot number
- GuardLogix safety network number
- Path from the GuardLogix controller to the 2198-xxxx-ERSx drive
- Configuration signature

If any differences are detected, the connection between the GuardLogix controller and the 2198-xxxx-ERSx inverter is lost, and the yellow yield icon appears in the controller project tree after you download the program.

- Click Advanced.

The Advanced Connection Reaction Time Limit Configuration dialog box appears.



Analyze each safety channel to determine the appropriate settings. The smallest Input RPI allowed is 6 ms. Selecting small RPI values consumes network bandwidth and can cause nuisance trips because other devices cannot get access to the network.

For more information about the Advanced Connection Reaction Time Limit Configuration, refer to [Additional Resources](#) on [page 12](#) for the appropriate user manual for your GuardLogix or Compact GuardLogix controller.

9. Click OK to close the Advanced dialog box.
10. Click Apply to save the Safety category parameters.

Continue Inverter Configuration

After you’ve established your Kinetix 5700 inverters in the Logix Designer application, the feedback options need to be defined for each axis. Each physical axis supports motor and auxiliary feedback.

Table 91 - Kinetix 5700 Feedback Axis Summary

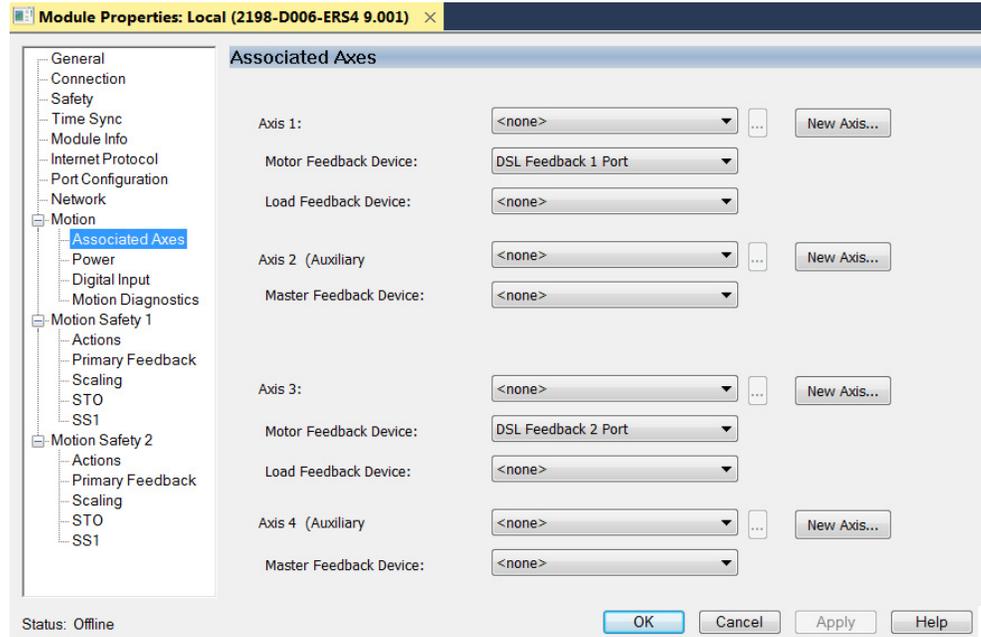
| Kinetix 5700 Inverter | Inverter Cat. No. | Motor Feedback | Auxiliary Feedback |
|-----------------------|----------------------------------|------------------|--------------------|
| Single-axis Inverters | 2198-Sxxx-ERS3 or 2198-Sxxx-ERS4 | 1 (axis 1) | 1 (axis 2) |
| Dual-axis Inverters | 2198-Dxxx-ERS3 or 2198-Dxxx-ERS4 | 2 (axis 1 and 3) | 2 (axis 2 and 4) |

Follow these steps to configure the axes for your Kinetix 5700 drive system.

1. Right-click the 2198-xxxx-ERS4 inverter you just created and choose Properties.

The Module Properties dialog box appears.

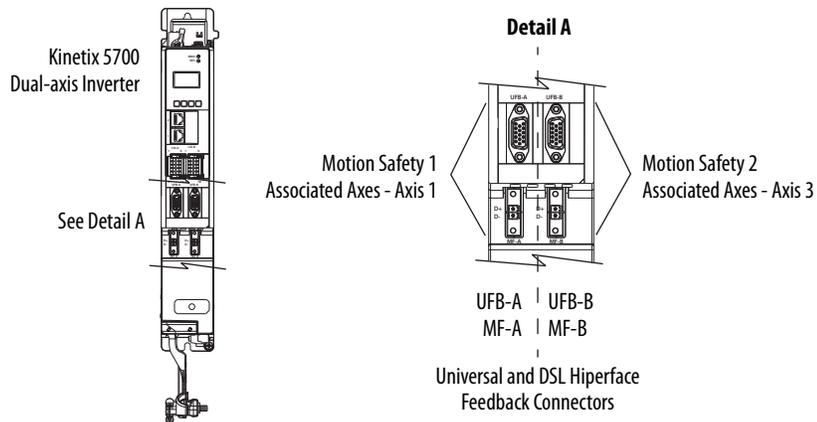
2. Select the Associated Axes category.



In this 2198-D006-ERS4 (dual-axis inverter) example, four axes are possible. Single-axis inverters support only two axes.

- Axis 1 and Axis 2 apply to Motor (DSL) Feedback Connector A (Port 1) and Universal Feedback Connector A (Port 1).
- Axis 3 and Axis 4 apply to Motor (DSL) Feedback Connector B (Port 2) and Universal Feedback Connector B (Port 2).

Figure 93 - Dual-axis Inverter Feedback



The Feedback Devices are configured for either the DSL Feedback Port or the Universal Feedback Port.

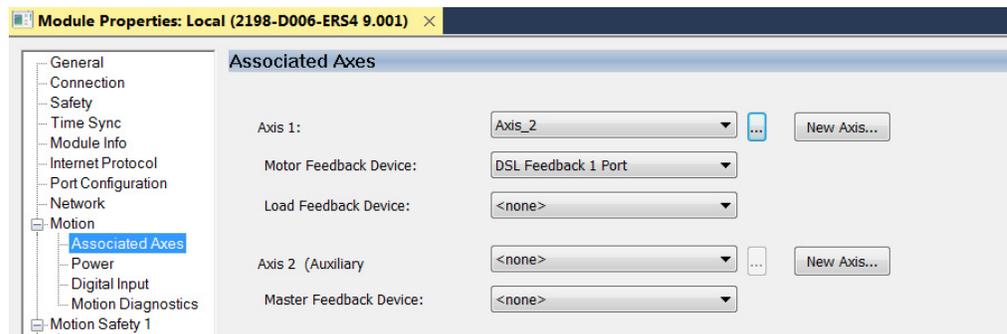
| Motor Feedback Options | Description |
|-------------------------|---|
| DSL Feedback Port | Applies to motors and actuators compatible with the 2198-KITCON-DSL connector kit and 2198-H2DCK converter kit (series B or later). These kits plug into the 2-pin motor feedback (MF) connector. |
| Universal Feedback Port | Applies to motors and actuators compatible with the 2198-K57CK-D15M universal connector kit. These kits plug into the 15-pin universal feedback (UFB) connector. |

- From the Axis x pull-down menu, choose an axis to assign to that motor feedback or auxiliary feedback device.
- From the Feedback Device pull-down menu, choose either DSL Feedback x Port or Universal Feedback x Port to associate with each axis.
- Click New Axis.

The New Tag dialog box appears.

- Type the axis Name.
AXIS_CIP_DRIVE is the default Data Type.
- Click Create.

The axis (Axis_1 in this example) appears in the Controller Organizer under Motion Groups> Ungrouped Axes and is assigned as Axis 1.



TIP You can configure an axis as Feedback Only. Refer to [Configure Feedback-only Axis Properties](#) on [page 169](#) for more information.

Refer to [Configure Module Properties](#) on [page 195](#) for configuring motor feedback, load feedback, and master feedback devices.

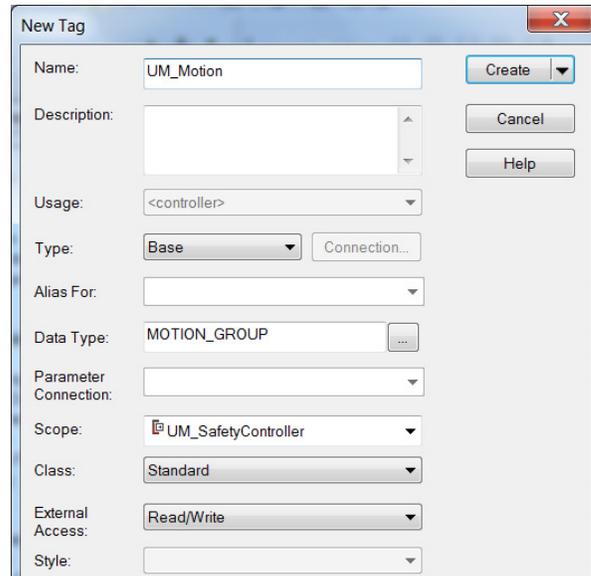
8. Click Apply.
9. Repeat [step 1](#) through [step 8](#) for each 2198-xxx-ERSx servo drive.

Configure the Motion Group

Follow these steps to configure the motion group.

1. In the Controller Organizer, right-click Motion Groups and choose New Motion Group.

The New Tag dialog box appears.



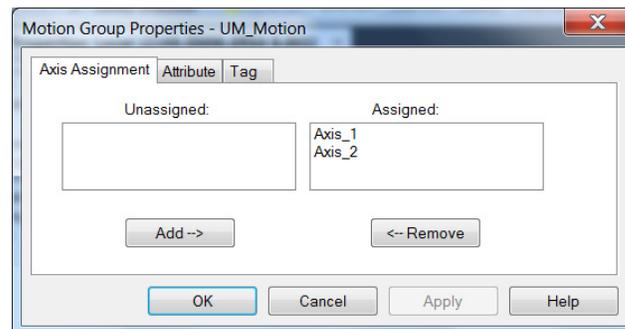
2. Type the new motion group Name.
3. Click Create.

Your new motion group appears in the Controller Organizer under the Motion Groups folder.



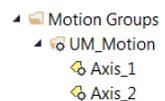
4. Right-click the new motion group and choose Properties.

The Motion Group Properties dialog box appears.



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.

Your axes moves to the new motion group.



Configure Vertical Load Control Axis Properties

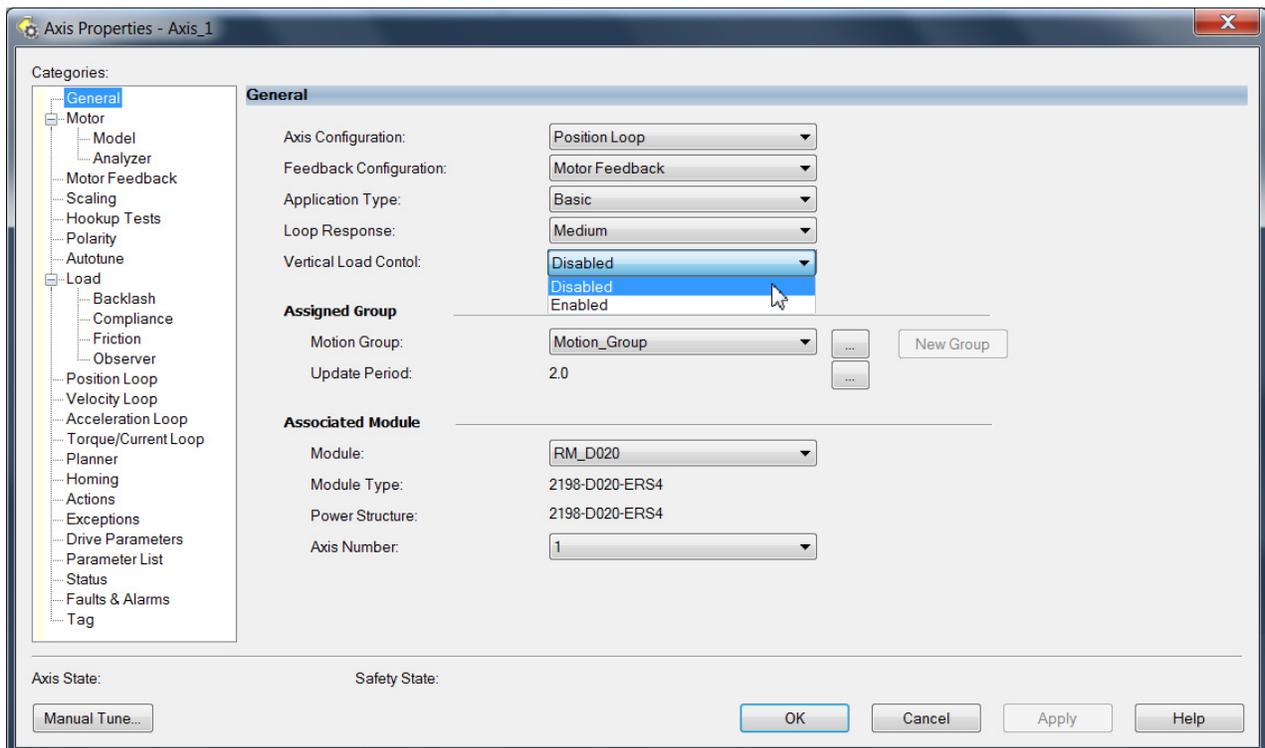
The 2198-xxxx-ERS4 servo drives (firmware 9.001 or later) support the Vertical Load Control feature. A vertical load is an axis that can move due to stored potential energy. Some examples include a robot arm, lift, or compressed spring. When set to Enabled, rather than applying Stop Category 0 stopping actions in response to most Major fault conditions, the drive brings the motor to a controlled stop and engages the holding brake prior to disabling the power structure.

When Vertical Load Control is enabled and the drive supports Torque Proving and Brake Proving functionality, the controller sets the associated Proving Configuration attribute default value to enable.

IMPORTANT Brake proving functionality is applicable only to drive control modes that are capable of generating holding torque based on a feedback device. Therefore, Brake Proving is not applicable to Frequency Control mode with Sensorless Vector control method.

For more information on controlling vertical loads, see the Vertical Load and Holding Brake Management Application Technique, publication [MOTION-AT003](#).

Figure 94 - Configure Vertical Load Control

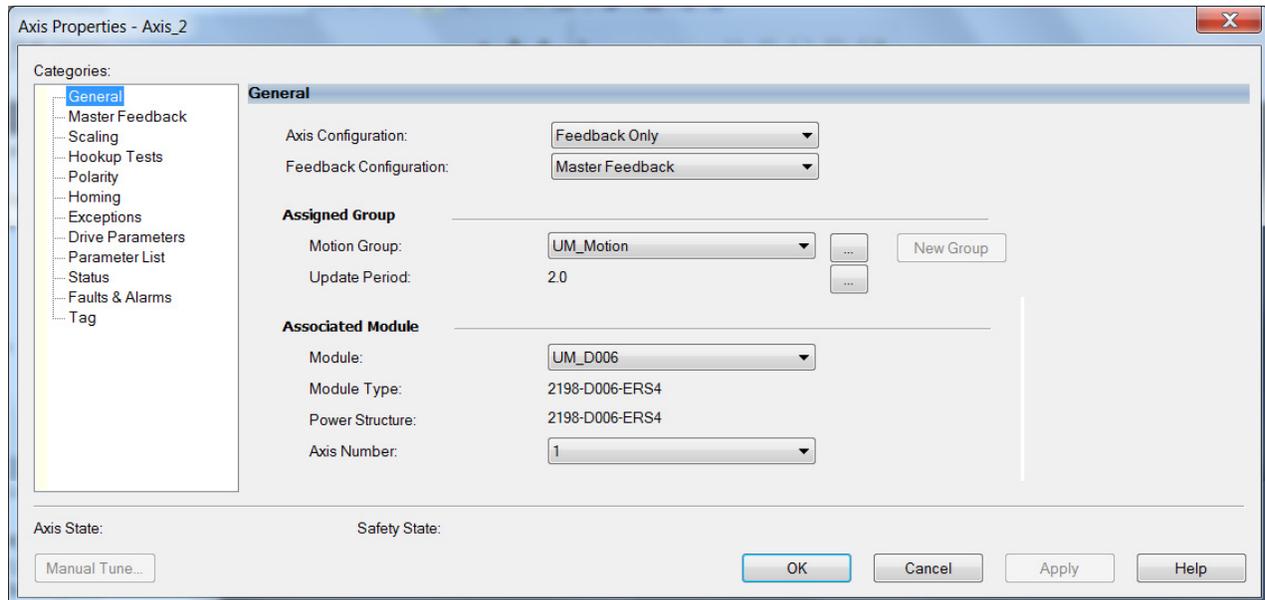


Configure Feedback-only Axis Properties

Follow these steps to configure stopping-action axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General dialog box appears.



3. From the Axis Configuration pull-down menu, choose Feedback Only.
4. From the Feedback Configuration pull-down menu, choose Master Feedback.
5. From the Module pull-down menu, choose the drive to associate with your Feedback Only axis.

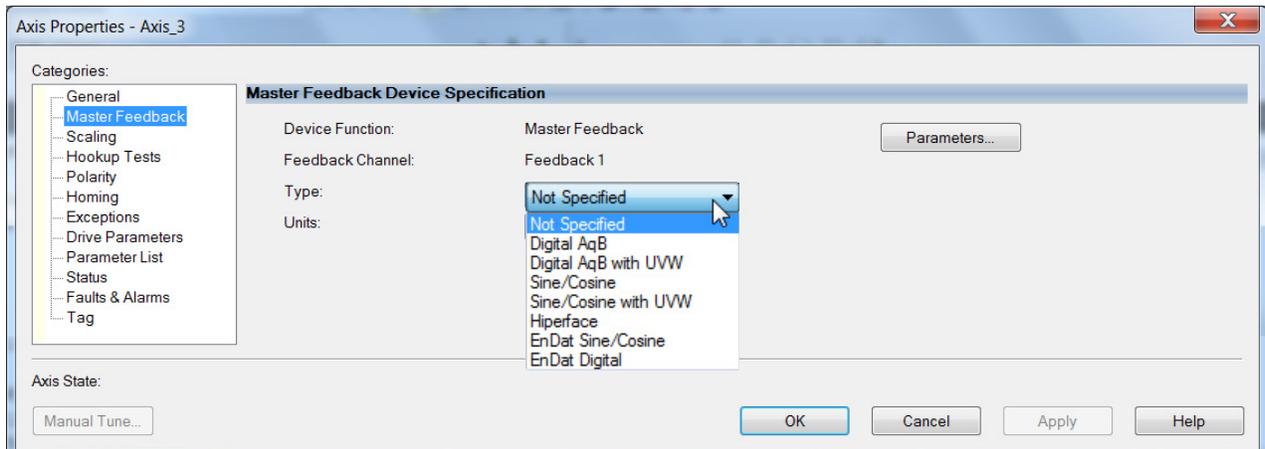
The Module Type and Power Structure fields populate with the chosen drive catalog number.

6. Click Apply.
7. Configure module properties for your Kinetix 5700 servo drive for Master Feedback.

See Configure Module Properties on [page 195](#) for configuration examples.

8. Select the Master Feedback Category.

The Master Feedback Device Specification appears.



9. From the Type pull-down menu, choose a feedback device type.

See [Configure Axis Properties](#) beginning on [page 197](#) for configuration examples.

10. Review other categories in the Controller Organizer and make changes as needed for your application.

11. Click OK.

See [Auxiliary Feedback Specifications](#) on [page 86](#) for more information on auxiliary feedback signals and Allen-Bradley auxiliary feedback encoders available for use.

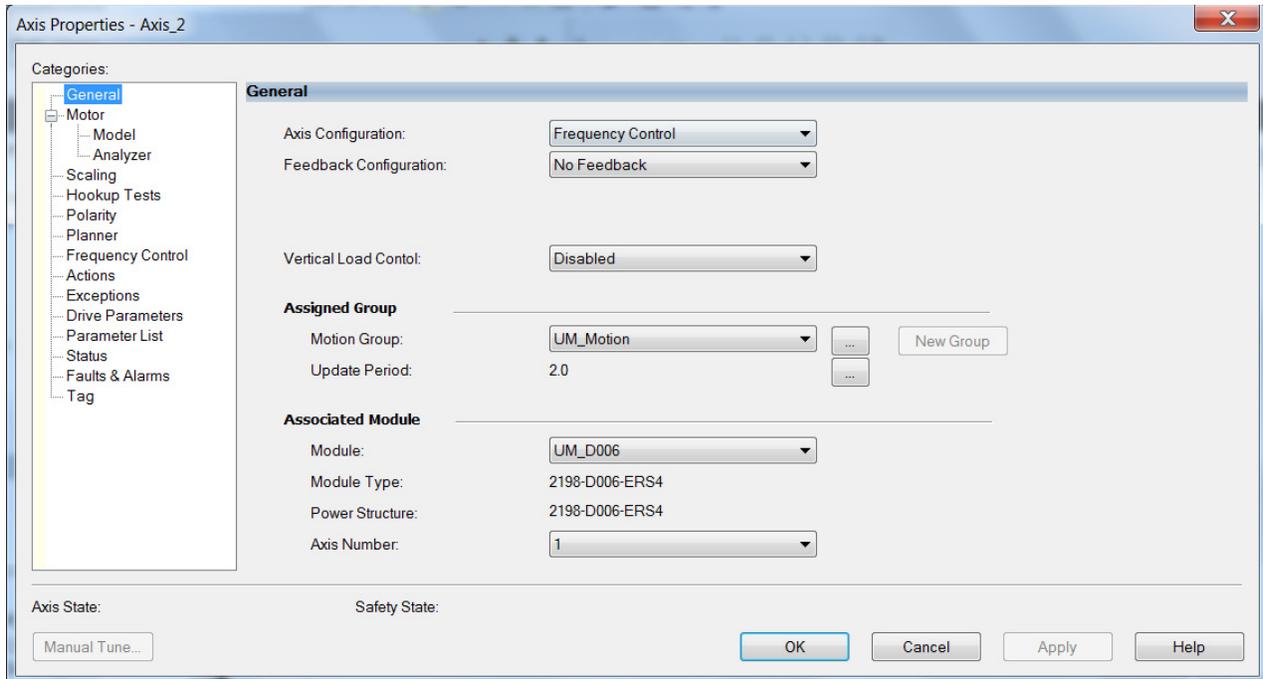
Configure Induction-motor Frequency-control Axis Properties

Follow these steps to configure induction-motor axis properties for various frequency control methods.

General and Motor Categories

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General dialog box appears.

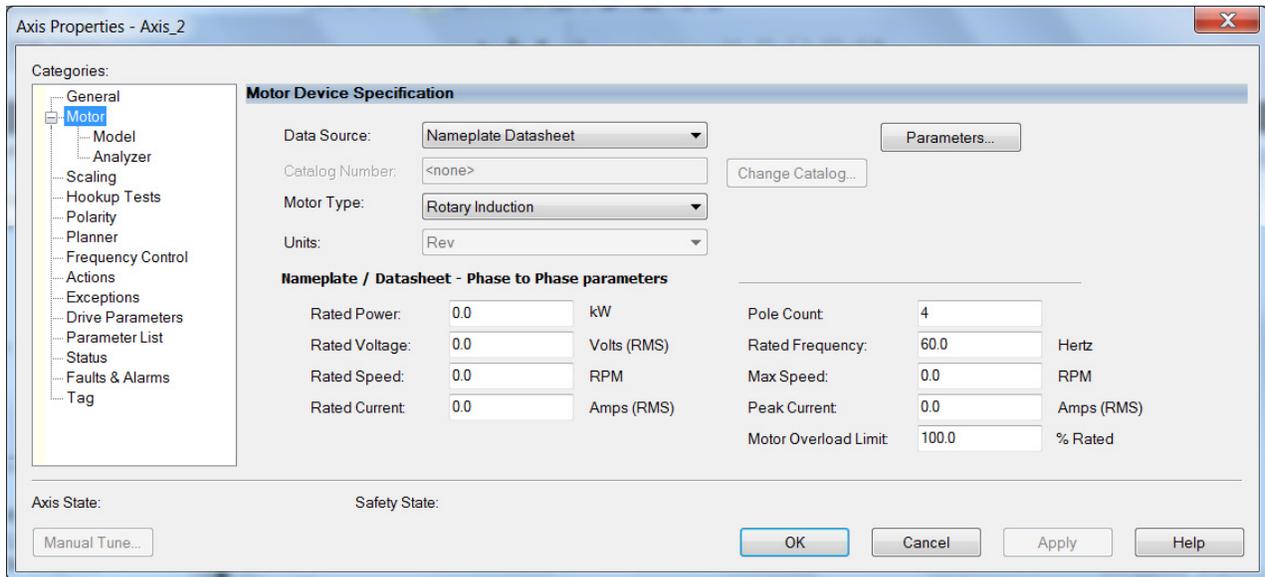


3. From the Axis Configuration pull-down menu, choose Frequency Control.
4. From the Feedback Configuration pull-down menu, choose No Feedback.
5. From the Module pull-down menu, choose the drive to associate with your Frequency Control (induction motor) axis.

The Module Type and Power Structure fields populate with the chosen drive catalog number.

6. Click Apply.

7. Select the Motor category.



8. From the Data Source pull-down menu, choose Nameplate Datasheet.

This is the default setting.

9. From the Motor Type pull-down menu, choose Rotary Induction.

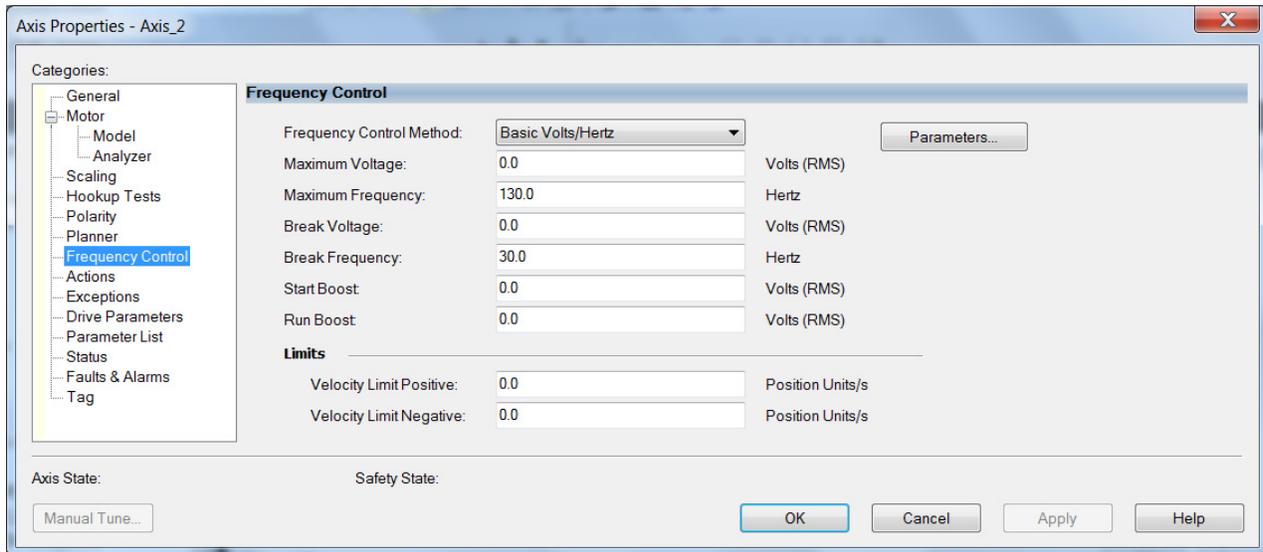
10. From the motor nameplate or datasheet, enter the phase-to-phase values for your motor.

See [Motor Category](#) on [page 342](#) for a motor performance datasheet example.

11. Click Apply.

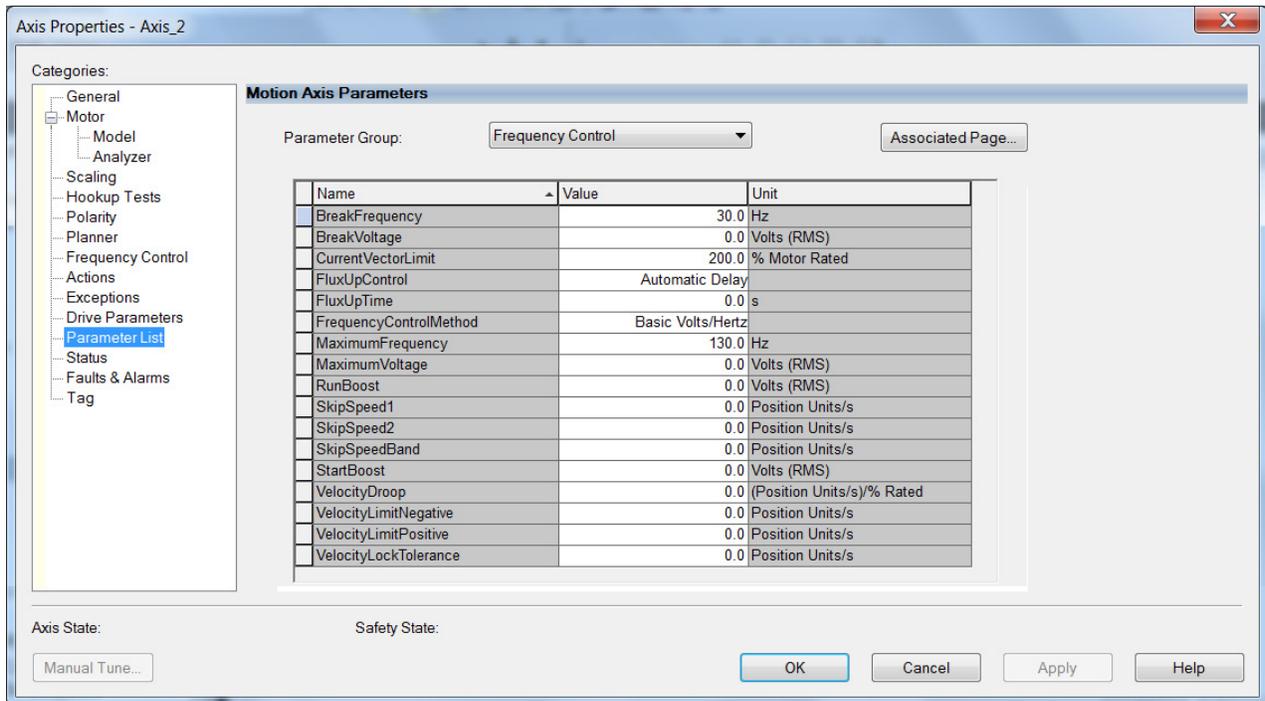
Basic Volts/Hertz Method

1. Configure the General category and Motor category as shown in [General and Motor Categories](#) on [page 171](#).
2. Select the Frequency Control category.
3. From the Frequency Control Method pull-down menu, select Basic Volts/Hertz.



4. Enter the Basic Volts/Hertz attribute values appropriate for your application.
Default values are shown.
5. Click Apply.
6. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.



7. From the Parameter Group pull-down menu, choose Frequency Control.

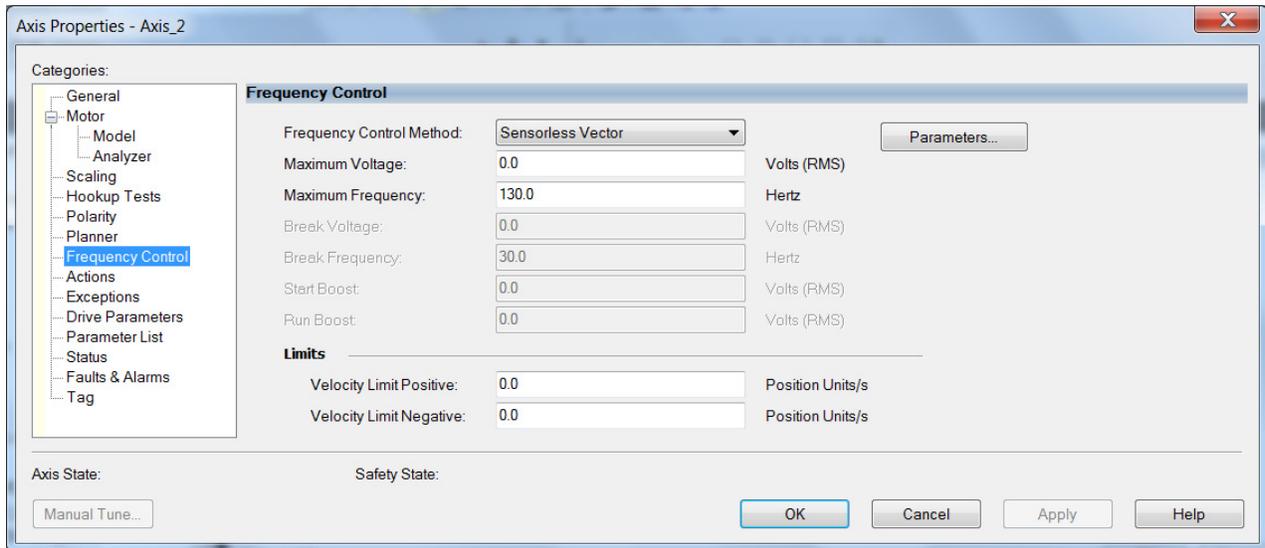
8. Set the FluxUp, SkipSpeed, VelocityDroop, and CurrentVectorLimit attributes appropriate for your application.

See the corresponding section in Appendix D, beginning on [page 327](#), for information and configuration examples regarding all of these topics.

9. Click OK.

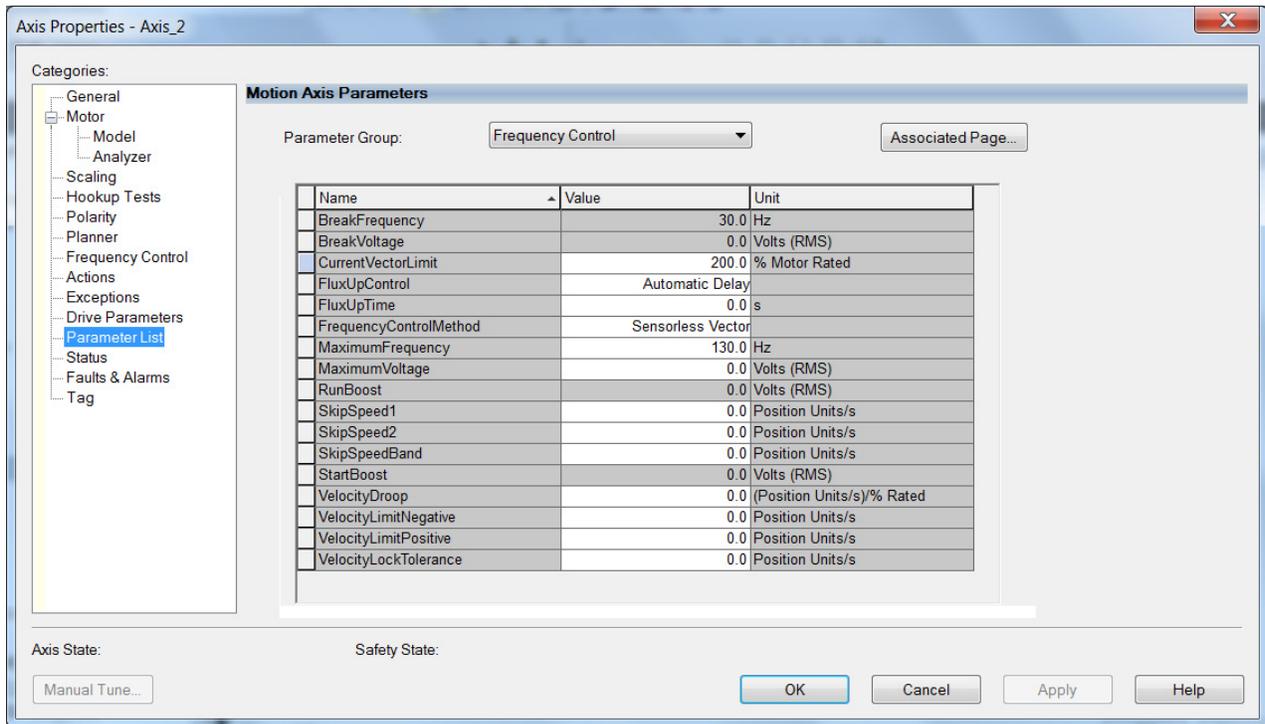
Sensorless Vector Method

1. Configure the General category and Motor category as shown in [General and Motor Categories](#) on [page 171](#).
2. Select the Frequency Control category.
3. From the Frequency Control Method pull-down menu, choose Sensorless Vector.



4. Enter the Basic Volts/Hertz attribute values appropriate for your application.
Default values are shown.
5. Click Apply.
6. Select the Parameter List category.

7. The Motion Axis Parameters dialog box appears.



8. From the Parameter Group pull-down menu, choose Frequency Control.

9. Set the FluxUp, SkipSpeed, VelocityDroop, MaximumFrequency, MaximumVoltage, and CurrentVectorLimit attributes appropriate for your application.

See the corresponding section in Appendix D, beginning on [page 327](#), for information and configuration examples regarding all of these topics.

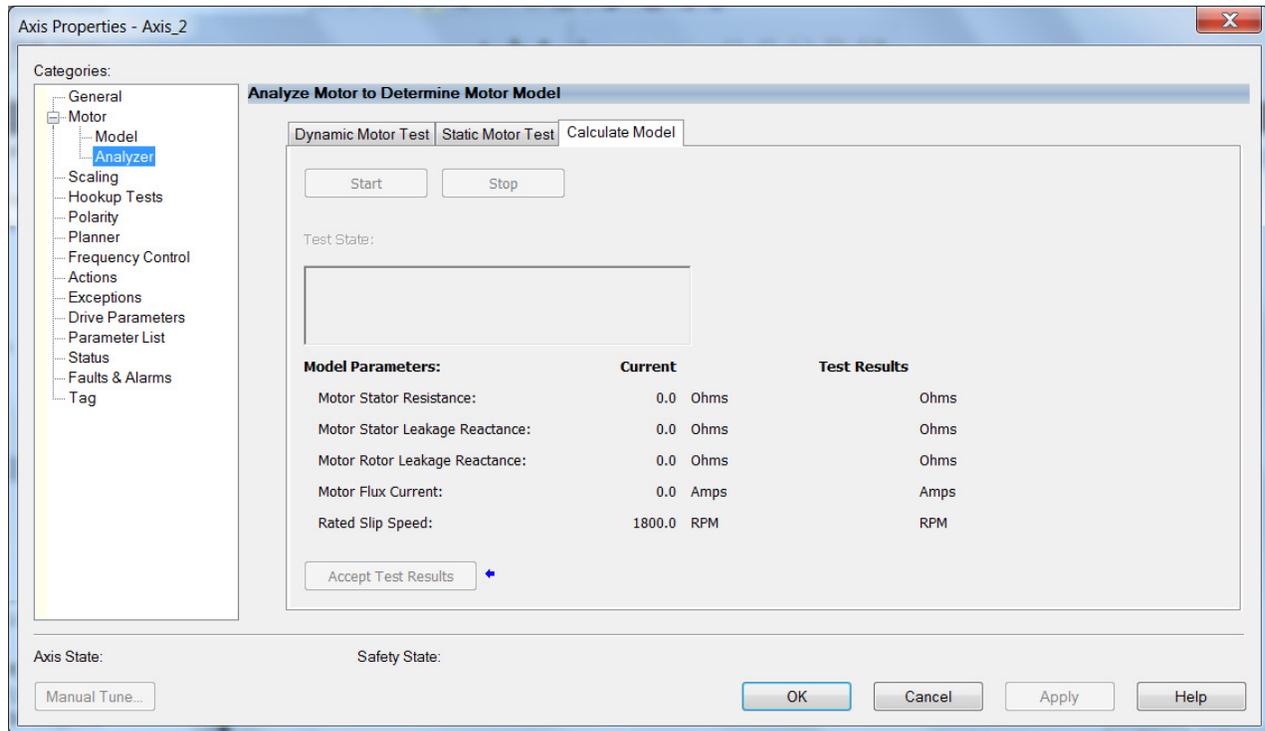
10. Click Apply.

11. Select the Motor>Model category.

Motor model attributes are automatically estimated from the Nameplate/Datasheet parameters. For improved performance, motor tests can be run.

12. Select the Motor>Analyzer category.

13. The Analyze Motor to Determine Motor Model dialog box opens.



14. Click one of the motor test tabs.

In this example, Calculate Model is chosen. See [Motor Tests and Autotune Procedure](#) on [page 344](#) for information about each of the tests.

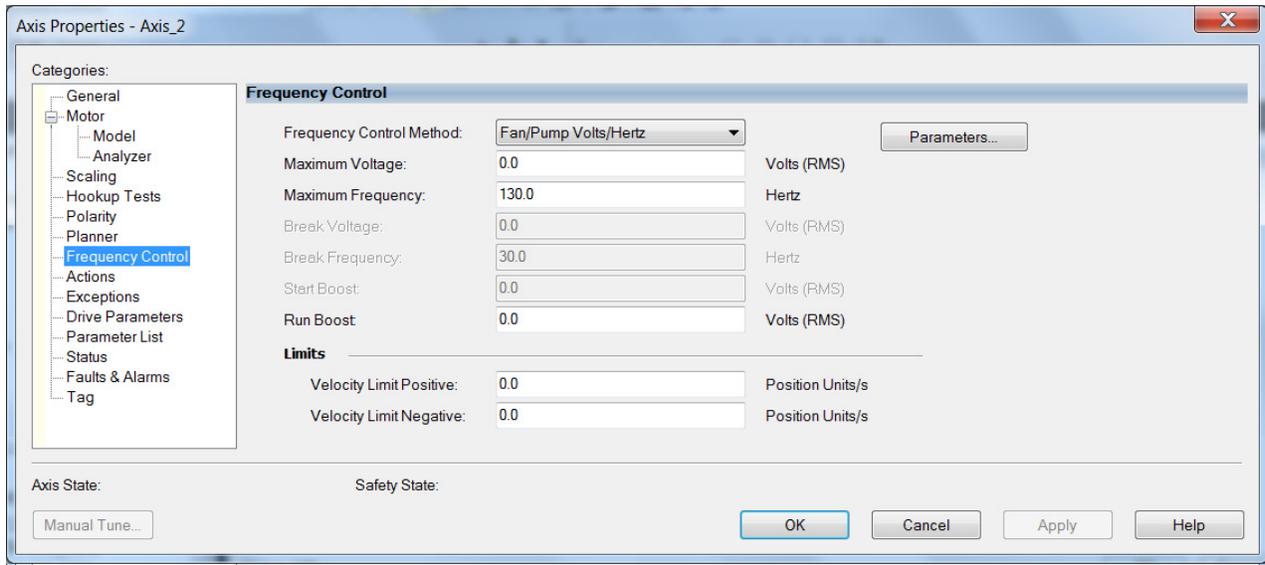
15. Click Start.

16. Click Accept Test Results.

17. Click OK.

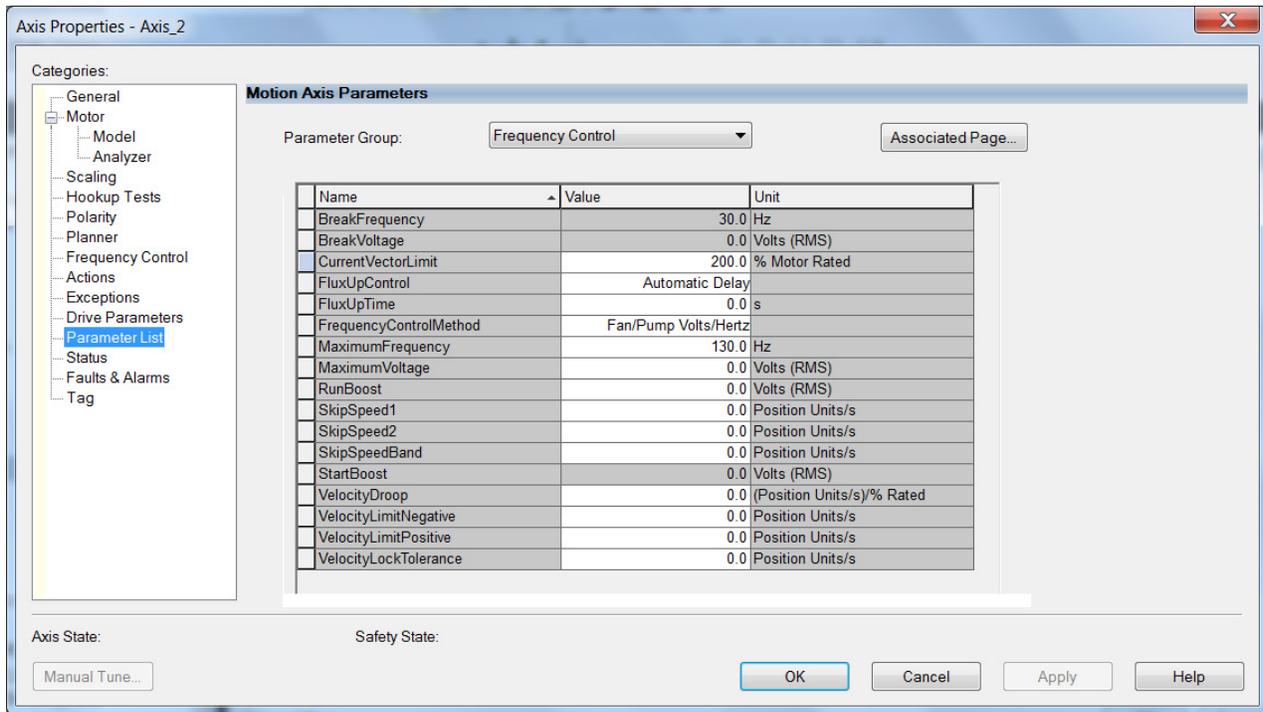
Fan/Pump Volts/Hertz Method

1. Configure the General category and Motor category as shown in [General and Motor Categories](#) on [page 171](#).
2. Select the Frequency Control category.
3. From the Frequency Control Method pull-down menu, select Fan/Pump Volts/Hertz.



4. Enter the Basic Volts/Hertz attribute values appropriate for your application.
Default values are shown.
5. Click Apply.
6. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.



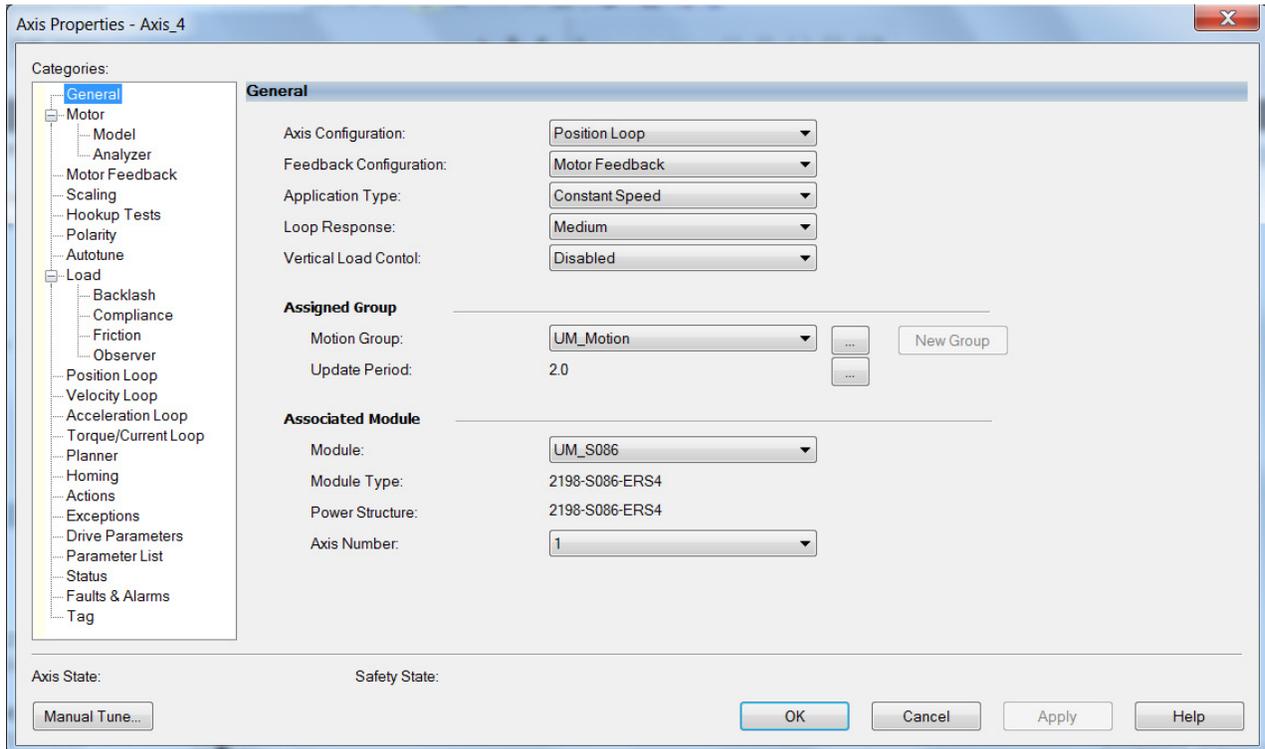
7. From the Parameter Group pull-down menu, choose Frequency Control.
8. Set the FluxUp, SkipSpeed, VelocityDroop, RunBoost, MaximumFrequency, MaximumVoltage and CurrentVectorLimit attributes appropriate for your application.
See the corresponding section in Appendix D, beginning on [page 327](#), for information and configuration examples regarding all of these topics.
9. Click OK.

Configure IPM Motor Closed-loop Control Axis Properties

Follow these steps to configure interior permanent-magnet (IPM) motor closed-loop axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General and Associated Module dialog box appears.



3. From the General pull-down menus, change configuration settings as needed for your application.

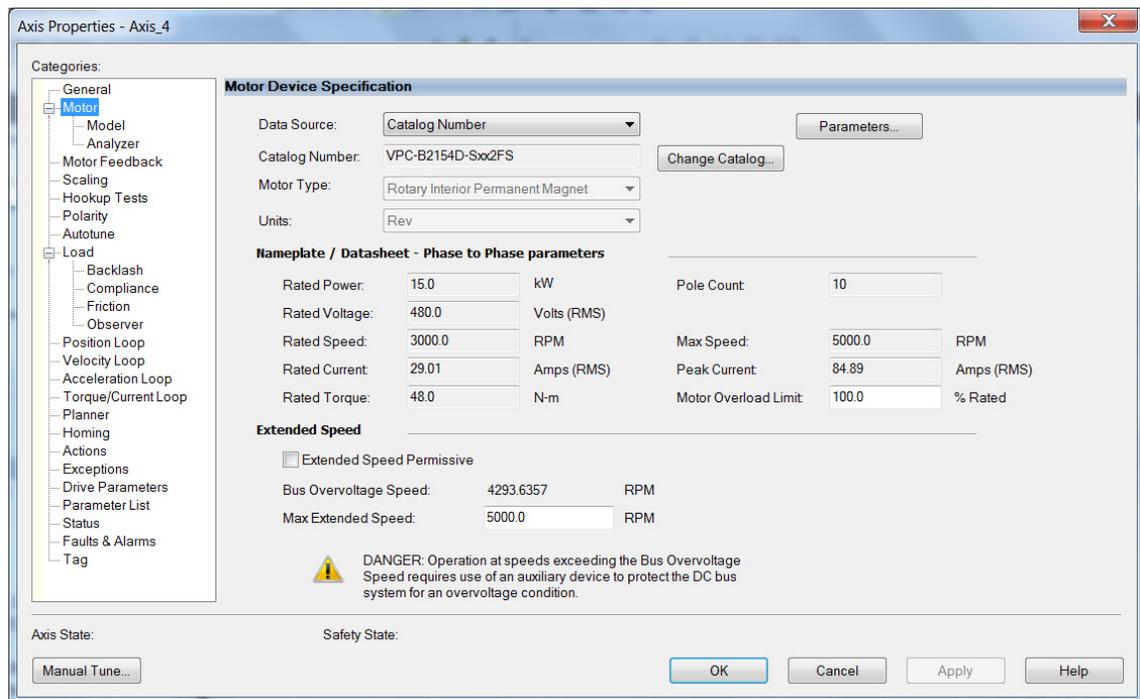
IMPORTANT Frequency Control is not supported for interior permanent magnet (IPM) motors.

4. From the Associated Module>Module pull-down menu, choose your Kinetix 5700 drive.

The drive catalog number populates the Module Type and Power Structure fields.

5. Click Apply.
6. Select the Motor category.

The Motor Device Specification dialog box appears.

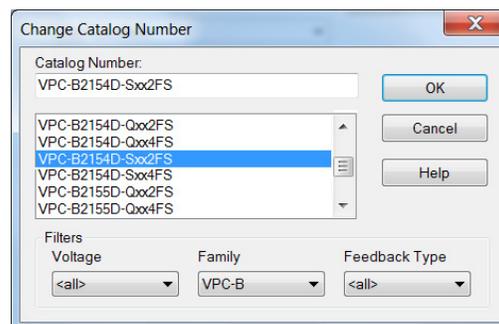


- From the Data Source pull-down menu, choose Catalog Number.

IMPORTANT Motor NV is not a supported data source in the Logix Designer application for axes configured as interior permanent-magnet (IPM) motor closed-loop. In addition, third-party IPM motors are not supported.

- Click Change Catalog.

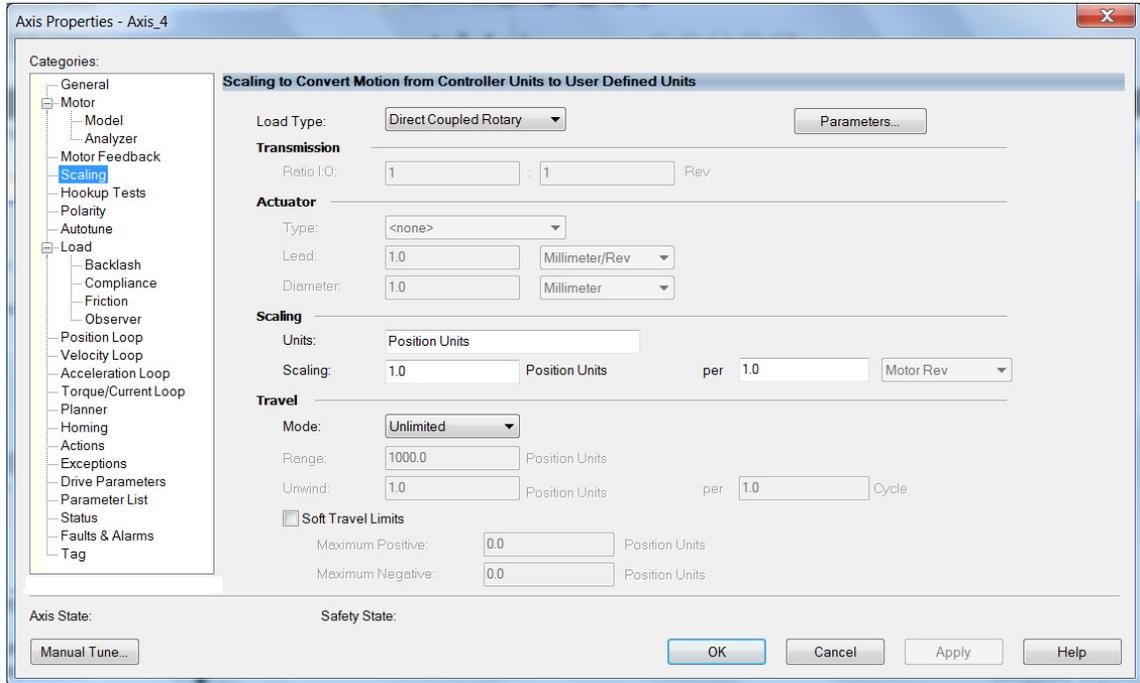
The Change Catalog Number dialog box appears.



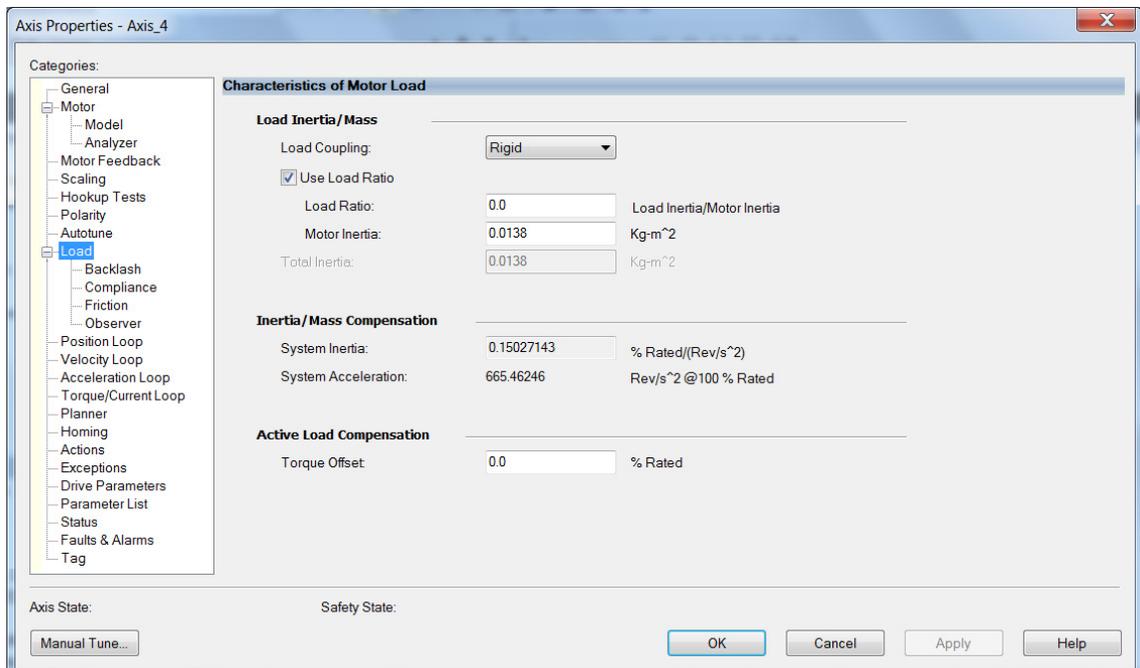
- Select the motor catalog number appropriate for your application.
To verify the motor catalog number, refer to the motor name plate.
- Click OK to close the Change Catalog Number dialog box.
- Click Apply.

Motor data specific to your motor appears in the Nameplate / Datasheet - Phase to Phase parameters field.

12. For Extended Speed operation, check Extended Speed permissive in the Extended Speed field. See [Field Weakening Mode](#) on [page 367](#), for more information.
13. Select the Scaling category and edit the default values as appropriate for your application.

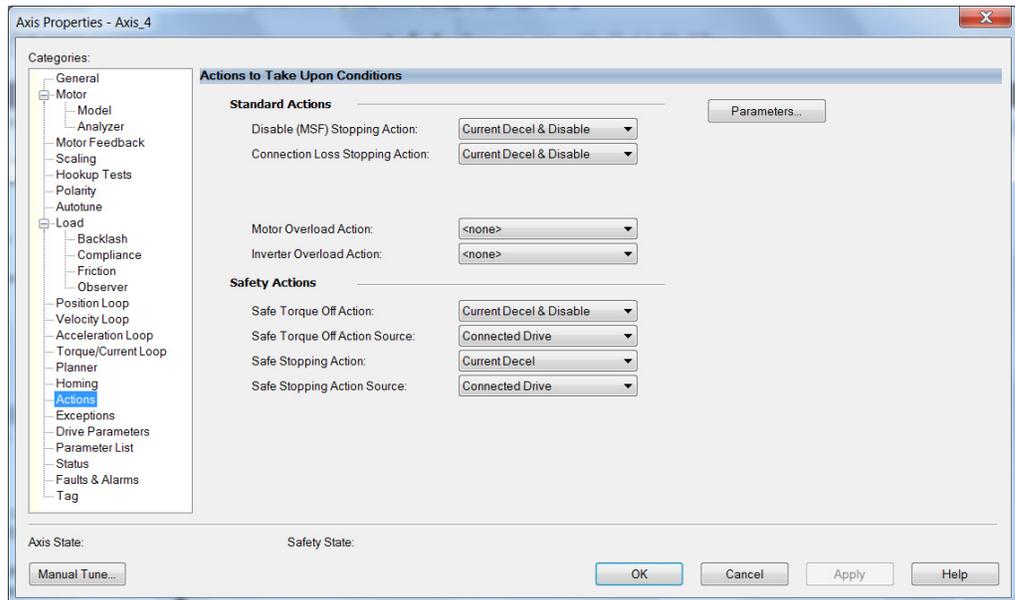


14. Click Apply, if you make changes.
15. Select the Load category and edit the default values as appropriate for your application.



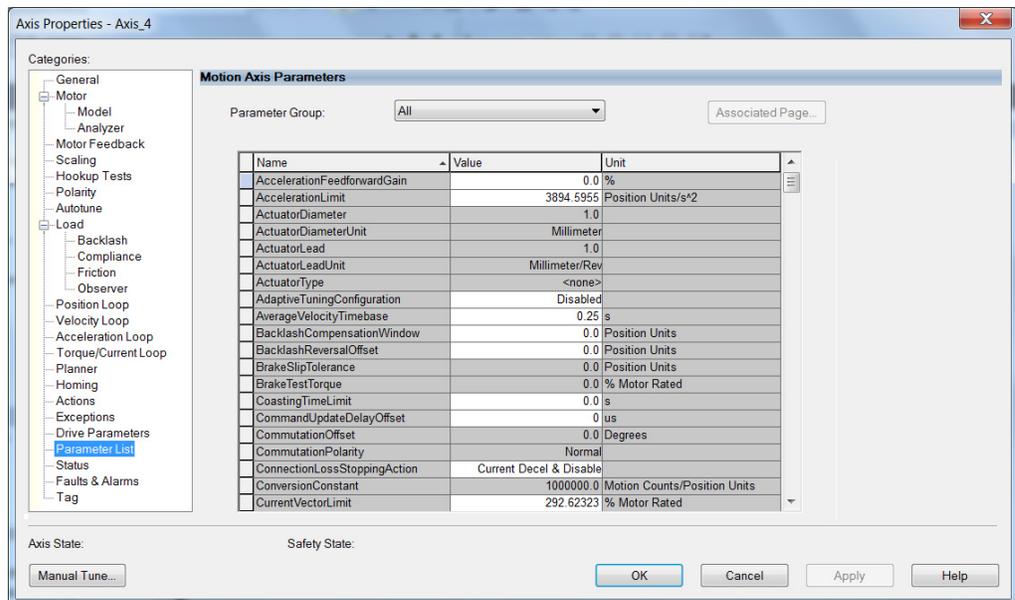
16. Click Apply, if you make changes.

17. Select the Actions category.



From this dialog box, you can program actions and change the action for exceptions (faults). Refer to [Logix 5000 Controller and Drive Module Behavior](#) on [page 226](#) for more information.

18. Select the Parameter List category.



From this dialog box you can set brake engage and release delay times for servo motors. For recommended motor brake delay times, refer to the Kinetix Rotary Motion Specifications Technical Data, publication [KNX-TD001](#).

19. Click OK.

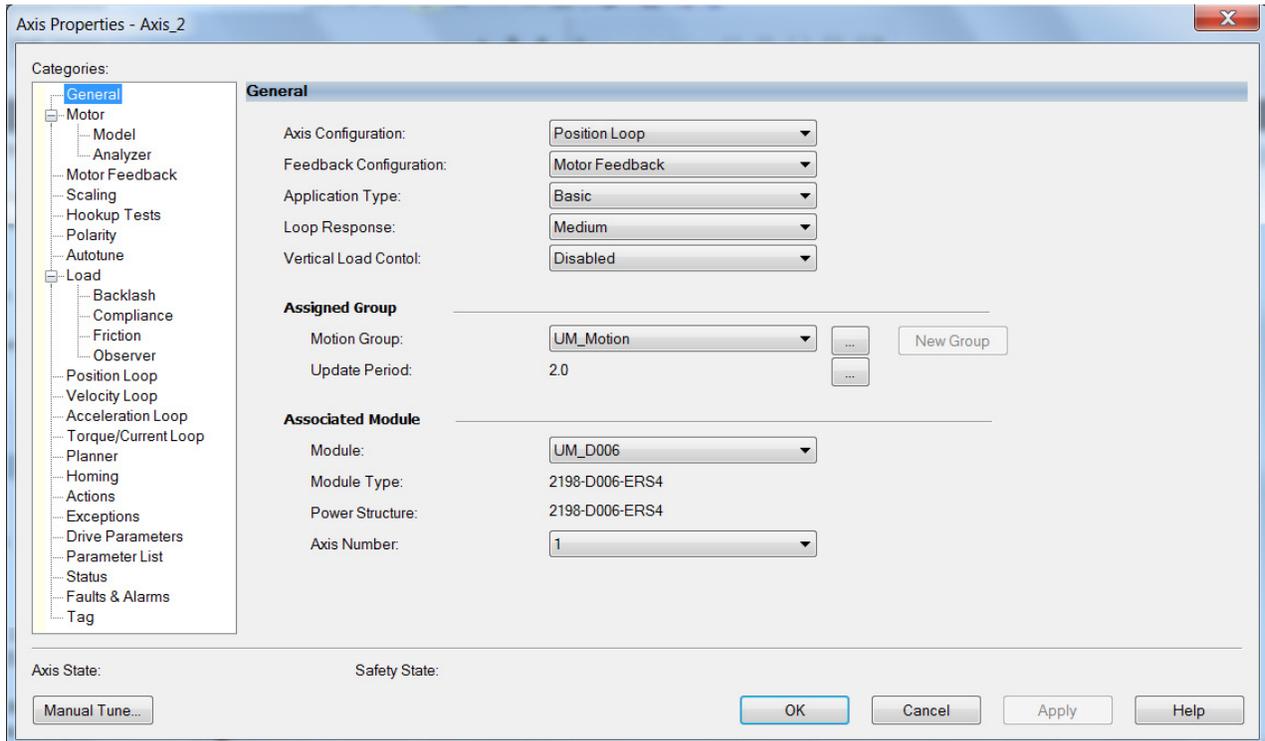
20. Repeat [step 1](#) through [step 19](#) for each servo motor axis.

Configure SPM Motor Closed-loop Control Axis Properties

Follow these steps to configure surface permanent-magnet (SPM) motor closed-loop axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General and Associated Module dialog box appears.



3. From the General pull-down menus, change configuration settings as needed for your application.

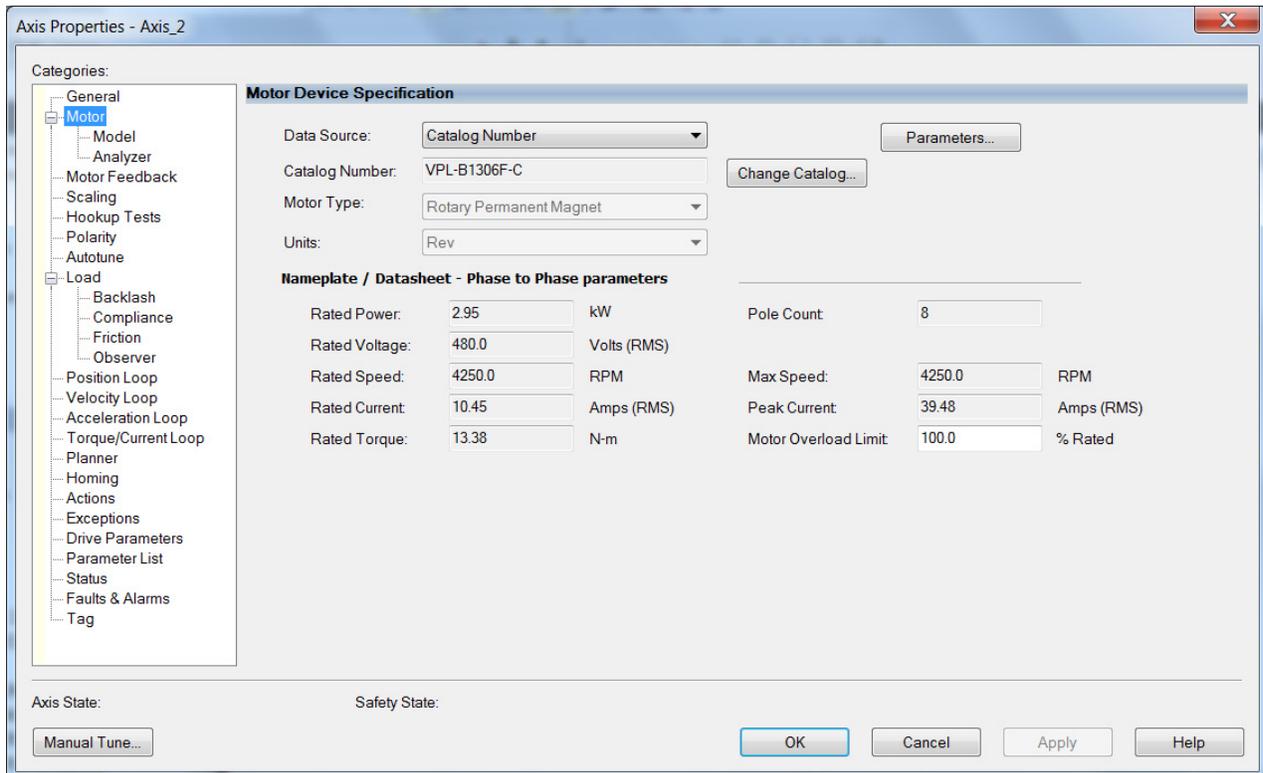
IMPORTANT Frequency Control is not supported for permanent magnet motors.

4. From the Associated Module>Module pull-down menu, choose your Kinetix 5700 drive.

The drive catalog number populates the Module Type and Power Structure fields.

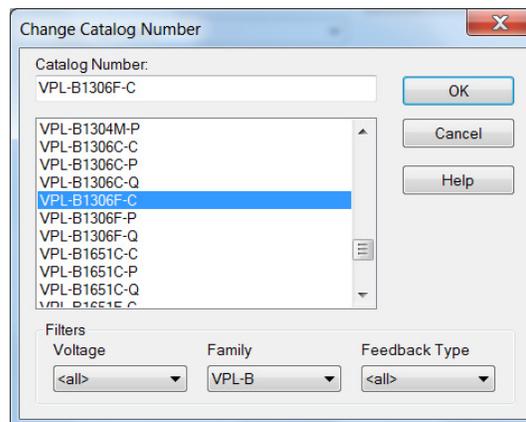
5. Click Apply.
6. Select the Motor category.

The Motor Device Specification dialog box appears.



7. From the Data Source pull-down menu, choose Catalog Number.
8. Click Change Catalog.

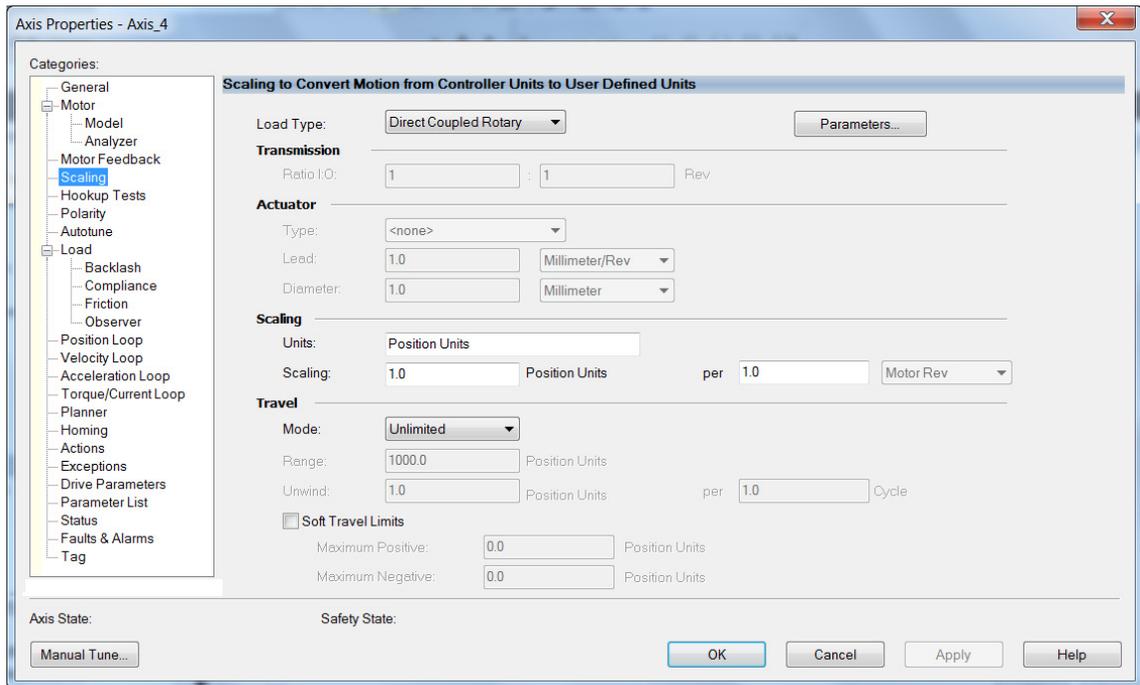
The Change Catalog Number dialog box appears.



9. Select the motor catalog number appropriate for your application.
To verify the motor catalog number, refer to the motor name plate.
10. Click OK to close the Change Catalog Number dialog box.
11. Click Apply.

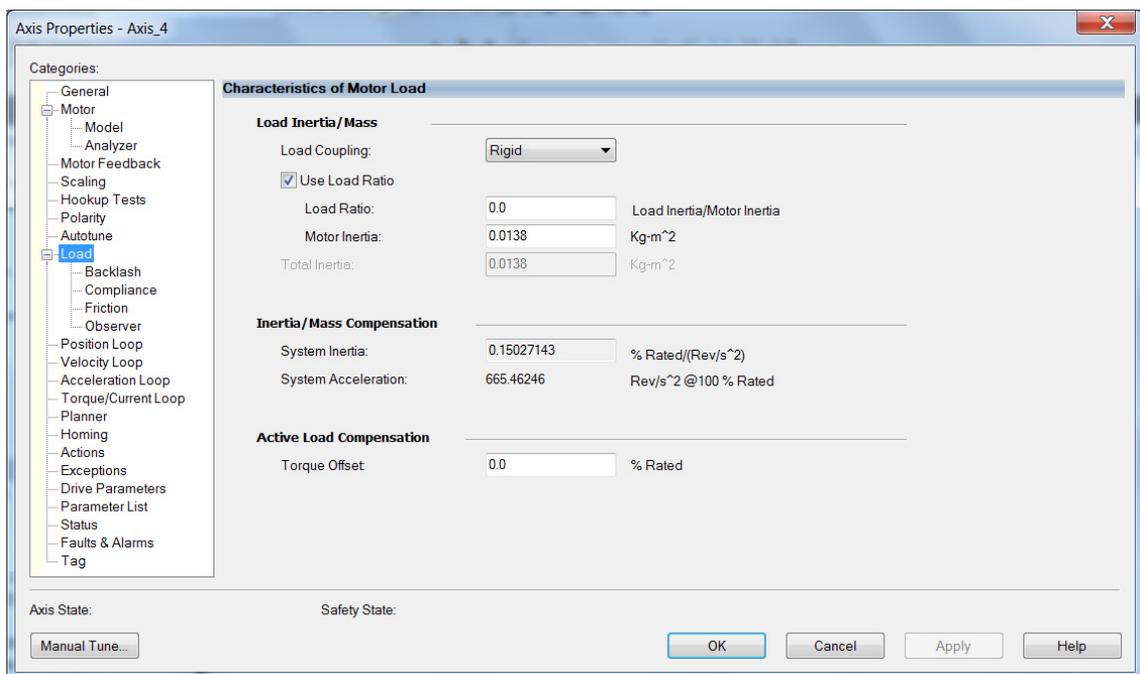
Motor data specific to your motor appears in the Nameplate / Datasheet - Phase to Phase parameters field.

12. Select the Scaling category and edit the default values as appropriate for your application.



13. Click Apply, if you make changes.

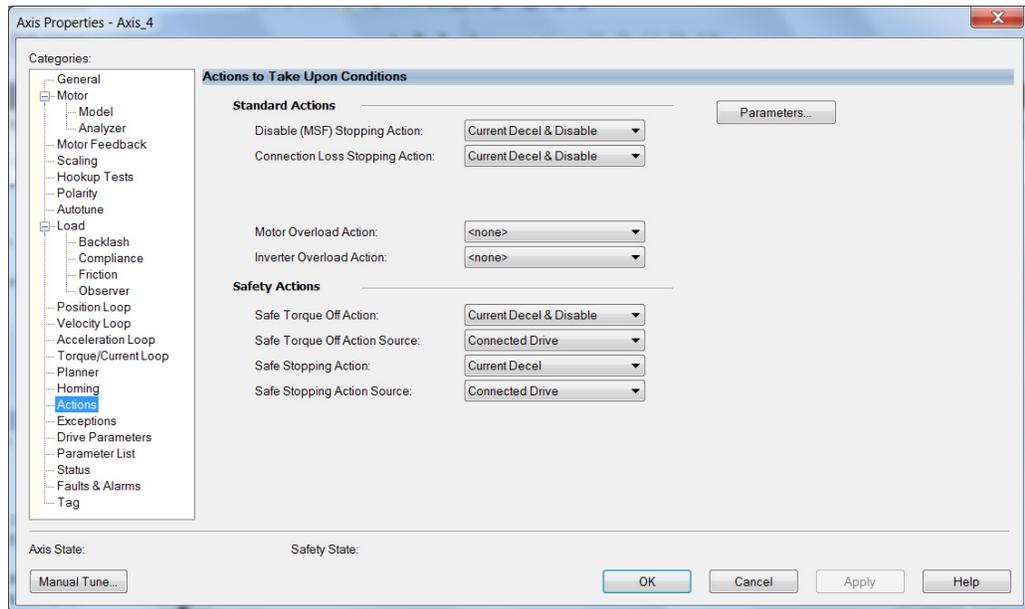
14. Select the Load category and edit the default values as appropriate for your application.



15. Click Apply, if you make changes.

16. Select the Actions category.

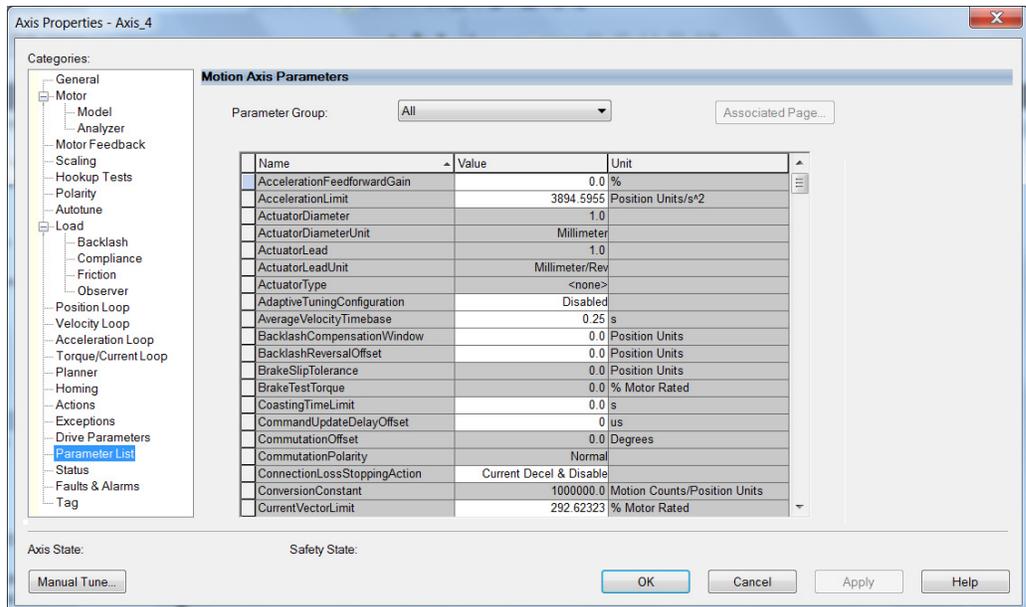
The Actions to Take Upon Conditions dialog box appears.



From this dialog box, you can program actions and change the action for exceptions (faults). Refer to [Logix 5000 Controller and Drive Module Behavior](#) on page 226 for more information.

17. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.



From this dialog box you can set brake engage and release delay times for servo motors. For recommended motor brake delay times, refer to the Kinetix Rotary Motion Specifications Technical Data, publication [KNX-TD001](#).

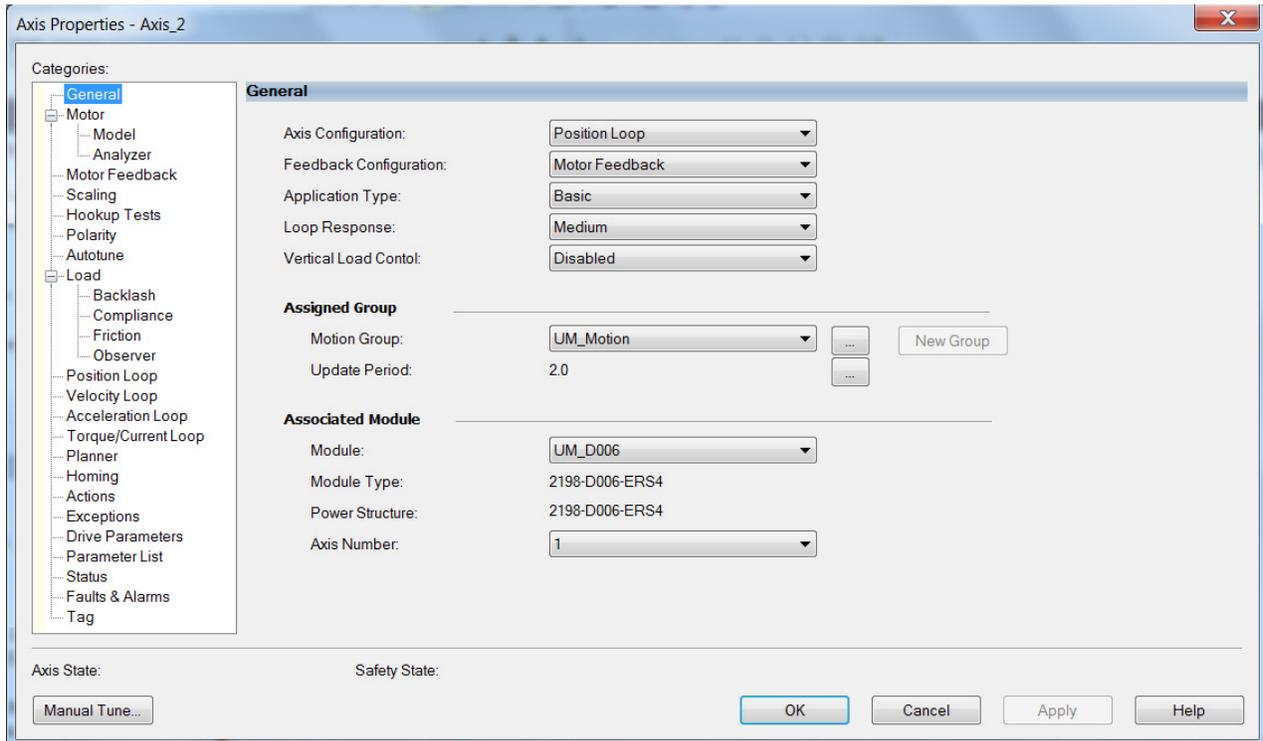
18. Click OK.
19. Repeat [step 1](#) through [step 18](#) for each servo motor axis.

Configure Induction-motor Closed-loop Control Axis Properties

Follow these steps to configure induction-motor closed-loop control axis properties.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General and Associated Module dialog box appears.

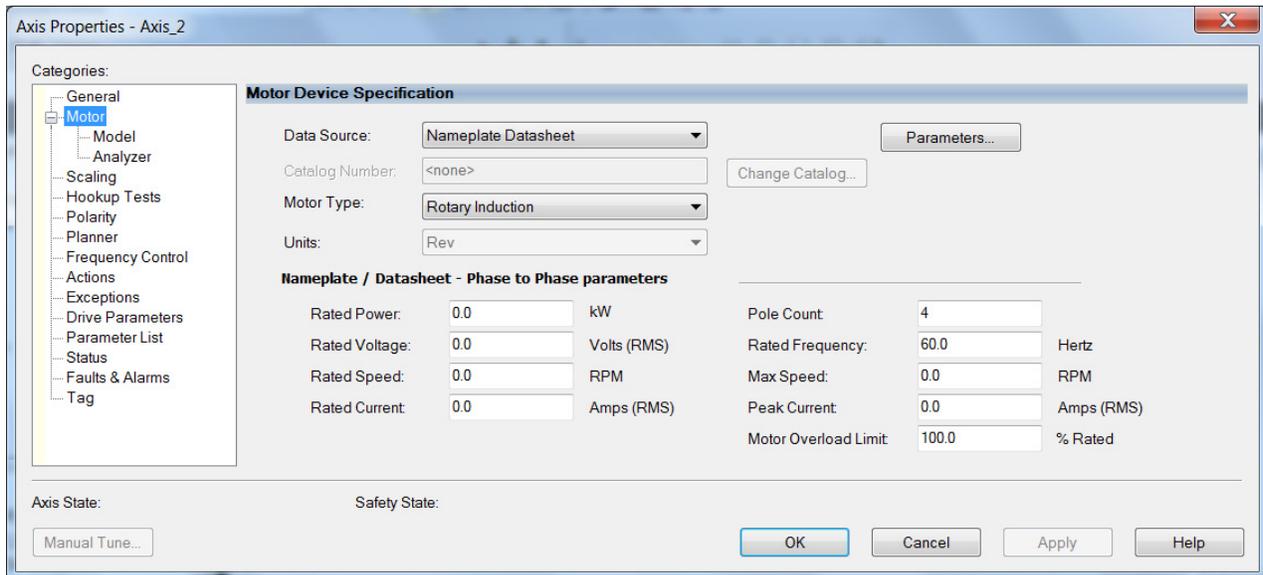


3. From the General pull-down menus, change configuration settings as needed for your application.
4. From the Associated Module>Module pull-down menu, choose your Kinetix 5700 drive.

The drive catalog number populates the Module Type and Power Structure fields.

5. Click Apply.
6. Select the Motor category.

The Motor Device Specification dialog box appears.



7. From the Data Source pull-down menu, choose Nameplate Datasheet.

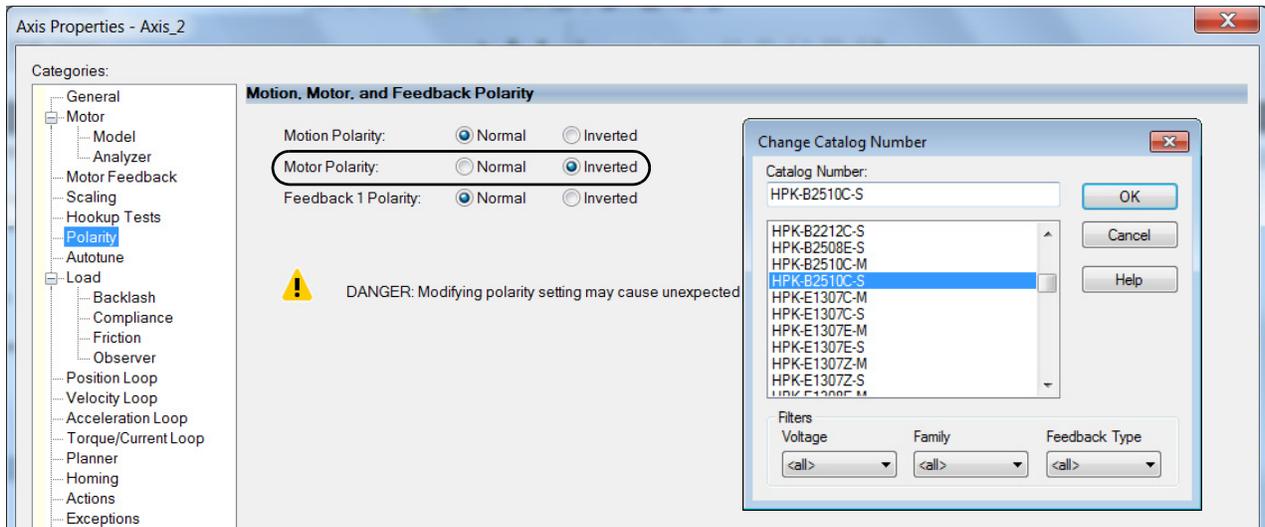
This is the default setting. If you have an Allen-Bradley HPK-Series™ asynchronous rotary motor, refer to [page 185](#) to see how to populate the Nameplate / Datasheet parameters by selecting the motor catalog number.

IMPORTANT When you configure HPK-Series motor parameters by selecting the motor catalog number, you must also configure the Polarity category. This requirement applies to only HPK-Series asynchronous motors. See Knowledgebase document [732760](#) for more information.

IMPORTANT Motor NV is not a supported data source in the Logix Designer application for axes configured as Induction-motor closed-loop.

- a. Select the Polarity category.

b. For Motor Polarity, click Inverted (default is Normal).



c. Click Apply and return to the Motor category.

8. From the Motor Type pull-down menu, choose Rotary Induction.

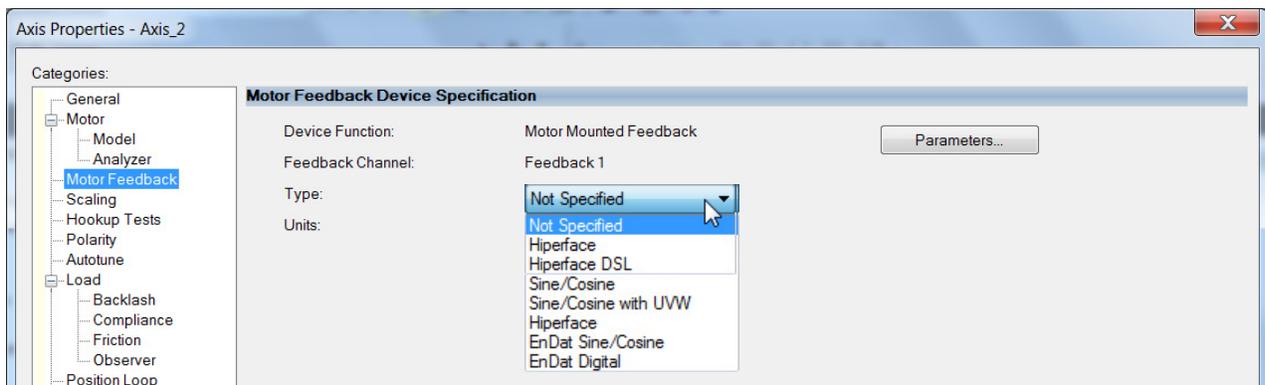
9. From the motor nameplate or datasheet, enter the phase-to-phase values for your motor.

See [Motor Category](#) on [page 342](#) for a motor performance datasheet example.

10. Click Apply.

11. Select the Motor Feedback category.

The Motor Feedback Device Specification dialog box appears.

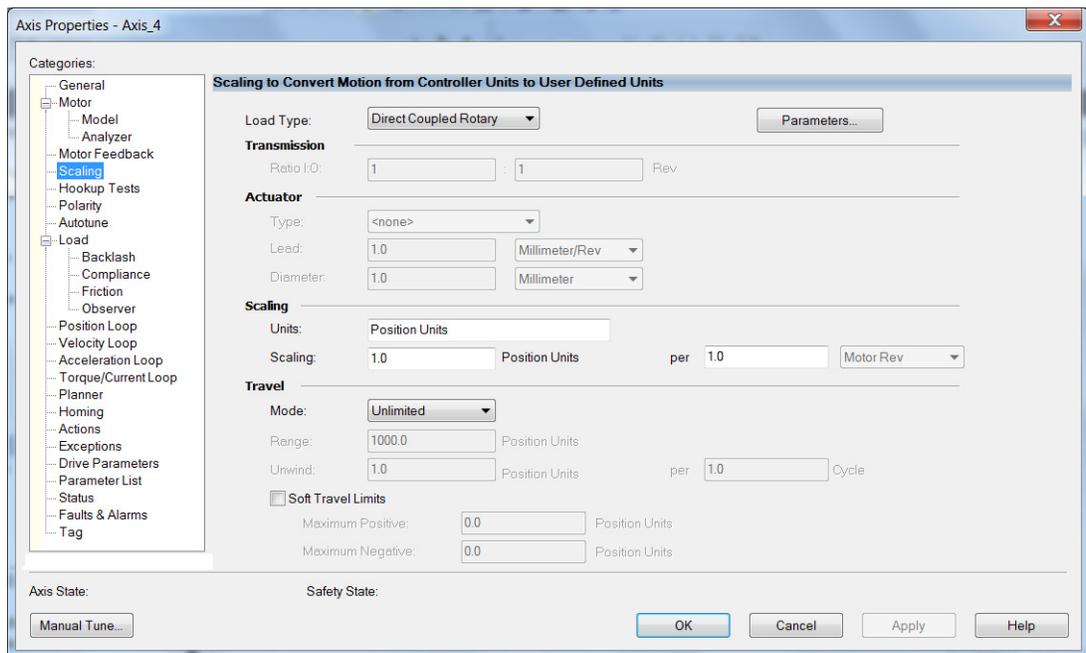


12. From the Type pull-down menu, choose the feedback type appropriate for your application.

See [Configure Feedback Properties](#) on [page 195](#) for feedback configuration examples.

13. Click Apply.

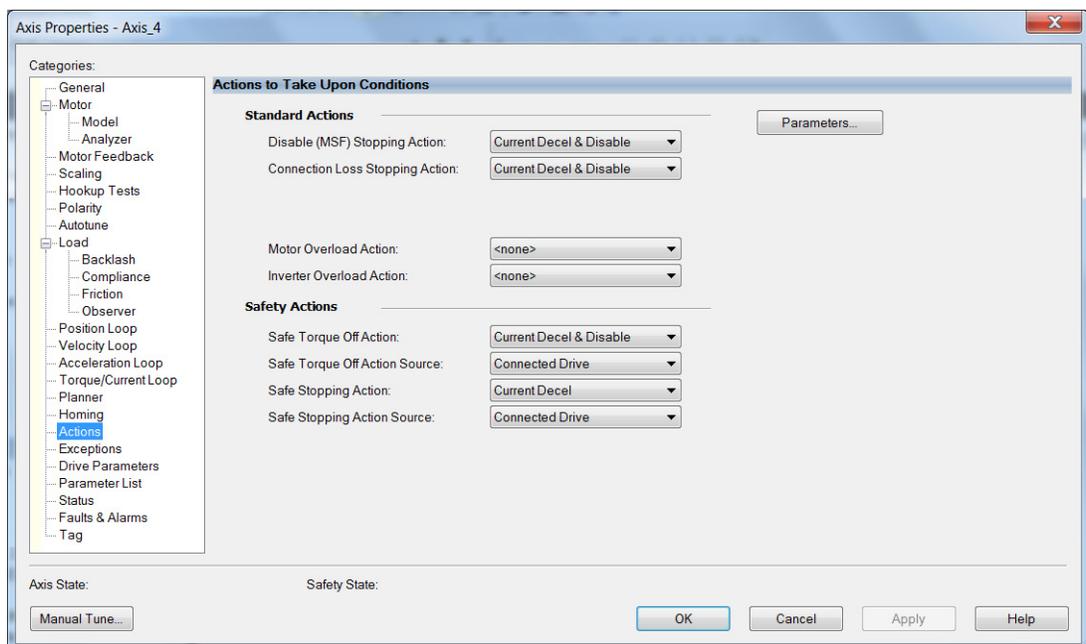
14. Select the Scaling category and edit the default values as appropriate for your application.



15. Click Apply, if you make changes.

16. Select the Actions category.

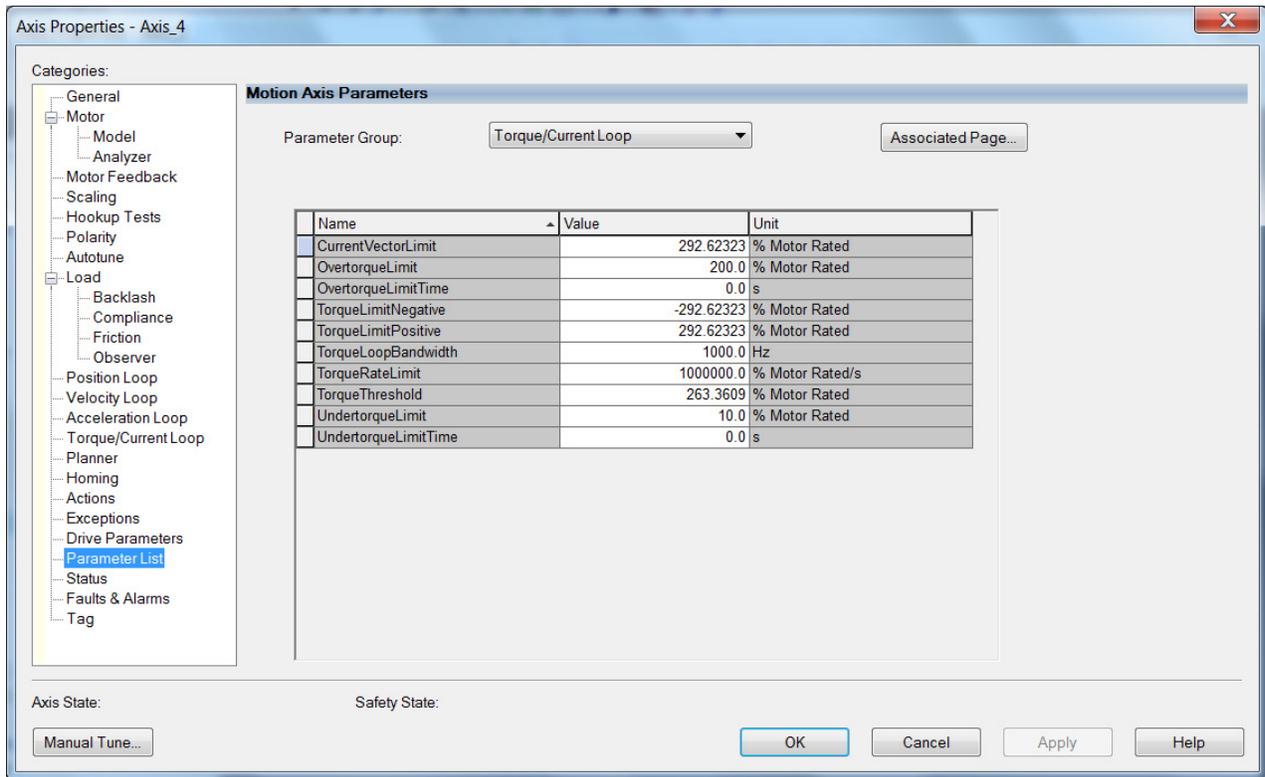
The Actions to Take Upon Conditions dialog box appears.



From this dialog box, you can program actions and change the action for exceptions (faults). Refer to [Logix 5000 Controller and Drive Module Behavior](#) on [page 226](#) for more information.

17. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.



18. From the Parameter Group pull-down menu, choose Torque/Current Loop.

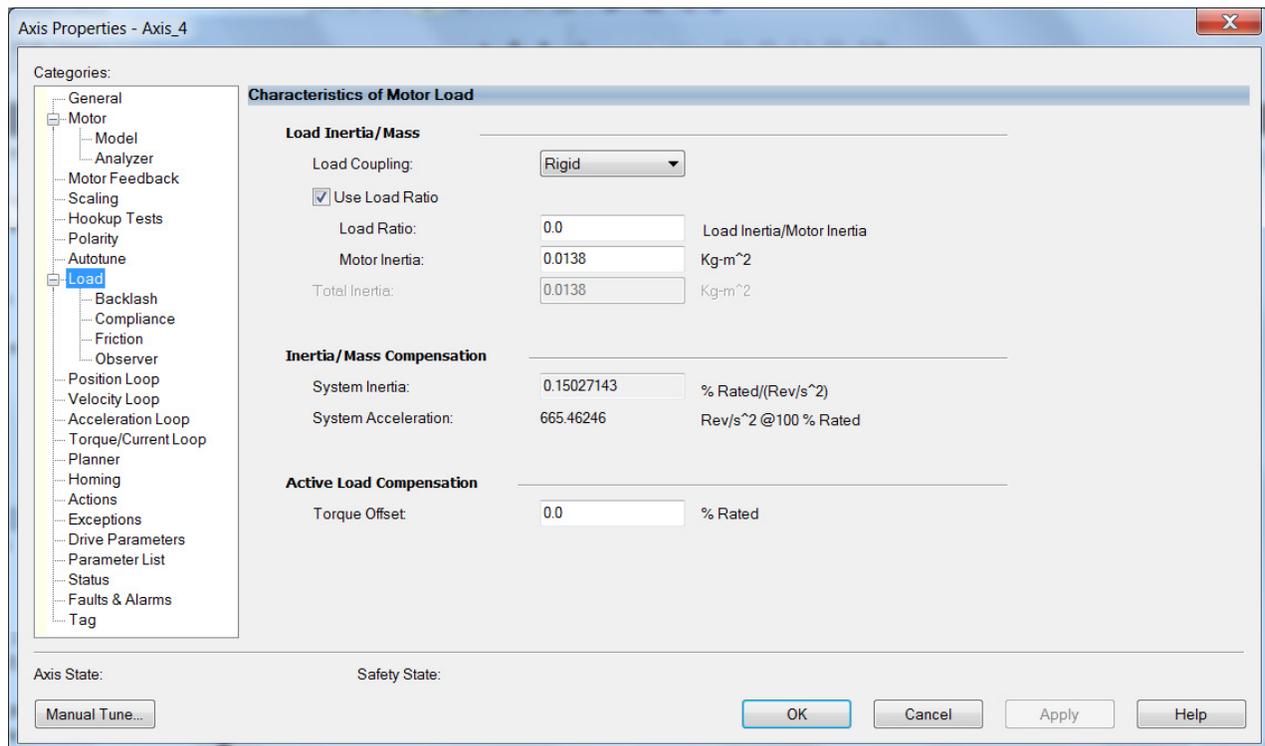
19. Set the FluxUp attributes appropriate for your application.

See the corresponding section in Appendix D, beginning on [page 327](#), for information and configuration examples regarding this topic.

IMPORTANT The Automatic FluxUpControl setting is recommended for best autotune results.

20. Click Apply.

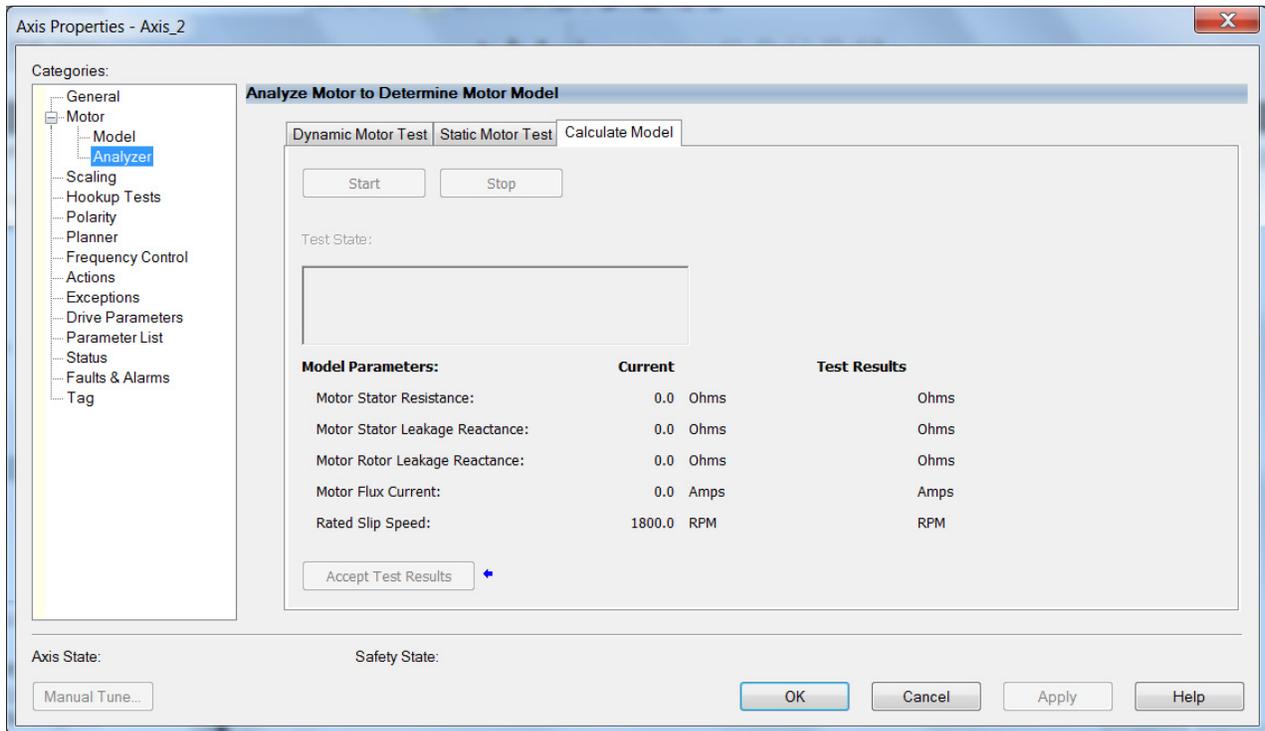
21. Select the Load category and edit the default values as appropriate for your application.



22. Click Apply, if you make changes.
23. Click OK.
24. Select the Motor>Model category.

Motor model attributes are automatically estimated from the Nameplate/Datasheet parameters. For improved performance, motor tests can be run.

25. The Analyze Motor to Determine Motor Model dialog box opens.



IMPORTANT The Dynamic motor test cannot be run without a non-zero motor inertia.

26. Click the tab corresponding to the Motor Test you want to run.
See [Motor Tests and Autotune Procedure](#) on [page 344](#) for information about each of the tests.
27. Click Start.
28. Click Accept Test Results.
29. Click Apply.
30. Select the Autotune category.
See [Tune Induction Motors](#) on [page 211](#) for more information.
31. Repeat [step 1](#) through [step 31](#) for each induction motor axis.

Configure Feedback Properties

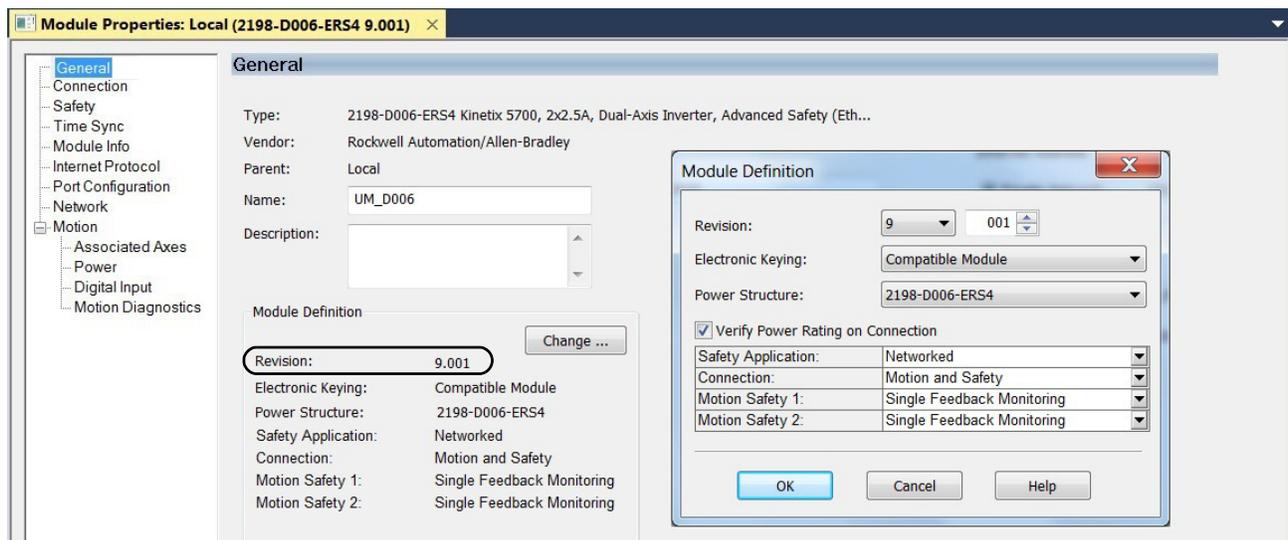
This section provides more configuration detail for module properties and axis properties when incremental feedback types are used in your application.

Configure Module Properties

Configure the module properties of your Kinetix 5700 servo drive depending on how you intend to use the feedback connectors.

1. Right-click a drive in the Controller Organizer to configure and choose Properties.

The Module Properties dialog box appears.

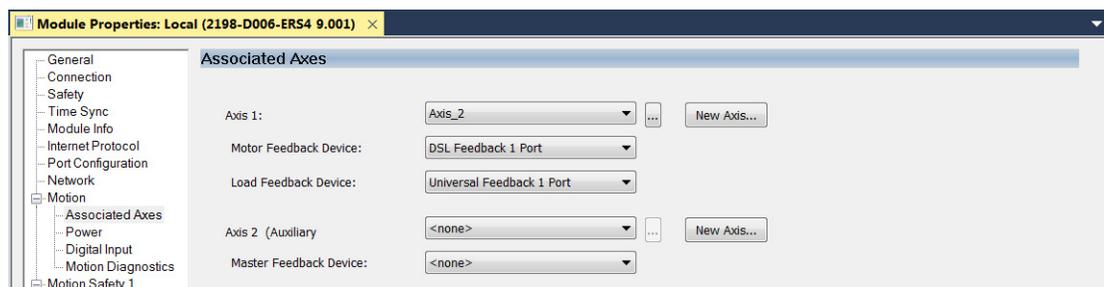


2. Under Module Definition click Change.

The Module Definition dialog box appears.

Depending on the Module Definition revision selection, alternate feedback types can be selected. However, 2198-xxxx-ERS4 drives only appear in firmware revision 9.001 or later.

3. Click the Associated Axes category.



4. Configure each axis for Motor feedback, Load feedback, and Master feedback devices appropriate for your application.

See Continue Inverter Configuration on [page 163](#) for more information on configuring module properties for dual-axis and single-axis inverters.

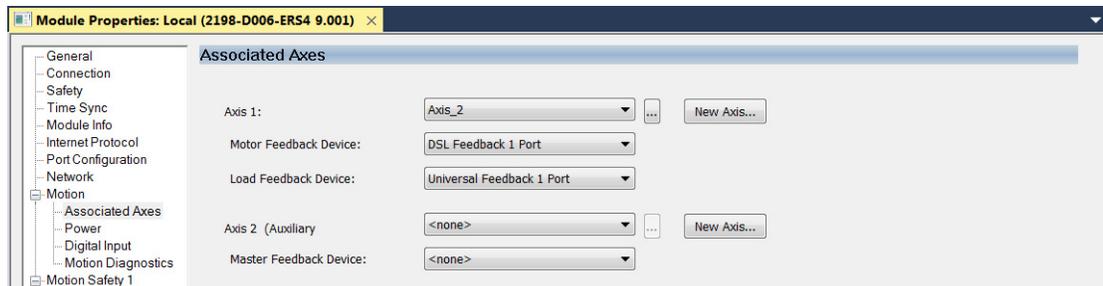
IMPORTANT The Logix Designer application prevents making feedback port assignments with incompatible feedback types. For example, you cannot assign the same port for multiple devices. The same port cannot be used for Motor Feedback Device, Load Feedback Device, and Master Feedback Device.

Table 92 - Motor Feedback Compatibility

| Motor Feedback Device Option | Feedback Type | Description | Feedback Connector | |
|------------------------------|--|---|--|---------------------------------|
| Universal Feedback 1 Port | <ul style="list-style-type: none"> Digital AqB Digital AqB with UVW Sine/Cosine Sine/Cosine with UVW | Incremental | Applies to Allen-Bradley Bulletin MPL (-H) rotary motors, Bulletin MPAS (direct-drive) linear actuators, LDAT-Series (-xBx) linear thrusters, and LDC-Series™ linear motors wired to the 2198-K57CK-D15M universal connector kit. | 15-pin universal feedback (UFB) |
| | <ul style="list-style-type: none"> EnDat Sine/Cosine EnDat Digital | High-resolution single-turn and multi-turn, absolute | Applies to Allen-Bradley Bulletin RDB and Bulletin VPC-Bxxxx-Y motors wired to the 2198-K57CK-D15M universal connector kit. | |
| DSL Feedback 1 Port | Hiperface | | Applies to Allen-Bradley Bulletin MPL, MPM, MPF, MPS (-M/S or -V/E), and VPC-Bxxxx-S rotary motors; Bulletin MPAS (ballscrew), MPAI, linear actuators; HPK-Series rotary motors; and LDAT-Series (-xDx) linear thrusters wired to the 2198-K57CK-D15M universal connector kit. | 2-pin motor feedback (MF) |
| | Hiperface DSL | Applies to Allen-Bradley Bulletin VPL, VPF, VPS and VPC-Bxxxx-Q rotary motors wired to the 2198-KITCON-DSL connector kit. | | |

IMPORTANT Unprogrammed Smart feedback devices (Hiperface Sin/Cos, Hiperface DSL, EnDat Digital, and EnDat Sin/Cos) are not supported. Unprogrammed as load or feedback-only feedback types are supported. Contact your local distributor or Rockwell Automation representative for support options.

This example shows acceptable feedback port assignments.



5. Click OK.

Configure Axis Properties

In this section you configure the axis properties of your Kinetix 5700 servo drive for the type of feedback you intend use in your application.

[Table 93](#) defines valid feedback assignments for each feedback type.

Table 93 - Valid Feedback Assignments

| Feedback Type | | Permanent Magnet Motors | | Induction Motors | | |
|----------------------|--|-------------------------|---------------|------------------|---------------|-----------------|
| Hiperface DSL | High-resolution single-turn and multi-turn, absolute | Motor feedback | Load feedback | Motor feedback | Load feedback | Master feedback |
| Hiperface | | | | | | |
| Digital AqB | Incremental | N/A | | | | |
| Digital AqB with UVW | | Motor feedback | N/A | N/A | N/A | N/A |
| Sine/Cosine | | N/A | Load feedback | Motor feedback | Load feedback | Master feedback |
| Sine/Cosine with UVW | | Motor feedback | N/A | N/A | N/A | N/A |
| EnDat Sine/Cosine | High-resolution single-turn and multi-turn, absolute | Motor feedback | Load feedback | Motor feedback | Load feedback | Master feedback |
| EnDat Digital | | | | | | |

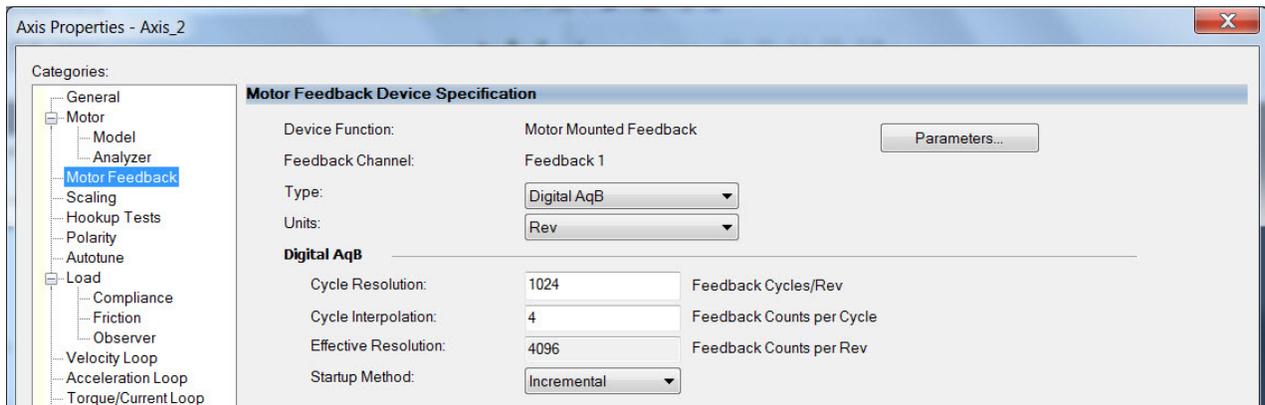
Digital AqB (TTL) Feedback

In this example, a motor feedback device is configured for Digital AqB feedback.

IMPORTANT When Motor Mounted Feedback is the Device Function, Digital AqB (without UVW) is not a valid feedback type for permanent magnet motors.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Motor Feedback category.

The Motor Feedback Device Specification dialog box appears.



3. Configure the device function and type.

In this example, Motor Feedback is the device function and Digital AqB is the feedback type.

4. Enter values for the Digital AqB specification fields.
The only valid value for Cycle Interpolation is 4.
5. From the Startup Method pull-down menu, choose Incremental.
6. Click Apply.

TIP When the Device Function is Load-Side Feedback or Master Feedback, configuration is identical to Motor Mounted Feedback.

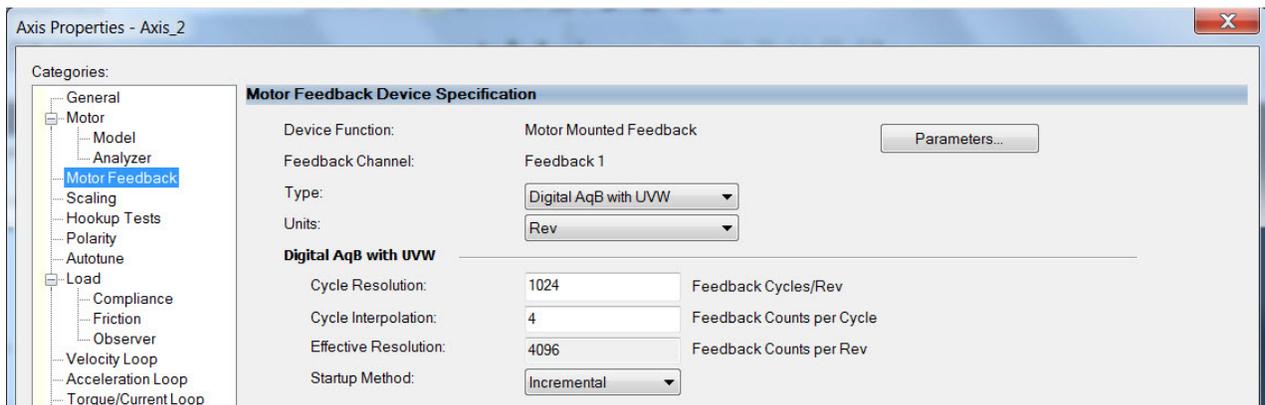
Digital AqB with UVW (TTL w/Hall) Feedback

In this example, a motor feedback device is configured for Digital AqB with UVW feedback.

IMPORTANT When Motor Mounted Feedback is the Device Function, Digital AqB with UVW is the only valid feedback type for permanent magnet motors.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Motor Feedback category.

The Motor Feedback Device Specification dialog box appears.



3. Configure the device function and type.
In this example, Motor Feedback is the device function and Digital AqB with UVW is the feedback type.
4. Enter values for the Digital AqB with UVW specification fields.
The only valid value for Cycle Interpolation is 4.
5. From the Startup Method pull-down menu, choose Incremental.
6. From the Alignment pull-down menu, choose Not Aligned.
7. Click Apply.

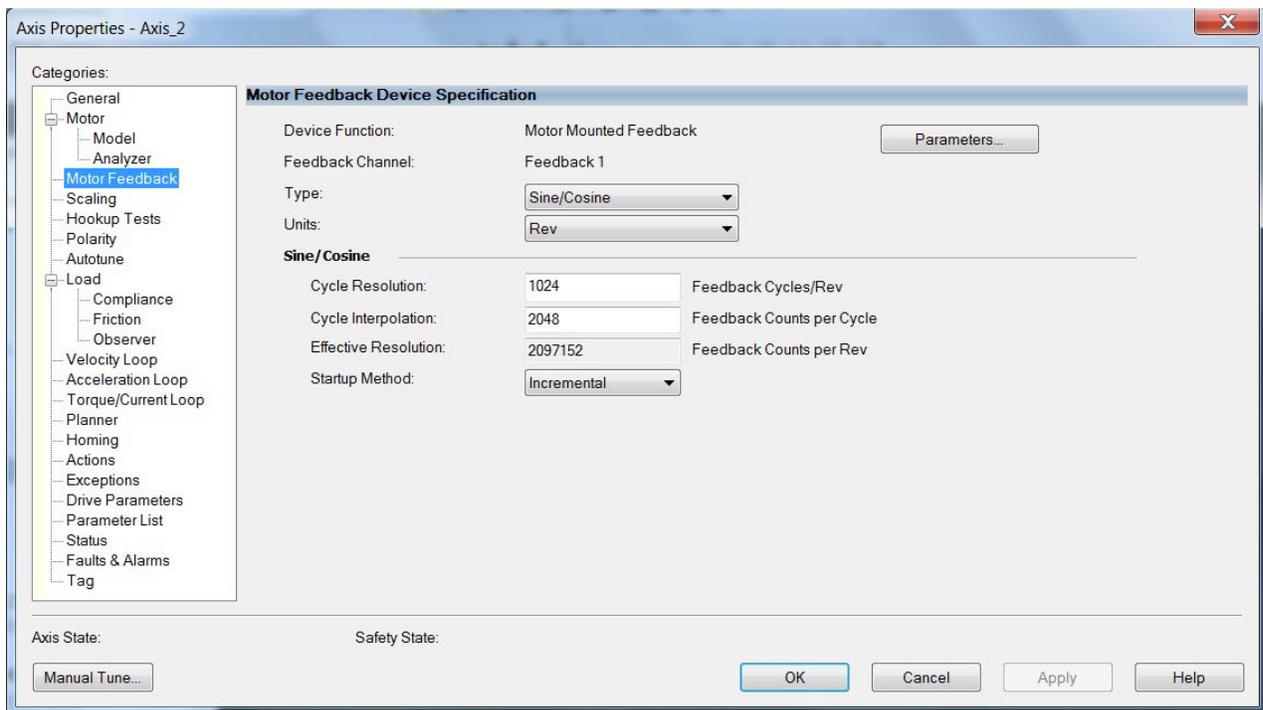
Sine/Cosine Feedback

In this example, a motor feedback device is configured for Sine/Cosine feedback.

IMPORTANT When Motor Mounted Feedback is the Device Function, Sine/Cosine is not a valid feedback type for permanent magnet motors.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Motor Feedback category.

The Motor Feedback Device Specification dialog box appears.



3. Configure the device function and type.

In this example, Motor Feedback is the device function and Sine/Cosine is the feedback type.

4. Enter values for the Sine/Cosine specification fields.

The only valid values for Cycle Interpolation are powers of 2 from 4 through 65536.

5. From the Startup Method pull-down menu, choose Incremental.
6. Click Apply.

TIP When the Device Function is Load-Side Feedback or Master Feedback, configuration is identical to Motor Mounted Feedback.

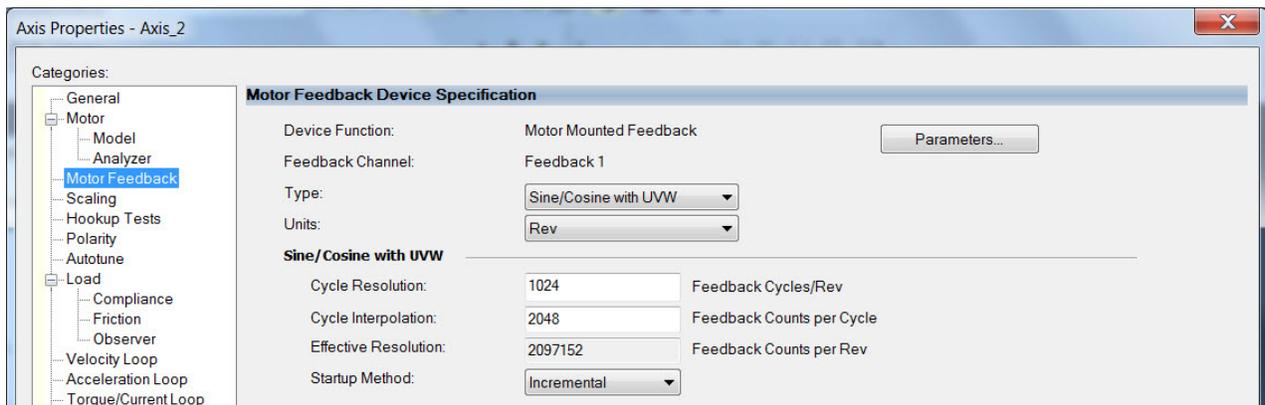
Sine/Cosine with Hall Feedback

In this example, a motor feedback device is configured for Sine/Cosine with UVW feedback.

IMPORTANT When Motor Mounted Feedback is the Device Function, Sine/Cosine with UVW is the only valid feedback type for permanent magnet motors.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Motor Feedback category.

The Motor Feedback Device Specification dialog box appears.



3. Configure the device function and type.

In this example, Motor Feedback is the device function and Sine/Cosine with UVW is the feedback type.

4. Enter values for the Sine/Cosine with UVW specification fields.

The only valid values for Cycle Interpolation are powers of 2 from 4 through 65536.

5. From the Startup Method pull-down menu, choose Incremental.
6. From the Alignment pull-down menu, choose Not Aligned.
7. Click OK.

Download the Program

After completing the Logix Designer application and saving the file you must download your program to the Logix 5000 processor.

Apply Power to the Kinetix 5700 Drive System

This procedure assumes that you have wired and configured your Kinetix 5700 system, your Logix 5000 controller, and iTRAK power supply if present.



SHOCK HAZARD: To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2198 servo drives prior to applying power. Once power is applied, connector terminals can have voltage present even when not in use.

Follow these steps to apply power to the Kinetix 5700 systems.

1. Disconnect the load to the motor (does not apply to iTRAK PS).



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. Apply 24V DC control power.

The LCD display begins the startup sequence. Refer to [Startup Sequence](#) on [page 145](#). If the startup sequence does not begin, check the 24V control power connections.

3. When the startup sequence completes, verify that the two status indicators are steady green.

- a. Verify the DC-bus power supply axis state is PRECHARGE.
- b. Verify the iTRAK power supply axis state is START INHIBITED.

If the DC-bus/iTRAK power supply does not reach the specified axis state and the two status indicators are not solid green, refer to [Kinetix 5700 Status Indicators](#) on [page 223](#).

IMPORTANT Apply control power before applying three-phase AC power. This makes sure the shunt is enabled, which can prevent nuisance faults or Bus Overvoltage faults.

4. Apply mains input power and monitor the DC BUS voltage on the LCD display.

If the DC BUS does not reach the expected voltage level, check the three-phase input power connections.

TIP It can take as long as 1.8 seconds after input power is applied before the drive can accept motion commands (does not apply to iTRAK power supply).

- a. Verify the DC-bus power supply axis state is RUNNING.
- b. Verify the iTRAK power supply axis state is RUNNING.

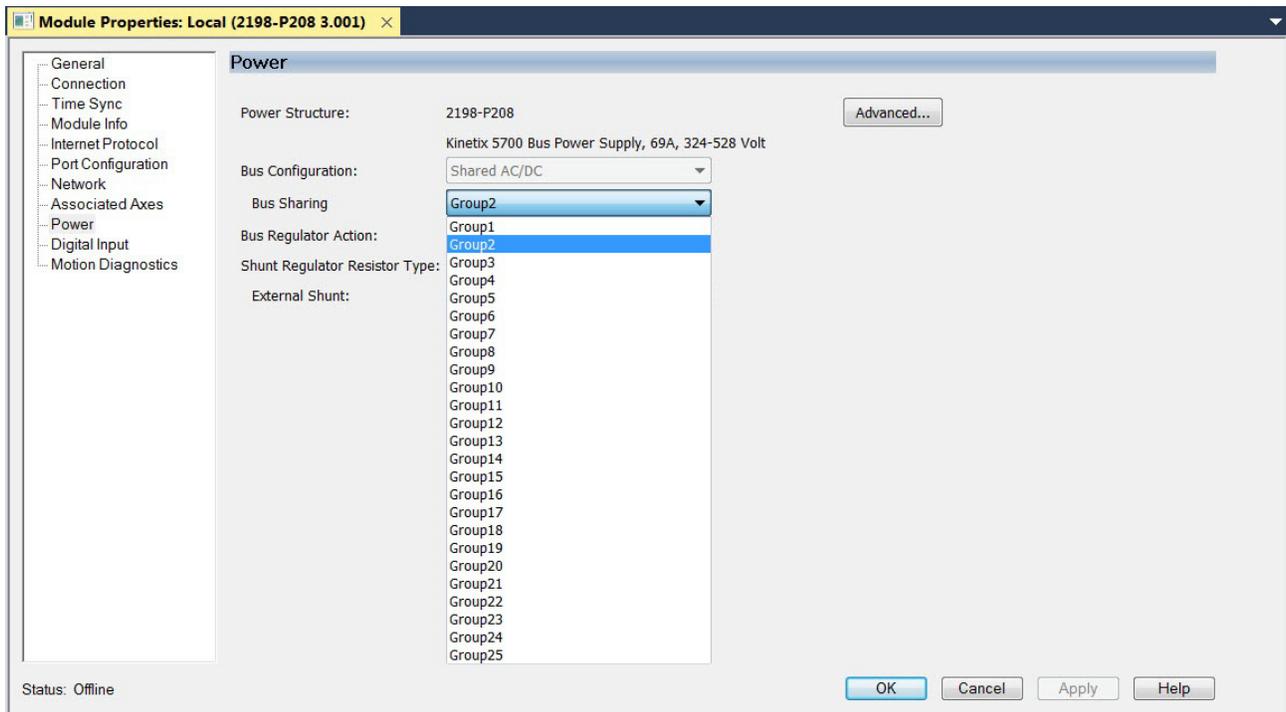
If the DC-bus/iTRAK power supply does not reach the specified axis state, refer to [Fault Codes](#) on [page 214](#).

Understand Bus-sharing Group Configuration

When configuring Module Properties>Power category for each Kinetix 5700 drive, you can breakout drives from one or more servo systems into multiple bus-sharing (power) groups.

A drive that faults in Group 1 does not affect the operation of Group 2, even though all of the drives in Groups 1 and 2 are in the same Motion group in the Logix Designer application. As many as 25 bus-sharing groups are possible.

Figure 95 - Bus-sharing Group Configuration



IMPORTANT The iTRAK power supply is not configured as part of a bus-sharing group in the Logix Designer application. The gateway computer monitors bus status and controls enabling and disabling the iTRAK power supply. See the iTRAK System User Manual, publication [2198T-UM001](#) for more information.

Bus-sharing Group Example

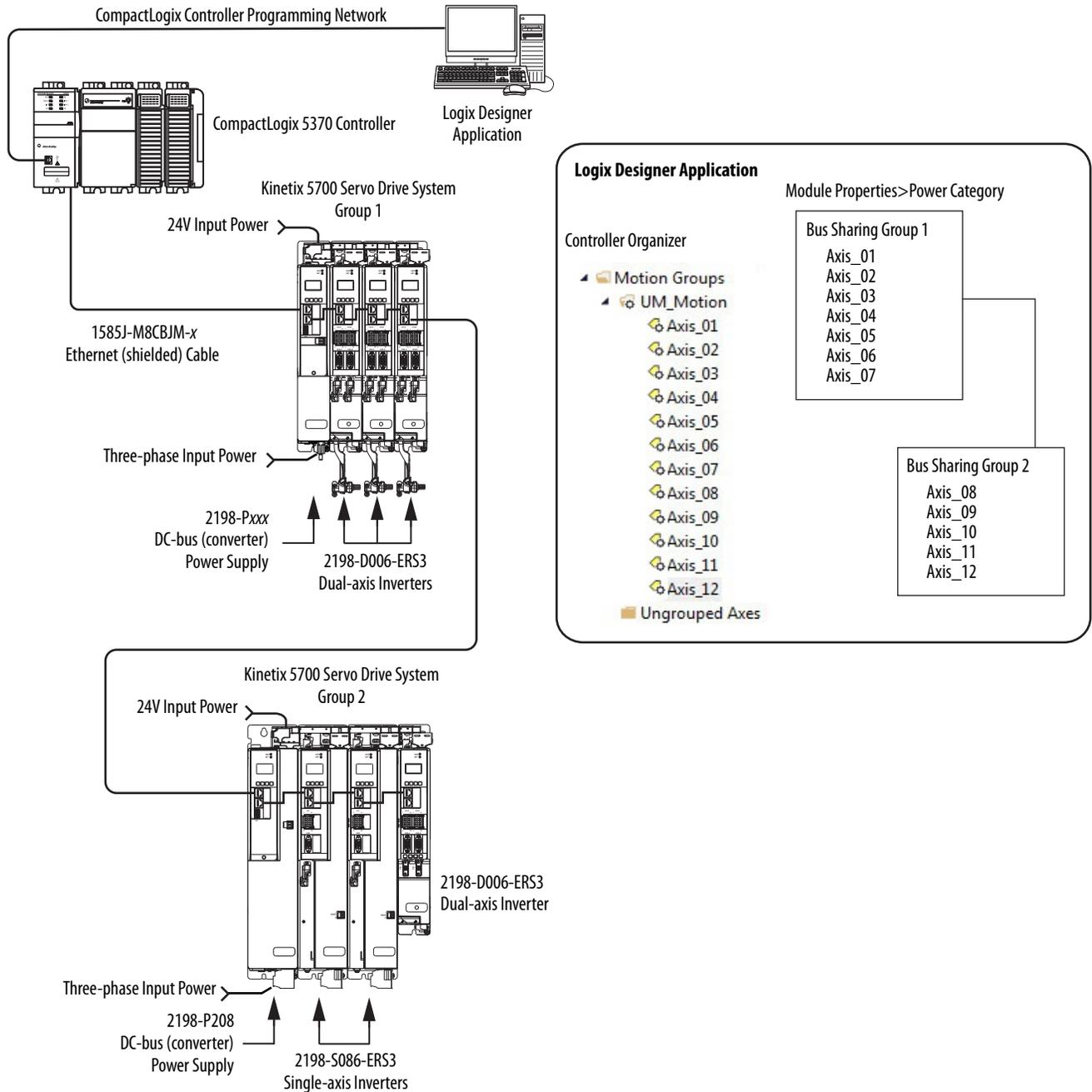
In [Figure 96](#), twelve axes are needed to support the motion application. All twelve axes are configured in the same Motion group in the Logix Designer application.

However, the twelve axes of motion are also configured as two bus-sharing groups in Module Properties>Power category. By creating two bus-sharing groups, a converter drive that faults in Group 1 only disables Group 1 drives, and has no effect on the drive operation of Group 2 drive.



ATTENTION: To avoid damage to equipment all modules physically connected to the same shared-bus connection system must be part of the same Bus Sharing Group in the Logix Designer application.

Figure 96 - Bus-sharing Group Example



Configure Bus-sharing Groups

In both groups, the Bus Configuration for the converter drive is Shared AC/DC and the Bus Configuration for the inverter drives is Shared DC.

Figure 97 - Group 1 DC-bus Power Supply (converter) Configuration

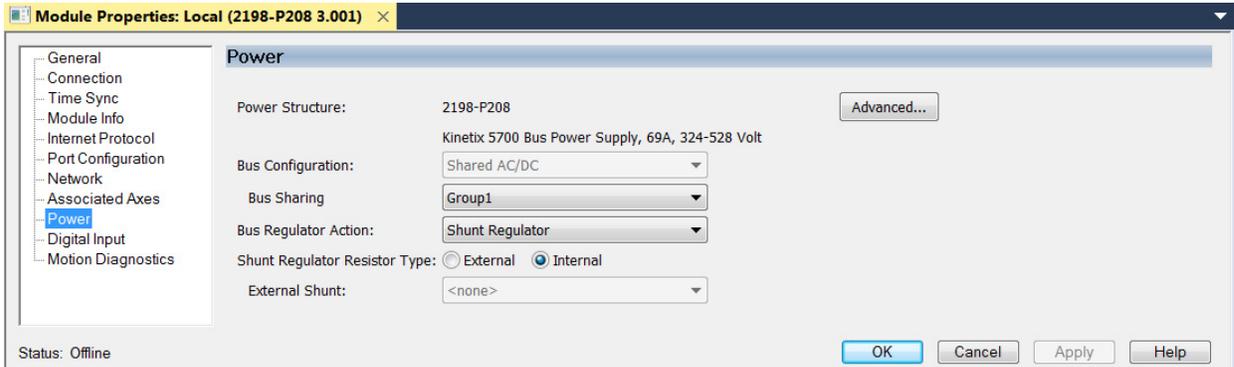


Figure 98 - Group 1 Dual-axis Inverter Configuration

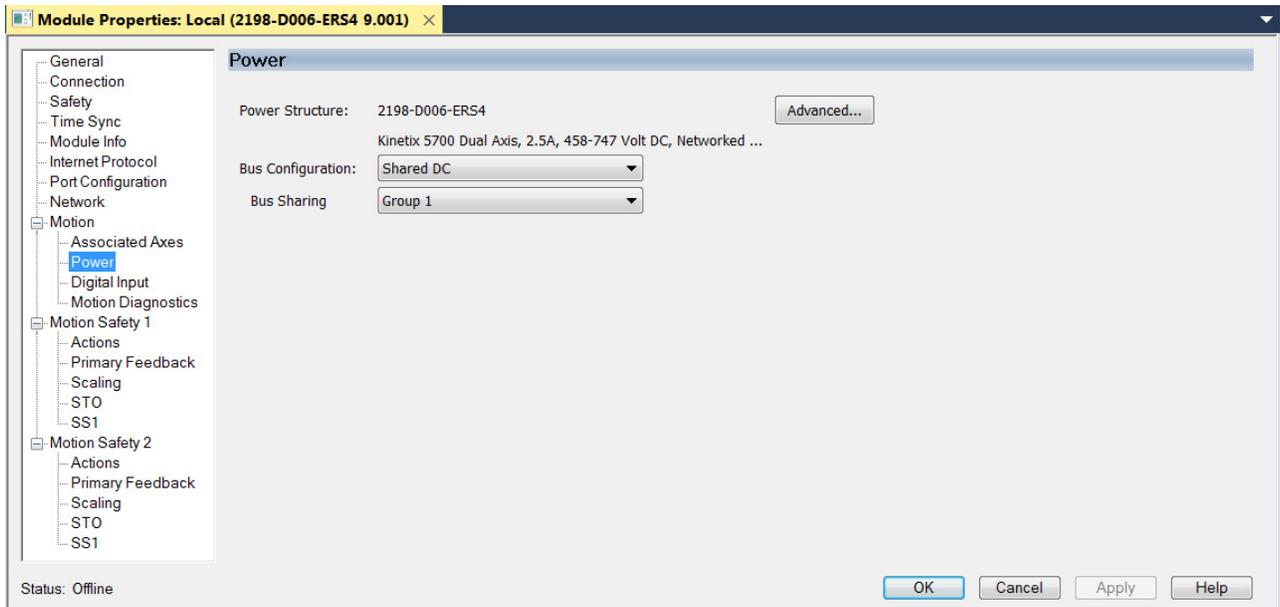


Figure 99 - Group 2 DC-bus Power Supply (converter) Configuration

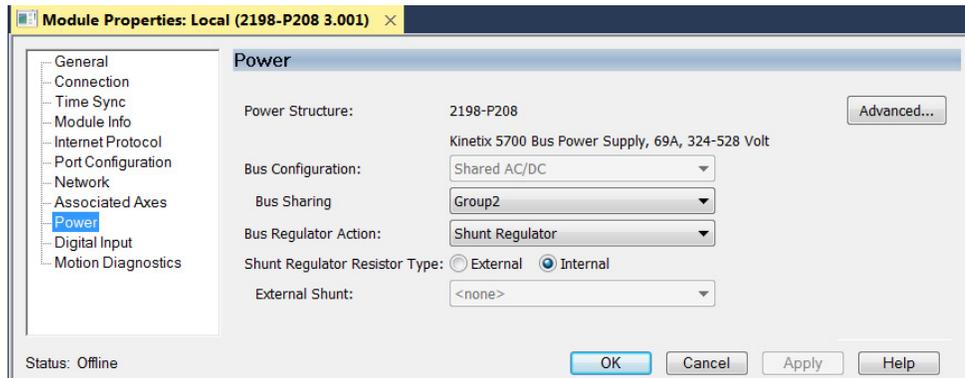
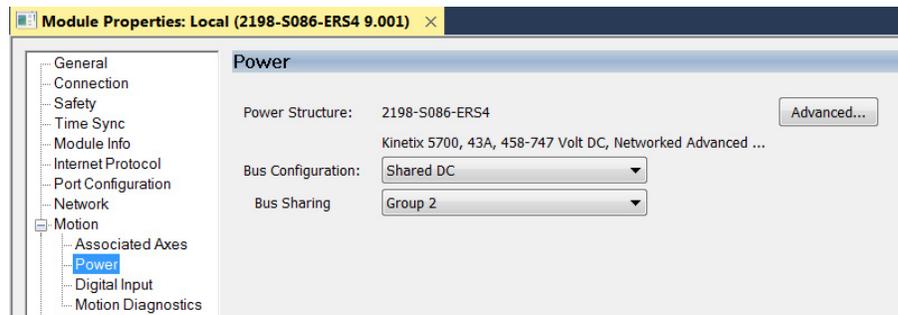
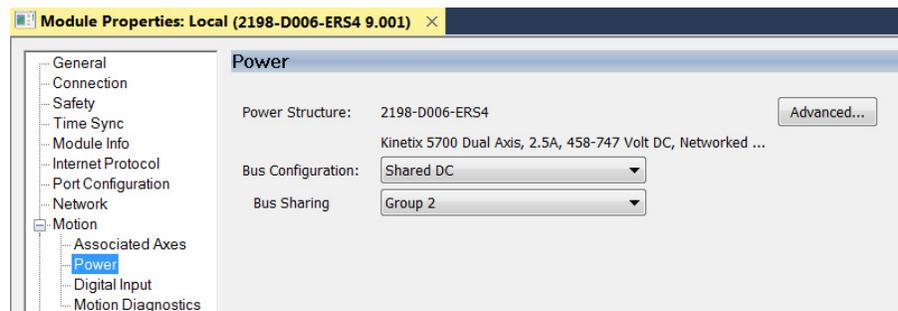


Figure 100 - Group 2 Single-axis Inverter Configuration**Figure 101 - Group 2 Dual-axis Inverter Configuration**

Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 5700 drive, your Logix 5000 controller, and applied power to the system.

IMPORTANT Before proceeding with testing and tuning your axes, verify that the MOD and NET status indicators are operating as described in [Kinetix 5700 Status Indicators](#) on [page 223](#).

For help using the Logix Designer application as it applies to testing and tuning your axes with ControlLogix EtherNet/IP modules or CompactLogix 5370 controllers, refer to [Additional Resources](#) on [page 12](#).

For testing and tuning iTRAK movers, see the iTRAK System User Manual, publication [2198T-UM001](#).

Test the Axes

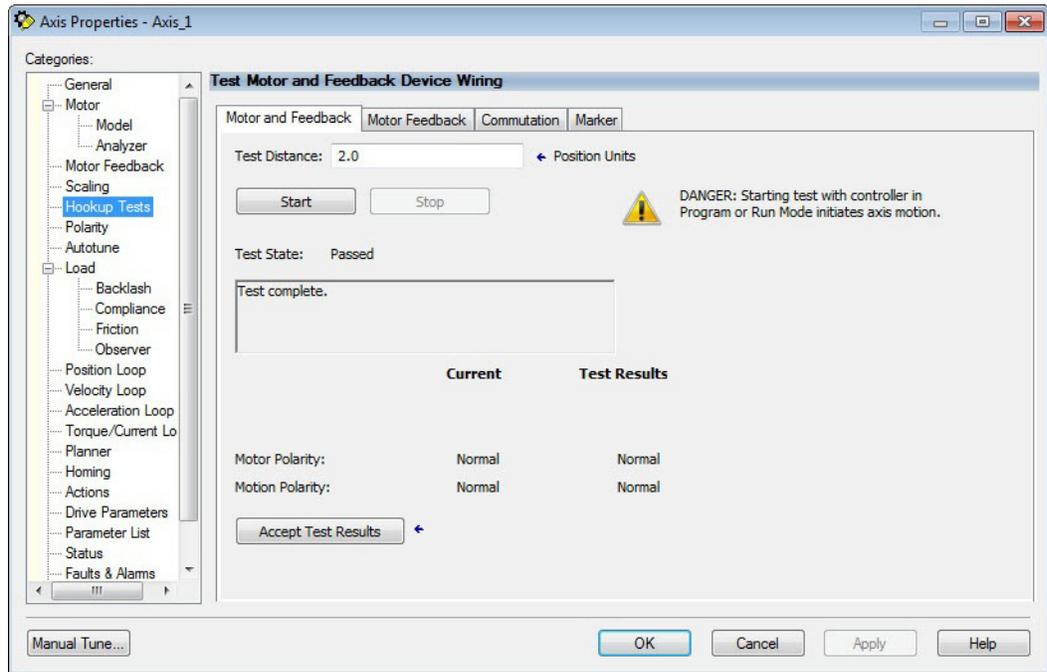
Follow these steps to test the axes.

1. Verify the load was removed from each axis.



ATTENTION: To avoid personal injury or damage to equipment, you must remove the load from each axis as uncontrolled motion can occur when an axis with an integral motor brake is released during the test.

- In your Motion Group folder, right-click an axis and choose Properties. The Axis Properties dialog box appears.



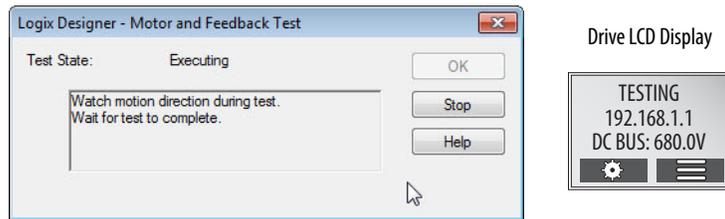
- Select the Hookup Tests category.
- In the Test Distance field, enter the desired test distance.

The Position Units are defined in Axis Properties>Scaling category.

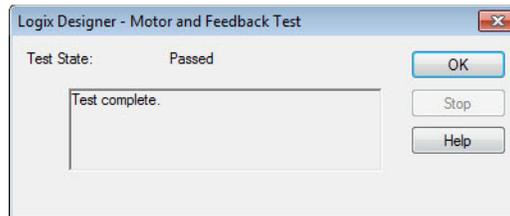
| Hookup Test | Definitions |
|--------------------|---|
| Marker | Verifies marker detection capability as you manually rotate the motor shaft. The test completes when the drive either detects the marker or when the motor moves the distance specified in the Test Distance field. If the marker remains undetected and the test completes successfully, it means the motor moved the full test distance. If the marker remains undetected and the test fails, the motor did not move the full test distance. Run this test after running the Motor Feedback and Motor and Feedback tests. |
| Commutation | Verifies the commutation offset and commutation polarity of the motor. This test applies to third-party or custom permanent-magnet motors equipped with (TTL with Hall and Sine/Cosine with Hall) incremental encoders that are not available as a catalog number in the Motion Database. See Commutation Test on page page 366 . |
| Motor Feedback | Verifies feedback connections are wired correctly as you manually rotate the motor shaft. The test completes when the drive determines that the motor moved the full distance specified in the Test Distance field. Run this test before the Motor and Feedback Test to verify that the feedback can be read properly. |
| Motor and Feedback | Verifies motor power and feedback connections are wired correctly as the drive commands the motor to rotate. Because the drive is rotating the motor, this test requires full bus power to run. Run the Motor Feedback test before running this test to verify that the feedback is being read correctly. |

- Click the desired test to verify connections.
- Click Start.

The Logix Designer - Motor and Feedback Test dialog box appears. The Test State is Executing. TESTING appears on the drive LCD display.

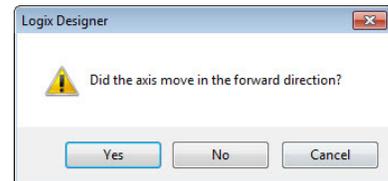


When the test completes successfully, the Test State changes from Executing to Passed.



7. Click OK.

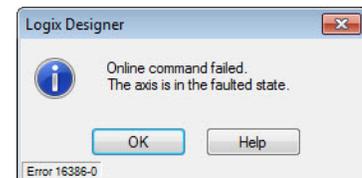
This dialog box appears asking if the axis moved in the forward direction.



8. Click Yes if you agree.
9. Click Accept Test Results.

10. If the test fails, this dialog box appears.

- a. Click OK.
- b. Verify the DC bus voltage.
- c. Verify unit values entered in the Scaling category.
- d. Verify the motor power and feedback wiring.
- e. Return to [step 5](#) and run the test again.



Tune the Axes

Choose the tuning procedure best suited for your motor type.

| Motor Type | Go directly to |
|-----------------------|---|
| Permanent magnet (PM) | Tune Permanent Magnet Motors |
| Induction | Tune Induction Motors on page 211 |

Tune Permanent Magnet Motors

The load observer feature provides high-performance motion control without having to manually tune your axis. Using load observer with a default set of gains can yield high-performance right out of the box. Most of the time, there is no need to perform an auto-tune procedure or further optimize gain settings.

Follow these steps to configure the drive for high-performance by using the load observer feature.

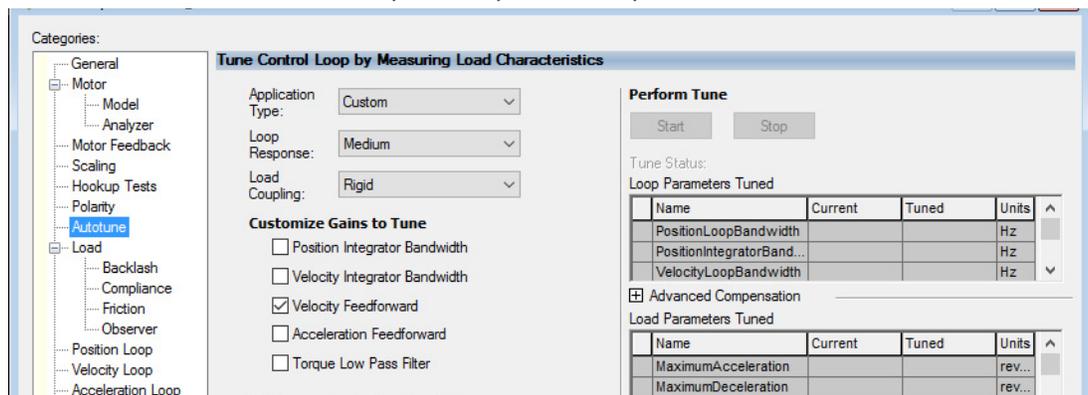
1. Verify that the load is connected.

Re-attach the load if it was disconnected for the Hookup Test.



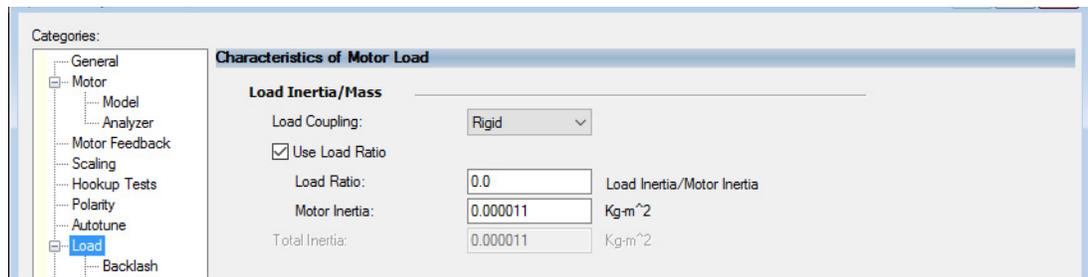
ATTENTION: If the drive has not been enabled before (new installation), verify that you have safeguards in place to safely remove power from the drive in the event of an unstable situation where the drive can produce undesired motion.

2. Click the Autotune category in the Axis Properties dialog box.
 - a. From the pull-down menus for Application Type, Loop Response, and Load Coupling, choose Custom, Medium, and Rigid settings, respectively.
 - b. Verify that only the Velocity Feedforward box is checked.

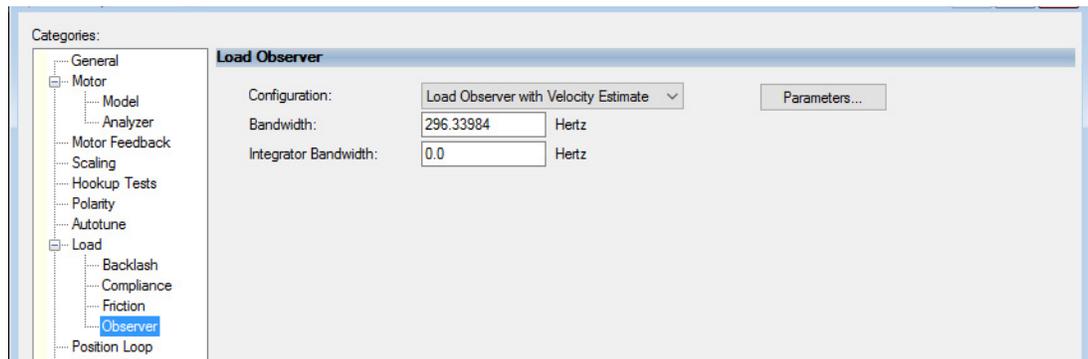


3. Click the Load category in the Axis Properties dialog box.
 - a. Check Use Load Ratio.

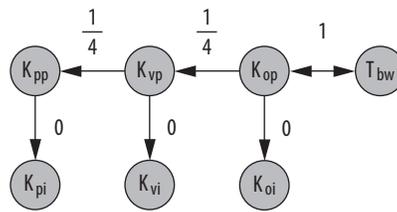
b. Set the Load Ratio = 0.



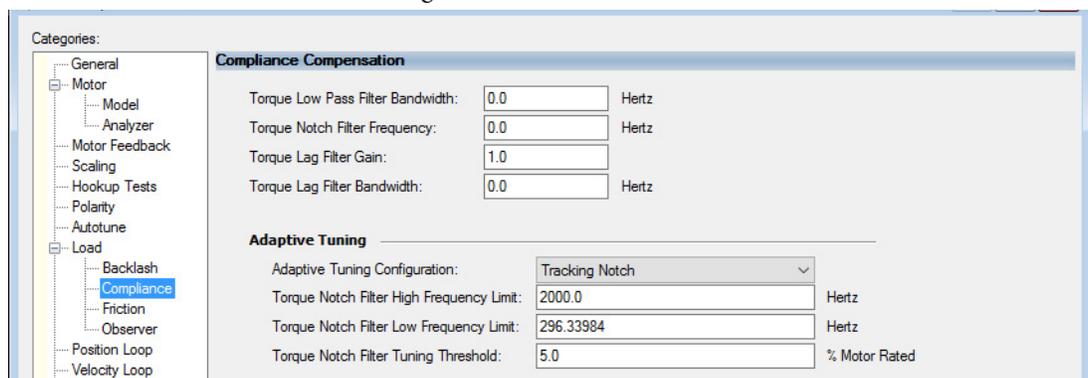
4. Click the Observer category in the Axis Properties dialog box.
 - a. From the Configuration pull-down menu, choose Load Observer with Velocity Estimate.



- b. Click Apply and click Yes to update all dependent attributes. The Load Observer Bandwidth and other gains are set automatically.



5. Click the Compliance category in the Axis Properties dialog box.
 - a. From the Adaptive Tuning Configuration pull-down menu, choose Tracking Notch.



- b. Click Apply.

6. Enable the drive for a few seconds with an MSO instruction or motion direct command, followed by an MSF instruction or motion direct command, to make sure that no audible squealing noise is present.

IMPORTANT If an audible squealing noise is heard, go to Axis Properties>Load>Compliance category and set the Torque Notch Filter Frequency field (Hz) to remove the noise. Refer to Motion System Tuning Application Techniques, publication [MOTION-AT005](#) (Compensating for High Frequency Resonances), for information on how to set the Torque Notch Filter Frequency field.

7. Repeat [Test and Tune the Axes](#) for each axis.

Tune Induction Motors

IMPORTANT The Automatic FluxUpControl setting is recommended for best Autotune results.

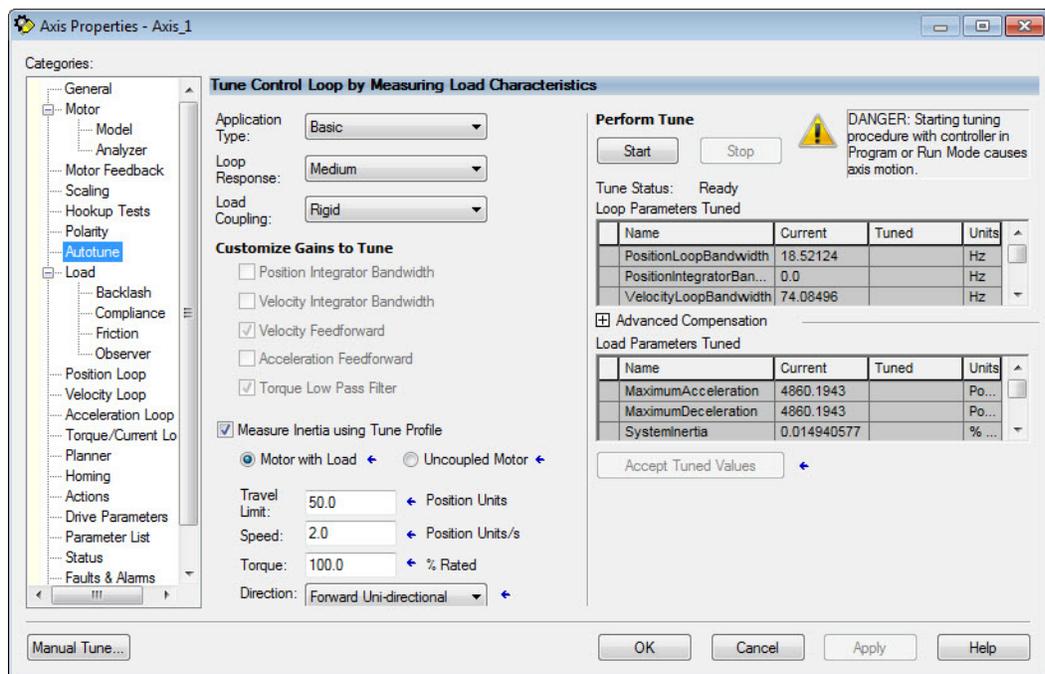
Follow these steps to tune the induction motor axes.

1. Verify the load is 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. Select the Autotune category.



3. Type values for Travel Limit and Speed.

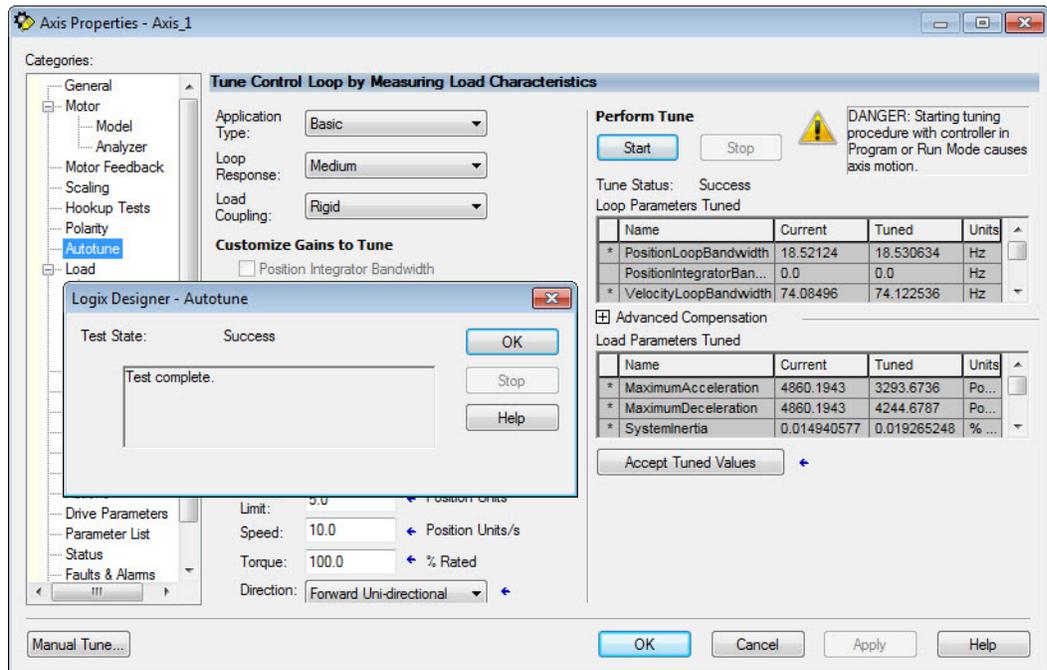
In this example, Travel Limit = 50.0 and Speed = 2.0. The actual value of programmed units depend on your application.

4. From the Direction pull-down menu, choose a setting appropriate for your application.

Forward Uni-directional is default.

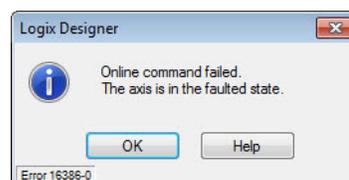
5. Edit other fields as appropriate for your application.
6. Click Start.

The Logix Designer - Autotune dialog box appears. When the test completes, the Test State changes from Executing to Success.



Tuned values populate the Loop and Load parameter tables. Actual bandwidth values (Hz) depend on your application and can require adjustment once motor and load are connected.

7. Click Accept Tuned Values.
8. Click OK to close the Logix Designer - Autotune dialog box.
9. Click OK to close the Axis Properties dialog box.
10. If the test fails, this dialog box appears.



- a. Click OK.
- b. Make an adjustment to motor velocity.
- c. Refer to the controller user manual for more information.
- d. Return to [step 6](#) and run the test again.
11. Repeat [Test and Tune the Axes](#) for each axis.

Troubleshoot the Kinetix 5700 Drive System

This chapter provides troubleshooting tables and related information for your Kinetix® 5700 drive system.

| Topic | Page |
|---|------|
| Safety Precautions | 213 |
| Interpret Status Indicators | 214 |
| General Troubleshooting | 224 |
| Logix 5000 Controller and Drive Module Behavior | 226 |

Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 5700 drive system.



ATTENTION: Capacitors on the DC bus can retain hazardous voltages after input power has been removed. Before working on the drive module, 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 module. Failure to observe this precaution could result in severe bodily injury or loss of life.



ATTENTION: Do not attempt to defeat or override the module 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.

Display Interface

The LCD display provides fault messages and troubleshooting information by using the soft menu items and navigation buttons.



Under the Main Menu, select FAULT LOG by using the up/down arrows.

| | |
|---|---|
|  | Press to display the list of active fault codes. |
|  | Press again to display the fault details (the problem in troubleshooting tables). |
|  | Press to display the fault help (possible solutions in troubleshooting tables). |

Refer to [Understand the Kinetix 5700 Display](#) on [page 138](#) for more information on navigating the LCD display menu.

Fault Codes

The fault code tables are designed to help you determine the source of the fault or exception. When a fault condition is detected, the drive module performs the appropriate fault action, the fault is displayed, and the fault is added to a persistent fault log (along with diagnostics data). The earlier faults have priority to be displayed.

The drive module removes the fault text from the display when a Fault Reset service is sent from the controller and the fault is no longer active. If a fault condition is still active following a Fault Reset service, the fault is again posted to the display and written to the fault log.

However, there can be a delay before the fault is posted again. In a Studio 5000 Logix Designer® application, this delay results as the AxisFault tag on the drive axis being cleared until the fault is posted again. During this delay, the AxisState tag continues to indicate that the axis is faulted. Use the AxisState tag on the axis object and only to determine if an axis is faulted.

Although software overtravel fault codes do not exist, software overtravel detection for the AXIS_CIP_DRIVE axis type is determined in the Logix 5000™ controller. For more information, see Integrated Motion on the EtherNet/IP™ Network Reference Manual, publication [MOTION-RM003](#).

The DC-bus power supply maintains a log of the last 25 faults. The single-axis and dual-axis inverters maintain a log of the last 128 faults. The fault log includes time stamps and is stored in persistent memory. However, the fault log cannot be cleared on the module.

Table 94 - Fault Code Summary

| Fault Code Type ⁽¹⁾ ⁽²⁾ | Description |
|---|---|
| FLT Sxx | Standard runtime axis exceptions. The exception can apply to an individual axis or to all axes. |
| FLT Mxx | Manufacturer-specific runtime axis exception. The exception can apply to an individual axis or to all axes. |
| INIT FLT Sxx | Exceptions that prevent normal operation and occur during the initialization process. |
| INIT FLT Mxx | |
| NODE FLTxx | Exceptions that can prevent normal operation of the drive module and apply to the entire module and affect all axes. |
| NODE ALARM xx | Exceptions that can prevent normal operation of the drive module, but do not result in any action other than reporting the alarm to the controller. |
| INHIBIT Sxx | Conditions that prevent normal operation and indicate the drive module is prevented from being enabled. |
| INHIBIT Mxx | |
| ALARM Sxx | An underlying exception condition that does not result in any action other than reporting the alarm to the controller. |
| ALARM Mxx | |
| SAFE FLTxx ⁽³⁾ | Exception generated by a fault condition detected in the safety function. |

- (1) Sxx refers to Standard exceptions.
- (2) Mxx refers to Manufacturer-specific exceptions.
- (3) For troubleshooting 2198-xxxx-ERS3 inverter SAFE FLT fault codes, refer to [Chapter 9](#) on [page 252](#) (hardwired safety) or [page 261](#) (integrated safety). For troubleshooting 2198-xxxx-ERS4 inverter SAFE FLT fault codes, refer to the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication [2198-RM001](#).

TIP Fault codes triggered by conditions that fall outside factory set limits are identified by FL at the end of the display message. For example, FLT S07 – MTR OVERLOAD FL.

Fault codes triggered by conditions that fall outside user set limits are identified by UL at the end of the display message. For example, FLT S08 – MTR OVERLOAD UL.

Table 95 - FLT Sxx Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|--------------------------------|--|--|---|-----------|
| FLT S02 – MTR COMMUTATION | Motor Commutation Fault | An illegal state transition of the motor hall-commutation feedback signals has been detected. | <ul style="list-style-type: none"> • Verify the motor hall feedback wiring is not open/shorted/missing • Use shielded cables, route feedback away from potential noise sources • Check system grounds, replace the motor | Inverters |
| FLT S03 – MTR OVERSPEED FL - 0 | Motor Overspeed Factory Limit Fault | Motor speed has exceeded 125% of its maximum speed. | Check control loop tuning. | Inverters |
| FLT S03 – MTR OVERSPEED FL - 1 | | The output frequency has exceeded 590 Hz. | <ul style="list-style-type: none"> • Check control loop tuning • Reduce the velocity command | |
| FLT S04 – MTR OVERSPEED UL | Motor Overspeed User Limit Fault | Motor speed has exceeded motor overspeed user limit. | <ul style="list-style-type: none"> • Check control loop tuning • Increase the Motor Overspeed UL attribute value | Inverters |
| FLT S05 – MTR OVERTEMP FL nn | Motor Overtemperature Factory Limit Fault | Calculations based on the motor thermistor indicate that the motor factory temperature limit has been exceeded. The nn sub-code is defined as follows: 01: Motor Thermostat or Thermistor 02: Encoder Temperature Sensor | <ul style="list-style-type: none"> • Operate motor within continuous torque rating • Reduce motor ambient temperature • Add motor cooling Available only on Kinetix VP and MP-Series™ motors. Not supported on induction motors. | Inverters |
| FLT S07 – MTR OVERLOAD FL | Motor Thermal Overload Factory Limit Fault | The motor thermal model has exceeded its factory set thermal capacity limit. | Modify the command profile to reduce speed or increase time. | Inverters |
| FLT S08 – MTR OVERLOAD UL | Motor Thermal Overload User Limit Fault | The motor thermal model has exceeded the thermal capacity limit given by Motor Thermal Overload User Limit. | <ul style="list-style-type: none"> • Modify the command profile • Increase the Motor Thermal Overload UL attribute value | Inverters |

Table 95 - FLT Sxx Fault Codes (continued)

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|---|--|---|---|-----------------------------------|
| FLT S09 – MTR PHASE LOSS | Motor Phase Loss | Torque Prove function detected motor current below a limit set by Torque Prove Current Limit. | Check motor connections. | Inverters |
| FLT S10 – INV OVERCURRENT | Inverter Overcurrent Fault | Inverter current has exceeded the instantaneous current limit (determined by hardware). | <ul style="list-style-type: none"> Check motor power cable for shorts Verify motor windings are not shorted Verify motor power wire gauge Operate within the continuous power rating Reduce acceleration times Verify iTRAK® power supply cable wiring | Inverters iTRAK PS |
| FLT S11 – INV OVERTEMP FL | Inverter Overtemperature Factory Limit Fault | The measured inverter temperature has exceeded the factory set temperature limit. | <ul style="list-style-type: none"> Modify the command profile to reduce speed or increase time Reduce drive ambient temperature Verify airflow through drive is not obstructed | Inverters |
| FLT S13 – INV OVERLOAD FL | Inverter Thermal Overload Factory Limit Fault | The thermal capacity of the inverter has exceeded the factory set limit. | Modify the command profile to reduce speed or increase time. | Inverters |
| FLT S14 – INV OVERLOAD UL | Inverter Thermal Overload User Limit Fault | The thermal capacity of the inverter has exceeded the user set limit given by the inverter Thermal Overload User Limit. | <ul style="list-style-type: none"> Modify the command profile to reduce speed or increase time Increase the Inverter Thermal Overload UL attribute value | Inverters |
| FLT S15 – CONV OVERCURRENT ⁽¹⁾ | Converter Overcurrent Fault | The measured converter current has exceeded the factory set current limit. | <ul style="list-style-type: none"> Reduce the number of drives in the same bus group Reduce number of capacitor modules Verify iTRAK power supply requirements | DC-bus PS iTRAK PS |
| FLT S16 – GROUND CURRENT ⁽¹⁾ | Ground Current Factory Limit Fault | The sensing circuitry in the power stage has detected excessive ground current. | <ul style="list-style-type: none"> Check motor power wiring; check power cable for shorts Replace motor if the fault persists Check DC bus wiring if using a capacitor module | Single-axis inverter DC-bus PS |
| FLT S18 – CONV OVERTEMP FL | Converter OverTemp Factory Limit Fault | The measured converter temperature has exceeded the factory set temperature limit. | <ul style="list-style-type: none"> Reduce the number of drives in the same bus group Modify the command profile of inverters in the same bus group to reduce speed or increase time Reduce drive ambient temperature Verify airflow through drive is not obstructed Verify iTRAK power supply requirements | DC-bus PS iTRAK PS |
| FLT S20 – CONV OVERLOAD FL ⁽¹⁾ | Converter Thermal Overload Factory Limit Fault | The converter thermal model indicates that the temperature has exceeded the factory set capacity rating of 110%. | <ul style="list-style-type: none"> Reduce the number of drives in the same bus group Reduce duty-cycle of commanded motion Verify iTRAK power supply requirements | DC-bus PS iTRAK PS |
| FLT S21 – CONV OVERLOAD UL | Converter Thermal Overload User Limit Fault | The converter thermal model indicates that the temperature has exceeded the limit given by the Converter Thermal Overload User Limit. | <ul style="list-style-type: none"> Reduce the number of drives in the same bus group Reduce duty-cycle of commanded motion Increase the Converter Thermal Overload UL attribute value Verify iTRAK power supply requirements | DC-bus PS iTRAK PS |
| FLT S22 – AC POWER LOSS | AC Power Loss Fault | All three AC input phases are detected as absent when any one of the inverters connected to a converter is in the enabled state. | Check AC input voltage on all phases | Inverters |
| FLT S23 – AC PHASE LOSS ⁽¹⁾ | AC Single Phase Loss Fault | A single AC input phase was lost. | Check AC input voltage on all phases. | DC-bus PS |
| FLT S25 – CONV PRECHARGE FAILURE ⁽¹⁾ | Precharge Failure Fault | The pre-charge circuit monitoring algorithm detected that the DC bus did not reach a factory set voltage level after charging for a period of time. | <ul style="list-style-type: none"> Check AC input voltage on all phases Check input power wiring Replace power supply or drive module if fault persists Verify iTRAK power supply cable wiring | DC-bus PS iTRAK PS |
| FLT S27 – BUS REG OVERTEMP FL ⁽¹⁾ | Bus Regulator Overtemperature Factory Limit Fault | The digital input assigned to the shunt thermal switch OK is asserted LOW. | <ul style="list-style-type: none"> Check the digital input wiring Check the digital input assignments Check the shunt power configuration in Logix Designer Reduce regenerative energy dissipation of the application Add a larger external shunt resistor or active brake module | Inverters DC-bus PS |
| FLT S29 – BUS REG OVERLOAD FL ⁽¹⁾ | Bus Regulator Thermal Overload Factory Limit Fault | The shunt thermal model has exceeded its factory set thermal capacity limit. | <ul style="list-style-type: none"> Modify the duty cycle of the application Add external shunt for additional capacity Add capacitor module | DC-bus PS |
| FLT S30 – BUS REG OVERLOAD UL | Bus Regulator Thermal Overload User Limit Fault | The shunt thermal model has exceeded the thermal capacity limit given by Bus Regulator Thermal Overload User Limit. | <ul style="list-style-type: none"> Modify the duty cycle of the application Add external shunt for additional capacity Increase the Bus Regulator Thermal Overload UL attribute value Add capacitor module | DC-bus PS |
| FLT S31 – BUS REG FAILURE | Bus Regulator Failure | The shunt circuit has detected that the shunt resistor is shorted. | <ul style="list-style-type: none"> Check for shorts in the shunt connector Unplug the shunt connector and measure the resistance of the shunt Replace power supply if shunt resistor is shorted | DC-bus PS |

Table 95 - FLT Sxx Fault Codes (continued)

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|---|--|---|---|------------------------------------|
| FLT S32 – BUS CAPACITOR MODULE FAILURE | Bus Capacitor Module Failure | The digital input assigned to capacitor module OK is asserted LOW. | <ul style="list-style-type: none"> Check the digital input wiring Check the digital input assignments Replace the capacitor module, if necessary | Inverters DC-bus PS |
| FLT S33 – BUS UNDERVOLT FL | Bus Undervoltage Factory Limit Fault | DC Bus voltage level is below the factory set limit. | <ul style="list-style-type: none"> Verify voltage level of the incoming AC Monitor AC power source for glitches or line droop Install UPS on AC input | Inverters iTRAK PS |
| FLT S34 – BUS UNDERVOLT UL | Bus Undervoltage User Limit Fault | DC Bus voltage level is below the user set limit as given by Bus Undervoltage User Limit. For iTRAK power supply, this refers to the output (IDC) power busses. | <ul style="list-style-type: none"> Verify voltage level of the incoming AC Monitor AC power source for glitches or line droop Install UPS on AC input Increase Bus Undervoltage UL attribute value Verify iTRAK power supply cable wiring | Inverters iTRAK PS |
| FLT S35 – BUS OVERVOLT FL | Bus Overvoltage Factory Limit Fault | DC Bus voltage level is above the factory set limit. For iTRAK power supply, this refers to the input or output iTRAK power busses. | <ul style="list-style-type: none"> Change the deceleration or motion profile of some or all of the drives connected to the DC bus Unplug the shunt connector and measure the resistance of the shunt Add an external shunt resistor or an active brake module Replace DC-bus power supply if shunt resistor is open Verify iTRAK power supply cable wiring | Inverters DC-bus PS iTRAK PS |
| FLT S37 – BUS POWER LOSS ⁽²⁾ | Bus Power Loss Fault | The DC-bus voltage level is below the bus power loss threshold for more than 50 ms. | <ul style="list-style-type: none"> Verify voltage level of the incoming AC Increase the Power Loss Threshold Attribute Monitor AC power source for glitches or line droop Install UPS on AC input | Inverters |
| FLT S38 – FUSE BLOWN nn | Bus Power Fuse Blown Fault | The internal DC-bus power fuse is blown. The nn sub-code is defined as follows: 00: Non user-replaceable fuse | <ul style="list-style-type: none"> Return drive for repair if fault continues Verify output power wiring (iTRAK power supply) | Inverters iTRAK PS |
| | | The internal DC-bus power fuse is blown. The nn sub-code is defined as follows: 01: User replaceable fuse (iTRAK power supply only) | <ul style="list-style-type: none"> Verify output power wiring Replace fuse | |
| FLT S40 – BUS POWER SHARING FAULT | Bus Power Sharing Fault | A power supply or RPS sharing DC-bus power with this module (power supply or drive) has requested that this module stop consuming power from the DC-bus | <ul style="list-style-type: none"> Check the fault condition on the DC-bus power supply Install UPS on AC input | Inverters DC-bus PS |
| FLT S41 – MTR AQB STATE FL | Feedback Signal Noise FL | The number of illegal state transitions of the motor AQB encoder feedback signals has exceeded a factory limit. | <ul style="list-style-type: none"> Verify the motor feedback wiring is not open/shorted/missing Use shielded cables, route feedback away from potential noise sources Check system grounds, replace motor/encoder | Inverters |
| FLT S43 – FDBK LOSS FL ⁽³⁾ | Feedback Signal Loss FL | The detected voltage levels of the A/B channel signals from the feedback device are below the Feedback Signal Loss factory limit. | <ul style="list-style-type: none"> Verify the motor feedback wiring is not open/shorted/missing Use shielded cables, route feedback away from potential noise sources Check system grounds, replace motor/encoder. | Inverters |
| FLT S44 – FDBK LOSS UL ⁽³⁾ | Feedback Signal Loss UL | The associated fault/alarm sub-code indicates which of the supported feedback channels is reporting this fault/alarm. | | Inverters |
| FLT S45 – FDBK COMM FL ⁽⁴⁾ | Motor Feedback Data Loss Factory Limit Fault | The number of consecutive missed or corrupted serial data packets, or invalid position feedback values from the intelligent feedback device has exceeded a factory set limit. | <ul style="list-style-type: none"> Check motor feedback cable and connector Check motor power cable and feedback wire shields are secured correctly Check motor frame is grounded correctly Consult Possible Solutions for FLT S47 | Inverters |
| FLT S46 – FDBK COMM UL ⁽⁴⁾ | Motor Feedback Data Loss User Limit Fault | The number of consecutive missed or corrupted serial data packets from the intelligent feedback device has exceeded a user set limit. | | Inverters |

Table 95 - FLT Sxx Fault Codes (continued)

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|-------------------------------------|--|--|--|-----------|
| FLT S47 – FDBK DEVICE FAILURE nn | Motor Feedback Device Failure Fault (DSL feedback) | The DSL feedback device has detected an internal error. The nn sub-code is defined as follows: 01: ACCELERATION OVERFLOW 04: TRACKING FILTER ERROR 05: VECTOR LENGTH ERROR 06: COUNTER ERROR 07: SYNCHRONIZATION ERROR 16: SINGLE TURN ERROR 17: MULTI TURN AMPLITUDE ERROR 18: MULTI TURN SYNC ERROR 19: MULTI TURN VECTOR LENGTH ERROR 35: STANDARD PARAMETER ERROR 36: INTERNAL COMMUNICATION ERROR1 37: INTERNAL COMMUNICATION ERROR2 38: INTERNAL SYSTEM ERROR 48: CRITICAL TEMPERATURE 49: CRITICAL LED CURRENT 50: CRITICAL SUPPLY VOLTAGE 51: CRITICAL SPEED 52: CRITICAL ACCELERATION 53: COUNTER OVERFLOW 54: INTERNAL MONITORING ERROR 66: INTERNAL RESOURCE ACCESS ERROR 88: POSITION OUT OF RANGE | <ul style="list-style-type: none"> Check motor feedback cable for proper connectivity and continuity Check motor phasing (U, V, W) and DSL feedback 2-pin wire connections at the drive Review Electrical Noise Reduction on page 40 <ul style="list-style-type: none"> See bonding painted panels on page 41 See wire-braid bonding on page 42 Cycle control power Check feedback shield connection Reduce shock and vibration to motor Replace motor if fault continues | Inverters |
| | Motor Feedback Device Failure Fault (Hiperface feedback) | The Hiperface feedback device has detected an internal error. The nn sub-code is defined as follows: 01: INCORRECT ALIGNMENT DATA 02: INCORRECT INTERNAL ANGULAR OFFSET 03: DATA FIELD PARTITIONING TABLE DESTROYED 04: ANALOG LIMIT VALUES NOT AVAILABLE 05: INTERNAL I2C BUS INOPERATIVE 06: INTERNAL CHECKSUM ERROR 07: ENCODER RESET OCCURRED AS A RESULT OF PROGRAM MONITORING 08: COUNTER OVERFLOW 09: PARITY ERROR 10: CHECKSUM OF TRANSMITTED DATA IS INCORRECT 11: UNKNOWN COMMAND CODE 12: NUMBER OF TRANSMITTED DATA IS INCORRECT 13: TRANSMITTED COMMAND AGRUMENT IS NOT ALLOWED 14: THE SELECTED DATA FIELD MAY NOT BE WRITTEN TO 15: INCORRECT ACCESS CODE 16: SIZE OF SPECIFIED DATA FIELD CANNOT BE CHANGED 17: SPECIFIED WORD ADDRESS LIES OUTSIDE THE DATA FIELD 18: ACCESS TO NON-EXISTENT DATA FIELD 28: VALUE MONITORING OF THE ANALOG SIGNALS (process data) 29: TRANSMITTER CURRENT CRITICAL (contamination, transmitter breakage) 30: ENCODER TEMPERATURE CRITICAL 31: SPEED TOO HIGH, NO POSITION FORMATION POSSIBLE 32: SINGLETURN POSITION UNRELIABLE 33: MULTITURN POSITION ERROR 34: MULTITURN POSITION ERROR 35: MULTITURN POSITION ERROR | <ul style="list-style-type: none"> Check motor feedback cable for proper connectivity and continuity Check motor phasing (U, V, W) and Hiperface feedback 15-pin wire connections at the drive Review Electrical Noise Reduction on page 40 <ul style="list-style-type: none"> See bonding painted panels on page 41 See wire-braid bonding on page 42 Cycle control power Check feedback shield connection Reduce shock and vibration to motor Replace motor if fault continues | Inverters |
| FLT S49 – BRAKE SLIP FLT | Brake Slip Exception | Motor displacement exceeded the brake slip tolerance while the mechanical brake was engaged. | Check motor brake. | Inverters |
| FLT S50 – POS HW OTRAVEL | Hardware Overtravel - Positive | The axis has moved beyond the digital input travel limit in the positive direction. | Check digital input and axis position. | Inverters |
| FLT S51 – NEG HW OTRAVEL | Hardware Overtravel - Negative | The axis has moved beyond the digital input travel limit in the negative direction. | Check digital input and axis position. | Inverters |
| FLT S54 – POSN ERROR ⁽⁵⁾ | Excessive Position Error Fault | The position error of the position control loop has exceeded the value given by Position Error Tolerance for a time period given by Position Error Tolerance Time. | <ul style="list-style-type: none"> Check position loop tuning Increase the feedforward gain Verify sizing of the drive and motor Check motor power wiring Increase Position Error Tolerance and/or Position Error Tolerance Time attribute values | Inverters |

Table 95 - FLT Sxx Fault Codes (continued)

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|--|--------------------------------|--|--|------------------------------------|
| FLT S55 – VEL ERROR ⁽⁵⁾ | Excessive Velocity Error Fault | The velocity error of the velocity control loop has exceeded the value given by Velocity Error Tolerance for a time period given by Velocity Error Tolerance Time. | <ul style="list-style-type: none"> Check velocity loop tuning Reduce acceleration Verify sizing of the drive and motor Check motor power wiring Increase Velocity Error Tolerance and/or Velocity Error Tolerance Time attribute values | Inverters |
| FLT S56 – OVERTORQUE LIMIT ⁽⁵⁾ | Overtorque Limit Fault | Motor torque has risen above user defined maximum torque level given by Overtorque Limit for a time period given by Overtorque Limit Time. | <ul style="list-style-type: none"> Verify Torque Trim value Verify motion profile Verify sizing of the drive and motor Increase Overtorque Limit and/or Overtorque Limit Time attribute values | Inverters |
| FLT S57 – UNDERTORQUE LIMIT ⁽⁵⁾ | Undertorque Limit Fault | Motor torque has dropped below user defined minimum torque level given by Undertorque Limit for a time period given by Undertorque Limit Time. | <ul style="list-style-type: none"> Verify motion profile Verify sizing of the drive and motor Decrease Undertorque Limit and/or Undertorque Limit Time attribute values | Inverters |
| FLT S61 – ENABLE INPUT | Enable Input Deactivated | The hardware enable input was deactivated while the drive was enabled. | <ul style="list-style-type: none"> Check drive enable input wiring Un-assign Enable as a digital input source | Inverters DC-bus PS iTRAK PS |

- (1) All modules in the same bus group assert a Bus Power Sharing Exception if they are enabled.
- (2) When the Power Loss Threshold Attribute (ID#628) is set to zero, the default value of 23.1% is used, which is equivalent to 150V DC allowable DC-bus voltage droop from nominal (650V DC). To calculate the percentage, use the following formula: $\text{Power Loss Threshold Attribute\%} = (650V\ DC - \text{Allowable Voltage Drop}) / (650V\ DC) * 100\%$.
- (3) Applies to all compatible feedback devices, except DSL encoder feedback.
- (4) Applies to DSL and Hiperface feedback devices.
- (5) Does not apply to induction motors in frequency control mode.

Table 96 - FLT Mxx Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|--|--|--|---|------------------------------------|
| FLT M02 – MOTOR VOLTAGE | Motor Voltage Mismatch Fault | The configured voltage of the drive is greater than the motor rated voltage. For example, a 400V-class drive with a 200V-class motor. | Set the drive voltage to a lower value or replace motor with voltage rating that matches the drive. | Inverters |
| FLT M07 – FEEDBACK INCREMENTAL COUNT ERROR FAULT | Feedback Incremental Count Error | The periodic check of the incremental encoder position against the absolute encoder position or Hall edges (when available) indicates they are out of tolerance. | Verify the motor feedback wiring is correct and not open/shorted/missing, use shielded cables, route feedback away from potential noise sources, check system grounds, replace motor/encoder. | Inverters |
| FLT M12 – POWER CYCLE FL ⁽¹⁾ | Converter Precharge Overload Factory Limit Fault | The thermal model for the precharge resistor detected that precharge capacity exceeded the factory limit. | <ul style="list-style-type: none"> Reduce the amount of modules in the same bus group Reduce the frequency of AC power cycling Remove capacitor modules | DC-bus PS |
| FLT M26 – RUNTIME ERROR | Runtime Error | The drive firmware encountered an unrecoverable runtime error. | <ul style="list-style-type: none"> Cycle control power Reset the drive Return drive for repair if fault continues | Inverters DC-bus PS iTRAK PS |
| FLT M28 – SAFETY COMM ⁽²⁾ | Safety Module Communication Error | Communication with the safety hardware within the drive has failed. | <ul style="list-style-type: none"> Cycle control power Reset the drive Return drive for repair if fault continues | Inverters |

- (1) All modules in the same bus group assert a Bus Power Sharing Exception if they are enabled.
- (2) Applies to drives using integrated safety.

Table 97 - INIT FLT Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|---|--------------------------------------|---|--|------------------------------------|
| INIT FLT M01 – ENCODER DATA | Smart Encoder Data Corruption | The data stored in the encoder has a checksum error. | <ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues | Inverters |
| INIT FLT M02 – MTR DATA RANGE nn | Motor Data Range Error | <p>A motor data attribute stored in the encoder is out of range. The nn sub-code is defined as follows:</p> <p>01: DATA_RANGE_REV 02: DATA_RANGE_CONT_CURRENT 03: DATA_RANGE_PEAK_CURRENT 04: DATA_RANGE_RATED_POWER 05: DATA_RANGE_OVERLOAD_LIMIT 06: DATA_RANGE_THERMAL_CAPACITANCE 07: DATA_RANGE_THERMAL_RESISTANCE 08: DATA_RANGE_MOTOR_RESISTANCE 09: DATA_RANGE_MOTOR_INDUCTANCE 10: DATA_RANGE_INERTIA 11: DATA_RANGE_RATED_SPEED 12: DATA_RANGE_MAX_SPEED 13: DATA_RANGE_RATED_TORQUE 14: DATA_RANGE_TORQUE_CONST 15: DATA_RANGE_BACK_EMF_CONST 16: DATA_RANGE_POLE_PITCH</p> | <ul style="list-style-type: none"> • Cycle control power • Return motor for repair if fault continues | Inverters |
| INIT FLT M03 – MTR ENC STARTUP | Motor Feedback Communication Startup | Communication with the encoder could not be established. | <ul style="list-style-type: none"> • Cycle control power • Check motor feedback connector • Check motor power and feedback shield terminations on the drive • Return motor for repair if fault continues | Inverters |
| INIT FLT M06 – MOTOR ABSOLUTE STARTUP SPEED | Feedback Absolute Startup Speed | The absolute encoder was not able to accurately determine the position after powerup due to speed greater than 100 rpm. | Make sure the motor shaft is not moving during power-up | Inverters |
| INIT FLT M14 – SAFETY FIRMWARE | Invalid Safety Firmware | The loaded Safety firmware is not compatible with the drive firmware. | <ul style="list-style-type: none"> • Cycle control power • Update the drive firmware • Return drive for repair if fault continues | Inverters |
| INIT FLT M20 – UNKNOWN MODULE | Unknown Module Fault | The product code of the power board is invalid. | <ul style="list-style-type: none"> • Cycle control power • Reset the drive • Return drive for repair if fault continues | Inverters DC-bus PS iTRAK PS |
| INIT FLT M21 – FACTORY CONFIG | Factory Configuration Error | Factory configuration data is missing or invalid. | <ul style="list-style-type: none"> • Cycle control power • Reset the drive • Return drive for repair if fault continues | Inverters DC-bus PS iTRAK PS |

Table 98 - INHIBIT Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|--|---|---|--|------------------------------------|
| INHIBIT S01 – ENABLE INPUT | Axis Enable Input Fault - Start Inhibit | When Enable Input Checking is enabled, the drive displays Axis Enable Input start inhibit when it detects the enable input is inactive and while the axis is in Starting/Running/Testing/Hold sub-state of Stopped state. | <ul style="list-style-type: none"> • Confirm that the digital input assigned to the Enable is active • Check module enable input wiring • Check digital input assignments • Verify Gateway computer and Logix Designer application operation (applies to iTRAK power supply) | Inverters DC-bus PS iTRAK PS |
| INHIBIT S02 – MOTOR NOT CONFIG | Motor Not Configured | The associated motor has not been properly configured for use. | Verify motor configuration in the Logix Designer application. | Inverters |
| INHIBIT S03 – FEEDBACK NOT CONFIGURED | Feedback Not Configured | The feedback has not been properly configured for use. | Verify feedback configuration in the Logix Designer application. | Inverters |
| INHIBIT S04 – COMMUTATION NOT CONFIGURED | Commutation Not Configured - Standard Start Inhibit | Associated permanent magnet motor commutation has not been configured for use. | Verify that the proper motor feedback commutation alignment has been selected. | Inverters |

Table 98 - INHIBIT Fault Codes (continued)

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|---------------------------------------|---|--|--|-----------|
| INHIBIT M02 – MOTOR FEEDBACK REQUIRED | Motor Feedback Required | Selected Motor Control mode cannot run without a valid feedback selection. | Verify that the proper motor feedback type has been selected. | Inverters |
| INHIBIT M04 – PROVING CONFIG | Torque Prove Configuration - Mfg Specific Start Inhibit | When Torque Proving configuration is enabled, control mode, feedback mode, motor feedback type, and motor option configuration must be set properly. | <ul style="list-style-type: none"> Verify that the proper axis configuration has been selected. Verify that sufficient torque prove current has been configured. | Inverters |
| INHIBIT M05 – SAFE TORQUE OFF | Start Inhibit – Safe Torque Off | The safety function has disabled the power structure. | <ul style="list-style-type: none"> Check safety input wiring Check state of safety devices | Inverters |

Table 99 - NODE FLT Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|------------------------------------|--------------------------------------|--|--|------------------------------------|
| NODE FLT 01 – LATE CTRL UPDATE | Control Connection Update Fault | Several consecutive updates from the controller have been lost. | <ul style="list-style-type: none"> Remove unnecessary network devices from the motion network Change network topology so that fewer devices share common paths Use high performance network equipment Use shielded cables Separate signal wiring from power wiring | Inverters DC-bus PS |
| NODE FLT 02 – PROC WATCHDOG nn | Processor Watchdog Fault | The processor on the power board or control board failed to update in a certain amount of time. The Possible Solutions are the same for all nn sub-codes. | <ul style="list-style-type: none"> Cycle control power Return drive for repair if fault continues | Inverters DC-bus PS iTRAK PS |
| NODE FLT 03 – HARDWARE 00 | Hardware Fault - PwrIF | Communication with the power board could not be established. | <ul style="list-style-type: none"> Cycle control power Update the drive firmware Return drive for repair if fault continues | Inverters DC-bus PS iTRAK PS |
| NODE FLT 03 – HARDWARE 02 | Hardware Fault - DSL | Communication with the encoder could not be established. | <ul style="list-style-type: none"> DSL feedback wiring is incorrect (check against wiring diagram) DSL feedback wiring is shorted or open DSL feedback cable is defective Kinetix VP motor feedback device is defective Cycle power Return drive for repair if fault continues | Inverters |
| NODE FLT 03 – HARDWARE 03 | DSL Internal Hardware Fault | A DSL hardware error internal to the drive was detected. | <ul style="list-style-type: none"> Check DSL feedback device, wiring, and cable Cycle power Return drive for repair if fault continues | Inverters |
| NODE FLT 03 – HARDWARE 04 | Hardware Fault - Board Compatibility | The control and power boards are incompatible. | Return drive for repair if fault continues | Inverters DC-bus PS iTRAK PS |
| NODE FLT 05 – CLOCK SKEW FLT | Clock Skew Fault | The controller time and the drive's system time are not the same. | <ul style="list-style-type: none"> Cycle control power Check controller and Ethernet switch operation | Inverters DC-bus PS |
| NODE FLT 06 – LOST CTRL CONN | Lost Controller Connection Fault | Communication with the controller has been lost. | <ul style="list-style-type: none"> Check Ethernet connection Check controller and Ethernet switch operation | Inverters DC-bus PS |
| NODE FLT 07 – CLOCK SYNC | Clock Sync Fault | Drive's local clock has lost synchronization with controller's clock and was not able to resynchronize within allotted time. | <ul style="list-style-type: none"> Check Ethernet connection Check controller and Ethernet switch operation | Inverters DC-bus PS |
| NODE FLT 09 – DUPLICATE IP ADDRESS | Duplicate IP Address Fault | Several consecutive updates from the controller have been lost. | Select an IP address not already in use on the network | Inverters DC-bus PS iTRAK PS |

Table 100 - NODE ALARM Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions | Module |
|----------------------------------|---------------------------------|---|---|------------------------|
| NODE ALARM 01 – LATE CTRL UPDATE | Control Connection Update Alarm | Updates from the controller have been late. | <ul style="list-style-type: none"> Remove unnecessary network devices from the motion network Change network topology so that fewer devices share common paths Use high performance network equipment Use shielded cables Separate signal wiring from power wiring | Inverters DC-bus PS |
| NODE ALARM 03 – CLOCK JITTER | Clock Jitter Alarm | The sync variance has exceeded the sync threshold while the device is running in sync mode. | <ul style="list-style-type: none"> Route the network cable away from potential noise sources Reduce the number of devices on the EtherNet/IP network | Inverters DC-bus PS |
| NODE ALARM 04 – CLOCK SKEW ALARM | Clock Skew Alarm | The controller time and the drive's time are not the same. | <ul style="list-style-type: none"> Check the Ethernet connection Check controller and Ethernet switch operation | Inverters DC-bus PS |
| NODE ALARM 05 – CLOCK SYNC ALARM | Clock Sync Alarm | Drive's local clock has lost synchronization with controller's clock for a short time during synchronous operation. | <ul style="list-style-type: none"> Check the Ethernet connection Check controller and Ethernet switch operation | Inverters DC-bus PS |

SAFE FLT Fault Codes

For troubleshooting 2198-xxxx-ERS3 inverter SAFE FLT fault codes, refer to [Chapter 9](#) on [page 252](#) (hardwired safety) or [page 261](#) (integrated safety).

For troubleshooting 2198-xxxx-ERS4 inverter SAFE FLT fault codes, refer to the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication [2198-RM001](#).

Kinetix 5700 Status Indicators

These status indicators apply to the Kinetix 5700 DC-bus power supply, the inverters, and the iTRAK power supply. The module status and network status indicators are just above the LCD status display.

IMPORTANT Status indicators are not reliable for safety functions. Use them only for general diagnostics during commissioning or troubleshooting. Do not attempt to use status indicators to determine operational status.

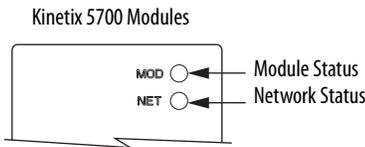


Table 101 - Module Status Indicator

| Condition | Status |
|--------------------|--|
| Steady Off | No power applied to the drive. |
| Steady Green | Drive is operational. No faults or failures. |
| Flashing Green | Standby (drive not configured). |
| Flashing Red | Major recoverable fault. The drive detected a recoverable fault, for example, an incorrect or inconsistent configuration. |
| Steady Red | Major fault. The drive detected a non-recoverable fault. |
| Flashing Green/Red | Self-test. The drive performs self-test during powerup. Once self-test is complete, Flashing Green/Red condition continues if drive is waiting for: <ul style="list-style-type: none"> • Safety configuration when in Integrated STO mode • Safety inputs when in Hardwired STO mode |

Table 102 - Network Status Indicator

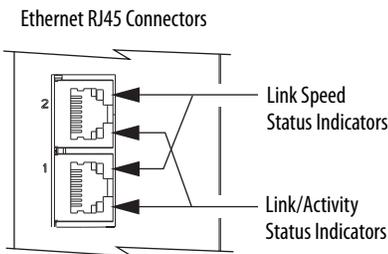
| Condition | Status |
|--------------------|--|
| Steady Off | No power applied to the drive or IP address is not configured. |
| Flashing Green | No Motion or Safety connection is established, but drive has obtained an IP address. |
| Steady Green | Motion or Safety connection is established and no timeout has occurred. Normal operation. |
| Flashing Red | Connection timeout. One or more of the connections, for which this drive is the target, has timed out. |
| Steady Red | Duplicate IP address. IP address specified is already in use. |
| Flashing Green/Red | Self-test. The drive performs self-test during powerup. Once self-test is complete, Flashing Green/Red condition continues if drive is processing a safety device ID proposal. |

Table 103 - Ethernet Link Speed Status Indicator

| Condition | Status |
|------------|----------|
| Steady Off | 10 Mbit |
| Steady On | 100 Mbit |

Table 104 - Ethernet Link/Activity Status Indicator

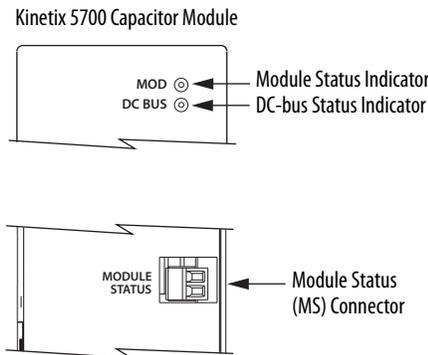
| Condition | Status |
|------------|------------------|
| Steady Off | No link |
| Steady On | Link established |
| Blinking | Network activity |



Kinetix 5700 Capacitor Module Status Indicators

The 2198-CAPMOD-2240 capacitor module status indicators and module status (MS) connector are on the front of the module. The module status connector is a relay output suitable for wiring to a DC-bus power supply digital input, assigned as Bus Capacitor OK, or the Logix 5000 controller.

Table 105 - Status Indicators and Relay Output



| Status Indicators | Status | Relay Output ⁽¹⁾ | Description | Resolution |
|-------------------|--------------|-----------------------------|---|--|
| Module status | Steady off | Open | 24V DC is not present | N/A |
| | Steady green | Closed | 24V DC is present and internal fuse is closed | N/A |
| | Steady red | Open | 24V DC is present and internal fuse is open | <ul style="list-style-type: none"> • Cycle control and bus power • Verify that AC input meets specifications • Replace the module if fault persists |
| DC-bus status | Steady off | Open | 24V DC is not present or DC-bus measures < 50V DC | N/A |
| | Steady green | Closed | 24V DC is present and DC-bus measures > 50V DC | N/A |

(1) Wiring the module status relay output is optional.

General Troubleshooting

These conditions do not always result in a fault code, but can require troubleshooting to improve servo drive performance. See the iTRAK System User Manual, publication [2198T-UM001](#) for general iTRAK troubleshooting.

Table 106 - General Troubleshooting

| Condition | Potential Cause | Possible Resolution |
|-----------------------------|---|--|
| Axis or system is unstable. | The position feedback device is incorrect or open. | Check wiring. |
| | Unintentionally in Torque mode. | Check to see what primary operation mode was programmed. |
| | Motor tuning limits are set too high. | Run Tune in the Logix Designer application. |
| | Position loop gain or position controller accel/decel rate is improperly set. | Run Tune in the Logix Designer application. |
| | 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). | <ul style="list-style-type: none"> • Check setups. • Run Tune in the Logix Designer application. |
| | Mechanical resonance. | <ul style="list-style-type: none"> • Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application). • Enable adaptive tuning. See Adaptive Tuning on page 366 for more notch filter information. |

Table 106 - General Troubleshooting (continued)

| Condition | Potential Cause | Possible Resolution |
|---|--|--|
| You cannot obtain the motor acceleration/deceleration that you want. | Torque Limit limits are set too low. | Verify that torque limits are set properly. |
| | Incorrect motor selected in configuration. | Select the correct motor and run Tune in the Logix Designer application again. |
| | The system inertia is excessive. | <ul style="list-style-type: none"> Check motor size versus application need. Review servo system sizing. |
| | The system friction torque is excessive. | Check motor size versus application need. |
| | Available current is insufficient to supply the correct accel/decel rate. | <ul style="list-style-type: none"> 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 motor is operating in the field-weakening range of operation. | Reduce the commanded acceleration or deceleration. |
| Motor does not respond to a command. | The axis cannot be enabled until stopping time has expired. | Disable the axis, wait the configured stopping time, and enable the axis. |
| | The motor wiring is open. | Check the wiring. |
| | The motor cable shield connection is improper. | <ul style="list-style-type: none"> Check feedback connections. Check cable shield connections. |
| | 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 torque limits are set incorrectly. | Check and properly set the limits. |
| | Brake connector not wired | Check brake wiring |
| Presence of noise on command or motor feedback signal wires. | Recommended grounding per installation instructions have not been followed. | <ul style="list-style-type: none"> Verify grounding. Route wire away from noise sources. Refer to System Design for Control of Electrical Noise, publication GMC-RM001. |
| | Line frequency can be present. | <ul style="list-style-type: none"> Verify grounding. Route wire away from noise sources. |
| | Variable frequency can be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew, and so forth. The frequency can be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance. | <ul style="list-style-type: none"> Decouple the motor for verification. Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism. |
| No rotation | The motor connections are loose or open. | Check motor wiring and connections. |
| | Foreign matter is lodged in the motor. | Remove foreign matter. |
| | The motor load is excessive. | Verify the servo system sizing. |
| | The bearings are worn. | Return the motor for repair. |
| | The motor brake is engaged (if supplied). | <ul style="list-style-type: none"> Check brake wiring and function. Return the motor for repair. |
| | The motor is not connect to the load. | Check coupling. |
| Motor overheating | The duty cycle is excessive. | Change the command profile to reduce accel/decel or increase time. |
| | The rotor is partially demagnetized causing excessive motor current. | Return the motor for repair. |
| Abnormal noise | Motor tuning limits are set too high. | Run Tune in the Logix Designer application. |
| | Loose parts are present in the motor. | <ul style="list-style-type: none"> Remove the loose parts. Return motor for repair. Replace motor. |
| | Through bolts or coupling is loose. | Tighten bolts. |
| | The bearings are worn. | Return motor for repair. |
| | Mechanical resonance. | Notch filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application). |
| Erratic operation - Motor locks into position, runs without control or with reduced torque. | Motor power phases U and V, U and W, or V and W reversed. | Check and correct motor power wiring. |

Logix 5000 Controller and Drive Module Behavior

By using the Logix Designer application, you can configure how the Kinetix 5700 system responds when a module fault/exception occurs.

TIP The INIT FLT *xxx* faults are always generated after powerup, but before the drive is enabled, so the stopping behavior does not apply.

NODE ALARM *xxx* faults do not apply because they do not trigger stopping behavior.

For troubleshooting SAFE FLT fault codes, refer to [Chapter 9](#) on [page 252](#) (hardwired safety) or [page 261](#) (integrated safety).

The iTRAK power supply cannot be configured by using the Studio 5000 Logix Designer application, but the pre-configured faults are shown on [page 229](#).

The DC-bus power supplies and servo drives support fault actions for Ignore, Alarm, Minor Fault, and Major Fault as defined in [Table 107](#). The drives also support five configurable stopping actions as defined in [Table 115](#).

Table 107 - Kinetix 5700 Module Exception Action Definitions

| Exception Action | Definition |
|------------------|--|
| Ignore | The drive module completely ignores the exception condition. For some exceptions that are fundamental to the operation of the planner, Ignore is not an available option. |
| Alarm | The drive module sets the associated bit in the Motion Alarm Status word, but does not otherwise affect axis behavior. Like Ignore, if the exception is so fundamental to the drive, Alarm is not an available option. When an exception action is set to Alarm, the Alarm goes away by itself when the exceptional condition has cleared. |
| Minor Fault | The drive module latches the exception condition, but the drive does not execute any exception action. |
| Major Fault | The drive module latches the exception condition and executes the configured exception action. |

You can configure exception behavior in the Logix Designer application from the Axis Properties dialog box, Actions category. These controller exception actions are mapped to the drive exception actions.

Table 108 - Logix Designer Exception Action Definitions

| Exception Action | Definition |
|-------------------|---|
| Ignore | The controller completely ignores the exception condition. For some exceptions that are fundamental to the operation of the planner, Ignore is not an available option. |
| Alarm | The controller sets the associated bit in the Motion Alarm Status word, but does not otherwise affect axis behavior. Like Ignore, if the exception is so fundamental to the drive, Alarm is not an available option. When an exception action is set to Alarm, the Alarm goes away by itself when the exceptional condition has cleared. |
| Fault Status Only | Like Alarm, Fault Status Only instructs the controller to set the associated bit in the Motion Fault Status word, but does not otherwise affect axis behavior. However, unlike Alarm an explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. Like Ignore and Alarm, if the exception is so fundamental to the drive, Fault Status Only is not an available option. |
| Stop Planner | The controller sets the associated bit in the Motion Fault Status word and instructs the Motion Planner to perform a controlled stop of all planned motion at the configured maximum deceleration rate. An explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. If the exception is so fundamental to the drive, Stop Planner is not an available option. |
| Stop Drive | When the exception occurs, the associated bit in the Fault Status word is set and the axis comes to a stop by using the stopping action defined by the drive for the particular exception that occurred. There is no controller based configuration to specify what the stopping action is, the stopping action is device dependent. |
| Shutdown | When the exception occurs, the drive brings the motor to a stop by using the stopping action defined by the drive (as in Stop Drive) and the power module is disabled. An explicit Shutdown Reset is required to restore the drive to operation. |

DC-bus Power Supply Behavior

Stopping action for exception fault codes does not apply to the DC-bus power supply. The StopDrive exception action for a DC-bus power supply means the power supply enters into a Major Fault state that opens the contactor-enable output, removing three-phase power from the Kinetix 5700 drive system. The Shutdown exception action exhibits the same behavior as Stop Drive, except the power supply enters into Shutdown as the final state and requires a Shutdown Reset to recover.

Fault actions are shown in [Table 109](#) and [Table 110](#).

Figure 102 - Logix Designer Axis Properties - Exceptions Category

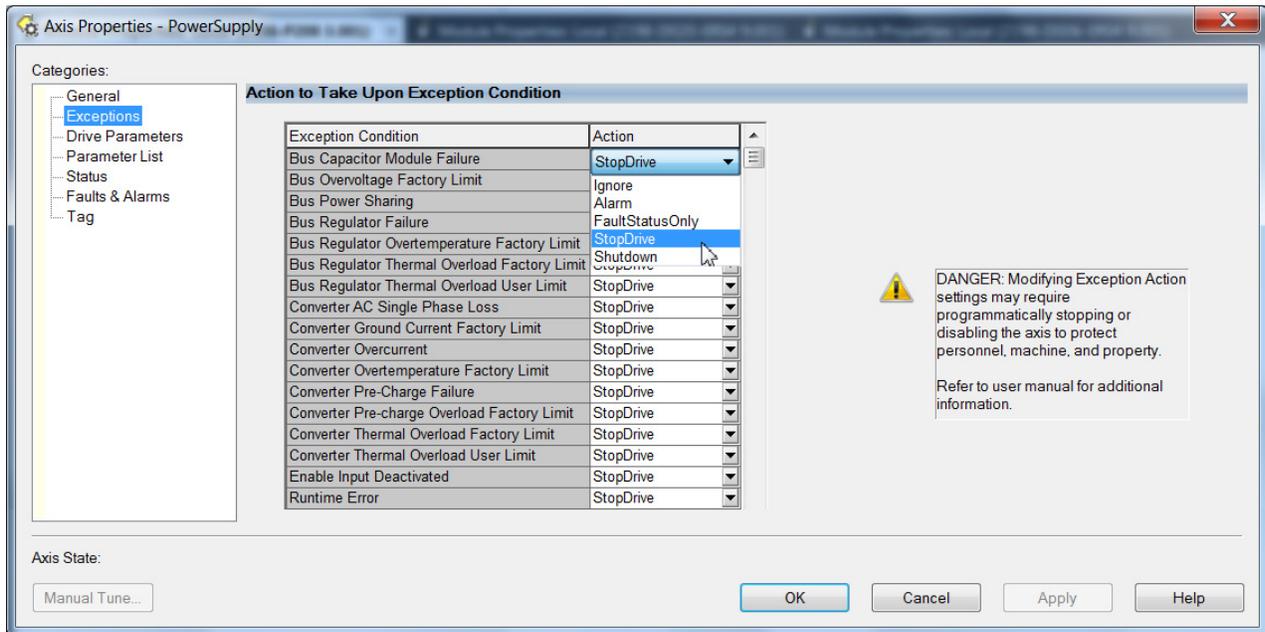


Table 109 - DC-bus Power Supply Behavior, FLT Sxx Fault Codes

| Exception Fault Code | Exception Text | Module | Fault Action | | | |
|--|--|-----------|--------------|-------|-------------|-------------|
| | | | Ignore | Alarm | Minor Fault | Major Fault |
| FLT S15 – CONV OVERCURRENT | Converter Overcurrent Fault | DC-bus PS | | | | X |
| FLT S16 – GROUND CURRENT | Ground Current Factory Limit Fault | DC-bus PS | | | | X |
| FLT S18 – CONV OVERTEMP FL | Converter OverTemp Factory Limit Fault | DC-bus PS | | | | X |
| FLT S20 – CONV OVERLOAD FL | Converter Thermal OverLoad Factory Limit Fault | DC-bus PS | | | | X |
| FLT S21 – CONV OVERLOAD UL | Converter Thermal Overload User Limit Fault | DC-bus PS | X | X | X | X |
| FLT S23 – AC PHASE LOSS | AC Single Phase Loss Fault | DC-bus PS | | | | X |
| FLT S25 – PRECHARGE FAILURE | Precharge Failure Fault | DC-bus PS | | | | X |
| FLT S27 – BUS REG OVERTEMP FL ⁽¹⁾ | Bus Regulator Overtemperature Factory Limit Fault | DC-bus PS | | | | X |
| FLT S29 – BUS REG OVERLOAD FL | Bus Regulator Thermal OverLoad Factory Limit Fault | DC-bus PS | | | | X |
| FLT S30 – BUS REG OVERLOAD UL | Bus Regulator Thermal Overload User Limit Fault | DC-bus PS | X | X | X | X |

Table 109 - DC-bus Power Supply Behavior, FLT Sxx Fault Codes (continued)

| Exception Fault Code | Exception Text | Module | Fault Action | | | |
|--|-------------------------------------|-----------|--------------|-------|-------------|-------------|
| | | | Ignore | Alarm | Minor Fault | Major Fault |
| FLT S31 – BUS REG FAILURE | Bus Regulator Failure | DC-bus PS | | | | X |
| FLT S32 – BUS CAPACITOR MODULE FAILURE | Bus Capacitor Module Failure | DC-bus PS | X | X | X | X |
| FLT S35 – BUS OVERVOLT FL | Bus Overvoltage Factory Limit Fault | DC-bus PS | | | | X |
| FLT S40 – BUS POWER SHARING FAULT | Bus Power Sharing Fault | DC-bus PS | | | | X |
| FLT S61 – ENABLE INPUT | Enable Input Deactivated | DC-bus PS | | | | X |

(1) Supported when shunt thermal switch is connected to the power supply digital input and configured in the Logix Designer application.

Table 110 - DC-bus Power Supply Behavior, FLT Mxx Fault Codes

| Exception Fault Code | Exception Text | Module | Fault Action | | | |
|---|--|-----------|--------------|-------|-------------|-------------|
| | | | Ignore | Alarm | Minor Fault | Major Fault |
| FLT M12 – POWER CYCLE FL ⁽¹⁾ | Converter Precharge Overload Factory Limit Fault | DC-bus PS | | | | X |
| FLT M26 – RUNTIME ERROR | Runtime Error | DC-bus PS | | | | X |

(1) Single-axis and dual-axis drives assert Bus Power Sharing Exception.

iTRAK Power Supply Behavior

The iTRAK power supply exceptions behavior, as defined in [Table 111](#), is shown in the following tables.

Table 111 - iTRAK Power Supply Exception Action Definitions

| Exception Action | Definition |
|------------------|---|
| Hold | Continue regulating the iTRAK DC busses. |
| Disable | Actively discharge the iTRAK DC busses then disable the regulators. |
| Shutdown | Disable the regulators, iTRAK DC busses passively discharge. |

Table 112 - iTRAK Power Supply Behavior, FLT Sxx Fault Codes

| Exception Fault Code | Exception Text | Module | Fault Action | | | | Stopping Action |
|-----------------------------|--|----------|--------------|-------|-------------|-------------|-----------------|
| | | | Ignore | Alarm | Minor Fault | Major Fault | |
| FLT S18 - CONV OVERTEMP FL | Converter OverTemp Factory Limit Fault | iTRAK PS | | | | X | Shutdown |
| FLT s20 - CONV OVERLOAD FL | Converter Thermal Overload Factory Limit Fault | iTRAK PS | | | | X | Shutdown |
| FLT S25 - PRECHARGE FAILURE | Precharge Failure Fault | iTRAK PS | | | | X | Shutdown |
| FLT S33 - BUS UNDERVOLT FL | Bus Undervoltage Factory Limit Fault | iTRAK PS | | | | X | Shutdown |
| FLT S35 - BUS OVERVOLT FL | Bus Overvoltage Factory Limit Fault | iTRAK PS | | | | X | Shutdown |
| FLT S38 - FUSE BLOWN | Bus Power Fuse Blown Fault | iTRAK PS | | | | X | Shutdown |
| FLT S61 - ENABLE INPUT | Enable Input Deactivated | iTRAK PS | | | | X | Disable |

Table 113 - iTRAK Power Supply Behavior, FLT Mxx Fault Codes

| Exception Fault Code | Exception Text | Module | Fault Action | | | | Stopping Action |
|-------------------------|----------------|----------|--------------|-------|-------------|-------------|-----------------|
| | | | Ignore | Alarm | Minor Fault | Major Fault | |
| FLT M26 - RUNTIME ERROR | Runtime Error | iTRAK PS | | | | X | Shutdown |

Table 114 - iTRAK Power Supply Behavior, NODE FLT Fault Codes

| Exception Fault Code | Exception Text | Module | Fault Action | | | | Stopping Action |
|------------------------------------|----------------------------|----------|--------------|-------|-------------|-------------|-----------------|
| | | | Ignore | Alarm | Minor Fault | Major Fault | |
| NODE FLT 02 - PROC | Processor Watchdog Fault | iTRAK PS | | | | X | Shutdown |
| NODE FLT 03 - HARDWARE | Hardware Fault | iTRAK PS | | | | X | Shutdown |
| NODE FLT 09 - DUPLICATE IP ADDRESS | Duplicate IP address Fault | iTRAK PS | | | | X | Shutdown |

Inverter Behavior

For the single-axis inverters and dual-axis inverters, only selected exceptions are configurable. In the drive behavior tables, the controlling attribute is given for programmable fault actions.

Table 115 - Configurable Stopping Actions

| Stopping Action | Description |
|---------------------------------------|---------------|
| Ramped Decel & Hold ⁽¹⁾ | Most control |
| Current Decel & Hold | Most control |
| Ramped Decel & Disable ⁽¹⁾ | Less control |
| Current Decel & Disable | Less control |
| Disable & Coast ⁽²⁾ | Least control |

The best available stopping action is the one that maintains the most control over the motor. However, not all faults support every stopping action.

(1) Ramped Decel is available only when General>Axis Configuration is set to Velocity Loop or Frequency Control.

(2) When configured for Frequency Control (induction motors only), select Decel & Disable only when the Current Limiting feature is enabled. For more information on this feature, see [Current Limiting for Frequency Control](#) on [page 332](#).

Actions define the drive behavior in response to specific conditions. The Actions category includes Standard Actions and Safety Actions.

Table 116 - Actions Definitions

| Action Category | Action Name | Action Trigger Condition | Available Actions |
|-----------------|---------------------------------|--|---|
| Standard | Disable (MSF) Stopping Action | Execution of an MSF motion instruction. | <ul style="list-style-type: none"> Ramped Decel & Hold Current Decel & Hold Ramped Decel & Disable Current Decel & Disable Disable & Coast |
| | Connection Loss Stopping Action | Loss of the motion connection (for example, inhibiting the module or a network cable disconnect). | <ul style="list-style-type: none"> Ramped Decel & Disable Current Decel & Disable Disable & Coast |
| | Motor Overload Action | Receiving MTR OVERLOAD fault. | <ul style="list-style-type: none"> Current Foldback None |
| | Inverter Overload Action | Receiving INV OVERLOAD fault. | <ul style="list-style-type: none"> Current Foldback None |
| Safety | Safe Torque Off Action | Transition from logic 0 to 1 of the SafeTorqueOffActiveStatus axis tag, which indicates a safe torque-off action was commanded (STO). ⁽¹⁾ | <ul style="list-style-type: none"> Ramped Decel & Disable Current Decel & Disable Disable & Coast |
| | Safe Stopping Action | Transition from logic 0 to 1 of the SS1ActiveStatus or SS2ActiveStatus axis tag which indicates a safe stopping action was commanded (SS1, SS2). | <ul style="list-style-type: none"> Ramped Decel Current Decel |

(1) This action is executed only if the axis tag transitions due to a requested STO, not if it was triggered by another safe-stop function (SS1, for example).

Standard Actions

When a controller connection loss (NODE FLT 06) occurs, it is possible with firmware revision 9.xxx that other node faults can occur first, triggering a fault action of Current Decel & Disable. Without knowing if NODE FLT 06 will occur first on a connection loss fault, we recommend that you do not change the default connection loss setting of Current Decel & Disable.

TIP Use DLR ring topology (see [Ring Topology](#) on [page 25](#)) for applications where the possibility of connection loss must be minimized.

Safety Actions

The Action Source pull-down menus include Connected Drive mode and Running Controller mode.

When configured for Connected Drive (default), the drive initiates the stopping sequence according to the selected stopping action. However, the drive must have an open connection to the motion controller for the configured stopping action to occur.

When configured for Running Controller and the controller is in Run mode, the stopping sequence is controlled by your application program in the motion controller. This provides flexibility based on your application and requires that your program provide the desired action in response to the safety function active status. If no logic is created, no stopping action will occur. If the motion controller is in Program mode (not actively running the application program), the drive ignores the Action Source and initiates the configured stopping sequence according to the corresponding Action selected in the pull-down menu.

Figure 103 - Logix Designer Axis Properties - Actions Category

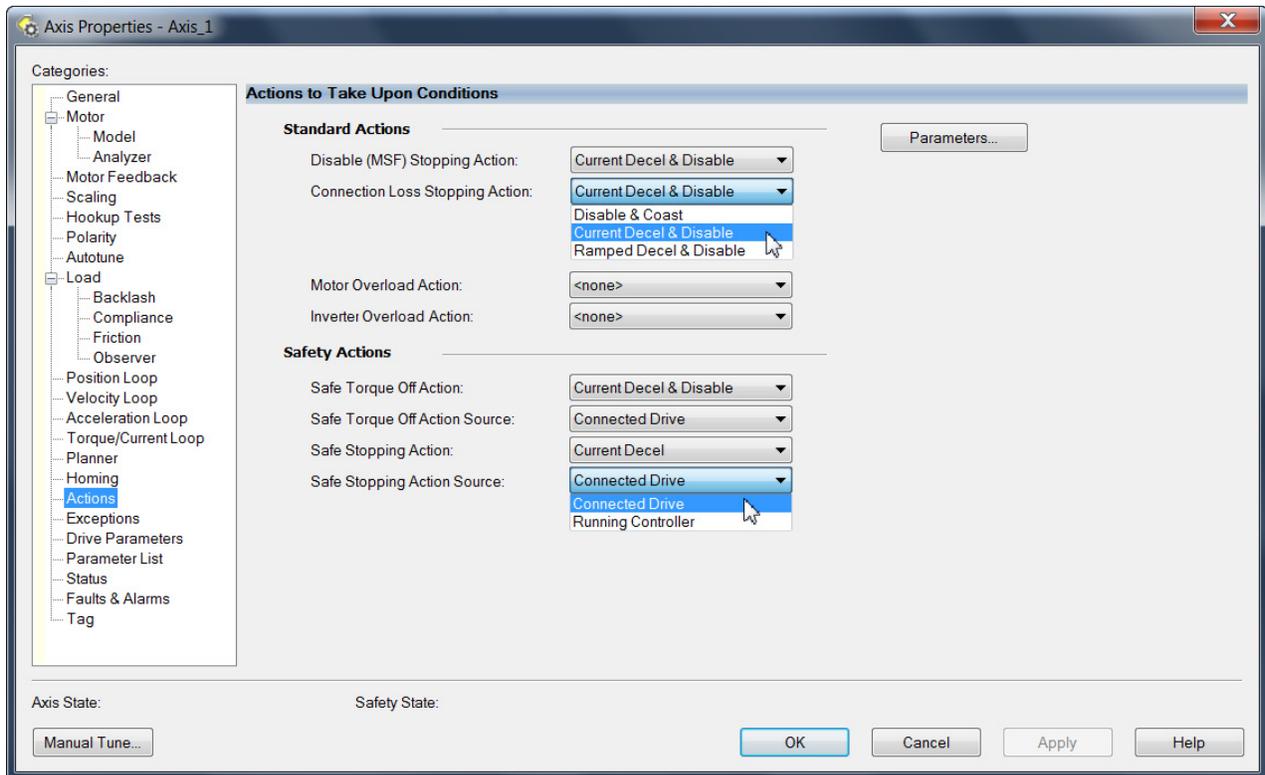


Table 117 - Drive Behavior, FLT Sxx Fault Codes

| Exception Fault Code | Exception Text | Inverter Modules 2198-xxxx | Permanent Magnet Motor | Induction Motor | Fault Action | | | | Best Available Stopping Action (applies to major faults) | |
|--|---|-----------------------------------|------------------------|-----------------|--------------|-------|-------------|-------------|---|-----------------------|
| | | | | | Ignore | Alarm | Minor Fault | Major Fault | | |
| FLT S02 – MTR COMMUTATION | Motor Commutation Fault | -ERSx | X | | | | | X | Disable/Coast | |
| FLT S03 – MTR OVERSPEED FL | Motor Overspeed Factory Limit Fault | -ERSx | X | X | | | | X | Disable/Coast | |
| FLT S04 – MTR OVERSPEED UL | Motor Overspeed User Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold | |
| FLT S05 – MTR OVERTEMP FL | Motor Overtemperature Factory Limit Fault | -ERS3 (series A) | X | X | | | | | Disable/Coast | |
| | Motor Overtemperature Factory Limit Fault (If #589 vertical load control) | -ERS4 | | | | | | | X | Current Decel/Disable |
| | Motor Overtemperature Factory Limit Fault (If not #589 vertical load control) | | | | | | | | | Disable/Coast |
| FLT S07 – MTR OVERLOAD FL | Motor Thermal Overload Factory Limit Fault | -ERS3 (series A) | X | X | | | | X | Decel/Disable | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Disable | |
| FLT S08 – MTR OVERLOAD UL | Motor Thermal OverLoad User Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold | |
| FLT S09 – MTR PHASE LOSS | Motor Phase Loss | -ERSx | X | | X | X | X | X | Disable/Coast | |
| FLT S10 – INV OVERCURRENT | Inverter Overcurrent Fault | -ERSx | X | X | | | | X | Disable/Coast | |
| FLT S11 – INV OVERTEMP FL | Inverter Overtemperature Factory Limit Fault | -ERS3 (series A) | X | X | | | | | Disable/Coast | |
| | Inverter Overtemperature Factory Limit Fault (If #589 vertical load control) | -ERS4 | | | | | | | X | Current Decel/Disable |
| | Inverter Overtemperature Factory Limit Fault (If not #589 vertical load control) | | | | | | | | | Disable/Coast |
| FLT S13 – INV OVERLOAD FL | Inverter Thermal Overload Factory Limit Fault | -ERS3 (series A) | X | X | | | | X | Disable/Coast | |
| | | -ERS4 | | | | | | | Current Decel/Disable | |
| FLT S14 – INV OVERLOAD UL | Inverter Thermal Overload User Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold | |
| FLT S16 – GROUND CURRENT | Ground Current Factory Limit Fault | -ERSx Single-axis inverters | X | X | | | | X | Disable/Coast | |
| FLT S22 – AC POWER LOSS | Converter AC Power Loss Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Disable | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Disable | |
| FLT S27 – BUS REG OVERTEMP FL ⁽¹⁾ | Bus Regulator Overtemperature Factory Limit Fault | -ERSx | X | X | | | | X | Disable/Coast | |
| FLT S32 – BUS CAPACITOR MODULE FAILURE | Bus Capacitor Module Failure | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold | |
| FLT S33 – BUS UNDERVOLT FL | Bus Undervoltage Factory Limit Fault | -ERS3 (series A) | X | X | | | | X | Decel/Disable | |
| | | -ERS4 -ERS3 (series B) | X | X | | | | X | Ramped Decel ⁽⁵⁾ /Disable | |
| FLT S34 – BUS UNDERVOLT UL | Bus Undervoltage User Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold | |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold | |
| FLT S35 – BUS OVERVOLT FL | Bus Overvoltage Factory Limit Fault | -ERSx | X | X | | | | X | Disable/Coast | |

Table 117 - Drive Behavior, FLT Sxx Fault Codes (continued)

| Exception Fault Code | Exception Text | Inverter Modules 2198-xxxx | Permanent Magnet Motor | Induction Motor | Fault Action | | | | Best Available Stopping Action (applies to major faults) |
|--|---|-------------------------------|------------------------|-----------------|--------------|-------|-------------|-------------|---|
| | | | | | Ignore | Alarm | Minor Fault | Major Fault | |
| FLT S37 – BUS POWER LOSS | Bus Power Loss | -ERS3 (series A) | X | X | X | X | X | X | Decel/Disable |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Disable |
| FLT S38 – FUSE BLOWN | Bus Power Fuse Blown Fault | -ERSx | X | X | | | | X | Disable/Coast |
| FLT S40 – BUS POWER SHARING FAULT | Bus Power Sharing Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Disable |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Disable |
| FLT S41 – MTR AQB STATE FL | Feedback Signal Noise FL | -ERSx | X | X | | | | X | Disable/Coast |
| FLT S43 – FDBK LOSS FL ^{(2) (4)} | Feedback Signal Loss FL | -ERSx | X | X | | | | X | Disable/Coast |
| FLT S44 – FDBK LOSS UL ^{(2) (4)} | Feedback Signal Loss UL | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S45 – FDBK COMM FL ^{(3) (4)} | Motor Feedback Data Loss Factory Limit Fault | -ERSx | X | X | | | | X | Disable/Coast |
| FLT S46 – FDBK COMM UL ^{(3) (4)} | Motor Feedback Data Loss User Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S47 – FDBK DEVICE FAILURE | Feedback Device Failure | -ERSx | X | X | | | | X | Disable/Coast |
| FLT S49 – BRAKE SLIP FLT | Brake Slip Exception | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S50 – POS HW OTRAVEL | Hardware Overtravel - Positive | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S51 – NEG HW OTRAVEL | Hardware Overtravel - Negative | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S54 – POSN ERROR ⁽⁴⁾ | Excessive Position Error Fault | -ERS3 (series A) | X | X | X | X | X | X | Disable/Coast |
| | Excessive Position Error Fault (If #589 vertical load control) | -ERS4 | | | | | | | Current Decel/Disable |
| | Excessive Position Error Fault (If not #589 vertical load control) | | | | | | | | Disable/Coast |
| FLT S55 – VEL ERROR ⁽⁴⁾ | Excessive Velocity Error Fault | -ERS3 (series A) | X | X | X | X | X | X | Disable/Coast |
| | Excessive Velocity Error Fault (If #589 vertical load control) | -ERS4 | | | | | | | Current Decel/Disable |
| | Excessive Velocity Error Fault (If not #589 vertical load control) | | | | | | | | Disable/Coast |
| FLT S56 – OVERTORQUE LIMIT ⁽⁴⁾ | Overtorque Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S57 – UNDERTORQUE LIMIT ⁽⁴⁾ | Undertorque Limit Fault | -ERS3 (series A) | X | X | X | X | X | X | Decel/Hold |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽⁵⁾ /Hold |
| FLT S61 – ENABLE INPUT | Enable Input Deactivated | -ERS3 (series A) | X | X | X | X | X | X | Disable/Coast |
| | | -ERS4 | | | | | | | Ramped Decel ⁽⁵⁾ /Disable |

- (1) Supported when shunt thermal switch is connected to the inverter digital input and configured in the Logix Designer application.
- (2) Applies to all compatible feedback devices, except DSL encoder feedback.
- (3) Applies to DSL and Hiperface feedback devices.
- (4) Does not apply to induction motors in frequency control mode.
- (5) Available only in Velocity Control mode. Available stopping action is Current Decel in Position Control mode.

Table 118 - Drive Behavior, FLT Mxx Fault Codes

| Exception Fault Code | Exception Text | Inverter Modules 2198-xxxx | Permanent Magnet Motor | Induction Motor | Fault Action | | | | Best Available Stopping Action (applies to major faults) |
|--|--|-------------------------------|------------------------|-----------------|--------------|-------|-------------|-------------|---|
| | | | | | Ignore | Alarm | Minor Fault | Major Fault | |
| FLT M02 – MOTOR VOLTAGE ⁽¹⁾ | Motor Voltage Mismatch Fault | -ERSx | X | X | X | X | X | X | Disable/Coast |
| FLT M07 – FEEDBACK INCREMENTAL COUNT ERROR FAULT | Feedback Incremental Count Error Fault | -ERSx | X | X | X | X | X | X | Disable/Coast |
| FLT M26 – RUNTIME ERROR | Runtime Error | -ERSx | X | X | | | | X | Disable/Coast |
| FLT M28 – SAFETY COMM ⁽²⁾ | Safety Module Communication Error | -ERSx | X | X | | | | X | Disable/Coast |

- (1) Does not apply to induction motors in frequency control mode.
- (2) Applies to drives in Integrated STO mode.

NODE FLT Fault Codes

These NODE FLT fault codes apply to Kinetix 5700 DC-bus power supplies and inverter modules.

Table 119 - System Behavior, NODE FLT Fault Codes

| Exception Fault Code | Exception Text | Inverter Modules 2198-xxxx | Permanent Magnet Motor | Induction Motor | Fault Action | | | | Best Available Stopping Action (applies to major faults) |
|------------------------------------|----------------------------------|-------------------------------|------------------------|-----------------|--------------|-------|-------------|-------------|---|
| | | | | | Ignore | Alarm | Minor Fault | Major Fault | |
| NODE FLT 01 – LATE CTRL UPDATE | Control Connection Update Fault | -ERS3 (series A) | X | X | | | | X | Decel/Disable |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽¹⁾ /Disable |
| NODE FLT 02 – PROC WATCHDOG | Processor Watchdog Fault | -ERSx | X | X | | | | X | Disable/Coast |
| NODE FLT 03 – HARDWARE | Hardware Fault | -ERSx | X | X | | | | X | Disable/Coast |
| NODE FLT 05 – CLOCK SKEW FLT | Clock Skew Fault | -ERS3 (series A) | X | X | | | | X | Decel/Disable |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽¹⁾ /Disable |
| NODE FLT 06 – LOST CTRL CONN | Lost Controller Connection Fault | -ERS3 (series A) | X | X | | | | X | Decel/Disable |
| | | -ERS4 -ERS3 (series B) | | | | | | | Programmable per ⁽²⁾ Connection Loss Stopping Action (see Table 116 on page 230). |
| NODE FLT 07 – CLOCK SYNC | Clock Sync Fault | -ERS3 (series A) | X | X | | | | X | Decel/Disable |
| | | -ERS4 -ERS3 (series B) | | | | | | | Ramped Decel ⁽¹⁾ /Disable |
| NODE FLT 09 – DUPLICATE IP ADDRESS | Duplicate IP Address Fault | -ERSx | X | X | | | | X | Disable/Coast |

- (1) Available only in Velocity Control mode. Available stopping action is Current Decel in Position Control mode.
- (2) With firmware revision 9.xxx. Do not change the default stopping action.

Remove and Replace Drive Modules

This chapter provides remove and replace procedures for Kinetix® 5700 drive modules.

| Topic | Page |
|---|------|
| Before You Begin | 235 |
| Remove and Replace Kinetix 5700 Drive Modules | 236 |
| Start and Configure the Drive Module | 240 |



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

When each drive module is installed, network settings are configured from the setup screens. Before removing the module, revisit the Network menu and make note of the static IP or DHCP settings. Refer to [Configure the Drive](#) on [page 146](#) to access those settings.

IMPORTANT If you intend to use the same Logix Designer application after replacing your drive module, the new module must be the same catalog number as the old module.

You also need these tools available before you begin removal and replacement procedures:

- Screwdrivers (to loosen/remove screws)
- Voltmeter (to make sure that no voltage exists on drive connectors)

Remove and Replace Kinetix 5700 Drive Modules

Follow these steps to remove and replace DC-bus power supplies, dual-axis inverters, single-axis inverters, iTRAK® power supplies, or capacitor modules from the system panel.

Remove Power and All Connections

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



ATTENTION: To avoid shock hazard or personal injury, make sure 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 5 minutes for the DC bus to discharge completely before proceeding.



SHOCK HAZARD: This product contains stored energy devices. To avoid the hazard of electrical shock, verify that 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.

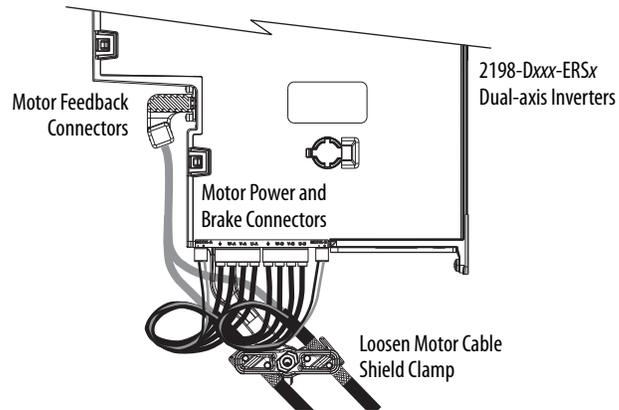
3. Using a voltmeter, verify that the DC-bus voltage has discharged, and for iTRAK power supply, verify that the output bus (ICP and IDC connectors) has discharged.
4. Label and remove all wiring connectors from the module you are removing.

To identify each connector, refer to [Kinetix 5700 Connector Data](#) on [page 64](#).

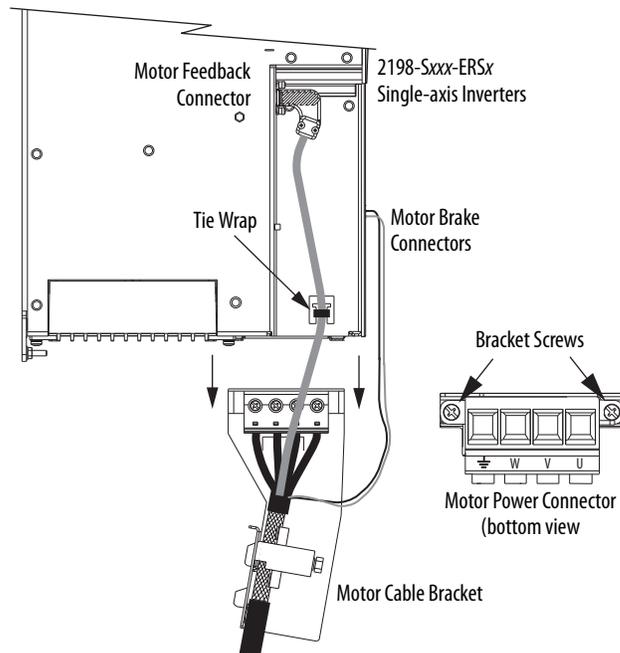
TIP For 2198-Pxxx DC-bus power supplies, you do not need to remove the shunt (RC) connector, unless there is an external shunt wired to it.

5. Unplug the DC-bus links and end caps from on top of the DC-bus power supply or other drive module you are removing.
6. Unplug the shared-bus 24V input wiring connector, T-connectors, and bus-bars from on top of the drive module you are removing.

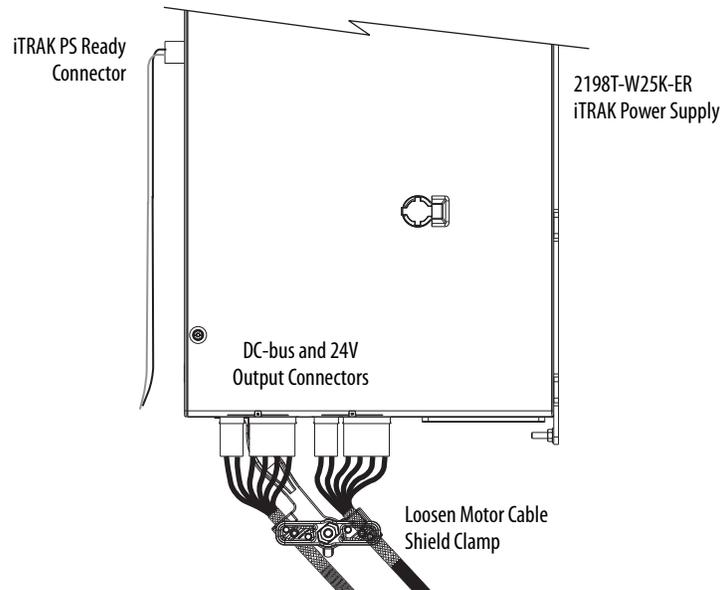
7. For 2198-Dxxx-ERSx dual-axis inverters, unplug the motor feedback, motor power, and motor brake connectors and loosen the shield clamp until you can remove the cable from the clamp.



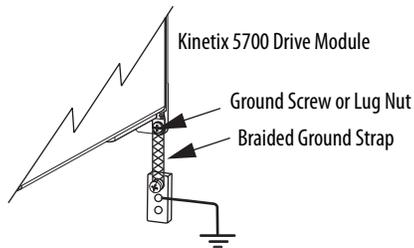
8. For 2198-Sxxx-ERSx single-axis inverters, unplug the motor feedback and brake connectors, remove the tie wrap, and remove the motor power bracket.



9. For 2198T-W25K-ER iTRAK power supplies, unplug the iPS ready connector, 24V control power output connectors and DC-bus output connectors and loosen the shield clamp until you can remove the cable from the clamp.



10. Remove the ground screw or lug nut and braided ground strap.



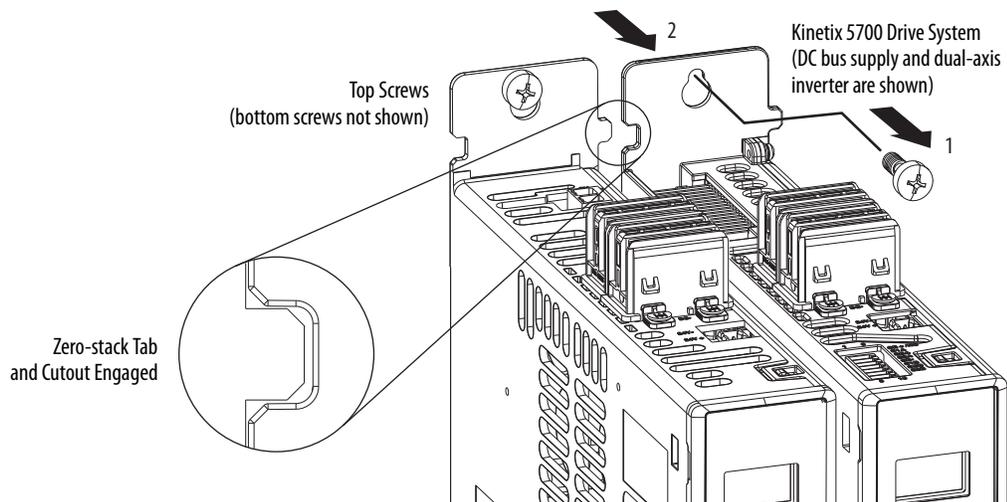
Remove the Drive Module

You can remove DC-bus power supplies, dual-axis inverters, single-axis inverters, iTRAK power supplies, or capacitor modules from the panel in any configuration by using the same procedure.

IMPORTANT This procedure applies to any Kinetix 5700 drive module in any configuration.

Follow these steps to remove Kinetix 5700 drive modules from the panel.

1. Loosen the top and bottom screws of the module you are removing.
Modules with 55 mm width have one top and bottom screw. Modules with 85 mm and 100 mm width have two top and bottom screws.
2. Grasp the top and bottom of the module with both hands and pull the module straight out and away from the panel, clearing the zero-stack mounting tabs and cutouts.



Replace the Drive Module

To replace the drive module, reverse the steps that are shown above or refer to [Mount Your Kinetix 5700 Drive Modules](#) on [page 61](#):

- Torque mounting, shield clamp, and ground screws to 2.0 N•m (17.7 lb•in) max.
- Reconnect the feedback connector kit and torque the mounting screws to 0.4 N•m (3.5 lb•in) max.

If replacing a drive module that was configured for Integrated STO mode, refer to [Understand Integrated Safety Drive Replacement](#) on [page 268](#).

Start and Configure the Drive Module

Follow these steps to configure the replacement module.

IMPORTANT If you intend to use the same Logix Designer application after replacing your drive module, the new module must be the same catalog number as the old module.

IMPORTANT If a servo drive was previously configured by a safety controller, reset the drive to the Out of Box state. Refer to [Out of Box State](#) on [page 246](#).

1. Reapply power to the drive system.

Refer to [Apply Power to the Kinetix 5700 Drive System](#) on [page 201](#) for the procedure.

2. Configure the network settings for the drive module.

For example, if your old module was configured as Static IP, you must set the IP address, gateway, and subnet mask in the new module identical to the old module.

Refer to [Configure the Drive](#) on [page 146](#) to access those settings.

3. If you are replacing a 2198-xxxx-ERS3 (series A) drive with a 2198-xxxx-ERS3 (series B) drive, see [Replacing 2198-xxxx-ERS3 \(series A\) Drives with Series B Drives](#) for more information.
4. Download the Logix Designer application to the controller.
5. Verify that the drive system is working properly.

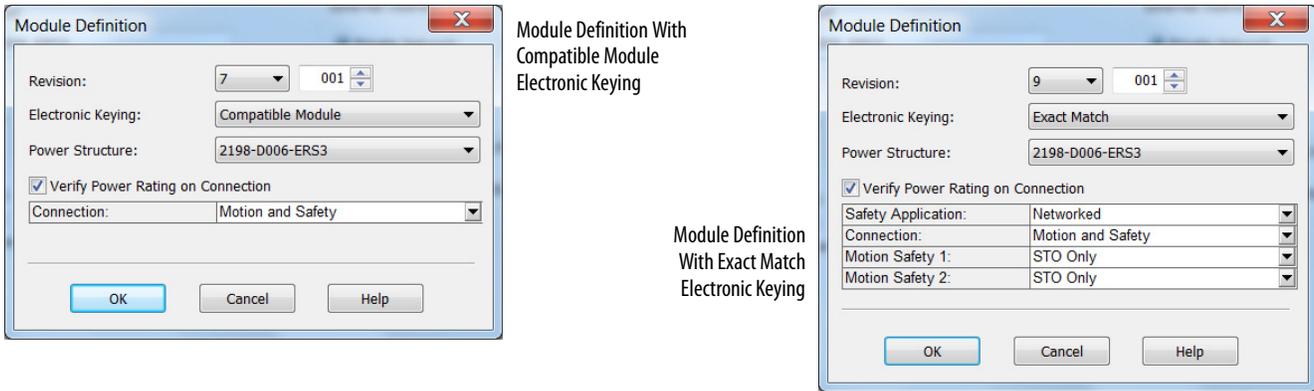
Replacing 2198-xxxx-ERS3 (series A) Drives with Series B Drives

When replacing a 2198-xxxx-ERS3 (series A) drive with a 2198-xxxx-ERS3 (series B) drive, the procedure depends on how Electronic Keying is configured in the Module Definition.

IMPORTANT If Electronic Keying in the Module Definition is configured for Exact Match, the following guidelines apply:

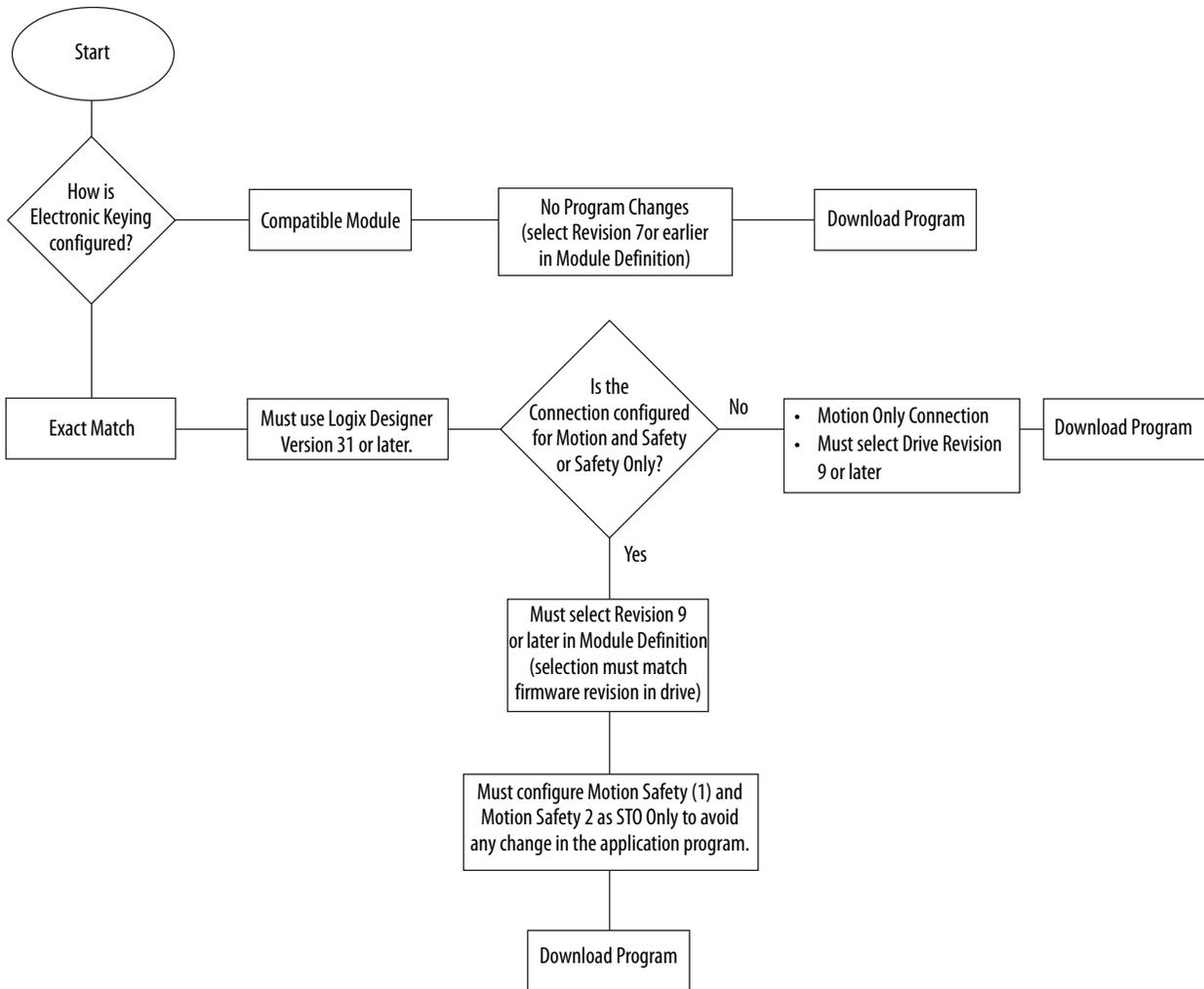
- The Module Definition Revision level must match the 2198-xxxx-ERS3 (series B) drive firmware (revision 9 or later)
- For backwards compatibility with series A drives, Motion Safety in the Module Definition of the 2198-xxxx-ERS3 (series B) drive must be configured for STO Only

Figure 104 - Module Definition for 2198-xxxx-ERS3 (series B) drives



In this flowchart, a 2198-xxxx-ERS3 series A drive (with drive firmware revision 7 or earlier) was programmed by using Studio 5000 Logix Designer®, version 30 or earlier, and is replaced by a 2198-xxxx-ERS3 series B drive (with drive firmware revision 9 or later).

Figure 105 - 2198-xxxx-ERS3 (series B) Replacement Drive Flowchart



Notes:

Kinetix 5700 Safe Torque-off Function

Use this chapter to become familiar with the safe torque-off functionality built into Kinetix® 5700 dual-axis and single-axis inverters.

| Topic | Page |
|----------------------------|------|
| Overview | 243 |
| Hardwired Safe Torque-off | 252 |
| Integrated Safe Torque-off | 261 |

Overview

The Kinetix 5700 dual-axis and single-axis inverters are equipped for hardwired safe torque-off (STO). Hardwired STO mode, as described in this chapter, applies to 2198-xxxx-ERS3 and 2198-xxxx-ERS4 dual-axis and single-axis inverters.

The Kinetix 5700 dual-axis and single-axis inverters are also equipped for integrated safe torque-off (STO) over the EtherNet/IP™ network. Integrated STO mode, as described in this chapter, applies to 2198-xxxx-ERS3 and 2198-xxxx-ERS4 dual-axis and single-axis inverters.

The integrated Monitored SS1 and Timed SS1 stopping functions are supported by the 2198-Dxxx-ERS4 dual-axis and 2198-Sxxx-ERS4 single-axis inverters. For integrated Monitored SS1 and Timed SS1 stopping function operations, see the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication [2198-RM001](#).

Table 120 - Kinetix 5700 Functional Safety Mode Support

| Safety Mode | Dual-axis Inverters Cat. No. | Single-axis Inverters Cat. No. |
|---------------------------------|---------------------------------|-----------------------------------|
| Hardwired STO mode | 2198-Dxxx-ERS3 | 2198-Sxxx-ERS3 |
| | 2198-Dxxx-ERS4 | 2198-Sxxx-ERS4 |
| Integrated STO mode | 2198-Dxxx-ERS3 | 2198-Sxxx-ERS3 |
| | 2198-Dxxx-ERS4 | 2198-Sxxx-ERS4 |
| Monitored SS1 stopping function | 2198-Dxxx-ERS4 | 2198-Sxxx-ERS4 |
| Timed SS1 stopping function | 2198-Dxxx-ERS4 | 2198-Dxxx-ERS4 |
| | 2198-Dxxx-ERS3 (series B) | 2198-Sxxx-ERS3 (series B) |

The hardwired and integrated STO modes and SS1 stopping functions meet the requirements of Performance Level e (PL e) per ISO 13849-1 and SIL CL 3 per IEC 61508, IEC 61800-5-2 and IEC 62061.

Certification

The TÜV Rheinland group has approved the 2198-Dxxx-ERSx and 2198-Sxxx-ERSx inverters with hardwired and integrated safe torque-off for use in safety-related applications up to ISO 13849-1 Performance Level e (PL e), SIL CL 3 per IEC 61508, IEC 61800-5-2, and IEC 62061, in which removing the motion producing power is considered to be the safe state.

For product certifications currently available from Rockwell Automation, go to <https://www.rockwellautomation.com/global/certification/overview.page>.

Important Safety Considerations

The system user is responsible for the following:

- Validation of any sensors or actuators connected to the system
- Completing a machine-level risk assessment
- Certification of the machine to the desired ISO 13849 performance level or IEC 62061 SIL level
- Project management and proof testing in accordance with ISO 13849

Stop Category Definition

Stop Category 0 as defined in IEC 60204 or safe torque-off as defined by IEC 61800-5-2 is achieved with immediate removal of motion producing power to the actuator.

IMPORTANT In the event of a malfunction, the most likely stop category is Stop Category 0. When designing the machine application, timing and distance must be considered for a coast to stop. For more information regarding stop categories, refer to IEC 60204-1.

Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to ISO 13849-1, and SIL levels, according to IEC 61508 and IEC 62061, include a rating of the systems ability to perform its safety functions. All of the safety-related components of the control system must be included in both a risk assessment and the determination of the achieved levels.

Refer to the ISO 13849-1, IEC 61508, and IEC 62061 standards for complete information on requirements for PL and SIL determination.

Average Frequency of a Dangerous Failure

Safety-related systems are classified as operating in a High-demand/continuous mode. The SIL value for a High-demand/continuous mode safety-related system is directly related to the probability of a dangerous failure per hour (PFH).

PFH calculation is based on the equations from IEC 61508 and show worst-case values. [Table 121](#) provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

IMPORTANT Determination of safety parameters is based on the assumptions that the system operates in High-demand mode and that the safety function is requested at least once every three months.

Table 121 - PFH for 20-year Proof Test Interval (STO function)

| Attribute | 2198- Sxxx -ERS3 Single-axis Inverters | 2198- Dxxx -ERS3 Dual-axis Inverters |
|--------------------|--|--|
| PFH (1e-9) | 1.57 | 1.64 |
| Proof test (years) | 20 | 20 |

Safe Torque-off Feature

The safe torque-off (STO) circuit, when used with suitable safety components, provides protection according to ISO 13849-1 (PL e), according to IEC 61508, IEC 61800-5-2, and IEC 62061 (SIL CL 3). All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The 2198-~~xxxx~~-ERS3 and 2198-~~xxxx~~-ERS4 STO circuit is designed to turn off all of the output-power transistors when the STO function is requested. You can use the 2198-~~xxxx~~-ERS~~x~~ STO circuit in combination with other safety devices to achieve a Stop Category 0 stop as described in [Stop Category Definition](#) on [page 244](#), and protection-against-restart as specified in IEC 60204-1.



ATTENTION: The safe torque-off (STO) feature is suitable only for performing mechanical work on the drive system or affected area of a machine. It does not provide electrical safety.



SHOCK HAZARD: In Safe Torque-off mode, hazardous voltages can still be present at the drive. To avoid an electric shock hazard, disconnect power to the system and verify that the voltage is zero before performing any work on the drive.



ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

Out of Box State

Kinetix 5700 servo drives are capable of safe torque-off (STO) functionality in Hardwired STO mode or Integrated STO mode. Out of the box, the Kinetix 5700 servo drives are in Hardwired STO mode, which means they are ready for hardwired connections to the safety (STO) connector. To bypass the hardwired safety function, jumper wires must be installed in the STO connector.

IMPORTANT Out of the box, Kinetix 5700 servo drives are in Hardwired STO mode.

IMPORTANT To bypass the STO feature while commissioning or testing the drive, the drive must be configured for Hardwired STO mode. Refer to [Safe Torque-off Feature Bypass](#) on [page 259](#) for a wiring example.

Out of the box, you can use Kinetix 5700 servo drives in Integrated STO mode only after a Motion and Safety or Safety-only connection has been established at least once in the Logix Designer application.

How to Recognize Hardwired STO Mode

You can read the safety control state from the axis tag `AxisSafetyState`, or by using an MSG command in the Logix Designer application to read the Safety Supervisor status.

In Hardwired STO mode, if STO inputs are OFF then Safety Supervisor state is Not Configured (8) and if STO inputs are ON then Safety Supervisor state is Not Configured, torque permitted (51).

Table 122 - Safety Supervisor States

| Value | Safety Supervisor State | Definition | Safety Mode |
|-------|-----------------------------------|--|----------------------------|
| 2 | Configured (no safety connection) | No active connections | Integrated |
| 4 | Running | Normal running state | Integrated |
| 7 | Configuring | Transition state | Integrated |
| 8 | Not Configured | Hardwired STO mode with torque disabled | Hardwired (out of the box) |
| 51 | Not Configured (torque permitted) | Hardwired STO mode with torque permitted | Hardwired (out of the box) |
| 52 | Running (torque permitted) | STO bypass state | Integrated |

Restore the Hardwired STO Mode by Using the Logix Designer Application

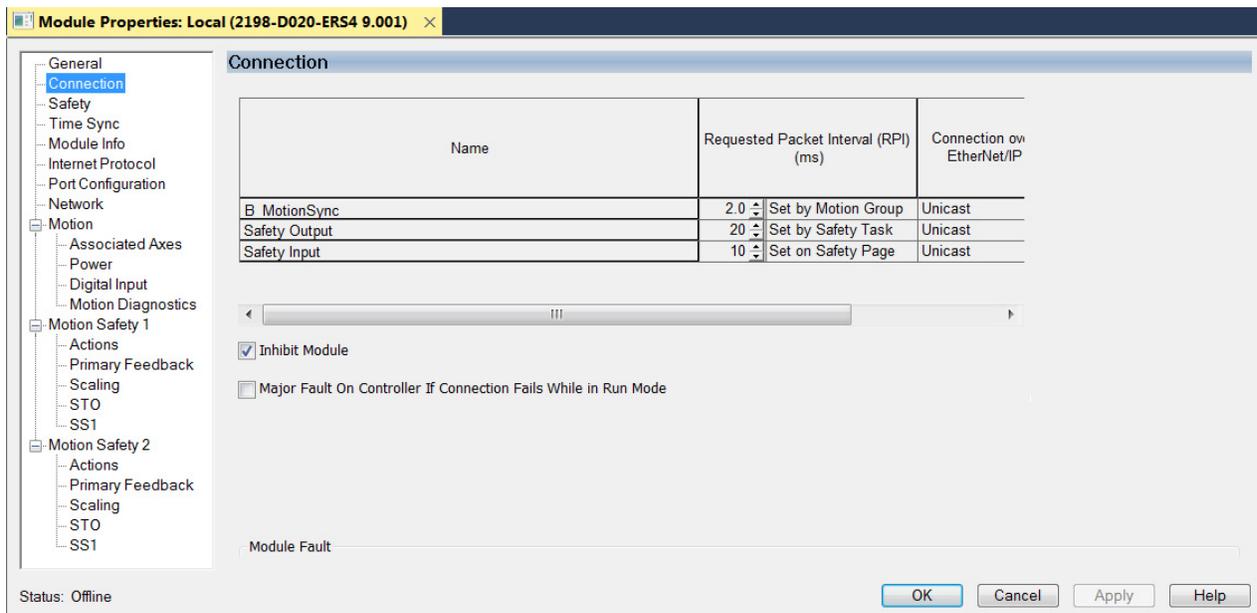
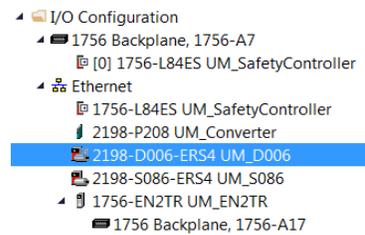
IMPORTANT This section applies to 2198-xxxx-ERS3 (series A) drives. The 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) drives are configured for Hardwired or Networked mode in the Module Definition dialog box under Module Properties>General category.

After the integrated safety connection configuration is applied to the Kinetix 5700 servo drive at least once, you can restore the drive to the Hardwired STO mode by using the Logix Designer application.

IMPORTANT Only authorized personnel should attempt Reset Ownership. The safety connection must be inhibited before the reset is attempted. If any active connection is detected, the safety reset is rejected and Reset Failed appears on the display.

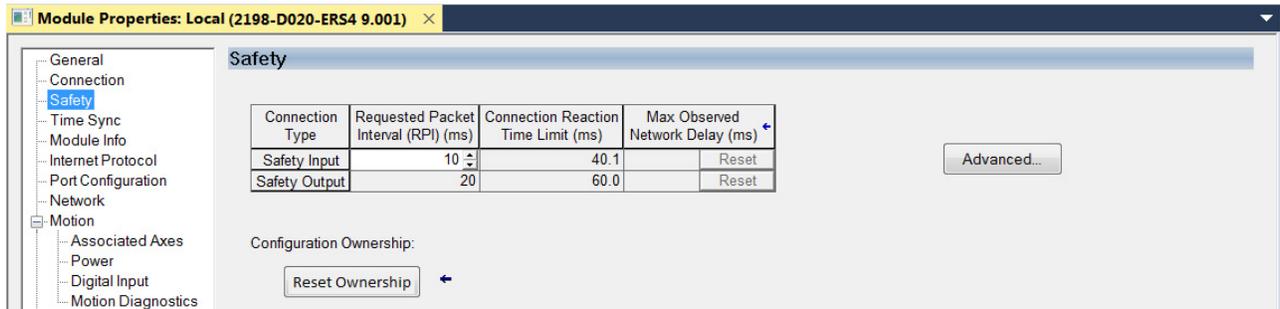
Follow these steps to restore your Kinetix 5700 servo drive to the Hardwired STO mode.

1. Right-click the Kinetix 5700 servo drive you just created and choose Properties.
2. Select the Connection category.
The Connection category appears.



3. Check Inhibit Module.
4. Click Apply.

5. Click the Safety category.



6. In the Configuration Ownership field, click Reset Ownership.

The drive reverts back to Hardwired STO mode.

7. Click OK.

Restore Hardwired STO mode by Using the Drive Display

After the integrated safety connection configuration is applied to the Kinetix 5700 servo drive at least once, you can restore the drive to Hardwired STO mode by using the drive display and navigation buttons.

IMPORTANT Only authorized personnel should attempt Reset Ownership. The safety connection must be inhibited before the reset is attempted. If any active connection is detected, the safety reset is rejected and Reset Failed appears on the display.

Follow these steps to restore your Kinetix 5700 drive to the Hardwired STO mode.

1. Disable any Motion and Safety connections configured in the Logix Designer application.
You can do this in Module Properties or by unplugging the Ethernet cable.
2. From the Home screen on the drive display, press the settings button.
3. From the SETTINGS menu, scroll down by using the arrows and select SAFETY.
4. Press to request a Reset Ownership.
Are You Sure? appears on the display.
5. Press to acknowledge and begin the reset ownership.

If a reset ownership is requested, but not acknowledged within 30 seconds, the display automatically reverts back to the Home screen and the drive does not complete the reset ownership.

If a reset ownership is requested and acknowledged within 30 seconds, the drive reverts back to Hardwired STO mode.

Safe Torque-off Status

This section describes the safety related status data that is available to the motion controller.

IMPORTANT The status data described in this section is STANDARD data (not SAFETY data) and cannot be used as part of a safety function.

When a Kinetix 5700 add on profile (AOP) is added to a Logix Designer application I/O tree, axis tags are added to the controller tags.

This table lists the safety related STANDARD tags that are added when a new AXIS_CIP_DRIVE axis is defined.

Table 123 - Safety Related Axis Tags

| Logix Designer Tag Name | Attribute [bit] | Type | Description |
|-------------------------------------|-----------------|------|--|
| AxisFaults | 34 | DINT | |
| GuardFaultStatus | [5] | BOOL | STO fault - Hardwired |
| SafetyFaultStatus | [8] | BOOL | STO fault - Integrated |
| ModuleFaults | 163 | DINT | |
| GuardStatus | 980 | DINT | |
| GuardOKStatus | [0] | BOOL | Not STO fault - Hardwired |
| GuardGateDriveOutputStatus | [2] | BOOL | Torque allowed - Hardwired |
| GuardStopInputStatus | [3] | BOOL | Safety inputs active - Hardwired |
| GuardStopRequestStatus | [4] | BOOL | Safety input requesting STO - Hardwired |
| GuardFault | 981 | DINT | |
| GuardStopInputFault | [9] | BOOL | STO fault - Hardwired |
| GuardGateDriveFault | [2] | BOOL | Internal STO circuit fault - Hardwired |
| CIPAxisFaultsRA | 903 | DINT | |
| SafetyModuleCommunicationErrorFault | [28] | BOOL | Loss of communication to safety control |
| CIPAxisAlarmsRA | 904 | DINT | |
| SafetyModuleCommunicationErrorAlarm | [28] | BOOL | Loss of communication to safety control |
| CIPInitializationFaultsRA | 910 | DINT | |
| InvalidSafetyFirmwareFault | [14] | BOOL | Invalid safety control firmware |
| CIPStartInhibits | 676 | DINT | |
| SafeTorqueOffActiveInhibit | [5] | BOOL | Torque disabled - Integrated |
| CIPStartInhibitsRA | 912 | DINT | |
| SafeTorqueOffInhibit | [5] | BOOL | Torque disabled - Hardwired |
| AxisSafetyState | 760 | DINT | Safety supervisor state |
| AxisSafetyStatus ⁽¹⁾ | 761 | DINT | |
| SafetyFaultStatus | [0] | BOOL | Status of SI.SafetyFault |
| SafetyResetRequestStatus | [1] | BOOL | Status of SO.Reset or SO.ResetRequest |
| SafetyResetRequiredStatus | [2] | BOOL | Status of SI.ResetRequired |
| SafeTorqueOffActiveStatus | [3] | BOOL | Status of SO.SafeTorqueOff or SO.STOOutput |

Table 123 - Safety Related Axis Tags (continued)

| Logix Designer Tag Name | Attribute [bit] | Type | Description |
|----------------------------------|-----------------|------|---|
| SafeTorqueOffDisableStatus | [4] | BOOL | Status of SI.TorqueDisabled |
| SafetyOutputConnectionClosed | [30] | BOOL | 1 if all output connections are closed |
| SafetyOutputConnectionIdleStatus | [31] | BOOL | 1 if safety controller is in program mode |
| AxisSafetyFaults | 763 | DINT | |
| SafetyCoreFault | [1] | BOOL | Loss of communications to safety control |
| SafetyTorqueOffFault | [3] | BOOL | Status of SI.SafetyFault |

(1) Bits not shown are always zero.

Explicit Messages

You can use explicit messages to obtain additional diagnostic information from the safety controller by using an MSG instruction.

Safety Supervisor State

The safety supervisor state provides information on the state of the integrated safety connection and the mode of operation. There is only one safety supervisor object per drive module. Therefore, for dual-axis inverters, the safety supervisor is the same on both axes.

Table 124 - Safety Supervisor State: MSG

| Parameter | Value | Description |
|--------------|-------|----------------------|
| Service Code | 0x0E | Get attribute single |
| Class | 0x39 | Safety supervisor |
| Instance | 1 | |
| Attribute | 0x0B | Device status |
| Data Type | SINT | Short integer |

Table 125 - Safety Supervisor States

| Value | Safety Supervisor State | Definition | Safety Mode |
|-------|-----------------------------------|--|----------------------------|
| 2 | Configured (no safety connection) | No active connections | Integrated |
| 4 | Running | Normal running state | Integrated |
| 7 | Configuring | Transition state | Integrated |
| 8 | Not Configured | Hardwired STO mode with torque disabled | Hardwired (out of the box) |
| 51 | Not Configured (torque permitted) | Hardwired STO mode with torque permitted | Hardwired (out of the box) |
| 52 | Running (torque permitted) | STO bypass state | Integrated |

Safe Torque-off Mode

You can use the attribute STO Mode to check if the Kinetix 5700 inverter is in STO Bypass mode.

Table 126 - Safe Torque-off Mode: MSG

| Parameter | Value | Description |
|--------------|--------|-----------------------|
| Service Code | 0x0E | Get attribute single |
| Class | 0x5A | Safety stop functions |
| Instance | 1 or 2 | Inverter axis number |
| Attribute | 0x104 | STO mode |
| Data Type | SINT | Short integer |

Table 127 - Safe Torque-off Mode: Values

| Value | Definition |
|-------|------------------|
| 1 | Normal operation |
| 2 | STO bypass mode |

Safe Torque-off Faults

When a safety fault is indicated in any of the following tags:

- SI.SafetyFault
- Axis.SafetyFaultStatus
- Axis.SafetyTorqueOffFault

The cause of the fault can be read using an explicit message.

Table 128 - Safe Torque-off Fault Type: MSG

| Parameter | Value | Description |
|--------------|--------|-----------------------|
| Service Code | 0x0E | Get attribute single |
| Class | 0x5A | Safety stop functions |
| Instance | 1 or 2 | Inverter axis number |
| Attribute | 0x108 | STO fault type |
| Data Type | SINT | Short integer |

Table 129 - Safe Torque-off Fault Type: Values

| Value | Definition |
|-------|---------------------------------|
| 1 | No Fault |
| 3 | Circuit Error |
| 104 | Hardwired input in Network mode |

Hardwired Safe Torque-off

This section introduces you to the Kinetix 5700 hardwired safe torque-off (STO) feature that meets the requirements of Performance Level e (PL e) per ISO 13849-1 and SIL CL 3 per IEC 61508, IEC 61800-5-2 and IEC 62061.

The 2198-xxxx-ERS3 and 2198-xxxx-ERS4 inverters use the STO connector for wiring external safety devices and cascading hardwired safety connections from drive-to-drive.

Compatible Controllers

A ControlLogix® 5570, ControlLogix 5580, CompactLogix™ 5370 or CompactLogix 5380 controller is required for drive control.

The Studio 5000 Logix Designer® application provides support for programming, commissioning, and maintaining these CompactLogix and ControlLogix controllers with Kinetix 5700 drive systems.

Table 130 - Studio 5000 Logix Designer Requirements

| Studio 5000 Logix Designer Application | Kinetix Dual-axis Inverters Cat. No. | Kinetix Single-axis Inverters Cat. No. |
|--|---|---|
| Version 26 or later | 2198-Dxxx-ERS3 (series A) | 2198-Sxxx-ERS3 (series A) |
| Version 31 or later | 2198-Dxxx-ERS4 2198-Dxxx-ERS3 (series B) | 2198-Sxxx-ERS4 2198-Sxxx-ERS3 (series B) |

Description of Operation

The safe torque-off feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When disabled, or any time power is removed from the safety enable inputs, all of the drive output-power transistors are released from the ON-state. This results in a condition where the drive performs a Category 0 Stop (refer to [Stop Category Definition](#) on [page 244](#)). Disabling the power transistor output does not provide physical isolation of the electrical output that is required for some applications.

For hardwired control of the safe torque-off (STO) function:

- The STO function needs to be in Hardwired STO mode
- The appropriate wiring must be connected to the Safety (STO) connector plug

Refer to [Hardwired Safe Torque-off Electrical Specifications](#) on [page 261](#) for more information on the safety inputs.

Under normal operation, the safe torque-off inputs are energized. If either of the safety enable inputs are de-energized, then all of the output power transistors turn off. The safe torque-off reaction time is less than 12 ms.

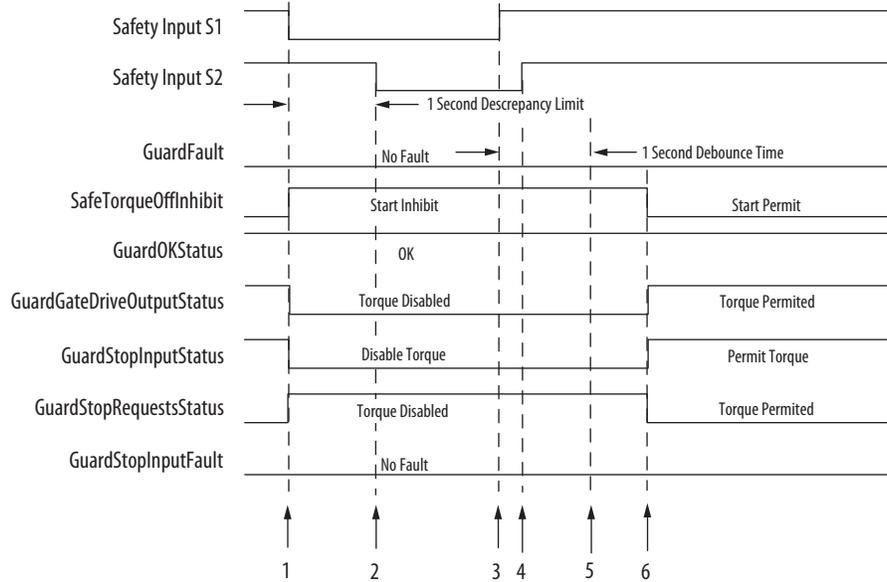


ATTENTION: Permanent magnet motors can, in the event of two simultaneous faults in the IGBT circuit, result in a rotation of up to 180 electrical degrees.



ATTENTION: If any of the safety enable inputs de-energize, the Start Inhibit field indicates the SafeTorqueOffInhibit and GuardStopRequestStatus bits of the AxisGuardStatus tag are set to 1. Both inputs must be de-energized within 1 second and re-energized within 1 second to avoid GuardStopInputFault conditions.

Figure 106 - System Operation when Inputs are Meeting Timing Requirements



| Event | Description |
|-------|--|
| 1 | At least one input is switched-off. The GuardStopRequestStatus bit is set to 1. |
| 2 | Second input is switched-off within 1 second. This event must always occur within 1 second to prevent a GuardStopInputFault condition. |
| 3 | First input is switched-on. |
| 4 | Second input is switched-on within 1 second of event 3. |
| 5 | Both inputs are in the ON state simultaneously within 1 second. As a result, GuardStopInputFault is not posted. |
| 6 | The GuardStopRequestStatus bit sets back to 0 if event 4 occurs within a 100 ms interval after event 3. If event 4 is outside of the 100 ms interval, but within the a 1 second interval after event 3, then the GuardStop RequestStatus bit sets back to 0 after the 1 second interval following event 3 (not immediately following event 4). |

Troubleshoot the Safe Torque-off Function

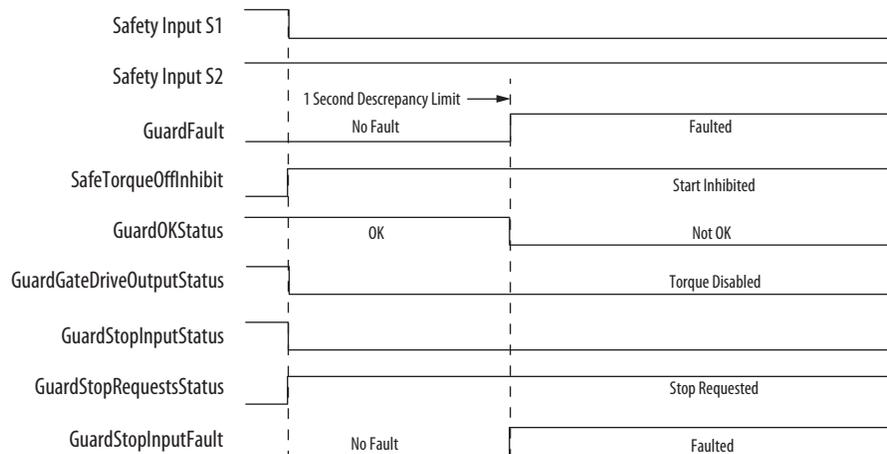
Table 131 - Kinetix 5700 Hardwired STO Troubleshooting

| Exception Code on Drive Display | Fault Message Logix Designer | Problem | Possible Solutions |
|--------------------------------------|------------------------------------|---|---|
| SAFE FLT 09 - SS IN | GuardStopInputFault | Safe torque-off function mismatch. System does not allow motion. Safe torque-off mismatch is detected when safety inputs are in a different state for more than 1.0 second. | <ul style="list-style-type: none"> Verify safety wiring and connections: <ul style="list-style-type: none"> Wire terminations at safe torque-off (STO) connector Cable/header not seated correctly +24V power Check state of safety inputs. Reset error and run proof test. If error persists, return the drive to Rockwell Automation. |
| SAFE FLT S01- Safety Core Internal | SafetyCoreFault | Drive safety diagnostic detected internal STO design failure. | <ul style="list-style-type: none"> Cycle control power Return drive for repair if fault continues |
| SAFE FLT S03 - Gate Drive | GuardGateDriveFault ⁽¹⁾ | Drive safety diagnostic detected internal STO design failure. | <ul style="list-style-type: none"> Cycle control power Execute STO function Return drive for repair if fault continues |
| SAFE FLT S03 - Safe Torque Off Fault | SafeTorqueOffFault ⁽¹⁾ | Hardwired input received while in integrated safety mode. | Reset the drive to the out-of-box safety state (Hardwired STO mode). See page 247 for more information. |

(1) Displayed in the Quick View Pane as Safety Fault.

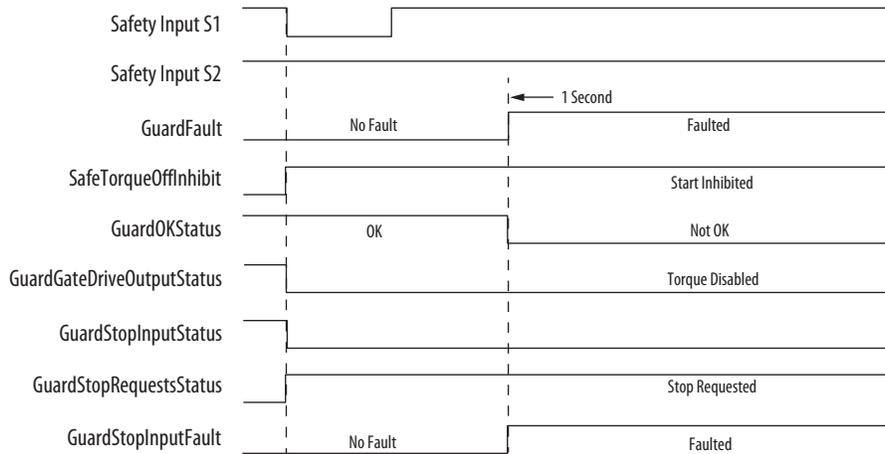
Figure 107 illustrates when the safe torque-off mismatch is detected and GuardStopInputFault is posted.

Figure 107 - System Operation when Safety Enable Inputs Mismatch Occurs



When one safety input is turned off, the second input must also be turned off, otherwise a fault is asserted (see Figure 108). The fault is asserted even if the first safety input is turned on again, without the second input transitioning to the ON state.

Figure 108 - System Operation when Safety Enable Inputs Mismatch Momentarily



ATTENTION: The safe torque-off fault is detected upon demand of the safe torque-off function. After troubleshooting the STO function or performing maintenance that might affect the STO function, the STO function must be executed to verify correct operation.

IMPORTANT The GuardStopInputFault can be reset only if both inputs are in the OFF-state for more than 1 second. After the fault reset requirement is satisfied, an MAFR command in the Logix Designer application must be issued to reset the GuardStopInputFault.

Safe Torque-off Connector Data

Two rows of eight pins are provided for making drive-to-drive connections. The dual-axis inverters have pins designated for axis A and axis B. The single-axis inverters do not use STO-6, -7, -8 and STO-14, -15, -16.

Figure 109 - Pin Orientation for 16-pin Safe Torque-off (STO) Connector

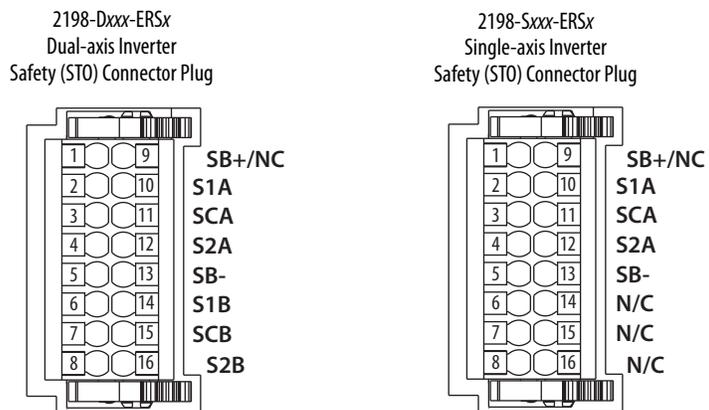


Table 132 - Safe Torque-off Connector Pinouts

| STO Pin | Description 2198-Dxxx-ERSx | Description 2198-Sxxx-ERSx | Signal |
|---------|---|---|--------|
| 1 | Safety bypass plus signal. Connect to both safety inputs to disable safe torque-off function. | | SB+ |
| 2 | 10 | Safe stop input channel 1, axis A. | S1A |
| 3 | 11 | Safe stop input common, axis A. | SCA |
| 4 | 12 | Safe stop input channel 2, axis A. | S2A |
| 5 | 13 | Safety bypass minus signal. Connect to safety common to disable safe torque-off function. | SB- |
| 6 | 14 | Safe stop input channel 1, axis B. | S1B |
| 7 | 15 | Safe stop input common, axis B. | SCB |
| 8 | 16 | Safe stop input channel 2, axis B. | S2B |
| 9 | N/C | N/C | - |

IMPORTANT STO-3 and STO-7 is common for the digital inputs, the safety inputs, and the encoder power supply (optional).

Wire the Safe Torque-off Circuit

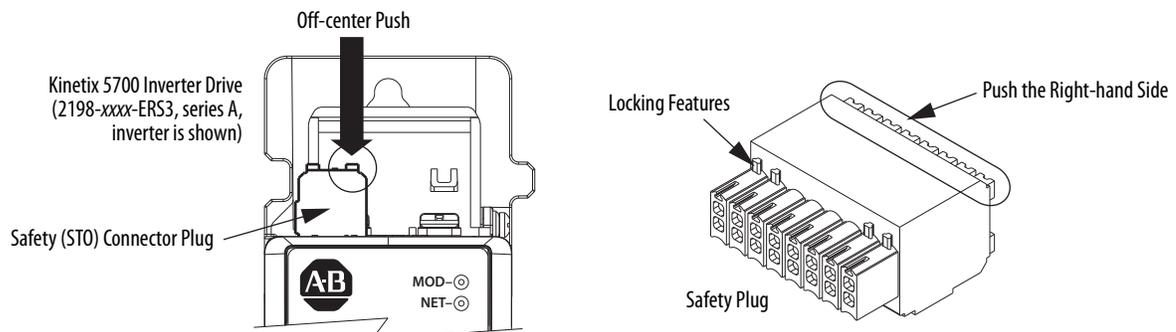
This section provides guidelines for wiring safe torque-off connections to your Kinetix 5700 drive.

Install 2198-xxx-ERS3 (series A) Safety (STO) Connector Plugs

The right side of the safety connector plug requires an off-center push when inserting it into the STO connector. This applies to 2198-xxx-ERS3 (series A) single-axis and dual-axis inverters.

IMPORTANT An off-center push is required to engage the locking features on the bottom of the safety connector plugs and seat properly with the drive STO connector. Failure to do this can result in the connector plug pulling out of the drive connector during normal operation.

Figure 110 - Insert the 2198-xxx-ERS3 (series A) Safety Connector Plug

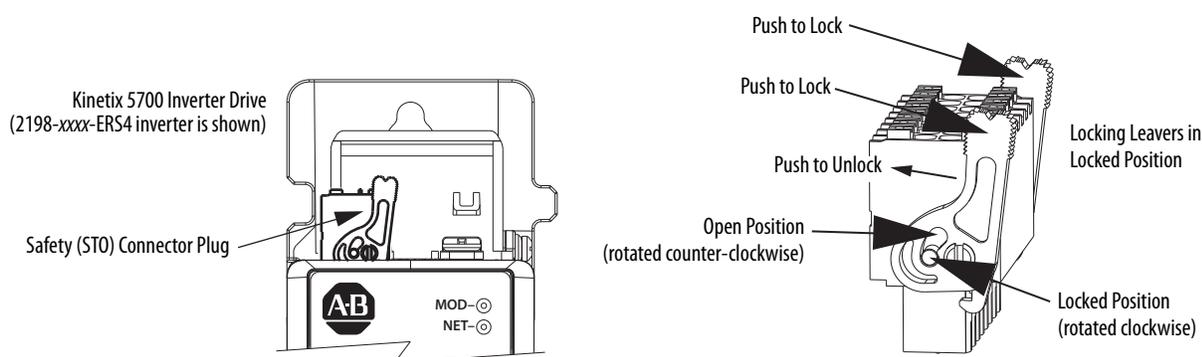


Install 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) Safety Connector Plugs

The safety connector plugs have two locking levers that you push in a clockwise direction as you insert the plugs into the drive connector. This is the locked position. Rotate the levers counter-clockwise to the open position to release the connector plugs. This applies to 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) single-axis and dual-axis inverters.

IMPORTANT Push the locking levers clockwise into the locked position as you insert the STO connector plugs. Failure to do this can result in the connector plugs pulling out of the drive connector during normal operation.

Figure 111 - Insert the 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) Safety Connector Plugs



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

IMPORTANT To improve system performance, run wires and cables in the wireways as established in [Establishing Noise Zones](#) beginning on [page 43](#).

IMPORTANT Pins STO-1 and STO-5 (SB+ and SB-) are used to disable the safe torque-off function. When wiring to the STO connector, use an external 24V supply for the external safety device that triggers the safe torque-off request. To avoid jeopardizing system performance, do not use pin STO-1 as a power supply for the external safety device.

Safe Torque-off Wiring Requirements

The safe torque-off (STO) connector uses spring tension to secure the wire. Depress the numbered tab along side each pin to insert or release each wire. Two rows of pins are provided for drive-to-drive connections. Wire must be copper with 75 °C (167 °F) minimum rating.

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

IMPORTANT Stranded wires must terminate with ferrules to prevent short circuits, per table D7 of ISO 13849.

Figure 112 - Safe Torque-off (STO) Terminal Plug

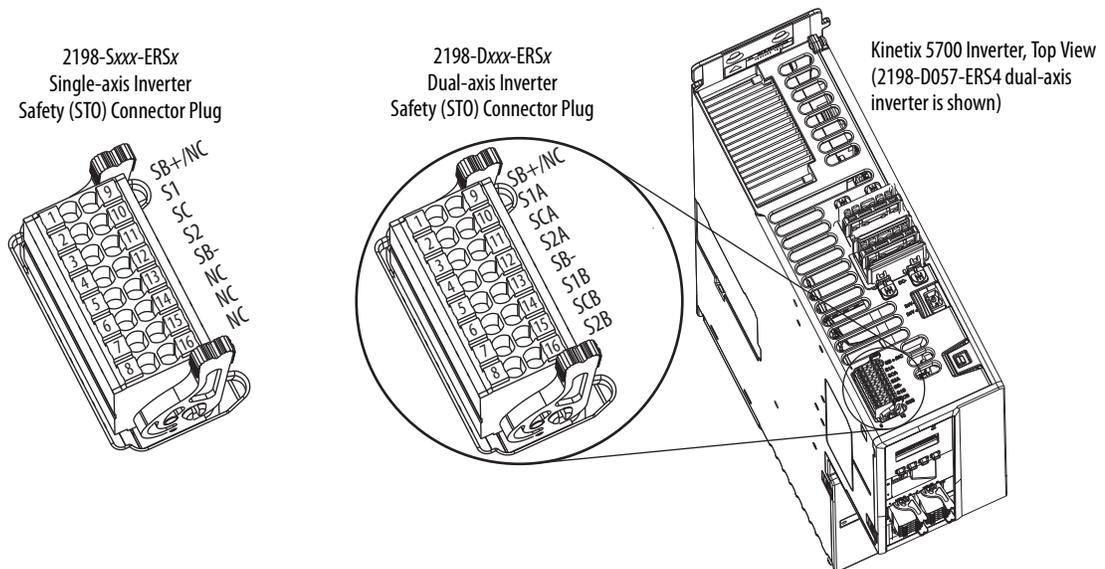


Table 133 - Safe Torque-off (STO) Connector Plug Wiring

| Safe Torque-off (STO) Connector | Signal | | Recommended Wire Size mm ² (AWG) | Strip Length mm (in.) | Torque Value N·m (lb·in) |
|---------------------------------|----------------|----------------|--|--------------------------|-----------------------------|
| | 2198-Dxxx-ERSx | 2198-Sxxx-ERSx | | | |
| STO Pin | | | | | |
| 1 | SB+ | SB+ | 0.14...1.5 (26...16) | 10 (0.39) | N/A ⁽¹⁾ |
| 2 | 10 | S1A | | | |
| 3 | 11 | SCA | | | |
| 4 | 12 | S2A | | | |
| 5 | 13 | SB- | | | |
| 6 | 14 | S1B | | | |
| 7 | 15 | SCB | | | |
| 8 | 16 | S2B | | | |
| 9 | NC | NC | | | |

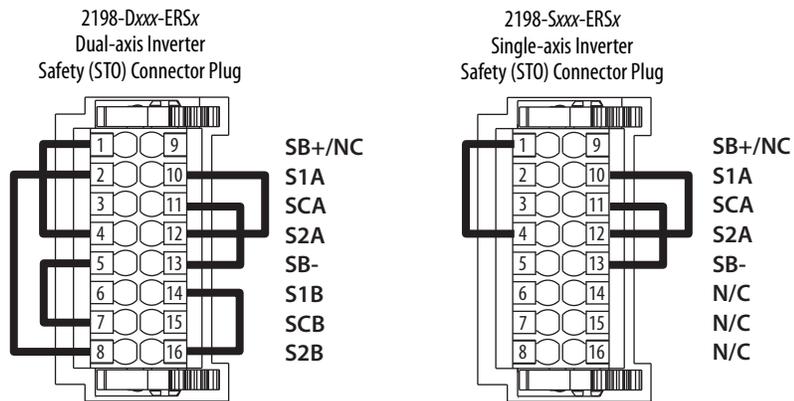
(1) This connector uses spring tension to hold wires in place.

Safe Torque-off Feature Bypass

The Kinetix 5700 inverters do not operate without a safety circuit or safety bypass wiring. For applications that do not require the safe torque-off feature you must install jumper wires to bypass the safe torque-off circuitry.

Kinetix 5700 inverters ship with a 16-pin wiring plug for wiring to safety devices. To bypass the safety function, wire these signals as shown in [Figure 113](#). With the jumper wires installed, the safe-off feature is not used.

Figure 113 - Safe Torque-off Bypass Wiring



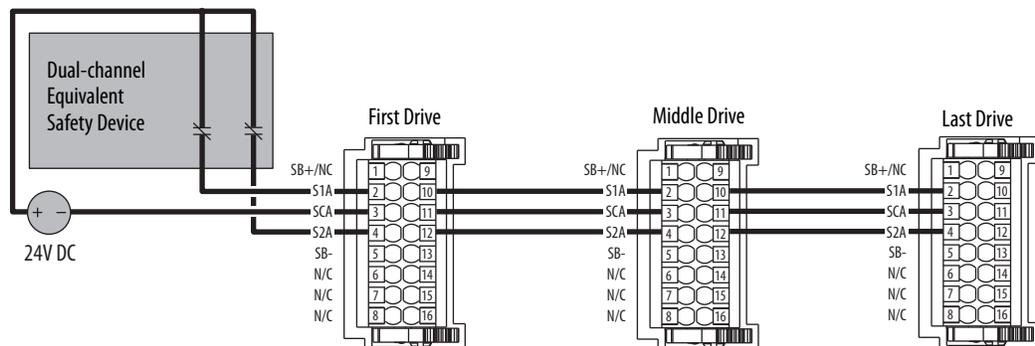
IMPORTANT If the safe torque-off function is not required, the drive safety configuration must be returned to Hardwired STO mode and the bypass jumper wires applied to the safety (STO) connector plugs.

Cascade the Safe Torque-off Signal

The total number of drives in a single cascaded safety circuit is limited by the current carrying capacity of the cascaded safety wiring. Refer to [Table 134](#) for current rating per channel, per drive.

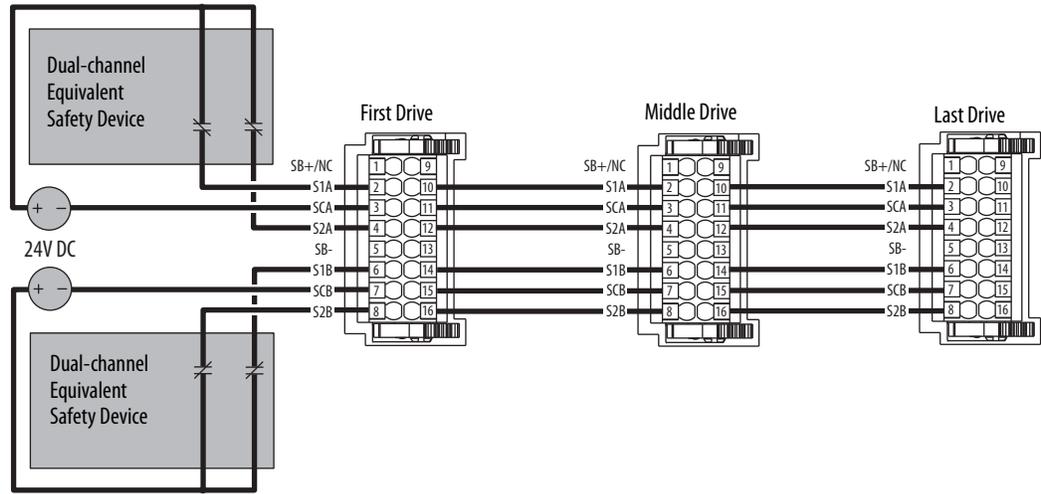
In this example, the cascaded safe torque-off (STO) wiring is for one single-axis inverter application.

Figure 114 - Cascaded STO Wiring - Single-axis Inverter



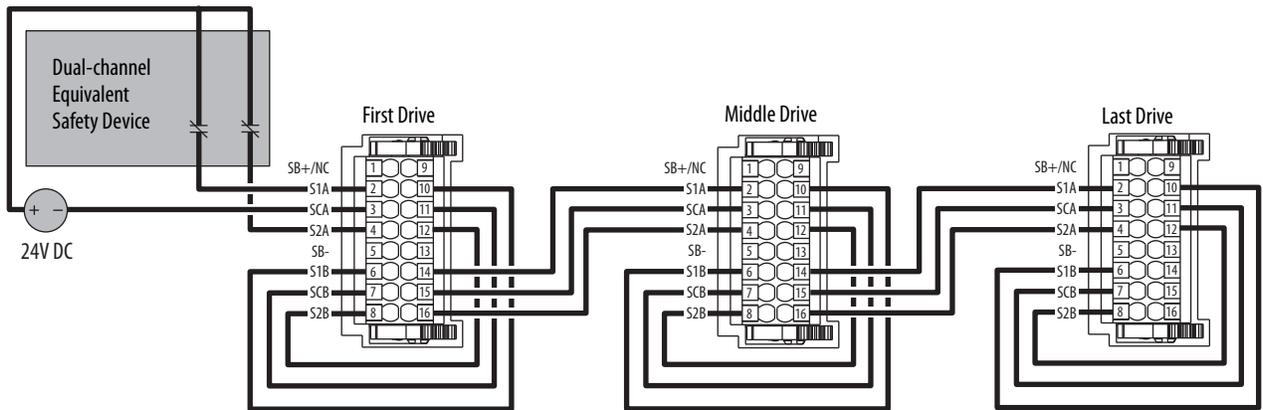
In this example, the cascaded safe torque-off (STO) wiring is for one dual-axis inverter application with a separate safety device for each axis.

Figure 115 - Cascaded STO Wiring - Dual-axis Inverter with Two Safety Devices



In this example, the cascaded STO wiring is for one dual-axis inverter application with a single safety device for both axes.

Figure 116 - Cascaded STO Wiring - Dual-axis Inverter with Single Safety Device



Hardwired Safe Torque-off Electrical Specifications

IMPORTANT To maintain their safety rating, Kinetix 5700 inverters must be installed inside protected control panels or cabinets appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet must be IP54 or higher.

Table 134 - Hardwired STO Electrical Specifications

| Attribute | Value | |
|--------------------------------|--|--|
| Safety inputs (per channel) | Input current | < 10 mA |
| | Input ON voltage range | 18...26.4V DC |
| | Input OFF voltage, max | 5V DC |
| | Input ON current, per input, max | 10 mA, each drive ⁽²⁾ |
| | Input OFF current, max (@ V in < 5V DC) | 2 mA |
| | Pulse rejection width | 700 μs |
| | External power supply ⁽¹⁾ | SELV/PELV |
| | Input type | Optically isolated and reverse voltage protected |

(1) SELV or PELV rated power supplies must be used to energize external safety devices connected to the Kinetix 5700 safety inputs.

(2) The maximum number of drives cascaded with safe torque-off wiring is 50.

For additional information regarding Allen-Bradley® safety products, including safety relays, light curtain, and gate interlock applications, refer to the Safety Products Catalog, website <http://www.rockwellautomation.com/global/catalogs/overview.page>.

Integrated Safe Torque-off

This section introduces you to the Kinetix 5700 safe torque-off (STO) feature over the EtherNet/IP network that meets the requirements of Performance Level e (PL e) per ISO 13849-1 and SIL 3 per IEC 61508, IEC 61800-5-2, and IEC 62061. Integrated STO applies to 2198-xxxx-ERS3 and 2198-xxxx-ERS4 dual-axis and single-axis inverters.

In Integrated STO mode, the GuardLogix® safety controller issues the STO command over the EtherNet/IP network and the 2198-xxxx-ERS3 and 2198-xxxx-ERS4 dual-axis and single-axis inverters execute the STO command.

Compatible Safety Controllers

A GuardLogix 5570 or Compact GuardLogix 5370 safety controller is required for integrated safety control of the Kinetix 5700 safe torque-off function.

The Studio 5000 Logix Designer application, version 26.00 or later, provides support for programming, commissioning, and maintaining Logix 5000™ safety controllers with Kinetix 5700 drive systems.

The safety connection can originate from either of these controller configurations:

- Single safety controller that provides both safety and motion control
- Safety controller that controls only the safety, while a separate ControlLogix 5570, ControlLogix 5580, CompactLogix 5370, or CompactLogix 5380 controller that controls motion

Table 135 - Studio 5000 Logix Designer Requirements

| Studio 5000 Logix Designer Application | Kinetix Dual-axis Inverters Cat. No. | Kinetix Single-axis Inverters Cat. No. |
|--|--|---|
| Version 26 or later | 2198-Dxxx-ERS3 (series A) | 2198-Sxxx-ERS3 (series A) |
| Version 31 or later | 2198-Dxxx-ERS4 2198-Dxxx-ERS3 (series B) ⁽¹⁾ | 2198-Sxxx-ERS4 2198-Sxxx-ERS3 (series B) |

(1) When 2198-xxxx-ERS3 (series B) drives are used in Timed SS1 safety applications, Studio 5000 Logix Designer application, version 31, must be used.

Safety Application Requirements

Safety application requirements include evaluating probability of failure rates (PFH), system reaction time settings, and functional verification tests that fulfill SIL 3 criteria. Refer to [Average Frequency of a Dangerous Failure](#) on [page 245](#) for more PFH information.

Creating, recording, and verifying the safety signature is also a required part of the safety application development process. Safety signatures are created by the safety controller. The safety signature consists of an identification number, date, and time that uniquely identifies the safety portion of a project. This includes all safety logic, data, and safety I/O configuration.

For safety system requirements, including information on the safety network number (SNN), verifying the safety signature, and functional verification tests refer to the appropriate GuardLogix controller publication as defined in [Additional Resources](#) on [page 12](#).

IMPORTANT You must read, understand, and fulfill the requirements detailed in the GuardLogix controller systems safety reference manual prior to operating a safety system that uses a GuardLogix controller and Kinetix 5700 drive.

Description of Operation

The safe torque-off (STO) feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When the command to execute the STO function is received from the GuardLogix controller, all of the drive output-power transistors are released from the ON-state. This results in a condition where the motor is coasting. Disabling the power transistor output does not provide isolation of the electrical output that is required for some applications.

These conditions must be met for integrated control of the STO function:

- The Kinetix 5700 drive module must be added to the GuardLogix 5570 or Compact GuardLogix 5370 controller I/O Configuration.
- The module must be configured for Safety Only or Motion and Safety connections
- The safety bypass jumper wires must be removed.

IMPORTANT If the STO bypass jumper wires were applied during machine commissioning or maintenance, they must be removed before the drive will operate in Integrated STO mode.

The Kinetix 5700 drive STO function reaction time is less than 10 ms. Reaction time for the drive is the delay between the time the drive STO command receives the CIP Safety™ packet with an STO request and the time when motion producing power is removed from the motor.

Table 136 - Safe Torque-off Network Specifications

| Attribute | 2198-xxxx-ERS3 | 2198-xxxx-ERS4 |
|--|----------------------------|----------------|
| STO function reaction time | 10 ms, max | |
| Safety connection RPI, min | 6 ms | |
| Input assembly connections ⁽¹⁾ | 3 | 1 |
| Output assembly connections ⁽¹⁾ | 1 | |
| Integrated safety open request support | Type 1 and Type 2 requests | |

(1) Motion and Safety and Safety Only connections with the inverter uses 1 input assembly connection and 1 output assembly connection.

Safe Torque-off Assembly Tags

In Integrated safe torque-off (STO) mode, a GuardLogix 5570 or Compact GuardLogix 5370 safety controller commands the Kinetix 5700 safe torque-off function through the appropriate tag in the safety output assembly.

IMPORTANT The tag names listed in [Table 137](#) changed in the Logix Designer application, version 31 and later, depending on how Motion Safety is configured in the Module Definition.

Table 137 - STO Tag Name Changes in the Logix Designer Application

| STO Tag Names Studio 5000 Logix Designer (version 30 and earlier) | STO Only Tag Names Studio 5000 Logix Designer (version 31 and later) | Safe Stop Only - No Feedback Tag Names Studio 5000 Logix Designer (version 31 and later) |
|---|--|--|
| SO.SafeTorqueOff | SO.SafeTorqueOff | SO.STOOutput |
| SO.Reset | SO.Reset | SO.ResetRequest |

The SO.Command tags are sent from the GuardLogix safety output assembly to the Kinetix 5700 safety output assembly to control the safe torque-off function.

The SI.Status tags are sent from the Kinetix 5700 inverter to the GuardLogix safety input assembly and indicate the Kinetix 5700 safety control status.

The SI.ConnectionStatus tags indicate the safety input connection status.

[Table 138](#) and [Table 139](#) list the safety tags added to the controller tags when a Kinetix 5700 servo drive is added to a GuardLogix I/O Configuration and the connection is configured for Motion and Safety or Safety Only.

IMPORTANT The SO.SafeTorqueOff and SO.ResetRequest tag names change when Motion Safety in the Module Definition is configured as Safe Stop Only - No Feedback.

The attribute values listed are the Assembly Object attribute values.

Table 138 - Single-axis Inverter Integrated STO Specifications

| Logix Designer Tag Name | Safe Stop Only - No Feedback Tag Names Studio 5000 Logix Designer (version 31 and later) | Attribute [bit] | Type | Description |
|--|--|--------------------|------|--|
| SI.ConnectionStatus ^{(1) (2)} | | | DINT | |
| SI.RunMode | | [0] | BOOL | Combinations of the RunMode and ConnectionFaulted states |
| SI.ConnectionFault | | [1] | BOOL | |
| SI.Status ^{(1) (3)} | | | SINT | |
| SI.TorqueDisabled | | [0] | BOOL | 0 = Torque Permitted 1 = Torque Disabled |
| SI.SafetyFault | | [6] | BOOL | 1 = STO fault present |
| SI.ResetRequired | | [7] | BOOL | 1 = Reset is required |
| SO.Command ^{(1) (4)} | | | SINT | |
| SO.SafeTorqueOff | SO.STOOutput | [0] | BOOL | 0 = Disable Permit 1 = Permit Torque |
| SO.Reset | SO.ResetRequest | [7] | BOOL | 0 --> 1 = Reset STO fault |

- (1) Bits not listed are always zero.
- (2) ConnectionStatus is determined by the Safety Validator in the GuardLogix controller.
- (3) Status is sent from the drive to the controller using integrated safety protocol.
- (4) Commands are sent from the controller to the drive using integrated safety protocol.

IMPORTANT Only the data listed in [Table 138](#) is communicated with SIL 3 integrity.

Table 139 - Dual-axis Inverter Integrated STO Specifications

| Logix Designer Tag Name | Safe Stop Only - No Feedback Tag Names Studio 5000 Logix Designer (version 31 and later) | Attribute [bit] | Type | Description |
|--|--|-----------------|------|---|
| SI.ConnectionStatus ^{(1) (2)} | | | DINT | |
| SI.RunMode | | [0] | BOOL | Combinations of the RunMode and |
| SI.ConnectionFaulted | | [1] | BOOL | ConnectionFaulted states |
| SI.Status1 ^{(1) (3)} | | | SINT | Motion Safety 1 |
| SI.TorqueDisabled1 | | [0] | BOOL | 0 = Torque Permitted; 1 = Torque Disabled |
| SI.SafetyFault1 | | [6] | BOOL | 1 = STO Fault present |
| SI.ResetRequired1 | | [7] | BOOL | 1 = A reset is required |
| SI.Status2 ^{(1) (3)} | | | SINT | Motion Safety 2 |
| SI.TorqueDisabled2 | | [0] | BOOL | 0 = Torque Permitted; 1 = Torque Disabled |
| SI.SafetyFault2 | | [6] | BOOL | 1 = STO Fault present |
| SI.ResetRequired2 | | [7] | BOOL | 1 = A reset is required |
| SO.Command1 ^{(1) (4)} | | | SINT | Motion Safety 1 |
| SO.SafeTorqueOff1 | SO.STOOutput1 | [0] | BOOL | 0 = Disable Permit; 1 = Permit Torque |
| SO.Reset1 | SO.ResetRequest1 | [7] | BOOL | 0->1 = Reset STO Fault |
| SO.Command2 ^{(1) (4)} | | | SINT | Motion Safety 2 |
| SO.SafeTorqueOff2 | SO.STOOutput2 | [0] | BOOL | 0 = Disable Permit; 1 = Permit Torque |
| SO.Reset2 | SO.ResetRequest2 | [7] | BOOL | 0->1 = Reset STO Fault |

- (1) Bits not listed are always zero.
- (2) ConnectionStatus is determined by the Safety Validator in the GuardLogix controller.
- (3) Status is sent from the drive to the controller using integrated safety protocol.
- (4) The Command is sent from the controller to the drive using integrated safety protocol.

IMPORTANT Only the data listed in [Table 139](#) is communicated with SIL 3 integrity.

In these examples, the appropriate STO bit permits torque when the bit is high (see [Table 137](#) on [page 264](#) for changes in STO tag names).

Figure 117 - STO Function (Logix Designer, version 30 or earlier)

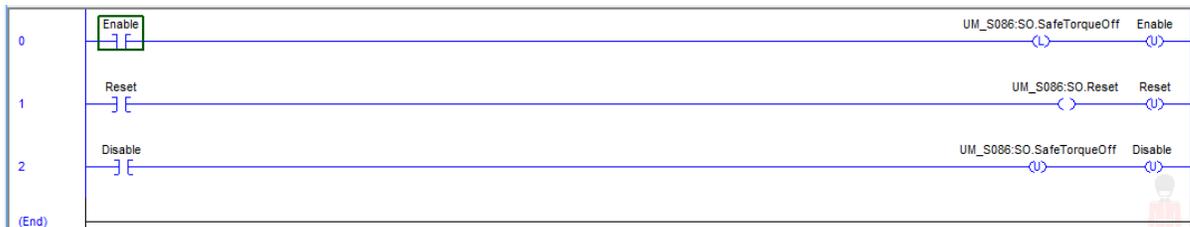


Figure 118 - STO Function with STO Only (Logix Designer, version 31 or later)

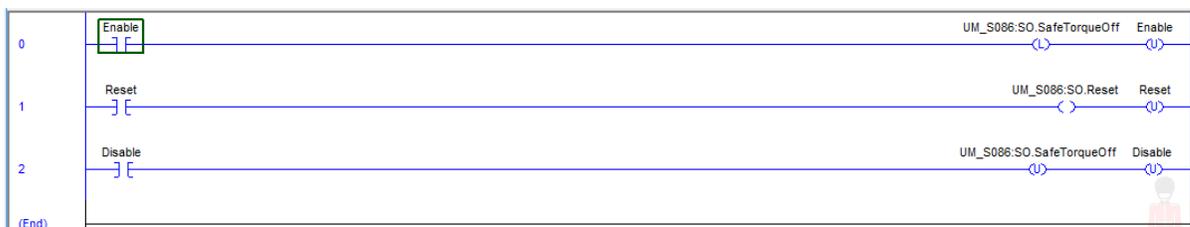
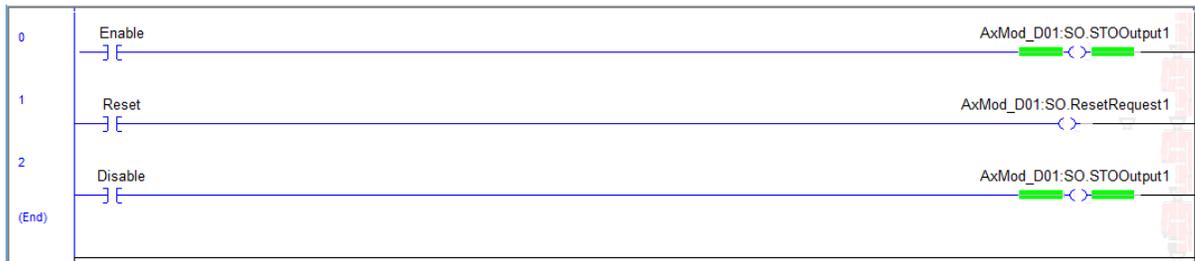


Figure 119 - STO Function with Safe Stop Only-No Feedback (Logix Designer, version 31 or later)



STO Fault Reset

To clear the STO Fault condition, a transition from logic 0 to 1 of the SO.Reset tag is required after the SO.SafeTorqueOff tag has transitioned from logic 0 to 1 (see [Table 137](#) on [page 264](#) for changes in STO tag names).

If the Kinetix 5700 servo drive safety controller detects a fault, the input assembly tag SI.SafetyFault is set to 1.

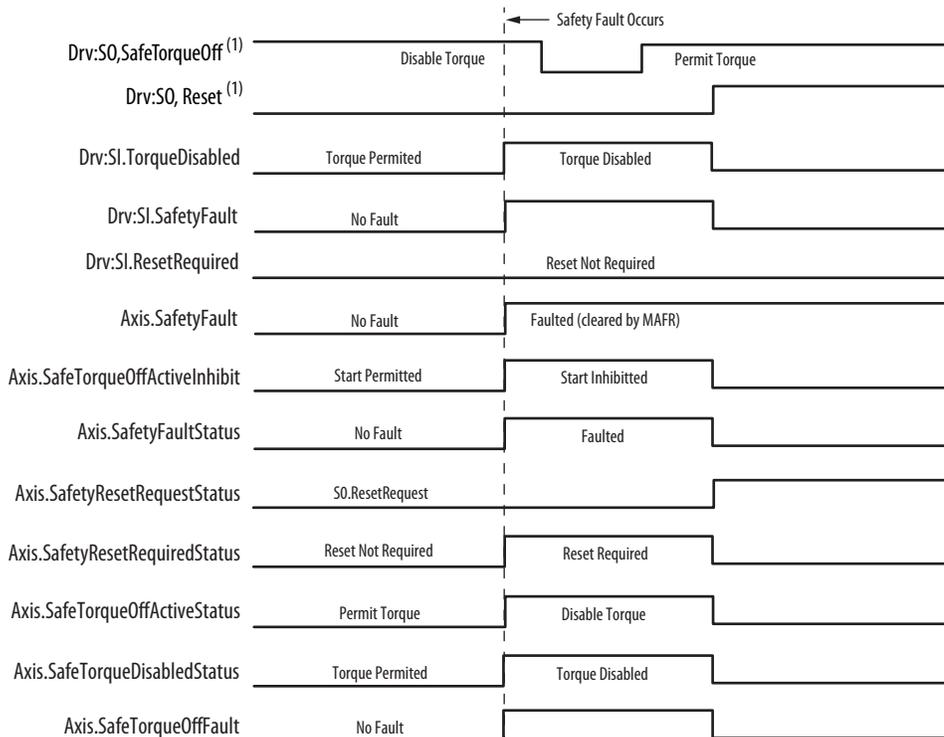
To reset Axis.SafetyFault, an MAFR command must be issued.

IMPORTANT Transition of the SO.SafeTorqueOff tag to logic 1 must always be executed prior to transition of the SO.Reset tag to logic 1.

IMPORTANT All Kinetix 5700 inverter axes enter the faulted state if any STO function fault is detected. Refer to [Table 140](#) on [page 267](#) for integrated safety troubleshooting.

Refer to [Figure 120](#) for an understanding of the Kinetix 5700 STO state restart functionality.

Figure 120 - Reset Safe Torque-off Fault Diagram



(1) See [Table 137](#) on [page 264](#) for STO tag name changes.

Troubleshoot the Safe Torque-off Function

Table 140 - Kinetix 5700 Integrated STO Fault Codes

| Exception Code on Drive Display | Fault Message Logix Designer | Problem | Possible Solutions |
|---|---|---|--|
| SAFE FLT S01 - Safety Core Internal Fault | SafetyFault | Drive safety diagnostic detected internal STO design failure. | <ul style="list-style-type: none"> • Cycle control power • Return drive for repair if fault continues |
| SAFE FLT S03 - Safe Torque Off Fault | SafeTorqueOffFault ⁽¹⁾ | Drive safety diagnostic detected internal STO design failure or hardwired input received while in integrated safety mode. | <ul style="list-style-type: none"> • Check the cause of the fault using a Safe Torque-off faults explicit message. Refer to Explicit Messages on page 250. • Remove any connection to the hardwired safety inputs and reset using the STO Fault Reset procedure. Refer to STO Fault Reset on page 266. • Execute STO function. • Return drive for repair if fault continues. |
| INIT FLT M14 - Safety Firmware | InvalidSafetyFirmwareFault ⁽²⁾ | Invalid safety firmware. | <ul style="list-style-type: none"> • Cycle control power. • Upgrade the drive firmware. • Call Technical Support. • Return drive for repair if fault continues. |

(1) Displayed in the Quick View Pane as Safety Fault.

(2) Displayed in the Quick View Pane as Initialization Fault.

Understand Integrated Safety Drive Replacement

GuardLogix controllers retain I/O device configuration on-board and are able to download the configuration to the replacement device.

IMPORTANT If the Kinetix 5700 replacement drive was used previously, clear the existing configuration before installing it on a safety network by resetting the drive to Hardwired STO mode. To see how this is done, refer to [Restore the Hardwired STO Mode by Using the Logix Designer Application](#) on page 247.

Replacing a Kinetix 5700 servo drive that sits on an integrated safety network is more complicated than replacing standard devices because of the safety network number (SNN). The device number and SNN make up the safety device's DeviceID. Safety devices require this more complex identifier to make sure that duplicate device numbers do not compromise communication between the correct safety devices. The SNN is also used to provide integrity on the initial download to the Kinetix 5700 servo drive.

When the Logix Designer application is online, the Safety category of the Module Properties dialog box displays the current configuration ownership. When the opened project owns the configuration, Local is displayed.



Configuration Ownership: Local

A communication error is displayed if the module read fails. Refer to [Replace an Integrated Safety Drive in a GuardLogix System](#) on page 269 for integrated safety drive replacement information.

Replace an Integrated Safety Drive in a GuardLogix System

When you replace an integrated safety drive, the replacement device must be configured properly and the replacement drives operation be user-verified.

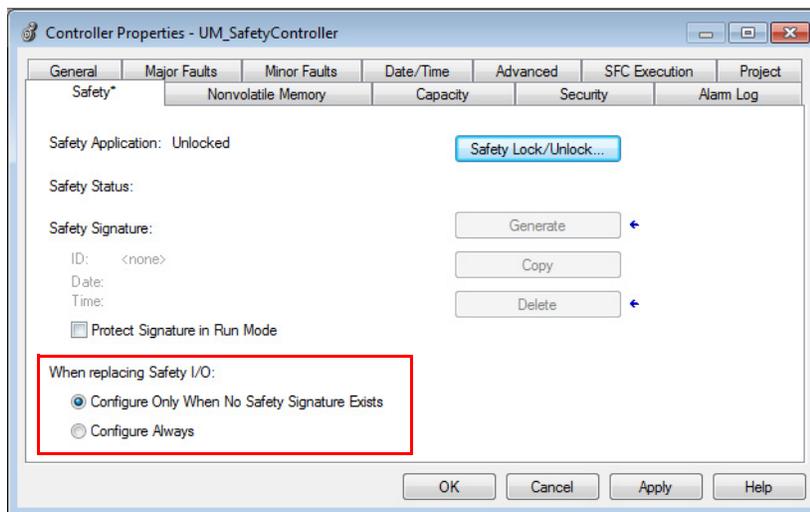


ATTENTION: During drive replacement or functional test, the safety of the system must not rely on any portion of the affected drive.

Two options for safety drive replacement are available on the Safety category of the Controller Properties dialog box in the Logix Designer application:

- Configure Only When No Safety Signature Exists
- Configure Always

Figure 121 - Safety Drive Replacement Options



Configure Only When No Safety Signature Exists

This setting instructs the GuardLogix controller to automatically configure a safety drive only when the safety task does not have a safety task signature, and the replacement drive is in an out-of-box condition, meaning that a safety network number does not exist in the safety drive.

If the safety task has a safety task signature, the GuardLogix controller automatically configures the replacement CIP Safety I/O device only if the following is true:

- The device already has the correct safety network number.
- The device electronic keying is correct.
- The node or IP address is correct.

For detailed information, refer to [Additional Resources](#) on [page 12](#) for the appropriate user manual for your GuardLogix or Compact GuardLogix controller.

Configure Always

When the Configure Always feature is enabled, the controller automatically checks for and connects to a replacement drive that meets all of the following requirements:

- The controller has configuration data for a compatible drive at that network address
- The drive is in Hardwired STO mode or has an SNN that matches the configuration



ATTENTION: Enable the Configure Always feature only if the entire integrated safety control system is not being relied on to maintain SIL 3 behavior during the replacement and functional testing of a Kinetix 5700 drive. Do not place drives that are in Hardwired STO mode on an integrated safety network when the Configure Always feature is enabled.

If other parts of the integrated safety control system are being relied upon to maintain SIL 3, make sure that the controller's Configure Always feature is disabled.

It is your responsibility to implement a process to make sure proper safety functionality is maintained during device replacement.



ATTENTION: Do not place any devices in the out-of-box condition on any integrated safety network when the Configure Always feature is enabled. For the device replacement procedure, refer to [Additional Resources](#) on [page 12](#) for the appropriate user manual for your GuardLogix or Compact GuardLogix controller.

Motion Direct Commands in Motion Control Systems

You can use the Motion Direct Command (MDC) feature to initiate motion while the controller is in Program mode, independent of application code that is executed in Run mode. These commands let you perform a variety of functions, for example, move an axis, jog an axis, or home an axis.

A typical use might involve a machine integrator testing different parts of the motion system while the machine is being commissioned or a maintenance engineer, under certain restricted scenarios in accordance with safe machine operating procedures, wanting to move an axis (like a conveyor) to clear a jam before resuming normal operation.



ATTENTION: To avoid personal injury or damage to equipment, follow these rules regarding Run mode and Program mode.

- Only authorized, trained personnel with knowledge of safe machine operation should be allowed to use Motion Direct Commands
 - Additional supervisory methods, like removing the controller key switch, should be used to maintain the safety integrity of the system after returning the safety controller to RUN mode
-

Understand STO Bypass When Using Motion Direct Commands

If a Safety-only connection between the GuardLogix safety controller and the Kinetix 5700 servo drive was established at least once after the drive was received from the factory, the drive does not allow motion while the safety controller is in Program mode by default.

This is because the safety task is not executed while the GuardLogix safety controller is in Program mode. This applies to applications running in a single-safety controller (with Motion and Safety connections). When an integrated safety drive has a Motion connection to a standard controller and a separate Safety connection to a safety controller, the standard controller can transition to Program mode while the safety controller stays in Run mode and continues to execute the safety task.

However, Kinetix 5700 drive systems are designed with a bypass feature for the STO function in single-safety controller configurations. You can use the MDC feature to allow motion while following all the necessary and prescribed steps per your machine's safety operating procedures.



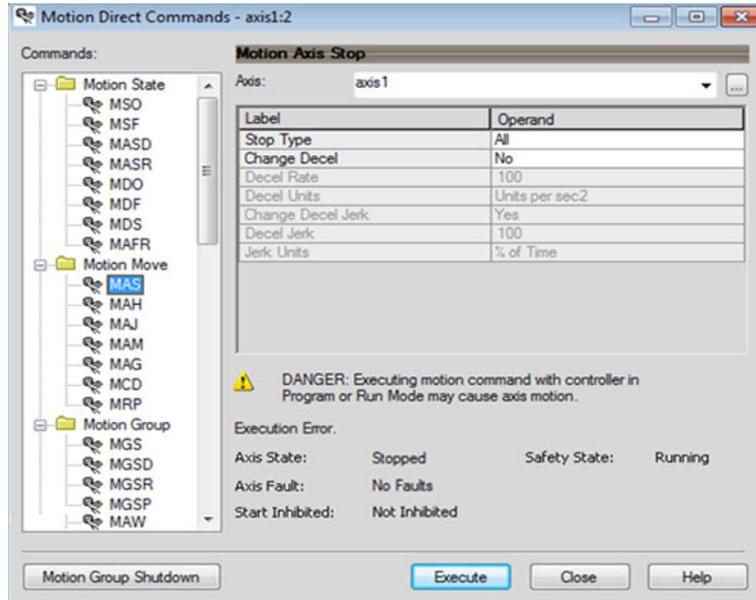
ATTENTION: Consider the consequences of allowing motion through the use of MDC when the controller is in Program mode. You must acknowledge warning messages in the Logix Designer application that warn of the drive bypassing the STO function and unintended motion can occur. The integrated safety drive does not respond to requests of the STO function if MDC mode is entered.

It is your responsibility to maintain machine safety integrity while executing motion direct commands. One alternative is to provide ladder logic for Machine Maintenance mode that leaves the controller in Run mode with safety functions executing.

Logix Designer Application Warning Messages

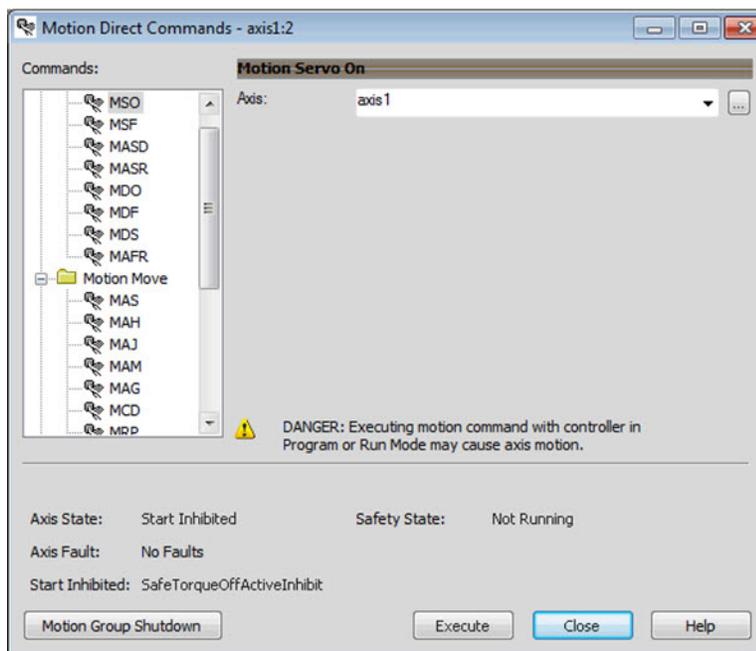
When the controller is in Run mode, executing safety functions, the Kinetix 5700 servo drive follows the commands that it receives from the safety controller. The controller reports Safety state = Running and Axis state = Stopped/Running, as shown in [Figure 122](#).

Figure 122 - Safety State Indications When Controller is in Run Mode (safety task executing)



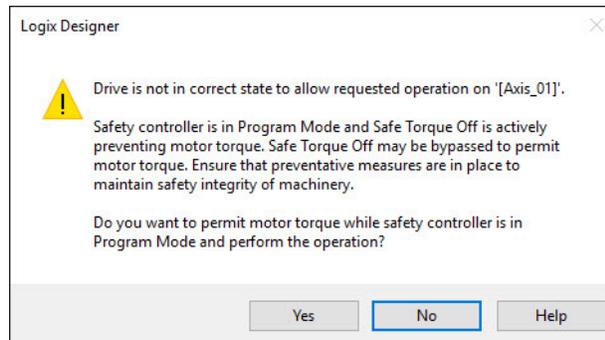
When the controller transitions to Program mode, the integrated safety drive is in the safe state (torque is not permitted). The controller reports Safety state = Not Running and Axis state = Start Inhibited, as shown in [Figure 123](#).

Figure 123 - Safety State Indications After Controller Transitions to Program Mode



When you issue a motion direct command to an axis to produce torque in Program mode, for example MSO or MDS, with the safety connection present to the drive, a warning message is presented before the motion direct command is executed, as shown in [Figure 124](#).

Figure 124 - STO Bypass Prompt When the Safety Controller is in Program Mode



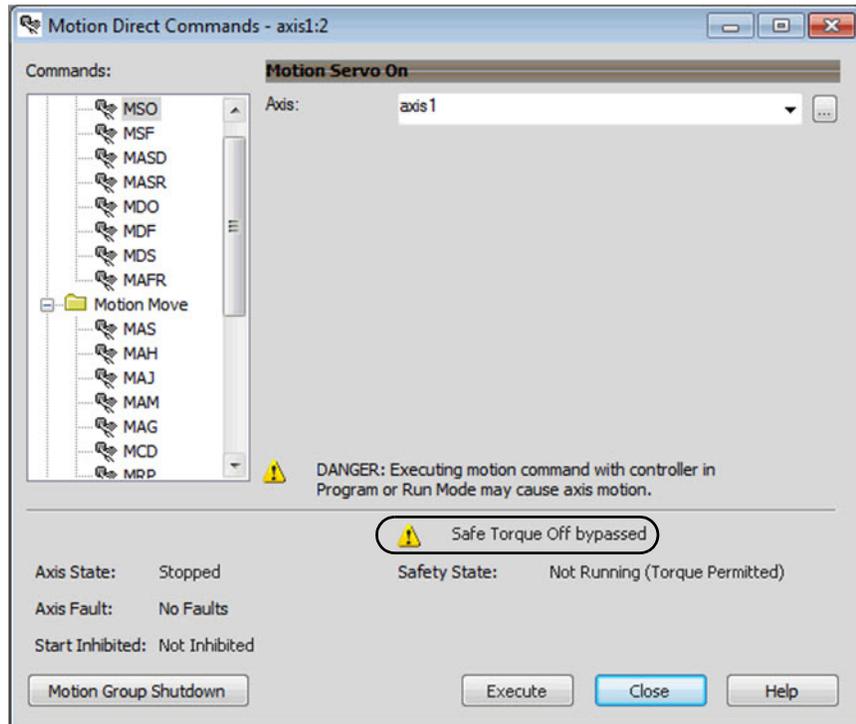
ATTENTION: Unexpected motion and the possibility of personal injury or equipment damage exists if a motion direct command is issued for one axis of any 2198-Dxxx-ERS3 dual-axis inverter. Both (A and B) inverters associated with the physical drive permit torque after you acknowledge this warning message by clicking Yes. Make sure that preventative measures are in place for both axes to maintain the safety integrity of the machine.

IMPORTANT The warning in [Figure 124](#) is displayed only the first time a motion direct command is issued.

After you acknowledge the warning message by clicking Yes, torque is permitted by the drive and a warning message is indicated in the software as shown in [Figure 125](#). The controller reports Safety state = Not Running (torque permitted), Axis state = Stopped/Running and Persistent Warning = Safe Torque Off Bypassed.

IMPORTANT Switch the controller to Run mode to exit Motion Direct Command mode and end the STO function bypass.

Figure 125 - Safety State Indications After Controller Transitions to Program Mode (MDC executing)

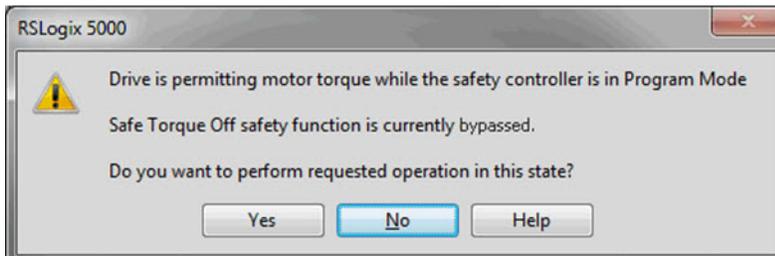


IMPORTANT The persistent warning message text Safe Torque Off bypassed appears when a motion direct command is executed. The warning message persists even after the dialog is closed and reopened as long as the integrated safety drive is in STO Bypass mode. The persistent warning message is removed only after the integrated safety drive's Safety State is restored to the Running state.

Torque Permitted in a Multi-workstation Environment

The warning in [Figure 126](#) is displayed to notify a second user working in a multi-workstation environment that the first user has placed the integrated safety drive in the STO state and that the current action is about to bypass the STO state and permit torque.

Figure 126 - STO Bypass Prompt When MDC is Issued in Multi-workstation Environment



Warning Icon and Text in Axis Properties

In addition to the other warnings that require your acknowledgement, the Logix Designer application also provides warning icons and persistent warning messages in other Axis Properties dialog boxes when the integrated safety drive is in STO Bypass mode.

Figure 127 - Axis and Safe State Indications on the Hookup Services Dialog Box

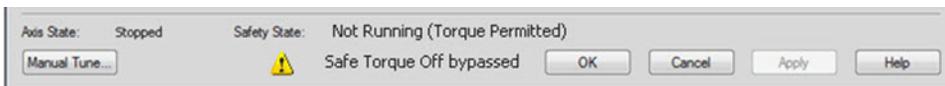


Figure 128 - Axis and Safe State Indications on Motion Direct Commands Dialog Box

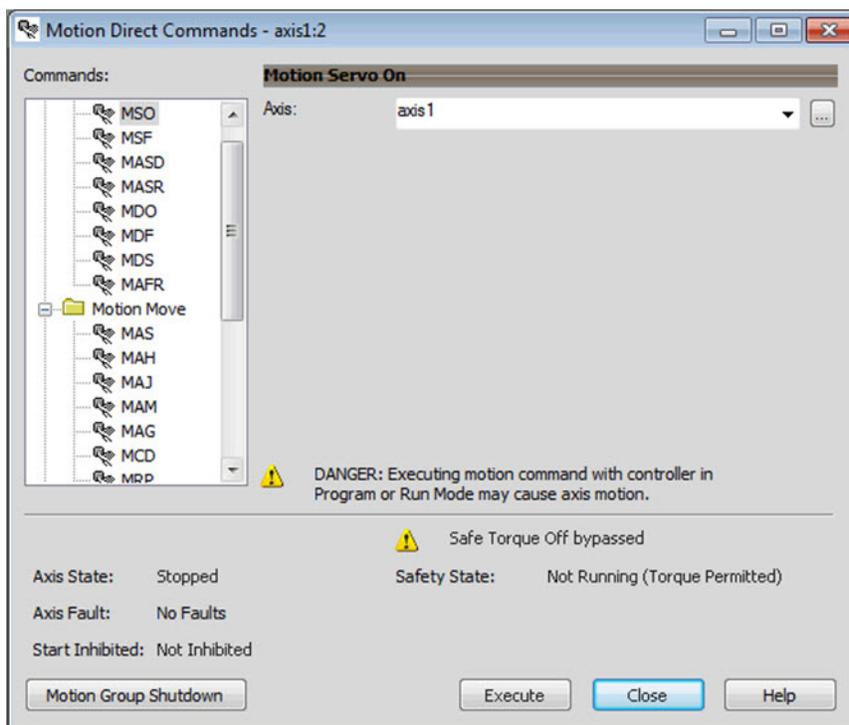
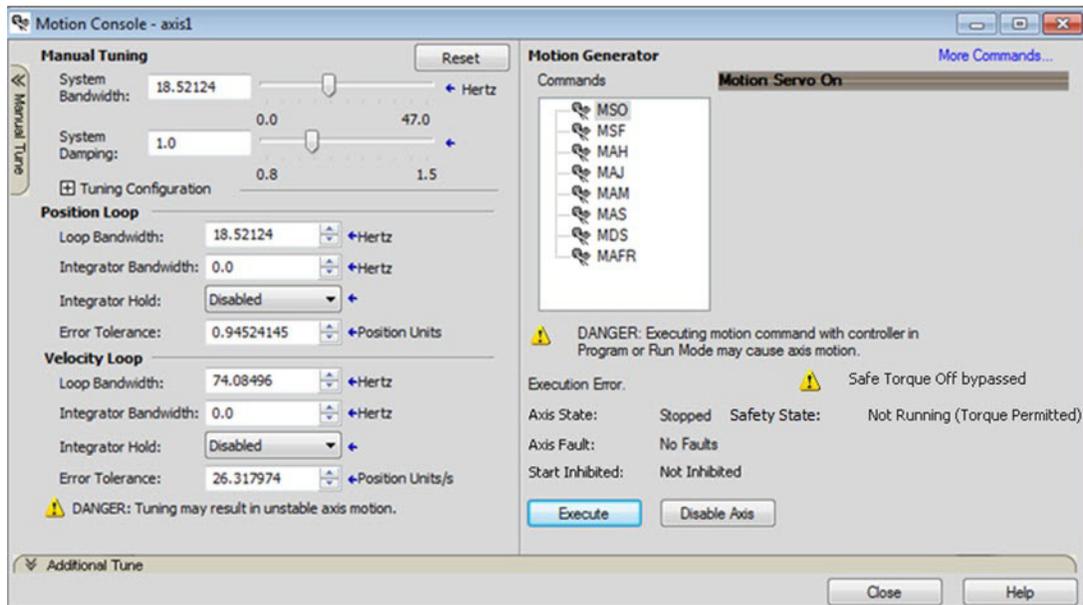


Figure 129 - Axis and Safe State Indications on the Motion Console Dialog Box



Functional Safety Considerations



ATTENTION: Before maintenance work can be performed in Program mode, the developer of the application must consider the implications of allowing motion through motion direct commands and should consider developing logic for run-time maintenance operations to meet the requirements of machine safety operating procedures.



ATTENTION: Motion is allowed and the STO function is not available when motion direct commands are used in Program mode. Motion direct commands issued when the controller is in Program mode cause the drive to bypass the STO Active condition. It is your responsibility to implement additional preventive measures to maintain safety integrity of the machinery during execution of motion direct commands in Program mode.



ATTENTION: To avoid personal injury and damage to equipment in the event of unauthorized access or unexpected motion during authorized access, return the controller to Run mode and remove the key before leaving the machine unattended.

Integrated Safe Torque-off Specifications

IMPORTANT To maintain safety rating, Kinetix 5700 drives must be installed inside protected control panels or cabinets appropriate for the environmental conditions of the industrial location. The protection class of the panel or cabinet must be IP54 or higher.

Table 141 - Integrated STO Specifications

| Attribute | Value | Logix Designer Tag Name |
|---|-------------------------------|--------------------------------|
| Safety connection RPI, min | 6 ms | N/A |
| Input assembly connections (2198-xxxx-ERS3 drives) | 3 | N/A |
| Input assembly connections (2198-xxxx-ERS4 drives) | 1 | |
| Output assembly connections | 1 | N/A |
| Integrated safety open request support | Type 1 and Type 2 requests | N/A |
| Axis safety status | Bit 0: Safety fault | Axis.SafetyFaultStatus |
| | Bit 1: Safety reset request | Axis.SafetyResetRequestStatus |
| | Bit 2: Safety Reset Required | Axis.SafetyResetRequiredStatus |
| | Bit 3: Safe torque-off active | Axis.SafeTorqueOffActiveStatus |
| | Bit 4: Safe torque disabled | Axis.SafeTorqueDisabledStatus |
| | Bit 5...31: Undefined (0) | N/A |
| Axis safety faults | Bit 1: Safety core fault | Axis.SafetyCoreFault |
| | Bit 3: Safe torque-off fault | Axis.SafeTorqueOffFault |
| | All others: Undefined (0) | N/A |

Table 142 - Single-axis Inverter STO Assembly Specifications

| Attribute | Value | Logix Designer Tag Name |
|------------------------|-------------------------------|---|
| Safety input assembly | Bit 0: Torque disabled | Drv:SI.TorqueDisabled |
| | Bit 6: Safety fault | Drv:SI.SafetyFault |
| | Bit 7: Reset required | Drv:SI.ResetRequired |
| Safety output assembly | Bit 0: Safe torque-off output | Drv:SO.SafeTorqueOff or Drv:SO.STOOutput |
| | Bit 7: Reset request | Drv:SO.Reset or Drv:SO.ResetRequest |

Table 143 - Dual-axis Inverter STO Assembly Specifications

| Attribute | Value | Logix Designer Tag Name |
|------------------------|--|---|
| Safety input assembly | Byte 0 Bit 0: Torque disabled 1 | Drv:SI.TorqueDisabled1 |
| | Byte 0 Bit 6: Safety fault 1 | Drv:SI.SafetyFault1 |
| | Byte 0 Bit 7: Reset required 1 | Drv:SI.ResetRequired1 |
| | Byte 1 Bit 0: Torque disabled 2 | Drv:SI.TorqueDisabled2 |
| | Byte 1 Bit 6: Safety fault 2 | Drv:SI.SafetyFault2 |
| | Byte 1 Bit 7: Reset required 2 | Drv:SI.ResetRequired2 |
| Safety output assembly | Byte 0 Bit 0: Safe torque-off output 1 | Drv:SO.SafeTorqueOff1 or Drv:SO.STOOutput1 |
| | Byte 0 Bit 7: Reset request 1 | Drv:SO.Reset1or Drv:SO.ResetRequest1 |
| | Byte 1 Bit 0: Safe torque-off output 2 | Drv:SO.SafeTorqueOff2 or Drv:SO.STOOutput2 |
| | Byte 1 Bit 7: Reset request 2 | Drv:SO.Reset2or Drv:SO.ResetRequest2 |

Interconnect Diagrams

This appendix provides wiring examples and system block diagrams for your Kinetix® 5700 system components.

| Topic | Page |
|--|------|
| Interconnect Diagram Notes | 279 |
| Power Wiring Examples | 281 |
| Capacitor Module Status Wiring Example | 292 |
| Passive Shunt Resistor Wiring Examples | 293 |
| Kinetix 5700 Servo Drive and Rotary Motor Wiring Examples | 294 |
| Kinetix 5700 Servo Drive and Linear Actuator Wiring Examples | 299 |
| System Block Diagrams | 304 |

Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 5700 drive system. These notes apply to the wiring examples on the following pages.

Table 144 - Interconnect Diagram Notes

| Note | Information |
|------|---|
| 1 | For power wiring specifications, refer to Wiring Requirements on page 101 . |
| 2 | For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Selection on page 35 . |
| 3 | The iTRAK® power supply must have three-phase power sourced from grounded-wye power distribution. |
| 4 | AC (EMC) line filter is required for EMC compliance. Place line filter 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 Kinetix Servo Drives Specifications Technical Data, publication KNX-TD003 . |
| 5 | Terminal block is required to make connections. |
| 6 | Cable shield clamp must be used to meet CE requirements. |
| 7 | 2198-Dxxx -ERSx dual-axis inverters include separate digital inputs, DSL feedback, universal feedback, motor power, and motor brake wiring plugs for each axis. |
| 8 | When a 2198-Dxxx -ERSx dual-axis inverter is the first drive module (adjacent to the 2198-CAPMOD-2240 capacitor module) you must configure the Digital Input category in the Logix Designer application as Regeneration OK and wire the IOD connector for each axis. |
| 9 | PE ground connection bonded to the panel must be used to meet CE requirements. |
| 10 | Contactors coil (MC) needs integrated surge suppressors for AC coil operation and must have a normally-open auxiliary contact that is terminated at TB3 (24V DC to MC input as shown). See the 8720MC Regenerative Power Supply Installation Manual, publication 8720MC-RM001 for contactor types and wiring examples. |
| 11 | Internal shunt wired to the RC connector is default configuration. Remove internal shunt wires to attach external shunt wires. |
| 12 | Default configuration for ground screws or jumper is for grounded power at customer site. For 8720MC-RPS DC-bus power, or ungrounded, corner-grounded, and impedance-grounded power configurations, remove the screws/jumper. Refer to Determine the Input Power Configuration on page 93 for more information. |
| 13 | Leave jumper between PR2 and PR3 as shown to use the internal precharge resistor. Remove jumper when external precharge/circuit is required. For more information, refer to the 8720MC Regenerative Power Supply Installation Manual, publication 8720MC-RM001 . |

Table 144 - Interconnect Diagram Notes (continued)

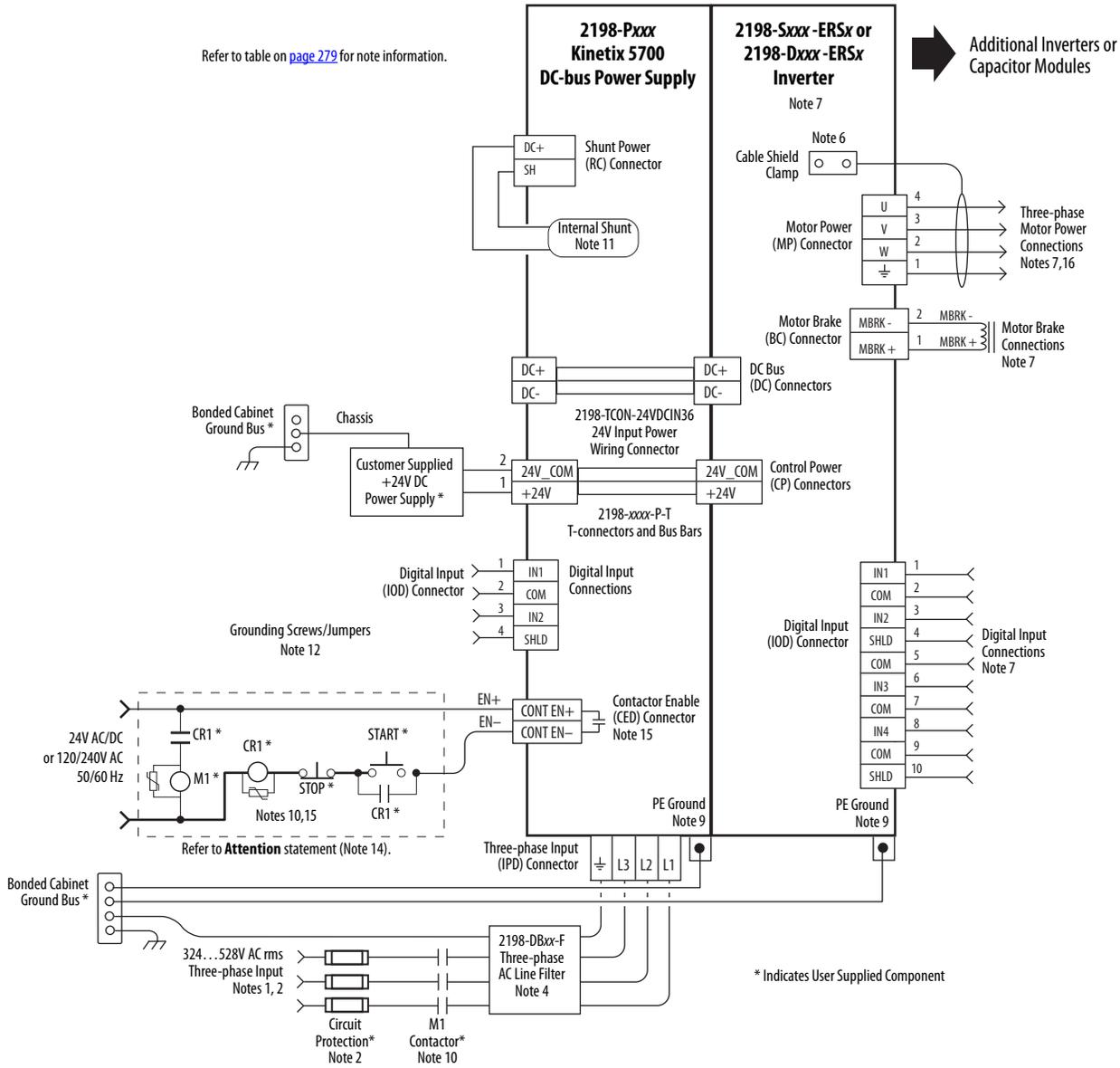
| Note | Information |
|------|--|
| 14 |  ATTENTION: Implementation of control circuits and risk assessment is the responsibility of the machine builder. Reference international standards EN 1050 and EN ISO 13849-1 estimation and safety performance categories. For more information, refer to Understanding the Machinery Directive, publication SHB-900 . |
| 15 |  ATTENTION: An AC three-phase mains contactor must be wired in series between the branch circuit protection and the DC-bus power supply. In addition, the AC three-phase contactor control string must be wired in series with the contactor-enable relay at the CED connector. Refer to Contactor Enable Relay on page 76 , for more information. The recommended minimum wire size for wiring the circuitry to the contactor-enable connector is 1.5 mm ² (16 AWG). |
| 16 | For motor cable specifications, refer to Kinetix Motion Accessories Specifications Technical Data, publication KNX-TD004 . |
| 17 | Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and $\frac{\perp}{\text{---}}$ (GND) or A, B, C, and $\frac{\perp}{\text{---}}$ (D) respectively. |
| 18 | LDAT-Series linear thrusters do not have a brake option, so only the 2090-CPWM7DF-xxAAxx or 2090-CPWM7DF-xxAFxx motor power cables apply. |
| 19 | MPAS-Bxxxx-VxxSxA (ballscrew) linear stages use the 9V supply. MPAS-Bxxxx-ALMx2C (direct-drive) linear stages use the 5V supply. |
| 20 | Mount the 8720MC-RPS unit on the same panel and as close to the Kinetix 5700 drive system as possible. DC-bus cables not to exceed 2.0 m (6.5 ft), maximum length. See the 8720MC Regenerative Power Supply Installation Manual, publication 8720MC-RM001, for installation and wiring instructions. |
| 21 | The 2198-CAPMOD-2240 capacitor module is used in applications with up to 100 A maximum external DC-bus current. You can add the 2198-CAPMOD-DCBUS-IO extension module to the left or right of the capacitor module when the external DC-bus current exceeds 100 A, up to a maximum of 200 A. |

Power Wiring Examples

You must supply input power components. The three-phase line filter is wired downstream of the circuit protection devices. Each drive module includes the appropriate DC-bus link and connector set. The 24V supply can be jumpered from drive-to-drive by using discrete wires or the shared-bus connection system.

In this example, the inverter drives and optional capacitor modules are downstream of a single DC-bus power supply.

Figure 130 - Kinetix 5700 Drives (single converter) Configuration



In this example, the inverter drives and optional capacitor modules are downstream of three DC-bus (converter) power supplies. When two or three DC-bus power supplies are used, they must be catalog number 2198-P208. This configuration provides more power (kW) to the drive system.

Figure 131 - Kinetix 5700 Drives (multiple converters) Configuration

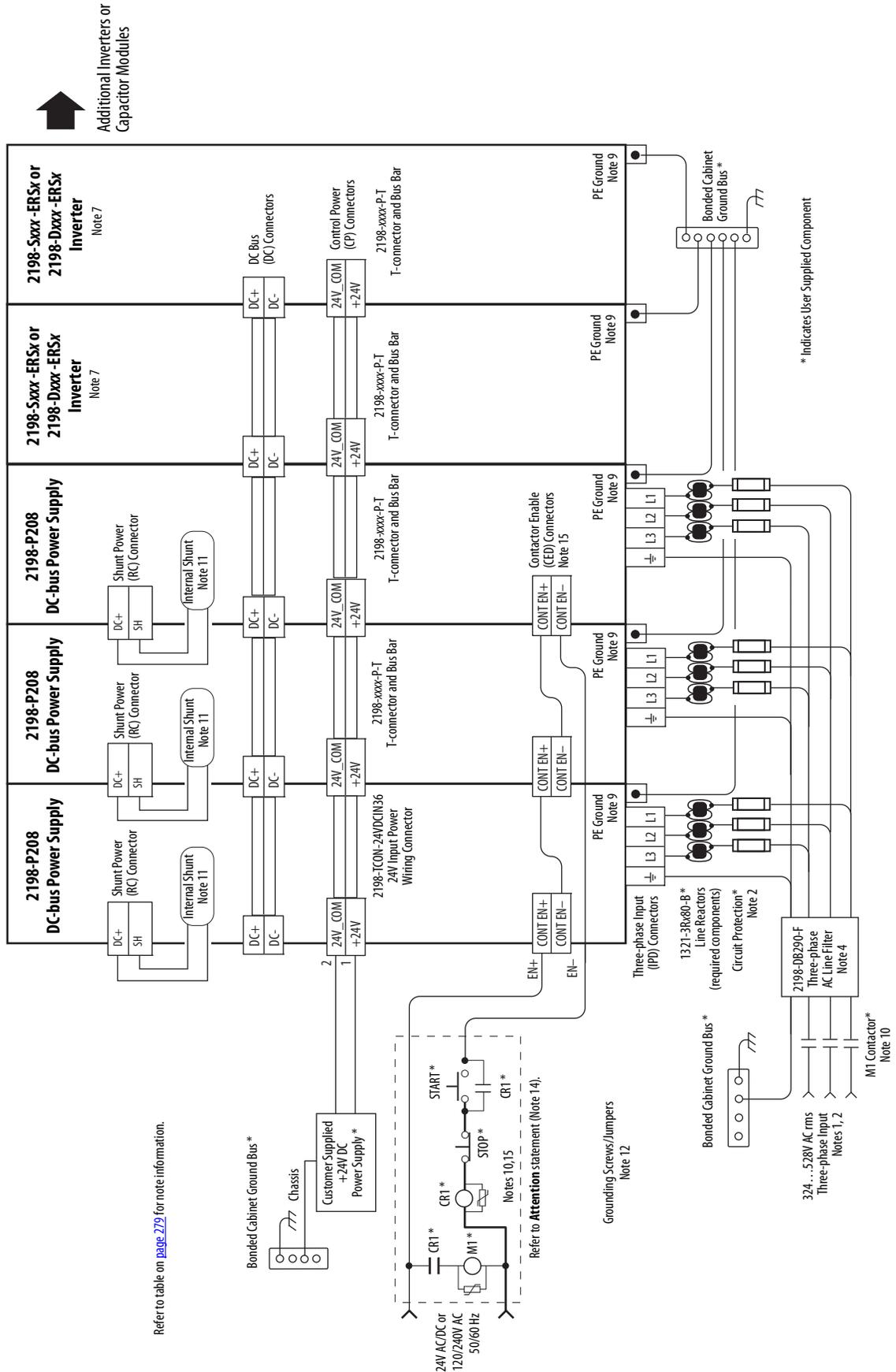
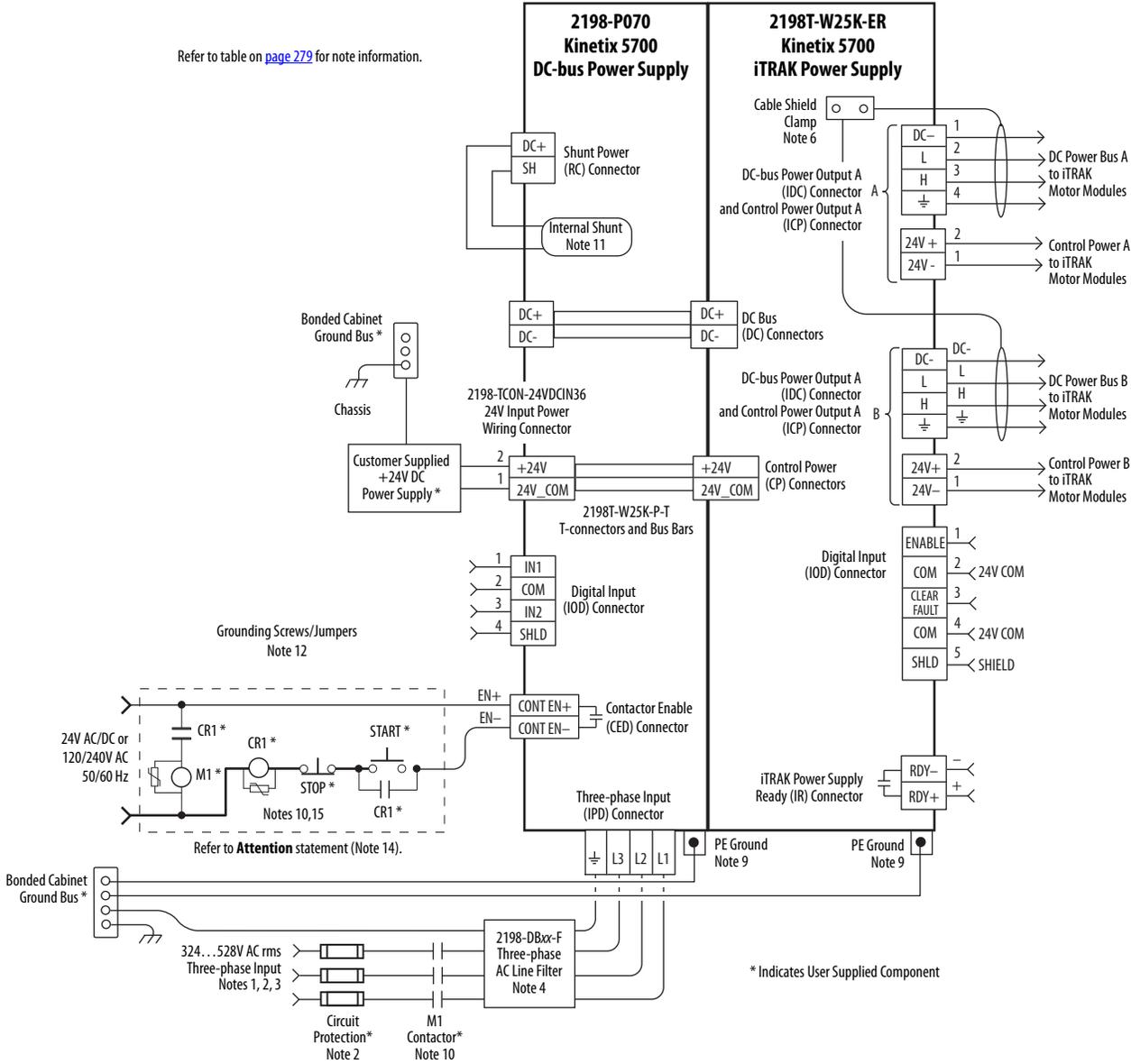
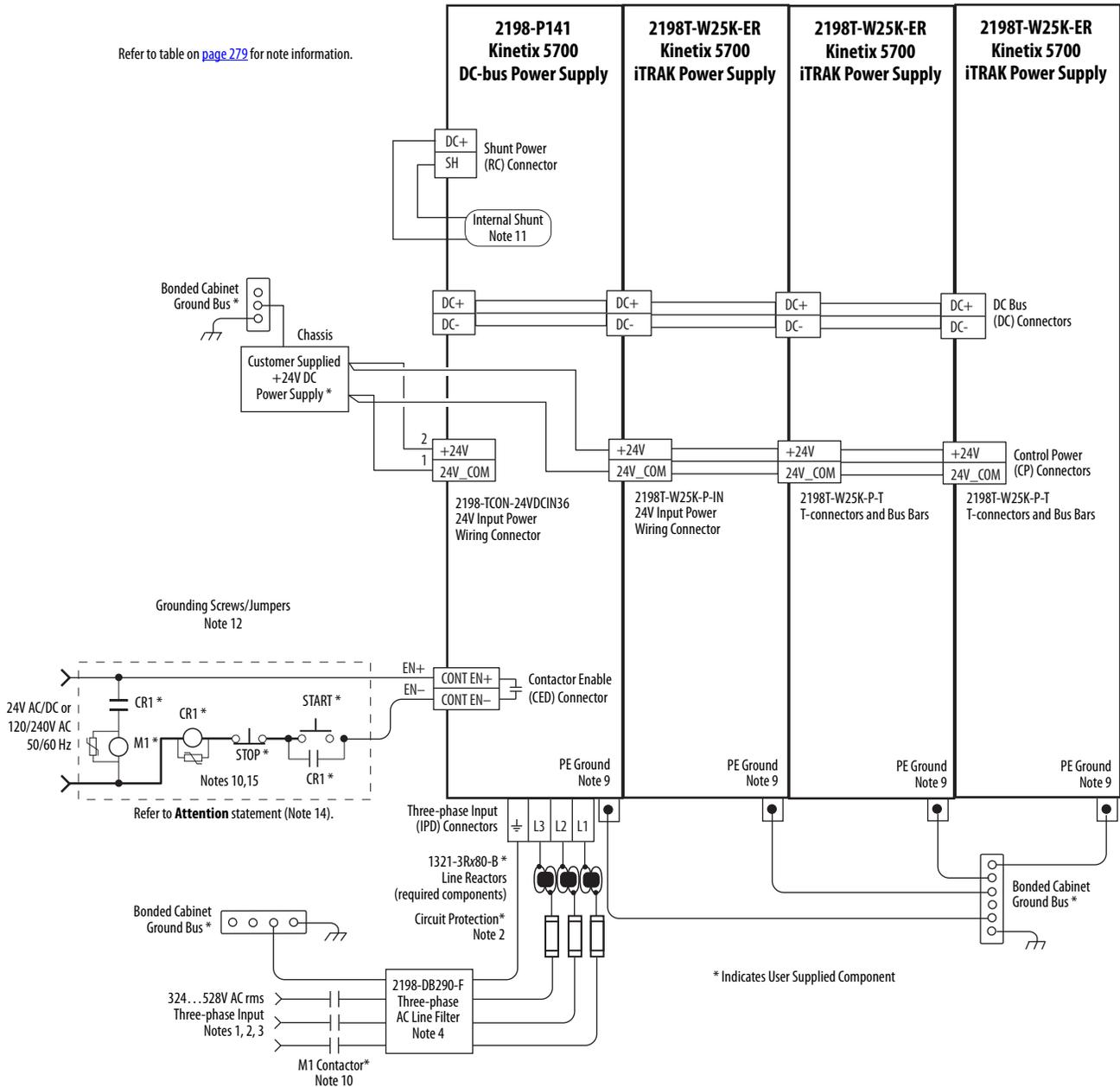


Figure 132 - Kinetix 5700 Drives (single iTRAK power supply) Configuration



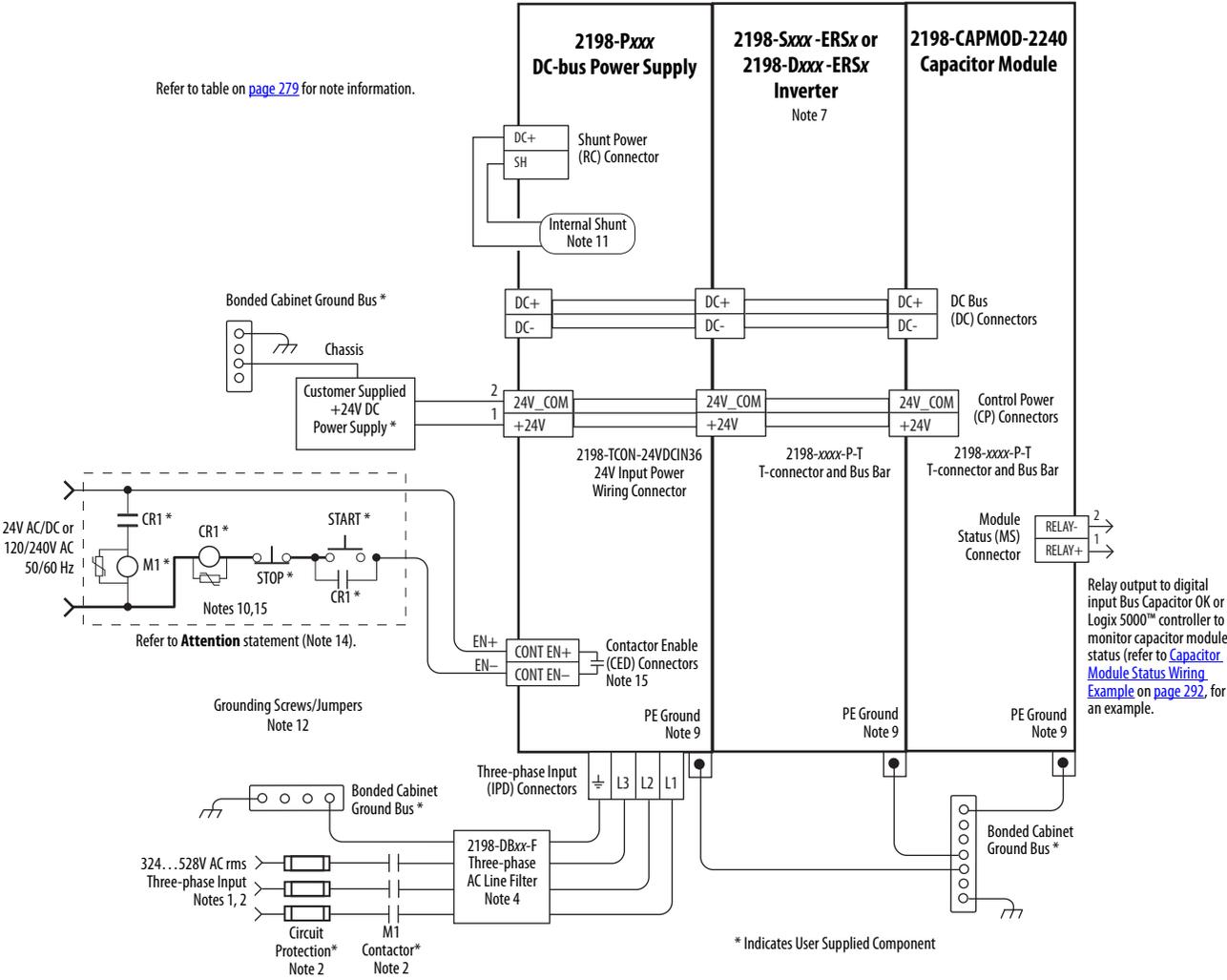
In this example, the DC-bus power supply 24V input wiring connector and the three iTRAK power supply 24V input wiring connectors are wired separately. The 2198T-W25K-P-IN input wiring connector is rated for 41 A. See Appendix C on page 319 to determine 24V input power requirements needed to design proper distribution for 24V control power.

Figure 133 - Kinetix 5700 Drives (multiple iTRAK power supply) Configuration



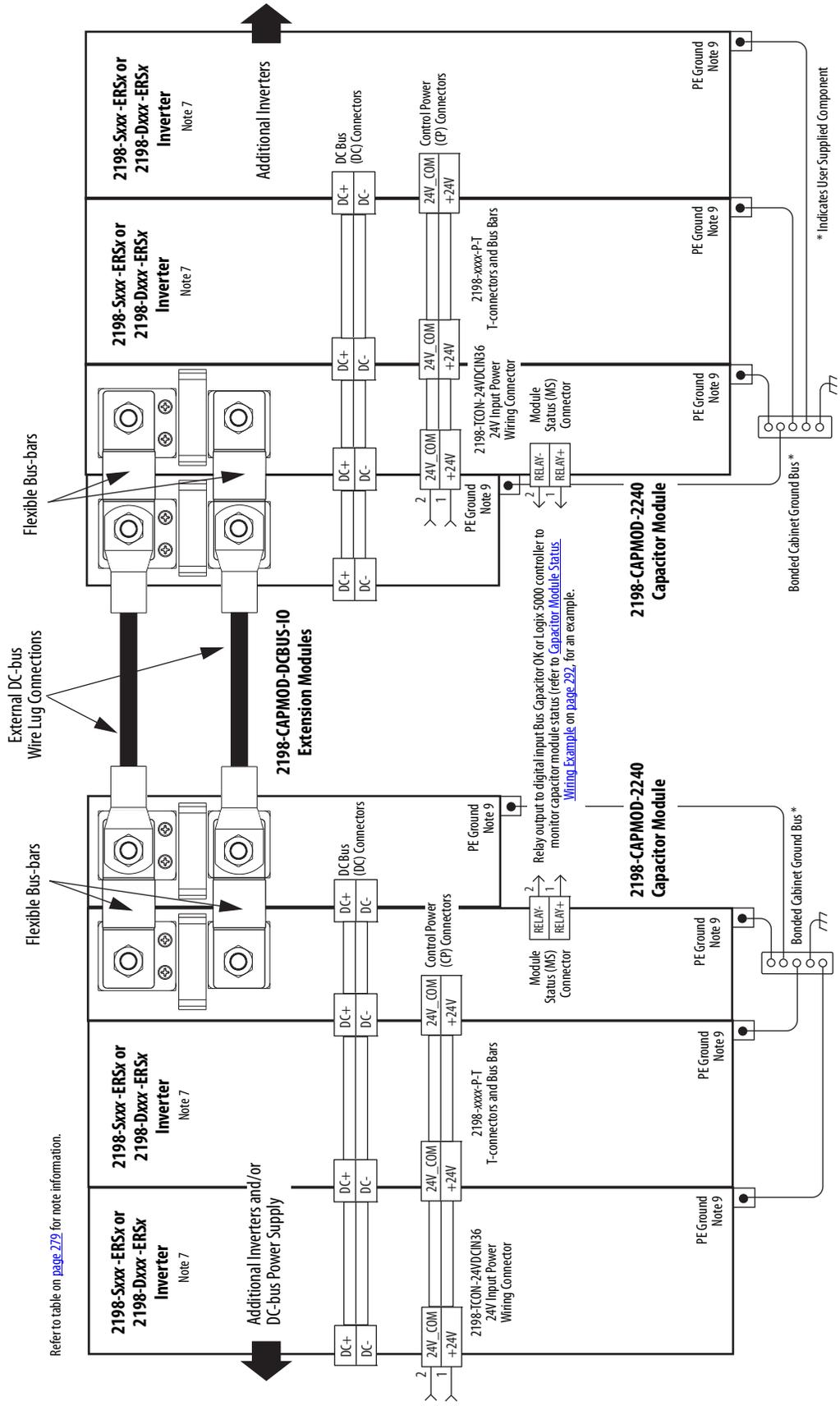
In this example, the 2198-CAPMOD-2240 capacitor module is used for energy storage and to improve dynamic performance.

Figure 134 - Kinetix 5700 Capacitor Module



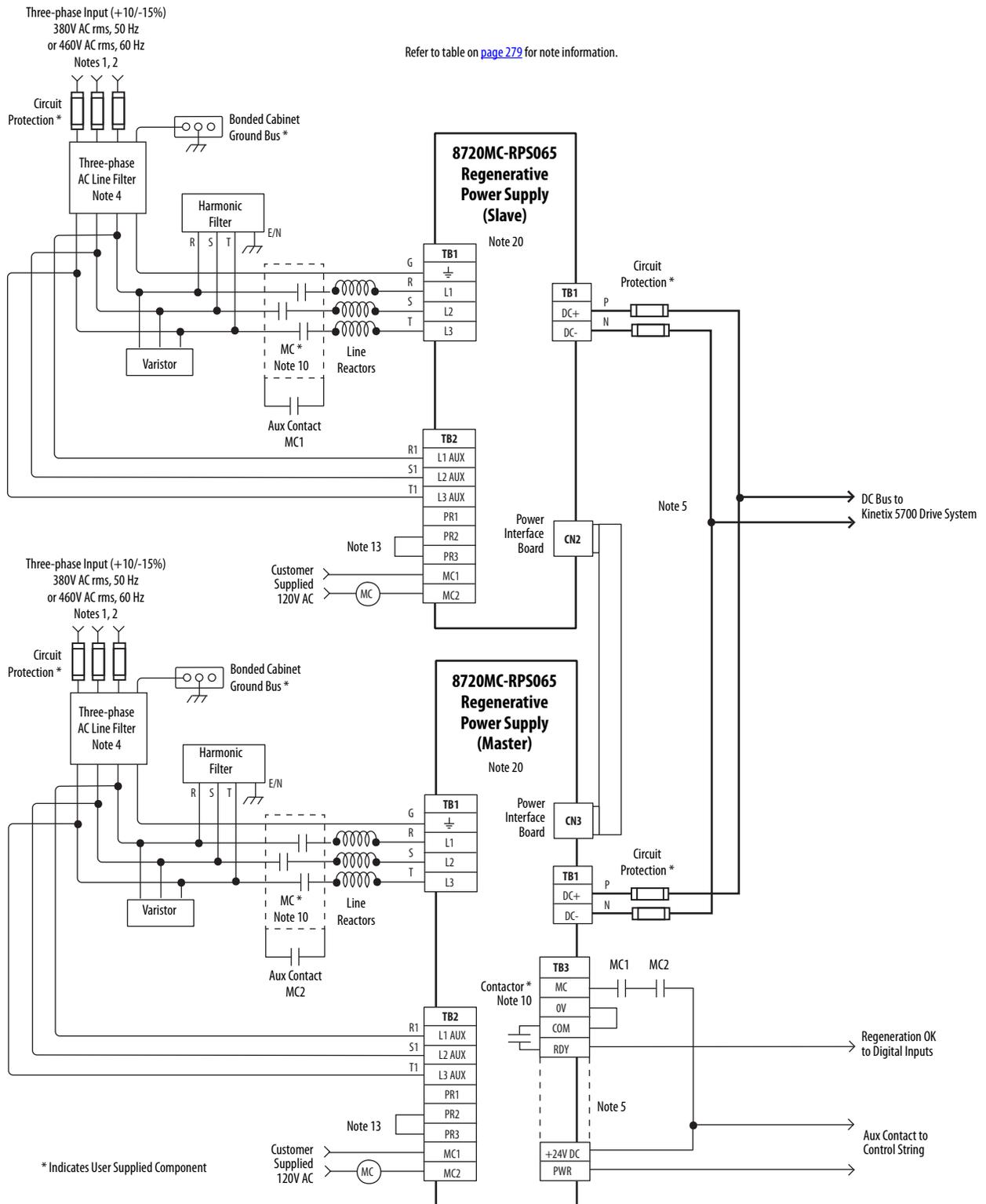
In this example, the 2198-CAPMOD-2240 capacitor module and 2198-CAPMOD-DCBUS-IO extension module are used for energy storage and to extend the DC-bus voltage to another inverter cluster. The capacitor modules are used alone when the external DC-bus current is less than 100 A. The extension module is needed when the external DC-bus current is greater than 100 A, up to a maximum 200 A.

Figure 135 - Kinetix 5700 Extended Drive System



In this example, three-phase AC input power is fed to two 8720MC-RPS065 units in a master/slave configuration. The DC-bus (TB1) terminals connect to the Kinetix 5700 DC-bus via the 2198-CAPMOD-DCBUS-IO extension module because the system current exceeds 100 A.

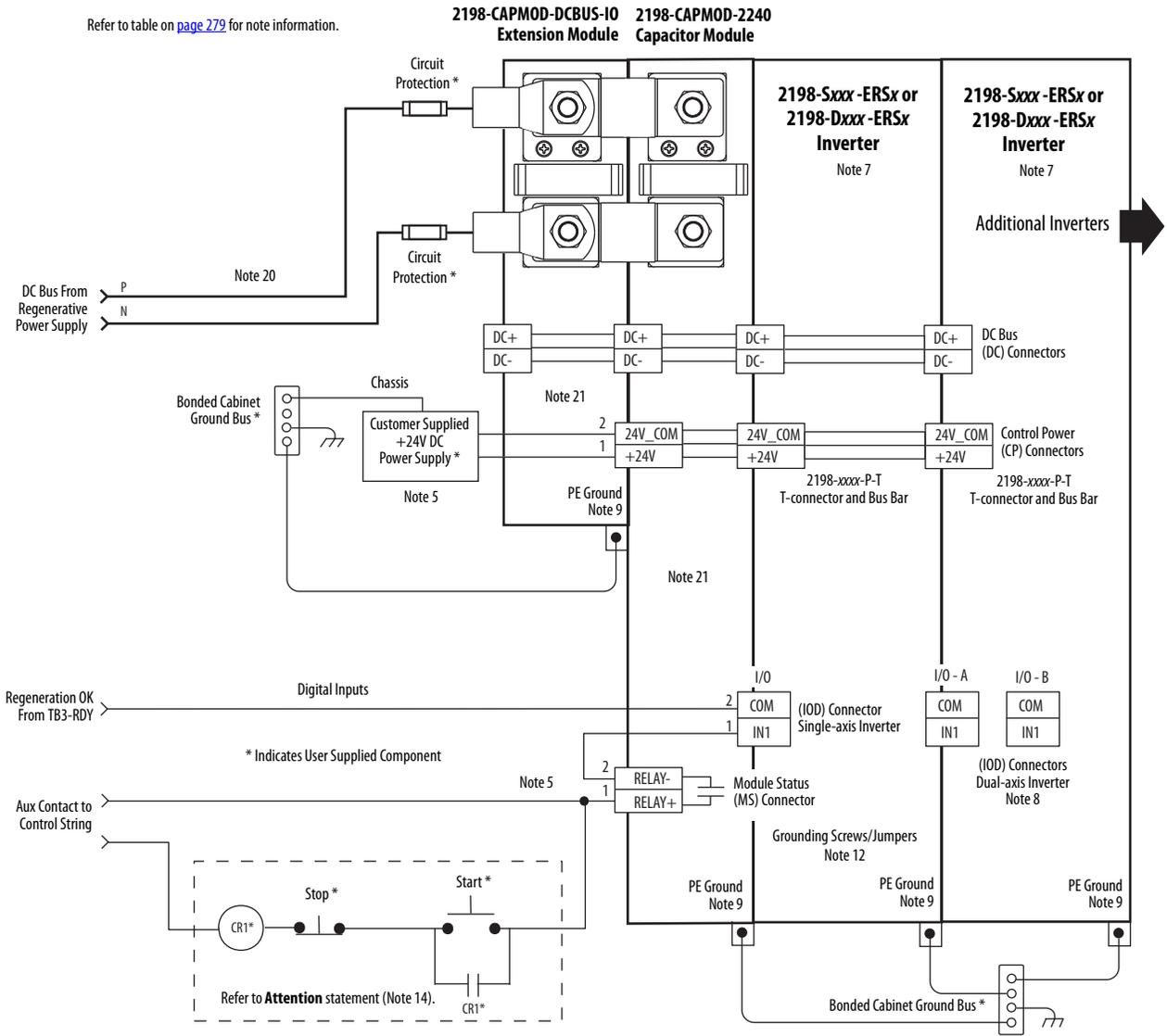
Figure 137 - 8720MC-RPS065 Master/Slave Units with Kinetix 5700 Drive System



IMPORTANT The 8720MC-RPS regenerative power supply is not compatible with the iTRAK power supply.

8720MC-RPS065 Master/Slave Units with Kinetix 5700 Drive System (continued)

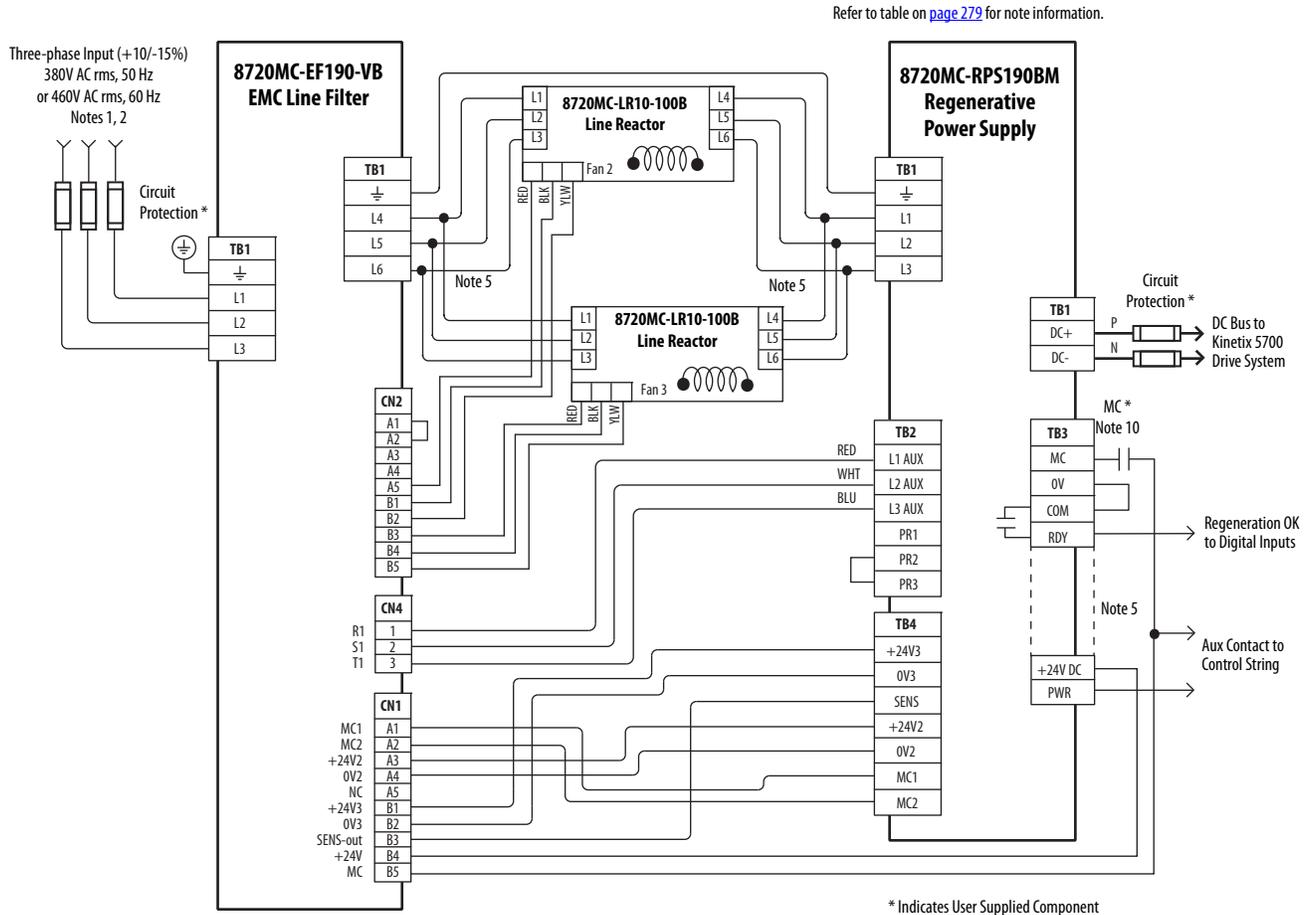
Refer to table on [page 279](#) for note information.



In this example, three-phase AC input power is fed to the 8720MC-RPS190 unit. The DC-bus (TB1) terminals connect to the Kinetix 5700 DC-bus via the 2198-CAPMOD-DCBUS-IO extension module because the system current exceeds 100 A.

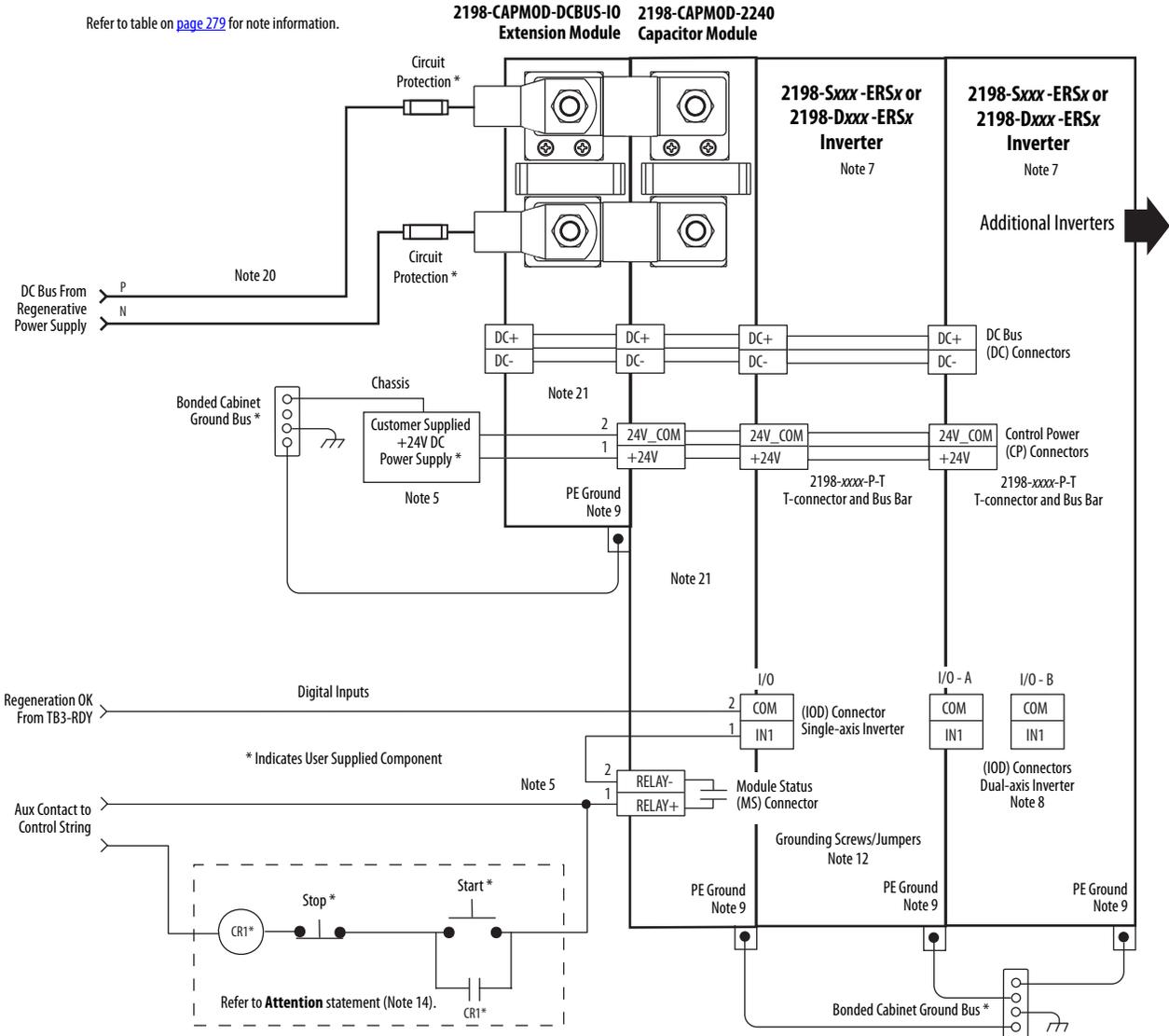
IMPORTANT The 8720MC-RPS regenerative power supply is not compatible with the iTRAK power supply.

Figure 138 - 8720MC-RPS190 Unit with Kinetix 5700 Drive System



8720MC-RPS190 Unit with Kinetix 5700 Drive System (continued)

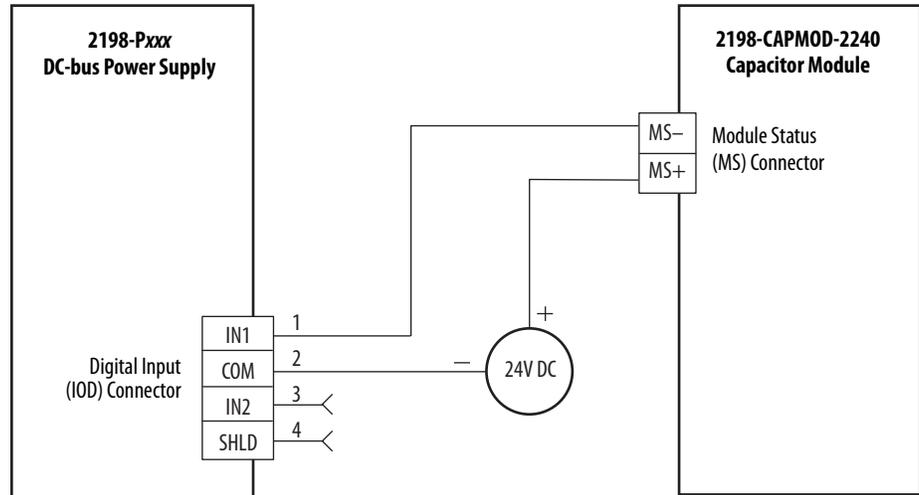
Refer to table on page 279 for note information.



Capacitor Module Status Wiring Example

You can configure either of the DC-bus power supply digital inputs as Bus Capacitor OK in the Logix Designer application. Refer to [page 153](#) to see how the DC-bus power supply Digital Inputs category is configured.

Figure 139 - DC-bus Power Supply with Capacitor Module



Refer to the Kinetix 5700 Capacitor Modules Installation Instructions, publication [2198-IN008](#), for additional installation information.

Passive Shunt Resistor Wiring Examples

Wiring from the Bulletin 2198 shunt modules and resistor are made directly to the shunt (RC) connector. You can configure either of the DC-bus power supply digital inputs as Shunt Thermal Switch OK in the Logix Designer application. Refer to [page 153](#) to see how the DC-bus power supply Digital Input category is configured.

IMPORTANT Before wiring the Bulletin 2198 external shunt to the RC connector, remove the wires from the internal servo-drive shunt. Do not connect both internal and external shunt resistors to the DC-bus power supply.



ATTENTION: To avoid damage to the Kinetix 5700 drive system, wire the 2198-R014, 2198-R031, or 2198-R127 shunt thermal switch to a digital input on the DC-bus power supply and configure the Shunt Thermal Switch OK function in the Logix Designer application.

Figure 140 - DC-bus Power Supply with External Passive Shunt Module

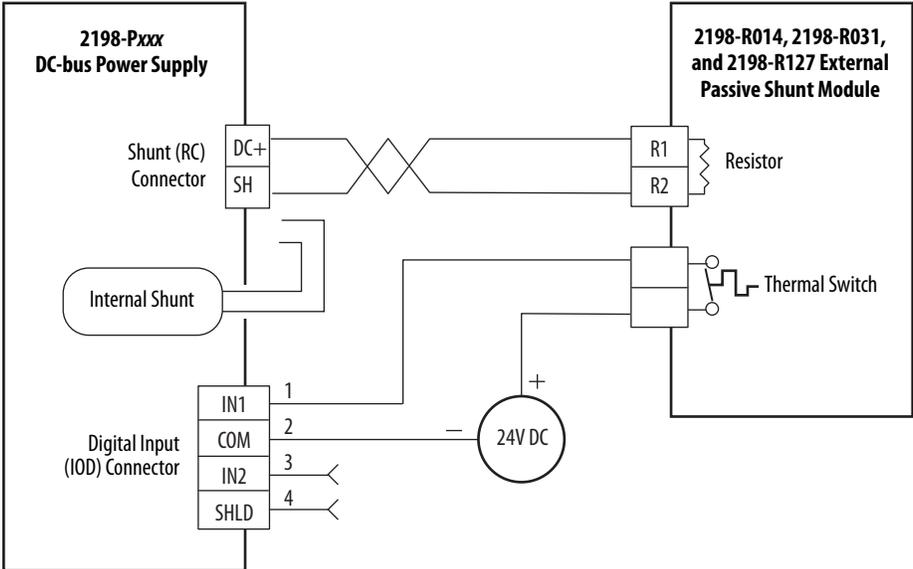
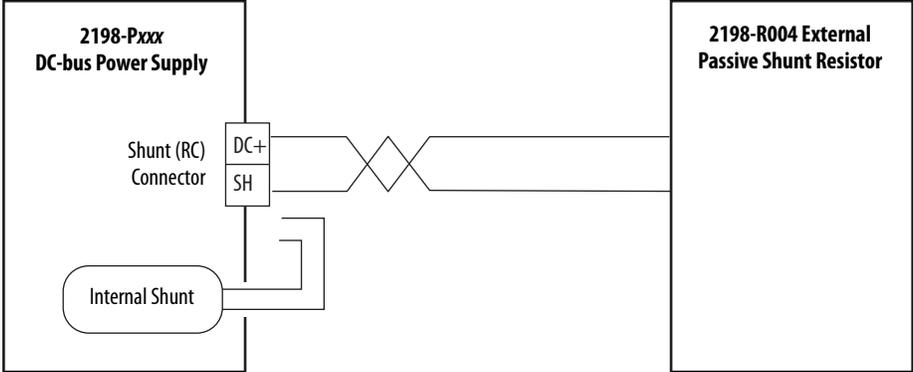


Figure 141 - DC-bus Power Supply with External Passive Shunt Resistor

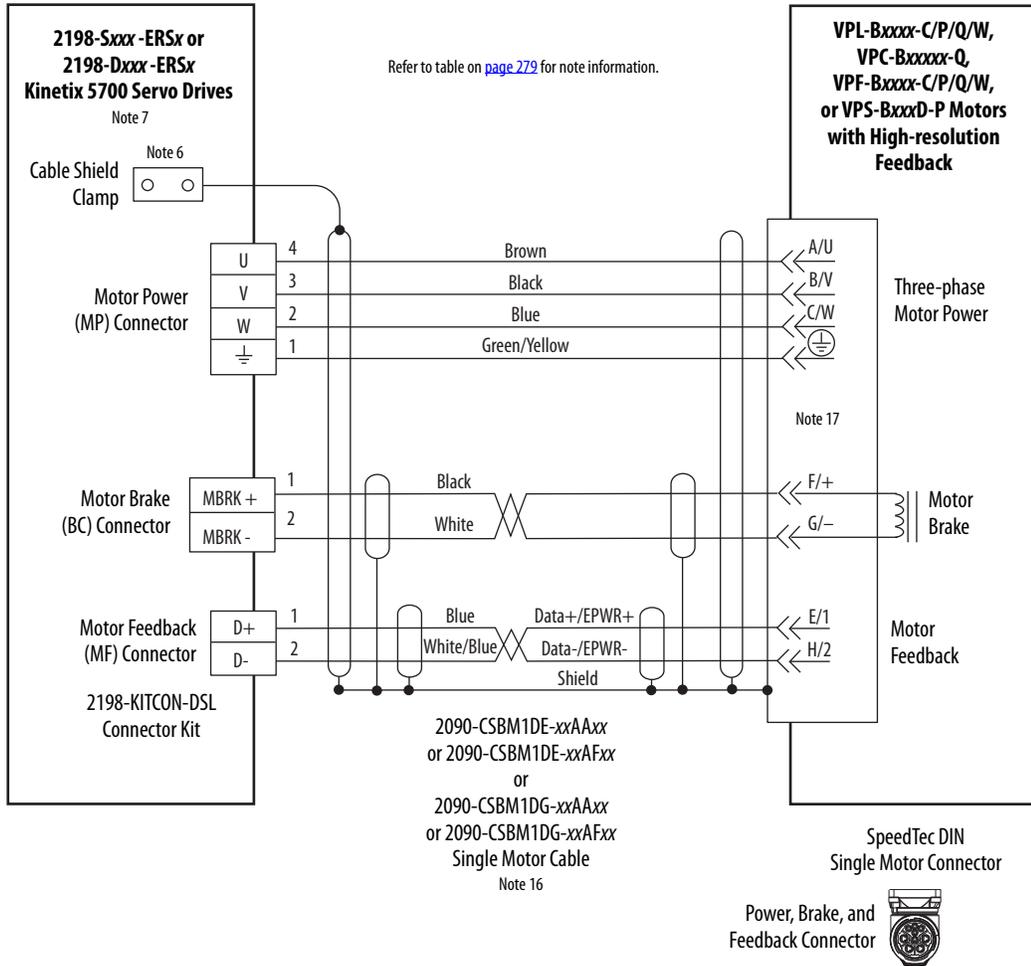


Refer to the Kinetix 5700 Passive Shunt Module Installation Instructions, publication [2198-IN011](#), for additional installation information.

Kinetix 5700 Servo Drive and Rotary Motor Wiring Examples

These Kinetix VP motors use single cable technology. The motor power, brake, and feedback wires are all packaged in a single cable.

Figure 142 - Kinetix 5700 Drives with Kinetix VP (Bulletin VPL, VPC-Bxxxx-Q, VPF, VPS) Motors



2090-CSxM1DE cables include the 2198-KITCON-DSL connector kit pre-assembled with the feedback conductors. 2090-CSxM1DG cables have flying-leads and the 2198-KITCON-DSL kit is ordered separately.

Figure 143 - Single Motor Cables for Kinetix 5700 Servo Drives

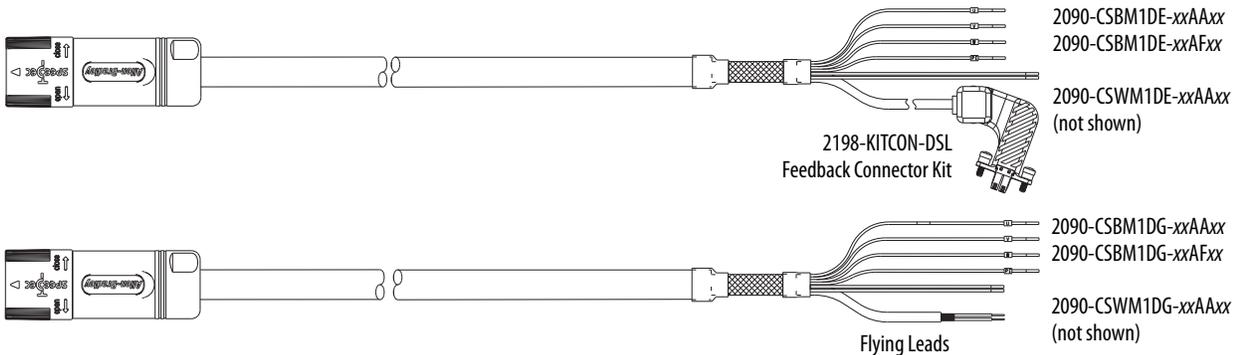
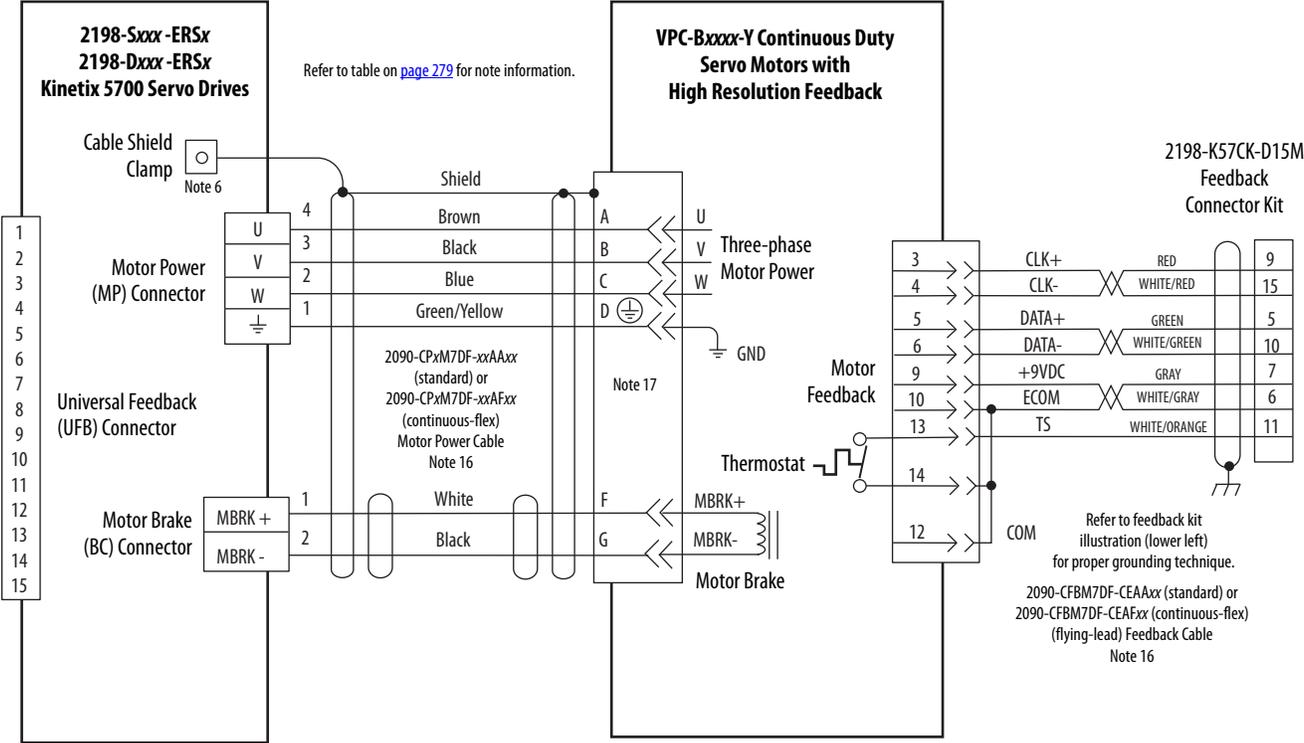
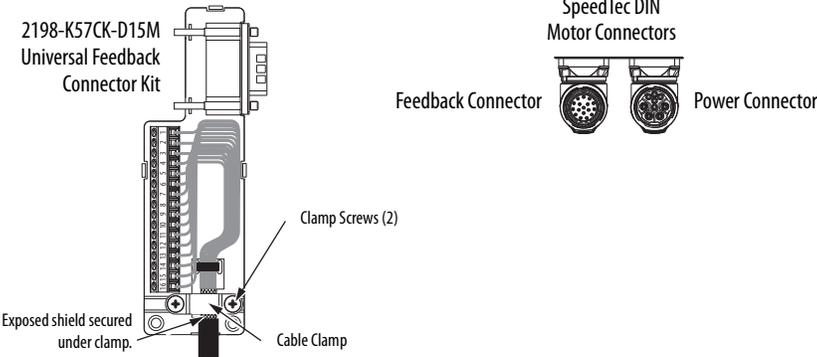


Figure 144 - Kinetix 5700 Drives with Kinetix VP Continuous Duty Motors



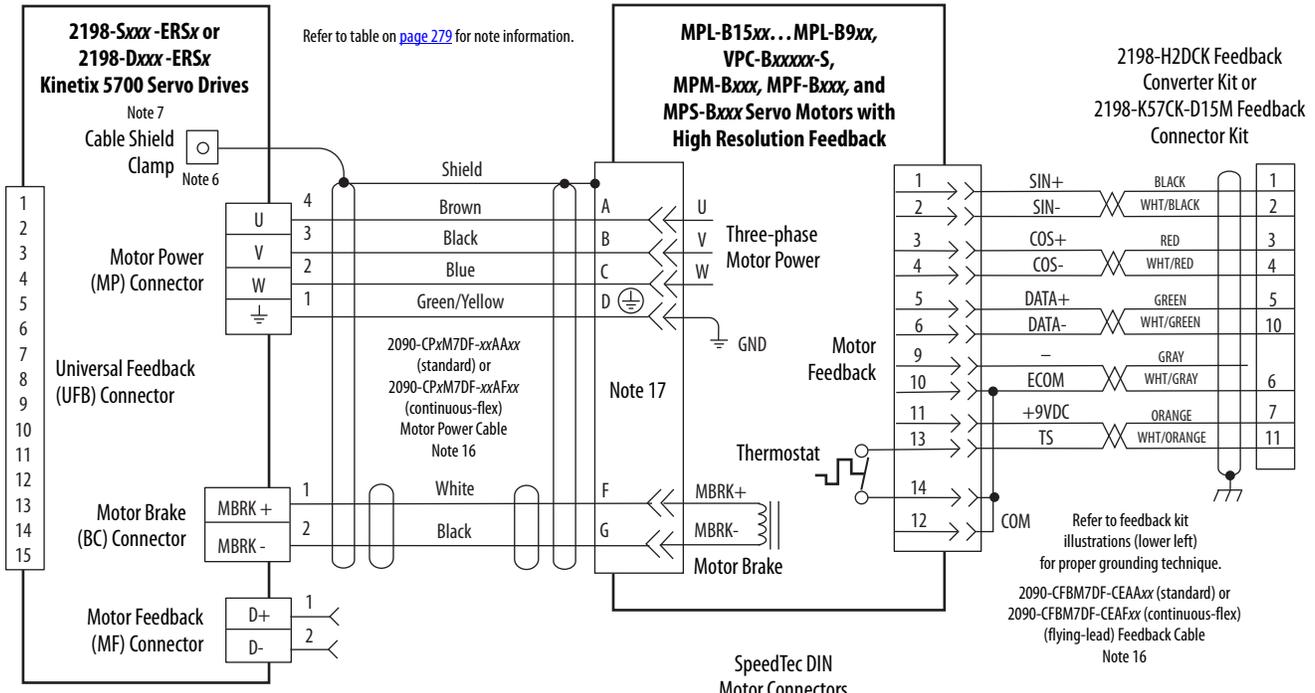
Grounding Techniques for Feedback Cable Shield



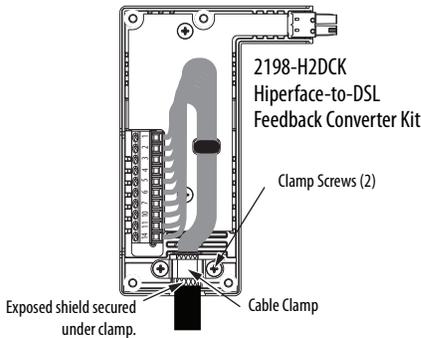
Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

These compatible Allen-Bradley® rotary motors have separate cables for motor power/brake and feedback connections.

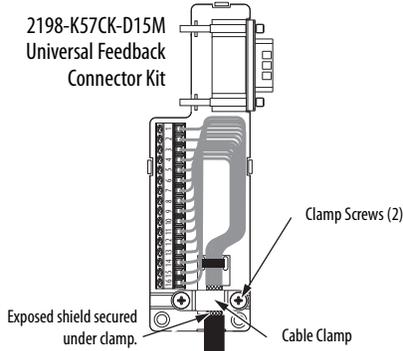
Figure 145 - Kinetix 5700 Drives with MP-Series and Kinetix VP (Bulletin VPC-Bxxxxx-S) Motors



Grounding Techniques for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006, for converter kit specifications.



Refer to Universal Feedback Connector Kit Installation Instructions, publication 2198-IN010, for connector kit specifications.

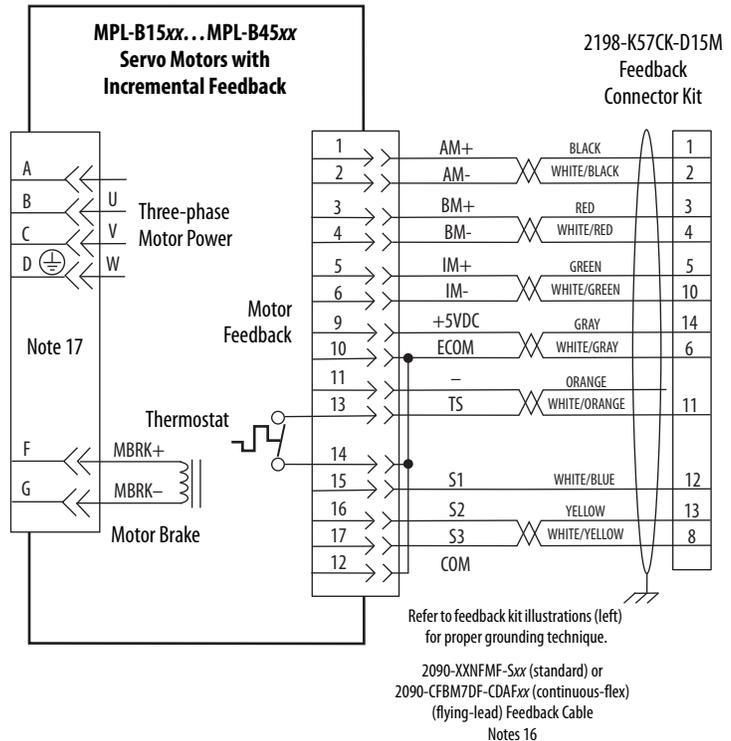
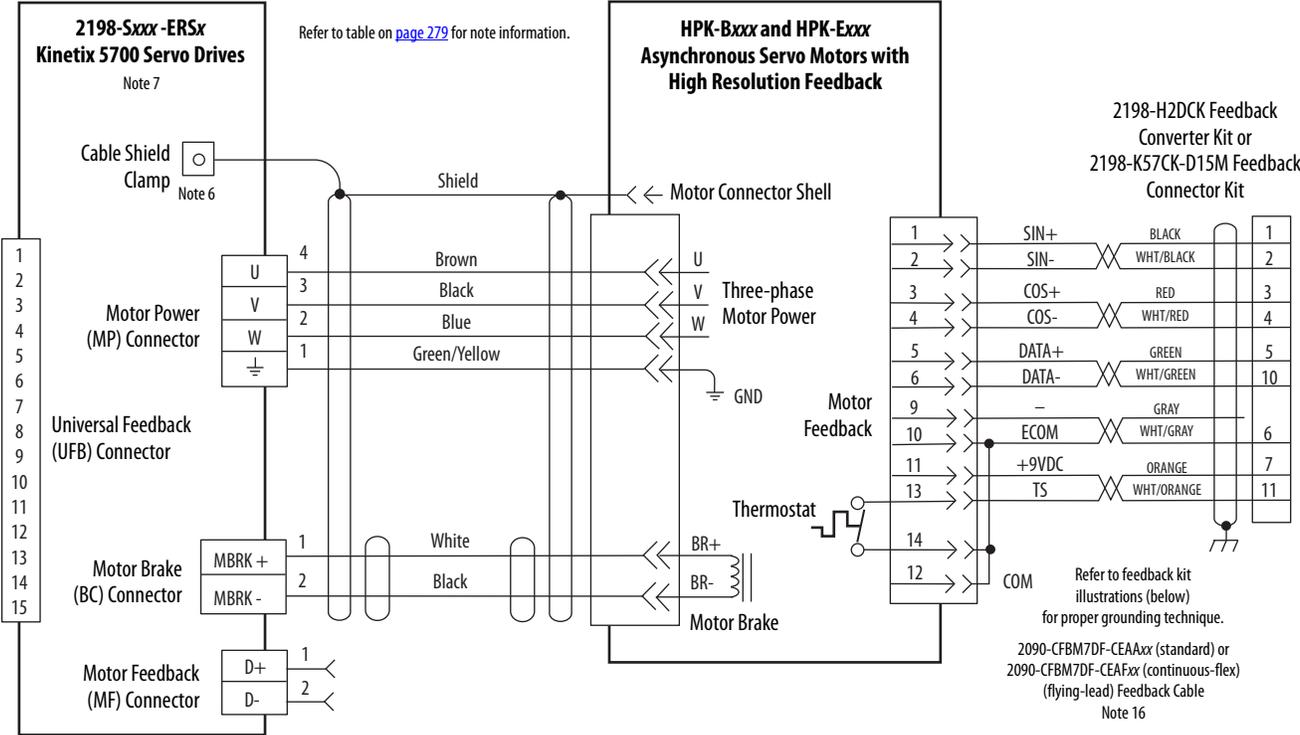
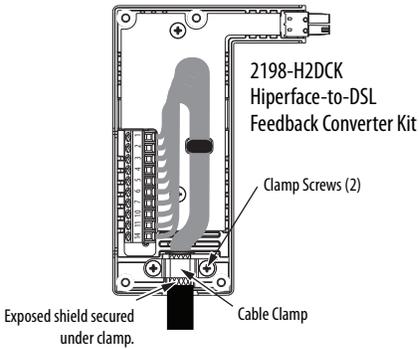


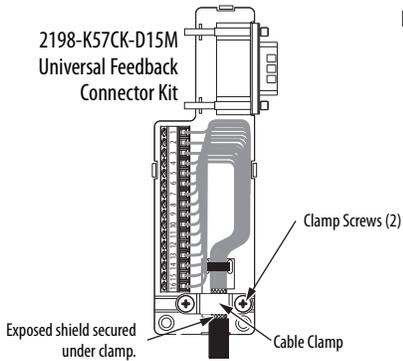
Figure 146 - Kinetix 5700 Drives with HPK-Series Rotary Motors



Grounding Techniques for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.

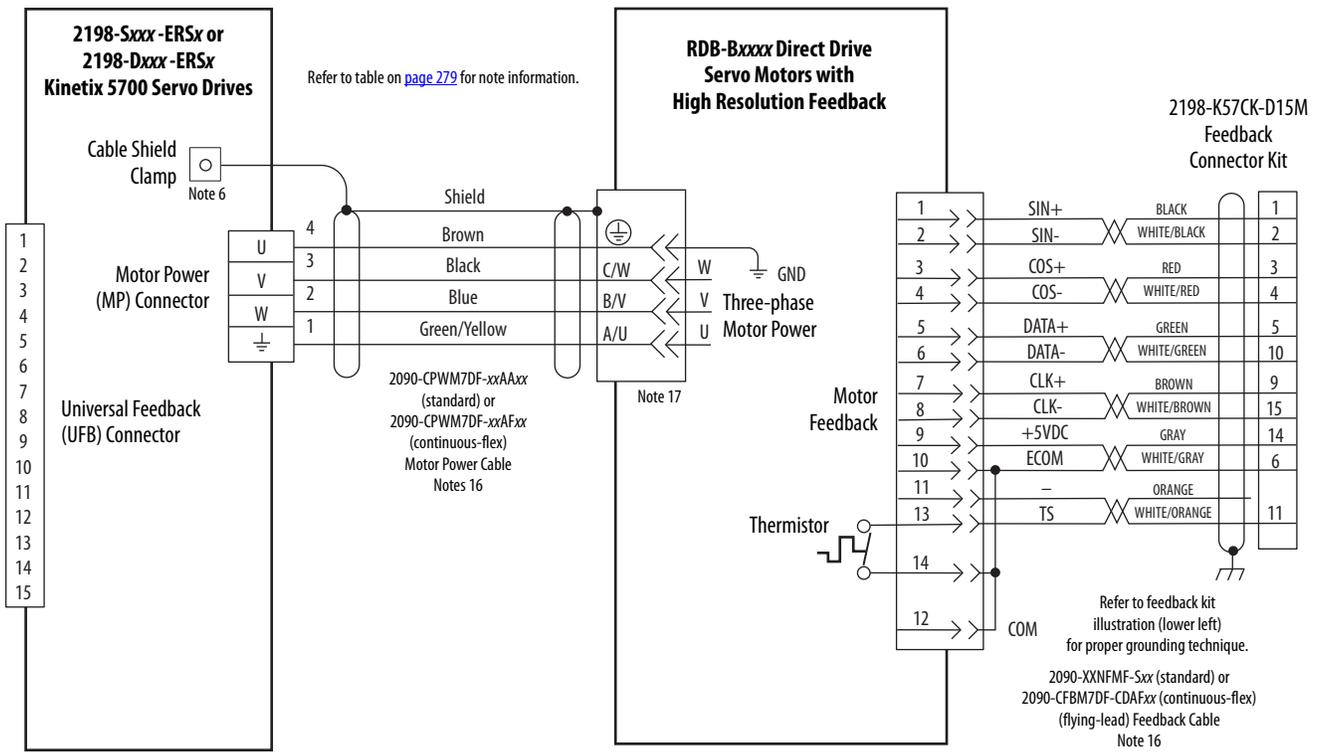


Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

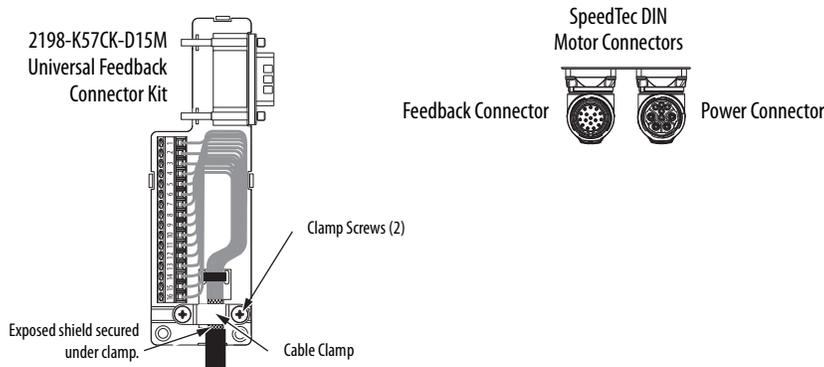


SpeedTec DIN Feedback Connector

Figure 147 - Kinetix 5700 Drives with RDD-Series Direct Drive Motors



Grounding Techniques for Feedback Cable Shield

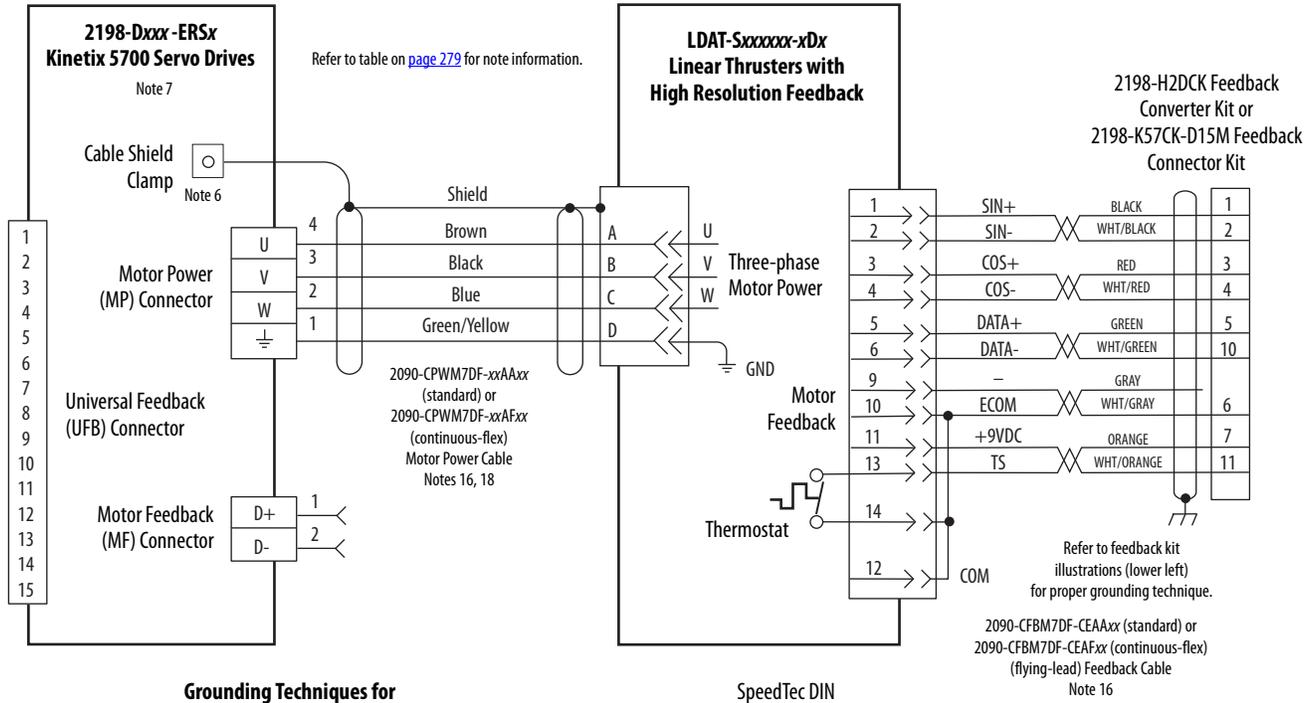


Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

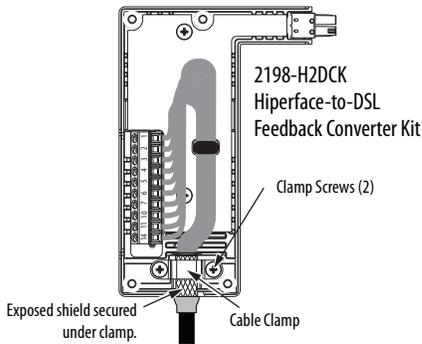
Kinetix 5700 Servo Drive and Linear Actuator Wiring Examples

Compatible linear actuators have separate cables for power/brake and feedback connections.

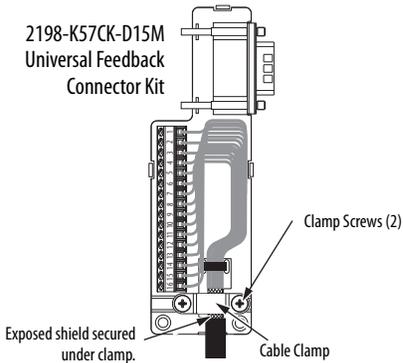
Figure 148 - Kinetix 5700 Drives with LDAT-Series Linear Thrusters



Grounding Techniques for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.



Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

SpeedTec DIN Motor Connectors

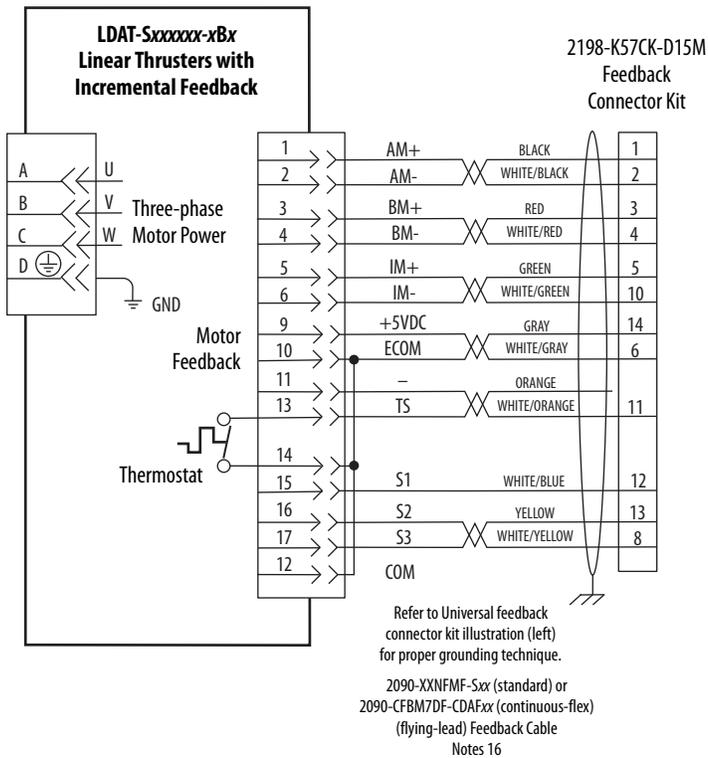
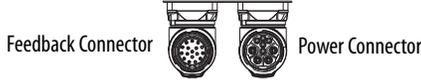
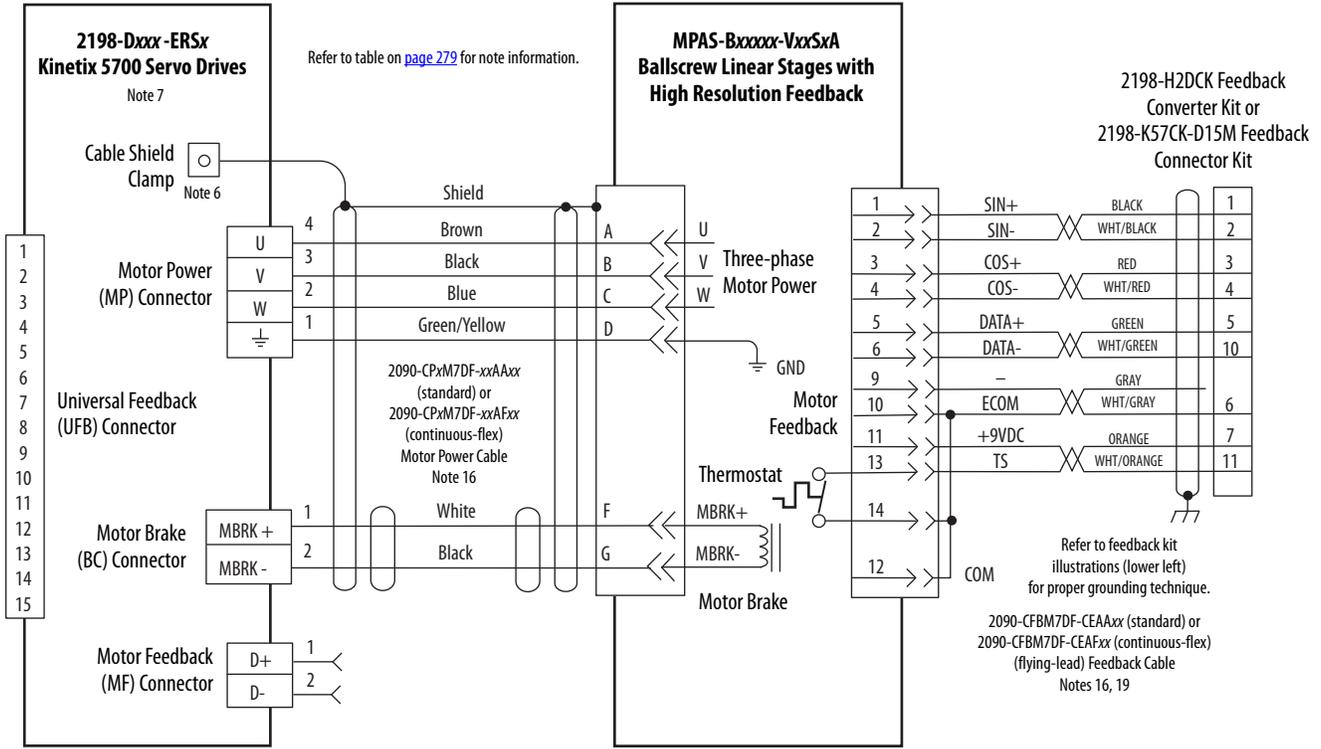
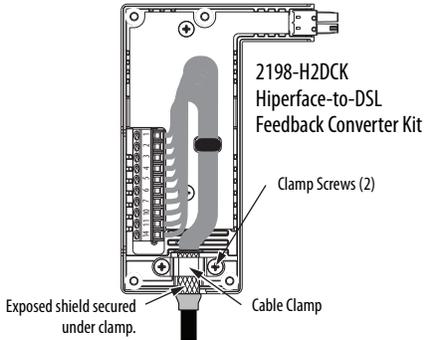


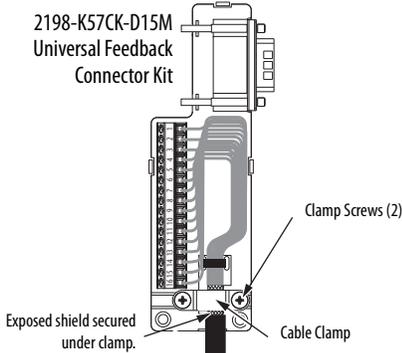
Figure 149 - Kinetix 5700 Drives with MP-Series Linear Stages



Grounding Techniques for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.



Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

SpeedTec DIN Motor Connectors

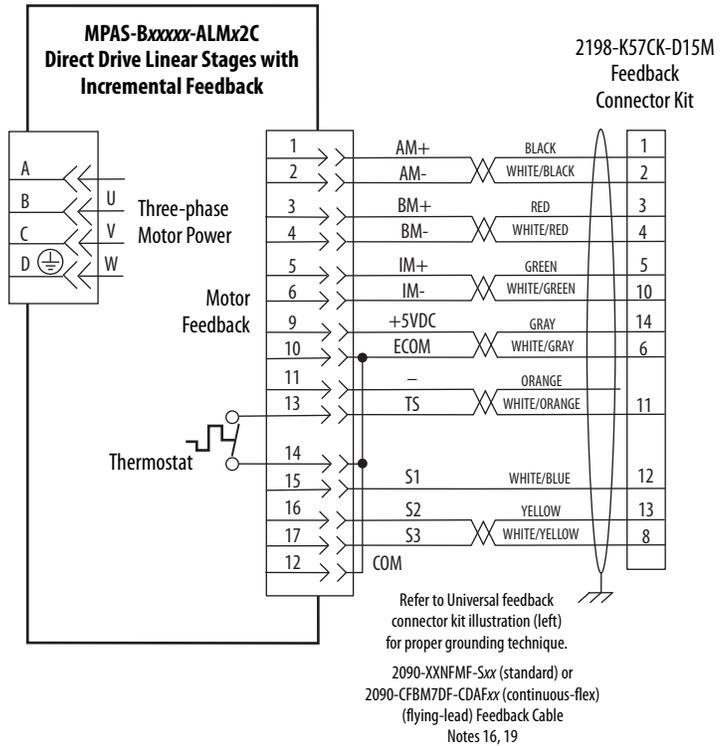
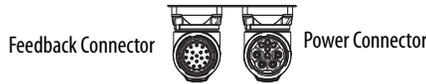
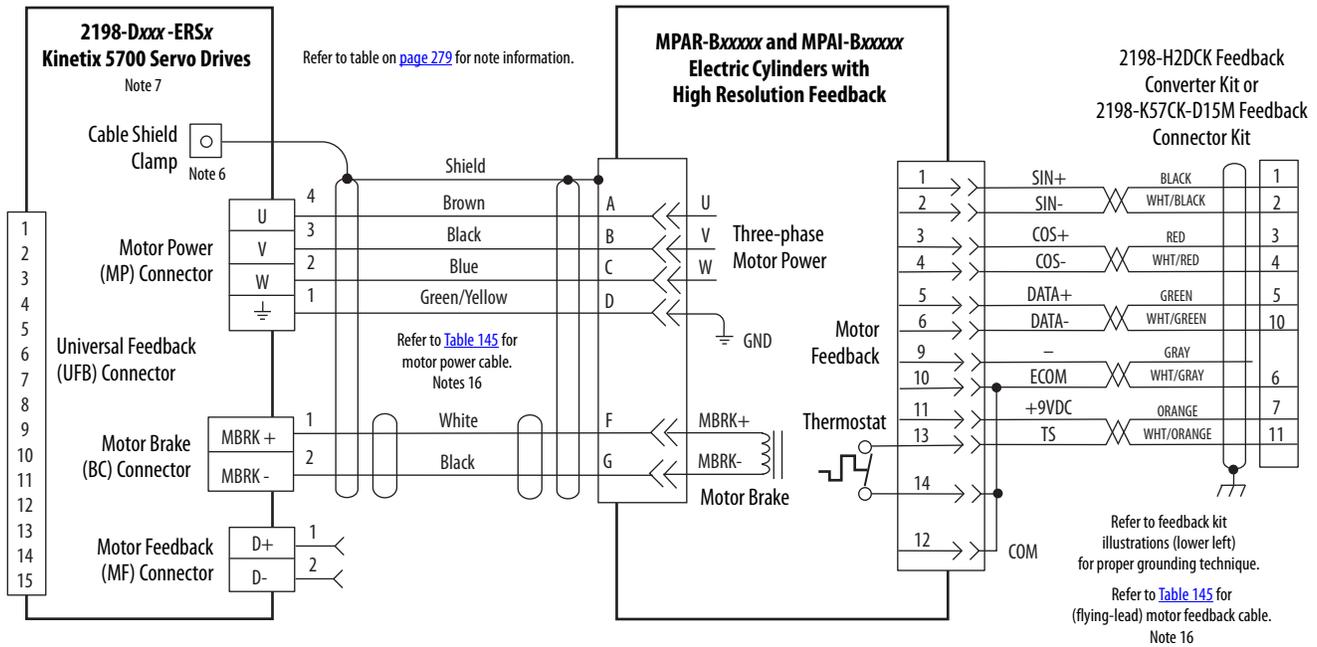


Figure 150 - Kinetix 5700 Drives with MP-Series Electric Cylinders



Grounding Techniques for Feedback Cable Shield

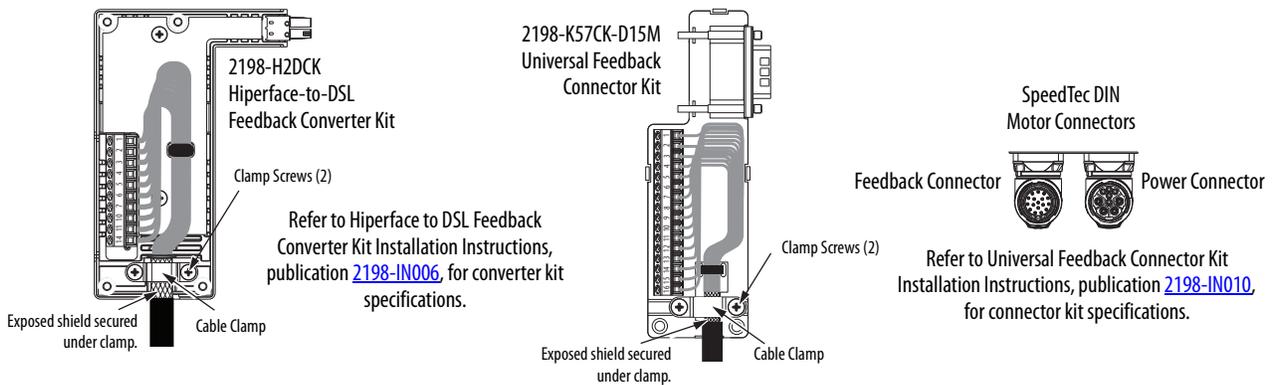
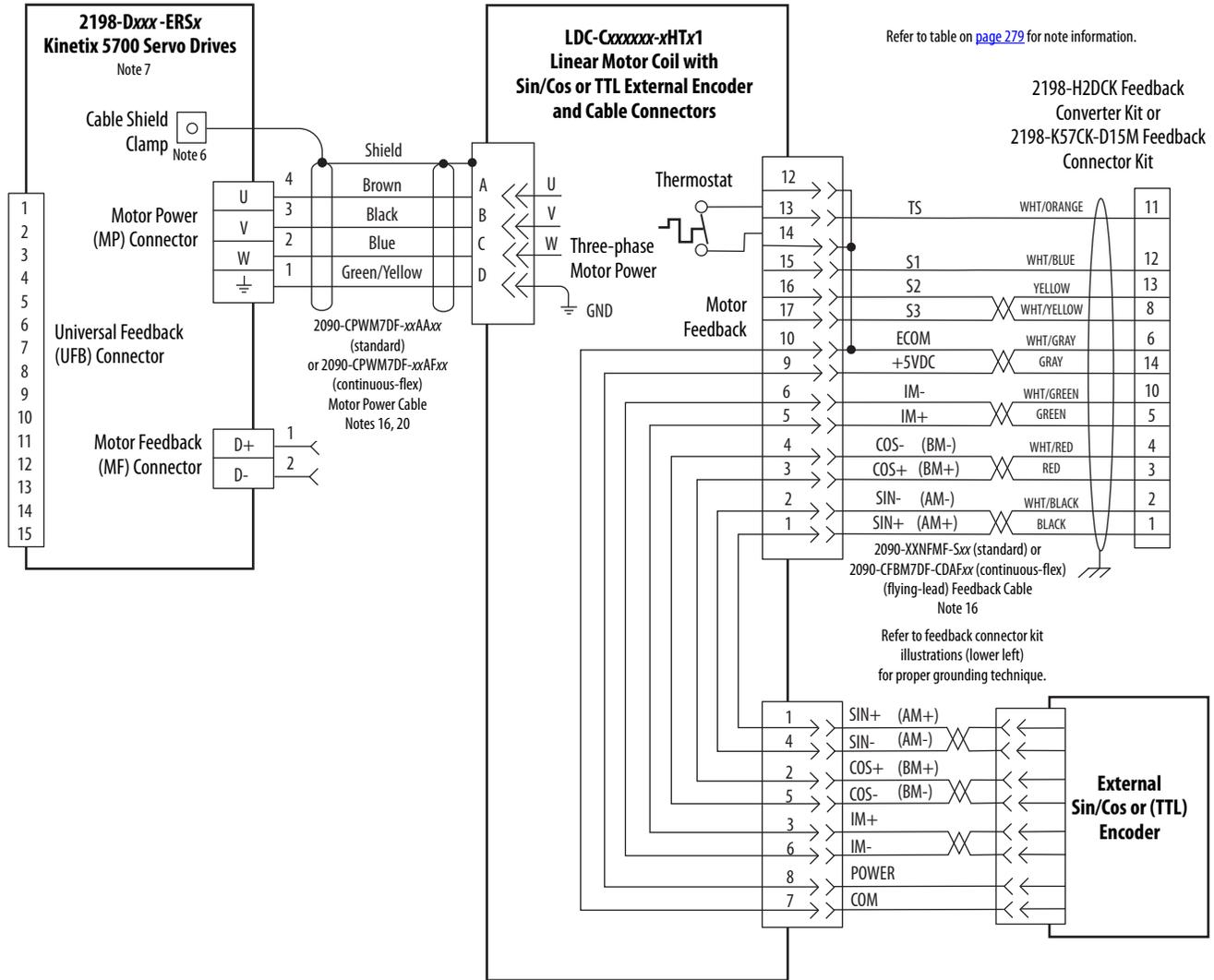


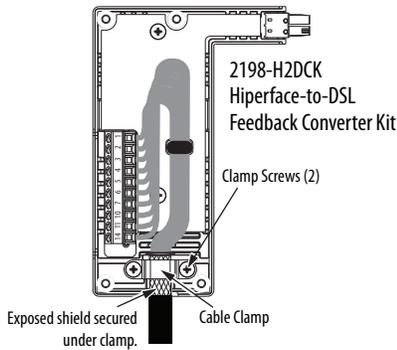
Table 145 - MP-Series Electric Cylinder Power and Feedback Cables

| MP-Series Electric Cylinder Cat. No. | Frame | Power Cable Cat. No. | Feedback Cable Cat. No. |
|--------------------------------------|-------|---|---|
| MPAR-B1xxx (series A and B) | 32 | 2090-XXNPMF-16Sxx (standard) or 2090-CPxM4DF-16AFxx (continuous-flex) | 2090-XXNFMF-Sxx (standard) or 2090-CFBM4DF-CDAFxx (continuous-flex) |
| MPAR-B2xxx (series A and B) | 40 | | |
| MPAR-B1xxx (series B and C) | 32 | | |
| MPAR-B2xxx (series B and C) | 40 | | |
| MPAR-B3xxx | 63 | | |
| MPAI-B2xxxx | 64 | 2090-CPxM7DF-16AAxx (standard) or 2090-CPxM7DF-16AFxx (continuous-flex) | 2090-CFBM7DF-CEAAxx (standard) or 2090-CFBM7DF-CEAFxx (continuous-flex) |
| MPAI-B3xxxx | 83 | | |
| MPAI-B4xxxx | 110 | | |
| MPAI-B5xxxx | 144 | | |

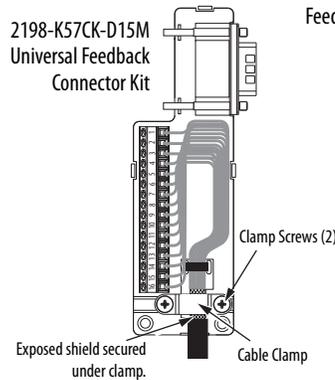
Figure 151 - Kinetix 5700 Drives with LDC-Series Linear Motors (cable connectors)



Grounding Techniques for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.



Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

SpeedTec DIN Motor Connectors

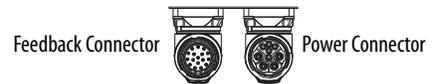
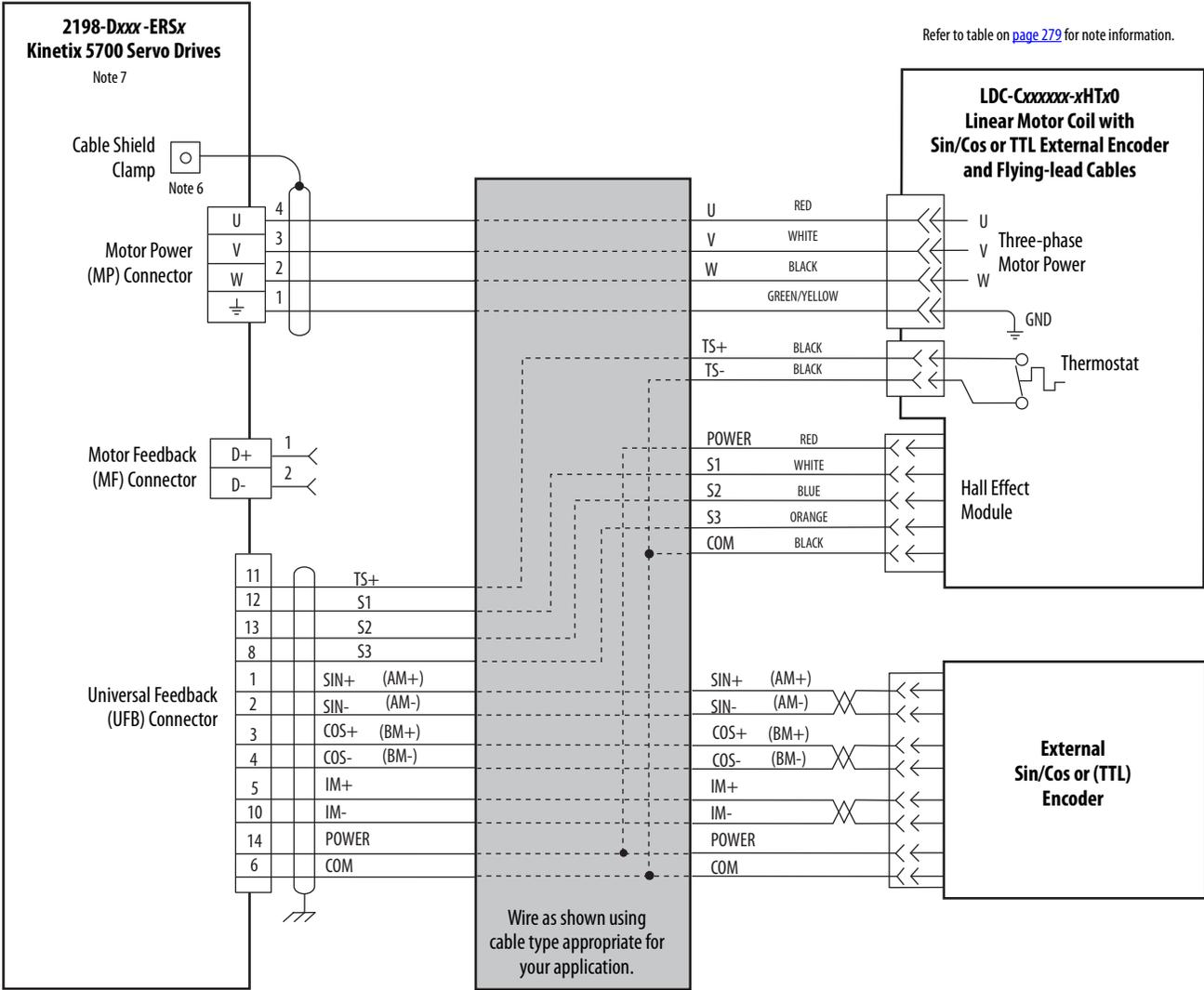
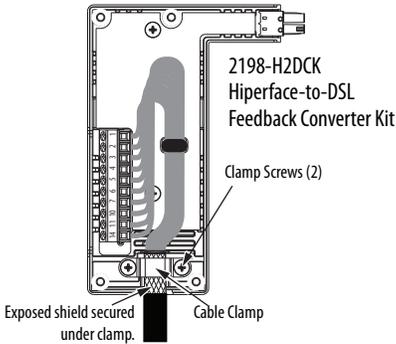


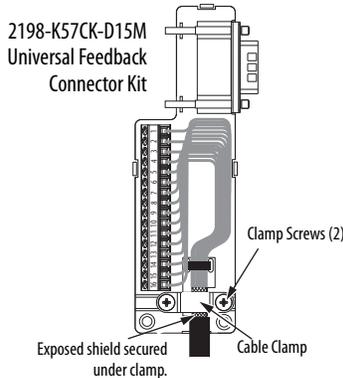
Figure 152 - Kinetix 5700 Drives with LDC-Series Linear Motors (flying-lead cables)



Grounding Techniques for Feedback Cable Shield



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication [2198-IN006](#), for converter kit specifications.

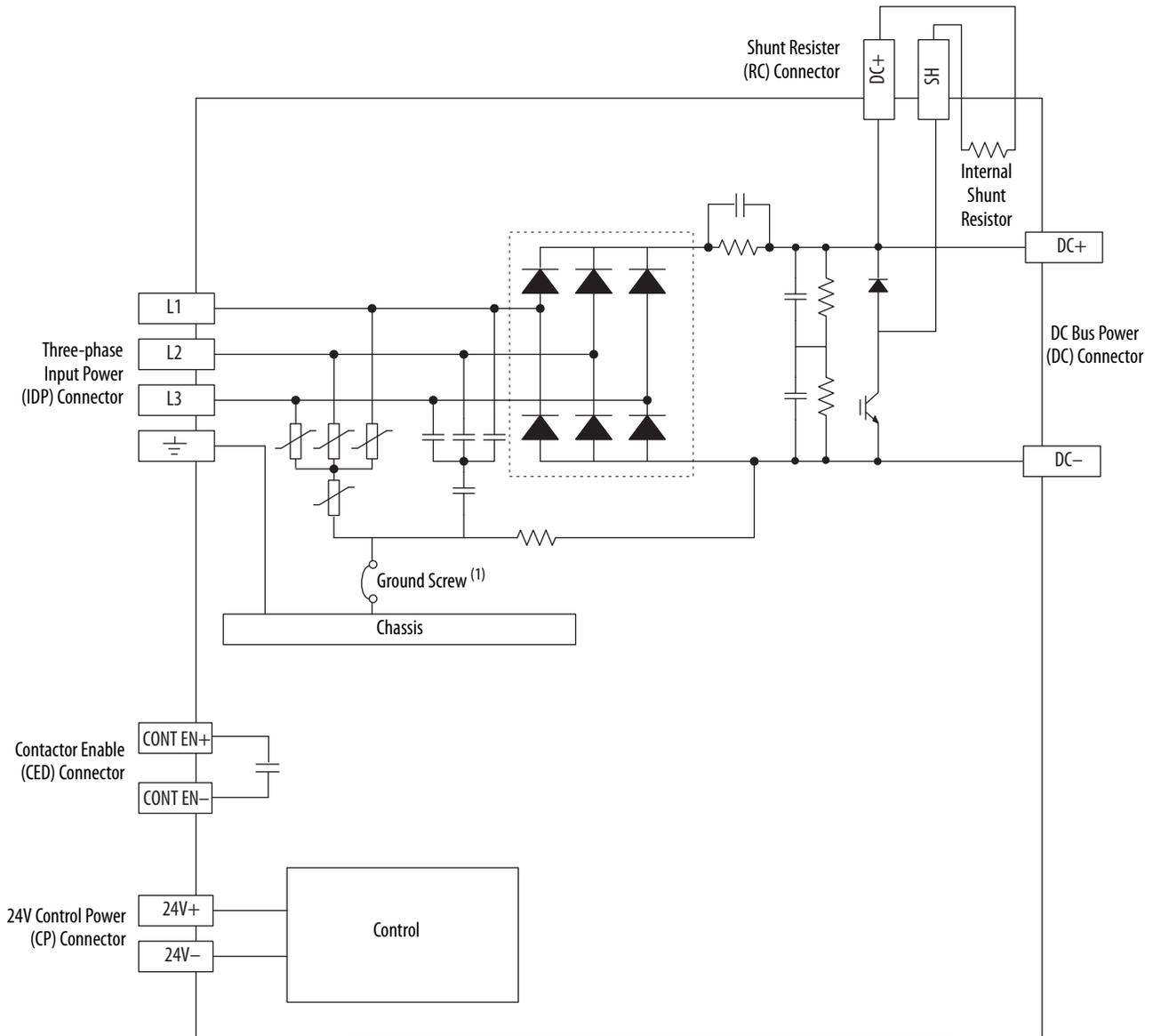


Refer to Universal Feedback Connector Kit Installation Instructions, publication [2198-IN010](#), for connector kit specifications.

System Block Diagrams

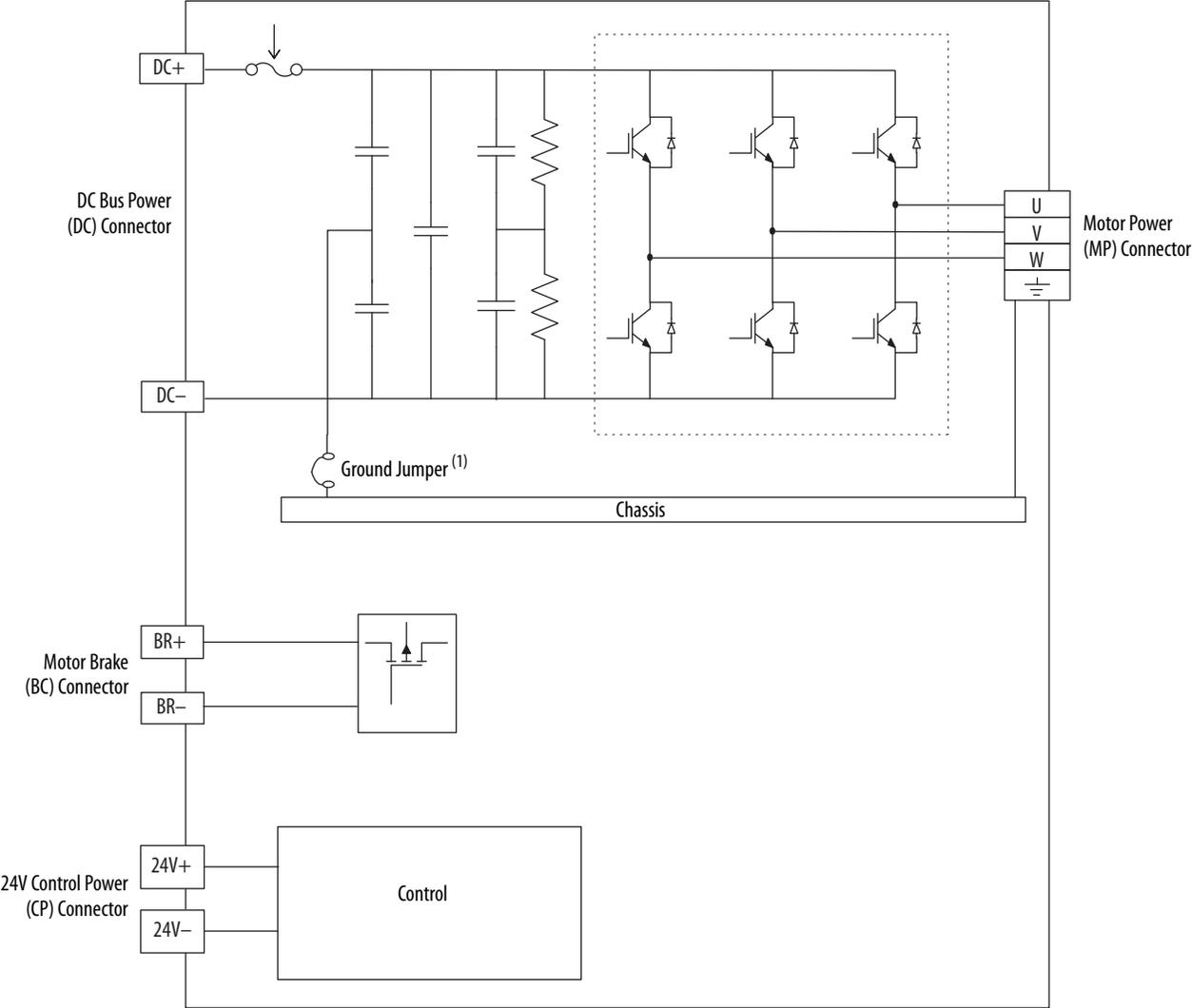
This section provides block diagrams of the Kinetix 5700 drive modules.

Figure 153 - DC-bus Power Supply Block Diagram



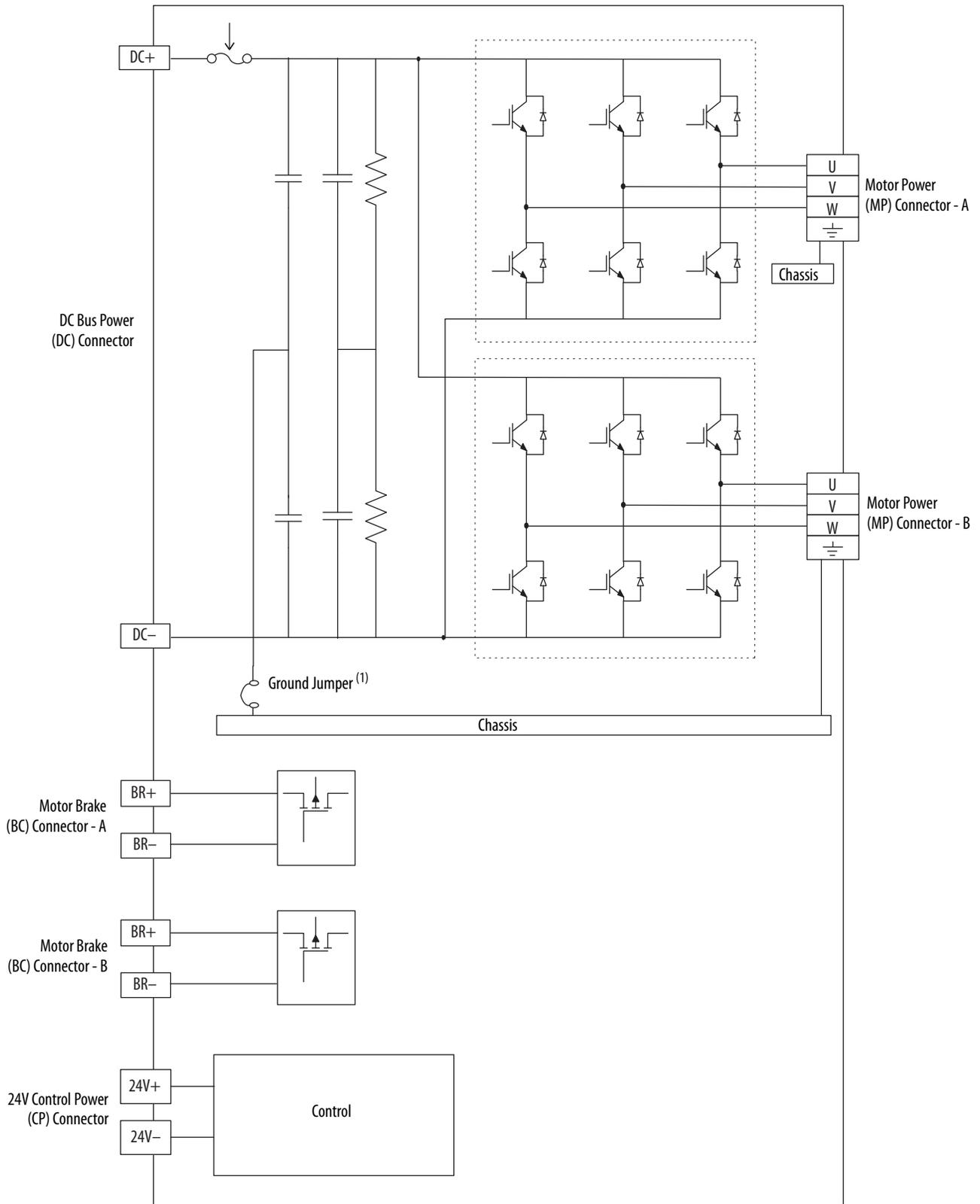
(1) Ground screw in the installed (default) configuration.

Figure 154 - Single-axis Inverter Block Diagram



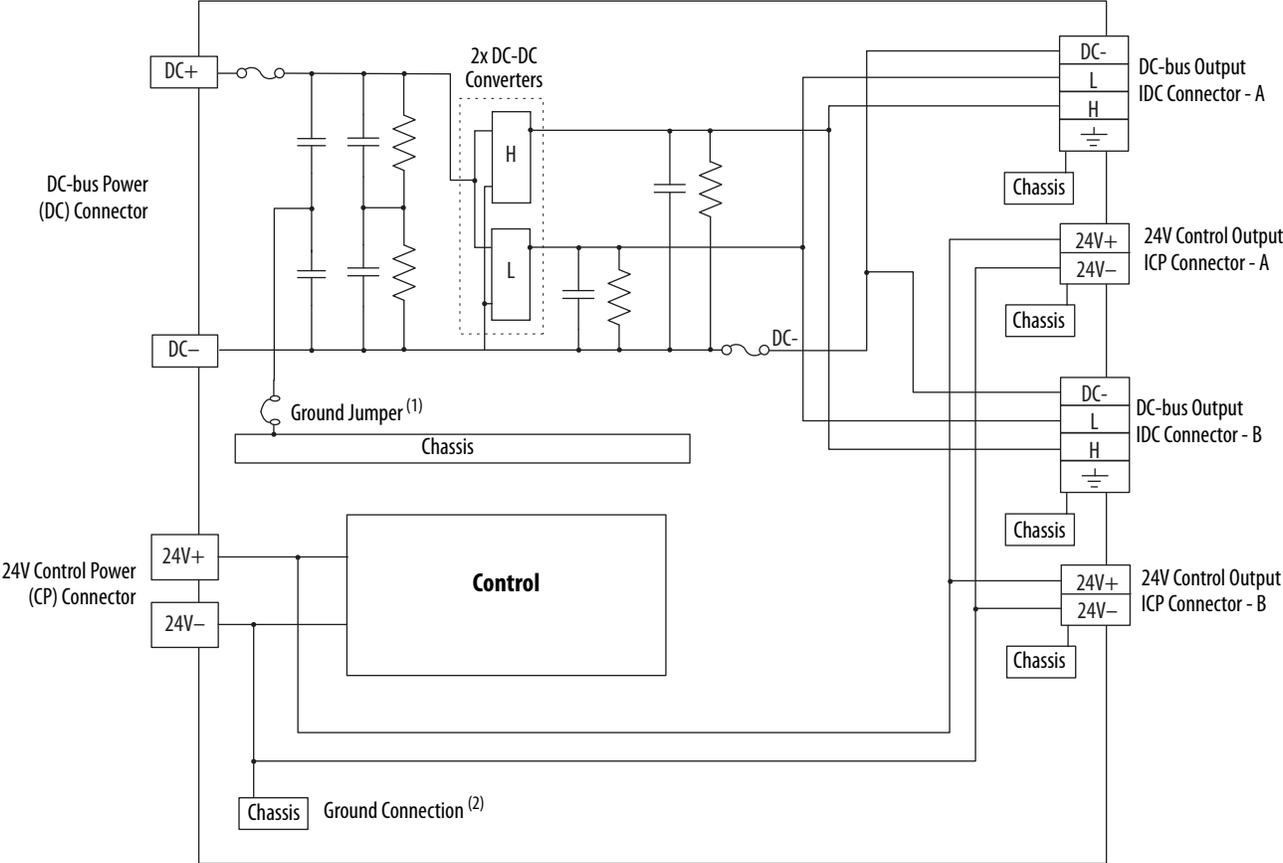
(1) Ground jumper in the installed (default) configuration.

Figure 155 - Dual-axis Inverter Block Diagram



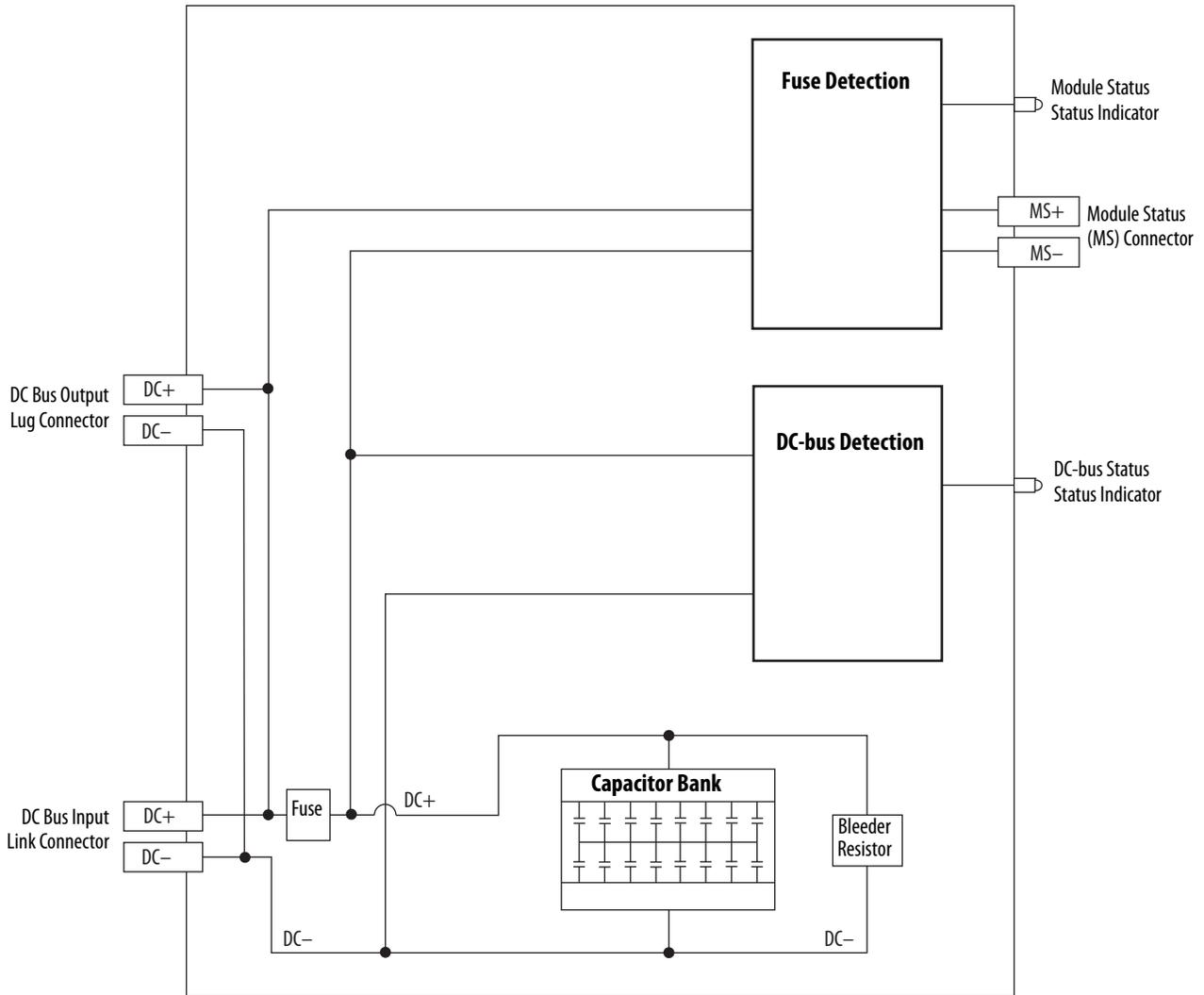
(1) Ground screw in the installed (default) configuration.

Figure 156 - iTRAK Power Supply Block Diagram



(1) Ground screw in the installed (default) configuration.
(2) Connection from 24V- to Chassis is made inside of the iTRAK power supply.

Figure 157 - Capacitor Module Block Diagram



Upgrade the Drive Firmware

This appendix provides procedures for upgrading your Kinetix® 5700 firmware by using ControlFLASH™ software.

| Topic | Page |
|-----------------------------|------|
| Before You Begin | 310 |
| Upgrade Firmware | 313 |
| Verify the Firmware Upgrade | 317 |

Upgrading drive firmware by using ControlFLASH software involves configuring your Logix 5000™ controller communication, selecting the drive to upgrade, and upgrading the firmware.

IMPORTANT If the drive firmware contains updated safety firmware, you must de-energize the safety inputs first or the upgrade fails.

To update the drive firmware in Feedback Only mode, you must inhibit the axis first. Refer to [Inhibit Feedback Only Axis](#) on [page 312](#) for more information.

Before You Begin

The firmware revision for software must be as shown for EtherNet/IP™ networks.

Table 146 - Kinetix 5700 System Requirements

| Description | Firmware Revision |
|--|-------------------|
| Logix Designer application | 26.00.00 or later |
| RSLinx® software | 3.60.00 or later |
| ControlFLASH software kit ⁽¹⁾ | 12.01.00 or later |

Catalog numbers of the targeted Kinetix 5700 drive module you want to upgrade.

Network path to the targeted Kinetix 5700 drive module you want to upgrade.

(1) Download the ControlFLASH kit from <http://support.rockwellautomation.com/controlflash>. Contact Rockwell Automation® Technical Support at (440) 646-5800 for assistance.

For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Software User Manual, publication [1756-UM105](#).

IMPORTANT Control power must be present at CP-1 (24V+) and CP-2 (24V-) prior to upgrading your target module.

IMPORTANT For the DC-bus power supply and inverter modules, the axis state on the LCD display must be STANDBY, CONFIGURING, or PRECHARGE before beginning this procedure.

IMPORTANT The axis state on the LCD display must be STANDBY, when Protected mode is enabled. See [Table 81](#) on [page 142](#) for more information.

IMPORTANT For the iTRAK® power supply, the axis state on the LCD display must be in the START INHIBITED state. See the iTRAK System User Manual, publication [2198T-UM001](#) for information on upgrading firmware on other iTRAK system components.



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 Logix 5000 Controller Communication

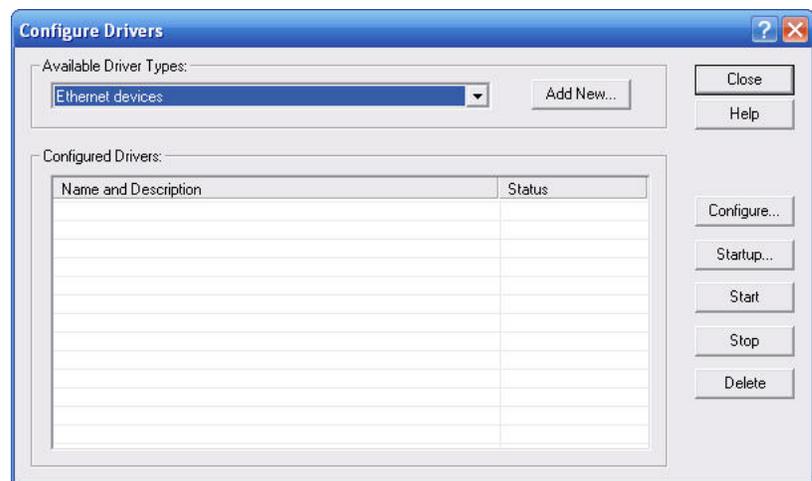
This procedure assumes that your communication method to the Logix 5000 controller is the Ethernet network. It also assumes that your Ethernet communication module or Logix 5000 controller has already been configured.

For more controller information, refer to [Additional Resources](#) on [page 12](#).

Follow these steps to configure Logix 5000 controller communication.

1. Open your RSLinx Classic software.
2. From the Communications menu, choose Configure Drivers.

The Configure Drivers dialog box appears.



3. From the Available Driver Types pull-down menu, choose Ethernet devices.
4. Click Add New.

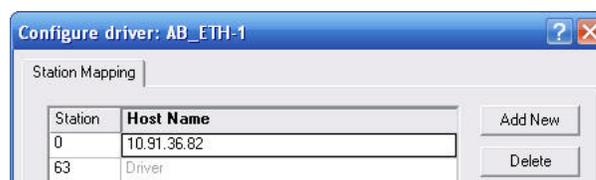
The Add New RSLinx Classic Driver dialog box appears.

5. Type the new driver name.



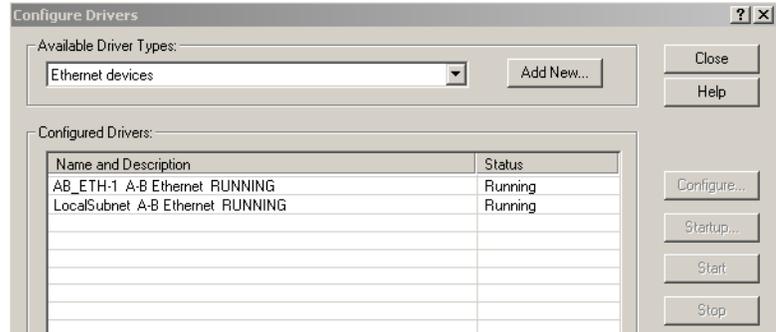
6. Click OK.

The Configure driver dialog box appears.



7. Type the IP address of your Kinetix 5700 servo drive.
8. Click OK.

The new Ethernet driver appears under Configured Drivers.



9. Click Close.
10. Minimize the RSLinx application dialog box.

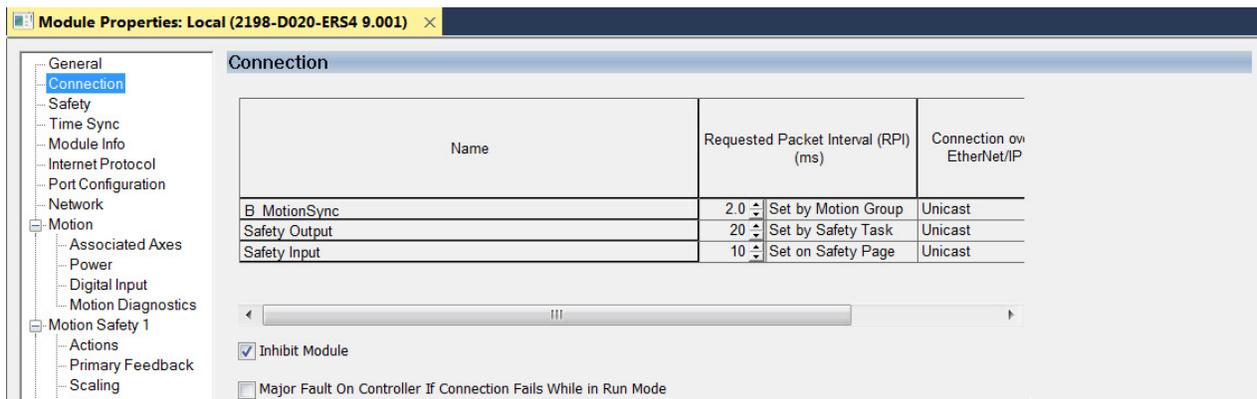
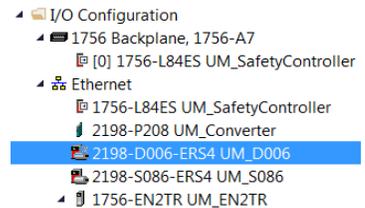
Inhibit Feedback Only Axis

If an axis is configured as Feedback Only, you must inhibit the axis prior to performing the firmware upgrade. Follow these steps to inhibit an axis.

1. Open your Logix Designer application.
2. Right-click the 2198-xxxx-ERSx servo drive you configured as Feedback Only and choose Properties.

The Module Properties dialog box appears.

3. Select the Connection category.



4. Check Inhibit Module.
5. Click OK.
6. Save your file and download the program to the controller.

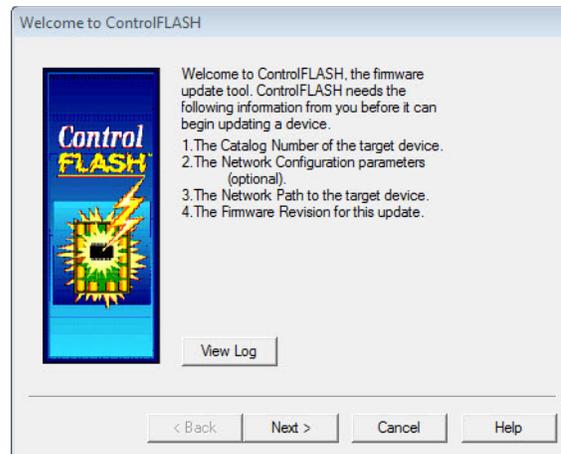
Upgrade Firmware

Follow these steps to select the drive module to upgrade.

1. In the Logix Designer application, from the Tools menu, choose ControlFLASH.

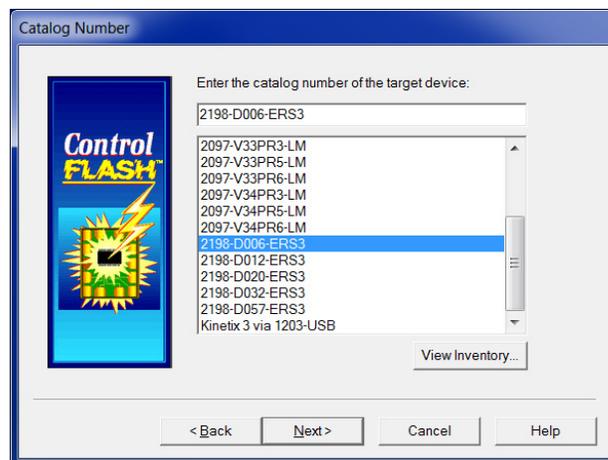
TIP You can also open ControlFLASH software by choosing Start>Programs>FLASH Programming Tools>ControlFLASH.

The Welcome to ControlFLASH dialog box appears.



2. Click Next.

The Catalog Number dialog box appears.

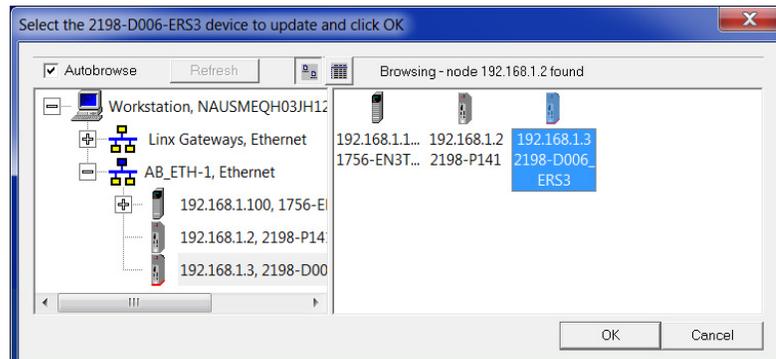


3. Select your drive module.

In this example, the 2198-D006-ERS3 servo drive is selected.

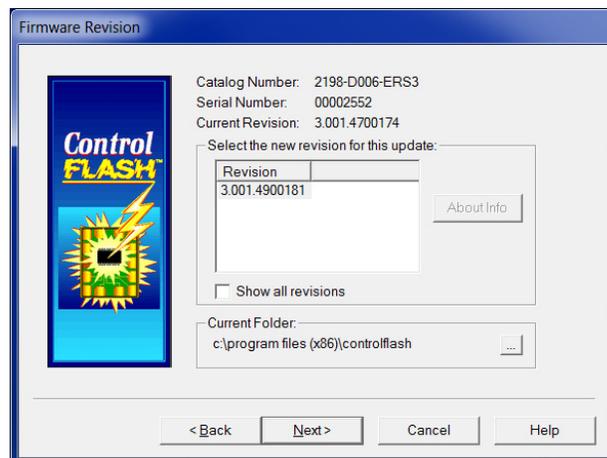
4. Click Next.

The Select Device to Update dialog box appears.



5. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.
6. Select the servo drive to upgrade.
7. Click OK.

The Firmware Revision dialog box appears.



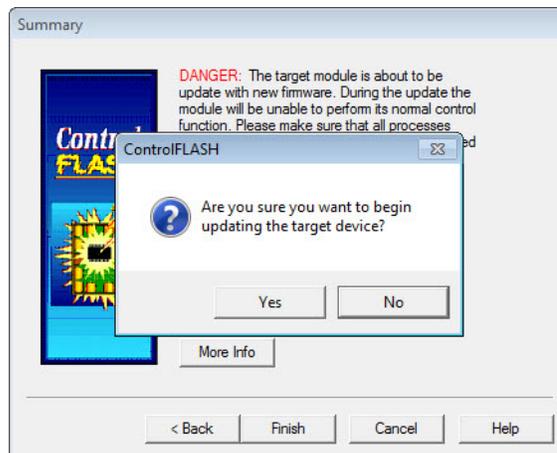
8. Select the firmware revision to upgrade.
9. Click Next.

The Summary dialog box appears.



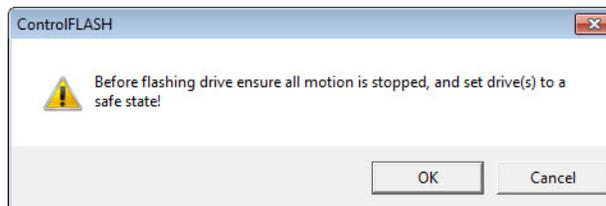
10. Confirm the drive catalog number and firmware revision.
11. Click Finish.

This ControlFLASH warning dialog box appears.



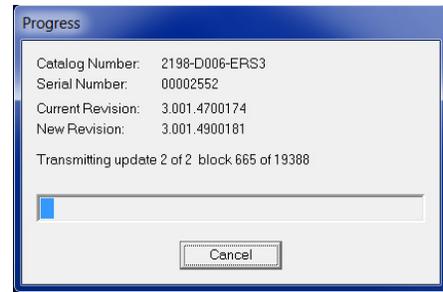
12. Click Yes (only if you are ready).

This ControlFLASH warning dialog box appears.



13. Acknowledge the warning and click OK.

The Progress dialog box appears and updating begins.

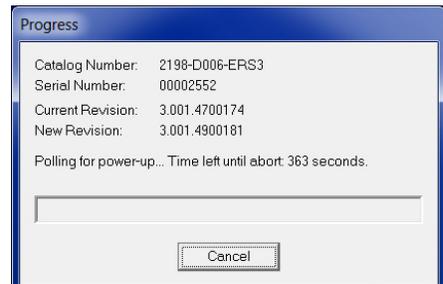


The axis state on the LCD display changes from CONFIGURING, STOPPED, or PRECHARGE to FIRMWARE UPDATE IN PROGRESS, which indicates that the upgrade is in progress.

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.

It is normal for this process to take several minutes.



IMPORTANT Do not cycle power to the drive during this process or the firmware upgrade does not complete successfully.

15. Verify that the Update Status dialog box appears and indicates success or failure as described below.

| Upgrading Status | If |
|------------------|--|
| Success | Update complete appears in a GREEN Status dialog box, then go to step 16 . |
| Failure | Update failure appears in a RED Status dialog box, then refer to the ControlFLASH Firmware Upgrade Software User Manual, publication 1756-UM105 for troubleshooting information. |



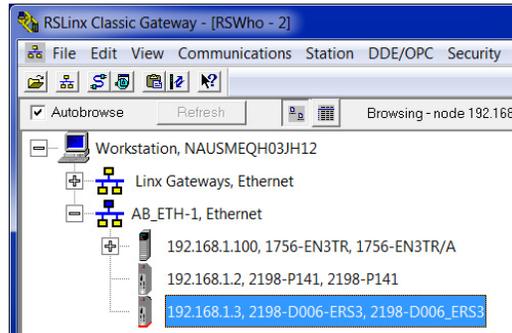
16. Click OK.

IMPORTANT If you are upgrading a feedback-only axis and you checked Inhibit Module on the Connection category in Module Properties, you must clear the Inhibit Module checkbox before resuming normal operation.

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 menu, choose RSWho.



3. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.
4. Right-click the drive module and choose Device Properties.

The Device Properties dialog box appears.



5. Verify the new firmware revision level.
6. Click Close.

Notes:

Size Multi-axis Shared-bus Configurations

This appendix provides information and examples for sizing your Kinetix® 5700 DC-bus power supplies and inverters in multi-axis shared-bus configurations.

| Topic | Page |
|-----------------------------------|------|
| Shared-bus Configurations | 319 |
| System Sizing Guidelines | 321 |
| System Sizing Example | 325 |
| System Sizing Application Example | 326 |

Shared-bus Configurations

You can supply input power to your Kinetix 5700 drive system from different sources. Shared-bus configurations for Kinetix 5700 drives include the following:

- Single 2198-Pxxx DC-bus power supply
- Multiple 2198-P208 DC-bus power supplies (up to three are possible)
- 8720MC-RPS regenerative power supply (RPS unit)

Shared-bus Definitions

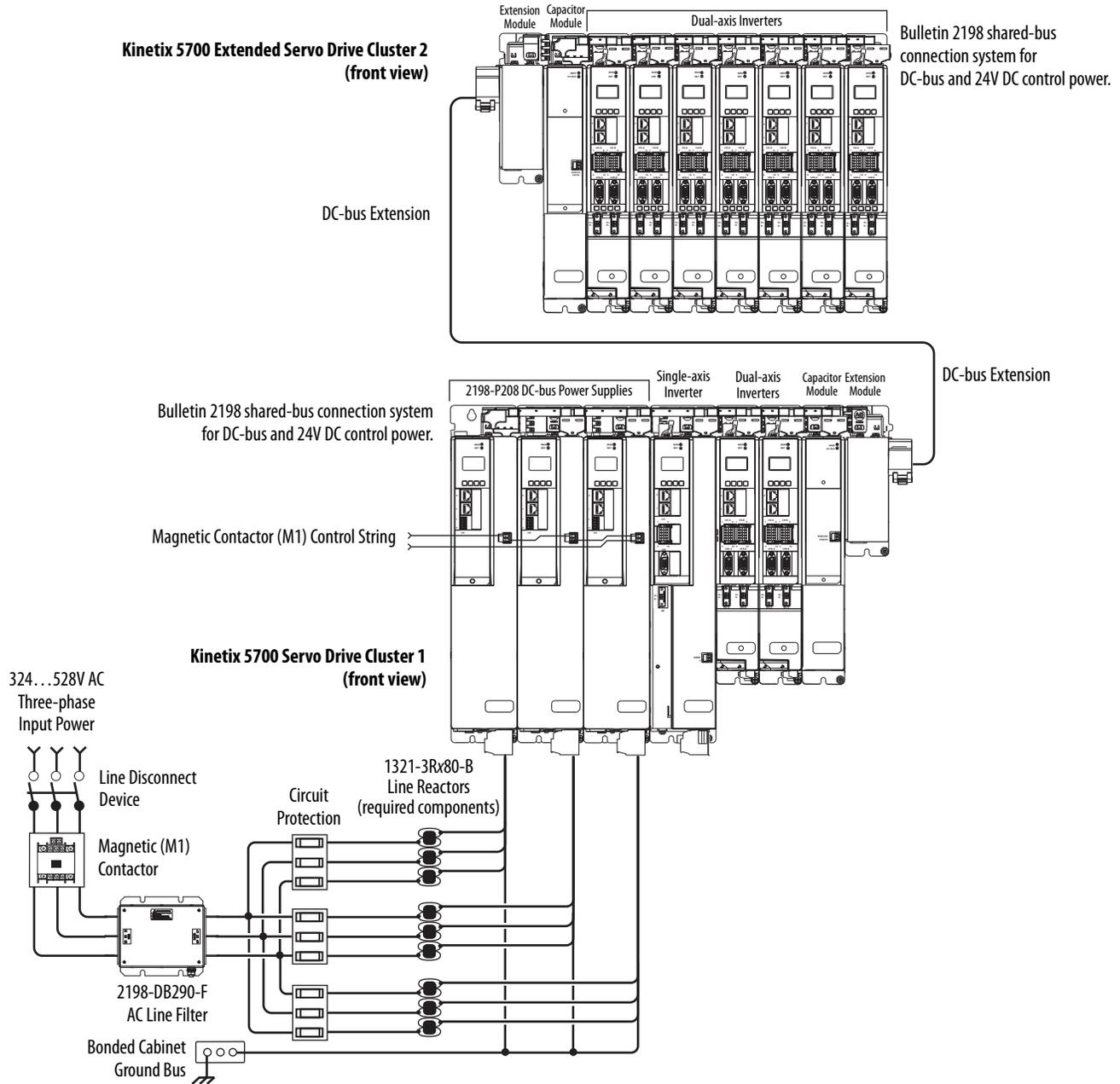
Throughout this manual, these terms are used to describe how drive modules are grouped together.

Table 147 - Shared-bus Terminology

| Term | Definition |
|-----------------|--|
| DC-bus group | Drive modules that are all connected to the same DC bus. |
| Clusters | Groups of drive modules that are connected to the same DC bus joined by the DC bus-bars. The maximum number of clusters in the same DC-bus group is 2. |
| Extended DC-bus | When 2 drive clusters are part of the same DC-bus group joined by the DC bus-bars. |

In this example, 2 drive clusters in the same cabinet are connected by the same 450...750V DC-bus voltage. Kinetix 5700 capacitor modules provide connection points for the DC bus at the end of cluster 1 and the beginning of cluster 2. The extension module is needed only when the DC-bus system current exceeds 100 A, and can support up to 200 A maximum external DC-bus current.

Figure 158 - Extended DC-bus Installation



IMPORTANT When two or three DC-bus power supplies are wired together in the same drive cluster, they must all be catalog number 2198-P208.

General Sizing Guidelines

These limitations apply to Kinetix 5700 servo drive systems supplied by a single 2198-Pxxx or multiple 2198-P208 DC-bus power supplies:

- The sum of the inverter motor-power cable lengths for all inverters on the same DC bus-sharing group must not exceed 400 m (1312 ft) to comply with CE requirements.
- The total system capacitance limit is based on the power supply catalog number. DC-bus groups must not exceed the limits defined in [Table 148](#).
- No more than three 2198-P208 DC-bus power supplies can be used to increase the converter power or to increase the total system capacitance.
- If using the 24V DC shared-bus connection system to distribute control input power to a cluster of drive modules, current from the 24V power supply must not exceed 52 A.
- The Kinetix 5700 system cannot have more than two drive clusters in a single DC-bus group.

Refer the 8720MC Regenerative Power Supply Installation Manual, publication [8720MC-RM001](#), for additional system sizing limitations.

System Sizing Guidelines

You begin the process by selecting the motor for your application and sizing the drive and power supply combinations. Next, calculate whether the motor power cable length, total system capacitance, and 24V current demand are within specifications.

For systems with an iTRAK® power supply, the iTRAK system requirements must be calculated to determine the following:

- Kinetix 5700 DC-bus loading (DC-bus motoring and bus-regulation power requirements)
- 2198-Pxxx power supply for supporting the iTRAK power supplies
- 24V current demand
- Number of iTRAK power supplies required
- Resulting net converter power and bus-regulator capacity

See the iTRAK System User Manual, publication [2198T-UM001](#) for more information.

For iTRAK hardware and iTRAK power supplies, skip ahead to the [Calculate Total System Capacitance](#) on [page 322](#).

Select Drive/Motor Combinations

The motor required for a particular application determines the servo drive required for full motor performance.

For best results, use the Motion Analyzer system sizing and selection tool, available at <https://motionanalyzer.rockwellautomation.com>. Drive/motor performance specifications and torque/speed curves are also available in the Kinetix 5700 Drive Systems Design Guide, publication [KNX-RM010](#).

Select the Power Supply and Define the DC-bus Groups

- Determine the converter DC-bus motoring and bus-regulation power requirements based on the load profile.
- Estimate the net converter and inverter power and bus-regulator capacity, based on the load profiles.
- Determine if 2198-CAPMOD-2240 capacitor modules are required.

For best results, use the Motion Analyzer system sizing and selection tool, available at <https://motionanalyzer.rockwellautomation.com>.

Calculate Total System Capacitance

Total system capacitance is the sum of all internal capacitance values from each of the drive modules (single-axis inverters, dual-axis inverters, power supplies, and capacitor modules) in the same DC-bus group.

The total system capacitance must be less than the maximum supported DC-bus capacitance value of the power supply.

IMPORTANT If your total system capacitance value exceeds the maximum supported capacitance value of the DC-bus power supply, perform one of the following:

- Increase the size of the DC-bus power supply
- Use multiple DC-bus power supplies (1...3 power supplies are possible)

Decrease the total system capacitance by removing inverters or capacitor modules from the DC-bus group.

Table 148 - Maximum Supported DC-bus Capacitance

| Power Supply | DC-bus Power Supply Cat. No. | Supported Capacitance, max μF |
|-------------------------|------------------------------|--|
| Single Power Supply | 2198-P031 | 8,000 |
| | 2198-P070 | |
| | 2198-P141 | 13,000 |
| | 2198-P208 | |
| Multiple Power Supplies | 2 x 2198-P208 | 26,000 |
| | 3 x 2198-P208 | 39,000 |

Table 149 - Internal Capacitance

| Drive Module | Drive Module Cat. No. | Internal Capacitance μF |
|---------------------------------|-----------------------|------------------------------------|
| DC-bus Power Supplies | 2198-P031 | 585 |
| | 2198-P070 | 780 |
| | 2198-P141 | 1640 |
| | 2198-P208 | 2050 |
| Dual-axis Inverters | 2198-D006-ERSx | 165 |
| | 2198-D012-ERSx | |
| | 2198-D020-ERSx | 330 |
| | 2198-D032-ERSx | 390 |
| | 2198-D057-ERSx | 705 |
| Single-axis Inverters | 2198-S086-ERSx | 560 |
| | 2198-S130-ERSx | 840 |
| | 2198-S160-ERSx | 1120 |
| iTRAK Power Supply | 2198T-W25K-ER | 390 |
| Capacitor Module ⁽¹⁾ | 2198-CAPMOD-2240 | 2240 |

(1) The 2198-CAPMOD-DCBUS-IO extension module does not have any internal bus capacitance.

Calculate the Total Motor Power Cable Length

To meet CE requirements, the sum of all motor power cable lengths from the same DC-bus group must not exceed 400 m (1312 ft).

Calculate 24V DC Control Power Current Demand

If using the 24V DC shared-bus connection system to distribute control input power to a drive cluster, output current from the 24V power supply must not exceed 52 A.

Table 150 - Control Power Current Specifications

| Drive Module | Drive Module Cat. No. | 24V Current Per Module (non-brake motor) A_{DC} | 24V Current, max (with maximum brake current) A_{DC} | 24V Inrush Current ⁽⁵⁾ A |
|-----------------------------------|-----------------------|--|---|--|
| DC-bus Power Supplies | 2198-P030 | 0.8 | N/A | 4.0 |
| | 2198-P070 | | | |
| | 2198-P141 | 1.9 | | |
| | 2198-P208 | | | |
| Dual-axis Inverters | 2198-D006-ERSx | 1.4 ⁽²⁾ | 5.5 ⁽³⁾ | 4.0 |
| | 2198-D012-ERSx | | | |
| | 2198-D020-ERSx | | | |
| | 2198-D032-ERSx | 1.7 ⁽²⁾ | 7.7 ⁽³⁾ | |
| | 2198-D057-ERSx | 2.3 ⁽²⁾ | 8.3 ⁽³⁾ | |
| Single-axis Inverters | 2198-S086-ERSx | 4.6 | 9.6 ⁽⁴⁾ | 4.0 |
| | 2198-S130-ERSx | | | |
| | 2198-S160-ERSx | | | |
| iTRAK Power Supply ⁽¹⁾ | 2198T-W25K-ER | 1.3 | N/A | 2.2 |
| Capacitor Modules | 2198-CAPMOD-2240 | 0.5 | N/A | N/A |
| | 2198-CAPMOD-DCBUS-IO | N/A | | |

- (1) These values represent only the iTRAK power supply. They do not include the iTRAK motor modules that are connected to the iTRAK power supply and also draw current from this 24V control power input. For more information regarding 24V control power requirements, see the iTRAK System User Manual, publication [2198T-UM001](#).
- (2) Values are base current per module.
- (3) Values assume two brake motors, each drawing the maximum rating of 2 A, are attached to each module.
- (4) Values assume the maximum rated brake current of 5 A.
- (5) Inrush current duration is less than 30 ms.

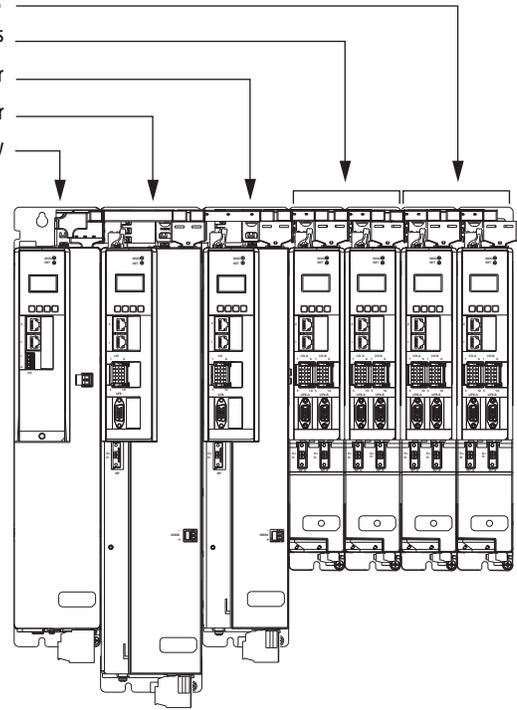
IMPORTANT If the 24V control-power output current (based on your system calculation) exceeds 52 A, you must add another 24V power supply. To do this, you can insert another 2198-TCON-24VDCIN36 control power input wiring connector at any point in your drive cluster.

System Sizing Example

This example shows how a single Kinetix 5700 drive cluster meets the total bus capacitance, power cable length, and 24V DC current limitations.

Figure 159 - Example DC-bus Group (single drive cluster)

- 2198-D006-ERSx Dual-axis Inverters
- 2198-D020-ERSx Dual-axis Inverters
- 2198-S086-ERSx Single-axis Inverter
- 2198-S160-ERSx Single-axis Inverter
- 2198-P208 DC-bus Power Supply



In this example, only 1 drive cluster defines the DC-bus group. Two drive clusters are possible by extending the DC-bus.

- Maximum motor power cable length: 400 m (1312 ft)
 - Total motor power cable length is 337 m (1106 ft)
- Maximum supported capacitance: 13,000 μ F
 - Total system capacitance is 4840 μ F
- Maximum 24V DC control power current: 52 A
 - Total 24V DC control power current is 20.3 A
 - The Coil Current column shows how much of the 24V current is consumed by the motor brake circuit.

All of the total system values are within the acceptable range.

Table 151 - System Sizing Example Data

| DC-bus Group Cat. No. | Axis | Internal Capacitance μ F | Cable Length m (ft) | Servo Motor | | 24V DC Control Power Current Calculations | | |
|-----------------------|------|------------------------------|---------------------|----------------------|---------------------|---|---|-----------------|
| | | | | Servo Motor Cat. No. | Brake Option Yes/No | Brake Current @ 24V DC A | 24V Current (non-brake motor) A _{DC} | Total Current A |
| 2198-P208 | | 2050 | N/A | N/A | N/A | N/A | 1.9 | 1.9 |
| 2198-S160-ERSx | | 1120 | 50 (164) | MPL-B980E | No | – | 4.6 | 4.6 |
| 2198-S086-ERSx | | 560 | 90 (295) | MPL-B660F | Yes | 2.1 | 4.6 | 6.7 |
| 2198-D020-ERSx | A | 390 | 20 (66) | VPL-B1152F | No | – | 1.4 | 1.4 |
| | B | | 15 (49) | VPL-B1152F | No | – | | |
| 2198-D020-ERSx | A | 390 | 9 (30) | VPL-B1003C | Yes | 0.50 | 1.4 | 2.4 |
| | B | | 90 (295) | VPL-B1003C | Yes | 0.50 | | |
| 2198-D006-ERSx | A | 165 | 9 (30) | MPL-B310P | Yes | 0.50 | 1.4 | 1.9 |
| | B | | 9 (30) | MPL-B310P | No | – | | |
| 2198-D006-ERSx | A | 165 | 15 (49) | MPL-B310P | No | – | 1.4 | 1.4 |
| | B | | 30 (98) | MPL-B310P | No | – | | |
| Totals | | 4840 | 337 (1106) | | | 3.6 | 16.7 | 20.3 |

For more information on motor and motor-brake specifications, refer to the Kinetix Rotary Motion Specifications Technical Data, publication [KNX-TD001](#).

System Sizing Application Example

This example shows how to size the DC-bus power supply for your multi-axis system by using the motor output power (kW). Sizing is based on the largest motor kW value in your drive system.

The Kinetix 5700 drive modules are zero-stacked and use the shared-bus connection system to extend power from the 2198-Pxxx DC-bus power supply to multiple drive modules. For best results, use the Motion Analyzer system sizing and selection tool, available at <https://motionanalyzer.rockwellautomation.com>.

Table 152 - DC-Bus Power Supply Continuous Output Power

| DC-Bus Power Supply Cat. No. | Continuous Output Power kW |
|------------------------------|----------------------------|
| 2198-P031 | 7 |
| 2198-P070 | 17 |
| 2198-P141 | 31 |
| 2198-P208 | 46 |

In this typical system, all axes are running in an asynchronous rapid acceleration/deceleration motion profile. Use this formula to calculate the minimum continuous output-power (kW) for your Kinetix 5700 drive system:

$$2198-Pxxx = \text{Largest motor-rated kW} \times (\text{axis-count} \times 0.6) + (\text{axis-count} \times 0.2)$$

Table 153 - Motor/Drive System Example

| Motor Quantity | Motor Cat. No. | Motor Rated Output ⁽¹⁾ kW | Drive Cat. No. |
|----------------|----------------|--------------------------------------|----------------|
| 1 | MPM-B2153F | 7.2 | 2198-S086-ERSx |
| 1 | | | 2198-S086-ERSx |
| 1 | MPL-B660F | 6.1 | 2198-S086-ERSx |
| 1 | | | 2198-S086-ERSx |
| 2 | VPL-B0753 | 0.82 | 2198-D020-ERSx |
| 2 | | | 2198-D020-ERSx |

8 = axis count

(1) For more motor specifications, see the Kinetix Rotary Motion Specifications Technical Data, publication [KNX-TD001](#).

$$\begin{aligned} \text{Continuous Output Power, min (kW)} &= 7.2 \times (8 \times 0.6) + (8 \times 0.2) \\ \text{kW} &= 7.2 \times 4.8 + 1.6 \\ \text{kW} &= 36.16 \end{aligned}$$

In this example, the MPM-B2153F motor has the largest motor-rated output. As a result, the minimum continuous output-power = 36.16 kW, and the 2198-P208 DC-bus power supply is required for the 8-axis system example.

Motor Control Feature Support

This appendix provides feature descriptions for the 400V-class induction motors and permanent-magnet motors that are supported by Kinetix® 5700 servo drives.

| Topic | Page |
|---|-------------|
| Frequency Control Methods | 328 |
| Current Limiting for Frequency Control | 332 |
| Stability Control for Frequency Control | 335 |
| Skip Speeds | 337 |
| Flux Up | 339 |
| Current Regulator Loop Settings | 342 |
| Motor Category | 342 |
| Selection of Motor Thermal Models | 347 |
| Speed Limited Adjustable Torque (SLAT) | 349 |
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| Velocity Droop | 364 |
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Frequency Control Methods

The Kinetix 5700 servo drives support three open-loop frequency control methods. These are the choices:

- **Basic Volts/Hertz** - This method is used in single asynchronous-motor applications
- **Basic Volts/Hertz - Fan Pump** - This method is similar to Basic Volts/Hertz, but is specifically tailored for fan/pump applications
- **Sensorless Vector with Slip Compensation** - This method is used for most constant torque applications. Provides excellent starting, acceleration, and running torque

To configure your induction motor in the Logix Designer application, refer to [Configure Induction-motor Frequency-control Axis Properties](#) on [page 171](#).

Open-loop frequency control is suitable in applications such as conveyors, pumps, and fans. Features include the following:

- Start Boost and Run Boost
- Electronic motor thermal-overload protection per Class 10 requirements
- Two skip frequencies, in which the drive does not operate
- All three-phase induction motors, suitable for variable speed drive (VFD) operation, are supported

Table 154 - Motor Specifications

| Attribute | Value |
|-------------------------|------------------------------|
| Output frequency, max | 590 Hz |
| Pole pairs, max | 50 |
| Motor cable length, max | 90 m (295 ft) ⁽¹⁾ |

(1) Applies to all Kinetix 5700 drives and compatible motors/actuators with Hiperface and Hiperface DSL high-resolution absolute feedback. For compatible motors/actuators with incremental feedback, 30 m (98 ft) is the maximum cable length.

Basic Volts/Hertz

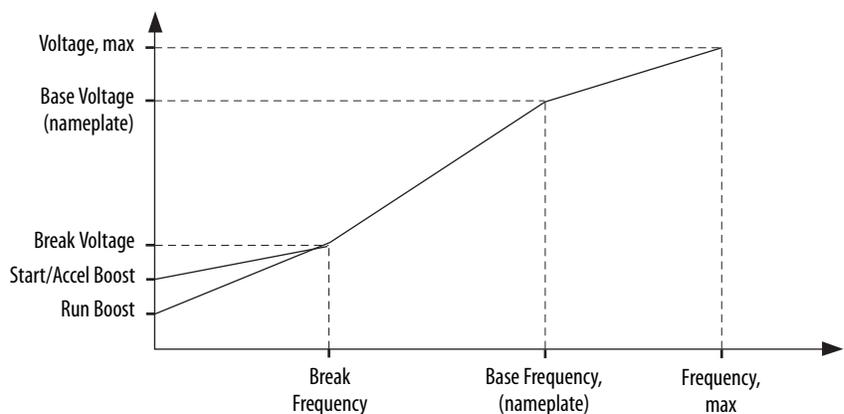
Volts/hertz operation creates a fixed relationship between output voltage and output frequency. Voltage is applied to the motor, which is based on the operating frequency command at a fixed volts/hertz ratio. The ratio is calculated from the motor nameplate data and entered into the Logix Designer application >Axis Properties>Frequency Control category.

The Basic Volts/Hertz method provides various patterns. The default configuration is a straight line from zero to rated voltage and frequency. As seen in [Figure 160](#), you can change the volts/hertz ratio to provide increased torque performance when required by programming five distinct points on the curve.

Table 155 - Basic Volts/Hertz Definitions

| Curve Feature | Definition |
|-----------------------------------|---|
| Start boost | Used to create additional torque for breakaway from zero speed and acceleration of heavy loads at lower speeds. |
| Run boost | Used to create additional running torque at low speeds. The value is typically less than the required acceleration torque. The drive lowers the boost voltage to this level when running at low speeds (not accelerating). This reduces excess motor heating that could result if the higher start/accel boost level were used. |
| Break voltage/frequency | Used to increase the slope of the lower portion of the Volts/Hertz curve, providing additional torque. |
| Motor nameplate voltage/frequency | Sets the upper portion of the curve to match the motor design. Marks the beginning of the constant power region. |
| Maximum voltage/frequency | Slopes the portion of the curve that is used above base speed. |

Figure 160 - Basic Volts/Hertz Method



Basic Volts/Hertz for Fan/Pump Applications

The Basic Volts/Hertz Fan/Pump (fan/pump) method is based on the Basic Volts/Hertz (V/Hz) method, but is specifically tailored for fan/pump applications.

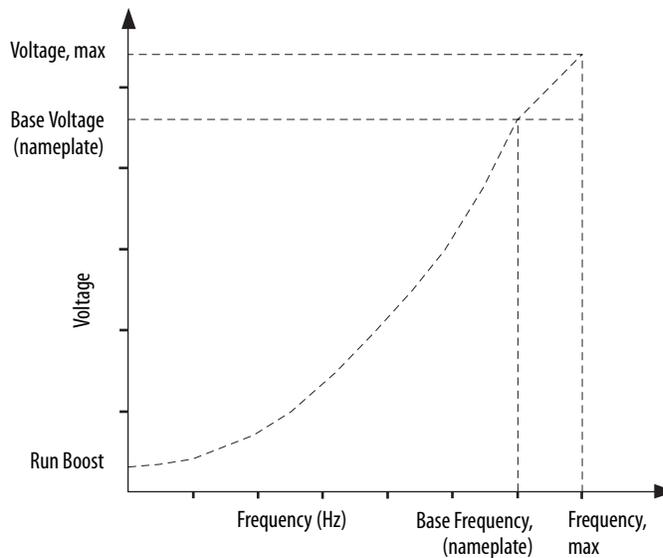
Figure 161 - Output Voltage Equation

$$V_x = \left(\frac{f_x}{f_n} \right)^2 (V_n - V_{boost}) + V_{boost}$$

Where:
 V_x = Output voltage
 f_x = Output frequency
 V_n = Rated voltage
 f_n = Rated frequency
 V_{boost} = Run boost voltage

For maximum system efficiency, fan/pump loads use variable frequency drives that are equipped with a specific V/Hz curve where voltage is proportional to square of the frequency.

Figure 162 - Basic Volts/Hertz Fan/Pump Method

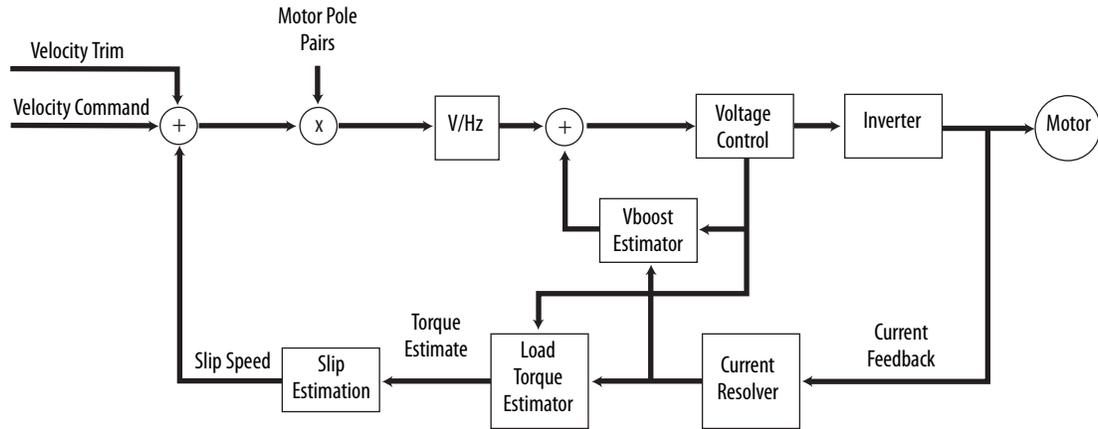


TIP The Fan/Pump control method supports the run-boost attribute, but does not support break-voltage, break-frequency, or start-boost.

Sensorless Vector

The Sensorless Vector method uses a volts/hertz core enhanced by a current resolver, slip estimator, and a voltage-boost compensator based on the operating conditions of the motor.

Figure 163 - Sensorless Vector Method

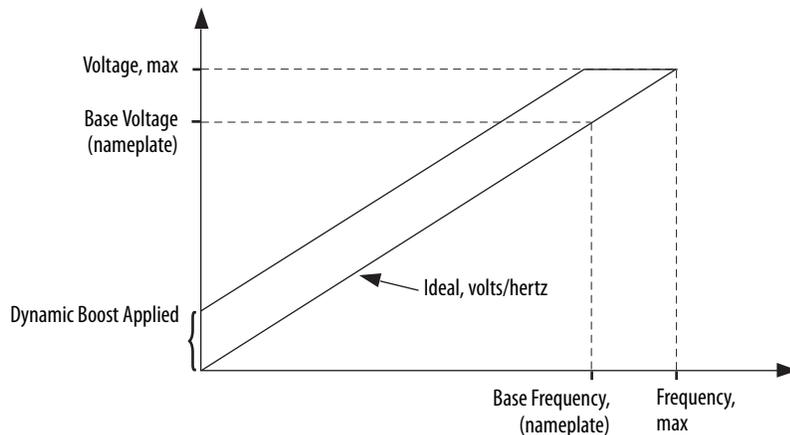


The algorithms operate on the knowledge of the relationship between the rated slip and torque of the motor. The drive uses applied voltages and measured currents to estimate operating slip-frequency. You can enter values to identify the motor resistance value or you can run a motor test to identify the motor resistance value (see [Motor Tests and Autotune Procedure](#) on [page 344](#)). Motor nameplate data and test results are ways to accurately estimate the required boost voltage.

The sensorless vector method offers better torque production and speed regulation over a wider speed range than basic volts/hertz.

Dynamic boost is applied internally to compensate voltage drop and improve starting torque.

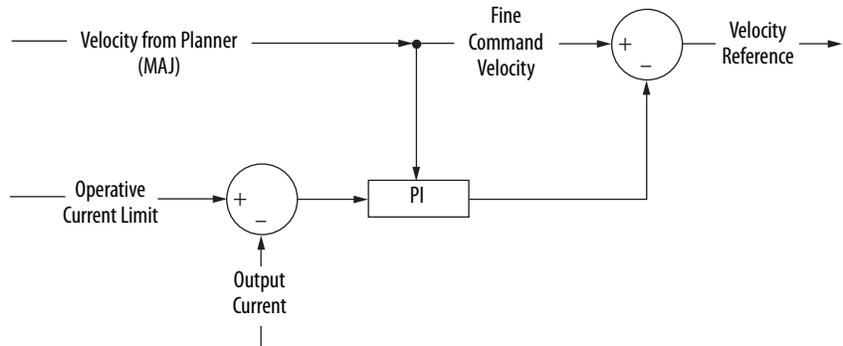
Figure 164 - Approximate Load Curve



Current Limiting for Frequency Control

The current limiting module prevents the OutputCurrent value from exceeding the OperativeCurrentLimit value when the drive is configured in Frequency Control mode.

Figure 165 - Current Limiting Module



In Frequency Control mode, OperativeCurrentLimit is the minimum value of the motor-thermal current limit, inverter-thermal current limit, motor-peak current limit, drive-peak current limit, and the CurrentVectorLimit value.

The Effects of Current Limiting

Indirect current limiting is available for induction motors configured for frequency control. You can use this feature to help prevent overcurrent faults due to aggressive acceleration/deceleration profiles or impact loads. The Current Limiting attribute uses a PI regulator to control the OutputCurrent by adjusting the velocity reference.

IMPORTANT When configured for Frequency Control (induction motors only), select the Decel and disable stopping action only when the Current Limiting feature is enabled.

Figure 166 - Effects of Current Limiting on an Aggressive Acceleration

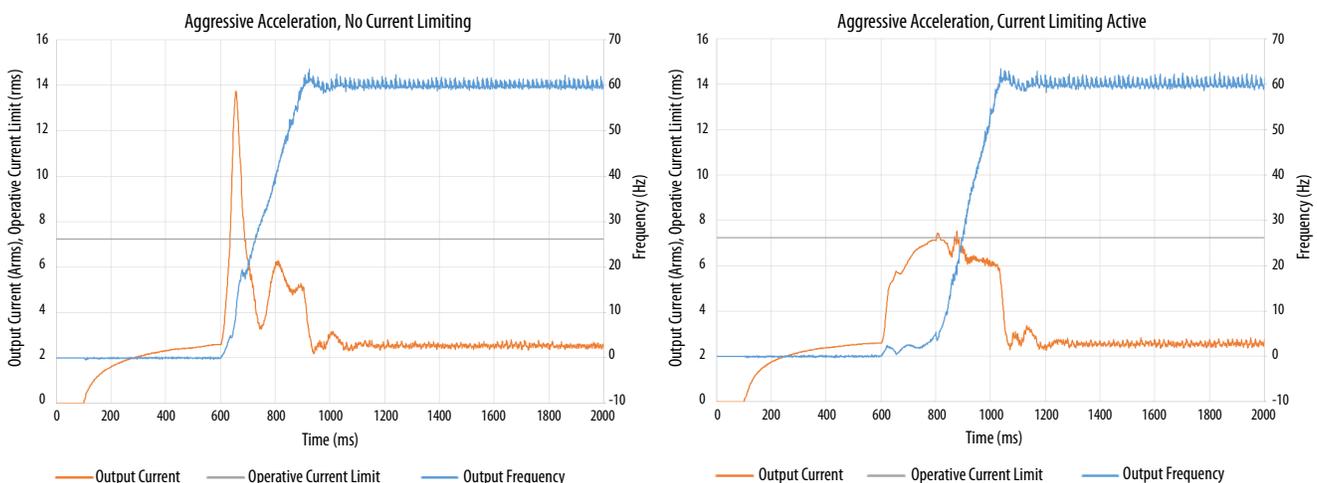
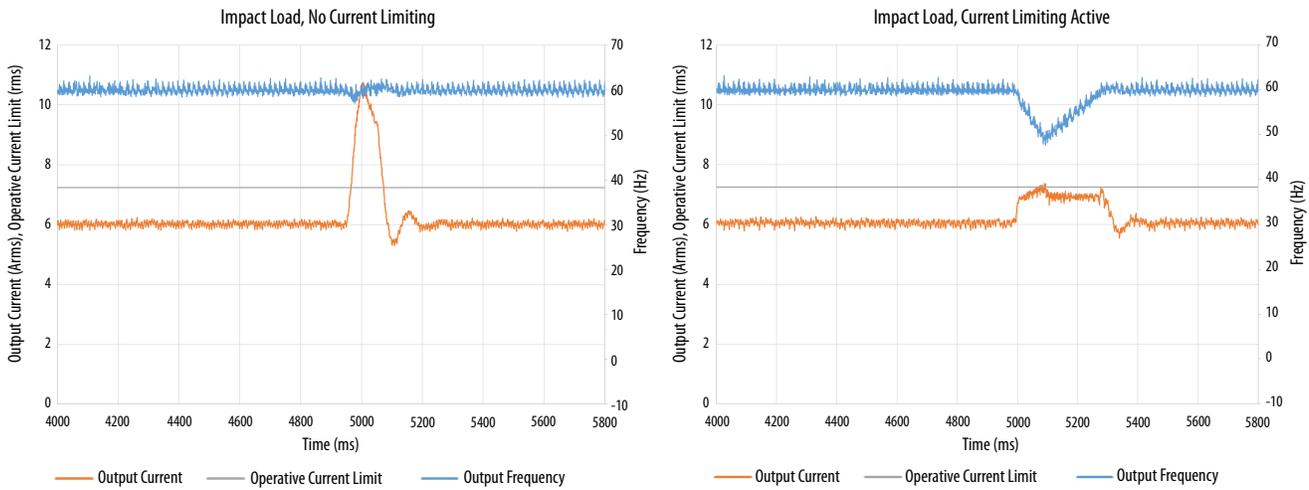


Figure 167 - Effects of Current Limiting on an Impact Load



Current limiting for frequency control is not enabled by default. You can enable via messaging by using the following device-specific attributes.

TIP We recommend you leave the Kp, Ki, Kd gains at the default values.

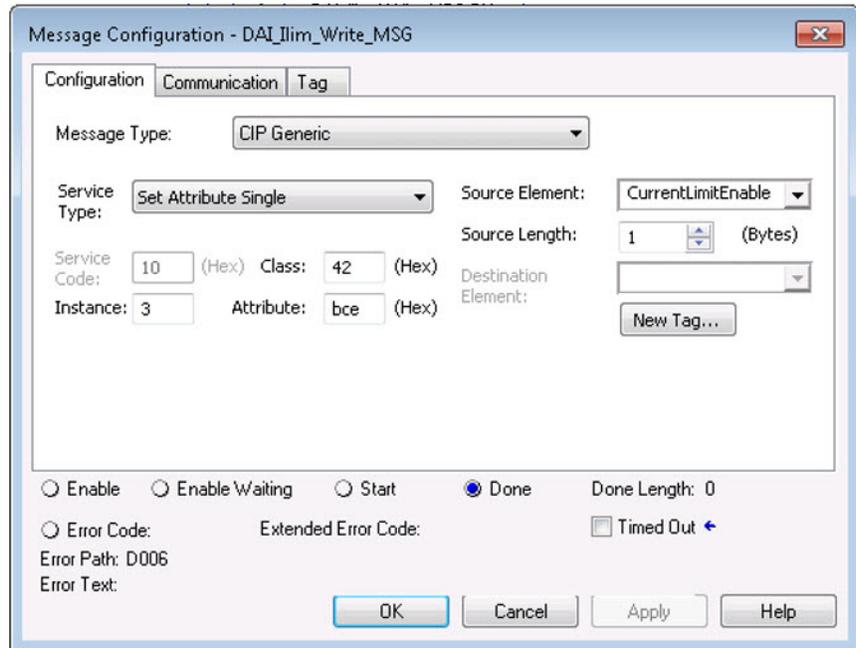
Table 156 - Enable Current Limiting via Messaging

| Attribute Offset | Type | Attribute Name | Conditional Implementation | Description |
|------------------|------|-------------------------|--|---|
| 3022 | SINT | Current Limiting Enable | Frequency Control Induction Motor only | When enabled, limits the rate of change to the velocity reference during high-current situations for improved current limiting. This feature is only active when executing an MDS command and when configured for Frequency Control. 0 = Current Limiting is disabled 1 = Current Limiting is enabled |
| 3023 | REAL | Current Limiting Kd | | Derivative gain for the current limiting function. Only functional when configured for Frequency Control and when executing an MDS command. Units of seconds. |
| 3024 | REAL | Current Limiting Ki | | Integral gain for the current limiting function. Only functional when configured for Frequency Control and when executing an MDS command. Units of feedback counts / (Amp, inst* Seconds). |
| 3025 | REAL | Current Limiting Kp | | Proportional gain for the current limiting function. Only functional when configured for Frequency Control and when executing an MDS command. Units of feedback counts / Amp, inst. |

IMPORTANT For induction motors greater than 5 Hp, it is recommended that the Stability Control feature also be enabled when Current Limiting is enabled.

Enable the Current Limiting Feature

attribute In this example, a Message Configuration (MSG) instruction is configured to set the CurrentLimitingEnable attribute for axis 3 of a dual-axis inverter. The Instance field is used to direct the message to the proper axis. For single-axis inverters the value of 1 is used for Instance.



Set the CurrentVectorLimit Attribute Value

For current limiting, the CurrentVectorLimit attribute is used to help determine the OperativeCurrentLimit of the drive. Set the CurrentVectorLimit value to artificially lower OperativeCurrentLimit below the drive or motor peak current limits.

1. Select the Parameter List category and scroll to CurrentVectorLimit.

| | | |
|--------------------|-----------|------------------------------|
| CoastingTimeLimit | 0.0 | s |
| ConversionConstant | 1000000.0 | Motion Counts/Position Units |
| CurrentVectorLimit | 100.0 | % Motor Rated |
| FluxUpControl | No Delay | |
| FluxUpTime | 0.0 | s |

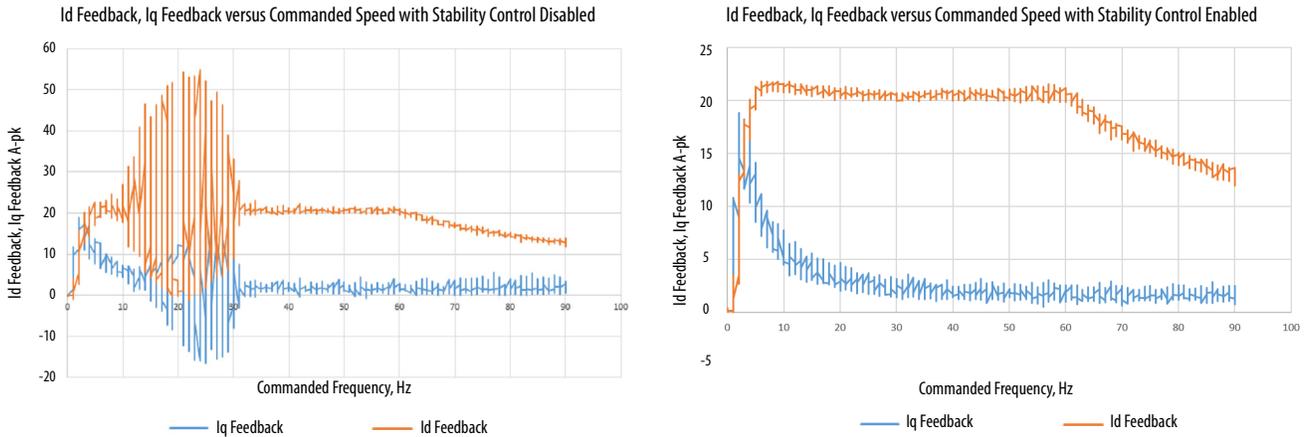
2. Set the CurrentVectorLimit value appropriate for your application.

IMPORTANT The CurrentVectorLimit attribute appears in the Parameter List of the Logix Designer application, version 29.00 and later. If you are using a previous version, the CurrentVectorLimit attribute must be set via a Message Configuration (MSG) instruction.

Stability Control for Frequency Control

Stability control is available for induction motors configured for frequency control. This feature can be used to help remove resonances that are sometimes seen on larger motors. The stability control feature adjusts the OutputFrequency and OutputVoltage commands to stabilize the OutputCurrent.

Figure 168 - Effects of Stability Control



Stability control for frequency control is not enabled by default. You can enable via messaging by using the following device-specific attributes.

TIP We recommend you leave the angle, voltage gains, and filter bandwidth at the default values.

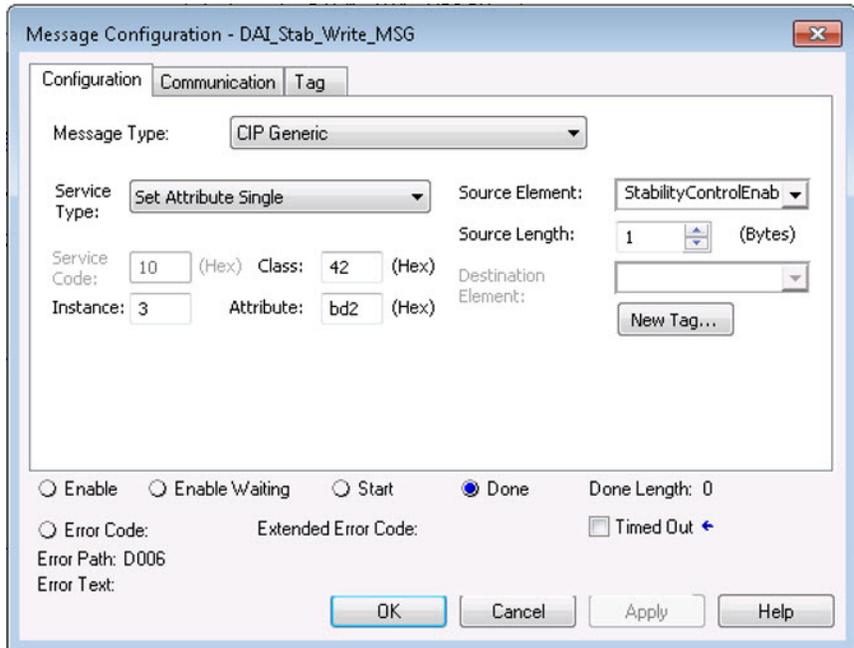
Table 157 - Enable Current Limiting via Messaging

| Attribute Offset | Type | Attribute Name | Conditional Implementation | Description |
|------------------|------|----------------------------|--|---|
| 3026 | SINT | Stability Control Enable | Frequency Control Induction Motor only | Enables stability control when configured for frequency control. 0 = Stability Control is disabled 1 = Stability Control is enabled |
| 3027 | REAL | Stability Filter Bandwidth | | Sets the bandwidth of the low-pass filter applied to the current feedback signal. This bandwidth is common to both the angle and voltage stability control algorithms. Units of radians/second. |
| 3028 | REAL | Stability Voltage Gain | | The gain of the voltage stability control function. Only active when configured for frequency control. Units of Volt (inst,p-n)/Amp (inst). |
| 3029 | REAL | Stability Angle Gain | | The gain of the electrical angle stability control function. Only active when configured for frequency control. Units of radians/Amp (inst). |

IMPORTANT Because the stability control feature works by manipulating the OutputVoltage and OutputFrequency signals, these signals may appear 'noisy' when the feature is enabled.

Enable the Stability Control Feature

In this example, a Message Configuration (MSG) instruction is configured to enable the StabilityControl attribute for axis 3 of a dual-axis inverter. The Instance field is used to direct the message to the proper axis. For single-axis inverters the value of 1 is used for Instance.

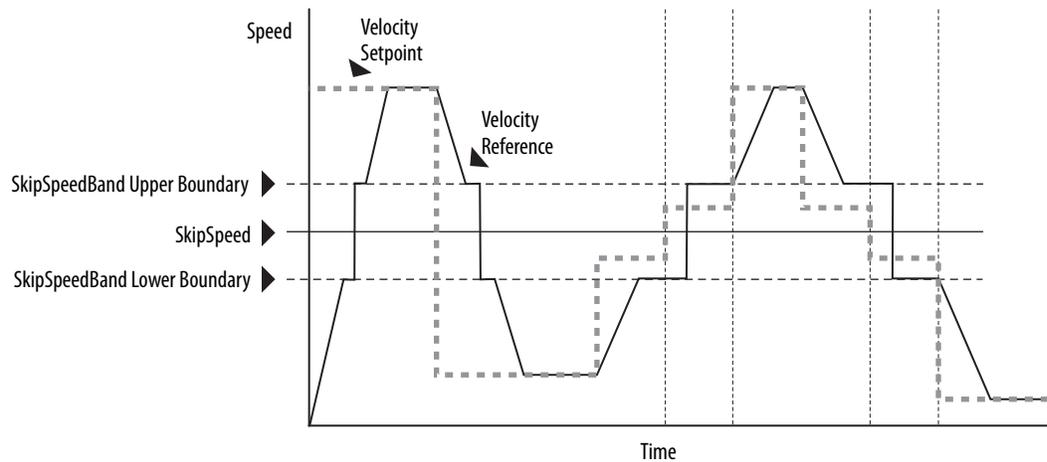


Skip Speeds

Some machines have a resonant operating frequency (vibration speed) that is undesirable or could cause equipment damage. To guard against continuous operation at one or more resonant points, you can configure the skip-speed attributes in the Logix Designer application > Axis Properties > Parameter List category.

The value that is programmed into the SkipSpeed1 or SkipSpeed2 attribute sets the central speed of a skip-speed band within which the drive does not operate. The width of the band is determined by the SkipSpeedBand attribute. The range is split, half above and half below the SkipSpeed x attribute. Any command set-point within this band is adjusted by the skip-speed feature to fall at either the upper or lower skip-speed band boundary value. The skip-speed feature contains hysteresis (25% of the SkipSpeedBand value) to prevent frequent switching of VelocityReference.

Figure 169 - Single Skip Speed Example



A SkipSpeedBand value of 0 disables the skip-speed feature.

IMPORTANT When a single SkipSpeed value is desired, the SkipSpeed1 and SkipSpeed2 settings must be the same.

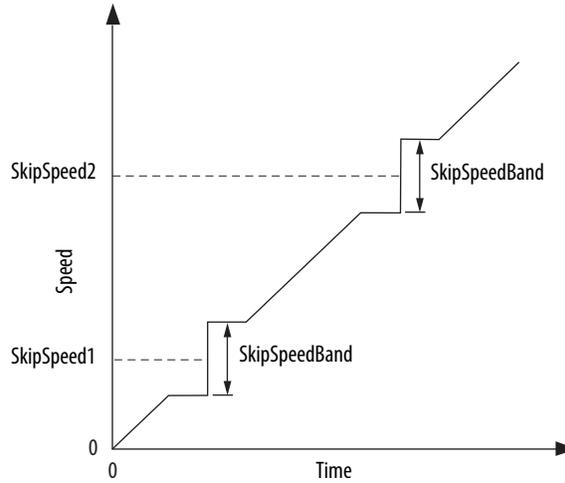
IMPORTANT Acceleration and deceleration are affected by the skip-speed feature. Too large of a SkipSpeedBand value can result in an overcurrent drive fault.

IMPORTANT The MaximumFrequency attribute is always enforced. Skip-speed band boundary values beyond the MaximumFrequency value do not apply.

Multiple Skip Speeds

The Kinetix 5700 drives feature two independent skip-speed attributes (SkipSpeed1 and SkipSpeed2) that use the same SkipSpeedBand.

Figure 170 - Multiple Skip Speed Example

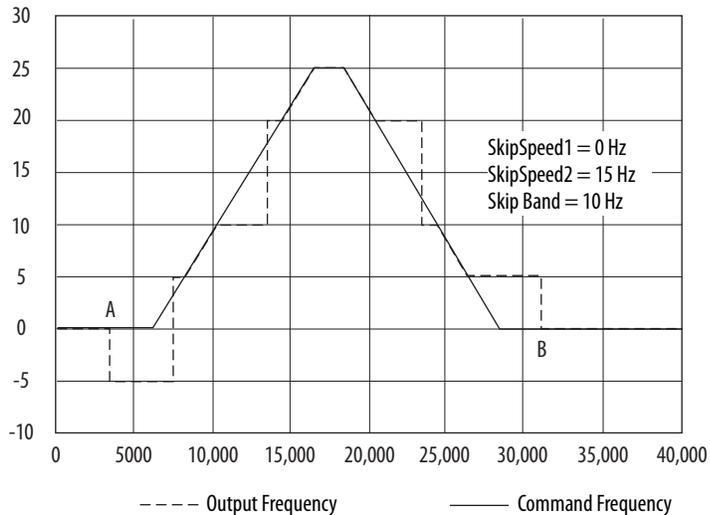


When skip-speed band boundaries of SkipSpeed1 and SkipSpeed2 overlap, the skip-speed hysteresis is calculated using the effective skip band.

In [Figure 171](#), SkipSpeed1 is set to 0 and SkipSpeed2 is set to 15 Hz. The skip band is 10 Hz wide.

At point A the axis is enabled, and the motor begins to rotate at -5 Hz even though the command is 0 Hz. As the command reaches hysteresis point the output frequency begins to follow the command. During deceleration, when the command decreases to 0 Hz, the output frequency continues at 5 Hz until the axis is disabled (point B), or the command is changed outside of the skip band.

Figure 171 - Zero-speed Skip Frequency

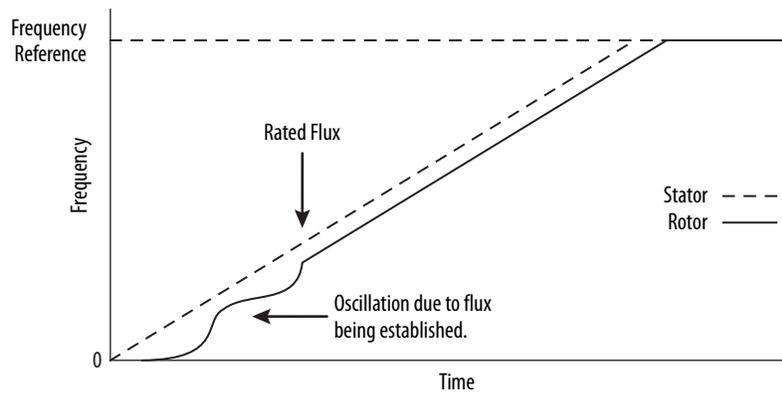


Flux Up

AC induction motors require that flux builds in the motor stator before controlled torque can develop. To build flux, voltage is applied. There are two methods to flux the motor and three configurable FluxUpControl settings.

With the No Delay setting (normal start), flux is established when the output voltage and frequency are applied to the motor. While flux is building, the unpredictable nature of the developed torque can cause the rotor to oscillate even though acceleration of the load can occur. In the motor, the acceleration profile does not follow the commanded acceleration profile due to the lack of developed torque.

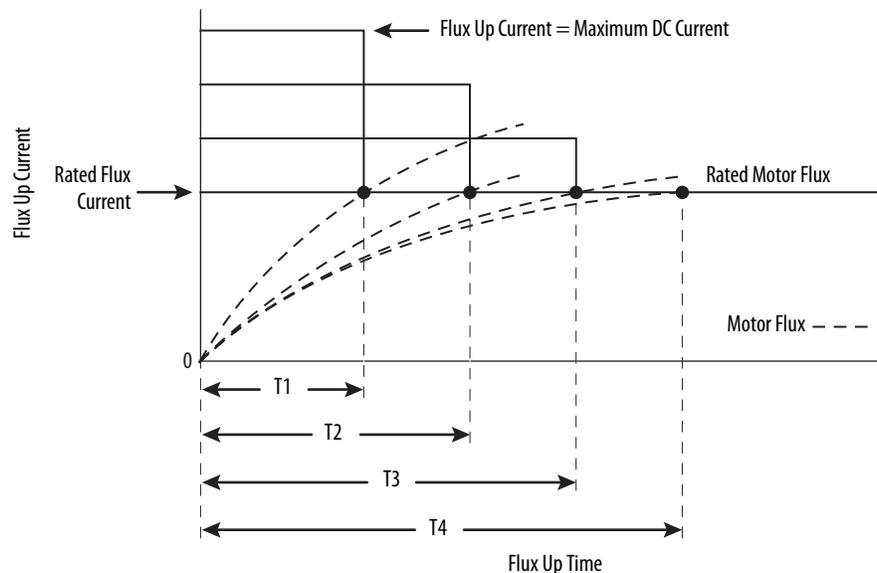
Figure 172 - Acceleration Profile during Normal Start - No Flux Up



With the Automatic setting (default) DC current is applied to the motor so that flux builds before rotation. The flux-up time period is based on the level of flux-up current and the rotor time constant of the motor. The flux-up current is not adjustable.

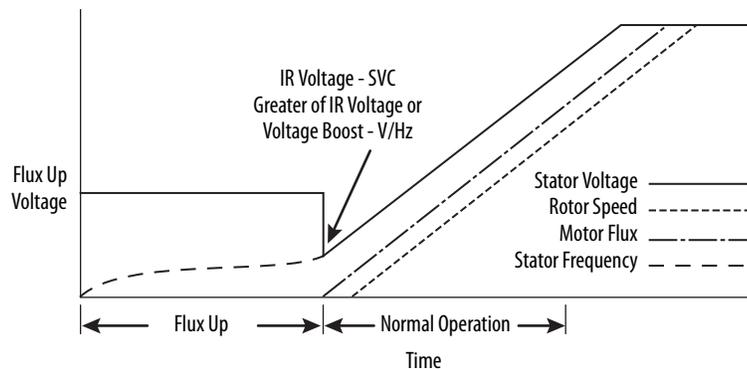
In the Manual setting, DC current is applied to the motor so that flux builds before rotation. The flux-up time period is determined by the FluxUpTime attribute. The flux-up current is not adjustable.

Figure 173 - Flux Up Current versus Flux Up Time



Once rated flux is reached in the motor, normal operation can begin and the desired acceleration profile achieved.

Figure 174 - Rated Flux Reached



Flux Up Attributes

| ID | Access | Attribute | Conditional Implementation |
|-----|--------|-----------------------------|--|
| 558 | Set | Flux Up Control | Ind Motor only 0 = No Delay 1 = Manual Delay 2 = Automatic Delay |
| 559 | Set | Flux Up Time ⁽¹⁾ | Ind Motor only Units: Seconds Default: 0.0000 Min/Max: 0.0000 / 1000.00 |

(1) This is the time designated for the Manual Delay setting. This attribute is not supported by the Automatic delay method. The flux-up feature is disabled if FluxUpControl is set to Manual Delay and FluxUpTime is set to 0.

FluxUpControl Attribute

When the motion axis is enabled, DC current is applied to an induction motor to build stator flux before transitioning to the Running state. This attribute controls how an induction motor is to be fluxed in the Starting state prior to transitioning to the Running state.

Table 158 - FluxUp Control Delay Methods

| Delay Method | Description |
|-----------------|--|
| No delay | The axis transitions immediately to the Running state while the motor flux is building. |
| Manual delay | The axis remains in the Starting state while the motor stator flux is building according to the Flux Up Time attribute. |
| Automatic delay | The drive determines the amount of delay time to fully flux the motor based on the motor configuration attribute data or measurements. |

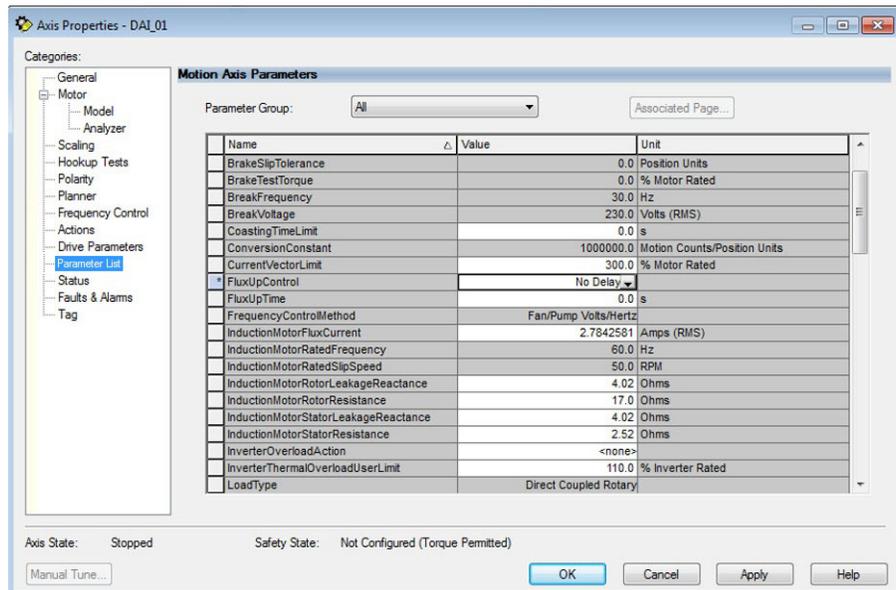
FluxUpTime Attribute

When FluxUpControl is configured for Manual Delay, this attribute sets the length of delay time to fully flux the motor before transitioning to the Running state.

Configure the Flux Up Attributes

Follow these steps to configure the flux-up attributes.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Parameter List category and scroll to FluxUpControl.



3. From the FluxUpControl pull-down menu, choose the proper delay value appropriate for your application.

| | |
|---------------------------|-----------------|
| CurrentVectorLimit | 300.0 |
| FluxUpControl | No Delay |
| FluxUpTime | No Delay |
| FrequencyControlMethod | Manual Delay |
| InductionMotorFluxCurrent | Automatic Delay |

4. If you chose Manual Delay in [step 3](#), enter a value in the FluxUpTime attribute appropriate for your application.

If you chose No Delay or Automatic Delay in [step 3](#), the FluxUpTime attribute does not apply.

Current Regulator Loop Settings

Current loop bandwidth is set differently based on the selected motor type.

Table 159 - Current Regulator Loop Settings

| Motor Type | Default Torque/Current Loop Bandwidth Hz |
|----------------------------------|---|
| Rotary permanent magnet | 1000 |
| Rotary interior permanent magnet | |
| Linear permanent magnet | |
| Rotary induction | 400 |

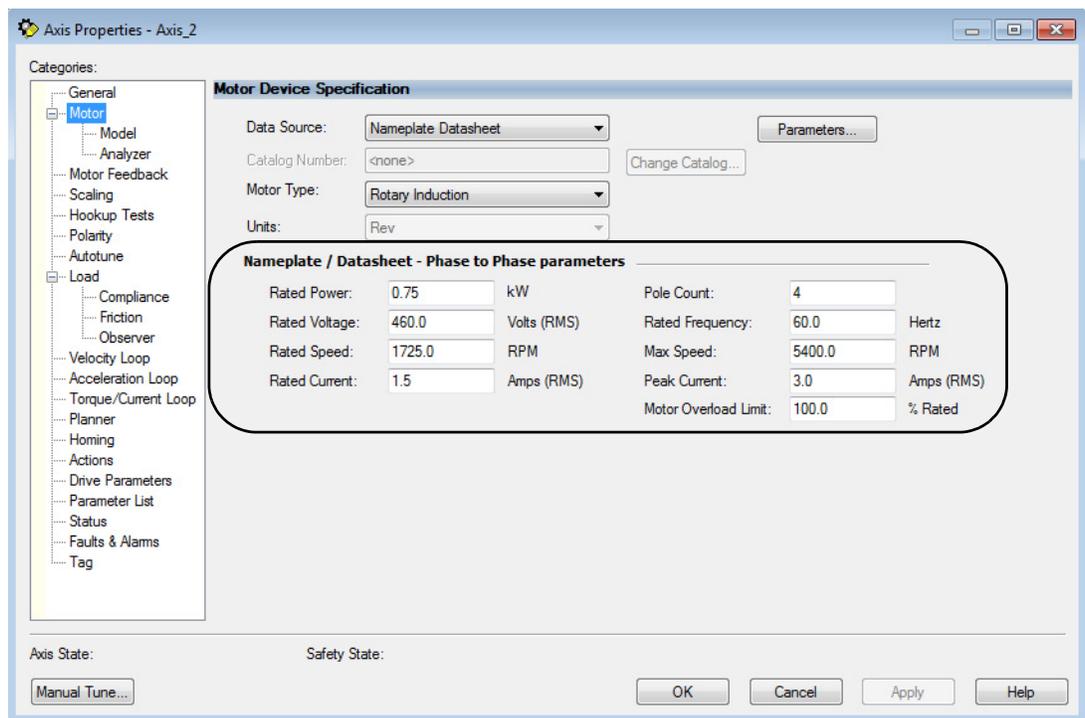
IMPORTANT The Logix Designer application does not perform calculations when the Torque/Current Loop Bandwidth attribute is updated. This bandwidth affects many other gains and limits. Changing, (lowering) the torque loop bandwidth without updating all the dependent attributes can result in drive/motor instability.

Motor Category

From the Motor category you can enter motor nameplate or datasheet values (phase-to-phase parameters) for rotary induction motors.

In this example, the Motor category>Nameplate / Datasheet parameters, were taken from a typical motor performance datasheet. Max Speed and Peak Current values are typically application dependent.

Figure 175 - Motor Nameplate / Datasheet Example



See [Figure 176](#) for motor manufacturer performance data sheet example.

Figure 176 - Motor Manufacturer Performance Data Sheet

CERTIFICATION DATA SHEET
TYPICAL MOTOR PERFORMANCE DATA

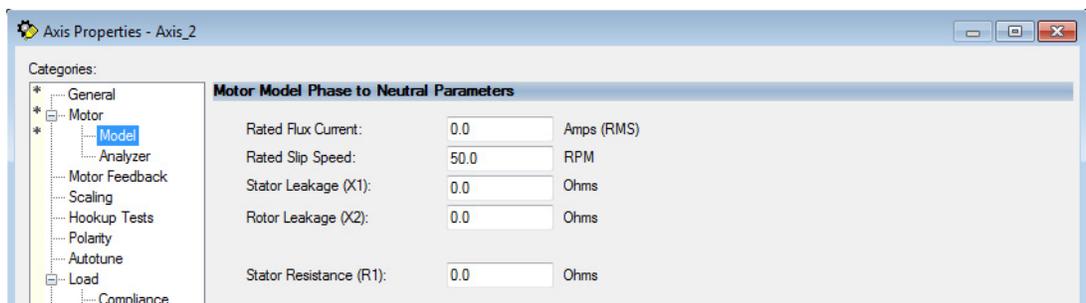
| | | | | | | | | | |
|---|--------------------|--------------------|---------------|------------------|---------------|-------------------|--------|-------|-----------|
| HP | kW | SYNC. RPM | F.L. RPM | FRAME | ENCLOSURE | KVA CODE | DESIGN | | |
| 1 | .75 | 1800 | 1725 | 56C | TENV | P | A | | |
| PH | Hz | VOLTS | FL AMPS | START TYPE | DUTY | INSL | S.F. | AMB°C | ELEVATION |
| 3 | 60 | 460 | 1.5 | INVERTER ONLY | CONTINUOUS | F3 | 1.0 | 40 | 3300 |
| FULL LOAD EFF: 84 | 3/4 LOAD EFF: 82.5 | 1/2 LOAD EFF: 78.5 | GTD. EFF | ELEC. TYPE | NO LOAD AMPS | | | | |
| FULL LOAD PF: 75 | 3/4 LOAD PF: 65.5 | 1/2 LOAD PF: 51 | 81.5 | SQ CAGE INV DUTY | 1 | | | | |
| F.L. TORQUE | LOCKED ROTOR AMPS | L.R. TORQUE | B.D. TORQUE | F.L. RISE°C | | | | | |
| 3 LB-FT | 30 / 15 | 10.8 LB-FT 360% | 15 LB-FT 500% | 65 | | | | | |
| SOUND PRESSURE @ 3 FT. | SOUND POWER | ROTOR WK ^2 | MAX. WK ^2 | SAFE STALL TIME | STARTS / HOUR | APPROX. MOTOR WGT | | | |
| 62 dBA | 72 dBA | 0.11 LB-FT ^2 | 0 LB-FT ^2 | 0 SEC. | 0 | 42 LBS. | | | |
| EQUIVALENT WYE CKT. PARAMETERS (OHMS PER PHASE) | | | | | | | | | |
| R1 | R2 | X1 | X2 | XM | | | | | |
| 8.378 | 5.6232 | 10.7068 | 9.9116 | 278.036 | | | | | |
| RM | ZREF | XR | TD | TD0 | | | | | |
| 11132.8 | 284 | 1.7 | 0.0071 | 0.136 | | | | | |

Motor>Model Category

From the Motor>Model category you can enter additional motor nameplate or datasheet values (phase-to-neutral parameters) for induction motors.

The Motor>Model parameters are used in closed-loop induction-motor control mode, sensorless vector control mode, and when FluxUp is enabled, and are estimated automatically by the Logix Designer application based on the motor nameplate data. You can also enter these parameter values directly from the motor nameplate/datasheet or indirectly by running a Motor>Analyzer test.

Figure 177 - Phase-to-Neutral Parameters



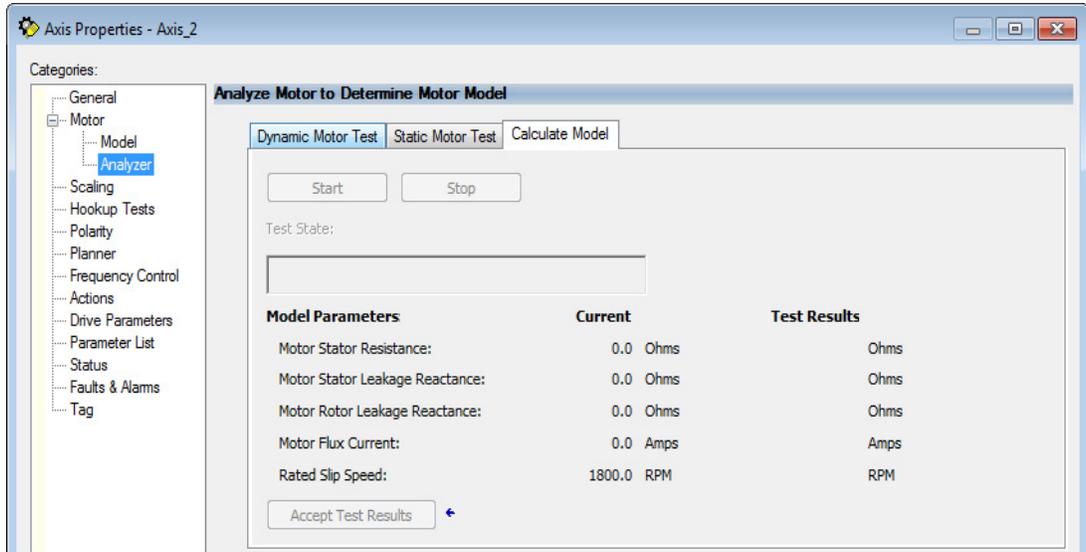
IMPORTANT If you do not know the Stator Leakage, Rotor Leakage, Stator Resistance, Rated Flux Current, and system inertia, you can run the static motor test and Autotune procedure to determine the parameter values.

Motor>Analyzer Category

From the Motor>Analyzer category you can perform three types of tests to identify motor parameters.

In this example, the Calculate Model test was run. If the Motor>Analyzer test executes successfully and you accept the test values, they populate the Model Parameter attributes.

Figure 178 - Motor Analyzer Category



Motor Tests and Autotune Procedure

You can perform three types of tests to identify motor parameters and one test for motor/system inertia. These parameters are used by sensorless-vector frequency-control and induction motor closed-loop modes. [Table 160](#) recommends which test to use based on the control mode and application.

Table 160 - Motor Tests and Autotune Matrix

| Control Mode | Description | Calculate | Static | Dynamic | Autotune (inertia test) |
|---------------------------------------|--------------------------------|-------------------------|--------------------------|--------------|-----------------------------|
| Induction motor - Frequency control | Basic volts/hertz | Not required | Not required | Not required | Not required |
| | Basic volts/hertz for Fan/Pump | Not required | Not required | Not required | Not required |
| | Sensorless vector | Required ⁽¹⁾ | Preferred | Not required | Not required |
| Induction motor - Closed-loop control | | Required ⁽¹⁾ | Preferred ⁽²⁾ | Preferred | Required ^{(1) (3)} |

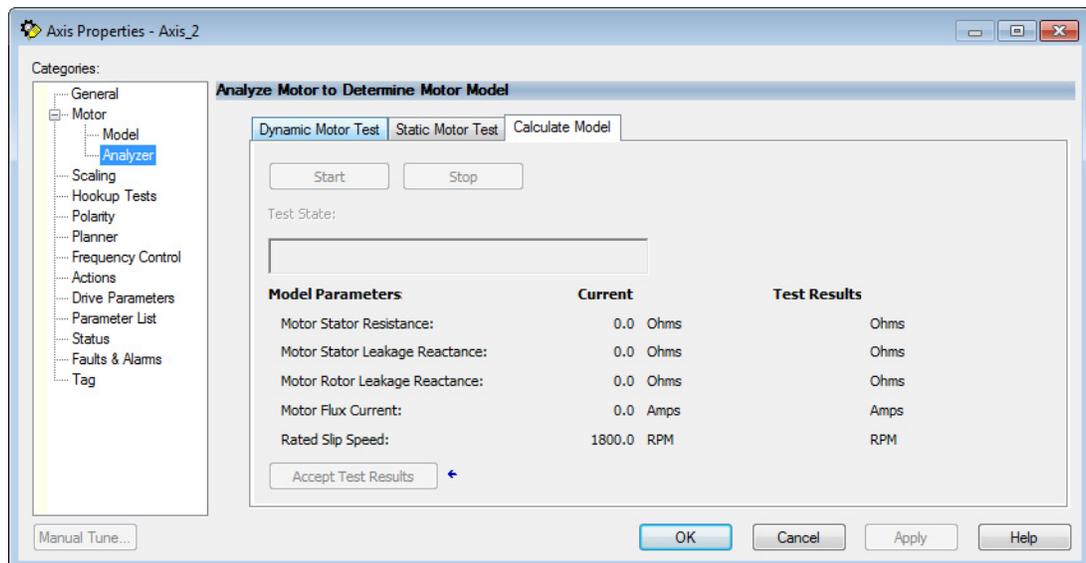
- (1) Not required for the Logix Designer application, version 29.00 and later.
- (2) If it is not desired to rotate the motor (due to coupled load) you can perform this test for induction motor closed-loop mode and skip the Dynamic test. The dynamic test provides the best results for induction motor closed-loop mode.
- (3) The motor inertia value must be non-zero prior to running a dynamic test. The motor inertia value is estimated automatically based upon the Motor Nameplate data in the Logix Designer application, version 29.00 and later. For previous versions, an Autotune test must be run or the motor inertia value entered directly.

For motor/system autotune procedure, see [Tune Induction Motors](#) on [page 211](#) for more information.

The Motor>Analyzer category offers three choices for calculating or measuring electrical motor data.

Follow these steps to run motor tests and identify motor parameters.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Motor>Analyzer category and select the motor test appropriate for your application.



3. Click Start to run the test.
4. Click Accept Test Results to save the values.
5. Click OK.

Motor Analyzer Category Troubleshooting

Calculate Model

When a Calculate test is run, the drive uses motor nameplate data to estimate the motor's Rated Flux Current, Stator Resistance (R_s), Stator Leakage Reactance (X_1) and Rotor Leakage Reactance (X_2). No measurements are taken when using the Calculate test.

Static Motor Test

Use the Static test if the motor shaft cannot rotate or if it is already coupled to the load. Only tests that do not create motor movement are run. During this test, the Stator Resistance (R_s), Stator Leakage Reactance (X_1), and Rotor Leakage Reactance (X_2) values are measured during a series of static tests. The Rated Flux Current is estimated, since measurement of this value requires motor movement.

The Static test requires that you enter initial estimates for Rated Flux Current, Stator Resistance (Rs), Stator Leakage Reactance (X1), and Rotor Leakage Reactance (X2) into the Motor Model fields.

- For the Logix Designer application, version 29.00 or later, initial estimates are populated by the controller.
- For the Logix Designer application, version 28.00 or earlier, this can be done by running and accepting the results of a Calculate test, or by entering the values directly into the Logix Designer application.

Dynamic Motor Test

Dynamic tests are run with the motor disconnected from the load, because the motor shaft turns and there are no travel limits. This is often the most accurate test method. During this test, the Stator Resistance (Rs), Stator Leakage Reactance (X1) and Rotor Leakage Reactance (X2) values are measured in a series of static tests. The Rated Flux Current is measured during a rotational test, in which the drive commands 75% of the motor rated speed.

IMPORTANT The Dynamic test does not support travel limits.

The Dynamic test also requires that you enter initial estimates for Rated Flux Current, Stator Resistance (Rs), Stator Leakage Reactance (X1), and Rotor Leakage Reactance (X2) into the Motor Model fields.

- For the Logix Designer application, version 29.00 or later, initial estimates are automatically populated by the controller.
- For the Logix Designer application, version 28.00 or earlier, this can be done by running and accepting the results of a Calculate test, or by entering the values directly into the Logix Designer application.

The Dynamic test uses the Ramp Acceleration and Ramp Deceleration attributes to set the rotational test ramp-up and ramp-down times. If the resulting acceleration/deceleration times are less than 10 seconds, 10 seconds is used. If these attributes are not supported, 10 seconds is also used.

When configured for closed-loop control, the Dynamic test requires that an accurate system inertia is set in the Logix Designer application.

- For the Logix Designer application, version 29.00 or later, a default value is automatically populated by the controller.
- For the Logix Designer application, version 28.00 or earlier, this can be done by running and accepting the results of an Autotune test, or by entering the motor inertia value directly into the Logix Designer application.

When configured for closed-loop control, the Dynamic test uses the velocity regulator tuning as entered into the Logix Designer application. If the motor is coupled to a load, the velocity regulator tuning may need to be adjusted to make sure the velocity response is well controlled. The Dynamic test fails if the steady-state velocity feedback is not within a $\pm 30\%$ tolerance of the commanded velocity.

IMPORTANT The Dynamic test is not supported in closed-loop Torque Control.

If using the Dynamic test in Frequency Control mode, uncouple the motor from any load or results may not be valid. In closed-loop control, either a coupled or uncoupled load produces valid results.

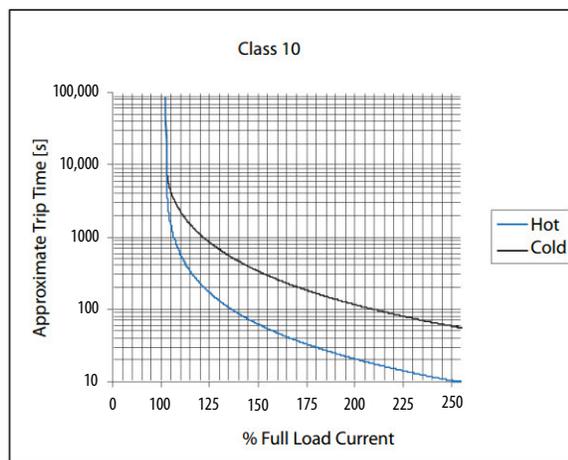
Selection of Motor Thermal Models

The Kinetix 5700 drives contain two motor thermal-overload protection algorithms that you can use to prevent the motor from overheating.

Generic Motors

The default thermal model is a generic I^2T Class 10 overload protection algorithm. This model is active if the MotorWindingToAmbientResistance or the MotorWindingToAmbientCapacitance values are 0.0. The purpose of this algorithm is to limit the time a motor is operating with excessive levels of current. The relationship between Motor Overload Factory Limit trip-time and motor output current is shown in [Figure 179](#).

Figure 179 - Motor Overload Curve



You can use the MotorOverloadLimit attribute (default of 100%, max of 200%) to increase the motor overload trip-time by artificially increasing the motor rated current (for thermal protection only). MotorOverloadLimit should only be increased above 100% if cooling options are applied. Increasing MotorOverloadLimit causes MotorCapacity to increase more slowly.

The generic motor thermal model also derates the motor rated current (for thermal protection only) when operating at low speeds. The derating factor is 30% at 0 Hz and 0% at 20 Hz, with linear interpolation between. Operating at output frequencies less than 20 Hz causes MotorCapacity to increase more quickly.

When the generic motor thermal-model is active, the MotorCapacity attribute increases only if the motor output current is greater than the effective motor rated current (taking into account the MotorOverloadLimit and low speed derating factor). The default MotorThermalOverloadFactoryLimit and MotorThermalOverloadUserLimit values for this thermal model are both 100%.

IMPORTANT The generic motor-thermal model does not support Current Foldback as a Motor Overload Action.

Thermally Characterized Motors

If the MotorWindingToAmbientResistance and MotorWindingToAmbientCapacitance attribute values are both non-zero, the motor is considered thermally characterized and an alternate motor thermal model is run. The purpose of this algorithm is to limit the time a motor is operating with excessive levels of current. This thermal model uses the first-order time constant determined from the MotorWindingToAmbientResistance and MotorWindingToAmbientCapacitance values to estimate the motor thermal capacity based on the motor output current.

The MotorOverloadLimit attribute (default of 100%, max of 200%) can be used to increase the motor overload trip-time by increasing the MotorThermalOverloadFactoryLimit value. The MotorOverloadLimit should be increased above 100% only if cooling options are applied. Increasing MotorOverloadLimit does not change the behavior of MotorCapacity.

This thermal model supports setting the MotorOverloadAction attribute as Current Foldback. Selecting the Current Foldback action results in a reduction in the current reference via the MotorThermalCurrentLimit attribute value that is reduced in proportion the percentage difference between the MotorCapacity and the MotorOverloadLimit values.

When this thermal model is active, the MotorCapacity attribute is non-zero if the motor output current is non-zero. The default MotorThermalOverloadFactoryLimit and MotorThermalOverloadUserLimit values for this thermal model are both 110%.

IMPORTANT This thermal model does not derate the motor-rated current when operating at low speeds. Operating at low output frequencies does not cause the MotorCapacity behavior to change.

Speed Limited Adjustable Torque (SLAT)

Speed limited adjustable torque (SLAT) is a special mode of operation used primarily in web handling applications. While configured for SLAT, the drive typically operates as a torque regulator. The drive can automatically enter velocity regulation based on conditions within the velocity regulator and the magnitude of the velocity regulator's output, relative to the applied TorqueTrim attribute.

A torque regulated application can be described as any process requiring tension control. For example, a winder or unwinder with material being drawn or pulled with a specific tension required. The process also requires that another element set the speed.

When operating as a torque regulator, the motor current is adjusted to achieve the desired torque. If the material being wound or unwound breaks, the load decreases dramatically and the motor can potentially go into a runaway condition.

The SLAT feature is used to support applications that require a robust transition from torque regulation to velocity regulation (and vice versa). The SLAT feature can be configured via the SLATConfiguration attribute as:

Table 161 - SLAT Configuration Descriptions

| Name | Description |
|-----------------------|---|
| SLAT Disable | SLAT function is disabled. Normal Velocity Loop operation. |
| SLAT Min Speed/Torque | Drive automatically switches from Torque regulation to Velocity regulation if VelocityError < 0 and switch back to Torque regulation if VelocityError > SLATSetPoint for SLATTimeDelay. |
| SLAT Max Speed/Torque | Drive automatically switches from Torque regulation to Velocity regulation if VelocityError > 0 and switches back to Torque regulation if VelocityError < SLATSetPoint for SLATTimeDelay. |

Direction of the applied torque and direction of the material movement determine whether SLAT minimum or SLAT maximum mode should be used.

Motion Polarity Setting

The Motion Polarity setting in the Logix Designer application > Axis Properties > Polarity does not affect SLAT behavior, however, you may require clarification on whether to use the SLAT Min Speed/Torque or SLAT Max Speed/Torque configuration when Motion Polarity is set to Inverted. In this case, the velocity error displayed in the Logix Designer application is inverted compared to what is actually used by the axis to control the SLAT function. So, if the SLAT configuration is set to Min and then Motion Polarity is switched to Inverted, change the SLAT configuration to Max.

Table 162 - SLAT Operation When Motion Polarity Is Inverted

| Velocity Command | Motion Polarity | SLAT Configuration |
|----------------------|-----------------|--------------------|
| Positive (clockwise) | Normal | Min |
| | Inverted | Max |
| Negative (CCW) | Normal | Min |
| | Inverted | Max |

SLAT Min Speed/Torque

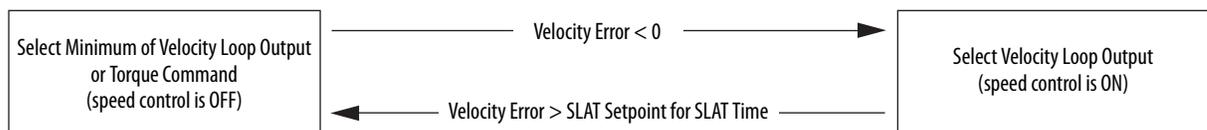
SLAT Min Speed/Torque is a special mode of operation primarily used in web handling applications. The drive typically operates as a torque regulator, provided that the TorqueTrim attribute is less than the torque output due to the velocity regulator's control effort. The drive can automatically enter velocity regulation based on conditions within the velocity regulator and the magnitude of the velocity regulator's output relative to the torque reference.

When used for SLAT control, an application dependent VelocityCommand value is applied to the drive via an MAJ instruction (2198-xxxx-ERS3 series A drives, firmware 7.001 or later) or MDS instruction (2198-xxxx-ERS4 and 2198-xxxx-ERS3 series B drives, firmware 9.001 or later). An application dependent TorqueTrim value is also applied via cyclic write. Under normal operation, VelocityCommand is set to a level that results in the velocity regulator's control effort becoming saturated when the motor's speed is mechanically limited. The TorqueReference value equals the TorqueTrim value, resulting in a positive VelocityError value.

Should the mechanical speed limitation be removed (example: web break), the motor accelerates and VelocityError becomes negative. At this time, a forced transition to velocity regulation occurs, and the motor's speed is regulated to the VelocityCommand attribute.

The axis remains in velocity regulation until VelocityError exceeds SLATSetPoint for a time specified by SLATTimeDelay. At this point, the axis returns to operating as a torque regulator.

Figure 180 - SLAT Min Speed/Torque



See the Integrated Motion on the EtherNet/IP™ Network Reference Manual, publication [MOTION-RM003](#), for more information on SLAT attributes.

SLAT Max Speed/Torque

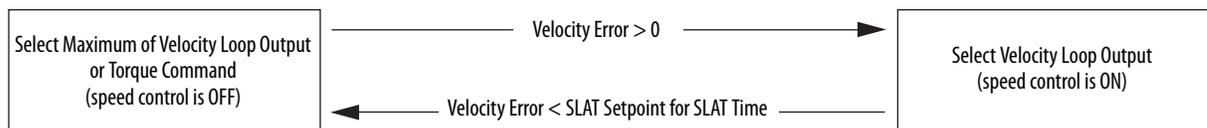
SLAT Max Speed/Torque is a special mode of operation primarily used in web handling applications. The drive typically operates as a torque regulator, provided that the TorqueTrim attribute is greater than the torque output due to the velocity regulator's control effort. The drive can automatically enter velocity regulation based on conditions within the velocity regulator and the magnitude of the velocity regulator's output relative to the torque reference.

When used for SLAT control, an application dependent VelocityCommand value is applied to the drive via an MAJ instruction (2198-xxxx-ERS3 series A drives, firmware 7.001 or later) or MDS instruction (2198-xxxx-ERS4 and 2198-xxxx-ERS3 series B drives, firmware 9.001 or later). An application dependent TorqueTrim value is also applied via cyclic write. Under normal operation, VelocityCommand is set to a level that results in the velocity regulator's control effort becoming saturated when the motor's speed is mechanically limited. The TorqueReference value equals the TorqueTrim value, resulting in a positive VelocityError value.

Should the mechanical speed limitation be removed (example: web break), the motor accelerates and VelocityError becomes negative. At this time, a forced transition to velocity regulation occurs, and the motor's speed is regulated to the VelocityCommand attribute.

The axis remains in velocity regulation until VelocityError is less than SLATSetPoint for a time specified by SLATTimeDelay. At this point, the axis returns to operating as a torque regulator.

Figure 181 - SLAT Max Speed/Torque



See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication [MOTION-RM003](#), for more information on SLAT attributes.

SLAT Attributes

| ID | Access | Attribute | Conditional Implementation |
|-----|--------|--------------------|---|
| 833 | Set | SLAT Configuration | 0 = SLAT Disable ⁽¹⁾ 1 = SLAT Min Speed/Torque 2 = SLAT Max Speed/Torque |
| 834 | Set | SLAT Set Point | Velocity Units |
| 835 | Set | SLAT Time Delay | Seconds |

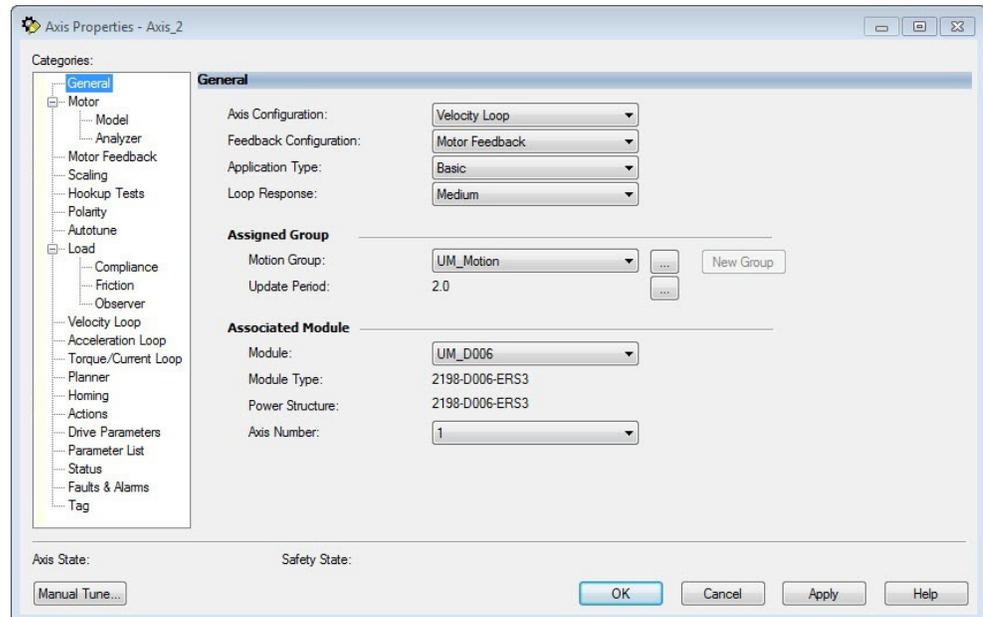
(1) SLAT Disable, when viewed in version 28.00 (and earlier) of the Logix Designer application, reads Torque Only. This is expected to change to SLAT Disable in a future version.

Configure the Axis for SLAT

Follow these steps to configure the SLAT attributes.

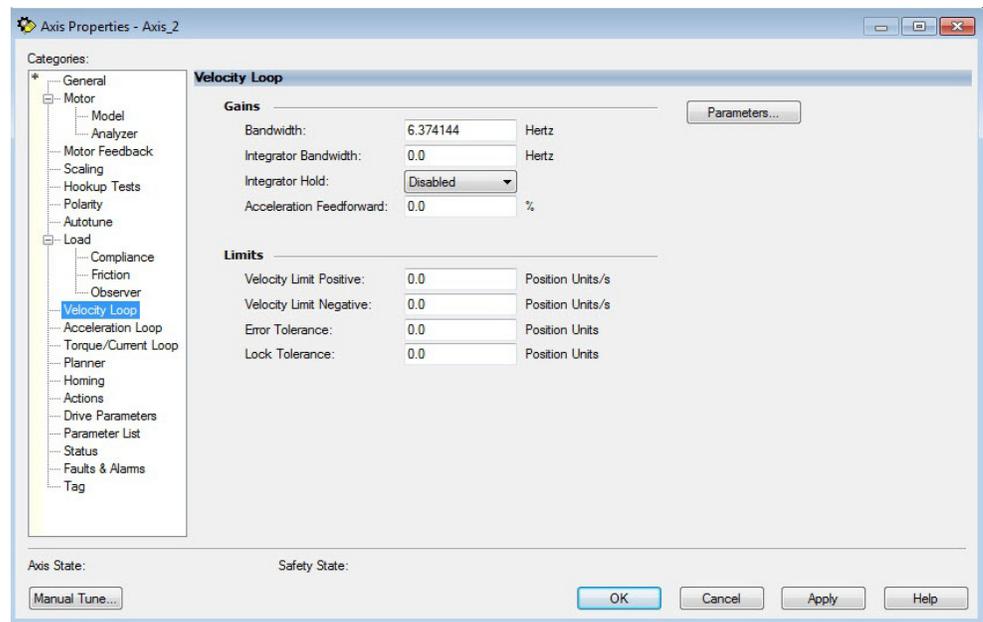
1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

The General dialog box appears.



3. From the Axis Configuration pull-down menu, choose Velocity Loop.

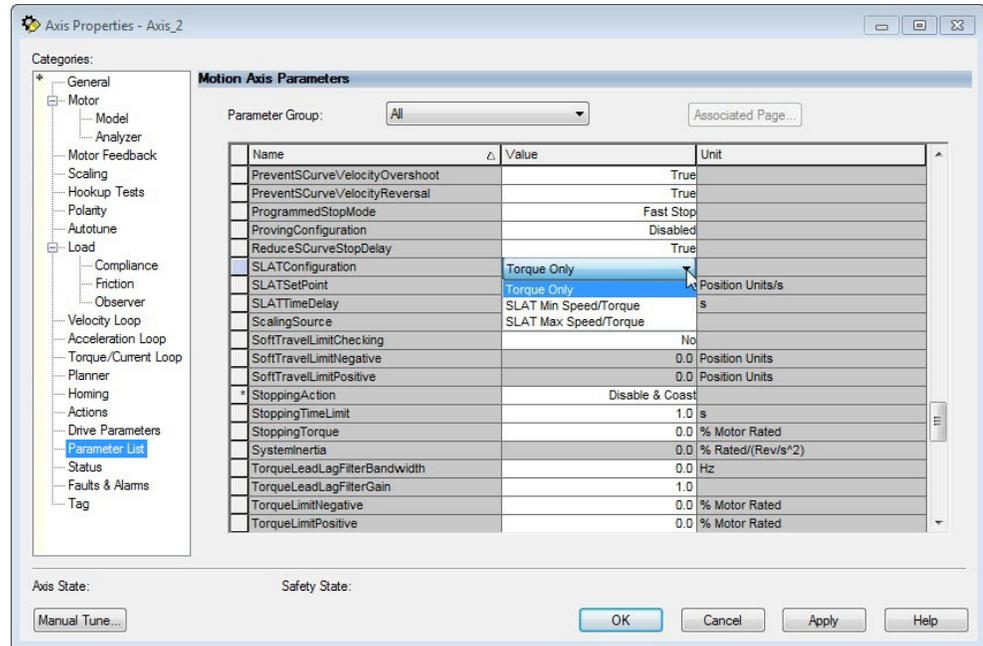
The Velocity Loop dialog box appears.



4. Enter values for the Velocity Loop attributes appropriate for your application.

5. Click Apply.
6. Select the Parameters List category.

The Motion Axis Parameters dialog box appears.



7. From the SLATConfiguration pull-down menu, choose the SLAT configuration appropriate for your application.

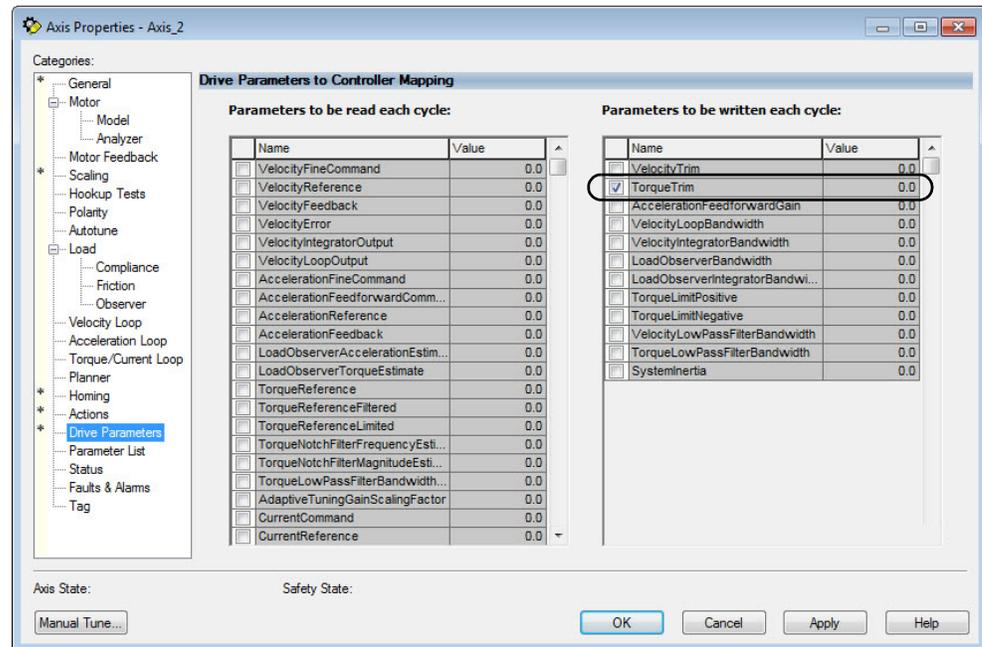
IMPORTANT SLAT parameters are configurable only when Velocity Loop is chosen from the General category, Axis Configuration pull-down menu.

8. Click Apply.
9. Enter values for SLATSetPoint and SLATTimeDelay attributes appropriate for your application.

| | | |
|-----------------------|-----------------|------------------|
| ReduceSCurveStopDelay | True | |
| SLATConfiguration | Torque Only | |
| SLATSetPoint | 0.0 | Position Units/s |
| SLATTimeDelay | 0.0 | s |
| ScalingSource | From Calculator | |

10. Click OK.
11. Select the Drive Parameters category.

The Drive Parameters to Controller Mapping dialog box appears.



When using SLAT with the Kinetix 5700, the velocity command is sent to the drive via an MAJ instruction (2198-xxxx-ERS3 series A drives, firmware 7.001 or earlier) or MDS instruction (2198-xxxx-ERS4 and 2198-xxxx-ERS3 series B drives, firmware 9.001 or later). The torque command is sent via the cyclic write TorqueTrim attribute. See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication [MOTION-RM003](#), for more information on cyclic read and cyclic write.

For MAJ instruction (2198-xxxx-(series A) drives, drives, firmware 7.001 or earlier):

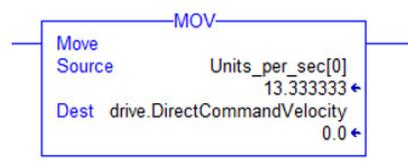
- When using SLAT, start the axis with the MSO instruction.
- The VelocityCommand is sent via the MAJ instruction.
- The TorqueCommand is sent to AxisTag.TorqueTrim.
- To make changes to the VelocityCommand, you must re-trigger the MAJ with the Speed value or use a MCD (motion change dynamics) instruction.
- To stop the axis use a MAS instruction.
- The axis accelerates and decelerates at the MAJ instruction programmed Acceleration and Deceleration rates.
- You can also change the rates using the MCD instruction.

For MDS instruction (2198-xxxx-ERS4 and 2198-xxxx-ERS3 series B drives, firmware 9.001 or later):

- When using SLAT, start the axis with an MDS instruction.
- The MDS instruction turns on the power structure enable and tracking command status along with execute the velocity command.

See sample code in [Motion Drive Start \(MDS\) Instruction](#).

- The acceleration and deceleration rate is controlled by Ramped Acceleration and Ramped Deceleration by using the SSV instruction.
- The Torque Command is set to Axis Tag.Torque Trim. Make sure the Torque Trim Write is checked in the drive parameter (see Drive Parameters dialog box above). The value can be changed.
 - Alternatively, you can use the Axis Tag.DirectCommandVelocity to alter the Velocity Command when the existing MDS instruction is being executed.



- To stop the axis, use MAS instructions, keeping the Change Decel to NO and by using an SSV instruction to change Ramped Deceleration for the desired rate.

Motion Drive Start (MDS) Instruction

Kinetix 5700 inverters, catalog numbers 2198-xxxx-ERS4 and 2198-xxxx-ERS3 (series B) with firmware revision 9.001 or later, provide access to the Motion Drive Start (MDS) instruction. Use the MDS instruction to activate the drive control loops for the specified axis and run the motor at the specified speed.

For information regarding the MDS instruction, refer to the Logix 5000™ Controllers Motion Instructions Reference Manual, publication [MOTION-RM002](#).

For the Kinetix 5700 drive, the MDS instruction is valid only when the axis configuration is set to one of these control modes:

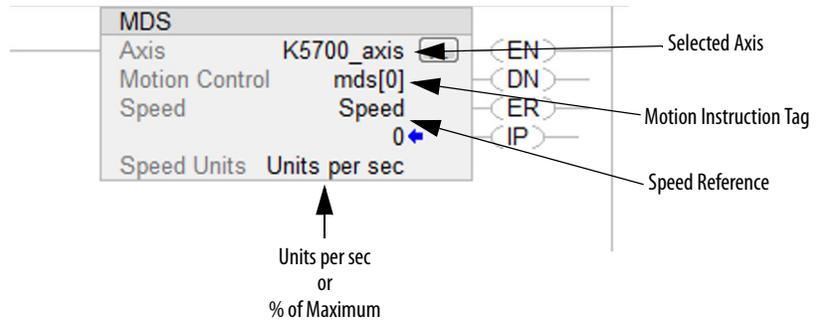
- Frequency Control
- Velocity Loop
- Torque Loop

IMPORTANT The MDS instruction is not valid when the axis configuration is set to Position Loop.

Motion Drive Start Instruction Configuration

The MDS instruction is configured in a similar fashion to most motion instructions, as seen in this example.

Figure 182 - Typical MDS Instruction

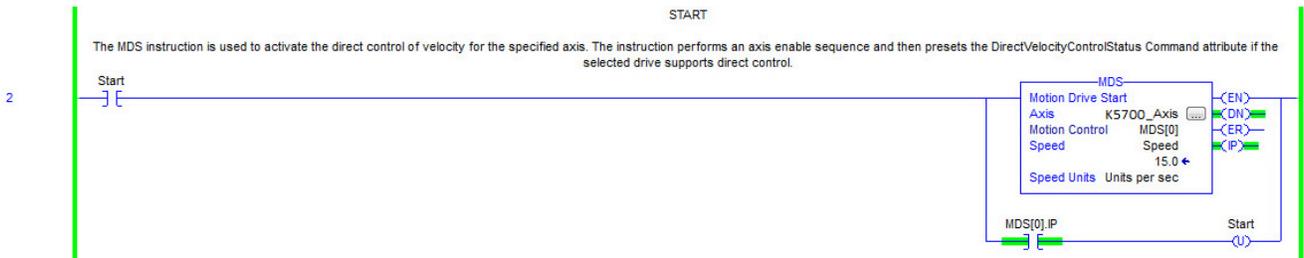


The MDS instruction is similar to a Motion Axis Jog (MAJ) instruction, however, the MDS instruction does not set the acceleration/deceleration rates. The acceleration rate is dynamically set by the ramp attributes configured in a Set System Value (SSV) instruction. See Ramp Attributes on [page 358](#).

TIP The K5700_Axis was configured for revolutions. Therefore, the Speed Units are revolutions per second (rev/s).

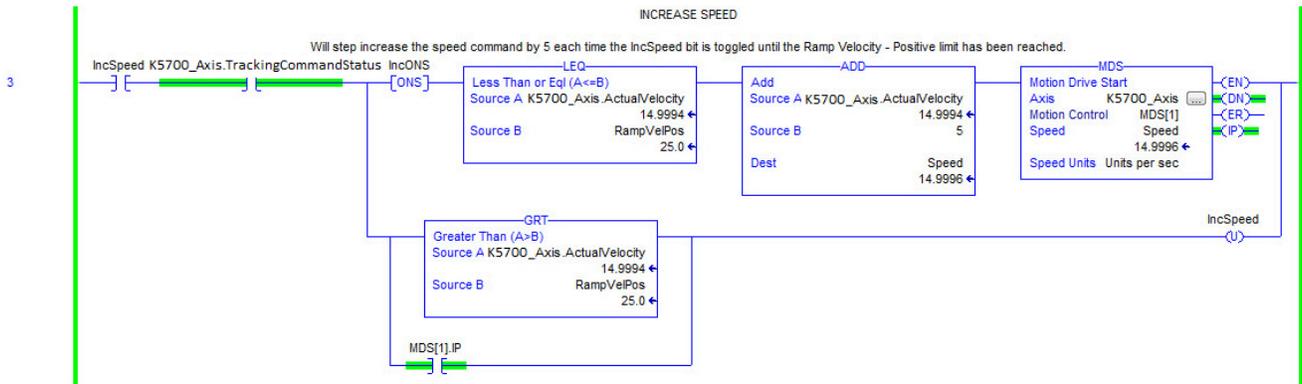
Motion Drive Start (MDS) Sample Code

Figure 183 - Start



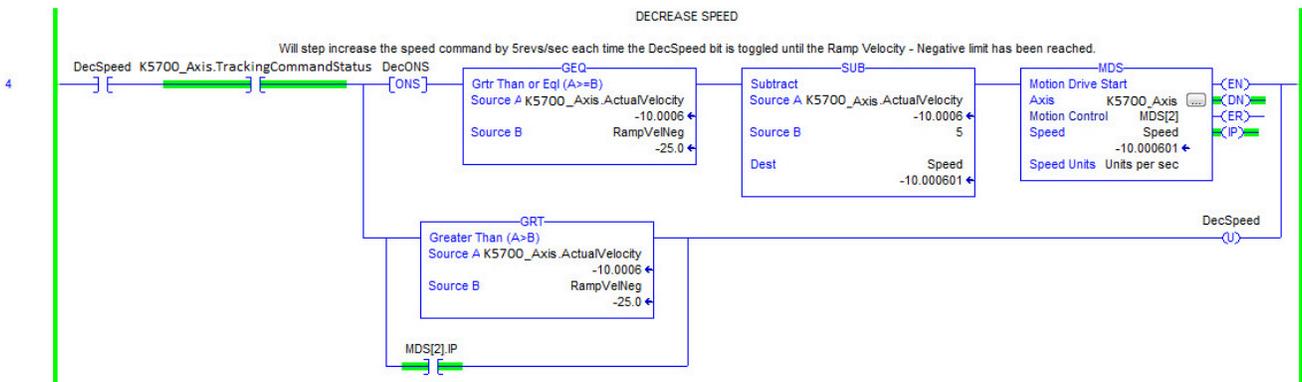
The speed is increased by updating the speed reference and then re-executing the MDS instruction.

Figure 184 - Increase Speed



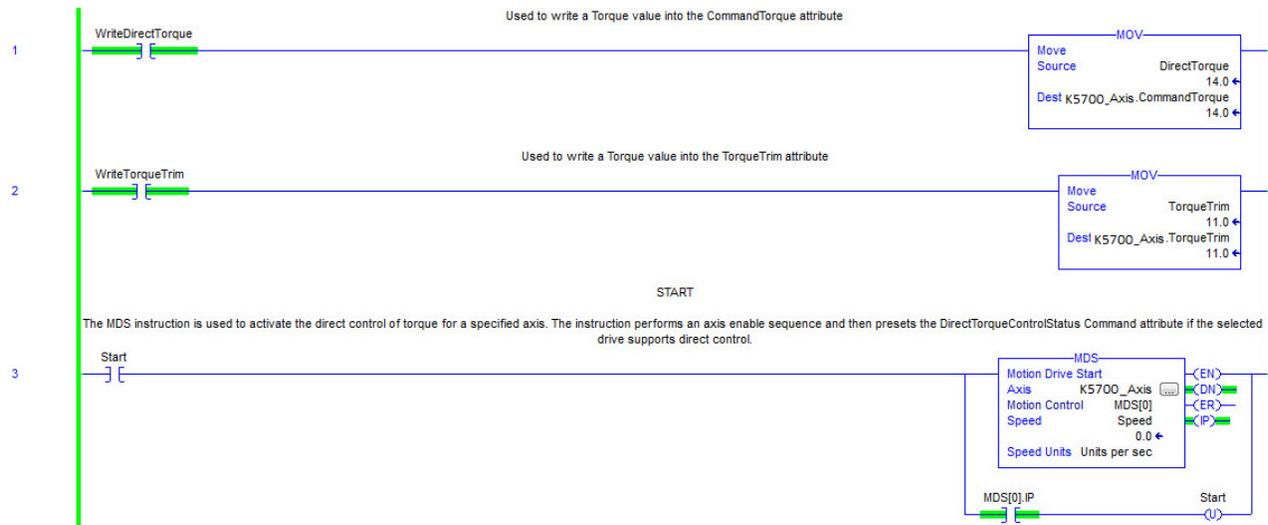
The speed is decreased by updating the speed reference and then re-executing the MDS instruction.

Figure 185 - Decrease Speed



When the axis configuration is in Torque Loop, the Speed attribute within the MDS instruction is not used to command the speed of the drive. The speed is determined by the amount of torque specified in the CommandTorque and/or TorqueTrim attributes.

Figure 186 - Torque Mode



IMPORTANT You must command zero torque in the CommandTorque and TorqueTrim attributes before you can use the Motion Axis Stop (MAS) instruction to stop a specific motion process on an axis or to stop the axis completely. To use the MAS instruction, you must set Change Decel to No. Otherwise, an instruction error can occur. The deceleration rate is set based on the Ramp Deceleration attribute. The Motion Servo Off (MSF) instruction is used to deactivate the drive output for the specified axis and to deactivate the axis' servo loop. If you execute an MSF instruction while the axis is moving, the axis coasts to an uncontrolled stop.

Ramp Attributes

The MDS instruction is validated if the Integrated Motion on EtherNet/IP drive device supports the following five ramp attributes:

- RampAcceleration
- RampDeceleration
- RampVelocity - Positive
- RampVelocity - Negative
- RampJerk - Control

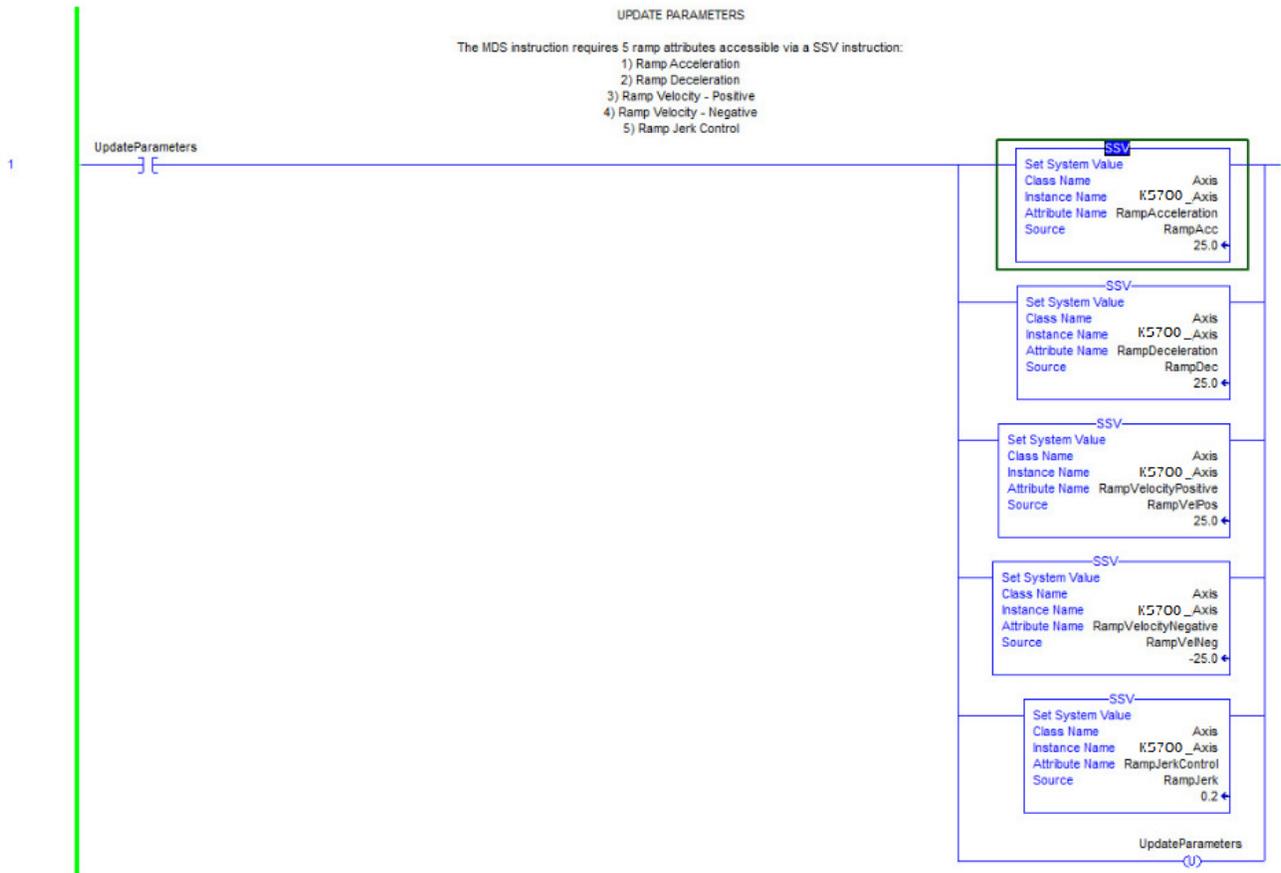
IMPORTANT Ramp attributes are available only when the Kinetix 5700 drive axis configuration is set to Frequency Control or Velocity Loop. Ramp attributes are not available when the axis configuration is set to Torque Loop or Position Loop.

Table 163 - Ramp Attributes

| Ramp Attribute | Access | ID | Description |
|-------------------------|--------|-----|---|
| RampVelocity - Positive | Set | 374 | Ramp Velocity - Positive attribute is a positive value that defines the maximum positive velocity command output of the Ramp Generator. |
| RampVelocity - Negative | Set | 375 | Ramp Velocity - Negative attribute is a negative value that defines the maximum negative velocity command output of the Ramp Generator. |
| RampAcceleration | Set | 376 | The Ramp Acceleration attribute is a positive value that defines the maximum acceleration (increasing speed) of the velocity command output by the Ramp Generator. |
| RampDeceleration | Set | 377 | The Ramp Deceleration attribute is a positive value that defines the maximum deceleration (decreasing speed) of the velocity command output by the Ramp Generator. |
| RampJerk - Control | Set | 379 | The Ramp Jerk Control attribute sets the percentage of acceleration or deceleration time that is applied to the speed ramp as jerk limited S-Curve based on a step change in velocity. The S-Curve time is added half at the beginning and half at the end of the ramp. A value of 0 results in no S-Curve, for example, a linear acceleration or deceleration ramp. A value of 100% results in a triangular acceleration profile with the peak being the configured ramp acceleration or deceleration. As the Jerk Control value increases, the derived accelerating jerk value decreases based on the following: $0.5 \cdot 0.01 \cdot \text{Jerk Control} \cdot \text{Ramp Vel Positive}/\text{Ramp Accel}$ The decelerating Jerk limit value also decreases according to the following: $0.5 \cdot 0.01 \cdot \text{Jerk Control} \cdot \text{Ramp Vel Negative}/\text{Ramp Decel}$. |

IMPORTANT The Ramp attributes are can only be viewed and set with an SSV or GSV instruction.

Figure 187 - Ramp Attribute Sample Code



Motor Overload Retention

The motor overload retention feature protects the motor in the event of a drive power-cycle, in which the motor thermal state is lost.

With motor overload retention, upon drive power-up the MotorCapacity attribute initially reads:

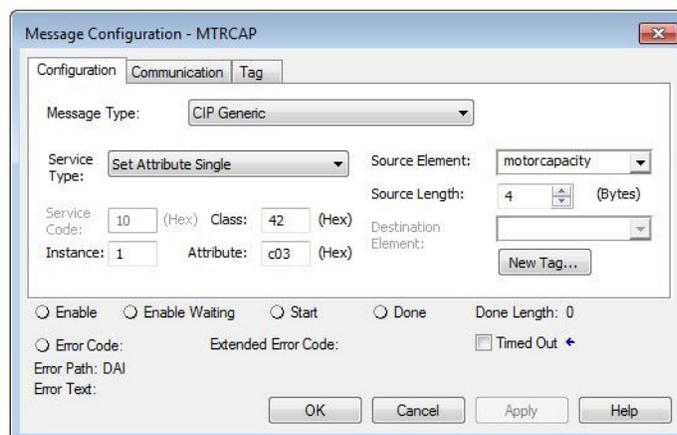
- 20% if the motor is configured to use an integral thermal switch or an integral motor winding temperature is available
- 50% if the motor is not configured to use an integral thermal switch or an integral motor winding temperature is not available

If you have a separate monitoring algorithm within your Logix 5000 controller, you can use the InitialMotorCapacity attribute $(3075)_{10}$ or $(C03)_{16}$ to change the initial MotorCapacity value that the motor overload retention feature populates.

- You can write to the InitialMotorCapacity attribute only in the Stopped state after power-up
- You cannot write to the InitialMotorCapacity attribute after the first time the axis is enabled following a power cycle.

Use a message instruction to write to the InitialMotorCapacity value.

In this example, the source element tag motorcapacity is a REAL Data type.



Phase Loss Detection

The phase-loss detection feature is designed to determine if motor power wiring is electrically connected to a motor and that reasonable current control exists. This attribute enables the operation of the drive's torque proving functions that work in conjunction with mechanical brake control.

When the ProvingConfiguration attribute is enabled, the drive performs a torque prove test of the motor current while in the Starting state to prove that current is properly flowing through each of the motor phases before releasing the brake. If the torque prove test fails, the motor brake stays engaged and a FLT-S09 Motor Phase Loss exception (fault) is generated.

IMPORTANT The mechanical brake must be set as soon as the drive is disabled. When the brake is under the control of the axis state machine, this is automatic. But, when controlled externally, failure to set the brake when the drive is disabled can cause a free-fall condition on a vertical application.

Table 164 - Phase-loss Detection Startup Sequence

| Startup Phase | Description |
|---------------|---|
| Phase 1 | When the drive receives an enable request, the Starting state begins execution and torque proving starts. |
| Phase 2 | The torque proving feature ramps current to the motor-phase output connector and verifies that the current feedback circuitry detects current on each of the phases. |
| Phase 3 | Once motor-current feedback has been verified in each motor phase, the drive attempts to enable the current control loop at a user-specified current level, and verifies that the current-loop error tolerance is within range. |

Torque proving is available for all motoring configurations including closed-loop servo control and induction motors.

For permanent magnet (PM) motors, the drive attempts to apply current to the motor phases such that all current through the motor is flux current. However, due to the electrical angle of the motor at the time of the MSO instruction, it may not be possible to verify the motor phase wiring with only flux current. Therefore, with a PM motor it is possible that the motor shaft can move slightly during torque proving if no motor brake exists to hold the load.

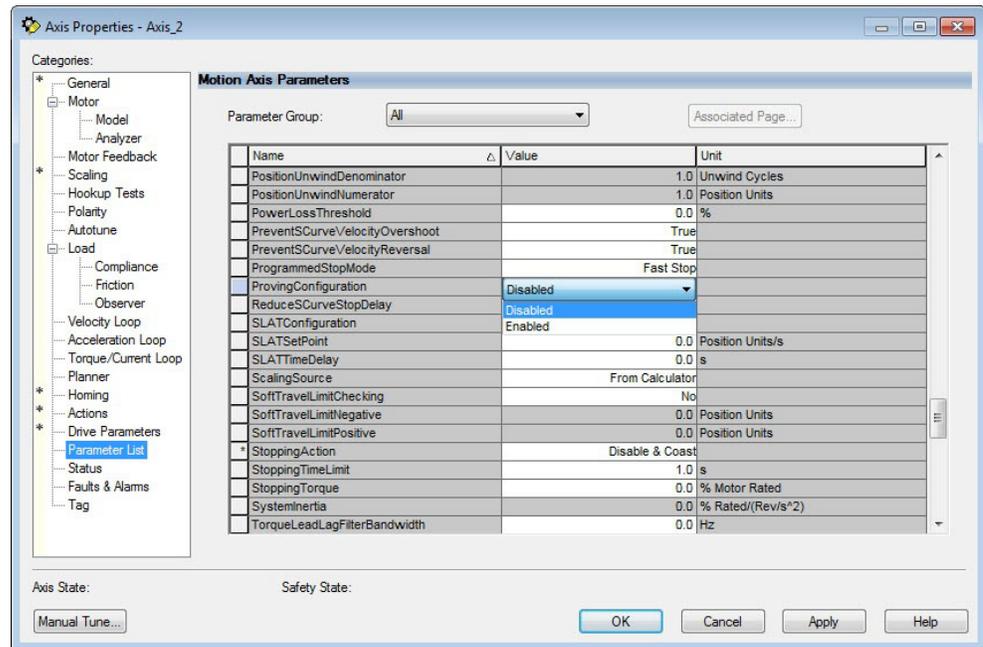
Phase-loss Detection Attributes

| ID | Access | Attribute | Conditional Implementation |
|-----|--------|-----------------------|---|
| 590 | SSV | Proving Configuration | 0 = Disabled 1 = Enabled |
| 591 | SSV | Torque Prove Current | % Motor Rated Units: Amps Default: 0.000 Min/Max: 0/10,000 |

Phase-loss Detection Configuration

Follow these steps to configure the phase-loss detection attributes.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Parameter List category and scroll to ProvingConfiguration.



3. From the ProvingConfiguration pull-down menu, choose Enabled to enable the torque proving feature.

| | | |
|--------------------|-----------|-----------------|
| TorqueOffset | 0.0 | % Motor Rated |
| TorqueProveCurrent | 0.0 | % Motor Rated |
| TorqueRateLimit | 1000000.0 | % Motor Rated/s |

4. Enter a value in the TorqueProveCurrent attribute appropriate for your application.
5. Click OK.

The TorqueProveCurrent attribute is active only if ProvingConfiguration is set to Enabled. TorqueProveCurrent lets you specify the amount of current that is used during the torque proving test and calculated as a percentage of motor

rating. The higher the TorqueProveCurrent value the more current the drive delivers to the motor to verify that the motor phase wiring is available and capable of that current level. High current levels conversely causes more thermal stress and (potentially) can cause more torque to be driven against the motor brake during the test. If the TorqueProveCurrent level selected is too small, the drive cannot distinguish the proving current from noise, and in this case the drive posts an INHIBIT M04 torque-proving configuration fault code. The minimum amount of torque proving current depends on catalog number of the drive.

Phase Loss Detection Current Example

In this example, a 2198-D020-ERS3 dual-axis inverter is paired with a VPL-B1003T-C motor with 6.77 A rms rated current. Use the phase-loss detection equation and table to calculate the initial minimum torque-proving current as a percentage of motor rated current. Depending on the unique characteristics of your application, the required torque-proving current value can be larger than the initial recommended value.

Figure 188 - Phase-loss Detection Equation

$$\left(\frac{\text{Rating From Table}}{\text{Motor Rated Current}} \right) \times 100\% = \frac{0.5746 \text{ A}}{6.77 \text{ A}} \times 100\% = 8.49\%$$

Table 165 - Recommended Phase-loss Detection Current

| Drive Cat. No. | Phase-loss Detection Current, min A, rms |
|----------------|---|
| 2198-S086-ERSx | 7.183 |
| 2198-S130-ERSx | 9.337 |
| 2198-S160-ERSx | 12.21 |
| 2198-D006-ERSx | 0.1796 |
| 2198-D012-ERSx | 0.3591 |
| 2198-D020-ERSx | 0.5746 |
| 2198-D032-ERSx | 0.9337 |
| 2198-D057-ERSx | 1.6520 |

Velocity Droop

The velocity droop function can be useful when some level of compliance is required due to rigid mechanical coupling between two motors. The feature is supported when the axis is configured for Frequency Control, Velocity Control, or Position Control.

Closed Loop Control

The closed-loop velocity droop function is supported when configured for either Velocity or Position control. The velocity error input to the integral term is reduced by a fraction of the velocity regulator's output, as controlled by the VelocityDroop attribute. Therefore, as torque loading on the motor increases, actual motor speed is reduced in proportion to the droop gain. This is helpful when some level of compliance is required due to rigid mechanical coupling between two motors.

IMPORTANT The closed-loop velocity droop function acts to reduce the velocity error input to the integral term, but never changes the polarity of the velocity error.

IMPORTANT When configured for closed-loop control, the units of the VelocityDroop attribute are Velocity Control Units / Sec / % Rated Torque.

Frequency Control

The velocity droop function is also supported when configured for Frequency Control. As the estimated I_q current within the motor increases, the velocity reference is reduced in proportion to the VelocityDroop attribute. Therefore, as torque loading on the motor increases, actual motor speed is reduced in proportion to the droop gain. This is helpful when some level of compliance is required due to rigid mechanical coupling between two motors.

IMPORTANT The frequency-control velocity droop function acts to reduce the velocity reference, but never changes the direction of the velocity reference.

IMPORTANT When configured for frequency control, the units of the VelocityDroop attribute are Velocity Control Units / Sec / % Rated I_q Current.

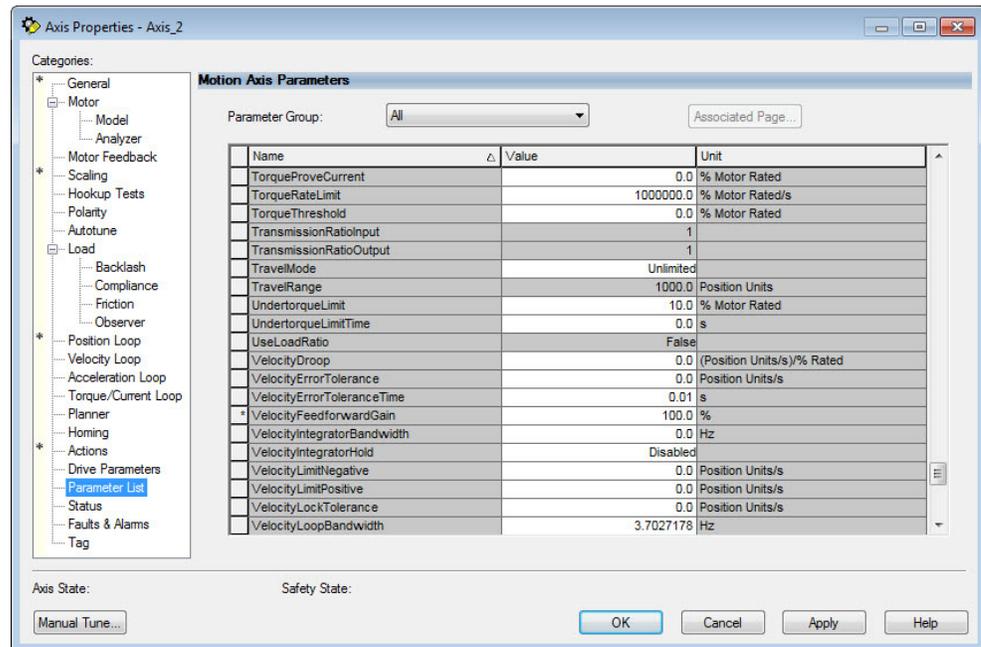
Velocity Droop Attribute

| ID | Access | Attribute | Conditional Implementation |
|---------|--------|----------------|--------------------------------|
| 464/321 | SSV | Velocity Droop | Velocity Units / Sec / % Rated |

Velocity Droop Configuration

Follow these steps to configure the velocity droop attribute.

1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the Parameter List category and scroll to VelocityDroop.



3. Enter a value in the Velocity Droop attribute appropriate for your application.
4. Click OK.

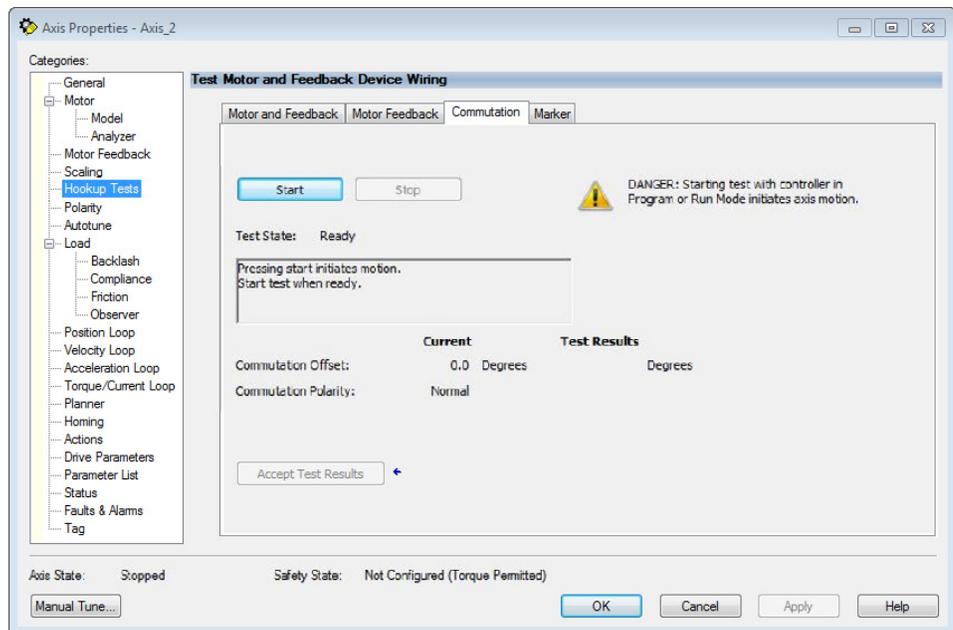
Commutation Test

The commutation test determines an unknown commutation offset and can also be used to determine the unknown polarity of the start-up commutation wiring. You can also use the commutation test to verify a known commutation offset and the polarity start-up commutation wiring.

IMPORTANT This test applies to third-party or custom permanent-magnet motors equipped with (TTL with Hall and Sine/Cosine with Hall) incremental encoders that are not available as a catalog number in the Motion Database.

IMPORTANT When motors have an unknown commutation offset and are not listed in the Motion Database by catalog number, you cannot enable the axis.

Figure 189 - Hookup Tests - Commutation Tab



To run the commutation test, see [Test the Axes](#) on [page 205](#).

Adaptive Tuning

The adaptive tuning feature is an algorithm inside the Kinetix 5700 servo drives. The algorithm continuously monitors and, if necessary, adjusts or adapts various filter parameters and control-loop gains to compensate for unknown and changing load conditions while the drive is running. Its primary function is to:

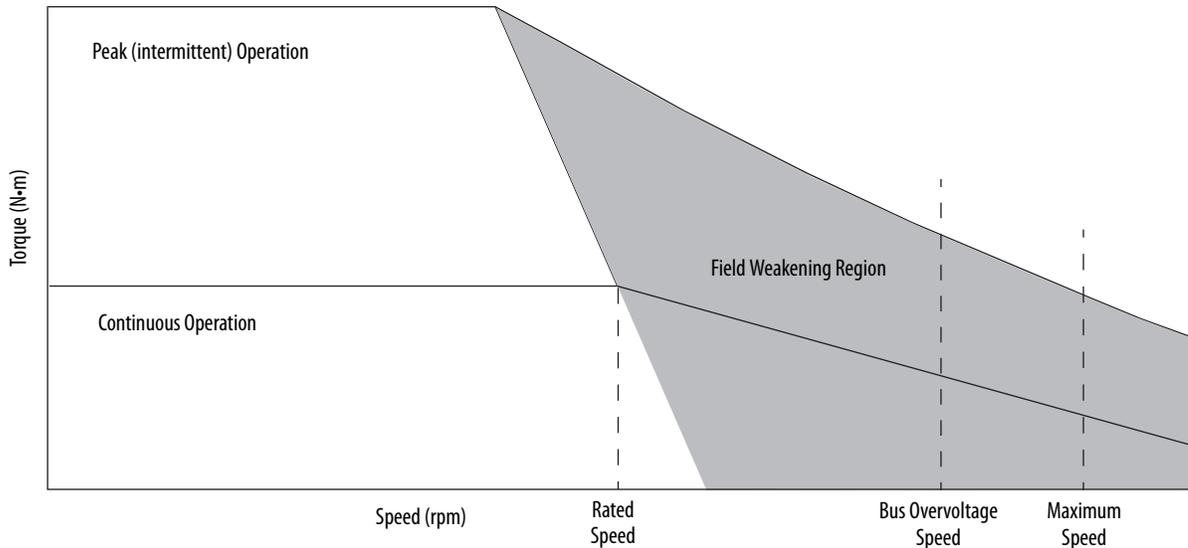
- Automatically adjust torque-loop notch and low-pass filter parameters to suppress resonances
- Automatically adjust control-loop gains to avoid instability when detected

See Motion System Tuning Application Techniques, publication [MOTION-AT005](#), for more information on the AdaptiveTuningConfiguration attribute.

Field Weakening Mode

Kinetix VP (Bulletin VPC) interior permanent-magnet (IPM) motors are designed to operate in Field Weakening mode to widen the speed range. Operation in Field Weakening mode can result in Back EMF voltage increasing to a level that exceeds the DC-bus voltage if a loss of control occurs. When this loss of control occurs, the Back EMF voltage can charge the DC-bus to a level that can overvoltage the DC-bus caps and result in a failure of the common DC-bus.

Figure 190 - Field Weakening Region



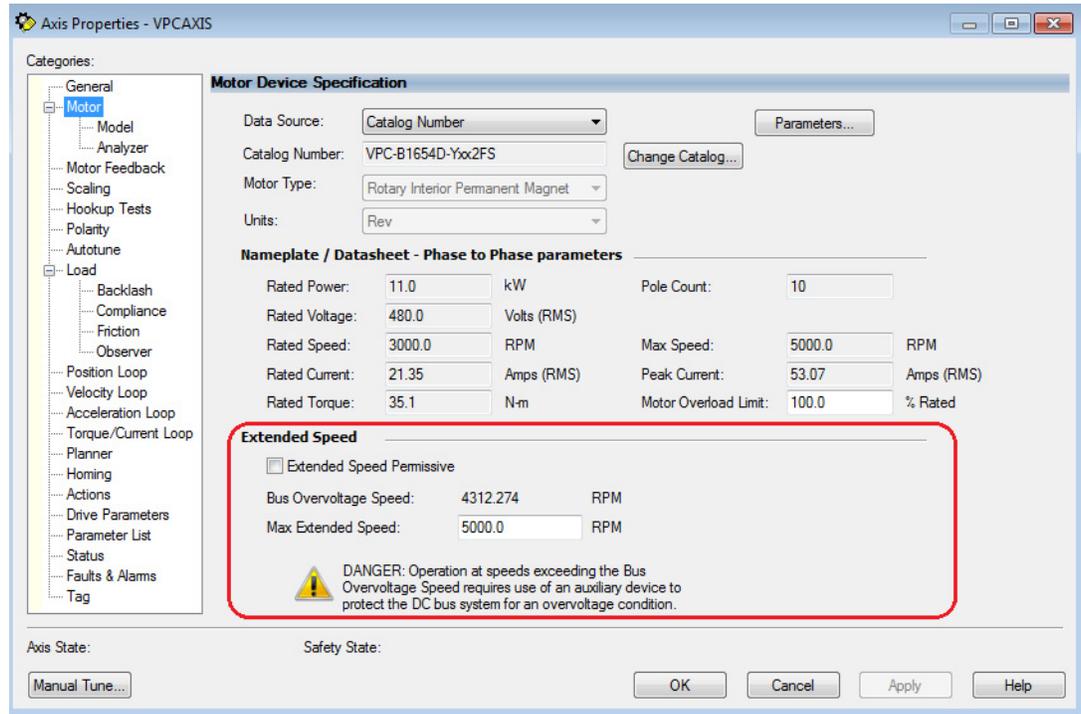
ATTENTION: DC-bus failure can cause damage to all drive modules in the bus group, not just the inverter connected to the Bulletin VPC motor.

Extended Speed Feature

The Extended Speed feature is implemented in the Logix Designer application to help prevent accidental operation at unsafe speeds. With this feature, the controller calculates a Bus Overvoltage Speed based upon the drive's maximum allowable bus-voltage and the Back EMF of the motor. This is the maximum speed that does not risk damaging the drive modules in the bus group. By default, the Extended Speed feature limits motor velocity to the Bus Overvoltage Speed.

Configure Extended Speed Operation

The extended speed feature is only configurable with Kinetix 5700 drives and Kinetix VP continuous-duty IPM motors. You can configure the Extended Speed feature in Axis Properties>Motor category of the Logix Designer application (version 29.00 or later).



Follow these steps to enable operating at speeds greater than the Bus Overvoltage Speed.

1. In the Extended Speed field, check Extended Speed Permissive.
2. Set the Max Extended Speed attribute as required by your application.



WARNING: Operation at speeds exceeding the Bus Overvoltage Speed requires use of an auxiliary device to protect the DC bus system from an overvoltage condition.

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Rockwell Automation Support

Use the following resources to access support information.

| | | |
|---|---|---|
| Technical Support Center | Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates. | https://rockwellautomation.custhelp.com/ |
| Local Technical Support Phone Numbers | Locate the phone number for your country. | http://www.rockwellautomation.com/global/support/get-support-now.page |
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Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444

Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640

Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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