Allen-Bradley

# Integrated Motion on Sercos and EtherNet/IP Network – Analysis and Comparison



This application technique compares the similarities and differences between these two Integrated Motion systems:

- Systems that use Serial Real-time Communications System (Sercos) interfaces
- Systems that use EtherNet/IP networks

Both comparisons use ControlLogix® controllers.

Topics that are covered include hardware, axis configurations, Get System Variable (GSV), Set System Variable (SSV), and axis exceptions for the two different systems.

## Hardware

This table lists the hardware information for Integrated Motion on Sercos interfaces and EtherNet/IP networks.

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| • Sercos II technology<br>• 1756-L6*x*, 1756-L7*x*, GuardLogix®, 1768-L43, and 1768-L45 controllers<br>• 1756-M03SE, 1756-M08SE, 1756-M16SE, and 1768-M04SE Sercos cards<br>• Ultra™ 3000 SE, Kinetix® 2000, Kinetix 6000, Kinetix 6200, and Kinetix 7000 servo drives | • EtherNet/IP technology<br>• 1756-L6*x*, 1756-L7*x*, 1756-L8*x*, 1769-L*xx*ERM, 1769-L3YS, and GuardLogix® controllers<br>• 1756-EN2T(1), 1756-EN2F, 1756-EN2TR, and 1756-EN3TR Ethernet communication modules<br>• Kinetix 6500 servo drive, PowerFlex® 755 AC drive, PowerFlex 527, Kinetix 350, Kinetix 5500, and Kinetix 5700 drives<br>• 1783-ETAP, 1783-ETAP1F, and 1783-ETAP2F EtherNet/IP taps with embedded switch technology (optional)<br>• Stratix 2000™, Stratix 5100™, Stratix 5400™, Stratix 5700™, Stratix 6000™, Stratix 8000™, and Stratix 8300™ switches (and commercially available switches, optional) |

(1) Firmware revision 4.00 or later.

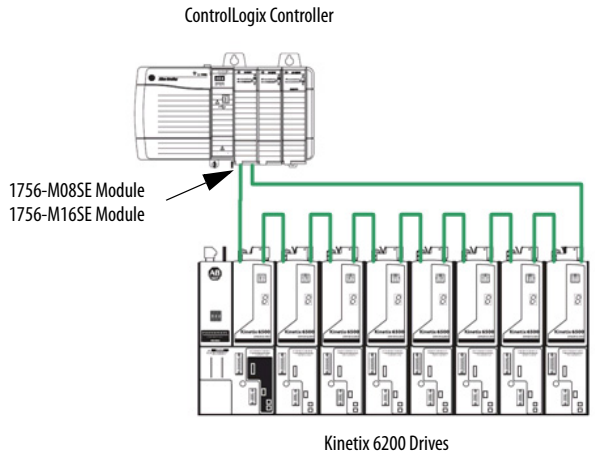
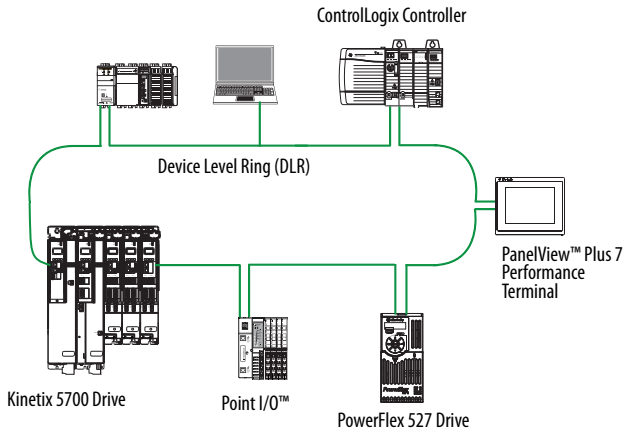
## Features

This table lists features for Integrated Motion on Sercos interfaces and EtherNet/IP networks.

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| • Sercos is a controller/drive interface that uses noise-immune, fiber-optic cables.<br>• A fiber-optic ring serves as the sole interface between the control and the drive. The fiber-optic ring replaces costly command and feedback wiring, which reduces installation time and the cost of wiring.<br>• Kinetix drives provide advanced diagnostics and process reports via the Sercos interface.<br>• Wide variety of motion module options for ControlLogix, CompactLogix™, and GuardLogix controllers.<br>• Up to 16 axes of motion can be controlled from one motion module.<br>• System is fully expandable, with up to 100 axes that are supported per controller.<br>• Multiple controllers can be used if additional axes are needed. | • EtherNet/IP technology, Integrated Motion on the EtherNet/IP network, and CIP Sync technologies are global standards from ODVA. These standards help to provide device standardization and compatibility.<br>• EtherNet/IP technology has an installed base that numbers in the billions of nodes. Compliance with IEEE Ethernet standards provides users with a choice of network interface speeds; for example, 10, 100 Mbps, and 1 Gbps.<br>• EtherNet/IP technology is an agile, multidiscipline network that can be used to control, configure, monitor, and do peer interlock for motion, safety, process, and discrete applications; it provides a Connected Enterprise.<br>• Multiplexing, a new feature in Integrated Motion on the EtherNet/IP network, allows for the controller to execute up to three effective Coarse Update Periods for a Motion Group. Within the Motion Group, drives can execute at different rates, relative to the needed application performance.<br>• The drive multiplex feature is available in Studio 5000® revision 24 and up, and is compatible with Axis CIP Drive and AXIS VIRTUAL data types.<br>• Single network architecture integration.<br>• High-performance drives, I/O, smart actuators, human machine interface (HMI), programming terminal, and any other EtherNet/IP device providing lower system cost, improved performance, flexibility, and ease-of-use benefits.<br>• Extends the benefits and simplicity of Integrated Motion to Kinetix 350, Kinetix 5500, Kinetix 5700, Kinetix 6500, PowerFlex 527, and PowerFlex 755 drives on an EtherNet/IP network.<br>• Kinetix and PowerFlex drives can be used on the same network to configure, program, commission, diagnose, and for drive maintenance.<br>• Support for any Ethernet topology for maximum flexibility. Embedded switch Device Level Ring (DLR) technology available on Kinetix 5500, Kinetix 5700, Kinetix 6500, PowerFlex 527, and PowerFlex 755 drives. An optional dual-port card is available on PowerFlex 755 drives. |

## Topology

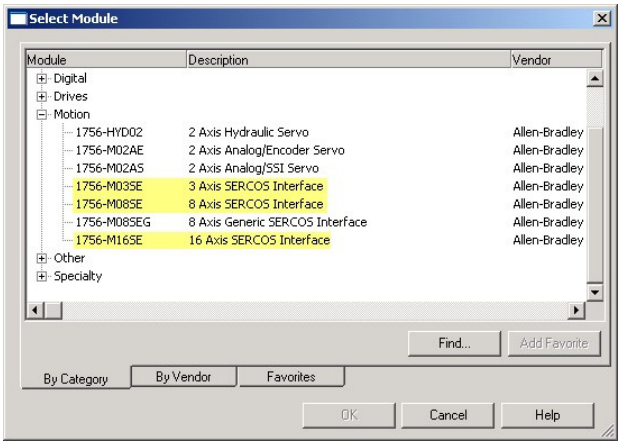
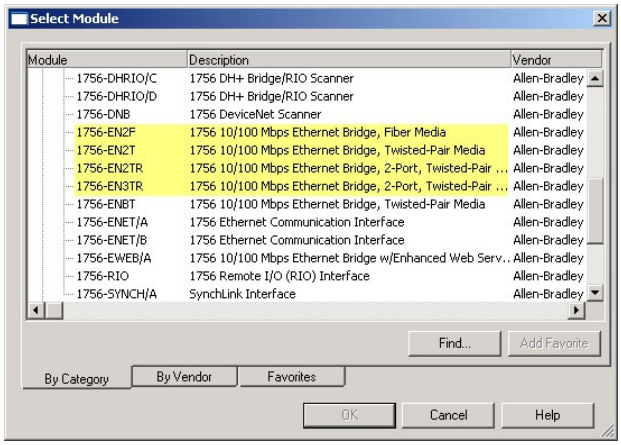
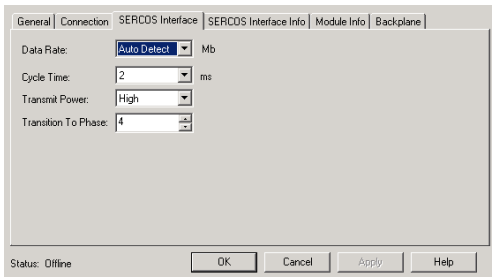
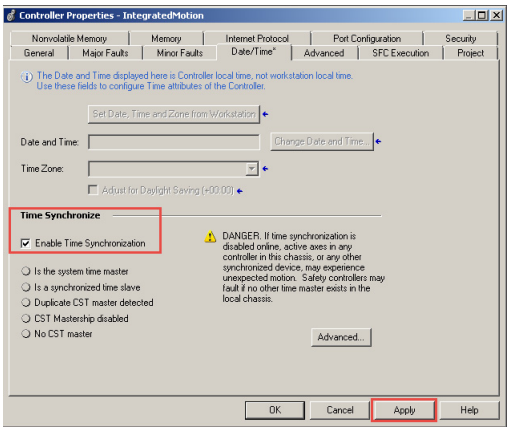
This section lists information on the topologies for Integrated Motion on Sercos and EtherNet/IP network.

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| • Sercos II technology, 8 MB transmission rate.<br>• Maximum of 16 drives per Sercos module or ring. Supports multiple Sercos modules per controller.<br>• Dedicated motion network. Supports only Sercos interface drives.<br>• Must be configured in ring topology. | • EtherNet/IP technology, 100 MB fast Ethernet.<br>• Standard unmodified Ethernet and maximum of 128 drives per Ethernet module.<br>• ControlLogix 5580 controllers offer a 1 GB embedded Ethernet port and support 300 devices in its I/O tree with 256 being drives.<br>• Any combination of EtherNet/IP devices on a common network: AC and servo drives, distributed I/O, EOI, and any other EtherNet/IP device.<br>• Coupled with an Ethernet communication module, the ControlLogix 5580 controller supports all Ethernet topologies: star, linear, ring (Device Level Ring or DLR), or hybrid.<br>**IMPORTANT:** A 1756-L7*x* controller motion group is limited to 100 axes while a ControlLogix 5580 controller motion group can have up to 256 axes. Multiple controllers can control drives on a common Ethernet module.<br>**IMPORTANT:** A standalone ControlLogix 5580 controller supports only linear topology. Other topologies (liner and ring) can be achieved by adding an Ethernet module to the rack. |
| **Ring Topology** | **Basic Ring Topology** |
|  |  <br>**IMPORTANT:** For additional topology examples, see Appendix C – Design and Implementation Guide for Using Integrated Motion on an EtherNet/IP Network on page 40. |

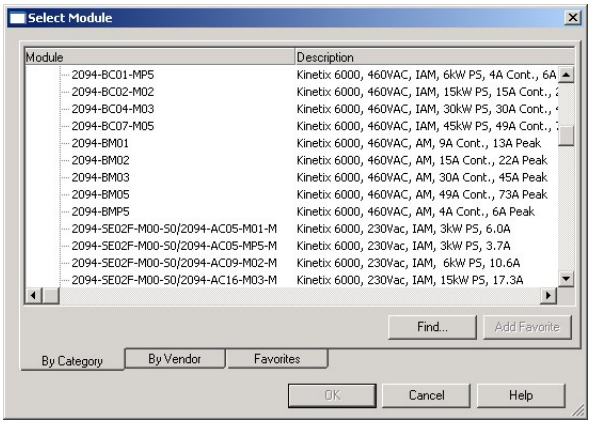
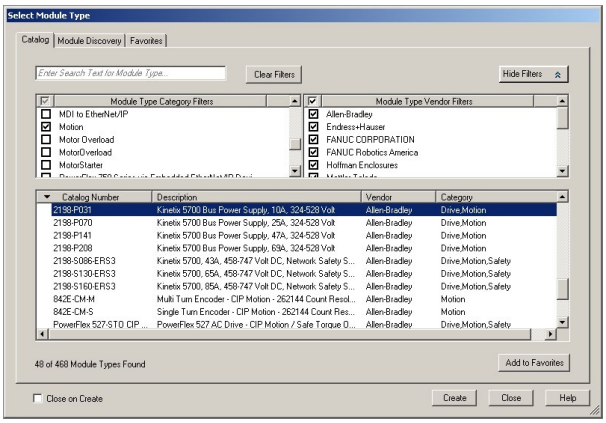
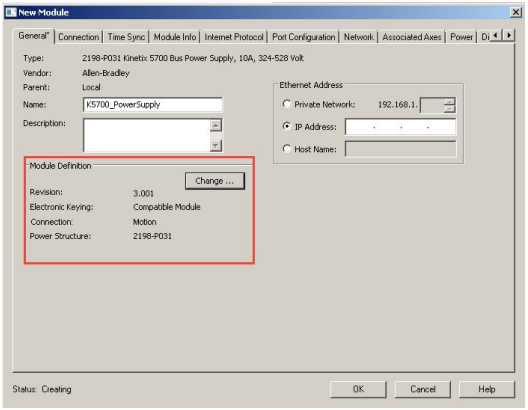
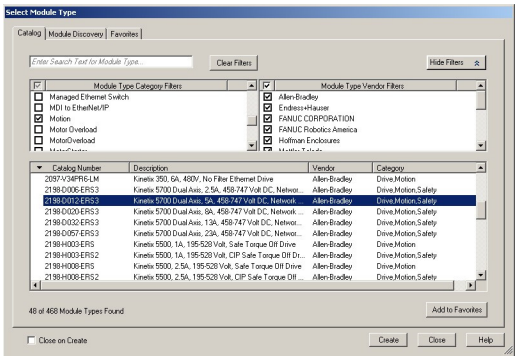
# Communication Module and Drive Configuration

This section compares the communication module and drive configuration for Integrated Motion on Sercos and EtherNet/IP systems.

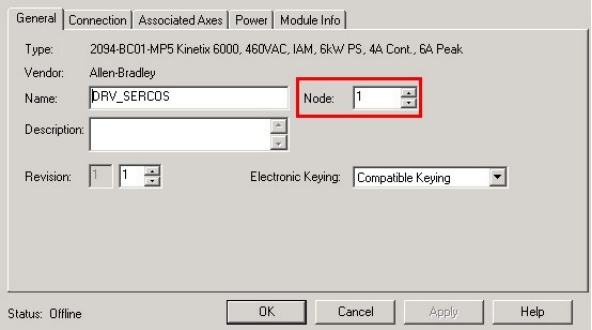
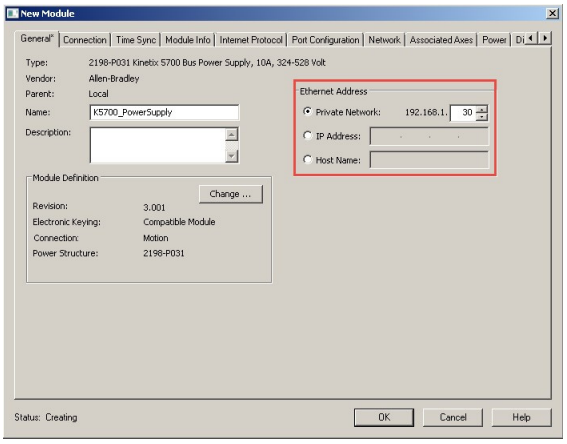
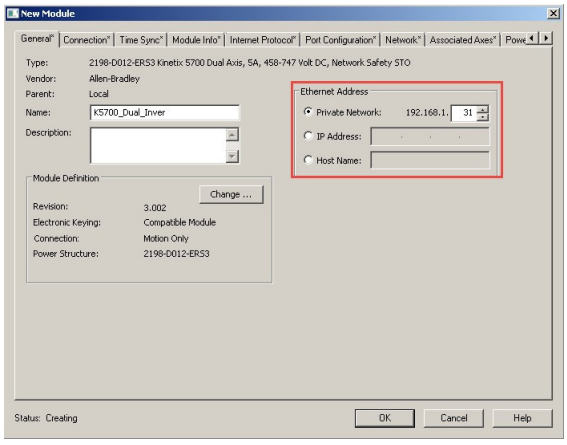
### Communication Module and Drive Configuration Comparison

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Select a Sercos Communication Module**<br><br>Select the appropriate Sercos communication module:<br>• 1756-M03SE = 3 Sercos drives<br>• 1756-M08SE = 8 Sercos drives<br>• 1756-M16SE = 16 Sercos drives<br><br>  <br> | **Select an Ethernet Communication Module**<br><br>Select the appropriate Ethernet communication module:<br>• 1756-EN2*x* = Up to 128 EtherNet/IP drives with a maximum of 8 position-configured drives<br>• 1756-EN3*x* = Up to 128 EtherNet/IP drives<br>• 5580 controller = Up to 256 EtherNet/IP drives<br><br>  <br><br><br>**ControlLogix 5580 Embedded Ethernet Controllers**<br><br>The ControlLogix 5580 controllers have an embedded 1 GB Ethernet port available. The controllers do not require a separate Ethernet communication module.<br><br>**IMPORTANT:** For additional information on the Ethernet communication module axis limits, see Appendix A – Communication Networks and Managed Communication on page 40. |
| **Configure the Sercos Communication Module**<br><br>Select the appropriate data rate, cycle time, and so on, that matches the Sercos interface. These settings are typically dependent on the number of drives in the network.<br><br>  <br> | **Configure the Ethernet Communication Module**<br><br>With an Ethernet module, you define Time Sync Connection to Time Sync and Motion to enable CIP Sync time coordination that is required for motion control.<br><br>With a direct connection from a Kinetix 5700 drive to a ControlLogix 5580 controller embedded Ethernet port, check 'Enable Time Synchronization' and click Apply.<br><br>  <br><br><br>**IMPORTANT:** To configure ControlLogix 5580 controllers, see the ControlLogix 5580 Controllers User Manual, publication 1756-UM543. |

## Communication Module and Drive Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Drive Selection**<br><br>When selecting a Sercos drive, select both the control and power structure.<br><br>  <br> | **Drive Selection: Control and Power Structure**<br><br>Compared to the Kinetix 5500 and Kinetix 6500 drives, the Kinetix 5700 drive consists of a power supply/converter and inverter. The power supply is separate from the axis module and is configured in the I/O tree. There is no auto population of the power structure. You can choose the required power supply.<br><br>  <br><br><br>**IMPORTANT:** For complete information on configuration of a Kinetix 5700 drive, see the Kinetix 5700 Servo Drives User Manual, publication 2198-UM002.<br><br>The power structure is displayed in the module definition.<br><br>  <br><br><br>After you select the power supply, then you select the inverter module.<br><br>  <br><br><br>**IMPORTANT:** Kinetix 5500 and Kinetix 6500 drives have an integrated axis (IAM) power module, which requires the power structure to be specified during configuration. |

## Communication Module and Drive Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Set the Node Address**<br><br>Each Sercos drive must have a unique network identifier that is the node address of the drive.<br><br>  <br> | **Set the IP Address**<br><br>Each EtherNet/IP drive must have a unique network identifier that is the IP address of the drive.<br><br>  <br><br><br>  <br><br><br>**IMPORTANT:** The IP address for the Kinetix 5700 drive can be assigned as Isolated, Static, Dynamic (BOOTP/DHCP), or DHCP Persistence. |

## Communication Module and Drive Configuration Comparison (Continued)

### Integrated Motion on Sercos Interface

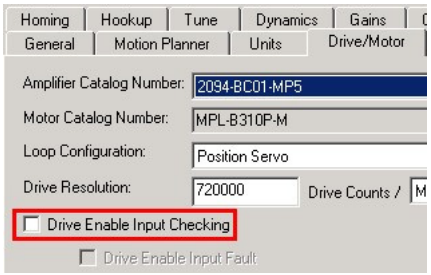
#### Digital Inputs

Sercos drives contain up to six digital inputs. Typically the function of these inputs cannot be configured.

| IOD Pin | Signal | Description |
|---|---|---|
| IOD-2 | ENABLE | Optically isolated, single-ended active high signal. The current load is nominally 10 mA. A 24V DC input is applied to this terminal to enable each axis. |
| IOD-5 | HOME | Optically isolated, single-ended active high signal. The current load is nominally 10 mA. Home switch (normally open contact) inputs for each axis require 24V DC (nominal). |
| IOD-15<br>IOD-17 | REG1<br>REG2 | Fast registration inputs are required to inform the motor interface to capture the positional information with less than 3 µs of uncertainty. Optically isolated, single-ended active high signal. The current load is nominally 10 mA. A 24V DC input is applied to this terminal to enable each axis. |
| IOD-8<br>IOD-11 | OT+<br>OT- | Over-travel detection is available as an optically isolated, single-ended active high signal. The current load is nominally 10 mA per input. The positive/negative limit switch (normally closed contact) inputs for each axis require 24V DC (nominal). |

#### Drive Enable Input Checking Example

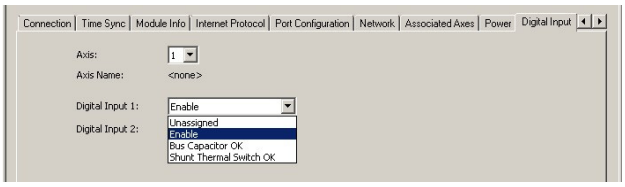
For a Sercos drive, the Drive Enable Input Checking checkbox is on the Drive/Motor tab of the Axis Properties.




### Integrated Motion on the EtherNet/IP Network

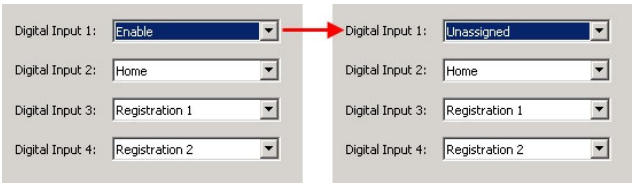
#### Configurable Digital Inputs

EtherNet/IP drives have configurable digital inputs. The Kinetix 5700 converter module has two configurable inputs, while its axis modules have four configurable inputs.




#### Drive Enable Input Checking Example

For an EtherNet/IP drive, to disable input checking, make sure that none of the inputs are assigned to enable.

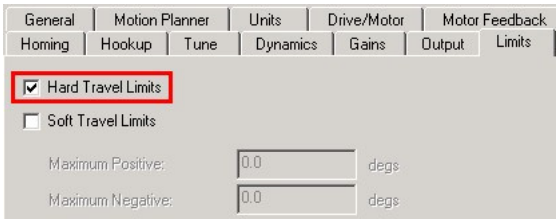


## Communication Module and Drive Configuration Comparison (Continued)

### Integrated Motion on Sercos Interface

**Hard Travel Limits Example**

For a Sercos drive, the Hard Travel Limits checkbox is on the Limits tab of the Axis Properties.




**IMPORTANT:** The Kinetix 6200 drive is limited to four digital inputs.

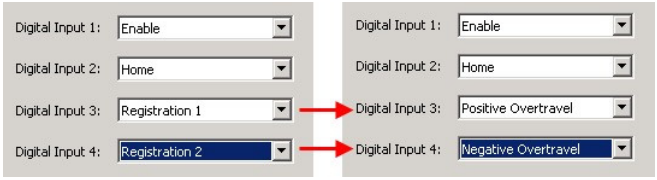
| IOD Pin | Input | IDN | Type | Default |
|---|---|---|---|---|
| 41 | 1 | P-0-052 | INT | Enable |
| 42 | 2 | P-0-053 | | Home |
| 43 | 3 | P-0-054 | | Registration 1 |
| 44 | 4 | P-0-055 | | Registration 2 |

The digital input default settings can be configured by using a Sercos IDN write instruction.

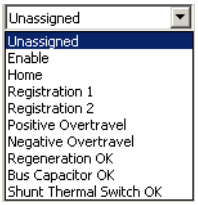
### Integrated Motion on the EtherNet/IP Network

**Overtravel Limits Example**

For an EtherNet/IP drive, to enable the hard travel limits on the Kinetix 5700 or Kinetix 6500 drives, assign the inputs to Positive Overtravel and Negative Overtravel.



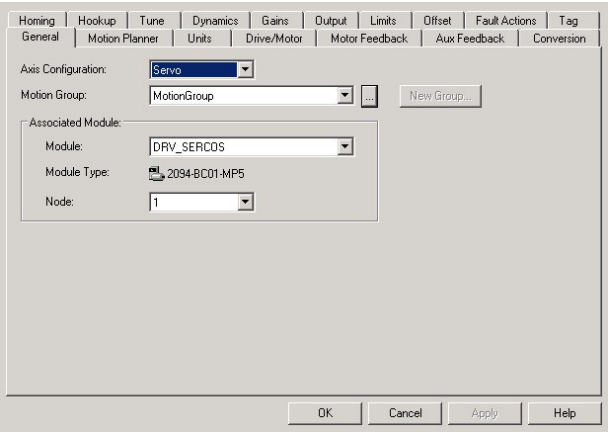
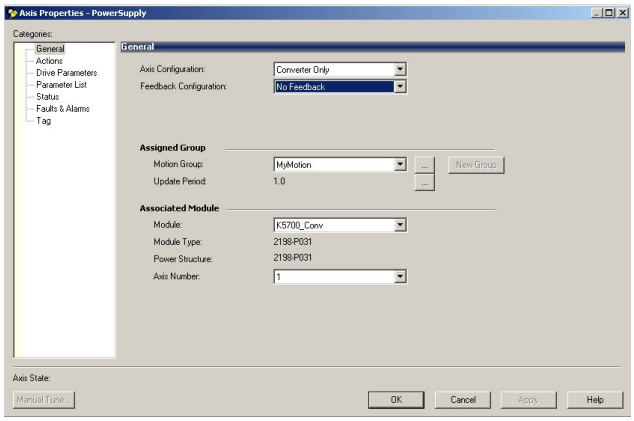
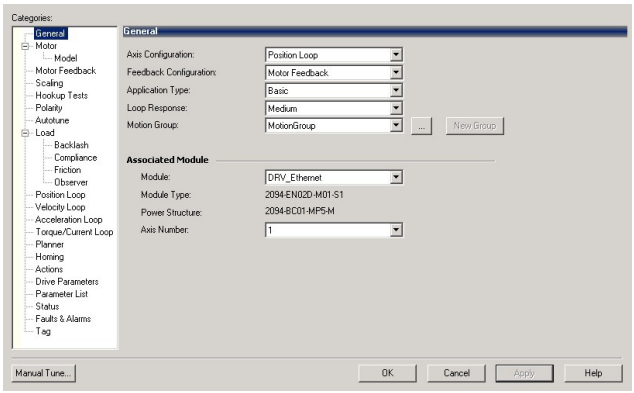

**IMPORTANT:** The following digital inputs can be assigned for the Kinetix 5700 drives.



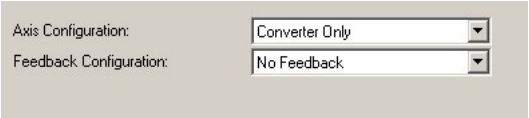
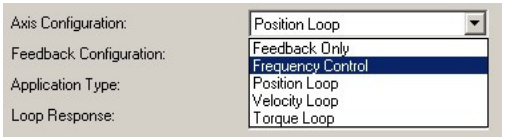
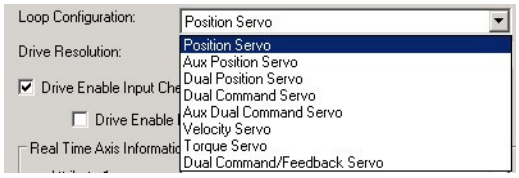
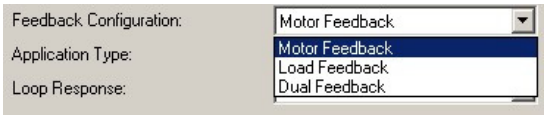
## Axis Configuration

This section compares the axis configuration for Integrated Motion on Sercos and EtherNet/IP systems.

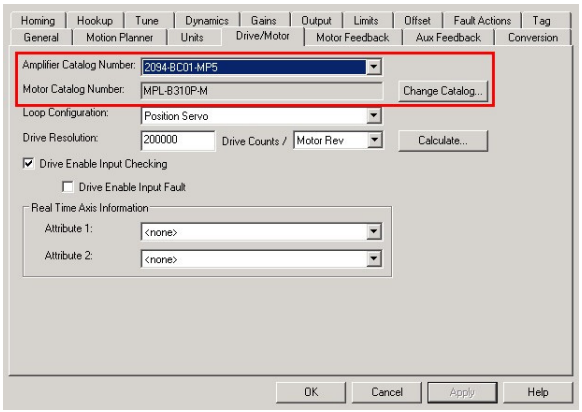
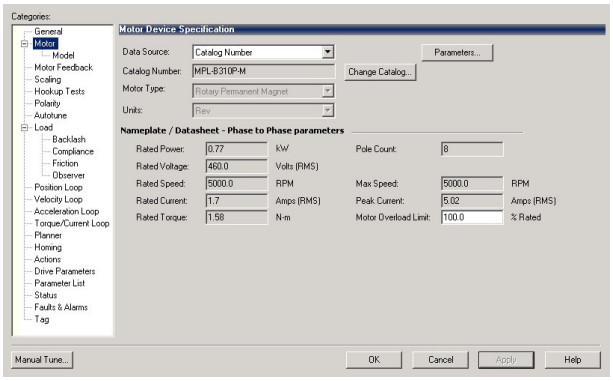
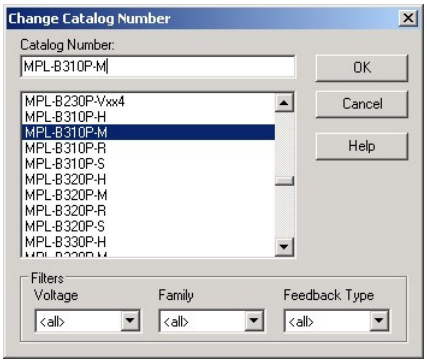
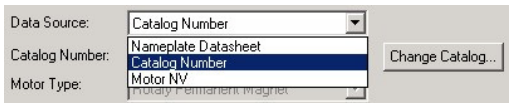
### Axis Configuration Comparison

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **General** | **General** |
|  |  <br>  |

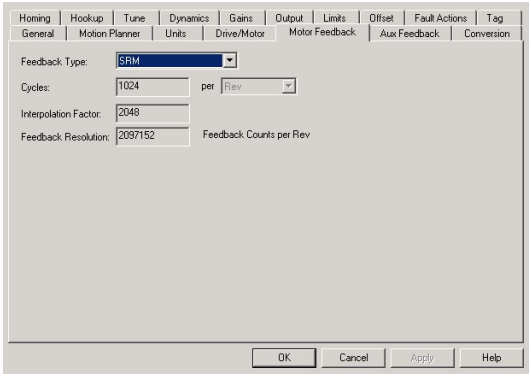
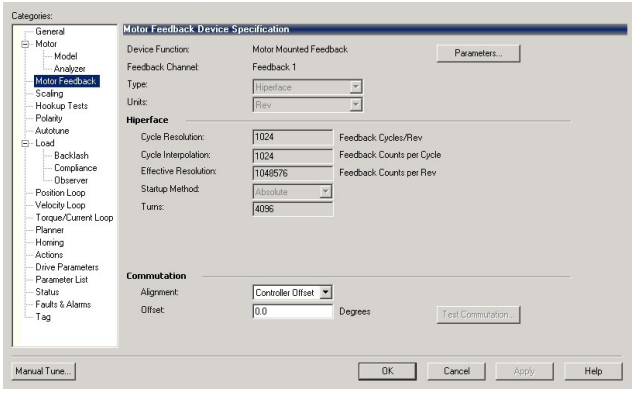
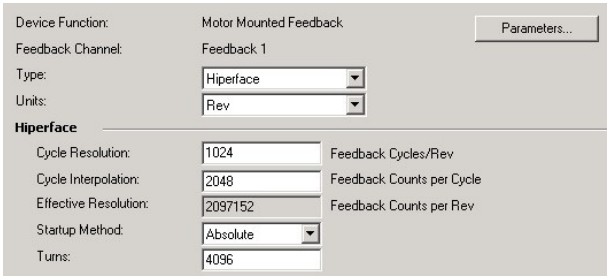
**Axis Configuration Comparison (Continued)**

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Axis and Loop Configuration** | **Axis and Feedback Configuration** |
| | For the Kinetix 5700 drive, configure the converter module as a CIP drive because it is used for the faults and shutdown mechanism of the inverter.<br>Axis Configuration<br>  <br>Even though the converter module does not spin a motor, an axis must be configured as part of the axis properties for the drive. |
| For a Sercos axis, the Axis Configuration selects between Servo and Feedback Only operation control.<br>Axis Configuration<br>  | For an EtherNet/IP axis, the control mode is a combination of the Axis Configuration and Feedback Configurations.<br>Axis Configuration<br>  <br>**IMPORTANT:** The Kinetix 5700 and Kinetix 5500 servo drives support the basic volts/hertz frequency control. Kinetix 6500 and PowerFlex 755 AC drives support all other modes. |
| To configure the axis for Velocity Servo, Torque Servo, and so on, see Loop Configuration on the Drive/Motor tab.<br>Loop Configuration<br>  | On the Kinetix 5700 drive, feedback connections are made at the DSL feedback, 2-pin motor feedback (MF) connector, and the 15-pin universal feedback (UFB) connector.<br>Feedback Configuration<br>  |

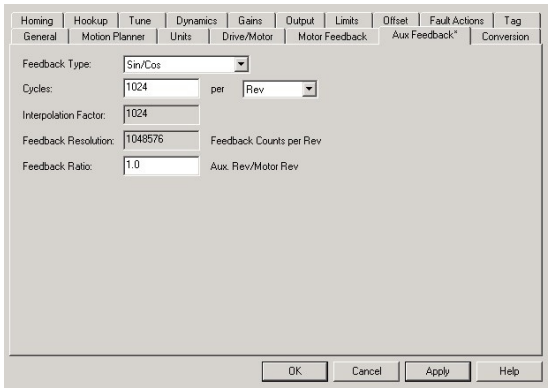
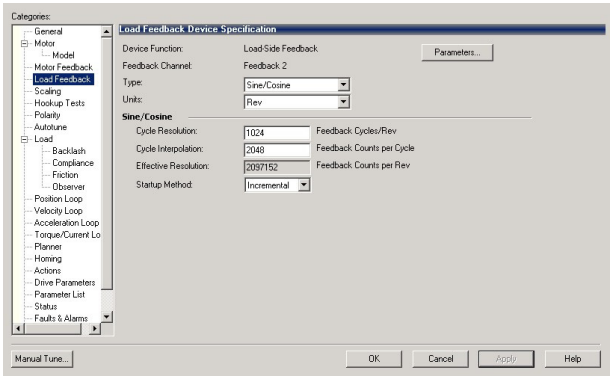
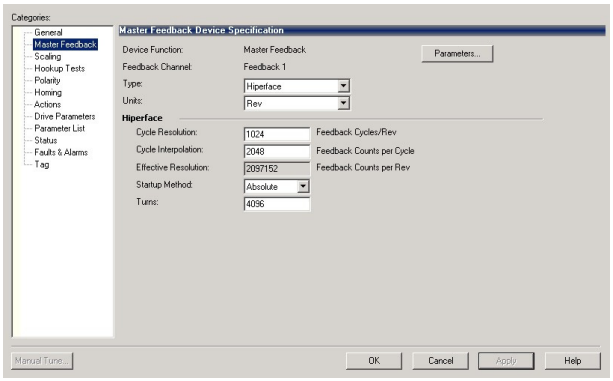
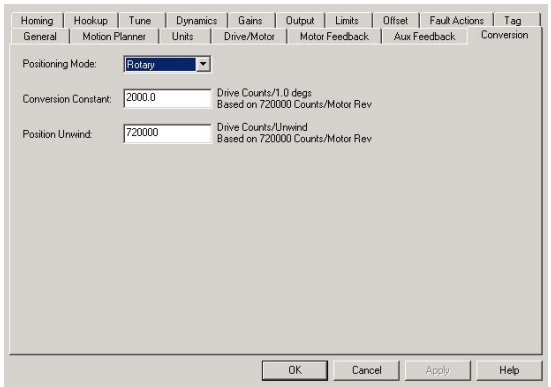
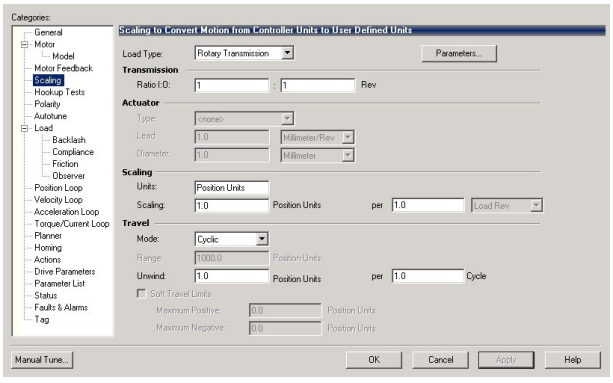
## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Drive/Motor**<br>  | **Motor**<br>  |
| **Change the Catalog Number**<br>For a Sercos axis, the Motor Data Source pull-down selection does not exist. By default, you can only select an available drive that is in the motor catalog database.<br>  | **Motor Data Source Options**<br>  <br>**Nameplate Datasheet**: Supported third-party motors, or motors that are not included in the motor database. You enter the motor parameters.<br>**Catalog Number**: Choose supported Allen-Bradley® motors by catalog number. Provides automatic setting of the required parameters.<br>**Motor NV**: Motor parameters are derived from nonvolatile memory of a smart feedback device that is equipped with a serial interface. Applies to any Hiperface or EnDat feedback device that is preprogrammed with Rockwell Automation formatted motor data. This option is not available for PowerFlex 755 AC drives. |

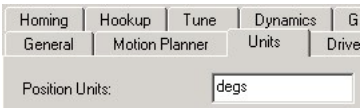
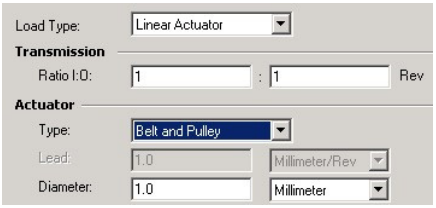
## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Motor Feedback**<br><br>For a Sercos axis, the Motor Feedback tab provides a summary of the connected feedback.<br><br>  <br> | **Motor Feedback**<br><br>For an EtherNet/IP axis, the Motor Feedback page provides a summary of the connected feedback device when Catalog Number is selected as a Motor Data Source.<br><br>  <br><br><br>When Nameplate Datasheet is selected, you can define the motor feedback information.<br><br>  <br><br><br>**IMPORTANT:** For system features on the Kinetix 5700 drives, see the release notes of your installed firmware. |

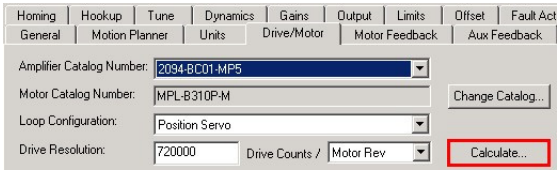
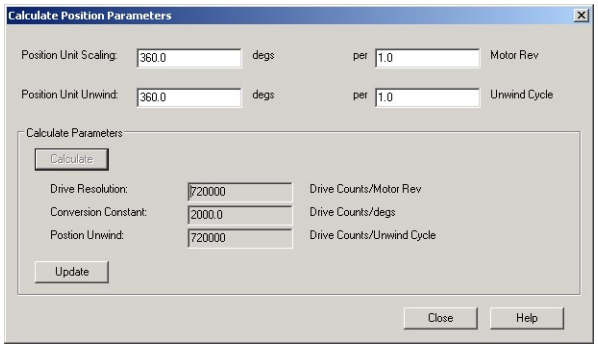
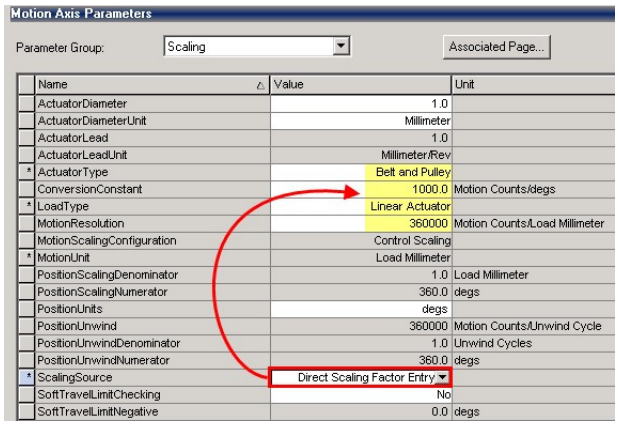
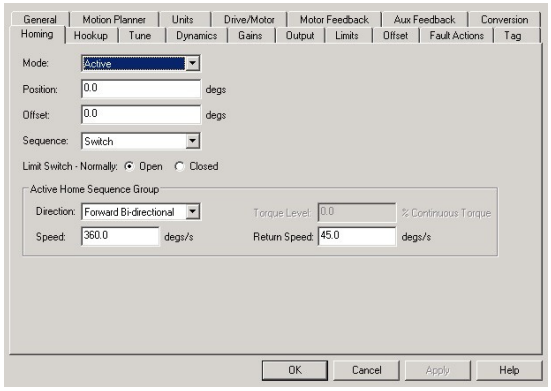
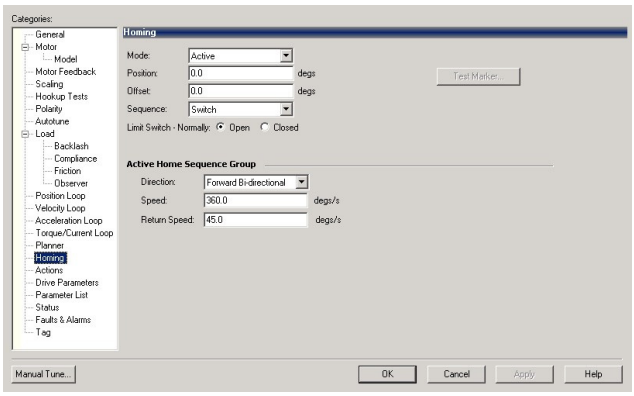
## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Aux Feedback**<br><br>The Aux Feedback page is not accessible unless one of these conditions is true:<br>• Axis Configuration is set to Feedback Only.<br>• Loop Configuration is set to Aux or Dual loop mode.<br><br>  <br> | **Load Feedback**<br><br>The Load Feedback page is only visible if the Feedback Configuration is set to Load or Dual Feedback.<br><br>  <br> |
| **N/A**<br><br>**IMPORTANT:** Each category with an asterisk indicates that a change was made but was not applied. Click Apply or OK to save the changes. | **Master Feedback**<br><br>If the Axis Configuration is set to Feedback Only, the Master Feedback page replaces the Motor and Load Feedback pages.<br><br>  <br> |
| **Conversion Constant**<br><br>  <br> | **Scaling Calculator**<br><br>  <br> |

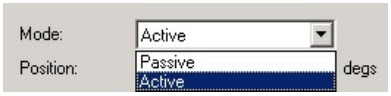
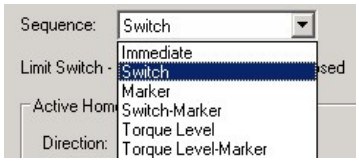
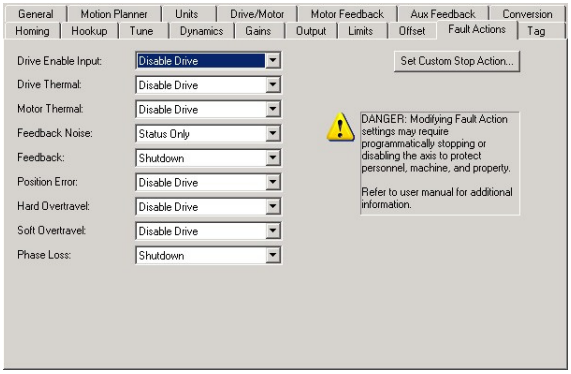
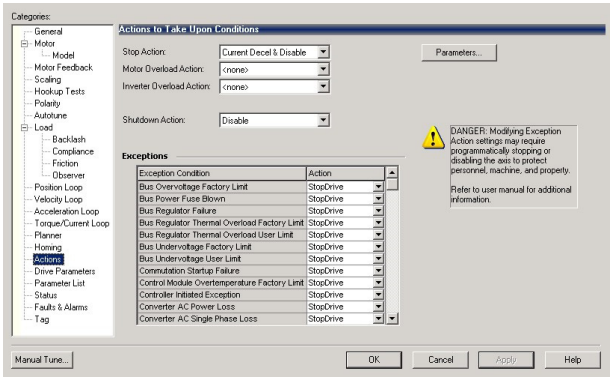
**Axis Configuration Comparison (Continued)**

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Position Units**<br><br>For a Sercos axis, the Position Units are on the Units tab.<br><br>  | **Units**<br><br>The Scaling units are user-defined and are reflected throughout the Axis Properties.<br><br>  |
| **N/A**<br><br>For a Sercos axis, the Transmission Ratio and Actuator entry does not exist. These input values must be directly included in the Conversion Constant and Drive Resolution calculations. | **Transmission Ratio and Actuator**<br><br>The Transmission Ratio and Actuator entry makes it easier to enter application-specific scaling information. For the Actuator, select from Screw, Belt and Pulley, Chain and Sprocket, and Rack and Pinion.<br><br>  |

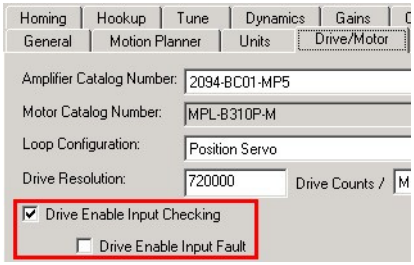
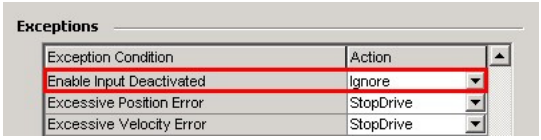
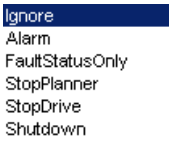
## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Positioning Mode, Drive Resolution, Conversion Constant, and Position Unwind**<br><br>For a Sercos axis, the Positioning Mode and Unit Scaling/Unwind reside on different tabs.<br><br>First, set the Positioning Mode on the Conversion tab.<br><br>  <br><br>Next, click Calculate on the Drive/Motor tab.<br><br>  <br><br>You can then use the Calculate Position Parameters calculator to calculate the Drive Resolution, Conversion Constant, and Position Unwind.<br><br>  | **Scaling and Travel**<br><br>For an EtherNet/IP axis, the Travel Mode selections include Unlimited, Limited, or Cyclic. The Cyclic mode is similar to when you select a Sercos Positioning Mode set to Rotary.<br><br>  <br><br>**IMPORTANT:** The Scaling can also be set manually without using the Scaling Calculator. On the scaling page, click Parameters to switch between the page and parameter views. On the parameter view, set the Scaling Source to Direct Scaling Factor Entry.<br><br>  <br><br>Set the Scaling Source to Direct Scaling Factor Entry to let the Conversion Constant, Motion Resolution, and other scaling parameters be calculated and entered manually. |
| **Homing**<br><br>  | **Homing**<br><br>  | |

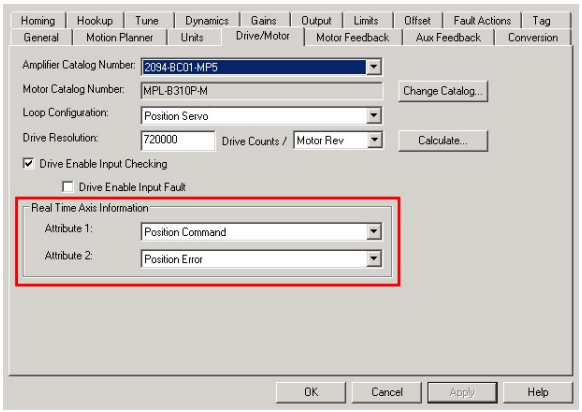
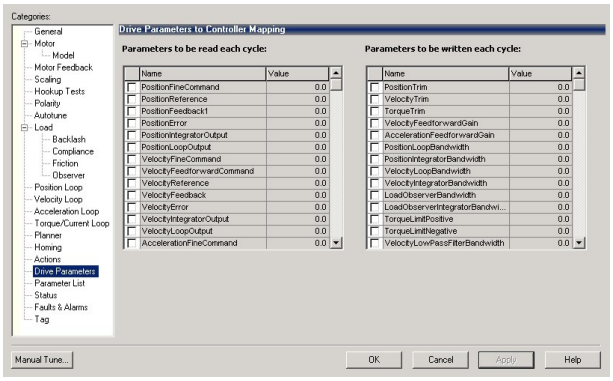
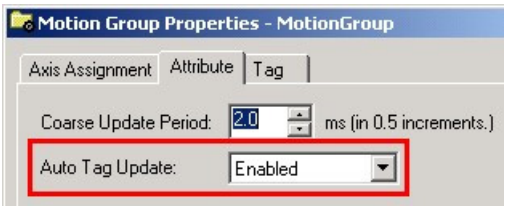
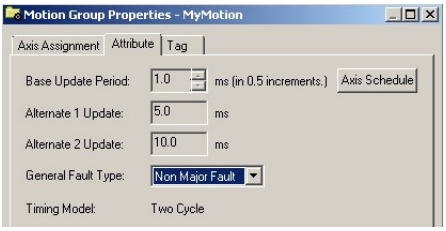
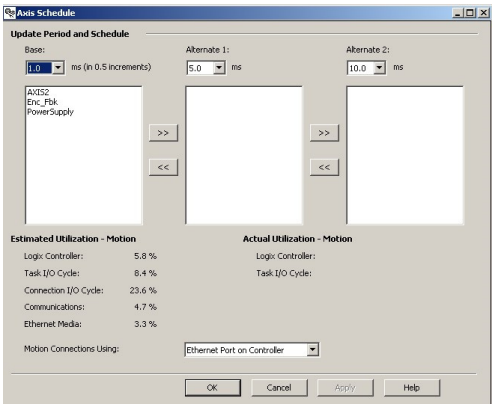
## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Homing Mode**<br>  | **Homing Mode**<br>  |
| **Active:** The desired homing sequence is selected by specifying whether a home limit switch or the encoder marker is used for this axis. Active homing sequences always use the trapezoidal velocity profile.<br>**Passive:** Passive homing is most commonly used to calibrate uncontrolled axes, although it can also be used with controlled axes to create a custom homing sequence. | |
| **Absolute:** The absolute homing process establishes the true absolute position of the axis by applying the configured Home Position to the reported position of the absolute feedback device.<br>**IMPORTANT:** The only valid Home Sequence for an absolute Homing Mode is immediate. | **IMPORTANT:** For an EtherNet/IP axis, if the motor contains an absolute position-capable feedback device, the homing operation automatically sets the absolute position. |
| **Homing Sequence**<br>  | **Homing Sequence**<br>  <br>**IMPORTANT:** EtherNet/IP axes currently do not support the home to torque level sequence. This functionality can be implemented via software in your Studio 5000 project.<br>See the Sample Code Library, filename/ID **055818** – CIP Axis Home To Torque AOI |
| **Fault Actions**<br>  | **Fault Actions**<br>  |
| A Sercos axis is limited to nine fault actions. | For an EtherNet/IP axis, see Appendix G – Axis Exceptions on page 61 for the fault actions referred to as exception conditions. The number of configurable conditions has been expanded. |

## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Drive Enable Input Fault Example**<br><br>For Sercos axis, the Drive Enable Input Fault checkbox is on the Drive/Motor tab. Uncheck this box to ignore this fault.<br><br>  <br><br><br>Otherwise assign the appropriate fault action.<br><br>  <br> | **Action – Enable Input Deactivated Example**<br><br>For an EtherNet/IP axis, the Enable Input Deactivated actions (including Ignore) are available on the Actions page.<br><br>  <br><br><br>Typically the following actions are available.<br><br>  <br><br><br>**IMPORTANT:** The available actions can vary between exception conditions. |

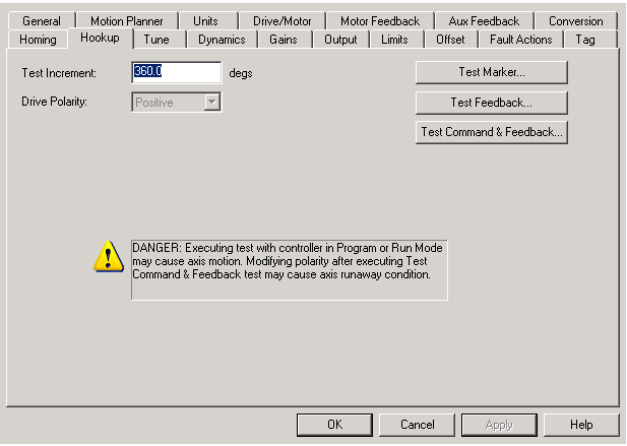
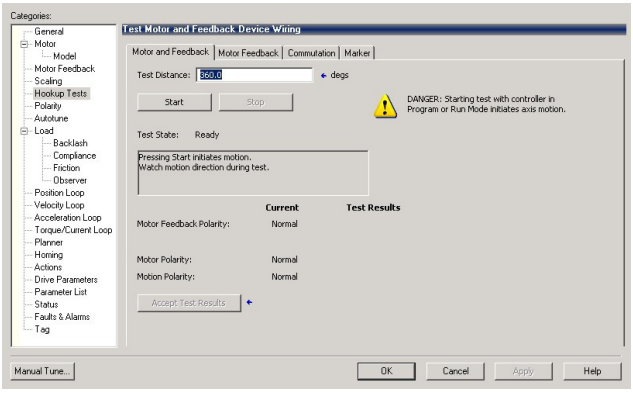
## Axis Configuration Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Real-Time Axis Information**<br>  <br><br>For a Sercos axis, you can select two additional real-time attributes, and default Auto Tag Update attributes. The attributes update at the coarse update rate and are read-only. | **Drives Parameters**<br>  <br><br>An EtherNet/IP axis supports up to 10 read parameters and 10 write parameters. These parameters are transferred at the cyclic/coarse rate and are available in the axis structure. For a detailed list of the parameters, see Appendix D – Drive Parameters Cyclic Read and Write List on page 43.<br>**IMPORTANT:** Each parameter that is selected as a cyclic read/write attribute adds overhead to the controller/drive data exchange. You must analyze the trade-off of real-time data on the timing of the axis. |
| **Update Period and Schedule**<br>To obtain real-time axis Information for both Sercos and EtherNet/IP axes, Auto Tag Update must be enabled. The Auto Tag Update Enable/Disable option has been moved to an SSV instruction in Studio 5000 Logix Designer® application, version 24 or later. The default setting for this feature is Enabled, the same as all previous releases of Logix Designer.<br>  <br> | **Update Period and Schedule**<br>The Base Update Period is essentially the RPI rate for Ethernet communication between the controller and the motion module, a Unicast connection.<br>  <br><br>Integrated Motion on the EtherNet/IP network multiplexing allows for the controller to execute up to three effective update rates for a motion group. Multiplexing also improves EtherNet/IP Integrated Architecture® motion system performance by reducing average Logix controller and EtherNet/IP network utilization.<br>  <br> |

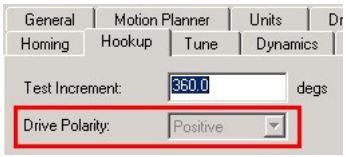
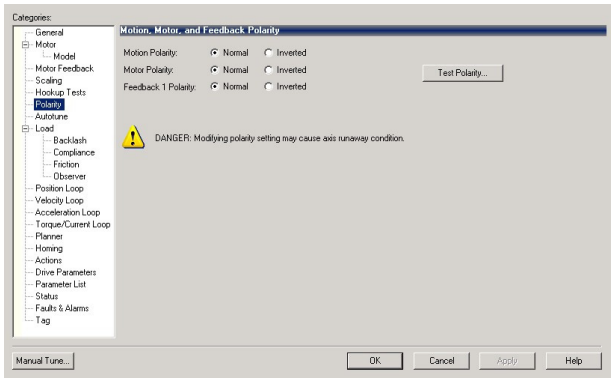
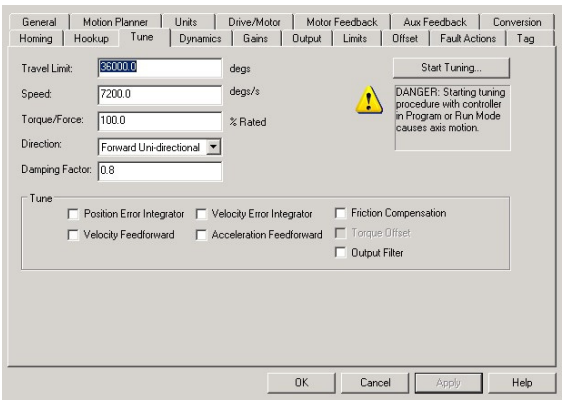
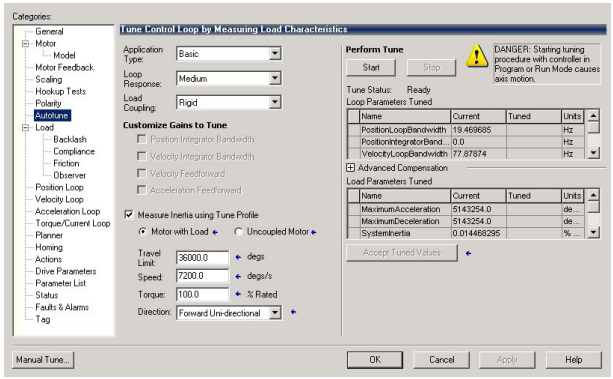
## Axis Commissioning

This section compares how to commission the axis for Integrated Motion on Sercos and EtherNet/IP systems.

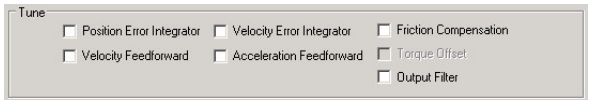
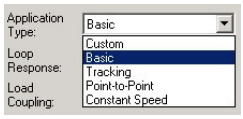
### Axis Commissioning Comparison

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Hookup Tests**<br>  | **Hookup Tests**<br>  |
| The hookup tests interfaces between the Sercos and EtherNet/IP axes are similar.<br>The hookup tests are used to verify the proper connection of the feedback device, and to determine motor and feedback polarity.<br>**IMPORTANT:** The Hookup Tests for both Sercos and EtherNet/IP axes can be executed while the controller is in Program Mode. | |
| **N/A**<br>**IMPORTANT:** For a Sercos axis, the commutation test feature is not supported. | **Commutation Test**<br>**IMPORTANT:** Check your firmware release notes for supported features. |

## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Drive Polarity**<br><br>For a Sercos axis, the Drive Polarity is updated based on the results of the hookup tests. The Drive Polarity setting is on the Hookup tab.<br><br>  <br><br>**IMPORTANT:** The drive polarity for a Sercos axis cannot be manually changed while online with a controller. | **Polarity**<br><br>For an EtherNet/IP axis, the Motion Polarity, Motor Polarity, and Feedback Polarity are updated based on the results of the hookup tests.<br><br>  <br><br>**IMPORTANT:** Use the hookup tests to adjust polarity settings correctly. An incorrect adjustment in the polarity settings can lead to an axis runaway condition. |
| **Tune**<br><br>  | **Autotune**<br><br>  |

## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Tune Settings**<br><br>For a Sercos axis, the Application Type pull-down selection does not exist. Instead, you select the individual tuning parameters that are appropriate for the applications.<br><br>  <br> | **Application Type**<br><br>Application Type defines the servo loop tuning parameters that are used. These combinations determine how the gains are calculated, which can eliminate the need to tune the system manually.<br><br>  <br> |

| Application Type | Kpi | Kvi | ihold | Kvff | Kaff | TorqLPF |
|---|---|---|---|---|---|---|
| Custom | – | – | – | – | – | – |
| Basic (version 20 and later) | No | No | No | Yes | No | Yes |
| Basic (version 19 and earlier) | No | No | No | No | No | – |
| Tracking | No | Yes | No | Yes | Yes | Yes |
| Point-to-Point | Yes | No | Yes | No | No | Yes |
| Constant Speed | No | Yes | No | Yes | No | Yes |

**Custom**: Advanced setup. You select specific tuning parameters that are based on the application.

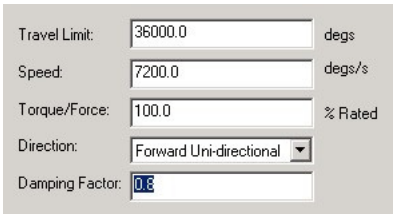
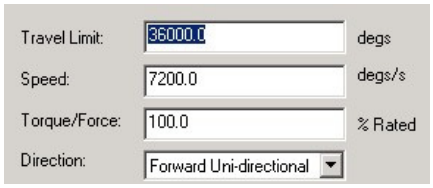
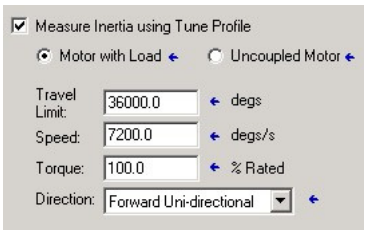
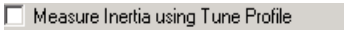
**Basic**: Default setup. Recommended as a starting point for or out-of-the-box configurations.

**Tracking**: Intended for applications that require minimal following error. For example, un/winding, flying shear, and web control applications.

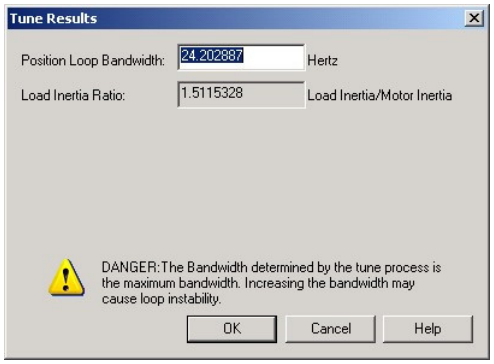
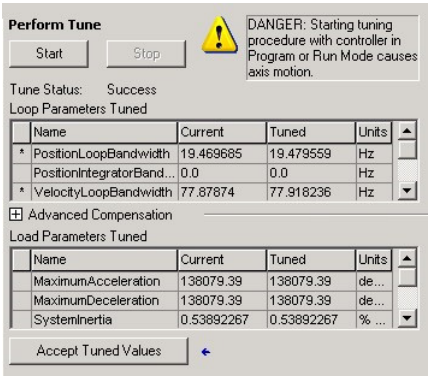
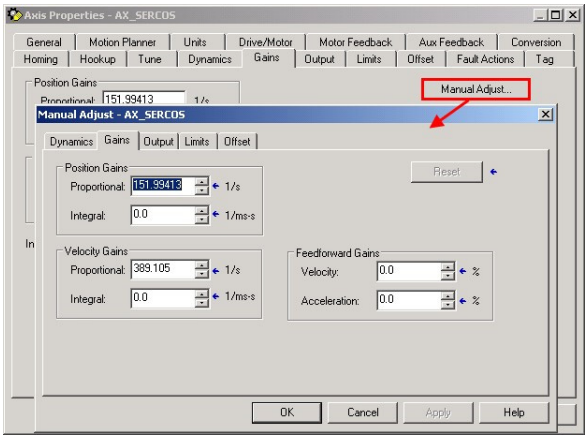
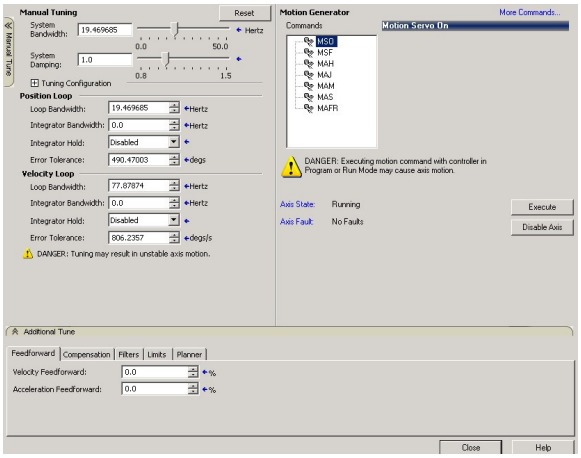
**Point-to-Point**: Intended for applications that require precise position moves with minimal overshoot. For example, pick-n-pace, packaging, and cut-to-length applications.

**Constant Speed**: Intended for applications that require minimal velocity error at steady state speed. For example, conveyor, line shaft, and crank applications.

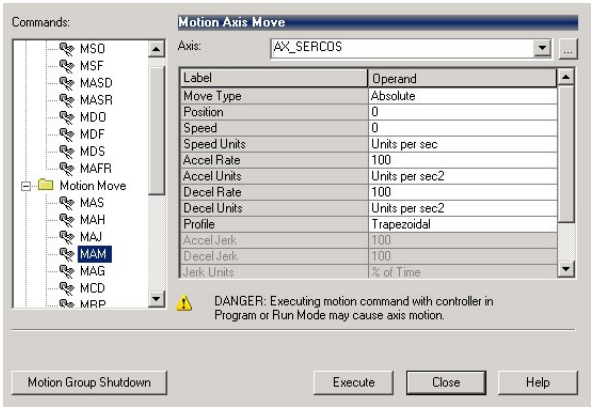
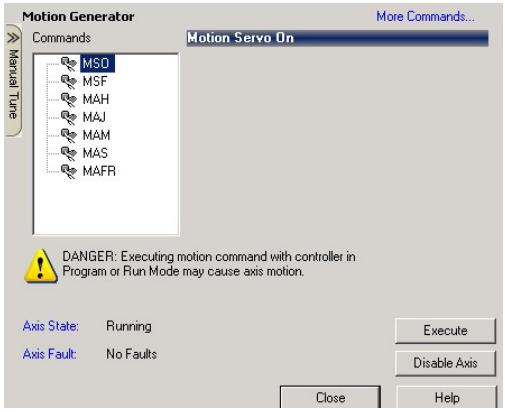
## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Damping Factor**<br><br>For a Sercos axis, the Loop Response pull-down selection does not exist. Instead you enter the desired damping factor, which impacts the gain calculations.<br><br>  | **Loop Response**<br><br>  <br>**Low**: Damping factor = 1.5<br>**Medium**: Damping factor = 1.0<br>Medium is the default setting. Recommended as a starting point for out-of-the-box configurations.<br>**High**: Damping factor = 0.8<br><br>**IMPORTANT:** The damping factor is used to calculate the maximum position and velocity servo bandwidth values. In general, the damping factor controls the dynamic response of the drive.<br>When the tuning gains are calculated by using a small damping factor, for example 0.8, a step response test tends to demonstrate an under-damped behavior with velocity overshoot.<br>However, when the damping factor is increased to 1.0, the step response tends to exhibit little to no overshoot and typically works well for most applications. |
| **N/A**<br><br>For a Sercos axis, the Load Coupling pull-down selection feature is not supported. | **Load Coupling**<br><br>  <br>The Load Coupling automatically corrects the loop gains according to how tightly the system is physically coupled. |
| **Tune Profile**<br><br>  <br><br>For a Sercos axis, you can adjust the tune profile according to the application limitations. The tune profile is used to measure the system inertia. This measurement requires the motor to move the connected load to assess the inertia. | **Tune Profile**<br><br>  <br><br>For an EtherNet/IP axis, you can adjust the tune profile, and the tune profile can be used to measure the uncoupled motor inertia separate from the load.<br>In cases where the system inertia has been established, the inertia test can also be disabled based on the selection of the Measure Inertia by using Tune Profile checkbox.<br><br>  <br><br>This allows the loop gains to be calculated each time the Perform Tune button is clicked and eliminates the need to re-run the inertia test during successive tuning iterations. |

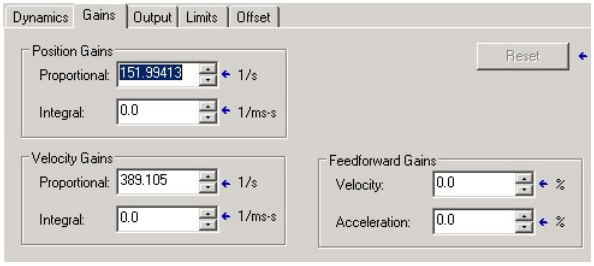
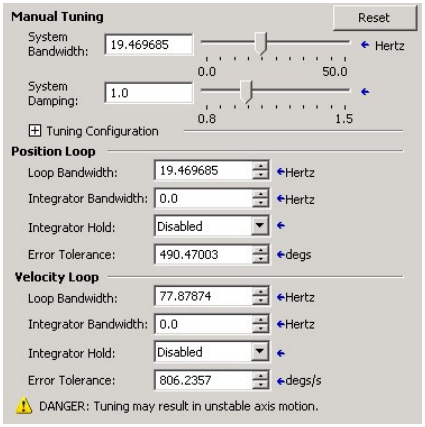
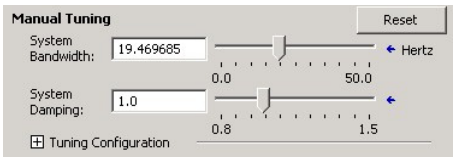
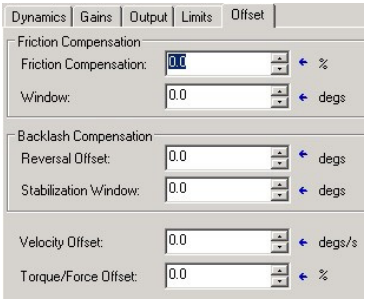
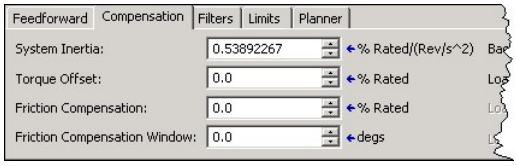
## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Tune Results** | **Tune Results** |
|  |  |
| Upon completion of the autotune, a Sercos axis displays the Position Loop Bandwidth and measured Load Inertia Ratio. Click OK to accept the tune results. | For an EtherNet/IP axis, a more encompassing list of both loop and load parameters are displayed.<br>The '*' next to a parameter indicates the values that are updated. Click Accept Tuned Values to accept these tune results. |
| **Manual Tuning – Manual Adjustment and Motion Direct Commands** | **Manual Tuning** |
|  |  |
| For a Sercos axis, the Manual Adjust interface adjusts only the tuning related parameters. | The Manual Tuning interface consolidates many of the commonly used features that are used during the manual tuning process. |

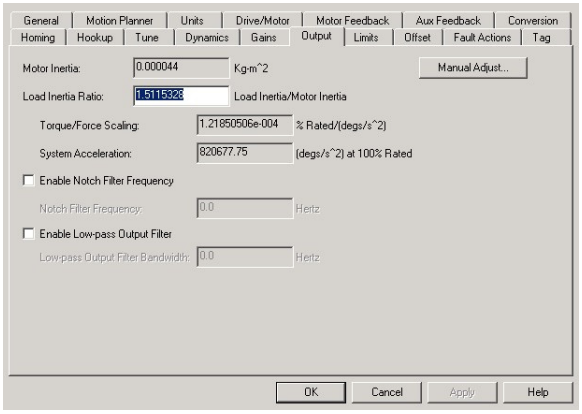
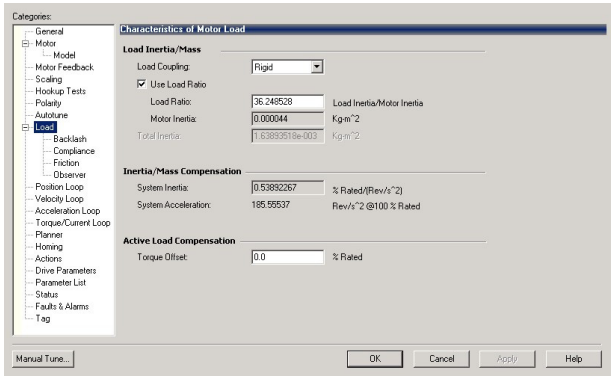
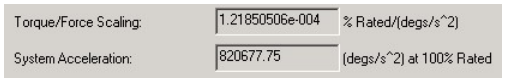
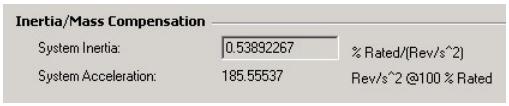
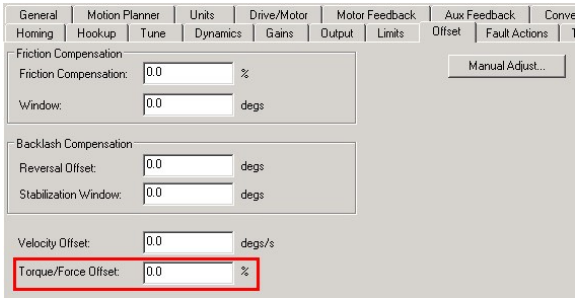
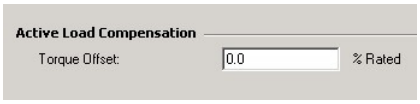
## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Motion Direct Commands**<br>  <br><br>For a Sercos axis, you typically launch the Motion Direct Commands for manual control of the drive during the tuning process. | **Motion Generator**<br>  <br><br>As a part of the manual tuning interface, the Motion Generator feature includes direct access to several of the most commonly used motion direct commands. The direct access reduces the need to launch the Motion Direct Commands interface to complete the manual tuning process. |

## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Gains**<br>  <br><br>For a Sercos axis, the gains can only be adjusted individually via the Manual Adjust interface. | **Manual Tune – Loop Gains**<br>  <br><br>The Manual Tuning interface offers two options to adjust the loop gains. Each parameter can be adjusted on an individual basis, or as an entire set of gains that are adjusted proportionally with a parameter.<br>Adjustments to the System Bandwidth or System Damping recalculates the gains accordingly.<br>  <br><br>**IMPORTANT:** For an EtherNet/IP axis, the loop gains (including System Bandwidth) are now represented in Hertz. |
| **Offset**<br>  <br><br>For a Sercos axis, the Manual Adjust interface provides access to the Dynamics, Gains, Output, Limits, and Offset parameters. | **Additional Tune**<br>  <br><br>The Manual Tuning interface provides access to additional loop and load parameters that are often adjusted during the tuning process. |

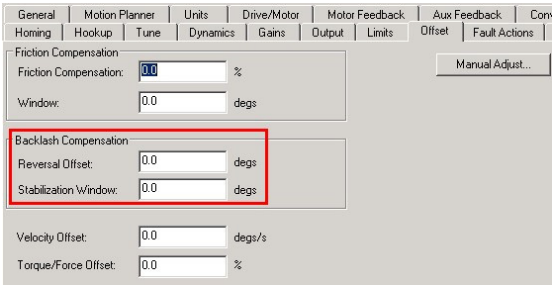
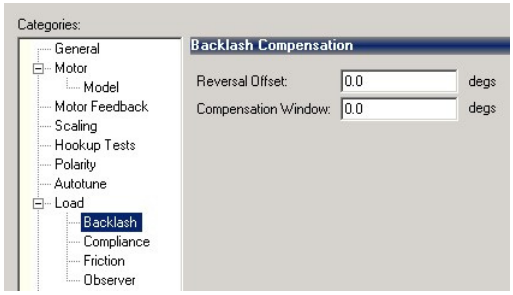
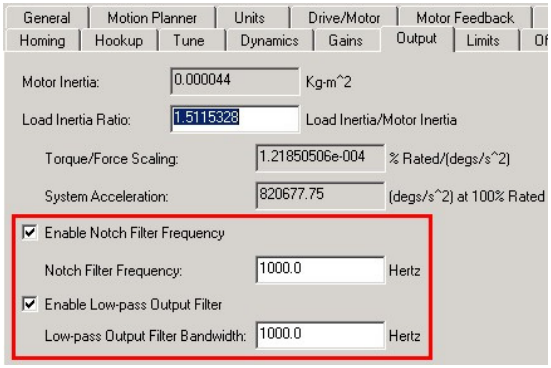
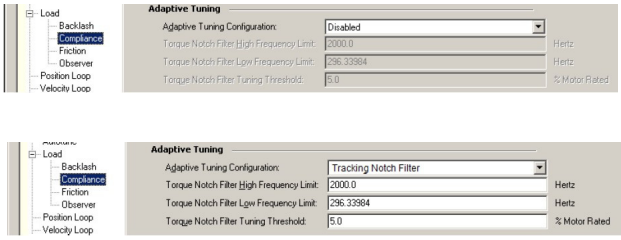
## Axis Commissioning Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Output**<br>  | **Load**<br>  |
| **Torque/Force Scaling**<br>  <br>The Torque/Force Scaling attribute is used to convert the acceleration of the servo loop into equivalent percentage-rated torque to the motor. This conversion normalizes the units of the servo loops gains so that variations in feedback resolution, drive scaling, motor/load inertia, and mechanical gear ratios do not affect their values. | **System Inertia**<br>  <br>For an EtherNet/IP axis, the Torque/Force Scaling is referred as System Inertia. |
| **Torque/Force Offset**<br>  <br>For a Sercos axis, Torque/Force Offset is on the Offset tab. | **Torque Offset**<br>  |

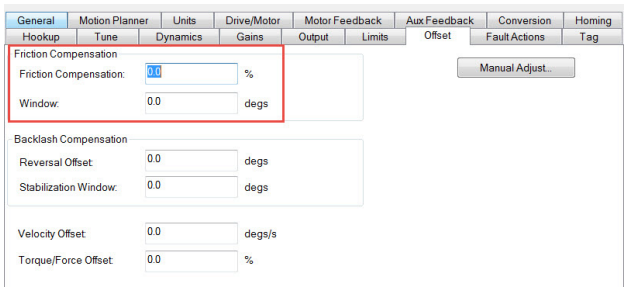
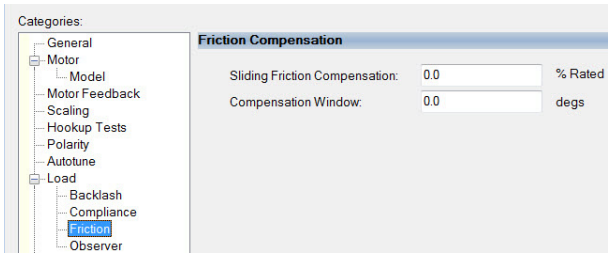
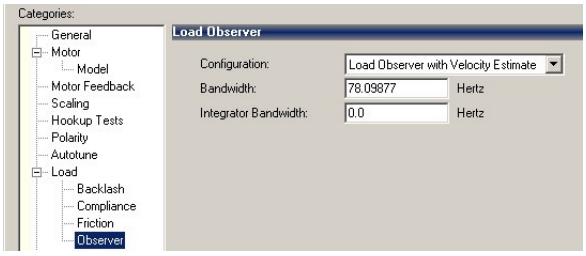
## Additional Axis Property Equivalents

This section compares the additional axis property equivalents for Integrated Motion on Sercos and EtherNet/IP systems.

### Additional Axis Property Equivalents Comparison

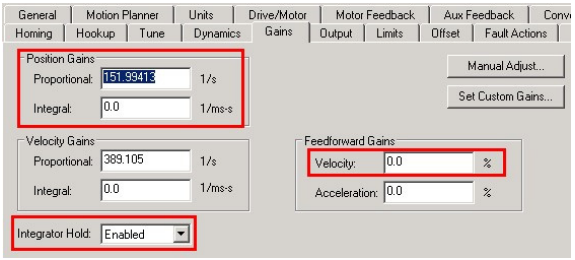
| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Torque Control Compensation Features**<br>A number of important compensation features are included in the torque control loop to help overcome physical effects that are typical in many mechanical systems.<br>**IMPORTANT:** For complete details on tuning, see the Motion System Tuning Application Technique, publication MOTION-AT005, for both Sercos and Integrated Motion on the EtherNet/IP network. | |
| **Offset – Backlash Compensation**<br>  | **Backlash Compensation**<br>  <br>Use Backlash Compensation to stabilize the control loop for applications with high load-inertia ratios and mechanical backlash. |
| **Output – Low Pass and Notch Filters**<br>  | **Compliance Compensation**<br>  <br>A new feature available in Kinetix 5500 and Kinetix 5700 drives is Adaptive Tuning, which includes the tracking notch filter and gain stabilization features. The Adaptive Tuning features operate while the axis runs to mitigate high frequency resonances and help maintain stability during operation.<br>**IMPORTANT:** The Lead-Lag filter in EtherNet/IP axes can be used in the lead configuration to boost velocity or acceleration loop bandwidth. The filter can also be used in the lag configuration to compensate for the frequency gain boost associated with compliant load mechanics. |

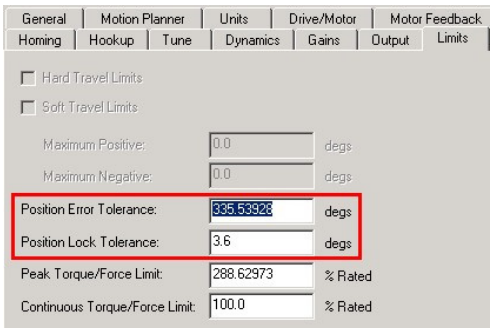
## Additional Axis Property Equivalents Comparison (Continued)

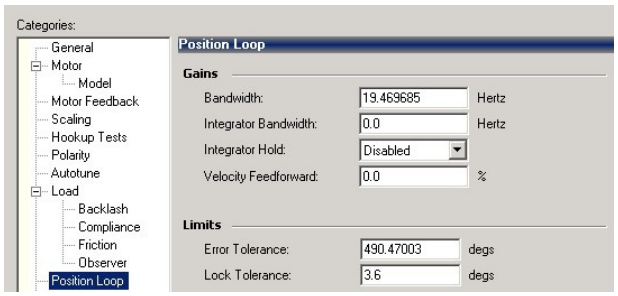
| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Offset – Friction Compensation**<br>  | **Friction Compensation**<br>  <br>Friction Compensation applies a compensating directional torque or force to the motor to overcome the effects of friction in the mechanical system. This compensation helps to minimize the amount of control effort required. |
| **Load Observer**<br>Load observer is not available through the Sercos Axis Properties menu. However, load observer can be configured with message instructions. | **Load Observer**<br>  <br>The Load Observer feature is a control loop inside the drive that estimates the mechanical load on the motor and compensates for the load. This feature allows the control loops to treat the motor as if it is unloaded and relatively easy to control. |

## Additional Axis Property Equivalents Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Loop Gains and Limits**<br>The loop gains between a Sercos and EtherNet/IP axis are similar; however, a few notable differences do exist. | |
| **Position Gains and Limits** | **Position Loop** |



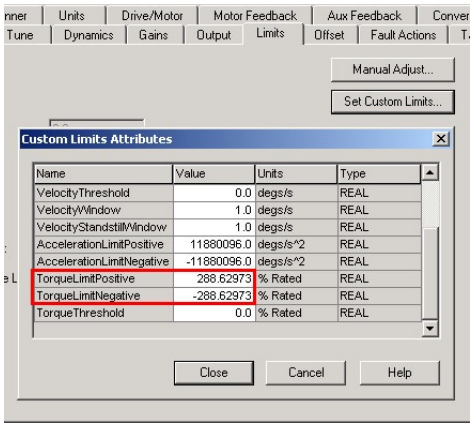
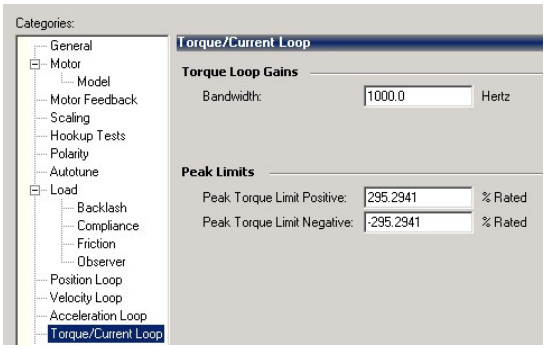
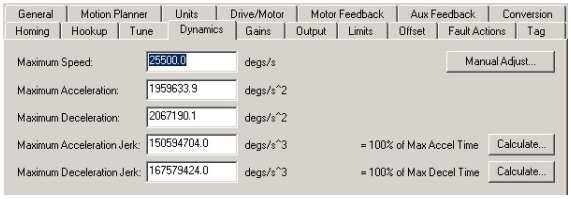
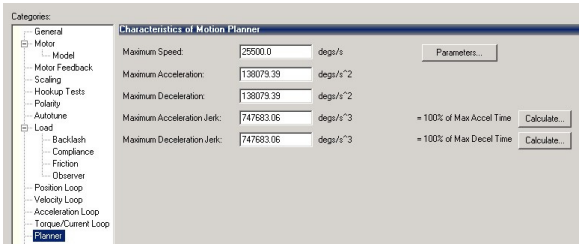



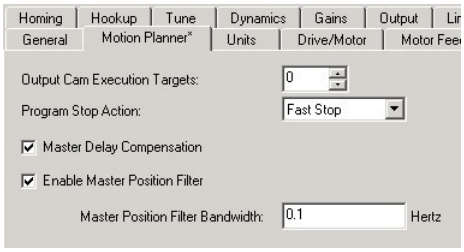
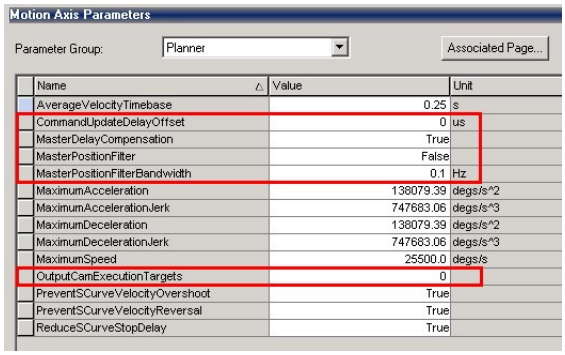
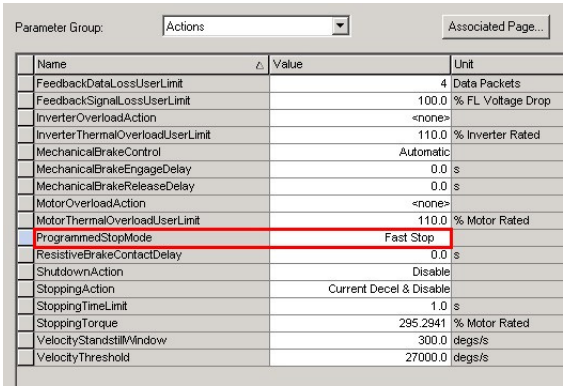
## Additional Axis Property Equivalents Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Velocity Gains and Limits** | **Velocity Loop** |
| | **IMPORTANT:** For an EtherNet/IP axis, the Bipolar Velocity Limit does not exist. The Velocity Limit Positive and Velocity Limit Negative limits must be set independently. |
| **Acceleration Limits** | **Acceleration Loop** |
| | **IMPORTANT:** For an EtherNet/IP axis, the Bipolar Acceleration Limit does not exist. The Acceleration Limit and Deceleration Limit must be set independently. |

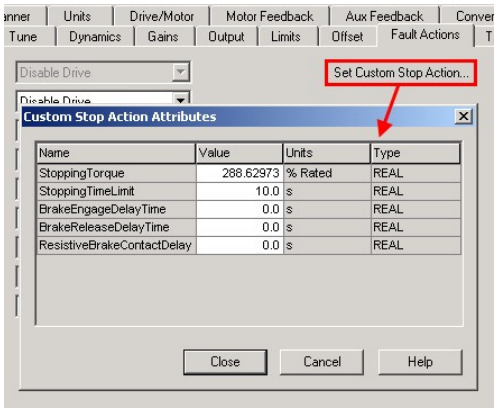
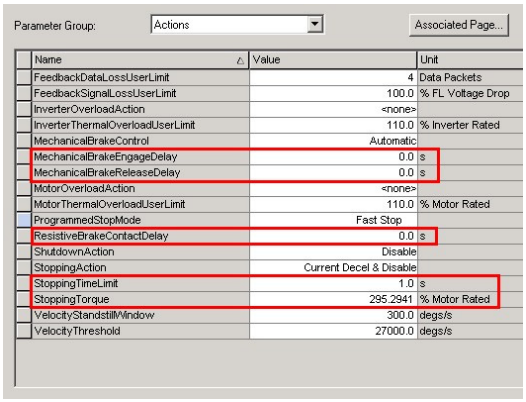
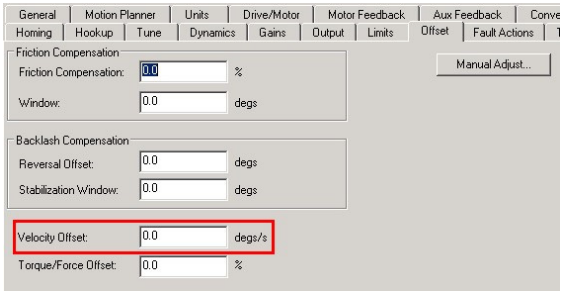
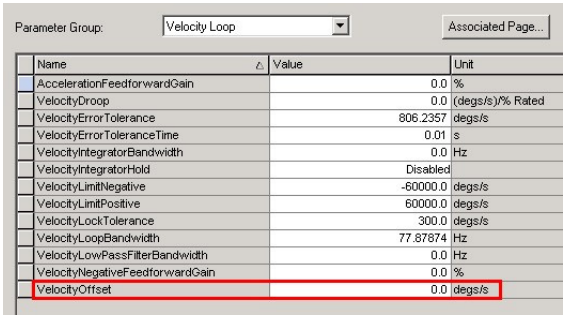
## Additional Axis Property Equivalents Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Torque Limits**<br>  <br><br>**IMPORTANT:** For a Sercos axis, direct access to the Torque Loop Gain is not available. | **Torque/Current Loop**<br>  <br> |
| **Dynamics**<br>  <br> | **Planner**<br>  <br><br>For an EtherNet/IP axis, the Dynamics tab is called Planner. |

## Additional Axis Property Equivalents Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Motion Planner**<br>  <br><br>The Motion Planner is the part of the controller that takes care of position and velocity information for the axes. | **Motion Planner Parameters**<br>For an EtherNet/IP axis, the Output Cam Execution Targets and Master Delay Compensation parameters are located under the Planner Parameter Group listing. Click Parameters... to switch between the page and parameter views.<br>  <br><br>The Program Stop Action is located under the Actions Parameter Group listing.<br>  <br><br>**IMPORTANT:** Each Parameter Group list can contain more attributes than the associated page. In some instances, attributes listed in the Parameter Group list are not displayed on the associated page. |

## Additional Axis Property Equivalents Comparison (Continued)

| Integrated Motion on Sercos Interface | Integrated Motion on the EtherNet/IP Network |
|---|---|
| **Set Custom Stop Action**<br>  | **Custom Stop Action**<br>  <br>For an EtherNet/IP axis, the Custom Stop Action parameters are located under the Action Parameter Group listing. |
| **Velocity Offset**<br>  | **Velocity Offset**<br>  <br>For an EtherNet/IP axis, the Velocity Offset parameter is located under the Velocity Loop Parameter Group listing. |

## Diagnostics

This section highlights some of the diagnostic capabilities unique to Integrated Motion on the EtherNet/IP networks.

### Axis Structure

The AXIS_CIP_DRIVE axis structure is different as compared to the AXIS_SERVO_DRIVE axis structure that is the required axis structure for Sercos-based servo drives. Some of the tags match or have similar functions, while additional tags are included in the AXIS_CIP_DRIVE axis structure:

- The AXIS_SERVO_DRIVE axis structure contains 209 tags.
- The AXIS_CIP_DRIVE axis structure contains 468 tags.

One reason for the increase in tags is the increase in the number of faults, and also the addition of alarm tags. For example, there is a series of basic fault bits that now exist under the Axis Fault word.

**Basic Axis Fault Tags**

| Name | Value | Force Mask | Style | Data Type |
|---|---|---|---|---|
| AX_Ethernet | {...} | {...} | | AXIS_CIP_DRIVE |
| AX_Ethernet.AxisFault | 16#0000_0001 | | Hex | DINT |
| AX_Ethernet.PhysicalAxisFault | 1 | | Decimal | BOOL |
| AX_Ethernet.ModuleFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ConfigFault | 0 | | Decimal | BOOL |
| AX_Ethernet.GroupFault | 0 | | Decimal | BOOL |
| AX_Ethernet.MotionFault | 0 | | Decimal | BOOL |
| AX_Ethernet.GuardFault | 0 | | Decimal | BOOL |
| AX_Ethernet.InitializationFault | 0 | | Decimal | BOOL |
| AX_Ethernet.APRFault | 0 | | Decimal | BOOL |

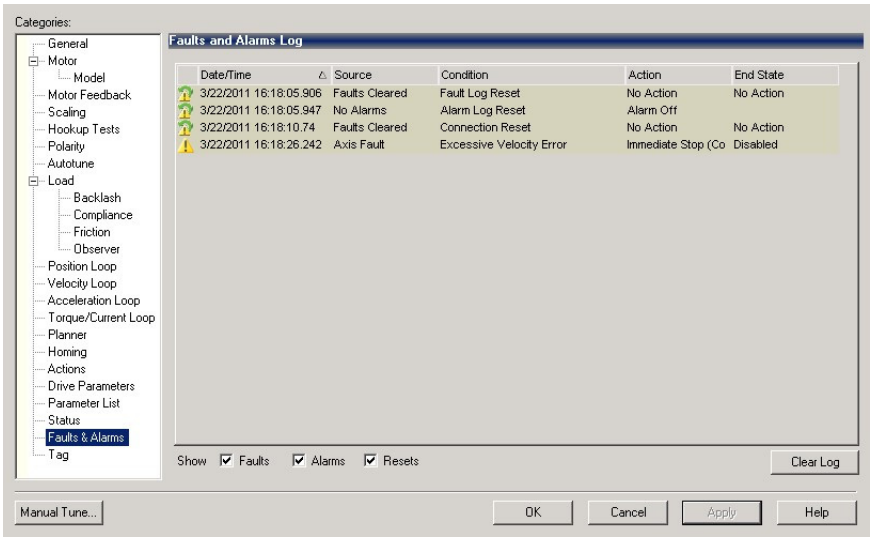
When a fault condition is detected, the associated fault type bit is set. This action provides a high-level view to determine which fault group is active. Also, the fault types are broken down into individual fault and alarm status bits.

**Fault and Alarm Status Bits**

| Name | Value | Force Mask | Style | Data Type |
|---|---|---|---|---|
| AX_Ethernet.ModuleFaults | 16#0000_0000 | | Hex | DINT |
| AX_Ethernet.ControlSyncFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ModuleSyncFault | 0 | | Decimal | BOOL |
| AX_Ethernet.TimerEventFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ModuleHardwareFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ModuleConnFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ConnFormatFault | 0 | | Decimal | BOOL |
| AX_Ethernet.LocalModeFault | 0 | | Decimal | BOOL |
| AX_Ethernet.CPUWatchdogFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ClockJitterFault | 0 | | Decimal | BOOL |
| AX_Ethernet.CyclicReadFault | 0 | | Decimal | BOOL |
| AX_Ethernet.CyclicWriteFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ClockSkewFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ControlConnFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ControlClockSyncFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ModuleClockSyncFault | 0 | | Decimal | BOOL |
| AX_Ethernet.LogicWatchdogFault | 0 | | Decimal | BOOL |
| AX_Ethernet.DuplicateAddressFault | 0 | | Decimal | BOOL |
| AX_Ethernet.ModuleAlarmStatus | 16#0000_0000 | | Hex | DINT |
| AX_Ethernet.ControlSyncAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.ModuleSyncAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.TimerEventAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.CPUOverloadAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.ClockJitterAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.OutOfRangeAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.ClockSkewAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.ClockSyncAlarm | 0 | | Decimal | BOOL |
| AX_Ethernet.NodeAddressAlarm | 0 | | Decimal | BOOL |

## Faults and Alarms Log

The Faults and Alarms Log displays the status of the faults and alarms that the controller logs for each individual axis.




The display is read-only except for the ability to clear each of the logs (Faults, Alarms, and Resets) independently. For example, the Alarms log can be cleared while maintaining the Faults and Resets logs. When online, select the Show checkboxes to toggle between show and hide for the specified group of entries, and click Clear Log to clear the selected log.

**IMPORTANT** Only the last 25 faults and alarms are displayed.

## High-level Feature Comparison

This section compares features of the selected Kinetix drives.

### Kinetix Product Comparison

| | |  |  |  |  |
|---|---|---|---|---|---|
| **Topics** | **Details** | **Kinetix 6000/6200 Drives** | **Kinetix 6500 Drives** | **Kinetix 5500 Drives** | **Kinetix 5700 Drives** |
| **Key Features** | Key features | • Common bus for multi-axis applications<br>• Sercos topology | • Integrated Motion on an EtherNet/IP network<br>• Common bus and modular design | • Small footprint with optimized density<br>• Drive power ratings optimized to match VP low inertia motor family<br>• Innovative common AC/DC bus eliminates hardware, reduces installation time, and lowers costs<br>• Integrated Motion on an EtherNet/IP network | • Small footprint with optimized power density for high axis applications<br>• Innovative and quick install DC bus connection eliminates hardware, reduces installation time, and lowers costs. Higher DC bus current capacity than the Kinetix 5500 drives.<br>• Integrated Motion on an EtherNet/IP network |
| **Ratings** | AC input voltage | • 195…264V AC, 3-phase<br>• 324…528V AC, 3-phase | 324…528V AC, 3-phase | • 195…264V AC, single-phase (H003…H015)<br>• 195…264V AC, 3-phase<br>• 324…528V AC, 3-phase | 324…528V AC, 3-phase |
| | Control power input voltage | 95…264V rms, single-phase | 95…264V rms, single-phase | 24V DC | 24V DC |
| | Output power rating (kW) 460V | 1.8…22 | 1.8…22 | 0.6…14.6 | 1.6…60 |
| | Converter rating (kW) 460V | 6…45 kW | 6…45 kW | 0.6…14.9 | 7.0…46 |
| | Continuous output current (A rms) | 2.8…34.6 | 2.8…34.6 | 1.0…23A | 3.5…120 A |
| | Peak output current (A rms) | 7.0…69.2 | 7.0…69.2 | 2.5…57.5 | 8.5A…226 A |
| | Peak/Continuous ratio | 250%<br>BM05-200% | 250%<br>BM05-200% | 250% | 250% |
| | Ambient temperature limit | 0…50 °C (32…122 °F) | 0…50 °C (32…122 °F) | 0…50 °C (32…122 °F) | 0…50 °C (32…122 °F) |
| | EMC filters | External | External | External | External |
| | Standards | C-UL, CE, CSA, TÜV, C-Tick, KC | C-UL, CE, CSA, TÜV, C-Tick, KC, ODVA | C-UL, CE, CSA, TÜV, C-Tick, KC, ODVA, OSHA | C-UL, CE, CSA, TÜV, C-Tick, KC, ODVA, OSHA, RoHS |
| **Drive configurations** | Bus configurations that are supported | Common bus/shared DC | Common bus/shared DC | • Standalone/single-axis<br>• Shared AC/DC<br>• Shared DC<br>• Hybrid | • Shared AC/DC<br>• Shared DC |
| **Bus-sharing** | Maximum number of axes in a bus-sharing group | 1…8 axes (power rail dependent) | 1…8 axes (power rail dependent) | 1…8 axes | >16 axes per group, limited by max cable length or precharge capability |
| **Axis instance** | Axis instance support | • One full axis instance support<br>• 1/2 axis instance support (feedback only) | • One full axis instance support<br>• 1/2 axis instance support (feedback only) | One axis instance support | • Two full axes instance support<br>• 2-1/2 axes instance support (feedback only) |
| **Network** | Network compatibility | Sercos interface | EtherNet/IP | EtherNet/IP | EtherNet/IP |
| **Controllers** | Controller comparability | L4*x*, L6*x*, L7*x* | L2, L36ERM, L7*x*, L8 | L2, L36ERM, L7*x*, L8 | L2, L36ERM, L7*x*, L8 |
| **Programming** | RSLogix™ software | RSLogix software<br>Version 17 or later | RSLogix software<br>Version 18 or later | Logix Designer application<br>Version 21 or later | Logix Designer application<br>Version 26 or later |

## Kinetix Product Comparison (Continued)

| | |  |  |  |  |
|---|---|---|---|---|---|
| **Topics** | **Details** | **Kinetix 6000/6200 Drives** | **Kinetix 6500 Drives** | **Kinetix 5500 Drives** | **Kinetix 5700 Drives** |
| **Dimensions** | Height, mm (in.) (1) | 287 (11.3) | 285 (11.2) | 170 (6.7) | 300 (11.8) |
| | Width, mm (in.) (1) | 125 (5.0) | 125 (5.0) | 50 (2.0) | 55 (2.2) |
| | Depth, mm (in.) (1) | 249 (9.8) | 290 (11.4) | 200 (7.9) | 200 (7.9) |
| | Volume, $m^3$ ($ft^3$) | 0.089 (3.143) | 0.103 (3.637) | 0.017 (0.600) | 0.033 (1.165) |
| **Safety** | Safety rating | • SIL 3 PLe<br>• Safe Torque Off<br>• Safe Speed Monitoring (only with K6200) | • SIL 3 PLe<br>• Safe Torque Off<br>• Safe Speed Monitoring | • SIL 3, PLe rated network Safe Torque Off with CIP safety<br>• SIL 2, PLd rated hardwired Safe Torque Off | • SIL 3, PLe rated network Safe Torque Off with CIP safety<br>• SIL3, PLe rated hardwired Safe Torque Off |
| **Digital inputs** | Digital input support | • Four inputs<br>• Enable, home, overtravel (+/-)<br>• High-speed registration (2/axis) | • Four inputs<br>• Enable, home, overtravel (+/-)<br>• High-speed registration (2/axis) | • Two configurable digital inputs<br>• Home/Registration 1 (dual function)<br>• High-speed registration | • Four configurable digital inputs<br>• Home/Registration 1<br>• Registration 2<br>• Over travel<br>• Enable/Regen OK |
| **Motor support** | Motor and actuator compatibility | • MP-Series™ low and medium inertia motors<br>• MP-Series food grade, stainless steel motors<br>• MP-Series linear stages and MPAR-Series linear actuators<br>• LDL-Series™ and LDC-Series™ linear motors<br>• RDD-Series™ direct drive motors<br>• Kinetix 6000 IDM system | • MP-Series low and medium inertia motors<br>• MP-Series food grade, stainless steel motors<br>• MP-Series linear stages and MPAR-Series linear actuators<br>• LDL-Series and LDC-Series linear motors<br>• RDD-Series direct drive motors | • VP low inertia servo motor with 2198-H2DCK DSL feedback converter kit<br>• MP-Series low and medium inertia motors<br>• MP-Series food grade, stainless steel motors<br>• MP-Series ball screw linear stages and linear actuators<br>• 3rd-party induction motors | • VP low inertia servo motor with 2198-H2DCK DSL feedback converter kit<br>• MP-Series low and medium inertia motors<br>• MP-Series food grade, stainless steel motors<br>• MP-Series ball screw linear stages and linear actuators<br>• 3rd-party induction motors |
| | Cable length (total), m (ft.) | 240 (787.4) | 240 (787.4) | 250 (820.2) | 400 (1 312.3)<br>(Max motor cable length per bus power-sharing group) |
| | Cable length (max/axis), m (ft.) | 90 (295.3) | 90 (295.3) | 50 (164.0) | 90 (295.3) |
| **Motor feedback support** | Motor feedback | **Kinetix 6000 drive**<br>• Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Heidenhain EnDat 2.1 (2)<br>• Heindenhain EnDat 2.2 (2)<br>• Resolver (3)<br>**Kinetix 6200 drive**<br>• Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Tamagawa 17 bit serial<br>• Heidenhain EnDat 2.1<br>• Heindenhain EnDat 2.2 | • Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Tamagawa 17 bit serial<br>• Heidenhain EnDat 2.1<br>• Heindenhain EnDat 2.2 | • Stegmann Hiperface DSL<br>• Stegmann Hiperface (4) | **DSL feedback port**<br>• Stegmann Hiperface DSL<br>• Stegmann Hiperface (4)<br>**Universal feedback port**<br>• Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Heidenhain EnDat 2.1<br>• Heindenhain EnDat 2.2 |
| **Auxiliary feedback support** | Aux feedback | **Kinetix 6000 drives**<br>• Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Heidenhain EnDat 2.1(2)<br>• Heindenhain EnDat 2.2(2)<br>**Kinetix 6200 drives**<br>• Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Heidenhain EnDat 2.1<br>• Heindenhain EnDat 2.2 | • Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Heidenhain EnDat 2.1<br>• Heindenhain EnDat 2.2 | Not applicable | **DSL feedback port**<br>• StegmannHiperface DSL<br>• Stegmann Hiperface(4)<br>**Universal feedback port**<br>• Stegmann Hiperface<br>• Generic TTL Incremental<br>• Generic Sine/Cosine Incremental<br>• Heidenhain EnDat 2.1<br>• Heindenhain EnDat 2.2 |

## Kinetix Product Comparison (Continued)

| | |  |  |  |  |
|---|---|---|---|---|---|
| **Topics** | **Details** | **Kinetix 6000/6200 Drives** | **Kinetix 6500 Drives** | **Kinetix 5500 Drives** | **Kinetix 5700 Drives** |
| **Motor control** | Surface-mounted permanent magnet motor (SPM) | Yes | Yes | Yes | Yes |
| | Induction motor (IM) | No | No | Yes | Yes |
| | Control type | No induction motor control | No induction motor control | • Induction motor control<br>• V/Hz<br>• Open-loop vector control | • Induction motor control<br>• V/Hz<br>• Open- and closed-loop vector control |
| **Performance** | Position loop update | 125 µs | 125 µs | 125 µs | 125 µs |
| | Velocity loop update | 125 µs | 125 µs | 125 µs | 125 µs |
| | Current loop update | 125 µs | 125 µs | 125 µs | 125 µs |
| | Pulse width modulation (PWM) frequency | • 8 kHz – 01 modules<br>• 4 kHz – 02 modules | • 8 kHz – 01 modules<br>• 4 kHz – 02 modules | • 8 kHz – H003<br>• 4 kHz | 4 kHz |
| | Current loop bandwidth | 1300 Hz | 1300 Hz | 1000 Hz | 1000 Hz |
| | Velocity loop bandwidth | 500 Hz | 500 Hz | 400 Hz | 400 Hz |
| | Dual loop control | Yes | Yes | No | Yes |
| | Load observer | Yes (with a message [MSG] instruction) | Yes | Yes | Yes |
| | Tracking notch | No | No | Yes | Yes |
| **Shunting** | Resistive brake modules | Yes | Yes | No | No |
| | Shunt modules | Yes | Yes | No | Yes |
| | Dynamic brake modules | No | No | No | Yes (through side car or capacitor module) |
| | External shunt resistors | Yes (through shunt module BSP2) | Yes (through shunt module BSP2) | Yes | Yes |
| | Shunt capability | Decentralized shunt (every drive has a shunt) | Decentralized shunt (every drive has a shunt) | Decentralized shunt (every drive has a shunt) | Centralized shunt (only power supplies) |
| **Power supplies** | Converter capability | • Shared DC with standalone non-CIP compliant active front end (AFE) (regenerative power supply [RPS] units)<br>• Centralized converter<br>• No parallel converter capability | • Shared DC with standalone non-CIP compliant active front end (AFE) (regenerative power supply [RPS] units)<br>• Centralized converter<br>• No parallel converter capability | • Integral converter in each drive<br>• Allows parallel converters for increased kW rating | • Shared DC with standalone non-CIP compliant active front end (AFE) (regenerative power supply [RPS] units)<br>• CIP-compliant DC-bus power supply power supplies<br>• Allows parallel converters for increased kW rating |

(1) Dimensions that are shown are for the smallest frame.
(2) Requires the use of drive firmware revision 1.116 or later and the 2090-K6CK-KENDAT low-profile feedback module for EnDat to Hiperface conversion.
(3) Resolver support only on motor feedback.
(4) Requires the use of drive firmware revision 2.002 or later and the 2198-H2DCK Hiperface to DSL feedback converter kit for Hiperface to DSL conversion.

## High-level Safety Feature Comparison

This section compares the high-level safety features of the selected Kinetix drives.

| |  |  |  |  |
|---|---|---|---|---|
| **Topics** | **Kinetix 6000/6200 Drives** | **Kinetix 6500 Drives** | **Kinetix 5500 Drives** | **Kinetix 5700 Drives** |
| **Safety type** | Hard-wire STO, catalog numbers:<br>• 2094-ACxx-Mxx-S<br>• 2094-BCxx-Mxx-S<br>• 2094-AMxx-S<br>• 2094-BMxx-S<br>• 2099-BMxx-S | Hard-wire advanced safety, catalog numbers:<br>• 2094-SE02F-M00-S0<br>• 2094-EN02D-M01-S0 | Hard-wire STO, catalog numbers:<br>• 2198-H003-ERS<br>• 2198-H008-ERS<br>• 2198-H015-ERS<br>• 2198-H025-ERS<br>• 2198-H040-ERS<br>• 2198-H070-ERS<br>Integrated STO, catalog numbers:<br>• 2198-H003-ERS2<br>• 2198-H008-ERS2<br>• 2198-H015-ERS2<br>• 2198-H025-ERS2<br>• 2198-H040-ERS2<br>• 2198-H070-ERS2 | Hard-wire STO mode/Integrated STO mode<br>Catalog numbers:<br>• 2198-S086-ERS3<br>• 2198-S130-ERS3<br>• 2198-S160-ERS3<br>• 2198-D006-ERS3<br>• 2198-D012-ERS3<br>• 2198-D020-ERS3<br>• 2198-D032-ERS3<br>• 2198-D057-ERS3 |
| **Configuration** | None | Web page | AOP/Studio 5000 application | AOP/Studio 5000 application |
| **Safety connection type** | Not applicable | Safety internal to drive, only motion | • Catalog numbers that end in -ERS, only motion<br>• Catalog numbers that end in -ERS2, motion and safety | Motion and safety (if network STO) |
| **Reference** | See the Kinetix Safe Torque Off Feature Safety Reference Manual, publication GMC-RM002, for connector data and wiring installation. | See the Kinetix 6200 and Kinetix 6500 Safe Torque Off Multi-axis Servo Drives Safety Reference Manual, publication 2094-RM002, for installation and wiring, and Safe Torque Off I/O signals. | See the Kinetix 5500 Servo Drives User Manual, publication 2198-UM001, for the STO connector pinout, installation, and wiring information.<br>See the 'Kinetix 5500 Safe Torque Off Integrated Safety' chapter for integrated safety drive specifications, configuration of motion and safety connections, direct motion commands, and the STO bypass feature. | See the Kinetix 5700 Servo Drives User Manual, publication 2198-UM002, for the STO connector pinout, installation, and wiring information.<br>See the 'Kinetix 5700 Safe Torque Off Function' chapter for integrated safety drive specifications, configuration of motion and safety connections, direct motion commands, and the STO bypass feature. |

## Appendix A – Communication Networks and Managed Communication

See the 'Communication Networks' and 'Manage Controller Communication' chapters of the ControlLogix 5580 Controllers User Manual, publication 1756-UM543, for examples of communication networks and connection resources available for ControlLogix® systems.

### EtherNet/IP Network Communication

The EtherNet/IP network offers control, configuration, and data collection services by layering the Common Industrial Protocol (CIP) over the standard Internet protocols, such as TCP/IP and UDP. This combination of accepted standards provides the capability that is required to support information data exchange and control applications.

### Connection Overview

A Logix5000™ controller provides connection resources whenever communications are established between two devices. Connections are used when the system contains the following conditions or activities:

- I/O modules, communication modules, and adapters are present in the I/O configuration of the user project.
- Produced or consumed tags are configured in the user project.
- Connected messages are executed in the user application.
- External devices, programming terminals, or HMIs communicate with the controller.

See the ControlLogix 5580 Controllers User Manual, publication 1756-UM543, for a detailed explanation of each topic.

## Appendix B – Configuration of the Kinetix 5700 Converter Module

For information on how to configure your Kinetix 5700 drive system with a Logix5000™ controller, see 'Configure and Start the Kinetix 5700 Drive System' in the Kinetix 5700 Servo Drives User Manual, publication 2198-UM002.

## Appendix C – Design and Implementation Guide for Using Integrated Motion on an EtherNet/IP Network

This section is intended to help balance the needs of the application with the cost of the network components. Motion control brings a need for real-time synchronization to the network, but a managed switched with Quality of Service (QoS) and CIP Sync on each machine is not always needed. However, when linking multiple automation cells or machines together, a managed switch with QoS and CIP Sync must be used. Detailed guidelines can be found in the 'CIP Sync' and 'CIP Sync Sequence of Events' chapters of the Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001.

### Answers to Frequently Asked Questions

How can real-time applications be accomplished over a non-deterministic network like Ethernet?

- Each time-sensitive device has its own internal clock, accurate to the nanosecond level.
- The internal clocks are synchronized and tuned to a master clock over the network once per second.
- This update mechanism is known as CIP Sync and is part of the IEEE 1588-2008 standard for time synchronization.
- CIP Sync is designed to account for real-time latencies in the network and to allow the devices to ride through master clock changes.

How is motion control accomplished over standard Ethernet?

- The clocks in the servo drives are coordinated to the master clock by using CIP Sync.
- A packet of information is sent out to each drive in advance of when it is needed, so the drive can receive it and execute it when required:
  - Think of these packets as meeting invitations with a location and a time that represents the key position and time stamp coordinates for the axis.
  - Like meeting invitations, the drives receive these packets at random times due to network loading. But because they are sent in advance, the axes still arrive in their coordinated positions at the precise time.
- The drive further interpolates its position between these points to improve smoothness.

What could cause these time-sensitive devices to get out of sync and effect motion accuracy?

- Any traffic that interrupts the CIP Sync messages from being delivered accurately, including these items:
  - Unexpected network traffic without proper prioritization.
  - Broadcast traffic without proper prioritization.
  - Loops created using unmanaged switches that could fault the system and stop production.
- However, even these disturbances typically add less inaccuracy than the usual mechanical errors induced by system tuning, backlash, and compliance (which are often greater by an order of magnitude).

How can these disturbances be minimized and any risks mitigated?

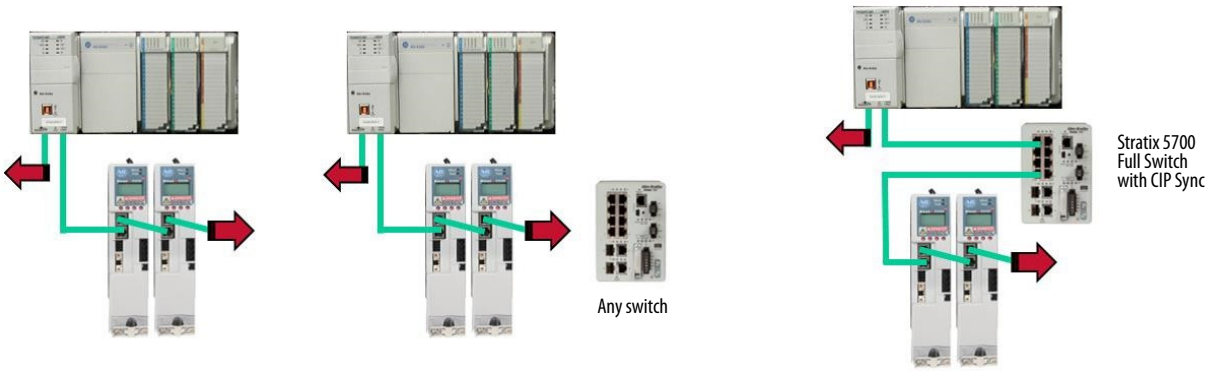
- Use managed switches with QoS and CIP Sync where economically feasible.
- Connect the time-sensitive devices that include embedded switches directly to the controller.
- Protect any unmanaged switches that are used in manufacturing cells with managed switches where they tie into the greater network.

### Component Selection Guidelines

General guidelines for devices that include an embedded Ethernet switch:

- Connect these devices directly to the controller without an interposing switch when possible.
- Place any switches without CIP Sync at the end of the line of embedded switch products.
- Use a switch that includes CIP Sync if connected between the controller and time-sensitive devices.
- Connect all other types of traffic to the red arrow points or to the switches as shown in Embedded Ethernet Switch Connection Example on page 41.

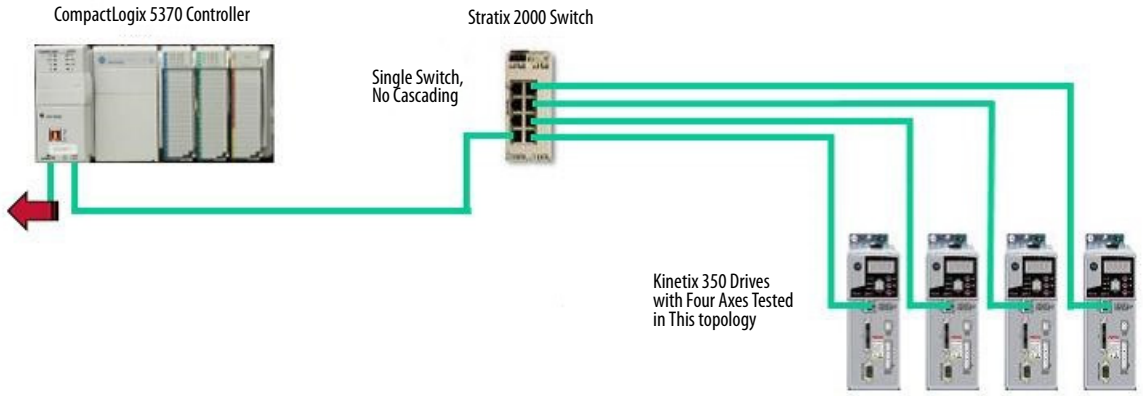
**Embedded Ethernet Switch Connection Example**



General guidelines for single-port Ethernet products (like Kinetix 350 drives):

- For 1...4 axes, offer a Stratix 2000 unmanaged switch(1) if price is a concern.
- For 5...8 axes, offer a Stratix 5700 full managed switch(1) if price is a concern.
- Over 8 axes, offer a Stratix 5700 full (with CIP Sync) managed switch.
- Use 1783-ETAP devices for ring topologies with Kinetix 350 drives.

**Single-port Ethernet Connection Example**




(1) The application must not require tight coordination between axes or minimal following error when using these switches.

# Appendix D – Drive Parameters Cyclic Read and Write List

This section provides cyclic read and write drive parameters.

**Drive Parameters Cyclic Read and Write List**

| Sercos Axis (Real-time Axis Info) Cyclic Read Parameters | Kinetix 5700 Drive EtherNet/IP Axis Cyclic Read Parameters | EtherNet/IP Axis Cyclic Write Parameters |
|---|---|---|
| PositionCommand | PositionFineCommand | PositionTrim |
| PositionFeedback | PositionReference | VelocityTrim |
| AuxPositionFeedback | PositionFeedback1 | TorqueTrim |
| PositionError | PositionError | VelocityFeedforwardGain |
| PositionIntegratorError | PositionIntegratorOutput | AccerlationFeedforwardGain |
| VelocityCommand | PositionLoopOutput | PositionLoopBandwidth |
| VelocityFeedback | VelocityFineCommand | PositionIntegratorBandwidth |
| VelocityError | VelocityFeedforwardCommand | VelocityLoopBandwidth |
| VelocityIntegratorError | VelocityReference | VelocityIntegratorBandwidth |
| AccelerationCommand | VelocityFeedback | LoadObserverBandwidth |
| AccelerationFeedback | VelocityError | LoadObserverIntegratorBandwidth |
| MarkerDistance | VelocityIntegratorOutput | TorqueLimitPositive |
| TorqueCommand | VelocityLoopOutput | TorqueLimitNegative |
| TorqueFeedback | AccelerationFineCommand | VelocityLowPassFilterBandwidth |
| PositiveDynamicTorqueLimit | AccelerationFeedforwardCommand | TorqueLowPassFilterBandwidth |
| NegativeDynamicTorqueLimit | AccelerationReference | SystemInertia= |
| MotorCapacity | AccelerationFeedback | |
| DriveCapacity | LoadObserverAccelerationEstimate | |
| PowerCapacity | LoadObserverTorqueEstimate | |
| BusRegulatorCapacity | TorqueReference | |
| MotorElectricalAngle | TorqueReferenceFiltered | |
| TorqueLimitSource | TorqueReferenceLimited | |
| DCBusVoltage | CurrentCommand | |
| | CurrentReference | |
| | CurrentFeedback | |
| | CurrentError | |
| | FluxCurrentReference | |
| | FluxCurrentFeedback | |
| | FluxCurrentError | |
| | OperativeCurrentLimit | |
| | CurrentLimitSource | |
| | MotorElectricalAngle | |
| | OutputFrequency | |
| | OutputCurrent | |
| | OutputVoltage | |

**Drive Parameters Cyclic Read and Write List (Continued)**

| Sercos Axis<br>(Real-time Axis Info)<br>Cyclic Read Parameters | Kinetix 5700 Drive EtherNet/IP Axis<br>Cyclic Read Parameters | EtherNet/IP Axis<br>Cyclic Write Parameters |
|---|---|---|
| | OutputPower | |
| | DCBusVoltage | |
| | MotorCapacity | |
| | InverterCapacity | |
| | **Kinetix 5700 Drive<br>EtherNet/IP Converter Axis<br>Cyclic Read Parameters** | |
| | ConverterOutputCurrent | |
| | ConverterOutputPower | |
| | DCBusVoltage | |
| | ConverterCapacity | |
| | BusRegulatorCapacity | |

# Appendix E – Available GSV and SSV Data

This section provides information for system variables.

**Get System Variable (GSV)**

| Get System Variable (GSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Acceleration Feedforward Command | | X |
| Acceleration Command | X | |
| Acceleration Feedback | X | X |
| Actual Acceleration | | X |
| Actual Position | X | X |
| Actual Velocity | X | X |
| Analog Input 1 | X | X |
| Analog Input 2 | X | X |
| Attribute Error Code | X | X |
| Attribute Error ID | X | X |
| Aux Position Feedback | X | |
| Average Velocity | X | X |
| Axis Configuration | | X |
| Axis Control Bits | X | |
| Axis Event Bits | X | X |
| Axis Fault Bits | X | X |
| Axis Response Bits | X | |
| Axis Status Bits | X | X |
| Axis Features | | X |
| Bus Regulator Capacity | X | X |
| CIP Axis Faults | | X |
| CIP Axis Faults RA | | X |
| CIP Axis IO Status | | X |
| CIP Axis IO Status RA | | X |
| CIP Axis State | | X |
| CIP Axis Status | | X |
| CIP Axis Status RA | | X |
| CIP Initialization Faults | | X |
| CIP Initialization Faults RA | | X |
| CIP Start Inhibit | | X |
| CIP Start Inhibit RA | | X |
| Command Acceleration | X | X |
| Command Position | X | X |
| Command Velocity | X | X |
| Control Method | | X |
| Current Command | | X |

**Get System Variable (GSV) (Continued)**

| Get System Variable (GSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| DC Bus Voltage | X | X |
| Drive Capacity | X | |
| Drive Fault Bits | X | |
| Drive Status Bits | X | |
| Drive Warning Bits | X | |
| Guard Faults | X | X |
| Guard Status | X | X |
| Hookup Test Commutation Offset | | X |
| Hookup Test Commutation Polarity | | X |
| Hookup Test Feedback 1 Direction | | X |
| Hookup Test Feedback 2 Direction | | X |
| Hookup Test Status | | X |
| Interpolated Actual Position | X | X |
| Interpolated Command Position | X | X |
| Inverter Capacity | | X |
| Marker Distance | X | X |
| Master Offset | X | X |
| Module Alarm Bits | | X |
| Module Fault Bits | X | X |
| Module Status Bits | X | |
| Motor Capacity | X | X |
| Motion Alarm Bits | | X |
| Motion Fault Bits | | X |
| Motion Status Bits | | X |
| Motor Electrical Angle | X | X |
| Motor Test Counter EMF | | X |
| Motor Test Inductance | | X |
| Motor Test Resistance | | X |
| Motor Test Status | | X |
| Motor Unit | | X |
| Negative Dynamic Torque Limit | X | |
| Output Cam Lock Status | X | X |
| Output Cam Pending Status | X | X |
| Output Cam Status | X | X |
| Output Cam Transition Status | X | X |
| Output Current | | X |
| Output Power | | X |
| Output Voltage | | X |
| Position Command | X | |

**Get System Variable (GSV) (Continued)**

| Get System Variable (GSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Position Error | X | X |
| Position Feedback | X | X |
| Position Integrator Error | X | |
| Position Integrator Output | | X |
| Position Loop Output | | X |
| Position Reference | | X |
| Positive Dynamic Torque Limit | X | |
| Power Capacity | X | |
| Registration 1 Negative Edge Position | | X |
| Registration 1 Negative Edge Time | | X |
| Registration 1 Position | | X |
| Registration 1 Positive Edge Position | | X |
| Registration 1 Positive Edge Time | | X |
| Registration 1 Time | | X |
| Registration 2 Negative Edge Position | | X |
| Registration 2 Negative Edge Time | | X |
| Registration 2 Position | | X |
| Registration 2 Positive Edge Position | | X |
| Registration 2 Positive Edge Time | | X |
| Registration 2 Time | | X |
| Registration 1 Position | X | X |
| Registration 1 Time | X | X |
| Registration 2 Position | X | X |
| Registration 2 Time | X | X |
| Sercos Error Code | X | |
| Start Actual Position | X | X |
| Start Command Position | X | X |
| Start Master Offset | X | X |
| Strobe Actual Position | X | X |
| Strobe Command Position | X | X |
| Strobe Master Offset | X | X |
| Test Direction Forward | X | |
| Test Status | X | |
| Torque Feedback | X | |
| Torque Limit Source | X | |
| Torque Reference | | X |
| Torque Reference Filtered | | X |
| Torque Reference Limited | | X |
| Tune Acceleration | X | X |

**Get System Variable (GSV) (Continued)**

| Get System Variable (GSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Tune Acceleration Time | X | X |
| Tune Deceleration | X | X |
| Tune Deceleration Time | X | X |
| Tune Inertia | X | |
| Tune Status | | X |
| Velocity Command | X | |
| Velocity Error | X | X |
| Velocity Feedback | X | X |
| Velocity Feedforward Command | | X |
| Velocity Integrator Error | X | |
| Velocity Integrator Output | | X |
| Velocity Loop Output | | X |
| Velocity Reference | | X |
| Watch Position | X | X |

**Set System Variables (SSV)**

| Set System Variables (SSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Acceleration Feedforward Gain | X | X |
| Acceleration Limit Bipolar | X | |
| Acceleration Limit Negative | X | |
| Acceleration Limit Positive | X | |
| Average Velocity Time Base | X | X |
| AxisInfoSelect 1 | X | |
| AxisInfoSelect 2 | X | |
| Axis Type | X | |
| Backlash Reversal Offset | X | X |
| Backlash Stabilization Window | X | |
| Brake Engage Time Delay | X | |
| Brake Release Time Delay | X | |
| CIP Axis Alarm Log Reset | | X |
| CIP Axis Fault Log Reset | | X |
| Command Update Delay Offset | X | X |
| Continuous Torque Limit | X | |
| Control Mode | | X |
| Conversion Constant | X | X |
| Damping Factor | X | X |
| Drive Enable Fault Action | X | |
| Drive Model Time Constant | X | X |
| Drive Polarity | X | |

**Set System Variables (SSV) (Continued)**

| Set System Variables (SSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Drive Thermal Fault Action | X | |
| Dynamics Configuration Bits | X | X |
| Fault Configuration Bits | X | |
| Feedback Configuration | | X |
| Feedback Mode | | X |
| Feedback Fault Action | X | |
| Feedback Noise Fault Action | X | |
| Friction Compensation | X | |
| Friction Compensation Window | X | |
| Gain Tuning Configuration Bits | | X |
| Hardware Overtravel Fault Action | X | |
| Home Configuration bits | X | X |
| Home Direction | X | X |
| Home Mode | X | X |
| Home Offset | X | X |
| Home Position | X | X |
| Home Return Speed | X | X |
| Home Sequence | X | X |
| Home Speed | X | X |
| Home Torque Level | X | |
| Hookup Test Distance | | X |
| Hookup Test Feedback Channel | | X |
| Inhibit Axis | X | X |
| Integrator Hold Enable | X | |
| Interpolation Time | X | X |
| Linear Motor Mass | X | |
| Load Inertia Ratio | X | X |
| Load Ratio | | X |
| Master Input Configuration Bits | X | X |
| Master Position Filter Bandwidth | X | X |
| Maximum Acceleration | X | X |
| Maximum Acceleration Jerk | X | X |
| Maximum Deceleration | X | X |
| Maximum Deceleration Jerk | X | X |
| Maximum Negative Travel | X | |
| Maximum Positive Travel | X | |
| Maximum Speed | | X |
| Motion Polarity | | X |
| Motion Resolution | | X |

**Set System Variables (SSV) (Continued)**

| Set System Variables (SSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Motor Inertia | X | |
| Motor Thermal Fault Action | X | |
| Output LP Filter Bandwidth | X | |
| Output Notch Filter Frequency | X | |
| Position Error Fault Action | X | |
| Position Error Tolerance | X | X |
| Position Integrator Bandwidth | | X |
| Position Integrator Control | | X |
| Position Integral Gain | X | |
| Position Lock Tolerance | X | X |
| Position Loop Bandwidth | | X |
| Position Proportional Gain | X | |
| Position Servo Bandwidth | | X |
| Position Trim | | X |
| Position Unwind | X | X |
| Programmed Stop Mode | X | X |
| Resistive Brake Contact Delay | X | |
| Rotary Axis | X | |
| Rotary Motor Inertia | X | |
| Scaling Source | | X |
| Servo Loop configuration | X | |
| Soft Overtravel Fault Action | X | |
| Soft Travel Limit Checking | | X |
| Soft Travel Limit Negative | | X |
| Soft Travel Limit Positive | | X |
| Stopping Action | | X |
| Stopping Time Limit | X | |
| Stopping Torque | X | X |
| System Bandwidth | | X |
| System Damping | | X |
| System Inertia | | X |
| Test Increment | X | |
| Torque Limit Bipolar | X | |
| Torque Limit Negative | X | X |
| Torque Limit Positive | X | X |
| Torque Offset | X | X |
| Torque Scaling | X | |
| Torque Threshold | X | X |
| Torque Trim | | X |

**Set System Variables (SSV) (Continued)**

| Set System Variables (SSV) | Sercos Axis | EtherNet/IP Axis |
|---|---|---|
| Travel Mode | | X |
| Travel Range | | |
| Tune Friction | | X |
| Tune Inertia Mass | | X |
| Tune Load Offset | | X |
| Tuning Configuration Bits | X | |
| Tuning Direction | | X |
| Tuning Select | | X |
| Tuning Speed | X | X |
| Tuning Torque | X | X |
| Tuning Travel Limits | X | X |
| Velocity Droop | X | X |
| Velocity Feedforward Gain | X | X |
| Velocity Integral Gain | X | |
| Velocity Integrator Bandwidth | | X |
| Velocity Integrator Control | | X |
| Velocity Limit Bipolar | X | |
| Velocity Limit Negative | X | X |
| Velocity Limit Positive | X | X |
| Velocity Loop Bandwidth | | X |
| Velocity Offset | X | X |
| Velocity Proportional Gain | X | |
| Velocity Servo Bandwidth | X | X |
| Velocity Standstill Window | X | X |
| Velocity Threshold | X | X |
| Velocity Trim | | X |
| Velocity Window | X | |

## Appendix F – Axis Attributes

This section highlights some of the differences in tags between Sercos axes and EtherNet/IP axes. Some tags in a Sercos axis are not applicable to an EtherNet/IP axis, and vice versa. Some tag names changed between Sercos and EtherNet/IP, such as AuxPositionFeedback and PositionFeedback2. See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for a comprehensive list of EtherNet/IP Axis Attributes.

| AXIS_SERVO_DRIVE<br>Sercos Axis | Type | AXIS_CIP_DRIVE<br>EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | DirectVelocity<br>ControlStatus | BOOL | When the Direct Velocity Control Status bit is set, the Direct Command Velocity value controls the axis speed. The Motion Drive Start instruction (MDS) sets this bit, and only applies to CIP drive axis types. |
| N/A | N/A | DirectTorque<br>ControlStatus | BOOL | When the Direct Torque Control Status bit is set, the Command Torque value controls the axis torque. The Motion Drive Start instruction (MDS) sets this bit, and only applies to CIP drive axis types. |
| N/A | N/A | MotionAlarm<br>Status | DINT | 0 = Reserved<br>1 = SoftTravelLimitPositiveAlarm<br>2 = SoftTravelLimit NegativeAlarm<br>3…31 = Reserved |
| N/A | N/A | SoftTravelLimit<br>PositiveAlarm | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Positive attribute value in the positive direction.<br>If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Positive value by using a motion instruction results in an instruction error. |
| N/A | N/A | SoftTravelLimit<br>NegativeAlarm | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Negative attribute value in the negative direction.<br>If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Negative value by using a motion instruction results in an instruction error. |
| N/A | N/A | MotionFaultStatus | DINT | 0 = Reserved<br>1 = SoftTravelLimitPositiveFault<br>2 = SoftTravelLimitNegativeFault<br>3…31 = Reserved |
| N/A | N/A | SoftTravelLimit<br>PositiveFault | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Positive attribute value in the positive direction.<br>If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Positive value by using a motion instruction results in an instruction error. |
| N/A | N/A | SoftTravelLimit<br>NegativeFault | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Negative attribute value in the negative direction.<br>If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Negative value by using a motion instruction results in an instruction error. |
| N/A | N/A | Registration1<br>PositiveEdgePosition | REAL | Feedback position that is latched on the rising edge of the Registration Input 1. |

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | Registration1 NegativeEdgePosition | REAL | Feedback Position latched on the falling edge of the Registration Input 1. |
| N/A | N/A | Registration2 PositiveEdgePosition | REAL | Feedback position that is latched on the rising edge of the Registration Input 2. |
| N/A | N/A | Registration2 NegativeEdgePosition | REAL | Feedback Position latched on the falling edge of the Registration Input 2. |
| N/A | N/A | Registration1 PositiveEdgeTime | DINT | CST time stamp on the rising edge of the Registration Input 1. |
| N/A | N/A | Registration1 NegativeEdgeTime | DINT | CST time stamp on the falling edge of the Registration Input 1. |
| N/A | N/A | Registration2 PositiveEdgeTime | DINT | CST time stamp on the rising edge of the Registration Input 2. |
| N/A | N/A | Registration2 NegativeEdgeTime | DINT | CST time stamp on the falling edge of the Registration Input 2. |
| N/A | N/A | DirectCommand Velocity | REAL | The Direct Command Velocity attribute provides tag access to the velocity command for the specified axis. Use this attribute to control the speed of a motor when an associated drive is configured for velocity control mode.<br>For the value of this attribute, to be applied as the velocity command, a Motion Drive Start instruction is executed. The instruction sets the Direct Velocity Control Status bit of the Motion Status Bits attribute.<br>If this bit is not set, the Direct Command Velocity value has no effect on axis motion. Only CIP Drive Axis data types currently support this capability. |
| PositionCommand | REAL | *Equivalent:* PositionFine Command | REAL | The Position Fine Command attribute is the output value from the Command Position fine interpolator. |
| N/A | N/A | PositionReference | REAL | The Position Reference attribute is the command position reference signal into the position loop-summing junction to be compared with a position feedback signal. |
| PositionFeedback | REAL | PositionFeedback1 | REAL | The Position Feedback 1 attribute is the actual position of the encoder. |
| AuxPosition Feedback | REAL | PositionFeedback2 | REAL | The Position Feedback 2 attribute is the actual position of the encoder. |
| PositionIntegrator Error | REAL | PositionIntegrator Output | REAL | The Position Integrator Output attribute is the output of position integrator that represents the contribution of the position integrator to Position Loop Output. |
| N/A | N/A | PositionLoop Output | REAL | The Position Loop Output attribute is the output of the position loop forward path that represents the total control effort of the position loop. |
| VelocityCommand | REAL | *Equivalent:* VelocityFine Command | REAL | The Velocity Fine Command attribute is the output value from the Command Velocity fine interpolator.<br>When no Command Velocity signal is present when performing position control, this signal can be derived by scaling the Differential Position output value of the Command Position fine interpolator. |
| N/A | N/A | VelocityFeedforwardCommand | REAL | The Velocity Feedforward Command attribute is a command signal that represents a scaled version of the command velocity profile.<br>This signal is the Velocity Fine Command signal that is scaled by Velocity Feedforward Gain and applied to the output of the position loop. |
| N/A | N/A | VelocityReference | REAL | Command velocity reference into velocity loop summing junction. |
| VelocityIntegrator Error | REAL | VelocityIntegrator Output | REAL | Output of velocity integrator that represents the contribution of the velocity integrator to Velocity Loop Output. |

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | VelocityLoop Output | REAL | Output of velocity forward path that represents the total control effort of the velocity loop. |
| N/A | N/A | AccelerationFine Command | REAL | The Acceleration Fine Command attribute is the output value from the Command Acceleration fine interpolator. When no Command Acceleration signal is present when performing position or velocity control, this signal can be derived by scaling the Differential Velocity output value of the Command Velocity fine interpolator.<br>If no Command Velocity signal is present, the Interpolated Command Acceleration signal can be derived by scaling the second Differential Position output value of the Command Position fine interpolator. |
| N/A | N/A | Acceleration FeedforwardCommand | REAL | The Acceleration Feedforward Command attribute is a signal that represents a scaled version of the command acceleration profile.<br>This signal is the Acceleration Fine Command signal that is scaled by Acceleration Feedforward Gain and applied to the output of the velocity loop. |
| N/A | N/A | Acceleration Reference | REAL | Command velocity reference into velocity loop summing junction. |
| N/A | N/A | LoadObserver AccelerationEstimate | REAL | Output of the Load Observer that, when the Load Observer block is enabled, is applied to the acceleration reference-summing junction. In the Load Observer configuration, this signal compensates for disturbances to the load relative to an ideal load model.<br>When the Load Observer is configured to operate in Acceleration Feedback Only mode, this signal is the estimated acceleration feedback signal that is used to close the acceleration loop.<br>When the Load Observer is disabled, this signal is 0. |
| N/A | N/A | LoadObserver TorqueEstimate | REAL | Product of the Load Observer Acceleration Estimate signal and the current System Inertia value, Kj. In the Load Observer configuration, this signal represents the estimated torque disturbances to the load relative to an ideal load model.<br>When the Load Observer is configured to operate in Acceleration Feedback Only mode, this signal is an estimate of the applied motor torque.<br>When the Load Observer is disabled, this signal is 0. |
| N/A | N/A | CommandTorque | REAL | Command torque output from Fine Command Generator (if active) into torque input summing junction when configured for torque control. |
| N/A | N/A | TorqueReference | REAL | Commanded torque reference input signal before torque filter section that represents the sum of the Torque Command and Torque Trim signal inputs. |
| N/A | N/A | TorqueReference Filtered | REAL | Commanded torque reference input signal after torque filter section. |
| N/A | N/A | TorqueReference Limited | REAL | Commanded torque reference input signal after torque limiter section. |
| TorqueCommand | REAL | *Equivalent:* CurrentReference | REAL | Current reference signal, Iq, into the torque-producing current loop-summing junction. |
| N/A | N/A | CurrentCommand | REAL | Represents the instantaneous commanded torque-producing current signal, Iq, before passing through the Current Vector Limiter. The attribute is tied directly to the output of torque reference path after the 1/Kt scaling that represents the torque effort to be applied to the torque-producing Iq current loop of the drive.<br>The nominal value for 1/Kt is 1 based on 100% rated torque that is produced by 100% rated current. |
| TorqueFeedback | REAL | *Equivalent:* CurrentFeedback | REAL | Actual torque current that is applied to the axis based on current sensor feedback (% Motor Rated). |
| N/A | N/A | CurrentError | REAL | Error between commanded and actual current that is the output of the torque-producing, q-axis, current loop. |

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | FluxCurrent Reference | REAL | Command current reference, Id, into the flux-producing current loop-summing junction. |
| N/A | N/A | FluxCurrent Feedback | REAL | Actual flux current that is applied to the axis based on current sensor feedback. |
| N/A | N/A | FluxCurrentError | REAL | Error between commanded and actual current that is the output of the flux-producing, d-axis, current loop summing junction. |
| N/A | N/A | OperativeCurrent Limit | REAL | Represents the operative current limit that is based on multiple limit sources. |
| TorqueLimit Source | DINT | *Equivalent:* CurrentLimit Source | DINT | Represents the operative source of a current limit if a current limit condition occurs. |
| N/A | N/A | SlipCompensation | REAL | Indicates the actual amount of slip compensation currently being applied. |
| N/A | N/A | OutputFrequency | REAL | The Output Frequency attribute is the time averaged output frequency that is applied to motor. Frequency value is in terms of electrical cycles. |
| N/A | N/A | OutputCurrent | REAL | The Output Current attribute is the total time averaged output current applied to motor. |
| N/A | N/A | OutputVoltage | REAL | The Output Voltage attribute is the total time averaged phase-to-phase output voltage that is applied to motor. |
| N/A | N/A | OutputPower | REAL | The Output Power attribute is the total time averaged output power of the motor. This value is based on the product of the Torque Reference signal and the Velocity Feedback. |
| DriveCapacity | REAL | *Equivalent:* InverterCapacity | REAL | The Inverter Capacity attribute is the real-time estimate of the continuous rated inverter thermal capacity that is used during operation that is based on the inverter thermal model.<br>A value of 100% indicates that the inverter is being used at 100% of rated capacity as determined by the continuous current rating of the inverter. |
| PowerCapacity | REAL | *Equivalent:* Converter Capacity | REAL | The Converter Capacity attribute is the real-time estimate of the continuous rated converter thermal capacity that is used during operation that is based on the converter thermal model.<br>A value of 100% indicates that the converter is being used at 100% of rated capacity as determined by the continuous current rating of the converter. |
| N/A | N/A | DigitalInputs | DINT | The Digital Inputs attribute is a 32-bit word with bits assigned by the vendor to general-purpose digital inputs. |
| N/A | N/A | PositionTrim | REAL | The Position Trim attribute is an additional position command added to the Position Command to generate the Position Reference signal into the position loop-summing junction. |
| VelocityOffset | REAL | *Equivalent:* VelocityTrim | REAL | Additional velocity command added to the velocity loop-summing junction. |
| Acceleration Command | REAL | *Equivalent:* AccelerationTrim | REAL | Additional acceleration command added to the acceleration loop-summing junction. |
| TorqueOffset | REAL | *Equivalent:* TorqueTrim | REAL | Additional torque command added to the torque input summing junction. |
| N/A | N/A | VelocityFeed forwardGain | REAL | The Velocity Feedforward Gain attribute multiplies the Velocity Feedforward Command signal to form the Velocity Feedforward Command that is applied to the velocity loop-summing junction. |
| N/A | N/A | Acceleration FeedforwardGain | REAL | The Acceleration Feedforward Gain attribute is a value that multiplies the Acceleration Fine Command signal to form the Acceleration Feedforward Command that is applied acceleration loop summing junction. |

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | PositionLoop Bandwidth | REAL | The Position Loop Bandwidth attribute determines the proportional gain, Kpp, of the position loop that multiplies the Position Error signal.<br>This value represents the unity gain bandwidth of the position loop beyond which the position loop is ineffective. |
| N/A | N/A | PositionIntegrator Bandwidth | REAL | The Position Integrator Bandwidth attribute determines the position loop integral gain, Kpi, which together with the Kpp, multiplies the integrated Position Error signal.<br>This value represents the bandwidth of the position integrator beyond which the integrator is ineffective. A value of 0 for this attribute disables the integrator. |
| N/A | N/A | VelocityLoop Bandwidth | REAL | The Velocity Loop Bandwidth attribute is a value that determines the proportional gain, Kvp, of the velocity loop that multiplies the Velocity Error signal.<br>This value represents the unity gain bandwidth of the velocity loop. |
| N/A | N/A | VelocityIntegrator Bandwidth | REAL | The Velocity Integrator Bandwidth attribute determines the velocity loop integral gain, Kvi, which together with the Kvp, multiplies the integrated Velocity Error signal.<br>This value represents the bandwidth of the velocity integrator beyond which the integrator is ineffective. A value of 0 for this attribute disables the integrator. |
| N/A | N/A | LoadObserver Bandwidth | REAL | The Load Observer Bandwidth attribute determines the proportional gain, Kop, of the load observer. This value represents the unity gain bandwidth of the load observer. |
| N/A | N/A | LoadObserver IntegratorBandwidth | REAL | The Load Observer Integrator Bandwidth attribute determines the load observer integral gain, Koi, which together with the Kop, multiplies the integrated error signal within the observer.<br>This value represents the bandwidth of the integrator beyond which the integrator is ineffective.<br>A value of 0 for this attribute disables the integrator. |
| N/A | N/A | TorqueLimit Positive | REAL | This positive value determines the maximum positive torque that can be applied to the motor. If the device attempts to exceed this value, the torque command is clamped to this value. |
| N/A | N/A | TorqueLimit Negative | REAL | This negative value determines the most negative torque value that can be applied to the motor. If the device attempts to apply a more negative torque than this limit, the torque command is clamped to this value. |
| N/A | N/A | VelocityLowPass FilterBandwidth | REAL | The Velocity Low Pass Filter Bandwidth attribute controls the bandwidth of the Low Pass Filter applied to the Velocity Error signal.<br>The recommended implementation is a two-pole IIR filter.<br>A value of 0 for this attribute disables this feature. |
| N/A | N/A | TorqueLowPass FilterBandwidth | REAL | Break frequency for the second order low pass filter that is applied to torque reference signal. |
| N/A | N/A | SystemInertia | REAL | Torque or force scaling gain value that converts commanded acceleration into equivalent rated torque/force.<br>Properly set, this value represents the total system inertia or mass. |
| N/A | N/A | Current Disturbance | REAL | Injected current command that produces torque that is used to excite the motor as part of Frequency Analysis service. |
| N/A | N/A | DigitalOutputs | DINT | The Digital Outputs attribute is a 32-bit word with bits assigned by the vendor to general-purpose digital outputs. |
| N/A | N/A | AnalogOutput1 | REAL | The Analog Output 1 attribute is a general-purpose analog output 1 level. |
| N/A | N/A | AnalogOutput2 | REAL | The Analog Output 1 attribute is a general-purpose analog output 2 level. |
| MarkerDistance | REAL | N/A | N/A | Marker Distance in Position Units. |

<table>
<tr><th>AXIS_SERVO_DRIVE<br>Sercos Axis</th><th>Type</th><th>AXIS_CIP_DRIVE<br>EtherNet/IP Axis</th><th>Type</th><th>Description</th></tr>
<tr><td>PosDynamicTorqueLimit</td><td>REAL</td><td>N/A</td><td>N/A</td><td>The currently operative maximum positive torque/current limits magnitude. It is the lowest value of all torque/current limits in the drive at a given time, including: amplifier peak limit, motor peak limit, user current limit, amplifier thermal limit, and motor thermal limit.</td></tr>
<tr><td>NegDynamic<br>TorqueLimit</td><td>REAL</td><td>N/A</td><td>N/A</td><td>The currently operative negative positive torque/current limits magnitude. It is the lowest value of all torque/current limits in the drive at a given time, including: amplifier peak limit, motor peak limit, user current limit, amplifier thermal limit, and motor thermal limit.</td></tr>
<tr><td>DriveStatus</td><td>DINT</td><td>N/A</td><td>N/A</td><td>The status bits for your servo drive.
<table>
<tr><th>Bit</th><th>No.</th><th>Data Type</th><th>Description</th></tr>
<tr><td>- no tag -</td><td>00</td><td>DINT</td><td>Servo Action Status</td></tr>
<tr><td>- no tag -</td><td>01</td><td>DINT</td><td>Drive Enable Status</td></tr>
<tr><td>- no tag -</td><td>02</td><td>DINT</td><td>Axis Shutdown Status</td></tr>
<tr><td>ProcessStatus</td><td>03</td><td>DINT</td><td>Process Status</td></tr>
<tr><td>Reserved</td><td>04, 05</td><td>N/A</td><td>Reserved</td></tr>
<tr><td>HomeInputStatus</td><td>06</td><td>DINT</td><td>Home Input Status</td></tr>
<tr><td>Reg1InputStatus</td><td>07</td><td>DINT</td><td>Registration 1 Input Status</td></tr>
<tr><td>Reg2InputStatus</td><td>08</td><td>DINT</td><td>Registration 12Input Status</td></tr>
<tr><td>PosOvertravelInputStatus</td><td>09</td><td>DINT</td><td>Positive Overtravel Input Status</td></tr>
<tr><td>NegOvertravelInputStatus</td><td>10</td><td>DINT</td><td>Negative Overtravel Input Status</td></tr>
<tr><td>EnableInputStatus</td><td>11</td><td>DINT</td><td>Enable Input Status</td></tr>
<tr><td>AccelLimitStatus</td><td>12</td><td>DINT</td><td>Accel Limit Status</td></tr>
<tr><td>AbsoluteReferenceStatus</td><td>13</td><td>DINT</td><td>Absolute Reference Status</td></tr>
<tr><td>Reserved</td><td>14, 15</td><td>N/A</td><td>Reserved</td></tr>
<tr><td>VelocityLockStatus</td><td>16</td><td>DINT</td><td>Velocity Lock Status</td></tr>
<tr><td>VelocityStandstillStatus</td><td>17</td><td>DINT</td><td>Velocity Standstill Status</td></tr>
<tr><td>VelocityThresholdStatus</td><td>18</td><td>DINT</td><td>Velocity Threshold Status</td></tr>
<tr><td>TorqueThresholdStatus</td><td>19</td><td>DINT</td><td>Torque Threshold Status</td></tr>
<tr><td>TorqueLimitStatus</td><td>20</td><td>DINT</td><td>Torque Limit Status</td></tr>
<tr><td>VelocityLimitStatus</td><td>21</td><td>DINT</td><td>Velocity Limit Status</td></tr>
<tr><td>PosLockStatus</td><td>22</td><td>DINT</td><td>Position Lock Status</td></tr>
<tr><td>Reserved</td><td>23…<br>31</td><td>N/A</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>ProcessStatus</td><td>BOOL</td><td>N/A</td><td>N/A</td><td>Process Status</td></tr>
<tr><td>BusReadyStatus</td><td>BOOL</td><td>N/A</td><td>N/A</td><td>Bus Ready Status</td></tr>
<tr><td>AbsoluteReferenceStatus</td><td>BOOL</td><td>N/A</td><td>N/A</td><td>Absolute Reference Status</td></tr>
<tr><td>SafeOffModeActiveStatus</td><td>BOOL</td><td>N/A</td><td>N/A</td><td>Safe-off Mode Active Status</td></tr>
</table>

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| PowerLimitStatus | BOOL | N/A | N/A | Power Limit Status |
| LowVelocity ThresholdStatus | BOOL | N/A | N/A | Low Velocity Threshold Status |
| HighVelocity ThresholdStatus | BOOL | N/A | N/A | High Velocity Threshold Status |
| N/A | N/A | CIPAxisState | INT | Bitmap:<br>0 = Initializing<br>1 = Pre-Charge<br>2 = Stopped<br>3 = Starting<br>4 = Running<br>5 = Testing<br>6 = Stopping<br>7 = Aborting<br>8 = Faulted<br>9 = Start Inhibited<br>10 = Shutdown<br>11 = Axis Inhibited<br>12 = Not Grouped<br>13 = No Module<br>14…255 = Reserved |
| N/A | N/A | CIPAxisStatus | DINT | Bitmap:<br>0 = Local Control<br>1 = Alarm<br>2 = DC Bus Up<br>3 = Power Structure Enabled<br>4 = Motor Flux Up<br>5 = Tracking Command<br>6 = Position Lock<br>7 = Velocity Lock<br>8 = Velocity Standstill<br>9 = Velocity Threshold<br>10 = Velocity Limit<br>11 = Acceleration Limit<br>12 = Deceleration Limit<br>13 = Torque Threshold<br>14 = Torque Limit<br>15 = Current Limit<br>16 = Thermal Limit<br>17 = Feedback Integrity<br>18 = Shutdown<br>19 = In Process<br>20…31 = Reserved |
| N/A | N/A | LocalControl Status | BOOL | This bit is set if axis is taking command reference and services from local interface instead of the remote (Integrated Motion on the EtherNet/IP network) interface. |
| N/A | N/A | AlarmStatus | BOOL | This bit is set if the axis has detected one or more exception conditions that are configured to generate an alarm. |
| N/A | N/A | DCBusUpStatus | BOOL | This bit is set if DC Bus has charged up to an operational voltage level. |
| N/A | N/A | PowerStructure EnabledStatus | BOOL | This bit is set if the axis amplifier is energized and capable to generate motor flux and torque. |
| N/A | N/A | MotorFluxUp Status | BOOL | This bit is set if motor flux for an induction motor has reached an operational level. |

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | Tracking CommandStatus | BOOL | This bit is set if the axis control structure is now actively tracking the command reference from motion planner. |
| AccelLimitStatus | BOOL | AccelerationLimit Status | BOOL | This bit is set if the acceleration reference signal is being limited by the Acceleration Limiter. |
| N/A | N/A | DecelerationLimit Status | BOOL | This bit is set if the acceleration reference signal is being limited by the Deceleration Limiter. |
| N/A | N/A | CurrentLimit Status | BOOL | This bit is set if the command current, Iq, is being limited by the Current Vector Limiter. |
| N/A | N/A | ThermalLimit Status | BOOL | This bit is set if Current Vector Limit condition of the axis is being limited by any of the Thermal Models of the axis. |
| N/A | N/A | FeedbackIntegrity Status | BOOL | This bit, when set, indicates that the feedback device is accurately reflecting changes to axis position. Also, there have been no conditions detected that would compromise the quality of the feedback position value. The bit is set at power-up after the feedback device passes any power-up self-test required.<br>If Feedback Integrity is cleared, the Axis Homed Status attribute is also cleared. This clearing prevents Soft Overtravel from checking if during operation a feedback exception occurs that could affect the fidelity of axis position, the bit is immediately cleared. The bit remains clear until the drive executes a fault reset, or you power cycle the drive.<br>The drive generates Fault Resets, or the resets can be initiated by the controller via motion instructions.<br>The Feedback Integrity bit behavior applies to both absolute and incremental feedback device operation. |
| N/A | N/A | CIPShutdown Status | BOOL | This bit is set when the axis is in the shutdown state or in the faulted state but would transition to the shutdown state if the faults were cleared. |
| N/A | N/A | InProcessStatus | BOOL | This bit is set for the duration of an active process. An example of active process is an operation that is initiated by a Run Motor Test, Run Hookup Test, or Run Inertia Test request service. |
| N/A | N/A | CIPAxisStatusRA | DINT | 0…31 = Reserved |
| N/A | N/A | CIPAxisIOStatus | DINT | Bitmap:<br>0 = Regenerative Power Input Status<br>1…31 = Reserved |
| Reg1InputStatus | BOOL | Registration1Input Status | BOOL | Registration 1 Input Status |
| Reg2InputStatus | BOOL | Registration2Input Status | BOOL | Registration 2 Input Status |
| PosOvertravel InputStatus | BOOL | PositiveOvertravel InputStatus | BOOL | Positive Overtravel Input Status |
| NegOvertravel InputStatus | BOOL | Negative OvertravelInputStatus | BOOL | Negative Overtravel Input Status |
| N/A | N/A | Feedback1 ThermostatStatus | BOOL | Feedback 1 Thermostat Status |
| N/A | N/A | ResistiveBrake OutputStatus | BOOL | Resistive Brake Output Status |
| N/A | N/A | MechanicalBrake OutputStatus | BOOL | Mechanical Brake Output Status |
| N/A | N/A | CIPAxisIOStatus RA | DINT | 0…31 = Reserved |
| N/A | N/A | Regenerative PowerInputStatus | BOOL | This bit represents the logical state of the Regenerative Power Input |

| AXIS_SERVO_DRIVE Sercos Axis | Type | AXIS_CIP_DRIVE EtherNet/IP Axis | Type | Description |
|---|---|---|---|---|
| N/A | N/A | CIPStartInhibits | INT | Bitmap:<br>1 = Axis Enable Input<br>2 = Motor Not Configured<br>3 = Feedback Not Configured<br>4…15 = Reserved |
| N/A | N/A | AxisEnableInput Inhibit | BOOL | Axis Enable Input is not active. |
| N/A | N/A | MotorNot ConfiguredInhibit | BOOL | The associated motor has not been configured for use. |
| N/A | N/A | FeedbackNot ConfiguredInhibit | BOOL | The associated feedback device has not been configured. |
| N/A | N/A | CIPStartInhibits RA | INT | Bitmap:<br>1 = Volts Hertz Curve Definition Inhibit<br>2 = Motor Feedback Required Inhibit<br>3 = Speed Limit Configuration Inhibit<br>4 = Torque Prove Configuration Inhibit<br>5 = Safe Torque Off Inhibit<br>6 = Safety Reset Required Inhibit<br>8…15 = Reserved |
| N/A | N/A | VoltsHertzCurve DefinitionInhibit | BOOL | Conflict exists in the V/Hz curve definition. |
| N/A | N/A | MotorFeedback RequiredInhibit | BOOL | Cannot run using the selected motor control mode with Primary Feedback or Alternate Feedback set as open loop. |
| N/A | N/A | SpeedLimit ConfigurationInhibit | BOOL | Speed Ref Limit Conflict, either Minimum Forward Speed Limit exceeds Maximum Forward Speed Limit, or Minimum Reverse Speed Limit exceeds Maximum Reverse Speed Limit. |
| N/A | N/A | TorqueProve ConfigurationInhibit | BOOL | When Torque Prove Config is enabled, Control Mode, Feedback Mode, Motor Feedback Type, and Motor Option Configuration are properly set. |
| N/A | N/A | Safe Torque Off Inhibit | BOOL | The safety function has disabled the power structure. |
| N/A | N/A | SafetyReset RequiredInhibit | BOOL | Toggle the safety reset input before the safety board allows motion again. |
| N/A | N/A | SafetyNot ConfiguredInhibit | BOOL | The embedded safety function of the drive has not been configured. |

# Appendix G – Axis Exceptions

This section highlights some of the differences in axis exceptions between Sercos axes and EtherNet/IP axes. Some exceptions in a Sercos axis are not applicable to an EtherNet/IP axis, and vice versa. See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for a comprehensive list of EtherNet/IP Axis Attributes.

**Axis Exceptions**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | MotionFault | BOOL | If the Motion Fault bit is set, it indicates that there is one or more fault conditions have occurred related to the Motion Planner function. The specific fault conditions can then be determined through access to the Motion Fault attribute of the associated axis. |
| *Equivalent:* GuardFaultExists | GuardFault | BOOL | If the Guard Fault bit is set, it indicates that there is one or more fault conditions that have occurred related to the GuardMotion™ safety function. The specific fault conditions can then be determined through access to the Guard Motion attribute of the associated axis. Guard Faults are only applicable if the drive device is equipped with Guard Safety functionality. |
| N/A | InitializationFault | BOOL | The Initialization Fault bit is set when initialization of an Integrated Motion on the EtherNet/IP network drive fails for any reason. Specific information concerning the Initialization Fault is found in the standard CIP Initialization attribute, or manufacturer-specific CIP Initialization Fault – RA, and CIP Initialization Fault – manufacturer attributes associated with the CIP Drive axis data types. |
| N/A | APRFault | BOOL | The APR (Absolute Position Recovery) Fault bit is set when during axis configuration the system is not able to recover the absolute position of the axis. Specific information concerning the APR Fault is found in the standard APR Fault attribute, or manufacturer-specific APR Fault – RA, and APR Fault – manufacturer attributes associated with the CIP Drive axis data types. |
| N/A | MotionAlarmStatus | DINT | These two attributes collect the fault and alarm exception conditions that are associated with the Motion Planner. When the controller detects one of the listed excepted conditions, the condition is indicated as a Fault or Alarm according to the associated Motion Exception Action attribute value.<br>In general, Alarms are considered warnings by the control system while Faults result in some form of action to stop the axis. |
| N/A | SoftTravelLimitPositiveAlarm | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Positive attribute value in the positive direction. If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Positive value by using a motion instruction results in an instruction error. As soon as the axis is moved back within the specified soft travel limits, the corresponding Soft Travel Limit - Positive fault bit is automatically cleared.<br>However the soft travel fault persists through any attempt to clear it while the axis position is still beyond the Soft Travel Limit - Positive value with the axis enabled. |
| N/A | SoftTravelLimitNegativeAlarm | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Negative attribute value in the negative direction. If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Negative value by using a motion instruction results in an instruction error. As soon as the axis is moved back within the specified soft travel limits, the corresponding Soft Travel Limit - Negative fault bit is automatically cleared.<br>However the soft travel fault persists through any attempt to clear it while the axis position is still beyond the Soft Travel Limit - Negative value with the axis enabled. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | MotionFaultStatus | DINT | These two attributes collect the fault and alarm exception conditions that are associated with the Motion Planner. When the controller detects one of the listed excepted conditions, the condition is indicated as a Fault or Alarm according to the associated Motion Exception Action attribute value.<br>In general, Alarms are considered warnings by the control system while Faults result in some form of action to stop the axis. |
| *Equivalent:*<br>PosSoftOvertravel Fault | SoftTravelLimitPositiveFault | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Positive attribute value in the positive direction. If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Positive value by using a motion instruction results in an instruction error. As soon as the axis is moved back within the specified soft travel limits, the corresponding Soft Travel Limit - Positive fault bit is automatically cleared.<br>However the soft travel fault persists through any attempt to clear it while the axis position is still beyond the Soft Travel Limit - Positive value with the axis enabled. |
| *Equivalent:*<br>NegSoftOvertravel Fault | SoftTravelLimitNegativeFault | BOOL | This exception condition occurs when Soft Travel Checking is enabled and when actual position has exceeded the configured Soft Travel Limit - Negative attribute value in the negative direction. If the Motion Exception Action for this bit is set for Stop Planner, the faulted axis can be moved or jogged back inside the soft travel limits.<br>However, any attempt to move the axis beyond the Soft Travel Limit - Negative value by using a motion instruction results in an instruction error. As soon as the axis is moved back within the specified soft travel limits, the corresponding Soft Travel Limit - Negative fault bit is automatically cleared.<br>However the soft travel fault persists through any attempt to clear it while the axis position is still beyond the Soft Travel Limit - Negative value with axis enabled. |
| ModuleFaults | ModuleFaults | DINT | This bit field is a roll-up of module scoped fault conditions that can include synchronization faults that are detected on either side of the Integrated Motion on the EtherNet/IP network connection. All defined Node Fault Codes are mapped into bits in this attribute. |
| ControlSyncFault | ControlSyncFault | BOOL | If this bit is set, the controller lost communication with the motion module and missed several position updates in a row. The controller can miss up to four position updates. After that, the Control Sync Fault bit is set.<br>The motion module can fault later or can already be faulted. For a consumed axis, this bit means that communication is lost with the producing controller. This bit clears when communication is re-established. |
| SERCOSRingFault | N/A | BOOL | If this bit is set, there is a problem on the Sercos ring; that is, the light has been broken or a drive has been powered down. |
| N/A | ModuleConnFault | BOOL | The Module Connection Fault bit indicates that the CIP Motion drive to controller connection from the controller has timed out. |
| N/A | ConnFormatFault | BOOL | This fault code indicates that an error has occurred in the data format between the controller and the device, for example, a Format Revision mismatch. |
| N/A | LocalModeFault | BOOL | The Local Mode Fault is set when the controller is locked in Local Mode operation. |
| N/A | CPUWatchdogFault | BOOL | The Processor Watchdog Fault code indicates that the processor that is associated with the device node has experienced an excessive overload condition that has tripped the associated processor watchdog mechanism. |
| N/A | ClockJitterFault | BOOL | The Clock Jitter Fault bit is set when there is excessive clock jitter between the controller and the motion device. |
| N/A | CyclicReadFault | BOOL | The Cyclic Read Fault is set when the controller detects a runtime error that is associated with the Cyclic Read mechanism. |
| N/A | CyclicWriteFault | BOOL | The Cyclic Write Fault is set when the controller detects a runtime error that is associated with the Cyclic Write mechanism. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | ClockSkewFault | BOOL | The Clock Skew Fault bit indicates that the motion device has detected significant difference between the System Time of the device and the System Time of the controller. The difference prevents the device from switching to synchronous operation after a time-out period. |
| N/A | ControlConnFault | BOOL | The Control Connection Loss fault bit indicates that the Integrated Motion on the EtherNet/IP network C-to-D connection from the controller has timed out. |
| N/A | ClockSyncFault | BOOL | The Clock Sync Fault bit indicates that the local clock of the motion device has lost synchronization with the master clock for an extended period of time (40…60 seconds) during synchronous operation. This fault condition is an indication that the local IEEE 1588 clock has lost synchronization with the master and is not able to resynchronize within the allotted timeout (40…60 seconds). |
| N/A | LogicWatchdogFault | BOOL | The Logic Watchdog Fault bit indicates that an auxiliary logic component, for example, FPGA, or ASIC, associated with the device node has experienced an excessive overload condition that has tripped the associated logic watchdog mechanism. |
| N/A | DuplicateAddressFault | BOOL | The Duplicate Address Fault bit indicates that a motion device node has been detected on the network that uses the same Node Address as this device node. For Ethernet, this address would be the IP address of the device. |
| N/A | ModuleAlarmStatus | DINT | This bit field is a roll-up of module scoped alarm conditions that can include synchronization alarms that are detected on either side of the Integrated Motion on the EtherNet/IP network connection. All defined Node Alarm Codes are mapped into bits in this attribute. |
| N/A | ControlSyncAlarm | BOOL | If this bit is set, the controller lost communication with the motion module and missed several position updates in a row. The controller can miss up to four position updates. After that, the Control Sync Fault bit is set.<br>The motion module can fault later or can already be faulted. For a consumed axis, this bit means that communication is lost with the producing controller. This bit clears when communication is re-established. |
| N/A | ModuleSyncAlarm | BOOL | If this bit is set, the motion module lost communication with the controller and missed several position updates in a row. The motion module can miss up to four position updates. After that, the motion module shuts down. This bit clears when communication is re-established. |
| N/A | TimerEventAlarm | BOOL | If this bit is set, the motion module has a problem with its timer event that synchronizes the servo loop of the module to the master time base of the chassis (that is, Coordinated System Time). To clear this bit, reconfigure the motion module. |
| N/A | ProcessorOverloadAlarm | BOOL | The Processor Overload Alarm bit indicates that the host processor associated with motion device is experiencing overload conditions that can lead to a fault. |
| N/A | ClockJitterAlarm | BOOL | The Clock Jitter Alarm bit indicates that the Sync Variance has exceeded the Sync Threshold while the motion device is running in Sync Mode. |
| N/A | OutOfRangeAlarm | BOOL | The Out of Range Alarm bit is set when the drive determines that a Cyclic Write attribute value is out of range. |
| N/A | ClockSkewAlarm | BOOL | The Clock Skew Alarm bit indicates that the motion device has detected significant difference between the System Time of the device and the System Time of the controller. The difference prevents the device from switching to synchronous operation. |
| AxisFault | AxisFault | | A fault exists on an axis. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| PosHardOvertravel Fault | *Equivalent:* HardwareOvertravelPositive Fault | BOOL | Set if the axis moves beyond the current position limits as established by hardware overtravel limit switches mounted on the equipment. This fault can only occur when the drive is in the enabled state and the Hard Overtravel Checking bit is set in the Fault Configuration Bits attribute. If the Hard Overtravel Fault Action is set for Stop Command, the faulted axis can be moved or jogged back inside the soft overtravel limits.<br>However, any attempt to move the axis beyond the hard overtravel limit switch by using a motion instruction results in an instruction error. To recover from this fault, the axis must be moved back within normal operation limits of the equipment and the limit switch closed. This fault condition is latched and requires execution of a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear.<br>Any attempt to clear the fault while the overtravel limit switch is still open and the drive is enabled is unsuccessful. |
| MotFeedbackFault | *Equivalent:* FeedbackSignalLossFLFault | BOOL | Set for the A Quad B feedback device when:<br>• The differential electrical signals for one or more of the feedback channels (for example, A+ and A-, B+ and B-, or Z+ and Z-) are at the same level (both high or both low). Under normal operation, the differential signals are always at opposite levels. The most common cause of this situation is a broken wire between the feedback transducer and the servo module or drive.<br>• Loss of feedback 'power' or feedback 'common' electrical connection between the servo module or drive and the feedback device. The controller latches this fault. Use a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear the fault. |
| MotFeedback NoiseFault | *Equivalent:* FeedbackSignalNoiseFLFault | BOOL | Set when there is noise on the signal lines of the feedback device.<br>For example, simultaneous transitions of the feedback A and B channels of an A Quad B are referred to generally as feedback noise.<br>Feedback noise is caused by loss of quadrature in the feedback device, or radiated common-mode noise signals that the feedback device wiring picks up. You can see both of these noises on an oscilloscope.<br>To troubleshoot the loss of channel quadrature, look for these things:<br>• Physical misalignment of the feedback transducer components.<br>• Excessive capacitance (or other delays) on the encoder signals.<br>Proper grounding and shielding usually cures radiated noise problems. The controller latches this fault. Use a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear the fault. |
| AuxFeedbackFault | N/A | BOOL | Set for an auxiliary feedback source when:<br>• The differential electrical signals for one or more of the feedback channels (for example, A+ and A-, B+ and B-, or Z+ and Z-) are at the same level (both high or both low). Under normal operation, the differential signals are always at opposite levels. The most common cause of this situation is a broken wire between the feedback transducer and the servo module or drive.<br>• Loss of feedback 'power' or feedback 'common' electrical connection between the servo module or drive and the feedback device. The controller latches this fault. Use a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear the fault. |
| AuxFeedbackNoise Fault | N/A | BOOL | Set when there is noise on the signal lines of the feedback device.<br>For example, simultaneous transitions of the feedback A and B channels of an A Quad B are referred to generally as feedback noise.<br>Feedback noise (shown below) is most often caused by loss of quadrature in the feedback device itself or radiated common-mode noise signals being picked up by the feedback device wiring. You can see both of these on an oscilloscope.<br>To troubleshoot the loss of channel quadrature, look for these things:<br>• Physical misalignment of the feedback transducer components.<br>• Excessive capacitance (or other delays) on the encoder signals.<br>Proper grounding and shielding usually cures radiated noise problems. The controller latches this fault. Use a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear the fault. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| DriveEnableInput Fault | *Equivalent:* EnableInputDeactivatedFault | BOOL | This fault would be declared if either one of two possible conditions occur:<br>1. If an attempt is made to enable the axis (typically via MSO or MAH instruction) while the Drive Enable Input is inactive.<br>2. If the Drive Enable Input transitions from active to inactive while the axis is enabled. This fault can only occur when the Drive Enable Input Fault Handling bit is set in the Fault Configuration Bits attribute.<br>If the Drive Enable Input Fault Action is set for Stop Command and the axis is stopped because of a Drive Enable Input Fault, the faulted axis cannot be moved until the fault is cleared. Any attempt to move the axis in the faulted state by using a motion instruction results in an instruction error.<br>If the Drive Enable Fault Action setting is Status Only or Stop Command and an attempt is made to enable the axis (typically via MSO or MAH instruction) while the Drive Enable Input is active, the axis enables in the faulted state indicating a Drive Enable Input Fault. When the Drive Enable Fault Action setting is Stop Command, instructions that both enable the axis and initiate motion (MAH, MRAT, MAHD) abort the motion process leaving the instruction with both the IP and PC bits clear. This fault condition is latched and requires execution of an explicit MAFR (Motion Axis Fault Reset) or MASR (Motion Axis Shutdown Reset) instruction to clear.<br>Any attempt to clear the fault while the drive enable input is still inactive and the drive is enabled is unsuccessful. However, the drive enable input fault may be cleared with the drive enable input inactive if the drive is disabled.<br>If the Drive Enable Input Checking bit is clear, then the state of the Drive Enable Input is irrelevant so no fault would be declared in any of the above conditions. |
| CommonBusFault | *Equivalent:* DCCommonBusFault | BOOL | The drive shuts down if you give it 3-phase power while it is configured for Common Bus Follower mode. If that happens, this bit turns on. |
| PreCharge OverloadFault | *Equivalent:* ConverterPreCharge OverloadFLFault | BOOL | The pre-charge resistor of the drive gets too hot if you cycle 3-phase power too many times. If that happens, this bit turns on. |
| GuardFaultExists | *Equivalent:* GuardFault | BOOL | If the Guard Fault bit is set, it indicates that one or more fault conditions have occurred related to the embedded Guard Motion safety function of the drive. The specific fault conditions can then be determined through access to the Guard Fault attribute of the associated axis. Guard Faults are applicable only if the drive device is equipped with hardwired guard safety functionality. |
| GroundShortFault | *Equivalent:* ConverterGroundCurrentFL Fault | BOOL | When the drive detects an imbalance in the DC bus supply current, the Ground Short Fault bit is set, indicating that current is flowing through an improper ground connection. |
| DriveHardFault | N/A | BOOL | Set when the drive detects a serious hardware fault.<br>NOTE: The Axis_CIP_Drive structure provides detailed fault, alarm, and inhibit tags to assist you to diagnose a failure. |
| OverSpeedFault | *Equivalent:* MotorOverspeedFLFault | BOOL | Set when the speed of the axis as determined from the feedback has exceeded the over speed limit, which is typically set to 150% of configured velocity limit for the motor. |
| OverloadFault | N/A | BOOL | When the load limit of the motor/drive is first exceeded, the Overload warning bit is set. If the condition persists, the Overload fault is set. Often this bit is tied into the IT limit of the drive.<br>NOTE: The Axis_CIP_Drive structure provides independent overload tags for all components of the servo system instead of consolidating them into one tag. |
| DriveOvertemp Fault | N/A | BOOL | Set when the temperature of the drive exceeds the drive shutdown temperature.<br>NOTE: The Axis_CIP_Drive structure provides specific fault and alarm tags for the converter, inverter, and bus regulator to provide more detailed information than this single tag. |
| MotorOvertemp Fault | *Equivalent:* MotorOvertemperatureFLFault | BOOL | Set when the temperature of the motor exceeds the motor shutdown temperature. |
| DriveCoolingFault | N/A | BOOL | Set when the ambient temperature surrounding the control circuitry of the drive temperature exceeds the drive ambient shutdown temperature. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| DriveControl VoltageFault | *Equivalent:* ModuleVoltageMismatchFault | BOOL | Set when the power supply voltages associated with the drive circuitry fall outside of acceptable limits. |
| FeedbackFault | *Equivalent:* FeedbackDeviceFault | BOOL | Set when one of the feedback sources that are associated with the drive axis has a problem that prevents the drive from receiving accurate or reliable position information from the feedback device.<br>Set when one of the feedback sources for the axis cannot send accurate or reliable position information because there is a problem.<br>For AXIS_SERVO axis, possible problems are:<br>• The differential electrical signals for one or more of the feedback channels (for example, A+ and A-, B+ and B-, or Z+ and Z-) are at the same level (both high or both low). Under normal operation, the differential signals are always at opposite levels. The most common cause of this situation is a broken wire between the feedback transducer and the servo module or drive.<br>• Loss of feedback power or common electrical connection between the servo module or drive and the feedback device.<br>The controller latches this fault. Use a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear the fault. |
| CommutationFault | *Equivalent:* MotorCommutationFault | BOOL | Set when the commutation feedback source that is associated with the drive axis has a problem that prevents the drive from receiving accurate or reliable motor shaft information to perform commutation. |
| DriveOvercurrent Fault | *Equivalent:* InverterOvercurrentFault | BOOL | Set when drive output current exceeds the predefined operating limits for the drive.<br>NOTE: As output current is the domain specifically of the inverter, the Axis_CIP_Drive structure indicates it as such rather than the generic drive label. |
| DriveOvervoltage Fault | *Equivalent:* BusOvervoltageFLFault | BOOL | Set when drive DC bus voltage exceeds the predefined operating limits for the bus.<br>NOTE: The Axis_CIP_Drive structure clearly indicates that this fault is specifically representing the DC bus voltage rather than the inverter or converter voltage. |
| DriveUndervoltage Fault | *Equivalent:* BusUndervoltageFLFault | BOOL | Set when drive DC bus voltage is below the predefined operating limits for the bus.<br>NOTE: The Axis_CIP_Drive structure clearly indicates that this fault is specifically representing the DC bus voltage rather than the inverter or converter voltage. |
| PowerPhaseLoss Fault | *Equivalent:* ConverterACSinglePhaseLoss Fault | BOOL | Set when the drive detects that one or more of the three power line phases is lost from the 3-phase power inputs.<br>NOTE: The Axis_CIP_Drive structure indicates that this fault is specifically representing the input power rather than the output power. |
| PositionErrorFault | *Equivalent:* ExcessivePositionErrorFault | BOOL | Set when the axis position error exceeds the Position Error Tolerance. This fault can only occur when the drive is in the enabled state.<br>The controller latches this fault. Use a Motion Axis Fault Reset (MAFR) or Motion Axis Shutdown Reset (MASR) instruction to clear the fault. |
| SercosFault | N/A | BOOL | Set when either a requested Sercos procedure fails to execute properly or the associated drive node has detected a Sercos communication fault.<br>NOTE: The Axis_CIP_Drive structure contains similar faults and alarms to describe the health of the Ethernet communications link, but there is no need for a Sercos fault indication. |
| *Equivalent:* OverSpeedFault | MotorOverspeedFLFault | BOOL | Motor speed has exceeded its maximum limit given by the Motor Overspeed Factory Limit attribute associated with the motor type. |
| N/A | MotorOverspeedULFault | BOOL | Motor speed has exceeded the user-defined speed limit given by Motor Overspeed User Limit. |
| *Equivalent:* MotorOvertemp Fault | MotorOvertemperatureFLFault | BOOL | Motor temperature has exceeded its factory set temperature limit given by Motor Overtemperature Factory Limit, or the integral motor thermal switch has tripped. |
| N/A | MotorOvertemperatureULFault | BOOL | Motor temperature has exceeded the user-defined temperature limit given by Motor Overtemperature User Limit. |
| N/A | MotorThermalOverloadFLFault | BOOL | Motor thermal model has exceeded its factory set thermal capacity limit given by Motor Thermal Overload Factory Limit. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | MotorThermalOverloadULFault | BOOL | Motor thermal model has exceeded its user-defined thermal capacity given by Motor Thermal Overload User Limit. |
| *Equivalent:* DriveOvercurrent Fault | InverterOvercurrentFault | BOOL | Inverter current has exceeded the factory set peak or instantaneous current limit. |
| N/A | InverterOvertemperatureFL Fault | BOOL | Inverter temperature has exceeded its factory set temperature limit given by Inverter Overtemperature Factory Limit. |
| N/A | InverterOvertemperatureUL Fault | BOOL | Inverter temperature has exceeded the user-defined temperature limit given by Inverter Overtemperature User Limit. |
| N/A | InverterThermalOverloadFL Fault | BOOL | Inverter thermal model has exceeded its factory set thermal capacity limit given by Inverter Thermal Overload Factory Limit. |
| N/A | InverterThermalOverloadUL Fault | BOOL | Inverter thermal model has exceeded its user-defined thermal capacity given by Inverter Thermal Overload User Limit. |
| *Equivalent:* GroundShortFault | ConverterGroundCurrentFL Fault | BOOL | Ground Current has exceeded its factory set current limit by Converter Ground Current Factory Limit. |
| N/A | ConverterGroundCurrentUL Fault | BOOL | Ground Current has exceeded user-defined limit given by Converter Ground Current User Limit. |
| N/A | ConverterOvertemperatureFL Fault | BOOL | Converter temperature has exceeded its factory set temperature limit given by Converter Overtemperature Factory Limit. |
| N/A | ConverterOvertemperature ULFault | BOOL | Converter temperature has exceeded the user-defined temperature limit given by Converter Overtemperature User Limit. |
| N/A | ConverterThermalOverloadFL Fault | BOOL | Converter thermal model has exceeded its factory set thermal capacity limit given by Converter Thermal Overload Factory Limit. |
| N/A | ConverterThermalOverloadUL Fault | BOOL | Converter thermal model has exceeded its user-defined thermal capacity given by Converter Thermal Overload User Limit. |
| N/A | ConverterACPowerLossFault | BOOL | Multiple AC phases have been lost on the AC line to the converter. |
| *Equivalent:* PowerPhaseLoss Fault | ConverterACSinglePhaseLoss Fault | BOOL | One AC phase was lost on the AC line to the converter. |
| N/A | ConverterACPhaseShortFault | BOOL | A short has been detected between an AC phase and another AC phase or ground. |
| N/A | ConverterPreChargeFault | BOOL | A problem has been detected in the Converter's Pre-Charge circuitry preventing the DC Bus from charging to an acceptable voltage level. |
| N/A | BusRegulatorOvertemperatureFLFault | BOOL | Bus Regulator temperature has exceeded its factory set temperature limit given by Bus Regulator Overtemperature Factory Limit. |
| N/A | BusRegulatorOvertemperatureULFault | BOOL | Bus Regulator temperature has exceeded the user-defined temperature limit given by Bus Regulator Overtemperature User Limit. |
| N/A | BusRegulatorFault | BOOL | The bus regulator (shunt) module in a multi-axis system has a failed. |
| *Equivalent:* DriveUndervoltageFault | BusUndervoltageFLFault | BOOL | DC Bus voltage level is below the factory set limit given by Bus Undervoltage Factory Limit. |
| N/A | BusUndervoltageULFault | BOOL | DC Bus voltage level is below user-defined limit given by Bus Undervoltage User Limit. |
| *Equivalent:* Drive OvervoltageFault | BusOvervoltageFLFault | BOOL | DC Bus voltage level is above the factory set limit given by Bus Overvoltage Factory Limit. |
| N/A | BusOvervoltageULFault | BOOL | DC Bus voltage level is above user-defined limit given by Bus Overvoltage User Limit. |
| N/A | BusPowerLossFault | BOOL | DC Bus voltage level is below the Bus Power Loss Threshold for more than the timeout period-specified Bus Power Loss Time value. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | BusPowerBlownFuseFault | BOOL | DC Bus power loss due to blown fuse. |
| *Equivalent:*<br>MotFeedbackNoiseFault | FeedbackSignalNoiseFLFault | BOOL | Noise induced A/B channel state changes (illegal states) from a feedback device were detected by the drive. Specifically, the number of these noise events that have occurred on this channel has exceeded the Feedback Noise Factory Limit.<br>The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| N/A | FeedbackSignalNoiseULFault | BOOL | Noise induced A/B channel state changes (illegal states) from a feedback device were detected on a feedback channel. Specifically, the number of these noise events that have occurred on this channel has exceeded the Feedback Noise User Limit.<br>The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| *Equivalent:*<br>MotFeedback<br>Fault) | FeedbackSignalLossFLFault | BOOL | 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 Loss Factory Limit.<br>The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| N/A | FeedbackSignalLossULFault | BOOL | 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 Loss User Limit.<br>The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| N/A | FeedbackDataLossFLFault | BOOL | 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.<br>The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| N/A | FeedbackDataLossULFault | BOOL | 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 User Limit.<br>The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| *Equivalent:*<br>FeedbackFault | FeedbackDeviceFault | BOOL | The feedback device has detected an internal error. |
| *Equivalent:*<br>PosHard<br>OvertravelFault | HardwareOvertravelPositive<br>Fault | BOOL | Axis moved beyond the physical travel limits in the positive direction and activated the Positive Overtravel limit switch. |
| *Equivalent:*<br>NegHard<br>OvertravelFault | HardwareOvertravelNegative<br>Fault | BOOL | Axis moved beyond the physical travel limits in the negative direction and activated the Negative Overtravel limit switch. |
| *Equivalent:*<br>PositionErrorFault | ExcessivePositionErrorFault | BOOL | The Position Error value of the position control loop has exceeded the configured value for Position Error Tolerance. |
| N/A | ExcessiveVelocityErrorFault | BOOL | The Velocity Error value of the velocity control loop has exceeded the configured value for Velocity Error Tolerance. |
| N/A | OvertorqueLimitFault | BOOL | Motor torque has risen above user-defined maximum torque level given by Overtorque Limit. |
| N/A | UndertorqueLimitFault | BOOL | Motor torque has dropped below user-defined minimum torque level given by Undertorque Limit. |
| N/A | IllegalControlModeFault | BOOL | Controller has specified an unsupported Control Mode or Feedback Mode |
| *Equivalent:*<br>DriveEnableInput<br>Fault | EnableInputDeactivatedFault | BOOL | Enable has been deactivated while the axis is in Running state. |
| N/A | ControllerInitiatedFault | BOOL | Exception generated specifically by controller. |
| N/A | ExternalInputFault | BOOL | Exception generated by external input to device. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | CIPAxisFaultsRA | LINT | A bit map that represents the state of all manufacturer-specific runtime faults. Fault bits when set are latched until a fault reset occurs.<br>A fault reset clears the runtime fault bits, but the bits set again immediately if the underlying exception condition is still present.<br>Any exceptions whose Axis Exception Action is configured to ignore or report as alarms do not appear in this attribute. |
| N/A | CommutationStartupFault | BOOL | The self-sensing commutation startup algorithm failed. |
| N/A | MotorVoltageMismatchFault | BOOL | The motor voltage is incompatible with the applied drive voltage. |
| N/A | FeedbackFilterNoiseFault | BOOL | Excessive levels of noise have been detected by the digital feedback filter. |
| N/A | FeedbackBatteryLossFault | BOOL | The battery voltage on a battery-backed motor encoder is low enough such that absolute position is not longer available. |
| N/A | FeedbackBatteryLowFault | BOOL | The battery voltage on a battery-backed motor encoder is below a caution level. |
| N/A | FeedbackIncrementalCountErrorFault | BOOL | The periodic check of the incremental encoder position against the absolute encoder position or Hall edges indicates they are out of tolerance. |
| N/A | ControlModuleOvertemperatureFLFault | BOOL | Kinetix drives: The control module temperature has exceeded its limit.<br>PowerFlex 755 drives: The temperature sensor on the Main Control Board detected excessive heat. |
| N/A | ControlModuleOvertemperature ULFault | BOOL | The control module temperature has exceeded a user-defined limit given by Control Module Overtemperature User Limit. Factory limit due to excessive power cycling. |
| *Equivalent:*<br>PreCharge OverloadFault | ConverterPreChargeOverloadFL Fault | BOOL | Converter estimates that the pre-charge circuit has exceeded its limit. |
| N/A | ConverterPreChargeOverloadUL Fault | BOOL | Converter estimates that the pre-charge circuit has exceeded its user-defined limit given by Converter Pre-charge Overload User Limit due to excessive power cycling. |
| N/A | ExcessiveCurrentFeedback OffsetFault | BOOL | Current in one or more phases has been lost or remains below a preset level. |
| N/A | RegenerativePowerSupplyFault | BOOL | The hardware Regeneration OK input was deactivated while the drive was enabled. |
| N/A | PWMFrequencyReducedFault | BOOL | Carrier Frequency foldback due to excessive Junction Temperature. |
| N/A | CurrentLimitReducedFault | BOOL | Current Limit reduced due to excessive Junction Temperature or due to Overload Protection. |
| N/A | TorqueProveFault | BOOL | Actual feedback indicates error in torque proving. |
| N/A | DecelOverrideFault | BOOL | The drive is not following a commanded deceleration because it is attempting to limit bus voltage. |
| N/A | PreventativeMaintenanceFault | BOOL | Component has reached lifetime limit. |
| N/A | MotorTestFault | BOOL | Motor Test procedure has failed. |
| N/A | HardwareConfigurationFault | BOOL | Error related to the tracking of optional hardware installation. |
| N/A | FirmwareChangeFault | BOOL | Errors or forced configuration changes relating to firmware update. |
| *Equivalent:*<br>CommonBusFault | DCCommonBusFault | BOOL | Error has been detected related to Common Bus operation. |
| N/A | RuntimeErrorFault | BOOL | Runtime Assertions detected. |
| N/A | BackplaneCommunicationError Fault | BOOL | Error in communicating over the modular backplane. |
| N/A | SafetyModuleCommunication ErrorFault | BOOL | Error in communicating to the Safety module. |
| N/A | ProductSpecificFault | BOOL | Product Specific (exotic) exceptions by Sub Code. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | CIPAxisAlarms | LINT | A bit map that represents the current state of all standard alarm conditions.<br>The bit map is identical to that of the Std. CIP Axis Exceptions attribute. Only exception conditions whose Axis Exception Action is configured to report as an alarm appear in this attribute, and will not be reported in the CIP Axis Faults attribute.<br>Alarm bits when set are not latched and will clear as soon as the underlying exception condition is corrected. |
| N/A | MotorCommutationAlarm | BOOL | Permanent magnet motor commutation problem detected. Example would be an illegal state "111" or "000" for UVW commutation signals, S1, S2, and S3. |
| N/A | MotorOverspeedFLAlarm | BOOL | Motor speed has exceeded its maximum limit given by the Motor Overspeed Factory Limit attribute associated with the motor type. |
| N/A | MotorOverspeedULAlarm | BOOL | Motor speed has exceeded the user-defined speed limit given by Motor Overspeed User Limit. |
| N/A | MotorOvertemperatureFL Alarm | BOOL | Motor temperature has exceeded its factory set temperature limit given by Motor Overtemperature Factory Limit, or the integral motor thermal switch has tripped. |
| N/A | MotorOvertemperatureUL Alarm | BOOL | Motor temperature has exceeded the user-defined temperature limit given by Motor Overtemperature User Limit. |
| N/A | MotorThermalOverloadFL Alarm | BOOL | Motor thermal model has exceeded its factory set thermal capacity limit given by Motor Thermal Overload Factory Limit. |
| N/A | MotorThermalOverloadUL Alarm | BOOL | Motor thermal model has exceeded its user-defined thermal capacity given by Motor Thermal Overload User Limit. |
| N/A | InverterOvercurrentAlarm | BOOL | Inverter current has exceeded the factory set peak or instantaneous current limit. |
| N/A | InverterOvertemperatureFL Alarm | BOOL | Inverter temperature has exceeded its factory set temperature limit given by Inverter Overtemperature Factory Limit. |
| N/A | InverterOvertemperatureUL Alarm | BOOL | Inverter temperature has exceeded the user-defined temperature limit given by Inverter Overtemperature User Limit. |
| N/A | InverterThermalOverloadFL Alarm | BOOL | Inverter thermal model has exceeded its factory set thermal capacity limit given by Inverter Thermal Overload Factory Limit. |
| N/A | InverterThermalOverloadUL Alarm | BOOL | Inverter thermal model has exceeded its user-defined thermal capacity given by Inverter Thermal Overload User Limit. |
| N/A | ConverterGroundCurrentFL Alarm | BOOL | Ground Current has exceeded its factory set current limit given by Converter Ground Current Factory Limit. |
| N/A | ConverterGroundCurrentUL Alarm | BOOL | Ground Current has exceeded user-defined limit given by Converter Ground Current User Limit. |
| N/A | ConverterOvertemperatureFL Alarm | BOOL | Converter temperature has exceeded its factory set temperature limit given by Converter Overtemperature Factory Limit. |
| N/A | ConverterOvertemperatureUL Alarm | BOOL | Converter temperature has exceeded the user-defined temperature limit given by Converter Overtemperature User Limit. |
| N/A | ConverterThermalOverloadFL Alarm | BOOL | Converter thermal model has exceeded its factory set thermal capacity limit given by Converter Thermal Overload Factory Limit. |
| N/A | ConverterThermalOverloadUL Alarm | BOOL | Converter thermal model has exceeded its user-defined thermal capacity given by Converter Thermal Overload User Limit. |
| N/A | ConverterACPowerLossAlarm | BOOL | Multiple AC phases have been lost on the AC line to the converter. |
| N/A | ConverterACSinglePhaseLoss Alarm | BOOL | One AC phase has been lost on the AC line to the converter. |
| N/A | ConverterACPhaseShortAlarm | BOOL | A short has been detected between an AC phase and another AC phase or ground. |
| N/A | ConverterPreChargeAlarm | BOOL | A problem has been detected in the Converter's Pre-Charge circuitry preventing the DC Bus from charging to an acceptable voltage level. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | BusRegulatorOvertemperature FLAlarm | BOOL | Bus Regulator temperature has exceeded its factory set temperature limit given by Bus Regulator Overtemperature Factory Limit. |
| N/A | BusRegulatorOvertemperature ULAlarm | BOOL | Bus Regulator temperature has exceeded the user-defined temperature limit given by Bus Regulator Overtemperature User Limit. |
| N/A | BusRegulatorThermalOverload FLAlarm | BOOL | Bus Regulator thermal model has exceeded its factory set thermal capacity limit given by Bus Regulator Thermal Overload Factory Limit. |
| N/A | BusRegulatorThermalOverload ULAlarm | BOOL | Bus Regulator thermal model has exceeded its user-defined thermal capacity given by Bus Regulator Thermal Overload User Limit. |
| N/A | BusRegulatorAlarm | BOOL | The bus regulator (shunt) module in a multi-axis system has failed. |
| N/A | BusUndervoltageFLAlarm | BOOL | DC Bus voltage level is below the factory set limit given by Bus Undervoltage Factory Limit. |
| N/A | BusUndervoltageULAlarm | BOOL | DC Bus voltage level is below user-defined limit given by Bus Undervoltage User Limit. |
| N/A | BusOvervoltageFLAlarm | BOOL | DC Bus voltage level is above the factory set limit given by Bus Overvoltage Factory Limit. |
| N/A | BusOvervoltageULAlarm | BOOL | DC Bus voltage level is above user-defined limit given by Bus Overvoltage User Limit. |
| N/A | BusPowerLossAlarm | BOOL | DC Bus voltage level is below the Bus Power Loss Threshold for more than the timeout period-specified Bus Power Loss Time value. |
| N/A | BusPowerBlownFuseAlarm | BOOL | DC Bus power loss due to blown fuse. |
| N/A | FeedbackSignalNoiseFLAlarm | BOOL | Noise induced A/B channel state changes (illegal states) from a feedback device were detected by the drive. Specifically, the number of these noise events that have occurred on this channel has exceeded the Feedback Noise Factory Limit. The offending feedback channel number is encoded in the associated Fault/ Alarm Sub Code. |
| N/A | FeedbackSignalNoiseULAlarm | BOOL | Noise induced A/B channel state changes (illegal states) from a feedback device were detected on a feedback channel. Specifically, the number of these noise events that have occurred on this channel has exceeded the Feedback Noise User Limit. The offending feedback channel number is encoded in the associated Fault/Alarm Sub Code. |
| N/A | FeedbackSignalLossFLAlarm | BOOL | 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 Loss Factory Limit. The offending feedback channel number is encoded in the associated Fault/Alarm Sub Code. |
| N/A | FeedbackSignalLossULAlarm | BOOL | 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 Loss User Limit. The offending feedback channel number is encoded in the associated Fault/Alarm Sub Code. |
| N/A | FeedbackDataLossFLAlarm | BOOL | 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 number is encoded in the associated Fault/Alarm Sub Code. |
| N/A | FeedbackDataLossULAlarm | BOOL | 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 User Limit. The offending feedback channel number is encoded in the associated Fault/Alarm Sub Code. |
| N/A | FeedbackDeviceAlarm | BOOL | The feedback device has detected an internal error. |
| N/A | HardwareOvertravelPositive Alarm | BOOL | Axis moved beyond the physical travel limits in the positive direction and activated the Positive Overtravel limit switch. |
| N/A | HardwareOvertravelNegative Alarm | BOOL | Axis moved beyond the physical travel limits in the negative direction and activated the Negative Overtravel limit switch. |
| N/A | ExcessivePositionErrorAlarm | BOOL | The Position Error value of the position control loop has exceeded the configured value for Position Error Tolerance. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | ExcessiveVelocityErrorAlarm | BOOL | The Velocity Error value of the velocity control loop has exceeded the configured value for Velocity Error Tolerance. |
| N/A | OvertorqueLimitAlarm | BOOL | Motor torque has risen above user-defined maximum torque level given by Overtorque Limit. |
| N/A | UndertorqueLimitAlarm | BOOL | Motor torque has dropped below user-defined minimum torque level given by Undertorque Limit. |
| N/A | IllegalControlModeAlarm | BOOL | Controller has specified an unsupported Control Mode or Feedback Mode. |
| N/A | EnableInputDeactivatedAlarm | BOOL | Enable has been deactivated while the axis is in Running state. |
| N/A | ControllerInitiatedAlarm | BOOL | Exception generated specifically by controller. |
| N/A | ExternalInputAlarm | BOOL | Exception generated by external input to device. |
| N/A | CIPAxisAlarmsRA | LINT | A bit map that represents the current state of all manufacturer-specific alarm conditions. Only exception conditions whose Axis Exception Action is configured to report as an alarm appear in this attribute, and will not be reported in the CIP Axis Faults attribute. Alarm bits when set are not latched and will clear as soon as the underlying exception condition is corrected. |
| N/A | CommutationStartupAlarm | BOOL | The self-sensing commutation startup algorithm failed. |
| N/A | MotorVoltageMismatchAlarm | BOOL | The motor voltage is incompatible with the applied drive voltage. |
| N/A | FeedbackFilterNoiseAlarm | BOOL | Excessive levels of noise have been detected by the digital feedback filter. |
| N/A | FeedbackBatteryLossAlarm | BOOL | The battery voltage on a battery-backed motor encoder is low enough such that absolute position is not longer available. |
| N/A | FeedbackBatteryLowAlarm | BOOL | The battery voltage on a battery-backed motor encoder is below a caution level. |
| N/A | FeedbackIncrementalCount ErrorAlarm | BOOL | The periodic check of the incremental encoder position against the absolute encoder position or Hall edges indicates they are out of tolerance. |
| N/A | ControlModuleOvertemperature FLAlarm | BOOL | Kinetix: The control module temperature has exceeded its limit. PF755: The temperature sensor on the Main Control Board detected excessive heat. |
| N/A | ControlModuleOvertemperature ULAlarm | BOOL | The control module temperature has exceeded a user-defined limit given by Control Module Overtemperature User Limit. |
| N/A | ConverterPreChargeOverload FLAlarm | BOOL | Converter estimates that the pre-charge circuit has exceeded its factory limit due to excessive power cycling. |
| N/A | ConverterPreChargeOverload ULAlarm | BOOL | Converter estimates that the pre-charge circuit has exceeded its user-defined limit given by Converter Pre-charge Overload User Limit due to excessive power cycling. |
| N/A | ExcessiveCurrentFeedback OffsetAlarm | BOOL | Current in one or more phases has been lost or remains below a preset level. |
| N/A | RegenerativePowerSupplyAlarm | BOOL | The hardware Regeneration OK input was deactivated while the drive was enabled. |
| N/A | PWMFrequencyReducedAlarm | BOOL | Carrier Frequency foldback due to excessive Junction Temperature. |
| N/A | CurrentLimitReducedAlarm | BOOL | Current Limit reduced due to excessive Junction Temperature or due to Overload Protection. |
| N/A | TorqueProveAlarm | BOOL | Actual feedback indicates error in torque proving. |
| N/A | DecelOverrideAlarm | BOOL | The drive is not following a commanded deceleration because it is attempting to limit bus voltage. |
| N/A | PreventativeMaintenanceAlarm | BOOL | Component has reached lifetime limit. |
| N/A | MotorTestAlarm | BOOL | Motor Test procedure has failed. |
| N/A | HardwareConfigurationAlarm | BOOL | Error related to the tracking of optional hardware installation. |
| N/A | FirmwareChangeAlarm | BOOL | Errors or forced configuration changes relating to firmware update. |
| N/A | DCCommonBusAlarm | BOOL | Error has been detected related to Common Bus operation. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | RuntimeErrorAlarm | BOOL | Runtime Assertions detected. |
| N/A | BackplaneCommunicationError Alarm | BOOL | Error in communicating over the modular backplane. |
| N/A | SafetyModuleCommunication ErrorAlarm | BOOL | Error in communicating to the Safety module. |
| N/A | ProductSpecificAlarm | BOOL | Product Specific (exotic) exceptions by Sub Code. |
| N/A | CIPInitializationFaults | DINT | A bit map that represents the state of all standard initialization faults.<br>These faults prevent any motion, and do not have configurable fault actions. Examples of initialization faults are corrupted memory data, calibration errors, firmware startup problems, or an invalid configuration attribute value.<br>Initialization faults cannot be cleared with a Fault Reset service, although a power-cycle provides a new attempt at initialization. |
| N/A | BootBlockChecksumFault | BOOL | Checksum or CRC error for Boot Block of Integrated Motion on the EtherNet/IP network device detected as part of self-test. |
| N/A | MainBlockChecksumFault | BOOL | Checksum or CRC error for Main Block of Integrated Motion on the EtherNet/IP network device detected as part of self-test. |
| N/A | NonvolatileMemoryChecksum Fault | BOOL | Checksum or CRC error for NV Memory of Integrated Motion on the EtherNet/IP network device detected as part of self-test. |
| N/A | CIPInitializationFaultsRA | DINT | A bit map that represents the state of all Rockwell Automation specific initialization faults.<br>These faults prevent any motion, and do not have configurable fault actions. Examples of initialization faults are corrupted memory data, calibration errors, firmware startup problems, or an invalid configuration attribute value.<br>Initialization faults cannot be cleared with a Fault Reset service, although a power-cycle provides a new attempt at initialization. |
| N/A | FeedbackDataCorruptionFault | BOOL | Smart Encoder Data Corruption detected. |
| N/A | FeedbackDataRangeFault | BOOL | Data within a motor data blob is out of range. |
| N/A | FeedbackCommunication StartupFault | BOOL | Communications with a smart encoder could not be established. |
| N/A | FeedbackAbsoluteOverspeed Fault | BOOL | Excessive speed was detected in the battery-backed encoder while power was off. |
| N/A | FeedbackAbsolutePowerOff TravelFault | BOOL | The power-off travel range of the battery-backed encoder has been exceeded. |
| N/A | FeedbackAbsoluteStartup SpeedFault | BOOL | The absolute encoder was not able to accurately determine the position after power-up due to speed greater than 100 RPM. |
| N/A | CommutationOffset UninitializedFault | BOOL | The commutation offset stored in a third-party motor has not been initialized. |
| N/A | InvalidFPGAImageFault | BOOL | The FPGA image is incompatible with hardware operation. |
| N/A | InvalidBoardSupportPackage Fault | BOOL | The board support package is incompatible with hardware operation. |
| N/A | InvalidSafetyFirmwareFault | BOOL | The safety firmware is not compatible with the drive firmware, or the main safety firmware is missing. |
| N/A | PowerBoardFault | BOOL | Power Board checksum error. |
| N/A | IllegalOptionCardFault | BOOL | The Main Control Board has detected an illegal option installed in the port. |
| N/A | OptionStorageChecksumFault | BOOL | Option data storage checksum failed. |
| *Equivalent:*<br>DriveControlVoltageFault | ModuleVoltageMismatchFault | BOOL | IAM detects a voltage rating mismatch on the modular backplane. |
| N/A | UnknownModuleFault | BOOL | Unknown module is detected on the modular backplane. |
| N/A | FactoryConfigurationErrorFault | BOOL | Factory Configuration Data is missing or invalid. |

**Axis Exceptions (Continued)**

| AXIS_SERVO_DRIVE | AXIS_CIP_DRIVE | Type | Description |
|---|---|---|---|
| N/A | IllegalAddressFault | BOOL | AM Node Address is out of range (>254). |
| N/A | SeriesMismatchFault | BOOL | Sercos AMs have been detected by the CIP IAM. |
| N/A | OpenSlotFault | BOOL | IAM detects an open slot on the modular backplane. |
| N/A | CIPStartInhibits | INT | A bit map that specifies the current state of all standard conditions that inhibits starting of the axis. |
| N/A | AxisEnableInputInhibit | BOOL | Axis Enable Input is not active. |
| N/A | MotorNotConfiguredInhibit | BOOL | The associated motor has not been configured for use. |
| N/A | FeedbackNotConfiguredInhibit | BOOL | The associated feedback device has not been configured for use. |
| N/A | CIPStartInhibitsRA | INT | A bit map that specifies the current state of all Rockwell Automation specific conditions that inhibits starting of the axis. |
| N/A | VoltsHertzCurveDefinition Inhibit | BOOL | Conflict exists in the V/Hz curve definition. |
| N/A | MotorFeedbackRequiredInhibit | BOOL | Can't run using the selected motor control mode with Primary Feedback or Alternate Feedback set as open loop. |
| N/A | SpeedLimitConfiguration Inhibit | BOOL | Speed Ref Limit Conflict, either Minimum Forward Speed Limit exceeds Maximum Forward Speed Limit, or Minimum Reverse Speed Limit exceeds Maximum Reverse Speed Limit. |
| N/A | TorqueProveConfiguration Inhibit | BOOL | When Torque Prove Config is enabled, Control Mode, Feedback Mode, Motor Feedback Type, and Motor Option Configuration must be properly set. |
| N/A | SafeTorqueOffInhibit | BOOL | The safety function has disabled the power structure. |
| N/A | SafetyResetRequiredInhibit | BOOL | The safety reset input needs to be toggled before the safety board will allow motion again. |
| N/A | SafetyNotConfiguredInhibit | BOOL | The embedded safety function of the drive has not been configured. |

## Additional Resources

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

| Resource | Description |
|---|---|
| Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002 | Provides detailed information about the Kinetix 6200 and Kinetix 6500 drives. |
| Kinetix 6200 and Kinetix 6500 Safe Speed Monitoring Multi-axis Servo Drives Safety Reference Manual, publication 2094-RM001 | Information on how to wire, configure, and troubleshoot the safe-speed features of your Kinetix 6200 and Kinetix 6500 drives. |
| Integrated Motion on the EtherNet/IP Network: Configuration and Startup User Manual, publication MOTION-UM003 | Information on how to configure and troubleshoot your ControlLogix and CompactLogix EtherNet/IP network modules. |
| Kinetix Motion Control Selection Guide, publication GMC-SG001 | Overview of Kinetix servo drives, motors, actuators, and motion accessories that are designed to help make initial decisions for the motion control products that are best suited for your system requirements. |
| Integrated Motion on the EtherNet/IP: 8 Axis Basic Linear/Ring Drawing, publication IASIMP-QR020 | Provides an example of an integrated motion on EtherNet/IP 8 axis basic linear/ring network. |
| Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003 | Provides a programmer with details about the AXIS_CIP_DRIVE motion control axis attributes and the Logix Designer application Control Modes. |
| ControlLogix 5580 Controllers User Manual, publication 1756-UM543 | Provides detailed information about the ControlLogix 5580 controllers. |
| Kinetix 5700 Servo Drives User Manual, publication 2198-UM002 | Provides detailed information about the Kinetix 5700 servo drives. |
| Motion System Tuning Application Technique, publication MOTION-AT005 | Provides detailed information about tuning motion systems. |
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 | Provides general guidelines for installing a Rockwell Automation industrial system. |
| Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page | Provides declarations of conformity, certificates, and other certification details. |

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

## Rockwell Automation Support

Use the following resources to access support information.

| | | |
|---|---|---|
| **Technical Support Center** | Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates. | www.rockwellautomation.com/knowledgebase |
| **Local Technical Support Phone Numbers** | Locate the phone number for your country. | www.rockwellautomation.com/global/support/get-support-now.page |
| **Direct Dial Codes** | Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer. | www.rockwellautomation.com/global/support/direct-dial.page |
| **Literature Library** | Installation Instructions, Manuals, Brochures, and Technical Data. | www.rockwellautomation.com/literature |
| **Product Compatibility and Download Center (PCDC)** | Get help determining how products interact, check features and capabilities, and find associated firmware. | www.rockwellautomation.com/global/support/pcdc.page |

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete the How Are We Doing? form at http://literature.rockwellautomation.com/idc/groups/literature/documents/du/ra-du002_-en-e.pdf.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.



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