

## Kinetix 350 Single-axis EtherNet/IP Servo Drives

Catalog Numbers 2097-V31PR0-LM, 2097-V31PR2-LM,  
2097-V32PR0-LM, 2097-V32PR2-LM, 2097-V32PR4-LM,  
2097-V33PR1-LM, 2097-V33PR3-LM, 2097-V33PR5-LM, 2097-V33PR6-LM,  
2097-V34PR3-LM, 2097-V34PR5-LM, 2097-V34PR6-LM



## 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.

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### IMPORTANT

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

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



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



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



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

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

### New and Updated Information

This table contains the changes made to this revision.

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## About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting your Kinetix 350 drive; and system integration for your drive/motor combination with a Logix5000™ controller.

## Conventions

The conventions starting below are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.

## Studio 5000 Environment

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



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

## Additional Resources

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

| Resource   | Description   |
|--|---|
| Kinetix 350 Single-axis EtherNet/IP Servo Drive Installation Instructions, publication <a href="#">2097-IN008</a>  | Information on installing your Kinetix 350 drive system.  |
| Kinetix 300 Shunt Resistor Installation Instructions, publication <a href="#">2097-IN002</a>   | Information on installing and wiring the Kinetix 300 shunt resistors.   |
| Kinetix 300 AC Line Filter Installation Instructions, publication <a href="#">2097-IN003</a>   | Information on installing and wiring the Kinetix 300 AC line filter.  |
| Kinetix 300 I/O Terminal Expansion Block Installation Instructions, publication <a href="#">2097-IN005</a>   | Information on installing and wiring the Kinetix 300 I/O terminal expansion block.  |
| CompactLogix L3ER Controllers User Manual, publication <a href="#">1769-UM021</a>  | Information on installing, configuring, programming, and operating a CompactLogix <sup>®</sup> system.                            |
| Stratix 2000 Ethernet Unmanaged Switches Installation Instructions, publication <a href="#">1783-IN001</a>   | Information on installing and operating a Stratix 2000 <sup>™</sup> Ethernet Switches.  |
| Ethernet/IP Benefits of Industrial Connectivity in Industrial Apps White Paper, publication <a href="#">1585-WP001A</a>  | Provides general guidelines and theory for Ethernet/IP industrial systems.  |
| Industrial Ethernet Media, publication <a href="#">1585-BR001</a>  | This brochure provides connectivity solutions for Ethernet networks and integrated architecture.                                  |
| Guidance for Selecting Cables for EtherNet/IP Networks White Paper, publication <a href="#">ENET-WP007</a>   | This guide is arranged to help you select cabling based on the application, environmental conditions, and mechanical requirements |
| Integrated Motion on SERCOS and EtherNet/IP Systems - Analysis and Comparison White Paper, publication <a href="#">MOTION-WP007</a>  | This white paper compares and contrasts SERCOS and EtherNet/IP with a ControlLogix <sup>®</sup> controller.                       |
| Industrial Automation Wiring and Grounding Guidelines, publication <a href="#">1770-4.1</a>  | Provides general guidelines for installing a Rockwell Automation industrial system.   |
| System Design for Control of Electrical Noise Reference Manual, publication <a href="#">GMC-RM001</a>  | 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 <a href="#">GMC-SG001</a>  | Specifications, motor/servo-drive system combinations, and accessories for Kinetix motion control products.                       |
| Kinetix Servo Drives Specifications Technical Data, publication <a href="#">GMC-TD003</a>  | Specifications for Kinetix servo drive motion control products.   |
| Motion Analyzer software, download at <a href="http://www.ab.com/e-tools">http://www.ab.com/e-tools</a>  | Drive and motor sizing with application analysis software.  |
| ControlLogix Controllers User Manual, publication <a href="#">1756-UM001</a>   | Information on installing, configuring, programming, and operating a ControlLogix system.   |
| CIP Motion Configuration and Startup User Manual, publication <a href="#">MOTION-UM003</a>   | Information on configuring and troubleshooting your ControlLogix and CompactLogix EtherNet/IP network modules.                    |
| 842E-CM Integrated Motion Encoder on EtherNet/IP User Manual. Publication <a href="#">842E-UM002A</a>  | Information on installing, wiring, and troubleshoot a integrated motion encoder on EtherNet /IP.                                  |
| ControlFLASH Firmware Upgrade Kit User Manual, publication <a href="#">1756-QS105</a>  | For ControlFLASH <sup>™</sup> information not specific to any drive family.   |
| Rockwell Automation Configuration and Selection Tools, website <a href="http://www.ab.com/e-tools">http://www.ab.com/e-tools</a>   | Online product selection and system configuration tools, including AutoCAD (DXF) drawings.  |
| Rockwell Automation Product Certification, website <a href="http://www.rockwellautomation.com/products/certification">http://www.rockwellautomation.com/products/certification</a> | For declarations of conformity (DoC) currently available from Rockwell Automation.  |
| 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 <a href="#">AG-7.1</a>   | 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



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## About the Kinetix 350 Drive System

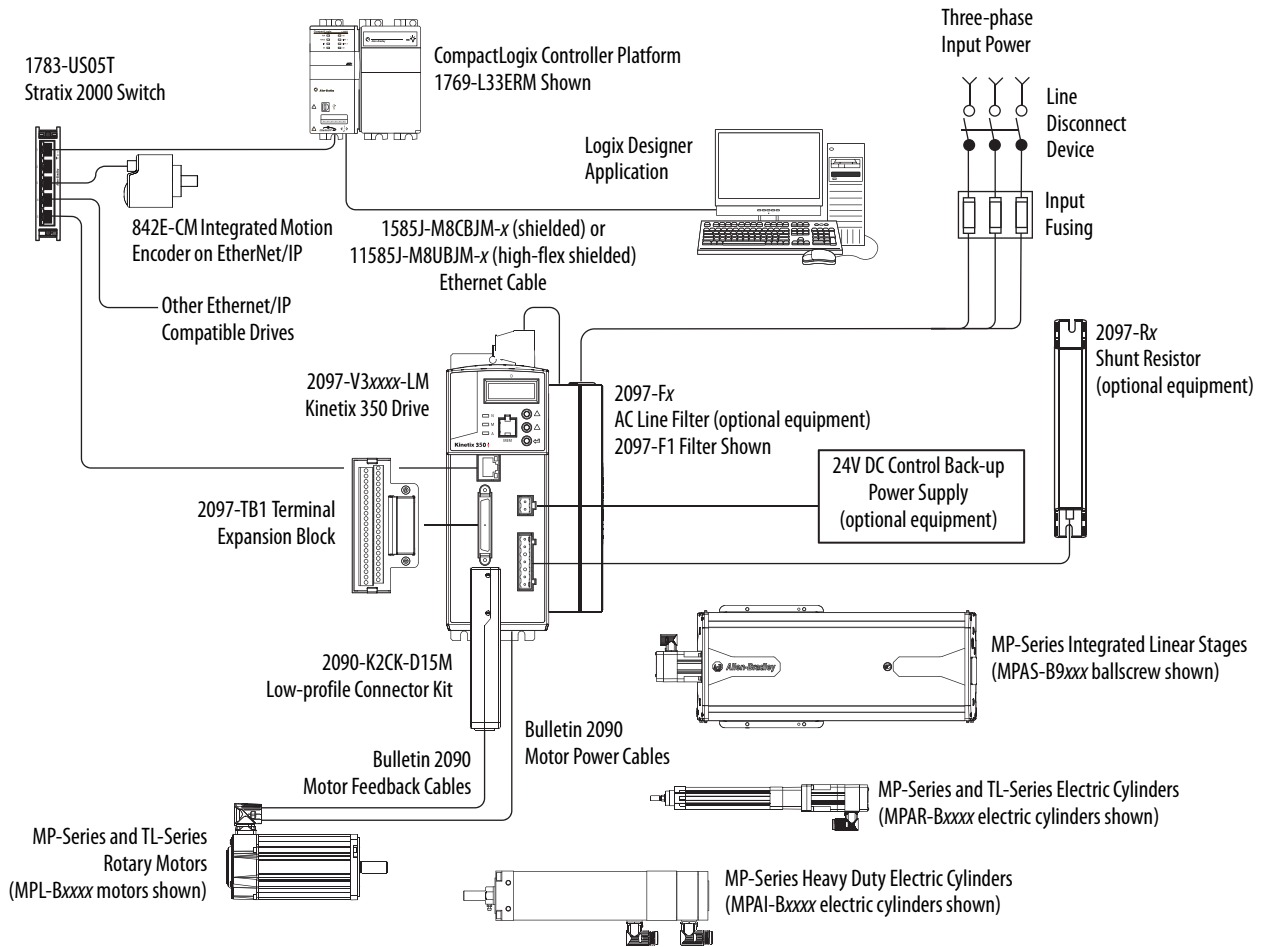
The Kinetix 350 single-axis EtherNet/IP servo drive is designed to provide a solution for applications with output power requirements between 0.4...3.0 kW (2...12 A rms).

**Table 1 - Kinetix 350 Drive System Overview**

| Kinetix 350 System Component                             | Cat. No.   | Description   |
|--|--|---|
| Kinetix 350 integrated motion on EtherNet/IP Servo Drive | 2097-V3xPRx-LM   | Kinetix 350 integrated motion on EtherNet/IP drives with safe torque-off feature are available with 120/240V or 480V AC input power.  |
| AC Line Filters  | 2090<br>2097-Fx  | Bulletin 2090 and Bulletin 2097-Fx AC line filters are required to meet CE with Kinetix 350 drives without an integrated line filter. Bulletin 2097 filters are available in foot mount and side mount.   |
| Shunt Module   | 2097-Rx  | Bulletin 2097 shunt resistors connect to the drive and provide shunting capability in regenerative applications.  |
| Terminal block for I/O connector                         | 2097-TB1   | 50-pin terminal block. Use with IOD connector for control interface connections.  |
| Stratix 2000 Ethernet Switch                             | 1783-US05T   | An Ethernet switch divides an Ethernet network into segments and directs network traffic efficiently.   |
| Logix5000 Controller Platform                            | 1769-L18ERM-BB1B<br>1769-L27ERM-QBFC1B<br>1769-L33ERM<br>1769-L36ERM<br>1769-L30ERM<br>1756-L6x <sup>(1)</sup><br>1756-L7x | CompactLogix controller with integrated dual-port Ethernet/IP interface serves as communication link with the Kinetix 350 drive system. The communication link uses EtherNet/IP protocol over a copper cable.   |
| Studio 5000 Environment                                  | N/A  | The Studio 5000 Logix Designer application provides support for programming, commissioning, and maintaining the Logix5000 family of controllers.  |
| Rotary Servo Motors                                      | MP-Series™, TL-Series  | Compatible rotary motors include the MP-Series (Bulletin MPL, MPM, MPF, and MPS) and TL-Series (Bulletin TLY) motors.   |
| Linear Stages  | MP-Series (BallScrew)  | Compatible stages include MP-Series (Bulletin MPAS) Integrated Linear Stages.   |
| Electric Cylinders                                       | MP-Series, TL-Series   | Compatible electric cylinders include MP-Series and TL-Series (Bulletin MPAI) Electric Cylinders.   |
| Encoder  | 842E-CM  | Integrated Motion Encoder on EtherNet/IP  |
| Cables   | Motor/brake and feedback cables  | Motor power/brake and feedback cables include SpeedTec and threaded DIN connectors at the motor. Power/brake cables have flying leads on the drive end and straight connectors that connect to servo motors. Feedback cables have flying leads that wire to low-profile connector kits on the drive end and straight connectors on the motor end. |
|  | Communication cables   | 1585J-M8CJM-x (shielded) or 1585J-M8UBJM-x (high-flex shielded) Ethernet cable.   |

(1) 1756-L6x CompactLogix controller requires RSLogix 5000 software version 17.01.02 or later.

**Figure 1 - Typical Kinetix 350 Drive Installation**



## Catalog Number Explanation

Kinetix 350 drive catalog numbers and descriptions are listed in these tables.

**Table 2 - Kinetix 350 Drives (single-phase)**

| Cat. No.       | Input Voltage          | Continuous Output Current A (0-pk) | Features   |
|----------------|------------------------|------------------------------------|--|
| 2097-V31PR0-LM | 120V, 1 Ø<br>240V, 1 Ø | 2.8                                | <ul style="list-style-type: none"> <li>• 120V Doubler mode</li> <li>• Safe Torque-off</li> </ul>         |
| 2097-V31PR2-LM |                        | 5.7                                |  |
| 2097-V32PR0-LM | 240V, 1 Ø              | 2.8                                | <ul style="list-style-type: none"> <li>• Integrated AC line filter</li> <li>• Safe Torque-off</li> </ul> |
| 2097-V32PR2-LM |                        | 5.7                                |  |
| 2097-V32PR4-LM |                        | 11.3                               |  |

**Table 3 - Kinetix 350 Drives (single/three-phase)**

| Cat. No.       | Input Voltage                       | Continuous Output Current A (0-pk) | Features        |
|----------------|-------------------------------------|------------------------------------|-----------------|
| 2097-V33PR1-LM | 120V, 1 Ø<br>240V, 1 Ø<br>240V, 3 Ø | 2.8                                | Safe Torque-off |
| 2097-V33PR3-LM |                                     | 5.7                                |                 |
| 2097-V33PR5-LM |                                     | 11.3                               |                 |
| 2097-V33PR6-LM |                                     | 17.0                               |                 |

**Table 4 - Kinetix 350 Drives (three-phase)**

| Cat. No.       | Input Voltage | Continuous Output Current A (0-pk) | Features        |
|----------------|---------------|------------------------------------|-----------------|
| 2097-V34PR3-LM | 480V, 3 Ø     | 2.8                                | Safe Torque-off |
| 2097-V34PR5-LM |               | 5.7                                |                 |
| 2097-V34PR6-LM |               | 8.5                                |                 |

**Table 5 - Kinetix 350 Drive Accessories**

| Cat. No.  | Drive Components                 |
|-----------|----------------------------------|
| 2097-Fx   | AC line filters                  |
| 2097-TB1  | Terminal block for I/O connector |
| 2097-Rx   | Shunt resistors                  |
| 2097-PGMR | Memory module programmer         |
| 2097-MEM  | Memory modules 12 pack           |

## 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. 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 [Grounding Your Kinetix 350 Drive System](#) on [page 58](#).

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

## CE Requirements

To meet CE requirements, these requirements apply:

- Install an AC line filter (Bulletin 2090 or 2097) as close to the drive as possible.
- Use 2090 series motor power cables or use connector kits and terminate the cable shields to the subpanel with clamp provided.
- Use 2090 series motor feedback cables or use connector kits and properly terminate the feedback cable shield. Drive-to-motor power and feedback cables must not exceed 20 m (65.6 ft).
- Install the Kinetix 350 system inside an enclosure. Run input power wiring in conduit (grounded to the enclosure) outside of the enclosure. Separate signal and power cables.
- Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a grounded 360° clamp termination.

Refer to Appendix A on [page 129](#) for interconnect diagrams, including input power wiring and drive/motor interconnect diagrams.

**Notes:**

## Install the Kinetix 350 Drive System

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

### System Design Guidelines

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

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

### System Mounting Requirements

- To comply with UL and CE requirements, the Kinetix 350 system must be enclosed in a grounded conductive enclosure offering protection as defined in standard EN 60529 (IEC 529) to IP4X such that they are not accessible to an operator or unskilled person. A NEMA 4X enclosure exceeds these requirements providing protection to IP66.
- The panel you install inside the enclosure for mounting your system components must be on a flat, rigid, vertical surface that won't be subjected to shock, vibration, moisture, oil mist, dust, or corrosive vapors.
- Size the drive enclosure so as not to exceed the maximum ambient temperature rating. Consider heat dissipation specifications for all drive components.
- Segregate input power wiring and motor power cables from control wiring and motor feedback cables. Use shielded cable for power wiring and provide a grounded 360° clamp termination.
- Use high-frequency (HF) bonding techniques to connect the enclosure, machine frame, and motor housing, and to provide a low-impedance return path for high-frequency (HF) energy and reduce electrical noise.

- Use 2090 series motor feedback cables or use connector kits and properly terminate the feedback cable shield. Drive-to-motor power and feedback cables must not exceed 20 m (65.6 ft).

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**IMPORTANT** System performance was tested at these cable length specifications. These limitations are also a CE requirement.

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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 Kinetix 350 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 controller to the available service.

To size a transformer for the main AC power inputs, refer to [Circuit Breaker/Fuse Specifications](#) on [page 20](#) and [Transformer Specifications for Input Power](#) on [page 23](#).

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

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**IMPORTANT** Use a form factor of 1.5 for single and three-phase power (where form factor is used to compensate for transformer, drive, and motor losses, and to account for utilization in the intermittent operating area of the torque speed curve).  
For example, sizing a transformer to the voltage requirements of catalog number 2097-V34PR6-LM = 3 kW continuous x 1.5 = 4.5 KVA transformer.

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## Circuit Breaker/Fuse Selection

The Kinetix 350 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 100,000 A. Fuses or circuit breakers that are adequate and can withstand interrupt ratings, as defined in NEC or applicable local codes, are permitted.

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

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

See Kinetix 350 Drive Power Specifications in Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#) for input current and inrush current specifications for your Kinetix 350 drive.

Refer to [Circuit Breaker/Fuse Specifications](#) on [page 20](#) for recommended circuit breakers and fuses.

## Circuit Breaker/Fuse Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses.

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

Use class CC or T fast-acting current-limiting type fuses, 200,000 AIC, preferred. Use Bussmann KTK-R, JJN, JJS or equivalent. Thermal-magnetic type breakers preferred. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with Kinetix 350 drives.

**Figure 2 - Fuse and Circuit Breaker (CB) Specifications**

| Drive Cat. No. | Drive Voltage | Phase                          | UL Applications  |                                      |  | IEC (non UL) Applications |                                      |   |
|----------------|---------------|--------------------------------|------------------|--------------------------------------|--|---------------------------|--------------------------------------|---|
|                |               |                                | Fuses (Bussmann) | Miniature CB <sup>(1)</sup> Cat. No. | Motor Protection CB <sup>(1)(2)</sup> Cat. No. | DIN gG Fuses Amps, max    | Miniature CB <sup>(1)</sup> Cat. No. | Motor Protection CB <sup>(1)</sup> Cat. No. |
| 2097-V31PR0-LM | 120V          | Single-phase (voltage doubler) | KTK-R-20 (20 A)  | 1489-A1C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP1D200                         | 140M-D8E-C20                                |
|                | 120/240V      | Single-phase                   | KTK-R-10 (10 A)  | 1489-A1C100                          | 140M-C2E-C10                                   | 10                        | 1492-SP1D100                         | 140M-C2E-C10                                |
| 2097-V31PR2-LM | 120V          | Single-phase (voltage doubler) | KTK-R-30 (30 A)  | 1489-A1C300                          | 140M-F8E-C32                                   | 32                        | 1492-SP1D300                         | 140M-F8E-C32                                |
|                | 120/240V      | Single-phase                   | KTK-R-20 (20 A)  | 1489-A1C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP1D200                         | 140M-D8E-C20                                |
| 2097-V32PR0-LM | 240V          | Single-phase                   | KTK-R-15 (15 A)  | 1489-A1C150                          | 140M-D8E-C16                                   | 16                        | 1492-SP1D150                         | 140M-D8E-C16                                |
| 2097-V32PR2-LM |               |                                | KTK-R-20 (20 A)  | 1489-A1C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP1D200                         | 140M-D8E-C20                                |
| 2097-V32PR4-LM |               |                                | KTK-R-30 (30 A)  | 1489-A1C300                          | 140M-F8E-C32                                   | 32                        | 1492-SP1D320                         | 140M-F8E-C32                                |
| 2097-V33PR1-LM | 120/240V      | Single-phase                   | KTK-R-20 (20 A)  | 1489-A1C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP1D200                         | 140M-D8E-C20                                |
|                | 240V          | Three-phase                    | KTK-R-15 (15 A)  | 1489-A3C150                          | 140M-D8E-C16                                   | 16                        | 1492-SP3D150                         | 140M-D8E-C16                                |
| 2097-V33PR3-LM | 120/240V      | Single-phase                   | KTK-R-20 (20 A)  | 1489-A1C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP1D200                         | 140M-D8E-C20                                |
|                | 240V          | Three-phase                    | KTK-R-15 (15 A)  | 1489-A3C150                          | 140M-D8E-C16                                   | 16                        | 1492-SP3D150                         | 140M-D8E-C16                                |
| 2097-V33PR5-LM | 120/240V      | Single-phase                   | KTK-R-30 (30 A)  | 1489-A1C300                          | 140M-F8E-C32                                   | 32                        | 1492-SP1D300                         | 140M-F8E-C32                                |
|                | 240V          | Three-phase                    | KTK-R-20 (20 A)  | 1489-A3C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP3D200                         | 140M-D8E-C20                                |
| 2097-V33PR6-LM | 120/240V      | Single-phase                   | LPJ-40SP         | N/A                                  | 140M-F8E-C32                                   | 40                        | N/A                                  | 140M-F8E-C32                                |
|                | 240V          | Three-phase                    | KTK-R-30 (30 A)  | 1489-A3C300                          |  | 32                        | 1492-SP3D300                         |   |
| 2097-V34PR3-LM | 480V          | Three-phase                    | KTK-R-10 (10 A)  | 1489-A3C100                          | 140M-C2E-C10                                   | 10                        | 1492-SP3D100                         | 140M-C2E-C10                                |
| 2097-V34PR5-LM |               |                                | KTK-R-10 (10 A)  | 1489-A3C100                          | 140M-C2E-C10                                   | 10                        | 1492-SP3D100                         | 140M-C2E-C10                                |
| 2097-V34PR6-LM |               |                                | KTK-R-20 (20 A)  | 1489-A3C200                          | 140M-D8E-C20                                   | 20                        | 1492-SP3D200                         | 140M-D8E-C20                                |

(1) Bulletin 1492 circuit protection devices have lower short-circuit current ratings than Bulletin 140M devices. Refer to <http://ab.rockwellautomation.com/allenbradley/productdirectory.page?> for product literature with specific short-circuit ratings.

(2) For UL applications, Bulletin 140M devices are applied as self-protected combination motor controllers.

## Enclosure Selection

This example is provided to assist you in sizing an enclosure for your Bulletin 2097 drive system. You need heat dissipation data from all components planned for your enclosure to calculate the enclosure size. See Power Dissipation Specifications on [page 23](#) for your drive.

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 <sup>2</sup> ). 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 <sup>2</sup> ). 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 350 drive system is 40 °C (104 °F) and if the maximum environmental temperature is 20 °C (68 °F), then T=20. In this example, the total heat dissipation is 416 W (sum of all components in enclosure). So, in the equation below, T=20 and Q=416.

$$A = \frac{0.38 (416)}{1.8 (20) - 1.1} = 4.53 \text{ m}^2$$

In this example, the enclosure must have an exterior surface of at least 4.53 m<sup>2</sup>. If any portion of the enclosure is not able to transfer heat, do not include heat in the calculation.

Because the minimum cabinet depth to house the Kinetix 350 system (selected for this example) is 332 mm (13 in.), the cabinet needs to be approximately 2000 x 700 x 332 mm (78.7 x 27.6 x 13.0 in.) HxWxD.

$$2 \times (0.332 \times 0.70) + 2 \times (0.332 \times 2.0) + 2 \times (0.70 \times 2.0) = 4.59 \text{ m}^2$$

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

## Contactor Ratings

**Table 6 - Kinetix 350 Drives (120/240V)**

| Cat. No.       | Drive Voltage | AC Coil Contactor | DC Coil Contactor |
|----------------|---------------|-------------------|-------------------|
| 2097-V31PR0-LM | 120V          | 100-C23x10        | 100-C23Zx10       |
|                | 240V          | 100-C12x10        | 100-C12Zx10       |
| 2097-V31PR2-LM | 120V          | 100-C30x10        | 100-C30Zx10       |
|                | 240V          | 100-C23x10        | 100-C23Zx10       |

**Table 7 - Kinetix 350 Drives (240V)**

| Cat. No.       | Drive Voltage | AC Coil Contactor | DC Coil Contactor |
|----------------|---------------|-------------------|-------------------|
| 2097-V32PR0-LM | 240V          | 100-C23x10        | 100-C23Zx10       |
| 2097-V32PR2-LM | 240V          | 100-C23x10        | 100-C23Zx10       |
| 2097-V32PR4-LM | 240V          | 100-C30x10        | 100-C30Zx10       |
| 2097-V33PR1-LM | 120V          | 100-C23x10        | 100-C23Zx10       |
|                | 240V          | 100-C16x10        | 100-C16Zx10       |
| 2097-V33PR3-LM | 120V          | 100-C23x10        | 100-C23Zx10       |
|                | 240V          | 100-C16x10        | 100-C16Zx10       |
| 2097-V33PR5-LM | 120V          | 100-C30x10        | 100-C30Zx10       |
|                | 240V          | 100-C23x10        | 100-C23Zx10       |
| 2097-V33PR6-LM | 120V          | N/A               | N/A               |
|                | 240V          | 100-C30x10        | 100-C30Zx10       |

**Table 8 - Kinetix 350 Drives (480V)**

| Cat. No.       | Drive Voltage | AC Coil Contactor | DC Coil Contactor |
|----------------|---------------|-------------------|-------------------|
| 2097-V34PR3-LM | 480V          | 100-C12x10        | 100-C12Zx10       |
| 2097-V34PR5-LM |               | 100-C12x10        | 100-C12Zx10       |
| 2097-V34PR6-LM |               | 100-C23x10        | 100-C23Zx10       |

## Transformer Specifications for Input Power

| Attribute          | Value (460V system) |
|--------------------|---------------------|
| Input volt-amperes | 750VA               |
| Input voltage      | 480V AC             |
| Output voltage     | 120...240V AC       |

## Power Dissipation Specifications

This table shows the maximum power dissipation of each drive. Use this table to size an enclosure and calculate required ventilation for your Kinetix 350 drive system.

| Cat. No.       | Power Dissipation, W |
|----------------|----------------------|
| 2097-V31PR0-LM | 28                   |
| 2097-V31PR2-LM | 39                   |
| 2097-V32PR0-LM | 28                   |
| 2097-V32PR2-LM | 39                   |
| 2097-V32PR4-LM | 67                   |
| 2097-V33PR1-LM | 28                   |
| 2097-V33PR3-LM | 39                   |
| 2097-V33PR5-LM | 67                   |
| 2097-V33PR6-LM | 117                  |
| 2097-V34PR3-LM | 39                   |
| 2097-V34PR5-LM | 58                   |
| 2097-V34PR6-LM | 99                   |

## Minimum Clearance Requirements

This section provides information to assist you in sizing your cabinet and positioning your Kinetix 350 system components.

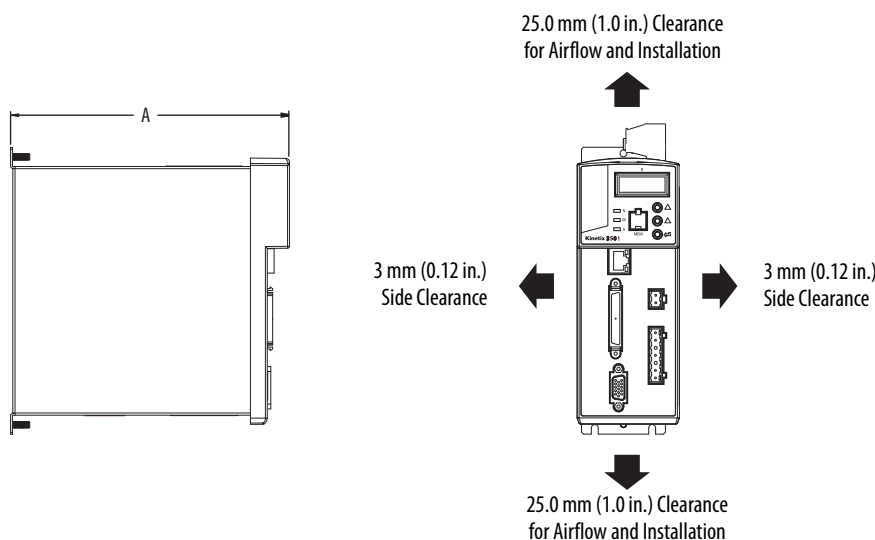
**IMPORTANT** Mount the module in an upright position as shown. Do not mount the drive module on its side.

[Figure 3](#) illustrates minimum clearance requirements for proper airflow and installation:

- Additional clearance is required depending on the accessory items installed.
- An additional 9.7 mm (0.38 in.) clearance is required left of the drive if the I/O expansion terminal block is used.
- An additional 26 mm (1.0 in.) clearance is required right of the drive when the heatsink is present.
- An additional 36 mm (1.42 in.) is required right of the drive when the side-mount line filter is present. An additional 50 mm (2.0 in.) is required behind the drive when the rear-mount line filter is present.
- An additional 5.0 mm (0.19 in.) clearance is required in front of the drive when the 2090-K2CK-D15M feedback connector kit is used.
- Additional clearance is required for the cables and wires connected to the top, front, and bottom of the drive.
- An additional 150 mm (6.0 in.) is required when the drive is mounted adjacent to noise sensitive equipment or clean wireways.

Refer to Kinetix 350 Drive Power Specifications in Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#) for Kinetix 350 drive dimensions.

**Figure 3 - Minimum Clearance Requirements**



| Drive Cat. No. | A          |
|----------------|------------|
| 2097-V31PRO-LM | 185 (7.29) |
| 2097-V31PR2-LM | 185 (7.29) |
| 2097-V32PRO-LM | 230 (9.04) |
| 2097-V32PR2-LM | 230 (9.04) |
| 2097-V32PR4-LM | 230 (9.04) |
| 2097-V33PR1-LM | 185 (7.29) |
| 2097-V33PR3-LM | 185 (7.29) |
| 2097-V33PR5-LM | 185 (7.29) |
| 2097-V33PR6-LM | 230 (9.04) |
| 2097-V34PR3-LM | 185 (7.29) |
| 2097-V34PR5-LM | 185 (7.29) |
| 2097-V34PR6-LM | 230 (9.04) |

Refer to [page 23](#) for power dissipation specifications.

## Electrical Noise Reduction

This section outlines best practices that minimize the possibility of noise-related failures as they apply specifically to Kinetix 350 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 Drives

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 drive 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 drive and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

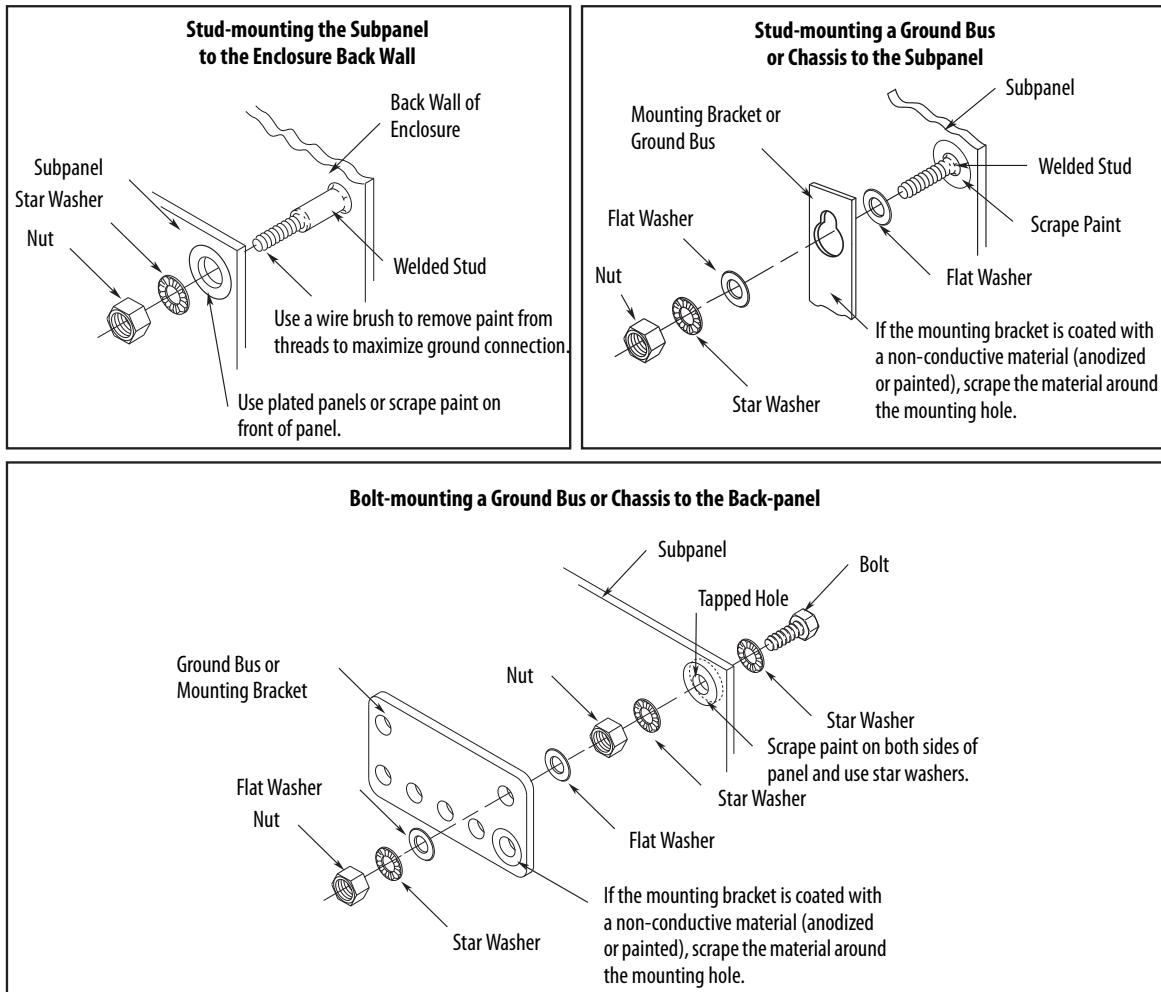
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Improper bonding of metal surfaces blocks the direct return path and lets high-frequency energy travel elsewhere in the cabinet. Excessive high-frequency energy can effect the operation of other microprocessor controlled equipment.



These illustrations show recommended bonding practices for painted panels, enclosures, and mounting brackets.

Figure 4 - Recommended Bonding Practices for Painted Panels

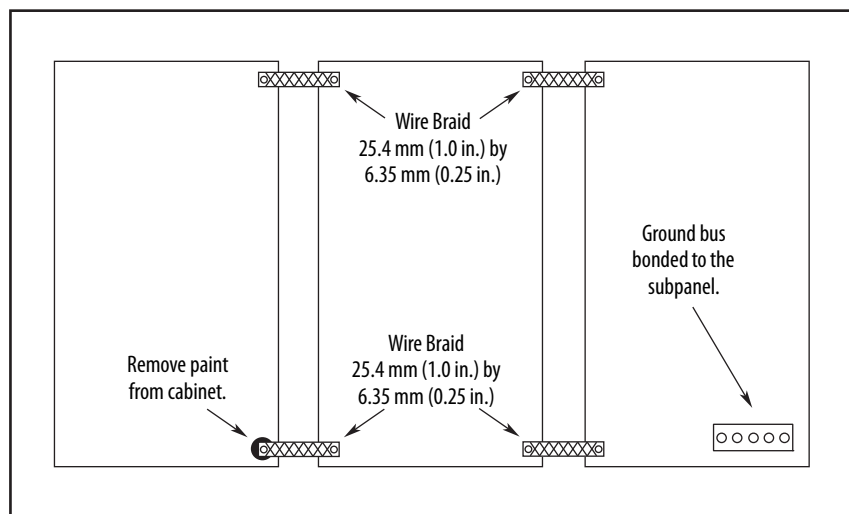


## Bonding Multiple Subpanels

Bonding multiple subpanels creates a common low impedance exit path for the high frequency energy inside the cabinet. Subpanels that are not bonded together can not 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 5 - Multiple Subpanels and Cabinet Recommendations**

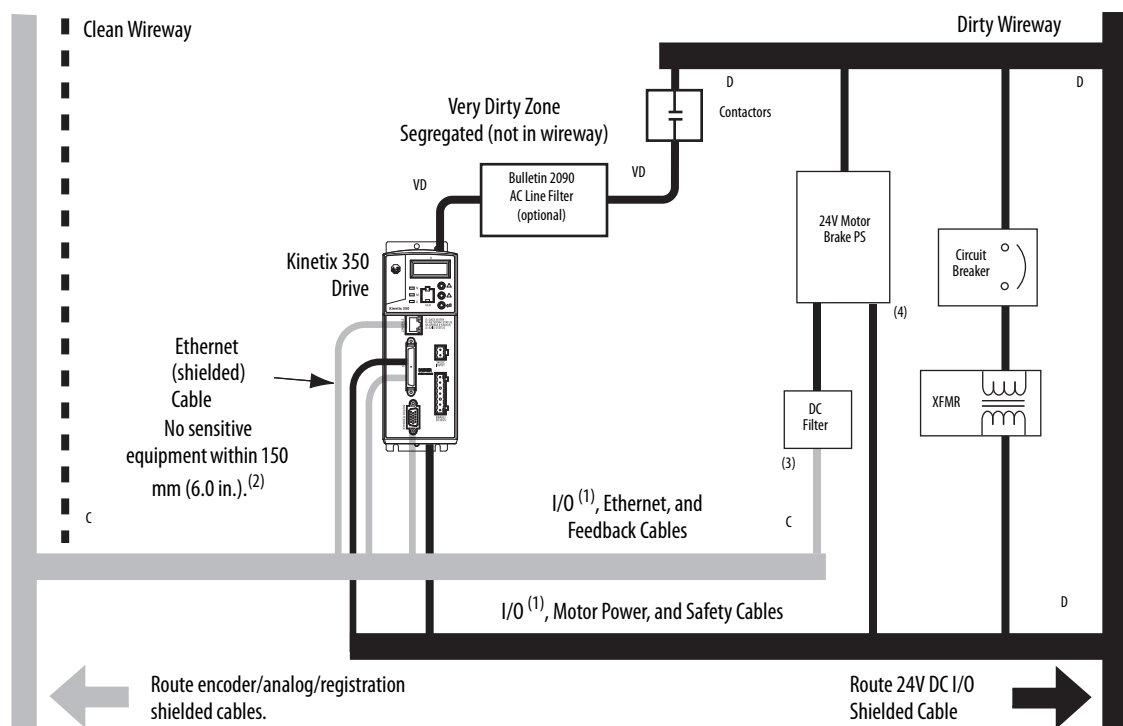


## Establishing Noise Zones

Observe these guidelines when individual input power components are used in the Kinetix 350 system:

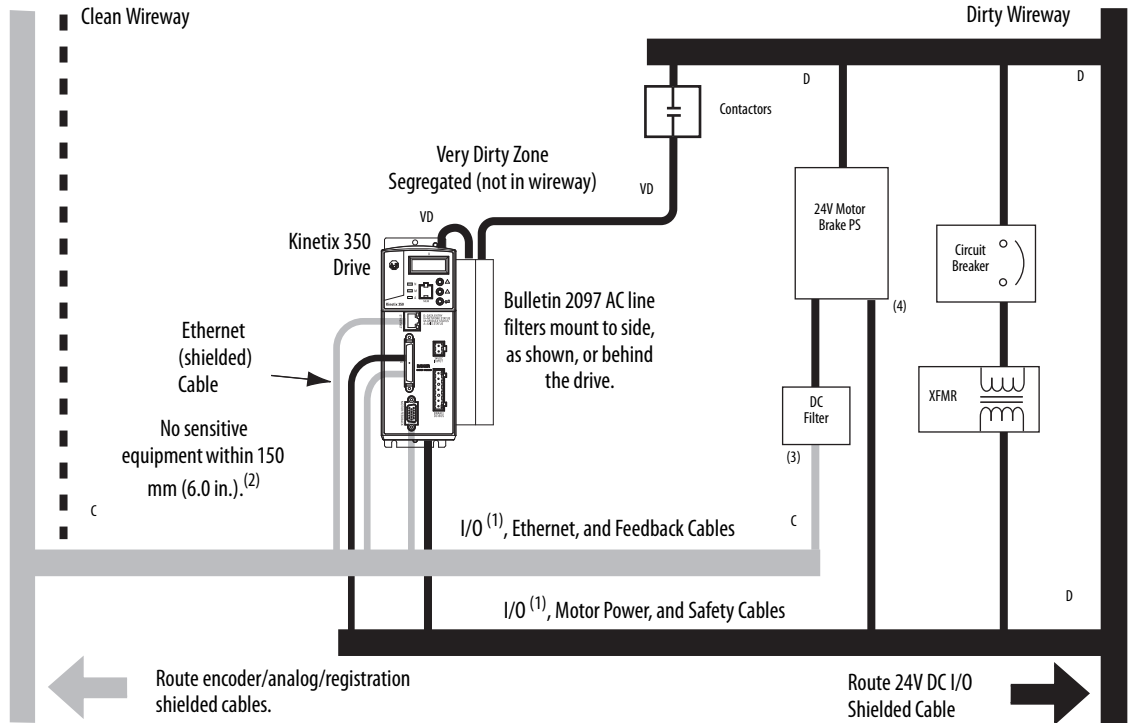
- The clean zone (C) exits left of the Kinetix 350 system and includes the I/O wiring, feedback cable, Ethernet cable, and DC filter (gray wireway).
- The dirty zone (D) exits right of the Kinetix 350 system (black wireway) and includes the circuit breakers, transformer, 24V DC power supply, contactors, AC line filter, motor power, and safety cables.
- The very dirty zone (VD) is limited to where the AC line (EMC) filter VAC output jumpers over to the drive. Shielded cable is required only if the very dirty cables enter a wireway.

Figure 6 - Noise Zones (Bulletin 2090 AC line filters)



- (1) If drive system I/O cable contains (dirty) relay wires, route cable in dirty wireway.
- (2) For tight spaces use a grounded steel shield. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).
- (3) This is a clean 24V DC available for any device that requires it. The 24V enters the clean wireway and exits to the left.
- (4) This is a dirty 24V DC available for motor brakes and contactors. The 24V enters the dirty wireway and exits to the right.

**Figure 7 - Noise Zones (Bulletin 2097 AC line filters)**



- (1) If drive system I/O cable contains (dirty) relay wires, route cable in dirty wireway.
- (2) For tight spaces use a grounded steel shield. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).
- (3) This is a clean 24V DC available for any device that requires it. The 24V enters the clean wireway and exits to the left.
- (4) This is a dirty 24V DC available for motor brakes and contactors. The 24V enters the dirty wireway and exits to the right.

## Cable Categories for Kinetix 350 Drive Components

These table indicate the zoning requirements of cables connecting to the Kinetix 350 drive components.

**Table 9 - Kinetix 350 Drive Components**

| Wire/Cable  | Connector | Zone       |       |       | Method         |                |
|---|-----------|------------|-------|-------|----------------|----------------|
|   |           | Very Dirty | Dirty | Clean | Ferrite Sleeve | Shielded Cable |
| L1, L2, L3 (unshielded cable)   | IPD       | X          |       |       |                |                |
| U, V, W (motor power)   | MP        |            | X     |       |                | X              |
| B+, B-, BR (shunt resistor)   | BC        |            | X     |       |                |                |
| 24V DC  | BP        |            |       | X     |                |                |
| Control COM, 24V DC control, safety enable, and feedback signals for safe-off feature | STO       |            | X     |       |                |                |
| Motor feedback  | MF        |            |       | X     |                | X              |
| Registration  | IOD       |            |       | X     |                | X              |
| Others  |           |            | X     |       |                |                |
| Ethernet  | Port 1    |            |       | X     |                | X              |

## Noise Reduction Guidelines for Drive Accessories

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

### AC Line Filters

If you are using a Bulletin 2090 line filter, mount the filter on the same panel as the Kinetix 350 drive, and as close to the drive as possible.

Observe these guidelines when mounting your AC line filter:

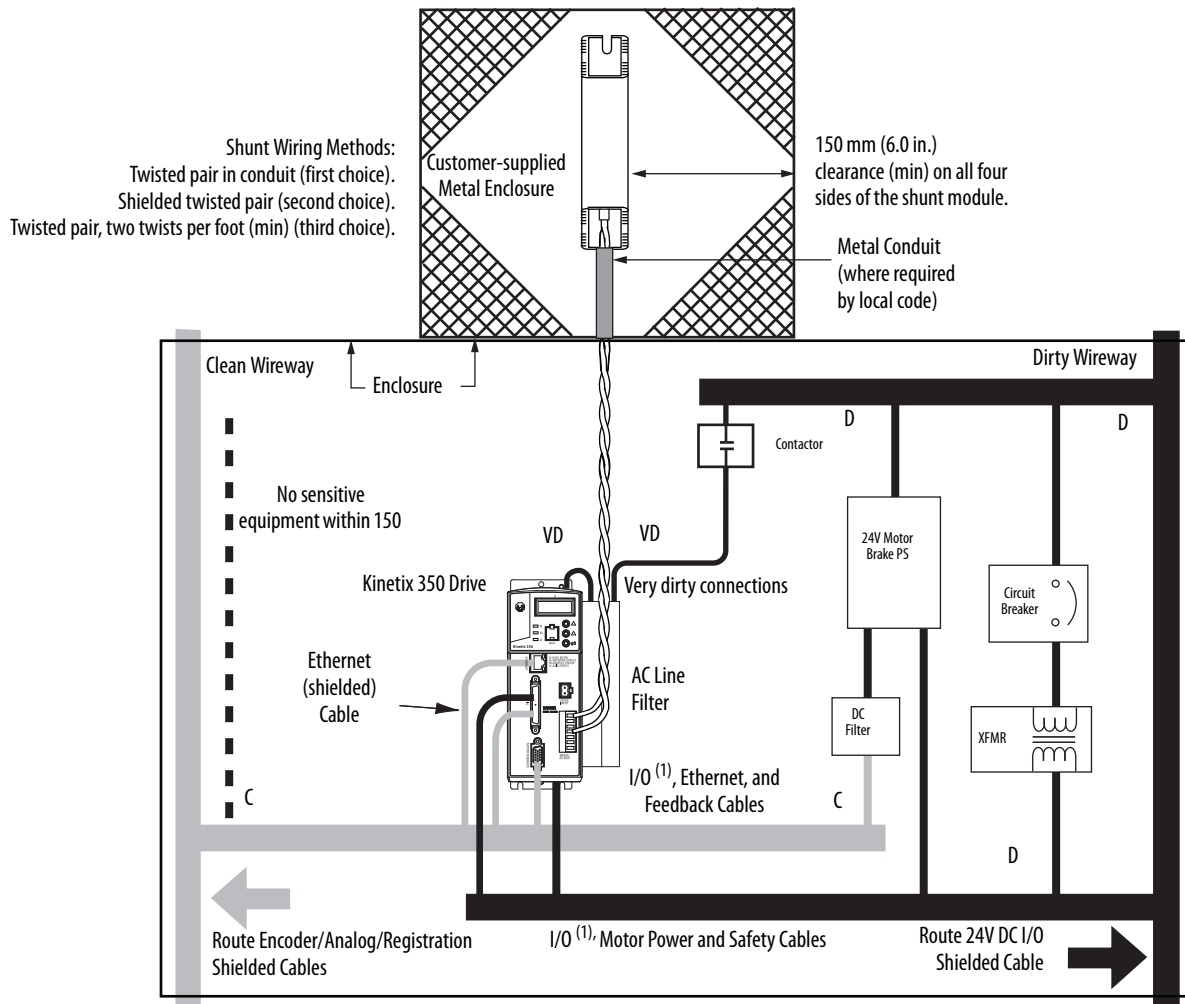
- Good HF bonding to the panel is critical. For painted panels, refer to the examples on [page 26](#).
- Segregate input and output wiring as far as possible.

### Shunt Resistors

Observe these guidelines when mounting your shunt resistor outside 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 the cabinet.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.

**Figure 8 - Shunt Resistor Outside the Enclosure**



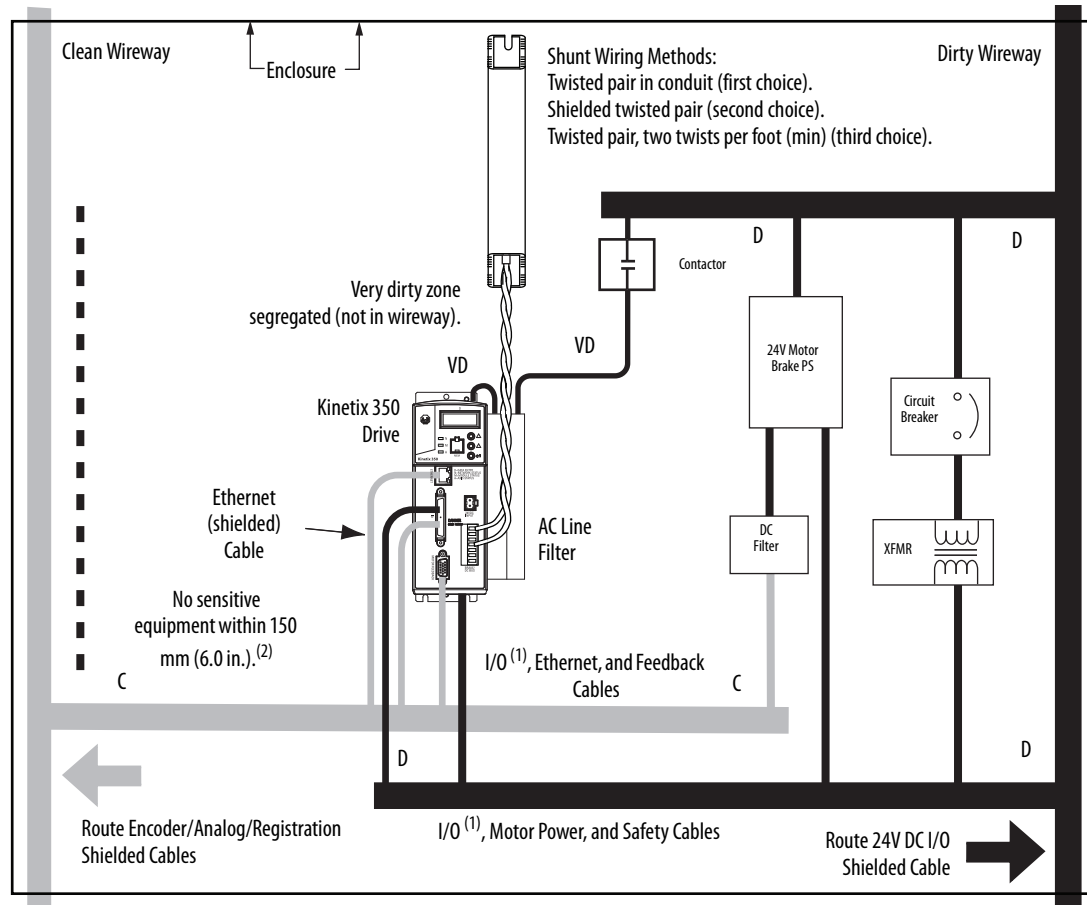
(1) If drive system I/O cable contains (dirty) relay wires, route cable in dirty wire way.

(2) When space does not permit 150 mm (6.0 in.) clearance, install a grounded steel shield between the drive and clean wireway. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

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

- Mount the shunt resistor anywhere in the dirty zone, but as close to the Kinetix 350 drive as possible.
- Shunt wires can be run with motor power cables.
- Keep unshielded wiring as short as possible. Keep shunt wiring as flat to the cabinet as possible.
- Separate shunt wires from other sensitive, low-voltage signal cables.

Figure 9 - Shunt Resistor inside the Enclosure



(1) If drive system I/O cable contains (dirty) relay wires, route cable in dirty wire way.  
 (2) When space does not permit 150 mm (6.0 in.) clearance, install a grounded steel shield between the drive and clean wireway. For examples, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

### Motor Brake

The brake is mounted inside the motor and how you connect to the drive depends on the motor series.

Refer to [Kinetix 350 Drive/Rotary Motor Wiring Examples](#) beginning on [page 134](#) for the interconnect diagram of your drive/motor combination.



## Mount Your Kinetix 350 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.



**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 Protection Handbook.

Follow these steps to mount your Kinetix 350 drive.

1. Lay out the position for the Kinetix 350 drive and accessories in the enclosure.

Refer to [Establishing Noise Zones](#) on [page 28](#) for panel layout recommendations. Mounting hole dimensions for the Kinetix 350 drive are shown in *Kinetix Servo Drives Specifications Technical Data*, publication number [GMC-TD003](#).

2. Attach the Kinetix 350 drive to the cabinet, first by using the upper mounting slots of the drive and then the lower.

The recommended mounting hardware is M4 (#6-32) steel machine screws torqued to 1.1 N•m (9.8 lb•in). Observe bonding techniques as described in [Bonding Drives](#) on [page 25](#).

**IMPORTANT** To improve the bond between the Kinetix 350 drive and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

3. Tighten all mounting fasteners.

**Notes:**

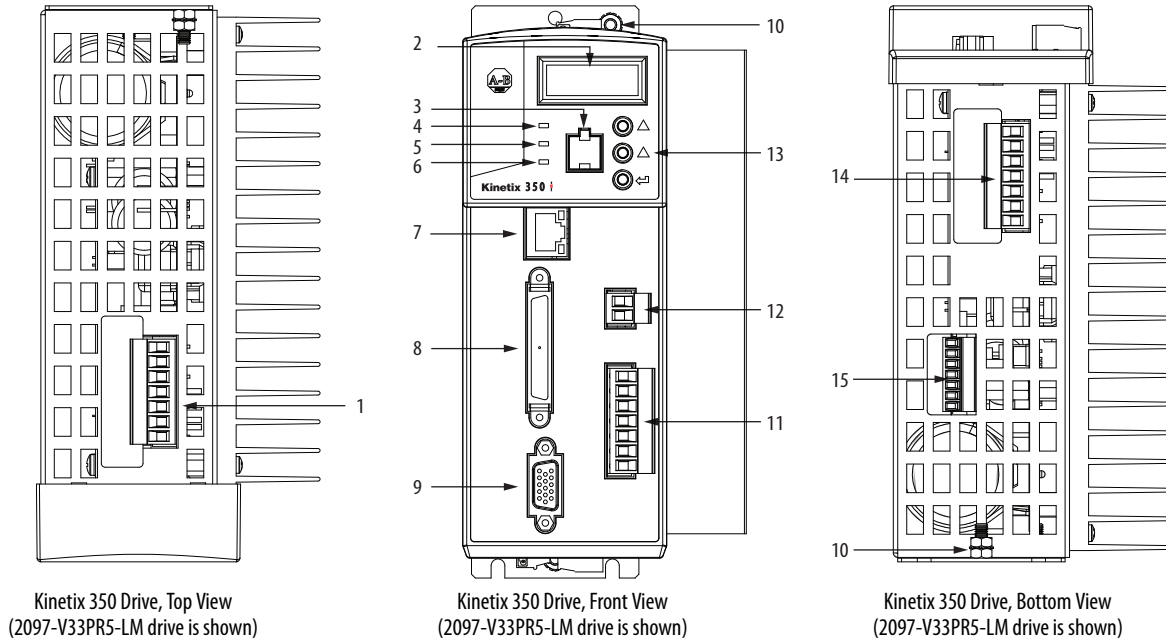
## Kinetix 350 Drive Connector Data

| Topic                                       | Page |
|---|------|
| Kinetix 350 Drive Connectors and Indicators | 36   |
| Control Signal Specifications               | 41   |
| Motor Feedback Specifications               | 46   |

## Kinetix 350 Drive Connectors and Indicators

Although the physical size of the Kinetix 350 drives vary, the location of the connectors and indicators is identical.

**Figure 10 - Kinetix 350 Drive Connector and Indicators**



Kinetix 350 Drive, Top View  
(2097-V33PR5-LM drive is shown)

Kinetix 350 Drive, Front View  
(2097-V33PR5-LM drive is shown)

Kinetix 350 Drive, Bottom View  
(2097-V33PR5-LM drive is shown)

| Item | Description                                  |
|------|--|
| 1    | Mains (IPD) connector                        |
| 2    | Data status indicator and diagnostic display |
| 3    | Memory module socket                         |
| 4    | Network status indicator                     |
| 5    | Module status indicator                      |
| 6    | Axis status indicator                        |
| 7    | Ethernet communication port (Port 1)         |
| 8    | I/O (IOD) connector                          |

| Item | Description                              |
|------|--|
| 9    | Motor feedback (MF) connector            |
| 10   | Ground lug                               |
| 11   | Shunt resistor and DC bus (BC) connector |
| 12   | Back-up power (BP) connector             |
| 13   | Display control push buttons (3)         |
| 14   | Motor power (MP) connector               |
| 15   | Safe torque-off (STO) connector          |

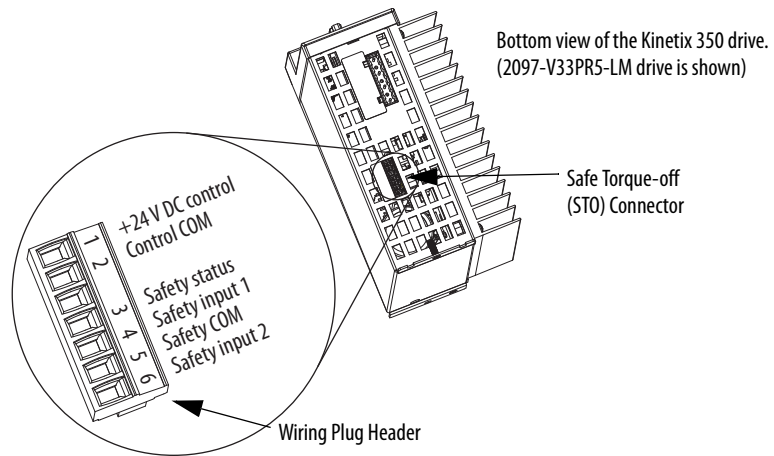
**Table 10 - Kinetix 350 Drive Connectors**

| Designator | Description                    | Connector                            |
|------------|--------------------------------|--------------------------------------|
| IPD        | AC input power                 | 3-position or 4-position plug/header |
| PORT1      | Ethernet communication port    | RJ45 Ethernet                        |
| IOD        | I/O                            | SCSI 50 pin high density connector   |
| MF         | Motor feedback                 | 15-pin high-density D-shell (male)   |
| BP         | Back-up power                  | 2-pin quick-connect terminal block   |
| BC         | Shunt Resistor and DC Bus      | 7-pin quick-connect terminal block   |
| MP         | Motor power                    | 6-pin quick-connect terminal block   |
| STO        | Safe torque off (STO) Terminal | 6-pin quick-connect terminal block   |

## Safe Torque-off Connector Pinout

The Kinetix 350 drive ships with the (6-pin) wiring-plug header that connects your safety circuit to the Kinetix 350 drive safe torque-off (STO) connector. If your system does not use the safe torque-off feature, follow instructions in [Safe Torque-off Feature Bypass](#) starting on [page 107](#) to wire the drive with motion-allowed jumpers.

**Figure 11 - Safe Torque-off Connector**



**Table 11 - Kinetix 350 Drive Safe Torque-off Connector Pinout**

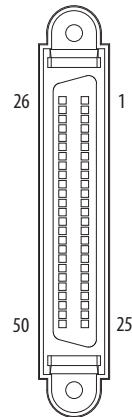
| STO Pin | Description                        | Signal          |
|---------|------------------------------------|-----------------|
| 1       | +24V DC output from the drive      | +24V DC control |
| 2       | +24V DC output common              | Control COM     |
| 3       | Safety status                      | Safety Status   |
| 4       | Safety input 1 (+24V DC to enable) | Safety Input 1  |
| 5       | Safety common                      | Safety COM      |
| 6       | Safety input 2 (+24V DC to enable) | Safety Input 2  |

**IMPORTANT** Use only pins STO-1 (+24V DC Control) and STO-2 (Control COM) of the motion-allowed jumpers to enable the drive when the safe torque-off function is not used. When the safe torque-off function is in operation, the 24V supply must come from an external source.

### I/O Connector Pinout

| IOD Pin | Description                             | Signal     |
|---------|---|------------|
| 1...25  | Reserved                                | Reserved   |
| 26      | +/- Overtravel, enable, and home common | COM        |
| 27      | Negative hardware overtravel            | NEG_OT     |
| 28      | Positive hardware overtravel            | POS_OT     |
| 29      | Drive enable                            | ENABLE     |
| 30      | Home switch                             | HOME_SW    |
| 31...35 | Reserved                                | —          |
| 36      | Registration common                     | REG_COM    |
| 37...38 | Reserved                                | —          |
| 39      | Registration input                      | REG        |
| 40...42 | Reserved                                | —          |
| 43      | Motor brake release positive            | MTR_BRAKE+ |
| 44      | Motor brake release negative            | MTR_BRAKE- |
| 44...50 | Reserved                                | —          |

Figure 12 - Pin Orientation for 50-pin SCSI I/O (IOD) Connector



### Motor Feedback (MF) Connector Pinout

| MF Pin | Description   | Signal                 |
|--------|---|------------------------|
| 1      | Sine differential input+<br>AM+ differential input+   | SIN+<br>AM+            |
| 2      | Sine differential input-<br>AM- differential input-   | SIN-<br>AM-            |
| 3      | Cosine differential input+<br>BM+ differential input+ | COS+<br>BM+            |
| 4      | Cosine differential input-<br>BM- differential input- | COS-<br>BM-            |
| 5      | Data differential input +<br>Index pulse+             | DATA+<br>IM+           |
| 6      | Common  | ECOM                   |
| 7      | Encoder power (+9V)                                   | EPWR_9V <sup>(2)</sup> |
| 8      | Single-ended 5V Hall effect<br>commutation            | S3                     |

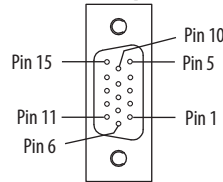
| MF Pin | Description  | Signal                 |
|--------|--|------------------------|
| 9      | Reserved   | —                      |
| 10     | Data differential input -<br>Index pulse-                | DATA-<br>IM-           |
| 11     | Motor thermal switch<br>(normally closed) <sup>(1)</sup> | TS                     |
| 12     | Single-ended 5V Hall effect<br>commutation               | S1                     |
| 13     | Single-ended 5V Hall effect<br>commutation               | S2                     |
| 14     | Encoder power (+5V)                                      | EPWR_5V <sup>(2)</sup> |
| 15     | Reserved   | —                      |

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

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

**IMPORTANT** Drive-to-motor power and feedback cable length must not exceed 20 m (65.6 ft). System performance was tested at these specifications and also apply when meeting CE requirements.

**Figure 13 - Pin Orientation for 15-pin Motor Feedback (MF) Connector**

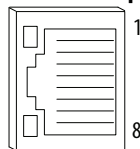


### Ethernet Communication Connector Pinout

| Port 1 Pin | Description                     | Signal |
|------------|---------------------------------|--------|
| 1          | Transmit port (+) data terminal | + TX   |
| 2          | Transmit port (-) data terminal | - TX   |
| 3          | Receive port (+) data terminal  | + RX   |
| 4          | —                               | —      |

| Port 1 Pin | Description                    | Signal |
|------------|--------------------------------|--------|
| 5          | —                              | —      |
| 6          | Receive port (-) data terminal | - RX   |
| 7          | —                              | —      |
| 8          | —                              | —      |

**Figure 14 - Pin Orientation for 8-pin Ethernet Communication (port 1) Port**



### AC Input Power Connector Pinout

| IPD Designator | Description (2097-V31PRx-LM drives)  | Signal |
|----------------|--------------------------------------|--------|
| L2/N           | AC power in (non-doubler operation)  | L2/N   |
| L1             | AC power in                          | L1     |
| N              | AC power neutral (only 120V doubler) | N      |
| PE             | Protective earth (ground)            | PE     |

| IPD Designator | Description (2097-V32PRx-LM drives) | Signal |
|----------------|-------------------------------------|--------|
| L2             | AC power in                         | L2     |
| L1             | AC power in                         | L1     |
| PE             | Protective earth (ground)           | PE     |

| IPD Designator | Description (2097-V33PRx-LM, and 2097-V34PRx-LM drives) | Signal |
|----------------|---|--------|
| L3             | AC power in (three-phase models)                        | L3     |
| L2             | AC power in   | L2     |
| L1             | AC power in   | L1     |
| PE             | Protective earth (ground)                               | PE     |

### Back-up Power Connector Pinout

| BP Designator | Description                | Signal  |
|---------------|----------------------------|---------|
| +24V          | Positive 24V DC            | +24V DC |
| -24V          | 24V DC power supply return | Return  |

### Shunt Resistor and DC Bus Connector Pinout

| BC Designator | Description                        | Signal |
|---------------|------------------------------------|--------|
| +             | Positive DC bus and shunt resistor | +      |
| +             |                                    | +      |
| SH            | Shunt resistor                     | SH     |
| -             | Negative DC bus                    | -      |
| -             |                                    | -      |

### Motor Power Connector Pinout

| MP Designator | Description               | Signal |
|---------------|---------------------------|--------|
| PE            | Protective earth (ground) | PE     |
| W             | Motor power out           | W      |
| V             | Motor power out           | V      |
| U             | Motor power out           | U      |



## Control Signal Specifications

This section provides a description of the Kinetix 350 drive I/O (IOD), communication, shunt resistor and DC bus (BC), and back-up power (BP) connectors.

### Digital Inputs

Five fixed inputs are available for the machine interface on the Kinetix 350 drive.

---

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

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

---

The five digital inputs (IOD-27...IOD-30 and IOD-39) have fixed pin assignments.

**Table 12 - Understanding Digital Inputs**

| IOD Pin          | Signal           | Description  | Capture Time | Edge/Level Sensitive |
|------------------|------------------|--|--------------|----------------------|
| IOD-29           | ENABLE           | Optically isolated, single-ended active high signal. Current loading is nominally 9 mA. A 24V DC input is applied to this terminal to enable the axis.   | 0.5 ms       | Level                |
| IOD-30           | HOME             | Optically isolated, single-ended active high signal. Current loading is nominally 9 mA. Home switch (normally open contact) inputs axis require 24V DC (nominal).  | 0.5 ms       | Edge                 |
| IOD-39           | REG              | Fast registration inputs are required to inform the motor interface to capture the positional information with less than 5 $\mu$ s uncertainty. Optically isolated, single-ended active high signal. Current loading is nominally 9 mA. A 24V DC input is applied to this terminal to enable axis. | 5 $\mu$ s    | Edge                 |
| IOD-27<br>IOD-28 | NEG_OT<br>POS_OT | Overtravel detection is available as an optically isolated, single-ended active high signal. Current loading is nominally 9 mA per input. The positive/negative limit switch (normally closed contact) inputs for axis require 24V DC (nominal).   | 1 ms         | Level                |

**Table 13 - Understanding Digital Input Functions**

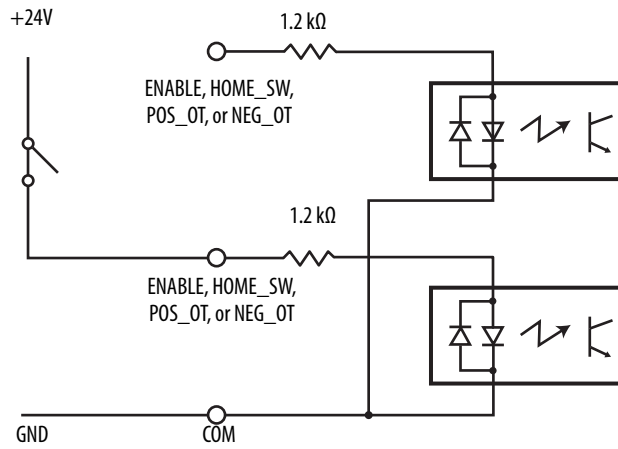
| Function             | Description   | Behavior   |
|----------------------|---|--|
| Enable               | If the controller configuration specifies checking of the enable input, an active state enables the power electronics to control the motor and an inactive state prevents motion.<br>The drive generates an exception if the input is inactive when the controller commands motion and has authorized checking. The drive behavior in this situation is programmable. | By default drive enable input checking is enabled. If the checking is authorized and the input is disabled the drive issues a Drive Enable Start Inhibit and you are not be able to issue a Servo On instruction from the controller.<br>To disable the Enable function: <ul style="list-style-type: none"> <li>• Tie input to 24V DC</li> <li>• Write a Logix Designer message instruction that changes enableInputChecking or Attribute 736 to zero, see instructions on <a href="#">page 100</a></li> </ul> |
| Home                 | An active state indicates to a homing sequence that the referencing sensor has been seen. Typically, a transition of this signal is used to establish a reference position for the machine axis.  | The function is always inactive unless armed by the controller.  |
| Registration         | 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.   |  |
| Positive Over-travel | If the controller configuration specifies checking of the hardware over-travel inputs, an inactive state indicates that a position limit has been exceeded in the positive direction.<br>The drive generates an exception if the input is inactive when the controller authorizes checking. The drive behavior in this situation is programmable.                     | The function is always active.<br>To disable function: <ul style="list-style-type: none"> <li>• Tie input to 24V</li> <li>• Set to only Fault Status</li> </ul>  |
| Negative Over-travel | If the controller configuration specifies checking of the hardware overtravel inputs, an inactive state indicates that a position limit has been exceeded in the negative direction.<br>The drive generates an exception if the input is inactive when the controller authorizes checking. The drive behavior in this situation is programmable.                      |  |

**Table 14 - Digital Input Specifications**

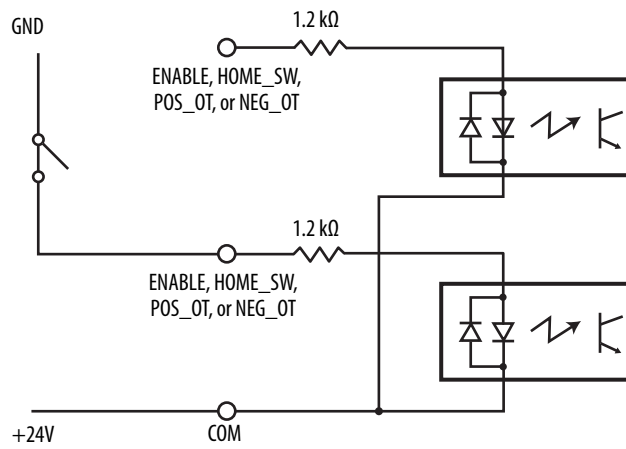
| Attribute  | Value  |
|--|--|
| Type   | Active high, single-ended, current sinking                             |
| Functions  | Enable, Home, Positive Over-travel, Negative Over-travel, Registration |
| Input current (with 24V applied)   | 9 mA, max  |
| On-state input voltage   | 4.2...24V @ 2...9 mA total   |
| Off-state input voltage  | 0...2.5V   |
| Pulse reject filtering (only Registration functions)                           | 120 ns, nom  |
| Pulse reject filtering, default (all other input functions, can be configured) | 1.0 ms, nom  |
| Propagation delay (only Registration function)                                 | 5 μs   |
| Registration repeatability   | 200 ns   |
| Input reaction time (Disable)  | 2 ms, max  |
| Input reaction time (Enable, Positive Over-travel inputs)                      | 2 ms, max  |

The digital inputs are optically isolated and sinks up to 24V DC. Electrical details are shown in [Table 13](#) on [page 42](#). You can set up the inputs for PNP sourcing or NPN sinking.

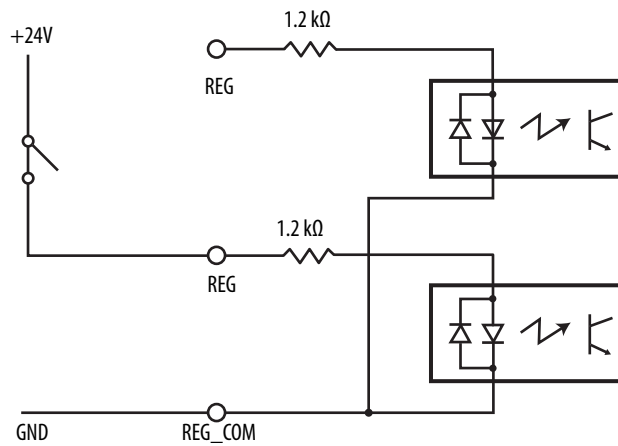
**Figure 15 - Sourcing of Digital Inputs**



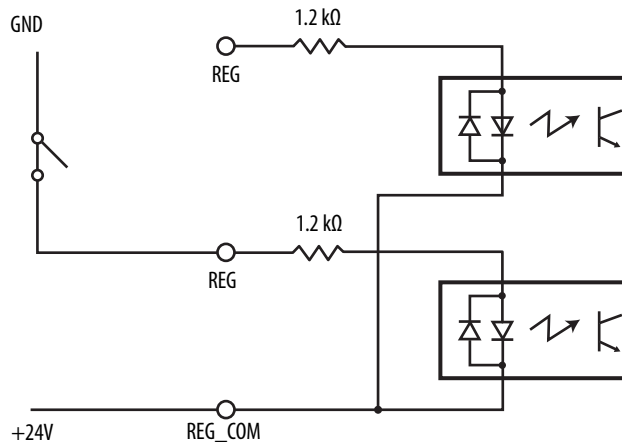
**Figure 16 - Sinking of Digital Inputs**



**Figure 17 - Sourcing of Registration Digital Input**



**Figure 18 - Sinking of Registration Digital Input**



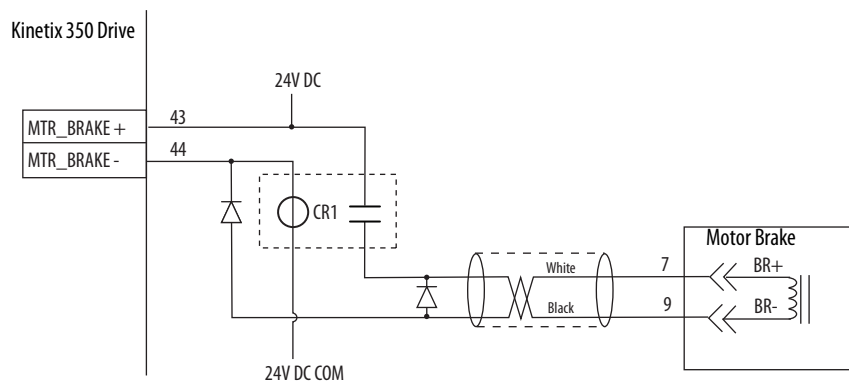
### Motor Brake Output

The two digital outputs (IOD-43 and IOD-44) have fixed pin assignments for motor brake function.

| Attribute    | Value                                     |
|--------------|---|
| Circuit type | Optically isolated open collector/emitter |
| Voltage, max | 30V DC                                    |
| Current, max | 100 mA                                    |

The following schematic shows how to wire your motor brake.

**Figure 19 - Brake Wiring Schematic**



Use these guideline to wire your brake:

- Connect a diode, 1N4004 or equivalent, as shown on both the rely and the motor brake coils.
- Wire the output as sourcing.
- The motor brake output is active on enable.
- Set the motor engage and disengage times based on the motor selected.

## Ethernet Communication Specifications

An RJ45 100 Mbit Ethernet connector (port 1) is provided on the Kinetix 350 drive. It is fully compliant to the EtherNet/IP standard. Restrict the location of all Ethernet cabling to clean zones with minimal electromagnetic interference.

| Attribute                                    | Value   |
|--|---|
| Communication                                | 100BASE-TX, full duplex                                 |
| Auto MDI/MDIX crossover detection/correction | Yes   |
| Cabling                                      | Rockwell Automation CAT5E shielded, 100 m (328 ft), max |

## 24V DC Back-up Power Specifications

The Kinetix 350 drive can use an external power supply to power the logic and communication circuits. If an independent 24V (@ 1 A) power supply is connected to the BP connector, the logic and communication circuits remain active during a mains input power loss.

| Attribute     | Value       |
|---------------|-------------|
| Input voltage | 20...26V DC |
| Current       | 500 mA      |
| Inrush, max   | 30 A        |

## Motor Feedback Specifications

The drive accepts motor feedback signals from the following types of encoders with these general specifications.

**Table 15 - Motor Feedback General Specifications**

| Attribute               | Value   |
|-------------------------|---|
| Feedback device support | <ul style="list-style-type: none"> <li>• Stegmann Hiperface</li> <li>• Generic TTL Incremental</li> <li>• Tamagawa 17-bit Serial</li> </ul> |
| Power supply (EPWR5V)   | 5.13...5.67V, 400 mA, max   |
| Power supply (EPWR9V)   | 8.3...9.9V, 275 mA, max   |
| Thermostat              | Single-ended, under 500 $\Omega$ = no fault, over 10 k $\Omega$ = fault   |

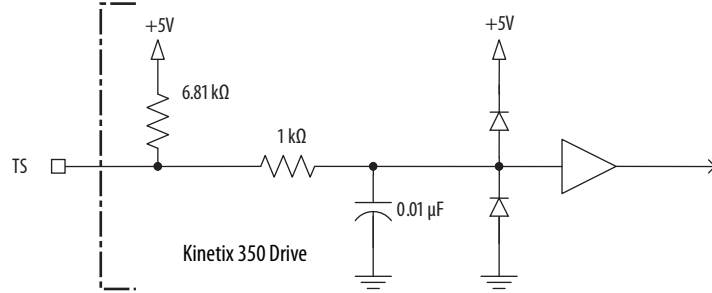
The Kinetix 350 drives support multiple types of feedback devices by using the 15-pin (MF) motor feedback connector and sharing connector pins in many cases.

**Table 16 - Motor Feedback Signals by Device Type**

| MF Pin | Stegmann Hiperface | Generic TTL Incremental | Tamagawa 17-bit Serial |
|--------|--------------------|-------------------------|------------------------|
| 1      | SIN+               | AM+                     | —                      |
| 2      | SIN-               | AM-                     | —                      |
| 3      | COS+               | BM+                     | —                      |
| 4      | COS-               | BM-                     | —                      |
| 5      | DATA+              | IM+                     | DATA+                  |
| 6      | ECOM               | ECOM                    | ECOM                   |
| 7      | EPWR9V             | —                       | —                      |
| 8      | —                  | S3                      | —                      |
| 9      | —                  | —                       | —                      |
| 10     | DATA-              | IM-                     | DATA-                  |
| 11     | TS                 | TS                      | TS                     |
| 12     | —                  | S1                      | —                      |
| 13     | —                  | S2                      | —                      |
| 14     | EPWR5V             | EPWR5V                  | EPWR5V                 |
| 15     | —                  | —                       | —                      |

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

**Figure 20 - Motor Thermostat Interface**



**Table 17 - Motor Thermostat State Specifications**

| State    | Resistance at TS <sup>(1)</sup> |
|----------|---------------------------------|
| No Fault | 500 Ω                           |
| Fault    | 10 kΩ                           |

(1) Resistance is measured between TS (MF pin 11) and ECOM (MF pin 6)

**Table 18 - Stegmann Hiperface Specifications**

| Attribute                    | Value   |
|------------------------------|---|
| Protocol                     | Hiperface   |
| Memory support               | Not programmed, or programmed with Allen-Bradley motor data |
| Hiperface data communication | RS485, 9600 bps, 8 data bits, no parity                     |
| Sine/Cosine interpolation    | 2048 counts/sine period                                     |
| Input frequency (AM/BM)      | 250 kHz, max  |
| Input voltage (AM/BM)        | 0.6...1.2V, p-p, measured at the drive inputs               |
| Line loss detection (AM/BM)  | Average (sin <sup>2</sup> + cos <sup>2</sup> ) > constant   |

**Figure 21 - Stegmann Hiperface Interface, SIN and COS Signals**

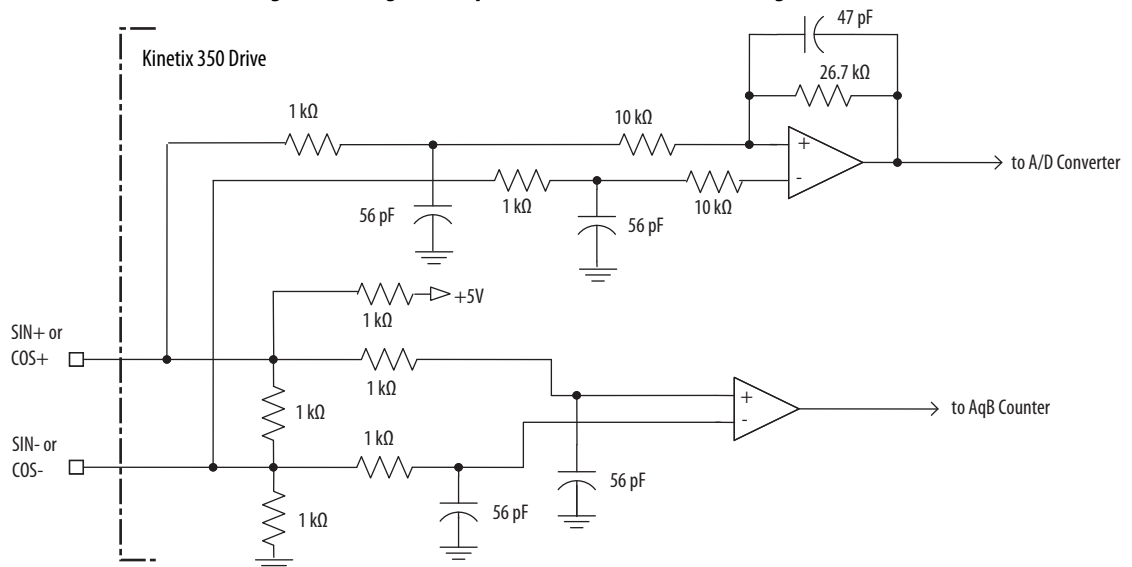


Figure 22 - Stegmann Hiperface Interface, DATA Signals

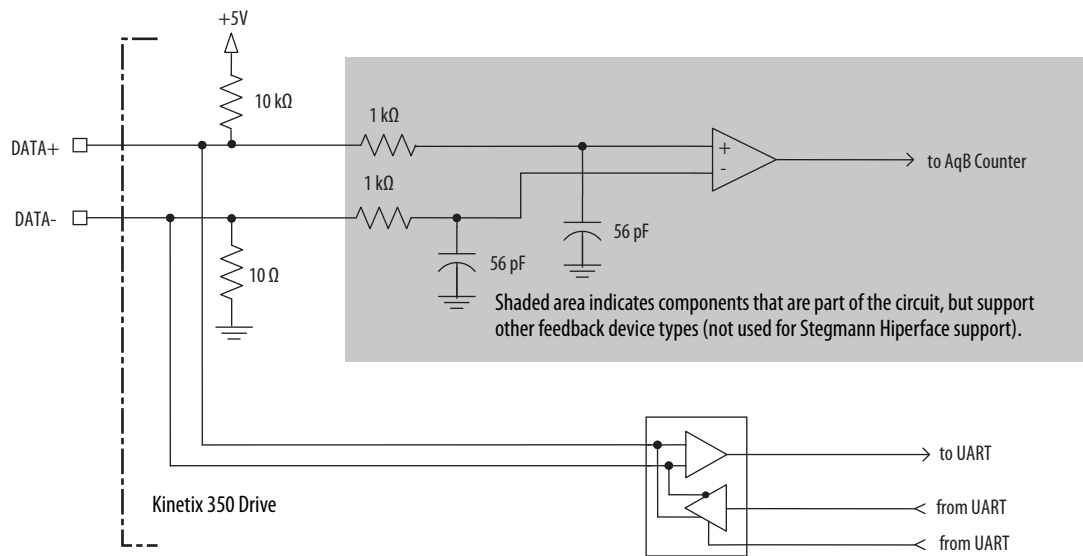
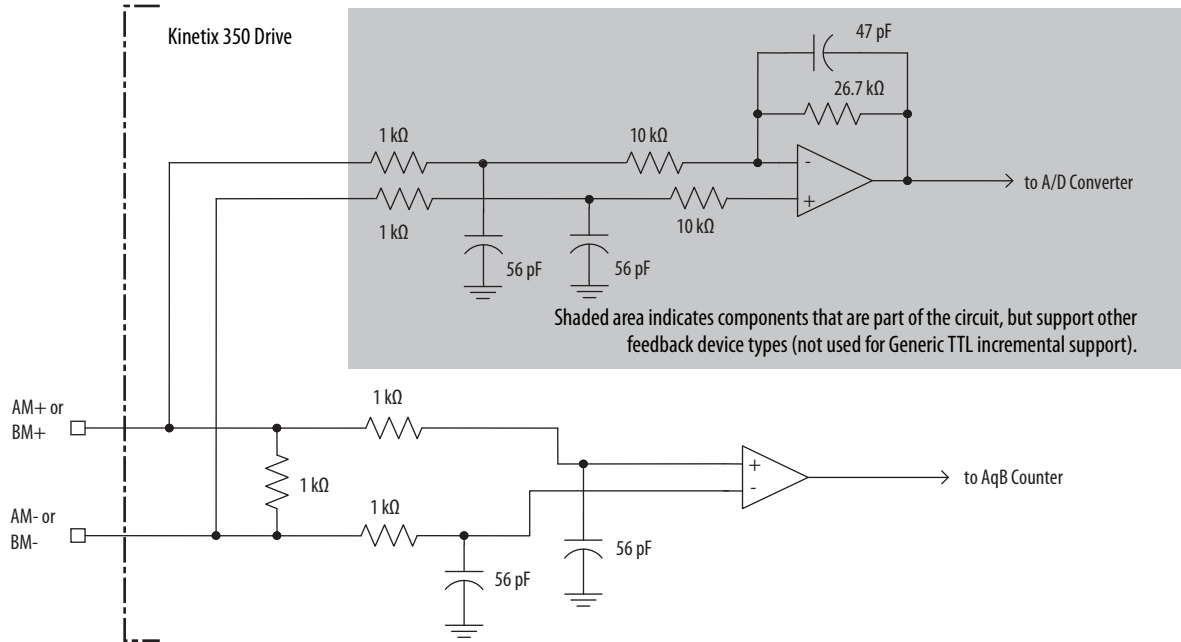


Table 19 - Generic TTL Incremental Specifications

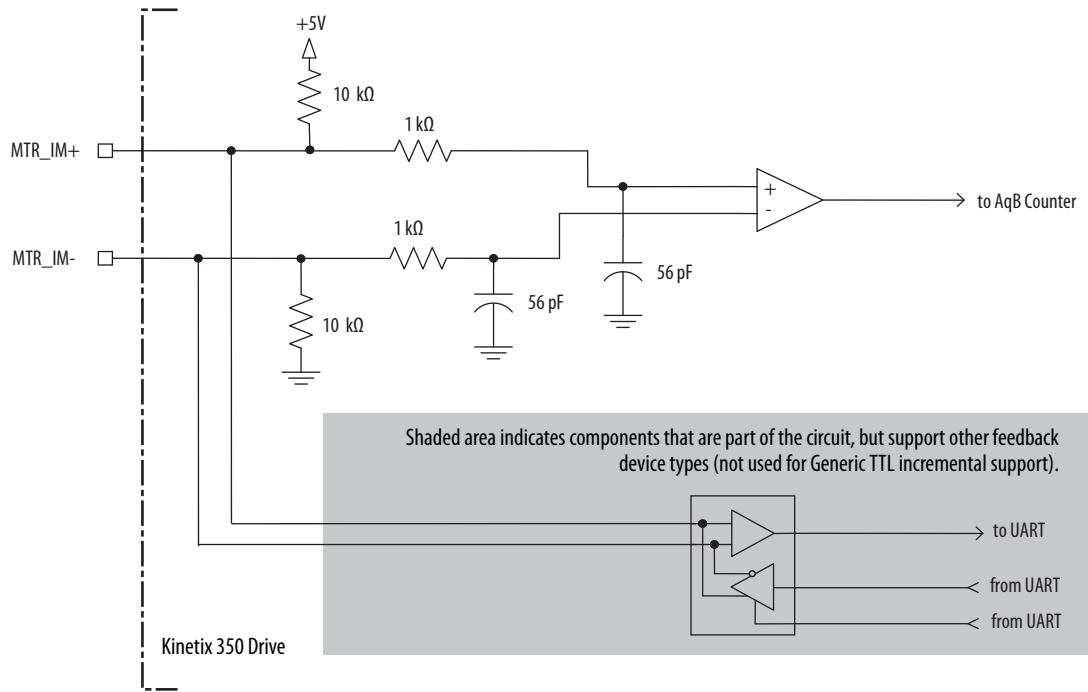
| Attribute                                   | Value                                      |
|---|--|
| TTL incremental encoder support             | 5V, differential A quad B                  |
| Quadrature interpolation                    | 4 counts/square wave period                |
| Differential input voltage (AM, BM, and IM) | 1.0...7.0V                                 |
| DC current draw (AM, BM, and IM)            | 30 mA, max                                 |
| Input signal frequency (AM, BM, and IM)     | 5.0 MHz, max                               |
| Edge separation (AM and BM)                 | 42 ns min, between any two edges           |
| Line loss detection (AM and BM)             | Average $(AM^2 + BM^2) > \text{constant}$  |
| Hall inputs (S1, S2, and S3)                | Single-ended, TTL, open collector, or none |



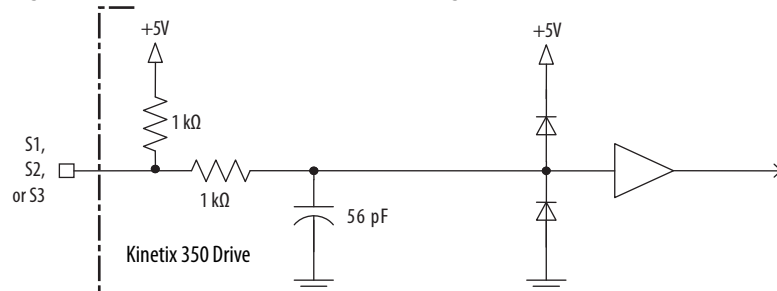
**Figure 23 - Generic TTL Incremental, AM and BM Signals**



**Figure 24 - Generic TTL Interface, IM Signals**



**Figure 25 - Generic TTL Interface, S1, S2, or S3 Signals**



**Table 20 - Tamagawa 17-bit Serial Specifications**

| Attribute                  | Value   |
|----------------------------|---|
| Tamagawa model support     | TS5669N124  |
| Protocol                   | Tamagawa proprietary                                    |
| Memory support             | Programmed with Allen-Bradley motor data                |
| Differential input voltage | 1.0...7.0V  |
| Data communication         | 2.5 Mbps, 8 data bits, no parity                        |
| Battery                    | 3.6V, on external to drive in low-profile connector kit |

Refer to [Figure 22](#) for the Tamagawa 17-bit serial interface schematic. It is identical to the Stegmann Hiperface (DATA) signals schematic.

### Feedback Power Supply

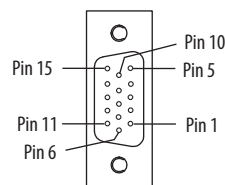
The Kinetix 350 drive generates +5V and +9V DC for motor feedback power. Short circuit protection and separate common mode filtering for each channel is included.

**Table 21 - Motor Feedback Power Specifications**

| Supply | Reference | Voltage |         |      | Current mA |                        |
|--------|-----------|---------|---------|------|------------|------------------------|
|        |           | Min     | Nominal | Max  | Min        | Max                    |
| +5V DC | EPWR_5V   | 5.13    | 5.4     | 5.67 | 0          | 400 <sup>(1)</sup> (2) |
| +9V DC | EPWR_9V   | 8.3     | 9.1     | 9.9  | 0          | 275 <sup>(2)</sup> (3) |

- (1) 400 mA on the 5V supply with no load on the 9V supply.
- (2) 300 mA on the 5V supply with 150 mA on the 9V supply.
- (3) 275 mA on the 9V supply with no load on the 5V supply.

**Figure 26 - Pin Orientation for 15-pin Motor Feedback (MF) Connector**



## Connect the Kinetix 350 Drive System

| Topic  | Page |
|--|------|
| Basic Wiring Requirements                            | 51   |
| Grounding Your Kinetix 350 Drive System              | 58   |
| Power Wiring Requirements                            | 59   |
| Wiring Guidelines                                    | 62   |
| Wiring the Kinetix 350 Drive Connectors              | 63   |
| Apply the Motor Cable Shield Clamp                   | 70   |
| Feedback and I/O Cable Connections                   | 71   |
| Wiring the Feedback and I/O Connectors               | 73   |
| Kinetix 350 Drive (IOD connector and terminal block) | 73   |
| Shunt Resistor Connections                           | 75   |
| Ethernet Cable Connections                           | 75   |

### Basic Wiring Requirements

This section contains basic wiring information for the Kinetix 350 drive.



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



**SHOCK HAZARD:** To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2097 drive 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.

## Recommended Cables

The [Motor Power Cable Compatibility](#) table on [page 66](#) and [Motor Feedback Cables for Specific Motor/Feedback Combinations](#) table on [page 71](#) show the cables Rockwell Automation recommends you use with the Kinetix 350 drive.

---

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

---

If it is necessary for you to build or modify your own cable, follow these guidelines:

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

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

## Route Power and Signal Wiring

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

Refer to [Electrical Noise Reduction](#) on [page 25](#) 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

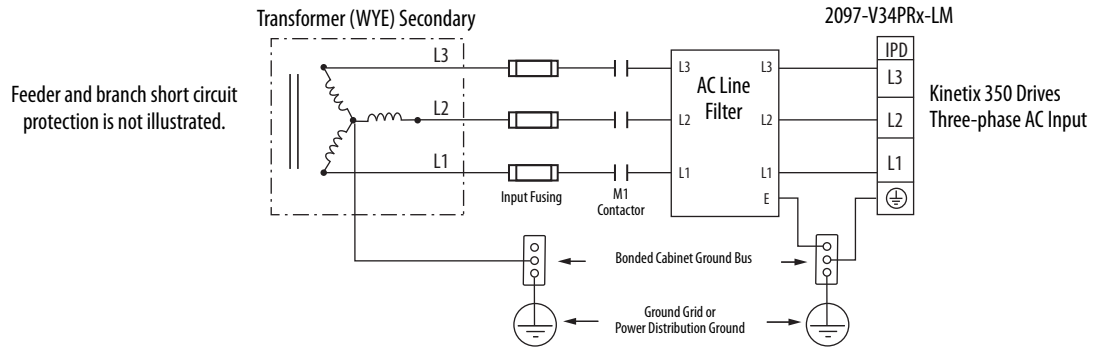
This section contains examples of typical single-phase and three-phase facility input power wired to single-phase and three-phase Kinetix 350 drives.

The grounded power configuration lets you ground your single-phase or three-phase power at a neutral point. Match your secondary to one of the examples and be certain to include the grounded neutral connection.

### Three-phase Power Wired to Three-phase Drives

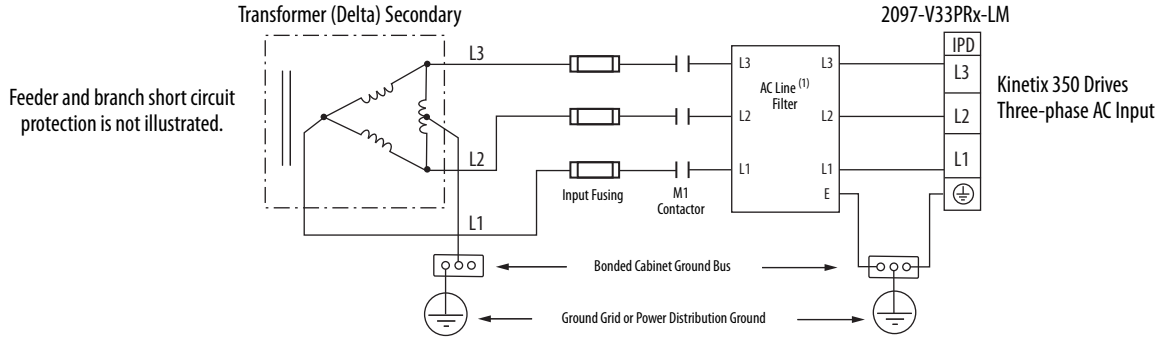
These examples illustrate grounded three-phase power wired to three-phase Kinetix 350 drives when phase-to-phase voltage is within drive specifications.

**Figure 26 - Three-phase (400/480V) Power Configuration (WYE secondary)**



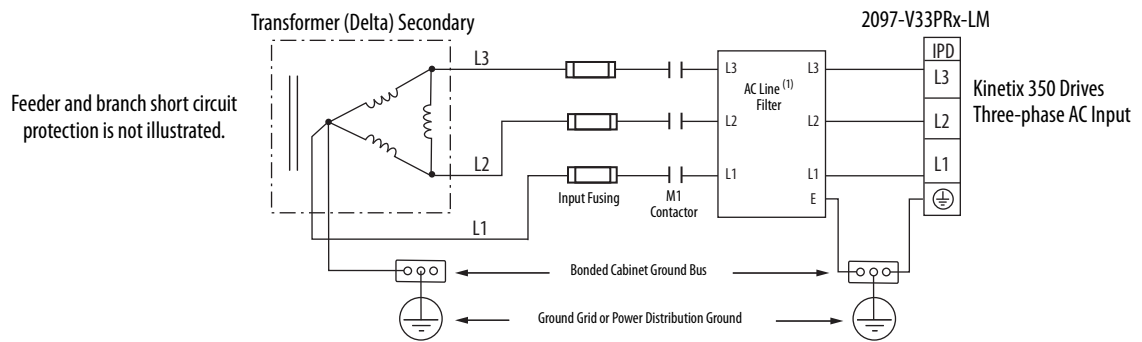
**IMPORTANT** For the 480V Kinetix 350 drives to meet proper voltage creepage and clearance requirements, each phase voltage to ground must be less than or equal to 300V AC rms. This means that the power system must use center grounded wye secondary configuration for 400/480V AC mains.

**Figure 27 - Three-phase (240V) Power Configuration (Delta secondary)**



(1) Leakage current from the line filter, in this configuration, typically is higher than a balanced (center ground) configuration.

**Figure 28 - Three-phase (240V) Power Configuration (Delta secondary)**



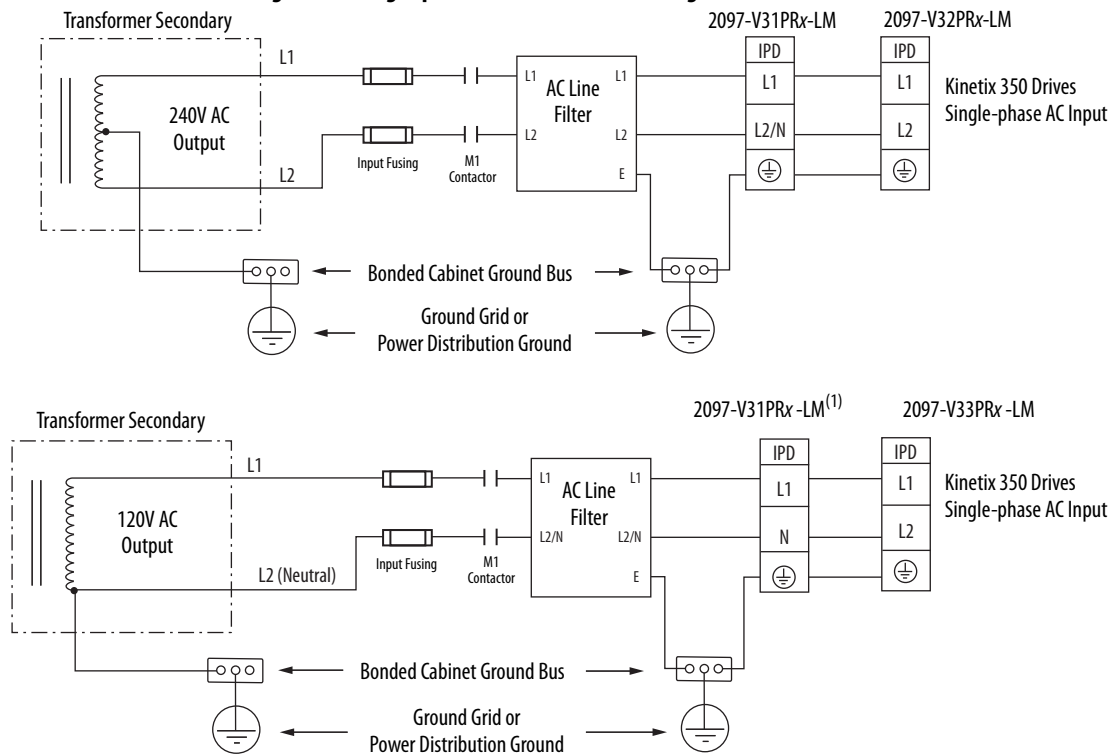
(1) Leakage current from the line filter, in this configuration, typically is higher than a balanced (center ground) configuration.

## Single-phase Power Wired to Single-phase Drives

These examples illustrate grounded single-phase power wired to single-phase Kinetix 350 drives when phase-to-phase voltage is within drive specifications.

**IMPORTANT** The 2097-V32PRx-LM models have integrated AC line filters and do not require the AC line filter shown in this diagram.

**Figure 29 - Single-phase Grounded Power Configurations**



(1) This configuration applies to voltage-doubler operation for 2097-V31PRx-LM drives.

Reducing transformer output reduces motor speed. Feeder and branch short circuit protection is not illustrated.

## Voltage Doubler Operation

You can wire the 2097-V31PRx-LM drives with 120V input voltage and achieve twice the output voltage. To use the voltage-doubler circuit, connect the 120V single-phase input power to the IPD-L1 and IPD-N terminals.

For Kinetix 350 drive power specifications, refer to Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#). For Kinetix 350 drive input wiring diagrams, refer to [Power Wiring Examples on page 131](#).

## Isolation Transformer in Grounded Power Configurations

When you are using an isolation transformer, attach the chassis ground wire to the neutral connection. This grounded neutral connection does the following:

- Prevents the system from floating and thereby avoids any high voltages that can otherwise occur, for example due to static electricity
- Provides a solid earth path for fault conditions

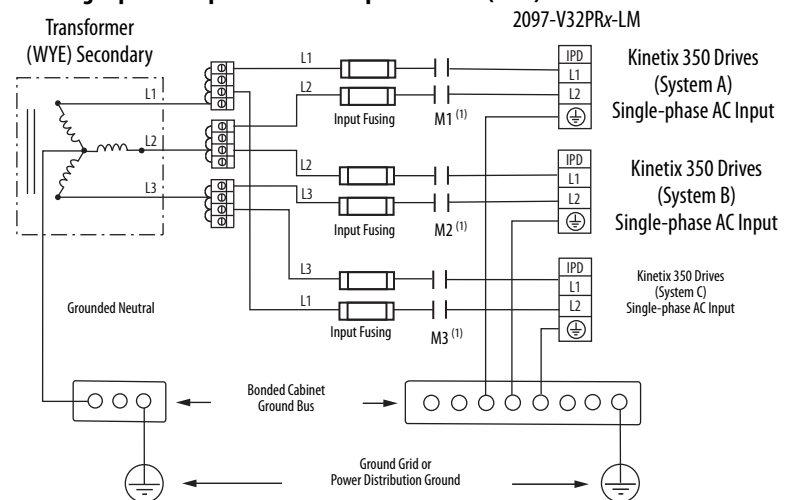


**ATTENTION:** If the supply transformer is an auto transformer (not recommended), do not add a chassis earth ground. A chassis earth ground is already included elsewhere in the system and adding another creates a short.

## Three-phase Power Wired to Single-phase Drives

This example illustrates grounded three-phase power wired to single-phase Kinetix 350 drives when phase-to-phase voltage is within drive specifications.

**Figure 30 - Single-phase Amplifiers on Three-phase Power (WYE)**



(1) Contactors (M1, M2, and M3) can be optional. For more information, refer to Understanding the Machinery Directive, publication [SHB-900](#). AC line filter is optional, but is required for CE compliance.

Feeder short circuit protection is not illustrated.

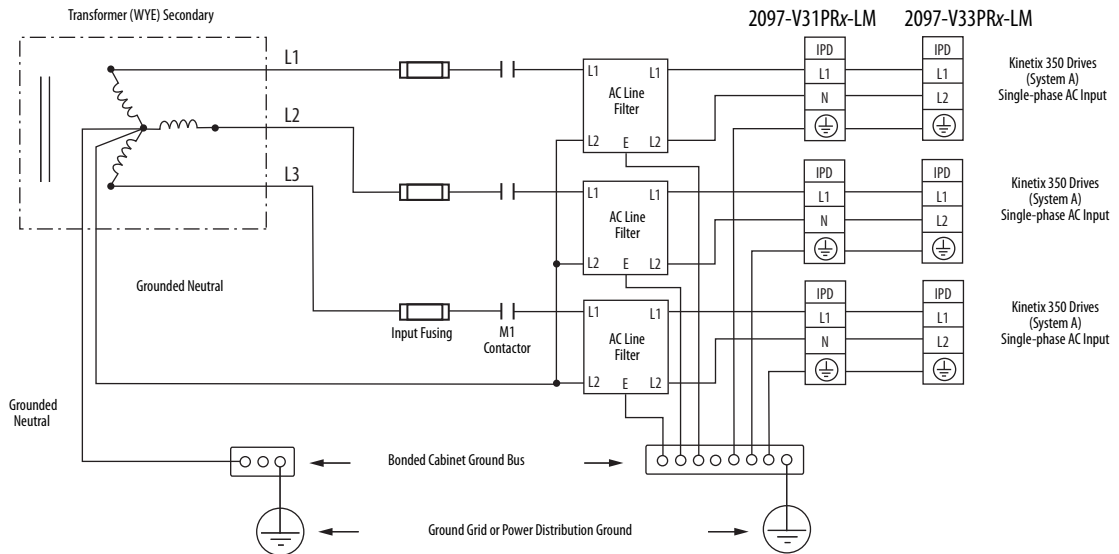
This example illustrates grounded three-phase power wired to single-phase Kinetix 350 drives when phase-to-phase voltage exceeds drive specifications.

A neutral must be connected when single-phase drives are attached to a three-phase isolating transformer secondary. It is not necessary that all three-phases be loaded with drives, but each drive must have its power return via the neutral connection.



**ATTENTION:** Failure to connect the neutral can result in supply voltage swings at the individual drives. This occurs when the neutral point moves vectorially as a result of load variations normally experienced by the individual drives. The supply voltage swing can cause undervoltage and overvoltage trips on the drives, and the drive can be damaged if the overvoltage limit is exceeded.

**Figure 31 - Single-phase Amplifiers (one AC line filter per drive)**



Feeder and branch short circuit protection is not illustrated.

**IMPORTANT** Providing an AC line filter for each drive is the preferred configuration and required for CE compliance.



## Voiding of CE Compliance

The three-phase and neutral in-line filter applications described above are not adequate for CE compliance for EMC. Therefore, EMC validity and CE marking by Rockwell Automation is voided when three-phase and neutral in line filters are used.



**ATTENTION:** The three-phase isolation transformer and neutral in-line filter applications described in this document have not been tested for EMC by Rockwell Automation and products used in such installations are not considered CE marked by Rockwell Automation.

If this three-phase isolation transformer and neutral in-line filter application is used, the responsibility for EMC validation lies with the user and CE marking of the system becomes the user's responsibility.

If CE compliance is a customer requirement, use single-phase line filters that have been tested by Rockwell Automation and specified for the product. Refer to Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#) for catalog numbers.

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## Grounding Your Kinetix 350 Drive System

All equipment and components of a machine or process system must have a common earth ground point connected to their chassis. A grounded system provides a safety ground path for short circuit protection. Grounding your modules and panels minimize shock hazard to personnel and damage to equipment caused by short circuits, transient overvoltages, and accidental connection of energized conductors to the equipment chassis. For CE grounding requirements, refer to [CE Requirements](#) in [Chapter 1](#).

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**IMPORTANT** To improve the bond between the Kinetix 350 drive and subpanel, construct your subpanel out of zinc plated (paint-free) steel.

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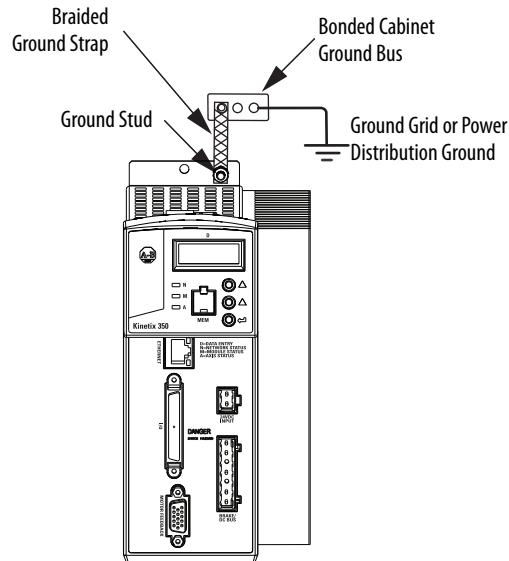
### Ground Your Drive to the System Subpanel



**ATTENTION:** The National Electrical Code contains grounding requirements, conventions, and definitions. Follow all applicable local codes and regulations to safely ground your system. Refer to the illustration below for details on grounding your Kinetix 350 drive. Refer to [Appendix A](#) for the power wiring diagram for your Kinetix 350 drive.

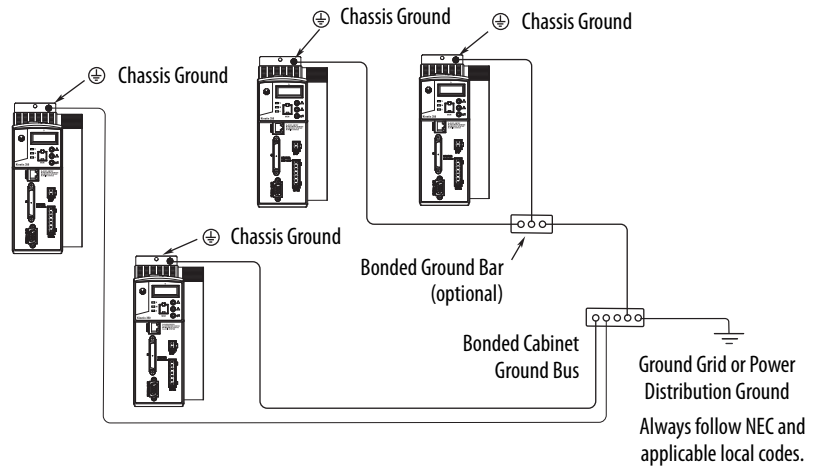
If the Kinetix 350 drive is mounted on a painted subpanel, ground the drive to a bonded cabinet ground bus by using a braided ground strap or 4.0 mm<sup>2</sup> (12 AWG) solid copper wire 100 mm (3.9 in.) long.

**Figure 32 - Connecting the Braided Ground Strap Example**



For drive dimensions, refer to Product Dimensions in Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#).

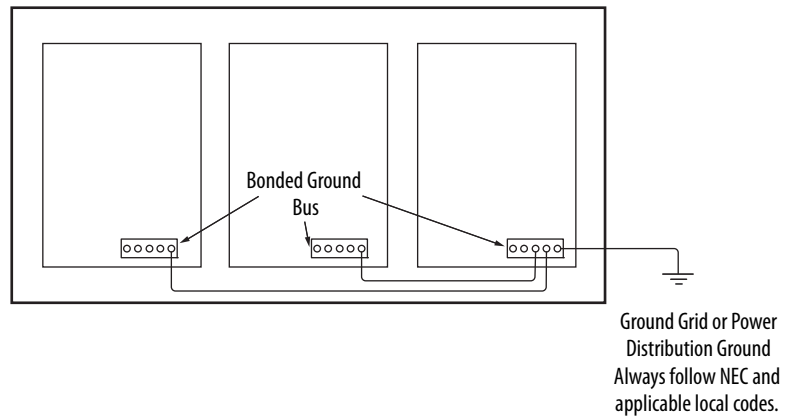
**Figure 33 - Chassis Ground Configuration (multiple Kinetix 350 drives on one panel)**



### Ground Multiple Subpanels

To ground multiple subpanels, refer to the figure below. HF bonding is not illustrated. For information, refer to [Bonding Multiple Subpanels](#) on [page 27](#).

**Figure 34 - Subpanels Connected to a Single Ground Point**



### Power Wiring Requirements

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

Refer to [Power Wiring Examples](#) on [page 131](#) for interconnect diagrams.

---

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

---

Table 22 - Kinetix 350 Drive Power Wiring Requirements

| Cat. No.   | Description                                | Terminals  |   |                                      | Recommended Wire Size mm <sup>2</sup> (AWG) | Strip Length mm (in.)                                 | Torque Value N·m (lb·in) |           |
|--|--|--|---|--------------------------------------|---|---|--------------------------|-----------|
|  |  | Pins   | Signals   |                                      |   |   |                          |           |
| 2097-V31PR0-LM<br>2097-V32PR0-LM<br>2097-V32PR2-LM<br>2097-V33PR1-LM<br>2097-V33PR3-LM<br>2097-V34PR3-LM<br>2097-V34PR5-LM<br>2097-V34PR6-LM   | Mains input power (IPD connector)          |  | L3<br>L2<br>L1<br>PE <sup>(1)</sup>   | L2/N<br>L1<br>N<br>PE <sup>(2)</sup> | L2<br>L1<br>PE <sup>(3)</sup>               | Motor power cable depends on motor/drive combination. | 7 (0.28)                 | 0.5 (4.5) |
| 2097-V32PR4-LM<br>2097-V33PR5-LM   |  |  |   |                                      |   | 2.5 (14)  |                          |           |
| 2097-V31PR2-LM<br>2097-V33PR6-LM   |  |  |   |                                      |   | 4.0 (12)  |                          |           |
| 2097-V31PR0-LM<br>2097-V31PR2-LM<br>2097-V32PR0-LM<br>2097-V32PR2-LM<br>2097-V32PR4-LM<br>2097-V33PR1-LM<br>2097-V33PR3-LM<br>2097-V33PR5-LM<br>2097-V34PR3-LM<br>2097-V34PR5-LM<br>2097-V34PR6-LM | Motor power (MP connector)                 |  | PE<br>W<br>V<br>U   |                                      |   | 2.5 (14)  | 7 (0.28)                 | 0.5 (4.5) |
| 2097-V33PR6-LM   |  |  |   |                                      |   | 4.0 (12)  |                          |           |
| 2097-V31PR0-LM<br>2097-V31PR2-LM<br>2097-V32PR0-LM<br>2097-V32PR2-LM<br>2097-V32PR4-LM<br>2097-V33PR1-LM<br>2097-V33PR3-LM<br>2097-V33PR5-LM<br>2097-V34PR3-LM<br>2097-V34PR5-LM<br>2097-V34PR6-LM | Shunt/DC Bus <sup>(4)</sup> (BC connector) |  | +<br>+<br>SH<br>-<br>-  |                                      |   | 2.5 (14)  | 7 (0.28)                 | 0.5 (4.5) |
| 2097-V33PR6-LM   |  |  |   |                                      |   | 4.0 (12)  |                          |           |
| 2097-V3xPRx-LM   | Control back-up power (BP connector)       |  | +24V DC<br>-24V DC  |                                      |   |   |                          |           |
| 2097-V3xPRx-LM   | Safe torque-off (STO connector)            | STO-1 <sup>(5)</sup><br>STO-2 <sup>(5)</sup><br>STO-3<br>STO-4<br>STO-5<br>STO-6 | +24V DC Control<br>Control COM<br>Safety Status<br>Safety Input 1<br>Safety COM<br>Safety Input 2 |                                      | 1.5 (16)                                    | 6 (0.25)  | 0.5 (4.5)                |           |

- (1) Applies to 2097-V33PRx-LM, and 2097-V34PRx-LM drive modules.
- (2) Applies to 2097-V31PRx-LM drive modules.
- (3) Applies to 2097-V32PRx-LM drive modules.
- (4) Use for only shunt resistor connection.
- (5) Use for bypassing only the STO circuit.



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

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

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

**Table 23 - Shunt Resistor Power Wiring Requirements**

| Accessory | Description    | Connects to Terminals | Recommended Wire Size<br>mm <sup>2</sup> (AWG) | Torque Value<br>N·m (lb·in) |
|-----------|----------------|-----------------------|--|-----------------------------|
| 2097-Rx   | Shunt resistor | +                     | 2.5 (14)                                       | 0.5 (4.5)                   |
|           |                | SH                    |  |                             |

## Wiring Guidelines

Use these guidelines as a reference when wiring the connectors on your Kinetix 350 drive power modules.

---

**IMPORTANT** For connector locations of the Kinetix 350 drives, refer to [Kinetix 350 Drive Connectors and Indicators](#) on [page 36](#).  
When tightening screws to secure the wires, refer to the tables beginning on [page 59](#) for torque values.  
When removing insulation from wires, refer to the tables beginning on [page 59](#) for strip lengths.

---

**IMPORTANT** To improve system performance, run wires and cables in the wireways as established in [Establishing Noise Zones](#) on [page 28](#).

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Follow these steps when wiring the connectors on your Kinetix 350 drive modules.

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

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

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2. Route the cable/wires to your Kinetix 350 drive.
3. Insert wires into connector plugs.  
Refer to connector pinout tables in [Chapter 3](#) 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 module connector.

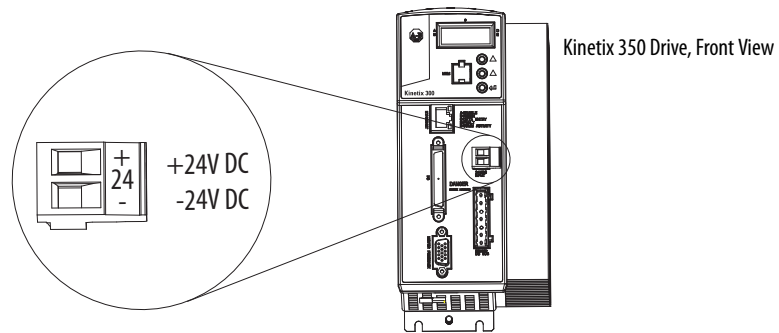
## Wiring the Kinetix 350 Drive Connectors

This section provides examples and wiring tables to assist you in making connections to the Kinetix 350 drive.

### Wire the Safe Torque-off (STO) Connector

For the safe torque-off (STO) connector pinouts, feature descriptions, and wiring information, refer to Chapter 6 on [page 101](#).

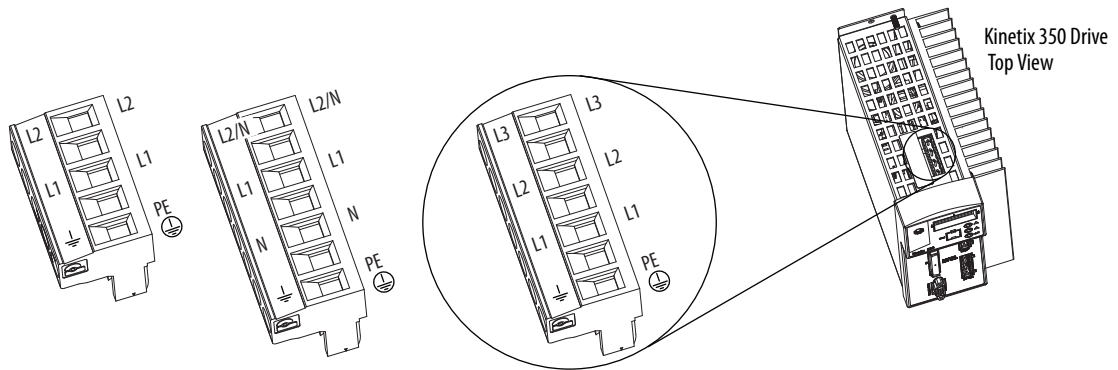
### Wire the Back-up Power (BP) Connector



**Table 24 - Back-up Power (BP) Connector**

| Drive Cat. No. | Terminals | Recommended Wire Size<br>mm <sup>2</sup> (AWG) | Strip Length<br>mm (in.) | Torque Value<br>N·m (lb·in) |
|----------------|-----------|--|--------------------------|-----------------------------|
| 2097-V3xPRx-LM | +24V DC   | 1.5 (16)                                       | 6 (0.25)                 | 0.5 (4.5)                   |
|                | -24V DC   |  |                          |                             |

## Wire the Input Power (IPD) Connector



**Table 25 - Input Power (IPD) Connector**

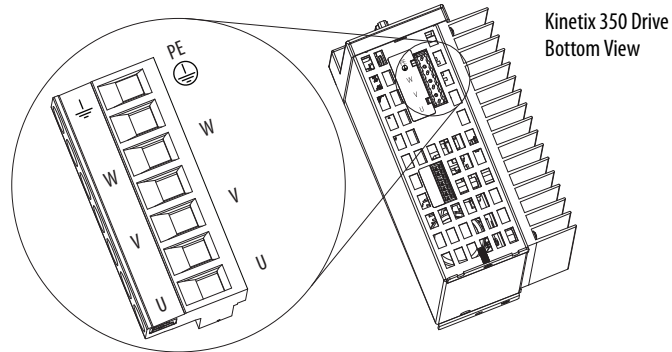
| Drive Cat. No.   | Terminals                           |                                      |                               | Recommended Wire Size<br>mm <sup>2</sup> (AWG) | Strip Length<br>mm (in.) | Torque Value<br>N·m (lb·in) |
|--|-------------------------------------|--------------------------------------|-------------------------------|--|--------------------------|-----------------------------|
| 2097-V31PRO-LM<br>2097-V32PRO-LM<br>2097-V32PR2-LM<br>2097-V33PR1-LM<br>2097-V33PR3-LM<br>2097-V34PR3-LM<br>2097-V34PR5-LM<br>2097-V34PR6-LM | L3<br>L2<br>L1<br>PE <sup>(1)</sup> | L2/N<br>L1<br>N<br>PE <sup>(2)</sup> | L2<br>L1<br>PE <sup>(3)</sup> | 2.5 (14)                                       | 7 (0.28)                 | 0.5 (4.5)                   |
| 2097-V32PR4-LM<br>2097-V33PR5-LM   |                                     |                                      |                               | 4.0 (12)                                       | 7 (0.28)                 | 0.5 (4.5)                   |
| 2097-V31PR2-LM<br>2097-V33PR6-LM   |                                     |                                      |                               | 6.0 (10)                                       | 7 (0.28)                 | 0.56...0.79<br>(5.0...7.0)  |

- (1) Applies to 2097-V33PRx-LM, and 2097-V34PRx-LM drive modules.
- (2) Applies to 2097-V31PRx-LM drive modules.
- (3) Applies to 2097-V32PRx-LM drive modules.



## Wire the Motor Power (MP) Connector

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



**Table 26 - Motor Power (MP) Termination Specifications**

| Drive Cat. No.   | Terminals         | Recommended Wire Size<br>mm <sup>2</sup> (AWG) | Strip Length<br>mm (in.) | Torque Value<br>N·m (lb·in) |
|--|-------------------|--|--------------------------|-----------------------------|
| 2097-V31PR0-LM<br>2097-V31PR2-LM<br>2097-V32PR0-LM<br>2097-V32PR2-LM<br>2097-V32PR4-LM<br>2097-V33PR1-LM<br>2097-V33PR3-LM<br>2097-V33PR5-LM<br>2097-V34PR3-LM<br>2097-V34PR5-LM<br>2097-V34PR6-LM | PE<br>W<br>V<br>U | 2.5 (14)                                       | 7 (0.28)                 | 0.5 (4.5)                   |
| 2097-V33PR6-LM   |                   | 4.0 (12)                                       |                          |                             |

### Cable Shield Terminations

Factory-supplied motor power cables for MP-Series and TL-Series motors and actuator are shielded. The braided cable shield must terminate near the drive during installation. Remove small portion of the cable jacket to expose the shield braid and clamp the exposed shield to the panel.



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

### IMPORTANT

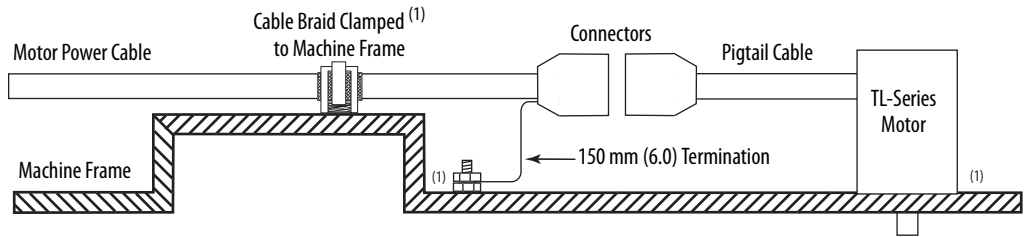
For TL-Series motors, also connect the 152 mm (6.0 in.) termination wire to the closest earth ground.

Refer to [Pigtail Terminations](#) on [page 66](#) for more information.

### Pigtail Terminations

TL-Series motors have a short pigtail cable that connects to the motor, but is not shielded. The preferred method for grounding the TL-Series power cable on the motor side is to expose a section of the cable shield and clamp it directly to the machine frame. The motor power cable also has a 150 mm (6.0 in.) shield termination wire with a ring lug that connects to the closest earth ground. Use this method in addition to the cable clamp. The termination wire can be extended to the full length of the motor pigtail if necessary, but it is best to connect the supplied wire directly to ground without lengthening.

**Figure 35 - Pigtail Terminations**



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

**Table 27 - Motor Power Cable Compatibility**

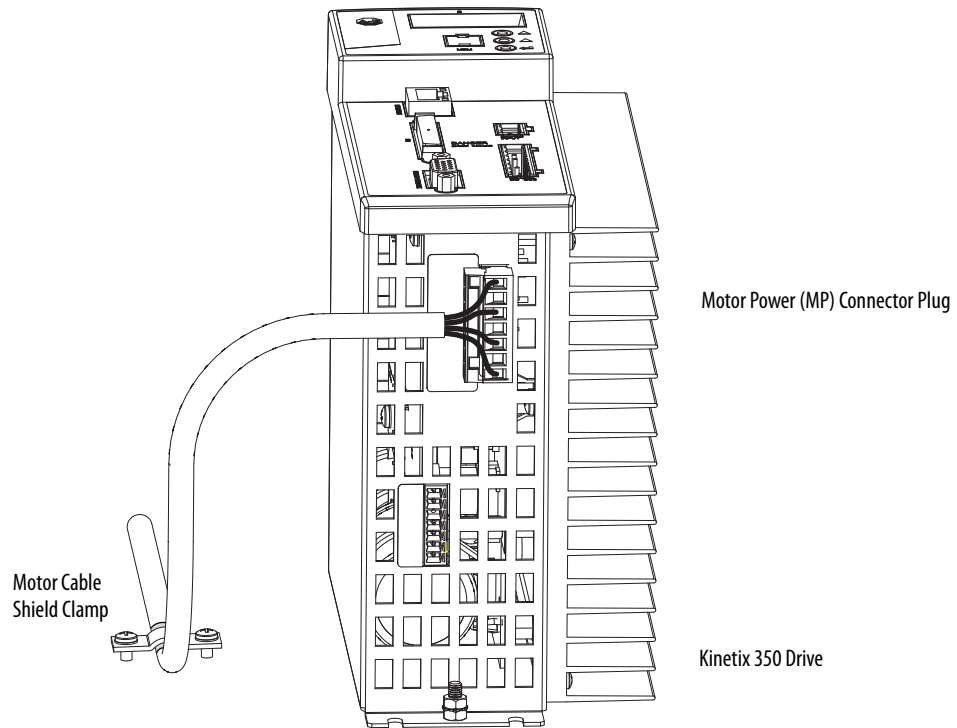
| Motor/Actuator            | Connector    | Motor/Actuator Cat. No.                                   | Motor Power Cables (with brake wires)   | Motor Power Cables (without brake wires)  |
|---------------------------|--------------|---|---|---|
| MP-Series (Bulletin MPL)  | Circular DIN | MPL-A/B15xxx-4xAA and MPL-A/B2xxx-4xAA                    | 2090-XXNPMF-xxSxx (standard)<br>2090-CPBM4DF-xxAFxx (continuous-flex)                                 | 2090-CPWM4DF-xxAFxx (continuous-flex)   |
|                           |              | MPL-A/B3xxx-7xAA, MPL-A/B4xxx-7xAA, and MPL-A/B45xxx-7xAA | 2090-CPBM7DF-xxAAxx <sup>(1)</sup> (standard)<br>2090-CPBM7DF-xxAFxx <sup>(1)</sup> (continuous-flex) | 2090-CPWM7DF-xxAAxx <sup>(1)</sup> (standard)<br>2090-CPWM7DF-xxAFxx <sup>(1)</sup> (continuous-flex) |
| MP-Series (Bulletin MPS)  |              | MPS-A/Bxxxx   | 2090-XXNPMF-xxSxx (standard)  | 2090-CPWM4DF-xxAFxx (continuous-flex)   |
| MP-Series (Bulletin MPAS) |              | MPAS-A/Bxxxx  | 2090-CPBM4DF-xxAFxx (continuous-flex)   |   |
| MP-Series (Bulletin MPAR) |              | MPAR-A/B1xxx and MPAR-A/B2xxx                             | 2090-CPBM7DF-xxAAxx <sup>(1)</sup> (standard)<br>2090-CPBM7DF-xxAFxx <sup>(1)</sup> (continuous-flex) | 2090-CPWM7DF-xxAAxx <sup>(1)</sup> (standard)<br>2090-CPWM7DF-xxAFxx <sup>(1)</sup> (continuous-flex) |
| MP-Series (Bulletin MPM)  |              | MPM-A/Bxxxx   |   |   |
| MP-Series (Bulletin MPF)  |              | MPF-A/Bxxxx   |   |   |
| MP-Series (Bulletin MPAI) |              | MPAI-A/Bxxxx  |   |   |
| TL-Series (Bulletin TLY)  |              | Circular Plastic  | TLY-Axxxx   | 2090-CPBM6DF-16AAxx (standard)  |
| TL-Series (Bulletin TLAR) | TLAR-Axxxx   |   |   |   |

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

This diagram shows an example of three-phase power wires for motors/actuators that have no brakes. Thermal switch wires are included in the feedback cable.

Refer to [Kinetix 350 Drive/Rotary Motor Wiring Examples](#) beginning on [page 134](#) for interconnect diagrams.

**Figure 36 - Motor Power Terminations (only three-phase wires)**

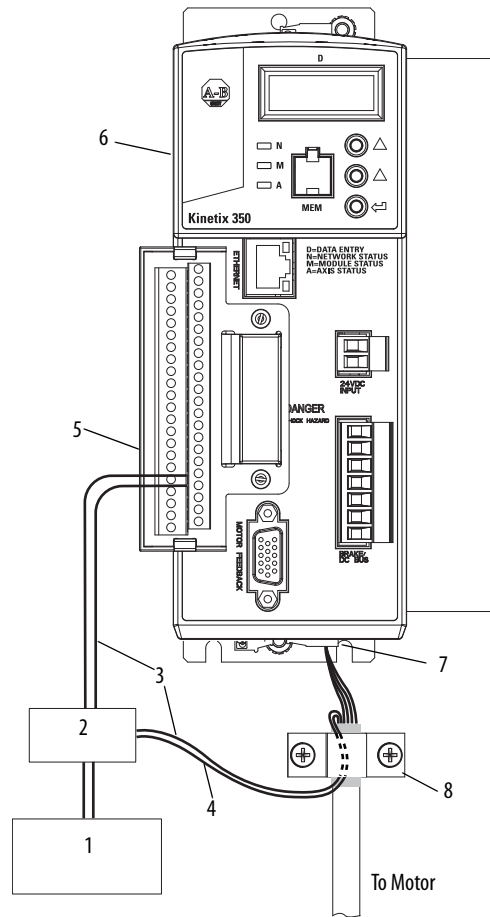


The cable shield clamp shown above is mounted to the subpanel. Ground and secure the motor power cable in your system following instructions on [page 70](#).

This diagram shows an example of wiring with three-phase power wires and brake wires. The brake wires have a shield braid (shown below as gray) that folds back under the cable clamp before the conductors are attached to the motor brake circuit. Thermal switch wires are included in the feedback cable.

Refer to [Kinetix 350 Drive/Rotary Motor Wiring Examples](#) beginning on [page 134](#) for interconnect diagrams.

**Figure 37 - Motor Power Terminations (three-phase and brake wires)**



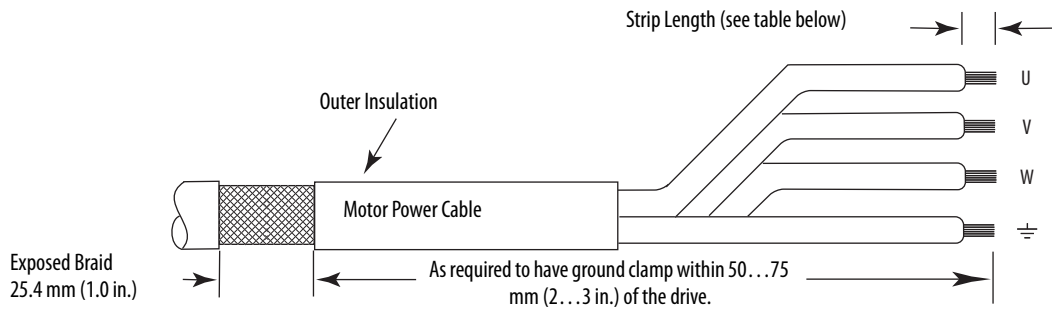
| Item             | Description                                |
|------------------|--|
| 1 <sup>(1)</sup> | 24V power supply                           |
| 2 <sup>(1)</sup> | Relay and diode assembly <sup>(3)</sup>    |
| 3                | Minimize unshielded wires in brake circuit |
| 4                | MP-Series cable brake wires                |

| Item | Description                        |
|------|------------------------------------|
| 5    | I/O (IOD) connector <sup>(2)</sup> |
| 6    | 2097-V3xPRx-LM Kinetix 350 drive   |
| 7    | Motor power (MP) connector         |
| 8    | Cable clamp <sup>(4)</sup>         |

- (1) User supplied. Size as required by motor brake, See [Motor Brake Currents](#) on [page 139](#).
- (2) Pin 43 and 44 are configured as MTR\_ BRAKE+ and MTR\_ BRAKE- Common respectively. Wire the output as sourcing and set brake engage and disengage times for motor selected. Motor brake is active on enable.
- (3) Diode 1N4004 rated 1.0 A @ 400V DC. See [Interconnect Diagram Notes](#) beginning on [page 131](#).
- (4) Exposed shield under clamp and place within 50...75 mm (2...3 in.) of drive, see [page 70](#) for details.

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

**Figure 38 - Cable Shield and Lead Preparation**



Refer to [Shunt Resistor Wiring Example](#) beginning on [page 133](#) for interconnect diagrams.

**Table 28 - Motor Power (MP) Connector**

| MP-Series or TL-Series Servo Motor | Terminal |
|------------------------------------|----------|
| U / Brown                          | U        |
| V / Black                          | V        |
| W / Blue                           | W        |
| ⊥ Green/Yellow                     | ⊥        |

**Table 29 - Motor Power (MP) Termination Specifications**

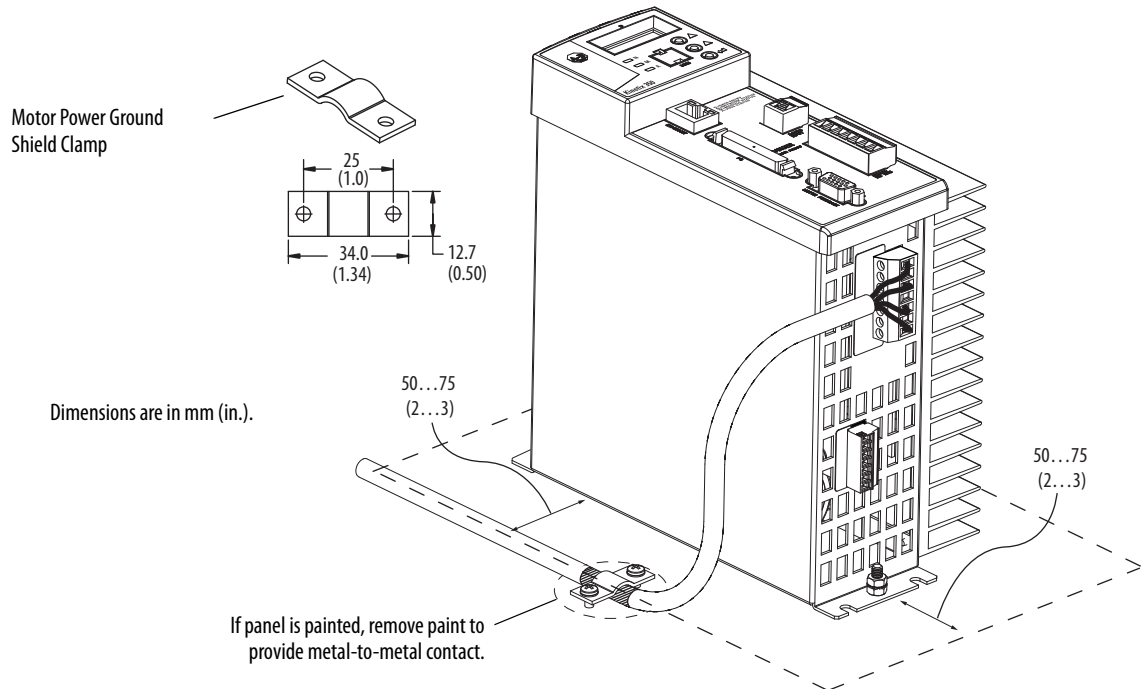
| Drive Cat. No.   | Terminals         | Recommended Wire Size<br>mm <sup>2</sup> (AWG) | Strip Length<br>mm (in.) | Torque Value<br>N·m (lb·in) |
|--|-------------------|--|--------------------------|-----------------------------|
| 2097-V31PR0-LM<br>2097-V31PR2-LM<br>2097-V32PR0-LM<br>2097-V32PR2-LM<br>2097-V32PR4-LM<br>2097-V33PR1-LM<br>2097-V33PR3-LM<br>2097-V33PR5-LM<br>2097-V34PR3-LM<br>2097-V34PR5-LM<br>2097-V34PR6-LM | PE<br>W<br>V<br>U | 2.5 (14)                                       | 7 (0.28)                 | 0.5 (4.5)                   |
| 2097-V33PR6-LM   |                   | 4.0 (12)                                       |                          |                             |

## Apply the Motor Cable Shield Clamp

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

Follow these steps to apply the motor cable shield clamp.

1. Locate a suitable position for installing cable shield clamp within 50...75 mm (2...3 in.) of the drive.



2. Lay out and drill holes for cable clamp.



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

3. Locate the position on the motor power cable that comes under the clamp and remove about an inch of the cable jacket to expose the shield braid.
4. Position the exposed portion of the cable braid directly in line with the clamp.
5. Clamp the exposed shield to the panel by using the clamp and two #6-32 x 1 screws provided.
6. Repeat [step 1](#)...[step 5](#) for each Kinetix 350 drive you are installing.

## Feedback and I/O Cable Connections

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

**Table 30 - Options for Connecting Motor Feedback and I/O**

| Connection Option     | Cat. No.       | Cable          | By Using This Type of Cable   |
|-----------------------|----------------|----------------|---|
| Premolded connectors  | N/A            | Motor feedback | Refer to the table below for the premolded motor feedback cable available for your motor. |
| Low-profile connector | 2090-K2CK-D15M | Motor feedback | Refer to the table below for the flying-lead cable available for your motor.              |
| I/O Terminal Block    | 2097-TB1       | I/O interface  | User-supplied flying-lead cable.  |

**Table 31 - Motor Feedback Cables for Specific Motor/Feedback Combinations**

| Motor Cat. No.  | Feedback Type           | Feedback Cable          |   |  |   |   |
|---|-------------------------|-------------------------|---|--|---|---|
|   |                         | Premolded               | Flying-lead   |  |   |   |
| MPL-A/B15xxx-V/Ex4xAA,<br>MPL-A/B2xxx-V/Ex4xAA                          | High-resolution encoder | N/A                     | 2090-XXNFMF-Sxx (standard)<br>2090-CFBM4DF-CDAFxx (continuous-flex) |  |   |   |
| MPL-A/B15xxx-Hx4xAA,<br>MPL-A/B2xxx-Hx4xAA                              | Incremental encoder     |                         | N/A   | 2090-XXNFMF-Sxx (standard)<br>2090-CFBM7DF-CDAFxx <sup>(1)</sup> (continuous-flex) |   |   |
| MPL-A/B3xxx-Hx7xAA,<br>MPL-A/B4xxx-Hx7xAA,<br>MPL-A/B45xxx-Hx7xAA       |                         | High-resolution encoder |   |  | 2090-CFBM7DD-CEAAxx <sup>(1)</sup> (standard)<br>2090-CFBM7DD-CEAFxx <sup>(1)</sup> (continuous-flex) | 2090-CFBM7DF-CEAAxx <sup>(1)</sup> (standard)<br>2090-CFBM7DF-CEAFxx <sup>(1)</sup> (continuous-flex) |
| MPL-A/B3xxx-M/Sx7xAA,<br>MPL-A/B4xxx-M/Sx7xAA,<br>MPL-A/B45xxx-M/Sx7xAA | High-resolution encoder | N/A                     |   |  |   |   |
| MPM-A/Bxxxx-M/S   |                         |                         |   |  |   |   |
| MPF-A/Bxxxx-M/S   |                         |                         |   |  |   |   |
| MPAR-A/B3xxxx   |                         |                         |   |  |   |   |
| MPAI-A/Bxxxx  |                         |                         |   |  |   |   |
| MPS-A/Bxxxx-M/S   |                         |                         |   |  |   |   |
| MPAS-A/Bxxxx-V/A  |                         |                         |   |  |   |   |
| MPAR-A/B1xxxx,<br>MPAR-A/B2xxxx   | High-resolution encoder | N/A                     | 2090-XXNFMF-Sxx (standard)<br>2090-CFBM4DF-CDAFxx (continuous-flex) |  |   |   |
| TLY-Axxxx-B   |                         |                         |   | High-resolution encoder  | 2090-CFBM6DD-CCAAxx (standard)  | 2090-CFBM6DF-CBAAxx (standard)  |
| TLAR-Axxxx  |                         |                         |   |  |   |   |
| TLY-Axxxx-H   | Incremental encoder     |                         |   |  |   |   |

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

## Flying-lead Feedback Cable Pin-outs

**Table 32 - 2090-XXNFMF-Sxx or 2090-CFBMxDF-xxAxxx Feedback Cable**

| Connector Pin | High-resolution Feedback |            | Incremental Feedback | Drive MF Connector Pin |
|---------------|--------------------------|------------|----------------------|------------------------|
|               | 9V Encoder               | 5V Encoder | 5V Encoder           |                        |
| 1             | Sin+                     | Sin+       | AM+                  | 1                      |
| 2             | Sin-                     | Sin-       | AM-                  | 2                      |
| 3             | Cos+                     | Cos+       | BM+                  | 3                      |
| 4             | Cos-                     | Cos-       | BM-                  | 4                      |
| 5             | Data+                    | Data+      | IM+                  | 5                      |
| 6             | Data-                    | Data-      | IM-                  | 10                     |
| 9             | Reserved                 | EPWR_5V    | EPWR_5V              | 14                     |
| 10            | Reserved                 | ECOM       | ECOM                 | 6                      |
| 11            | EPWR_9V                  | Reserved   | Reserved             | 7                      |
| 12            | ECOM                     | Reserved   | Reserved             | 6                      |
| 13            | TS+                      | TS+        | TS+                  | 11                     |
| 14            | TS-                      | TS-        | TS-                  | –                      |
| 15            | Reserved                 | Reserved   | S1                   | 12                     |
| 16            | Reserved                 | Reserved   | S2                   | 13                     |
| 17            | Reserved                 | Reserved   | S3                   | 8                      |

**Table 33 - 2090-CFBM6DF-CBAxxx Feedback Cable**

| Connector Pin | High Resolution           | Incremental Feedback | Drive MF Connector Pin |
|---------------|---------------------------|----------------------|------------------------|
|               | TLY-Axxxx-B<br>TLAR-Axxxx | TLY-Axxxx-H          |                        |
| 6             | BAT+                      | Reserved             | BAT+                   |
| 9             | Reserved                  | AM+                  | 1                      |
| 10            |                           | AM-                  | 2                      |
| 11            |                           | BM+                  | 3                      |
| 12            |                           | BM-                  | 4                      |
| 13            | DATA+                     | IM+                  | 5                      |
| 14            | DATA-                     | IM-                  | 10                     |
| 15            | Reserved                  | S1                   | 12                     |
| 17            |                           | S2                   | 13                     |
| 19            |                           | S3                   | 8                      |
| 22            | EPWR 5V                   | EPWR 5V              | 14                     |
| 23            | ECOM and BAT-             | ECOM                 | 6                      |
| 24            | Shield                    | Shield               | Connector housing      |



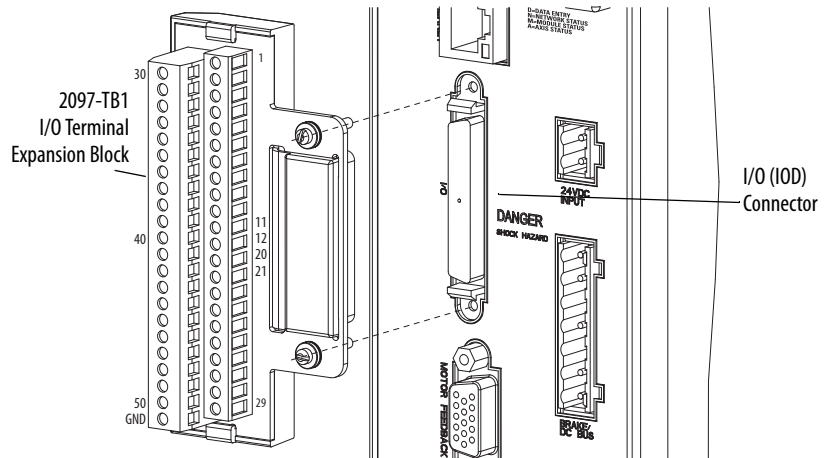
## Wiring the Feedback and I/O Connectors

These procedures assume you have mounted your Kinetix 350 system, completed the power wiring, and are ready to connect motor feedback.

### Wire the I/O Connector

Connect your I/O wires to the IOD connector by using the 2097-TB1 I/O Terminal Expansion Block. Refer to the Kinetix 300 I/O Terminal Expansion Block Installation Instructions, publication [2097-IN005](#).

**Figure 39 - Kinetix 350 Drive (IOD connector and terminal block)**

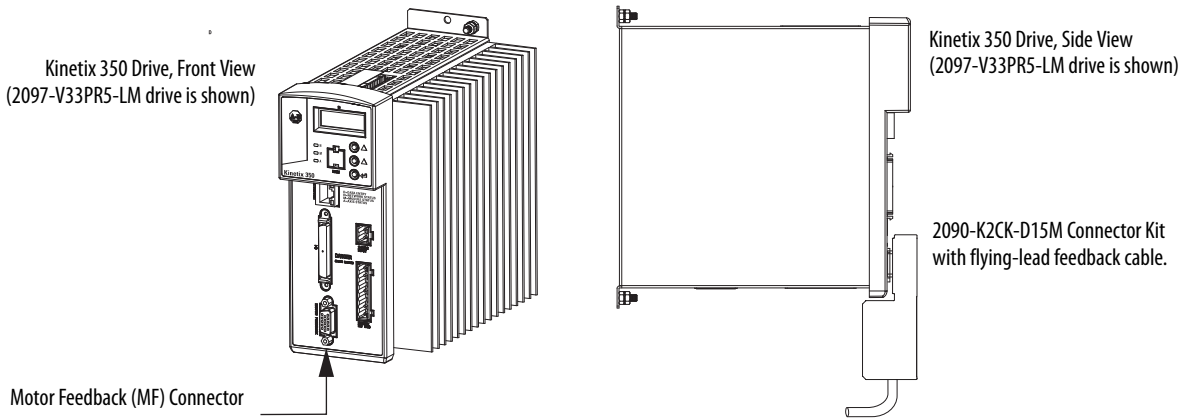


## Wire the Low-profile Connector Kit

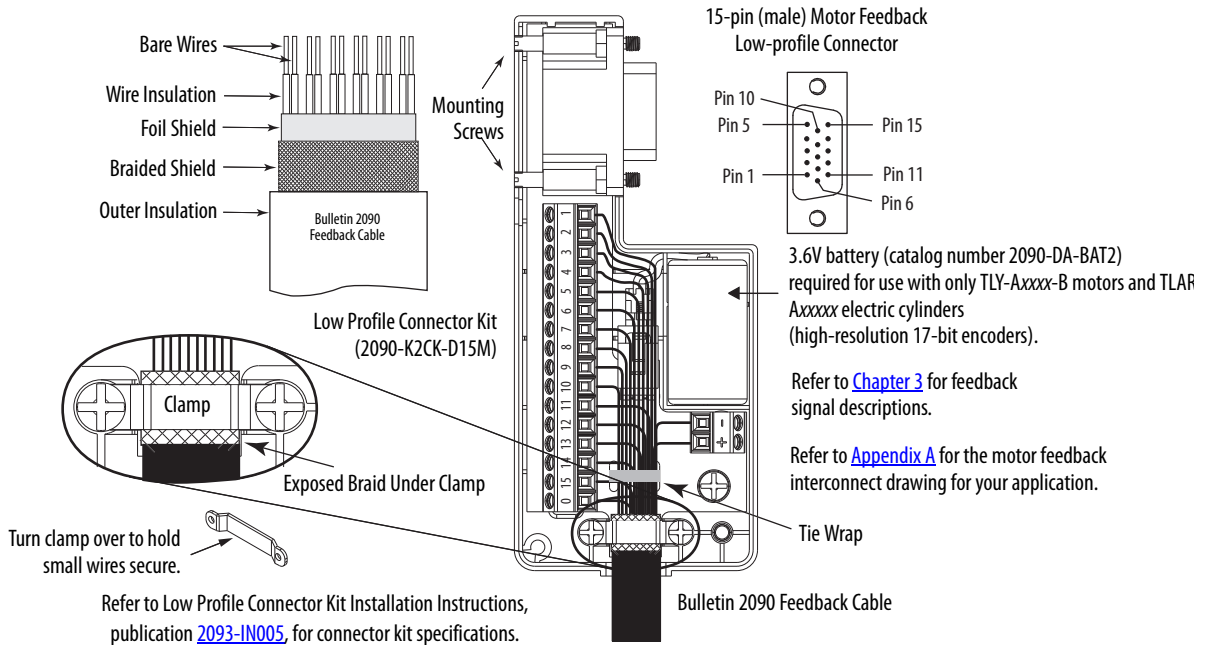
The 2090-K2CK-D15M low-profile connector kit is suitable for terminating flying-lead motor feedback cables. Use it with the Kinetix 350 drive and all motors with incremental or high-resolution feedback. It has a 15-pin, male, D-sub connector and is compatible with all Bulletin 2090 feedback cables.

TLY-Axxxx-B rotary motors and TLAR-Axxxxx electric cylinders also require the 2090-DA-BAT2 battery to back up the high-resolution encoder.

**Figure 40 - Kinetix 350 Drive (MF connector)**



**Figure 41 - Wiring (15-pin) Flying-lead Feedback Cable Connections 2090-K2CK-D15M Connector Kit**



## Shunt Resistor Connections

Follow these guidelines when wiring your 2097-Rx shunt resistor.

---

**IMPORTANT** When tightening screws to secure the wires, refer to the tables beginning on [page 59](#) for torque values.

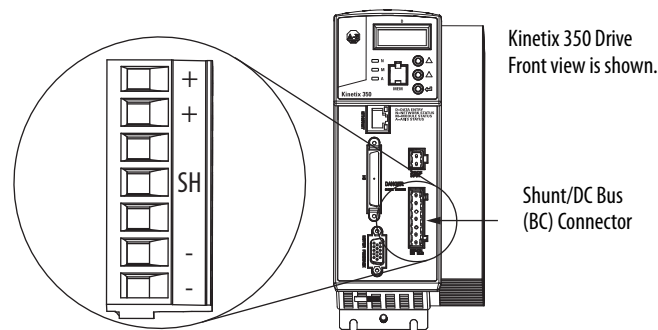
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**IMPORTANT** To improve system performance, run wires and cables in the wireways as established in [Chapter 2](#).

---

- Refer to [Shunt Resistors](#) on [page 31](#) for noise zone considerations.
- Refer to [Shunt Resistor Wiring Example](#) on [page 133](#).
- Refer to the installation instructions provided with your Bulletin 2097 shunt resistor, publication [2097-IN002](#).

**Figure 42 - Shunt/DC Bus (BC) Connector**



## Ethernet Cable Connections

This guideline assumes you have your Logix5000 Ethernet/IP module and Kinetix 350 drive mounted and ready to connect the network cables.

---

**IMPORTANT** Connection to a larger network through an un-managed switch without Internet Group Management Protocol Snooping could cause degradation to the larger network. Network switches without IEEE-1588 impacts the overall system accuracy. However, for general time stamping this switch type is usually sufficient. Your overall network topology, number of connected nodes and choice of EtherNet switch affects motion performance. For more detailed information on designing your network, please consult the Converged Plantwide Ethernet Design & Implementation Guide, publication [ENET-TD001](#).

---

The EtherNet/IP network is connected by using the Port 1 connector. Refer to [page 36](#) to locate the Ethernet connector on your Kinetix 350 drive. Refer to the figure below to locate the connector on your Logix5000 communication module.

Shielded Ethernet cable is available in lengths up to 78 m (256 ft). However, the total length of Ethernet cable connecting drive-to-drive, drive-to-controller, or drive-to-switch must not exceed 100 m (328 ft).

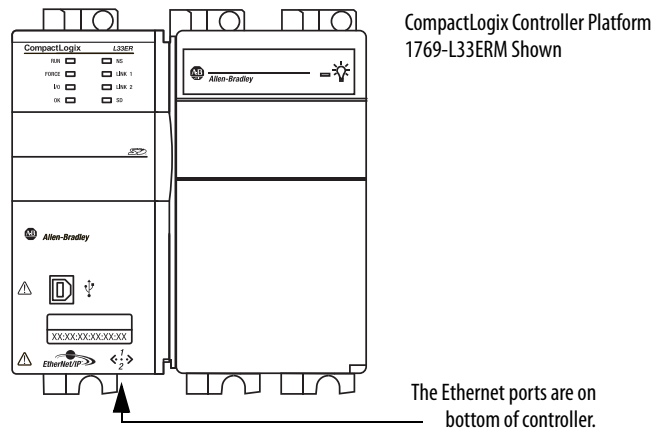
If the entire channel is constructed of stranded cable (no fixed cable), then this is the equation for calculating maximum length:

$$\text{Maximum Length} = (113 - 2N) / y, \text{ meters}$$

where N = the number of connections in the channel

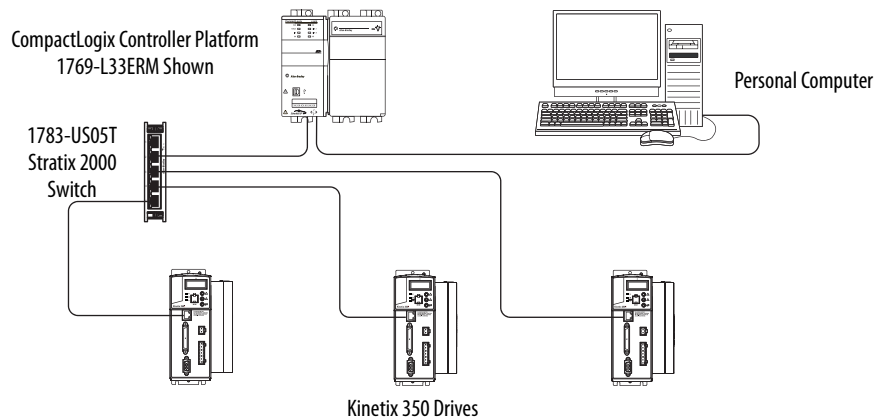
and y = the loss factor compared to fixed cable (typically 1.2...1.5).

**Figure 43 - CompactLogix Ethernet Port Location**



The Port 1 Ethernet connection is used for connecting to a Logix5000 controller and configuring your Kinetix 350 drive.

**Figure 44 - Ethernet Wiring Example - External Switch**











## Configure and Start Up the Kinetix 350 Drive System

| Topic   | Page |
|---|------|
| Keypad Input  | 78   |
| Configure the Kinetix 350 Drive Ethernet IP Address                       | 81   |
| Configure the Logix5000 EtherNet/IP Controller                            | 84   |
| Apply Power to the Kinetix 350 Drive                                      | 93   |
| Test and Tune the Axes  | 94   |
| Disable EnableInputChecking by Using a Logix Designer Message Instruction | 100  |

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

## Keypad Input

The Kinetix 350 drive is equipped with a diagnostic status indicator and three push buttons that are used to select displayed information and to edit a limited set of parameter values. Parameters can be scrolled by using  . To view a value, press . To return back to Scroll mode press .

After pressing  on editable parameters, the yellow status indicator D blinks indicating that the parameter value can be changed. Use   to change the value. Press  to store the new setting and return back to Scroll mode.

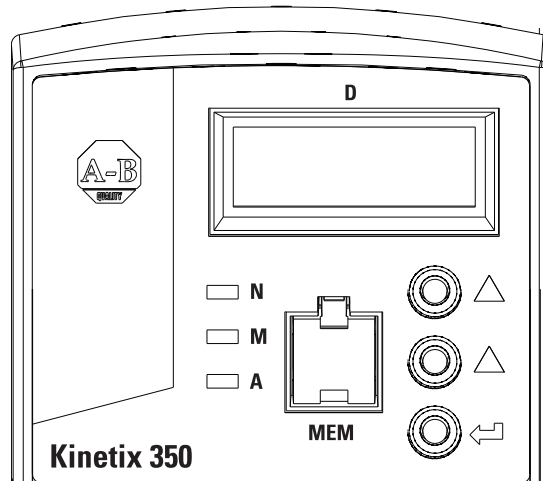
**Table 34 - Status Display Information**

| Status Indicator | Description   |
|------------------|---|
| Hx.xx            | Hardware revision. For example, H2.00.                                  |
| Fx.xx            | Firmware revision. For example, F2.06.                                  |
| dHCP             | Ethernet DHCP Configuration: 0='dHCP' is disabled; 1='dHCP' is enabled. |
| IP_1             | Lets you modify the first octet of the IP address.                      |
| IP_2             | Lets you modify the second octet of the IP address.                     |
| IP_3             | Lets you modify the third octet of the IP address.                      |
| IP_4             | Lets you modify the fourth octet of the IP address.                     |
| nEt1             | Lets you modify the first octet of the netmask.                         |
| nEt2             | Lets you modify the second octet of the netmask.                        |
| nEt3             | Lets you modify the third octet of the netmask.                         |
| nEt4             | Lets you modify the fourth octet of the netmask.                        |
| gat1             | Lets you modify the first octet of the gateway.                         |
| gat2             | Lets you modify the second octet of the gateway.                        |
| gat3             | Lets you modify the third octet of the gateway.                         |
| gat4             | Lets you modify the fourth octet of the gateway.                        |

## Status Indicators

The Kinetix 350 drive has four status indicators and a four-digit display on the top front panel as shown below. These status indicators and the display are used to monitor the system status, activity, and troubleshoot faults.

**Figure 45 - Front Panel Display**



**Table 35 - Status Indicators**

| Status Indicator | Function      | Description  |
|------------------|---------------|--|
| D                | Data entry    | Yellow status indicator flashes when changing.   |
| N                | Network state | Indicates the state of the Network. See <a href="#">Network State Status Indicator on page 80</a> . The bicolored status indicator shows red, green, or amber. |
| M                | Module state  | Indicates the state of the Network. See <a href="#">Module State Status Indicator on page 79</a> . The bicolored status indicator shows red, green, or amber.  |
| A                | Axis state    | Indicates the state of the Network. See <a href="#">Axis State Status Indicator on page 80</a> . The bicolored status indicator shows red, green, or amber.    |

**Table 36 - Module State Status Indicator**

| Status Indicator | State                     |
|------------------|---------------------------|
| Off              | Power off                 |
| Flash red/green  | Drive self-testing        |
| Flashing green   | Standby                   |
| Solid green      | Operational               |
| Flashing red     | Major recoverable fault   |
| Solid red        | Major unrecoverable fault |

**Table 37 - Axis State Status Indicator**

| Status Indicator                  | State                       |
|-----------------------------------|-----------------------------|
| Off                               | Off                         |
| Flash red/green                   | Self test                   |
| Off                               | Initialization - bus not up |
| Flashing green                    | Initialization - bus up     |
| Off                               | Shutdown - bus not up       |
| Flashing amber <sup>(1)</sup>     | Shutdown - bus up           |
| Off                               | Pre-charge - bus not up     |
| Flashing amber <sup>(1)</sup>     | Start inhibit               |
| Flashing green <sup>(1) (2)</sup> | Stopped                     |
| Solid green <sup>(1) (2)</sup>    | Stopping                    |
|                                   | Starting                    |
|                                   | Running                     |
|                                   | Testing                     |
| Flashing red                      | Aborting                    |
|                                   | Major faulted               |
| Solid red                         | Aborting                    |
|                                   | Major faulted               |

(1) The axis and the drive define minor fault conditions. While a minor fault does not affect the drive status indicator, it does affect the axis status indicator. When a minor fault condition is detected, a normally solid green status indicator indication changes to alternating red-green-red-green, a normally flashing green status indicator indication changes to alternating red-off-green-off, and a normally flashing amber indications changes to red-off-amber-off.

(2) The drive also defines alarm conditions. When an alarm condition is detected, a normally solid green status indicator indication changes to alternating amber-green-amber green while a normally flashing green status indicator indication changes to alternating amber-off-green-off.

**Table 38 - Network State Status Indicator**

| Status Indicator       | State                      |
|------------------------|----------------------------|
| Steady off             | Not powered, no IP address |
| Flashing green         | No connections             |
| Steady green           | Connected                  |
| Flashing red           | Connection time-out        |
| Steady red             | Duplicate IP               |
| Flashing green and red | Self-test                  |



## Configure the Kinetix 350 Drive Ethernet IP Address

This section offers guidance on configuring your Ethernet connection to the Kinetix 350 drive.

### Ethernet Connection

Configuration, programming, and diagnostics of the Kinetix 350 drive are performed over the standard 10/100 Mbps Ethernet communication port by using the Studio 5000 Logix Designer application.

The Kinetix 350 drive and your personal computer must be configured to operate on the same Ethernet network. The IP addresses of the Kinetix 350 drive, the personal computer, or both drive and personal computer can require configuring to enable Ethernet communication between the two devices.

---

**IMPORTANT** Any changes made to the Ethernet communication settings on the Kinetix 350 drive do not take effect until the drive is powered off and powered on again. Until the power is cycled the drive continues to use its previous settings.


---



### Kinetix 350 Drive Ethernet Port Configuration

The IP address of the Kinetix 350 drive is composed of four sub-octets that are separated by three dots to conform to the Class C Subnet structure. Each sub-octet can be configured with number between 1 and 254. As shipped from the factory the default IP address of a drive is 192.168.124.200.

There are two methods of changing the current IP address. An address can be assigned to the drive automatically (dynamic IP address) when the drive is connected to a DHCP (Dynamic Host Configuration Protocol) enabled server, or you can manually assign an IP address to the drive (static IP address). Both methods of configuring the drive's IP address are shown here.

### Obtain the Kinetix 350 Drives' Current Ethernet Settings

The current Ethernet setting and IP address of the Kinetix 350 drive can be obtained from the drive display and keypad. Press  on the display and use

  to access parameters IP\_1, IP\_2, IP\_3, and IP\_4. Each of these parameters contain one sub-octet of the full IP address, for example in the case of the drive default (factory set) address parameters:

IP\_1 = 192  
 IP\_2 = 168  
 IP\_3 = 124  
 IP\_4 = 200






By accessing these four parameters the full IP address on the drive can be obtained.

If parameters IP\_1, IP\_2, IP\_3, and IP\_4 all contain '----' rather than a numerical values it means that the drive has DHCP enabled and the DHCP server is yet to assign the drive its dynamic IP address. As soon as an IP address is assigned by the server the address assigned is displayed by the drive in the above parameters. See Configure the IP Address Automatically (dynamic address) on [page 83](#).

### Configure the IP Address Manually (static address)

When connecting directly from the Kinetix 350 drive to the personal computer without a server or when connecting to a private network, where all devices have static IP addresses, assign the IP address of the Kinetix 350 drive manually.

To assign the address manually, disable the DHCP mode. Do this by using the drive keypad and following these steps.

1. Press .
2. Use   to access parameter DHCP.
3. Check this parameter is set to a value of 0.
4. If the DHCP parameter is set to 1 then use  and  to set to 0.
5. Cycle power to the drive.





The change takes effect.

When DHCP is disabled and power cycled to the drive, it reverts back to its previous static IP address.

If you are connecting more than one drive to the personal computer create unique IP address for each drive. Do this by using the keypad on each drive to change the IP\_4 parameter. IP\_4 is the only octet that can be changed via the keypad. IP\_1, IP2, and IP\_3 are read-only accessed this way. The drive power must be cycled for any changes to take effect.

## Configure the IP Address Automatically (dynamic address)

When connecting a Kinetix 350 drive to a network domain with a DHCP enabled server the IP address of the Kinetix 350 drive is assigned automatically. To have the address assigned automatically the drive must have its DHCP mode enabled. Follow these steps by using the drive keypad and display.

1. Press .
2. Use the  to access parameter DHCP.
3. Check this parameter is set to 1.
4. If the DHCP parameter is set to 0, use  and  to set the parameter to 1.
5. Cycle power to the drive to make this change take effect.

When the Kinetix 350 drive is waiting for an IP address to be assigned to it by the server it displays '----' in each of the four octet parameters (IP\_1, IP\_2, IP\_3, and IP\_4) on its display. Once the address is assigned by the server it appears in these parameters. If this parameter continues to display '----' then it is likely that a connection between the drive and server has not been established, or the server is not DHCP enabled.

DHCP can be enabled through the Logix Designer application. If you choose to configure the drive by using a manual (static) IP address, you can switch over to an automatic (dynamic) address once configuration is complete. See [Obtain the Kinetix 350 Drives' Current Ethernet Settings](#) on [page 81](#) for information on enabling DHCP from within the Logix Designer application.

**TIP** A useful feature of the Logix Designer application, and communication interface to the Kinetix 350 drive is the ability to assign the drive a name (text string). This name can then be used to discover the drive's IP address and is useful when the drive has its IP address assigned automatically by the server for easy connection.

## Configure the Logix5000 EtherNet/IP Controller

This procedure assumes that you have wired your Kinetix 350 drive system and are using Logix Designer application version 21.00.00 or later.

For help using Logix Designer application as it applies to configuring the ControlLogix EtherNet/IP controller, refer to [Additional Resources](#) on [page 10](#).

### Configure the Logix5000 Controller

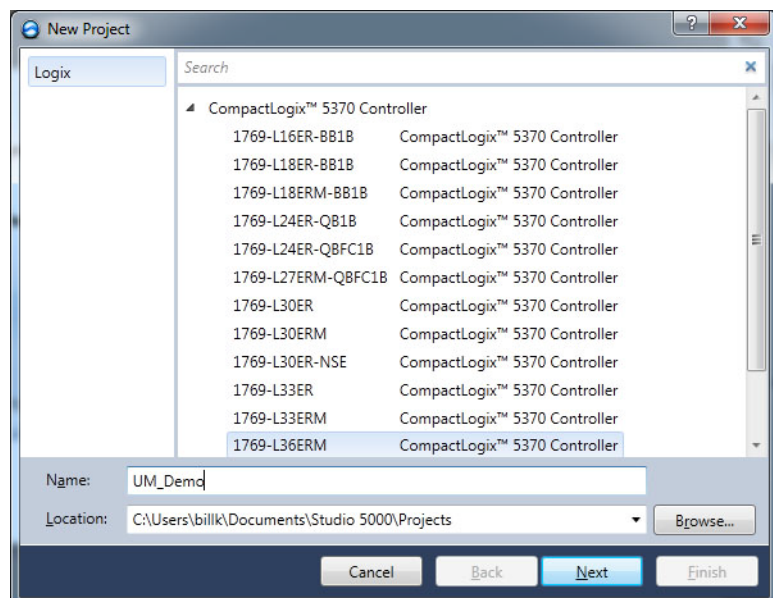
Follow these steps to configure the Logix5000 controller.

1. Apply power to your Logix5000 controller containing the EtherNet/IP port and open your Studio 5000 environment.



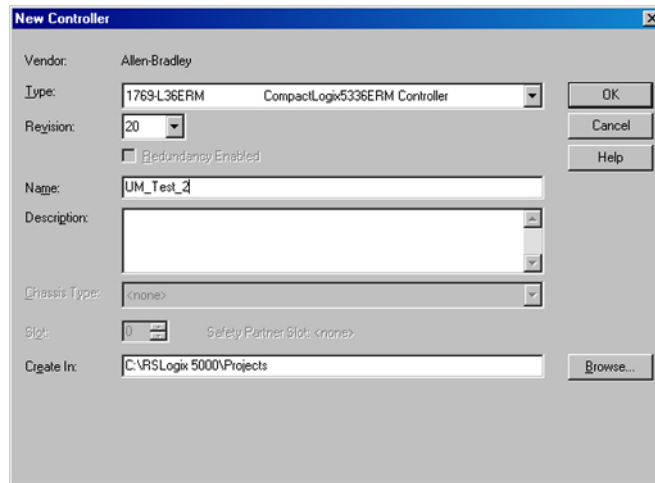
2. Click New Project.

The New Project dialog box appears.



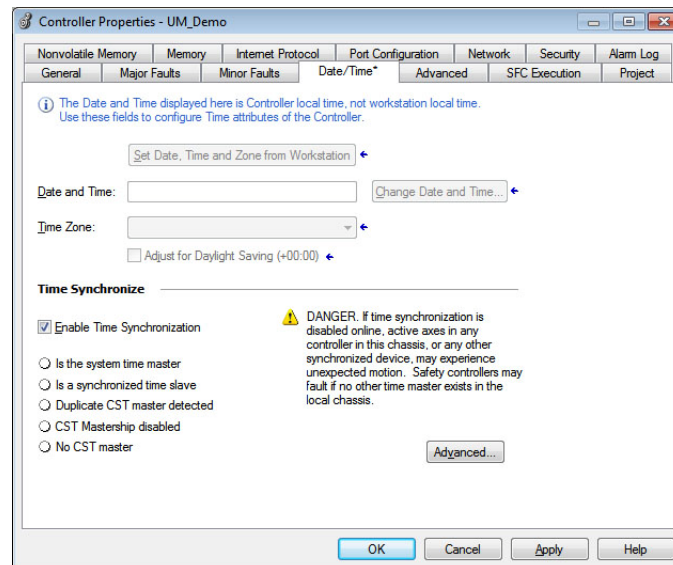
3. Select the controller you are using for your project and click Next.

The New Controller dialog box appears.



4. Configure the new controller.
  - a. From the Type pull-down menu, choose the controller type.
  - b. From the Revision pull-down menu, choose the revision.
  - c. Enter the file Name.
5. Click OK.
6. From the Edit menu, choose Controller Properties.

The Controller Properties dialog box appears.



7. Click the Date/Time tab.
8. Check Enable Time Synchronization.

This permits the controller to participate in the ControlLogix Time Synchronization or CIP Sync. The controller also participates in an election in the Logix5000 system for the best GrandMaster clock.

9. Click OK.

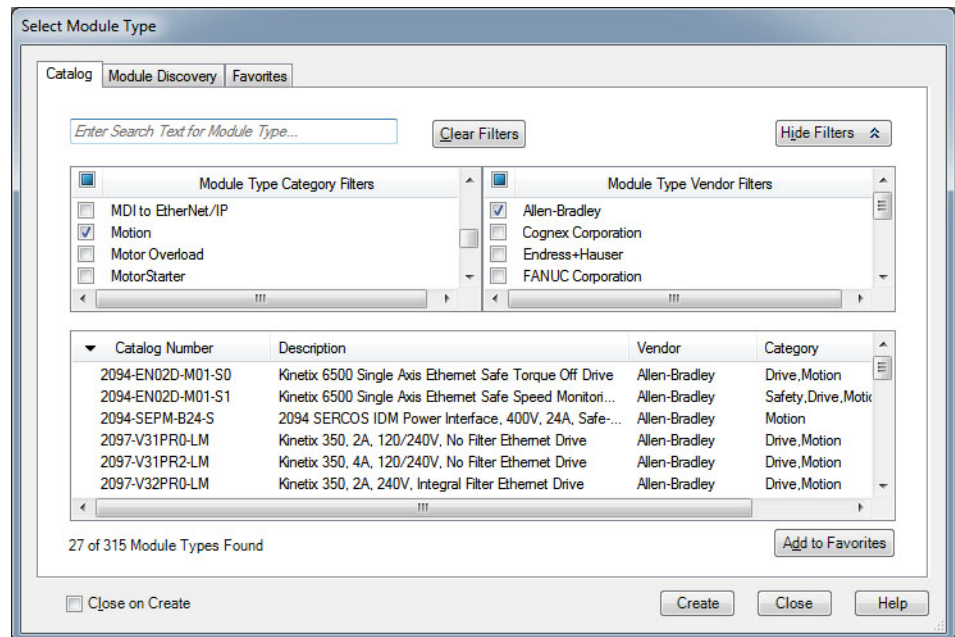
## Configure the Kinetix 350 Drive

**IMPORTANT** To configure Kinetix 350 drive (catalog numbers 2097-V3xPRx-LM) you must be using RSLogix 5000 software, version 20 or later, or Logix Designer Application.

Follow these steps to configure the Kinetix 350 drive.

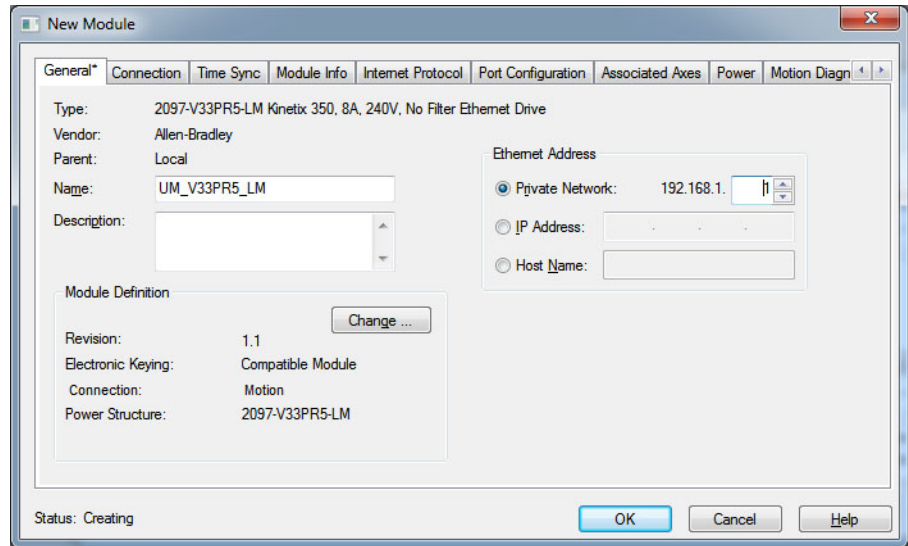
1. Right-click the Logix5000 EtherNet/IP controller you just created and choose New Module.

The Select Module dialog box appears.



2. Clear the Module Type Category Filter and check the Motion category.
3. Select your 2097-V3xPRx-LM drive as appropriate for your actual hardware configuration and click Create.

The New Module dialog box appears.



4. Configure the new drive.
  - a. Enter the drive Name.
  - b. Click an Ethernet Address option.

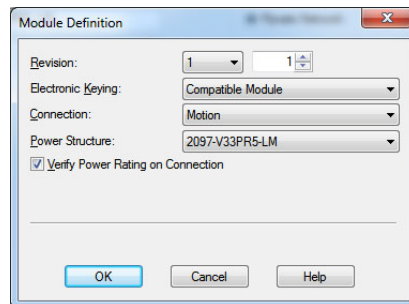
In this example, the Private Network address is selected.

- c. Enter the address of your EtherNet/IP drive.

In this example, the last octet of the address is 1. This must match the base node address of the drive.

5. Click Change in the Module Definition area.

The Module Definition dialog box appears.



6. From the Power Structure pull-down menu, choose the Bulletin 2097 drive appropriate for your application.

In the example, the 2097-V3xPRx-LM module is chosen.

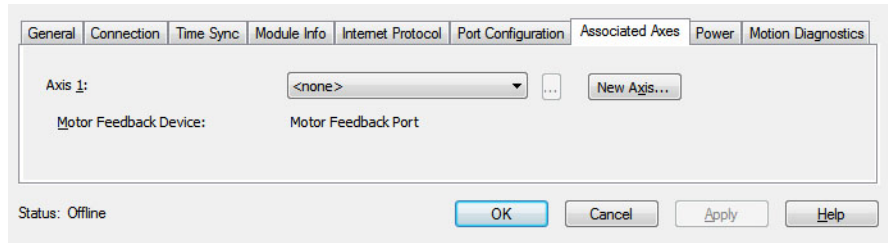
7. Click OK to close the Module Definition dialog box.
8. Click OK to close the Module Properties dialog box.

The 2097-V3xPRx-LM drive appears under the EtherNet/IP module in the I/O Configuration folder.

- Right-click the 2097-V3xPRx-LM module you just created and choose Properties.

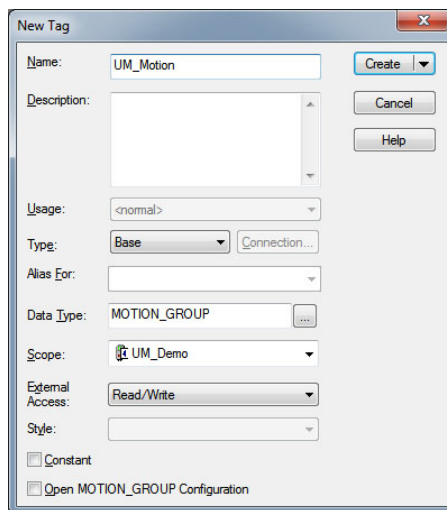
The Module Properties dialog box appears.

- Click the Associated Axes tab.



- Click New Axis.

The New Tag dialog box appears.

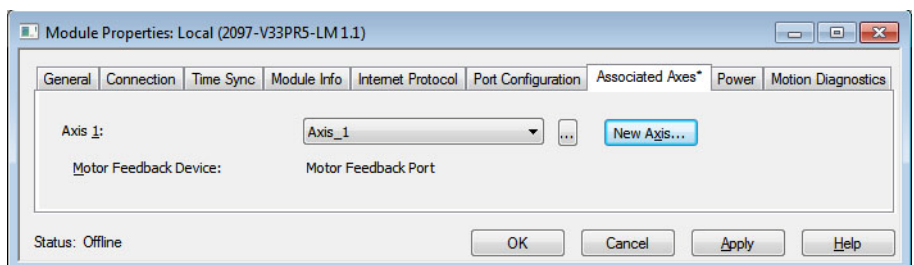


- Type the axis Name.

AXIS\_CIP\_DRIVE is the default Data Type.

- Click Create.

The new axis (Axis\_1) appears under Motion Groups>Ungrouped Axes in the Controller Organizer and is assigned as Axis 1.



- Click Apply.

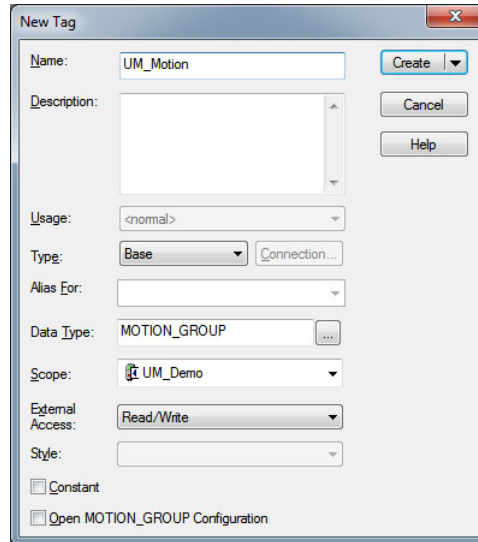


## Configure the Motion Group

Follow these steps to configure the motion group.

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

The New Tag dialog box appears.

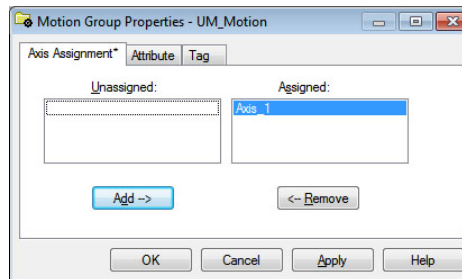


2. Type the new motion group Name.
3. Click Create.

The new motion group appears under the Motion Groups folder.

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

The Motion Group Properties dialog box appears.



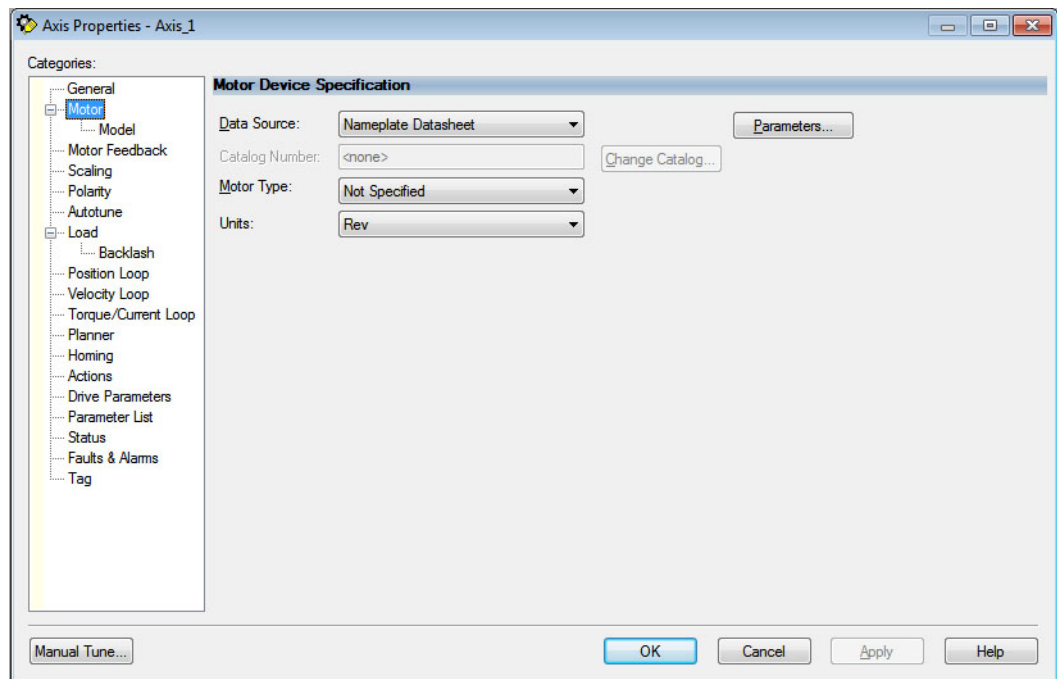
5. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.
6. Click the Attribute tab and edit the default values as appropriate for your application.
7. Click OK.

## Configure Axis Properties

Follow the instructions below to configure axis properties for your motor or actuator. If you are using an Integrated Motion Encoder on EtherNet/IP, catalog number 842E-CM for an axis refer to 842E-CM Integrated Motion Encoder on EtherNet/IP User Manual, publication [842E-UM002](#).

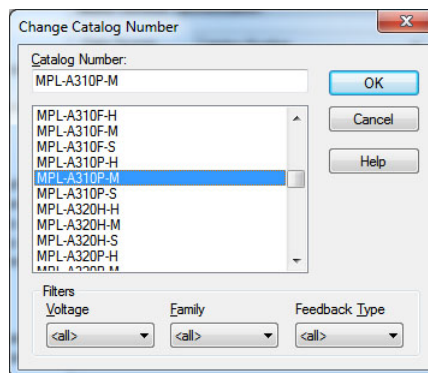
1. Right-click an axis in the Controller Organizer and choose Properties.
2. Click the Motor category.

The Motor Device Specification dialog box appears.



3. From the Data Source pull-down menu, choose Catalog Number.
4. Click Change Catalog.

The Change Catalog Number dialog box appears.

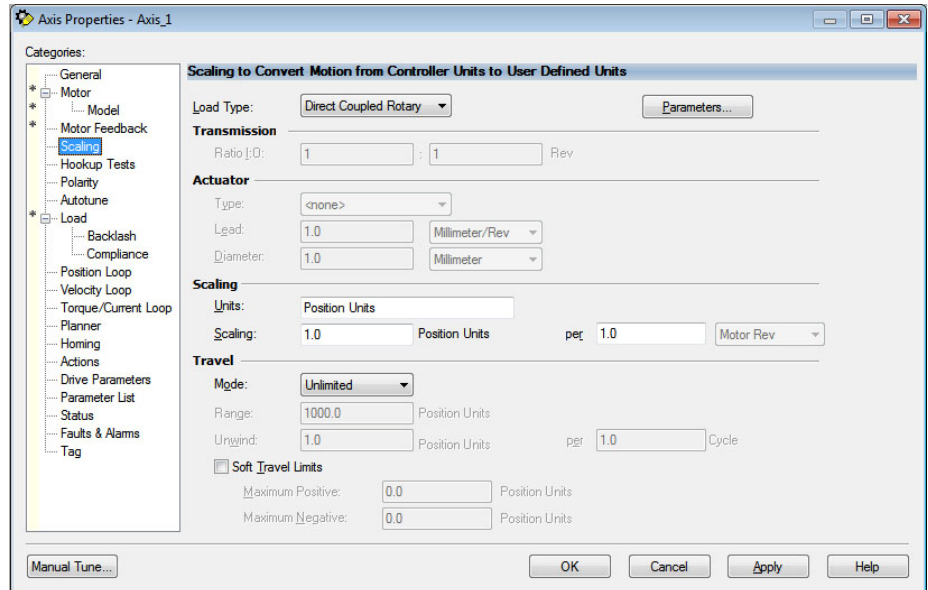


5. Select the motor catalog number appropriate for your application.  
To verify the motor catalog number, refer to the motor name plate.
6. Click OK to close the Change Catalog Number dialog box.

## 7. Click Apply.

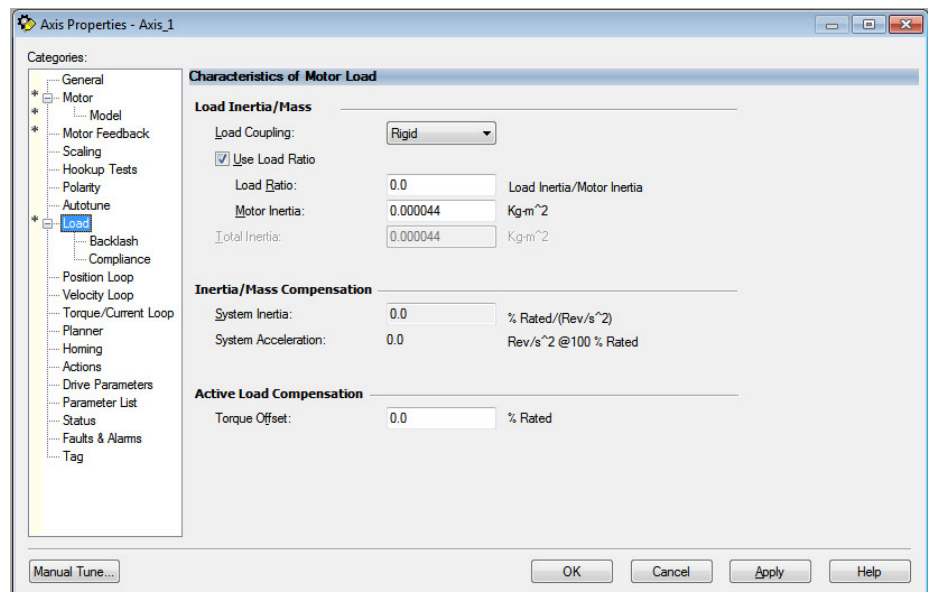
Motor data specific to your motor appears in the Motor category.

## 8. Click the Scaling category and edit the default values as appropriate for your application.



## 9. Click Apply, if you make changes.

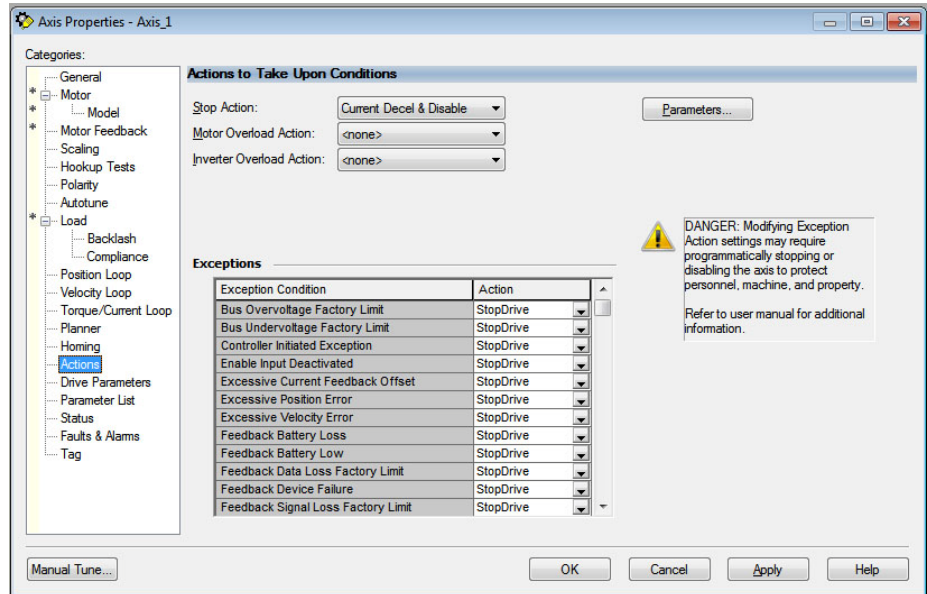
## 10. Click Load category and edit the default values as appropriate for your application.



## 11. Click Apply, if you make changes.

12. Click Actions category.

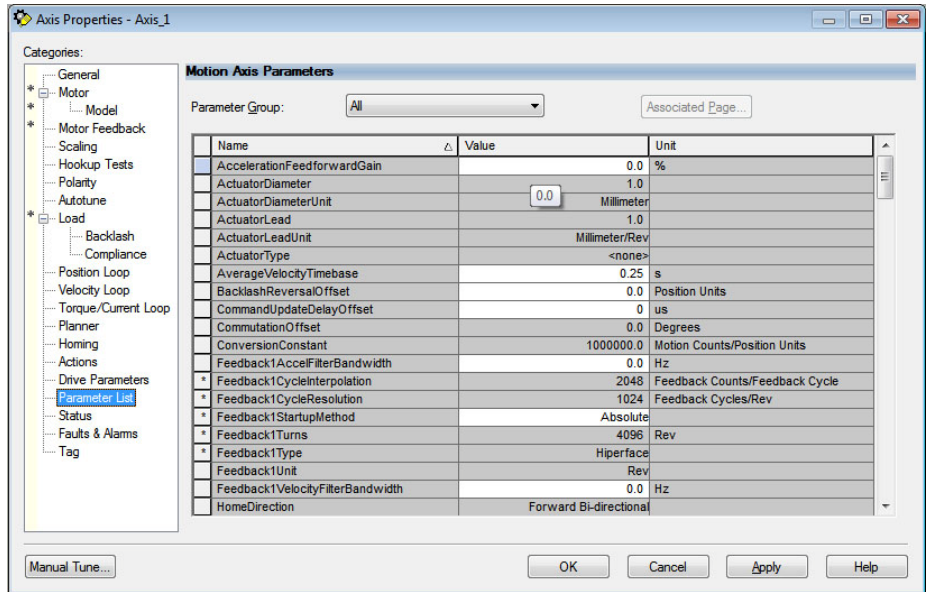
The Actions to Take Upon Conditions dialog box appears.



From this dialog box, you can program actions and change the action for exceptions (faults).

13. Click Parameters.

The Motion Axis Parameters dialog box appears.



From this dialog box you can set delay times for servo motors. For recommended motor brake delay times, refer to the Kinetix Motion Control Selection Guide, publication [GMC-SG001](#).

14. Click OK.

15. Verify your Logix5000 program and save the file.

## Download the Program

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

## Apply Power to the Kinetix 350 Drive

This procedure assumes that you have wired and configured your Kinetix 350 drive system and your Ethernet/IP interface controller.



**SHOCK HAZARD:** To avoid hazard of electrical shock, perform all mounting and wiring of the Bulletin 2097 drive 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 350 drive system.

1. Disconnect the load to the motor.

The axis does not operate in position mode during the execution of this process. Therefore, the position of the axis cannot be guaranteed if the axis is connected to a vertical load, or the axis is connected to a stored mechanical energy.

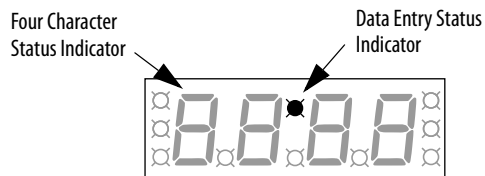


**ATTENTION:** To avoid personal injury or damage to equipment, disconnect the load to the motor; including vertical loads. Make sure each motor is free of all linkages when initially applying power to the system.

2. Determine the source of the drive logic power.

| If Your Logic Power            | Then   |
|--------------------------------|--|
| Is from (24V DC) back-up power | Apply (24V DC) back-up power to the drive (BP connector).                  |
| Mains input power              | Apply 120, 240, or 460V AC mains input power to the drive (IPD connector). |

3. Apply 120, 240, or 460V AC mains input power to the Kinetix 350 drive IPD connector.
4. Observe the four digit status indicator.



| If the status indicator is | Then                                   |
|----------------------------|--|
| -00-                       | Go to <a href="#">step 5</a>           |
| Blank                      | Go back to main <a href="#">step 2</a> |

5.

| If Your Logic Power            | Then  |
|--------------------------------|---|
| Is from (24V DC) back-up power | Apply 120, 240, or 460V AC mains input power to the drive (IPD connector) |
| Mains input power              | Go to <a href="#">step 5</a>  |

6.

| If drive ENABLE is | Then   |
|--------------------|--|
| Hard wired         | Apply 24V DC   |
| Not used           | Disable enableInputChecking by using procedure on <a href="#">page 100</a> |

7. Observe the status indicator on the front of the Kinetix 350 drive.

| Status Indicator | Condition                         | Status                 | Do This   |
|------------------|-----------------------------------|------------------------|---|
| Module           | Steady green                      | Operational condition  | Observe the Axis, status indicator <a href="#">page 79</a>                      |
|                  | Steady or flashing red            | Drive is faulted       | Go to <a href="#">Module State Status Indicator</a> on <a href="#">page 79</a>  |
| Axis             | Steady green or amber, flashing   | Operational condition  | Observe the Network, status indicator <a href="#">page 79</a>                   |
|                  | Steady or flashing red            | Axis is faulted        | Go to <a href="#">Axis State Status Indicator</a> on <a href="#">page 80</a>    |
| Network          | Steady green                      | Communication is ready | Go to Test and Tune the Axes on <a href="#">page 94</a>                         |
|                  | Any state other than steady green | Communication error    | Go to <a href="#">Network State Status Indicator</a> on <a href="#">page 80</a> |

## Test and Tune the Axes

This procedure assumes that you have configured your Kinetix 350 drive, your ControlLogix EtherNet/IP controller, and applied power to the system.

---

**IMPORTANT** Before proceeding with testing and tuning your axes, verify that the drive status indicators are operating as described in [Status Indicators](#) on [page 119](#).

---

For help using Logix Designer Application as it applies to testing and tuning your axes with ControlLogix EtherNet/IP controller, refer to [Additional Resources](#) on [page 10](#).

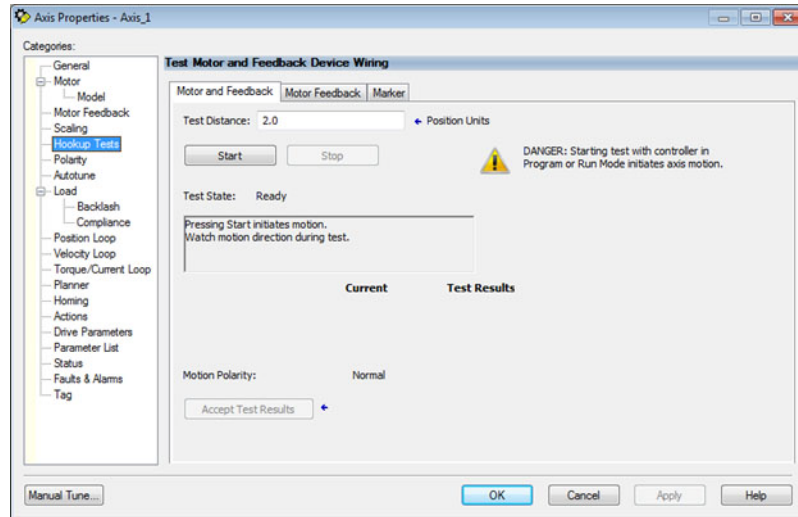
### Test the Axes

Follow these steps to test the axes.

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

The Axis Properties dialog box appears.

3. Click Hookup Tests category.



4. Type 2.0 as the number of revolutions for the test or another number more appropriate for your application.

| This Test          | Performs this Test  |
|--------------------|---|
| Marker             | Verifies marker detection capability as you rotate the motor shaft.                                   |
| Motor Feedback     | Verifies feedback connections are wired correctly as you rotate the motor shaft.                      |
| Motor and Feedback | Verifies motor power and feedback connections are wired correctly as you command the motor to rotate. |

5.

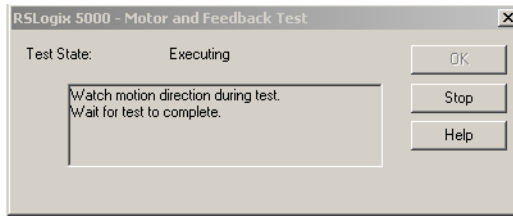
| If drive ENABLE is | Then   |
|--------------------|--|
| Hard wired         | Apply 24V DC   |
| Not used           | Disable enableInputChecking by using procedure on <a href="#">page 100</a> |



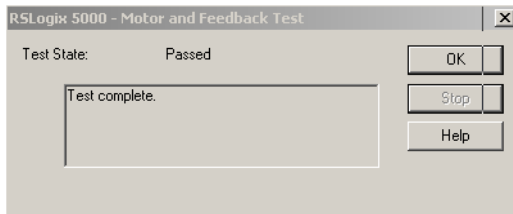
**ATTENTION:** To avoid personal injury or damage to equipment, apply only 24V ENABLE signal to the axis you are testing.

6. Click the desired tab (Marker/Motor Feedback/Motor and Feedback).  
In this example, the Motor and Feedback test is chosen.
7. Click Start.

The RSLogix 5000 - Motor and Feedback Test dialog box appears. The Test State is Executing.

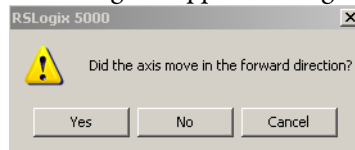


When the test completes successfully, the Test State changes from Executing to Passed.



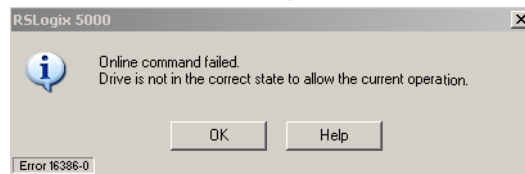
8. Click OK.

This dialog box appears asking if the direction was correct.



9. Click Yes.

If the test fails, this dialog box appears.



- a. Click OK.
- b. Verify the Axis status indicator turned solid green during the test.
- c. Verify that the drive ENABLE signal is applied to the axis you are testing or that the enableInputChecking attribute is set to zero.
- d. Verify the unit values entered in the Scaling category.
- e. Return to main [step 6](#) and run the test again.



## Tune the Axes

This is a basic procedure for simple systems. If you have a complicated system refer to CIP Motion Configuration and Startup User Manual, publication [Motion-UM003](#).

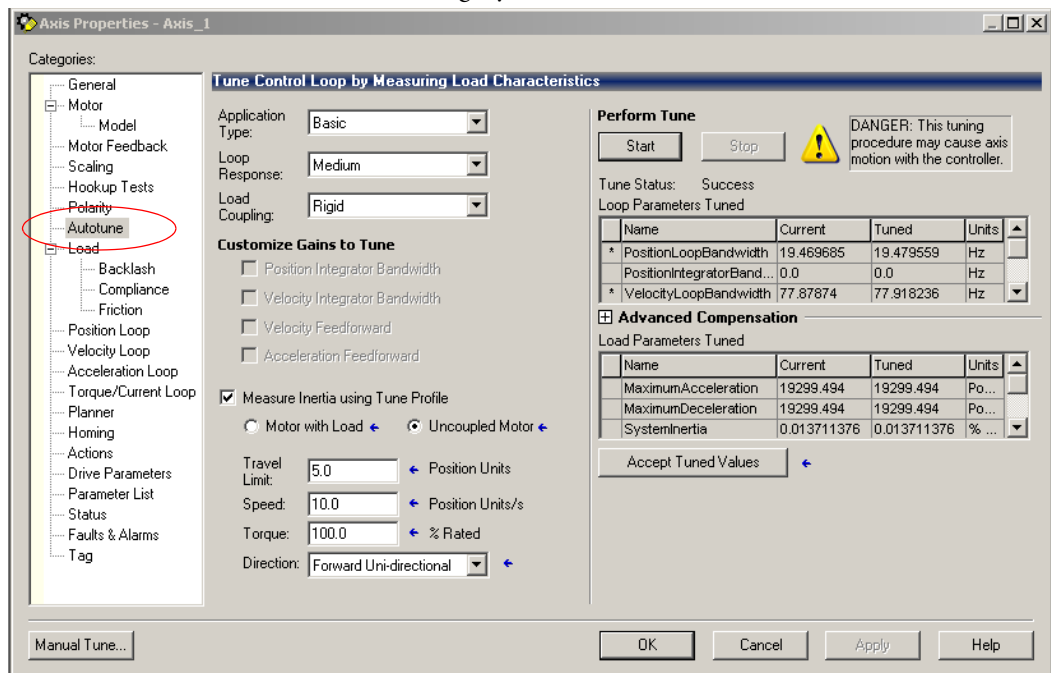
Follow these steps to tune the axes.

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



**ATTENTION:** To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, including vertical loads, then re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click Autotune category.



3. Type values for Travel Limit and Speed.

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

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

Forward Uni-directional is default.

5. Edit other fields as appropriate for your application and click Apply.

6.

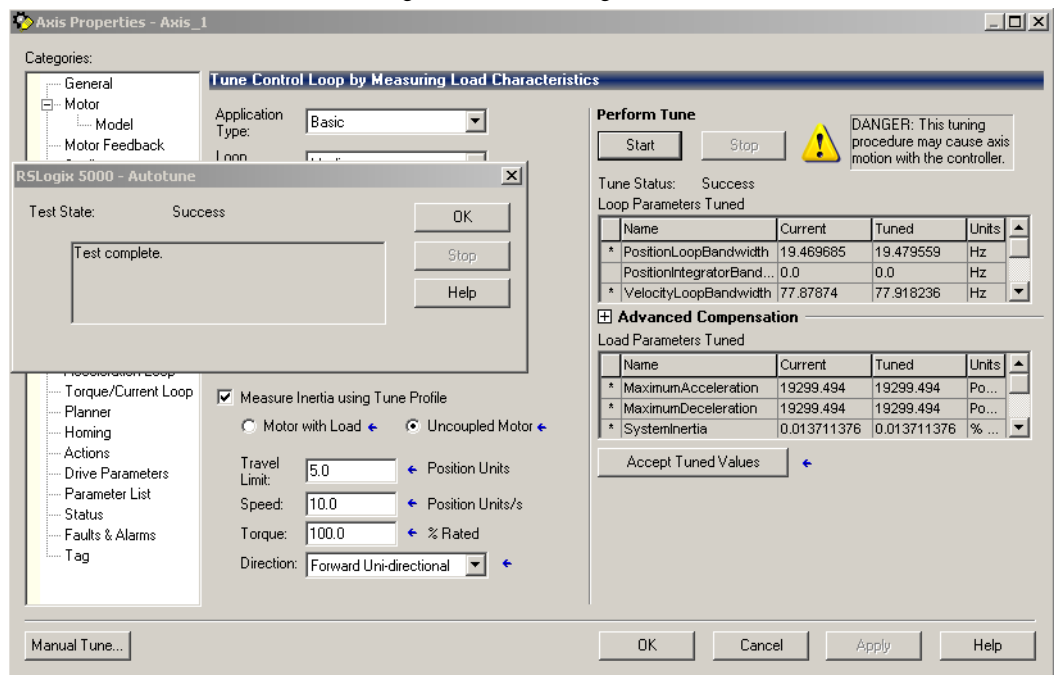
| If drive ENABLE is | Then   |
|--------------------|--|
| Hard wired         | Apply 24V DC   |
| Not used           | Disable enableInputChecking by using procedure on <a href="#">page 100</a> |



**ATTENTION:** To avoid personal injury or damage to equipment, apply only 24V ENABLE signal to the axis you are testing.

7. Click Start.

The RSLogix - 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.

At this point, you can compare existing and tuned values for your gains and inertias with the prospective tune values.

8. Accept the new values and apply them to the controller.

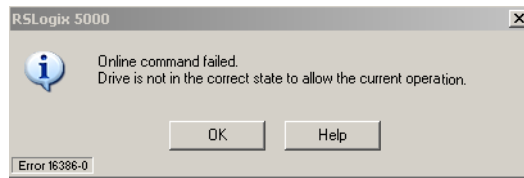
Now you can run the system with the new gain set and evaluate performance. You can improve the performance by adjusting application type, loop response, and/or load coupling selections.

**TIP** If your application requires stricter performance you can further improve performance with manual tuning.

9. Click OK to close the RSLogix 5000 - Autotune dialog box.

10. Click OK to close the Axis Properties dialog box.

11. If the test fails, this dialog box appears.

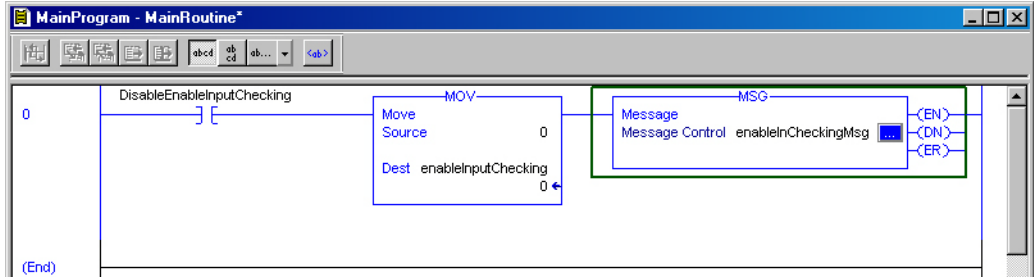


- a. Click OK.
  - b. Make an adjustment to motor velocity.
  - c. Refer to the appropriate Logix5000 motion module user manual for more information.
  - d. Return to [step 7](#) and run the test again.
12. Repeat [Test and Tune the Axes](#) for each axis.

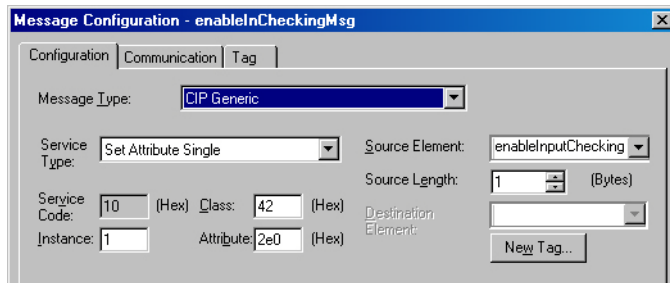
## Disable EnableInputChecking by Using a Logix Designer Message Instruction

This procedure sends a Logix5000 message to disable the EnableInputChecking attribute in the Kinetix 350 drive.

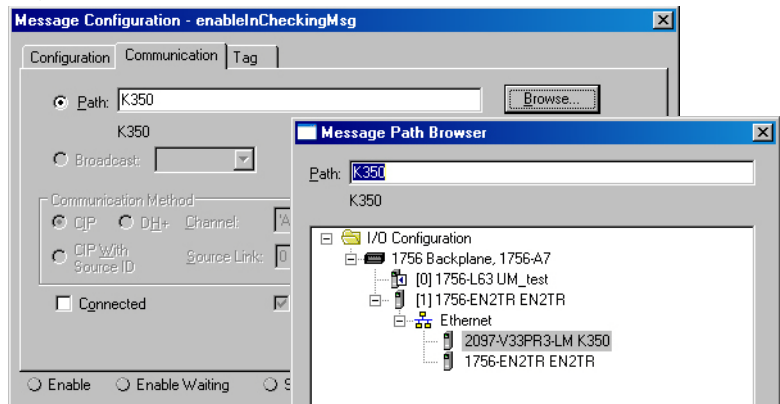
1. From the Controller Organizer, choose Tasks>MainTask>MainProgram>MainRoutine.
2. Create a MSG instruction rung as shown.



3. Set the values in the Message Configuration as shown.



4. Click the Communications tab and browse to the drive tag, in this case K350, as shown.



5. When the program is in Run mode, trigger the rung to run the instruction.

The drive does not check the enable input signal on IOD-29 Enable to IOD -26 Common. This MSG instruction is executed only once as it is a persistent type instruction and gets saved to the drive Non-volatile Memory. To re-enable the enable input signal checking on IOD-29 Enable to IOD-26 Common, change the Source Element register, EnableInputChecking from 0 to 1 and trigger the run again.

## Kinetix 350 Drive Safe Torque-off Feature

| Topic   | Page |
|---|------|
| Certification                                     | 101  |
| Description of Operation                          | 102  |
| PFD and PFH Definitions                           | 103  |
| PFD and PFH Data                                  | 103  |
| Safe Torque-off Connector Data                    | 104  |
| Wiring Your Safe Torque-off Circuit               | 105  |
| Kinetix 350 Drive Safe Torque-off Feature         | 107  |
| Kinetix 350 Drive Safe Torque-off Wiring Diagrams | 108  |
| Safe Torque-off Signal Specifications             | 109  |

### Certification

The safe torque-off circuit is type-approved and certified for use in safety applications up to and including ISO 13849-1 performance level d (PLd) safety category 3.

The TÜV Rheinland group has approved the Kinetix 350 drives for use in safety-related applications up to ISO 13849-1 performance level d (PLd) safety category 3, in which the de-energized state is considered to be the safe state. All of the examples related to I/O included in this manual are based on achieving de-energization as the safe state for typical machine safety systems.

### Important Safety Considerations

The system user is responsible for the following:

- Validation of any sensors or actuators connected to the drive system
- Completing a machine-level risk assessment
- Certification of the machine to the desired ISO 13849-1 performance level
- Project management and proof testing
- Programming the application software and the device configurations in accordance with the information in this safety reference manual and the drive product manual

## Safety Category 3 Requirements

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.

## Stop Category Definition

Stop category 0 is achieved with immediate removal of power to the actuator.

---

**IMPORTANT** In the event of drive or control failure, the most likely stop category is category 0. When designing the machine application, consider timing and distance for a coast to stop. For more information regarding stop categories, refer to EN 60204-1.

---

## Performance Level and Safety Integrity Level (SIL) CL2

For safety-related control systems, Performance Level (PL), according to 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 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 on demand, 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 drives output-power transistors are released from the ON state, effectively removing motive power generated by the drive. This results in a condition where the motor is in a coasting condition (stop category 0). Disabling the power transistor output does not provide mechanical isolation of the electrical output, which can be required for some applications.

Under normal drive operation, the safe torque-off switches are energized. If either of the safety enable inputs are de-energized, the gate control circuit is disabled. To meet ISO 13849-1 (PLd) both safety channels must be used and monitored.



**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.

---

## Troubleshooting the Safe Torque-off Function



**ATTENTION:** The safe torque-off fault is detected upon demand by the safe torque-off function. After troubleshooting, a proof test safety function must be performed to verify correct operation.

### PFD and PFH Definitions

Safety-related systems can be classified as operating in either a Low Demand mode, or in a High Demand/Continuous mode:

- Low Demand mode: where the frequency of demands for operation made on a safety-related system is no greater than one per year or no greater than twice the proof-test frequency.
- High Demand/Continuous mode: where the frequency of demands for operation made on a safety-related system is greater than once per year or greater than twice the proof test interval.

The SIL value for a low demand safety-related system is directly related to order-of-magnitude ranges of its average probability of failure to satisfactorily perform its safety function on demand or, simply, average probability of failure on demand (PFD). 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).

### PFD and PFH Data

These PFD and PFH calculations are based on the equations from EN 61508 and show worst-case values.

This table provides data for a 20-year proof test interval and demonstrates the worst-case effect of various configuration changes on the data.

**Table 39 - PFD and PFH for 20-year Proof Test Interval**

| Attribute  | Value |
|------------|-------|
| PFH [1e-9] | 5.9   |
| PFD [1e-3] | 1.0   |

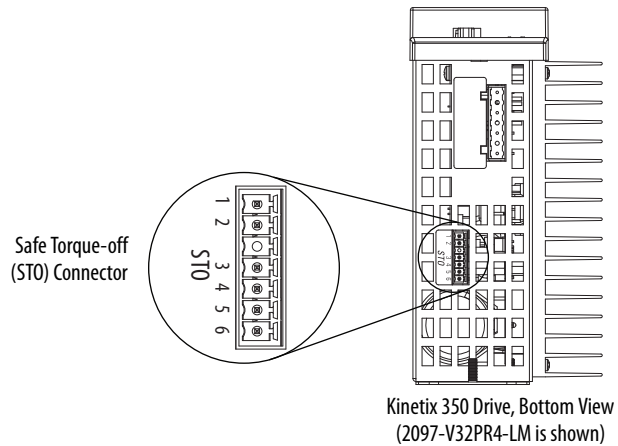
## Safe Torque-off Connector Data

This section provides safe torque-off (STO) connector and header information for the Kinetix 350 drive safe torque-off.

### STO Connector Pinouts

Headers extend the STO connector signals for use in wiring or to defeat (not use) the safe torque-off function.

**Figure 46 - 6-pin Safe Torque-off (STO) Connector**



| STO Pin | Description                        | Signal          |
|---------|------------------------------------|-----------------|
| 1       | +24V DC output from the drive      | +24V DC control |
| 2       | +24V DC output common              | Control COM     |
| 3       | Safety status                      | Safety Status   |
| 4       | Safety input 1 (+24V DC to enable) | Safety Input 1  |
| 5       | Safety common                      | Safety COM      |
| 6       | Safety input 2 (+24V DC to enable) | Safety Input 2  |



## Wiring Your Safe Torque-off Circuit

This section provides guidelines for wiring your Kinetix 350 safe torque-off drive connections.

### European Union Directives

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

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

#### *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 61000-6-4 EMC - Emission Standard, Part 2 - Industrial Environment
- EN 61000-6-2 EMC - Immunity Standard, Part 2 - Industrial Environment

The product described in this manual is intended for use in an industrial environment.

#### *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 to instructions found in this manual.

CE Declarations of Conformity are available online at:  
<http://www.rockwellautomation.com/products/certification/ce>.

#### *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 50178 Electronic Equipment for use in Power Installations apply in whole or in part.

## Safe Torque-off Wiring Requirements

These are the safe torque-off (STO) wiring requirements. Wire must be copper with 75 °C (167 °F) minimum rating.

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

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

Figure 47 - Safe Torque-off (STO) Terminal Plug

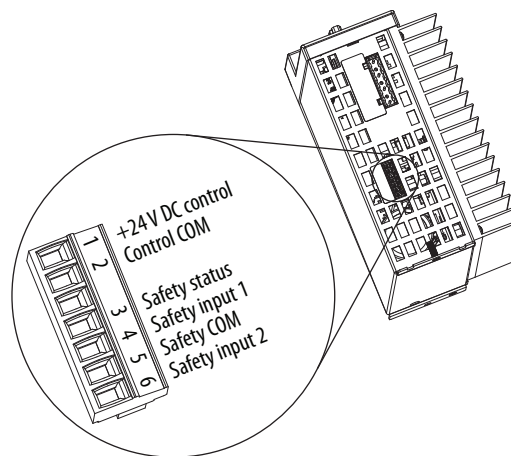


Table 40 - Safe Torque-off (STO) Terminal Plug Wiring

| Safe Torque-off (STO) Connector                    |   | Recommended Wire Size                                  |                                     | Strip Length<br>mm (in.) | Torque Value<br>N·m (lb·in) |
|--|---|--|-------------------------------------|--------------------------|-----------------------------|
| Pin  | Signal  | Stranded Wire<br>with Ferrule<br>mm <sup>2</sup> (AWG) | Solid Wire<br>mm <sup>2</sup> (AWG) |                          |                             |
| STO-1<br>STO-2<br>STO-3<br>STO-4<br>STO-5<br>STO-6 | +24V DC Control<br>Control COM<br>Safety Status<br>Safety Input 1<br>Safety COM<br>Safety Input 2 | 0.75 (18)  | 1.5 (16)                            | 6 (0.25)                 | 0.2 (1.8)                   |

**IMPORTANT** Use only pins STO-1 (+24V DC Control) and STO-2 (Control COM) of the motion-allowed jumpers to defeat the safe torque-off function. When the safe torque-off function is in operation, the 24V supply must come from an external source.

**IMPORTANT** To be sure of system performance, run wires and cables in the wireways as established in the user manual for your drive.

## Kinetix 350 Drive Safe Torque-off Feature

The safe torque-off circuit, when used with suitable safety components, provides protection according to ISO 13849-1 (PLd). The safe torque-off option is just one safety control system. 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 remove power from the gate firing circuits of the drives output power devices (IGBTs). This prevents them from switching in the pattern necessary to generate AC power to the motor.

You can use the safe torque-off circuit in combination with other safety devices to meet the stop and protection-against-restart requirements of ISO 13849-1.



**ATTENTION:** This option is suitable for performing mechanical work on only the drive system or affected area of a machine. It does not provide electrical safety.



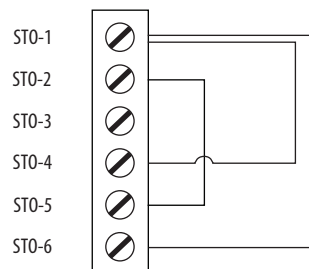
**SHOCK HAZARD:** In Safe Torque-off mode, hazardous voltages can still be present at the motor. To avoid an electric shock hazard, disconnect power to the motor and verify that the voltage is zero before performing any work on the motor.

### Safe Torque-off Feature Bypass

The drive is supplied from the factory with the safe torque-off circuit enabled. The drive is not operational until +24V is present at terminals STO-4 and STO-6. When safety connections are not required, the drive can be operated with the safety circuit disabled.

Use jumper wires, as shown, to defeat the safe torque-off function.

**Figure 48 - STO Motion-allowed Jumpers**



**IMPORTANT** Use only pins STO-1 (+24V DC Control) and STO-2 (Control COM) of the motion-allowed jumpers to defeat the safe torque-off function. When the safe torque-off function is in operation, the 24V supply must come from an external source.

## Kinetix 350 Drive Safe Torque-off Wiring Diagrams

This section provides typical wiring diagrams for the Kinetix 350 drive safe torque-off feature with other Allen-Bradley safety products.

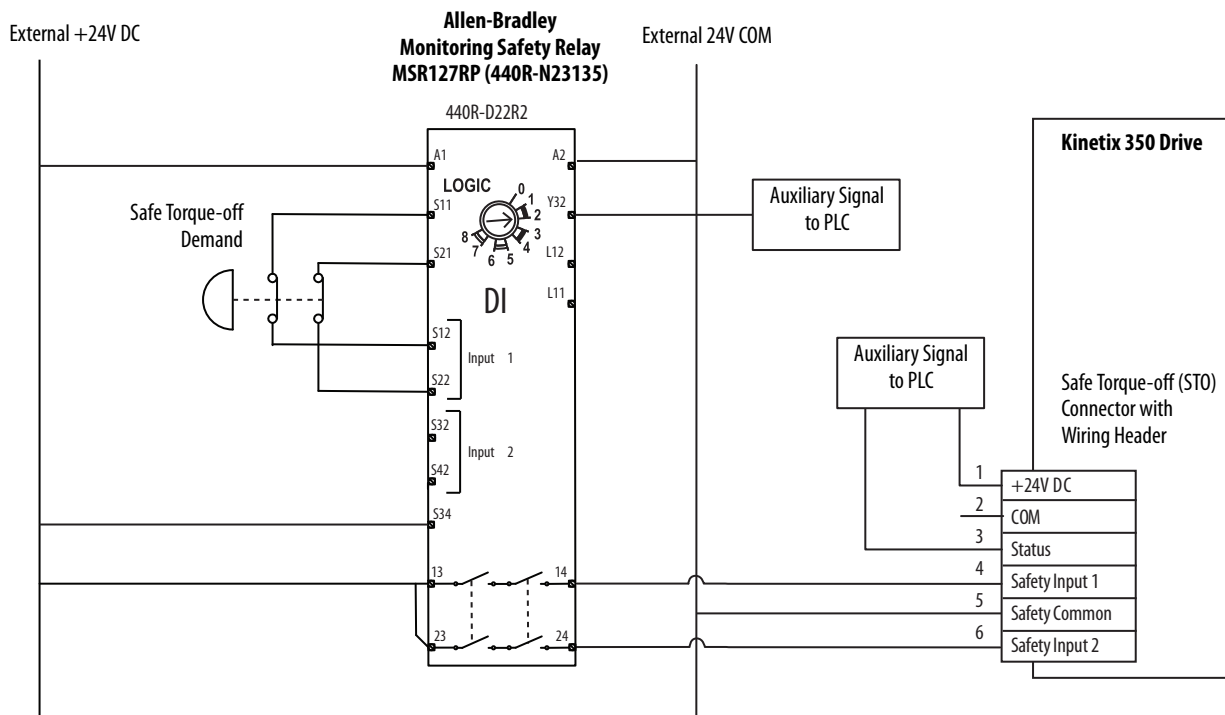
For additional information regarding Allen-Bradley safety products, including safety relays, light curtain, and gate interlock applications, refer to the Safety Products Catalog, website <http://www.ab.com/catalogs>.

The drive is shown in a single-axis relay configuration for category 0 stop per EN-60204-1 Safety of Machinery Directive. These are examples, however, and user applications can differ based on the required overall machine performance level requirements.

**IMPORTANT** The Kinetix 350 drive meets the requirements of ISO 13849-1 Safety of Machinery, Safety-related Parts of Control Systems, category (CAT 3), performance level (PL)d and Safety Integrity Level (SIL) 2 per EN 61800-5-2:2007. Dual inputs and drive monitoring of the safe torque-off circuit, STO-4 and STO-6, are done to prevent drive enable if either or both of these inputs do not function.

It is suggested to evaluate the entire machine performance level required with a risk assessment and circuit analysis. Contact your local distributor or Rockwell Automation Sales for more information.

**Figure 49 - Single-axis Relay Configuration (Stop Category 0) with Automatic Reset**



## Safe Torque-off Signal Specifications

This table provides specifications for the safe torque-off signals used in the Kinetix 350 servo drives.

| Attribute                    | Value  |
|------------------------------|--|
| Safety inputs <sup>(1)</sup> | Insulated, compatible with single-ended output (+24V DC) |
|                              | Enable voltage range: 20...24V DC                        |
|                              | Disable voltage range: 0...1.0V DC                       |
| Input impedance              | 6.8 k $\Omega$   |
| Safety status                | Isolated Open Collector (Emitter is grounded.)           |
| Output load capability       | 100 mA   |
| Digital outputs max voltage  | 30V DC   |

(1) Safety inputs are not designed for pulse testing.

**Notes:**

## Troubleshoot the Kinetix 350 Drive

| Topic                                   | Page |
|---|------|
| Safety Precautions                      | 111  |
| Interpret Status Indicators             | 112  |
| General System Behavior                 | 121  |
| Logix5000 Controller and Drive Behavior | 123  |
| Web Server Interface                    | 127  |

### Safety Precautions

Observe the following safety precautions when troubleshooting your Kinetix 350 drive.



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



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



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

## Interpret Status Indicators

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

### Four-digit Display Messages

The control modules include a four-digit seven-segment display for status and fault messages. The display scrolls to display text strings.

The Four-digit Display Messages table lists the messages along with their priorities. When messages of different priorities need to be displayed, for example, when the drive has both a fault and a start inhibit, only the higher priority message is displayed. When messages of equal priority are needed, for example, when there is more than one fault, the messages are displayed in a round-robin fashion. Only two messages scroll in this manner. When a fault is announced, the entire fault text scrolls on the display regardless of when the fault is cleared.

The IP address is always an active condition, meaning that it scrolls in conjunction with the axis state as long as there are no higher priority messages to display.

Refer to the table on [Four-digit Display Messages](#) for a description of the messages that scroll across the display during powerup.

**Table 41 - Four-digit Display Messages**

| Device Condition                     | Display Digit   | Priority (lower is higher) |
|--------------------------------------|-----------------|----------------------------|
| IP address (always active)           | xxx.xxx.xxx.xxx | 4                          |
| Executing device self-test           | -08-            |                            |
| Waiting for connection to controller | -00-            |                            |
| Configuring device attributes        | -01-            |                            |
| Waiting for group synchronization    | -02-            |                            |
| Waiting for DC Bus to charge         | -03-            |                            |
| Device is operational                | -04-            |                            |
| Start inhibit code                   | Sxx             | 3                          |
| Start inhibit code - custom          | Scxx            |                            |
| Axis fault code                      | Fxx             | 2                          |
| Axis fault code - custom             | Fcxx            |                            |
| Boot error                           | Lxxx            | 1                          |
| Power on Self Test (POST) error      | Pxxx            |                            |
| Initialization fault code - custom   | Icxx            |                            |
| Node fault code                      | nFxx            | 1                          |



## Error Codes

The following list helps you resolve memory anomalies.

When a fault is detected, the status indicator displays an E and a two-digit error code until the anomaly is cleared.

| Error Code | Anomaly              | Possible Cause                                       | Action/Solution   |
|------------|----------------------|--|---|
| E38        | Memory module error. | Bad memory module.                                   | Replace memory module.  |
| E76        | Blank memory module. | A Blank MEM module has been inserted into the drive. | Push and hold the drive's enter key (bottom most red button) on the drive's front display until the drive shows "bUSY". This will make the drive format the blank memory module for usage with the drive. |

## Fault Codes

These fault code tables are designed to help you resolve anomalies. When a fault is detected, the four-digit status indicator scrolls the display message. This is repeated until the fault code is cleared.

**Table 42 - Fault Code Summary**

| Fault Code Type | Description  |
|-----------------|--|
| Sxx             | Conditions that prevent the drive from enabling, see <a href="#">Table 43</a> .  |
| Scxx            |  |
| Fxx             | Standard axis fault, see <a href="#">Table 44</a> and <a href="#">Table 45</a> .   |
| Fcxx            |  |
| Lxxx            | Unrecoverable errors that occur during the boot process. Return drive to Rockwell Automation.  |
| Pxxx            | Unrecoverable errors that occurred during the Power on Self Test (POST). Return drive to Rockwell Automation.                                  |
| lcxx            | Anomalies that prevent normal operation and occur during the initialization process.   |
| nFxx            | Anomalies that prevent normal operation of the drive. Node Fault. This type of fault that impacts the servo drive not just the axis of motion. |

**Table 43 - Sxx and Scxx Start Inhibit Codes**

| Four-digit Display | RSLogix 5000 Fault Message | Problem or Symptom                    | Potential Cause                  | Possible Resolution  |
|--------------------|----------------------------|---------------------------------------|----------------------------------|--|
| S 01               | Axis enable input.         | The axis enable input is deactivated. | Axis Enable Input is not active. | <ul style="list-style-type: none"> <li>Check wiring and 24V source for drive ENABLE Input.</li> <li>Disable enableInputChecking attribute by using a message instruction.</li> </ul> |

**Table 43 - Sxx and Scxx Start Inhibit Codes**

| Four-digit Display | RSLogix 5000 Fault Message | Problem or Symptom  | Potential Cause                                       | Possible Resolution  |
|--------------------|----------------------------|---|---|--|
| S 02               | Motor not configured.      | The associated motor has not been configured for use.   | Faulty intelligent encoder or incorrect motor file.   | <ul style="list-style-type: none"> <li>• Cycle power or reset the drive.</li> <li>• Check proper motor has been selected in Logix Designer Application.</li> <li>• Replace motor if faulting continues.</li> </ul> |
| S 03               | Feedback not configured.   | The associated feedback device has not been configured for use or the configuration does not match what is connected. |   |  |
| Sc05               | Safe torque off.           | No power or safety circuitry not configured.  | The safety function has disabled the power structure. | <ul style="list-style-type: none"> <li>• Apply 24V sources to safety circuit.</li> <li>• Use jumpers to bypass safety circuit.</li> </ul>  |

**Table 44 - Fxx Fault Codes**

| Four-digit Display | RSLogix 5000 Fault Message | Problem or Symptom   | Potential Cause  | Possible Resolution   |
|--------------------|----------------------------|--|--|---|
| F 02               | Illegal Hall State         | State of Hall feedback inputs is incorrect.  | Improper connections.  | <ul style="list-style-type: none"> <li>• Check wiring of S1,S2, and S3</li> <li>• Check the power supply to the encoder.</li> </ul>   |
| F 03               | Motor Overspeed            | Motor speed has exceeded 125% of maximum rated speed.  |  | <ul style="list-style-type: none"> <li>• Check motor wire phasing.</li> <li>• Check cables for noise.</li> <li>• Check tuning.</li> </ul>   |
| F 05               | Motor Overtemperature      | The motor thermostat, motor thermistor, or encoder temperature sensor indicates that the motor factory temperature limit has been exceeded.    | High motor ambient temperature and/or Excessive Current.                                     | <ul style="list-style-type: none"> <li>• Check motor wiring at motor feedback (MF) connector.</li> <li>• Check TS+ and COM wiring.</li> <li>• Operate within (not above) the continuous torque rating for the ambient temperature.</li> <li>• Lower ambient temperature or increase motor cooling.</li> <li>• Verify the proper motor has been selected.</li> </ul>                             |
| F 07               | Motor Thermal Protection   | The thermal model for the motor indicates that the temperature has exceeded 110% of its rating.  | The machine duty cycle requires an RMS current exceeding the continuous rating of the motor. | Change the command profile to reduce speed or increase time.  |
| F 10               | Inverter Overcurrent       | The drive fault output indicates that the power transistors were turned off because of overcurrent, overtemperature, or power supply problems. | Motor cables shorted.  | Verify continuity of motor power cable and connector.   |
|                    |                            |  | Motor winding shorted internally.  | Disconnect motor power cables from the motor. Use multimeter to check that the resistance of phase-to-phase is not open and that phase-to-ground is open.   |
|                    |                            |  | The drive temperature is too high.   | <ul style="list-style-type: none"> <li>• Check for clogged vents or defective fan.</li> <li>• Make sure cooling is not restricted by insufficient space around the unit.</li> <li>• Verify ambient temperature is within the specification. See Kinetix 350 Drive Power Specifications in Kinetix Servo Drives Specifications Technical Data, publication <a href="#">GMC-TD003</a>.</li> </ul> |
|                    |                            |  | Operation above continuous power rating and/or product environmental ratings.                | <ul style="list-style-type: none"> <li>• Operate within the continuous power rating.</li> <li>• Reduce acceleration rates.</li> </ul>   |
|                    |                            |  | The drive has a short circuit, overcurrent, or failed component.                             | Remove all power and motor connections, and perform a continuity check from the DC bus to the U, V, and W motor outputs. If a continuity exists, check for wire fibers between terminals, or send drive in for repair.  |
|                    |                            |  | Loss of TTL signal   | Check AM+, AM-, BM+, and BM-signals.  |

**Table 44 - F.xx Fault Codes (continued)**

| Four-digit Display | RSLogix 5000 Fault Message                                   | Problem or Symptom  | Potential Cause  | Possible Resolution  |
|--------------------|--|---|--|--|
| F 11               | Inverter Overtemperature                                     | Inverter thermal switch tripped.  | Drive fan failed.  | Replace the failed drive.  |
|                    |  |   | The cabinet ambient temperature is above rating.   | Check the cabinet temperature. See Kinetix 350 Drive Power Specifications in Kinetix Servo Drives Specifications Technical Data, publication <a href="#">GMC-TD003</a>   |
|                    |  |   | The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.  | Change the command profile to reduce speed or increase time.   |
|                    |  |   | The airflow access to the drive system is limited or blocked.  | Check airflow and re-route cables away from the drive system.  |
| F 13               | Inverter Thermal Protection                                  | The thermal model for the power transistors indicates that the temperature has exceeded 110% of its rating.   | The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.  | Change the command profile to reduce speed or increase time.   |
|                    |  |   | Motor brake on.  | Turn motor brake off.  |
| F 33               | Bus Undervoltage   | With three-phase power present, the DC bus voltage is below limits.   | DC bus voltage for 460V system is below 275V.<br>DC bus voltage for 230V system is below 137V.<br>DC bus voltage for 120V system is below 80V  | <ul style="list-style-type: none"> <li>Verify voltage level of the incoming AC power.</li> <li>Check AC power source for glitches or line drop.</li> <li>Install an uninterruptible power supply (UPS) on your AC input.</li> </ul>  |
| F 35               | Bus Overvoltage  | The DC bus voltage is measured above a factory limit.   | Excessive regeneration of power.   | Change the deceleration or motion profile.   |
|                    |  |   | When the motor is driven by an external mechanical power source, it can regenerate too much peak energy through the drive power supply. The system faults to save itself from an overload. | Use a larger system (motor and drive).   |
|                    |  |   | DC bus voltage for 460V system is over 820V.   | Install shunt resistor.  |
| F 43               | Feedback Loss  | <ul style="list-style-type: none"> <li>On sin/cos encoders, the sum of the square of the sin/cos signals has been measured below a factory limit.</li> <li>On TTL encoders, the absolute value of the differential A/B signals is below a factory limit.</li> </ul> | The motor feedback wiring is open, shorted, or missing.  | <ul style="list-style-type: none"> <li>Check motor encoder wiring.</li> <li>Run Hookup test in RSLogix 5000 software.</li> </ul>   |
| F 45               | Feedback Serial Comms (only TL-Series motors and actuators ) | The number of consecutive missed or corrupted serial data packets from the feedback device has exceeded a factory set limit.  | Communication was not established with an intelligent encoder.   | <ul style="list-style-type: none"> <li>Verify motor selection.</li> <li>Verify motor encoder wiring.</li> </ul>  |
| F 47               | Feedback Self Test   | The feedback device has detected an internal error.   | Damage to feedback device.   | Call your Rockwell Automation sales representative to return motor for repair.   |
| F 50               | Hardware Overtravel - Positive                               | Axis moved beyond the physical travel limits in the positive direction.   | Dedicated overtravel input is inactive.  | <ul style="list-style-type: none"> <li>Check wiring.</li> <li>Verify motion profile.</li> <li>Verify axis configuration in software.</li> </ul>  |
| F 51               | Hardware Overtravel - Negative                               | Axis moved beyond the physical travel limits in the negative direction.   |  |  |
| F 54               | Excessive Position Error                                     | Position error limit was exceeded.  | Partial loss of feedback signals.  | Check all wiring at motor feedback (MF) connector.   |
|                    |  |   | Improperly sized drive or motor.   | Verify sizing of system.   |
|                    |  |   | Mechanical system out of specifications.   | <ul style="list-style-type: none"> <li>Increase the feed forward gain.</li> <li>Increase following error limit or time.</li> <li>Check position loop tuning.</li> <li>Verify mechanical integrity of system within specification limits.</li> <li>Check motor power wiring.</li> </ul> |

**Table 44 - F xx Fault Codes (continued)**

| Four-digit Display | RSLogix 5000 Fault Message     | Problem or Symptom  | Potential Cause   | Possible Resolution  |
|--------------------|--------------------------------|---|---|--|
| F 55               | Excessive Velocity Error       | Velocity Error value of the velocity control loop has exceeded the configured value for Velocity Error Tolerance.               | Partial loss of feedback signals.   | Check all wiring at motor feedback (MF) connector.   |
|                    |                                |   | Improperly sized drive or motor.  | <ul style="list-style-type: none"> <li>Increase velocity error limit or time.</li> <li>Check velocity loop tuning.</li> <li>Verify sizing of system.</li> </ul>  |
|                    |                                |   | Mechanical system out of specifications.  | <ul style="list-style-type: none"> <li>Increase velocity error limit or time.</li> <li>Check velocity loop tuning.</li> <li>Verify mechanical integrity of system within specification limits.</li> <li>Check motor power wiring.</li> <li>Reduce acceleration.</li> </ul> |
| F 56               | Overtorque Limit               | Motor torque has exceeded a user-programmable setting.  | <ul style="list-style-type: none"> <li>Overly aggressive motion profile.</li> <li>Mechanical binding.</li> </ul>  | <ul style="list-style-type: none"> <li>Verify motion profile.</li> <li>Verify Overtorque settings are appropriate.</li> <li>Verify sizing of system.</li> <li>Verify torque offset</li> </ul>  |
|                    |                                |   | Mechanical system out of specifications.  | Verify mechanical integrity of system within specification limits.   |
| F 57               | Undertorque Limit              | Motor torque has fallen below a user-programmable setting.  | <ul style="list-style-type: none"> <li>Improperly configured limit.</li> <li>Improperly configured motion.</li> <li>Improperly drive/motor sizing.</li> </ul> | <ul style="list-style-type: none"> <li>Verify motion profile.</li> <li>Verify Overtorque settings are appropriate.</li> <li>Verify sizing of system.</li> </ul>  |
|                    |                                |   | Mechanical system out of specifications.  | Verify mechanical integrity of system within specification limits.   |
| F 61               | Drive Enable Input             | The hardware enable input was deactivated while the drive was enabled. This is applicable when only drive enable input is used. | An attempt was made to enable the axis through software while the Drive Enable hardware input was inactive.   | <ul style="list-style-type: none"> <li>Check wiring of drive enable input.</li> <li>Check 24V source.</li> </ul>   |
|                    |                                |   | The Drive Enable input transitioned from active to inactive while the axis was enabled.   | Verify that Drive Enable hardware input is active whenever the drive is enabled through software.  |
| F 62               | Controller Initiated Exception | The controller has requested the drive to generate an exception.  | User configured software overtravel.  | <ul style="list-style-type: none"> <li>Move axis out of soft overtravel range.</li> <li>Clear soft overtravel fault.</li> <li>Check soft overtravel configuration.</li> <li>Consult controller documentation.</li> </ul>   |

**Table 45 - Fc xx Fault Codes**

| Four-digit Display | RSLogix 5000 Fault Message  | Problem or Symptom   | Potential Cause                          | Possible Resolution   |
|--------------------|---|--|--|---|
| Fc 02              | Motor Voltage Mismatch  | Motor voltage incompatible with drive voltage.   | Wrong motor connected to drive.          | Connect appropriate motor to drive.   |
| Fc 05              | Motor Encoder Battery Loss (applies to Bulletin TLY motors with B feedback) | The battery voltage on a battery-backed motor encoder is low enough such that a power loss has caused the absolute position to no longer be available. | Weak battery or poor battery connection. | <ul style="list-style-type: none"> <li>Replace battery.</li> <li>Check battery connection.</li> </ul> |
| Fc 06              | Motor Encoder Battery Low (applies to Bulletin TLY motors with B feedback)  | The battery voltage on a battery-backed motor encoder is low enough such that a power loss causes the absolute position to be lost.                    |  |   |
| Fc 14              | Excessive Current Feedback Offset   | Current in one or more phases has been lost or remains below a preset level.   |  | Replace the drive.  |
| Fc 26              | Runtime Drive Error   | The drive firmware encountered an unrecoverable runtime error.   |  | <ul style="list-style-type: none"> <li>Cycle control power.</li> <li>Replace drive.</li> </ul>        |

**Table 46 - Ic.xx Fault Codes**

| Four-digit Display | RSLogix 5000 Fault Message           | Problem or Symptom  | Potential Cause  | Possible Resolution   |
|--------------------|--------------------------------------|---|--|---|
| Ic 01              | Boot Block Check Sum Fault           | The motor data stored in a smart encoder has a checksum error.  | Faulty intelligent encoder.  | <ul style="list-style-type: none"> <li>• Cycle power or reset the drive.</li> <li>• Replace motor if faulting continues.</li> </ul>   |
| Ic 02              | Motor Data Range Error               | Data within a motor data blob is out of range.  | Faulty intelligent encoder or incorrect motor file.                                | <ul style="list-style-type: none"> <li>• Cycle power or reset the drive.</li> <li>• Check validity of the motion database.</li> <li>• Replace motor if faulting continues.</li> </ul> |
| Ic 03              | Motor Feedback Communication Startup | Communication with a smart encoder could not be established on the motor feedback port.   | Incorrect motor selected or connected.   | Check motor selection.  |
|                    |                                      |   | Faulty wiring.   | Check motor encoder wiring.   |
| Ic 06              | Motor Absolute Startup Speed         | The motor absolute encoder was not able to accurately determine the position after powerup due to motor speed greater than 100 rpm. | Mechanical movement of machine causing excessive rotation of motor during powerup. | Allow machine motion to stop before powerup.  |

Status messages of the format Lxxx indicate an unrecoverable error while starting the drive. Reload firmware and restart the drive, if status message repeats contact Rockwell Automation technical support to return drive for repair.

**Table 47 - Lxxx Fault Codes**

| Four-digit Display Message | Cause                                  |
|----------------------------|--|
| L001                       | Identity block corrupted               |
| L002                       | Firmware file load failed              |
| L004                       | Firmware not programmed (drive is new) |
| L008                       | DSP load operation failed              |

Status messages of the format Pxxx indicate an unrecoverable error during the Power on Self Test (POST). Contact Rockwell Automation technical support to return drive for repair.

**Table 48 - Pxxx Fault Codes**

| Four-digit Display Message | Cause                              |
|----------------------------|------------------------------------|
| P001                       | SDRAM test failed                  |
| P002                       | FPGA load operation failed         |
| P004                       | DPRAM Test failed                  |
| P005                       | DSP I/F to DPram - no DSP response |
| P006                       | I/F to DPram failed                |
| P007                       | Firmware file md5 test failure     |

**Table 49 - nF xx Fault Codes**

| Four-digit Display | RSLogix 5000 Fault Message | Problem or Symptom  | Potential Cause            | Possible Resolution  |
|--------------------|----------------------------|---|----------------------------|--|
| nF 01              | Control Update Fault       | Several consecutive updates from the controller have been lost.         | Excessive network traffic. | <ul style="list-style-type: none"> <li>Remove unnecessary network devices from the motion network.</li> <li>Change the network topology so that fewer devices share common paths.</li> <li>Use faster/higher performance network equipment.</li> </ul> |
|                    |                            |   | Noisy environment.         | <ul style="list-style-type: none"> <li>Segregate signal wiring from power wiring.</li> <li>Use shielded cables.</li> <li>Add snubbers to power devices.</li> </ul>   |
| nF 02              | Processor Watchdog Fault   | The watchdog circuit monitoring processor operation detected a problem. |                            | <ul style="list-style-type: none"> <li>Recycle control power or reset the drive.</li> <li>Replace control module if problem persists.</li> </ul>   |
| nF 03              | Hardware Fault             | The drive has an internal hardware problem.                             |                            | <ul style="list-style-type: none"> <li>Recycle control power or reset the drive.</li> <li>Replace drive.</li> </ul>  |
|                    |                            | Nonvolatile write or write to memory failed.                            | Faulty memory component.   | <ul style="list-style-type: none"> <li>Recycle control power or reset the drive.</li> <li>Replace drive if problem persists.</li> </ul>  |
| nF 04              | Data Format Error          | A data format error was discovered in the controller-to-drive message.  | Faulty memory component.   | <ul style="list-style-type: none"> <li>Recycle control power or reset the drive.</li> <li>Replace control module if problem persists.</li> </ul>   |

## Status Indicators

**Table 50 - Drive Status Indicator**

| Status                | Description   |
|-----------------------|---|
| Off                   | No power. Apply power.  |
| Alternating green/red | Self-test (power-up diagnostics). Wait for steady green.          |
| Flashing green        | Standby (device not configured). Wait for steady green.           |
| Steady green          | Normal operation, no faults.                                      |
| Flashing red          | Minor fault (recoverable). Refer to four-digit fault message.     |
| Steady red            | Major fault (non-recoverable). Refer to four-digit fault message. |

**Table 51 - Axis Status Indicator**

| Status                            | Description                 |
|-----------------------------------|-----------------------------|
| Off                               | Off                         |
| Flash red/green                   | Self test                   |
| Off                               | Initialization - bus not up |
| Flashing green                    | Initialization - bus up     |
| Off                               | Shutdown - bus not up       |
| Flashing amber <sup>(1)</sup>     | Shutdown - bus up           |
| Off                               | Pre-charge - bus not up     |
| Flashing amber <sup>(1)</sup>     | Start inhibit               |
| Flashing green <sup>(1) (2)</sup> | Stopped                     |
| Solid green <sup>(1) (2)</sup>    | Stopping                    |
|                                   | Starting                    |
|                                   | Running                     |
|                                   | Testing                     |
| Flashing red                      | Aborting                    |
|                                   | Major faulted               |
| Solid red                         | Aborting                    |
|                                   | Major faulted               |

(1) The axis and the drive define minor fault conditions. While a minor fault does not affect the drive status indicator, it does affect the axis status indicator. When a minor fault condition is detected, a normally solid green status indicator indication changes to alternating red-green-red-green, a normally flashing green status indicator indication changes to alternating red-off-green-off, and a normally flashing amber indications changes to red-off-amber-off.

(2) The drive also defines alarm conditions. When an alarm condition is detected, a normally solid green status indicator indication changes to alternating amber-green-amber green while a normally flashing green status indicator indication changes to alternating amber-off-green-off.

**Table 52 - Network Status Indicators**

| Status                | Description   |
|-----------------------|---|
| Off                   | No power or no IP address defined.                                |
| Alternating green/red | Self-test mode (power-up diagnostics).                            |
| Flashing green        | Standby (device not configured, or connection not established).   |
| Steady green          | Normal operation. Device has at least one established connection. |
| Flashing red          | Recoverable minor fault or connection timeout.                    |
| Steady red            | Non-recoverable major fault or duplicate IP address.              |

---

**IMPORTANT** Under some fault conditions, two reset commands can be required to clear drive.

---

**Table 53 - Port 1 Ethernet Communication Status Indicators**

| Status         | Description                                       |
|----------------|---|
| Off            | No link partner present.                          |
| Flashing green | Link partner present, communication occurring.    |
| Steady green   | Link partner present, no communication occurring. |



## General System Behavior

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

**Table 54 - General System Behavior**

| Condition  | Potential Cause  | Possible Resolution  |
|--|--|--|
| Axis or system is unstable.  | The position feedback device is incorrect or open.   | Check wiring.  |
|  | Unintentionally in Torque mode.  | Check to see what primary operation mode was programmed.   |
|  | Motor tuning limits are set too high.  | Run Tune in RSLogix 5000 software.   |
|  | Position loop gain or position controller accel/decel rate is improperly set.  | Run Tune in RSLogix 5000 software.   |
|  | Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.  | Check wiring and ground.   |
|  | Motor Select limit is incorrectly set (servo motor is not matched to axis module).   | <ul style="list-style-type: none"> <li>Check setups.</li> <li>Run Tune in RSLogix 5000 software.</li> </ul>  |
|  | Mechanical resonance.  | Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in RSLogix 5000 software).  |
| You cannot obtain the motor acceleration/deceleration that you want. | Torque Limit limits are set too low.   | Verify that current limits are set properly.   |
|  | Incorrect motor selected in configuration.   | Select the correct motor and run Tune in Logix Designer Application again.   |
|  | The system inertia is excessive.   | <ul style="list-style-type: none"> <li>Check motor size versus application need.</li> <li>Review servo system sizing.</li> </ul>   |
|  | The system friction torque is excessive.   | Check motor size versus application need.  |
|  | Available current is insufficient to supply the correct accel/decel rate.  | <ul style="list-style-type: none"> <li>Check motor size versus application need.</li> <li>Review servo system sizing.</li> </ul>   |
|  | Acceleration limit is incorrect.   | Verify limit settings and correct them, as necessary.  |
|  | Velocity Limit limits are incorrect.   | Verify limit settings and correct them, as necessary.  |
| Motor does not respond to a velocity command.                        | The axis cannot be enabled for 1.5 seconds after disabling.  | Disable the axis, wait for 1.5 seconds, and enable the axis.   |
|  | Enable signal has not been applied or the enable wiring is incorrect.  | <ul style="list-style-type: none"> <li>Check the controller.</li> <li>Check the wiring.</li> </ul>   |
|  | The motor wiring is open.  | Check the wiring.  |
|  | The motor thermal switch has tripped.  | <ul style="list-style-type: none"> <li>Check for a fault.</li> <li>Check the wiring.</li> </ul>  |
|  | The motor has malfunctioned.   | Repair or replace the motor.   |
|  | The coupling between motor and machine has broken (for example, the motor moves, but the load/machine does not).   | Check and correct the mechanics.   |
|  | Primary operation mode is set incorrectly.   | Check and properly set the limit.  |
|  | Velocity or current limits are set incorrectly.  | Check and properly set the limits.   |
| Presence of noise on command or motor feedback signal wires.         | Recommended grounding per installation instructions have not been followed.  | <ul style="list-style-type: none"> <li>Verify grounding.</li> <li>Route wire away from noise sources.</li> <li>Refer to System Design for Control of Electrical Noise, publication <a href="#">GMC-RM001</a>.</li> </ul> |
|  | Line frequency can be present.   | <ul style="list-style-type: none"> <li>Verify grounding.</li> <li>Route wire away from noise sources.</li> </ul>   |
|  | Variable frequency can be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls, and so forth. The frequency can be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance. | <ul style="list-style-type: none"> <li>Decouple the motor for verification.</li> <li>Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism.</li> </ul>                               |

**Table 54 - General System Behavior**

| Condition   | Potential Cause   | Possible Resolution   |
|---|---|---|
| No rotation   | The motor connections are loose or open.                                  | Check motor wiring and connections.   |
|   | Foreign matter is lodged in the motor.                                    | Remove foreign matter.  |
|   | The motor load is excessive.  | Verify the servo system sizing.   |
|   | The bearings are worn.  | Return the motor for repair.  |
|   | The motor brake is engaged (if supplied).                                 | <ul style="list-style-type: none"> <li>• Check brake wiring and function.</li> <li>• Return the motor for repair.</li> </ul>              |
|   | The motor is not connect to the load.                                     | Check coupling.   |
| Motor overheating   | The duty cycle is excessive.  | Change the command profile to reduce accel/decel or increase time.  |
|   | The rotor is partially demagnetized causing excessive motor current.      | Return the motor for repair.  |
| Abnormal noise  | Motor tuning limits are set too high.                                     | Run Tune in RSLogix 5000 software.  |
|   | Loose parts are present in the motor.                                     | <ul style="list-style-type: none"> <li>• Remove the loose parts.</li> <li>• Return motor for repair.</li> <li>• Replace motor.</li> </ul> |
|   | 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 RSLogix 5000 software).                                  |
| Erratic operation - Motor locks into position, runs without control or with reduced torque. | Motor power phases U and V, U and W, or V and W reversed.                 | Check and correct motor power wiring.   |
|   | Sine, cosine or rotor leads are reversed in the feedback cable connector. | Check and correct motor feedback wiring.  |
|   | Sine, cosine, rotor lead sets of resolver feedback are reversed.          | Check and correct motor feedback wiring.  |
| No motion from a motor with a TTL encoder, axis is enabled and there are no faults          | Sine and cosine signals are broken.                                       | Check feedback wiring.  |

## Logix5000 Controller and Drive Behavior

By using Logix Designer Application, you can configure how the Bulletin 2097 drives respond when a drive fault/exception occurs.

**TIP** The lxx faults are always generated after powerup, but before the drive is enabled, so the stopping behavior does not apply.

### Kinetix 350 Drive Exception Behavior

For Kinetix 350 drives, you can configure exception behavior in RSLogix 5000 software from the Axis Properties dialog box, Actions category.

**Table 55 - Kinetix 350 Drive 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 | 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, 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, Fault Status Only is not an available option.  |
| Stop Planner      | The controller sets the associated bit in the Motion Fault Status word and instructs the Motion Planner to perform a controlled stop of all planned motion at the configured maximum deceleration rate. An explicit Fault Reset is required to clear the fault once the exceptional condition has cleared. If the exception is so fundamental to the drive, Stop Planner is not an available option. |
| Stop Drive        | When the exception occurs, the associated bit in the Fault Status word is set and the axis comes to a stop by using the stopping action defined by the drive for the particular exception that occurred. There is no controller based configuration to specify what the stopping action is, the stopping action is device dependent.   |
| Shutdown          | When the exception occurs, the drive brings the motor to a stop by using the stopping action defined by the drive (as in Stop Drive) and the power module is disabled. Optionally, if the Shutdown Action attribute is configured for Drop DC Bus, the contactor opens. An explicit Shutdown Reset is required to restore the drive to operation.  |

Only selected drives faults can be configured. In the [Drive Behavior, F xx Fault Codes](#) tables, the controlling attribute is given for programmable fault actions.

Figure 50 - RSLogix 5000 Axis Properties - Actions Category

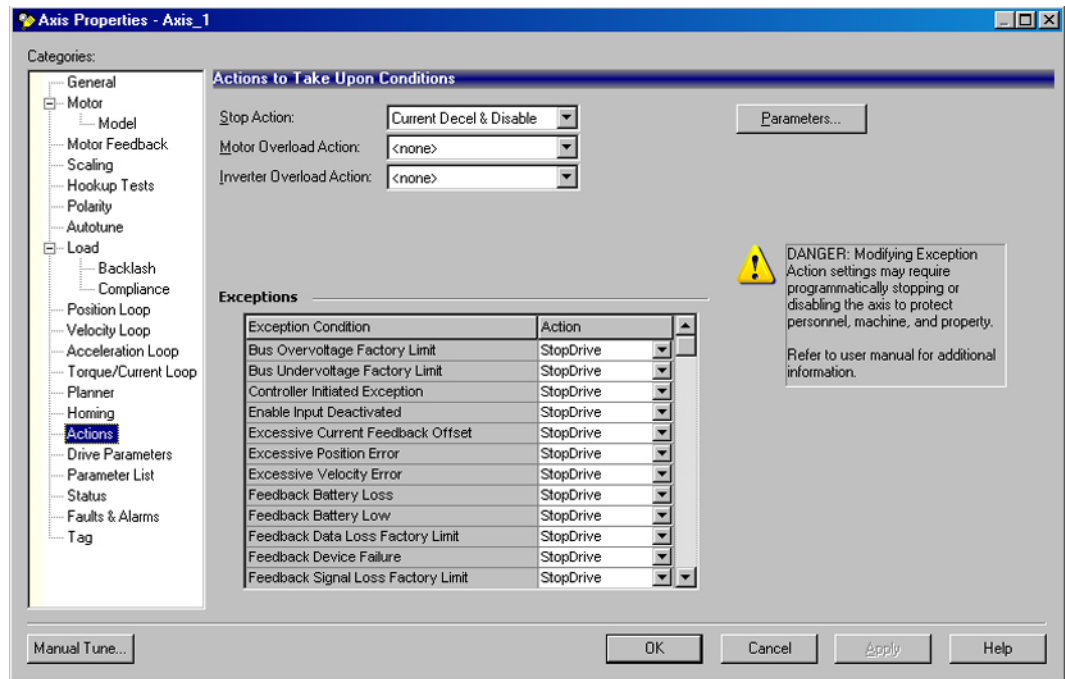


Table 56 - Drive Behavior, F xx Fault Codes

| Four-digit Display | Exception                 | Description  | Best Stopping Method (only major fault) |
|--------------------|---------------------------|--|---|
| F 02               | Motor Commutation         | Permanent magnet motor commutation problem detected. For example illegal state 111 or 000 for a UVW commutation device. This exception is supported for only TTL motors with Hall sensors.   | Disable/Coast                           |
| F 03               | Motor Overspeed           | Motor speed has exceeded its maximum limit given by the Motor Overspeed Factory Limit attribute associated with the motor type. This exception triggers when either the electrical frequency exceeds 500 Hz or the motor is command to go 125% of its max rated speed. | Disable/Coast                           |
| F 05               | Motor Overtemperature     | Motor temperature has exceeded its factory set temperature limit given by Motor Overtemperature Factory Limit, or the integral motor thermal switch has tripped.   | Disable/Coast                           |
| F 07               | Motor Thermal Overload    | Motor thermal model has exceeded its factory set thermal capacity limit given by Motor Thermal Overload Factory Limit. This limit is 108 °C (226 °F) for the Kinetix 350 drive.  | Decel/Disable                           |
| F 10               | Inverter Overcurrent      | Inverter current has exceeded the factory set peak or instantaneous current limit. This limit is set to 450% of the rated drive current for a single phase.  | Disable/Coast                           |
| F 11               | Inverter Overtemperature  | Inverter temperature has exceeded its factory set temperature limit given by Inverter Overtemperature Factory Limit. Detected when an internal temperature sensor senses 108 °C (226 °F).  | Disable/Coast                           |
| F 13               | Inverter Thermal Overload | Inverter thermal model has exceeded its factory set thermal capacity limit given by Inverter Thermal Overload Factory Limit. This threshold is set to 108 °C (226 °F).   | Disable/Coast                           |
| F 33               | Bus Undervoltage          | DC Bus voltage level is below the factory set limit given by Bus Undervoltage Factory Limit. This limit is set at 75% of the nominal voltage as determined on powerup.   | Decel/Disable                           |
| F 35               | Bus Overvoltage           | DC Bus voltage level is above the factory set limit given by Bus Overvoltage Factory Limit. For 240V drives the limit is 420V. For 480V drives, the limit is 840V.   | Disable/Coast                           |

**Table 56 - Drive Behavior, F xx Fault Codes (continued)**

| Four-digit Display  | Exception                      | Description   | Best Stopping Method (only major fault) |
|---------------------|--------------------------------|---|---|
| F 43 <sup>(1)</sup> | Feedback Signal Loss           | One or more A/B channel signals from a feedback device are open, shorted, missing, or severely attenuated. Specifically, the detected voltage levels of the signals are below the Feedback Signal Loss Factory Limit. The offending feedback channel is encoded in the associated Fault/Alarm Sub Code. | Disable/Coast                           |
| F 45                | Feedback Data Loss             | The number of consecutive missed or corrupted serial data packets over the serial data channel from a feedback device has exceeded the Feedback Data Loss Factory Limit. The offending feedback channel is encoded in the associated Fault/Alarm Sub Code. The threshold is set at four misses.         | Disable/Coast                           |
| F 47                | Feedback Device Failure        | The feedback device has detected an internal error. Stegmann encoders return an error code and Tamagawa encoders have an error flag.  | Disable/Coast                           |
| F 50                | Hardware Overtravel Positive   | Axis moved beyond the physical travel limits in the positive direction and activated the Positive Overtravel limit switch.  | Decel/Disable                           |
| F 51                | Hardware Overtravel Negative   | Axis moved beyond the physical travel limits in the negative direction and activated the Negative Overtravel limit switch.  | Decel/Disable                           |
| F 54 <sup>(1)</sup> | Excessive Position Error       | The Position Error value of the position control loop has exceeded the configured value for Position Error Tolerance.   | Decel/Disable                           |
| F 55 <sup>(1)</sup> | Excessive Velocity Error       | The Velocity Error value of the velocity control loop has exceeded the configured value for Velocity Error Tolerance.   | Decel/Disable                           |
| F 56                | Overtorque Limit               | Motor torque has risen above user defined maximum torque level given by Overtorque Limit.   | Decel/Disable                           |
| F 57                | Undertorque Limit              | Motor torque has dropped below user defined minimum torque level given by Undertorque Limit.  | Decel/Disable                           |
| F 61                | Enable Input Deactivated       | Enable has been deactivated while the axis is in Running state.   | Decel/Disable                           |
| F 62                | Controller Initiated Exception | Exception generated specifically by controller.   | Disable/Coast                           |

(1) When a TTL encoder loses its A/B signals it is not detected directly. Instead a secondary fault to detect the condition, typically excessive position or velocity error. In this case the motor coasts to a stop, but is still be enabled in Logix Designer application.

---

**IMPORTANT** The fault detection ability of TTL encoders is not as advanced as with Stegmann hipiface or Tamagawa 17-bit serial encoders. When a TTL encoder loses its A/B signals, the Kinetix 350 drive is unable to detect this directly. Instead it relies on a secondary fault to detect the condition, typically excessive position or velocity error. There are some cases, particularly in Torque mode where the fault isn't detected at all. In this case the motor coasts to a stop, but is still be enabled in Logix Designer application.

---

**Table 57 - Drive Behavior, Fcxx Custom Fault Codes**

| Four-digit Display | Exception              | Description   | Best Stopping Method (only Major Fault) |
|--------------------|------------------------|---|---|
| Fc02               | Motor Voltage Mismatch | The motor voltage is incompatible with the applied drive voltage.   | Disable/Coast                           |
| Fc05               | Feedback Battery Loss  | The battery voltage on a battery-backed motor encoder is low enough such that absolute position is not longer available. This occurs when the battery is too low and encoder main power has been removed. | Decel/Disable                           |
| Fc06               | Feedback Battery Low   | The battery voltage on a battery-backed motor encoder is below a caution level. This occurs when the battery is too low, but main power has not yet been removed.   | Decel/Disable                           |

**Table 57 - Drive Behavior, Fc<sub>xx</sub> Custom Fault Codes**

| Four-digit Display | Exception                         | Description  | Best Stopping Method (only Major Fault) |
|--------------------|-----------------------------------|--|---|
| Fc14               | Excessive Current Feedback Offset | Current in one or more phases has been lost or remains below a preset level. | Disable/Coast                           |
| Fc26               | Runtime Error                     | Runtime Assertions detected.   | Disable/Coast                           |
| Fc63               | Product Specific                  | Product Specific (exotic) exceptions by Sub Code.                            | Disable/Coast                           |

A node fault is a fault that impacts the whole drive.

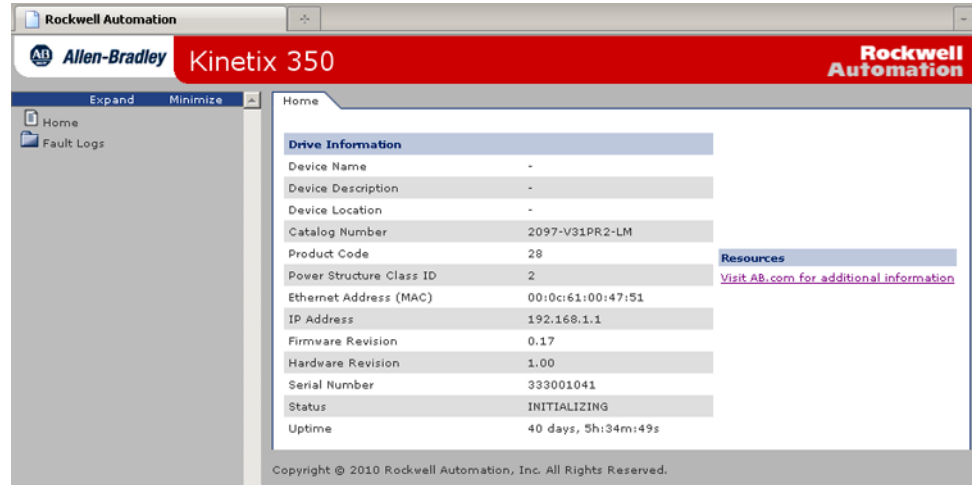
**Table 58 - Drive Behavior, nF<sub>xx</sub> Node Fault Codes**

| Four-digit Display | Name                            | Description   | Best Stopping Method |
|--------------------|---------------------------------|---|----------------------|
| nF01               | Control Connection Update Fault | The Control Connection Update Fault code is used to indicate that updates from the controller over the controller to drive connection have been excessively late as determined by the Controller Update Delay High Limit attribute value. | Disable/Coast        |
| nF02               | Processor Watchdog Fault        | The Processor Watchdog Fault code indicates that the processor associated with the device node has experienced an excessive overload condition that has tripped the associated processor watchdog mechanism.                              | Disable/Coast        |
| nF03               | Hardware Fault                  | The Hardware Fault code indicates that the critical support hardware such as the FPGA or ASIC associated with the device node has experienced a fault condition. This occurs when the EPM module has been removed.                        | Disable/Coast        |
| nF04               | Data Format Error               | This fault code indicates that an error has occurred in the data format between the controller and the device, such as a Format Revision mismatch.  | Disable/Coast        |
| nF06               | Control Connection Loss Fault   | The Control Connection Loss fault code indicates that the Motion controller to drive connection from the controller has timed out.  | Disable/Coast        |

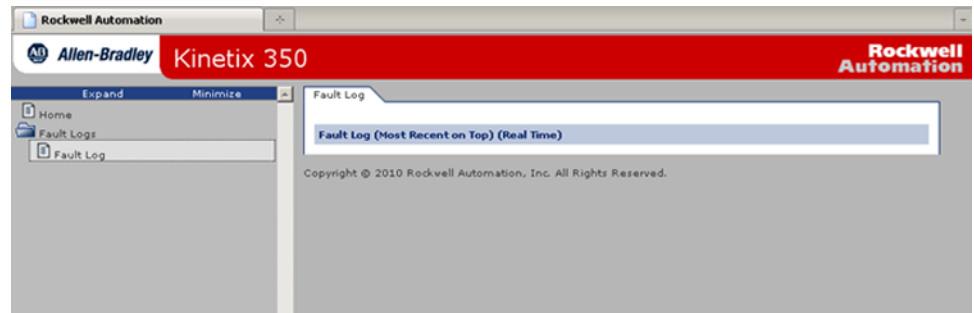
## Web Server Interface

The Kinetix 350 drive supports a basic web interface for common status reporting and network configuration attributes. No attributes are configurable from this page. To access the page open a web browsers program and enter the IP address of the drive.

**Figure 51 - Main Page**



**Figure 52 - Fault Page**



**Notes:**



## Interconnect Diagrams

| <b>Topic</b>                                   | <b>Page</b> |
|--|-------------|
| Interconnect Diagram Notes                     | 130         |
| Power Wiring Examples                          | 131         |
| Kinetix 350 Drive/Rotary Motor Wiring Examples | 134         |
| Kinetix 350 Drive/Actuator Wiring Examples     | 136         |
| Motor Brake Currents                           | 139         |
| System Block Diagrams                          | 140         |

## Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 350 system. The notes below apply to the wiring examples on the pages that follow.

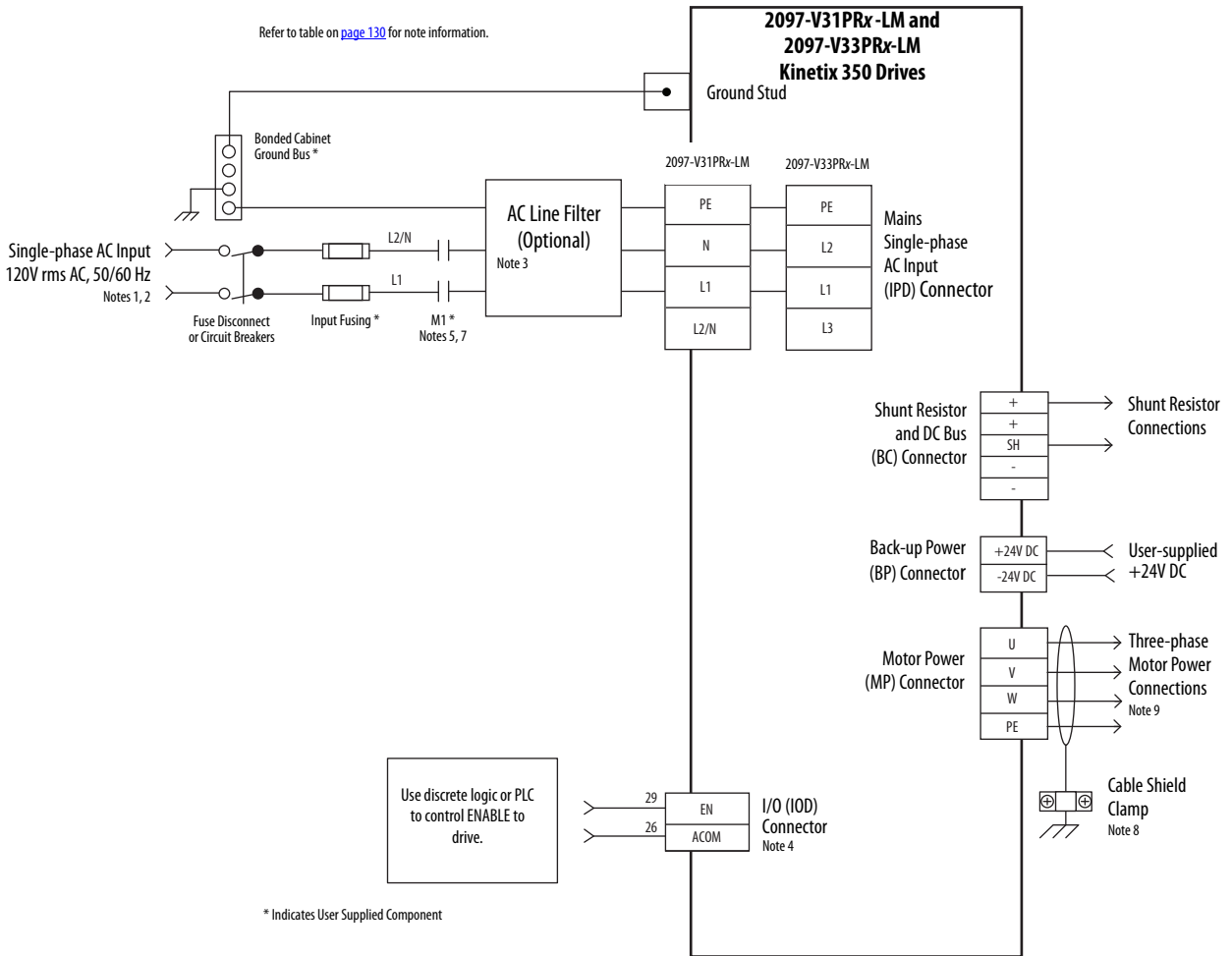
| Note | Information  |
|------|--|
| 1    | For power wiring specifications, refer to <a href="#">Power Wiring Requirements</a> on <a href="#">page 59</a> .   |
| 2    | For input fuse and circuit breaker sizes, refer to <a href="#">Circuit Breaker/Fuse Specifications</a> on <a href="#">20</a> .   |
| 3    | Place the AC (EMC) line filters as close to the drive as possible and do not route very dirty wires in the 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 350 Drive Power Specifications in Kinetix Servo Drives Specifications Technical Data, publication <a href="#">GMC-TD003</a> . This filter does not apply to 2097-V32PRx-LM drives because they have integrated AC line filters. |
| 4    | Terminal block is required to make connections.  |
| 5    | Contactors coil (M1) needs integrated surge suppressors for AC coil operation. Refer to <a href="#">Contactor Ratings</a> on <a href="#">22</a> .  |
| 6    | Refer to the Motor Brake Currents table on <a href="#">page 139</a> to size the interposing relay for your application and for a detailed schematic of brake implementation.   |
| 7    | Drive Enable input must be opened when main power is removed, or a drive fault occurs. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.   |
| 8    | Cable shield clamp must be used to meet CE requirements. No external connection to ground is required.   |
| 9    | For motor cable specifications, refer to the Kinetix Motion Accessories Specifications Technical Data, publication <a href="#">GMC-TD004</a> .   |
| 10   | Motor power cables (catalog numbers 2090-XXNPMF-xxSxx and 2090-CPBM6DF-16AAxx) have a drain wire that must be folded back under the cable shield clamp.  |
| 11   | MPL-Axxx, MPM-Axxx, MPF-Axxx, MPS-Axxx, MPAR-Axxx, MPAL-Axxx, and MPAS-Axxx, encoders use the +5V DC supply. MPL-Bxxx, MPM-Bxxx, MPF-Bxxx, MPS-Bxxx, MPAR-Bxxx, MPAL-Bxxx, and MPAS-Bxxx, encoders use +9V DC.   |
| 12   | Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and GND or A, B, C, and D respectively.   |

## Power Wiring Examples

You must supply input power components. The single-phase and three-phase line filters are wired downstream of fusing and the M1 contactor.

In this example, the 2097-V31PRx-LM drives are wired to use the voltage doubling circuit. The 120V input voltage provides 240V output to motors. The 2097-V33PRx-LM drives are wired for single-phase 120V operation.

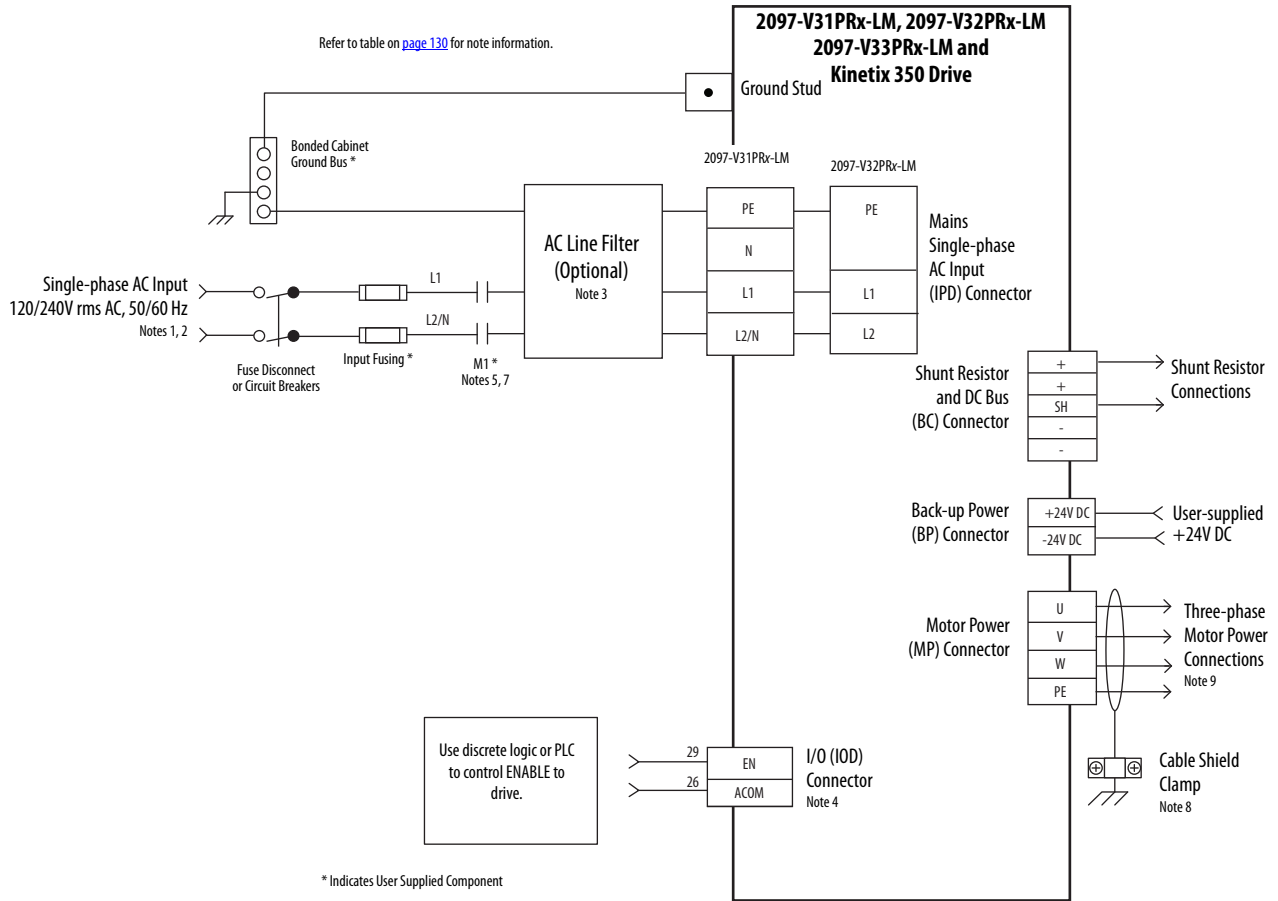
**Figure 53 - Kinetix 350 Drive (120V single-phase input power)**



In this example, single-phase 240V AC is applied to 2097-V31PRx-LM and 2097-V32PRx-LM drives.

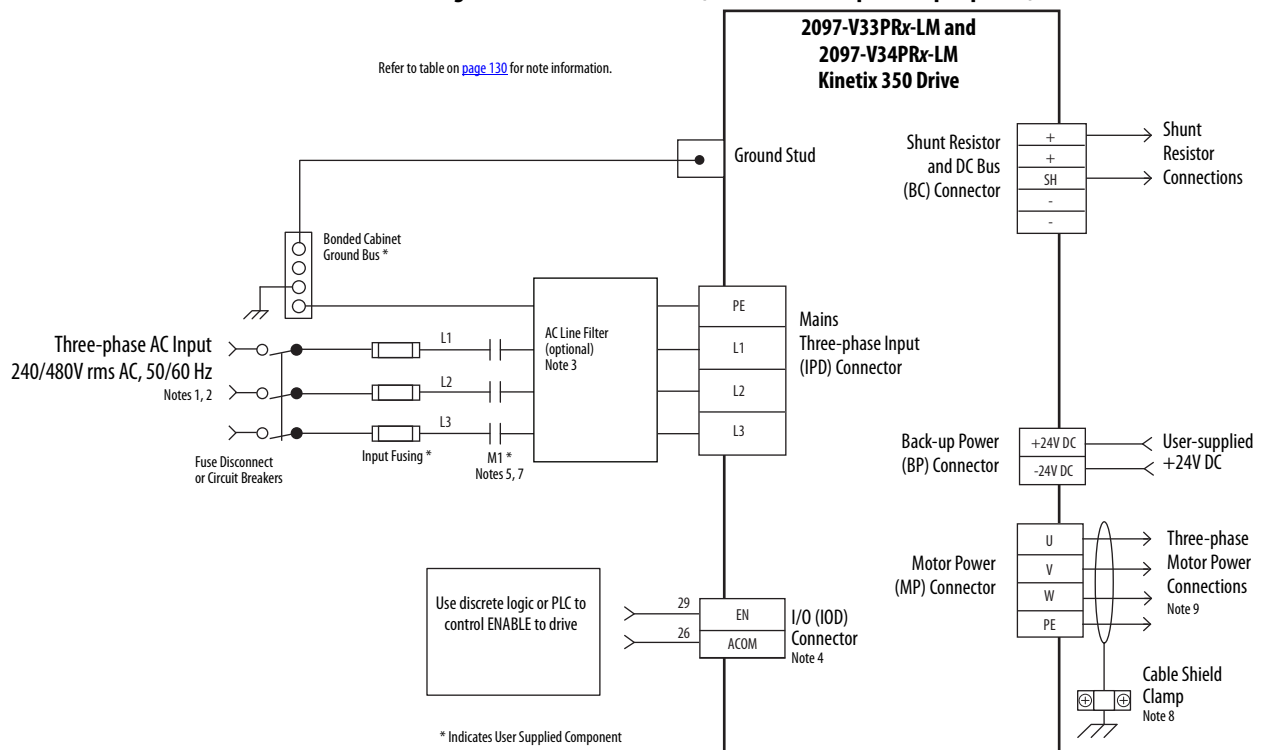
**IMPORTANT** The 2097-V32PRx-LM models have integrated AC line filters and do not require the AC line filter shown in this diagram.

**Figure 54 - Kinetix 350 Drives (240V single-phase input power)**



In this example, three-phase 240V AC is applied to 2097-V33PR *x*-LM drives and 480V AC is applied to 2097-V34PR *x*-LM drives.

**Figure 55 - Kinetix 350 Drive (240/480V three-phase input power)**

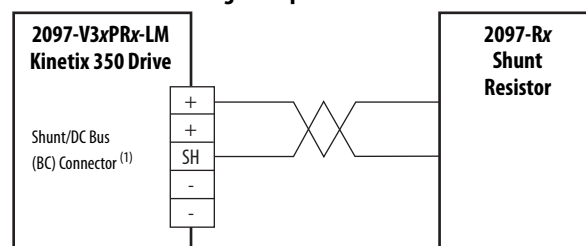


**IMPORTANT** For the 480V Kinetix 350 drives to meet ISO 13849-1 (PLd) spacing requirements, each phase voltage to ground must be less than or equal to 300V AC rms. This means that the power system must use center grounded wye secondary configuration for 400/480V AC mains.

## Shunt Resistor Wiring Example

Refer to the Kinetix 350 Drive Power Specifications in Kinetix Servo Drives Specifications Technical Data, publication [GMC-TD003](#) for the Bulletin 2097-Rx shunt resistors available for the Kinetix 350 drives. Refer to the Shunt Resistor Installation Instructions, publication [2097-IN002](#), for additional installation information.

**Figure 56 - Shunt Resistor Wiring Example**

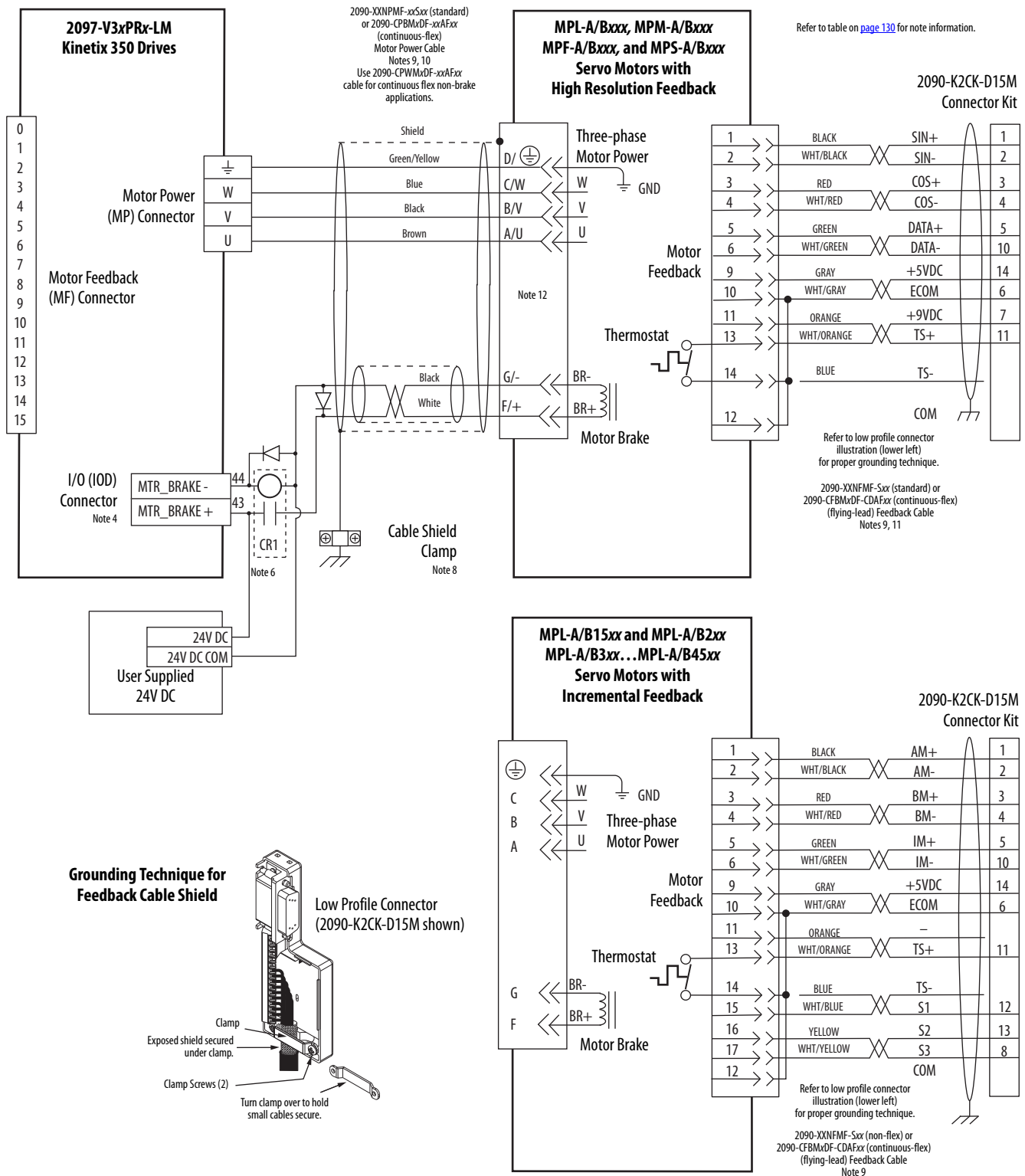


(1) This connector is for the shunt resistor, not the motor brake.

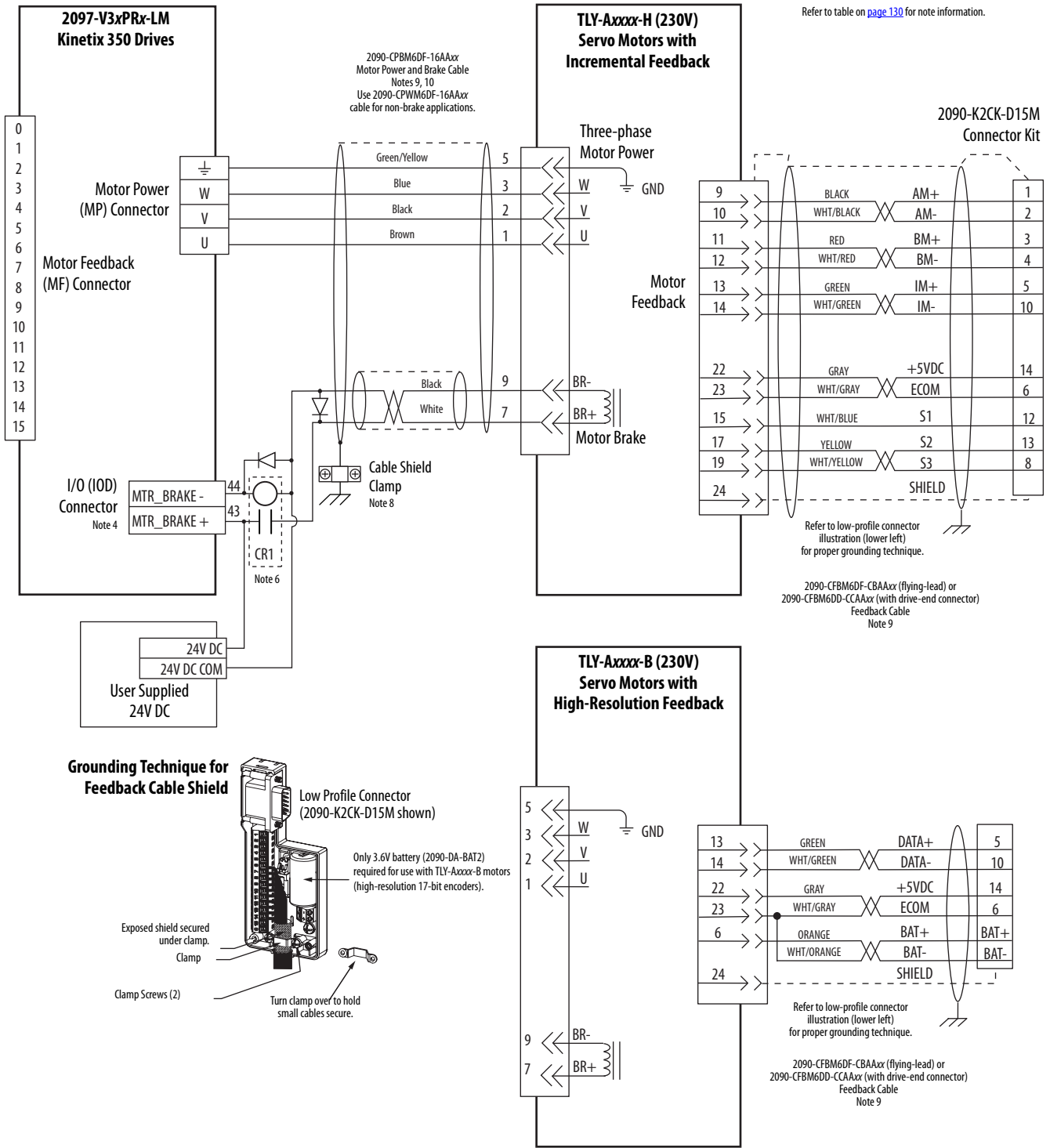
# Kinetix 350 Drive/Rotary Motor Wiring Examples

These wiring diagrams apply to Kinetix 350 drives with compatible rotary motors.

Figure 57 - MP-Series (Bulletin MPL, MPM, MPF, and MPS) Motors



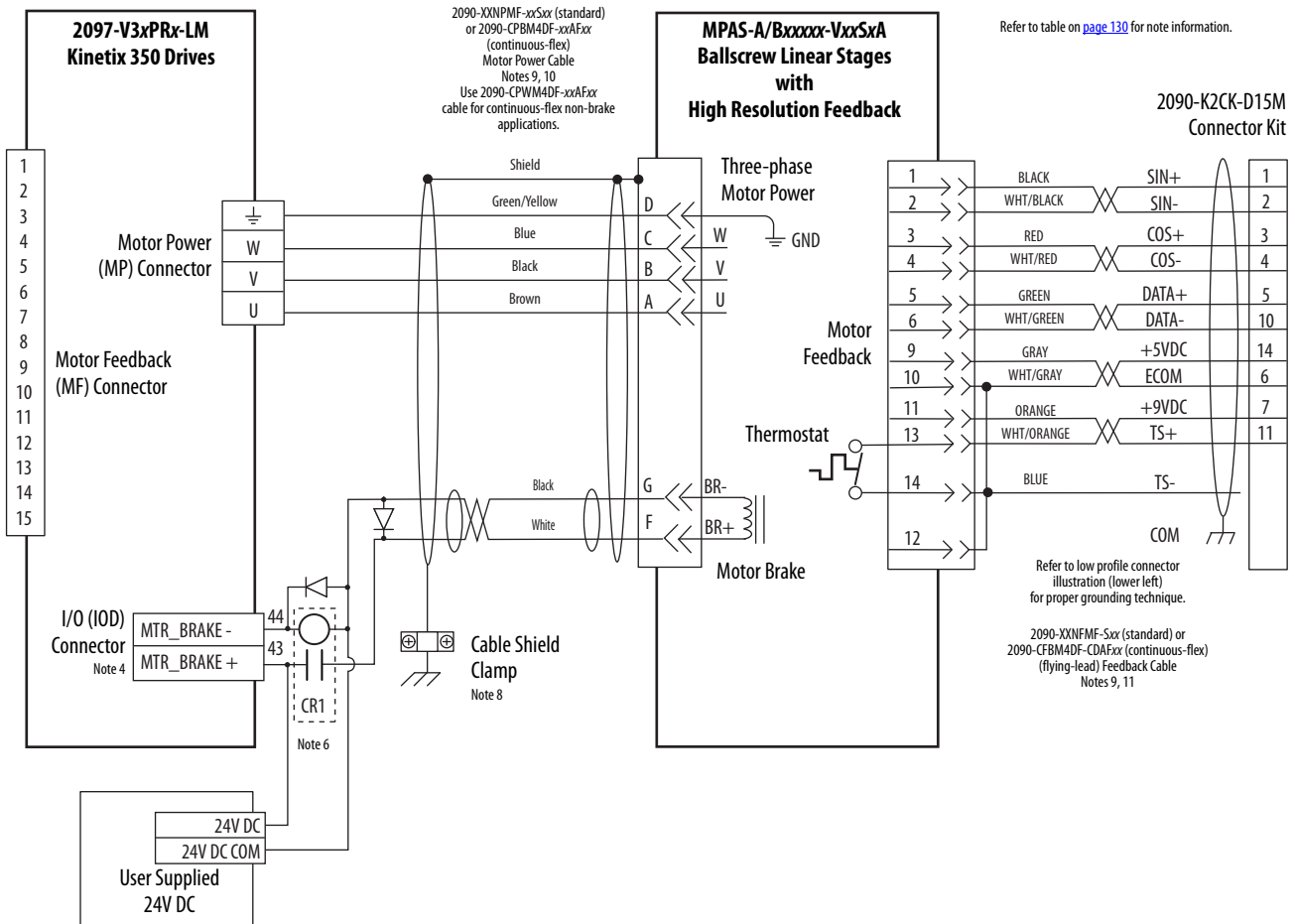
**Figure 58 - Kinetix 350 Drive with TL-Series (TLY-A) Motors**



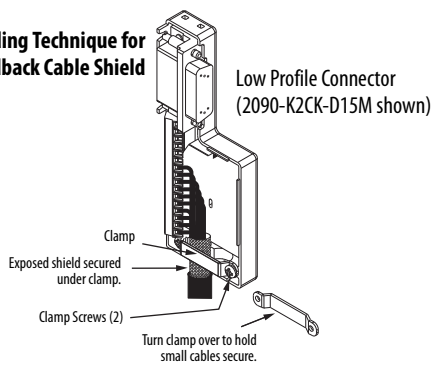
# Kinetix 350 Drive/Actuator Wiring Examples

These wiring diagrams apply to Kinetix 350 drives with compatible linear actuators.

**Figure 59 - Kinetix 350 Drive with MP-Series (Bulletin MPAS-A/B) Linear Stages**

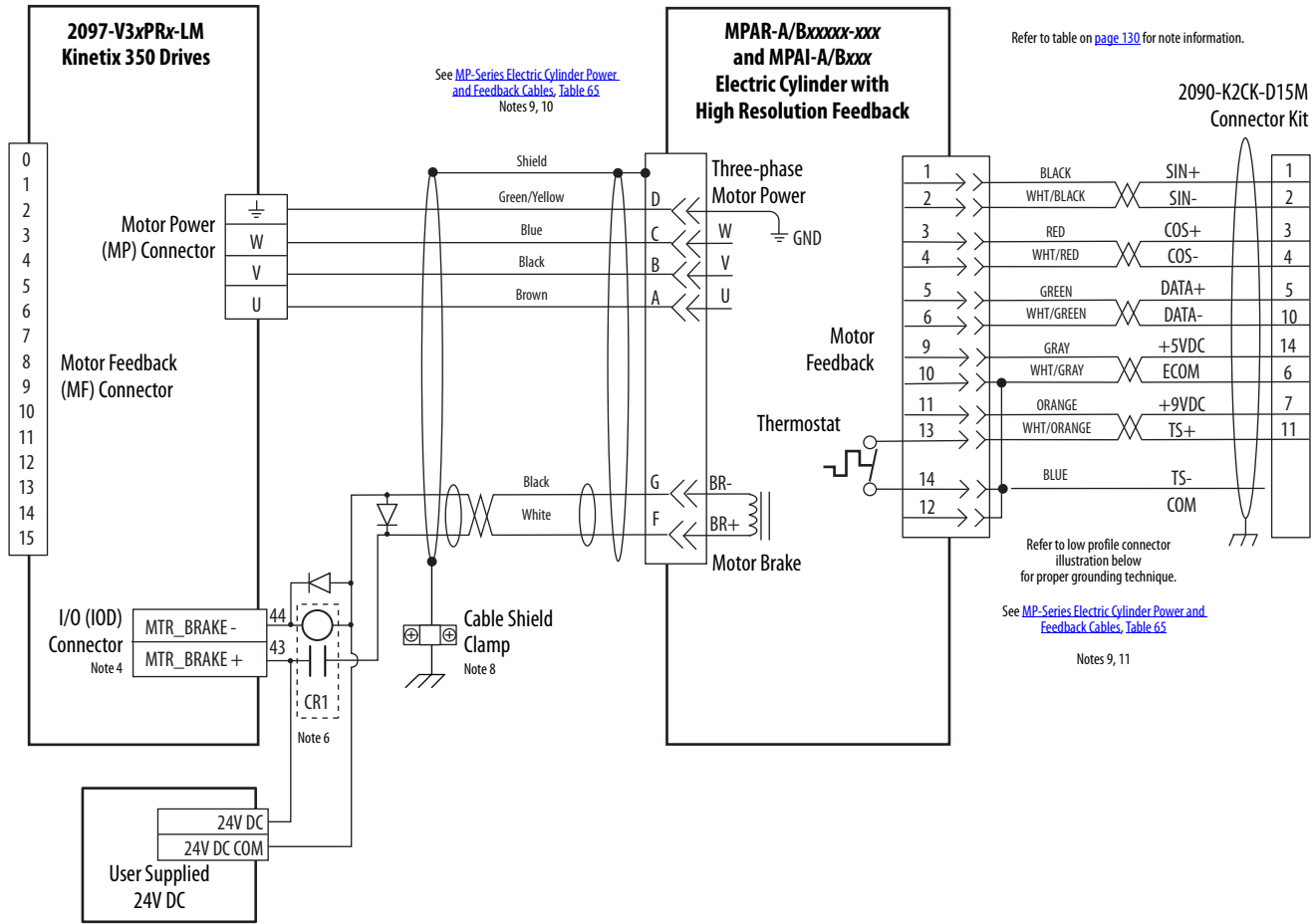


### Grounding Technique for Feedback Cable Shield

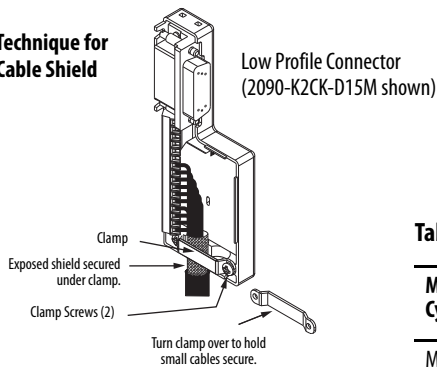




**Figure 60 - Kinetix 350 Drive with MP-Series (Bulletin MPAR and MPAI) Electric Cylinders**



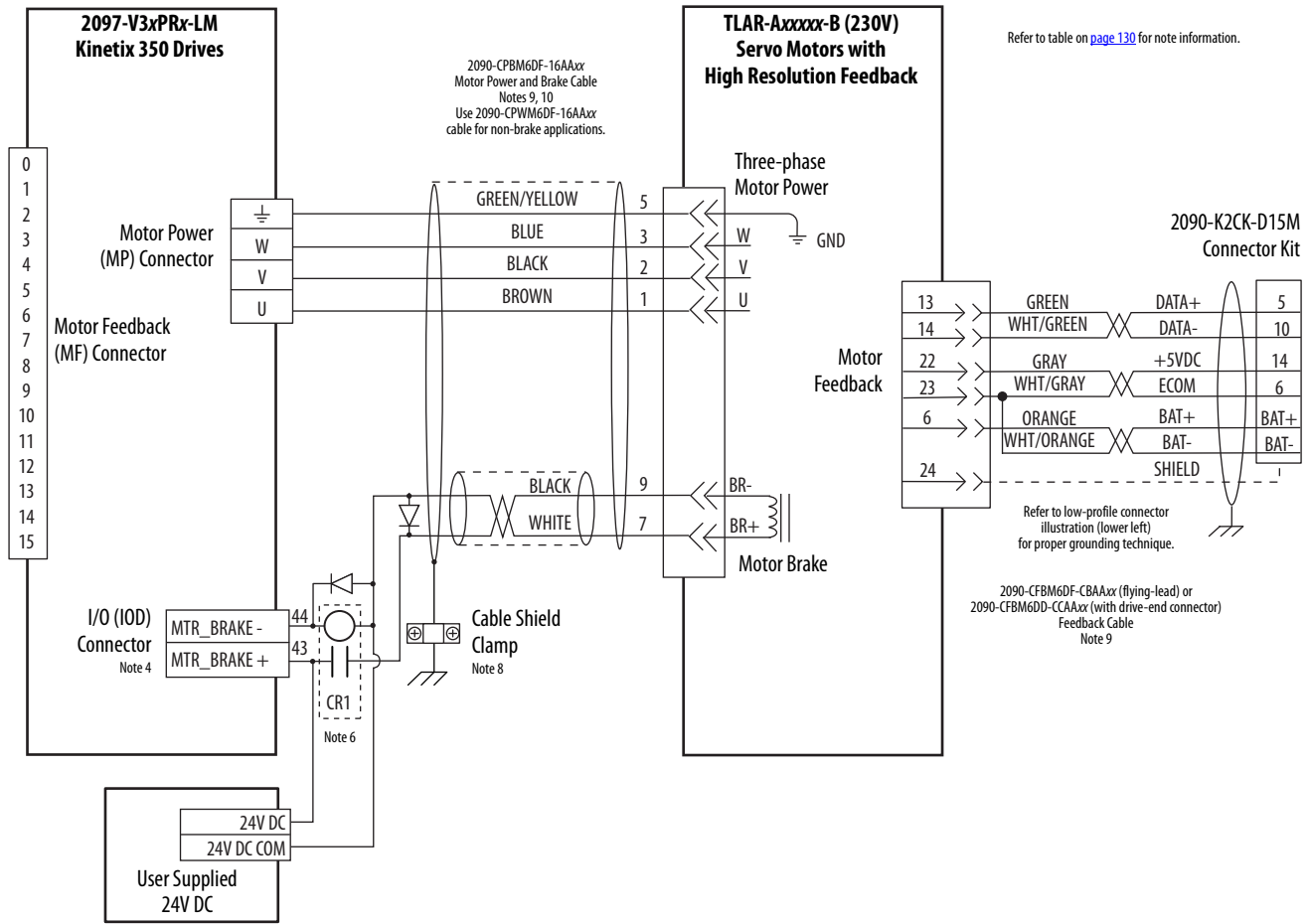
**Grounding Technique for Feedback Cable Shield**



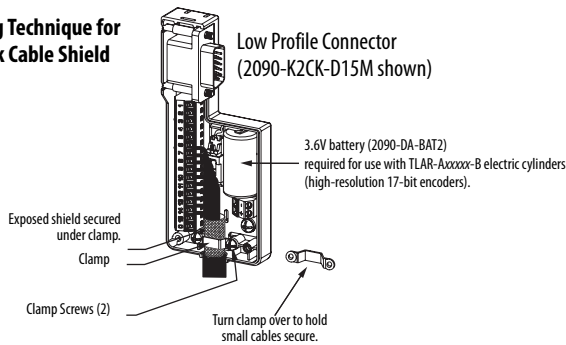
**Table 65 - MP-Series Electric Cylinder Power and Feedback Cables**

| MP-Series Electric Cylinder Cat. No. | Frame | Power Cable Cat. No.                  | Feedback Cable Cat. No.               |
|--------------------------------------|-------|---------------------------------------|---------------------------------------|
| MPAR-A/B1.xxx                        | 32    | 2090-XXNPMF-16Sxx (standard)          | 2090-XXNFMF-Sxx (standard)            |
| MPAR-A/B2.xxx                        | 40    | 2090-CPxM4DF-16AFxx (continuous-flex) | 2090-CFBM4DF-CDAFxx (continuous-flex) |
| MPAR-A/B3.xxx                        | 63    | 2090-CPxM7DF-16AAxx (standard)        | 2090-CFBM7DF-16AAxx (standard)        |
| MPAI-A/Bxxx                          | 83    | 2090-CPxM7DF-16AFxx (continuous-flex) | 2090-CFBM7DF-CEAAxx (continuous-flex) |
|                                      | 110   |                                       |                                       |

Figure 61 - Kinetix 350 Drive with TL-Series (Bulletin TLAR) Electric Cylinders



**Grounding Technique for Feedback Cable Shield**



## Motor Brake Currents

Use these coil current values to size the interposing relay required for your application. Refer to the interconnect diagram for your Kinetix 350 drive/motor beginning on [page 134](#) for typical motor brake circuitry.

**Table 66 - Motor Brake Coil Currents**

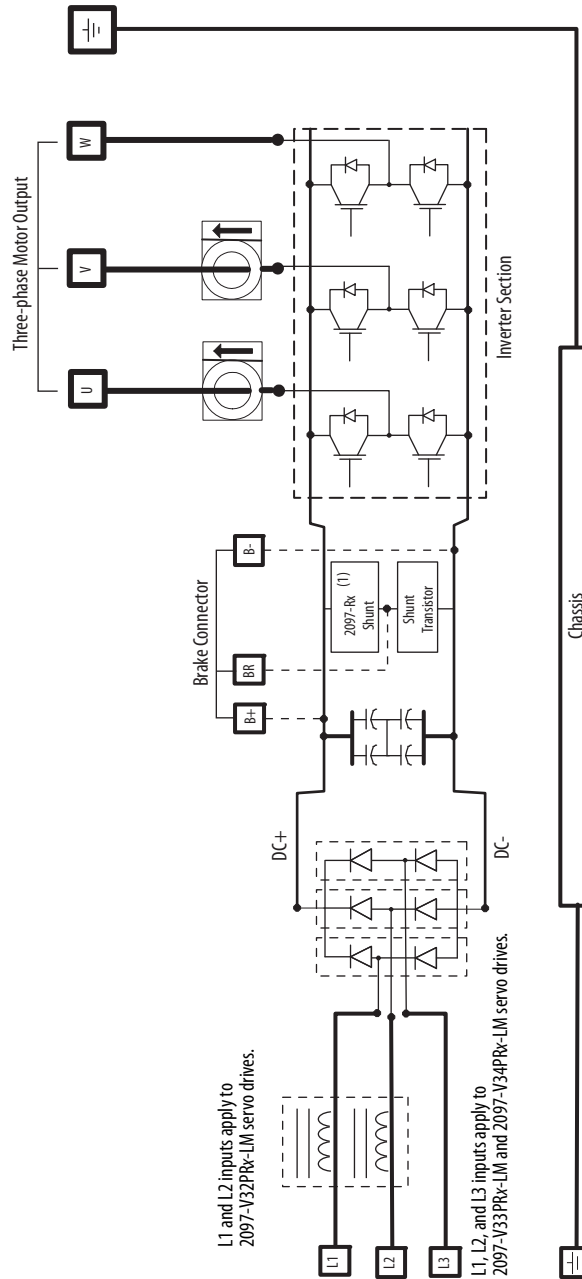
| Compatible Brake Motors/Actuators <sup>(1)</sup>               | Coil Current    |
|--|-----------------|
| MPL-x1510, MPL-x1520, MPL-x1530                                | 0.43...0.53 A   |
| MPL-x210, MPL-x220, MPL-x230                                   | 0.46...0.56 A   |
| MPL/MPF-x310, MPL/MPF-x320, MPL/MPF-x330                       | 0.45...0.55 A   |
| MPM-x115   |                 |
| MPS-x330   |                 |
| MPL-x420, MPL-x430, MPL-x4520, MPL-x4530, MPL-x4540, MPL-B4560 | 0.576...0.704 A |
| MPM-x130   |                 |
| MPF-x430, MPF-x4530, MPF-x4540                                 |                 |
| MPS-x4540  |                 |
| TLY-A110T, TLY-A120T, and TLY-A130T                            | 0.18...0.22 A   |
| TLY-A220T and TLY-A230T  | 0.333...0.407 A |
| TLY-A2530P, TLY-A2540P, and TLY-A310M                          | 0.351...0.429 A |

(1) Use of the variable x indicates this specification applies to 230V and 460V motors.

# System Block Diagrams

This power block diagram applies to 2097-V32PRx-LM, 2097-V33PRx-LM, and 2097-V34PRx-LM, servo drives.

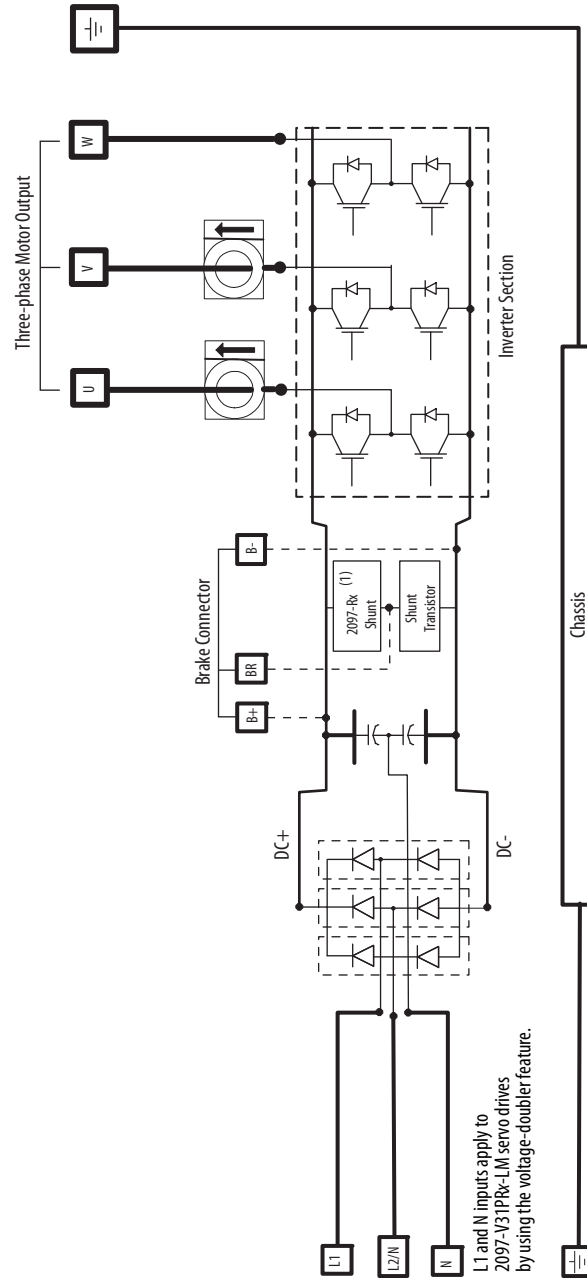
**Figure 62 - Power Block Diagram**



(1) The 2097-Rx shunt module is external to the Kinetix 350 drive.

This power block diagram applies to 2097-V31PRx-LM, servo drives. The voltage-doubler circuitry lets the drives with 120V input power get full performance from 240V motors.

**Figure 63 - Voltage Doubler Block Diagram**



(1) The 2097-Rx shunt module is external to the Kinetix 350 drive.

**Notes:**

## Upgrade the Kinetix 350 Drive Firmware

| Topic   | Page |
|---|------|
| Upgrade Drive Firmware with ControlFLASH Software | 143  |

### Upgrade Drive Firmware with ControlFLASH Software

Upgrading axis module firmware by using ControlFLASH software involves configuring your Logix5000 communication, selecting the drive to upgrade, and upgrading the firmware.

#### Before You Begin

You need the following software and information before you begin.

**Table 67 - Kinetix 350 System Requirements**

| Description                                      | Cat. No.      | Firmware Revision |
|--|---------------|-------------------|
| RSLogix 5000 software                            | 9324-RLD300NE | 20.x or later     |
| RSLink® software                                 |               | 2.58 or later     |
| ControlFLASH firmware upgrade kit <sup>(1)</sup> |               | 8.00.017 or later |

Catalog numbers of the targeted Kinetix 350 drive you want to upgrade.

Network path to the targeted Kinetix 350 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** Input power or back-up power must be present at IPD or BP connector prior to upgrading your target drive.



**ATTENTION:** To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase AC.

## Configure Logix5000 Communication

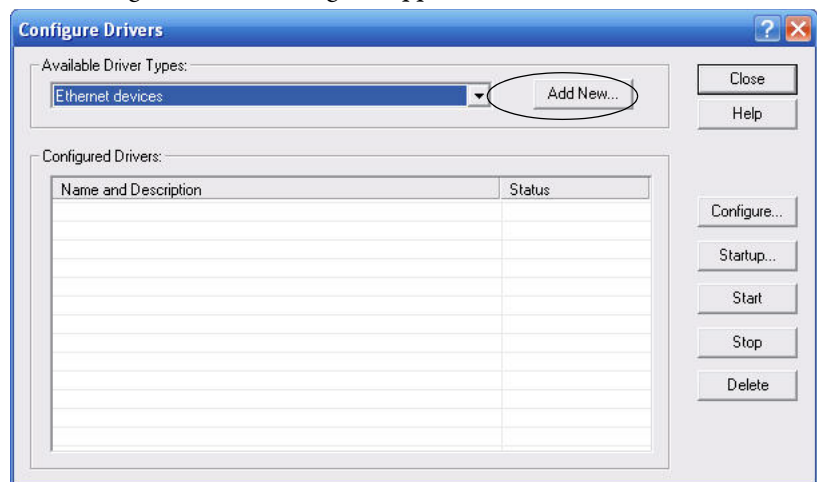
This procedure assumes that your communication method to the Logix5000 controller by using the Ethernet protocol. It is also assumed that your Logix5000 Ethernet module has already been configured.

For more information, refer to the ControlLogix System User Manual, publication [1756-UM001](#).

Follow these steps to configure Logix5000 communication.

1. Open your RSLinx Classic software.
2. From the Communications pull-down menu, choose Configure Drivers.

The Configure Drivers dialog box appears.



3. From the Available Drive 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.





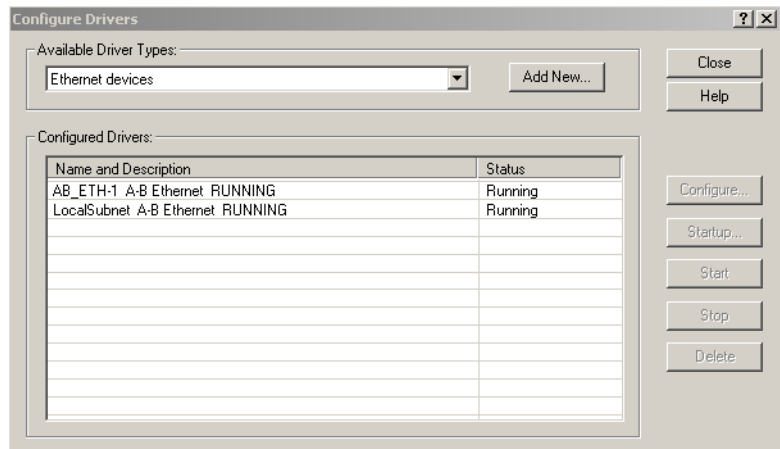
6. Click OK.

The Configure driver dialog box appears.



7. Type the IP address of your drive.
8. Click OK.

The new Ethernet driver appears under Configured Drivers.



9. Click Close.
10. Minimize the RSLinx application dialog box.

## Upgrade Firmware

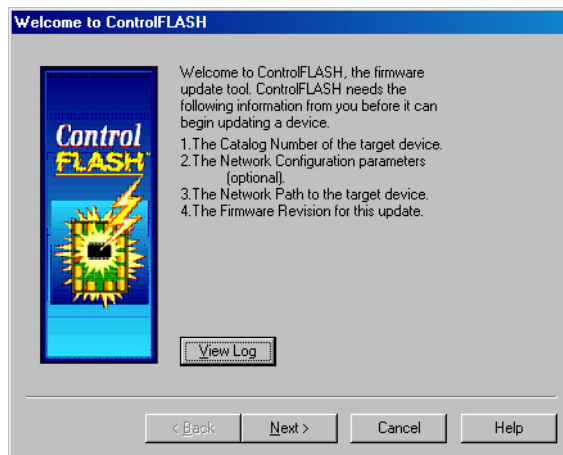
Follow these steps to select the drive module to upgrade.

1. Open your ControlFLASH software.

You can access the ControlFLASH software by either of these methods:

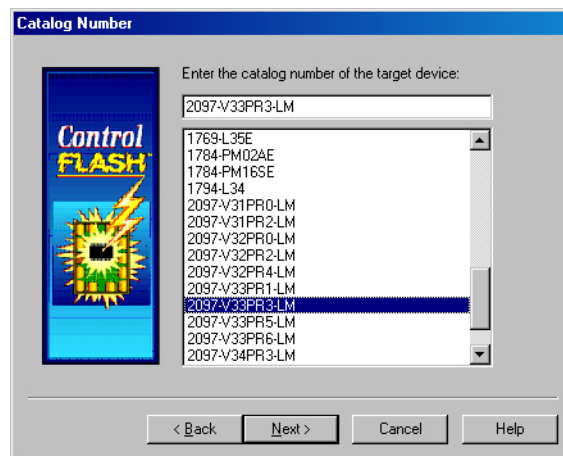
- In RSLogix 5000 software from the Tools menu, choose ControlFLASH.
- Choose Start>Programs>FLASH Programming Tools>ControlFLASH.

The Welcome to ControlFLASH dialog box appears.



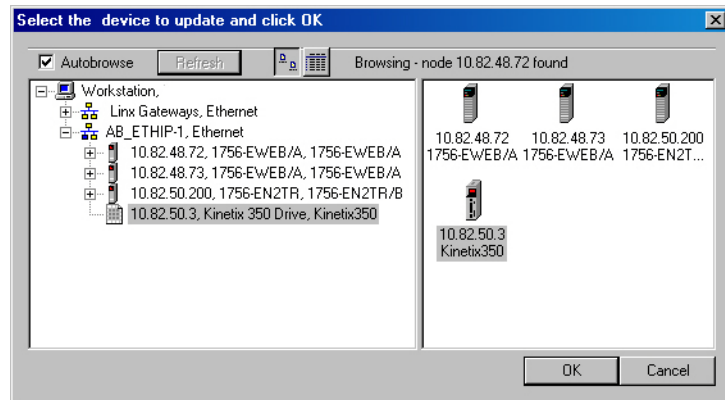
2. Click Next.

The Catalog Number dialog box appears.



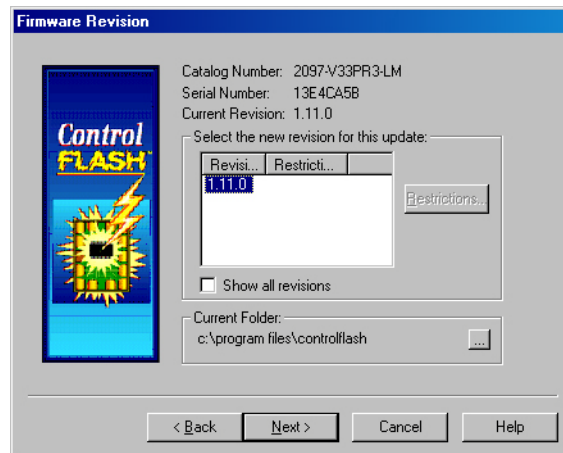
3. Select your drive module and click Next.

The Select Device to Update dialog box appears.



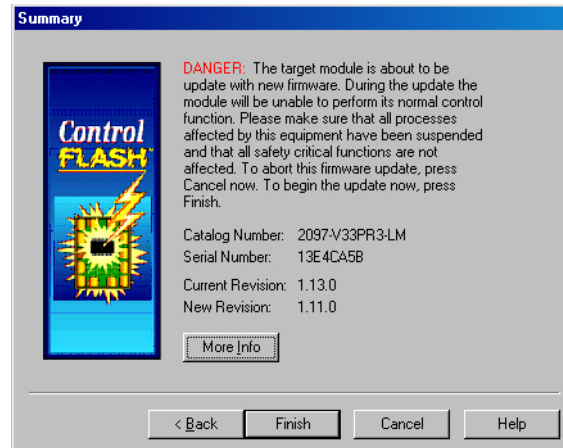
4. Expand your Ethernet node, Logix5000 backplane, and EtherNet/IP network module.
5. Select the servo drive to upgrade and click OK.

The Firmware Revision dialog box appears.

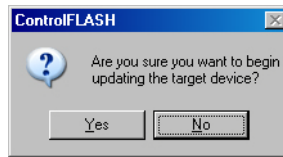


6. Select the firmware revision to upgrade and click Next.

The Summary dialog box appears.

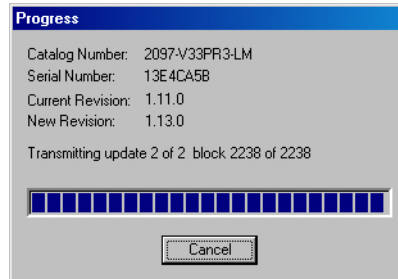


7. Confirm the drive catalog number and firmware revision and click Finish  
This ControlFLASH warning dialog box appears.



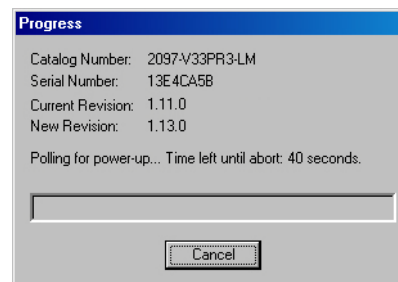
8. Click Yes (when ready).

The Progress dialog box appears and upgrading begins.



The drive four-digit status indicator changes to -PS- and scrolls IP address, which indicates that upgrading is in progress.

After the upgrade information is sent to the drive, the drive resets and performs diagnostic check in. It displays 350, -08-, and scroll -00- and the IP address.



9. Wait for the Progress dialog box to time out.

It is normal for this process to take several minutes.

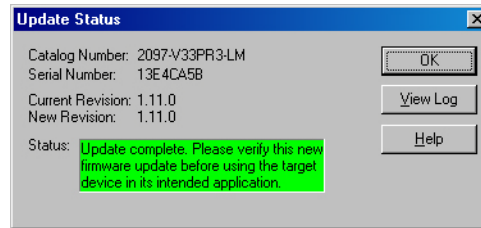
---

**IMPORTANT** Do not cycle power to the drive during this process or the firmware upgrade is not completed successfully.

---

10. The Update Status dialog box appears and indicates success or failure as described below.

| Upgrading Status | If   |
|------------------|--|
| Success          | <ol style="list-style-type: none"> <li>1. Update complete appears in a GREEN Status dialog box.</li> <li>2. Go to <a href="#">step 11</a>.</li> </ol>  |
| Failure          | <ol style="list-style-type: none"> <li>1. Update failure appears in a RED Status dialog box.</li> <li>2. Refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication <a href="#">1756-QS105</a>, for troubleshooting information.</li> </ol> |



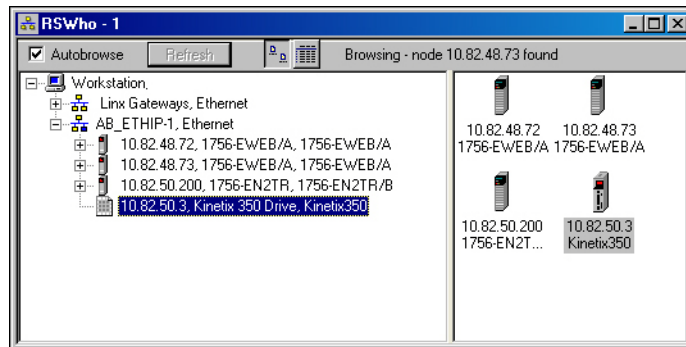
11. Click OK.

## Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

**TIP** Verifying the firmware upgrade is optional.

1. Open your RSLinx software.
2. From the Communications pull-down menu, choose RSWho.



3. Expand your Ethernet node, Logix5000 backplane, and EtherNet/IP network module.
4. Right-click the drive module and choose Device Properties.

The Device Properties dialog box appears.



5. Verify the new firmware revision level.
6. Click Close.

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## 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.

|                                 |  |
|---------------------------------|--|
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