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# ALLEN-BRADLEY KINETIX 5500 USER MANUAL




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User Manual

Allen-Bradley

# Kinetix 5500 Servo Drives

Catalog Numbers 2198-H003-ERS, 2198-H008-ERS, 2198-H015-ERS, 2198-H025-ERS, 2198-H040-ERS, 2198-H070-ERS
2198-H003-ERS2, 2198-H008-ERS2, 2198-H015-ERS2, 2198-H025-ERS2, 2198-H040-ERS2, 2198-H070-ERS2,
2198-CAPMOD-1300









Original Instructions

## 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). |

Allen-Bradley, CompactLogix, ControlFLASH, ControlLogix, GuardLogix, HPK-Series, Kinetix, Logix5000, MP-Series, PanelView, POINT I/O, RDD-Series, Rockwell Automation, Rockwell Software, RSLinx, Stratix 5700, Studio 5000 Logix Designer, Studio 5000, and TL-Series are trademarks of Rockwell Automation, Inc. CIP Sync and EtherNet/IP are trademarks of ODVA, Inc.

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

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| Updated references to compatible Logix5000™ PAC controllers. Added compatibility with ControlLogix® 5580 controllers. | 14, 24…26 and throughout |
| Added support for using 2090-CS*x*M1DG cables with Kinetix® 5500 servo drives. | 14, 84, 86 and throughout |
| Updated fuse/CB tables by removing footnotes regarding UL approval. | 31 |
| Added footnote to v21 Kinetix 5500 AOP with link to v26 Kinetix 5500 AOP. | 89 |
| Added ControlLogix 5580 controller to Ethernet Cable Connections. | 100 |
| Added link and installation information for the Kinetix 5500/5700 Add-on Profile available with drive firmware 4.001. | 107 |
| Added Configure Feedback-only Axis Properties. | 124 |
| Added Configure Induction-motor Frequency-control Axis Properties with support for Basic Volts/Hz, Sensorless Vector, and Fan/Pump Volts/Hz methods available with drive firmware 4.001. | 125 |
| Updated Configure PM Motor Closed-loop Control Axis Properties with minor changes. | 134 |
| Updated Test the Axes with minor changes. | 143 |
| Added Tune Induction Motors. | 147 |
| Updated fault memory description to reflect 128 fault log. | 150 |
| Updated Appendix D with support information for new features available with drive firmware 4.001. | 233…260 |

## Notes:

## About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting the Kinetix 5500 servo drives, and system integration for your drive and motor/actuator combination with a Logix5000 controller.

## Audience

This manual is intended for engineers or technicians directly involved in the installation and wiring of the Kinetix 5500 drives, and programmers directly involved in the operation, field maintenance, and integration of these drives with the EtherNet/IP™ communication module or controller.

If you do not have a basic understanding of Kinetix 5500 servo drives, contact your local Rockwell Automation sales representative for information on available training courses.

## Conventions Used in This Manual

These conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Catalog number string 2198-H*xxx*-ERS*x* is used when there's no need to distinguish between -ERS or -ERS2 servo drives.

| Kinetix 5500 Drive Cat. No. | Description |
|---|---|
| 2198-H*xxx*-ERS | Kinetix 5500 drive with hardwired safe torque-off functionality |
| 2198-H*xxx*-ERS2 | Kinetix 5500 drive with integrated safe torque-off functionality |

## Additional Resources

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

**Table 1 - Additional Resources**

| Resource | Description |
|---|---|
| Kinetix 5000 AC Line Filter Installation Instructions, publication 2198-IN003 | Information on installing AC line filters designed for Kinetix 5500 and Kinetix 5700 servo drive systems. |
| Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004 | Information on installing and wiring the Kinetix 5500 capacitor module. |
| Kinetix 5000 Shared-bus Connector Kit Installation Instructions, publication 2198-IN005 | Information on installing shared-bus connector kits designed for Kinetix 5500 and Kinetix 5700 servo drive systems. |
| Hiperface-to-DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006 | Information on installing the Hiperface-to-DSL feedback converter kit. |
| Shunt Resistor Installation Instructions, publication 2097-IN002 | Information on installing and wiring Bulletin 2097 shunt resistors. |
| System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001 | Information, examples, and techniques designed to minimize system failures caused by electrical noise. |
| EMC Noise Management DVD, publication GMC-SP004 | |
| Kinetix Motion Control Selection Guide, publication GMC-SG001 | 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. |

**Table 1 - Additional Resources (continued)**

| Resource | Description |
|---|---|
| Kinetix 5500 Drive Systems Design Guide, publication GMC-RM009 | System design guide to select the required (drive specific) drive module, power accessory, feedback connector kit, and motor cable catalog numbers for your Kinetix 5500 drive and Kinetix VP motor motion control system. |
| Kinetix Rotary Motion Specifications Technical Data, publication GMC-TD001 | Product specifications for Kinetix VP (Bulletin VPL, VPF, and VPS), MP-Series™ (Bulletin MPL, MPM, MPF, and MPS), Kinetix 6000M (Bulletin MDF), TL-Series™, RDD-Series™, and HPK-Series™ rotary motors. |
| Kinetix Linear Motion Specifications Technical Data, publication GMC-TD002 | Product specifications for MP-Series (Bulletin MPAS ballscrew, MPAR, and MPAI) and LDAT-Series linear actuators. |
| Kinetix Servo Drives Specifications Technical Data, publication GMC-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 GMC-TD004 | Product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items. |
| Rockwell Automation® Configuration and Selection Tools website http://www.rockwellautomation.com/en/e-tools | Motion Analyzer application analysis software for drive/motor sizing. |
| | Online product selection and system configuration tools, including AutoCAD (DXF) drawings. |
| Rockwell Automation Product Certification, website http://www.rockwellautomation.com/products/certification | For declarations of conformity (DoC) currently available from Rockwell Automation. |
| Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003 | Information on the AXIS_CIP_DRIVE attributes and the configuration software control modes and methods. |
| 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. |
| GuardLogix 5570 Controllers User Manual, publication 1756-UM022 | Information on designing, installing, programming, or troubleshooting control systems that use GuardLogix® 5570 controllers. |
| GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099 | Information for development, operation, or maintenance of a GuardLogix 5570 controller-based safety system that uses the Studio 5000 Logix Designer® application. |
| Safety Products Catalog website http://www.ab.com/catalogs | Information regarding Allen-Bradley® safety products, including safety relays, light curtain, and gate interlock applications. |
| ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-QS105 | For ControlFLASH™ information not specific to any drive family. |
| National Electrical Code, published by the National Fire Protection Association of Boston, MA | An article on wire sizes and types for grounding electrical equipment. |
| Rockwell Automation Industrial Automation Glossary, publication AG-7.1 | A glossary of industrial automation terms and abbreviations. |

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

# Start

Use this chapter to become familiar with the design and installation requirements for Kinetix 5500 drive systems.


| Topic | Page |
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| About the Kinetix 5500 Servo Drive System | 13 |
| Drive Hardware and Input Power Configurations | 15 |
| Motor Feedback and Feedback-only Configurations | 20 |
| Typical Communication Configurations | 21 |
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## About the Kinetix 5500 Servo Drive System

The Kinetix 5500 servo drives are designed to provide a Kinetix Integrated Motion solution for your drive and motor/actuator application.

**Table 2 - Kinetix 5500 Drive System Overview**

| Drive System Component | Cat. No. | Description |
|---|---|---|
| Kinetix 5500 Servo Drives | 2198-H*xxx*-ERS | 200V-class (single-phase or three-phase) and 400V-class (three-phase) drives operate in standalone and multi-axis shared AC, shared DC, shared AC/DC, and shared AC/DC hybrid configurations. Modules are zero-stacked from drive-to-drive and use the shared-bus connection system to extend power in multi-axis configurations. Safe torque-off via hardwired (STO) connector. |
| | 2198-H*xxx*-ERS2 | Same power structures with standalone and multi-axis bus-sharing capability. Safe torque-off via the EtherNet/IP network. |
| Kinetix 5500 Capacitor Module | 2198-CAPMOD-1300 | Use for energy storage and/or to improve performance in applications producing regenerative energy and requiring shorter duty cycles (1360 µf). Modules are zero-stacked side-by-side with servo drives and use the shared-bus connection system to extend power. |
| Shared-bus Connector Kits | 2198-H040-*x*-*x* | Input wiring connectors and DC bus T-connector for frame 1 and 2 servo drives. |
| | 2198-H070-*x*-*x* | Input wiring connectors and DC bus T-connector for frame 3 servo drives. |
| Feedback Connector Kit | 2198-KITCON-DSL | Replacement feedback connector kit with 2-pin connector plug and grounding plate inside the connector housing. |
| Hiperface to DSL Converter Kit | 2198-H2DCK (series B or later) | Use the 2198-H2DCK (series B or later) Hiperface-to-DSL feedback converter kit with MP-Series (Bulletin MPL, MPM, MPF, and MPS) rotary motors, MP-Series (Bulletin MPAS ballscrew, MPAR, MPAI) linear actuators, and LDAT-Series linear thrusters. |
| I/O Connector Kits | 2198-KITCON-IOSP | Replacement I/O connector kit (spring clamp) for I/O (IOD) connector. |
| | 2198-KITCON-IOSC | Replacement I/O connector kit (screw terminal) for I/O (IOD) connector. |
| Connector Sets | 2198-KITCON-PWR40 | Replacement connector set, 40 A, for frame 1 and frame 2 drives. |
| | 2198-KITCON-PWR70 | Replacement connector set, 70 A, for frame 3 drives. |
| | 2198-KITCON-CAP1300 | Replacement connector set, 40 A, for capacitor module. |

**Table 2 - Kinetix 5500 Drive System Overview**

| Drive System Component | Cat. No. | Description |
|---|---|---|
| Logix5000 Controller Platform | Bulletin 1769 | Integrated Motion on the EtherNet/IP network in CompactLogix 5370 controllers and Integrated Safety in Compact GuardLogix 5370 controllers. Linear, device-level ring (DLR), and star topology is supported. |
| | 1756-EN2T module<br>1756-EN2TR module<br>1756-EN3TR module | EtherNet/IP network communication modules for use with ControlLogix 5570, ControlLogix 5580, and GuardLogix 5570 controllers. Linear, device-level ring (DLR), and star topology is supported. |
| Studio 5000® Environment | N/A | Studio 5000 Logix Designer application, version 21.00 or later, provides support for programming, commissioning, and maintaining the CompactLogix and ControlLogix controller families. Version 24.00 or later is required for 2198-H*xxx*-ERS2 servo drives. |
| Rotary Servo Motors | VPL-A*xxxx*, VPL-B*xxxx*<br>VPF-A*xxxx*, VPF-B*xxxx*<br>VPS-B*xxxx* | Compatible rotary motors include 200V and 400V-class Kinetix VP (Bulletin VPL, VPF, and VPS). |
| | MP-Series | Compatible rotary motors include 200V and 400V-class MP-Series (Bulletin MPL, MPM, MPF, and MPS) when used with the Hiperface-to-DSL feedback converter kit. |
| Linear Actuators | MP-Series<br>LDAT-Series | Compatible linear actuators include 200V and 400V-class MP-Series (Bulletin MPAS ballscrew, MPAR, and MPAI) and LDAT-Series when used with the Hiperface-to-DSL feedback converter kit. |
| Induction Motors | N/A | Induction motors with open loop frequency control are also supported. |
| Cables | 2090-CS*x*M1DF-*xx*A*xxx* | Bulletin 2090 flying-lead single-cable for motor power, feedback, and 24V DC brake power with Kinetix VP motors. Designed specifically for Kinetix 5500 servo drives. |
| | 2090-CS*x*M1DG-*xx*A*xxx* | Bulletin 2090 flying-lead single cable for motor power, feedback, and 24V DC brake power with Kinetix VP motors. Designed with longer leads than 2090-CS*x*M1DF cables to accommodate Kinetix 5500 or Kinetix 5700 drive families. |
| | 2090-CFBM7DF-CEA*xxx* | Bulletin 2090 motor feedback cables for MP-Series motors and actuators. |
| | 2090-CP*x*M7DF-*xx*A*xxx* | Bulletin 2090 motor power/brake cables for MP-Series motors and actuators. |
| | 1585J-M8CBJM-*x* | Ethernet cables are available in standard lengths. Shielded cable is recommended. |
| AC Line Filters | 2198-DB08-F<br>2198-DB20-F<br>2198-DB42-F | Bulletin 2198 three-phase AC line filters are required to meet CE and available for use in all Kinetix 5500 drive systems. |
| 24V DC Power Supply | 1606-XL*xxx* | Bulletin 1606 24V DC power supply for control circuitry, digital inputs, safety, and motor brake. |
| External Shunt Resistors | 2097-R6 and 2097-R7 | Bulletin 2097 external passive shunt resistors for when the drive's internal shunt capability is exceeded. |

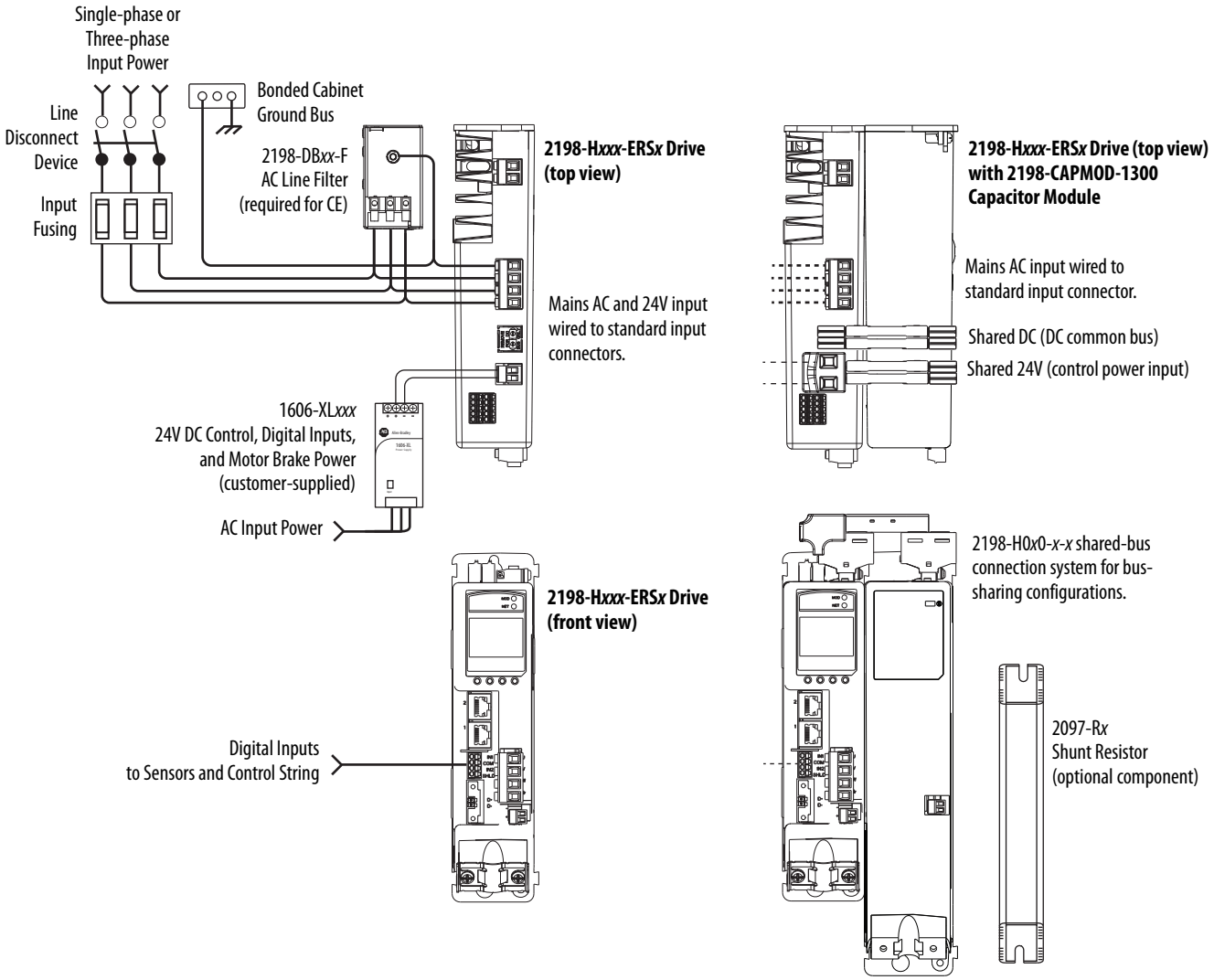
# Drive Hardware and Input Power Configurations

Typical Kinetix 5500 systems include single-phase and three-phase standalone configurations, three-phase shared AC, shared AC/DC, shared DC, and shared AC/DC hybrid configurations.

## Standalone Configurations

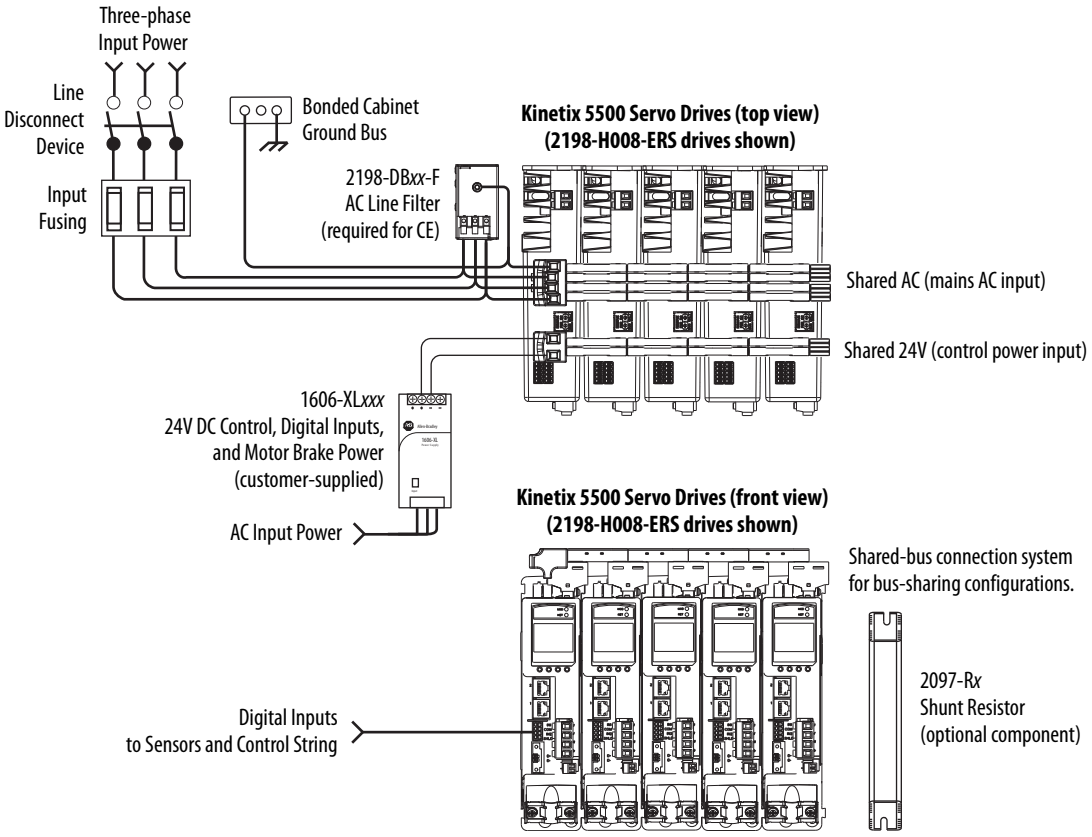
In these examples, a single standalone drive is shown with and without the Bulletin 2198 capacitor module.

**Figure 1 - Typical Kinetix 5500 Standalone Installation**



In this example, three-phase AC power and 24V control power is shared in a multi-axis configuration. All drives must have the same power rating (catalog number).

**Figure 2 - Typical Shared AC Installations**



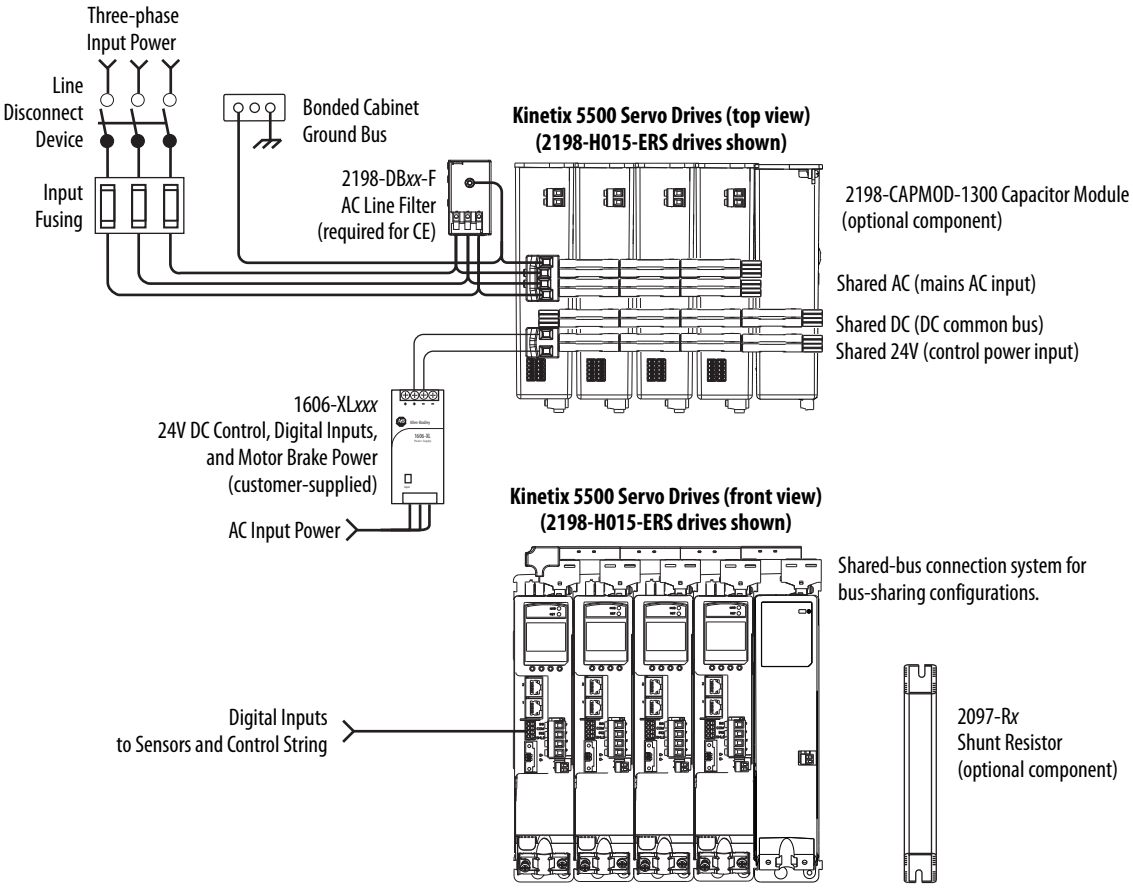

**IMPORTANT** In shared AC configurations, all drives must have the same power rating.

Shared AC configurations do not support Bulletin 2198 capacitor modules.

## Shared AC/DC Configurations

In this example, three-phase AC input power, 24V control power, and DC-bus power are shared in a multi-axis configuration. All drives must be the same power rating (catalog number).

**Figure 3 - Typical Shared AC/DC Installations**

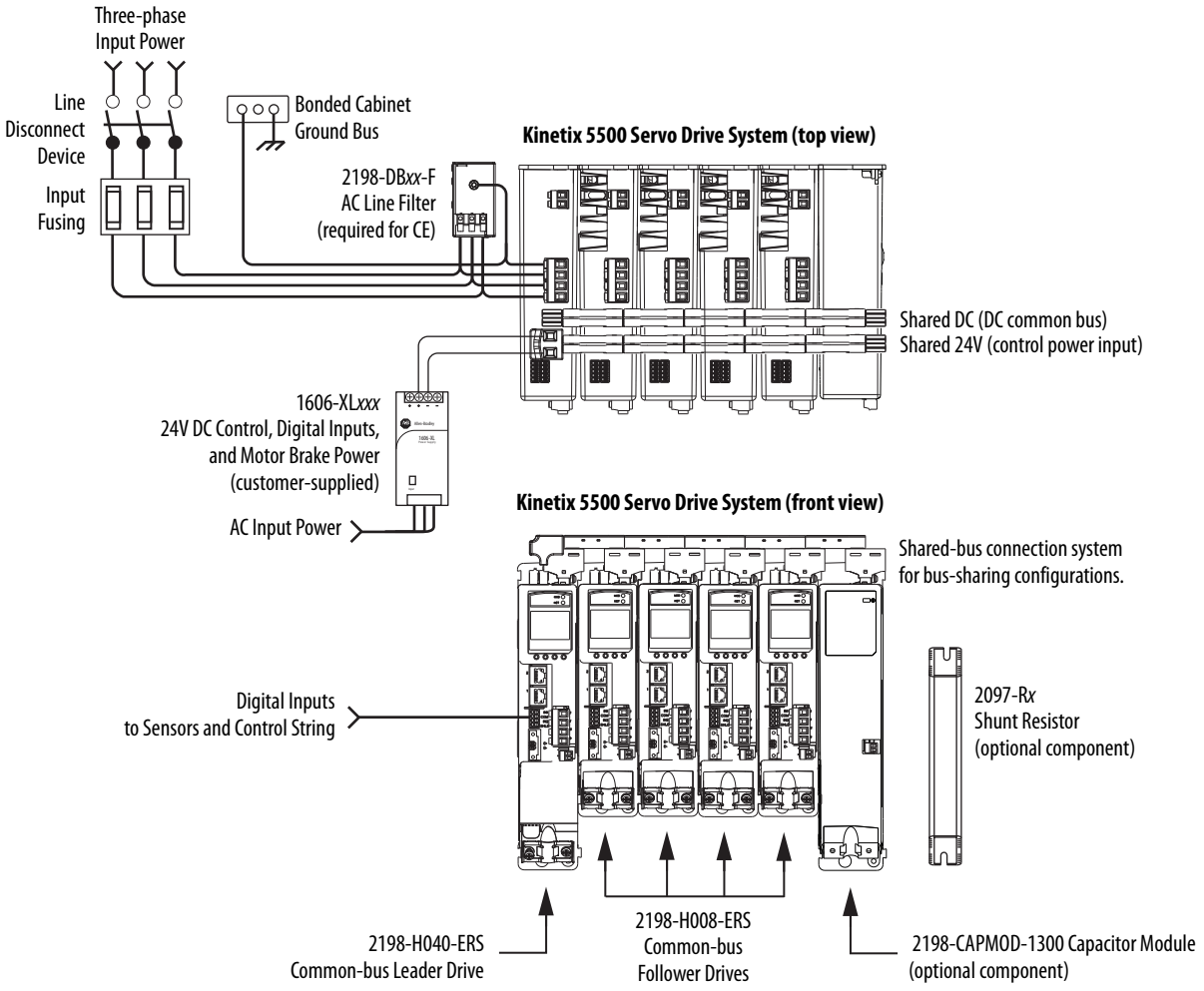



**IMPORTANT** In shared AC/DC configurations, all drives must have the same power rating (catalog number).

## Shared DC Common-bus Configurations

In this multi-axis example, the common-bus leader (sourcing) drive receives three-phase AC input power and supplies DC power to common-bus follower (sinking) drives. The common-bus leader-drive power rating is greater than or equal to the power rating of each follower drive.

**Figure 4 - Typical Shared DC Common-bus Installations**

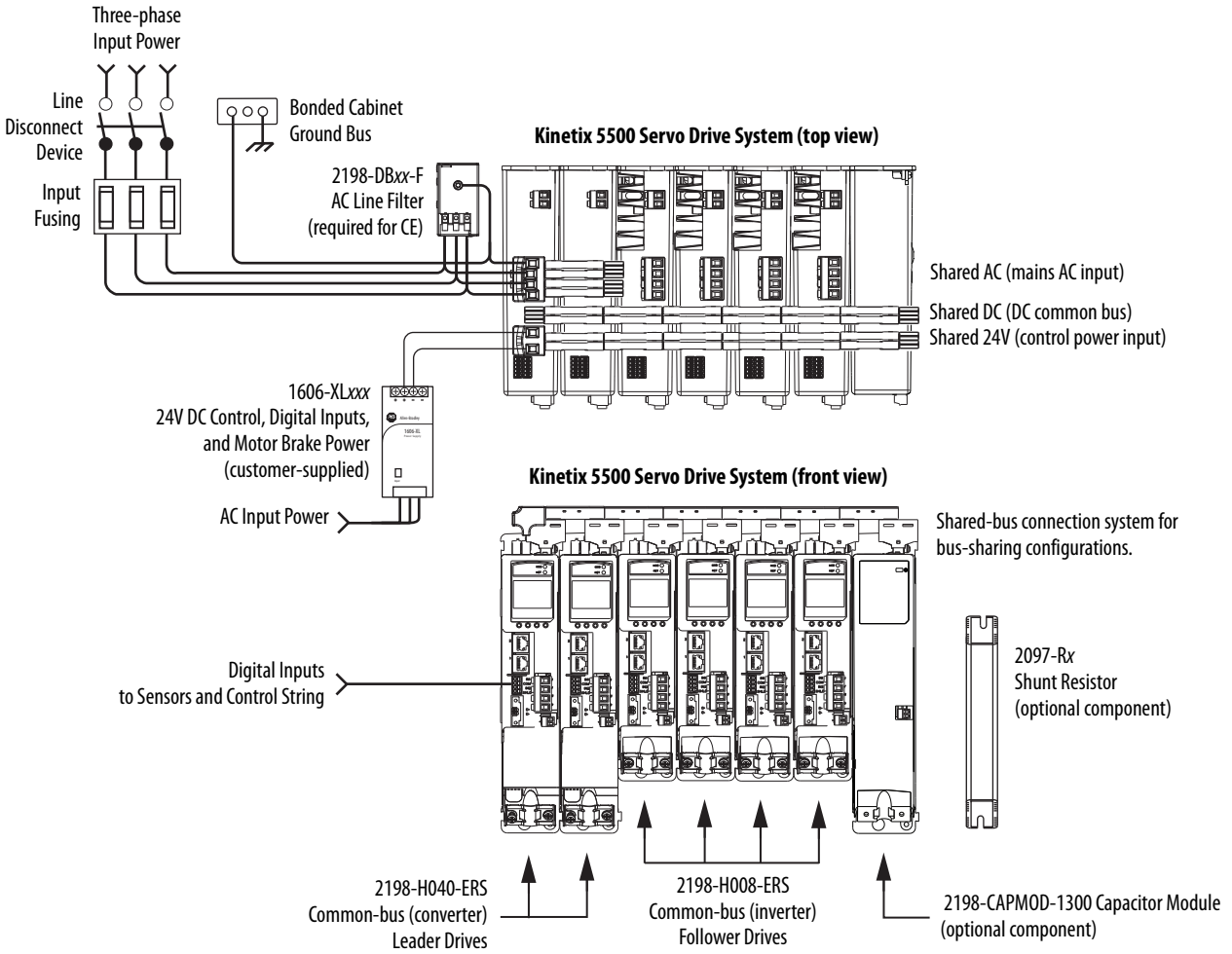



**IMPORTANT** In shared DC common-bus configurations, the leader drive power rating must be greater than or equal to the power rating of the follower drives.

## Shared AC/DC Hybrid Configuration

In this multi-axis example, three-phase AC input power is supplied to two converter drives. The converter drive ratings must be the same, and greater than or equal to the power ratings of the inverter drives. This parallel converter configuration increases the DC-bus power supplied to the inverter drives.

**Figure 5 - Typical Shared AC/DC Bus Hybrid Installations**

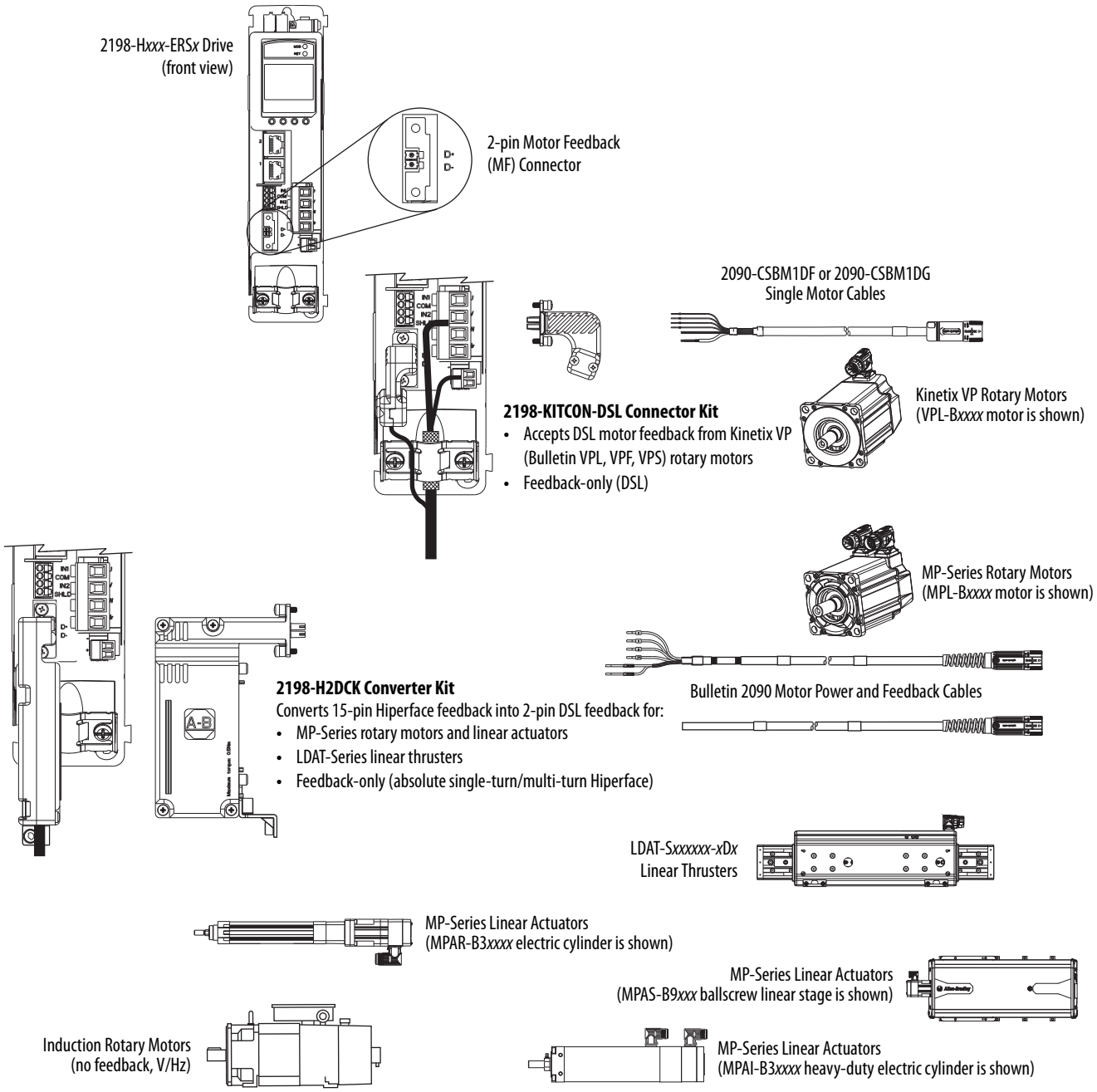



**IMPORTANT** In shared AC/DC hybrid configuration, the converter drives must have the same power rating and must be greater than or equal to the power ratings of the inverter drives.

## Motor Feedback and Feedback-only Configurations

Feedback connections are made at the 2-pin motor feedback (MF) 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 69.

**Figure 6 - Feedback Configuration Examples**




**IMPORTANT** In 2198-H2DCK converter kit applications, you can replace the 2090-CP*x*M7DF power/brake cable with a 2090-CSBM1DF single motor cable (and reuse the 2090-CFBM7DF feedback cable) to increase the maximum cable length to 50 m (164 ft). However, this applies to only 18 and 14 AWG single cables. 2090-CS*x*M1DF-10A*xxx* (10 AWG) cables do not support this 50 m (164 ft) option.

# Typical Communication Configurations

The Kinetix 5500 drives support any Ethernet topology including linear, ring, and star by using ControlLogix, GuardLogix, or CompactLogix controllers.

These examples feature the CompactLogix 5370 programmable automation controllers (Bulletin 1769) with support for Integrated Motion over the EtherNet/IP network. Controller features include the following:

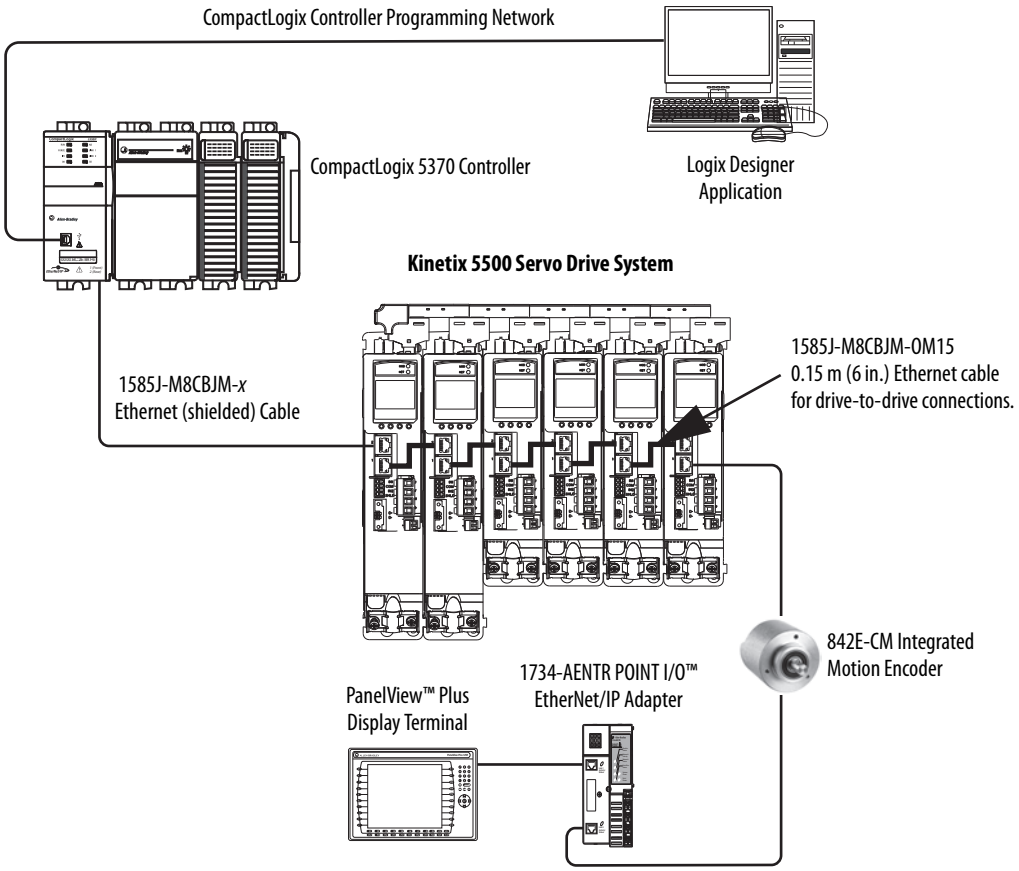
- Supports up to 16 axes
- Supports up to 48 devices in linear configurations
- Dual-port connectivity to support device-level ring (DLR) topology

Refer to CompactLogix Controllers Specifications Technical Data, publication 1769-TD005, for more information on CompactLogix 5370 L1, L2, and L3 controllers.

## Linear Topology

In this example, all devices are connected in linear topology. The Kinetix 5500 drives 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 5500 Linear Communication Installation**

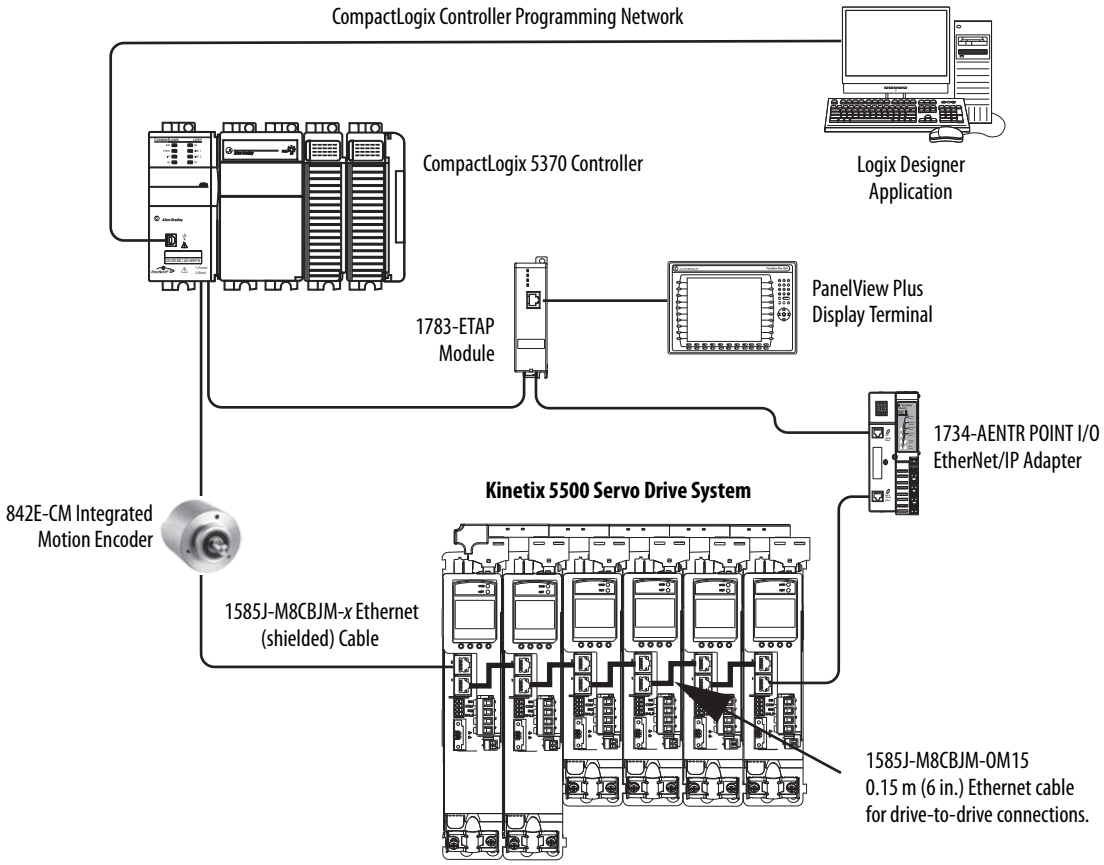


## Ring Topology

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 5500 Ring Communication Installation**

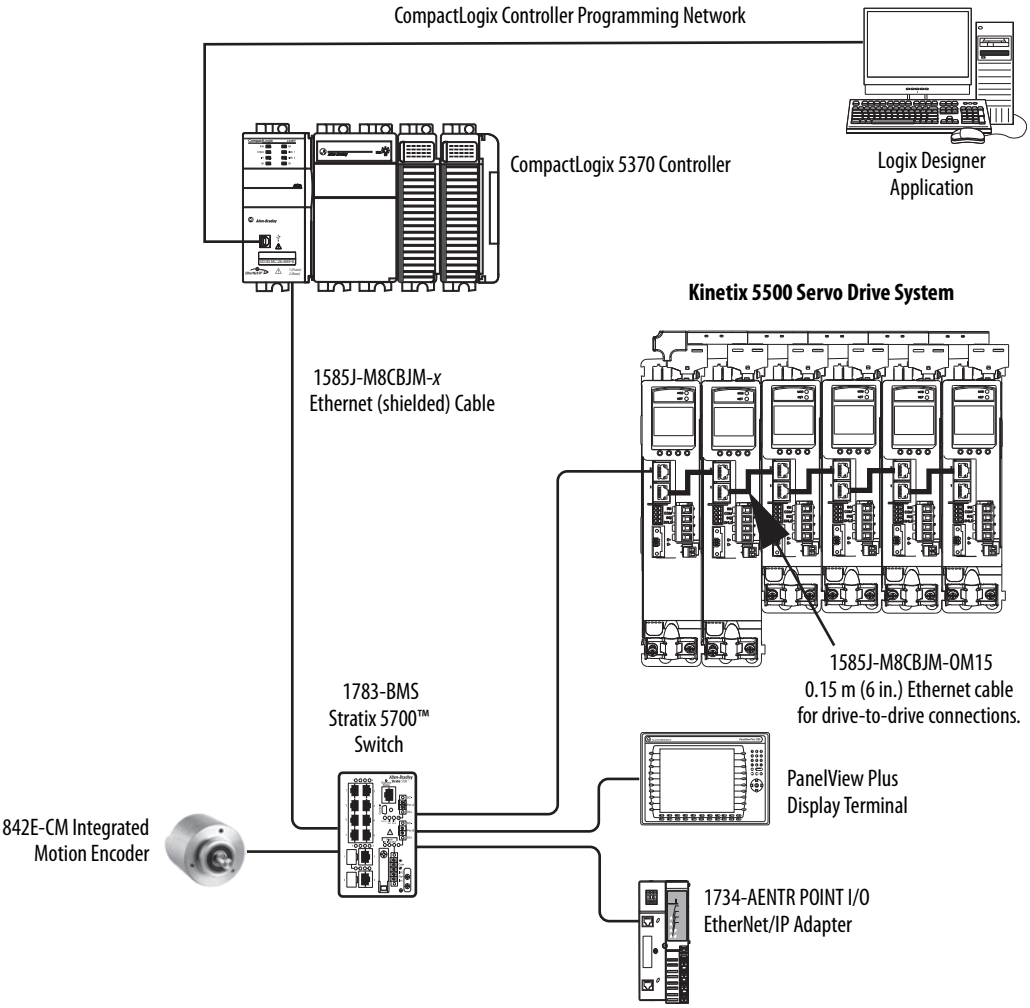


## Star Topology

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

Kinetix 5500 drives have dual ports, so linear topology is maintained from drive-to-drive, but Kinetix 5500 drives and other devices operate independently. The loss of one device does not impact the operation of other devices.

**Figure 9 - Kinetix 5500 Star Communication Installation**



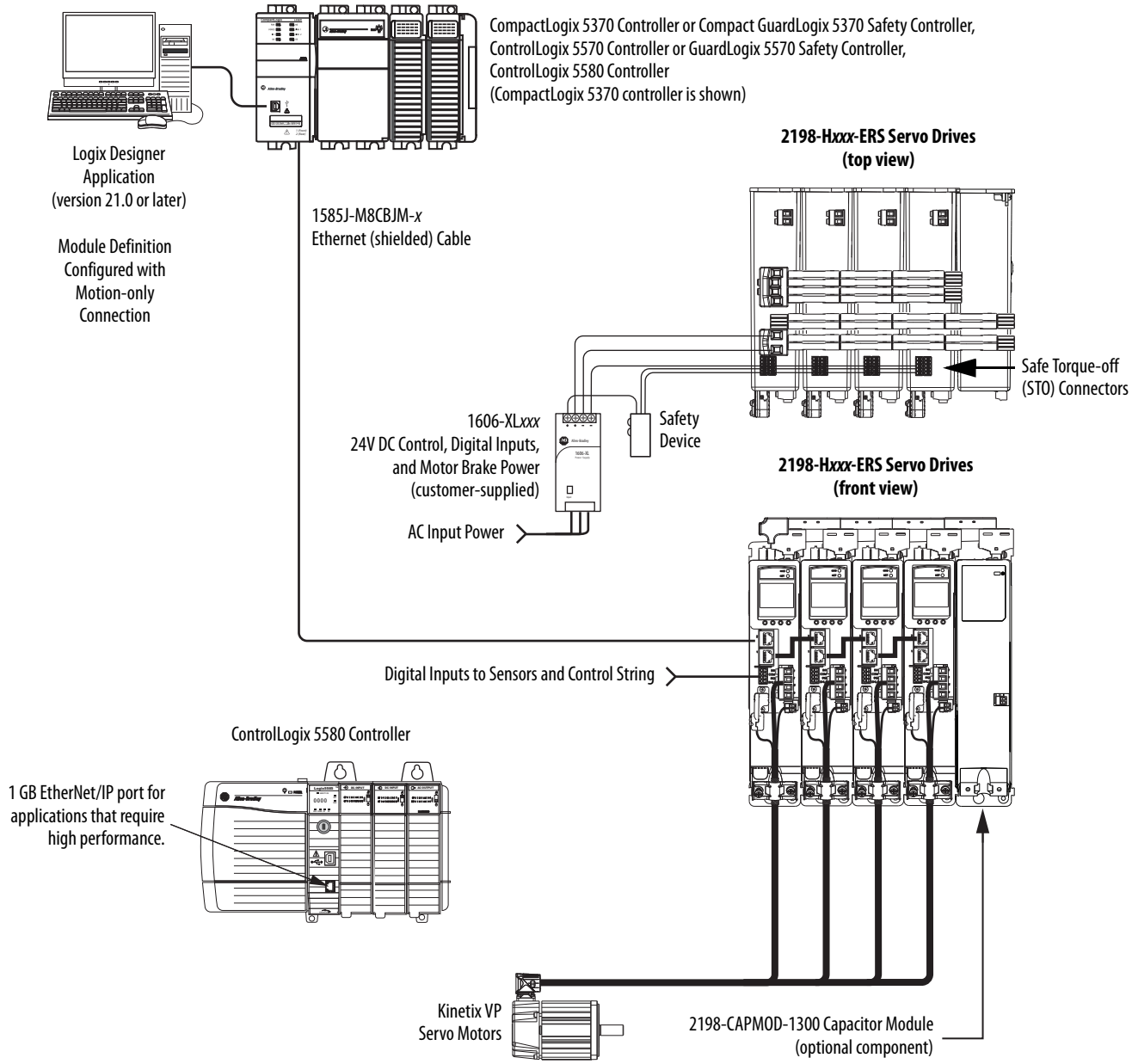
# Safe Torque-off Configurations

Kinetix 5500 servo drives are available with safe torque-off via hardwired connections or integrated over the EtherNet/IP network. These examples illustrate the safe torque-off configuration options.

## Hardwired Safety Configuration

The 2198-H*xxx*-ERS 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**



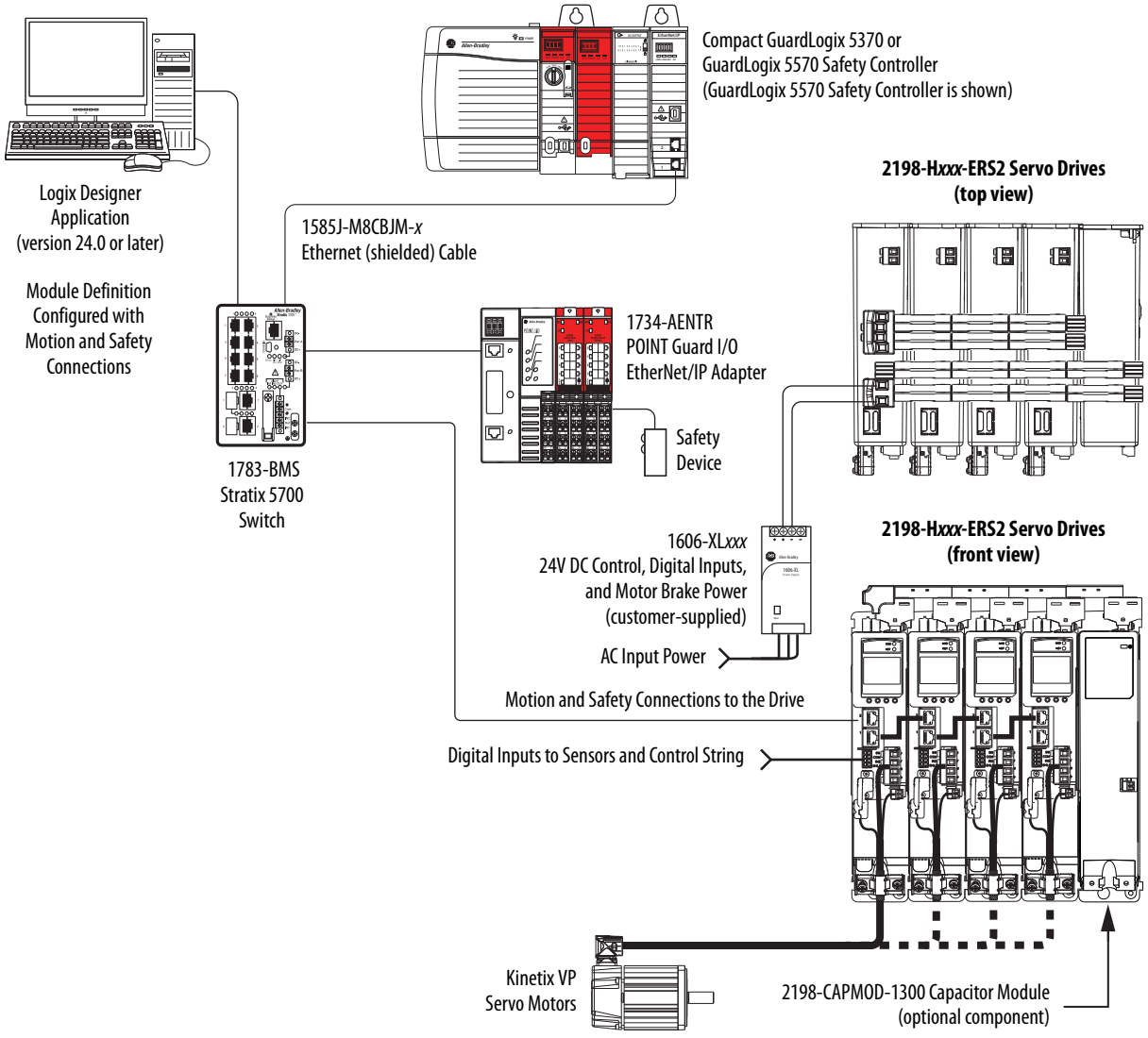
## Integrated Safety Configurations

The GuardLogix 5570 or Compact GuardLogix 5370 safety controller issues the safe torque-off (STO) command over the EtherNet/IP network and the 2198-H*xxx*-ERS2 integrated safety drive executes the command.

In this example, a single GuardLogix safety controller makes a Motion and Safety connection with the 2198-H*xxx*-ERS2 integrated safety drives.

**IMPORTANT** If only one controller is used in an application with Motion and Safety connections, the controller must be a GuardLogix 5570 or Compact GuardLogix 5370 safety controller.

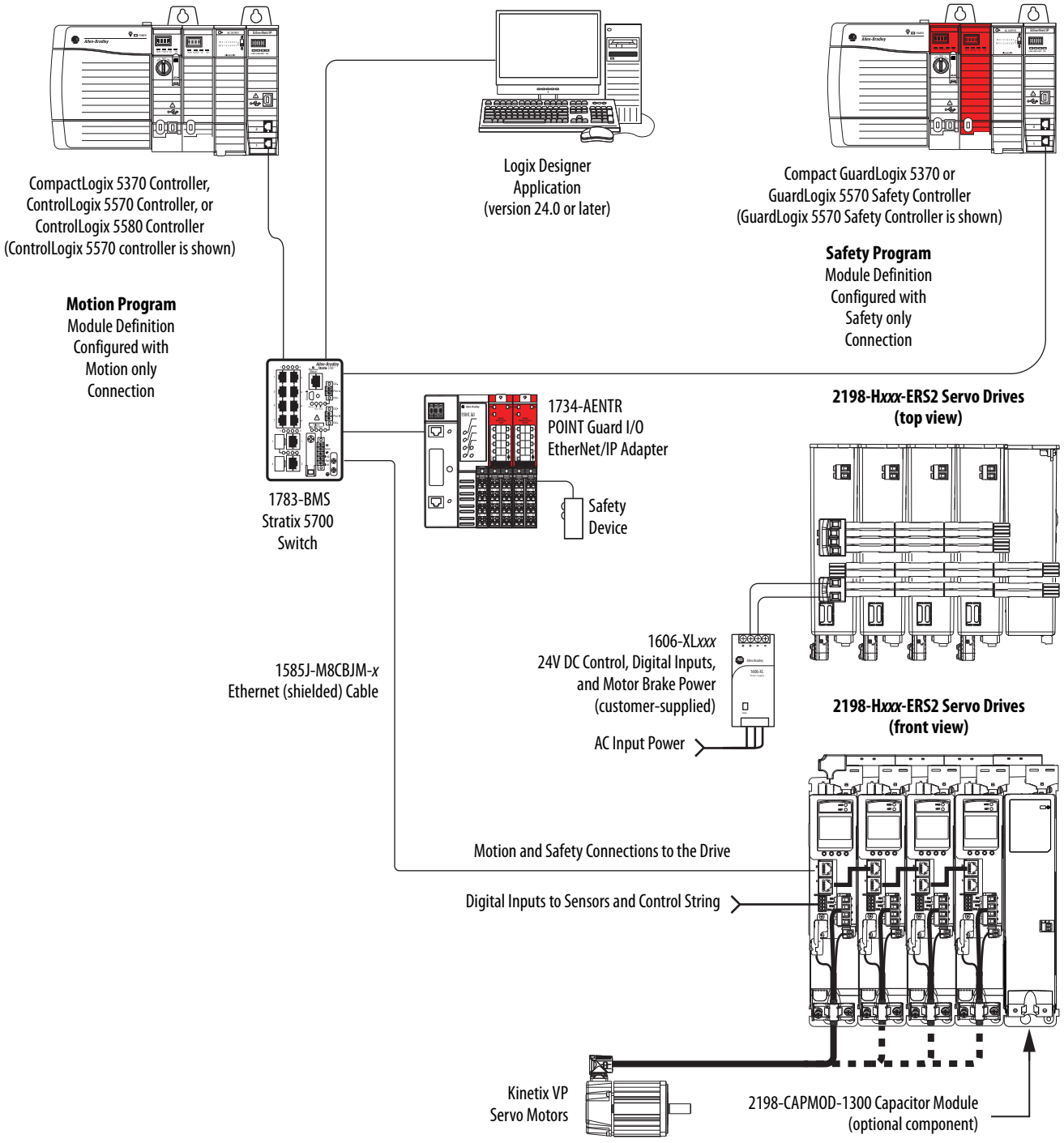
**Figure 11 - Motion and Safety Configuration (single controller)**



In this example, a non-safety controller makes the Motion-only connection and a separate GuardLogix safety controller makes the Safety-only connection with 2198-H*xxx*-ERS2 integrated safety drives.

**IMPORTANT** If two controllers are used in an application with Motion-only and Safety-only connections, the Safety-only connection must be a GuardLogix 5570 or Compact GuardLogix 5370 safety controller and the Motion-only connection must be a ControlLogix 5570 or CompactLogix 5370 controller.

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



# Catalog Number Explanation

Kinetix 5500 drive catalog numbers and performance descriptions.

**Table 3 - Kinetix 5500 Servo Drive Catalog Numbers**

| Drive Cat. No. (hardwired STO) | Drive Cat. No. (integrated STO) | Frame Size | Input Voltage | Continuous Output Power<br>kW | Continuous Output Current<br>A 0-pk |
|---|---|---|---|---|---|
| 2198-H003-ERS | 2198-H003-ERS2 | 1 | 195…264V rms, single-phase<br>195…264V rms, three-phase<br>324…528V rms, three-phase | 0.2 kW<br>0.3 kW<br>0.6 kW | 1.4 |
| 2198-H008-ERS | 2198-H008-ERS2 | | | 0.5 kW<br>0.8 kW<br>1.6 kW | 3.5 |
| 2198-H015-ERS | 2198-H015-ERS2 | 2 | | 1.0 kW<br>1.5 KW<br>3.2 kW | 7.1 |
| 2198-H025-ERS | 2198-H025-ERS2 | | 195…264V rms, three-phase<br>324…528V rms, three-phase | 2.4 kW<br>5.1 kW | 11.3 |
| 2198-H040-ERS | 2198-H040-ERS2 | | | 4.0 kW<br>8.3 kW | 18.4 |
| 2198-H070-ERS | 2198-H070-ERS2 | 3 | | 7.0 kW<br>14.6 kW | 32.5 |

**Table 4 - Capacitor Module Catalog Number**

| Capacitor Module Cat. No. | Frame Size | Rated Voltage | Capacitance |
|---|---|---|---|
| 2198-CAPMOD-1300 | 2 | 650V DC, nom | 1360 µF, min |

**Table 5 - Shared-bus Connector Kit Catalog Numbers**

| Kit Cat. No. | Frame Size | Application | Description |
|---|---|---|---|
| 2198-H040-ADP-IN | Frame 1 or 2 | First drive | • Mains AC input wiring connector<br>• 24V DC input wiring connector<br>• DC bus T-connector |
| 2198-H040-A-T | Next drive is…<br>Frame 1 drives:<br>2198-H003-ERS*x*<br>2198-H008-ERS*x*<br>Frame 2 drives:<br>2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | AC sharing only | AC bus T-connector |
| 2198-H040-D-T | | DC sharing only | DC bus T-connector |
| 2198-H040-P-T | | Control power sharing only | Control power T-connector |
| 2198-H040-AD-T | | AC and DC bus sharing | AC and DC bus T-connectors |
| 2198-H040-AP-T | | AC and control power sharing | AC and control power T-connectors |
| 2198-H040-DP-T | | DC and control power sharing | DC and control power T-connectors |
| 2198-H040-ADP-T | | AC, DC, and control power sharing | AC, DC, and control power T-connectors |
| 2198-H070-ADP-IN | Frame 3 drive:<br>2198-H070-ERS*x* | First drive | • Mains AC input wiring connector<br>• 24V DC input wiring connector<br>• DC bus T-connector |
| 2198-H070-A-T | Next drive is…<br>Frame 3 drives:<br>2198-H070-ERS*x* | AC sharing only | AC bus T-connector |
| 2198-H070-D-T | | DC sharing only | DC bus T-connector |
| 2198-H070-P-T | | Control power sharing only | Control power T-connector |
| 2198-H070-AD-T | | AC and DC bus sharing | AC and DC bus T-connectors |
| 2198-H070-AP-T | | AC and control power sharing | AC and control power T-connectors |
| 2198-H070-DP-T | | DC and control power sharing | DC and control power T-connectors |
| 2198-H070-ADP-T | | AC, DC, and control power sharing | AC, DC, and control power T-connectors |

## Agency Compliance

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

**ATTENTION:** Meeting CE requires a grounded system, and the method of grounding the AC line filter and drive must match. Failure to do this renders the filter ineffective and can cause damage to the filter. For grounding examples, refer to Grounded Power Configurations on page 71.

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 Kinetix 5500 drive as possible.
- Bond drive, capacitor module, and line filter grounding screws by using a braided ground strap as shown in Figure 42 on page 76.
- 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.
- Combined motor cable length for all axes on the same DC bus must not exceed 250 m (820 ft). Drive-to-motor cables must not exceed 50 m (164 ft); however, use of continuous-flex cable and 2198-H2DCK converter kit limits the maximum length.

**Table 6 - Drive-to-Motor Maximum Cable Length**

| Kinetix 5500 Servo Drive Cat. No. | Kinetix VP Servo Motors | | Other Compatible Rotary Motors and Linear Actuators (1) |
|---|---|---|---|
| | Standard (non-flex) Cables<br>Cat. No. 2090-CS*x*M1DF-*xx*AA*xx*<br>m (ft) | Continuous-flex Cables<br>Cat. No. 2090-CSBM1DF-*xx*AF*xx*<br>m (ft) | Bulletin 2090 Motor/Actuator Cables (2)<br>Cat. No. 2090-C*xx*M7DF<br>m (ft) |
| 2198-H003-ERS*x*<br>2198-H008-ERS*x* | 50 (164) | 30 (98.4) | 20 (65.6) |
| 2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | 50 (164) | | |
| 2198-H070-ERS*x* | 50 (164) | | |

(1) Requires use of the 2198-H2DCK Hiperface-to-DSL (series B or later) feedback converter kit.

(2) The 20 m (65.6 ft) limitation is attributed to the 2090-CP*x*M7DF power/brake cable. In 2198-H2DCK converter kit applications, you can replace the 2090-CP*x*M7DF power/brake cable with a 2090-CSBM1DF or 2090-CSBM1DG single motor cable (and reuse the 2090-CFBM7DF feedback cable) to increase the maximum cable length to 50 m (164 ft). Applies to only 18 and 14 AWG single cables. 2090-CS*x*M1DF-10A*xxx* (10 AWG) cables and any other 2090-CS*x*M1DF/DG cables with M40 or M58 connectors do not support this 50 m (164 ft) option.

- Install the Kinetix 5500 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 199 for input power wiring and drive/motor interconnect diagrams.

# Plan the Kinetix 5500 Drive System Installation

This chapter describes system installation guidelines used in preparation for mounting your Kinetix 5500 drive components.


| Topic | Page |
|---|---|
| System Design Guidelines | 30 |
| Electrical Noise Reduction | 36 |




**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 http://www.rockwellautomation.com/en/e-tools.

## System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 5500 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 protection class IP20 (EN 60529) and pollution degree 2 (EN 61800-5-1).
- Size the drive enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all drive components.
- Combined motor power cable length for all axes on the same DC bus must not exceed 250 m (820 ft). Drive-to-motor cables must not exceed 50 m (164 ft), however use of continuous-flex cable and 2198-H2DCK converter kit limits the maximum length. Refer to Table 6 on page 28 for specifications by frame size.

  **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 drive, capacitor module, and line filter grounding screws by using a braided ground strap as shown in Figure 42 on page 76.

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 servo drive does not require an isolation transformer for three-phase input power. However, a transformer can be required to match the voltage requirements of the drive to the available service.

To size a transformer for the main AC power inputs, refer to the Kinetix 5500 power specifications in the Kinetix Servo Drives Technical Data, publication GMC-TD003.

| | |
|---|---|
| **IMPORTANT** | When using an autotransformer, make sure that the phase to neutral/ground voltage does not exceed the input voltage ratings of the drive. |

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

| | |
|---|---|
| **IMPORTANT** | 150 KVA, max and 3% impedance, min |

| | |
|---|---|
| **EXAMPLE** | Sizing a transformer to the voltage requirements of this drive:<br>2198-H040-ERS*x* = 8.4 kW = 12.6 KVA transformer. |

## Circuit Breaker/Fuse Selection

The Kinetix 5500 drives 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 200, 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.

*Standalone Drive Systems*

| Kinetix 5500 Drives | | | UL Applications | IEC (non-UL) Applications |
|---|---|---|---|---|
| **Drive Cat. No.** | **Drive Voltage, nom** | **Phase** | **Bussmann Fuses Cat. No.** | **Molded Case CB Cat. No.** |
| 2198-H003-ERS*x* | 240V | Single-phase | KTK-R-2 | 140U-D6D2-B10 |
| | 240/480V | Three-phase | KTK-R-3 | 140U-D6D3-B20 |
| 2198-H008-ERS*x* | 240V | Single-phase | KTK-R-5 | 140U-D6D2-B20 |
| | 240/480V | Three-phase | KTK-R-7 | 140U-D6D3-B60 |
| 2198-H015-ERS*x* | 240V | Single-phase | KTK-R-10 | 140U-D6D2-B80 |
| | 240/480V | Three-phase | KTK-R-15 | 140U-D6D3-C12 |
| 2198-H025-ERS*x* | 240/480V | Three-phase | KTK-R-20 | 140U-D6D3-C20 |
| 2198-H040-ERS*x* | 240/480V | Three-phase | KTK-R-25 | 140U-D6D3-C25 |
| 2198-H070-ERS*x* | 240/480V | Three-phase | LPJ-35SP (class J) | N/A |

*Shared DC (common-bus) Drive Systems*

| Kinetix 5500 Drives | | UL Applications | IEC (non-UL) Applications |
|---|---|---|---|
| **Drive Cat. No.** | **Drive Voltage (three-phase) nom** | **Bussmann Fuses Cat. No.** | **Molded Case CB Cat. No.** |
| 2198-H003-ERS*x* | 240/480V | KTK-R-10 | N/A |
| 2198-H008-ERS*x* | 240/480V | KTK-R-10 | N/A |
| 2198-H015-ERS*x* | 240/480V | KTK-R-15 | 140U-D6D3-C15 |
| 2198-H025-ERS*x* | 240/480V | KTK-R-20 | 140U-D6D3-C20 |
| 2198-H040-ERS*x* | 240/480V | KTK-R-25 | 140U-D6D3-C25 |
| 2198-H070-ERS*x* | 240/480V | LPJ-35SP | N/A |

*Shared AC Drive Systems*

| Kinetix 5500 Drives | | UL Applications | | | | IEC (non-UL) Applications | | | |
|---|---|---|---|---|---|---|---|---|---|
| Drive Cat. No. | Drive Voltage, (three-phase) nom | Bussmann Fuses Cat. No. | | | | Molded Case CB Cat. No. | | | |
| | | 2 Axes | 3 Axes | 4 Axes | 5 Axes | 2 Axes | 3 Axes | 4 Axes | 5 Axes |
| 2198-H003-ERS*x* | 240/480V | KTK-R-15 | | | | N/A | | | |
| 2198-H008-ERS*x* | 240/480V | KTK-R-15 | | | | N/A | | | |
| 2198-H015-ERS*x* | 240/480V | KTK-R-20 | KTK-R-25 | N/A | | 140U-D6D3-C15 | 140U-D6D3-C20 | N/A | |
| 2198-H025-ERS*x* | 240/480V | KTK-R-30 | | N/A | | 140U-D6D3-C25 | 140U-D6D3-C30 | N/A | |
| 2198-H040-ERS*x* | 240/480V | LPJ-35SP | LPJ-45SP | N/A | | N/A | | | |
| 2198-H070-ERS*x* | 240/480V | LPJ-60SP | N/A | | | N/A | | | |

*Shared AC/DC and Hybrid Systems*

| Kinetix 5500 Drives | | UL Applications | | | | | | | IEC (non-UL) Applications | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Drive Cat. No. | Drive Voltage, (three-phase) nom | Bussmann Fuse Cat. No. | | | | | | | Molded Case CB Cat. No. | | | | | | |
| | | 2 Axes | 3 Axes | 4 Axes | 5 Axes | 6 Axes | 7 Axes | 8 Axes | 2 Axes | 3 Axes | 4 Axes | 5 Axes | 6 Axes | 7 Axes | 8 Axes |
| 2198-H003-ERS*x* | 240/480V | KTK-R-10 | | | | | KTK-R-15 | | N/A | | | | | | |
| 2198-H008-ERS*x* | 240/480V | KTK-R-15 | | | | KTK-R-20 | | | N/A | | | | | | |
| 2198-H015-ERS*x* | 240/480V | KTK-R-20 | | | N/A | | | | 140U-D6D3-C15 | 140U-D6D3-C20 | | N/A | | | |
| 2198-H025-ERS*x* | 240/480V | KTK-R-30 | | | N/A | | | | 140U-D6D3-C20 | 140U-D6D3-C30 | | N/A | | | |
| 2198-H040-ERS*x* | 240/480V | KTK-R-30 | LPJ-45SP | LPJ-50SP | N/A | | | | 140U-D6D3-C30 | N/A | | | | | |
| 2198-H070-ERS*x* | 240/480V | LPJ-50SP | N/A | | | | | | N/A | | | | | | |

## Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Kinetix 5500 drive system. You need heat dissipation data from all components planned for your enclosure to calculate the enclosure size (refer to Table 7).

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 5500 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.

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

In this example, the enclosure must have an exterior surface of at least 2.99 $m^2$. 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 5500 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.

$$1.5 \times (0.300 \times 0.70) + 1.5 \times (0.300 \times 2.0) + 1.5 \times (0.70 \times 2.0) = 3.31\,m^2$$

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 7 - Power Dissipation Specifications**

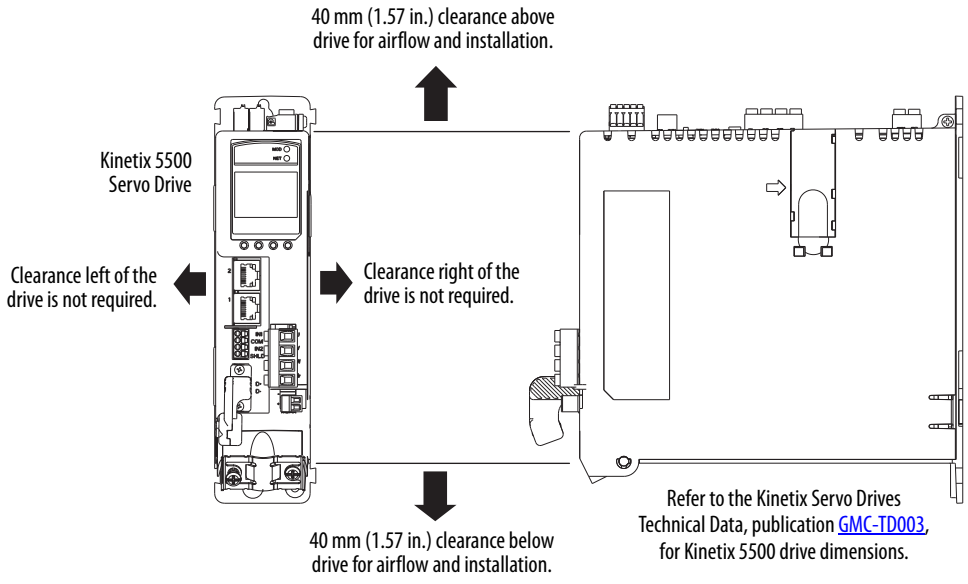
| Kinetix 5500 Drive Cat. No. | Frame Size | Usage as % of Rated Power Output (watts) | | | | |
|---|---|---|---|---|---|---|
| | | 20% | 40% | 60% | 80% | 100% |
| 2198-H003-ERS*x* | 1 | 12 | 25 | 37 | 50 | 62 |
| 2198-H008-ERS*x* | | | | | | |
| 2198-H015-ERS*x* | 2 | 40 | 80 | 120 | 160 | 200 |
| 2198-H025-ERS*x* | | | | | | |
| 2198-H040-ERS*x* | | | | | | |
| 2198-H070-ERS*x* | 3 | 64 | 128 | 192 | 256 | 320 |

## Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 5500 drive:

- Additional clearance is required for cables and wires or the shared-bus connection system connected to the top of the drive.
- Additional clearance is required if other devices are installed above and/or below the drive and have clearance requirements of their own.
- Additional clearance left and right of the drive is required when mounted adjacent to noise sensitive equipment or clean wire ways.
- The recommended minimum cabinet depth is 300 mm (11.81 in.).

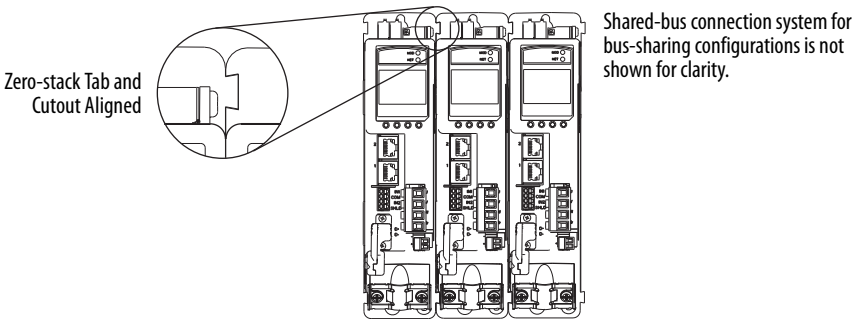
**Figure 13 - Minimum Clearance Requirements**




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

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

**Figure 14 - 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 5500 system installations. For more information on the concept of high-frequency (HF) bonding, the ground plane principle, and electrical noise reduction, refer to the System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.

### Bonding Modules

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

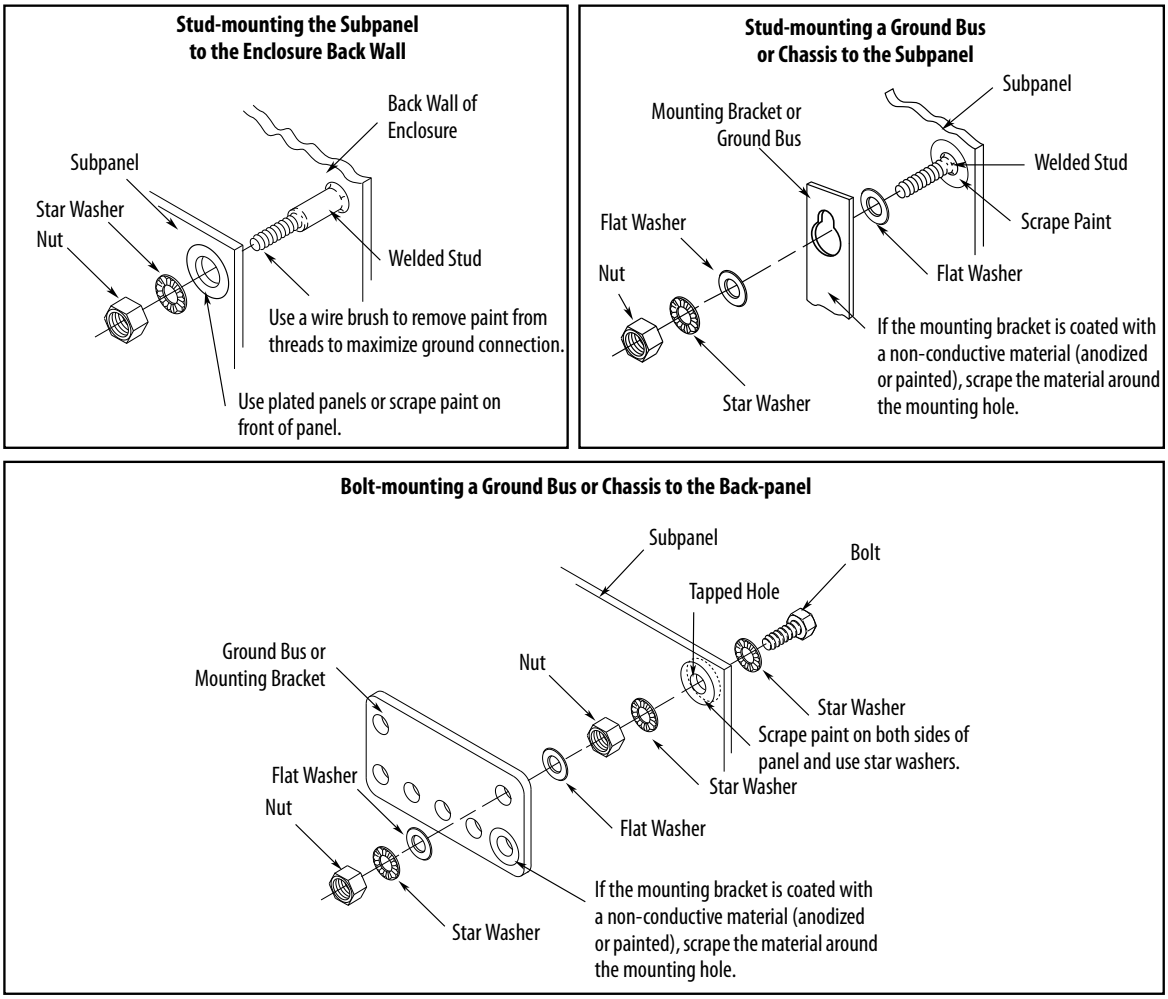
Unless specified, most paints are not conductive and act as insulators. To achieve a good bond between power rail and the subpanel, surfaces need to be paint-free or plated. Bonding metal surfaces creates a low-impedance return path for high-frequency energy.

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

Improper bonding 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 15 - Recommended Bonding Practices for Painted Panels**

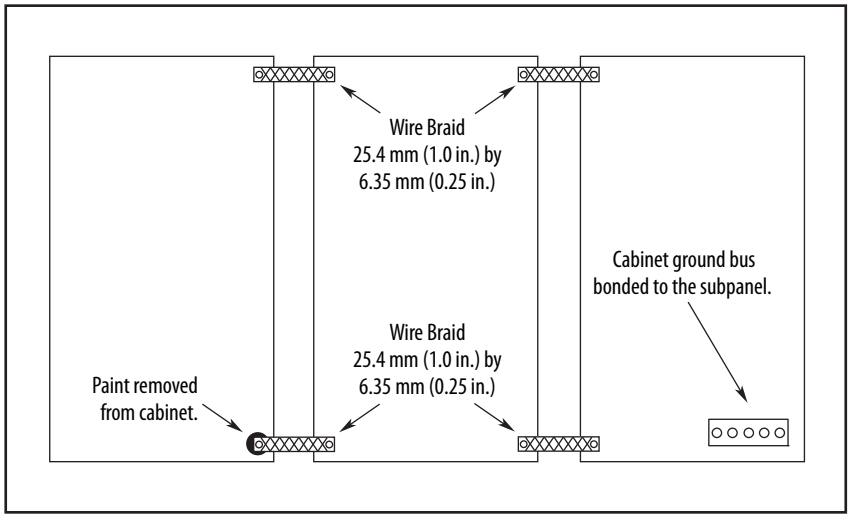


## Bonding Multiple Subpanels

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 16 - Multiple Subpanels and Cabinet Recommendations**

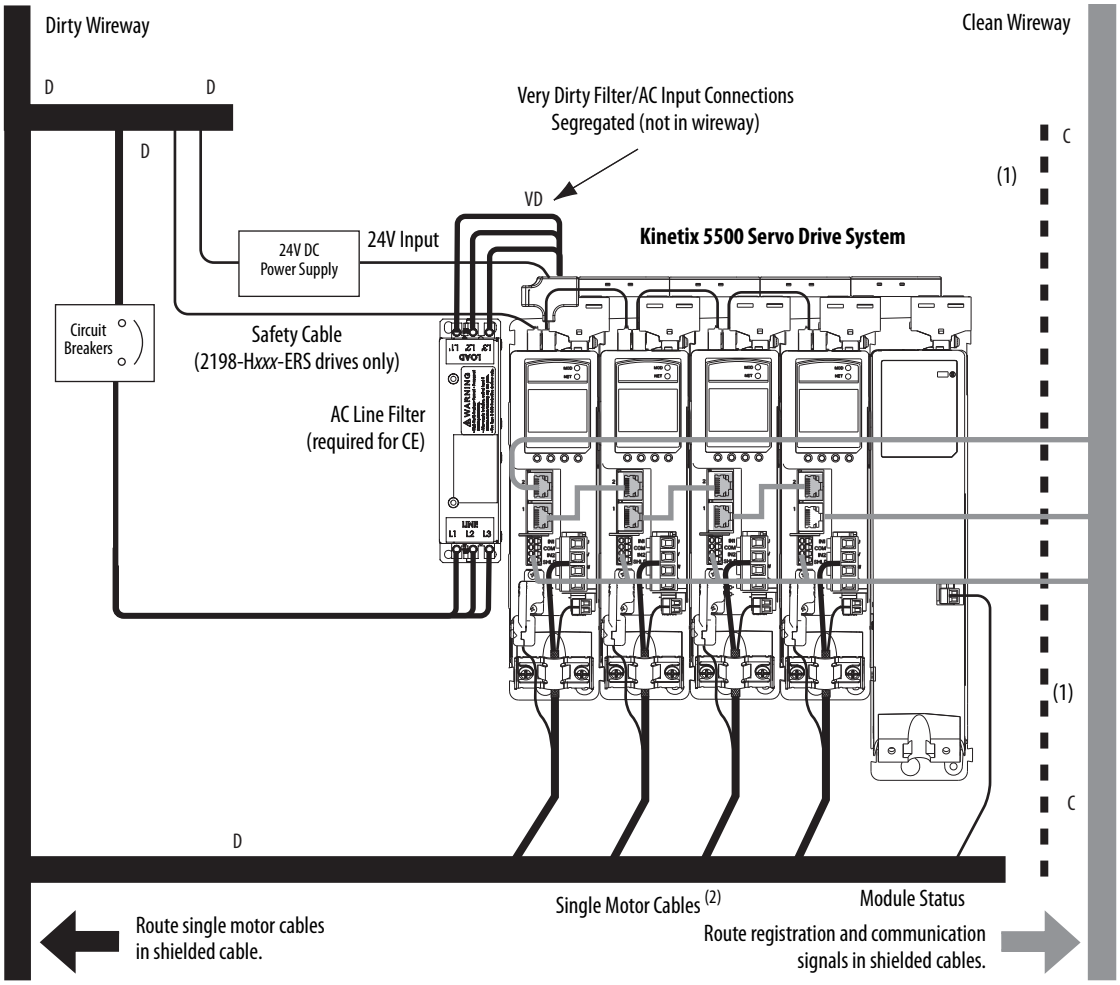


## Establishing Noise Zones

Observe these guidelines when routing cables used in the Kinetix 5500 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 above 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 drive (or first drive in multi-axis systems). Shielded cable is required only if the very dirty cables enter a wireway.

**Figure 17 - Noise Zones**




(1) When space to the right of the drive 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 2198-H2DCK converter kit is used, feedback cable routes in the clean wireway.

## Cable Categories for Kinetix 5500 Systems

These tables indicate the zoning requirements of cables connecting to the Kinetix 5500 drive components.

**Table 8 - Kinetix 5500 Drive**

| 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 | | | |
| U, V, W (motor power)<br>Motor feedback (1)<br>Motor brake | MP<br>MF<br>BC | | X<br>X<br>X | | | X<br>X<br>X |
| 24V DC | CP | | X | | | |
| Safety enable for safe torque-off (hardwired) (2) | 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<br>PORT2 | | | X | | X |

(1) When the 2198-H2DCK converter kit is used, the feedback cable routes in the clean wireway.
(2) STO connector applies to only 2198-H*xxx*-ERS (hardwired) servo drives.

**Table 9 - 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. | | | | |
| 24V DC | CP | Bus-bar only, no wiring connector. | | | | |
| Module status | MS | | X | | | |

## Noise Reduction Guidelines for Drive Accessories

Refer to this section when mounting an AC (EMC) line filter or external passive-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 39 for an example):

- Mount the AC line filter on the same panel as the Kinetix 5500 drive and as close to the drive as possible.
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on page 37.
- Segregate input and output wiring as far as possible.

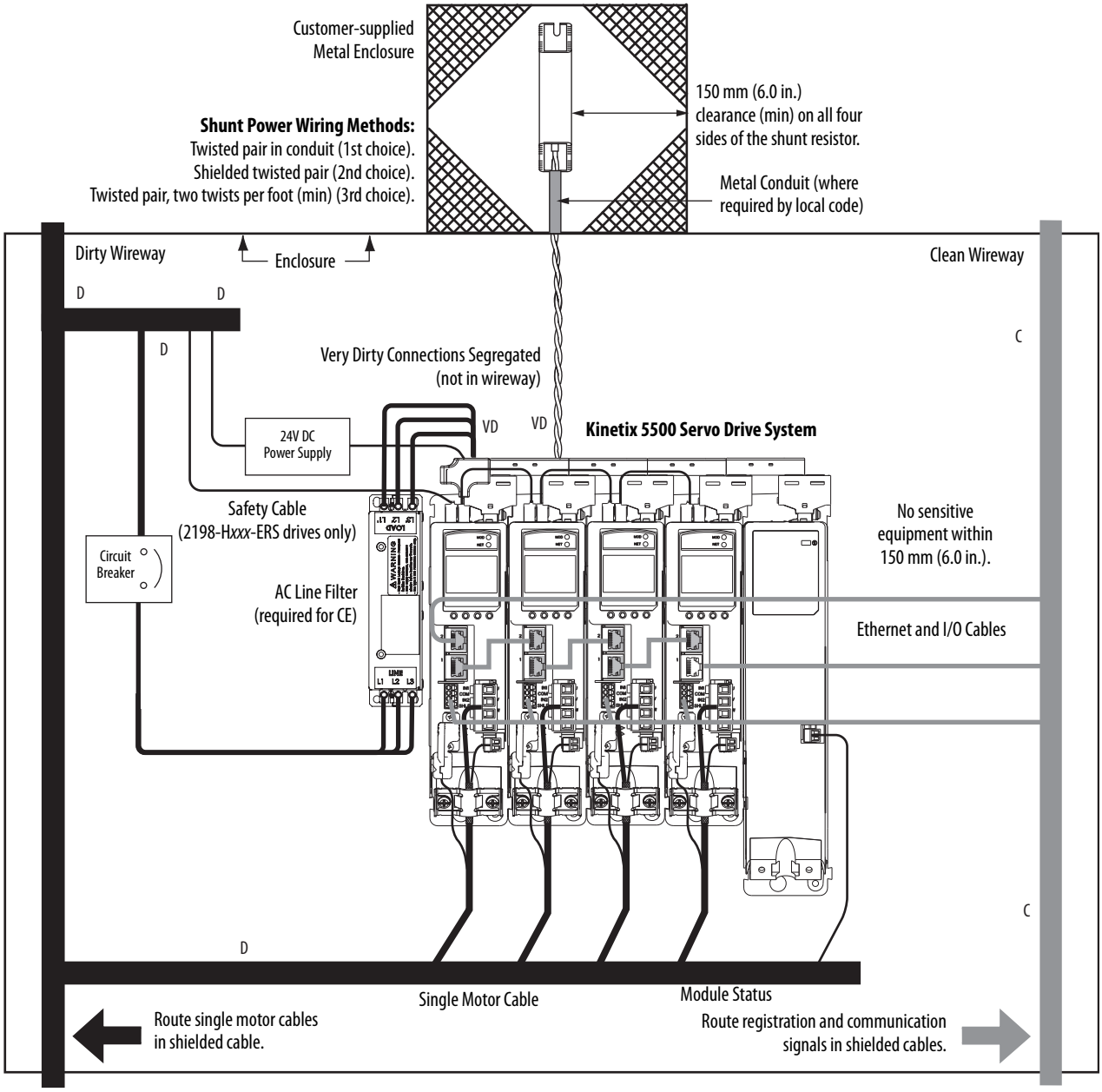
**IMPORTANT** CE test certification applies to only the AC line filter used with a single drive or the line filter used in multi-axis drive configurations. Sharing a line filter with more than one multi-axis drive configuration can perform satisfactorily, but the customer takes legal responsibility.

### *External Passive Shunt Resistor*

Observe these guidelines when mounting your Bulletin 2097 external passive-shunt resistor outside of the enclosure:

- Mount shunt resistor and wiring in the very dirty zone or in an external shielded enclosure.
- Mount resistors in a shielded and ventilated enclosure outside of the cabinet.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.

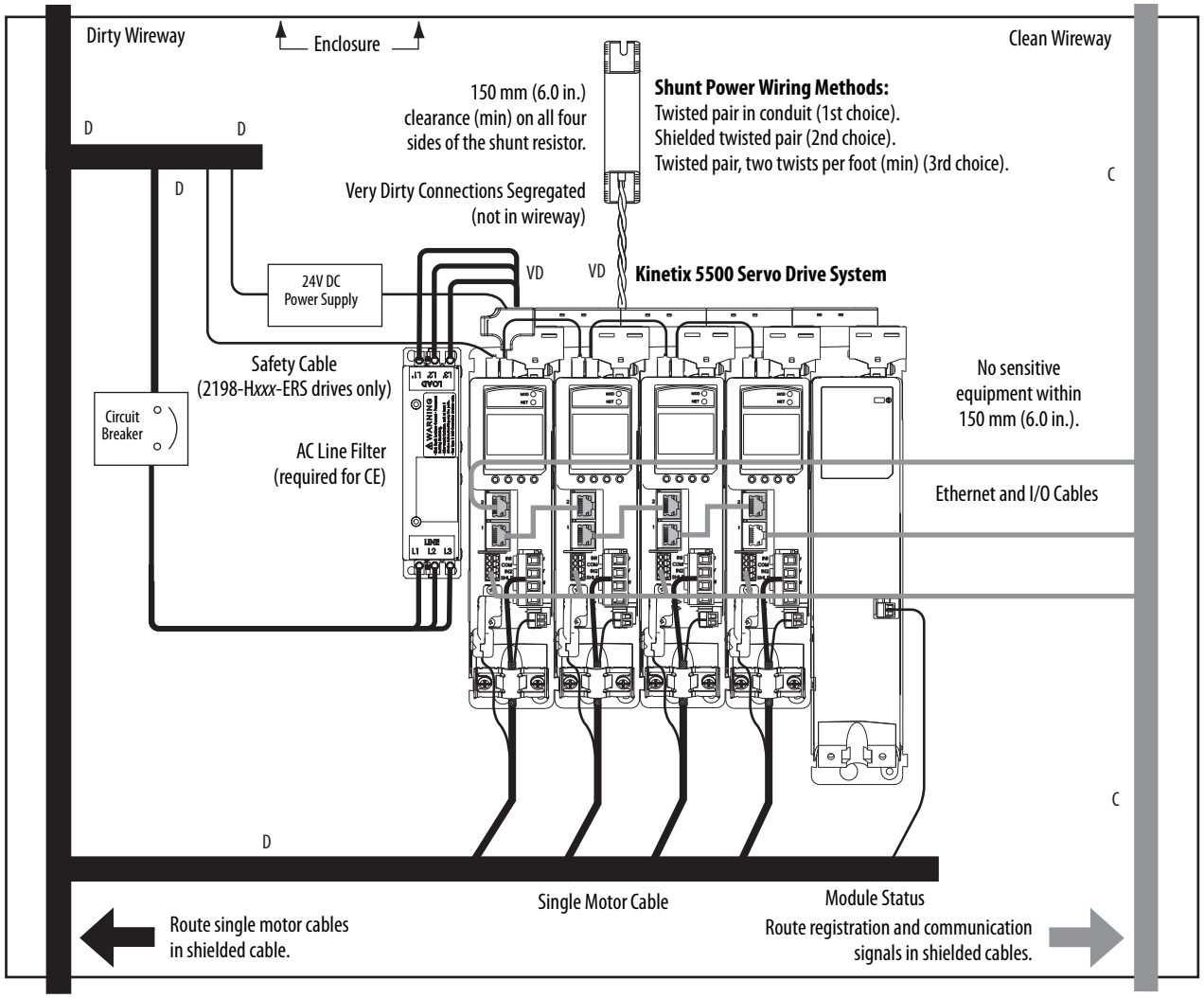
**Figure 18 - External Shunt Resistor Outside the Enclosure**



When mounting your Bulletin 2097 passive-shunt resistor inside the enclosure, follow these additional guidelines:

- Mount metal-clad modules anywhere in the dirty zone, but as close to the Kinetix 5500 drive as possible.
- Route shunt power wires with other very dirty wires.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt power cables from other sensitive, low voltage signal cables.

**Figure 19 - External Shunt Resistor Inside the Enclosure**



## Notes:

# Mount the Kinetix 5500 Drive System

This chapter provides the system installation procedures for mounting your Kinetix 5500 drives to the system panel.


| Topic | Page |
|---|---|
| Determine Mounting Order | 46 |
| Drill-hole Patterns | 49 |
| Mount Your Kinetix 5500 Drive | 56 |


This procedure assumes 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 hazard of electrical shock, perform all mounting and wiring of the Kinetix 5500 drives prior to applying power. Once power is applied, connector terminals can have voltage present even when not in use.



**ATTENTION:** Plan the installation of your system so that you can perform all cutting, drilling, tapping, and welding with the system removed from the enclosure. Because the system is of the open type construction, be careful to keep 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

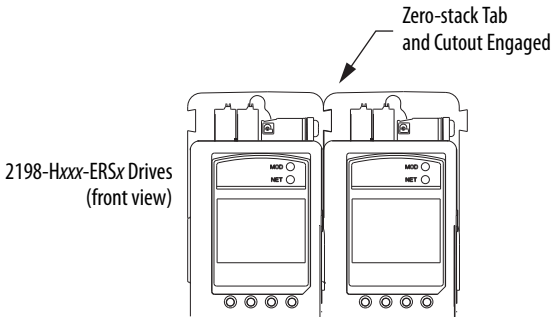
Mount drives in order (left to right) according to power rating (highest to lowest) starting with the highest power rating. If power rating is unknown, position drives (highest to lowest) from left to right based on amp rating.

### Zero-stack Tab and Cutout

Engaging the zero-stack tab and cutout from drive-to-drive makes efficient use of panel space for installations with multiple drives.

**IMPORTANT** Engaging the zero-stack tab and cutout from drive-to-drive is required for shared-bus multi-axis drive systems. This is done to make sure the drive connectors are spaced properly to accept the shared-bus connection system.

**Figure 20 - Zero-stack Tab and Cutout Example**

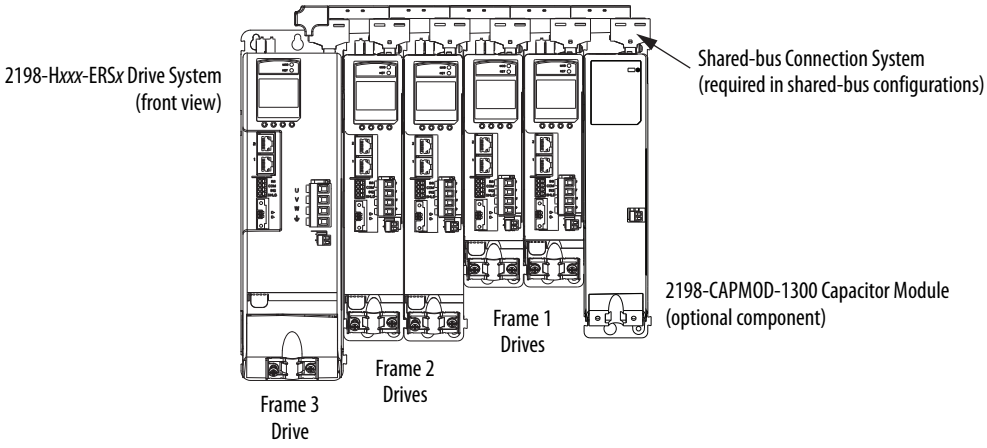



For the zero-stack feature to engage properly (when more than one frame size exists in the drive system) frame 3 drives must mount left of frame 1 or 2 drives, and frame 2 drives must mount left of frame 1 drives.

Capacitor modules can mount to the right of any frame size, but are always rightmost in any drive configuration.

**IMPORTANT** Mount drives in descending order, left to right, according to frame size with capacitor modules always mounted on the far right.

**Figure 21 - Shared-bus Connection System Example**



## Shared-bus Connection System

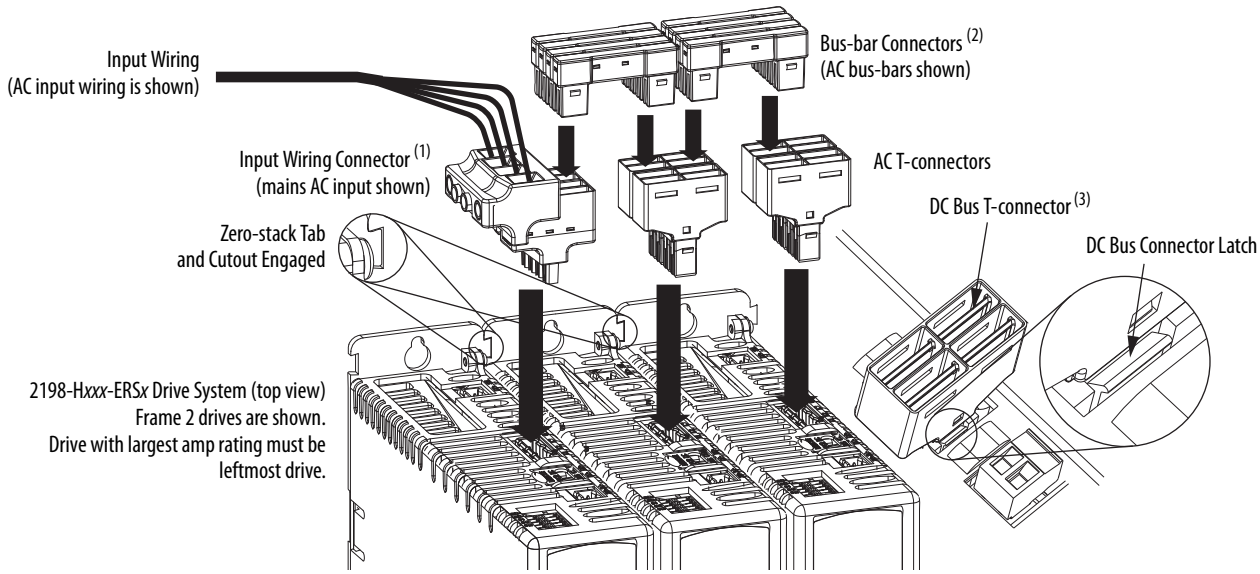
The shared-bus connection system is used to extend the mains AC input, 24V control input, and the DC bus power from drive-to-drive in shared-bus multi-axis configurations.

| **IMPORTANT** | When the shared-bus connection system is used, the zero-stack tab and cutout must be engaged between adjacent drives. |
|---|---|

The connection system is comprised of three components:

- Input wiring connectors that plug into the leftmost drive and receive input wiring for mains AC and 24V DC.
- AC bus, DC bus, and 24V DC T-connectors that plug into the drives downstream from the first where AC, DC, and/or 24V control power is shared. DC bus T-connectors also plug into the first drive where DC bus power is shared.
- Bus bars that connect between drives to extend the mains AC bus, DC bus, and 24V DC control power from drive-to-drive.

**Figure 22 - Connection System Example**




(1) Due to the higher amp rating of frame 3 drives, input wiring connectors for frame 3 drives (catalog number 2198-H070-ADP-IN) are slightly larger than connectors for frame 1 and 2 drives (catalog number 2198-H040-ADP-IN).

(2) Due to the extra width of frame 3 drives, bus-bar connectors between frame 3 drives are slightly longer (85 mm) than connectors between frame 3, frame 2, and frame 1 drives (55 mm).

(3) DC bus T-connectors latch on both sides when inserted into the drive. To remove the DC bus T-connector, at least one latch must be pried away with a non-conductive probe.

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

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

## Single-axis Configurations

The following restrictions exist for standalone (single-axis) configurations:

- Standalone (single-axis) drives can be mounted to the panel individually or by using the zero-stack tab and cutout (refer to Figure 22 on page 47)
- The shared-bus connection system does not apply and must not be used

For a single-axis example configuration, refer to Typical Kinetix 5500 Standalone Installation on page 15.

## Multi-axis Configurations

Each multi-axis configuration has restrictions that apply:

- The shared-bus connection system must be used. Do not attach discrete wires from drive-to-drive.
- The maximum number of drives in Shared AC bus power-sharing groups cannot exceed 5.
- The maximum number of drives in any other bus power-sharing group cannot exceed 8.

For a multi-axis example configuration, refer to Typical Shared AC/DC Bus Hybrid Installations on page 19.

## Drill-hole Patterns

Hole patterns for drives mounted in zero-stack or shared-bus configuration are provided for mounting your drives to the panel. Drives with the highest power rating are always mounted to the left of any drive with a lower power rating in shared-bus configurations:

- Frame 1 drives can be followed by only another frame 1 drive.
- Frame 2 drives can be followed by frame 1 drives or another frame 2 drive.
- Frame 3 drives can be followed by frame 1, frame 2, or another frame 3 drive.
- Mount Bulletin 2198 capacitor modules in the rightmost position.
  - Capacitor modules have the same hole pattern as frame 2 drives.
  - Only Shared DC, Shared AC/DC, and Shared AC/DC, hybrid configurations are compatible with Bulletin 2198 capacitor modules.

**Table 10 - Hole Pattern Overview**

| Drive Cat. No. | Frame Size | Frame Size Patterns | Page |
|---|---|---|---|
| 2198-H003-ERS*x*<br>2198-H008-ERS*x* | Frame 1 | As many as eight frame 1 drives | 51 |
| 2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | Frame 2 | As many as 8 frame 2 drives | |
| | | One frame 2 drive followed by as many as seven frame 1 drives | 52 |
| 2198-H070-ERS*x* | Frame 3 | As many as 8 frame 3 drives | 53 |
| | | One frame 3 drive followed by as many as seven frame 1 drives | 54 |
| | | One frame 3 drive followed by as many as seven frame 2 drives | 55 |

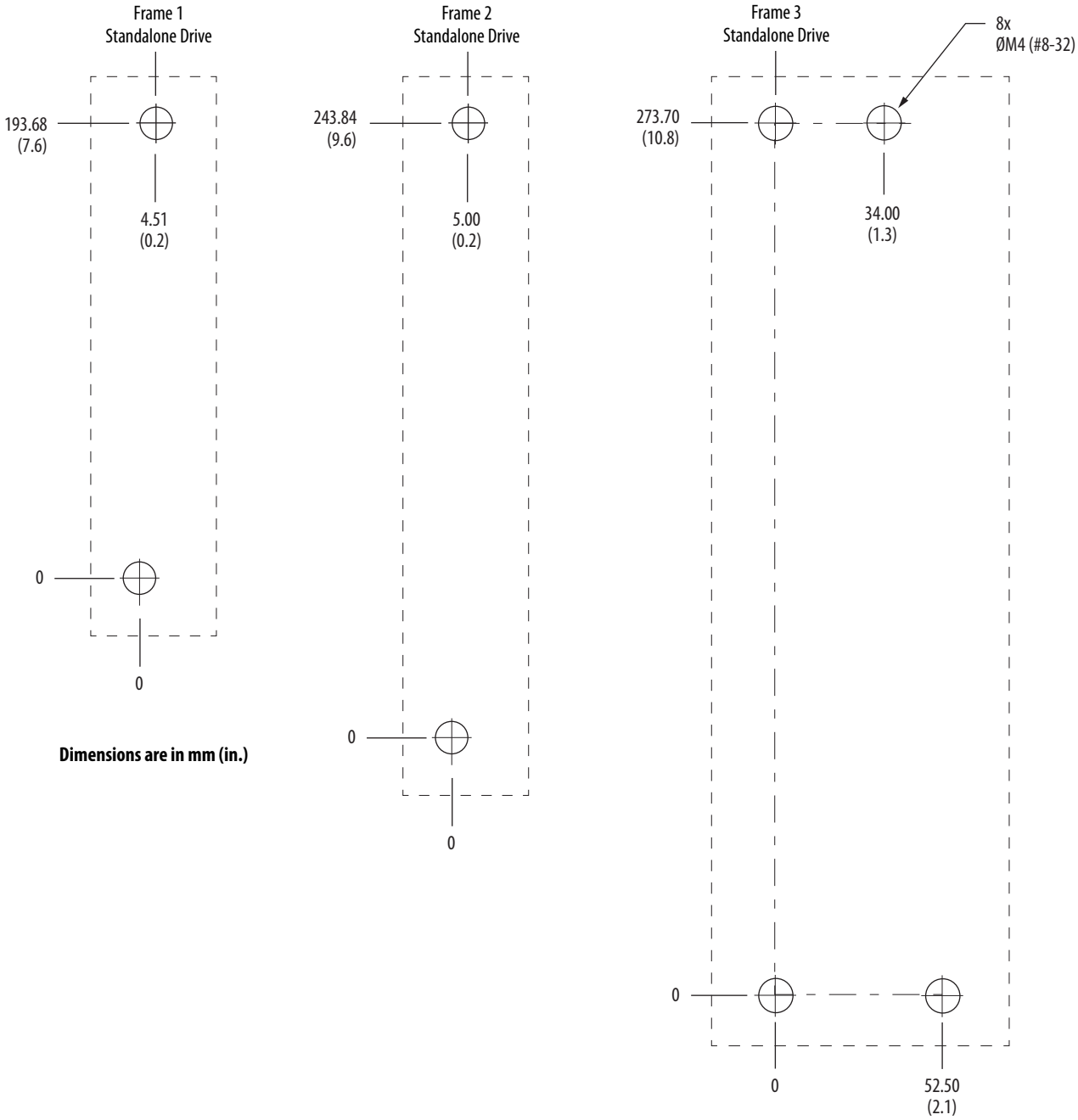
**Table 11 - Capacitor Module Support**

| Drive Cat. No. | Frame Size | Standalone Single Phase Operation | Three-phase Operation | | | |
|---|---|---|---|---|---|---|
| | | | Standalone | Shared DC | Shared AC/DC | Shared AC/DC Hybrid |
| | | Number of capacitor modules connected, max | | | | |
| 2198-H003-ERS*x* (1) | 1 | 0 | 0 | | | |
| 2198-H008-ERS*x* (1) | | | 1 | | 2 | |
| 2198-H015-ERS*x* (1) | 2 | | | | | |
| 2198-H025-ERS*x* | | N/A | 3 | | 4 | |
| 2198-H040-ERS*x* | | | | | | |
| 2198-H070-ERS*x* | 3 | | 4 | | | |

(1) Catalog number 2198-H003-ERS and any drive in standalone single-phase operation is not compatible with the Kinetix 5500 capacitor module.

These hole patterns apply to standalone drives.

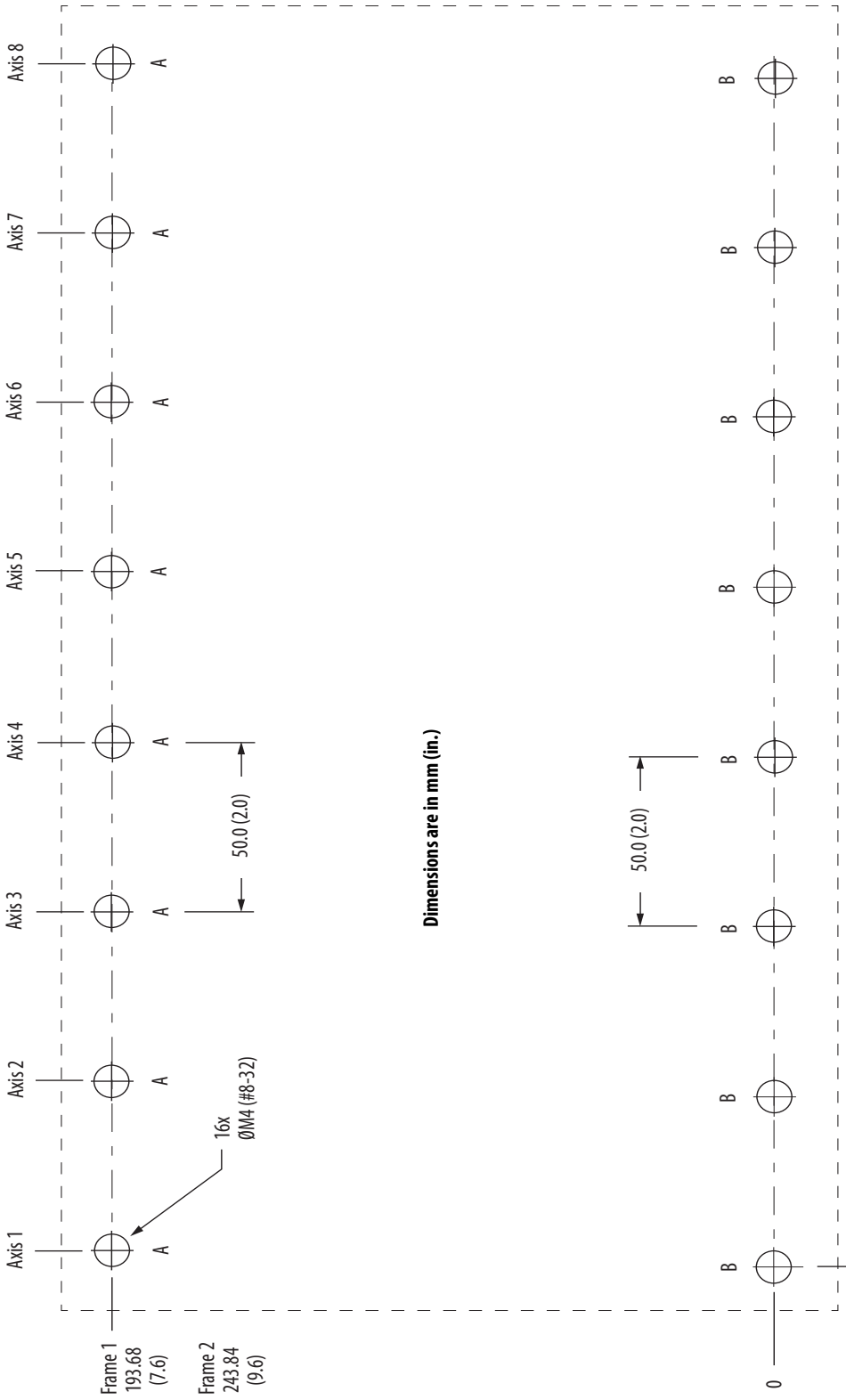
**Figure 23 - Frame 1, Frame 2, and Frame 3 Standalone Hole Patterns**




**Dimensions are in mm (in.)**

These hole patterns apply when all drives in the system are frame 1 or frame 2. There is 50 mm (2.0 in.) between mounting holes (A-to-A and B-to-B).

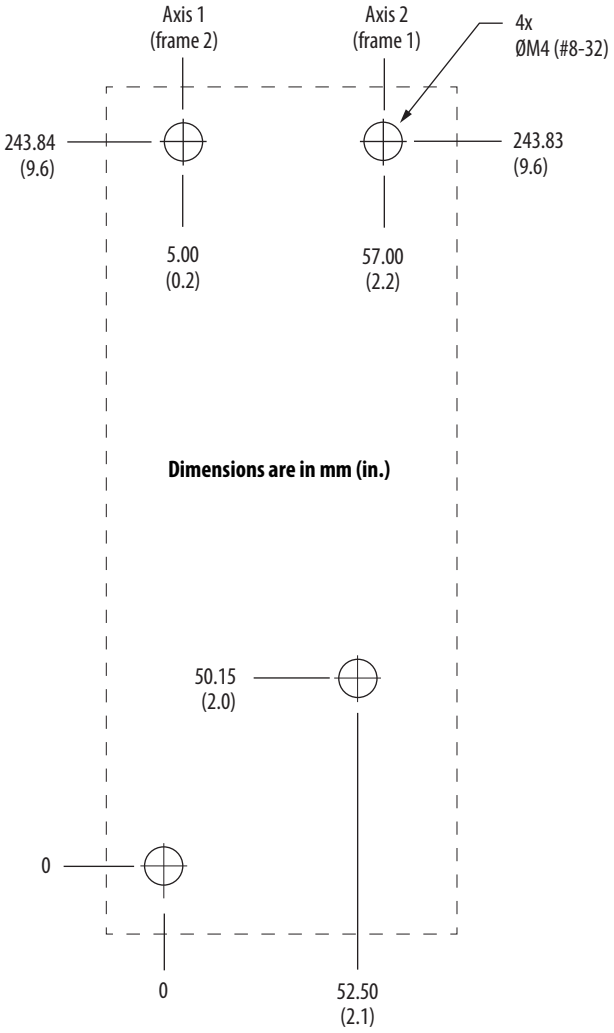
**Figure 24 - Frame 1 and Frame 2 Hole Patterns**




| Frame Size | Dimension | Axis 1 | Axis 2 | Axis 3 | Axis 4 | Axis 5 | Axis 6 | Axis 7 | Axis 8 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 4.51 (0.2) | 54.51 (2.1) | 104.51 (4.1) | 154.51 (6.1) | 204.51 (8.1) | 254.51 (10.0) | 304.51 (12.0) | 354.51 (14.0) |
| | B | 0 | 50.0 (2.0) | 100.0 (3.9) | 150.0 (5.9) | 200.0 (7.9) | 250.0 (9.8) | 300.0 (11.8) | 350.0 (13.8) |
| 2 | A | 5.00 (0.2) | 60.0 (2.4) | 115.0 (4.5) | 170.0 (6.7) | 225.0 (8.9) | 280.0 (11.0) | 335.0 (13.2) | 390.0 (15.4) |
| | B | 0 | 55.0 (2.2) | 110.0 (4.3) | 165.0 (6.5) | 220.0 (8.7) | 275.0 (10.8) | 330.0 (13.0) | 385.0 (15.2) |

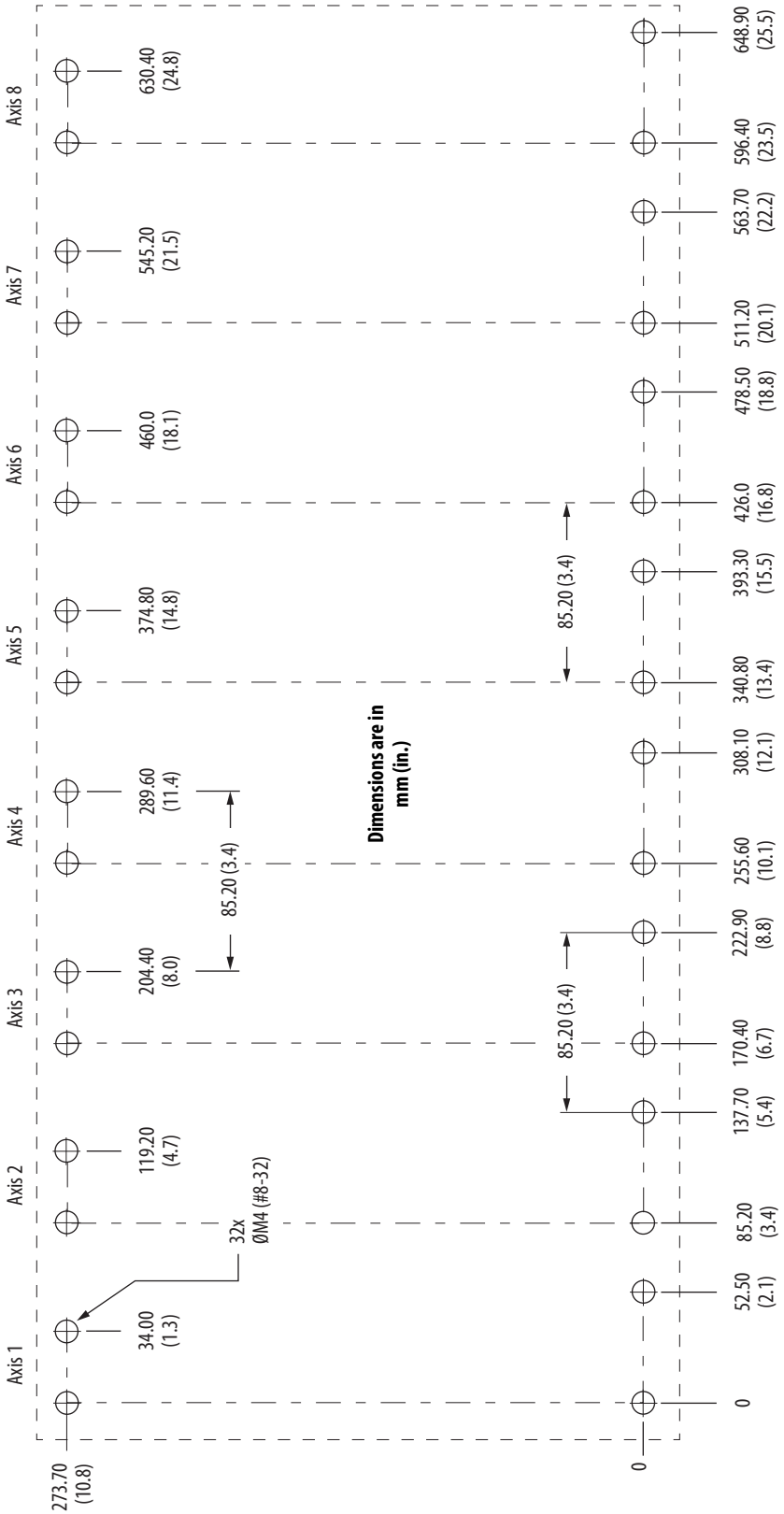
This hole pattern applies when transitioning from frame 2 drives to frame 1 drives. To mount additional frame 1 drives to the right of Axis 2 in this figure, refer to the frame 1 hole pattern in Figure 24.

**Figure 25 - Frame 2 to Frame 1 Hole Pattern**



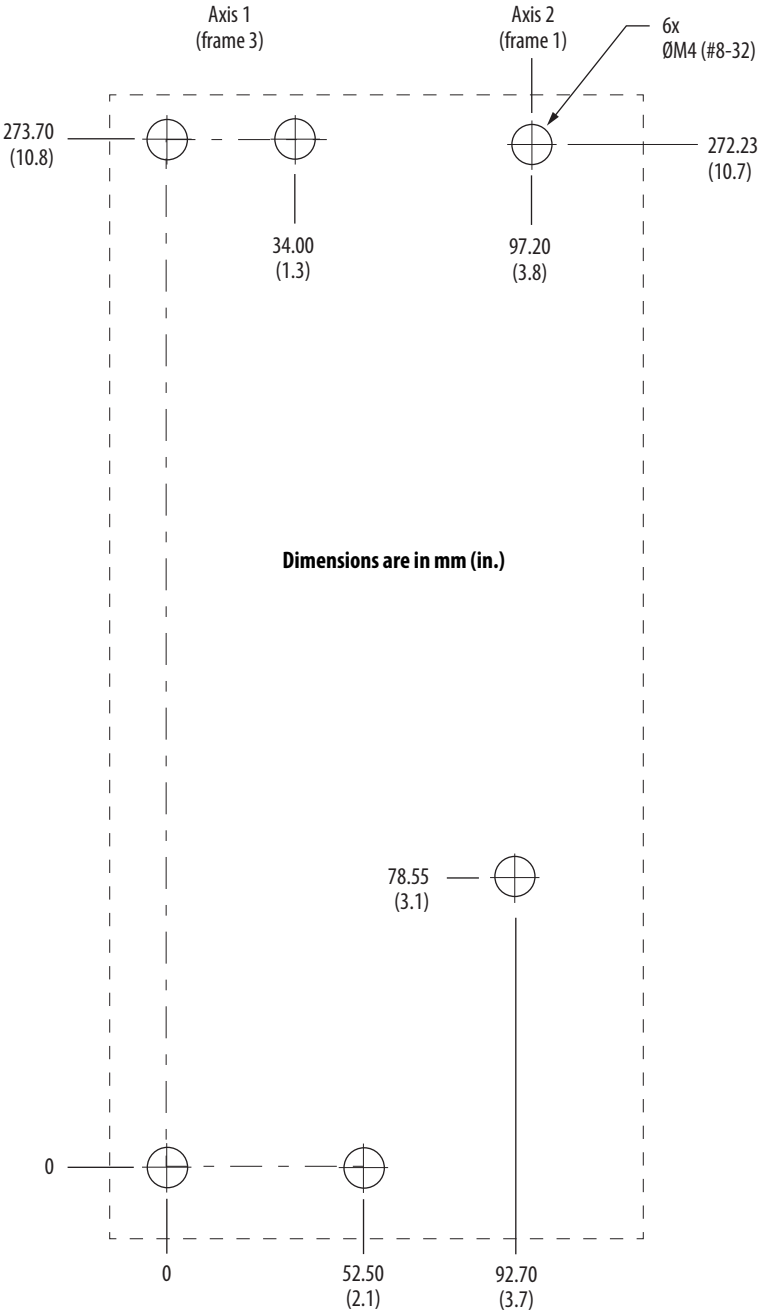
This hole pattern applies when all drives in the system are frame 3 drives. There is 85.20 mm (3.4 in.) between mounting holes, as shown.

**Figure 26 - Frame 3 Hole Pattern**



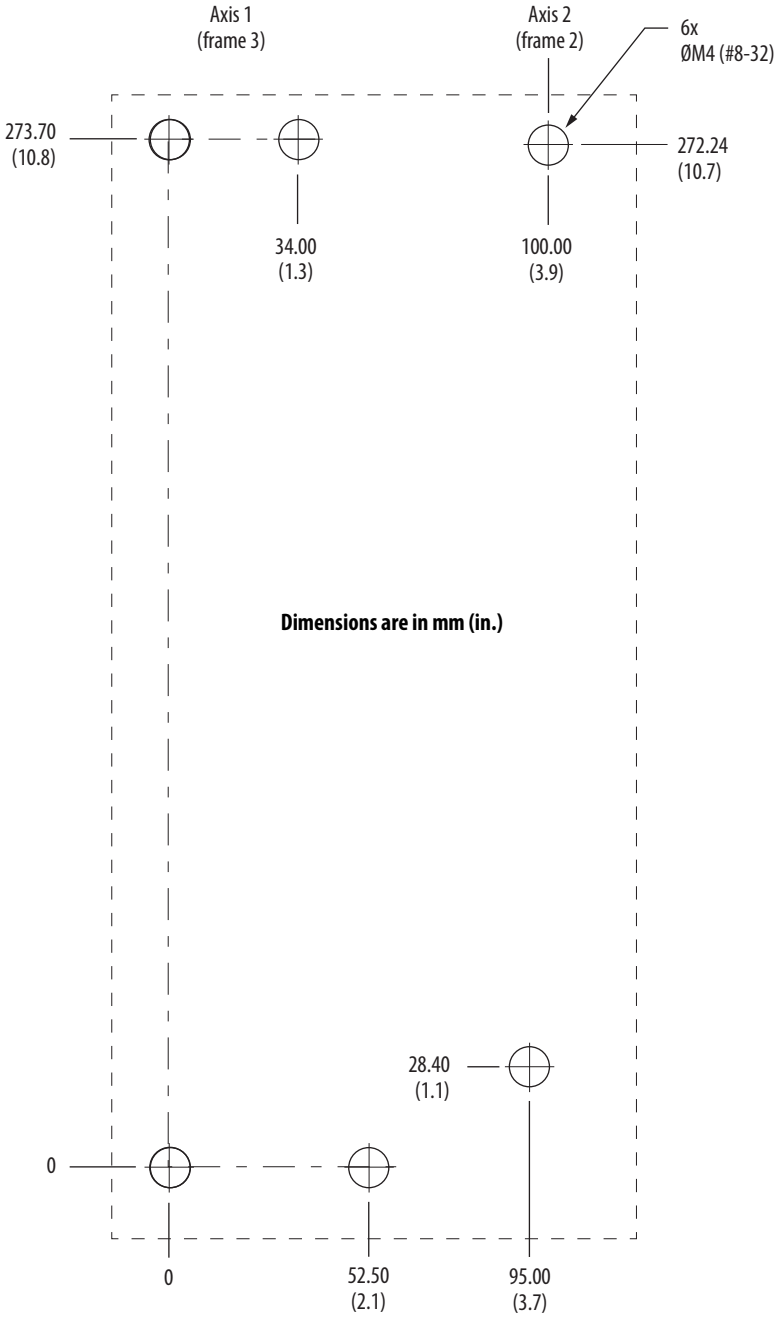
This hole pattern applies when transitioning from frame 3 drives to frame 1 drives. To mount additional frame 1 drives to the right of Axis 2 in this figure, refer to the frame 1 hole pattern in Figure 24.

**Figure 27 - Frame 3 to Frame 1 Hole Pattern**



This hole pattern applies when transitioning from frame 3 drives to frame 2 drives. To mount additional frame 2 drives to the right of Axis 2 in this figure, refer to the frame 2 hole pattern in Figure 24.

**Figure 28 - Frame 3 to Frame 2 Hole Pattern**



## Mount Your Kinetix 5500 Drive

This procedure assumes 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 5500 drives to the panel.

1. Lay out the hole pattern for each Kinetix 5500 drive in the enclosure.

   Refer to Establishing Noise Zones on page 39 for panel layout recommendations.

   **IMPORTANT** To improve the bond between the Kinetix 5500 drive and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

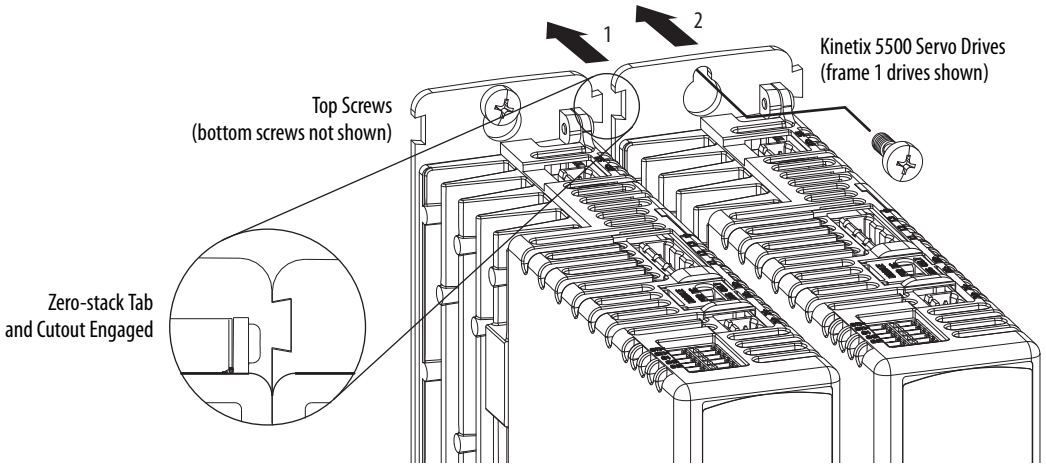
2. Drill holes in the panel for mounting your drive system.

   Hole patterns, by frame size, are shown in Drill-hole Patterns beginning on page 49.

3. Loosely attach the mounting hardware to the panel.

   The recommended mounting hardware is M4 (#8-32) steel bolts. Observe bonding techniques as described in Bonding Modules on page 36.

4. Attach the leftmost drive to the cabinet panel.




5. Attach additional drives (if any) just to the right of the previous drive by using the same method, but also making sure the zero-stack tabs and cutouts are engaged.

   Zero-stack mounting is required based on configuration, refer to the Zero-stack Tab and Cutout Example on page 46.

6. Tighten all mounting fasteners.

   Apply 2.0 N•m (17.7 lb•in) maximum torque to each fastener.

# Connector Data and Feature Descriptions

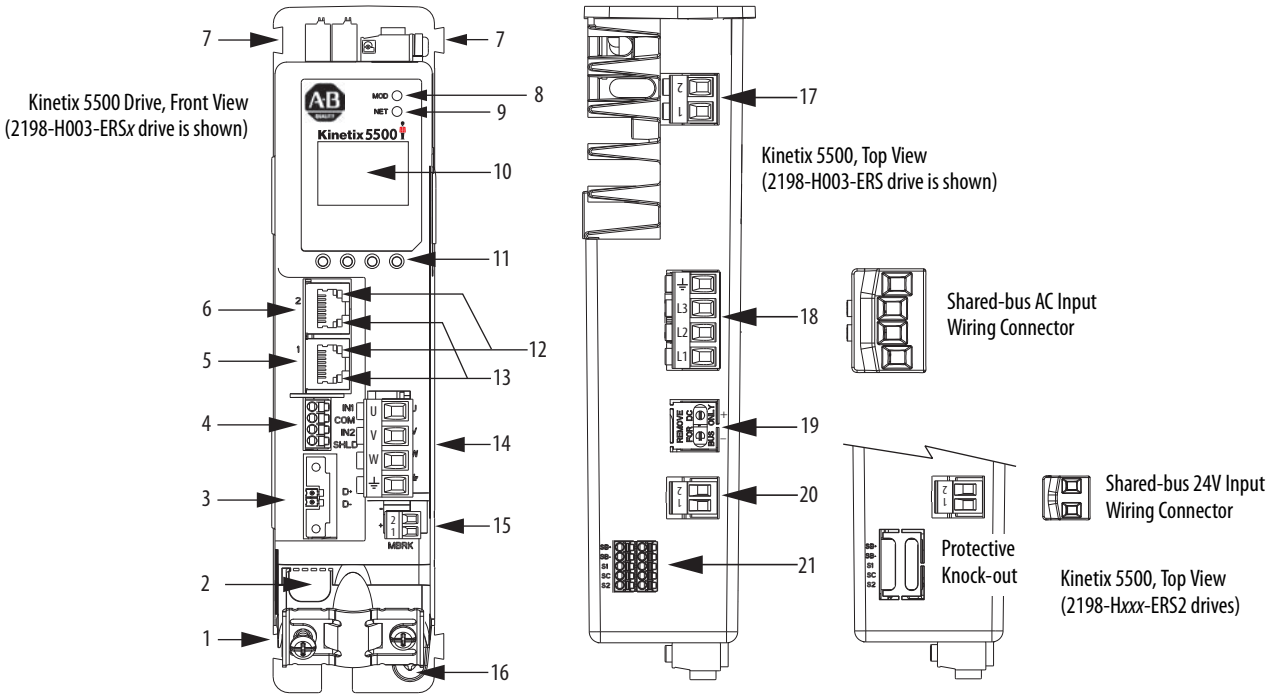
This chapter illustrates drive connectors and indicators, including connector pinouts, and provides descriptions for Kinetix 5500 drive features.


| Topic | Page |
|---|---|
| Kinetix 5500 Connector Data | 58 |
| Understanding Control Signal Specifications | 62 |
| Feedback Specifications | 66 |
| Safe Torque-off Safety Features | 67 |

## Kinetix 5500 Connector Data

Use these illustrations to identify the connectors and indicators for the Kinetix 5500 servo drives.

**Figure 29 - Kinetix 5500 Drive Features and Indicators**




| Item | Description |
|---|---|
| 1 | Motor cable shield clamp |
| 2 | Converter kit mounting hole [1] (under cover) |
| 3 | Motor feedback (MF) connector |
| 4 | Digital inputs (IOD) connector |
| 5 | Ethernet (PORT1) RJ45 connector |
| 6 | Ethernet (PORT2) RJ45 connector |
| 7 | Zero-stack mounting tab/cutout |

| Item | Description |
|---|---|
| 8 | Module status indicator |
| 9 | Network status indicator |
| 10 | LCD display |
| 11 | Navigation pushbuttons |
| 12 | Link speed status indicators |
| 13 | Link/Activity status indicators |
| 14 | Motor power (MP) connector |

| Item | Description |
|---|---|
| 15 | Motor brake (BC) connector |
| 16 | Ground terminal |
| 17 | Shunt resistor (RC) connector |
| 18 | AC mains input power (IPD) connector |
| 19 | DC bus (DC) connector (under cover) [2] |
| 20 | 24V control input power (CP) connector |
| 21 | Safe torque-off (STO) connector [3] (does not apply to 2198-Hxxx-ERS2 drives) |

(1) Protective knock-out covers the 2198-H2DCK Hiperface-to-DSL feedback converter kit mounting hole. Remove knock-out for use with the converter kit.

(2) DC bus connector ships with protective knock-out cover that can be removed for use in shared-bus configurations.

(3) Protective knock-out cover is removed on 2198-Hxxx-ERS (hardwired STO) drives.

## Safe Torque-off Connector Pinout

For the hardwired safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to Chapter 9 beginning on page 169.

## Input Power Connector Pinouts

**Table 12 - Mains Input Power Connector**

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

**Table 13 - 24V Input Power Connector**

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

## DC Bus and Shunt Resistor Connector Pinouts

**Table 14 - DC Bus Power Connector**

| DC Pin | Description | Signal |
|---|---|---|
| 1 | DC bus connections | DC- |
| 2 | | DC+ |

**Table 15 - Shunt Resistor Connector**

| RC Pin | Description | Signal |
|---|---|---|
| 1 | Shunt connections (frames 2 and 3) | DC+ |
| 2 | | SH |
| 1 | Shunt connections (frame 1) | SH |
| 2 | | DC+ |

## Digital Inputs Connector Pinout

The Kinetix 5500 drive has two configurable digital inputs and 5 configurable functions to choose from in the Logix Designer application. Digital input 1 can be configured as a dual-function (home/registration) input.

**Table 16 - Digital Inputs Pinouts**

| IOD Pin | Description | Signal |
|---|---|---|
| 1 | 24V current-sinking fast input #1. This is a dual-function input. | IN1 (1) |
| 2 | I/O common for customer-supplied 24V supply. | COM |
| 3 | 24V current-sinking fast input #2. | IN2 |
| 4 | I/O cable shield termination point. | SHLD |

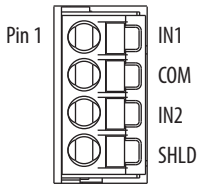
(1) This signal has dual-functionality. You can use IN1 (IOD-1) as Registration 1 or Home input when Home/Registration 1 is configured.

**Table 17 - Configurable Functions**

| Default Configuration (1) | Description |
|---|---|
| Digital input1= Home/Registration 1<br>Digital input2 = Registration 2 | Unassigned |
| | Home |
| | Registration 1 |
| | Registration 2 |
| | Positive overtravel |
| | Negative overtravel |
| | Home/Registration 1 |

(1) Studio 5000 Logix Designer, version 27 or later, is required to change from the default configuration.

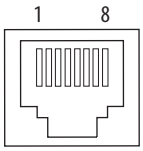
**Figure 30 - Pin Orientation for 4-pin Digital Inputs (IOD) Connector**



## Ethernet Communication 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 | – |

**Figure 31 - Pin Orientation for 8-pin Ethernet PORT1 and PORT2 Connectors**




## Motor Power, Brake, and Feedback Connector Pinouts

**Table 18 - Motor Power Connector**

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

**ATTENTION:** To avoid damage to the Kinetix 5500 DC-bus power supply and inverter, make sure the motor power signals are wired correctly. Refer to Figure 49 on page 84 for connector wiring examples.

**IMPORTANT** Drive-to-motor power cables must not exceed 50 m (164 ft).

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

**Table 19 - Motor Brake Connector**

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

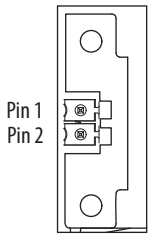
## Motor Feedback Connector Pinout

| 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 |

**IMPORTANT** Drive-to-motor power cables must not exceed 50 m (164 ft).

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

**Figure 32 - Pin Orientation for 2-pin Motor Feedback (MF) Connector**




# Understanding Control Signal Specifications

This section provides a description of the Kinetix 5500 digital inputs, Ethernet communication, power and relay specifications, encoder feedback specifications, and safe torque-off features.

## Digital Inputs

Two digital inputs are available for the machine interface on the IOD connector. Digital inputs require a 24V DC @ 15 mA supply. These are sinking inputs that require a sourcing device. A common and cable shield connection is provided on the IOD connector for digital inputs.

The Registration 1 input is capable of dual functionality. You can also use this as the Home input. Configuration for dual functionality is not needed.

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

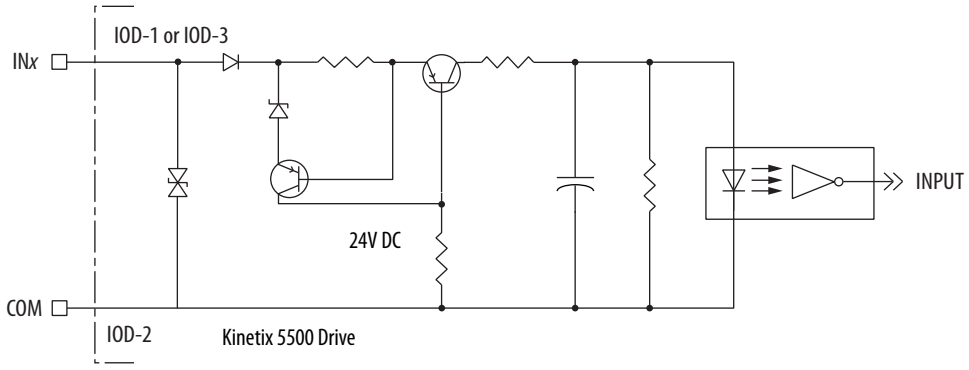
**Table 20 - Understanding Digital Input Functions**

| Function | Description | Default Behavior |
|---|---|---|
| Home/Reg1 | 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. | The function is always inactive. You can enable in the Logix Designer application. |
| 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<br>Negative overtravel | The positive/negative limit switch (normally closed contact) inputs for each axis require 24V DC (nominal). | |

**Table 21 - Digital Input Specifications**

| Attribute | Value |
|---|---|
| Type | Active high, single-ended, current sinking (EN 61131-2 Type 1) |
| Dedicated functions | Registration 1, Home, Registration 2, Positive overtravel, Negative overtravel |
| 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 repeatability | 700 ns |
| Windowed registration invalid-to-valid event delay | 125 µs, min |

**Figure 33 - Digital Input Circuitry**



## Ethernet Communication Specifications

The PORT1 and PORT2 (RJ45) Ethernet connectors are provided for communication with the Logix5000 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 |

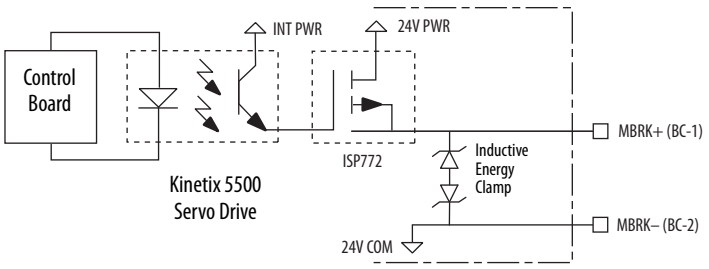
## Motor Brake Circuit

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 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. Connections are rated for 2.0 A @ +24V (refer to Figure 34).

**Figure 34 - Motor Brake Circuit**




**IMPORTANT** Motor parking-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 PM Motor Closed-loop Control Axis Properties beginning on page 134). 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 199.
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 GMC-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 5500 drive requires 24V DC input power for control circuitry.

**IMPORTANT** SELV and PELV rated power supplies must be used to energize external safety devices connected to the Kinetix 5500 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 22 - Control Power Input Power Specifications**

| Attribute | Frame 1 | Frame 2 | Frame 3 |
|---|---|---|---|
| Input voltage | 21.6…26.4V DC | | |
| Control power AC input current<br>Nom @ 24V DC (1)<br>Inrush, max | <br>400 mA<br>2.0 A | <br>800 mA<br>3.0 A | <br>1.3 A<br>3.0 A |

(1) Plus BC connector (MBRK+) current.

## Feedback Specifications

The Kinetix 5500 drive accepts motor feedback signals from Stegmann Hiperface digital-servo-link (DSL) encoders on the motor feedback (MF) connector.

**TIP** Auto-configuration in the Logix Designer application of intelligent absolute, high-resolution encoders is possible with only Allen-Bradley motors.

The Kinetix 5500 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, but only when using drive firmware revision 2.002 or later, and the 2198-H2DCK Hiperface-to-DSL (series B or later) feedback converter kit for Hiperface-to-DSL conversion.

You can also use the MF connector for feedback-only applications.

**Table 23 - Stegmann Hiperface DSL Specifications**

| Attribute | Value |
|---|---|
| Protocol | Hiperface DSL |
| Memory support | Programmed with Allen-Bradley motor data |
| Hiperface data communication | 9.375 Mbits/s |

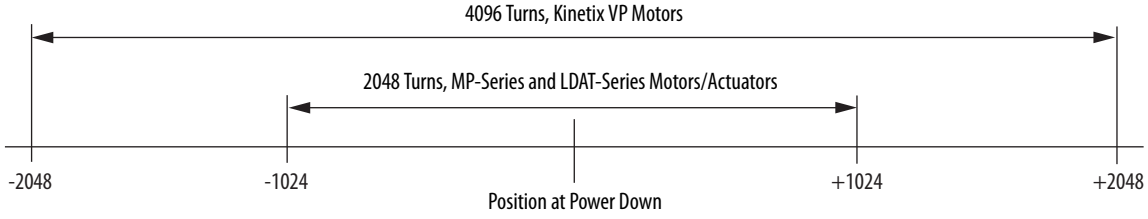
### Absolute Position Feature

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

**Table 24 - Absolute Position Designator Examples**

| Encoder Type | Cat. No. Designator | Cat. No. Examples | Motor Family |
|---|---|---|---|
| Stegmann Hiperface (DSL) | -P | VPL-*xxxxxx*-P, VPF-*xxxxxx*-P, VPS-*xxxxxx*-P | Kinetix VP |
| Stegmann Hiperface | -M | MPL-B310P-M, MPM-*xxxxxx*-M, MPF-*xxxxxx*-M, MPS-*xxxxxx*-M, MPAR-*x*3*xxxx*-M, MPAI-*xxxxxx*M | MP-Series |
| | -V | MPL-B230P-V, MPAS-*xxxxx*1-V05, MPAS-*xxxxx*2-V20, MPAR-*x*1*xxxx*-V, MPAR-*x*2*xxxx*-V, MPAI-*xxxxxx*V | |
| Stegmann Hiperface (magnetic scale) | -*x*D*x* | LDAT-S*xxxxxx*-*x*D*x* | LDAT-Series |

**Figure 35 - Absolute Position Retention Limits**



# Safe Torque-off Safety Features

Kinetix 5500 servo drives have safe torque-off (STO) capability and can safely turn off the inverter power transistors in response to a monitored digital input, according to Category 0 Stop behavior.

## Servo Drives with Hardwired Safety

2198-H*xxx*-ERS (hardwired) servo drives support parallel input terminals for cascading to adjacent drives over duplex wiring. For applications that do not require the STO safety function you must install jumper wires to bypass the safe torque-off feature.

Refer to Chapter 9 on page 169 for the STO connector pinout, installation, and wiring information.

## Servo Drives with Integrated Safety

For 2198-H*xxx*-ERS2 (integrated safety) servo drives, the GuardLogix 5570 or Compact GuardLogix 5570 safety controller issues the STO command via the EtherNet/IP network and the 2198-H*xxx*-ERS2 servo drives execute the command.

Refer to Chapter 10 on page 177 for integrated safety drive specifications, configuring motion and safety connections, motion direct commands, and the STO bypass feature.

## Notes:

# Connect the Kinetix 5500 Drive System

This chapter provides procedures for wiring your Kinetix 5500 system components and making cable connections.


| Topic | Page |
|---|---|
| Basic Wiring Requirements | 70 |
| Determine the Input Power Configuration | 71 |
| Remove the Grounding Screws in Select Power Configurations | 74 |
| Grounding the Drive System | 76 |
| Wiring Requirements | 78 |
| Wiring Guidelines | 79 |
| Wiring the Power Connectors | 80 |
| Wiring the Digital Input Connectors | 82 |
| Wiring Kinetix VP Motors | 83 |
| Wiring Other Allen-Bradley Motors and Actuators | 88 |
| Capacitor Module Connections | 98 |
| External Passive-shunt Resistor Connections | 99 |
| Ethernet Cable Connections | 100 |

## Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 5500 drives.



**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 36 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

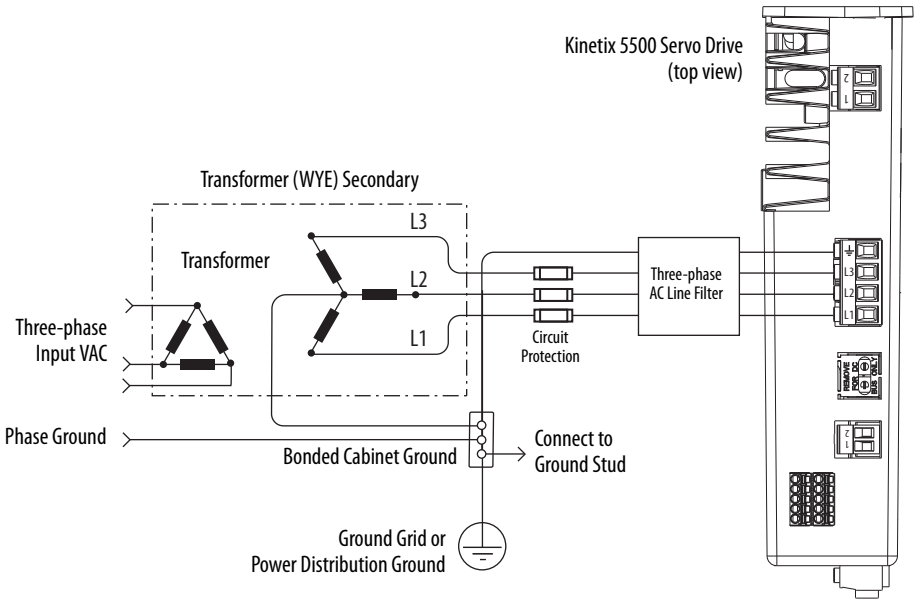
Before wiring input power to your Kinetix 5500 system, you must determine the type of input power within your facility. The drive is designed to operate in both grounded and ungrounded environments.

**ATTENTION:** Ungrounded, corner-grounded, and impedance-grounded input power configurations are permitted, but you must remove the ground screws. Refer to Remove the Grounding Screws in Select Power Configurations on page 74 for more information.

## Grounded Power Configurations

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

**Figure 36 - Grounded Power Configuration (WYE Secondary)**




The Kinetix 5500 drive has factory-installed grounding screws for grounded power distribution.

**IMPORTANT** If you determine that you have grounded power distribution in your plant, you do not need to remove the grounding screws.

Refer to Power Wiring Examples beginning on page 200 for input power interconnect diagrams.

**Figure 37 - Impedance-grounded Power Configuration (WYE Secondary)**

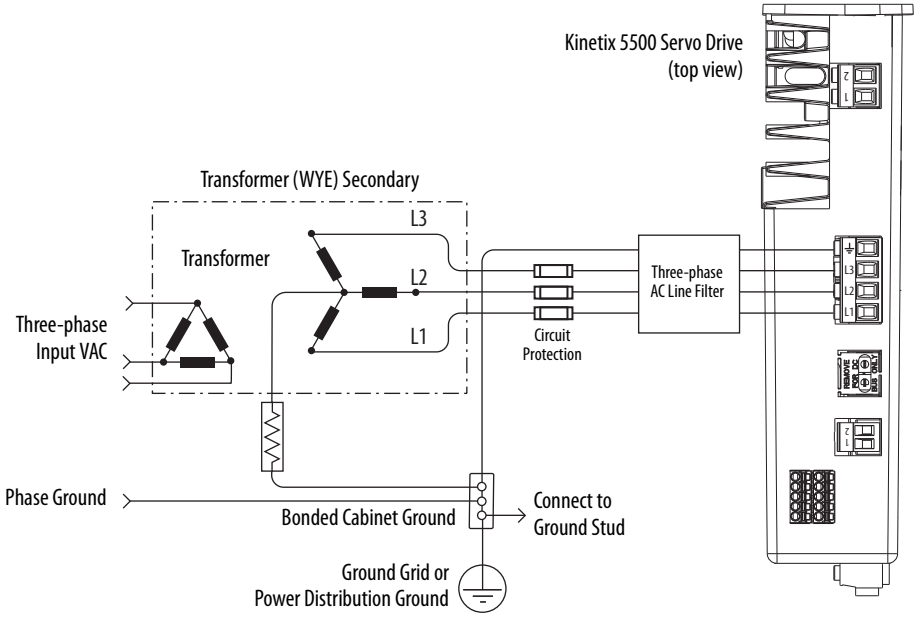
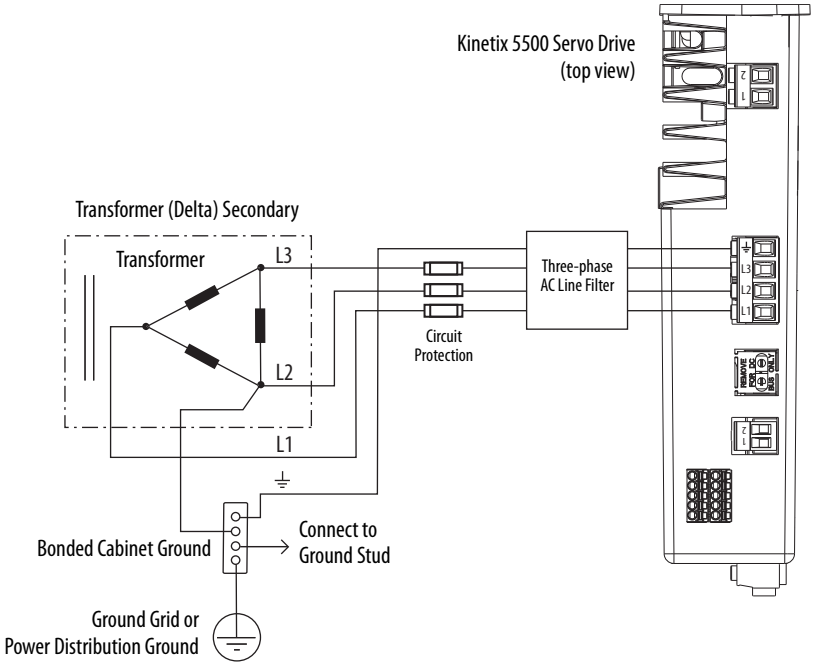


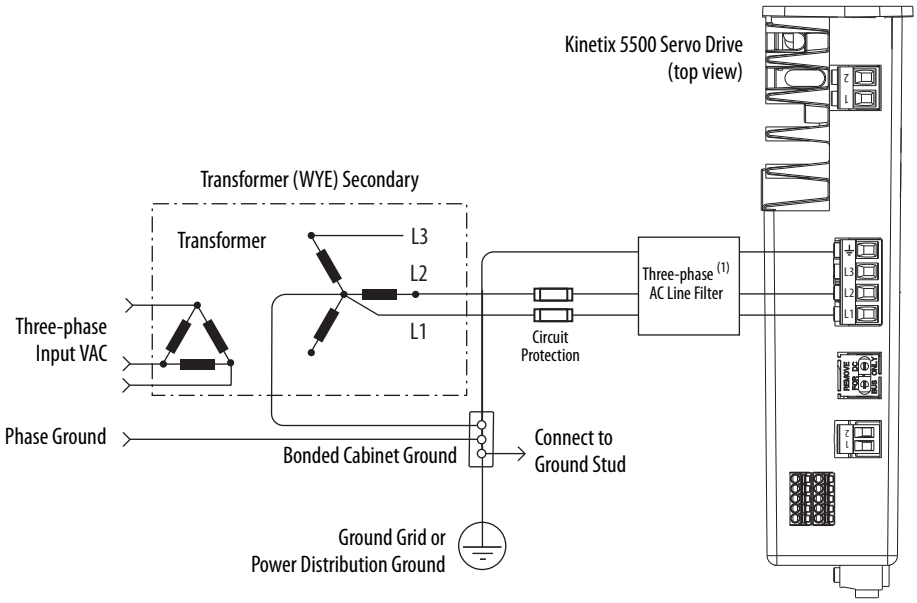

**Figure 38 - Corner-grounded Power Configuration (Delta Secondary)**




**IMPORTANT** Even though impedance-grounded and corner-grounded power configurations have a ground connection, treat them as ungrounded when installing Kinetix 5500 drive systems.

Refer to Power Wiring Examples beginning on page 200 for input power interconnect diagrams.

**Figure 39 - Grounded Power Configuration (single-phase input)**




(1) Single-phase operation with an AC line filter can increase leakage current.

**IMPORTANT** Using single-phase input AC power can increase leakage current. To minimize leakage current remove the AC ground screw (refer to Figure 41 on page 75). Removing the AC ground screw can affect EMC performance.

Refer to Power Wiring Examples beginning on page 200 for input power interconnect diagrams.

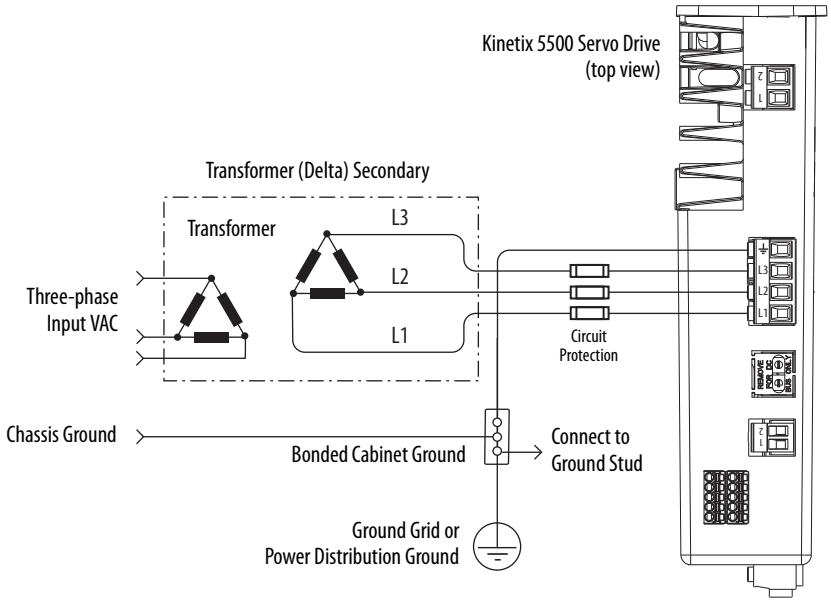
## Ungrounded Power Configurations

The ungrounded power configuration (Figure 40), corner-grounded (Figure 38), and impedance-grounded (Figure 37) 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 grounding screws in each of your drives that receive input power.

Refer to Remove the Grounding Screws in Select Power Configurations on page 74 for more information.

**Figure 40 - 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 200 for input power interconnect diagrams.

## Remove the Grounding Screws in Select Power Configurations

Remove the grounding screws when using the following power configurations:

- Ungrounded
- Corner grounded
- Impedance grounded

Removing the screws involves gaining access, opening the sliding door, and removing the screws.

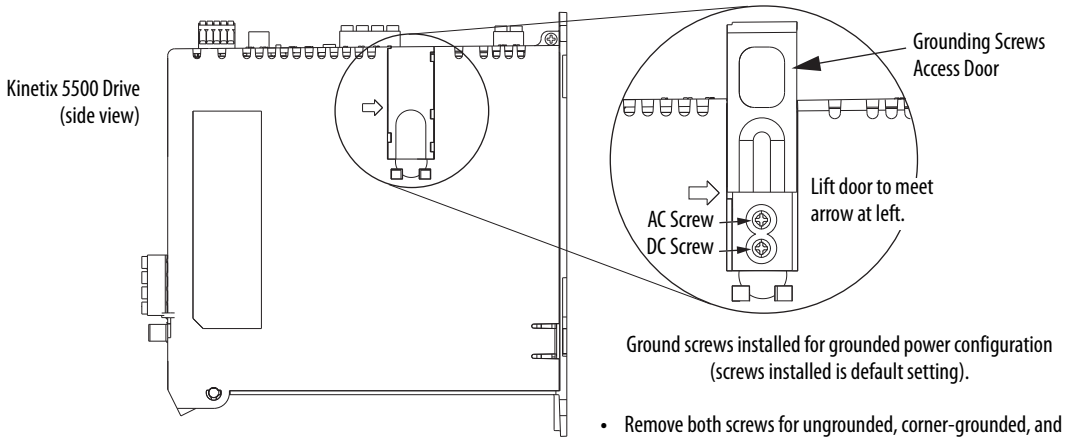
**IMPORTANT** If you have grounded power distribution, you do not need to remove the grounding screws. Go to Grounding the Drive System on page 76.

Removing the grounding screws in multi-axis configurations is best done when the drive is removed from the panel and placed on its side on a solid surface.

**ATTENTION:** Because the unit no longer maintains line-to-neutral voltage protection, the risk of equipment damage exists when you remove the grounding screws.

**ATTENTION:** To avoid personal injury, the grounding screws 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 grounding screws.

**Figure 41 - Removing the Ground Screws**




Ground screws installed for grounded power configuration (screws installed is default setting).

- Remove both screws for ungrounded, corner-grounded, and impedance-grounded power for three-phase operation
- Remove only the AC screw for single-phase operation

**ATTENTION:** Risk of equipment damage exists. The drive ground configuration must be accurately determined. Leave the grounding screws installed for grounded power configurations (default). Remove the screws for ungrounded, corner-grounded, and impedance-grounded power configurations.

**Table 25 - Grounding Screw Configurations**

| Ground Configuration | Example Diagram | Grounding Screw Configuration | Benefits of Correct Configuration |
|---|---|---|---|
| Grounded (wye) | Figure 36 on page 71 | Both screws installed (default setting) | • UL and EMC compliance<br>• Reduced electrical noise<br>• Most stable operation<br>• Reduced voltage stress on components and motor bearings |
| • AC fed ungrounded<br>• Corner grounded<br>• Impedance grounded | Figure 40 on page 74<br>Figure 38 on page 72<br>Figure 37 on page 72 | Both screws removed | • Helps avoid severe equipment damage when ground faults occurs<br>• Reduced leakage current |
| Single-phase input power | Figure 39 on page 73 | AC screw removed (1) | Minimizes leakage current for single-phase operation |

(1) Removing the AC grounding screw to minimize leakage current in single-phase operation can affect EMC performance.

# Grounding the Drive System

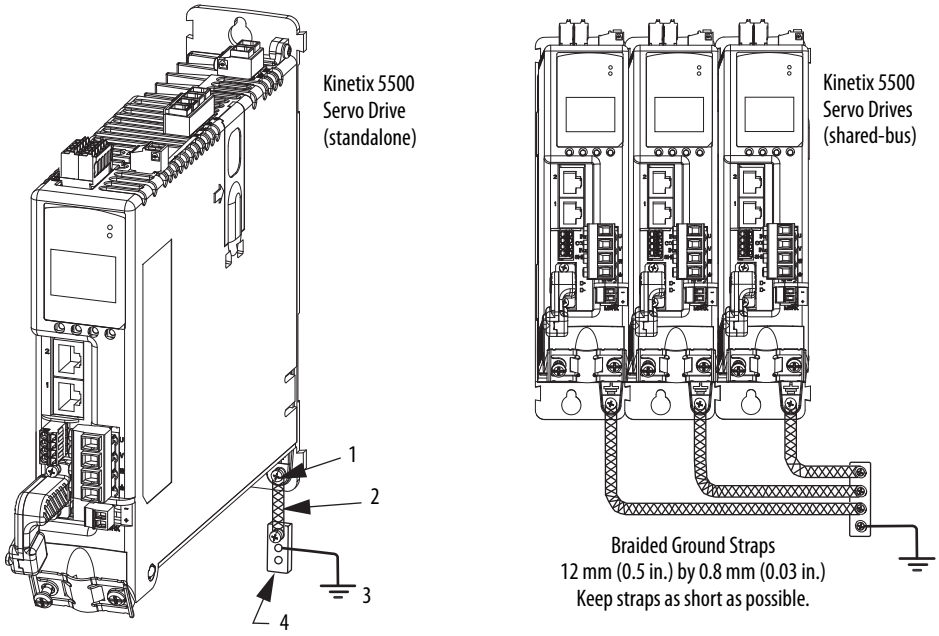
All equipment and components of a machine or process system must have a common earth ground point connected to chassis. A grounded system provides a ground path for protection against electrical shock. Grounding your drives and panels minimize the shock hazard to personnel and damage to equipment caused 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 28.

## Ground the System Subpanel

Ground Kinetix 5500 drives and 2198-CAPMOD-1300 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 42 - Connecting the Ground Terminal**



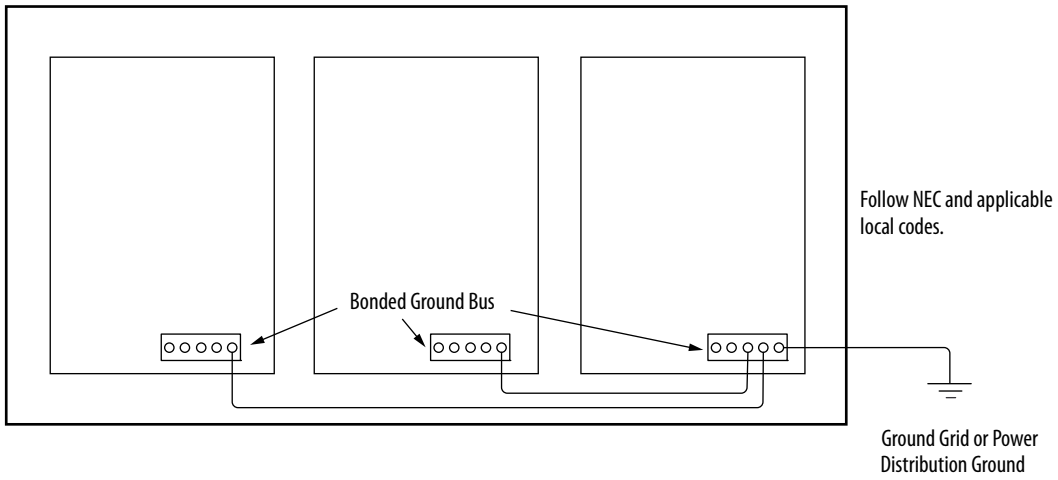

| Item | Description |
|---|---|
| 1 | Ground screw (green) 2.0 N•m (17.7 lb•in), max |
| 2 | Braided ground strap (customer supplied) |
| 3 | Ground grid or power distribution ground |
| 4 | Bonded cabinet ground bus (customer supplied) |

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 43 - 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 38.

## 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 200 for interconnect diagrams.

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

**Table 26 - Power and I/O Wiring Requirements**

| Kinetix 5500 Drive Cat. No. | Description | Connects to Terminals | | Wire Size mm² (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|---|
| | | Pin | Signal | | | |
| 2198-H003-ERS*x*<br>2198-H008-ERS*x*<br>2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | Mains input power (1)<br>(single-axis IPD connector) | ⏚<br>L3<br>L2<br>L1 | ⏚<br>L3<br>L2<br>L1 | 1.5…4<br>(16…12) | 8.0 (0.31) | 0.5…0.6<br>(4.4…5.3) |
| 2198-H070-ERS*x* | | | | 1.5…6<br>(16…10) | 10.0 (0.39) | |
| 2198-H003-ERS*x*<br>2198-H008-ERS*x*<br>2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | Motor power | U<br>V<br>W<br>⏚ | U<br>V<br>W<br>⏚ | Motor power cable depends on motor/drive combination.<br>0.75…2.5 (2)<br>(18…14) | 7.0 (0.28) | 0.5…0.6<br>(4.4…5.3) |
| 2198-H070-ERS*x* | | | | 2.5…6 (2)<br>(14…10) | 10.0 (0.39) | 0.5…0.8<br>(4.4…7.1) |
| 2198-*xxxx*-ERS*x* | PELV/SELV 24V power (1)<br>(single-axis CP connector) | CP-1<br>CP-2 | 24V+<br>24V- | 0.5…2.5<br>(20…14) | 7.0 (0.28) | 0.22…0.25<br>(1.9…2.2) |
| | Brake power | BC-1<br>BC-2 | MBRK+<br>MBRK- | N/A (3) | | |
| | DC Bus power | DC-1<br>DC-2 | DC-<br>DC+ | N/A (4) | N/A (4) | N/A (4) |
| | Shunt resistor<br>(frame 2 and 3) | RC-1<br>RC-2 | DC+<br>SH | 0.5…4.0<br>(20…12) | 8.0 (0.31) | 0.5…0.6<br>(4.4…5.3) |
| | Shunt resistor<br>(frame 1) | RC-1<br>RC-2 | SH<br>DC+ | | | |
| | Safety (5) | STO-1<br>STO-2<br>STO-3<br>STO-4<br>STO-5 | SB+<br>SB-<br>S1<br>SC<br>S2 | 0.2…1.5<br>(24…16) | 10.0 (0.39) | N/A (6) |
| | Digital inputs | IOD-1<br>IOD-2<br>IOD-3<br>IOD-4 | IN1 (7)<br>COM<br>IN2<br>SHLD | 0.2…1.5<br>(24…16) | 10.0 (0.39) | N/A (6) |

(1) The wire size, strip length, and torque specifications shown here apply to the single-axis connector that ships with the drive. For the shared-bus connector specifications, refer to Table 28 on page 80 (CP connector) and Table 30 on page 82 (IPD connector).

(2) Building your own cables or using third-party cables is not an option. Use single motor cable catalog number 2090-CS*x*M1DF-*xx*AA*xx*. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for cable specifications.

(3) Motor brake wires are part of the 2090-CSBM1DF-*xx*AA*xx* motor cable.

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

(5) These signals and the safe torque-off (STO) connector apply to only the 2198-H*xxx*-ERS drives.

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

(7) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.

**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 unit 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 5500 drive.

**IMPORTANT** For connector locations of the Kinetix 5500 drives, refer to Kinetix 5500 Connector Data on page 58.

When removing insulation from wires and tightening screws to secure the wires, refer to the table on page 78 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 39.

Follow these steps when wiring the connectors for your Kinetix 5500 drive.

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

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

2. Route the cable/wires to your Kinetix 5500 drive.
3. Insert wires into connector plugs.

   Refer to 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 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 200 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 single-axis connector plug is included with the drive, shared-bus connector kits are purchased separately.

**Figure 44 - CP Connector Wiring - Single Axis**

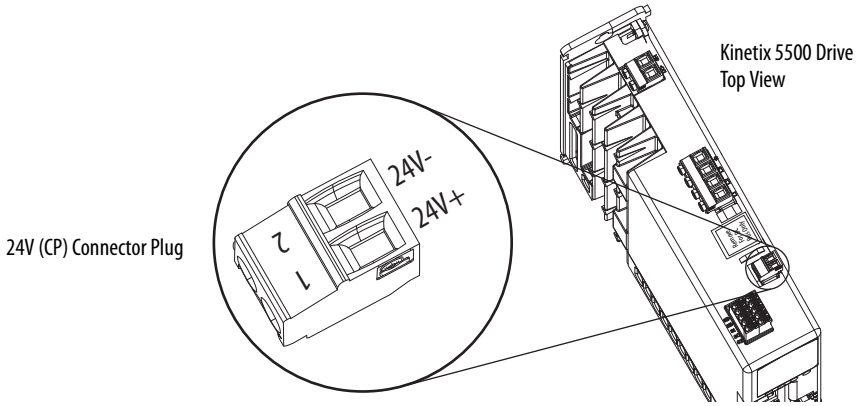



**Table 27 - Single-axis CP Connector Wiring Specifications**

| Drive Module Cat. No. | CP Pin | Signal | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H*xxx*-ERS*x*<br>2198-CAPMOD-1300 | CP-1 | 24V+ | 0.5…2.5 (20…14) | 7.0 (0.28) | 0.22…0.25 (1.9…2.2) |
| | CP-2 | 24V- | | | |

**Figure 45 - CP Connector Wiring - Shared Bus**

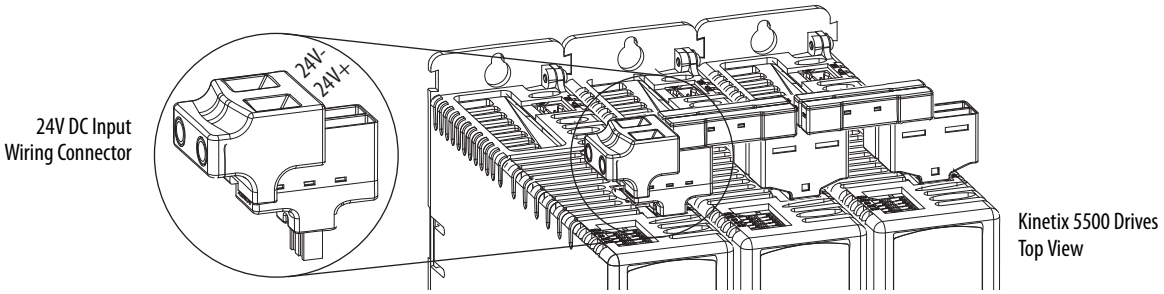



**Table 28 - Shared-bus CP Connector Wiring Specifications**

| Drive 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-H*xxx*-ERS*x*<br>2198-CAPMOD-1300 | CP-1 | 24V+ | 32 | 8.4 (8) | 11.0 (0.43) | 1.7…1.8 (15.0…15.9) |
| | CP-2 | 24V- | | | | |

## Wire the Input Power Connector

The input power (IPD) connector requires 195...528V AC (single-phase or three-phase) for mains input power. The single-axis connector plug is included with the drive, shared-bus connector kits are purchased separately.

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

**Figure 46 - IPD Connector Wiring - Single Axis**

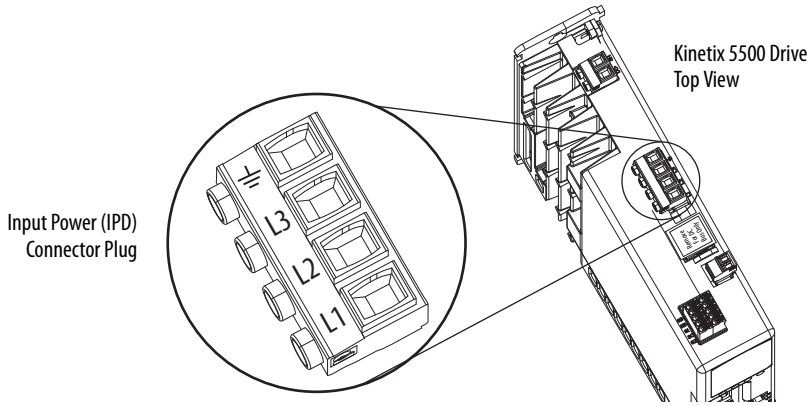



**Table 29 - Single-axis IPD Connector Wiring Specifications**

| Kinetix 5500 Drive Cat. No. | Pin | Signal | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H003-ERS*x*<br>2198-H008-ERS*x*<br>2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | ⏚<br>L3<br>L2<br>L1 | ⏚<br>L3<br>L2<br>L1 | 1.5…4<br>(16…12) | 8.0 (0.31) | 0.5…0.6<br>(4.4…5.3) |
| 2198-H070-ERS*x* | | | 1.5…6<br>(16…10) | 10.0 (0.39) | |

**Figure 47 - IPD Connector Wiring - Shared Bus**

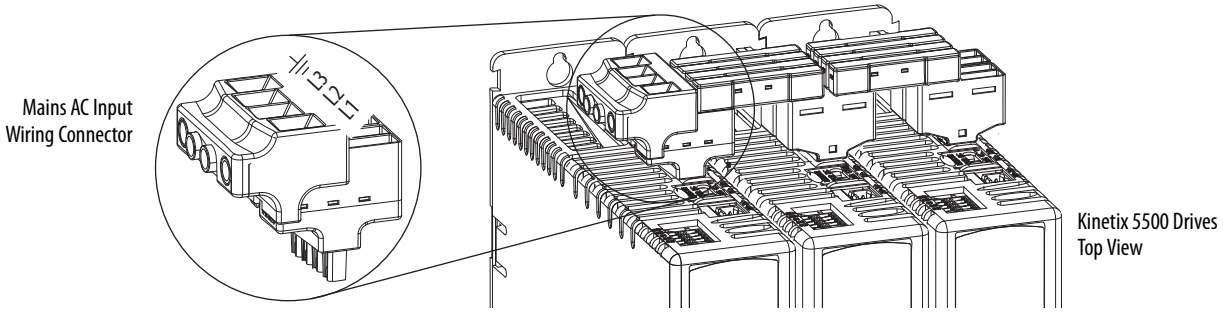



**Table 30 - Shared Bus IPD Connector Wiring Specifications**

| Kinetix 5500 Drive Cat. No. | Pin | Signal | Input Current, max A rms | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|---|
| 2198-H003-ERS*x*<br>2198-H008-ERS*x*<br>2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | ⏚<br>L3<br>L2<br>L1 | ⏚<br>L3<br>L2<br>L1 | 52 | 13.3…3.3 (6…12) | 11.0 (0.43) | 1.7…1.8 (15.0…15.9) |
| 2198-H070-ERS*x* | | | | 13.3 (6) | | |

# Wiring the Digital Input Connectors

This section provides guidelines to assist you in making digital input connections.

## 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 169.

## Wire the Digital Inputs Connector

The digital inputs (IOD) connector uses spring tension to hold wires in place.

**Figure 48 - IOD Connector Wiring**

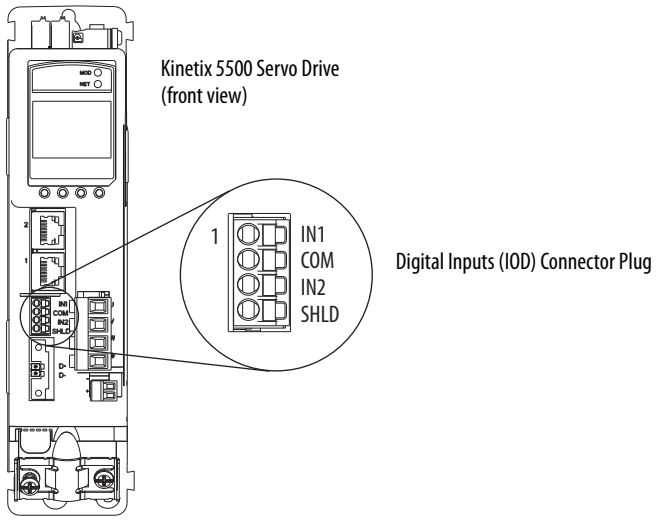



**Table 31 - Digital Inputs (IOD) Connector Specifications**

| Drive Cat. No. | DC Pin | Signal | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H*xxx*-ERS*x* | IOD-1<br>IOD-2<br>IOD-3<br>IOD-4 | IN1 (1)<br>COM<br>IN2<br>SHLD | 0.2…1.5<br>(24…16) | 10.0 (0.39) | N/A (2) |

(1) This signal has dual-functionality. You can use IN1 (IOD-1) as registration or Home input.
(2) This connector uses spring tension to hold wires in place.

# Wiring Kinetix VP Motors

Kinetix 5500 drives and 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 5500 drives and Kinetix VP motors, you cannot build your own cables or use third-party cables. |
|---|---|

Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for cable specifications.

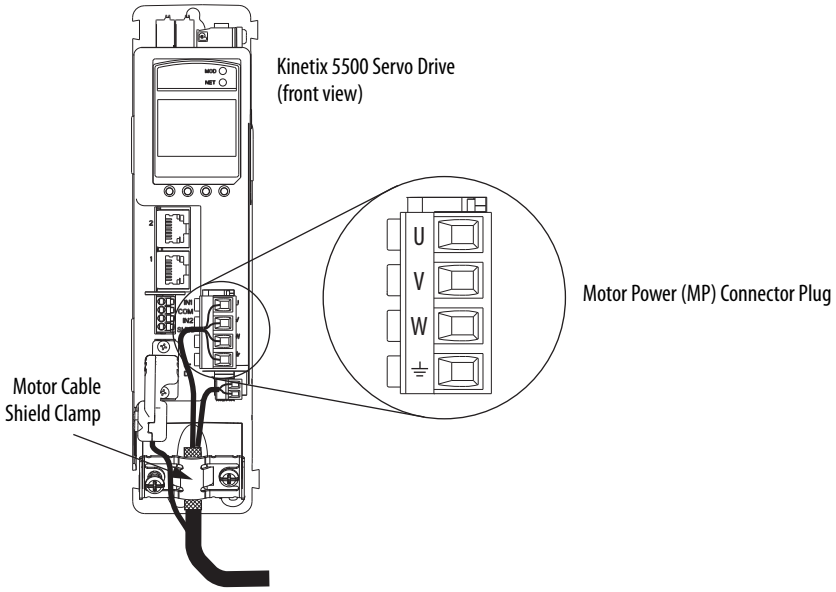
**Table 32 - Single Cable Catalog Numbers**

| Motor Cat. No. | Feedback Kit Cat. No. | Motor Cable Cat. No. (with brake wires) | Motor Cable Cat. No. (without brake wires) | Feedback Connections |
|---|---|---|---|---|
| VPL-B*xxxx*<br>VPF-B*xxxx*<br>VPS-B*xxxxx* | 2198-KITCON-DSL (included with each servo drive) | 2090-CSBM1DF-*xx*AA*xx* (standard) cables<br>2090-CSBM1DF-*xx*AF*xx* (continuous-flex) cables | 2090-CSWM1DF-*xx*AA*xx* (standard) cables | Flying-lead feedback conductors. Cables are designed specifically for Kinetix 5500 drives. |
| | | 2090-CSBM1DG-*xx*AA*xx* (standard) cables<br>2090-CSBM1DG-*xx*AF*xx* (continuous-flex) cables | 2090-CSWM1DG-*xx*AA*xx* (standard) cables | Flying-lead feedback conductors. Leads are longer to accommodate Kinetix 5500 or Kinetix 5700 drives. Extra service loops are required with Kinetix 5500 drives. |

## Motor Power Connections

Refer to Kinetix 5500 Drive and Motor/Actuator Wiring Examples on page 205 for an interconnect diagram.

**Figure 49 - MP Connector Wiring**




**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 an explosion or damage to equipment.

**Table 33 - Motor Power (MP) Connector Specifications**

| Drive Cat. No. | Pin | Signal/Wire Color | Recommended Wire Size (1) mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H003-ERS*x*<br>2198-H008-ERS*x*<br>2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x* | U<br>V<br>W<br>⏚ | U Brown<br>V Black<br>W Blue<br>⏚ Green/Yellow | Motor power cable depends on motor/drive combination.<br>0.75…2.5 (18…14) max | 8.0 (0.31) | 0.5…0.6 (4.4…5.3) |
| 2198-H070-ERS*x* | | | 2.5…6 (14…10) max | 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-CSxM1DF/DG single motor cables. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for cable specifications.

## Motor Brake Connections

**Figure 50 - BC Connector Wiring**

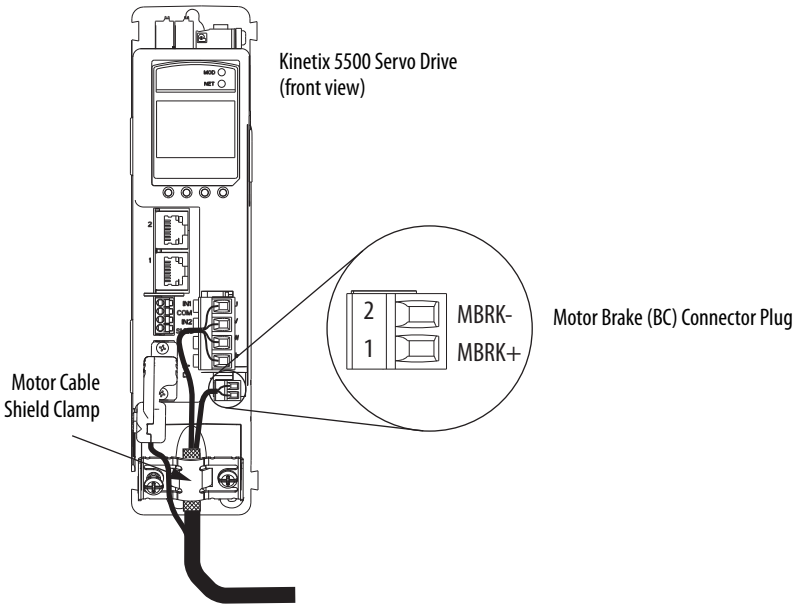



**Table 34 - Motor Brake (BC) Connector Specifications**

| Drive Cat. No. | Pin | Signal/ Wire Color | Recommended (1) Wire Size (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H*xxx*-ERS*x* | BC-1 | MBRK+/Black | N/A | 7.0 (0.28) | 0.22…0.25 (1.9…2.2) |
| | BC-2 | MBRK-/White | | | |

(1) Motor brake wires are part of the 2090-CSBM1DF/DG motor cable.

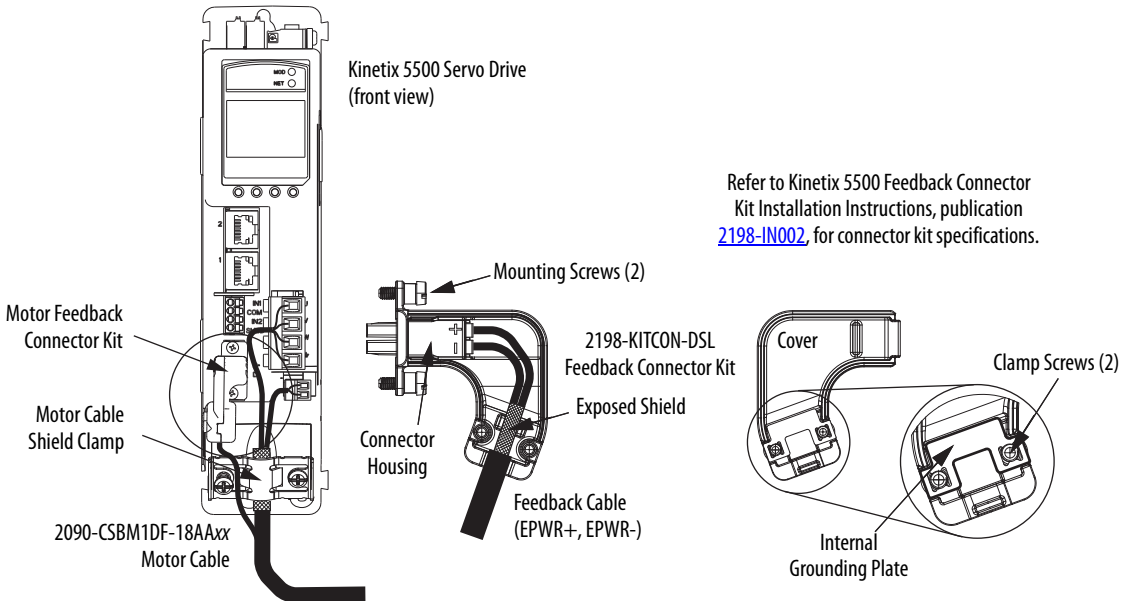
## Motor Feedback Connections

Single motor-cable feedback connections are made by using the 2198-KITCON-DSL feedback connector kit (included with each servo drive).

- 2090-CS*x*M1DF cables have flying-lead conductors designed specifically for Kinetix 5500 servo drives.
- 2090-CS*x*M1DG cables also have flying-lead feedback conductors. Leads are longer than 2090-CS*x*M1DF cables to accommodate Kinetix 5500 or Kinetix 5700 servo drives. Because the leads are longer, extra service loops are required with Kinetix 5500 drives.

**IMPORTANT** When using the 2198-KITCON-DSL feedback connector kit, the ambient temperature for the Kinetix 5500 drive enclosure is 0…50 °C (32…122 °F).

**Figure 51 - MF Connector Wiring**




**IMPORTANT** Cable preparation and positioning that provides a high-frequency bond between the shield braid and grounding plate is required to optimize system performance.

**Table 35 - Motor Feedback (MF) Connector Specifications**

| Drive Cat. No. | Pin | Signal/ Wire Color | Wire Size AWG | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H*xx*-ERS*x* | MF-1 | D+/Blue | 22 | 10.0 (0.39) | 0.4 (3.5) |
| | MF-2 | D-/White/Blue | | | |

**IMPORTANT** The feedback bundle in 2090-CS*x*M1DF-18AA*xx* motor cables (typically used with frame 1 drives) route around the shield clamp (as shown in Figure 51). The feedback bundle in 14 and 10 AWG cables (typically used with frame 2 and 3 drives) route with the power and brake wires inside the cable shield.

## 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.

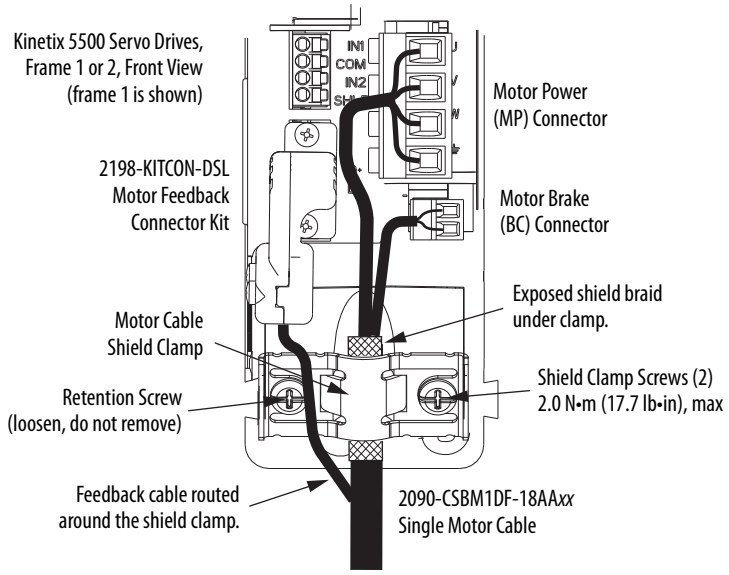
**TIP** Cables for Kinetix VP motors (catalog numbers 2090-CB*x*M1DF-18AA*xx*) do not route the feedback bundle under the shield clamp. The same cables with 14 or 10 AWG conductors have the feedback bundle within the cable shield braid.

This procedure assumes you have completed wiring your motor power, brake, and feedback connectors and are ready to apply the cable shield clamp.

Follow these steps to apply the motor cable shield clamp.

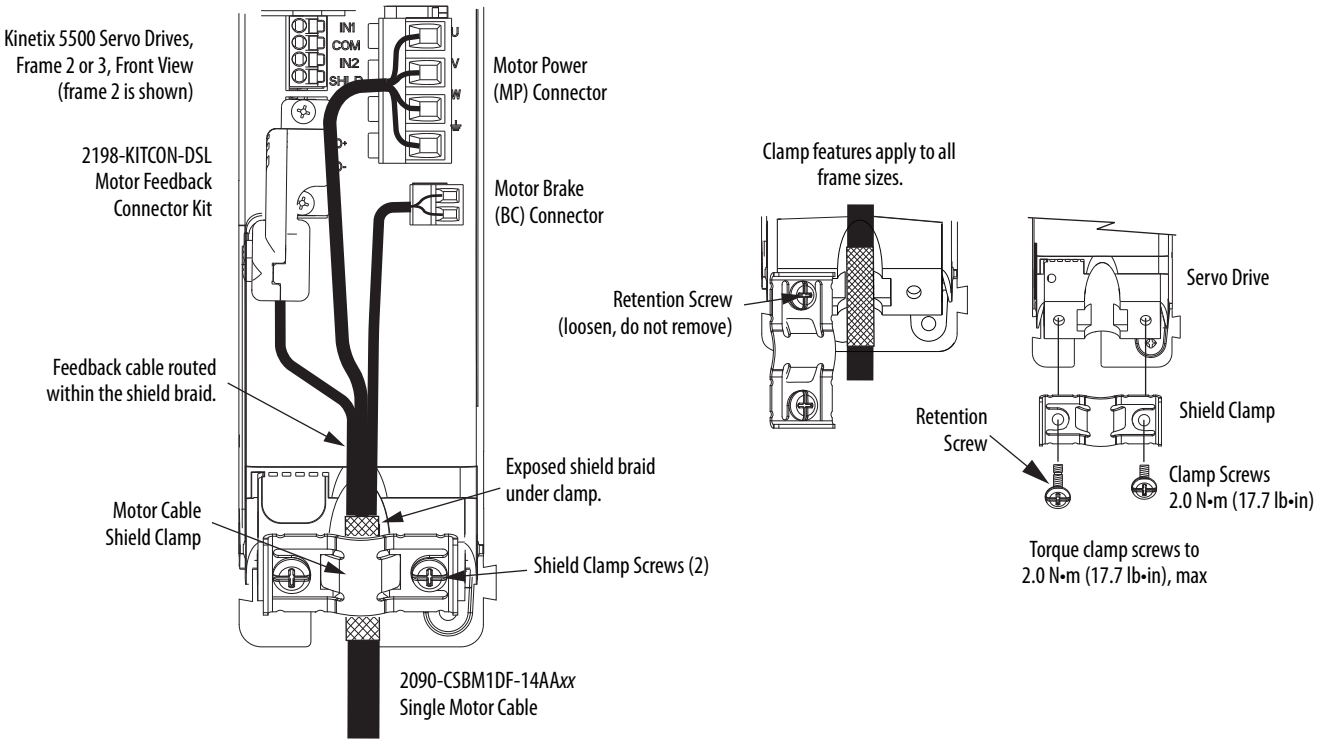
1. Loosen the left-side (retention) clamp screw and remove the right-side screw.

**Figure 52 - 18 AWG Cable Installation**




When the drive/motor combination calls for 18 AWG cable, the feedback cable routes around the motor cable shield clamp.

**Figure 53 - 14 and 10 AWG Cable Installation**




When the drive/motor combination calls for 14 or 10 AWG cable, the feedback cable routes along with the power and brake wiring.

2. Position the exposed portion of the cable shield directly in line with the clamp.

| **IMPORTANT** | Loosen the retention screw, if needed, until you can start threading both clamp screws with the cable shield under the clamp. |
|---|---|

3. Tighten each screw a few turns at a time until the maximum torque value of 2.0 N•m (17.7 lb•in) is achieved.
4. Repeat step 1 through step 3 for each drive in multi-axis configurations.

## Wiring Other Allen-Bradley Motors and Actuators

Kinetix 5500 drives are also compatible with other Allen-Bradley motors and actuators, however the 2198-H2DCK Hiperface-to-DSL (series B or later) feedback converter kit is required for converting the 15-pin Hiperface feedback signals to 2-pin DSL feedback signals.

Follow these guidelines when 2090-CP*x*M7DF (power/brake) cables and 2090-CFBM7DF (feedback) cables are used in a new installation or reused in an existing installation with Kinetix 5500 servo drives. MP-Series servo motors and actuators have separate connectors for 2090-CP*x*M7DF power/brake cables and 2090-CFBM7DF feedback cables.

**IMPORTANT** To configure these additional motors and actuators (see Table 37) with your Kinetix 5500 servo drive, you must have drive firmware 2.002 or later. Refer to Table 36 to determine if you need to install the Kinetix 5500 Add-on Profile.

**Table 36 - AOP Installation Requirement**

| Drive Firmware Revision | Logix Designer Application Version | Kinetix 5500 AOP Needed? |
|---|---|---|
| 2.002 or later | 21.00 | Yes |
| | 21.03 or later (1) | No |

(1) If you are planning to use drive firmware revision 4.001 or later, see Kinetix 5500/5700 Add-On Profile on page 107.

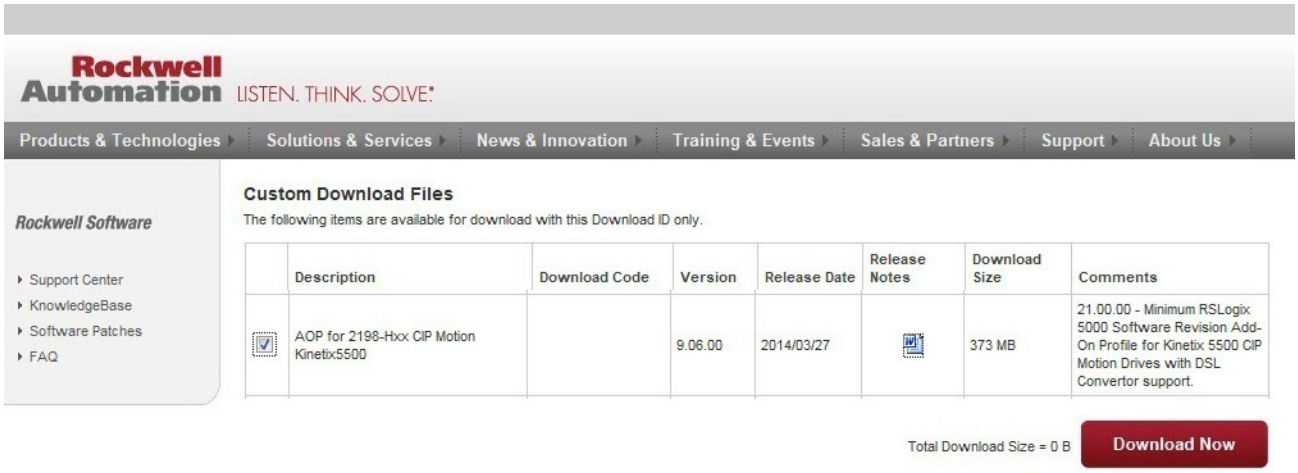
## Install the Kinetix 5500 Add-On Profile

Add-On profiles (AOP) are available for download at the Custom Downloads Add-On Profiles website: https://download.rockwellautomation.com/esd/download.aspx?downloadid=addonprofiles

Follow these steps to download the Kinetix 5500 Add-On profile.

1. Login to the Custom Download Add-On Profiles website.

   The Custom Download Files dialog box opens.




2. Check AOP for 2198-Hxx CIP Motion Kinetix5500.
3. Click Download Now and accept the user license agreement.

   If prompted to install the Download Manager, allow the installation.
4. Click the Add-On Profile icon and follow the download instructions.
5. Extract the AOP zip file and run Setup.

## Motor Power and Brake Connections

The motors and actuators in Table 37 have separate power/brake and feedback cables. The motor power/brake cable attaches to the cable clamp on the drive and wires to the MP and BC connectors, respectively.

**Table 37 - Current Motor Power Cable Compatibility**

| Motor/Actuator Cat. No. (1) | Motor Power Cat. No. (2) (with brake wires) | Motor Power Cat. No. (2) (without brake wires) |
|---|---|---|
| MPL-A/B15*xxx*-*xx*7*x*AA, MPL-A/B2*xxx*-*xx*7*x*AA, MPL-A/B3*xxx*-*xx*7*x*AA, MPL-A/B4*xxx*-*xx*7*x*AA, MPL-A/B45*xxx*-*xx*7*x*AA, MPL-A/B5*xxx*-*xx*7*x*AA, MPL-B6*xxx*-*xx*7*x*AA | 2090-CPBM7DF-*xx*AA*xx* (standard) or 2090-CPBM7DF-*xx*AF*xx* (continuous-flex) | 2090-CPWM7DF-*xx*AA*xx* (standard) or 2090-CPWM7DF-*xx*AF*xx* (continuous-flex) |
| MPM-A/B*xxxx*, MPF-A/B*xxxx*, MPS-A/B*xxxx* | | |
| MPAS-A/B*xxxx*1-V05S*x*A, MPAS-A/B*xxxx*2-V20S*x*A MPAI-A/B*xxxx*, MPAR-A/B3*xxx*, MPAR-A/B1*xxx* and MPAR-A/B2*xxx* (series B) | | |
| LDAT-S*xxxxx*-*x*D*x* | N/A | |

(1) The 2198-H2DCK (series B or later) feedback converter kit is required.

(2) Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for cable specifications.

Refer to Motor Power Connections on page 84 and Motor Brake Connections on page 85 for the MP and BC connector specifications.

**Table 38 - Legacy Motor Power Cables**

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

**Table 39 - 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 | | |

To use your existing Bulletin 2090 cables with Kinetix 5500 drives, some preparation is necessary so that the cable shield, conductor, and strip lengths are correct. Follow these cable preparation guidelines:

- Trim the shield flush so that no strands can short to adjacent terminals.
- Measure the conductor lengths and include a service loop.
- Remove just enough insulation to provide the proper strip length.

### *Maximum Cable Lengths*

The power cable length for Kinetix 5500 drive and MP-Series motor/actuator combinations is limited to 20 m (65.6 ft); however, you can replace the existing motor power/brake cable with a 2090-CSBM1DF or 2090-CSBM1DG single motor cable to extend the length up to 50 m (164 ft).

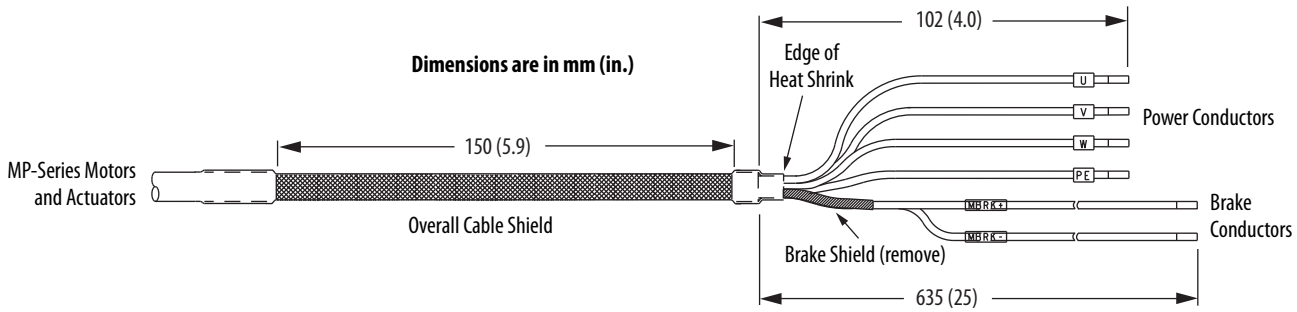
**IMPORTANT** The option to replace 2090-CPBM7DF power/brake cables with 2090-CSBM1DF/DG single cables applies to only 18 and 14 AWG single cables. 2090-CS*x*M1D*x*-10A*xxx* (10 AWG) cables do not support this 50 m (164 ft) option.

When replacing your existing motor power/brake cable with a 2090-CSBM1DF/DG single motor cable, only the motor power and brake conductors are used. Cut off the feedback conductors in the single motor cable and reuse the existing 2090-Series feedback cable.

### *Motor Power/Brake Cable Preparation*

The 2090-CPBM7DF cable power and brake conductors 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 54 - 2090-CPBM7DF Power/brake Cable Dimensions**




Power cable preparation on existing 16 and 14 AWG cables is sufficient to reuse on Kinetix 5500 frame 1 and 2 drives, except for the brake conductors, which are much longer than required.

However, for frame 3 drives with 14 or 10 AWG cables, the overall length of the cable preparation area needs to be increased for the motor power conductors to reach the MP connector and also provide a proper service loop.

Follow these steps to prepare your existing brake conductors and 14 or 10 AWG power cable.

1. Remove a total of 325 mm (12.8 in.) of cable jacket from your existing cable.

   This exposes additional cable shield.
2. Remove all but 63.5 mm (2.5 in.) of the shield.

3. Cover 12.5 mm (0.5 in.) of the shield ends and an equal length of the conductors with 25 mm (1.0 in.) of electrical tape or heat shrink.

   Do the same on the other side of the cable shield. This keeps the shield ends from fraying and holds the conductors together.

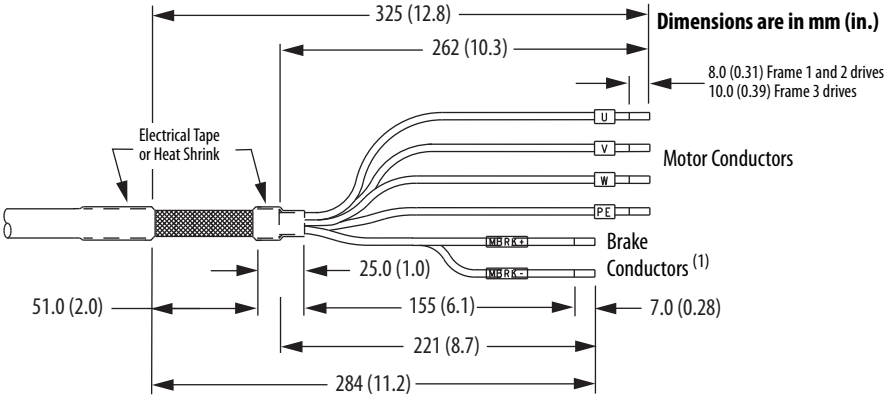
4. Cut the brake conductors back to 163 mm (6.4 in.) and trim the shield braid at the base of the jacket.

   The shield braid covering the brake conductors is not needed.

5. Remove the specified length of insulation from the end of each wire.

This example applies to existing 2090-Series cables and 2090-Series single motor cables. If you are using a 2090-CSBM1DF/DG single motor cable, you can remove the shield braid covering the brake conductors.

**Figure 55 - Power/brake Cable (14 and 10 AWG)**




(1) The overall shield braid covering the brake conductors can be removed.

### *Apply the Motor Power/brake Shield Clamp*

The power/brake cable shield attaches to the drive cable clamp. A clamp spacer is included with the 2198-H2DCK feedback converter kit for cable diameters that are too small for a tight fit within the drive clamp alone.

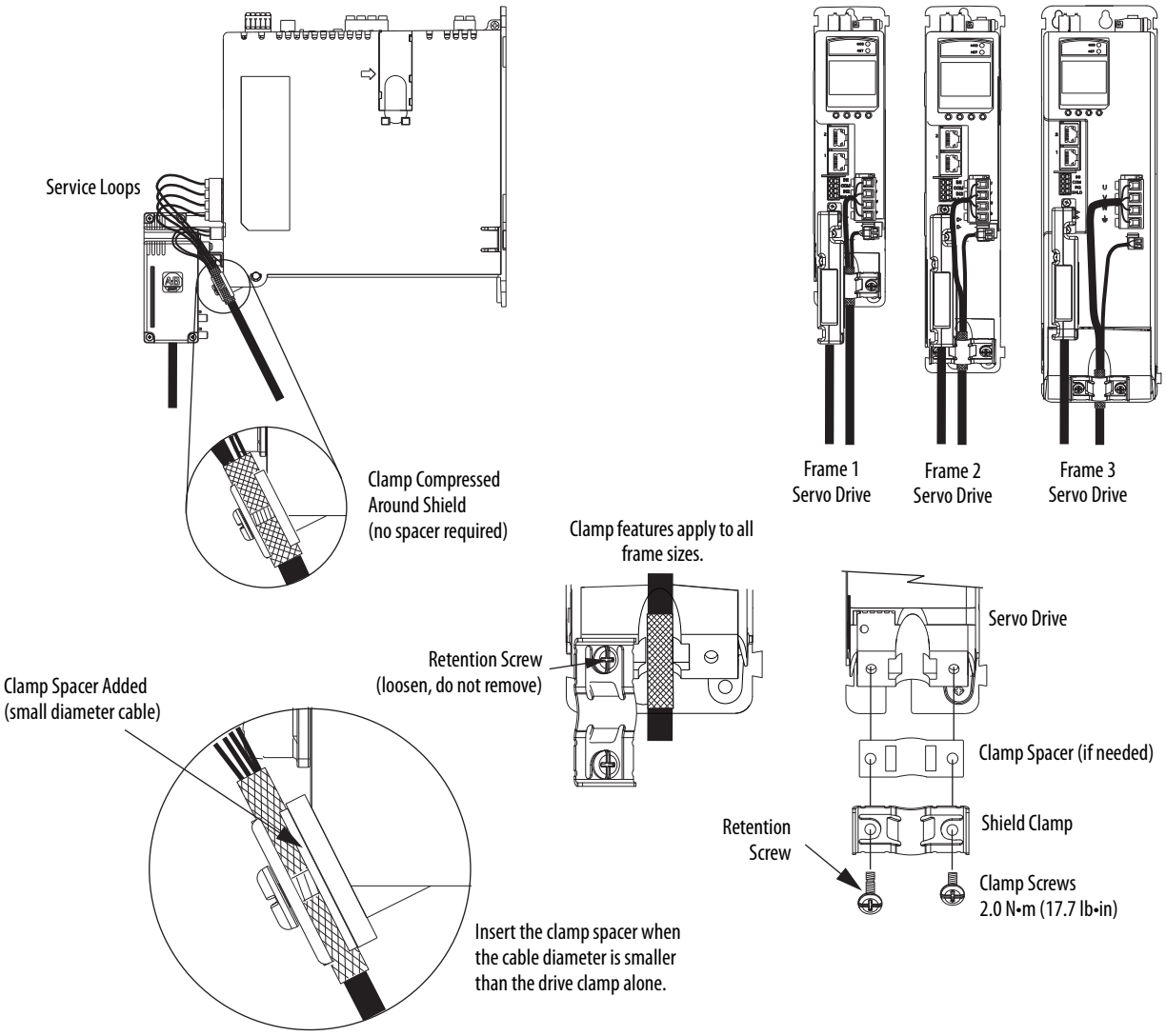
- Routing the conductors with service loops provides stress relief to the motor power and brake conductors.
- Make sure the cable clamp tightens around the cable shield and provides a good bond between the cable shield and the drive chassis.

| **IMPORTANT** | Loosen the retention screw, if needed, until you can start threading both clamp screws with the cable shield under the clamp. |
|---|---|

- Tighten each screw, a few turns at a time, until the maximum torque value of 2.0 N•m (17.7 lb•in) is achieved.

**IMPORTANT** If the power/brake cable shield has a loose fit inside the shield clamp, insert the clamp spacer between the shield clamp and the drive to reduce the clamp diameter. When the clamp screws are tight, 2.0 N•m (17.7 lb•in), the result must be a high-frequency bond between the cable shield and the drive chassis.

**Figure 56 - Cable Clamp Attachment**



## Motor Feedback Connections

The feedback cable attaches to the 2198-H2DCK converter kit and is wired to the 10-pin connector. Bulletin 2090 feedback cables require preparation to make sure the shield clamp attaches properly and conductors route smoothly to the 10-pin connector terminals.

**IMPORTANT** When using the 2198-H2DCK feedback connector kit and Bulletin 2090 feedback cables listed in Table 40 or Table 41, the ambient temperature for the Kinetix 5500 drive enclosure is derated to 0…40 °C (32…104 °F).

All of the current and legacy feedback cables listed below are compatible with the 2198-H2DCK (series B or later) converter kit.

**IMPORTANT** Only Allen-Bradley motors and actuators with single-turn or multi-turn high-resolution absolute encoders are compatible.

**Table 40 - Motor Feedback Cable Compatibility**

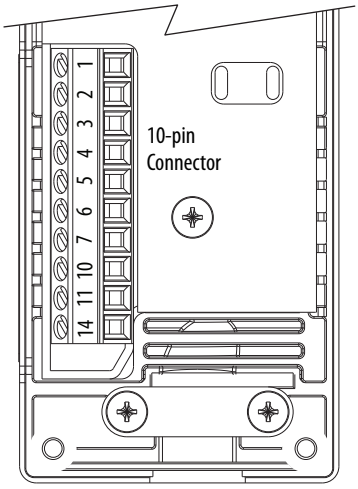
| Motor/Actuator Family | Motor/Actuator Cat. No. (1) | Feedback Cable Cat. No. |
|---|---|---|
| MP-Series low-inertia motors | MPL-A/B15*xxx*-V/E*x*7*x*AA<br>MPL-A/B2*xxx*-V/E*x*7*x*AA | 2090-CFBM7DF-CEAA*xx*<br>2090-CFBM7DD-CEAA*xx*<br>2090-CFBM7DF-CERA*xx*<br>(standard) or<br>2090-CFBM7DF-CEAF*xx*<br>2090-CFBM7DD-CEAF*xx*<br>2090-CFBM7DF-CDAF*xx*<br>(continuous-flex) |
| | MPL-A/B3*xxx*-S/M*x*7*x*AA<br>MPL-A/B4*xxx*-S/M*x*7*x*AA<br>MPL-A/B45*xxx*-S/M*x*7*x*AA<br>MPL-A/B5*xxx*-S/M*x*7*x*AA<br>MPL-B6*xxx*-S/M*x*7*x*AA | |
| MP-Series medium-inertia motors | MPM-A/B*xxxx*-S/M | |
| MP-Series food-grade motors | MPF-A/B*xxxx*-S/M | |
| MP-Series stainless-steel motors | MPS-A/B*xxxxx*-S/M | |
| MP-Series integrated linear stages | MPAS-A/B*xxxx*1-V05S*x*A<br>MPAS-A/B*xxxx*2-V20S*x*A | |
| MP-Series electric cylinders | MPAR-A/B1*xxxx*-V and MPAR-A/B2*xxxx*-V (series B)<br>MPAR-A/B3*xxxx*-M | |
| MP-Series heavy-duty electric cylinders | MPAI-A/B*xxxxx*M3 | |
| LDAT-Series linear thrusters | LDAT-S*xxxxxx*-x*Dx* | |

(1) The 2198-H2DCK (series B or later) feedback converter kit is required.

**Table 41 - Legacy Motor Feedback Cables**

| Motor Cable | Description | Feedback Cable Cat. No. |
|---|---|---|
| Standard | Encoder feedback, threaded | 2090-XXNFMF-S*xx*<br>2090-UXNFBMF-S*xx* |
| | Encoder feedback, bayonet | 2090-UXNFBMP-S*xx* |
| | | 2090-XXNFMP-S*xx* |
| Continuous-flex | Encoder feedback, bayonet | 2090-XXTFMP-S*xx* |
| | Encoder feedback, threaded | 2090-CFBM4DF-CDAF*xx* |

**Figure 57 - 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 5V and 9V from a 12V supply coming from the drive. The 5V supply is used by 5V encoders in 230V motors. The 9V supply is used by 9V encoders in 460V motors.

### *Motor Feedback Cable Preparation*

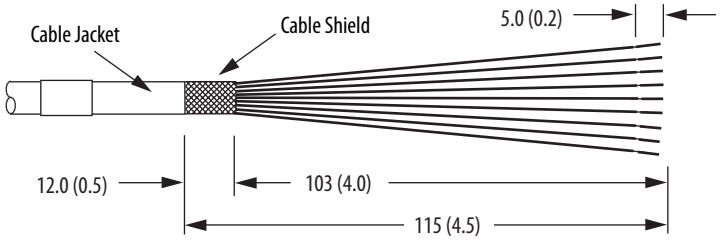
Follow these steps to prepare feedback cables.

1. Remove 115 mm (4.5 in.) of cable jacket and 103 mm (4.0 in.) of cable shield.

**IMPORTANT** This length of wire is needed to provide a service loop for the longest wires terminated at the 10-pin connector. However, most wires need to be trimmed shorter, depending on the terminal they are assigned to.

2. Determine the length for each of the 10 wires and trim as necessary.
3. Remove 5.0 mm (0.2 in.) of insulation from the end of each wire.

**Dimensions are in mm (in.)**



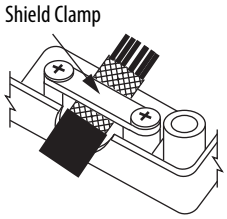
### *Apply the Converter Kit Shield Clamp*

Follow these steps to apply the converter kit shield clamp.

1. Apply the shield clamp to the 12 mm (0.5 in.) of exposed cable shield to achieve a high-frequency bond between the shield braid and clamp.

   | **IMPORTANT** | Cable preparation and positioning that provides a high-frequency bond between the shield braid and clamp is required to optimize system performance. |
   |---|---|

   Apply 0.30 N•m (2.6 lb•in) torque to each screw.

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

   Include a service loop, as shown in Figure 58, and refer to the connector pinout in Figure 57.

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.

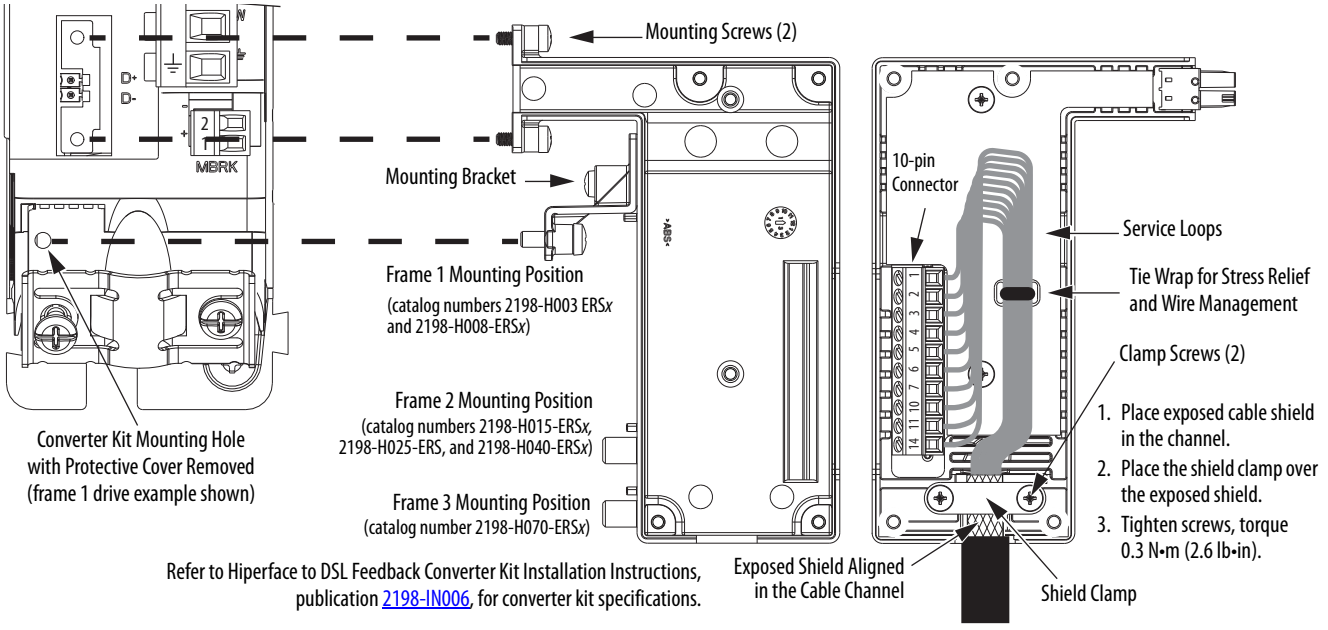
**Table 42 - 2090-CFBM7DF-CEA*xxx* Feedback Cables**

| | | | |
|---|---|---|---|
| **Rotary Motors** | **MPL-B15*xxx*…MPL-B2*xxx*-V/Ex4/7*x*AA<br>MPL-B3*xxx*…MPL-B6*xxx*-M/Sx7*x*AA<br>MPL-A5*xxx*-M/Sx7*x*AA** | **MPL-A15*xxx*…MPL-A2*xxx*-V/Ex4/7*x*AA<br>MPL-A3*xxx*-M/Sx7*x*AA<br>MPL-A4*xxx*-M/Sx7*x*AA<br>MPL-A45*xxx*-M/Sx7*x*AA<br>MPM-A115*xxx*…MPM-A130*xxx*-M/S<br>MPF/MPS-A3*xx*-M/S<br>MPF/MPS-A4*xx*-M/S<br>MPF/MPS-A45*xx*-M/S<br>MPS-A5*xxx*-M/S** | **2198-H2DCK Converter Kit Pin** |
| | **MPM-A165*xxx*…MPM-A215*xxx*<br>MPM-B*xxxxx*-M/S<br>MPF-B*xxx*-M/S<br>MPF-A5*xxx*-M/S<br>MPS-B*xxx*-M/S** | | |
| **Linear Actuators** | **MPAS-B*xxxxx*-V*xx*Sx*A*<br>**MPAR-B*xxxx*,<br>MPAI-B*xxxx*<br>LDAT-S*xxxxxx*-x*Dx*** | **MPAS-A*xxxxx*-V*xx*Sx*A*<br>MPAR-A*xxxx*, MPAI-A*xxxx*** | |
| 1 | Sin+ | Sin+ | 1 |
| 2 | Sin- | Sin- | 2 |
| 3 | Cos+ | Cos+ | 3 |
| 4 | Cos- | Cos- | 4 |
| 5 | Data+ | Data+ | 5 |
| 6 | Data- | Data- | 10 |
| 9 | Reserved | EPWR_5V | 14 |
| 10 | ECOM | ECOM | 6 (1) |
| 11 | EPWR_9V | Reserved | 7 |
| 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 mounting position specific to the frame size of your drive.

**Figure 58 - Wiring the 2198-H2DCK Feedback Converter Kit**



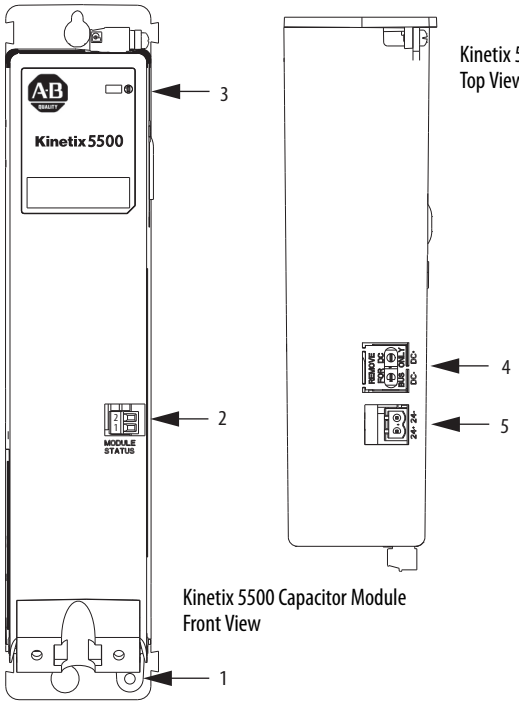
## Capacitor Module Connections

Follow these guidelines when wiring the 2198-CAPMOD-1300 capacitor module:

- Wire relay output (MS) connections to the Logix5000 controller (optional).
- Refer to Kinetix 5500 Capacitor Module wiring example on page 201.
- Refer to Kinetix 5500 Capacitor Module Status Indicators on page 158 for troubleshooting the module status indicator and relay output.
- Refer to the installation instructions provided with your Bulletin 2198 capacitor module, publication 2198-IN004.

**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 59 - Capacitor Module Features and Indicators**




| Item | Description |
|---|---|
| 1 | Ground screw (green) |
| 2 | Module status (MS) connector (relay output) |
| 3 | Module status indicator |
| 4 | DC bus (DC) connector (under cover) (1) (2) |
| 5 | 24V control input power (CP) connector (2) |

(1) The DC-bus connector ships with a protective knock-out cover that can be removed for use in shared-bus configurations.

(2) The shared-bus connector set for the capacitor module, catalog number 2198-KITCON-CAP1300, is included for connection to the upstream drive. Replacement kits are also available.

**Table 43 - Capacitor Module Connector Specifications**

| Capacitor Module Cat. No. | Pin | Signal | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-CAPMOD-1300 | MS-1 | RELAY+ | 0.14…1.5 (28…16) | 7.0 (0.28) | 0.22…0.25 (1.9…2.2) |
| | MS-2 | RELAY- | | | |

## External Passive-shunt Resistor Connections

Follow these guidelines when wiring your 2097-R*x* shunt resistor:

- Refer to External Passive Shunt Resistor on page 42 for noise zone considerations.
- Refer to Shunt Resistor Wiring Example on page 204.
- Refer to the installation instructions provided with your Bulletin 2097 shunt resistor, publication 2097-IN002.

**IMPORTANT** To improve system performance, run wires and cables in the wireways as established in Chapter 2.

**Figure 60 - RC Connector Wiring**

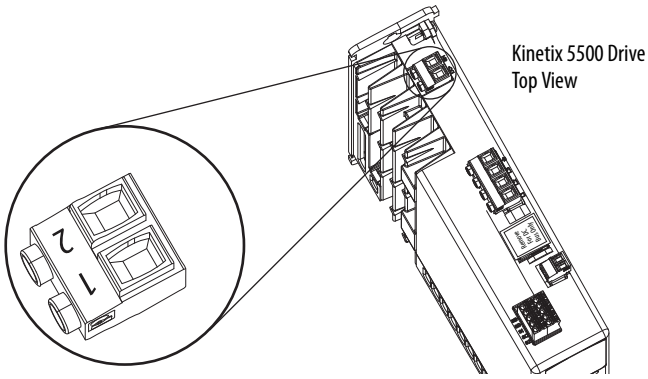



**Table 44 - Shunt Resistor (RC) Connector Specifications**

| Drive Cat. No. | Pin | Signal | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|---|
| 2198-H003-ERS*x*<br>2198-H008-ERS*x* | RC-1<br>RC-2 | SH<br>DC+ | 0.5…4.0 (20…12) | 8.0 (0.31) | 0.5…0.6 (4.4…5.3) |
| 2198-H015-ERS*x*<br>2198-H025-ERS*x*<br>2198-H040-ERS*x*<br>2198-H070-ERS*x* | RC-1<br>RC-2 | DC+<br>SH | | | |

**IMPORTANT** You must disconnect the internal shunt wires at the RC connector before connecting the Bulletin 2097 shunt resistor wires.

**Table 45 - Shunt Resistor Selection**

| Drive Cat. No. | Bulletin 2097 Shunt Resistor Cat. No. |
|---|---|
| 2198-H003-ERS*x* | 2097-R7 |
| 2198-H008-ERS*x* | |
| 2198-H015-ERS*x* | |
| 2198-H025-ERS*x* | |
| 2198-H040-ERS*x* | 2097-R6 |
| 2198-H070-ERS*x* | |

## Ethernet Cable Connections

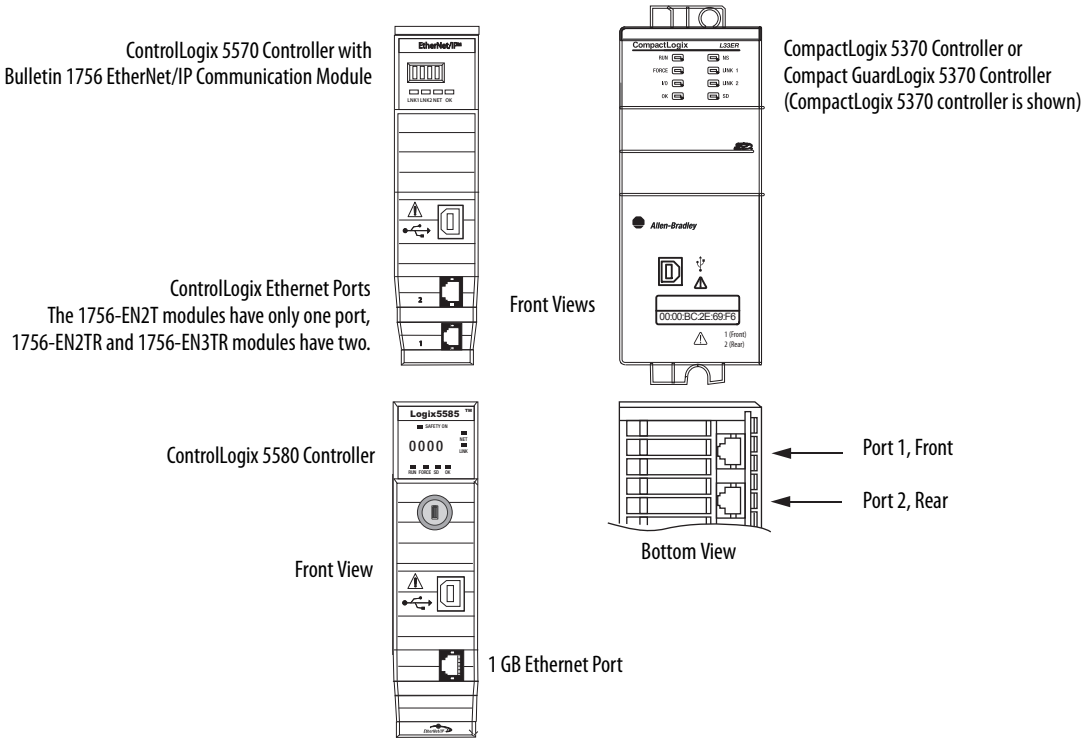
This procedure assumes you have your Logix5000 controller and Kinetix 5500 drive modules mounted and are ready to connect the network cables.

The EtherNet/IP network is connected by using the PORT 1 and PORT 2 connectors. Refer to page 58 to locate the Ethernet connectors on your Kinetix 5500 drive. Refer to the figure below to locate the connectors on your Logix5000 controller.

Shielded Ethernet cable is required and available in several standard lengths. Refer to the Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004, for more information.

Ethernet cable lengths connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).

**Figure 61 - ControlLogix and CompactLogix Ethernet Port Locations**




These Logix5000 controllers accept linear, ring (DLR), and star network configurations. Refer to Typical Communication Configurations on page 21 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.

# Configure and Start the Kinetix 5500 Drive System

This chapter provides procedures for configuring your Kinetix 5500 drive system with a Logix5000 controller.

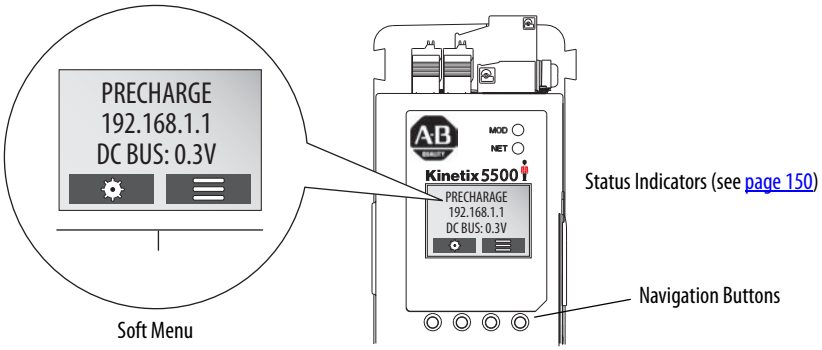

| Topic | Page |
|---|---|
| Understanding the Kinetix 5500 Display | 102 |
| Configure the Drive | 106 |
| Studio 5000 Logix Designer | 106 |
| Configure the Logix5000 Controller | 108 |
| Configure Feedback-only Axis Properties | 124 |
| Configure Induction-motor Frequency-control Axis Properties | 125 |
| Configure PM Motor Closed-loop Control Axis Properties | 134 |
| Download the Program | 137 |
| Apply Power to the Kinetix 5500 Drive | 138 |
| Understanding Bus Sharing Group Configuration | 139 |
| Test and Tune the Axes | 143 |


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

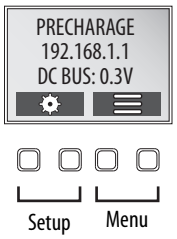
# Understanding the Kinetix 5500 Display

The Kinetix 5500 drive has 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 are directly below the display and are used to select items from a soft menu.

**Figure 62 - Kinetix 5500 Drive LCD Display and Status Indicators**




This is the Home screen. The setup selections are tied to the two Setup (left-side) buttons and the menu selections are tied to the two Menu (right-side) buttons.

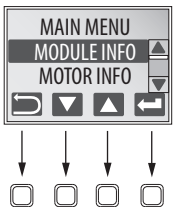



The soft menu provides a changing selection that corresponds to the current screen. Use the navigation buttons to perform the following.

| | |
|---|---|
| | 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 192 to review the troubleshooting tables.

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



## 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.

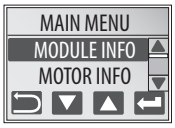


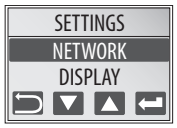

**Table 46 - Navigating the Inverter Menu**

| Menu/Sub Menu Selections | Attributes | Description | Example Values |
|---|---|---|---|
| Drive Info | Catalog number | | 2198-H*xxx*-ERS*x* |
| | Firmware revision | | FW REV: 1.1.450167 |
| | Hardware revision | | HW REV: 1.1 |
| | Serial number | | SERIAL#: xxxxxxxxxx |
| Motor Info | Model number | | MODEL: VPL-B1306F |
| | Serial number | | SERIAL#: xxxxxxxxxx |
| Diagnostics> Drive Diagnostics | Bus diagnostics | | BUS VOLT: 0.0V |
| | | | BUS CUR: 0.0A |
| | Converter diagnostics | | CONV UTIL: 0.7% |
| | | | CONV TEMP: 31.7C |
| | 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#xxxxxxxxxx |
| | 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 |
| Fault Log | Fault text | Fault code as listed in Fault Codes beginning on page 192. | FLT S20 - CONV OVERLOAD FL |
| | Fault details | The problem as reported in Fault Codes on page 192. | 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 192. | • Reduce the number of drives in the same bus group<br>• Reduce duty-cycle of commanded motion |

## Setup Screens

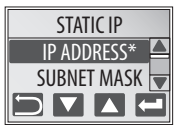
The setup screens provide the means of changing drive settings, for example, the IP address. Press one of the setup buttons to access the setup screens.

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 47 - Navigating the 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 | 192.168.001.001 | 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 |
| | | 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 |
| | Contrast | -10…+10 | 0 | Contrast setting of the display |
| Safety (3) | Reset Ownership | Are you sure? | | Resets safety ownership (reset fails after 30 seconds) |
| Web | Enabled | | | Enables the web server |
| | ->Disabled | | | Disables the web server |

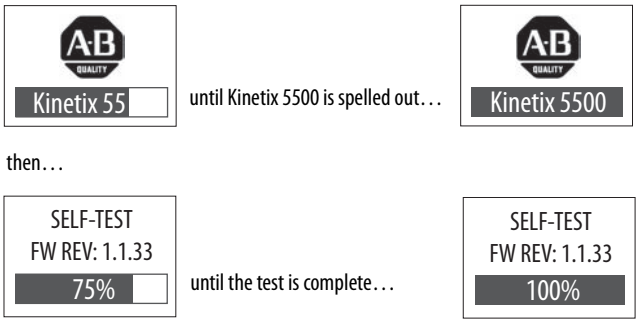
(1) An arrow (->) appears in front of the chosen attribute indicating that this attribute is currently configured. This is also the factory default setting.

(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.

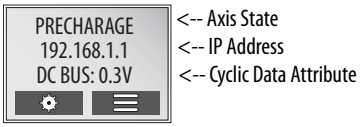
(3) The Safety menu applies to only 2198-H*xxx*-ERS2 drives.

## 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 48 lists the other axis states and their descriptions.

**Table 48 - 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 is fully configured, 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 | • The drive is enabled, configured with an active control mode, and actively tracking a command.<br>• 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 Logix Designer application by adding it to a configured EtherNet/IP module or controller and adding it under the I/O configuration tree. After setting network parameters, you can view the drive status information in Studio 5000 software 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 104 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 11.

## Kinetix 5500/5700 Add-On Profile

The Logix Designer application, version 28.00 and later, makes possible the configuration of additional drive features not available in previous versions.

**IMPORTANT** To configure these additional drive features with your Kinetix 5500 servo drive, you must have drive firmware 4.001 or later. Refer to Table 49 to determine if you need to install the Kinetix 5500/5700 Add-on Profile.

**Table 49 - AOP Installation Requirement**

| Drive Firmware Revision | Logix Designer Application Version | Kinetix 5500/5700 AOP Needed? |
|---|---|---|
| 4.001 or later | 26.00 or 27.00 | Yes |
| | 28.00 or later | No |

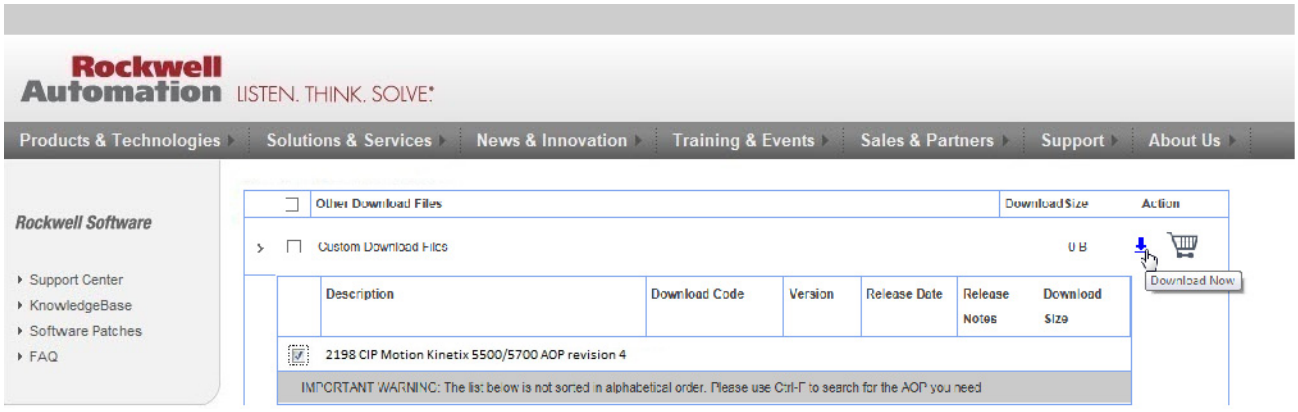
## Install the Kinetix 5500/5700 Add-On Profile

Add-On profiles (AOP) are available for download at the Custom Downloads Add-On Profiles website: https://download.rockwellautomation.com/esd/download.aspx?downloadid=addonprofiles

Follow these steps to download the Kinetix 5500/5700 Add-On profile.

1. Login to the Custom Download Add-On Profiles website.

   The Custom Download Files dialog box opens.




2. Check 2198 CIP Motion Kinetix 5500/5700 AOP revision 4.
3. Click the Download Now icon and accept the user license agreement.

   If prompted to install the Download Manager, allow the installation.
4. Click the Add-On Profile icon and follow the download instructions.
5. Extract the AOP zip file and run Setup.

## Configure the Logix5000 Controller

These procedures assume that you have wired your Kinetix 5500 drive system. In this example, the GuardLogix 5570 safety controller, ControlLogix 1756-EN2T communication module, and CompactLogix 5370 controller dialog boxes are shown.

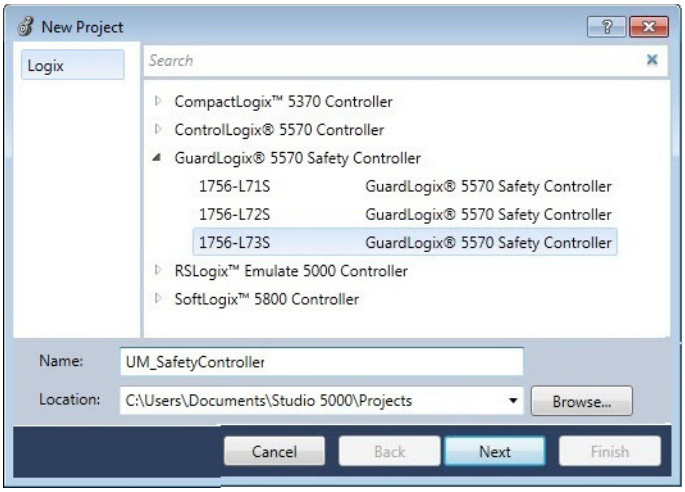
Follow these steps to configure the controller.

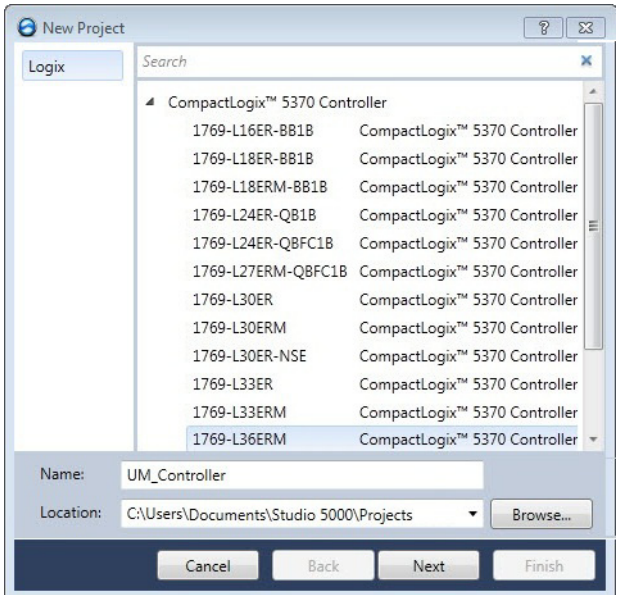
1. Apply power to your controller and open your Logix Designer application.




2. From the Create menu, choose New Project.

   The New Project dialog box appears.



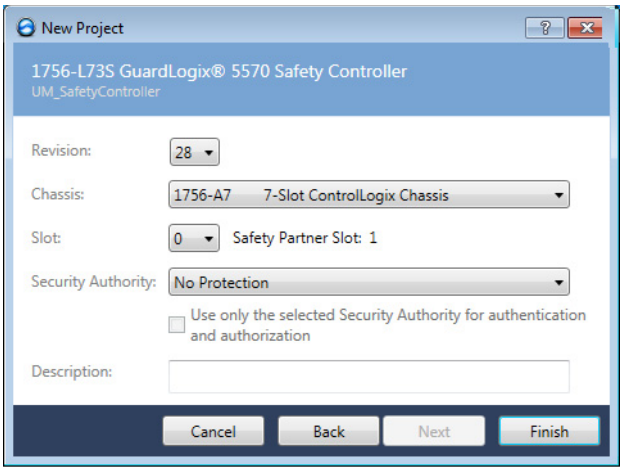

**IMPORTANT** If you are configuring a 2198-H*xxx*-ERS2 (integrated) servo drive in a safety application, you must use a GuardLogix safety controller.

In this example, the typical dialog boxes for 1756-EN*x*T EtherNet/IP modules and CompactLogix 5370 controllers with embedded Ethernet are shown.

Follow these steps to configure your Logix5000 controller.

1. Expand the Logix5000 controller family and select your controller.
2. Type the file Name.
3. Click Next.

   The New Project dialog box appears.



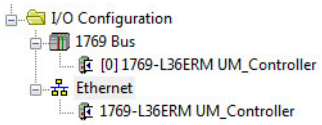




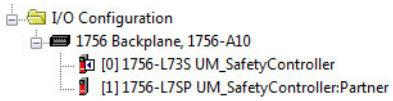
4. From the Revision pull-down menu, choose your software revision.
5. Click Finish.

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

Controller Organizer with CompactLogix 5370 controller.




Controller Organizer with GuardLogix 5570 controller.



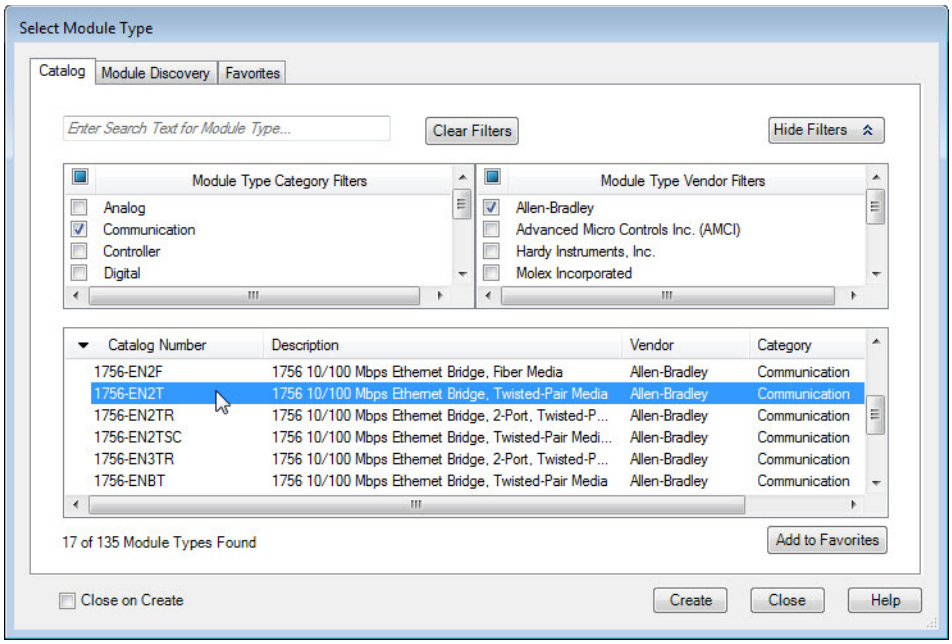

**IMPORTANT** If your project includes a ControlLogix or GuardLogix controller, you need to add an Ethernet communication module to your Bulletin 1756 chassis and configure it for use in your application.

- For ControlLogix or GuardLogix controllers, go to step 6
- For CompactLogix 5370 controllers, go to step 13

Refer to the EtherNet/IP Network Configuration User Manual, publication, ENET-UM001 for more information.

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

   The Select Module Type dialog box appears.

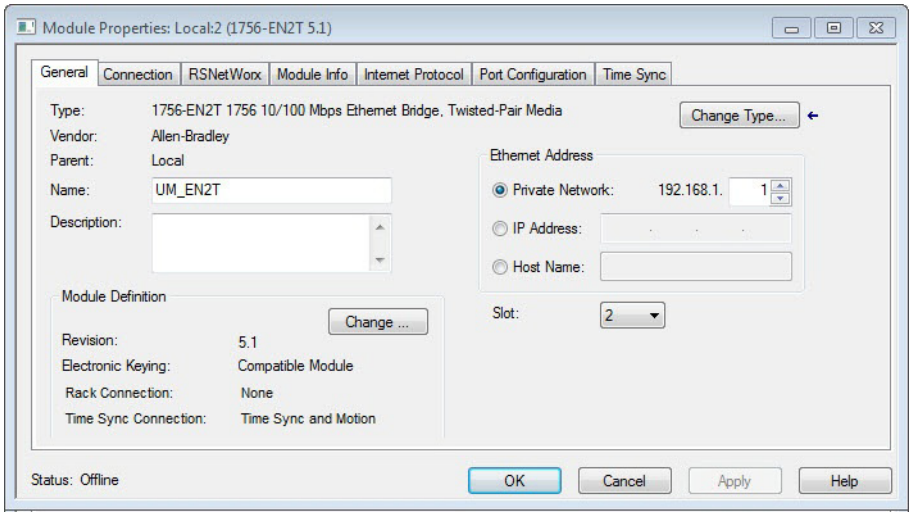



7. By using the filters, check Communication and Allen-Bradley, and select 1756-EN2T, 1756-EN2TR, or 1756-EN3TR as appropriate for your actual hardware configuration.

   In this example, the 1756-EN2T module is selected.

8. Click Create.

   The New Module dialog box appears.




   a. Configure the new module.
   b. Type the module Name.
   c. Enter the Logix EtherNet/IP module slot (leftmost slot = 0).

d. Select an Ethernet Address option.

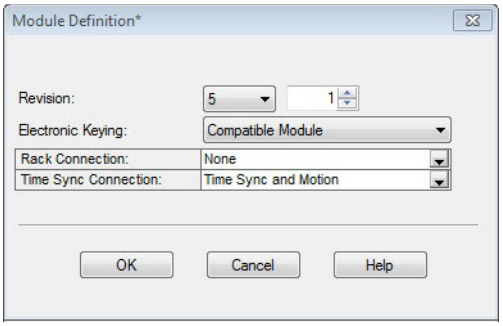
In this example, the Private Network address is selected.

e. Enter the address of your EtherNet/IP module.

In this example, the last octet of the address is 1.

f. Click Change in the Module Definition area.

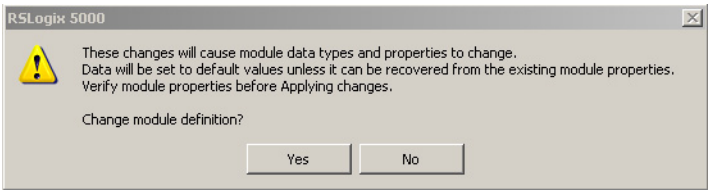
The Module Definition dialog box opens.




9. From the Time Sync Connection pull-down menu, choose Time Sync and Motion.

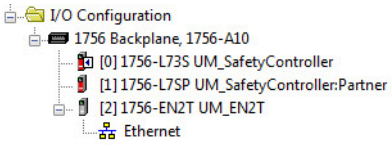
**IMPORTANT** Time Sync functionality is what enables motion control on an Ethernet network. Without this setting, you won't be able to run your motion application.

10. Click OK to close the Module Definition dialog box.
11. Click Yes when prompted to confirm your module definition changes.




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

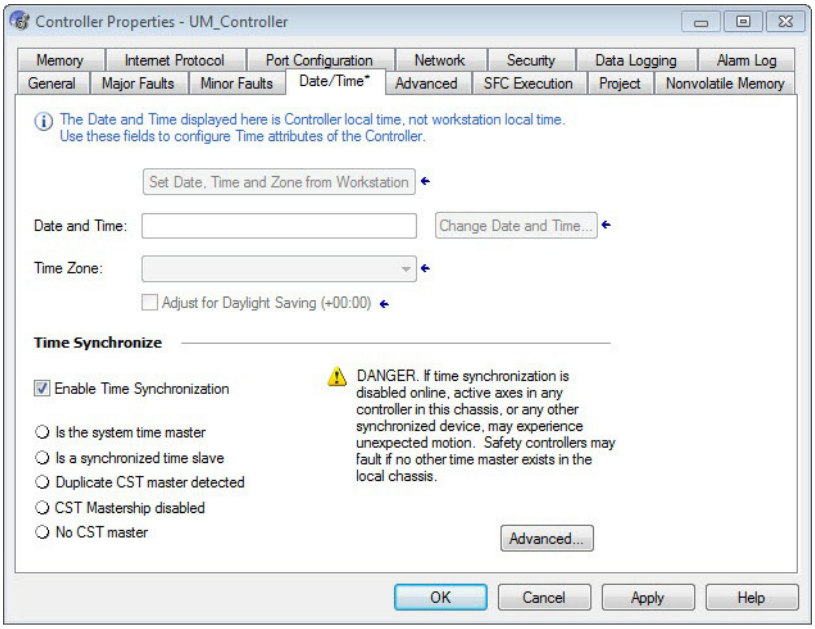
Your new 1756-EN*x*T Ethernet module appears under the I/O Configuration folder in the Controller Organizer.




13. From the Edit menu, choose Controller Properties.

The Controller Properties dialog box appears.

14. Click the Date/Time tab.




15. 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 the Advanced tab. |
|---|---|

16. Click OK.

## Configure the Kinetix 5500 Drive

**IMPORTANT** To configure 2198-H*xxx*-ERS (hardwired safety) drives, you must be using the Logix Designer application, version 21.00 or later.

To configure 2198-H*xxx*-ERS2 (integrated safety) drives, you must be using the Logix Designer application, version 24.00 or later.

Use this table to determine where to begin your drive configuration.

| Drive Cat. No. | Start Here | Page |
|---|---|---|
| 2198-H*xxx*-ERS | Configure Drive with Hardwired Safety Connections | 113 |
| 2198-H*xxx*-ERS2 | Configure Drive with Integrated Safety Connections | 115 |

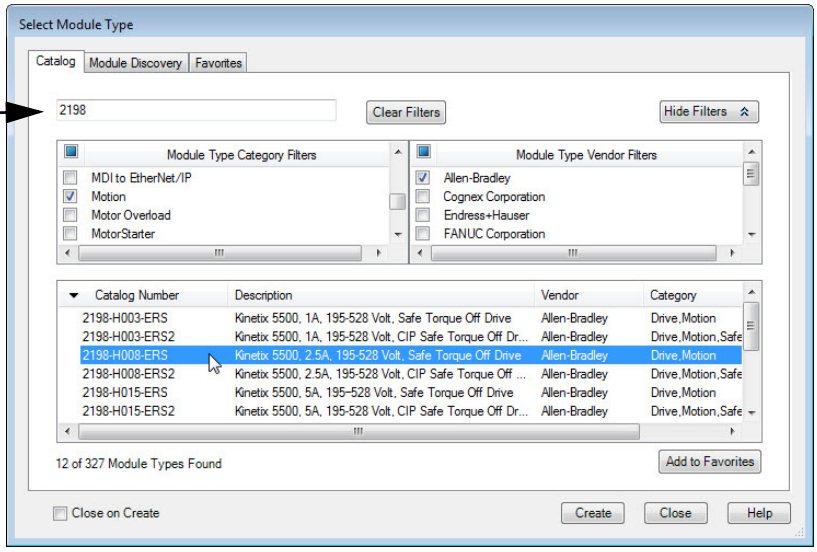
### *Configure Drive with Hardwired Safety Connections*

Follow these steps to configure Kinetix 5500 drives with hardwired safety.

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

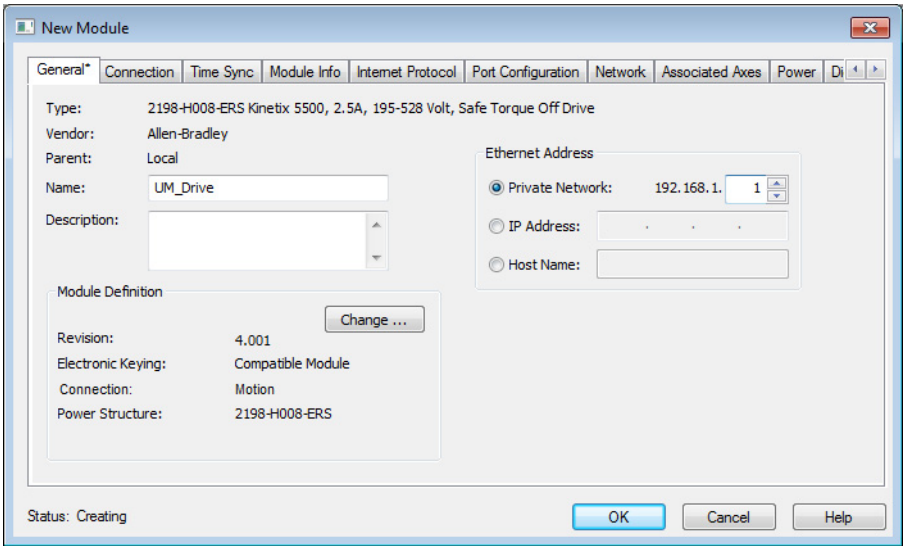
   The Select Module Type dialog box appears.

Enter 2198 here to further limit your search.




2. By using the filters, check Motion and Allen-Bradley, and select your 2198-H*xxx*-ERS servo drive as appropriate for your actual 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.

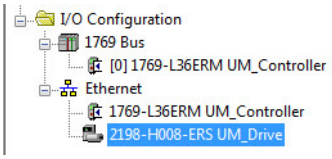
      In this example, the Private Network address is selected.

   c. Enter the address of your 2198-H*xxx*-ERS drive.

      In this example, the last octet of the address is 1.

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

   Your 2198-H*xxx*-ERS servo drive appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.




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

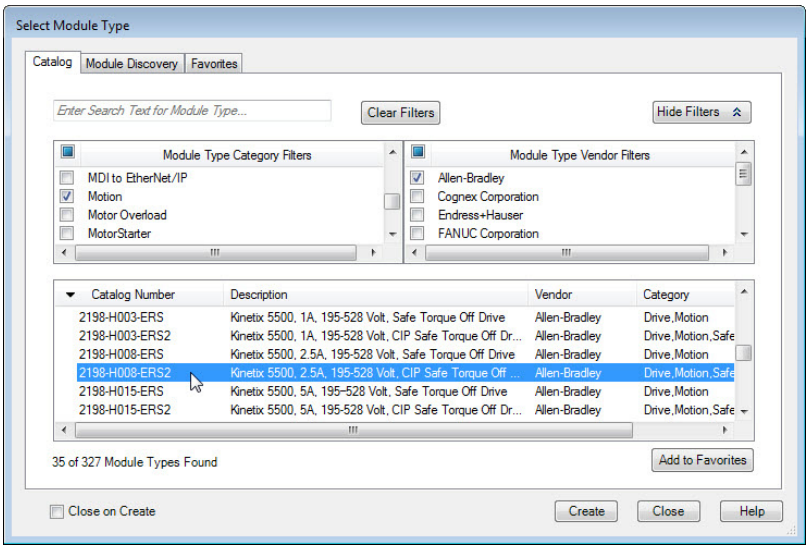
7. Jump to Continue Drive Configuration on page 119 to continue with your drive configuration.

### *Configure Drive with Integrated Safety Connections*

Follow these steps to configure Kinetix 5500 drives with integrated safety.

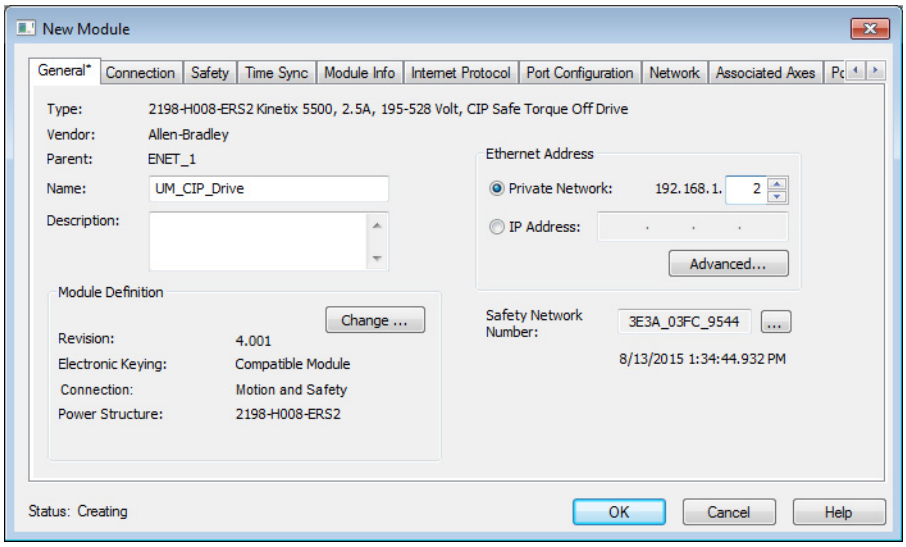
1. Below the controller you just created, right-click Ethernet and choose New Module.

   The Select Module Type dialog box appears.

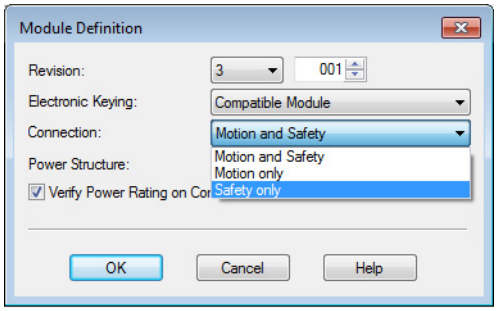



2. By using the filters, check Motion and Allen-Bradley, and select your 2198-H*xxx*-ERS2 servo drive as appropriate for your actual hardware configuration.
3. Click Create.

   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-H*xxx*-ERS2 servo drive.
      In this example, the last octet of the address is 2.
   d. Under Module Definition click Change.
      The Module Definition dialog box appears.




   e. 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.

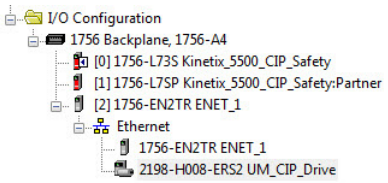
**Table 50 - Module Connection Definitions**

| Connection Mode | Controller Needed | Description<br>Drive Cat. No. 2198-H*xxx*-ERS | Description<br>Drive Cat. No. 2198-H*xxx*-ERS2 |
|---|---|---|---|
| Motion only | ControlLogix 5570 and 5580<br>GuardLogix 5570,<br>or CompactLogix 5370 | Only hardwired safe torque-off connections are possible. | Motion is managed by this controller.<br>Safety is managed by another controller that has a Safety-only connection to the drive. |
| Motion and Safety | GuardLogix 5570<br>or Compact GuardLogix 5370 | N/A | Motion and Safety are managed by this controller. |
| Safety only | GuardLogix 5570<br>or Compact GuardLogix 5370 | N/A | Safety is managed by this controller.<br>Motion is 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 GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM099.

5. Click OK to close the Module Definition dialog box.
6. Click OK to close the New Module dialog box.

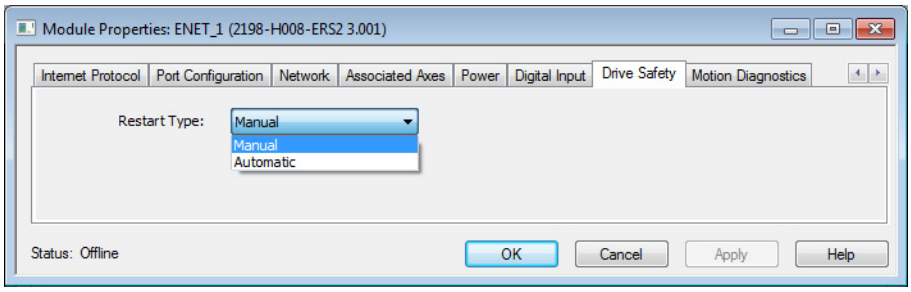
Your 2198-H*xxx*-ERS2 servo drive appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.



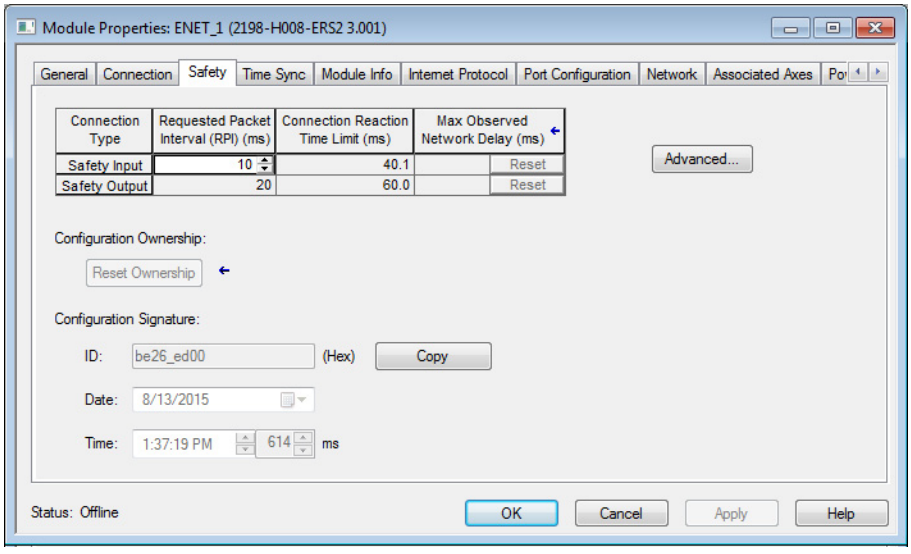

7. Right-click the drive you just created in the Controller Organizer and choose Properties.

   The Module Properties dialog box appears.

8. Click the Drive Safety tab.




9. From the Restart Type pull-down menu, choose Manual or Automatic depending on your specific application.
   - Manual restart indicates a transition from 0 to 1 on the SO.Reset tag is required to allow torque after the SO.SafeTorqueOff tag has transitioned from 0 to 1.
   - Automatic restart indicates torque will be allowed only by transitioning the SO.SafeTorqueOff tag from 0 to 1. The SO.Reset tag is used only for resetting safety faults.
10. Click Apply.
11. Click the Safety tab.



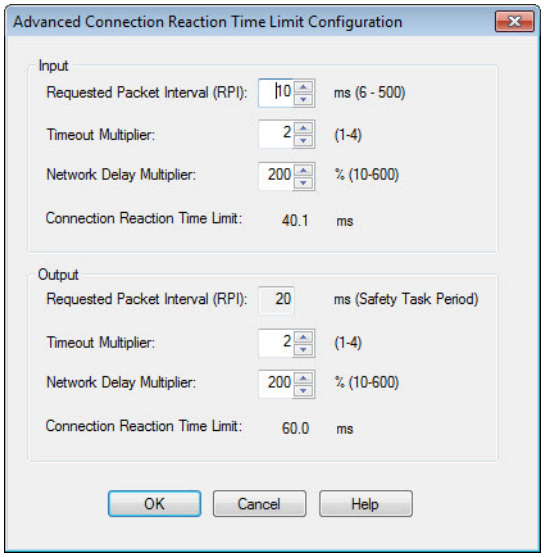
The connection between the owner and the 2198-H*xxx*-ERS2 servo drive is based on the following:

- Servo drive catalog number must be 2198-H*xxx*-ERS2 (integrated)
- Servo drive safety network number
- GuardLogix slot number
- GuardLogix safety network number
- Path from the GuardLogix controller to the 2198-H*xxx*-ERS2 drive
- Configuration signature

If any differences are detected, the connection between the GuardLogix controller and the 2198-H*xxx*-ERS2 drive is lost, and the yellow yield icon appears in the controller project tree after you download the program.

12. 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.

13. Click OK.

For more information about the Advanced Connection Reaction Time Limit Configuration, refer to the GuardLogix 5570 Controllers User Manual, publication 1756-UM022.

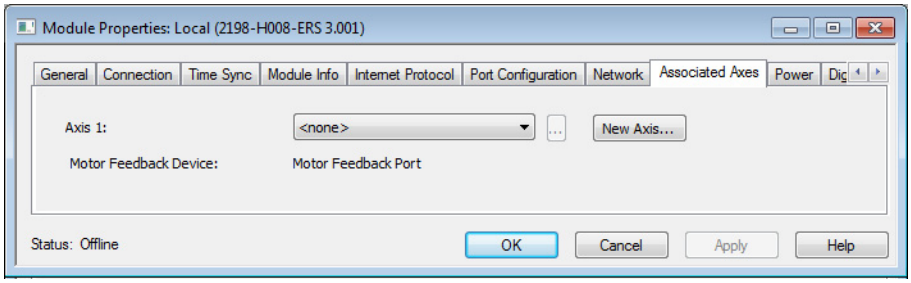
### *Continue Drive Configuration*

After you've established your Kinetix 5500 drive in the Logix Designer application, the remaining configuration steps are the same regardless of the drive catalog number.

1. Right-click the 2198-H*xxx*-ERS*x* servo drive you just created and choose Properties.

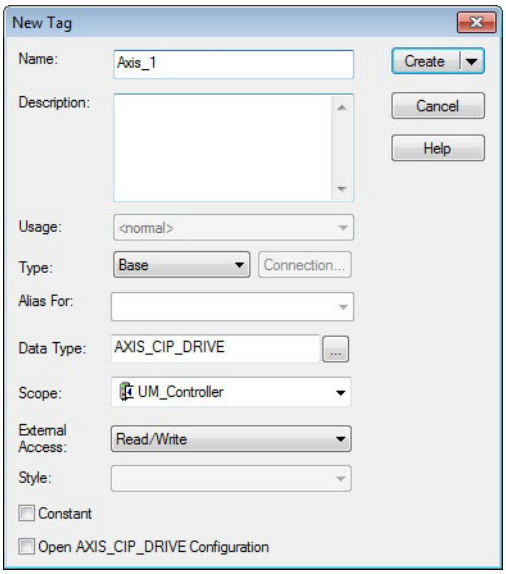
   The Module Properties dialog box appears.

2. Click the Associated Axes tab.




3. Click New Axis.

   The New Tag dialog box appears.

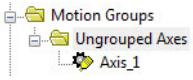


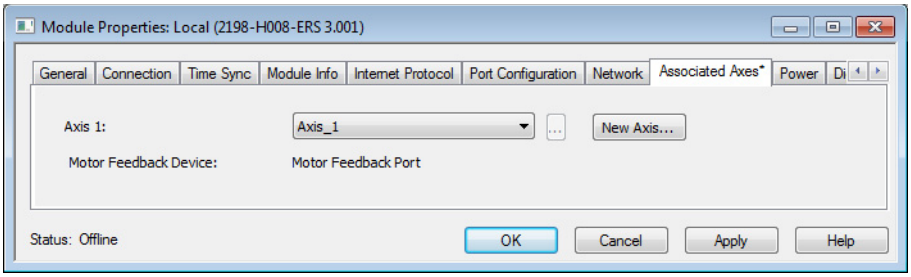

4. Type the axis Name.

   AXIS_CIP_DRIVE is the default Data Type.

5. Click Create.

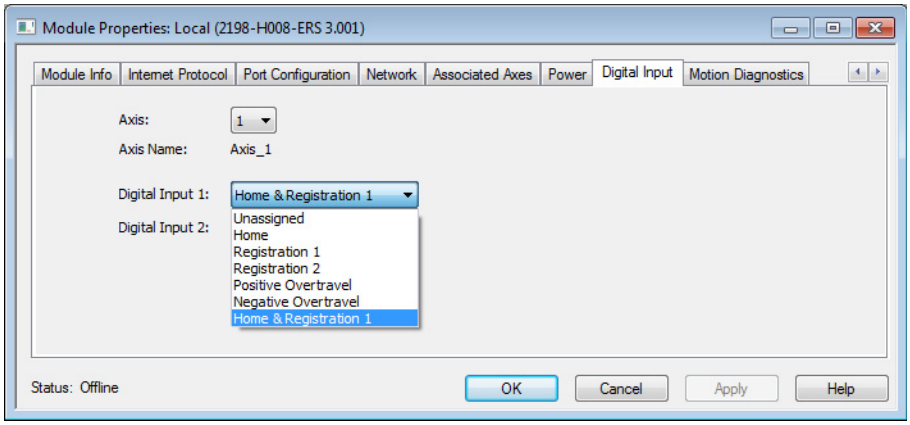
The axis (Axis_1 in this example) appears in the Controller Organizer under Motion Groups> Ungrouped Axes and is assigned as Axis 1.



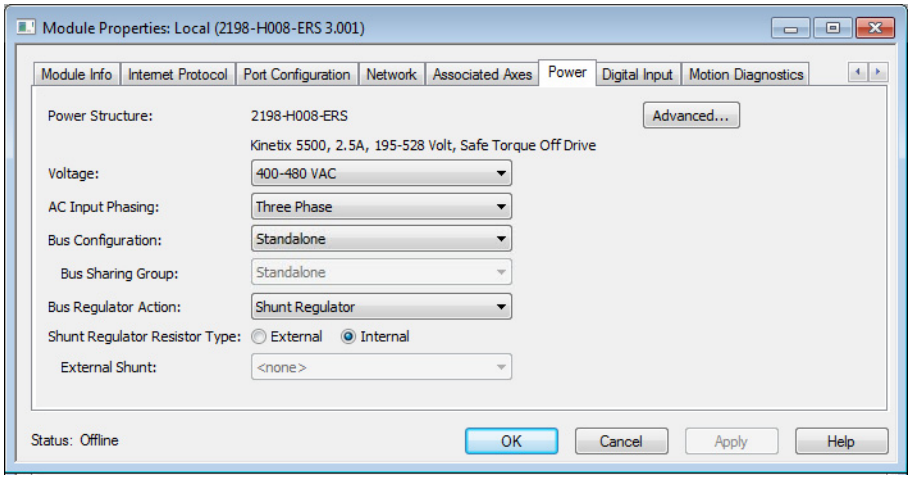

**TIP** You can configure an axis as Feedback Only. Refer to Configure Feedback-only Axis Properties on page 124 for more information.

6. Click Apply.
7. Click the Digital Input tab.




8. From the Axis pull-down menu, choose an axis to configure.
9. From the Digital Input pull-down menus, choose a digital input assignment appropriate for your application. Refer to page 60 and page 62 for more information.
10. Click Apply.

**11.** Click the Power tab.




| **IMPORTANT** | Single-phase operation is possible only when Module Properties>Power tab>Bus Configuration is configured as Standalone. |
|---|---|

| **IMPORTANT** | The Logix Designer application enforces shared-bus configuration rules for Kinetix 5500 drives, except for shared AC configurations. |
|---|---|

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



**ATTENTION:** To avoid damage to equipment, make sure the AC input voltage configured in the Logix Designer application matches the actual hardware being configured.

| Attribute | Menu | Description |
|---|---|---|
| Voltage | 400-480 VAC | 324…528 AC rms input voltage |
| | 200-240 VAC | 195…264 AC rms input voltage |
| AC Input Phasing | • Three Phase<br>• Single Phase | Input power phasing. Kinetix 5500 drives with single-phase operation is limited to 2198-H003-ERS*x*, 2198-H008-ERS*x*, and 2198-H015-ERS*x*. |
| Bus Configuration (1) (2) | Standalone | Applies to single-axis drives and drives with Shared AC input configurations. |
| | Shared AC/DC | Applies to converter drives with Shared AC/DC and Shared AC/DC Hybrid input configurations. |
| | Shared DC | Applies to inverter drives with Shared DC input (common-bus) configurations. |
| Bus Sharing Group (3) (2) | Standalone | Applies to standalone bus configurations. |
| | • Group1<br>• Group2<br>• Group3… | Applies to any bus sharing configuration (4). |
| Shunt 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 (5) | • None<br>• 2097-R6<br>• 2097-R7 | Selects external shunt option. Only the shunt model intended for the drive model is shown. |

(1) Refer to Chapter 3 for more information on single-axis and multi-axis configurations.
(2) Bus Configuration selection is not applicable to all EtherNet/IP drives.
(3) For more information on bus sharing groups, refer to Understanding Bus Sharing Group Configuration on page 139.
(4) All drives physically connected to the same shared-bus connection system must be part of the same Bus Sharing Group in the Logix Designer application.
(5) Refer to the Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003, for more information on the Bulletin 2097 external shunt resistors.

13. Click OK.

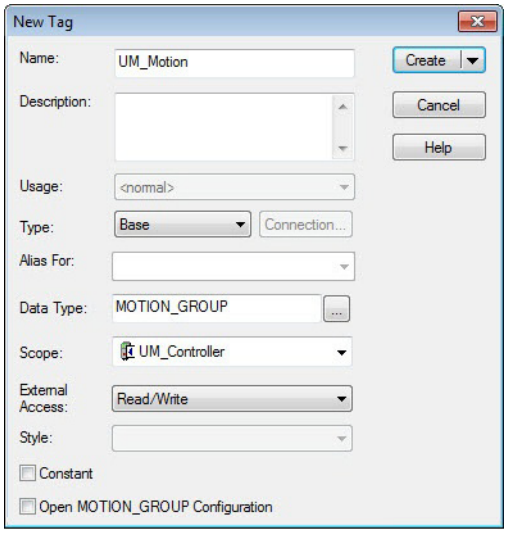
14. Repeat step 1 through step 13 for each 2198-H*xxx*-ERS*x* servo drive.

## 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.



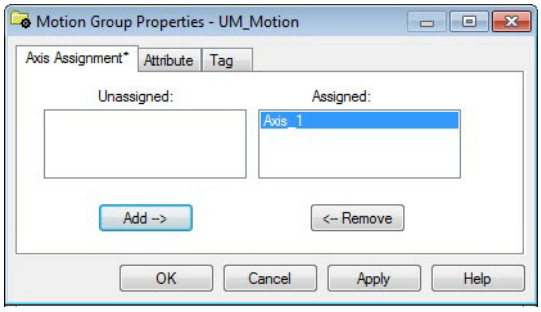

2. Type the new motion group Name.
3. Click Create.

   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 axis moves to the new motion group.

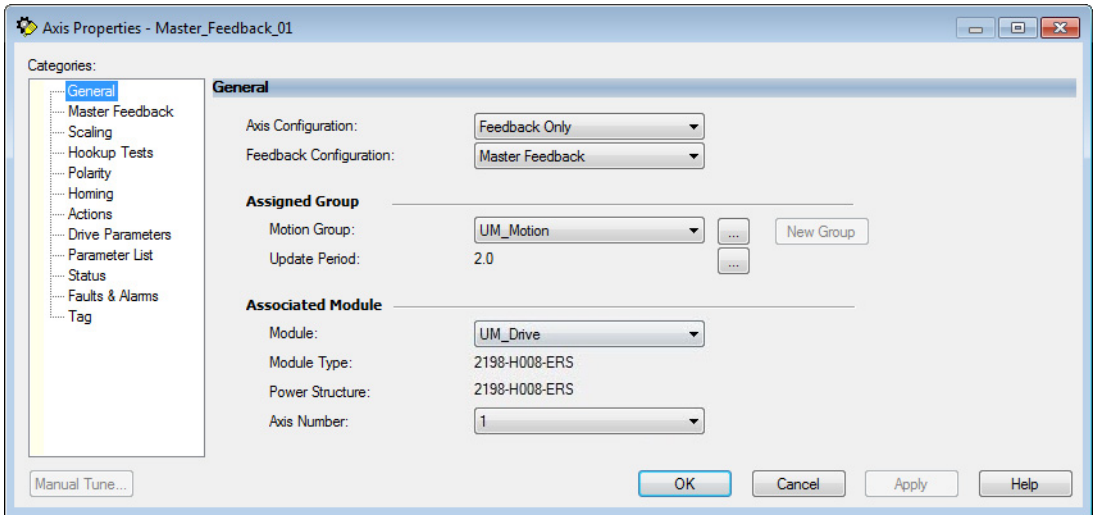


## Configure Feedback-only Axis Properties

Follow these steps to configure feedback-only axis properties.

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

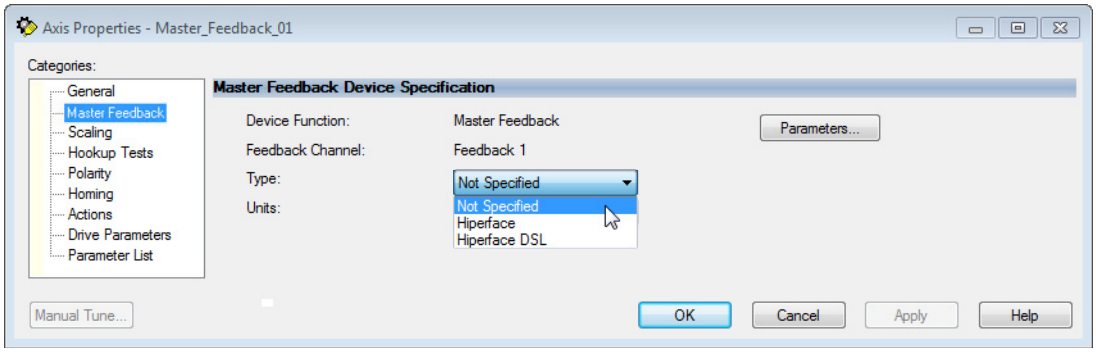
   The General dialog box appears.




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. Select the Master Feedback Category.

   The Master Feedback Device Specification appears.




8. From the Type pull-down menu, choose a feedback device type.
9. Review other categories in the Controller Organizer and make changes as needed for your application.
10. Click OK.

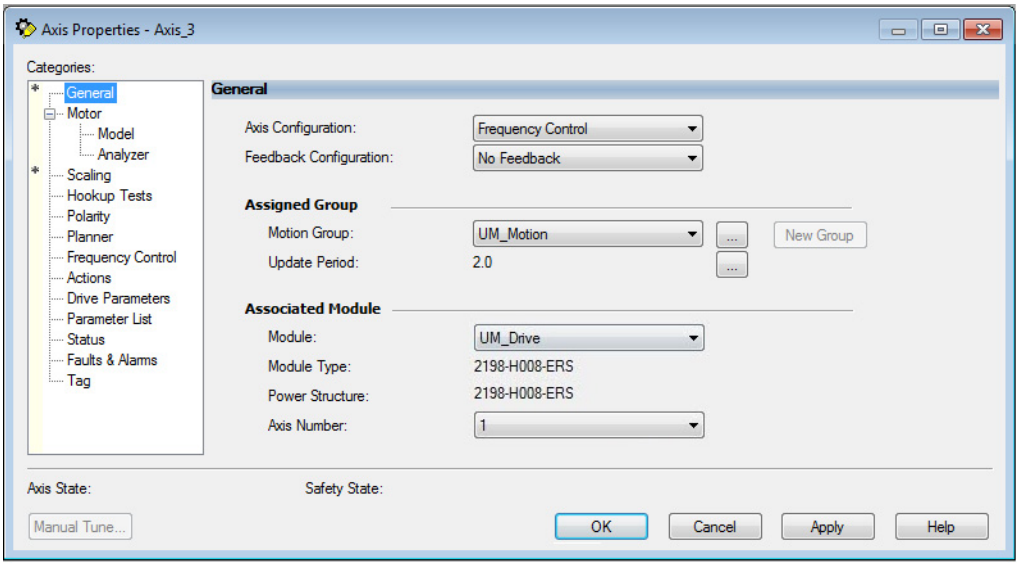
# Configure Induction-motor Frequency-control Axis Properties

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.

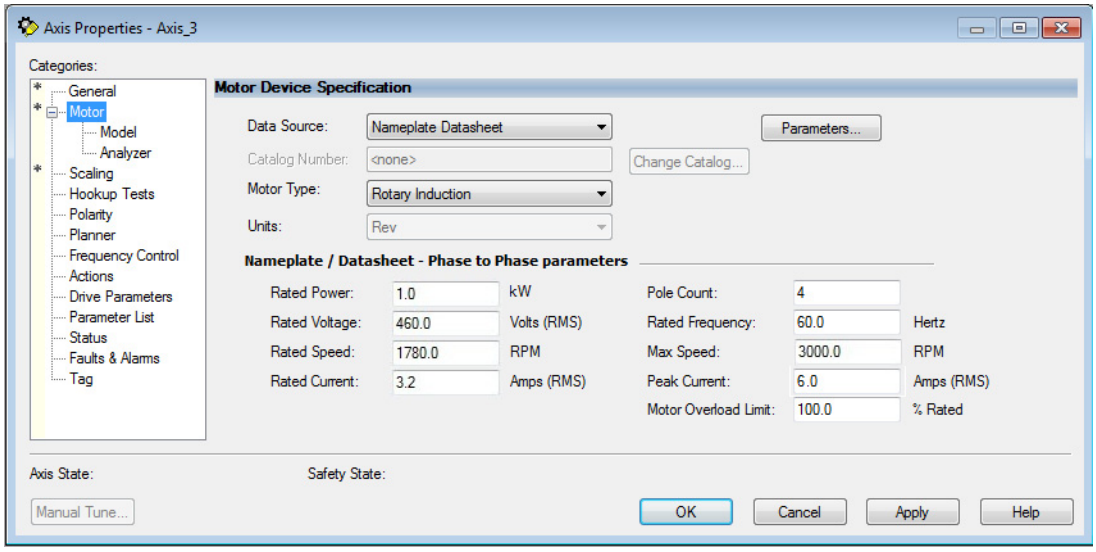
   The General dialog box appears.




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.

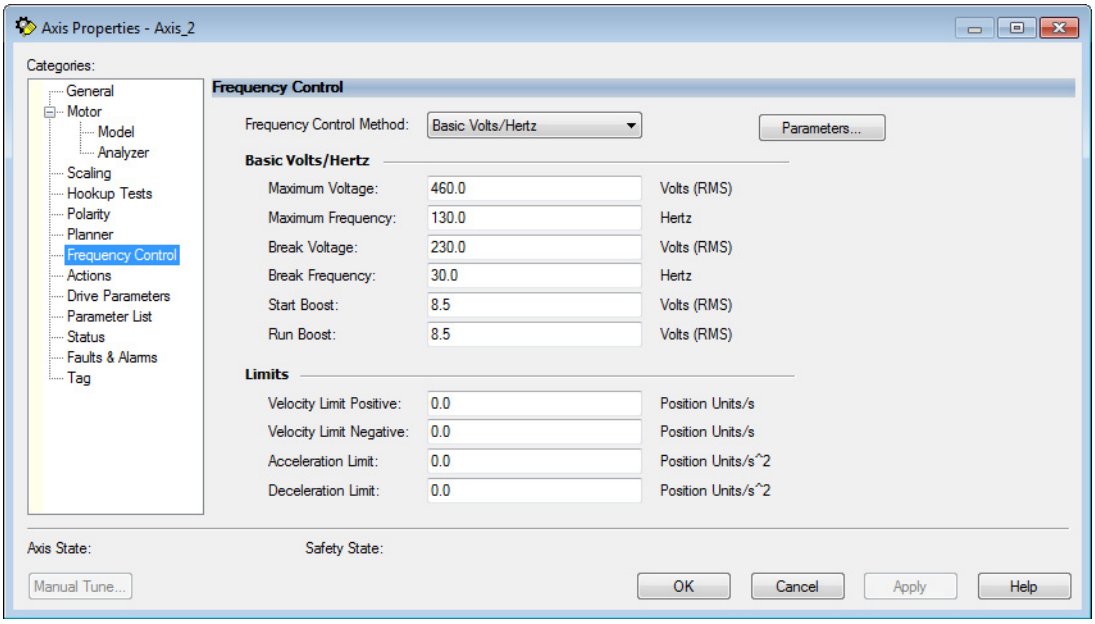
10. From the motor nameplate or datasheet, enter the phase-to-phase values for your motor.

    See Motor Category on page 242 for a motor performance datasheet example.

11. Click Apply.

## Basic Volts/Hertz Method

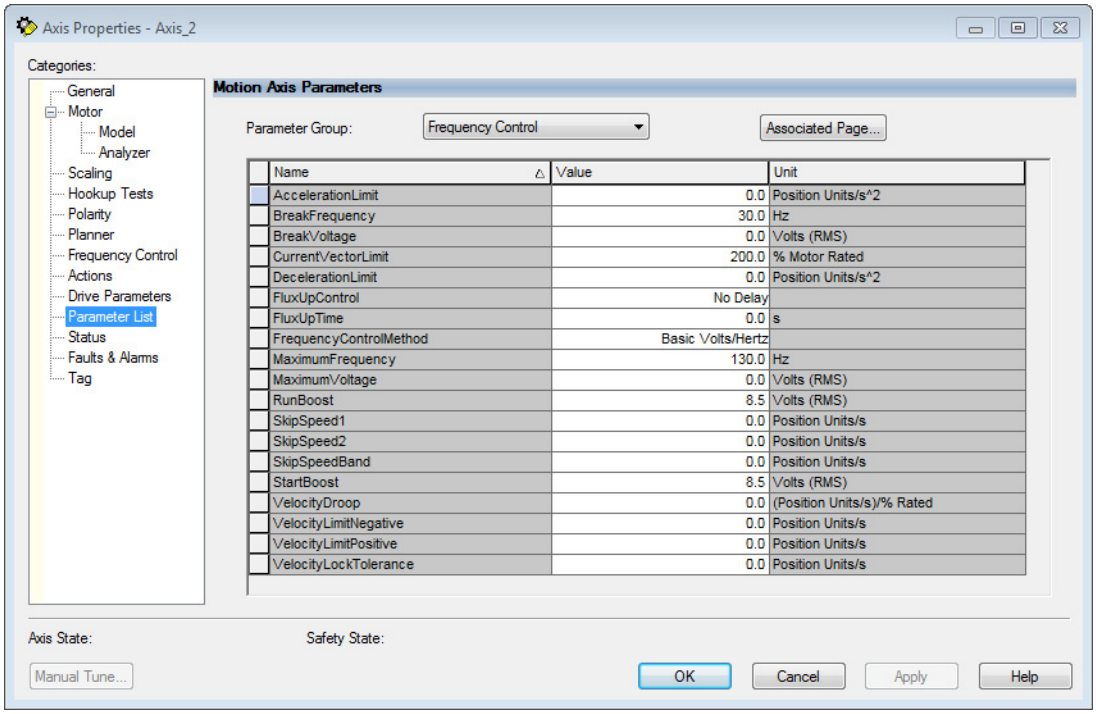
1. Configure the General tab and Motor tab as shown in General and Motor Categories on page 125.
2. Select the Frequency Control category.
3. From the Frequency Control Method pull-down menu, select Basic Volts/Hertz.




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.

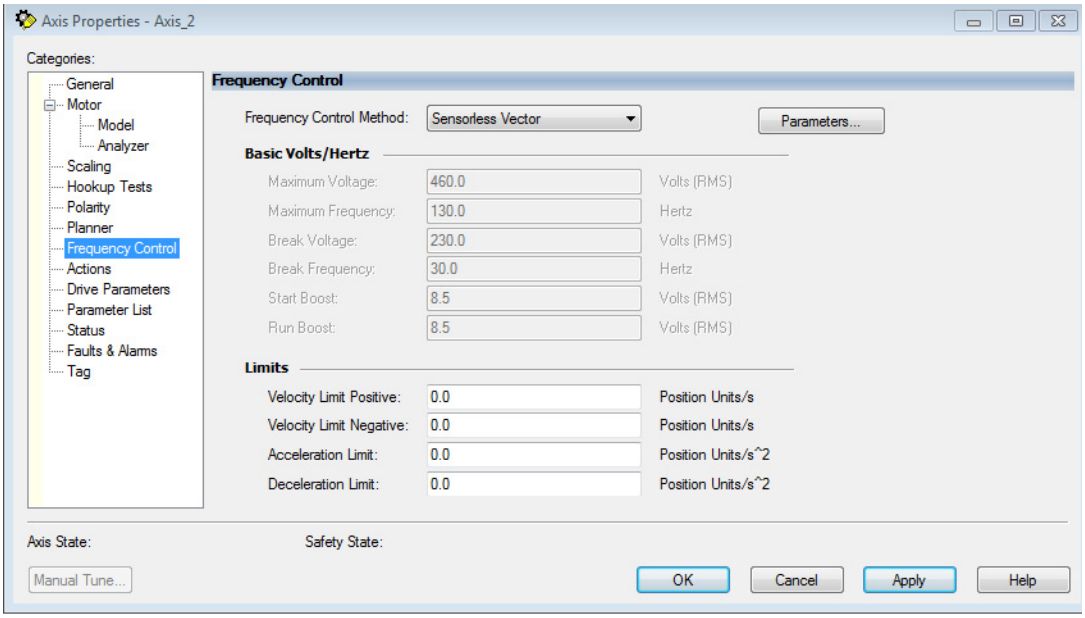



7. From the Parameter Group pull-down menu, choose Frequency Control.
8. Set the FluxUp, SkipSpeed, and VelocityDroop attributes appropriate for your application.

   See the corresponding section in Appendix D, beginning on page 233, for information and configuration examples regarding all of these topics.
9. Click OK.

## Sensorless Vector Method

1. Configure the General tab and Motor tab as shown in General and Motor Categories on page 125.
2. Select the Frequency Control category.
3. From the Frequency Control Method pull-down menu, select Sensorless Vector.




4. Enter the Basic Volts/Hertz attribute values appropriate for your application.

   Default values are shown. There is more than one way to enter values. If attributes are inactive, there are two other ways to make changes.

   Method #1

   a. Change the Frequency Control Method to Basic Volts/Hertz.
   b. Enter new attribute values as needed.
   c. Change the Frequency Control Method back to Sensorless Vector.

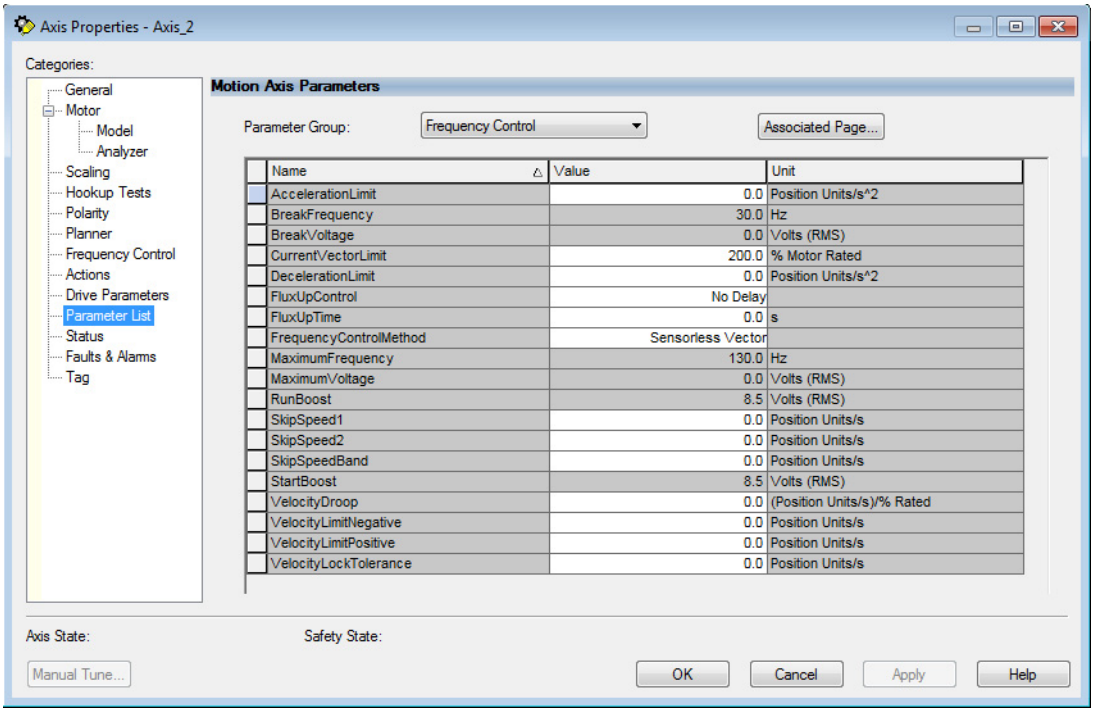
   Method #2

   a. Select the Parameter List category.
   b. Scroll for MaximumVoltage and MaximumFrequency attributes and enter new values as needed.

   These temporary measures are in affect pending a future software revision.

5. Click Apply.
6. Select the Parameter List category.

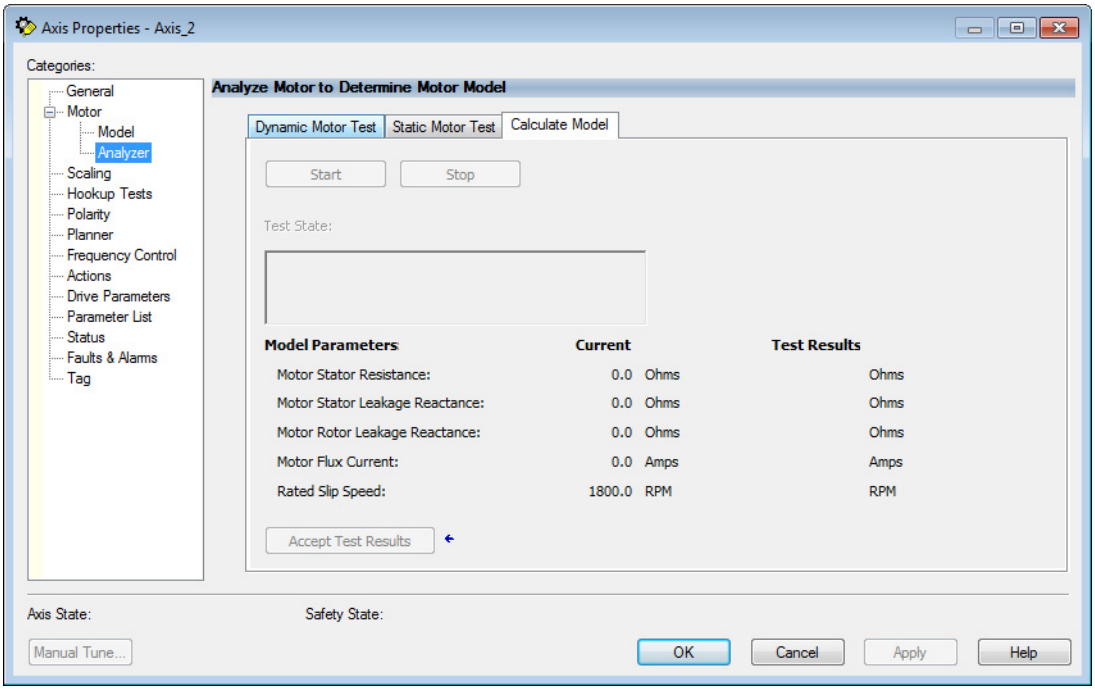
7. The Motion Axis Parameters dialog box appears.




8. From the Parameter Group pull-down menu, choose Frequency Control.
9. Set the FluxUp, SkipSpeed, VelocityDroop, MaximumFrequency, and MaximumVoltage attributes appropriate for your application.

   See the corresponding section in Appendix D, beginning on page 233, for information and configuration examples regarding all of these topics.
10. Click Apply.
11. Select the Motor>Analyzer category.

12. The Analyze Motor to Determine Motor Model dialog box opens.




13. Click one of the motor test tabs.

    In this example, Calculate Model is chosen. See Motor Tests and Autotune Procedure on page 244 for information about each of the tests.

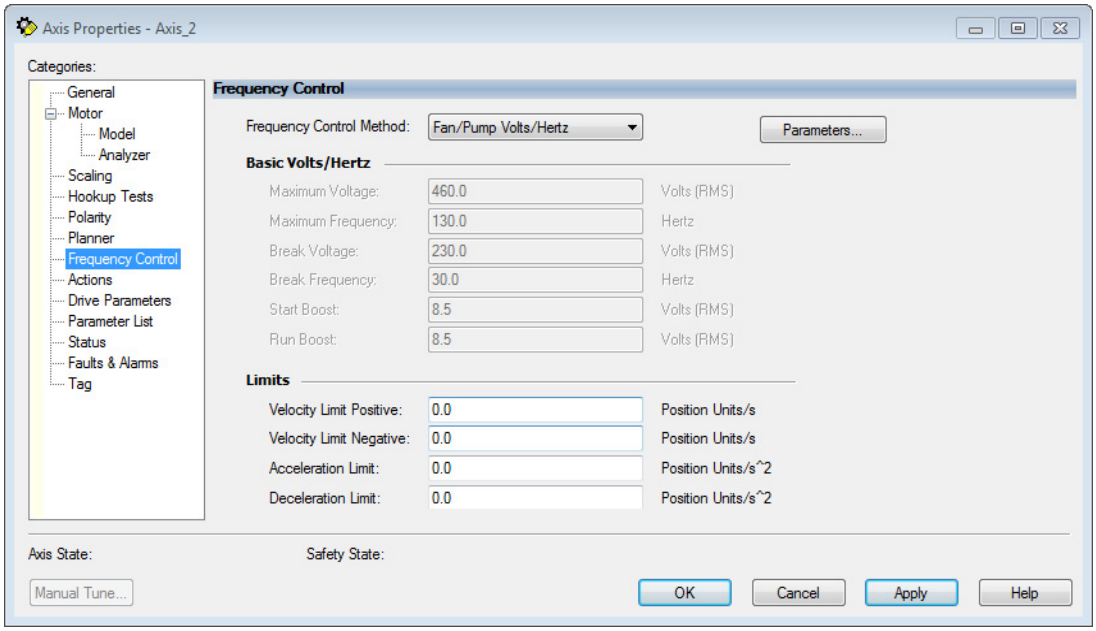
14. Click Start.

15. Click Accept Test Results.

16. Click OK.

## Fan/Pump Volts/Hertz Method

1. Configure the General tab and Motor tab as shown in General and Motor Categories on page 125.
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. There is more than one way to enter values. If attributes are inactive, there are two other ways to make changes.

   Method #1

   a. Change the Frequency Control Method to Basic Volts/Hertz.
   b. Enter new attribute values as needed.
   c. Change the Frequency Control Method back to Fan/Pump Volts/Hertz

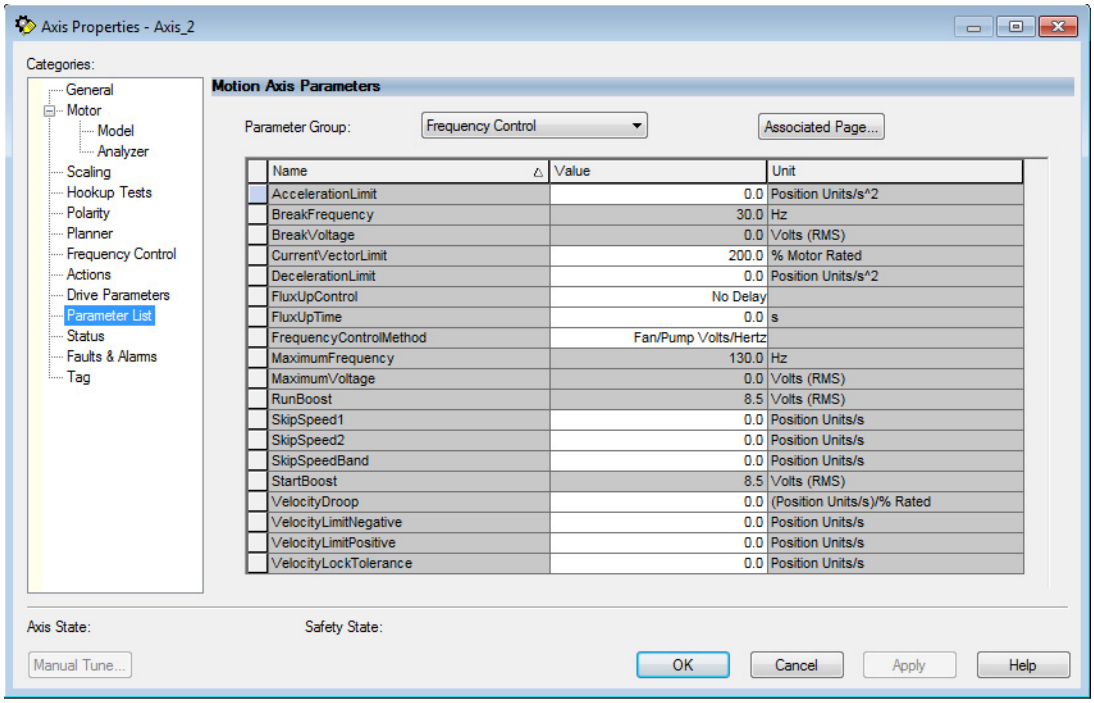
   Method #2

   a. Select the Parameter List category.
   b. Scroll for MaximumVoltage and MaximumFrequency attributes and enter new values as needed.

   These temporary measures are in affect pending a future software revision.

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, and MaximumVoltage attributes appropriate for your application.

   See the corresponding section in Appendix D, beginning on page 233, for information and configuration examples regarding all of these topics.
9. Click OK.

## Configure PM Motor Closed-loop Control Axis Properties

Kinetix 5500 drives accept Hiperface and Hiperface DSL feedback from permanent magnet (PM) motors when the appropriate feedback connector kit is used. Table 51 lists the compatible Allen-Bradley motors and actuators.

**Table 51 - Motor Feedback Compatibility**

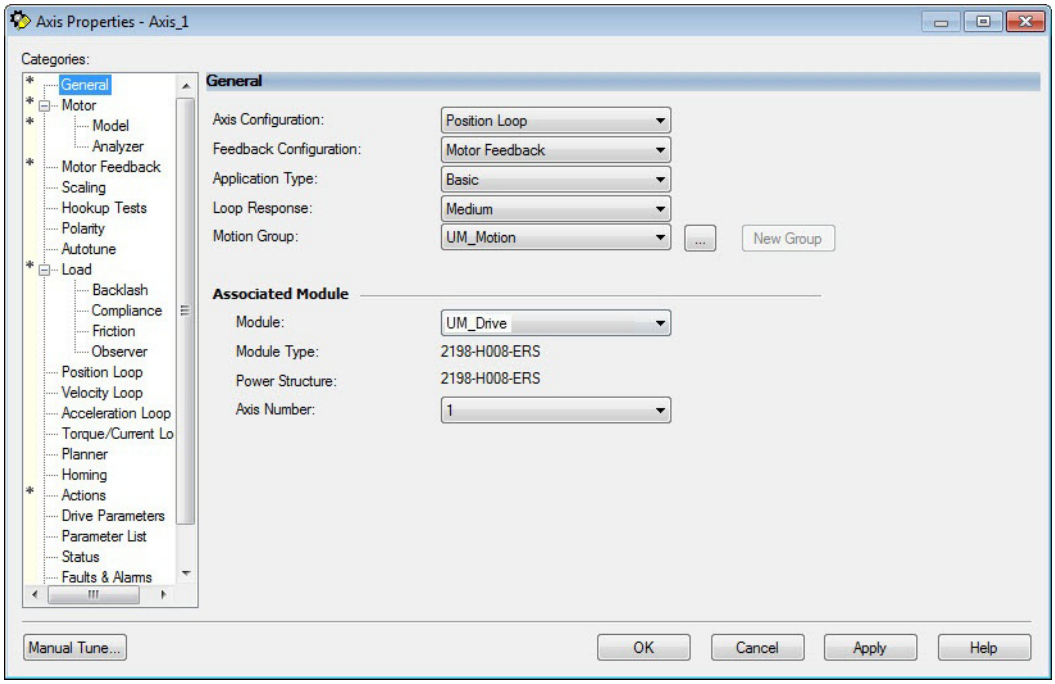
| Feedback Type | | Description | Feedback Connector |
|---|---|---|---|
| Hiperface | High-resolution single-turn and multi-turn, absolute | Applies to Allen-Bradley Bulletin MPL, MPM, MPF, MPS (-M/S or -V/E) rotary motors and Bulletin MPAS (ballscrew), MPAR, MPAI linear actuators, and LDAT-Series (-*x*D*x*) linear thrusters, wired to the 2198-H2DCK converter kit. | 2-pin motor feedback (MF) |
| Hiperface DSL | | Applies to Allen-Bradley Bulletin VPL, VPF, VPS rotary motors wired to the 2198-KITCON-DSL connector kit. | |

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

Follow these steps to configure permanent-magnet (PM) 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.

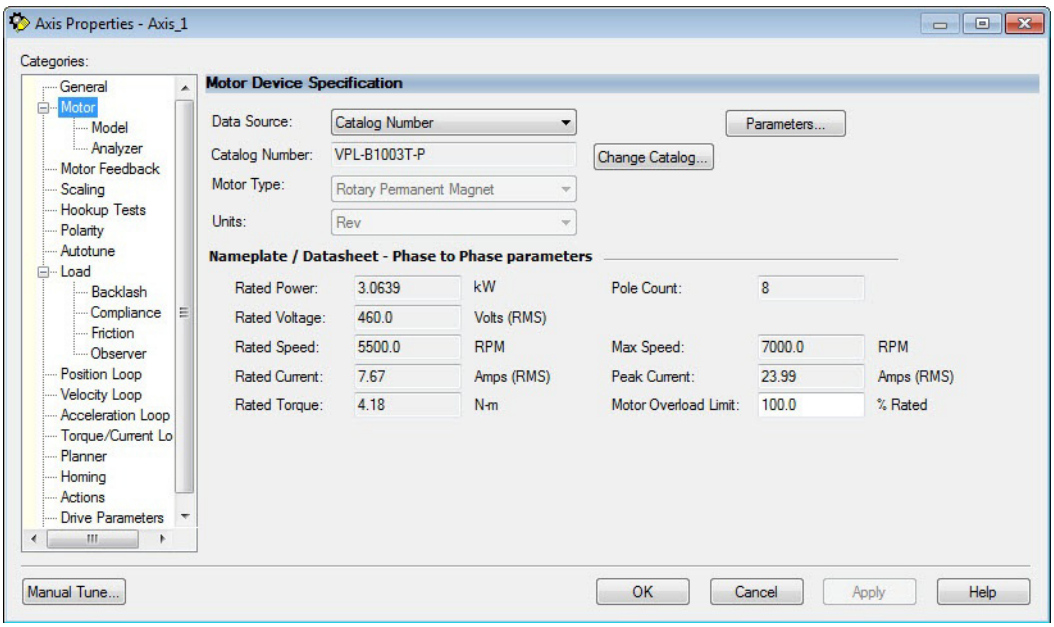
4. From the Associated Module>Module pull-down menu, choose your Kinetix 5500 drive.

   The drive catalog number populates the Module Type and Power Structure fields.

5. Click Apply.

6. Select the Motor category.

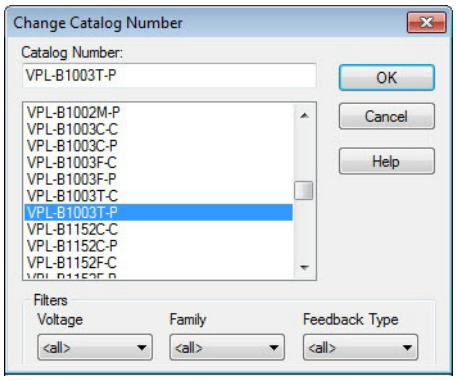
   The Motor Device Specification dialog box appears.




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.

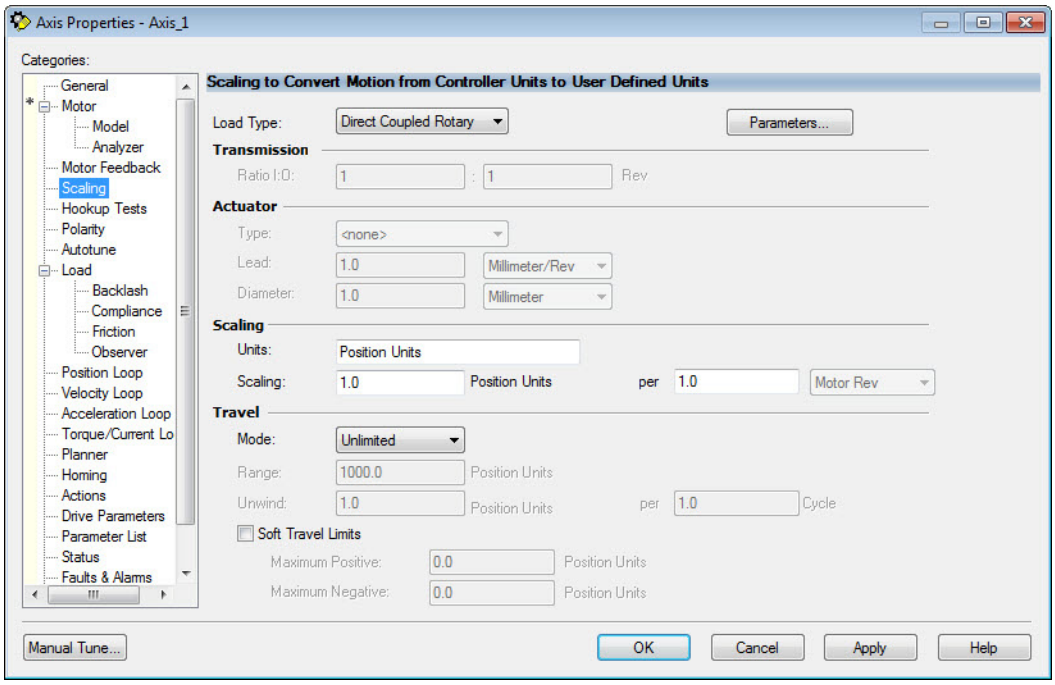
   To verify the motor catalog number, refer to the motor name plate.

10. Click OK to close the Change Catalog Number dialog box.

11. Click Apply.

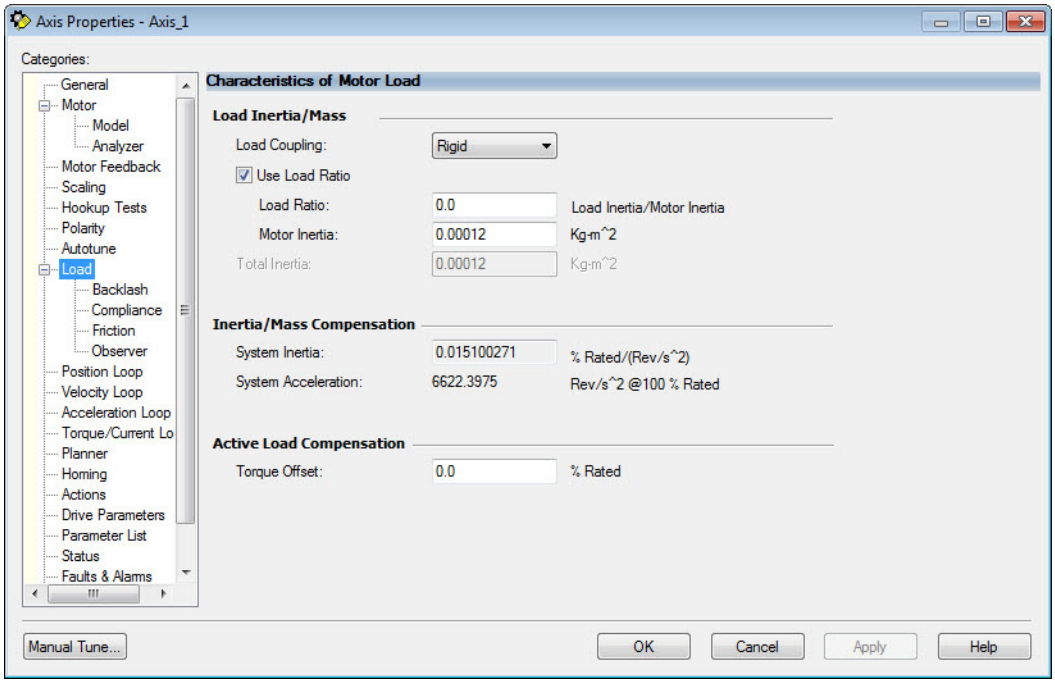
    Motor data specific to your motor appears in the Nameplate / Datasheet - Phase to Phase parameters field.

12. Select the Scaling category and edit the default values as appropriate for your application.




13. Click Apply, if you make changes.

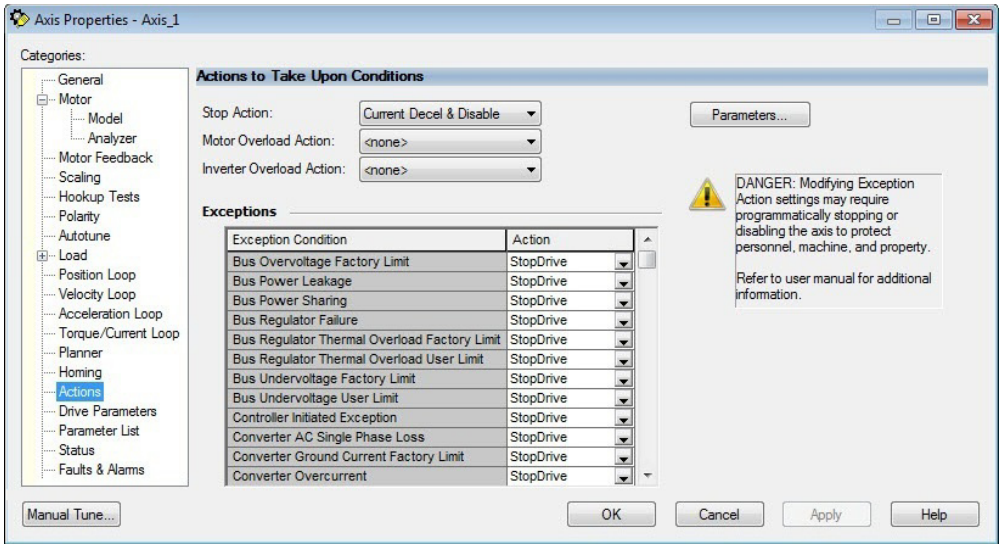
14. Select the Load category and edit the default values as appropriate for your application.




15. Click Apply, if you make changes.

16. Select the Actions category.

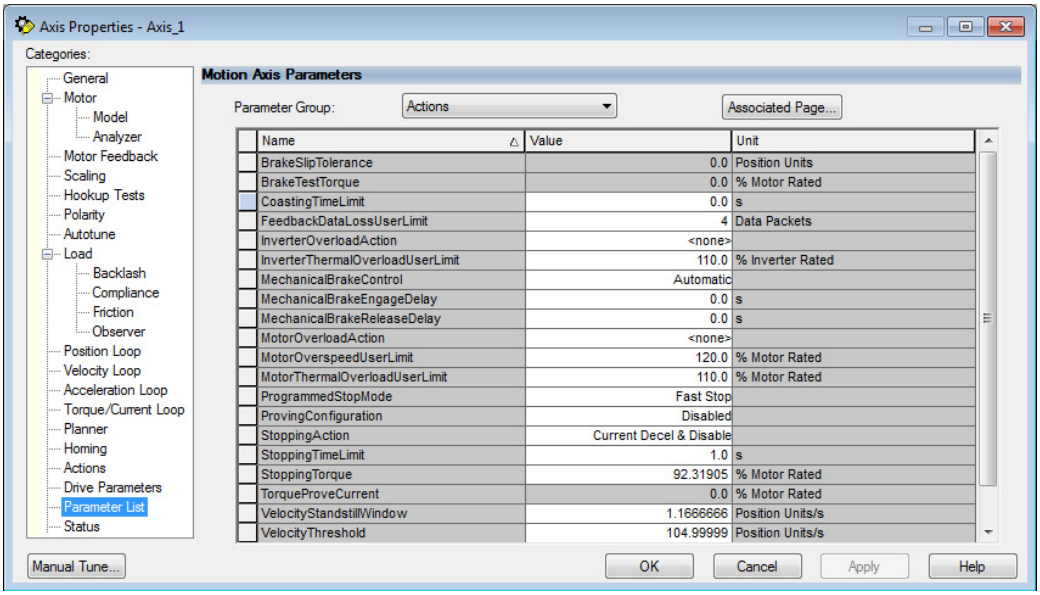
    The Actions to Take Upon Conditions dialog box appears.




From this dialog box, you can program actions and change the action for exceptions (faults). Refer to Logix5000 Controller and Drive Behavior on page 160 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 GMC-TD001.

18. Click OK.
19. Repeat step 1 through step 18 for each servo motor axis.

## Download the Program

After completing the Logix Designer application and saving the file you must download your program to the Logix5000 processor.

## Apply Power to the Kinetix 5500 Drive

This procedure assumes that you have wired and configured your Kinetix 5500 system and your Logix5000 controller.



**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 5500 system.

1. Disconnect the load to the motor.



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

2. Apply 24V DC control power.

   The LCD display begins the startup sequence. Refer to Startup Sequence on page 105. 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 and the axis state is PRECHARGE.

   If the axis state does not reach PRECHARGE and the two status indicators are not solid green, refer to Kinetix 5500 Drive Status Indicators on page 157.

**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. Also, it can take as many as 1.8 seconds after input power is applied before the drive can accept motion commands.

5. Verify that the axis state changes to STOPPED.

   If the axis state does not change to STOPPED, refer to Fault Codes on page 150.

### Applying Power after Changing Input Voltage Range

This step applies to any drive or multi-axis drive configuration.



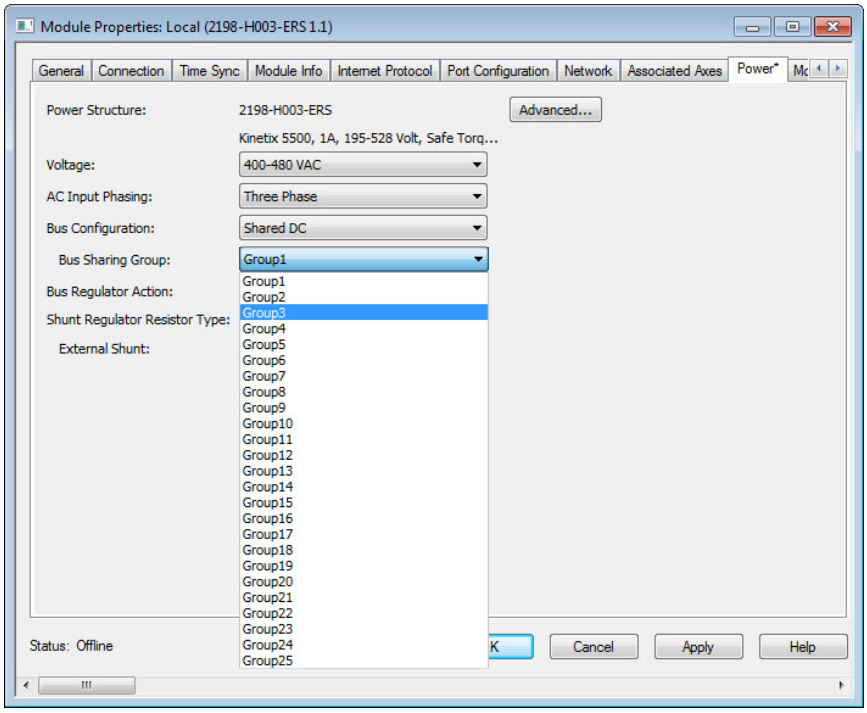
**ATTENTION:** To avoid damage to equipment when the configured input voltage range of the drive or drives changes from 230V AC to 460V AC or from 460V AC to 230V AC, the bus voltage needs to bleed down below 50V DC before the new configured input voltage is applied.

## Understanding Bus Sharing Group Configuration

When configuring Module Properties>Power tab for each Kinetix 5500 servo drive, you can breakout drives from one or more servo systems into multiple bus-sharing (power) groups.

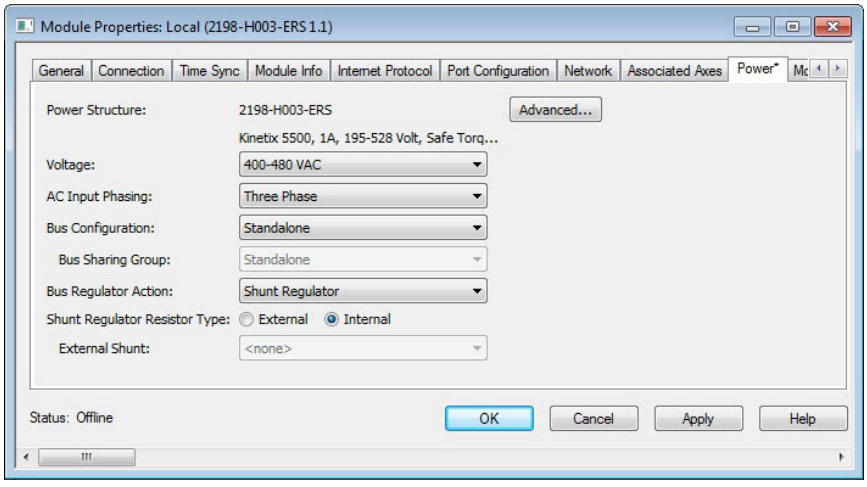
A drive that faults in Group 1 does not affect the operation of Group 2, even though all of the drives in Groups 1 and 2 are in the same Motion group in the Logix Designer application.

As many as 25 bus-sharing groups are possible.




**IMPORTANT** Bus-sharing groups do not apply to drives with a Bus Configuration of Standalone.

When Standalone is configured as the Bus Configuration, Standalone (dimmed) is also configured as the Bus Sharing Group.

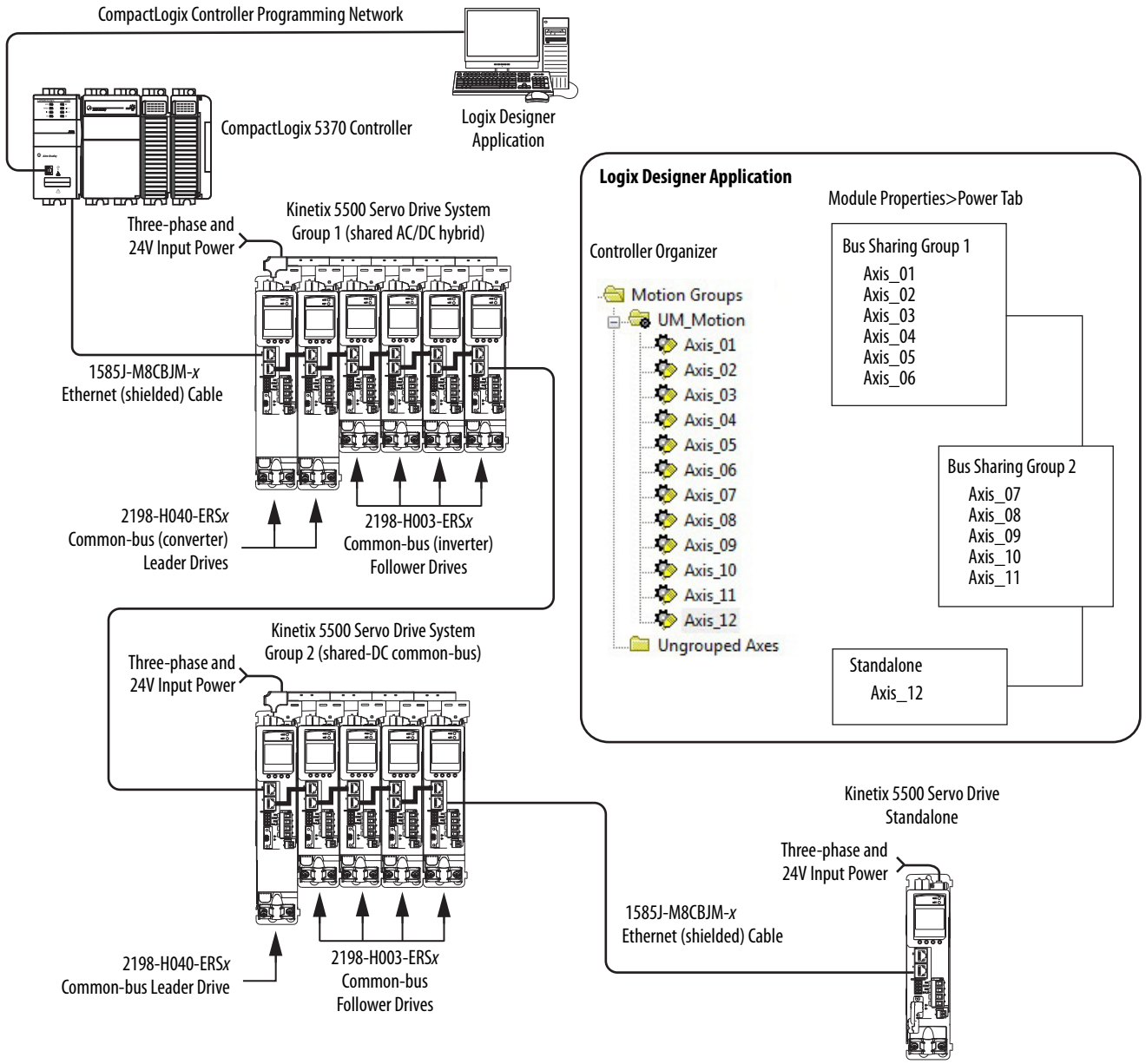


## Bus Sharing Group Example

In this example, 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 and one standalone drive in Module Properties>Power tab. 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 or the Standalone drive.

**Figure 63 - Bus-sharing Group Example**



## Configure Bus-sharing Groups

Group 1 is a shared AC/DC hybrid configuration. The Bus Configuration for the first two converter drives is Shared AC/DC. The Bus Configuration for the inverter drives is Shared DC.

**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 64 - Group 1 Converter Drives Configuration**

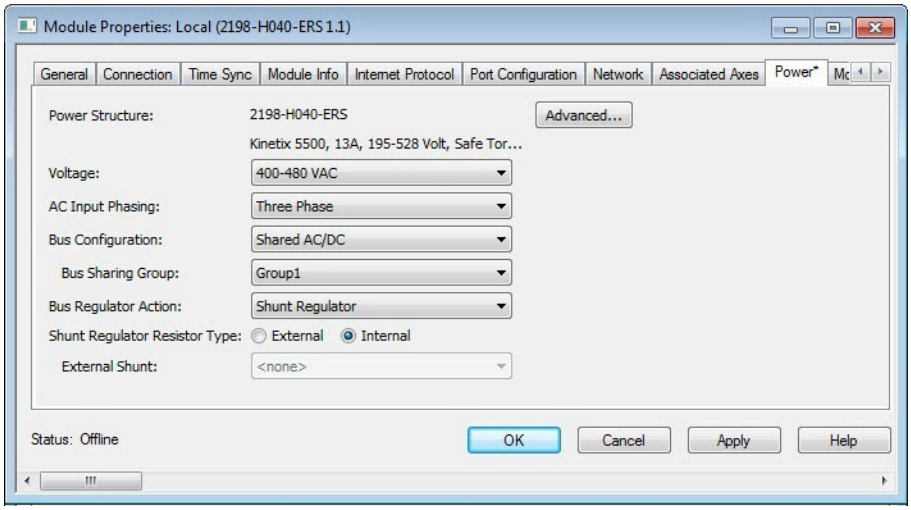
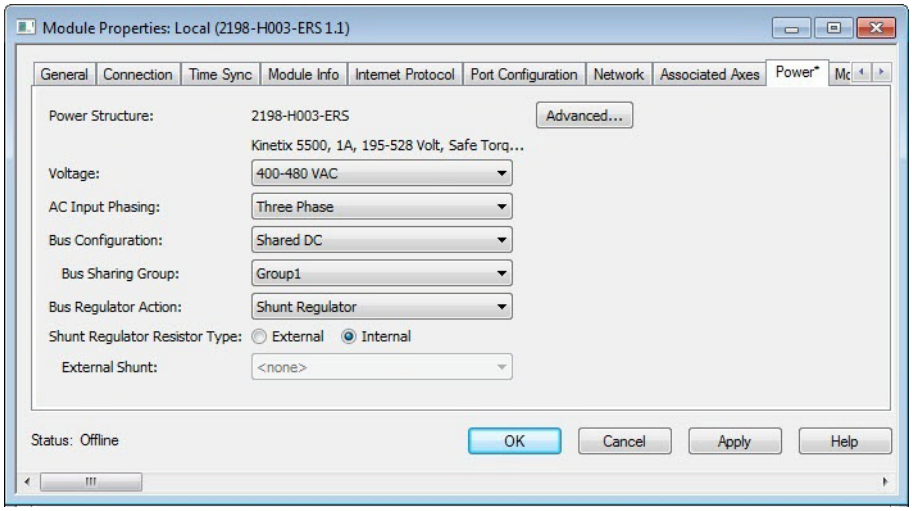



**Figure 65 - Group 1 Inverter Drives Configuration**



Group 2 is a shared DC (common-bus) configuration. The Bus Configuration for the leader drive is Shared AC/DC. The Bus Configuration for the follower drives is Shared DC.

**Figure 66 - Group 2 Leader Drive Configuration**

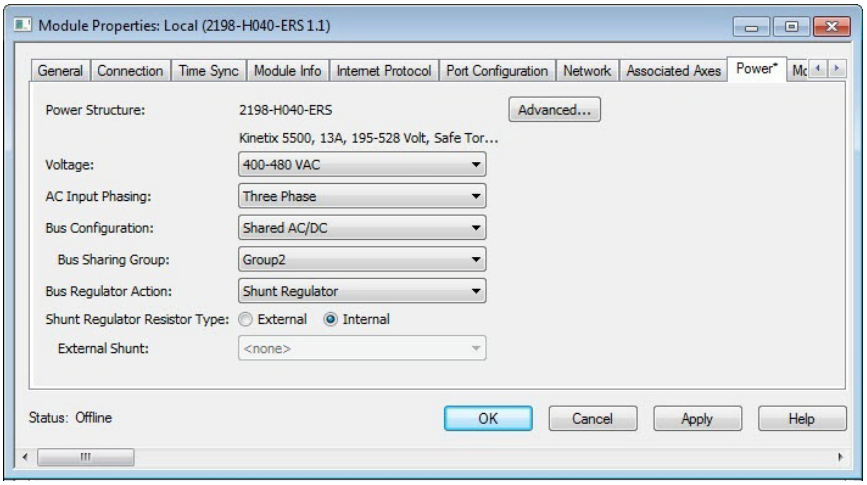



**Figure 67 - Group 2 Follower Drives Configuration**

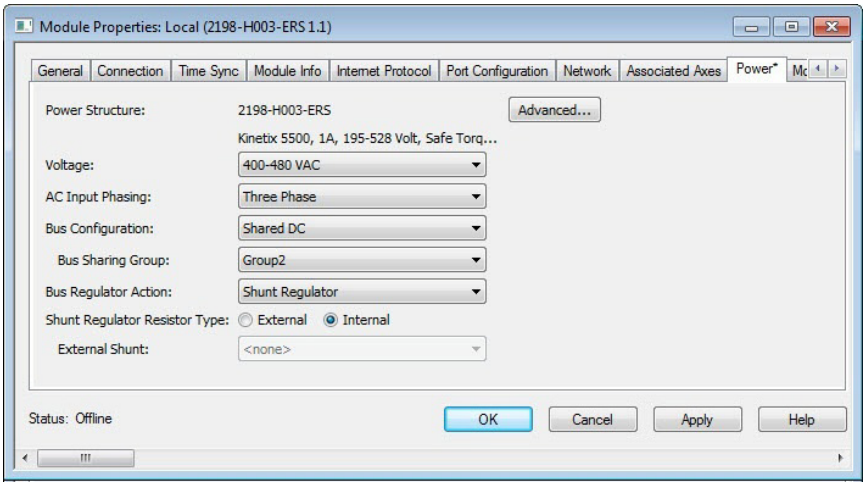
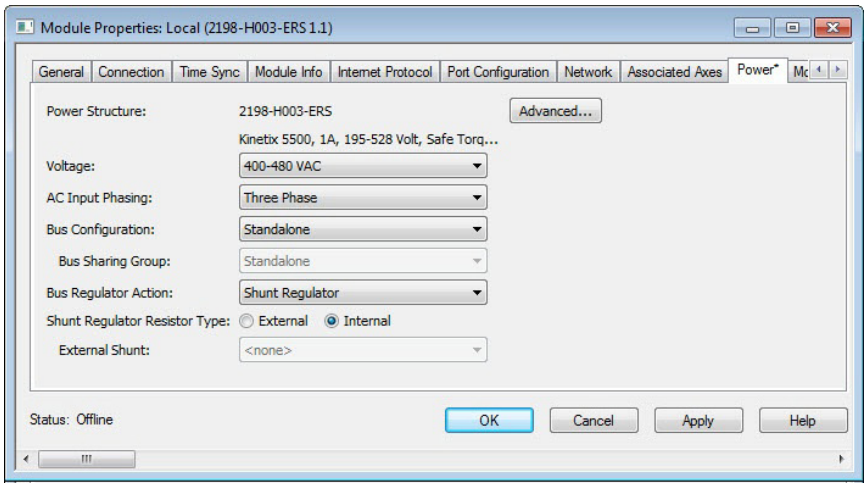



**Figure 68 - Standalone Drive Configuration**



## Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 5500 drive, your Logix5000 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 5500 Drive Status Indicators on page 157.

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 11.

### Test the Axes

Follow these steps to test the axes.

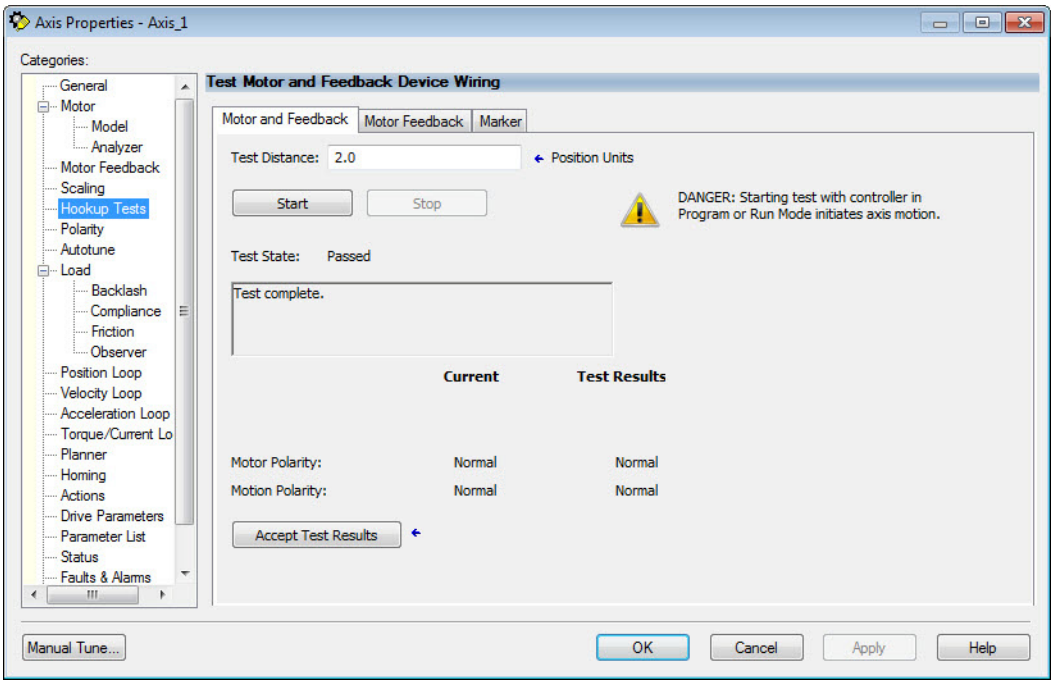
1. Verify the load was removed from each axis.

   **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.

2. In your Motion Group folder, right-click an axis and choose Properties.

   The Axis Properties dialog box appears.

3. Click the Hookup Tests category.



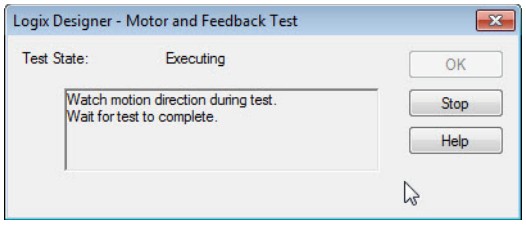

4. In the Test Distance field, enter the desired test distance.

   The Position Units are defined in the Axis Properties>Scaling tab.

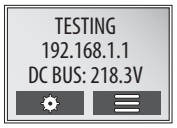
| Test | Description |
|---|---|
| Marker | Verifies marker detection capability as you manually rotate the motor shaft. The test completes when the drive either detects the marker or when the motor moves the distance specified in the Test Distance field. If the marker remains undetected, the test completes successfully, but if the marker is not detected before the motor moves the full test distance the test fails. Run this test after running the Motor Feedback and Motor and Feedback tests. |
| 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. |

5. Click the desired test to verify connections.
6. Click Start.

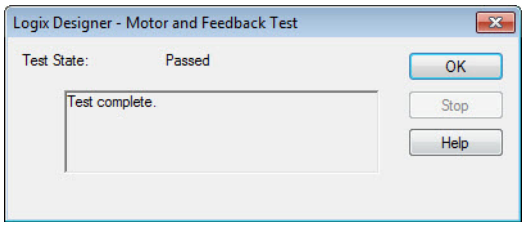
   The Logix Designer - Motor and Feedback Test dialog box appears. The Test State is Executing. TESTING appears on the drive LCD display.




Drive LCD Display

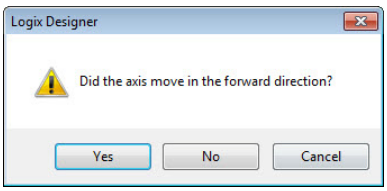



   When the test completes successfully, the Test State changes from Executing to Passed.

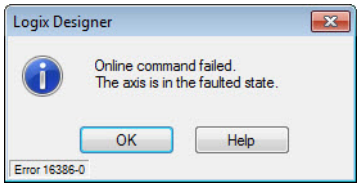



7. Click OK.

   This dialog box appears asking if the direction was correct.




8. Click Yes.
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 147 |

### *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.

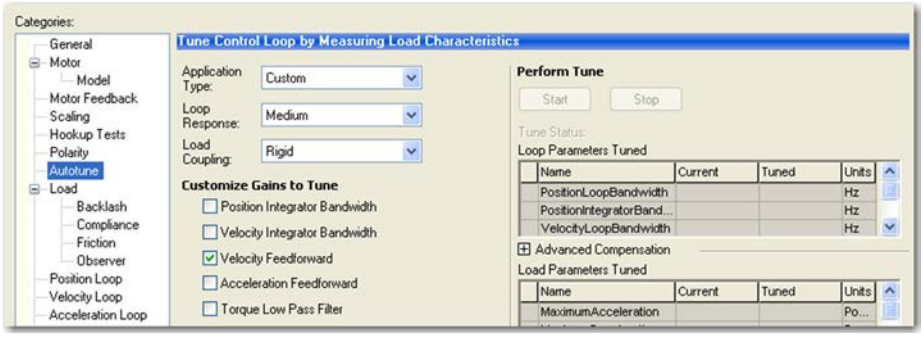
Follow these steps to configure the drive for high-performance by using the load observer feature.

1. Verify that the load is connected.

   Re-attach the load if it was disconnected for the Hookup Test.

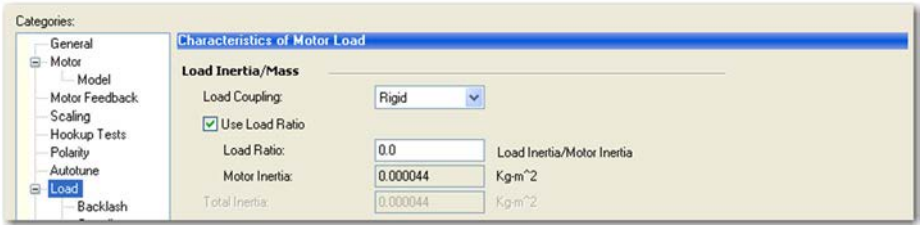
   **ATTENTION:** If the drive has not been enabled before (new installation), verify that you have safeguards in place to safely remove power from the drive in the event of an unstable situation where the drive can produce undesired motion.

2. Click the Autotune tab 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.



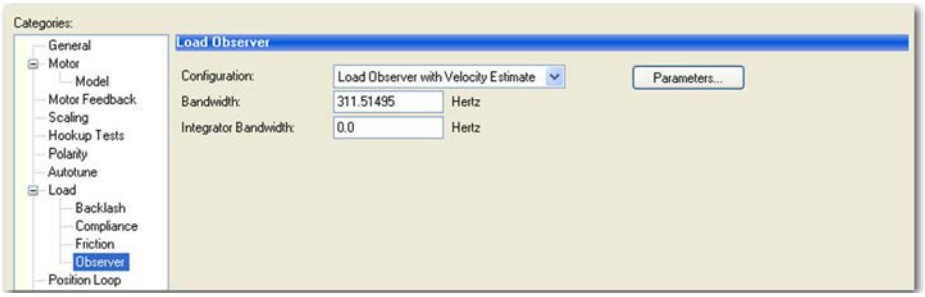

3. Click the Load tab in the Axis Properties dialog box.
   a. Check Use Load Ratio.

b. Set the Load Ratio = 0.



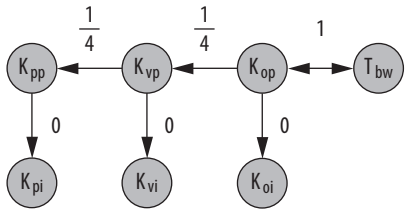

4. Click the Observer tab in the Axis Properties dialog box.

   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. 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. |
|---|---|

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

### *Tune Induction Motors*

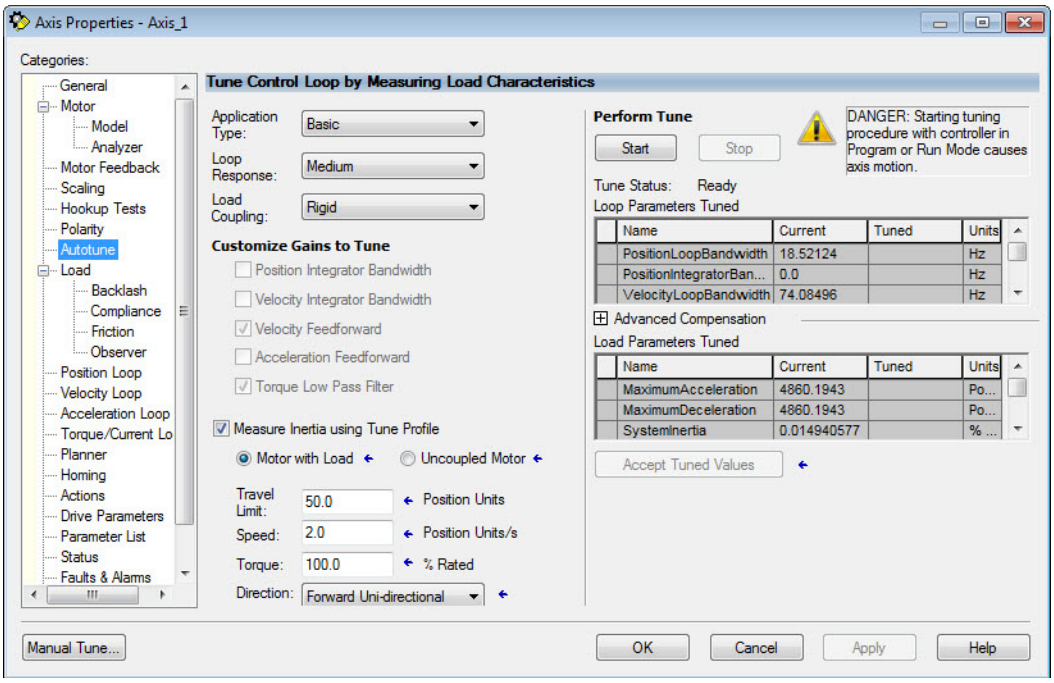
**IMPORTANT** The Automatic FluxUpControl setting is recommended for best Autotune results.

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.

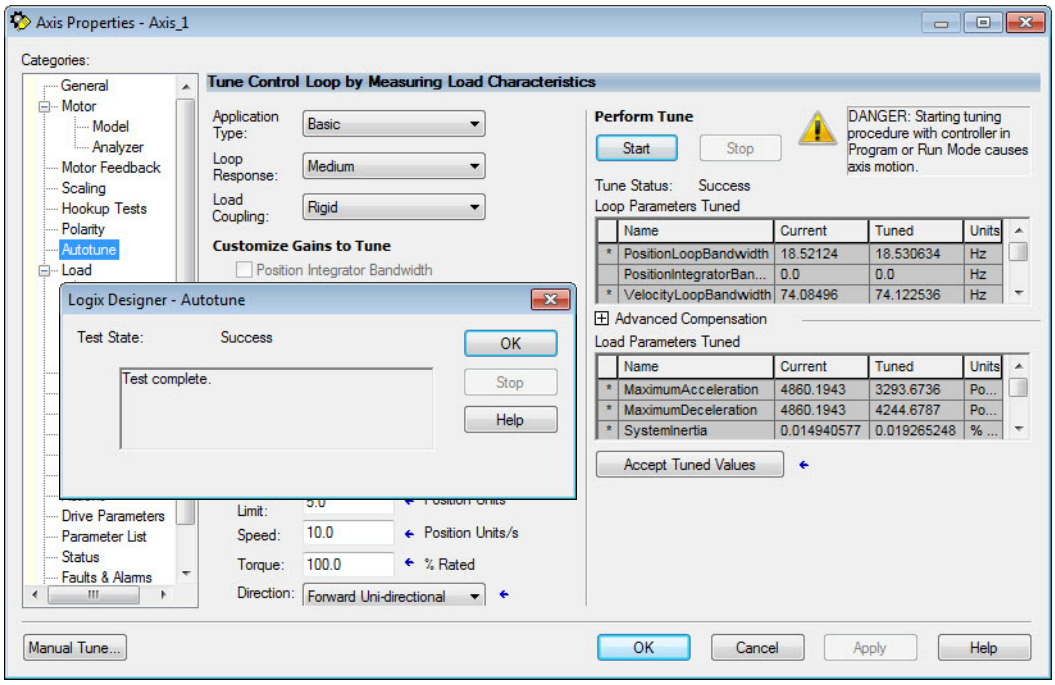
4. From the Direction pull-down menu, choose a setting appropriate for your application.

   Forward Uni-directional is default.

5. Edit other fields as appropriate for your application.

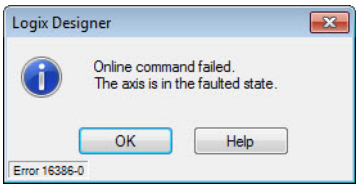
6. Click Start.

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 5500 Drive System

This chapter provides troubleshooting tables and related information for your Kinetix 5500 servo drives.


| Topic | Page |
|---|---|
| Safety Precautions | 149 |
| Interpret Status Indicators | 150 |
| General Troubleshooting | 158 |
| Logix5000 Controller and Drive Behavior | 160 |


## Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 5500 servo drive.

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

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

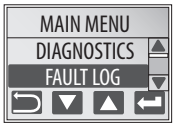
**ATTENTION:** Provide an earth ground for test equipment (oscilloscope) used in troubleshooting. Failure to ground the test equipment could result in personal injury.

# Interpret Status Indicators

Refer to these troubleshooting tables to identify faults, potential causes, and the appropriate actions to resolve the fault. If the fault persists after attempting to troubleshoot the system, 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 Understanding the Kinetix 5500 Display on page 102 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 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 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 is still active following a Fault Reset service, the fault is again posted to the display and written to the fault log.

However, there is 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.

The drive maintains a log of the last 128 faults with time stamps and stores the fault login persistent memory. However, the fault log cannot be cleared on the drive.

**Table 52 - Fault Code Summary**

| Fault Code Type (1) (2) | Description |
|---|---|
| FLT S*xx* | Standard runtime axis exceptions. |
| FLT M*xx* | Manufacturer-specific runtime axis exception. |
| INIT FLT S*xx* | Exceptions that prevent normal operation and occur during the initialization process. |
| INIT FLT M*xx* | |
| NODE FLT*xx* | Exceptions that can prevent normal operation of the drive module and apply to the entire module. |
| 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 S*xx* | Conditions that prevent normal operation and indicate that the drive module is prevented from being enabled. |
| INHIBIT M*xx* | |
| ALARM S*xx* | An underlying exception condition that does not result in any action other than reporting the alarm to the controller. |
| ALARM M*xx* | |
| SAFE FLT*xx* (3) | Exception that is generated by a fault condition that is detected in the safety function. |

(1) S*xx* refers to Standard exceptions.
(2) M*xx* refers to Manufacturer-specific exceptions.
(3) For troubleshooting SAFE FLT fault codes, refer to Chapter 9 on page 171 (hardwired safety) or Chapter 10 on page 180 (integrated safety).

**TIP** Fault codes that are 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 that are 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 53 - FLT S*xx* Fault Codes**

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| FLT S03 – MTR OVERSPEED FL - 0 | Motor Overspeed Factory Limit Fault | Motor speed has exceeded 125% of its maximum speed. | Check control loop tuning. |
| FLT S03 – MTR OVERSPEED FL - 1 | | The output frequency has exceeded 590 Hz. | • Check control loop tuning<br>• Reduce the velocity command |
| FLT S04 – MTR OVERSPEED UL | Motor Overspeed User Limit Fault | Motor speed has exceeded motor overspeed user limit. | • Check control loop tuning<br>• Increase the Motor Overspeed UL attribute value<br>Not supported on induction motors. |
| 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.<br>The nn sub-code is defined as follows:<br>01: Motor Thermostat or Thermistor<br>02: Encoder Temperature Sensor | • Operate motor within continuous torque rating<br>• Reduce motor ambient temperature<br>• Add motor cooling<br>Available only on Kinetix VP and MP-Series motors. Not supported on induction motors. |
| FLT S07 – MTR OVERLOAD FL | Motor Thermal Overload Factory Limit Fault | The motor thermal model has exceeded its factory set thermal capacity limit of 110%. | Modify the command profile to reduce speed or increase time. |
| 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. | • Modify the command profile<br>• Increase the Motor Thermal Overload UL attribute value |
| 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. |
| FLT S10 – INV OVERCURRENT | Inverter Overcurrent Fault | Inverter current has exceeded the instantaneous current limit (determined by hardware). | • Check motor power cable for shorts<br>• Verify motor windings are not shorted<br>• Verify motor power wire gauge<br>• Operate within the continuous power rating<br>• Modify the command profile to reduce speed or increase time |

**Table 53 - FLT *Sxx* Fault Codes (continued)**

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| FLT S11 – INV OVERTEMP FL | Inverter Overtemperature Factory Limit Fault | The measured inverter temperature has exceeded the factory set temperature limit. | • Modify the command profile to reduce speed or increase time<br>• Reduce drive ambient temperature<br>• Verify airflow through drive is not obstructed |
| 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. |
| 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. | • Modify the command profile to reduce speed or increase time<br>• Increase the Inverter Thermal Overload UL attribute value |
| FLT S15 – CONV OVERCURRENT | Converter Overcurrent Fault | The measured converter current has exceeded the factory set current limit. | • Reduce number of shared DC follower drives<br>• Reduce number of capacitor modules |
| FLT S16 – GROUND CURRENT | Ground Current Factory Limit Fault | The sensing circuitry in the power stage has detected excessive ground current. | • Check motor power wiring; check power cable for shorts<br>• Replace motor if the fault persists |
| FLT S18 – CONV OVERTEMP FL | Converter OverTemp Factory Limit Fault | The measured converter temperature has exceeded the factory set temperature limit. | • Reduce number of shared DC follower drives<br>• Modify the command profile to reduce speed or increase time<br>• Reduce drive ambient temperature<br>• Verify airflow through drive is not obstructed |
| FLT S20 – CONV OVERLOAD FL | Converter Thermal Overload Factory Limit Fault | The converter thermal model indicates that the temperature has exceeded the factory set capacity rating of 110%. | • Reduce number of shared DC follower drives<br>• Reduce duty-cycle of commanded motion |
| 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 Converter Thermal Overload User Limit. | • Reduce number of shared DC follower drives<br>• Reduce duty-cycle of commanded motion<br>• Increase the Converter Thermal Overload UL attribute value |
| FLT S23 – AC PHASE LOSS | AC Single Phase Loss Fault | A single AC input phase was lost while the drive was enabled. | Check AC input voltage on all phases. |
| FLT S25 – CONV PRECHARGE FAILURE | Converter Pre-charge 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 or the DC-bus voltage is too high. | • Check AC input voltage on all phases<br>• Check input power wiring<br>• Replace drive if fault persists |
| FLT S29 – BUS REG OVERLOAD FL | Bus Regulator Thermal Overload Factory Limit Fault | The shunt thermal model has exceeded its factory set thermal capacity limit. | • Modify the duty cycle of the application<br>• Add external shunt for additional capacity<br>• Add capacitor module |
| 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. | • Modify the duty cycle of the application<br>• Add external shunt for additional capacity<br>• Increase the Bus Regulator Thermal Overload UL attribute value<br>• Add capacitor module |
| FLT S31 – BUS REG FAILURE | Bus Regulator Failure | The shunt circuit has detected the shunt resistor is shorted. | • Check for shorts in the shunt connector<br>• Unplug the shunt connector and measure the resistance of the shunt<br>• Replace drive if shunt resistor is shorted |
| FLT S33 – BUS UNDERVOLT FL | Bus Undervoltage Factory Limit Fault | DC Bus voltage level is below the factory set limit as determined by the configured input voltage. | • Verify voltage level of the incoming AC<br>• Monitor AC power source for glitches or line droop<br>• Install UPS on AC input |
| 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. | • Verify voltage level of the incoming AC<br>• Monitor AC power source for glitches or line droop<br>• Install UPS on AC input<br>• Increase Bus Undervoltage UL attribute value |
| FLT S35 – BUS OVERVOLT FL | Bus Overvoltage Factory Limit Fault | DC Bus voltage level is above the factory set limit as determined by the configured input voltage. | • Change the deceleration or motion profile of all drives connected to the DC bus<br>• Unplug the shunt connector and measure the resistance of the shunt<br>• Replace drive if shunt resistor is open |
| FLT S39 – BUS POWER LEAKAGE | Bus Power Leakage Fault | Measured converter power exceeded estimated inverter output power by more than a factory limit. | • Check bus power sharing configuration attribute<br>• Check AC input and DC bus sharing connections |
| FLT S45 – FDBK COMM FL | 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. | • Check motor feedback cable and connector<br>• Check motor power cable and feedback wire shields are secured correctly<br>• Check motor frame is grounded correctly |

**Table 53 - FLT S*xx* Fault Codes (continued)**

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| FLT S47 – FDBK DEVICE FAILURE nn | Feedback Device Failure | The feedback device has detected an internal error. The nn sub-code is defined as follows:<br>1: ACCELERATION OVERFLOW<br>4: TRACKING FILTER ERROR<br>5: VECTOR LENGTH ERROR<br>6: COUNTER ERROR<br>7: SYNCHRONIZATION ERROR<br>16: SINGLE TURN ERROR<br>17: MULTI TURN AMPLITUDE ERROR<br>18: MULTI TURN SYNC ERROR<br>19: MULTI TURN VECTOR LENGTH ERROR<br>35: STANDARD PARAMETER ERROR<br>36: INTERNAL COMMUNICATION ERROR1<br>37: INTERNAL COMMUNICATION ERROR2<br>38: INTERNAL SYSTEM ERROR<br>48: CRITICAL TEMPERATURE<br>49: CRITICAL LED CURRENT<br>50: CRITICAL SUPPLY VOLTAGE<br>51: CRITICAL SPEED<br>52: CRITICAL ACCELERATION<br>53: COUNTER OVERFLOW<br>54: INTERNAL MONITORING ERROR<br>66: INTERNAL RESOURCE ACCESS ERROR (1)<br>88: POSITION OUT OF RANGE (2) | • Check motor feedback cable and connector<br>• Cycle control power<br>• Replace motor if fault continues<br>• Check feedback shield connection<br>• Reduce shock and vibration to motor |
| FLT S49 – BRAKE SLIP FLT | Brake Slip Exception | The brake proving function detected that motor displacement exceeded the brake slip tolerance while the mechanical brake was engaged. | Check motor brake. |
| 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. |
| 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. |
| FLT S54 – POSN ERROR (3) | 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. | • Check position loop tuning<br>• Increase the feedforward gain<br>• Verify sizing of the drive and motor<br>• Check motor power wiring<br>• Increase Position Error Tolerance and/or Position Error Tolerance Time attribute values |
| FLT S55 – VEL ERROR (3) | 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. | • Check velocity loop tuning<br>• Reduce acceleration<br>• Verify sizing of the drive and motor<br>• Check motor power wiring<br>• Increase Velocity Error Tolerance and/or Velocity Error Tolerance Time attribute values |
| FLT S56 – OVERTORQUE LIMIT (3) | 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. | • Verify Torque Trim value<br>• Verify motion profile<br>• Verify sizing of the drive and motor<br>• Increase Overtorque Limit and/or Overtorque Limit Time attribute values |
| FLT S57 – UNDERTORQUE LIMIT (3) | 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. | • Verify motion profile<br>• Verify sizing of the drive and motor<br>• Decrease Undertorque Limit and/or Undertorque Limit Time attribute values |

(1) For the 2198-H2DCK feedback converter kit, a Motion Axis Fault Reset is required and can take up to 30 seconds to complete. Cycling control power does not always fix the error.

(2) A control power cycle is required to reset the fault.

(3) Does not apply to induction motors in frequency control mode.

### Table 54 - FLT M*xx* Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| 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. |
| FLT M25 – DC COMMON BUS | DC Common Bus Fault | AC power was detected by the drive while configured for shared DC operation. | • Check the drive power configuration from controller<br>• Check wiring |
| FLT M26 – RUNTIME ERROR | Runtime Error | The drive firmware encountered an unrecoverable runtime error. | • Cycle control power<br>• Reset the drive<br>• Return drive for repair if fault continues |
| FLT M28 – SAFETY COMM (2198-H*xxx*-ERS2 drives only) | Safety Module Communication Error | Communication with the safety hardware within the drive has failed. | • Cycle control power<br>• Reset the drive<br>• Return drive for repair if fault continues |

### Table 55 - INIT FLT Fault Codes

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| INIT FLT M01 – ENCODER DATA | Smart Encoder Data Corruption | The data stored in the encoder has a checksum error. | • Cycle control power<br>• Return motor for repair if fault continues |
| INIT FLT M02 – MTR DATA RANGE nn | Motor Data Range Error | A motor data attribute stored in the encoder is out of range. The nn sub-code is defined as follows:<br>01: DATA_RANGE_REV<br>02: DATA_RANGE_CONT_CURRENT<br>03: DATA_RANGE_PEAK_CURRENT<br>04: DATA_RANGE_RATED_POWER<br>05: DATA_RANGE_OVERLOAD_LIMIT<br>06: DATA_RANGE_THERMAL_CAPACITANCE<br>07: DATA_RANGE_THERMAL_RESISTANCE<br>08: DATA_RANGE_MOTOR_RESISTANCE<br>09: DATA_RANGE_MOTOR_INDUCTANCE<br>10: DATA_RANGE_INERTIA<br>11: DATA_RANGE_RATED_SPEED<br>12 DATA_RANGE_MAX_SPEED<br>13: DATA_RANGE_RATED_TORQUE<br>14: DATA_RANGE_TORQUE_CONST<br>15: DATA_RANGE_BACK_EMF_CONST<br>16: DATA_RANGE_POLE_PITCH | • Cycle control power<br>• Return motor for repair if fault continues |
| INIT FLT M03 – MTR ENC STARTUP | Motor Feedback Communication Startup | Communication with the encoder could not be established. | • Cycle control power<br>• Check motor feedback connector<br>• Check motor power and feedback shield terminations on the drive<br>• Return motor for repair if fault continues |
| INIT FLT M14 – SAFETY FIRMWARE | Safety Firmware | The loaded Safety firmware is not compatible with the drive firmware. | • Cycle control power<br>• Update the drive firmware<br>• Return drive for repair if fault continues |
| INIT FLT M20 – UNKNOWN MODULE | Unknown Module | The product code of the power board is invalid. | • Cycle control power<br>• Reset the drive<br>• Return drive for repair if fault continues |
| INIT FLT M21 – FACTORY CONFIG | Factory Configuration Error | Factory configuration data is missing or invalid | • Cycle control power<br>• Reset the drive<br>• Return drive for repair if fault continues |

**Table 56 - INHIBIT Fault Codes**

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| INHIBIT S02 – MTR NOT CONFIG | Motor Not Configured | The motor has not been properly configured for use. | Verify motor configuration in the Logix Designer application. |
| INHIBIT S03 – FEEDBACK NOT CONFIG | Feedback Not Configured | The feedback has not been properly configured for use. | Verify feedback configuration in the Logix Designer application. |
| INHIBIT S05 – START INHIBIT | Safe Torque Off Active | The safety function has disabled the power structure. | • Check S0.SafeTorqueOff bit of safety connection.<br>• Check if Reset is required (SI.ResetRequired on safety connection, Axis.SafetyResetRequiredStatus on motion connection) if so, toggle the S0.Reset bit on the safety connection.<br>• Check that there is an active safety connection and the safety controller is in run mode.<br>• Check for safety faults. |
| 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. | • Verify that the proper axis configuration has been selected.<br>• Verify that sufficient torque prove current has been configured. |
| INHIBIT M05 – SAFE TORQUE OFF | Start Inhibit – Safe Torque Off | The safety function has disabled the power structure. | • Check safety input wiring<br>• Check state of safety devices |

**Table 57 - NODE FLT Fault Codes**

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| NODE FLT 01 – LATE CTRL UPDATE | Control Connection Update Fault | Several consecutive updates from the controller have been lost. | • Remove unnecessary network devices from the motion network<br>• Change network topology so that fewer devices share common paths<br>• Use high performance network equipment<br>• Use shielded cables<br>• Separate signal wiring from power wiring |
| 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.<br>The nn sub-codes 00…06 are internal and result in the same possible solution. | • Cycle control power<br>• Update the drive firmware<br>• Return drive for repair if fault continues |
| NODE FLT 03 – HARDWARE 00 | Hardware Fault -PwrIF | Communication with the power board could not be established. | • Cycle control power<br>• Update the drive firmware<br>• Return drive for repair if fault continues |
| NODE FLT 03 – HARDWARE 02 | Hardware Fault - DSL | Communication with the encoder could not be established. | • DSL feedback wiring is incorrect (check against wiring diagram)<br>• DSL feedback wiring is shorted or open<br>• DSL feedback cable is defective<br>• Kinetix VP motor feedback device is defective<br>• Cycle power<br>• Return drive for repair if fault continues |
| NODE FLT 03 – HARDWARE 03 | DSL Internal Hardware Fault | A DSL hardware error internal to the drive was detected. | • Check DSL feedback device, wiring, and cable<br>• Cycle power<br>• Return drive for repair if fault continues |
| NODE FLT 03 – HARDWARE 04 | Hardware Fault - Board Compatibility | The control and power boards are incompatible. | Return drive for repair if fault continues |
| NODE FLT 05 – CLOCK SKEW FLT | Clock Skew Fault | The controller time and the drive's system time are not the same. | • Cycle control power<br>• Check controller and Ethernet switch operation |
| NODE FLT 06 – LOST CTRL CONN | Lost Controller Connection Fault | Communication with the controller has been lost. | • Check Ethernet connection<br>• Check controller and Ethernet switch operation |
| 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. | • Check Ethernet connection<br>• Check controller and Ethernet switch operation |
| 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 |

**Table 58 - NODE ALARM Fault Codes**

| Exception Code on Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| NODE ALARM 01 – LATE CTRL UPDATE | Control Connection Update Alarm | Updates from the controller have been late. | • Remove unnecessary network devices from the motion network<br>• Change network topology so that fewer devices share common paths<br>• Use high performance network equipment<br>• Use shielded cables<br>• Separate signal wiring from power wiring |
| NODE ALARM 03 – CLOCK JITTER | Clock Jitter Alarm | The sync variance has exceeded the sync threshold while the device is running in sync mode. | • Check the Ethernet connection<br>• Check controller and Ethernet switch operation |
| NODE ALARM 04 – CLOCK SKEW ALARM | Clock Skew Alarm | The controller time and the drive's time are not the same. | • Check the Ethernet connection<br>• Check controller and Ethernet switch operation |
| 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. | • Check the Ethernet connection<br>• Check controller and Ethernet switch operation |

## SAFE FLT Fault Codes

For troubleshooting SAFE FLT fault codes, refer to Chapter 9 on page 171 (hardwired safety) or Chapter 10 on page 180 (integrated safety).

## Kinetix 5500 Drive Status Indicators

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.

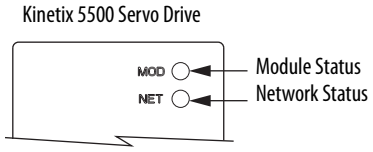



**Table 59 - Module Status Indicator**

| 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. |

**Table 60 - Network Status Indicator**

| Condition | Status |
|---|---|
| Steady Off | No power applied to the drive or IP address is not configured. |
| Flashing Green | Drive connection is not established, but has obtained an IP address. |
| Steady Green | Drive connection is established. 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. |

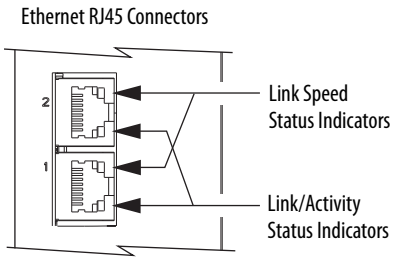



**Table 61 - Ethernet Link Speed Status Indicator**

| Condition | Status |
|---|---|
| Steady Off | 10 Mbit |
| Steady On | 100 Mbit |

**Table 62 - Ethernet Link/Activity Status Indicator**

| Condition | Status |
|---|---|
| Steady Off | No link |
| Steady On | Link established |
| Blinking | Network activity |

## Kinetix 5500 Capacitor Module Status Indicators

The capacitor module status indicator and module status (MS) connector are on the front of the module. The module status connector is a relay output suitable for wiring to the Logix5000 controller.

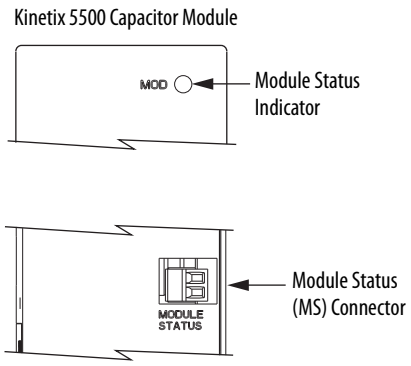



**Table 63 - Module Status Indicator and Relay Output**

| Module Status Indicator | Relay Output (1) | Status | Resolution |
|---|---|---|---|
| Steady Green | Closed | Bus is fully charged and no faults exist. | N/A |
| Flashing Green | Open | Control power is present and bus is waiting to charge up. | N/A |
| Flashing Red | Open | Recoverable fault (precharge or overvoltage fault). | • Cycle control and bus power<br>• Verify that AC input meets specifications |
| Steady Red | Open | Internal, non-recoverable fault condition inside the module. | • Cycle control and bus power<br>• Verify that AC input meets specifications<br>• Replace the module if fault persists |

(1) Wiring the module status relay output to the Logix5000 controller is optional.

## General Troubleshooting

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

**Table 64 - 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). | • Check setups.<br>• Run Tune in the Logix Designer application. |
| | Mechanical resonance. | Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application). |
| 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. | • Check motor size versus application need.<br>• 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. | • Check motor size versus application need.<br>• 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. |

**Table 64 - General Troubleshooting (continued)**

| Condition | Potential Cause | Possible Resolution |
|---|---|---|
| Motor does not respond to a command. | The axis cannot be enabled until stopping time has expired. | Disable the axis, wait for 1.5 seconds, and enable the axis. |
| | The motor wiring is open. | Check the wiring. |
| | The motor cable shield connection is improper. | • Check feedback connections.<br>• 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. | • Verify grounding.<br>• Route wire away from noise sources.<br>• Refer to System Design for Control of Electrical Noise, publication GMC-RM001. |
| | Line frequency can be present. | • Verify grounding.<br>• 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. | • Decouple the motor for verification.<br>• 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). | • Check brake wiring and function.<br>• 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. | • Remove the loose parts.<br>• Return motor for repair.<br>• 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. |

## Logix5000 Controller and Drive Behavior

By using the Logix Designer application, you can configure how the Kinetix 5500 drives respond when a drive 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.

The drive supports fault actions for Ignore, Alarm, Minor Fault, and Major Fault as defined in Table 65. The drive also supports three configurable stopping actions as defined in Table 67.

Refer to the drive behavior tables beginning on page 161 to see how the fault and stopping actions apply to each of the exception fault codes.

**Table 65 - Kinetix 5500 Drive Exception Action Definitions**

| Exception Action | Definition |
|---|---|
| Ignore | The drive 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 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 latches the exception condition but the drive does not execute any exception action. |
| Major Fault | The drive 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 66 - 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 dependant. |
| 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. |

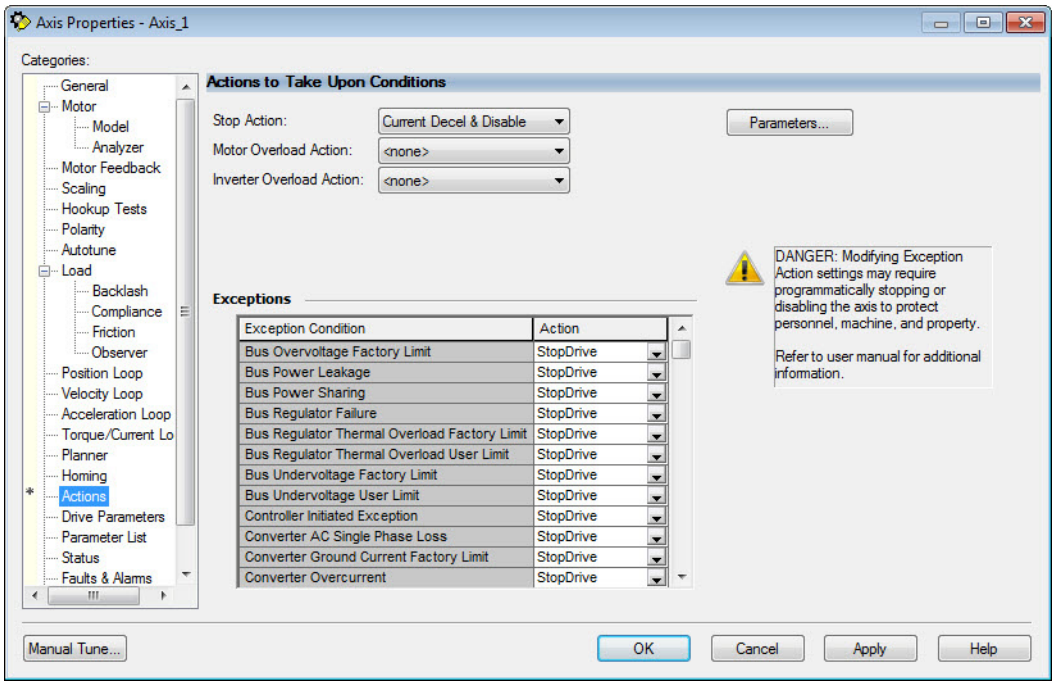
For Kinetix 5500 drives, only selected exceptions are configurable. In the drive behavior tables, the controlling attribute is given for programmable fault actions.

**Table 67 - Configurable Stopping Actions**

| Stopping Action | Description | |
|---|---|---|
| Decel and hold | Most 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. |
| Decel and disable | Less control | |
| Disable and coast | Least control | |

Only selected drive exceptions are configurable. In the drive behavior tables, the controlling attribute is given for programmable fault actions.

**Figure 69 - Logix Designer Axis Properties - Actions Category**




This dialog box applies to Kinetix 5500 (EtherNet/IP network) servo drives.

**Table 68 - Drive Behavior, FLT S*xx* Fault Codes**

| Exception Fault Code | Exception Text | Permanent Magnet Motor | Induction Motor | Fault Action | | | | Best Available Stopping Action (applies to major faults) |
|---|---|---|---|---|---|---|---|---|
| | | | | Ignore | Alarm | Minor Fault | Major Fault | |
| FLT S03 – MTR OVERSPEED FL | Motor Overspeed Factory Limit Fault | X | | | | | X | Disable/Coast |
| FLT S04 – MTR OVERSPEED UL | Motor Overspeed User Limit Fault | X | | X | X | X | X | Decel/Hold |
| FLT S05 – MTR OVERTEMP FL | Motor Overtemperature Factory Limit Fault | X | | | | | X | Disable/Coast |
| FLT S07 – MTR OVERLOAD FL | Motor Thermal Overload Factory Limit Fault | X | X | | | | X | Decel/Disable |
| FLT S08 – MTR OVERLOAD UL | Motor Thermal OverLoad User Limit Fault | X | X | X | X | X | X | Decel/Hold |

**Table 68 - Drive Behavior, FLT S*xx* Fault Codes (continued)**

| Exception Fault Code | Exception Text | Permanent Magnet Motor | Induction Motor | Fault Action | | | | Best Available Stopping Action (applies to major faults) |
|---|---|---|---|---|---|---|---|---|
| | | | | Ignore | Alarm | Minor Fault | Major Fault | |
| FLT S10 – INV OVERCURRENT | Inverter Overcurrent Fault | X | X | | | | X | Disable/Coast |
| FLT S11 – INV OVERTEMP FL | Inverter Overtemperature Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S13 – INV OVERLOAD FL | Inverter Thermal Overload Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S14 – INV OVERLOAD UL | Inverter Thermal Overload User Limit Fault | X | X | X | X | X | X | Decel/Hold |
| FLT S15 – CONV OVERCURRENT | Converter Overcurrent Fault | X | X | | | | X | Disable/Coast |
| FLT S16 – GROUND CURRENT | Ground Current Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S18 – CONV OVERTEMP FL | Converter OverTemp Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S20 – CONV OVERLOAD FL | Converter Thermal OverLoad Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S21 – CONV OVERLOAD UL | Converter Thermal Overload User Limit Fault | X | X | X | X | X | X | Decel/Hold |
| FLT S23 – AC PHASE LOSS | AC Single Phase Loss Fault | X | X | X | X | X | X | Disable/Coast |
| FLT S25 – PRECHARGE FAILURE | Pre-charge Failure Fault | X | X | | | | X | Disable/Coast |
| FLT S29 – BUS OVERLOAD FL | Bus Regulator Thermal OverLoad Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S30 – BUS OVERLOAD UL | Bus Regulator Thermal Overload User Limit Fault | X | X | X | X | X | X | Decel/Hold |
| FLT S31 – BUS REG FAILURE | Bus Regulator Failure | X | X | | | | X | Disable/Coast |
| FLT S33 – BUS UNDERVOLT FL | Bus Undervoltage Factory Limit Fault | X | X | | | | X | Decel/Disable |
| FLT S34 – BUS UNDERVOLT UL | Bus Undervoltage User Limit Fault | X | X | X | X | X | X | Decel/Hold |
| FLT S35 – BUS OVERVOLT FL | Bus Overvoltage Factory Limit Fault | X | X | | | | X | Disable/Coast |
| FLT S39 – BUS POWER LEAKAGE | Bus Power Leakage Fault | X | X | | | | X | Decel/Coast |
| FLT S45 – FDBK COMM FL | Motor Feedback Data Loss Factory Limit Fault | X | | | | | X | Disable/Coast |
| FLT S47 – FDBK DEVICE FAILURE | Feedback Device Failure | X | | | | | X | Disable/Coast |
| FLT S49 – BRAKE SLIP FLT | Brake Slip Exception | X | | X | X | X | X | Decel/Hold |
| FLT S50 – POS HW OTRAVEL | Hardware Overtravel - Positive | X | X | X | X | X | X | Decel/Hold |
| FLT S51 – NEG HW OTRAVEL | Hardware Overtravel - Negative | X | X | X | X | X | X | Decel/Hold |
| FLT S54 – POSN ERROR | Excessive Position Error Fault | X | | X | X | X | X | Disable/Coast |
| FLT S55 – VEL ERROR | Excessive Velocity Error Fault | X | | X | X | X | X | Disable/Coast |
| FLT S56 – OVERTORQUE LIMIT | Overtorque Limit Fault | X | | X | X | X | X | Decel/Hold |
| FLT S57 – UNDERTORQUE LIMIT | Undertorque Limit Fault | X | | X | X | X | X | Decel/Hold |

**Table 69 - Drive Behavior, FLT M*xx* Fault Codes**

| Exception Fault Code | Exception Text | 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 | Motor Voltage Mismatch Fault | X | | X | X | X | X | Disable/Coast |
| FLT M25 – COMMON BUS | DC Common Bus Fault | X | X | | | | X | Disable/Coast |
| FLT M26 – RUNTIME ERROR | Runtime Error | X | X | | | | X | Disable/Coast |
| FLT M28 – SAFETY COMM (2198-H*xxx*-ERS2 drives only) | Safety Module Communication Error | X | X | | | | X | Disable/Coast |

**Table 70 - Drive Behavior, NODE FLT Fault Codes**

| Exception Fault Code | Exception Text | 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 | X | X | | | | X | Decel/Disable |
| NODE FLT 02 – PROC WATCHDOG | Processor Watchdog Fault | X | X | | | | X | Disable/Coast |
| NODE FLT 03 – HARDWARE | Hardware Fault | X | X | | | | X | Disable/Coast |
| NODE FLT 05 – CLOCK SKEW FLT | Clock Skew Fault | X | X | | | | X | Disable/Coast |
| NODE FLT 06 – LOST CTRL CONN | Lost Controller Connection Fault | X | X | | | | X | Decel/Disable |
| NODE FLT 07 – CLOCK SYNC | Clock Sync Fault | X | X | | | | X | Disable/Coast |
| NODE FLT 09 – DUPLICATE IP ADDRESS | Duplicate IP Address Fault | X | X | | | | X | Disable/Coast |

## Notes:

# Remove and Replace Servo Drives

This chapter provides remove and replace procedures for Kinetix 5500 drives.


| Topic | Page |
|---|---|
| Before You Begin | 165 |
| Remove and Replace Kinetix 5500 Servo Drives | 166 |
| Start and Configure the Drive | 168 |


**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 is installed, network settings are configured from the setup screens. Before removing the drive, revisit the Network menu and make note of the static IP or DHCP settings. Refer to Configure the Drive on page 106 to access those settings.

**IMPORTANT** If you intend to use the same Logix Designer application after replacing your drive, the new drive must be the same catalog number as the old drive.

You also need these tools available before you begin removal and replacement procedures:

- Screwdrivers (to loosen/remove screws)
- Voltmeter (to make sure no voltage exists on drive connectors)
- Non-conductive probe for removing DC bus T-connectors

# Remove and Replace Kinetix 5500 Servo Drives

Follow these steps to remove and replace servo drives from the 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, assure that all power has been removed before proceeding. This system can have multiple sources of power. More than one disconnect switch can be required to de-energize the system.

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

> **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. Label and remove all wiring connectors from the drive you are removing.

   To identify each connector, refer to Kinetix 5500 Connector Data on page 58.

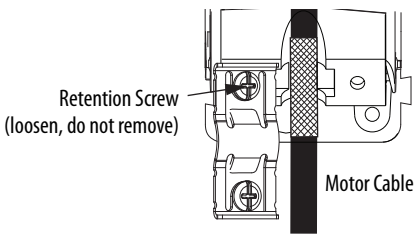
   **TIP** You do not need to remove the shunt (RC) connector, unless there is an external shunt wired to it.

4. Remove the shared-bus input wiring connectors, T-connectors, and bus-bars from the drive you are removing.

   **IMPORTANT** DC bus T-connectors latch on both sides when inserted into the drive. To remove the DC bus T-connector, at least one latch must be pried away with a non-conductive probe.

   Refer to Shared-bus Connection System on page 47.

5. Use a screwdriver to loosen the two cable clamp screws, removing the screw on the right.




6. Remove the single motor cable from the cable shield clamp.
7. Remove the ground screw and braided ground strap.

   Refer to Ground the System Subpanel on page 76.

## Remove the Servo Drive

You can remove single-axis drives from the panel or any single drive from a multi-axis configuration by using the same procedure.

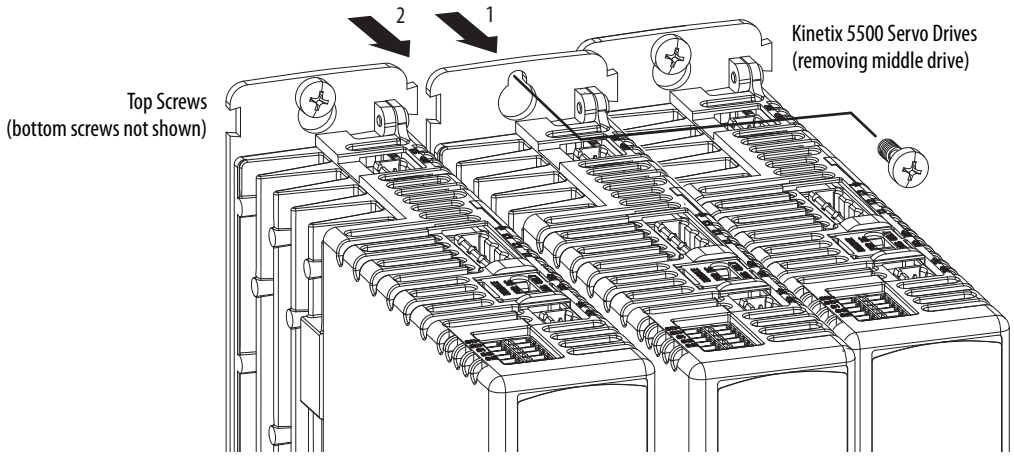
**IMPORTANT** This procedure applies to any 2198-H*xxx*-ERS*x* drive in any configuration.

Follow these steps to remove Kinetix 5500 servo drives from the panel.

1. Loosen the top and bottom screws of the drive to remove.

   Frame 1 and 2 drives have one top and bottom screw. Frame 3 drives have two top and bottom screws.

2. Grasp the top and bottom of the drive with both hands and pull the drive straight out and away from the panel, clearing the zero-stack mounting tabs and cutouts.




## Replace the Servo Drive

To replace the servo drive, reverse the steps shown above or refer to Mount Your Kinetix 5500 Drive on page 56:

- 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.

## Start and Configure the Drive

Follow these steps to configure the replacement drive.

| **IMPORTANT** | If you intend to use the same Logix Designer application after replacing your drive, the new drive must be the same catalog number as the old drive. |
|---|---|

| **IMPORTANT** | If a 2198-H*xxx*-ERS2 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 182. |
|---|---|

1. Reapply power to the drive/system.

   Refer to Apply Power to the Kinetix 5500 Drive on page 138 for the procedure.

2. Configure the network settings for the drive.
   a. If your old drive was configured as Static IP, you need to set the IP address, gateway, and subnet mask in the new drive identical to the old drive.

      Refer to Configure the Drive on page 106 to access those settings.

   b. If you replaced a 2198-H*xxx*-ERS2 servo drive in an integrated safety application, review Understanding Integrated Safety Drive Replacement on page 183 and follow the appropriate procedure in Replacing an Integrated Safety Drive in a GuardLogix System on page 184 to properly set the safety network number for the new drive.
3. Download the Logix Designer application to the controller.
4. Verify the drive/system is working properly.

# Kinetix 5500 Safe Torque-off - Hardwired Safety

The 2198-H*xxx*-ERS servo drives are equipped for hardwired safe torque-off (STO). The hardwired STO function meets the requirements of Performance Level d (PLd) and safety category 3 (CAT 3) per EN ISO 13849-1 and SIL 2 per IEC EN 61508, EN 61800-5-2 and EN 62061.


| Topic | Page |
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| Certification | 169 |
| Description of Operation | 170 |
| Probability of Dangerous Failure Per Hour | 173 |
| Safe Torque-off Connector Data | 173 |
| Wire the Safe Torque-off Circuit | 174 |
| Safe Torque-off Feature | 175 |
| Safe Torque-off Specifications | 176 |


A ControlLogix 5570, ControlLogix 5580, or CompactLogix 5370 controller is required for hardwired safety control of the Kinetix 5500 safe torque-off function. The 2198-H*xxx*-ERS servo drives use the STO connector for wiring external safety devices and cascading hardwired safety connections from one drive to another.

## Certification

The TÜV Rheinland group has approved the 2198-H*xxx*-ERS servo drives with hardwired safe torque-off for use in safety-related applications up to EN ISO 13849-1 Performance Level d (PLd) and Category 3, SIL 2 per IEC EN 61508, EN 61800-5-2, and EN 62061, in which removing the motion producing power is considered to be the safe state.

Refer to Appendix E on page 261 for these certification documents.

- EC Type - Examination Certificate
- EC Declaration of Conformity
- European Union Directives

### 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 EN ISO 13849-1 performance level or EN 62061 SIL level
- Project management and proof testing in accordance with EN ISO 13849

### Category 3 Requirements According to EN ISO 13849-1

Safety-related parts are designed with these attributes:

- A single fault in any of these parts does not lead to the loss of the safety function.
- A single fault is detected whenever reasonably practicable.
- Accumulation of undetected faults can lead to the loss of the safety function and a failure to remove motion producing power from the motor.

### Stop Category Definition

Stop Category 0 as defined in EN 60204 or safe torque-off as defined by EN 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 EN 60204-1. |

### Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to EN ISO 13849-1, and SIL levels, according to EN 61508 and EN 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 EN ISO 13849-1, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

## 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. Disabling the power transistor output does not provide mechanical isolation of the electrical output that is required for some applications.

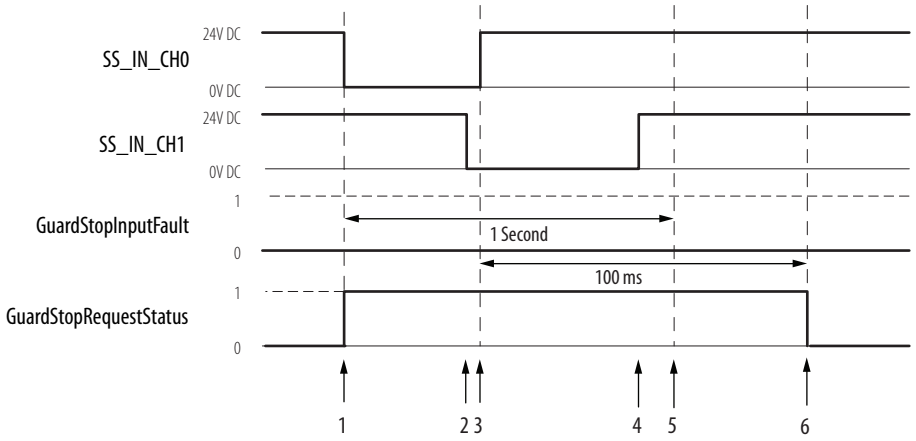
Under normal operation, the safe torque-off inputs are energized. If either of the safety enable inputs are de-energized, then all of the output power transistors turn off. The safe torque-off response time is less then 12 ms.



**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 SafeTorqueOffInhibit and GuardStopRequestStatus bit of AxisGuardStatus tag set to 1. Both inputs must be de-energized within 1 second and re-energized within 1 second to avoid GuardStopInputFault conditions.

**Figure 70 - System Operation when Inputs are Meeting Timing Requirements**




| Event | Description |
|---|---|
| 1 | At least one input is switched-off. GuardStopRequestStatus bit is set to 1. |
| 2 | Second input is switched-off within 1 second. This event must always occur prior to Event 3 to prevent GuardStopInputFault. |
| 3 | First input is switched-on. |
| 4 | Second input is switched-on within 1 second of event 3. |
| 5 | Both inputs are in OFF 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). |

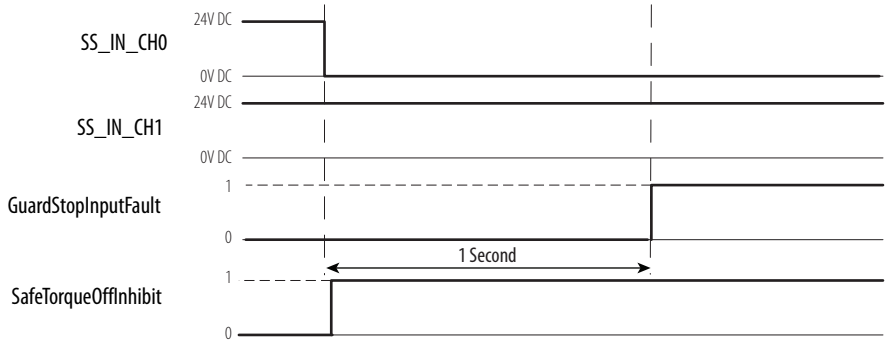
## Troubleshoot the Safe Torque-off Function

**Table 71 - 2198-H*xxx*-ERS Servo Drive Troubleshooting**

| Exception Code on Drive Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| SAFE FLT 09 - SS IN | Guard Stop Input Fault | Safe torque-off function mismatch. The 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. | • Verify safety wiring and connections:<br>– Wire terminations at safe torque-off (STO) connector<br>– Cable/header not seated correctly<br>– +24V power<br>• Check state of safety inputs.<br>• Reset error and run proof test.<br>• If error persists, return the drive to Rockwell Automation. |

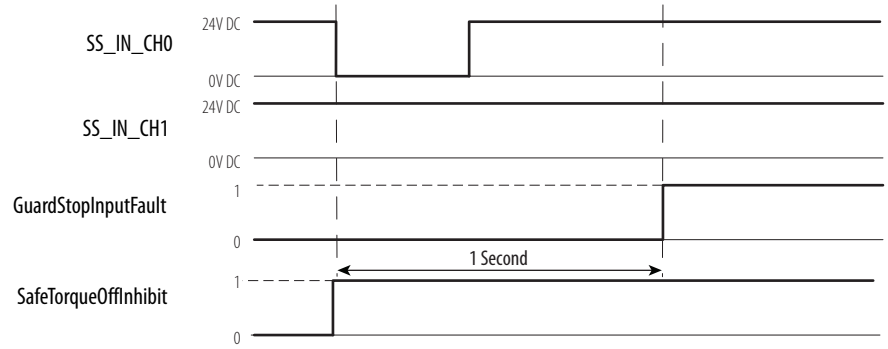
Figure 71 demonstrates when the safe torque-off mismatch is detected and a GuardStopInputFault is posted.

**Figure 71 - System Operation in the Event that the Safety Enable Inputs Mismatch**




When one safety input is turned off, the second input must also be turned off, otherwise a fault is asserted (see Figure 72). The fault is asserted even if the first safety input is turned on again, without the second input transitioning to the ON state.

**Figure 72 - System Operation in the Event that the 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.

## Probability of Dangerous Failure Per Hour

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 occurring per hour (PFH).

PFH calculation is based on the equations from EN 61508 and show worst-case values. Table 72 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 72 - PFH for 20-year Proof Test Interval**

| Attribute | Value |
|---|---|
| PFH (1e-9) | 0.35 |
| Proof test (years) | 20 |

## Safe Torque-off Connector Data

The 10-pin connector consists of two parallel 5-pin rows for cascading safety connections from drive-to-drive in multi-axis configurations.

**Figure 73 - Pin Orientation for 10-pin Safe Torque-off (STO) Connector**

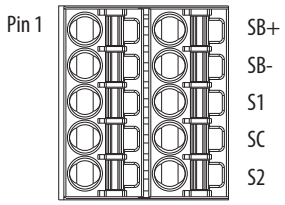



**Table 73 - Safe Torque-off (STO) Connector Pinouts**

| STO Pin | Description | Signal |
|---|---|---|
| 1 | Safety bypass plus signal. Connect to both safety inputs to disable the STO function. | SB+ |
| 2 | Safety bypass minus signal. Connect to safety common to disable the STO function. | SB- |
| 3 | STO input 1 (SS_IN_CH0). | S1 |
| 4 | STO input common (SCOM). | SC |
| 5 | STO input 2 (SS_IN_CH1). | S2 |

# Wire the Safe Torque-off Circuit

This section provides guidelines for wiring your Kinetix 5500 safe torque-off drive connections.

| | |
|---|---|
| **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 39. |

| | |
|---|---|
| **IMPORTANT** | Pins ST0-1 and ST0-5 (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 ST0-1 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 tab, along side each pin, to insert or release the wire. Two rows of pins are provided for drive-to-drive connections. Wire must be copper with 75 °C (167 °F) minimum rating.

| | |
|---|---|
| **IMPORTANT** | Stranded wires must terminate with ferrules to prevent short circuits, per table D7 of EN ISO 13849-1. |

**Figure 74 - Safe Torque-off (ST0) Terminal Plug**

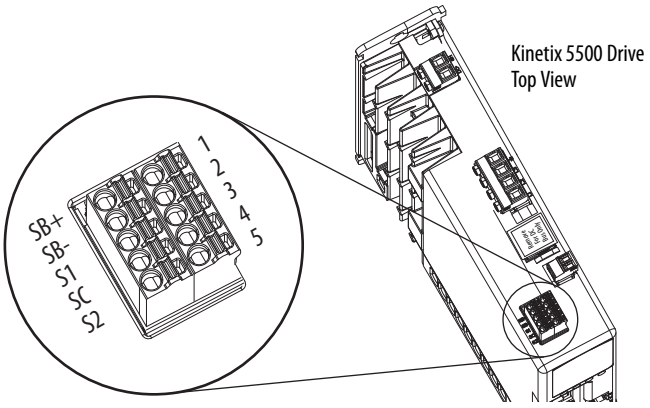



**Table 74 - Safe Torque-off (ST0) Terminal Plug Wiring**

| Safe Torque-off (ST0) Connector | | Recommended Wire Size mm$^2$ (AWG) | Strip Length mm (in.) | Torque Value N•m (lb•in) |
|---|---|---|---|---|
| **Pin** | **Signal** | | | |
| ST0-1<br>ST0-2<br>ST0-3<br>ST0-4<br>ST0-5 | SB+<br>SB-<br>S1<br>SC<br>S2 | 0.2…1.5<br>(24…16) | 10 (0.25) | N/A (1) |

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

## Safe Torque-off Feature

The safe torque-off circuit, when used with suitable safety components, provides protection according to EN ISO 13849-1 (PLd), Category 3 or according to IEC EN 61508, EN 61800-5-2, and EN 62061 (SIL CL2). All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The safe torque-off circuit is designed to safely turn off all of the output-power transistors. You can use the safe torque-off circuit in combination with other safety devices to achieve Stop Category 0 and protection-against-restart as specified in IEC 60204-1.

**ATTENTION:** This option 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.

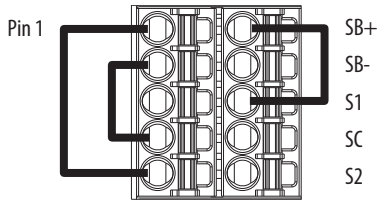
**ATTENTION:** Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

### Safe Torque-off Feature Bypass

The 2198-H*xxx*-ERS drives 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.

Each 2198-H*xxx*-ERS drive includes one 10-pin wiring plug for wiring to safety devices. To bypass the safety function, wire these signals as shown in Figure 75. With the jumper wires installed, the safe-off feature is not used.

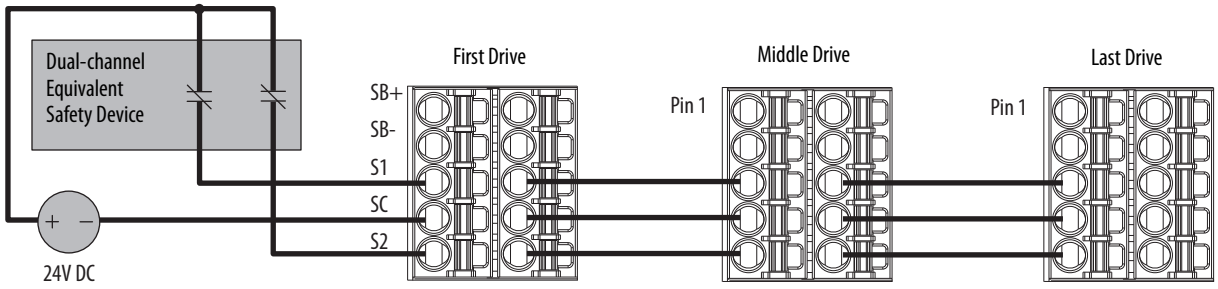
**Figure 75 - Safe Torque-off Bypass Wiring**



## 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 75 for current rating per channel, per drive.

**Figure 76 - Cascaded Safe Torque-off Wiring**




# Safe Torque-off Specifications

To maintain safety rating, Kinetix 5500 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 75 - Safe Torque-off Signal 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 (1) |
| | Input OFF current, max (@ V in < 5V DC) | 2 mA |
| | Pulse rejection width | 700 µs |
| | External power supply | SELV/PELV |
| | Input type | Optically isolated and reverse voltage protected |

(1) 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.ab.com/catalogs.

# Kinetix 5500 Safe Torque-off - Integrated Safety

The 2198-H*xxx*-ERS2 servo drives are equipped for integrated safe torque-off (STO). The integrated STO function meets the requirements of Performance Level e (PLe) and safety category 3 (CAT 3) per EN ISO 13849-1 and SIL 3 per IEC EN 61508, EN 61800-5-2 and EN 62061.

With integrated safety, the GuardLogix 5570 or Compact GuardLogix 5570 safety controller issues the safe torque-off (STO) command over the EtherNet/IP network and the 2198-H*xxx*-ERS2 servo drive executes the STO command.


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| Safe Torque-off Specifications | 197 |


## Certification

The TÜV Rheinland group has approved the 2198-H*xxx*-ERS2 servo drives with integrated safe torque-off for use in safety-related applications up to PLe, Category 3 according to EN ISO 13849 and SIL CL3 according to IEC 61508, EN 61800-5-2, and EN 62061, in which removing the motion producing power is considered to be the safe state.

Refer to Appendix E on page 261 for these certification documents.

- EC Type - Examination Certificate
- EC Declaration of Conformity
- European Union Directives

## 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 EN ISO 13849-1 performance level or EN 62061 SIL level
- Project management and proof testing performed in accordance with EN ISO 13849

## 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 Probability of Dangerous Failure Per Hour on page 181 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 GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099.

| | |
|---|---|
| **IMPORTANT** | You must read, understand, and fulfill the requirements detailed in publication 1756-RM099 prior to operating a safety system that uses a GuardLogix controller and 2198-H*xxx*-ERS2 servo drive. |

## Category 3 Requirements According to ISO 13849

Safety-related parts are designed with these attributes:

- A single fault in any of these parts does not lead to the loss of the safety function.
- A single fault is detected whenever reasonably practicable.
- Accumulation of undetected faults can lead to the loss of the safety function and a failure to remove motion producing power from the motor.

### Stop Category Definition

Stop Category 0 as defined in EN 60204 or safe torque-off as defined by EN 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 EN 60204-1.

### Performance Level (PL) and Safety Integrity Level (SIL)

For safety-related control systems, Performance Level (PL), according to EN ISO 13849-1, and SIL levels, according to EN 61508 and EN 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 EN ISO 13849-1, EN 61508, and EN 62061 standards for complete information on requirements for PL and SIL determination.

## 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 drive is coasting. Disabling the power transistor output does not provide mechanical isolation of the electrical output that is required for some applications.

The 2198-H*xxx*-ERS2 drive STO function response time is less than 10 ms. Response time is the delay between the time the drive STO function receives the integrated safety packet with an STO request and the time when motion producing power is removed from the motor.

### STO State Reset

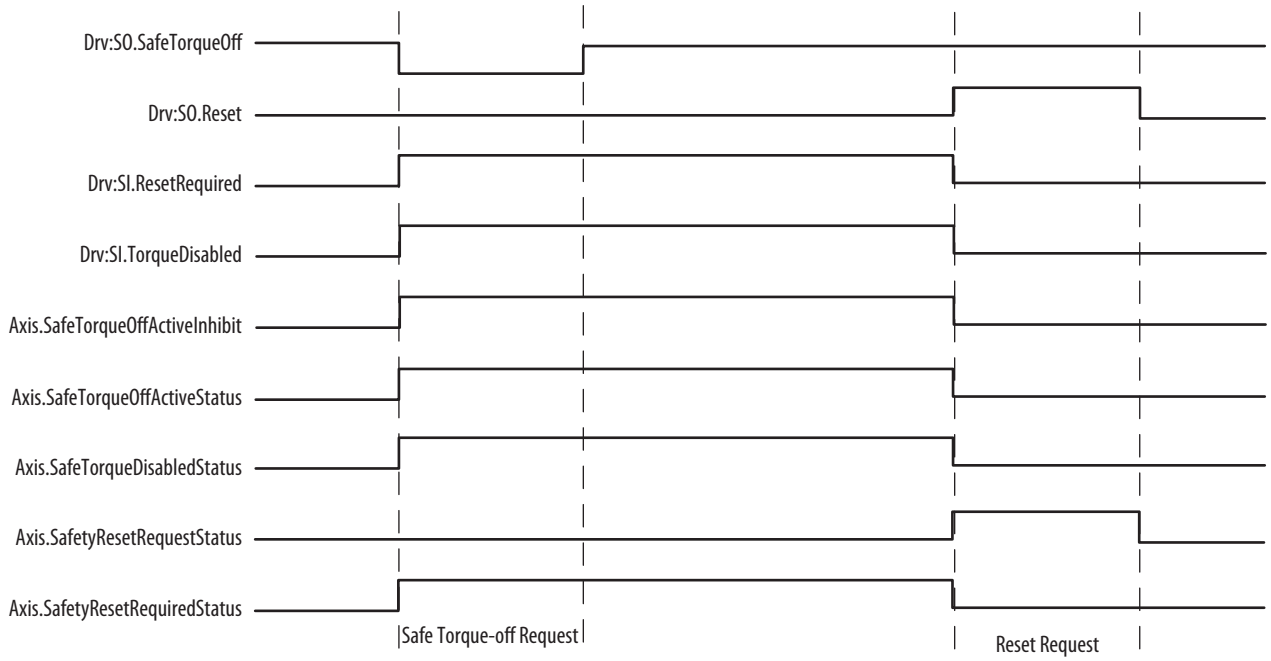
The 2198-H*xxx*-ERS2 servo drives support both manual and automatic restart types for exiting the STO state.

- Manual restart indicates a transition from 0 to 1 on the SO.Reset tag is required to allow torque after the SO.SafeTorqueOff tag has transitioned from 0 to 1.
- Automatic restart indicates torque will be allowed only by transitioning the SO.SafeTorqueOff tag from 0 to 1. The SO.Reset tag is used only for resetting safety faults.

**IMPORTANT** 2198-H*xxx*-ERS2 servo drives enter the STO state if any STO function fault is detected. Refer to Table 76 for integrated safety troubleshooting.

Refer to Figure 77 for an understanding of the 2198-H*xxx*-ERS2 STO-state manual restart functionality.

**Figure 77 - Kinetix 5500 STO Timing Diagram - Manual Restart**




## Troubleshoot the Safe Torque-off Function

**Table 76 - 2198-H*xxx*-ERS2 Servo Drive Troubleshooting**

| Exception Code on Drive Display | Exception Text | Problem | Possible Solutions |
|---|---|---|---|
| SAFE FLT S01- Safety Core Internal | Safety Core Internal | Drive safety diagnostic detected internal STO design failure. | • Cycle control power<br>• Return drive for repair if fault continues |
| SAFE FLT S03- Safe Torque Off | Safe Torque Off | Drive safety diagnostic detected internal STO design failure. | • Cycle control power<br>• Execute STO function<br>• Return drive for repair if fault continues |
| INIT FLT M14 - Safety Firmware | Safety Firmware | The loaded Safety firmware is not compatible with the drive firmware. | • Cycle control power<br>• Update the drive firmware<br>• Return drive for repair if fault continues |

## Probability of Dangerous Failure Per Hour

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 occurring per hour (PFH).

PFH calculation is based on the equations from EN 61508 and show worst-case values. Table 77 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 77 - PFH for 20-year Proof Test Interval**

| Attribute | Value |
|---|---|
| PFH (1e-9) | 1.54 |
| Proof test (years) | 20 |

## Safe Torque-off Feature

The safe torque-off feature, when used with suitable safety components, provides protection according to EN ISO 13849-1 (PLe), Category 3 or according to IEC 61508, EN 61800-5-2, and EN 62061 (SIL CL3). All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding.

The safe torque-off feature is designed to safely turn off all of the output power transistors. You can use the safe torque-off feature in combination with other safety devices to achieve Stop Category 0 and protection-against-restart as specified in IEC 60204-1.



**ATTENTION:** This option is designed to restrict motion producing power 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

The 2198-H*xxx*-ERS2 servo drives ship in the out-of-box state.

**ATTENTION:** In the out-of-box state, motion producing power is allowed by the safe torque-off (STO) function unless an integrated safety connection configuration has been applied to the drive at least once.

In the out-of-box state, you can configure 2198-H*xxx*-ERS2 servo drives:

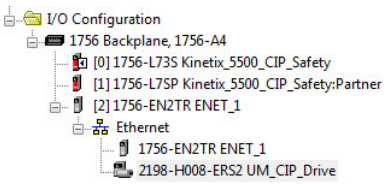
- Without a GuardLogix 5570 safety controller for a non-safety application.
- With a GuardLogix 5570 safety controller when the safe torque-off (STO) function is not required.

## Out-of-Box State Support

After the integrated safety connection configuration is applied to the 2198-H*xxx*-ERS2 servo drive at least once, you can restore the drive to the out-of-box state.

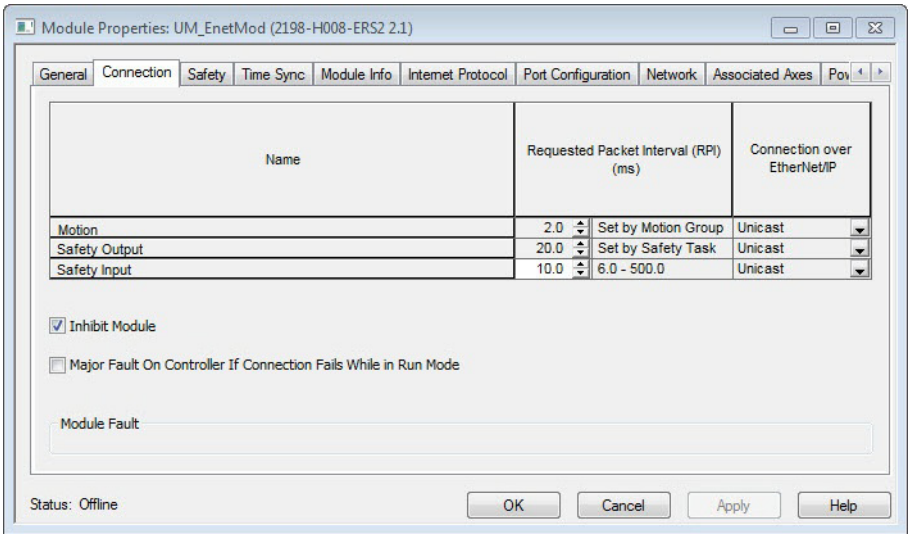
Follow these steps to restore your 2198-H*xxx*-ERS2 servo drive to the out-of-box state.

1. Right-click the 2198-H*xxx*-ERS2 servo drive you created and choose Properties.



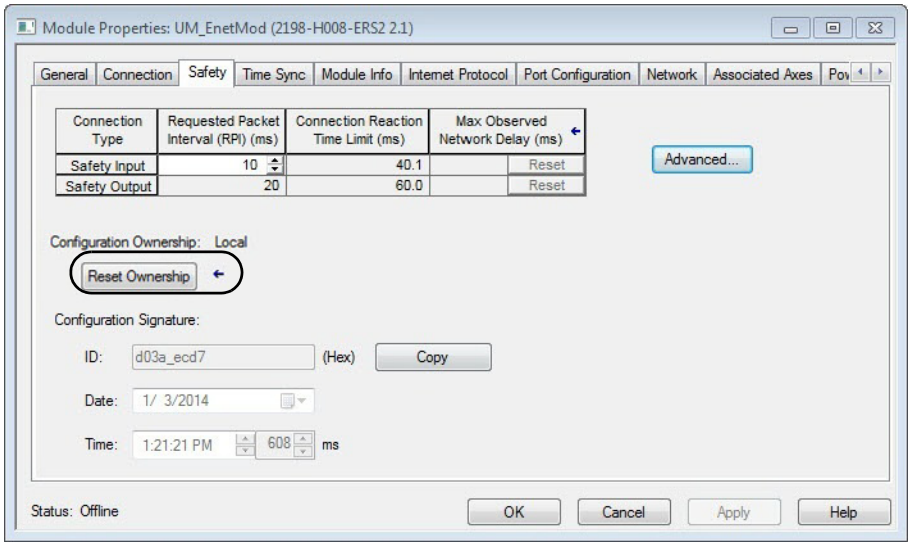

2. Click the Connection tab.

   The Connection tab appears.




3. Check Inhibit Module.
4. Click Apply and click the Safety tab.

The Safety tab appears.




5. In the Configuration Ownership field, click Reset Ownership.

| | |
|---|---|
| **IMPORTANT** | Only authorized personnel should attempt Reset Ownership. |

If any active connection is detected, the reset is rejected.

6. Cycle drive power.

The drive is in the out-of-box state.

| | |
|---|---|
| **IMPORTANT** | If power to the drive is not cycled after Step 5, the drive does not transition to the out-of-box state and maintains STO function. |

| | |
|---|---|
| **IMPORTANT** | When the drive returns to the out-of-box state, STO safety integrity is lost. |

## Understanding 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 a 2198-H*xxx*-ERS2 servo drive was used previously, clear the existing configuration before installing it on a safety network by resetting the drive to its out-of-box condition. To see how this is done, refer to Out-of-Box State Support on page 182. |

Replacing a 2198-H*xxx*-ERS2 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 2198-H*xxx*-ERS2 servo drive.

When the Logix Designer application is online, the Safety tab of the Module Properties dialog box displays the current configuration ownership. When the opened project owns the configuration, Local is displayed.

Configuration Ownership: Local

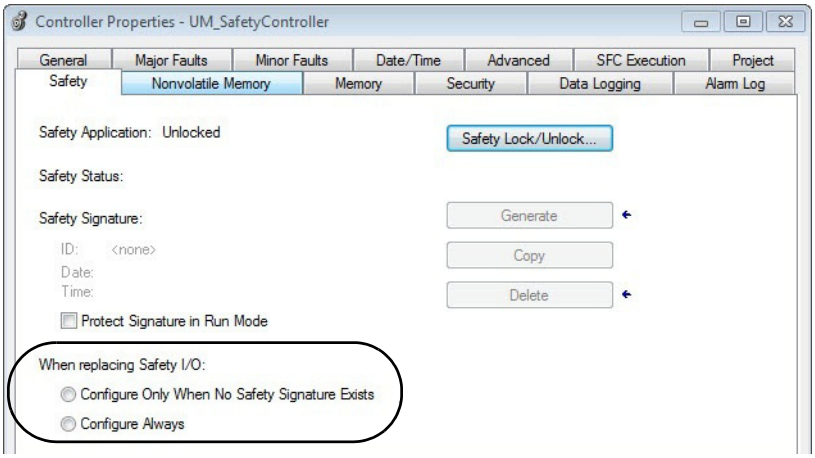
Communication error is displayed if the module read fails. Refer to Replacing an Integrated Safety Drive in a GuardLogix System on page 184 for integrated safety drive replacement examples.

## Replacing an Integrated Safety Drive in a GuardLogix System

Use the Configure Always feature when you are not relying on the entire routable integrated safety control system to maintain PLe/SIL 3 behavior during the replacement and functional testing of a 2198-H*xxx*-ERS2 servo drive. Drive replacement is configured on the Safety tab of the GuardLogix controller.

| **IMPORTANT** | If you are relying on a portion of the integrated safety system to maintain SIL 3 behavior during drive replacement and functional testing, do not use the Configure Always feature. |
|---|---|

**Figure 78 - Setting the SNN with a GuardLogix Controller**



## Replacement with Configure Only When No Safety Signature Exists Enabled

When a 2198-H*xxx*-ERS2 servo drive is replaced and the DeviceID of the new drive matches the original, you can download the configuration from the safety controller. The DeviceID is a combination of the node/IP address and the safety network number (SNN), and is updated whenever the SNN is set.

If the project is configured as Configure Only When No Safety Signature Exists, follow the appropriate instructions in Table 78 to replace a 2198-H*xxx*-ERS2 drive based on your scenario. Once you have completed the steps correctly and the DeviceID matches the original, the safety controller is enabled to download the proper drive configuration and re-establish the safety connection.

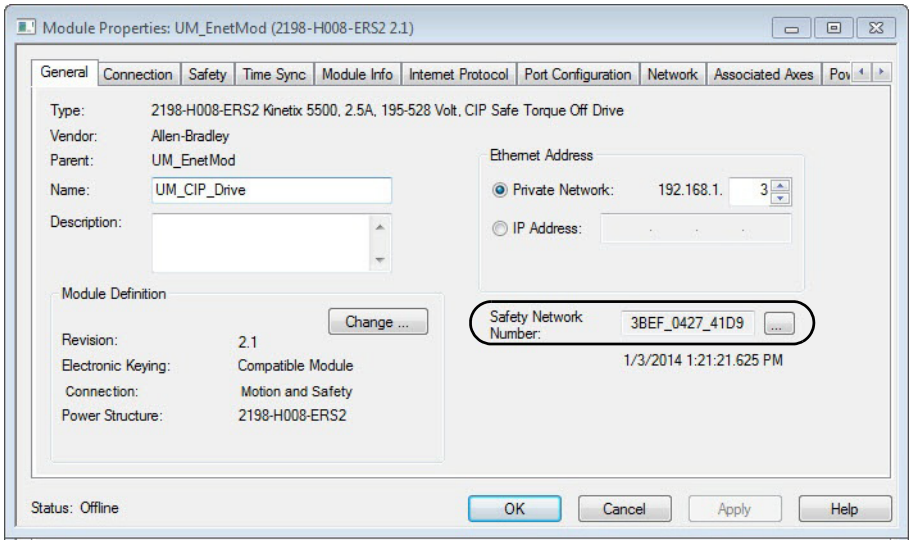
**Table 78 - Replacing a 2198-H*xxx*-ERS2 Servo Drive**

| GuardLogix Safety Signature Exists | Replacement Module Condition | Action Required |
|---|---|---|
| No | No SNN (out-of-box) | None. The module is ready for use. |
| Yes or No | Same SNN as original safety task configuration | |
| Yes | No SNN (out-of-box) | Refer to Scenario 1 on page 185. |
| Yes | Different SNN than original safety task configuration | Refer to Scenario 2 on page 187. |
| No | | Refer to Scenario 3 on page 189. |

*Scenario 1 - Replacement Integrated Safety Drive Is Out-of-box and Safety Signature Exists*

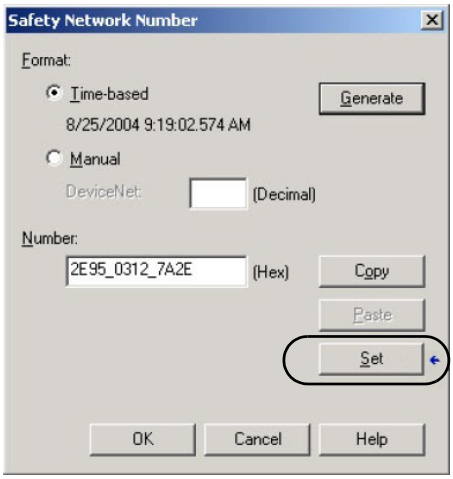
1. Remove and replace the existing integrated safety drive.
2. Right-click the replacement drive and choose Properties.

   The General tab appears in Module Properties dialog box.

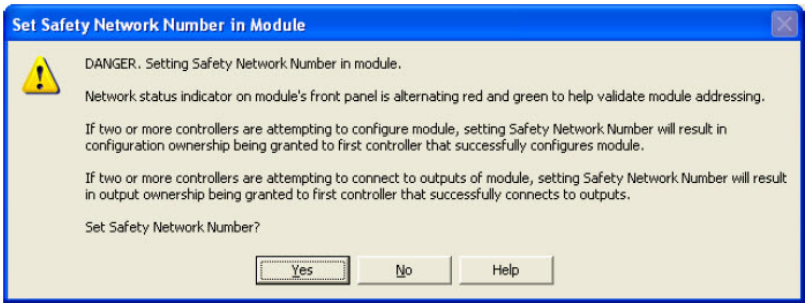



3. Click ... to the right of the safety network number.

The Safety Network Number dialog box appears.




4. Click Set.
5. Verify that the Network Status (NET) status indicator is alternating red/green on the correct drive.

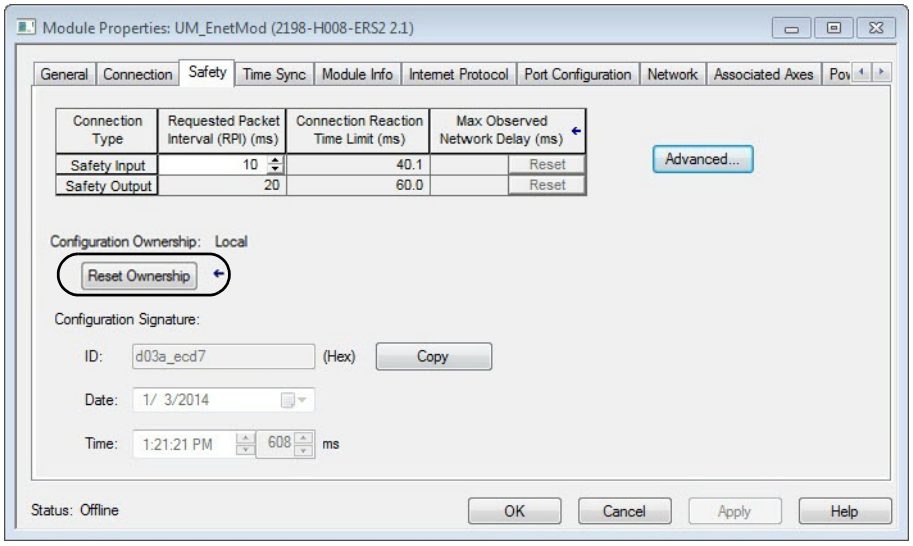



6. Click Yes to set the SNN and accept the replacement drive.

**IMPORTANT** Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use.

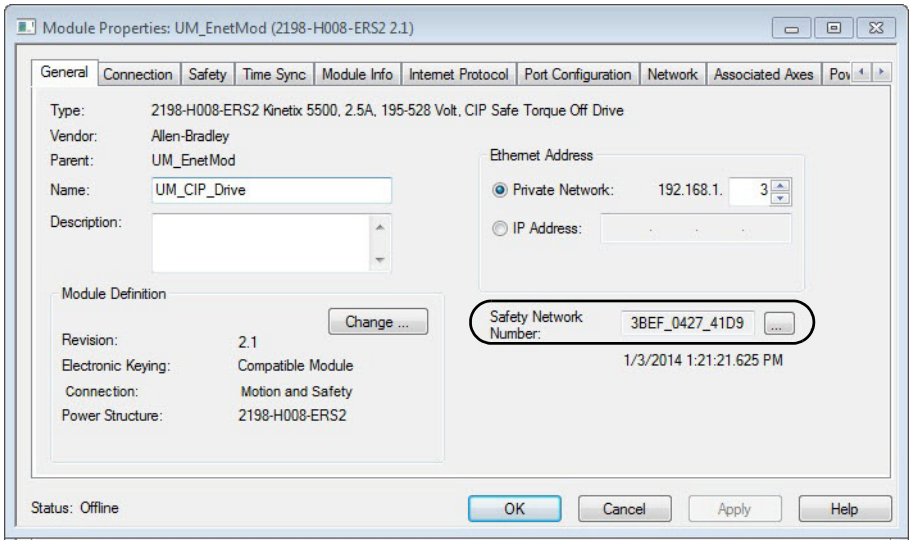
*Scenario 2- Replacement Integrated Safety Drive SNN Is Different from Original and Safety Signature Exists*

1. Remove and replace the existing integrated safety drive.
2. Right-click the replacement drive and choose Properties.
3. Click the Safety tab.



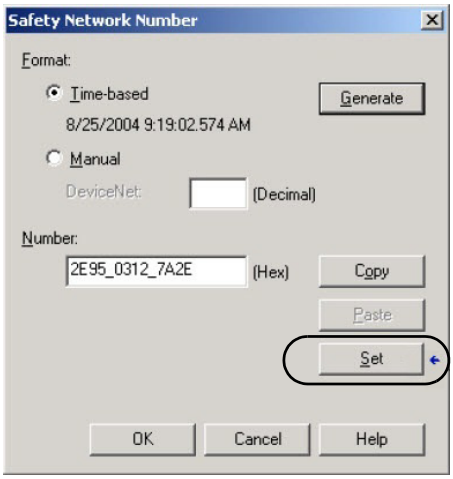

4. Click Reset Ownership.
5. Click OK.
6. Right-click the replacement drive and choose Properties.

   The General tab appears in Module Properties dialog box.

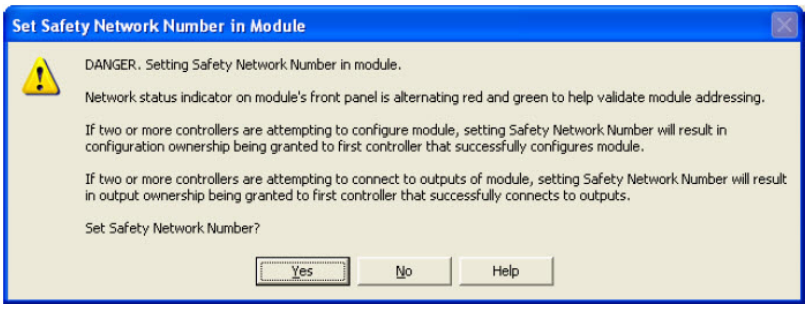



7. Click ... to the right of the safety network number.

The Safety Network Number dialog box appears.



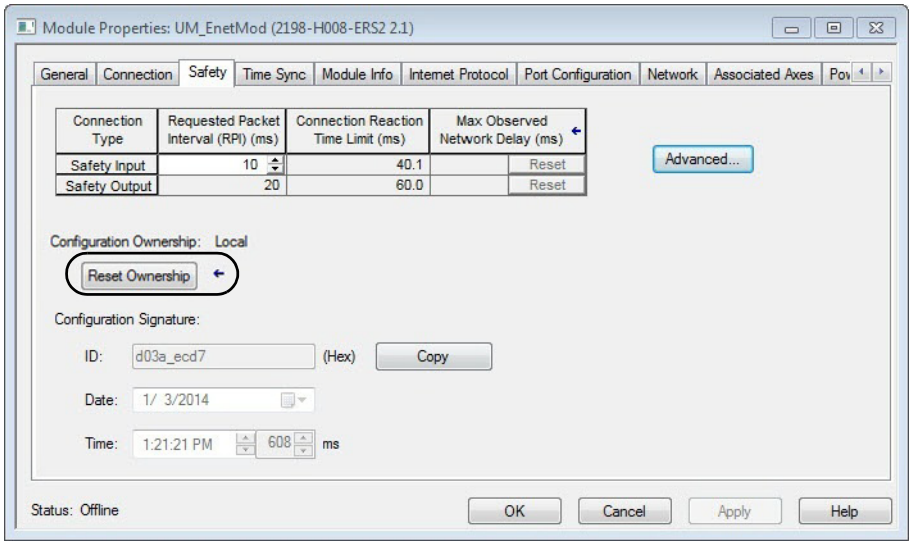

8. Click Set.
9. Verify that the Network Status (NET) status indicator is alternating red/green on the correct drive.




**IMPORTANT** Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use.

*Scenario 3- Replacement Integrated Safety Drive SNN Is Different from Original and No Safety Signature Exists*

1. Remove and replace the existing integrated safety drive.
2. Right-click the replacement drive and choose Properties.
3. Click the Safety tab.




4. Click Reset Ownership.
5. Click OK.

| **IMPORTANT** | Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use. |
|---|---|

## Replacement with Configure Always Enabled

**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 2198-H*xxx*-ERS2 servo drive. Do not place drives that are in the out-of-box condition on an integrated safety network when the Configure Always feature is enabled, except while following this replacement procedure.

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 out-of-box condition or has an SNN that matches the configuration

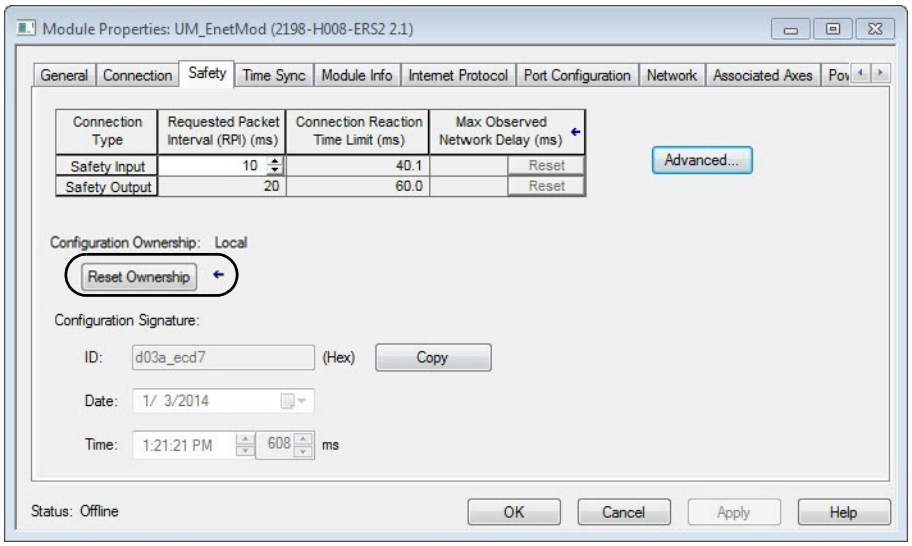
If the project is configured for Configure Always, follow the appropriate steps to replace a 2198-H*xxx*-ERS2 servo drive.

Follow these steps when the Configure Always feature is enabled.

1. Remove and replace the existing integrated safety drive.

| If | Then |
|---|---|
| The drive is in out-of-box condition | Go to step .<br>No action is needed for the GuardLogix controller to take ownership of the drive. |
| An SNN mismatch error occurs | Go to the next step to reset the drive to out-of-box condition. |

2. Right-click the replacement drive and choose Properties.
3. Click the Safety tab.




4. Click Reset Ownership.
5. Click OK.

**IMPORTANT** Follow your company-prescribed procedures to functionally test the replacement drive and system and to authorize the system for use.

## 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 do 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

### Understanding STO Bypass When Using Motion Direct Commands

If a Safety-only connection between the GuardLogix safety controller and the 2198-H*xxx*-ERS2 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 dual-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, 2198-H*xxx*-ERS2 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 machine safety operating procedures.



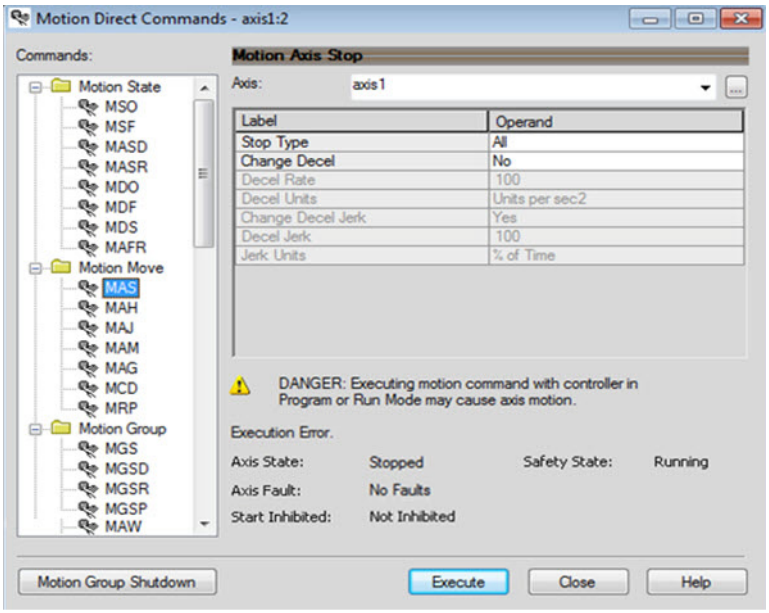
**ATTENTION:** Consider the consequences of allowing motion through the use of MDC when the controller is in Program mode. You must acknowledge warning messages in the Logix Designer application that warn of the drive bypassing the STO function and unintended motion can occur. The integrated safety drive does not respond to the request of STO function if MDC mode is entered.

**ATTENTION:** 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

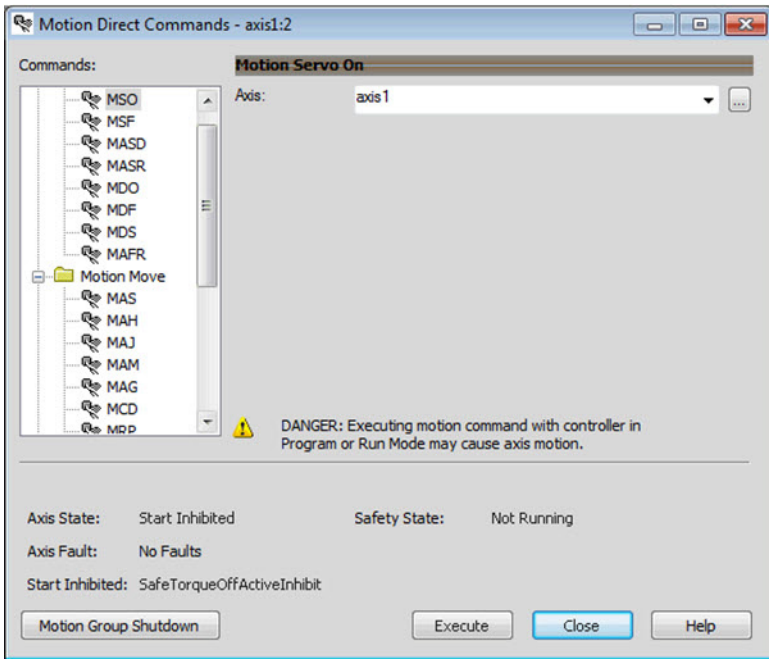
When the controller is in Run mode, executing safety functions, the 2198-H*xxx*-ERS2 drive follows the commands that it receives from the safety controller. Safety state = Running, Axis state = Stopped/Running, as shown in Figure 79.

**Figure 79 - Safety State Indications When Controller is in Run Mode (safety task executing)**



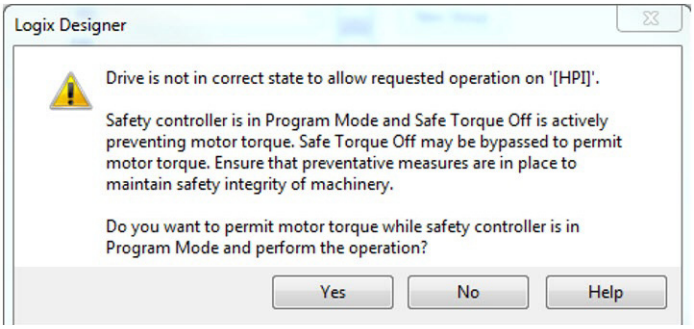

When the controller transitions to Program mode, the integrated safety drive is in the safe state (torque not permitted). Safety state = Not Running, Axis state = Start Inhibited, as shown in Figure 80).

**Figure 80 - 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 81.

**Figure 81 - STO Bypass Prompt When the Safety Controller is in Program Mode**

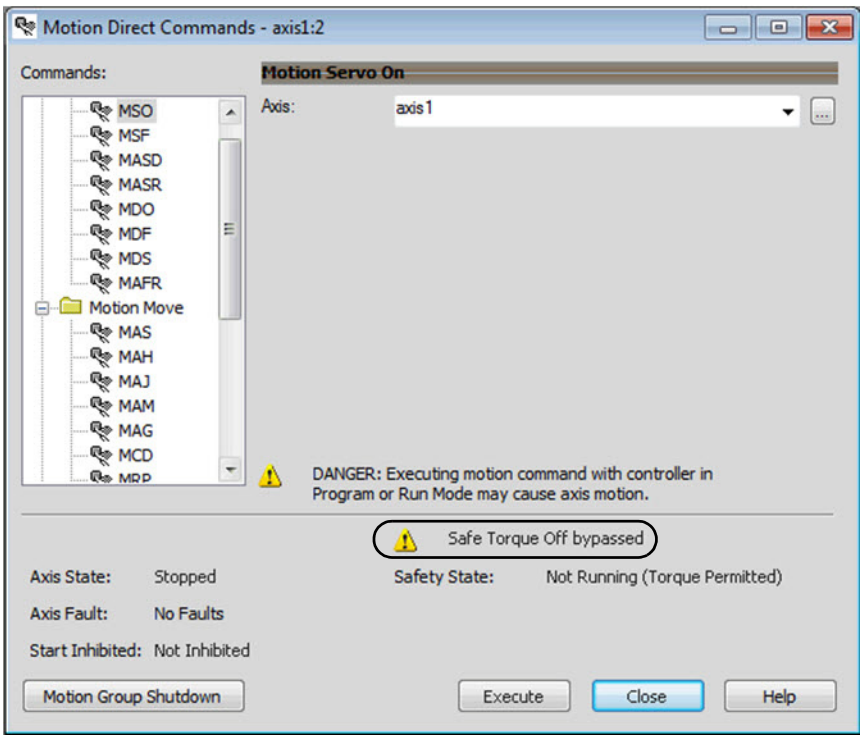



The warning in Figure 81 is displayed the first time a motion direct command is issued.

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 82. Safety state = Not Running (torque permitted), Axis state = Stopped/ Running, Persistent Warning = Safe Torque Off Bypassed.

**IMPORTANT** Switch the controller to Run mode to exit Motion Direct Command mode with STO function bypassed.

**Figure 82 - Safety State Indications After Controller Transitions to Program Mode (MDC executing)**

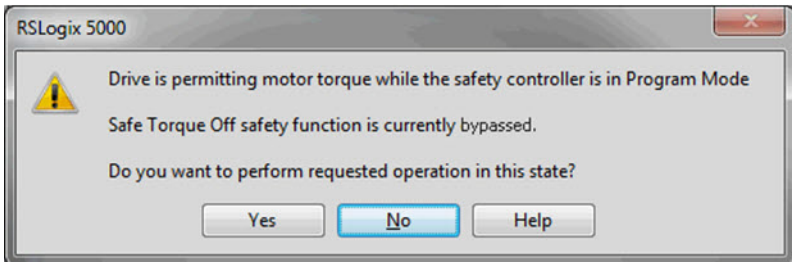


| | |
|---|---|
| **IMPORTANT** | The persistent warning message text Safe Torque Off bypassed appears when a motion direct command is executed.<br>Warning message persists even after the dialog is closed and reopened as long as the integrated safety drive is in STO Bypass mode.<br>The persistent warning message is removed only after the integrated safety drive is restored to the Safe state. |

## Torque Permitted in a Multi-workstation Environment

The warning in Figure 83 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 83 - 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 84 - Axis and Safe State Indications on the Hookup Services Dialog Box**

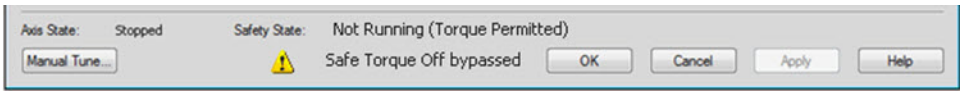


**Figure 85 - Axis and Safe State Indications on Motion Direct Commands Dialog Box**

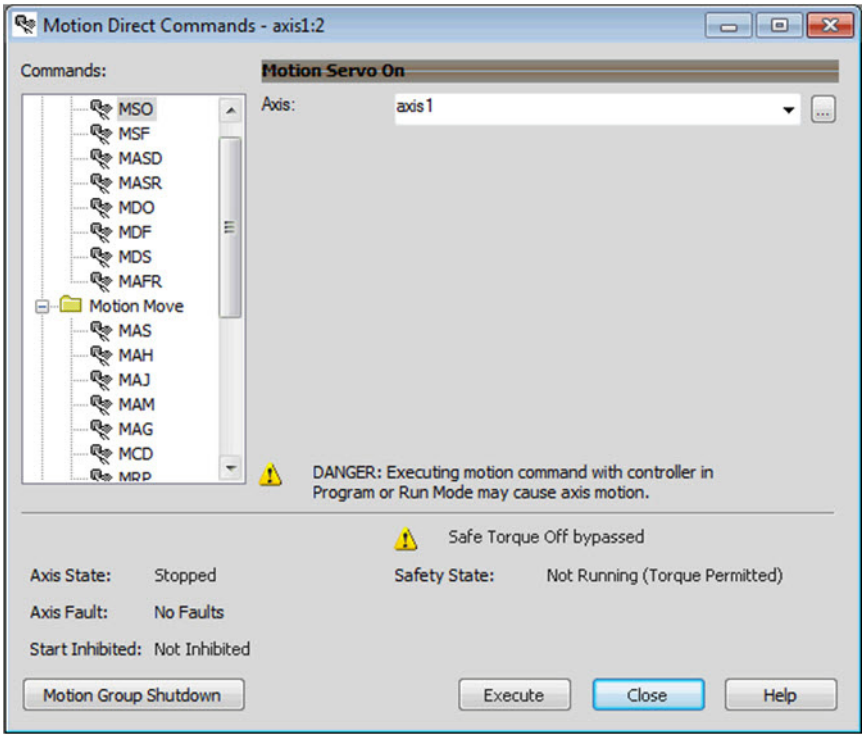
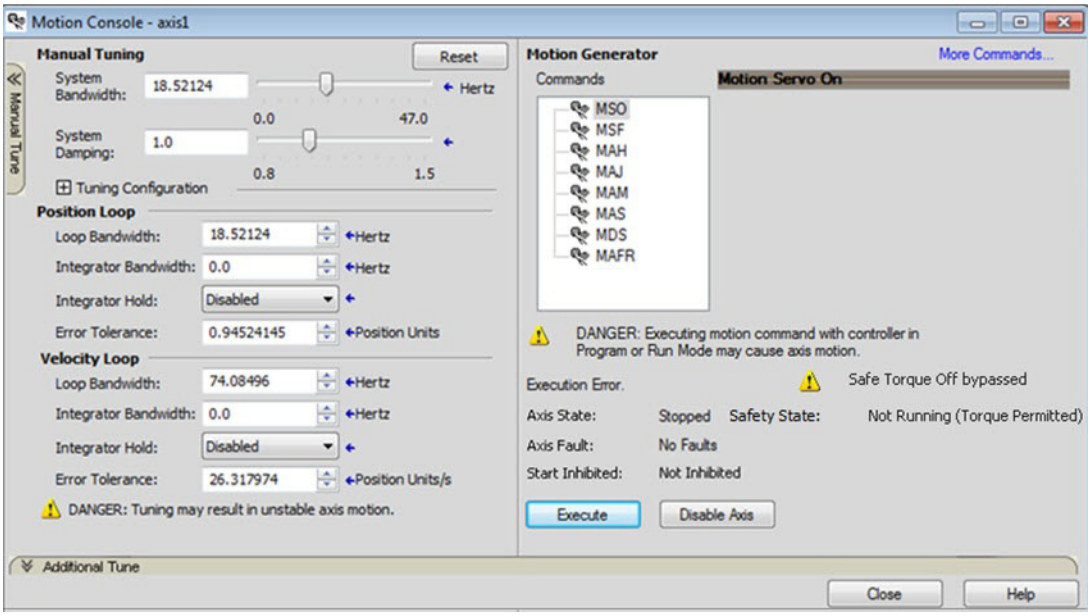



**Figure 86 - Axis and Safe State Indications on the Motion Console Dialog Box**



## 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 when motion direct commands are used in Program mode and STO function is not available.
Motion direct commands issued when the controller is in Program mode causes 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.

## Safe Torque-off Specifications

To maintain safety rating, Kinetix 5500 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 79 - Safe Torque-off Network Specifications**

| Attribute | Value | Logix Designer Tag Name |
|---|---|---|
| Safety connection RPI, min | 6 ms | N/A |
| Input assembly connections | 3 | N/A |
| 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 80 - Safe Torque-off Assembly Specifications**

| Attribute | Instance Attribute | Value | Logix Designer Tag Name |
|---|---|---|---|
| Safety input assembly | 0X1A0 | Bit 0: Torque disabled | Drv:SI.TorqueDisabled |
| | | Bit 6: Safety fault | Drv:SI.SafetyFault |
| | | Bit 7: Reset required | Drv:SI.ResetRequired |
| Safety output assembly | 0X180 | Bit 0: Safe torque-off output | Drv:SO.SafeTorqueOff |
| | | Bit 7: Reset request | Drv:SO.Reset |

## Notes:

# Interconnect Diagrams

This appendix provides wiring examples and system block diagrams for your Kinetix 5500 system components.


| Topic | Page |
|---|---|
| Interconnect Diagram Notes | 199 |
| Power Wiring Examples | 200 |
| Bus-sharing Wiring Examples | 202 |
| Shunt Resistor Wiring Example | 204 |
| Kinetix 5500 Drive and Motor/Actuator Wiring Examples | 205 |
| System Block Diagrams | 210 |


## Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 5500 drive system. These notes apply to the wiring examples on the pages that follow.

| Note | Information |
|---|---|
| 1 | For power wiring specifications, refer to Wiring Requirements on page 78. |
| 2 | For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Selection on page 31. |
| 3 | 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 GMC-TD003. |
| 4 | Terminal block is required to make connections. |
| 5 | Cable shield clamp must be used to meet CE requirements. |
| 6 | PE ground connection bonded to the panel must be used to meet CE requirements. |
| 7 | DC connector covered with protective knockout is default configuration. Remove knockout to insert DC bus T-connector and bus-bars. Do not attach discrete wiring to the DC bus terminals is. |
| 8 | Internal shunt wired to the RC connector is default configuration. Remove internal shunt wires to attach external shunt wires. |
| 9 | Default configuration for ground screws is for grounded power at user site. For ungrounded or corner-grounded power, remove the screws. Refer to Determine the Input Power Configuration on page 71 for more information. |
| 10 | **ATTENTION:** Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards ISO 14121-1 and EN ISO 13849-1 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication SHB-900. |
| 11 | For motor cable specifications, refer to Kinetix Motion Accessories Specifications Technical Data, publication GMC-TD004. |
| 12 | MPL-A15*xx*...MPL-A45*xx*, MPM-A115*xx*...MPM-A130*xx*, MPF-A3*xx*...MPF-A45*xx*, MPS-A*xxx*, MPAR-A*xxx*, MPAS-A*xxx*, and LDAT-S*xx*-*x*B*x* encoders use the +5V DC supply. |
| 13 | MPL-B*xx*, MPL-A5*xx*, MPM-B*xx*, MPM-A165*xx*...MPM-A215*xx*, MPF-B*xx*, MPF-A5*xx*, MPS-B*xxx*, MPAR-B*xxx*, MPAS-B*xxx*, and LDAT-S*xx*-*x*D*x* encoders use the +9V DC supply. |
| 14 | Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and ⏚ (GND) or A, B, C, and ⏚ (D) respectively. |
| 15 | LDAT-Series linear thrusters do not have a brake option, so only the 2090-CPWM7DF-*xx*AA*xx* or 2090-CPWM7DF-*xx*AF*xx* motor power cables apply. |

# Power Wiring Examples

You must supply input power components. The single-phase and three-phase line filters are wired downstream of the circuit protection.

## Single-axis Drive Wiring Examples

**Figure 87 - Kinetix 5500 Drives Power Wiring (three-phase operation)**

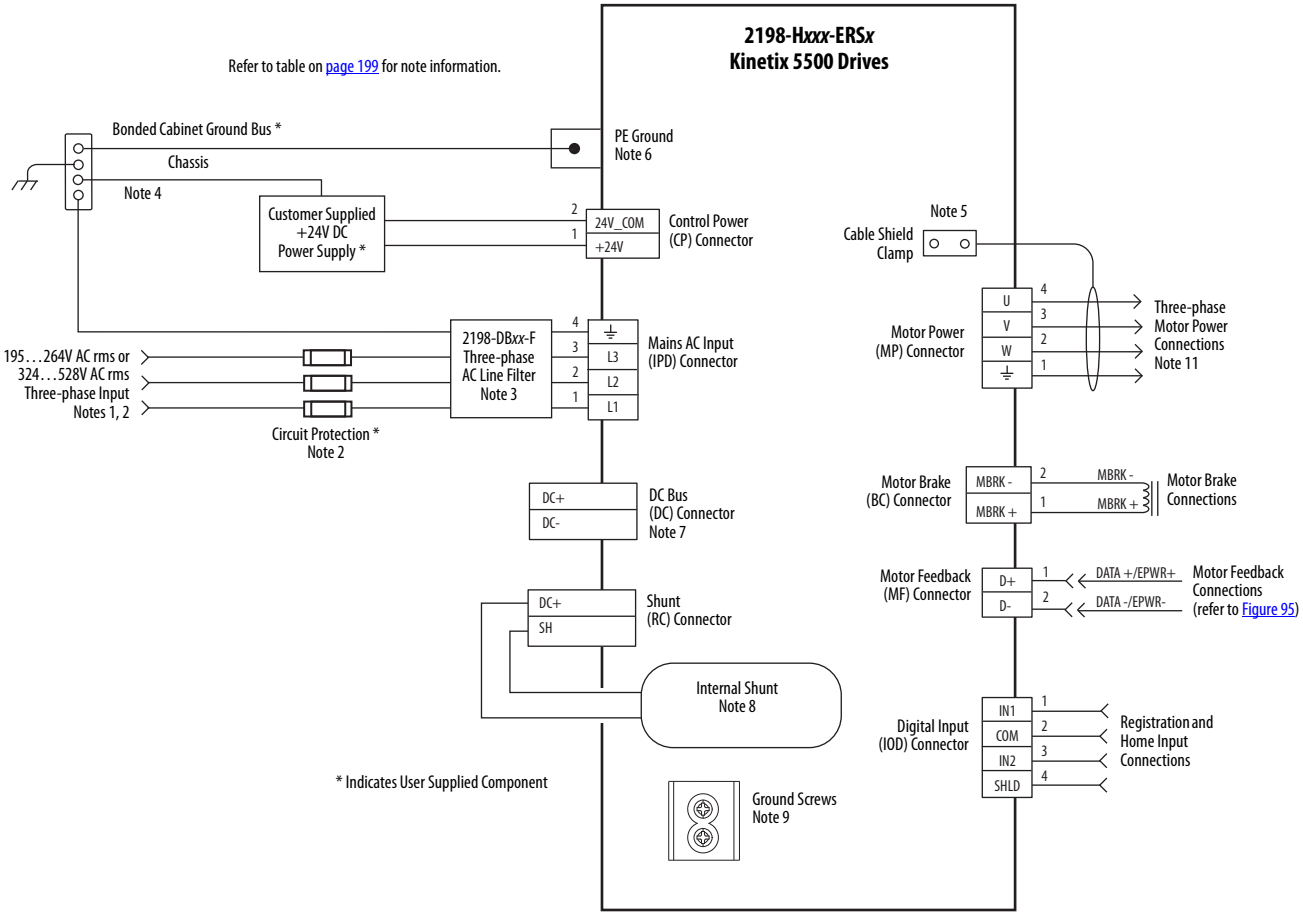


**Figure 88 - Kinetix 5500 Drives Power Wiring (single-phase operation)**

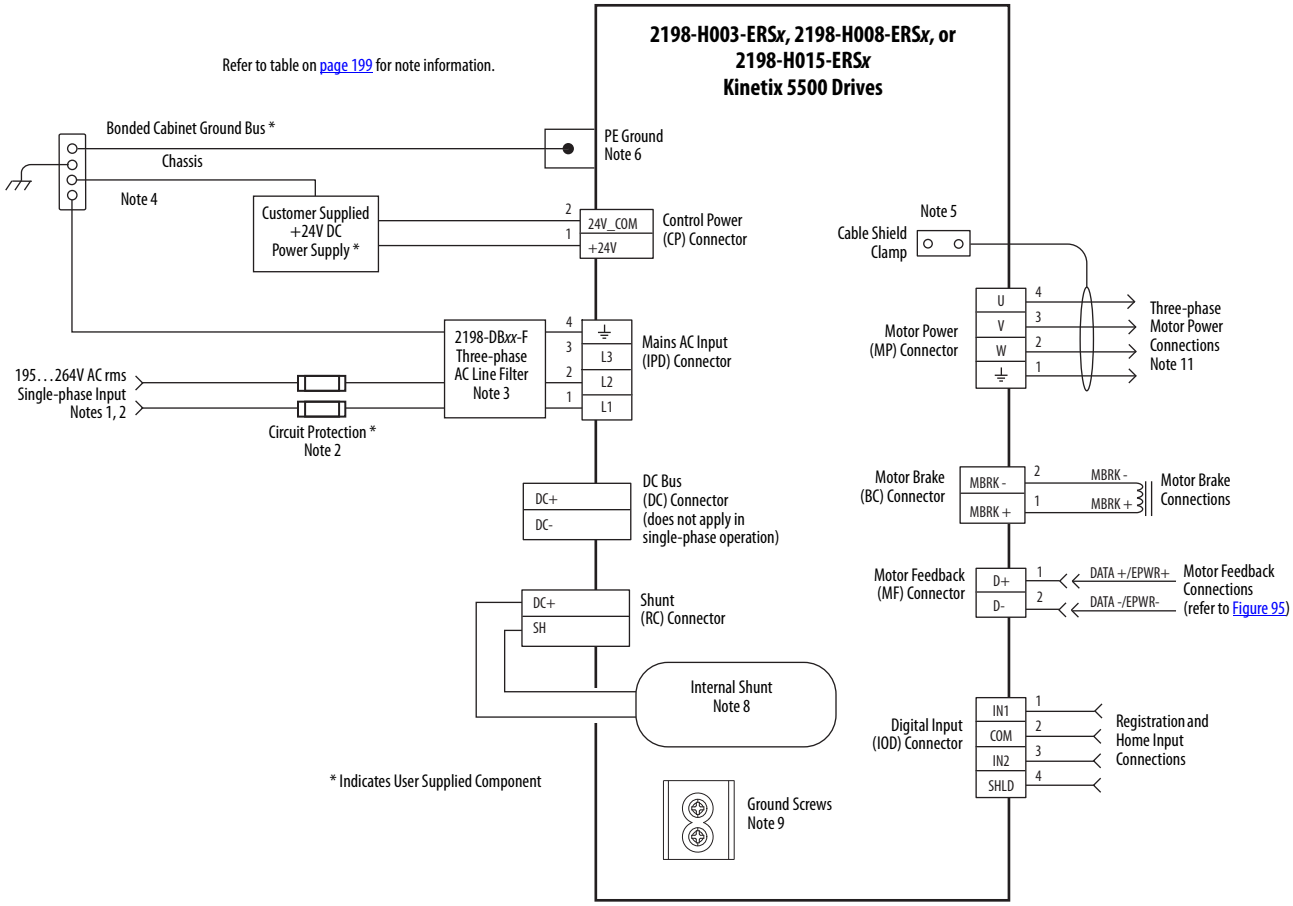
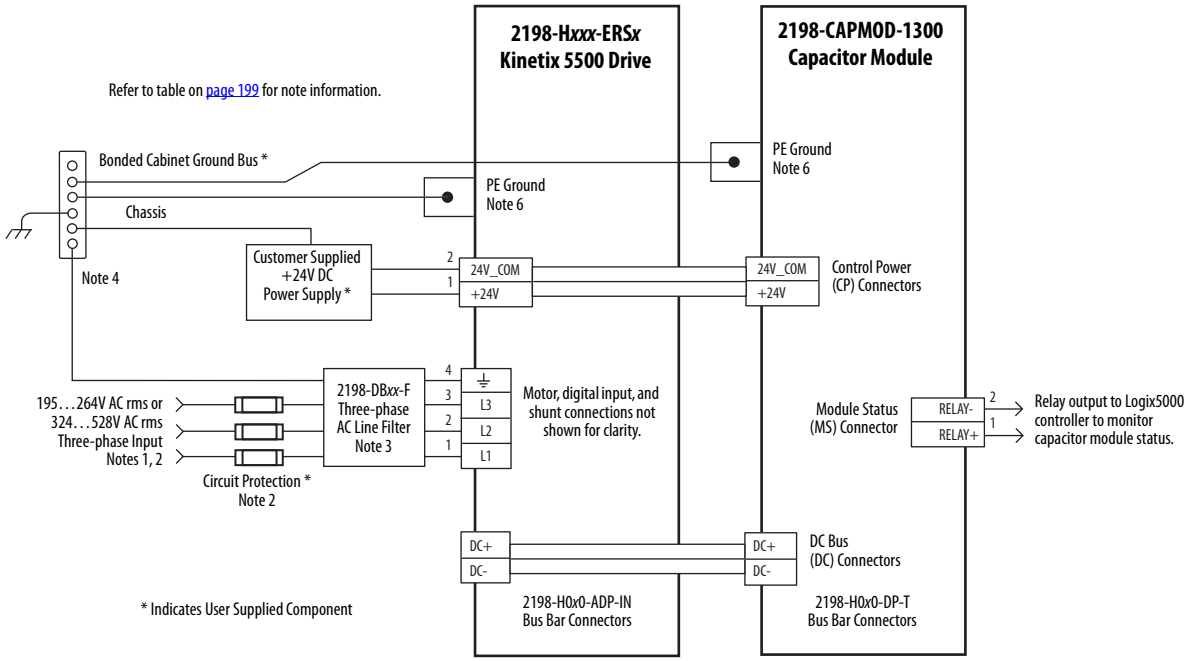



**Figure 89 - Kinetix 5500 Capacitor Module**



## Bus-sharing Wiring Examples

For bus-sharing configurations, use the 2198-H0*x*0-*xx-x* shared-bus connection system to extend power from drive to drive.

**Figure 90 - Kinetix 5500 Drives with Shared AC Bus**

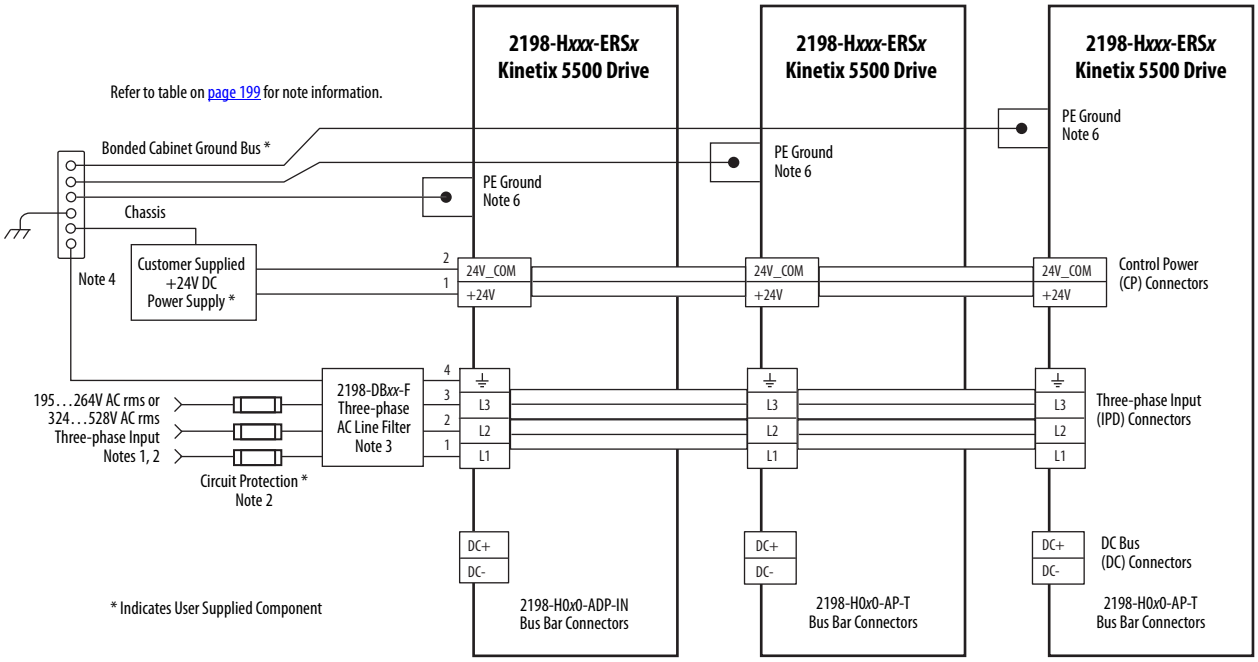



**Figure 91 - Kinetix 5500 Drives with Shared AC/DC Bus**

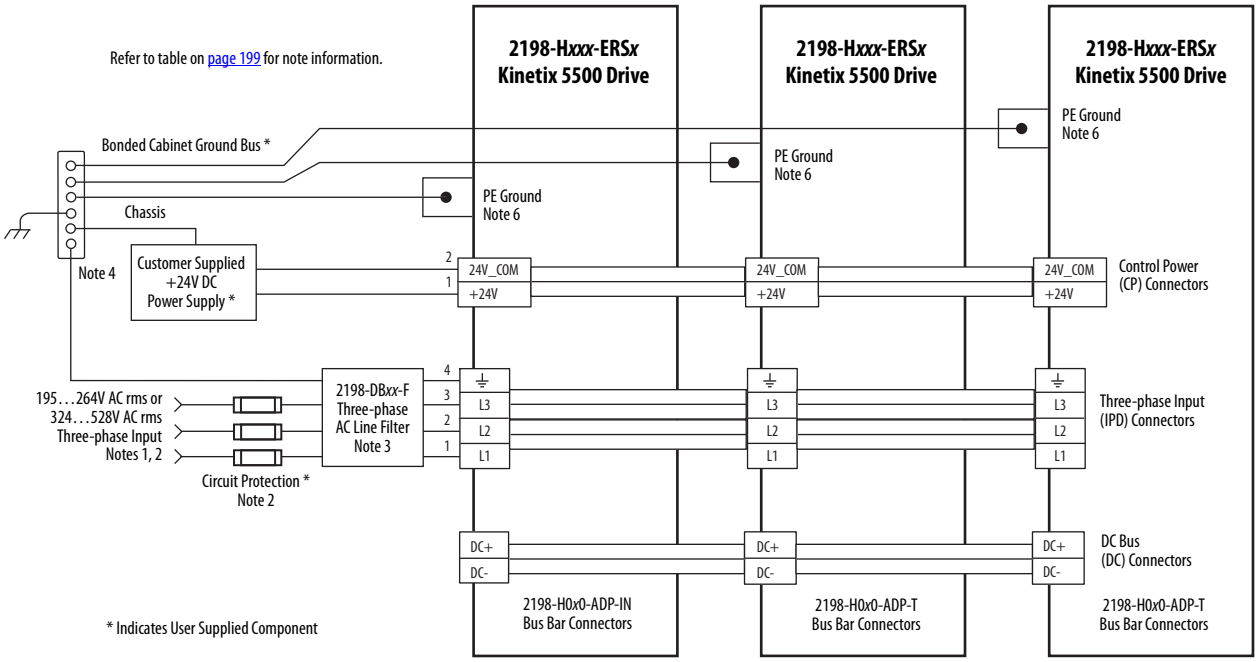


**Figure 92 - Kinetix 5500 Drives with Shared DC (common bus)**

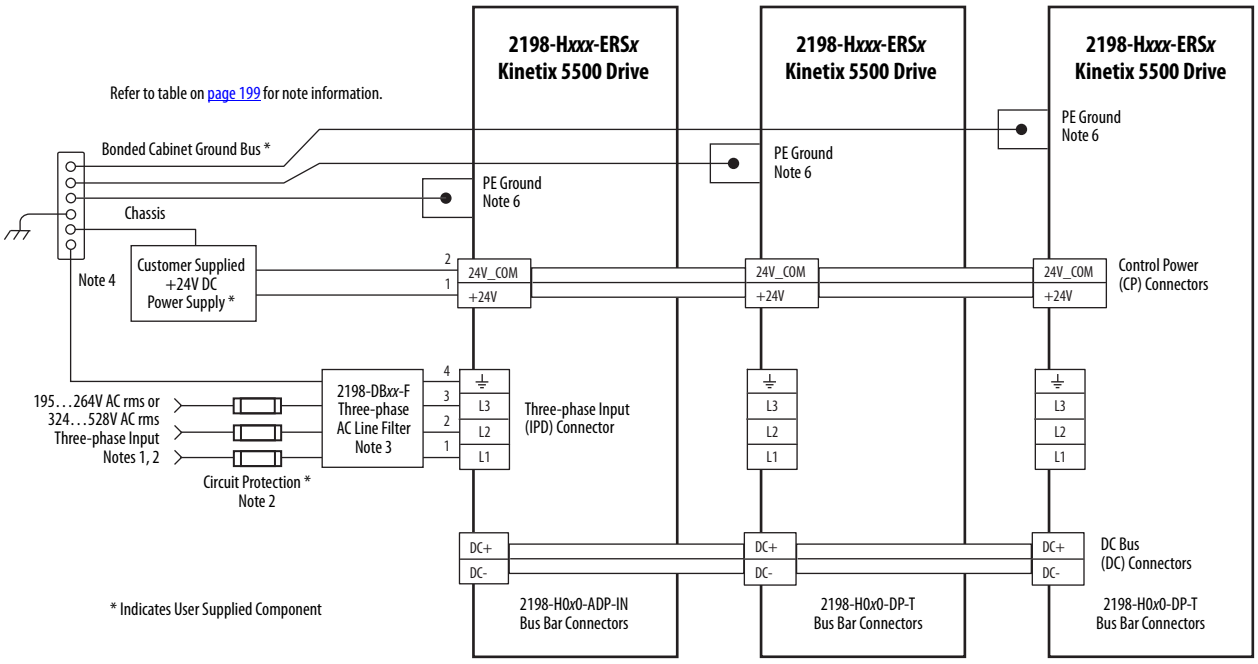
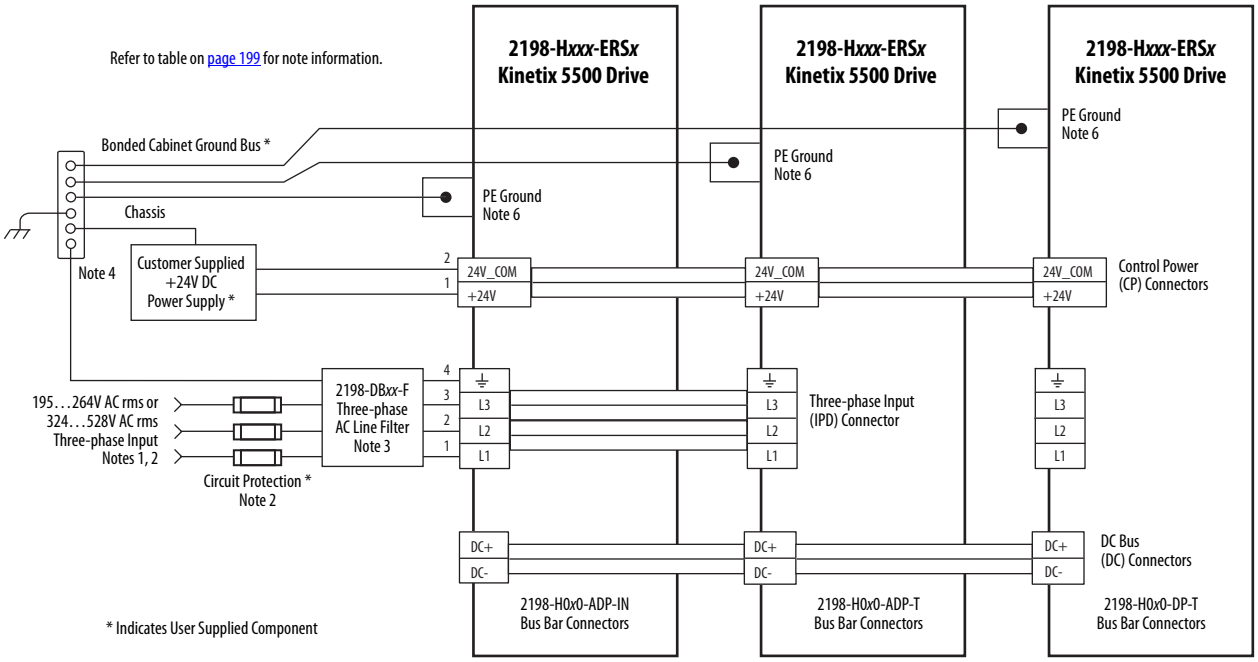



**Figure 93 - Kinetix 5500 Drives with Shared AC/DC Hybrid Bus**

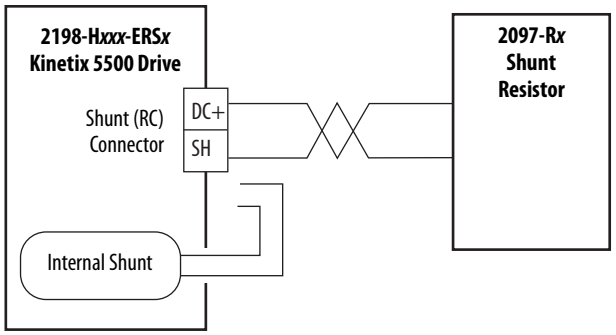


## Shunt Resistor Wiring Example

Refer to the External Passive-shunt Resistor Connections on page 99 for the Bulletin 2097 external shunt resistor catalog numbers available for Kinetix 5500 servo drives.

**IMPORTANT** Before wiring the Bulletin 2097 external shunt to the RC connector, remove the wires from the servo drive internal shunt. Do not connect internal and external shunt resistors to the drive.

**Figure 94 - Shunt Resistor Wiring Example**

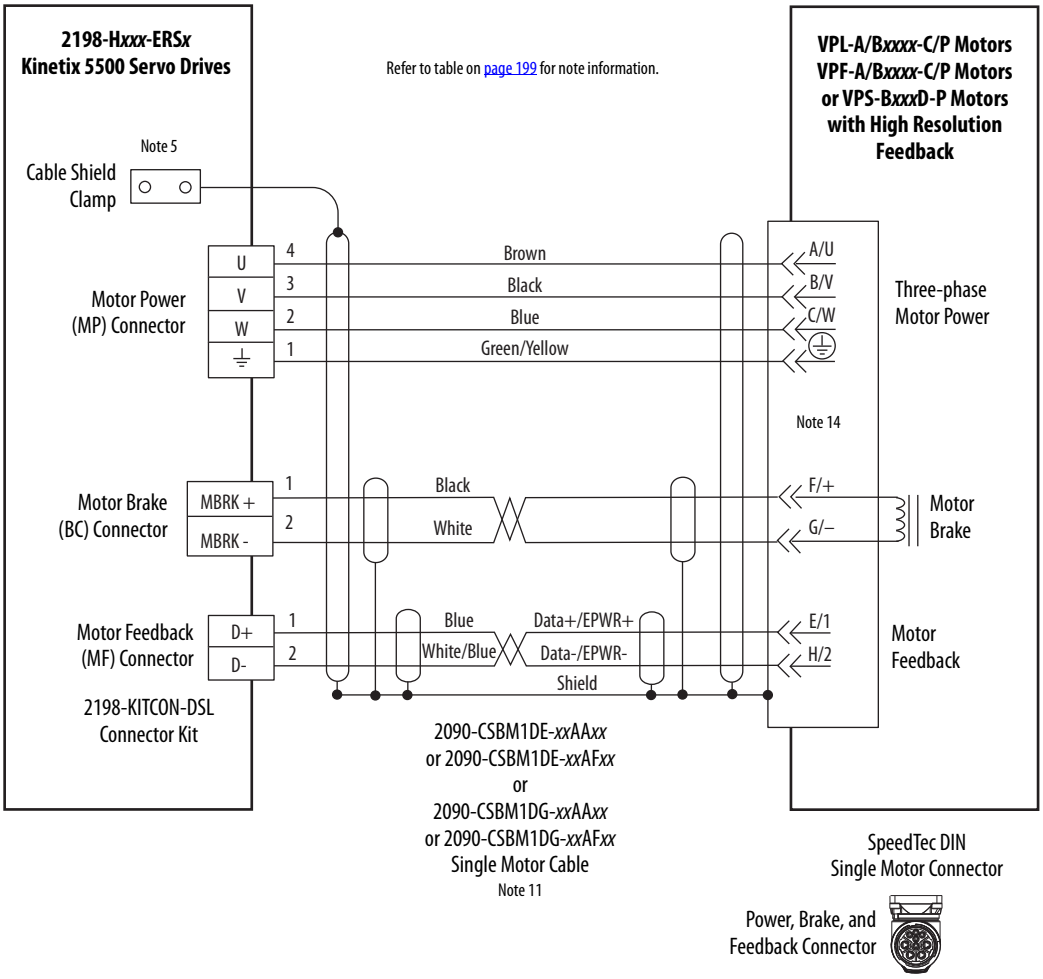



Refer to the Kinetix 300 Shunt Resistor Installation Instructions, publication 2097-IN002, for shunt resistor installation instructions.

## Kinetix 5500 Drive and Motor/Actuator Wiring Examples

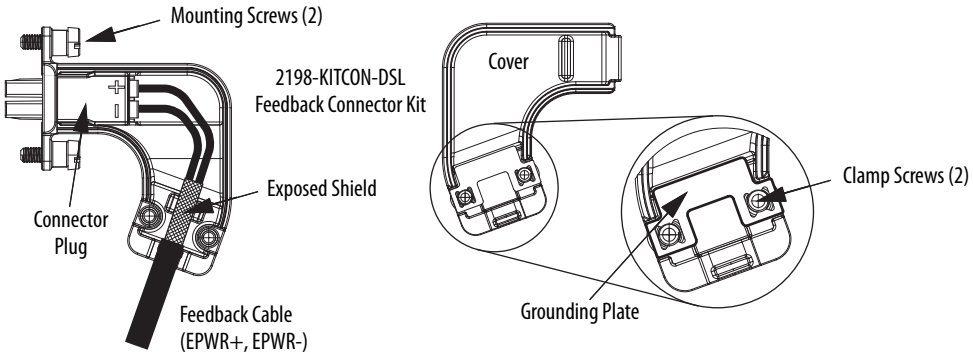
The Kinetix VP motors use single cable technology. The motor power, brake, and feedback wires are all packaged in a single cable.

**Figure 95 - Kinetix 5500 Drives with Kinetix VP Motors (Bulletin VPL, VPF, and VPS)**




2090-CS*x*M1DF cables have flying-lead conductors designed specifically for Kinetix 5500 servo drives. 2090-CS*x*M1DG cables have flying-leads that are longer than 2090-CS*x*M1DF cables to accommodate Kinetix 5500 or Kinetix 5700 servo drives.

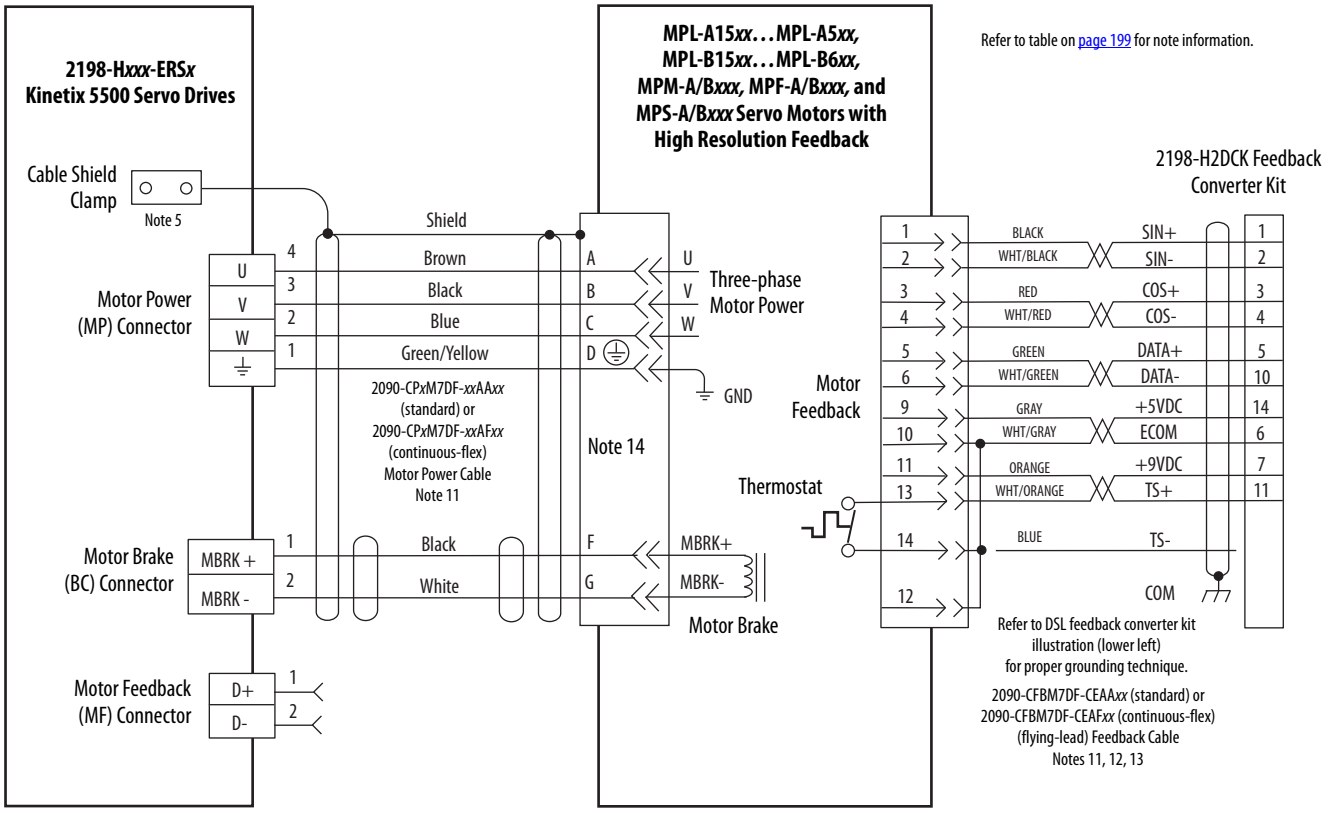
**Figure 96 - Grounding Technique for Feedback Cable Shield**



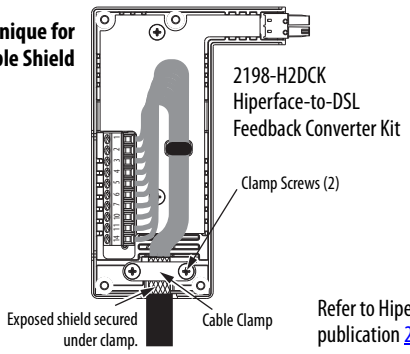

Refer to Kinetix 5500 Feedback Connector Kit Installation Instructions, publication 2198-IN002, for connector kit specifications.

Compatible Allen-Bradley rotary motors (Bulletin MPL, MPM, MPF, and MPS) and linear actuators (Bulletin MPAS, MPAR, MPAI, and LDAT-Series) have separate connectors and cables for power/brake and feedback connections.

**Figure 97 - Kinetix 5500 with MP-Series Rotary Motors**




**Grounding Technique for Feedback Cable Shield**

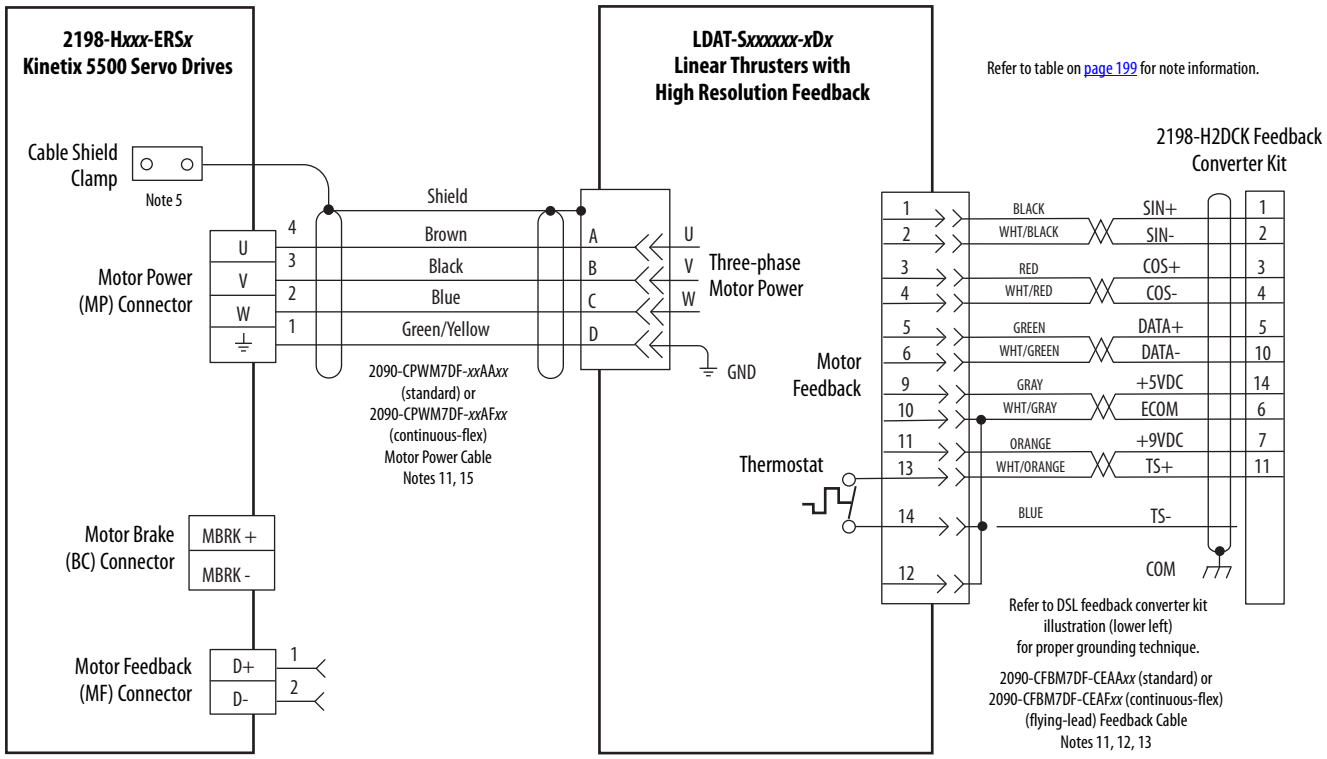


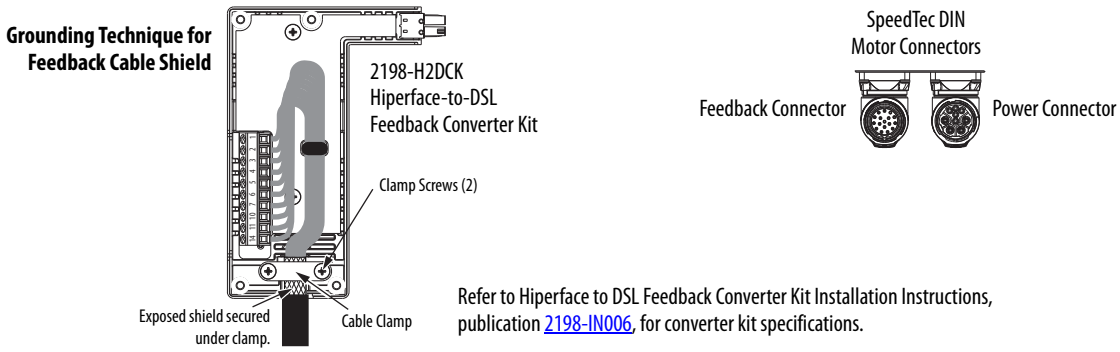

SpeedTec DIN
Motor Connectors




Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006, for converter kit specifications.

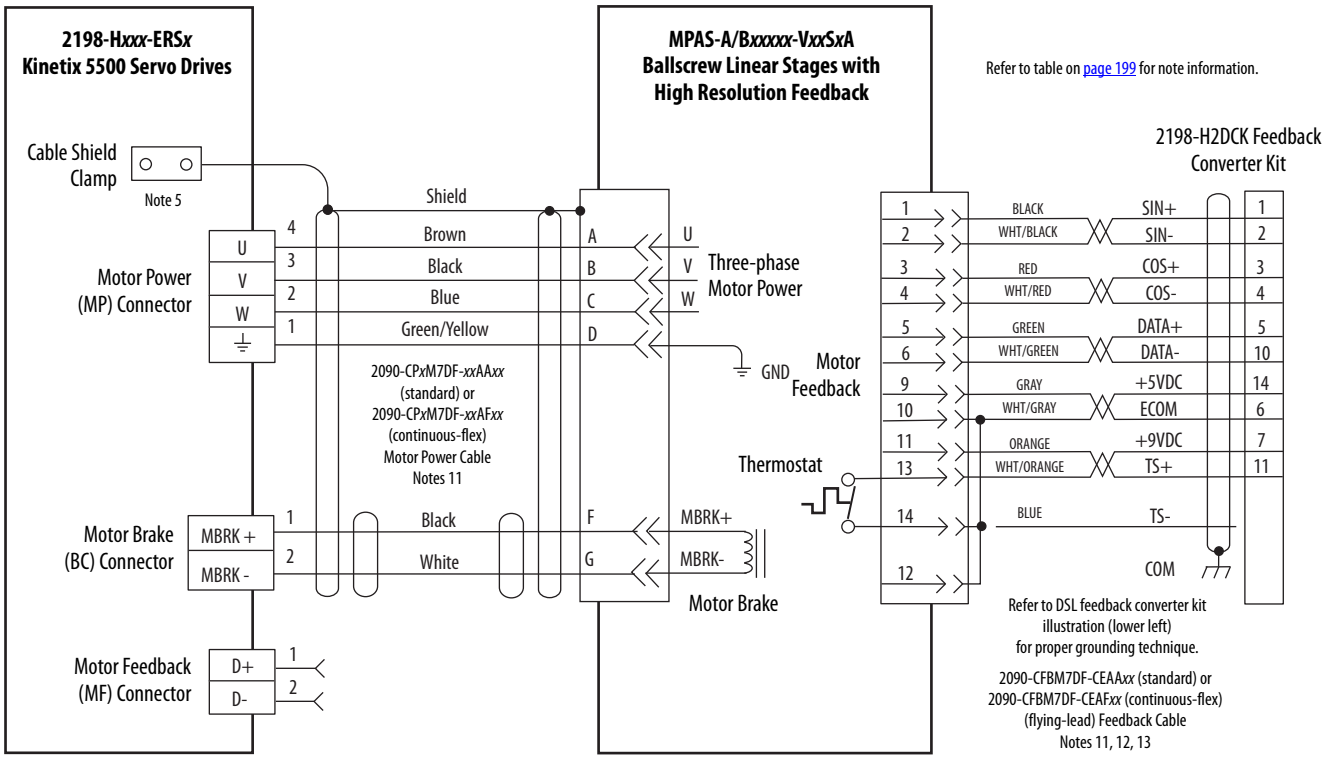
**Figure 98 - Kinetix 5500 with LDAT-Series Linear Thrusters**



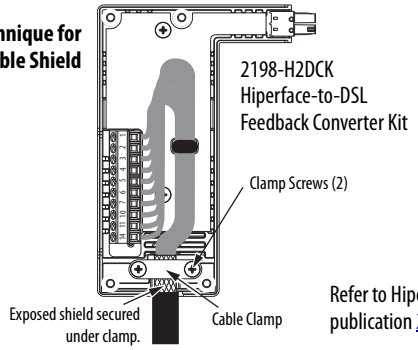




Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006, for converter kit specifications.

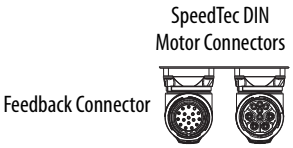
**Figure 99 - Kinetix 5500 with MP-Series Linear Stages**




**Grounding Technique for Feedback Cable Shield**

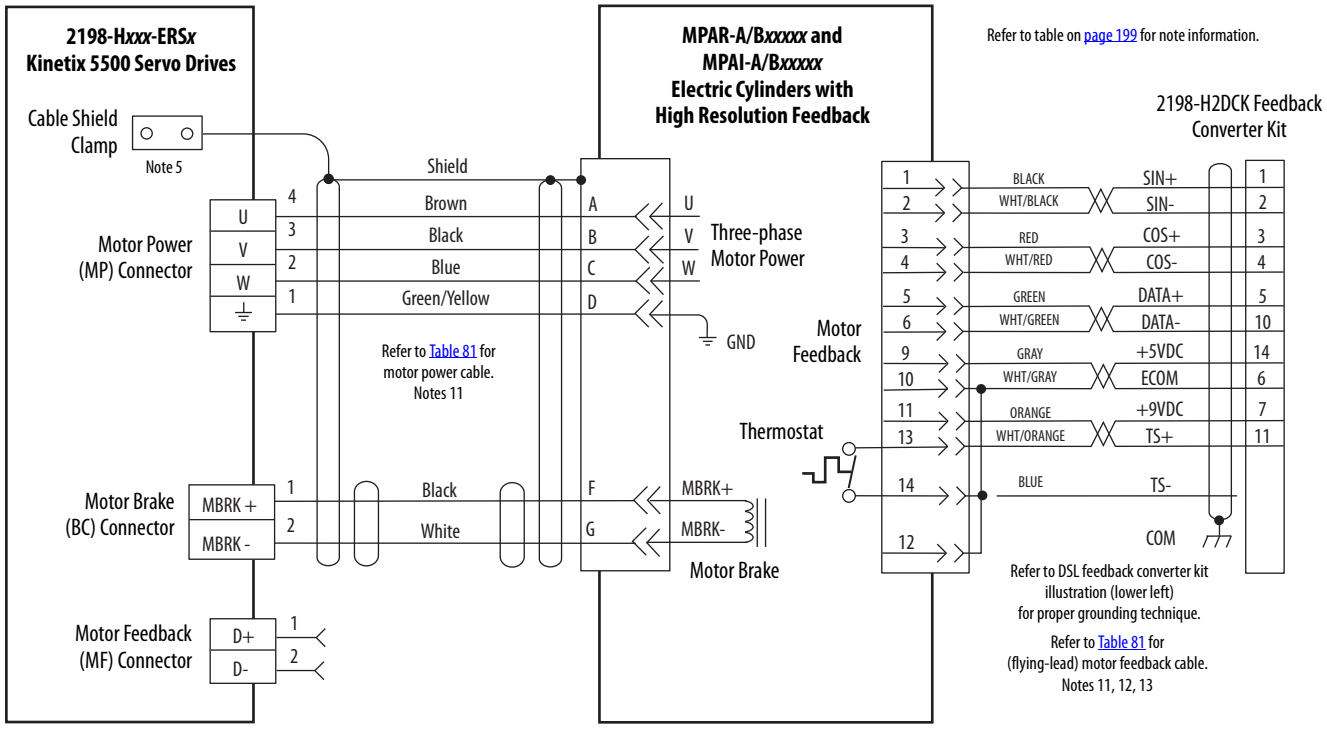


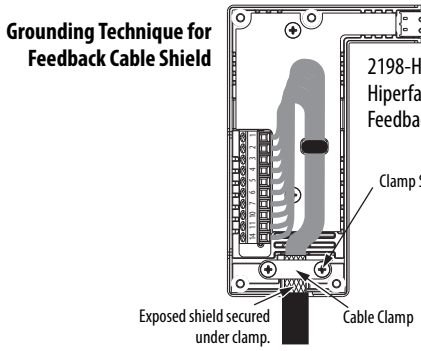

SpeedTec DIN
Motor Connectors

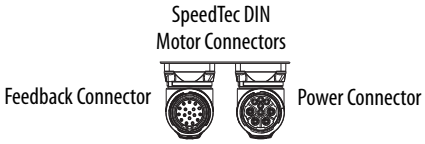



Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006, for converter kit specifications.

**Figure 100 - Kinetix 5500 with MP-Series Electric Cylinders**




Refer to Hiperface to DSL Feedback Converter Kit Installation Instructions, publication 2198-IN006, for converter kit specifications.

**Table 81 - MP-Series Electric Cylinder Power and Feedback Cables**

| MP-Series Electric Cylinder Cat. No. | Frame | Power Cable Cat. No. | Feedback Cable Cat. No. |
|---|---|---|---|
| MPAR-A/B1*xxx* (series A) | 32 | 2090-XXNPMF-16S*xx* (standard) or 2090-CP*x*M4DF-16AF*xx* (continuous-flex) | 2090-XXNFMF-S*xx* (standard) or 2090-CFBM4DF-CDAF*xx* (continuous-flex) |
| MPAR-A/B2*xxx* (series A) | 40 | | |
| MPAR-A/B1*xxx* (series B) | 32 | 2090-CP*x*M7DF-16AA*xx* (standard) or 2090-CP*x*M7DF-16AF*xx* (continuous-flex) | 2090-CFBM7DF-CEAA*xx* (standard) or 2090-CFBM7DF-CEAF*xx* (continuous-flex) |
| MPAR-A/B2*xxx* (series B) | 40 | | |
| MPAR-A/B3*xxx* | 63 | | |
| MPAI-A/B2*xxxx* | 64 | | |
| MPAI-A/B3*xxxx* | 83 | | |
| MPAI-A/B4*xxxx* | 110 | | |
| MPAI-B5*xxxx* | 144 | | |
| MPAI-A5*xxxx* | 144 | 2090-CP*x*M7DF-14AA*xx* (standard) or 2090-CP*x*M7DF-14AF*xx* (continuous-flex) | 2090-CFBM7DF-CEAA*xx* (standard) or 2090-CFBM7DF-CEAF*xx* (continuous-flex) |

## System Block Diagrams

This section provides block diagrams of the Kinetix 5500 drive modules.

**Figure 101 - Kinetix 5500 Drive Block Diagram**

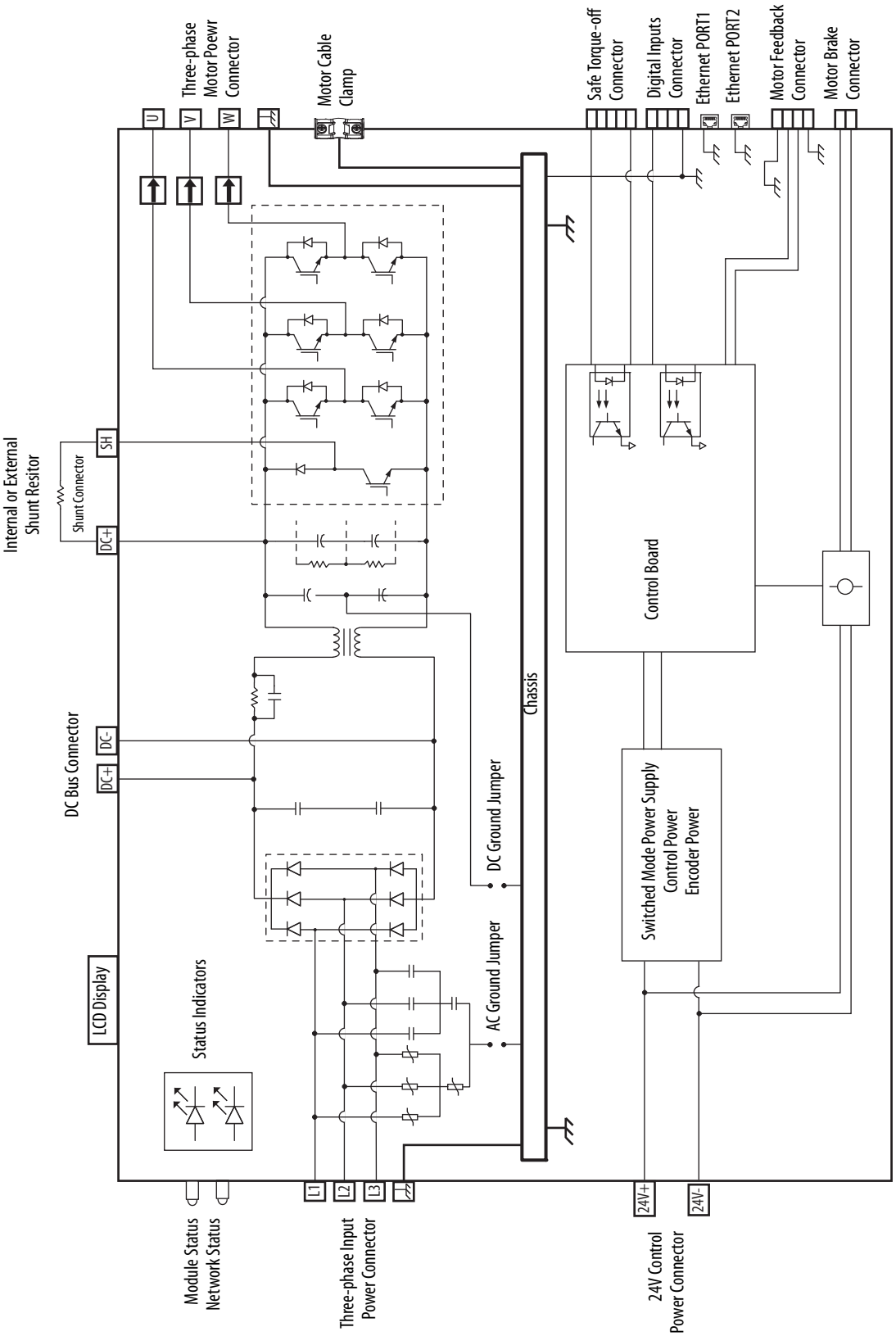
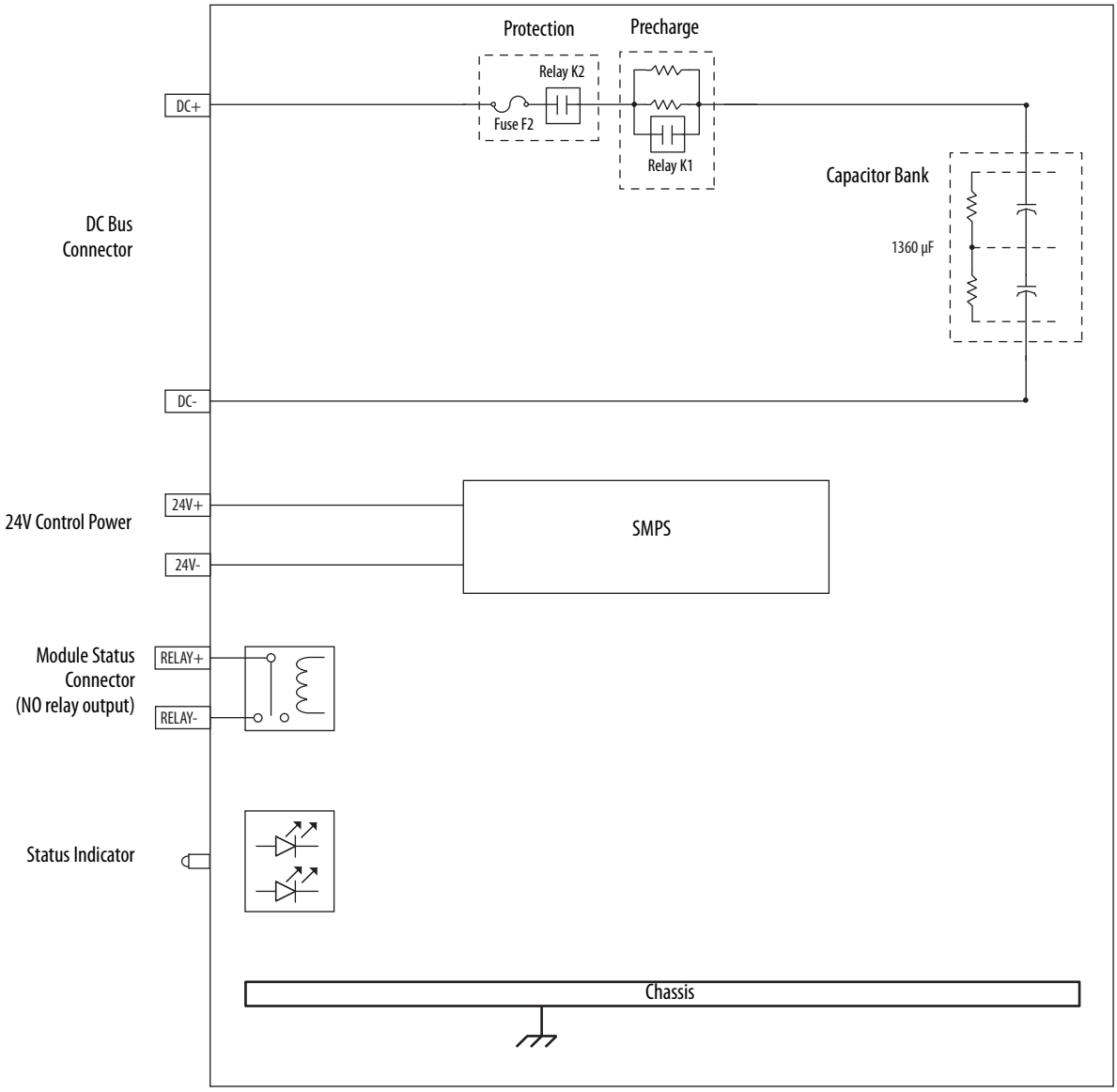


**Figure 102 - Kinetix 5500 Capacitor Module Block Diagram**



## Notes:

# Upgrade the Drive Firmware

This appendix provides procedures for upgrading firmware by using ControlFLASH software.


| Topic | Page |
|---|---|
| Before You Begin | 214 |
| Upgrade Firmware | 217 |
| Verify the Firmware Upgrade | 221 |


Upgrading drive firmware by using ControlFLASH software involves configuring your Logix5000 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 216 for more information.

## Before You Begin

These are the minimum firmware revisions and software versions required for upgrading drive firmware.

**Table 82 - Kinetix 5500 System Requirements**

| Description | Firmware Revision |
|---|---|
| Logix Designer application | 21.00 or later |
| RSLinx software | 2.58 or later |
| ControlFLASH software kit (1) | 11.00 or later |
| Catalog numbers of the targeted Kinetix 5500 drive module you want to upgrade. | |
| Network path to the targeted Kinetix 5500 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 Kit Quick Start, publication 1756-QS105.

**IMPORTANT** Control power must be present at CP-1 (24V+) and CP-2 (24V-) prior to upgrading your target drive. The axis state on the LCD display must be STANDBY, CONFIGURING, STOPPED, or PRECHARGE before beginning this procedure.



**ATTENTION:** To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase AC or common-bus DC input power to the drive.

## Configure Logix5000 Controller Communication

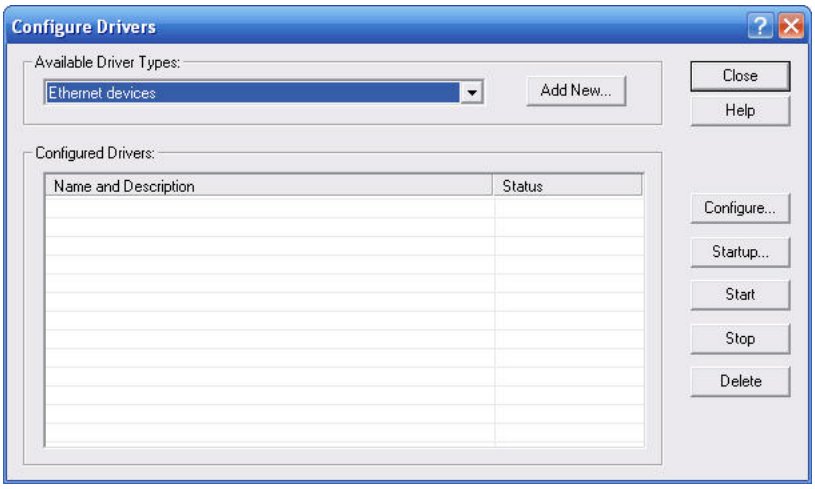
This procedure assumes that your communication method to the Logix5000 controller is the Ethernet network. It also assumes that your Logix5000 Ethernet module or controller has already been configured.

For more controller information, refer to Additional Resources on page 11.

Follow these steps to configure Logix5000 controller communication.

1. Open your RSLinx Classic software.
2. From the Communications menu, choose Configure Drivers.

   The Configure Drivers dialog box appears.



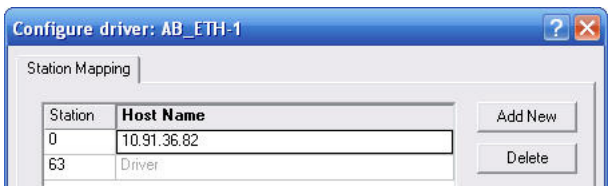

3. From the Available Driver Types pull-down menu, choose Ethernet devices.
4. Click Add New.

   The Add New RSLinx Classic Driver dialog box appears.
5. Type the new driver name.



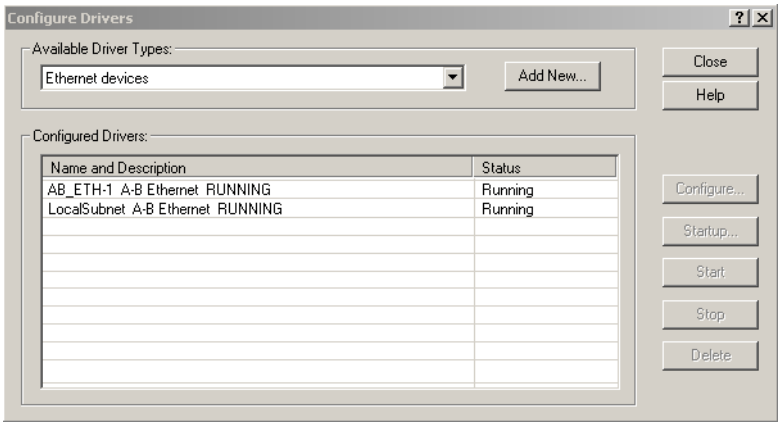

6. Click OK.

   The Configure driver dialog box appears.



7. Type the IP address of your Kinetix 5500 servo drive.
8. Click OK.

   The new Ethernet driver appears under Configured Drivers.



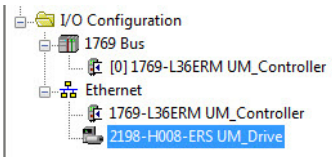

9. Click Close.
10. Minimize the RSLinx application dialog box.

## Inhibit Feedback Only Axis

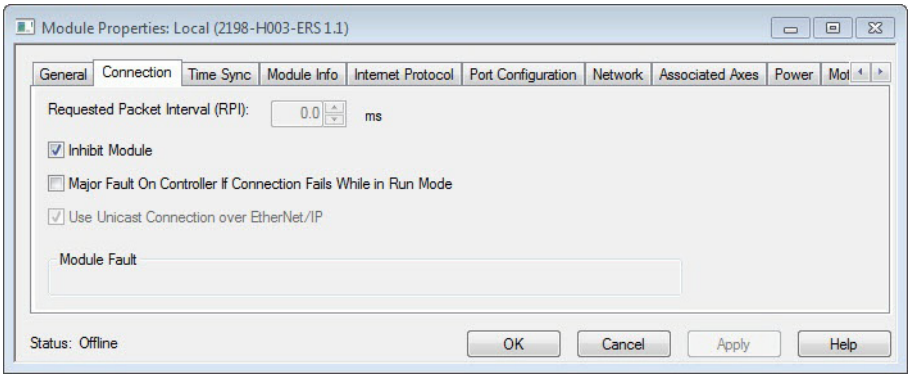
If an axis is configured as Feedback Only, you must inhibit the axis prior to performing the firmware upgrade. Follow these steps to inhibit an axis.

1. Open your Logix Designer application.
2. Right-click the 2198-H*xxx*-ERS*x* servo drive you configured as Feedback Only and choose Properties.

   The Module Properties dialog box appears.




3. Click the Connection tab.




4. Check Inhibit Module.
5. Click OK.
6. Save your file and download the program to the controller.

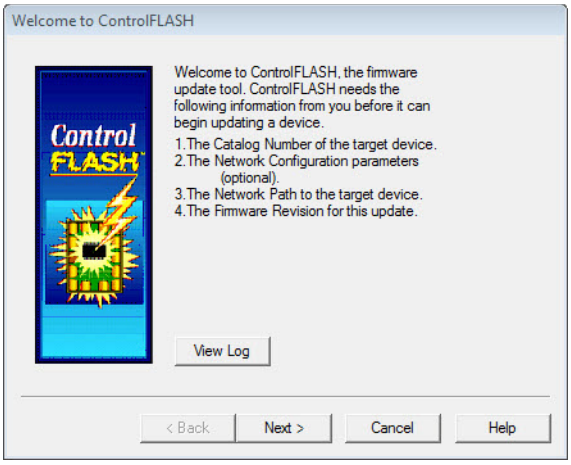
## Upgrade Firmware

Follow these steps to select the drive module to upgrade.

1. In the Logix Designer application, from the Tools menu, choose ControlFLASH.

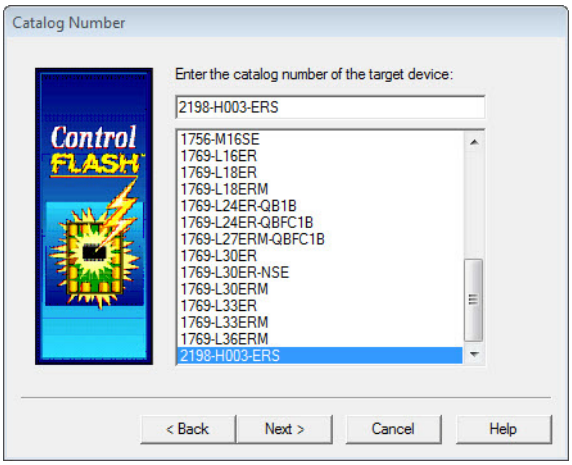
   **TIP** You can also open ControlFLASH software by choosing Start>Programs>FLASH Programming Tools>ControlFLASH.

   The Welcome to ControlFLASH dialog box appears.




2. Click Next.

   The Catalog Number dialog box appears.

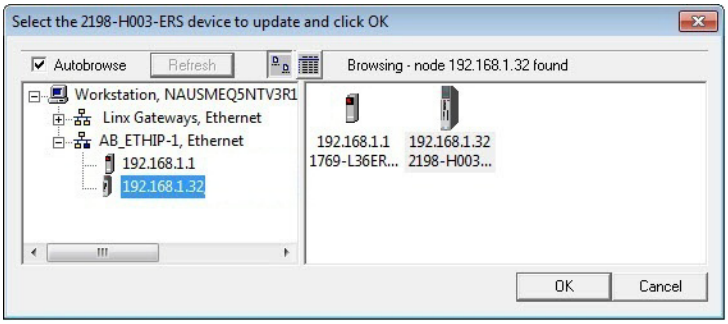


3. Select your drive module.

   In this example, the 2198-H003-ERS servo drive is selected.

4. Click Next.

   The Select Device to Update dialog box appears.

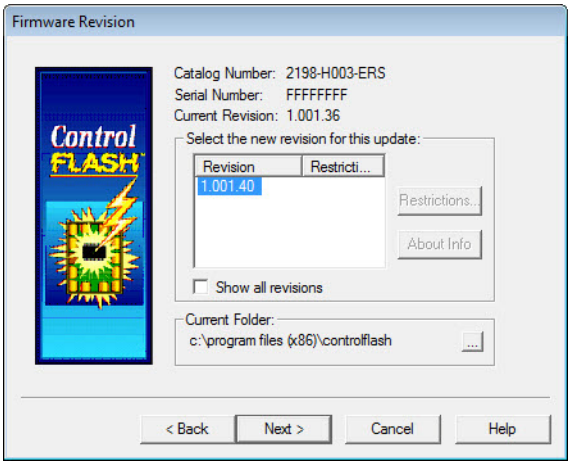



5. Expand your Ethernet node, Logix backplane, and EtherNet/IP network module.

6. Select the servo drive to upgrade.

7. Click OK.

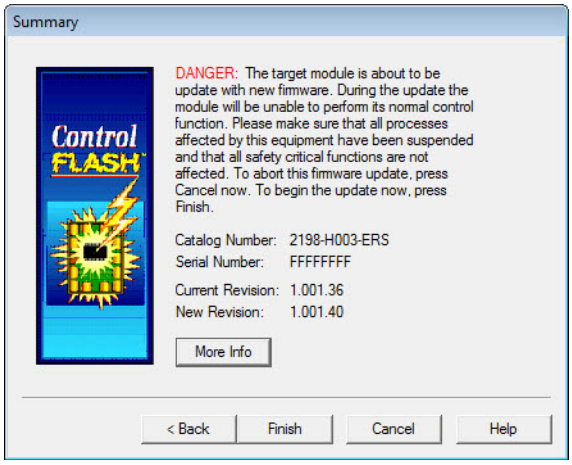
   The Firmware Revision dialog box appears.




8. Select the firmware revision to upgrade.

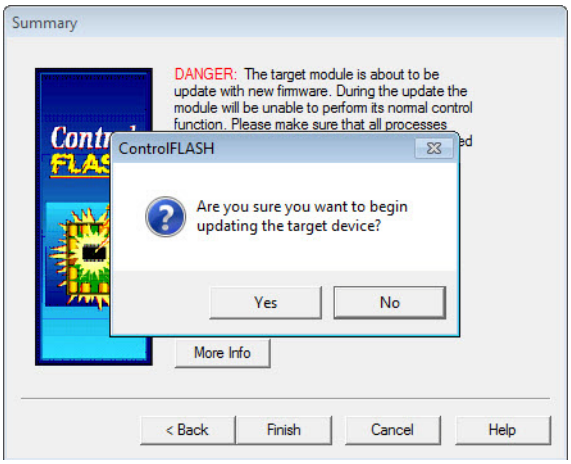
9. Click Next.

The Summary dialog box appears.



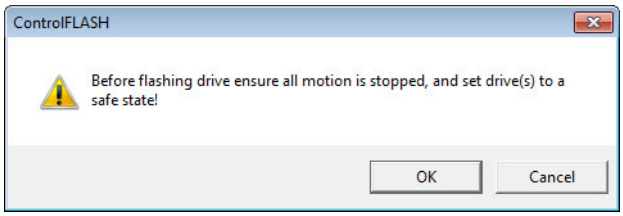

10. Confirm the drive catalog number and firmware revision.
11. Click Finish.

    This ControlFLASH warning dialog box appears.



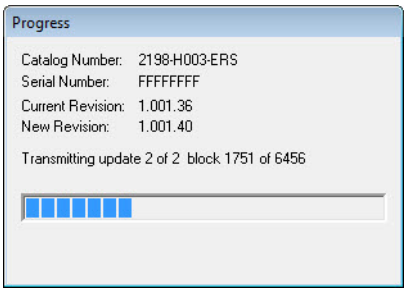

12. Click Yes (only if you are ready).

    This ControlFLASH warning dialog box appears.



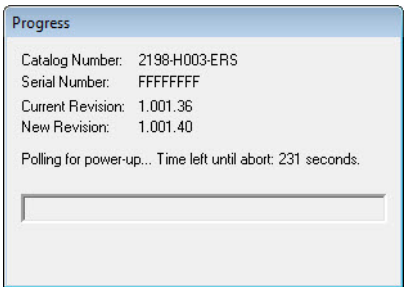

13. Acknowledge the warning and click OK.

The Progress dialog box appears and updating begins.




The axis state on the LCD display changes from CONFIGURING, STOPPED, or PRECHARGE to FIRMWARE UPDATE, which indicates that the upgrade is in progress.

After the upgrade information is sent to the drive, the drive resets and performs diagnostic checking.



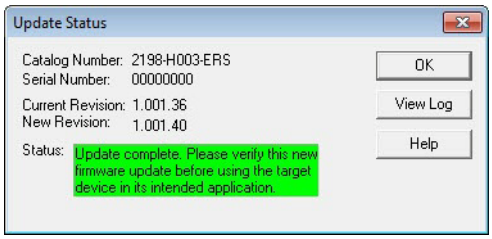

14. Wait for the Progress dialog box to time out.

    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 ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105, for troubleshooting information. |




16. Click OK.

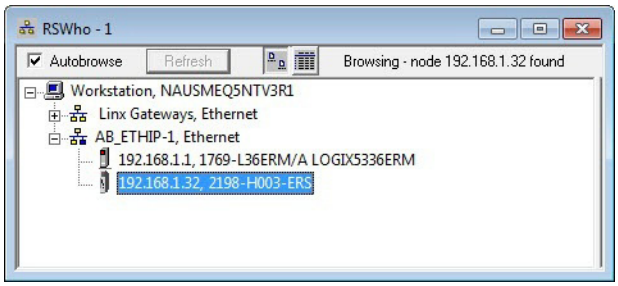
**IMPORTANT** If you are upgrading a feedback-only axis and you checked Inhibit Module on the Connection tab in Module Properties, you must clear the Inhibit Module checkbox before resuming normal operation.

## Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

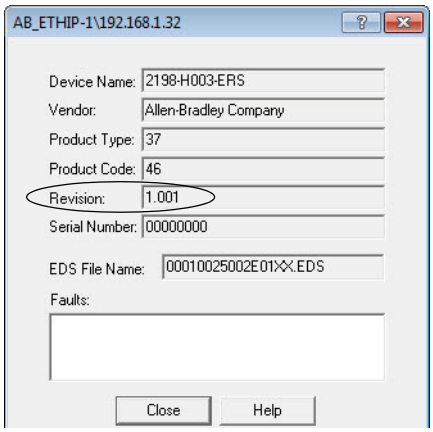
**TIP** Verifying the firmware upgrade is optional.

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 5500 drive shared-bus configurations.


| Topic | Page |
|---|---|
| Shared-bus Configurations | 223 |
| Power Sharing Sizing Examples | 228 |
| Control Power Current Calculations | 230 |
| Energy Calculations | 232 |


Shared-bus configurations include the following types:

- Shared AC
- Shared DC (common bus)
- Shared AC/DC
- Shared AC/DC Hybrid

These restrictions apply to all shared-bus configurations:

- Shared-bus configurations must use the shared-bus connection system.

  **IMPORTANT** Do not make drive-to-drive connections with discrete wires.

- Single-phase drive operation is not supported.
- Shared AC/DC and shared AC/DC hybrid configurations result in a derating of 30% of the total converter power available.
- The zero-stack tabs and cutouts must be engaged from drive-to-drive. Systems cannot start in one cabinet and end in another.
- Program drives for the same converter AC input voltage.

## Shared-bus Configurations

Shared AC configurations are configured as Standalone in the project file and do not share these restrictions that apply to multi-axis shared-bus configurations:

- All drives in a bus-sharing group must be configured with the same bus power-sharing group number in the Logix Designer application.
- The maximum number of drives in any bus power-sharing group cannot exceed eight.

## Shared AC Configurations

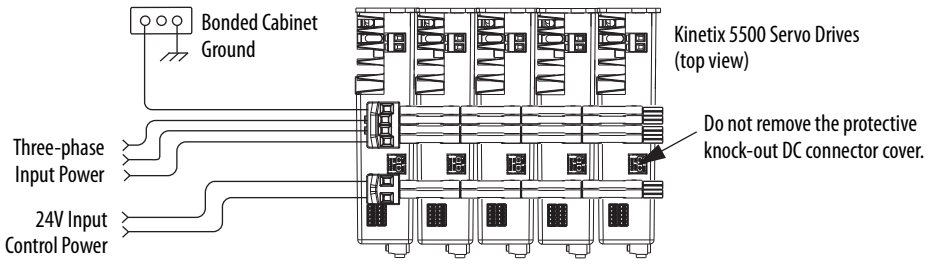
In shared AC configurations, the first (leftmost) drive receives AC input voltage. The shared-bus connection system extends the AC bus to all downstream drives:

- All drives are configured in the project file as Standalone drives.
- Drives must be of the same power rating (catalog number).
- Shared AC configurations do not support Bulletin 2198 capacitor modules.
- The maximum number of drives in Shared AC configurations is restricted as described in Table 83.

**Table 83 - Shared AC Panel Layout**

| Drive Cat. No. | Frame Size | Number of Drives Configured as Shared AC, max |
|---|---|---|
| 2198-H003-ERS*x* | 1 | 5 |
| 2198-H008-ERS*x* | | |
| 2198-H015-ERS*x* | 2 | 3 |
| 2198-H025-ERS*x* | | |
| 2198-H040-ERS*x* | | |
| 2198-H070-ERS*x* | 3 | 2 |

**Figure 103 - Typical Shared AC Configuration**




For an example shared AC installation with additional details, refer to Typical Shared AC Installations on page 16.

## Shared DC Configurations

In a Shared DC (DC common bus) configuration, the first (leftmost) drive is the leader drive and is the only drive that receives the AC input voltage. All drives to the right of the leader drives are follower drives. They receive the DC bus voltage extended from the leader drive through the shared-bus connection system:

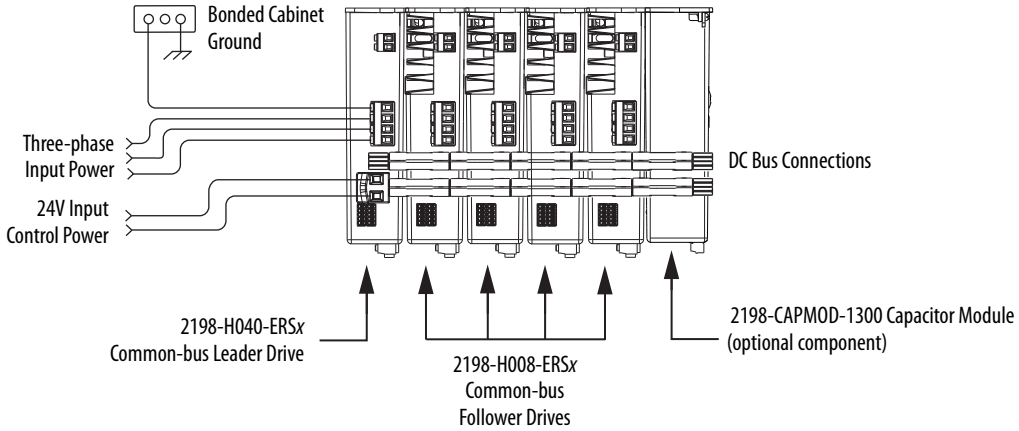
- For DC common-bus installations, the power rating of the leader drive must be greater than or equal to the power rating of the follower drives.
- The leader drive is configured in the project file as a Shared AC/DC drive.
- The follower drives are configured in the project file as Shared DC drives.
- Shared DC configurations support Bulletin 2198 capacitor modules.

**Table 84 - Shared DC Panel Layout**

| Frame Size Combination | Leader Drive Cat. No. | Follower Drives, max (1) | Follower Cat. No. | Number of Capacitor Modules, max |
|---|---|---|---|---|
| 1 | 2198-H003-ERS*x* | 4 | 2198-H003-ERS*x* | 0 |
| | 2198-H008-ERS*x* | 4 | 2198-H003-ERS*x* | 1 |
| | | | 2198-H008-ERS*x* | 1 |
| 2 and 1 | 2198-H015-ERS*x* | 6 | 2198-H003-ERS*x* | 1 |
| | | | 2198-H008-ERS*x* | |
| 2 | | | 2198-H015-ERS*x* | |
| 2 and 1 | 2198-H025-ERS*x* | 6 | 2198-H003-ERS*x* | 3 |
| | | | 2198-H008-ERS*x* | |
| 2 | | | 2198-H015-ERS*x* | |
| | | | 2198-H025-ERS*x* | |
| 2 and 1 | 2198-H040-ERS*x* | 6 | 2198-H003-ERS*x* | 3 |
| | | | 2198-H008-ERS*x* | |
| 2 | | | 2198-H015-ERS*x* | |
| | | | 2198-H025-ERS*x* | |
| | | | 2198-H040-ERS*x* | |
| 3 and 1 | 2198-H070-ERS*x* | 7 | 2198-H003-ERS*x* | 4 |
| | | | 2198-H008-ERS*x* | |
| 3 and 2 | | | 2198-H015-ERS*x* | |
| | | | 2198-H025-ERS*x* | |
| | | | 2198-H040-ERS*x* | |
| 3 | | | 2198-H070-ERS*x* | |

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004.

**Figure 104 - Typical DC Common Bus Configuration**




**IMPORTANT** Total number of drives in Kinetix 5500 drive system must not exceed 8.

For an example shared DC installation with additional details, refer to Typical Shared DC Common-bus Installations on page 18.

## Shared AC/DC Configurations

In a shared AC/DC configuration, the first (leftmost) drive receives AC input voltage. The shared-bus connection system extends the AC and DC bus to all downstream drives:

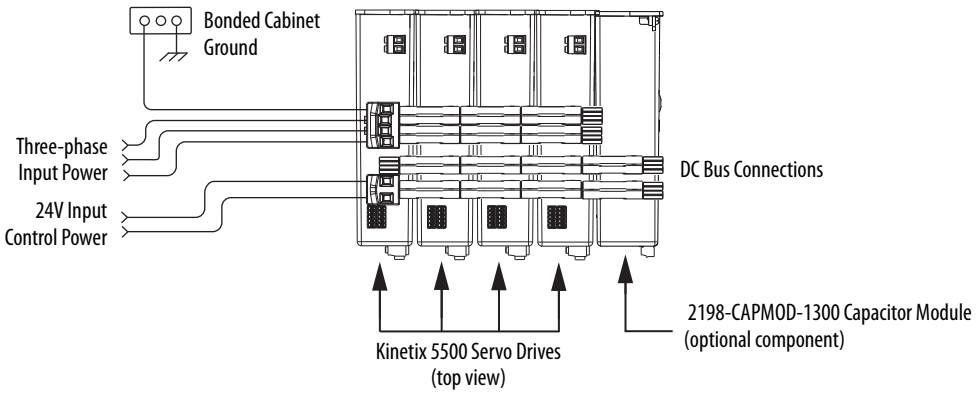
- All drives are configured in the project file as Shared AC/DC drives.
- Drives must be of the same power rating (catalog number).
- Shared AC/DC configurations support Bulletin 2198 capacitor modules
- Total available converter power is derated by 30%.
- The maximum number of drives configured as Shared AC/DC is described in Table 85.

**Table 85 - Shared AC/DC Panel Layout**

| Drive Cat. No. | Frame Size | Drives Configured as Shared AC/DC, max (1) | Number of Capacitor Modules, max |
|---|---|---|---|
| 2198-H003-ERS*x* | 1 | 8 | 0 |
| 2198-H008-ERS*x* | | | 1 |
| 2198-H015-ERS*x* | 2 | 4 | 4 |
| 2198-H025-ERS*x* | | | |
| 2198-H040-ERS*x* | | | |
| 2198-H070-ERS*x* | 3 | 2 | 4 |

(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004.

**Figure 105 - Typical Shared AC/DC Configuration**



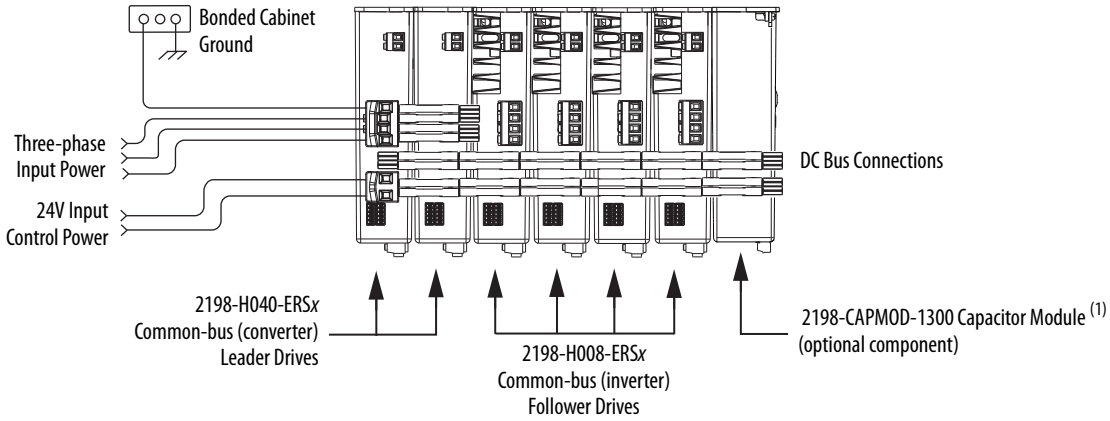

For an example shared AC/DC installation with additional details, refer to Typical Shared AC/DC Installations on page 17.

## Shared AC/DC Hybrid Configurations

In shared AC/DC hybrid configurations, three-phase AC input power is supplied to two or more (leader) drives that act as converters. This parallel converter configuration increases the DC power supplied to the inverter (follower) drives:

- The leftmost drives in a hybrid configuration act as parallel converter drives and must be of the same power rating (catalog number).
- Shared DC (inverter) drives mounted to the right of the shared AC/DC (converter) drives must have the same or lower power rating (catalog number) than the shared AC/DC drives.
- The total motoring load must not exceed the rated load for the drives sourcing the DC power. Each follower drive must be sized for the motor load connected to it.
- Total available converter power is derated by 30%.
- The maximum number of drives configured in the project file as Shared AC/DC is restricted according to Table 85 on page 226.
- The maximum number of drives configured in the project file as Shared DC is restricted according to Table 84 on page 225.
- Shared AC/DC hybrid configurations support Bulletin 2198 capacitor modules.

**Figure 106 - Typical Shared AC/DC Hybrid Configuration**




(1) For Bulletin 2198 capacitor module maximum values, refer to the Kinetix 5500 Capacitor Module Installation Instructions, publication 2198-IN004.

For an example shared AC/DC hybrid installation with additional details, refer to Typical Shared AC/DC Bus Hybrid Installations on page 19.

# Power Sharing Sizing Examples

For best results, size motors based on load torque requirements by using Motion Analyzer software. Select drives based on continuous or peak torque requirements. Based on the load profile, use Motion Analyzer software to estimate the net converter and inverter power and bus regulator capacity.

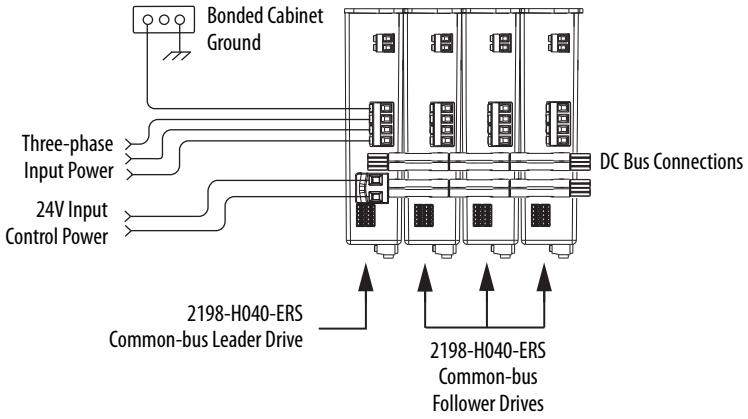
**Table 86 - Converter and Bus Regulator Capacity**

| Configuration | Available Converter Capacity | Available Regenerative Capacity |
|---|---|---|
| Shared AC | Converter power rating of each drive | Internal shunt of each drive |
| Common bus | Converter power rating of leader drive | Sum of all internal shunts from each drive in bus-sharing group |
| Shared AC/DC | Sum of converter power ratings times 0.7 (70%) | |
| Shared AC/DC hybrid | | |

## Shared DC Example

In this example four 2198-H040-ERS drives are used in a common-bus configuration.

**Figure 107 - DC Common Bus Configuration**



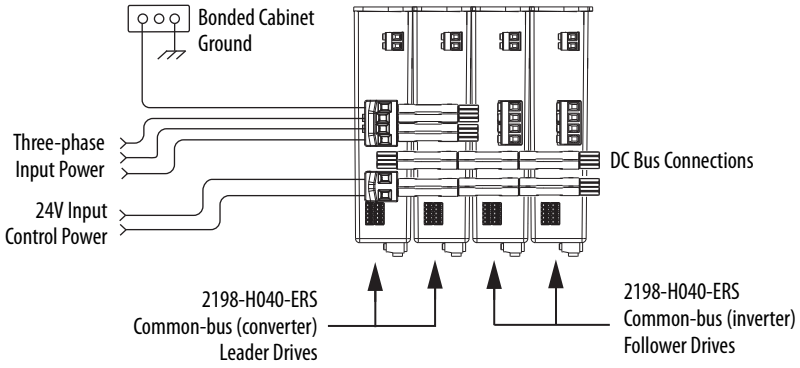

Each 2198-H040-ERS drive is rated at 8.4 kW continuous output power to bus. However, only the leader drive acts as the converter, so the available converter power to the system is 8.4 kW. In this example, total motoring load must not exceed 8.4 kW.

## Shared AC/DC Hybrid Example

If the required motoring power exceeds the available converter power sourced by the shared DC configuration, then connect a second converter drive to make a shared AC/DC hybrid configuration. This increases the available converter power.

In this example, the same four 2198-H040-ERS drives are used, however, two are connected as parallel converter (leader) drives and the other two as common-bus (follower) drives. The total converter power is derated by 30%.

**Figure 108 - Shared AC/DC Hybrid Configuration**



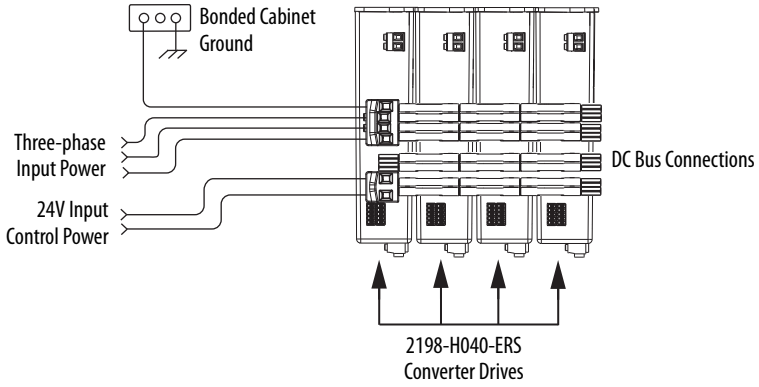

The available converter power to the system is (8.4 • 2) • 0.7 = 11.76 kW. In this example, total motoring load must not exceed 11.76 kW. The available converter power was increased by 40% over the same drives in shared DC configuration.

### Shared AC/DC Example

If the required motoring power exceeds the available converter power sourced by two leader drives, then connect all four drives as parallel converter drives. This further increases the available converter power.

In this example, the same four 2198-H040-ERS drives are used, however, all four are connected as parallel converter (leader) drives. The total converter power is derated by 30%.

**Figure 109 - Shared AC/DC Configuration**




The available converter power to the system is (8.4 • 4) • 0.7 = 23.52 kW. In this example, total motoring load must not exceed 23.52 kW. The available converter power was increased by 180% over the same drives in shared DC configuration.

## Control Power Current Calculations

Kinetix 5500 servo drives and the Bulletin 2198 capacitor module have different 24V DC power consumption. Factors to consider when calculating the combined current demand from your 24V DC power supply includes the following:

- Catalog number for each drive in the system
- Whether the motor or actuator includes the holding brake option
- Whether the system includes Bulletin 2198 capacitor modules (1 to 4 modules are possible)

**Table 87 - Control Power Current Demand**

| Cat. No. | **24V Current (non-brake motor)** $A_{DC}$ | **24V Current (2 A brake motor)** $A_{DC}$ | **24V Inrush Current** (1) A |
|---|---|---|---|
| 2198-H003-ERS*x* | 0.4 | 2.4 | 2.0 |
| 2198-H008-ERS*x* | | | |
| 2198-H015-ERS*x* | 0.8 | 2.8 | 3.0 |
| 2198-H025-ERS*x* | | | |
| 2198-H040-ERS*x* | | | |
| 2198-H070-ERS*x* | 1.3 | 3.3 | |
| 2198-CAPMOD-1300 | 0.3 | N/A | 2.0 |

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

## Kinetix 5500 System Current Demand Example

In this example, the Kinetix 5500 drive system includes two 2198-H040-ERS drives, four 2198-H008-ERS drives, and one capacitor module.

**Figure 110 - Shared AC/DC Hybrid Configuration**

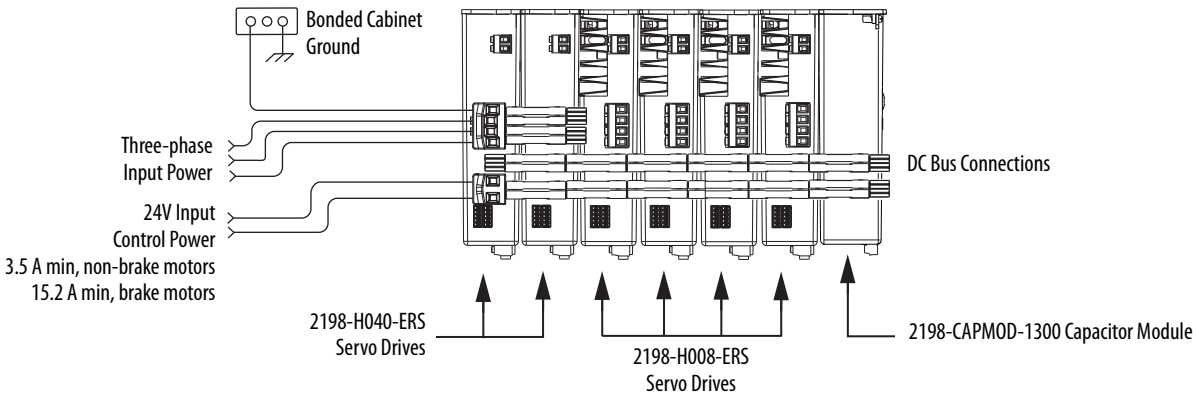



**Table 88 - Kinetix 5500 System Current Demand Calculations**

| Kinetix 5500 Module Cat. No. | Qty | **24V Current (non-brake motors)** $A_{DC}$ | **24V Current (2 A brake motors)** $A_{DC}$ | **24V Inrush Current** (1) A |
|---|---|---|---|---|
| 2198-H008-ERS*x* | 4 | 0.4 x 4 = 1.6 | 2.4 x 4 = 9.6 | 2 x 4 = 8 |
| 2198-H040-ERS*x* | 2 | 0.8 x 2 = 1.6 | 2.8 x 2 = 5.6 | 3 x 2 = 6 |
| 2198-CAPMOD-1300 | 1 | 0.3 x 1 = 0.3 | N/A | 2 x 1 = 2 |
| Total current demand | | 3.5 | 15.2 | 16 |

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

## Energy Calculations

The Kinetix 5500 servo drives have internal shunt resistors for dissipating excessive energy. In addition, Bulletin 2097 external shunt resistors and Bulletin 2198 capacitor modules are available to increase the shared DC bus capacitance.

Use this table to calculate the total energy absorbing potential (joules) and determine if a capacitor module or external shunt resistor is needed.

**Table 89 - Energy Absorbing Potential**

| Kinetix 5500 Drive Cat. No. | Internal Shunt [1] J | External Shunt kJ | Capacitor Module [1] J | Capacitor Module, max [2] J |
|---|---|---|---|---|
| 2198-H003-ERS*x* | 427.09 | 12.51 | N/A | N/A |
| 2198-H008-ERS*x* | | | 554.4 | 554.4 |
| 2198-H015-ERS*x* | 549.01 | 12.521 | 676.32 | 676.32 |
| 2198-H025-ERS*x* | 575.223 | 12.549 | 702.53 | 957.162 |
| 2198-H040-ERS*x* | 601.434 | 22.647 | 728.74 | 983.373 |
| 2198-H070-ERS*x* | 1827.01 | 27.218 | 1954.3 | 2208.95 |

(1) Value assumes the use of one servo drive and one capacitor module.
(2) Value assumes the use of one servo drive and the maximum number of capacitor modules allowed.

Refer to Motion Analyzer software, version 7.0 or later, for custom shunt sizing.

# Motor Control Feature Support

This appendix provides feature descriptions for the induction motors and permanent-magnet motors that are supported by Kinetix 5500 servo drives.


| Topic | Page |
|---|---|
| Frequency Control Methods | 233 |
| Skip Speeds | 237 |
| Flux Up | 239 |
| Current Regulator Loop Settings | 242 |
| Motor Category | 242 |
| Selection of Motor Thermal Models | 247 |
| Speed Limited Adjustable Torque (SLAT) | 249 |
| Motor Overload Retention | 255 |
| Torque Proving | 256 |
| Velocity Droop | 259 |
| Adaptive Tuning | 260 |


## Frequency Control Methods

The Kinetix 5500 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 125.

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 90 - Motor Specifications**

| Attribute | Value |
|---|---|
| Output frequency, max | 590 Hz |
| Pole pairs, max | 50 |
| Motor cable length, max | 50 m (164 ft) (1) |

(1) Applies to all Kinetix 5500 (frame 2 and 3) drives. For Kinetix 5500 (frame 1) drives in continuous-flex applications, 30 m (98 ft) is the maximum cable length.

## Basic Volts/Hertz

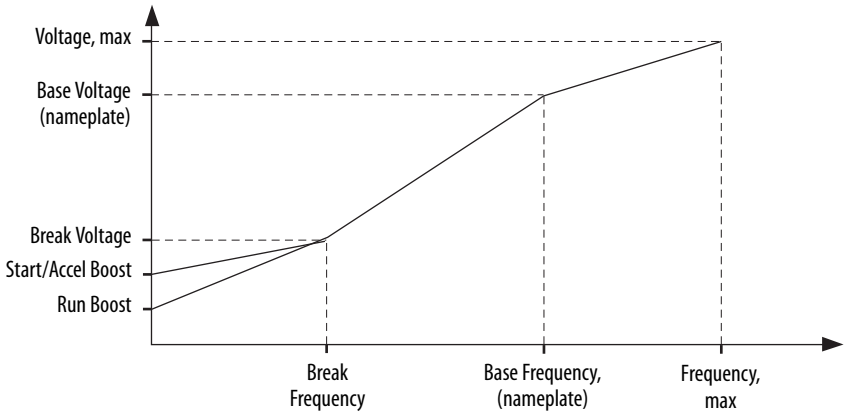
Volts/hertz operation creates a fixed relationship between output voltage and output frequency. Voltage is applied to the motor, which is based on the operating frequency command at a fixed volts/hertz ratio. The ratio is calculated from the motor nameplate data and entered into the Logix Designer application> 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 111, you can change the volts/hertz ratio to provide increased torque performance when required by programming five distinct points on the curve.

**Table 91 - 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 111 - 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.

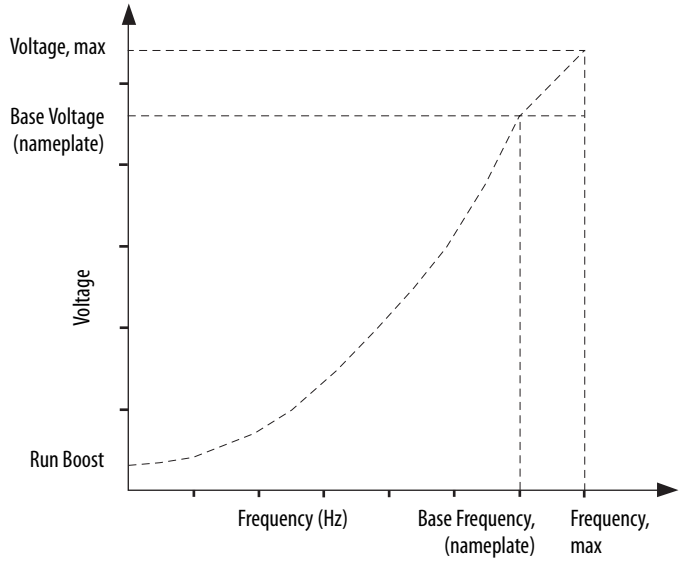
**Figure 112 - Output Voltage Equation**

$$V_x = \left(\frac{f_x}{f_n}\right)^2 \left(V_n - V_{boost}\right) + V_{boost}$$

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 113 - Basic Volts/Hertz Fan/Pump Method**

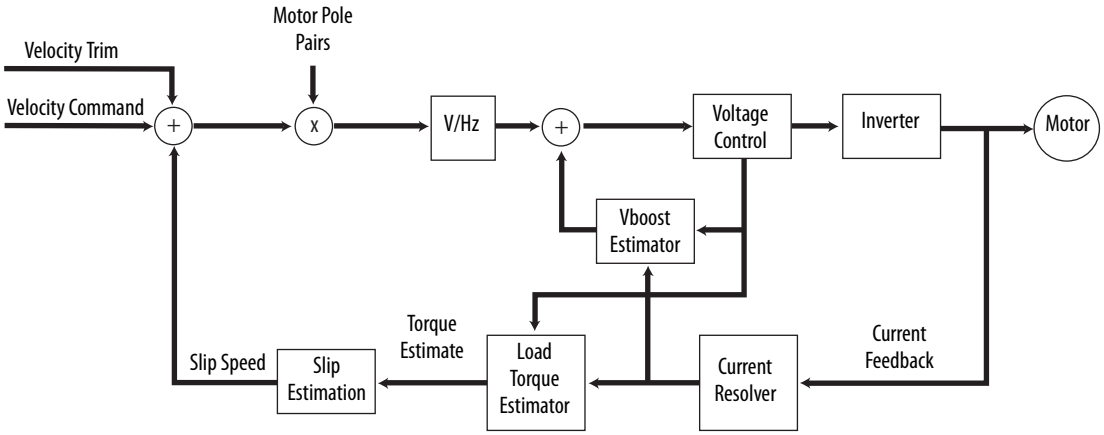



**TIP** The Fan/Pump control method supports the run-boost attribute, but does not support break-voltage, break-frequency, or start-boost.

## 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 114 - Sensorless Vector Method**

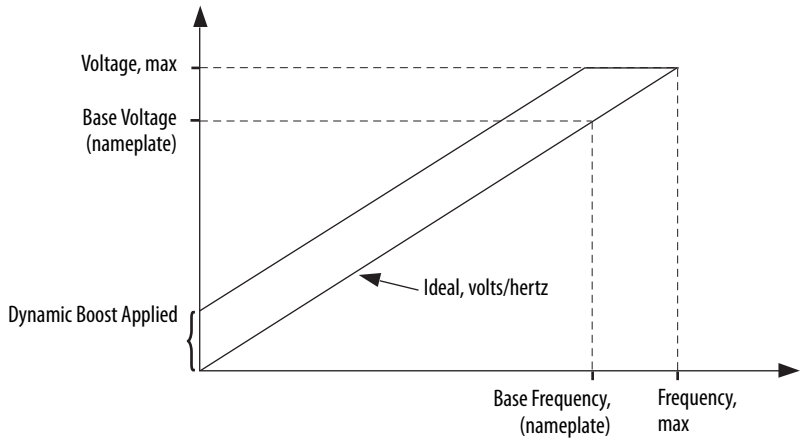



The algorithms operate on the knowledge of the relationship between the rated slip and torque of the motor. The drive uses applied voltages and measured currents to estimate operating slip-frequency. You can enter values to identify the motor resistance value or you can run a motor test to identify the motor resistance value (see Motor Tests and Autotune Procedure on page 244). 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 115 - Approximate Load Curve**

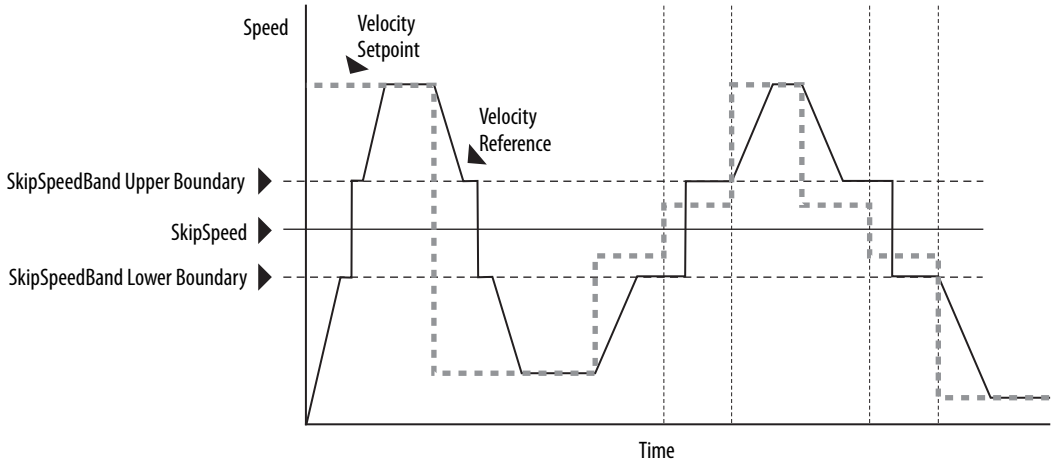


## Skip Speeds

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 116 - 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. |

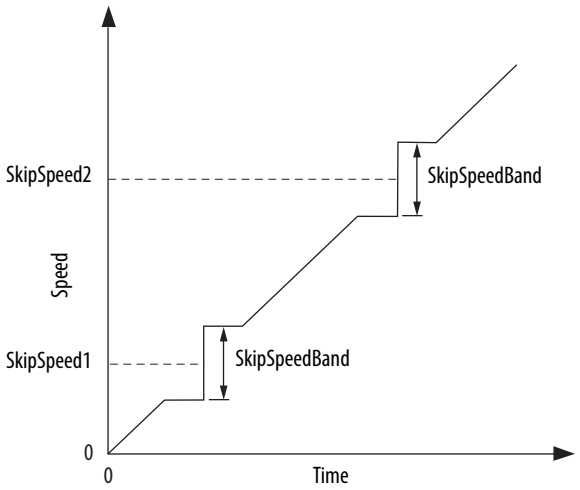
| | |
|---|---|
| **IMPORTANT** | Acceleration and deceleration are affected by the skip-speed feature. Too large of a SkipSpeedBand value can result in an overcurrent drive fault. |

| | |
|---|---|
| **IMPORTANT** | The MaximumFrequency attribute is always enforced. Skip-speed band boundary values beyond the MaximumFrequency value do not apply. |

## Multiple Skip Speeds

The Kinetix 5500 drives feature two independent skip-speed attributes (SkipSpeed1 and SkipSpeed2) that use the same SkipSpeedBand.

**Figure 117 - Multiple Skip Speed Example**

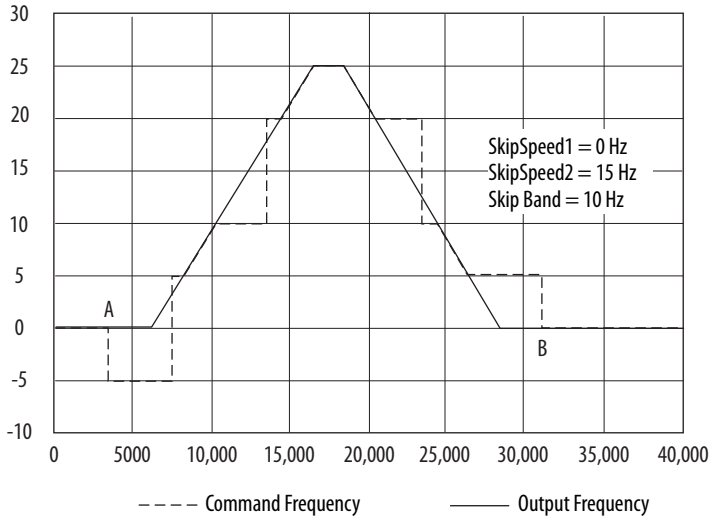



When skip-speed band boundaries of SkipSpeed1 and SkipSpeed2 overlap, the skip-speed hysteresis is calculated using the effective skip band.

In Figure 118, 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 118 - Zero-speed Skip Frequency**

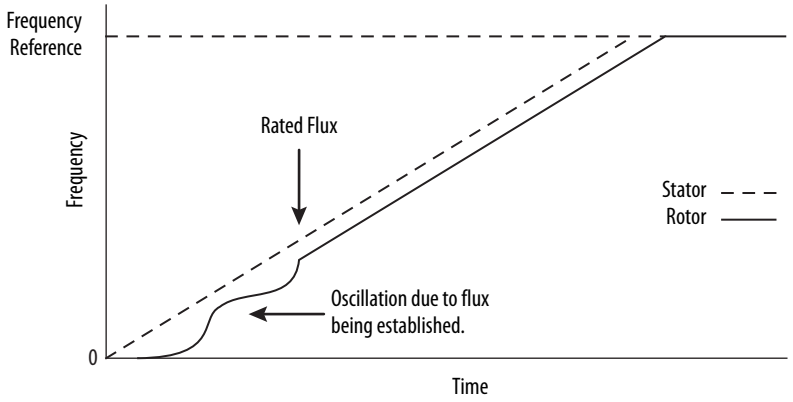


## Flux Up

AC induction motors require that flux builds in the motor stator before controlled torque can develope. 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.

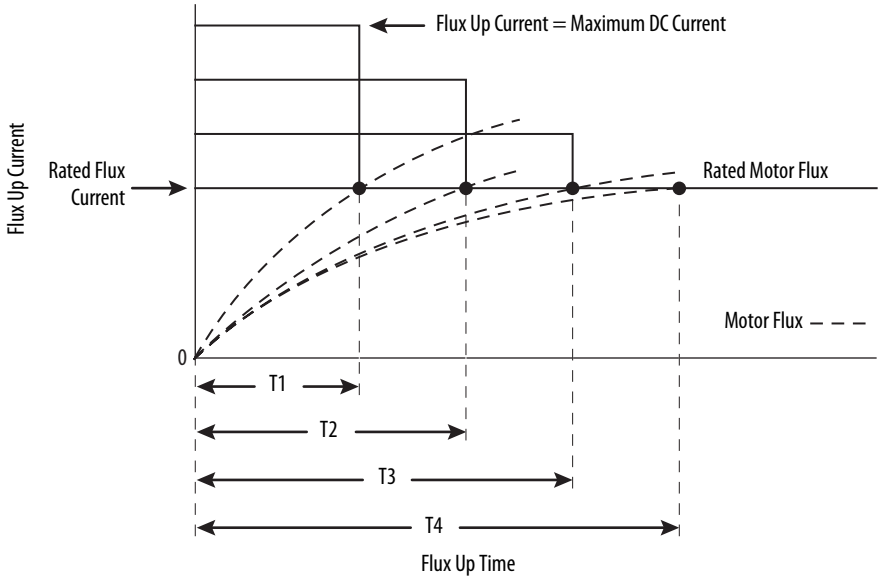
**Figure 119 - Acceleration Profile during Normal Start - No Flux Up**




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.

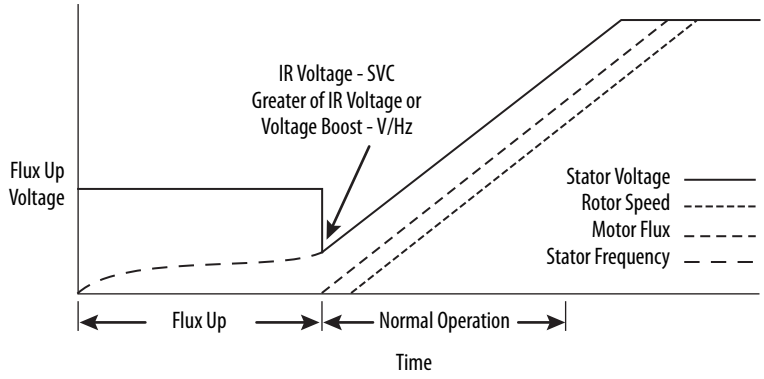
In the Manual setting, DC current is applied to the motor so that flux builds before rotation. The flux-up time period is determined by the FluxUpTime attribute. The flux-up current is not adjustable.

**Figure 120 - 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 121 - Rated Flux Reached**




## Flux Up Attributes

| ID | Access | Attribute | Conditional Implementation |
|---|---|---|---|
| 558 | Set | Flux Up Control | Ind Motor only<br>0 = No Delay<br>1 = Manual Delay<br>2 = Automatic Delay |
| 559 | Set | Flux Up Time (1) | Ind Motor only<br>Units: Seconds<br>Default: 0.0000<br>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 92 - 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. |

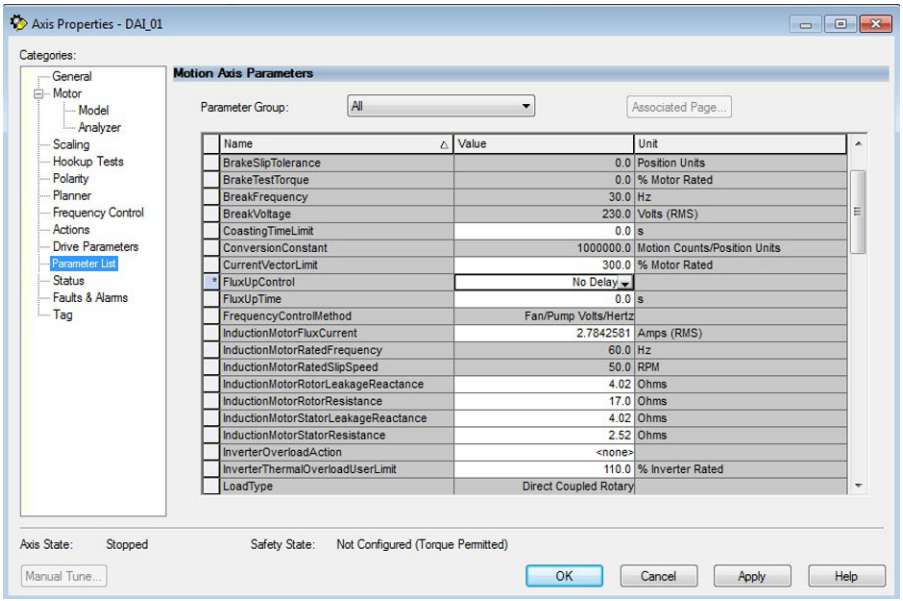
### *FluxUpTime Attribute*

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.

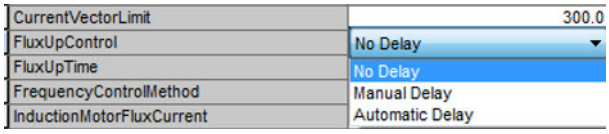
## Configure the Flux Up Attributes

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.




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 93 - Current Regulator Loop Settings**

| Motor Type | Default Torque/Current Loop Bandwidth<br>Hz |
|---|---|
| Rotary permanent magnet | 1000 |
| Rotary induction | 400 |
| Linear permanent magnet | 1000 |

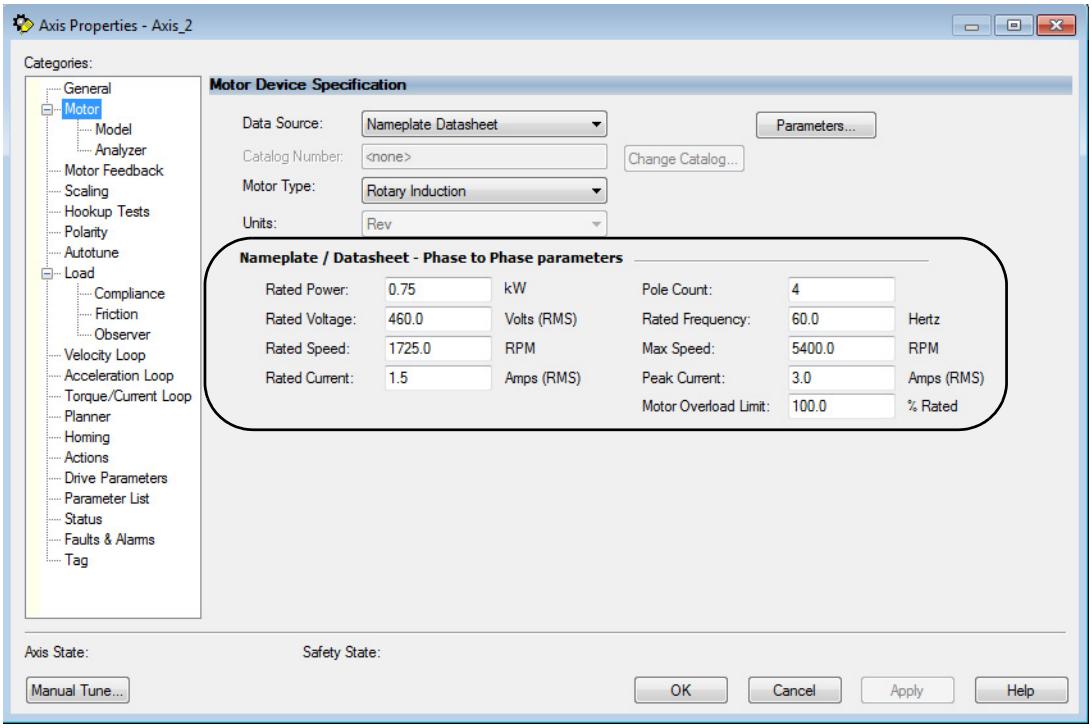
**IMPORTANT** The Logix Designer application does not perform calculations when the Torque/Current Loop Bandwidth attribute is updated. This bandwidth affects many other gains and limits. Changing, (lowering) the torque loop bandwidth without updating all the dependent attributes can result in drive/motor instability.

## Motor Category

From the Motor category you can enter motor nameplate or datasheet values (phase-to-phase parameters) for permanent magnet 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 122 - Motor Nameplate / Datasheet Example**




See Figure 123 for motor manufacturer performance data sheet example.

**Figure 123 - 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)

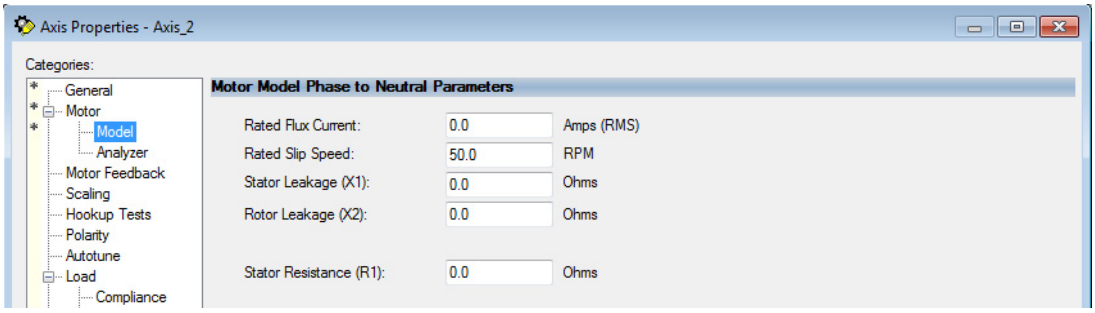
| R1 | R2 | X1 | X2 | XM |
|---|---|---|---|---|
| 8.378 | 5.6232 | 10.7068 | 9.9116 | 278.036 |

| 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. You can enter these parameter values directly from the motor nameplate/datasheet or indirectly by running a Motor>Analyzer test.

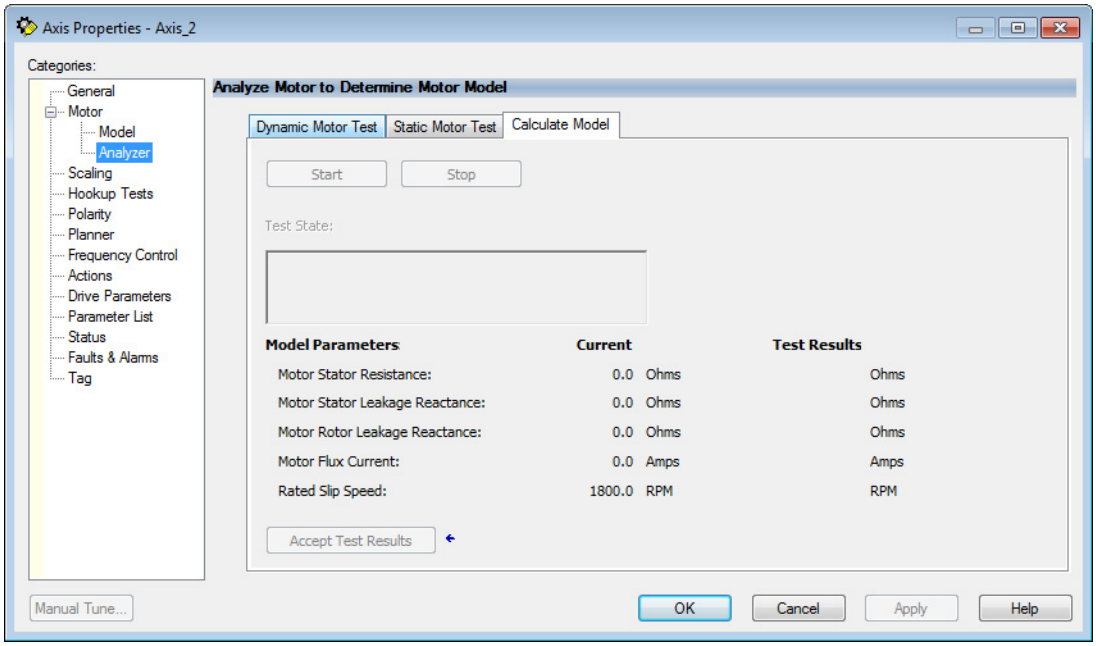



**IMPORTANT** If you do not know the Stator Leakage, Rotor Leakage, Stator Resistance, Rated Flux Current, and system inertia, you can run the static motor test and Autotune procedure to determine the parameter values.

*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.




## 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 94 recommends which test to use based on the control mode and application.

**Table 94 - 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 | Preferred | Not required | Not required |
| Induction motor - Closed-loop control | | Required | Preferred (1) | Preferred | Required (2) |

(1) 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.

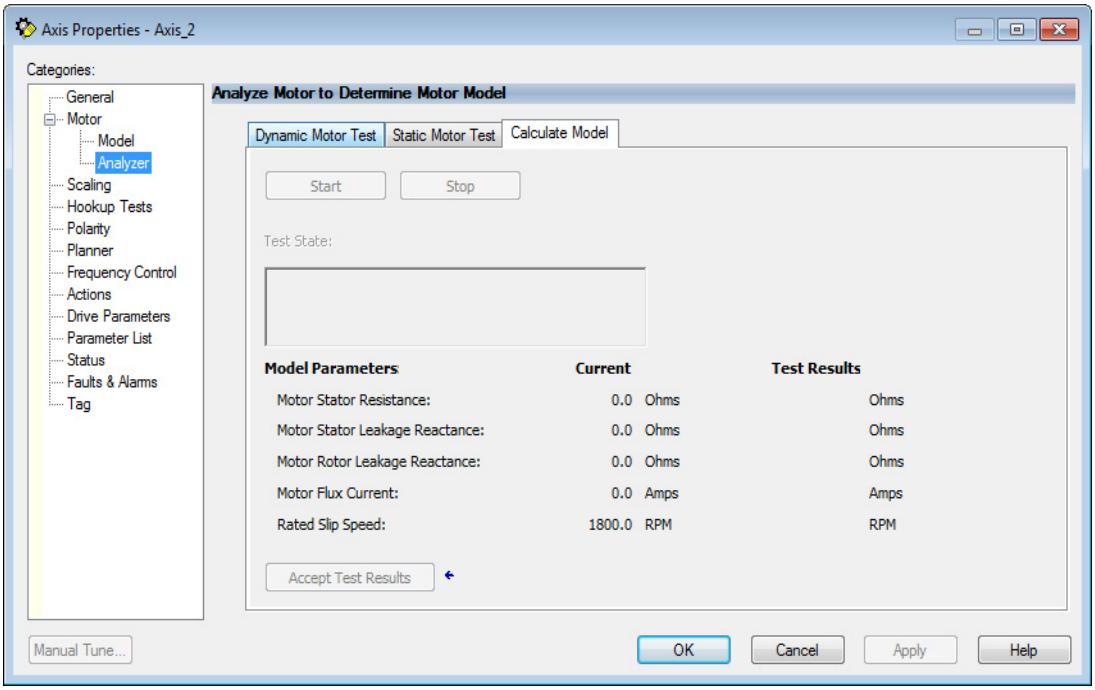
(2) Autotune must be performed to identify the inertia motor value before running a dynamic test.

For motor/system autotune procedure, see Tune Induction Motors on page 147 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.

**Table 95 - Motor>Analyzer Tests**

| Motor Test Type | Description |
|---|---|
| Calculate | When a Calculate test is run, the drive uses motor nameplate data to estimate the motor's Rated Flux Current, Stator Resistance (Rs), Stator Leakage Reactance (X1) and Rotor Leakage Reactance (X2). No measurements are taken when using the Calculate test. |
| Static | 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 (Rs), Stator Leakage Reactance (X1), and Rotor Leakage Reactance (X2) values are measured during a series of static tests. The Rated Flux Current is estimated, since measurement of this value requires motor movement. |
| Dynamic | 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 Static and Dynamic tests require that you enter initial estimates for the Rated Flux Current, Stator Resistance (Rs), Stator Leakage Reactance (X1), and Rotor Leakage Reactance (X2) into the Motor Model fields. 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. |

| | |
|---|---|
| **IMPORTANT** | 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. |

| | |
|---|---|
| **IMPORTANT** | When configured for closed-loop control, the Dynamic test requires that the system inertia is set in the Logix Designer application. 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. |

| | |
|---|---|
| **IMPORTANT** | 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. |

| | |
|---|---|
| **IMPORTANT** | 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 ±30% tolerance of the commanded velocity. |

| | |
|---|---|
| **IMPORTANT** | The Dynamic test is not supported in closed-loop Torque Control. |

| | |
|---|---|
| **IMPORTANT** | The Dynamic test does not support travel limits. |

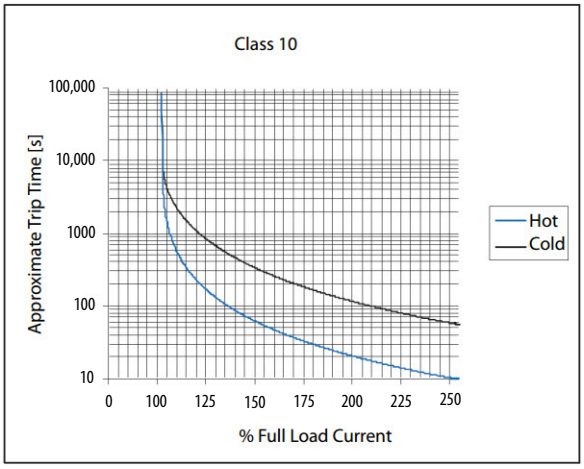
# Selection of Motor Thermal Models

The Kinetix 5500 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 124.

**Figure 124 - 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 96 - 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.

## SLAT Min Speed/Torque

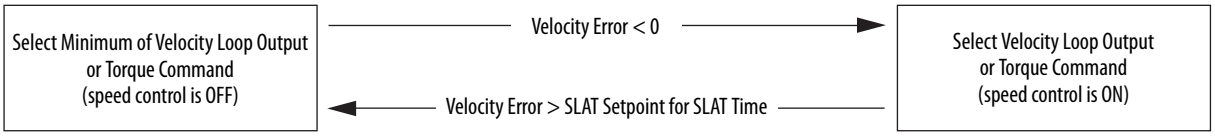
SLAT Min Speed/Torque is a special mode of operation primarily used in web handling applications. The drive typically operates as a torque regulator, provided that the TorqueTrim attribute is less than the torque output due to the velocity regulator's control effort. The drive can automatically enter 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. 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 125 - 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

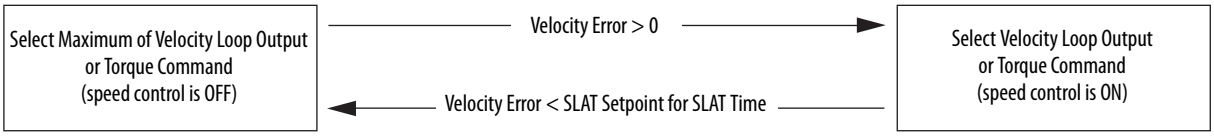
SLAT Max Speed/Torque is a special mode of operation primarily used in web handling applications. The drive typically operates as a torque regulator, provided that the TorqueTrim attribute is greater than the torque output due to the velocity regulator's control effort. The drive can automatically enter 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. 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 126 - 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 | Ind Motor only<br>0 = SLAT Disable (1)<br>1 = SLAT Min Speed/Torque<br>2 = SLAT Max Speed/Torque |
| 834 | Set | SLAT Set Point | Ind Motor only<br>Velocity Units |
| 835 | Set | SLAT Time Delay | Ind Motor only<br>Seconds |

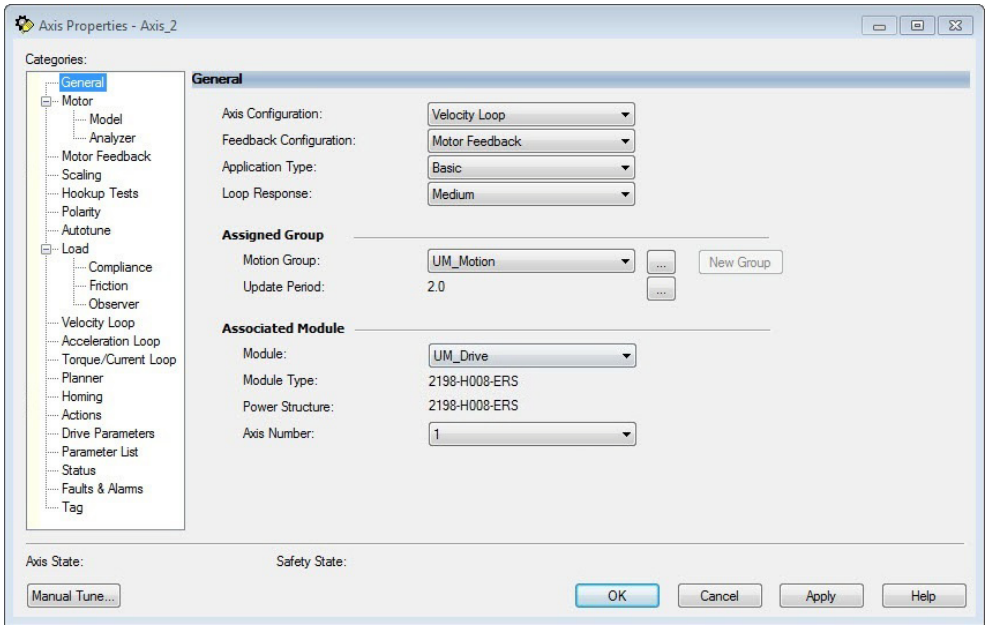
(1) SLAT Disable, when viewed in version 28.00 (and earlier) of the Logix Designer application, reads Torque Only. This is expected to change to SLAT Disable in a future version.

## Configure the Axis for SLAT

Follow these steps to configure the SLAT attributes.

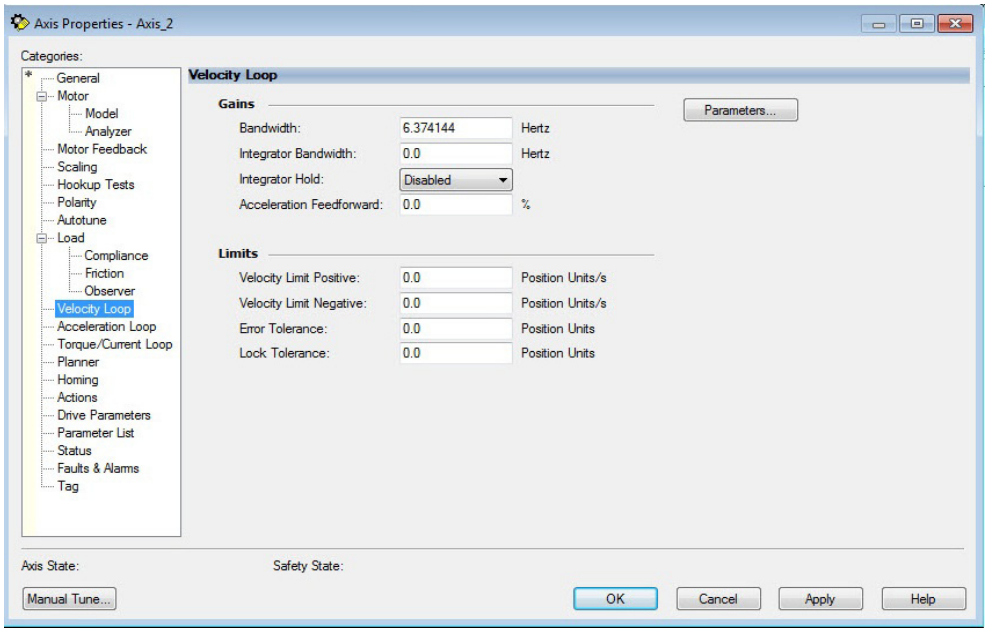
1. In the Controller Organizer, right-click an axis and choose Properties.
2. Select the General category.

   The General dialog box appears.




3. From the Axis Configuration pull-down menu, choose Velocity Loop.

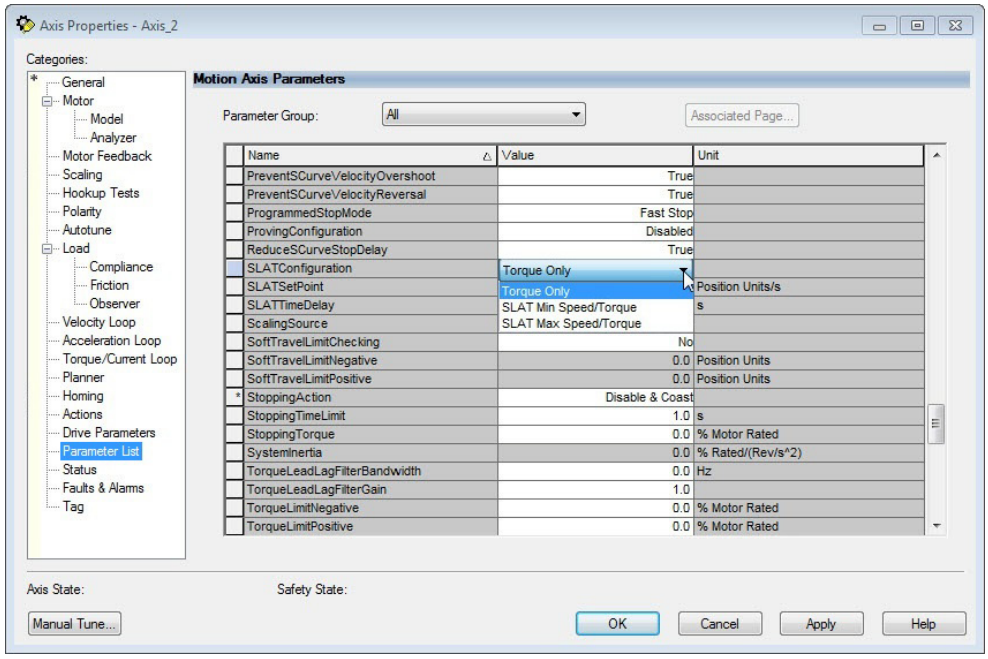
   The Velocity Loop dialog box appears.




4. Enter values for the Velocity Loop attributes appropriate for your application.

5. Click Apply.
6. Select the Parameters List category.

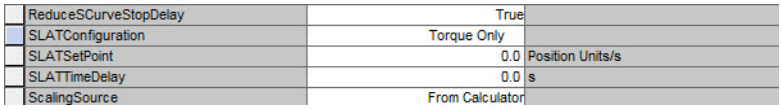
   The Motion Axis Parameters dialog box appears.




7. From the SLATConfiguration pull-down menu, choose the SLAT configuration appropriate for your application.

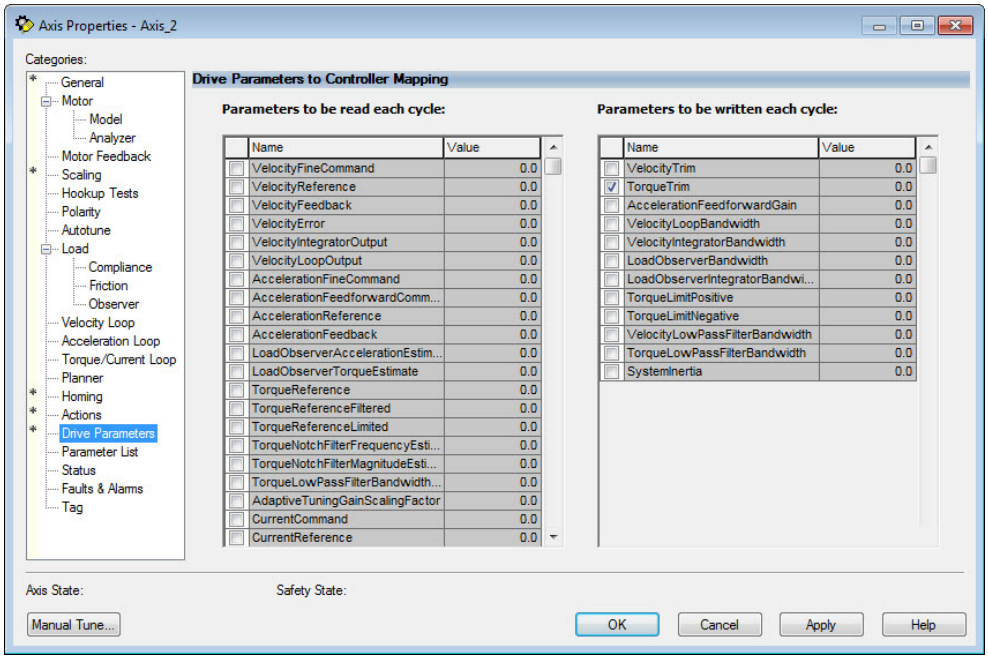
**IMPORTANT** SLAT Disable, when viewed in the Logix Designer application, version 28.00 (and earlier) reads Torque Only. This is expected to change to SLAT Disable in a future version.

8. Click Apply.
9. Enter values for SLATSetPoint and SLATTimeDelay attributes appropriate for your application.




10. Click OK.
11. Select the Drive Parameters category.

The Drive Parameters to Controller Mapping dialog box appears.




When using SLAT with the Kinetix 5500, the velocity command is sent to the drive via an MAJ instruction. 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.

- 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.

## Motor Overload Retention

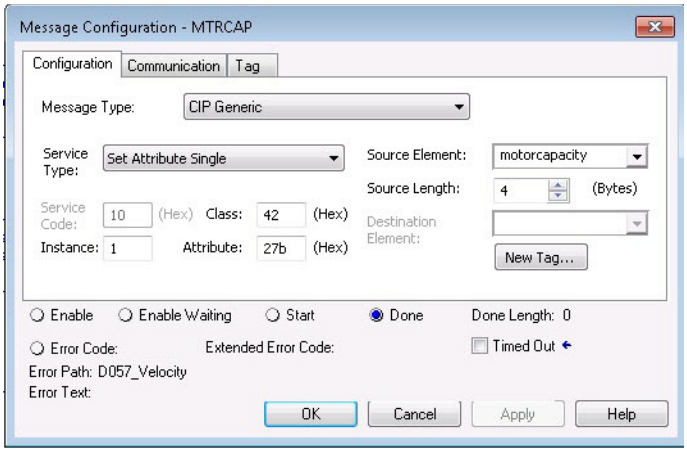
The motor overload retention feature protects the motor in the event of a drive power-cycle, in which the motor thermal state is lost.

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 Logix5000 controller, you can use the MotorCapacity attribute $(635)_{10}$ or $(27B)_{16}$ to change the initial MotorCapacity value that the motor overload retention feature populates. You can write to the MotorCapacity attribute only in the Stopped state after the initial power-up. You cannot write to the MotorCapacity attribute after the axis is enabled. Use a message instruction to write to the value.

In this example, the source element tag motorcapacity is a REAL Data type.



## Torque Proving

The torque proving 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 97 - Torque Proving 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.

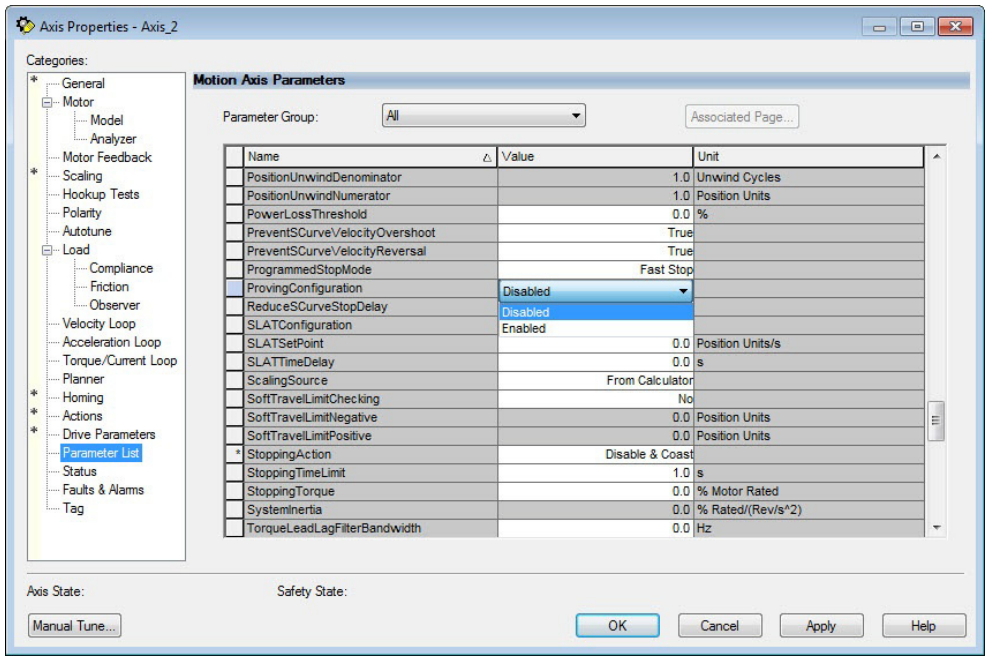
### Torque Proving Attributes

| ID | Access | Attribute | Conditional Implementation |
|---|---|---|---|
| 590 | SSV | Proving Configuration | 0 = Disabled<br>1 = Enabled |
| 591 | SSV | Torque Prove Current | % Motor Rated<br>Units: Amps<br>Default: 0.000<br>Min/Max: 0/10,000 |

## Torque Proving Configuration

Follow these steps to configure the torque proving 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.

## Torque Proving Current Example

In this example, a 2198-H025-ERS*x* servo drive is paired with a VPL-B1003T-C motor with 6.77 A rms rated current. Use the torque-proving equation and table to calculate the minimum torque-proving current as a percentage of motor rated current.

**Figure 127 - Torque Proving Equation**

$$\left(\frac{\textit{Rating From Table}}{\textit{Motor Rated Current}}\right) \text{x } 100\% = \frac{0.5746 \text{ A}}{6.77 \text{ A}} \text{ x } 100\% = 8.49\%$$

**Table 98 - Recommended Torque Proving Current**

| **Drive Cat. No.** | **Torque Proving Current, min** A, rms |
|---|---|
| 2198-H003-ERS*x* | 0.2514 |
| 2198-H008-ERS*x* | 0.6285 |
| 2198-H015-ERS*x* | 1.257 |
| 2198-H025-ERS*x* | 2.011 |
| 2198-H040-ERS*x* | 3.268 |
| 2198-H070-ERS*x* | 5.782 |

# 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 Iq 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 Iq Current. |

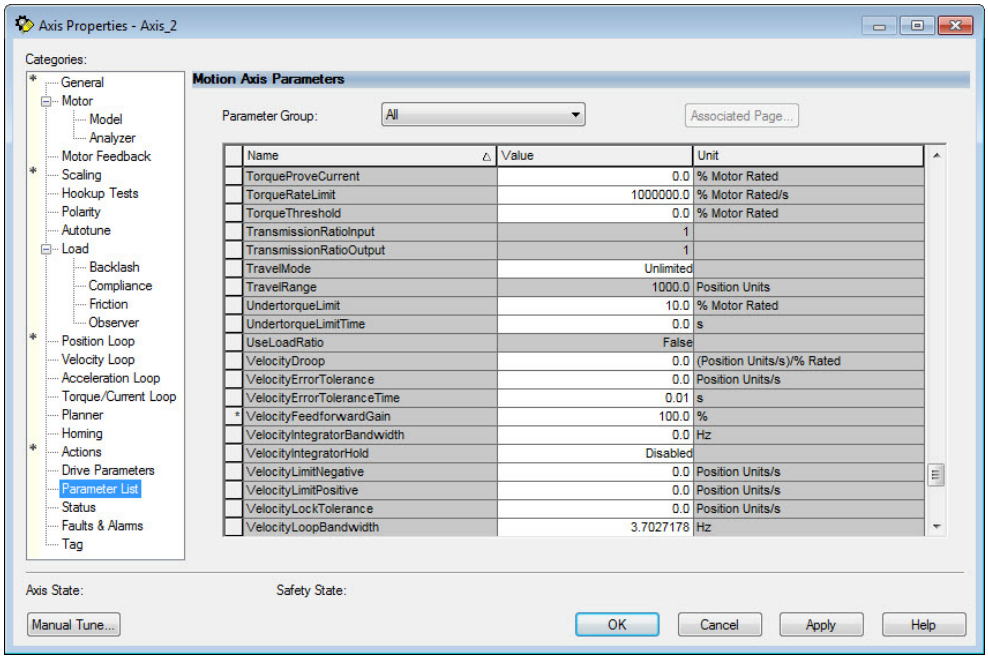
## Velocity Droop Attribute

| 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.

## Adaptive Tuning

The adaptive tuning feature is an algorithm inside the Kinetix 5500drives. 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.

# EC Certifications

This appendix provides Kinetix 5500 servo drive certification information.


| Topic | Page |
|---|---|
| EC Type - Examination Certificate | 261 |
| EU Declaration of Conformity | 262 |
| European Union Directives | 267 |


## EC Type - Examination Certificate

For product certifications currently available from Rockwell Automation, go to http://www.rockwellautomation.com/products/certification.



EC Type-Examination Certificate

Functional Safety Type Approved

TÜVRheinland CERTIFIED

www.tuv.com ID 0600000000

Reg.-No.: 01/205/5255.02/15

| | | | |
|---|---|---|---|
| **Product tested** | Safety Function "Safe Torque Off" (STO) within the AC Servo Drives Kinetix 5500 and 5700 | **Certificate holder** | Rockwell Automation 6400 West Enterprise Drive Mequon, WI 53092 USA |
| **Type designation** | Safe Torque Off-Hardwired (Kinetix 5500): 2198-H003-ERS, 2198-H008-ERS, 2198-H015-ERS, 2198-H025-ERS, 2198-H040-ERS, 2198-H070-ERS<br>Safe Torque Off-Integrated (Kinetix 5500): 2198-H003-ERS2, 2198-H008-ERS2, 2198-H015-ERS2, 2198-H025-ERS2, 2198-H040-ERS2, 2198-H070-ERS2<br>Safe Torque Off Hardwired / Integrated (Kinetix 5700): 2198-S086-ERS3, 2198-S130-ERS3, 2198-S160-ERS3, 2198-D006-ERS3, 2198-D012-ERS3, 2198-D020-ERS3, 2198-D032-ERS3, 2198-D057-ERS3 | | |
| **Codes and standards** | EN 61800-5-2:2007<br>EN 61800-5-1:2007 (in extracts)<br>EN 61800-3:2004 + A1:2012<br>EN ISO 13849-1:2008 + AC:2009 | | EN 62061:2005 + AC:2010 + A1:2013<br>EN 60204-1:2006 + A1:2009 + AC:2010 (in extracts)<br>IEC 61508 Parts 1-7:2010 |
| **Intended application** | The integrated safety function "Safe Torque Off-Hardwired" complies with the requirements of the relevant standards (Cat. 3 / PL d acc. to EN ISO 13849-1, SILCL 2 acc. to EN 62061 / EN 61800-5-2 / IEC 61508) and can be used in applications up to PL d acc. to EN ISO 13849-1, SIL 2 acc. to EN 62061 / IEC 61508.<br>The integrated safety functions "Safe Torque Off-Integrated" and "Safe Torque Off Hardwired / Integrated" comply with the requirements of the relevant standards (Cat. 3 / PL e acc. to EN ISO 13849-1, SILCL 3 acc. to EN 62061 / EN 61800-5-2 / IEC 61508) and can be used in applications up to PL e acc. to EN ISO 13849-1, SIL 3 acc. to EN 62061 / IEC 61508. | | |
| **Specific requirements** | The instructions of the associated Installation and Operating Manual shall be considered. | | |

It is confirmed that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.

Valid until 2020-04-07

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/M 367.03/15 dated 2015-04-07.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

0035 Notified Body

Berlin, 2015-04-07

Certification Body for Machinery, NB 0035

Dipl.-Ing. Eberhard Frejno

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## EU Declaration of Conformity

For all declarations of conformity (DoC) currently available from Rockwell Automation, go to http://www.rockwellautomation.com/rockwellautomation/certification/overview.page.

Rockwell Automation

### *EU Declaration of Conformity*

| | | |
|---|---|---|
| *Product:* | ***Kinetix 5500/5700 Digital Servo Drives and Accessories*** | |
| *Name and address of the manufacturer:*<br>***Rockwell Automation, Inc.***<br>***6400 W. Enterprise Drive***<br>***Mequon, WI 53092***<br>***USA*** | | *Name and address of the authorised representative:*<br>***Rockwell Automation B.V.***<br>***Rivium Promenade 160***<br>***2909 LM Capelle aan den Ijssel***<br>***The Netherlands*** |
| *This declaration of conformity is issued under the sole responsibility of the manufacturer.* | | |
| *Object of the declaration:* | ***Allen-Bradley Bulletin 2198***<br>*(reference the attached list of catalogue numbers)* | |
| *The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:* | | |
| *2006/95/EC* | *Low Voltage Directive* | *(LVD)* |
| *2004/108/EC* | *EMC Directive* | *(EMC)* |
| *2006/42/EC* | *Machinery Directive* | *(MD)* |
| *References to the relevant harmonised standards used or references to the other technical specifications in relation to which conformity is declared:* | | |
| *EN 61800-5-1:2007* | *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy.* | |
| *EN 61800-5-2:2007* | *Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional* | |
| *EN 61800-3:2004 + A1:2012* | *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods* | |
| *EN 60204-1:2006 + A1:2009* | *Safety of machinery – Electrical equipment of machines – Part 1: General requirements* | |
| *IEC 61508: Part 1-7:2010* | *Functional safety of electrical/electronic/programmable electronic safety-related systems* | |
| *EN 62061:2005 + A1:2013* | *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems* | |
| *EN ISO 13849-1:2008* | *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design* | |
| *Notified Body:*<br>*performed:*<br>*and issued the certificate:* | *TÜV Rheinland, Am Grauen Stein, 51105 Koln, (NB 0035)*<br>*EC Type Examination*<br>*01/205/5255.02/15 (MD)* | |
| *Additional information:* | | |
| *Year of CE Marking (LVD):* | *2012* | |
| *Person authorised to compile the technical file (MD):* | *Authorised representative (see details above).* | |
| *Product Safety Function (MD):* | *Safe Torque-Off* | |
| *Signed for and on behalf of the above named manufacturer:* | | |
| *Place and date of issue:* | *Mequon, WI USA* | *15-Apr-2015* |
| *Name, function:* | *Thomas Van Groll, Director Engineering* | |
| *Signature:* |  | |

Document Control Number: IMC-0040-I-EN 1 / 5

Rockwell Automation

| *Catalogue number* | *Series* [3] | *Description* | *Directive* [4] | | |
|---|---|---|---|---|---|
| | | | *EMC* | *LVD* | *MD* |
| Bulletin 2198 Servo Drives | | | | | |
| 2198-H003-ERS | | *Kinetix 5500, Frame 1, 195-528Vrms, 2.5Apk, Hardwired Safety* | *Yes* | *Yes* | *Yes* |
| 2198-H008-ERS | | *Kinetix 5500, Frame 1, 195-528Vrms, 6.25Apk, Hardwired Safety* | *Yes* | *Yes* | *Yes* |
| 2198-H015-ERS | | *Kinetix 5500, Frame 2, 195-528Vrms, 12.5Apk, Hardwired Safety* | *Yes* | *Yes* | *Yes* |
| 2198-H025-ERS | | *Kinetix 5500, Frame 2, 195-528Vrms, 20Apk, Hardwired Safety* | *Yes* | *Yes* | *Yes* |
| 2198-H040-ERS | | *Kinetix 5500, Frame 2, 195-528Vrms, 32.5Apk, Hardwired Safety* | *Yes* | *Yes* | *Yes* |
| 2198-H070-ERS | | *Kinetix 5500, Frame 3, 195-528Vrms, 57.5Apk, Hardwired Safety* | *Yes* | *Yes* | *Yes* |
| 2198-H003-ERS2 | | *Kinetix 5500, Frame 1, 195-528Vrms, 2.5Apk, Integrated Safety Over Ethernet/IP* | *Yes* | *Yes* | *Yes* |
| 2198-H008-ERS2 | | *Kinetix 5500, Frame 1, 195-528Vrms, 6.25Apk, Integrated Safety Over Ethernet/IP* | *Yes* | *Yes* | *Yes* |
| 2198-H015-ERS2 | | *Kinetix 5500, Frame 2, 195-528Vrms, 12.5Apk, Integrated Safety Over Ethernet/IP* | *Yes* | *Yes* | *Yes* |
| 2198-H025-ERS2 | | *Kinetix 5500, Frame 2, 195-528Vrms, 20Apk, Integrated Safety Over Ethernet/IP* | *Yes* | *Yes* | *Yes* |
| 2198-H040-ERS2 | | *Kinetix 5500, Frame 2, 195-528Vrms,32.5Apk, Integrated Safety Over Ethernet/IP* | *Yes* | *Yes* | *Yes* |
| 2198-H070-ERS2 | | *Kinetix 5500, Frame 3, 195-528Vrms, 57.5Apk, Integrated Safety Over Ethernet/IP* | *Yes* | *Yes* | *Yes* |
| 2198-P031 | | *Kinetix 5700, 31.6A, DC Bus Supply* | *Yes* | *Yes* | *N/R* |
| 2198-P070 | | *Kinetix 5700, 70.3A, DC Bus Supply* | *Yes* | *Yes* | *N/R* |
| 2198-P141 | | *Kinetix 5700, 140.8A, DC Bus Supply* | *Yes* | *Yes* | *N/R* |
| 2198-P208 | | *Kinetix 5700, 207.6A, DC Bus Supply* | *Yes* | *Yes* | *N/R* |
| 2198-S086-ERS3 | | *Kinetix 5700, 86.0A, Single Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-S130-ERS3 | | *Kinetix 5700, 130.0A, Single Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-S160-ERS3 | | *Kinetix 5700, 160.0A, Single Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-D006-ERS3 | | *Kinetix 5700, 6.3Arms Peak, Dual Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-D012-ERS3 | | *Kinetix 5700, 12.5A, Dual Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-D020-ERS3 | | *Kinetix 5700, 20.0A, Dual Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-D032-ERS3 | | *Kinetix 5700, 32.5A, Dual Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| 2198-D057-ERS3 | | *Kinetix 5700, 57.5A, Dual Axis Inverter, Integrated Safety* | *Yes* | *Yes* | *Yes* |
| AC Line Filters | | | | | |
| 2198-DB08-F | | *460 Volt 7.5 Amp Three-Phase AC Line Filter* | *Yes* | *Yes* | *N/R* |
| 2198-DB20-F | | *460 Volt 20 Amp Three-Phase AC Line Filter* | *Yes* | *Yes* | *N/R* |
| 2198-DB42-F | | *460 Volt 42 Amp Three-Phase AC Line Filter* | *Yes* | *Yes* | *N/R* |
| 2198-DB80-F | | *460 Volt 80 Amp Three-Phase AC Line Filter* | *Yes* | *Yes* | *N/R* |
| 2198-DB290-F | | *460 Volt 290 Amp Three-Phase AC Line Filter* | *Yes* | *Yes* | *N/R* |
| Shunts | | | | | |
| 2097-R6 | | *75 Ohm, 150W, External Shunt Resistor* | *Yes* | *Yes* | *N/R* |
| 2097-R7 | | *150 Ohm, 80 W, External Shunt Resistor* | *Yes* | *Yes* | *N/R* |
| 2198-R004 | | *Kinetix 5700 Passive External Shunt Resistor 33.0Ω, 400W* | *N/R* | *N/R* | *N/R* |

Document Control Number: IMC-0040-I-EN 2 / 5

Rockwell Automation

| *Catalogue number* | *Series* [3] | *Description* | *Directive* [4] | | |
|---|---|---|---|---|---|
| | | | *EMC* | *LVD* | *MD* |
| 2198-R014 | | *Kinetix 5700 Passive External Shunt Resistor 9.0Ω, 1.4KW* | *N/R* | *N/R* | *N/R* |
| 2198-R031 | | *Kinetix 5700 Passive External Shunt Resistor 33.0Ω, 3.1KW* | *N/R* | *N/R* | *N/R* |
| 2198-R127 | | *Kinetix 5700 Passive External Shunt Resistor 12.5Ω, 12.7KW* | *N/R* | *N/R* | *N/R* |
| Capacitor Modules | | | | | |
| 2198-CAPMOD-1300 | | *Kinetix 5500, Capacitor Module* | *Yes* | *Yes* | *N/R* |
| 2198-CAPMOD-2240 | | *Kinetix 5700, Capacitor Module* | *Yes* | *Yes* | *N/R* |
| 2198-CAPMOD-DCBUS-IO | | *Kinetix 5700, Capacitor Extension Module* | *Yes* | *Yes* | *N/R* |
| Motor Compatibility[2] | | | | | |
| VPL-Axxxxx-yyyyyy[1] | | *230 Volt VP Low-inertia Servo Motor* | *Yes* | *Yes* | *N/R* |
| VPL-Bxxxxx-yyyyyy[1,5] | | *460 Volt VP Low-inertia Servo Motor* | *Yes* | *Yes* | *N/R* |
| VPF-Axxxxx-yyyyyy[1,5] | | *230 Volt VP Low-inertia Servo Motor* | *Yes* | *Yes* | *N/R* |
| VPF-Bxxxxx-yyyyyy[1,5] | | *460 Volt VP Low-inertia Servo Motor* | *Yes* | *Yes* | *N/R* |
| VPS-Bxxxxx-yyyyyy[1,5] | | *460 Volt VP Low-inertia Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPF-Axxxx-yyyyy[1,5] | | *230 Volt Food Grade High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPF-Bxxxx-yyyyy[1,5] | | *460 Volt Food Grade High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPG-Axxxx-yyyyy[1,5] | | *230 Volt Integrated Gear High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPG-Bxxxx-yyyyy[1,5] | | *460 Volt Integrated Gear High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPS-Axxxx-yyy[1,5] | | *230V Stainless Steel High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPS-Bxxxx-yyy[1,5] | | *460V Stainless Steel High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPL-Axxxx-yyyyy[1,5] | | *230 Volt High Resolution Feedback High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPL-Bxxxx-yyyyy[1,5] | | *460 Volt High Resolution Feedback High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPM-Axxxxxx-yyyyy[1,5] | | *230 Volt High Resolution Feedback High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| MPM-Bxxxxxx-yyyyy[1,5] | | *460 Volt High Resolution Feedback High Performance Servo Motor* | *Yes* | *Yes* | *N/R* |
| LDAT-xxxxyyy-xDxx[1,5] | | *LDAT, Integrated Linear Thruster, 230V/460V* | *Yes* | *Yes* | *N/R* |
| Cable Compatibility | | | | | |
| 2090-CSWM1DF-YYAALL[1] | | *Motor power/feedback cable for use with VP family motors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CSBM1DF-YYAALL[1] | | *Motor power/feedback with brake cable for use with VP family motors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CSWM1DE-YYAALL[5] | | *Motor power/feedback cable for use with VP family motors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CSBM1DE-YYAALL[5] | | *Motor power/feedback with brake cable for use with VP family motors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CSWM1DE-YYAFLL[5] | | *Motor power/feedback cable for use with VP family motors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CSBM1DE-YYAFLL[5] | | *Motor power/feedback with brake cable for use with VP family motors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPWM4E2-YYTR[1,5] | | *Motor power transition cables for use with MP family motors. YY = gauge. (From Bayonet Style to DIN Style Connectors)* | *N/R* | *N/R* | *N/R* |
| 2090-CPBM4E2-YYTR[1,5] | | *Motor power with brake transition cables for use with MP motors, YY = wire gauge (From Bayonet Style to DIN Style Connectors)* | *N/R* | *N/R* | *N/R* |
| 2090-CFBM4E2-CATR[1,5] | | *Motor feedback transition cable for use with MP family motors (From Bayonet Style to DIN Style Connectors)* | *N/R* | *N/R* | *N/R* |

Rockwell Automation

| *Catalogue number* | *Series* [3] | *Description* | *Directive* [4] | | |
|---|---|---|---|---|---|
| | | | *EMC* | *LVD* | *MD* |
| 2090-XXNPMP-YYSLL[1,5] | | *Power Cable for MP or 1326AB motor using the MP connector system, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-XXNFMP-SLL[1,5] | | *Feedback Cable for MP or 1326AB motor using the MP connector system, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-UXNFBMP-SLL[1,5] | | *Feedback Cable for MP or 1326AB motor using the MP connector system, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-XXNPMF-YYSLL[1,5] | | *MPF-motor power cable, non-flex, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-XXNFMF-SLL[1,5] | | *MPF-encoder feedback cable, non-flex, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-XXTPMP-YYSLL[1,5] | | *Continuous Flex Motor power cables for MP family motors, YY = gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-XXTFMP-SLL[1,5] | | *Continuous Flex Motor feedback cables for MP family motors, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPWM4DF-YYAFLL[1,5] | | *Continuous Flex Motor power cable for MP or 1326AB motor, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CFBM4DF-CDAFLL[1,5] | | *Continuous Flex Motor feedback cable for MP or 1326AB motor, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CDNFDMP-SLL[1,5] | | *Motor Resolver feedback cable, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CFBM4DF-CEAALL[1,5] | | *Motor Resolver feedback cable, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CFBM4DD-CDAALL[1,5] | | *Feedback Cable for MP or 1326AB motor using the MP connector system, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CFBM7DF-CDAFLL[1,5] | | *Continuous Flex Motor feedback cable for MP or 1326AB motor, with SPEEDTEC connectors, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPWM7DF-YYAFLL[1,5] | | *Continuous Flex Motor power cable for MP or 1326AB motor, with SPEEDTEC connector, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPBM7DF-YYAFLL[1,5] | | *Continuous Flex Motor power with brake cable for MP or 1326AB motor, with SPEEDTEC connector, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CFBM7E7-YYAFLL[1,5] | | *Continuous Flex Motor feedback extension cable for MP or 1326AB motor, with SPEEDTEC connectors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPBM7E7-YYAFLL[1,5] | | *Continuous Flex Motor power with brake extension cable for MP or 1326AB motor, with SPEEDTEC connectors, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPWM7DF-YYAALL[1,5] | | *Power Cable for MP, RD or 1326AB motor with SPEEDTEC connector, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| 2090-CPBM7DF-YYAALL[1,5] | | *Power with Brake Cable for MP, RD or 1326AB motor with SPEEDTEC connector, YY = wire gauge, LL = length in meters* | *N/R* | *N/R* | *N/R* |
| Connector Kits and Miscellaneous Accessories[2] | | | | | |
| 2198-H040-x-x | | *Input Wiring Connectors and DC Bus T Connector for Frame 1 and 2 Servo Drives* | *N/R* | *N/R* | *N/R* |
| 2198-H070-x-x | | *Input Wiring Connectors and DC Bus T Connector for Frame 3 Servo Drive.* | *N/R* | *N/R* | *N/R* |
| 1585J-M8CBJM-x | | *Shielded Ethernet Cable* | *N/R* | *N/R* | *N/R* |
| 1606-XLxxx | | *24V DC Power Supply* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-DSL | | *Replacement Feedback Connector Kit For Kinetix 5500* | *N/R* | *N/R* | *N/R* |

Rockwell Automation

| *Catalogue number* | *Series* [3] | *Description* | *Directive* [4] | | |
|---|---|---|---|---|---|
| | | | *EMC* | *LVD* | *MD* |
| 2198-KITCON-IOSP | | *Replacement I/O Connector Kit (spring clamp) for IOD Connector* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-IOSC | | *Replacement I/O Connector Kit (screw terminal) for IOD Connector* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-PWR40 | | *Replacement Connector Set, 40 Amp, for Kinetix 5500 Frame 1 & 2 Drives* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-PWR70 | | *Replacement Connector Set, 70 Amp, for Kinetix 5500 Frame 3 Drives* | *N/R* | *N/R* | *N/R* |
| 2198-H2DCK | | *DSL Feedback Converter Kit* | *Yes* | *Yes* | *N/R* |
| 2198-K57CK-D15M | | *K5700 Auxiliary Universal Feedback Connector Kit* | *N/R* | *N/R* | *N/R* |
| 2198-H040-P-T | | *K5500 FR1,2 Control Power Connector Kit* | *N/R* | *N/R* | *N/R* |
| 2198-H070-P-T | | *K5500 FR3 Control Power Connector Kit* | *N/R* | *N/R* | *N/R* |
| 2198-S170-P-T | | *Kinetix 5700 100mm Control Power Connect* | *N/R* | *N/R* | *N/R* |
| 2198-BARCON-100DC100 | | *Kinetix 5700 100 mm Bus Bar Replacement* | *N/R* | *N/R* | *N/R* |
| 2198-BARCON-100DC200 | | *Kinetix 5700 DC Bus Link Kit, 100mm* | *N/R* | *N/R* | *N/R* |
| 2198-BARCON-55DC200 | | *Kinetix 5700 DC Bus Link Kit, 55mm* | *N/R* | *N/R* | *N/R* |
| 2198-BARCON-55DCAC100 | | *CONKIT, K5500, Bus Bar, SM* | *N/R* | *N/R* | *N/R* |
| 2198-BARCON-85DC200 | | *Kinetix 5700 DC Bus Link Kit, 85mm* | *N/R* | *N/R* | *N/R* |
| 2198-BARCON-85DCAC100 | | *CONKIT, K5500, Bus Bar, LG* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-ENDCAP200 | | *200A Bus Link Connection End Caps* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-CAPMOD2240 | | *K5700 Connector Kit Capacitor Module* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-D032 | | *K5700 Connector Kit Dual Axis 55mm* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-D046 | | *K5700 Connector Kit Dual Axis 85mm* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-P070 | | *Kinetix 5700 Connector Kit DC Bus Supply* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-P208 | | *Kinetix 5700 Connector Kit DC Bus Supply* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-S130 | | *K5700 Connector Kit Single Axis* | *N/R* | *N/R* | *N/R* |
| 2198-KITCON-S160 | | *K5700 Connector Kit Single Axis* | *N/R* | *N/R* | *N/R* |
| 2198-TCON-24VDCIN36 | | *Connector Kit, Midrange, 24 Vdc Input* | *N/R* | *N/R* | *N/R* |

*1) Only the following motor and cable families are compatible with the Kinetix 5500 servo drives.*

*2) The following letters are used in the compatibility matrix to indicate model number description fields that do not affect this DoC: x, y. These fields may be filled with any number(s) or letter(s).*

*3) If no series number is given, then all series are covered.*

*4) Legend as follows:*
*No = Product is not certified to this directive.*
*Yes = Product is certified to this directive.*
*N/R = this directive is not required for this product*

*5) Only the following motor and cable families are compatible with the Kinetix 5700 servo drives.*

Document Control Number: IMC-0040-I-EN 5 / 5

# European Union Directives

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

## CE Conformity

Conformity with the Low Voltage Directive and Electromagnetic Compatibility (EMC) Directive is demonstrated by using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The safe torque-off circuit complies with the EN standards when installed according instructions found in this manual.

## EMC Directive

This unit is tested to meet Council Directive 2004/108/EC Electromagnetic Compatibility (EMC) by using these standards, in whole or in part:

- EN 61800-3 - Adjustable Speed Electrical Power Drive Systems, Part 3 - EMC Product Standard including specific test methods
- EN 61326-3-1 EMC - Immunity requirements for safety-related systems

The product described in this manual is intended for use in an industrial environment.

CE Declarations of Conformity are available online at http://www.rockwellautomation.com/rockwellautomation/certification/overview.page and in EU Declaration of Conformity on page 262.

## Low Voltage Directive

These units are tested to meet Council Directive 2006/95/EC Low Voltage Directive. The EN 60204-1 Safety of Machinery-Electrical Equipment of Machines, Part 1-Specification for General Requirements standard applies in whole or in part. Additionally, the standard EN 61800-5-1 Electronic Equipment for use in Power Installations apply in whole or in part.

Refer to the Kinetix Servo Drives Specifications Technical Data, publication GMC-TD003, for environmental and mechanical specifications.

## Notes:

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## Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

## Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

| | |
|---|---|
| United States or Canada | 1.440.646.3434 |
| Outside United States or Canada | Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative. |

## New Product Satisfaction Return

Rockwell Automation tests all of its products to verify that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | |
|---|---|
| United States | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process. |
| Outside United States | Please contact your local Rockwell Automation representative for the return procedure. |

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

KLINKMANN

**Helsinki**
tel. +358 9 540 4940
info@klinkmann.fi

**St. Petersburg**
tel. +7 812 327 3752
klinkmann@klinkmann.spb.ru

**Moscow**
tel. +7 495 641 1616
moscow@klinkmann.spb.ru

**Yekaterinburg**
tel. +7 343 287 19 19
yekaterinburg@klinkmann.spb.ru

**Samara**
tel. +7 846 273 95 85
samara@klinkmann.spb.ru

**Kiev**
tel. +38 044 495 33 40
klinkmann@klinkmann.kiev.ua

**Riga**
tel. +371 6738 1617
klinkmann@klinkmann.lv

**Vilnius**
tel. +370 5 215 1646
post@klinkmann.lt

**Tallinn**
tel. +372 668 4500
klinkmann.est@klinkmann.ee

**Minsk**
tel. +375 17 200 0876
minsk@klinkmann.com

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