

User Manual Original Instructions

Integrated Motion on the EtherNet/IP Network: Configuration and Startup

ControlLogix, CompactLogix, GuardLogix, Compact GuardLogix, Kinetix 350, Kinetix 5500, Kinetix 5700, Kinetix 6500, PowerFlex 527, PowerFlex 755





Allen-Bradley • Rockwell Software

Important User Information

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

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

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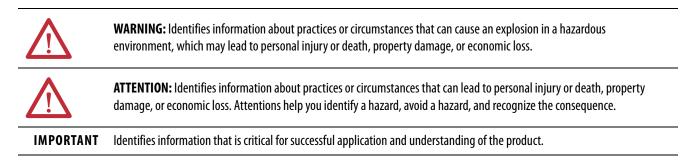
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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.



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



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



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



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

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Use this manual to configure an integrated motion on the EtherNet/IP[™] network application and to start up your motion solution with a Logix controller-based system.

This manual is designed to give you a straightforward approach to an integrated motion control solution. If you have any comments or suggestions, see <u>Documentation Feedback</u> on the back cover of this manual.

Summary of Changes

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

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Additional Resources

These resources contain information about related products from Rockwell Automation[®].

Table 1 - Publications About Related Products

Resource	Description	
842E-CM Integrated Motion Encoder on EtherNet/IP User Manual, publication <u>842E-UM002</u>	Describes the necessary tasks to install, wire, and troubleshoot your encoder.	
ControlLogix 5580 Controllers Migration Guide, publication <u>1756-RM100</u>	Provides information about the features and functions of the ControlLogix [®] 5580 controllers.	
ControlLogix 5580 and GuardLogix 5580 Controllers User Manual, publication <u>1756-UM543</u>	Provides information on how to install, configure, program, and operate ControlLogix 5580 and GuardLogix $^{\circ}$ 5580 controllers.	
CompactLogix 5380 and Compact GuardLogix 5380 Controllers User Manual, publication <u>5069-UM001</u>	Provides information on how to install, configure, program, and operate CompactLogix™ 5380 and Compact GuardLogix 5380 controllers.	
ControlLogix System User Manual, publication <u>1756-UM001</u>	Describes the necessary tasks to install, configure, program, and operate a ControlLogix system.	
EtherNet/IP Network Configuration User Manual, publication ENET-UM001	Describes Ethernet network considerations, networks, and setting IP addresses.	
GuardLogix 5570 Controllers User Manual, publication <u>1756-UM022</u>	Provides information on how to install, configure, and operate GuardLogix 5570 controllers in Studio 5000 Logix Designer® projects, version 21 or later.	
GuardLogix 5570 and Compact GuardLogix 5370 Controller Systems Safety Reference Manual, publication <u>1756-RM099</u>	Provides information on how to meet safety application requirements for GuardLogix 5570 controllers in Studio 5000 Logix Designer projects, version 21 or later.	
GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Safety Reference Manual, publication <u>1756-RM012</u>	Describes the necessary tasks to install, configure, program, and operate a ControlLogix system.	
Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003	Provides a programmer with details about the Integrated Motion on the EtherNet/IP network Control Modes, Control Methods, and AXIS_CIP_DRIVE Attributes.	
Kinetix 350 Single-axis EtherNet/IP Servo Drive User Manual, publication 2097-UM002	Provides detailed information on wiring, power, troubleshooting, and integration with ControlLogix, or CompactLogix controller platforms.	

Table 1 - Publications About Related Products (continued)

Resource	Description		
Kinetix 5500 Servo Drives Installation Instructions, publication 2198-IN001	Provides installation instructions for the Kinetix [®] 5500 Integrated Axis Module and Axis Module components.		
Kinetix 5500 Servo Drives User Manual, publication 2198-UM001	Provides information on installation, configuration, start up, troubleshooting, and applications for the Kinetix 5500 servo drive systems.		
Kinetix 5700 Servo Drives User Manual, publication 2198-UM002	Provides information on installing, configuring, start up, troubleshooting, and applications for the Kinetix 5700 servo drive systems.		
Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication <u>2094-UM002</u>	Provides information on installation, configuration, start up, troubleshooting, and applications for the Kinetix 6200 and Kinetix 6500 servo drive systems.		
Logix 5000 Controllers Motion Instructions Reference Manual, publication MOTION-RM002	Provides a programmer with details about motion instructions for a Logix-based controller.		
Logix 5000 Controllers Common Procedures, publication <u>1756-PM001</u>	Provides detailed and comprehensive information about how to program a Logix 5000 [™] controller.		
Logix 5000 Controllers General Instructions Reference Manual, publication <u>1756-RM003</u>	Provides a programmer with details about general instructions for a Logix-based controller.		
LOGIX 5000 Controllers Advanced Process Control and Drives and Equipment Phase and Sequence Instructions Reference Manual, publication <u>1756-RM006</u>	Provides a programmer with details about process and drives instructions for a Logix- based controller.		
Logix 5000 Controllers Quick Start, publication <u>1756-QS001</u>	Describes how to get started programming and maintaining Logix5000 controllers.		
Motion System Tuning Application Technique, publication MOTION-AT005	Provides detailed information on motion system tuning.		
PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u>	Provides information on installation, configuration, start up, troubleshooting, and applications for the PowerFlex $^{\circ}$ 527 drive.		
PowerFlex 750-Series AC Drives Programming Manual, publication 750-PM001	Provides information that is necessary to install, start-up, and troubleshoot PowerFlex 750-Series Adjustable Frequency AC Drives.		
PowerFlex 750-Series AC Drives Reference Manual, publication 750-RM002	Provides detailed drive information including operation, parameter descriptions, programming of the AC drive.		
PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication 750COM-UM001	Provides information on installation, configuration, start up, troubleshooting, and applications for the PowerFlex 755 Drive Embedded EtherNet/IP Adapter.		
PowerFlex 750-Series Safe Speed Monitor Option Module Safety Reference Manual, publication <u>750-RM001</u>	These publications provide detailed information on installation, setup, and operation of the 750-Series safety option modules.		
PowerFlex 750-Series Safe Torque Off Option Module User Manual, publication 750-UM002			
PowerFlex 755 Integrated Safety - Safe Torque Off Option Module User Manual, publication 750-UM004			
PowerFlex 755/755T Integrated Safety Functions Option Module User Manual, publication <u>750-UM005</u>			
The Integrated Architecture and CIP Sync Configuration Application Technique, publication <u>IA-AT003</u>	Provides detailed configuration information on CIP [™] Sync technology and time synchronization.		
Industrial Automation Wiring and Grounding Guidelines, publication <u>1770-4.1</u>	Provides general guidelines for installing a Rockwell Automation® industrial system.		
Product Certifications website, <u>www.rok.auto/certifications</u>	Provides declarations of conformity, certificates, and other certification details.		
Network specifications details, <u>http://www.odva.org</u>	ODVA is the organization that supports network technologies that are built on the Common Industrial Protocol (CIP) — DeviceNet [™] , EtherNet/IP, CompoNet [™] , and ControlNet [™] .		

You can view or download publications at

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

Component	ts of a	Motion	System
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Controller, Communication, Drive, and Software Options

You need a Logix 5000[™] controller with a connection to the EtherNet/IP[™] network (either via an embedded Ethernet port or an Ethernet communication module). You also need an Ethernet adapter for the controller (if the controller does not have embedded Ethernet), an Integrated Motion drive (see <u>Table 4</u>), and configuration and programming software.

TIP ControlLogix® 5560 and GuardLogix® 5560 controllers are not supported in Studio 5000 Logix Designer® application, version 21.00.00 and later.

Controller and Ethernet Communication Module Options

A GuardLogix or Compact GuardLogix safety controller is required for motion and safety applications.

<u>Table 2</u> lists the available controllers and minimum required version of the Studio 5000 Logix Designer application.

Controller	Studio 5000 Logix Designer Version
ControlLogix 5580 controllers	Version 28 or later
GuardLogix 5580 controllers	Version 31 or later
CompactLogix 5380 controllers	Version 30 or later
Compact GuardLogix 5380 controllers	Version 31 or later
ControlLogix 5570 controllers	Version19 or later
GuardLogix 5570 controllers	Version 20 or later
CompactLogix 5370 controllers	Version 20 or later
Compact GuardLogix 5370 controllers	Version 28 or later

Table 3 provides information on how many motion axes are supported depending on the hardware that is used in your application and the configuration of your axes. For example, you can have eight Position Loop axes per 1756-EN2T module. Each drive requires one TCP and one CIP[™] connection. If you have other devices that consume TCP connections on the module, it reduces the number of drives you can support. Only the drives and axes that are configured for Position Loop are limited. Frequency Control, Velocity Loop, and Torque Loop configured drives and axes are not limited.

Table 3 - Supported Axes by Controller Type

Controller		Communication	Supported Axes ⁽³⁾		
		Modules ⁽¹⁾	Position Loop ⁽⁴⁾	Other Loop Types	Integrated Motion Drives ⁽⁵⁾
		1756-EN2T and 1756-EN2TF	8	Up to 100	—
		1756-EN3TR	100	Up to 100	—
ControlLogix 5560, GuardLog		1756-EN2TR	8	Up to 100	—
ControlLogix 5570,GuardLog Armor [™] ControlLogix 5570, <i>I</i>		1756-EN2T and 1756-EN2F	8	Up to 100	—
ControlLogix 5580, GuardLog	-	1756-EN2TP	8	Up to 100	
		1756-EN3TR	100	Up to 256	—
		1756-EN2TR	8	Up to 256	
ControlLogix 5580,	1756-L81E, 1756-L81ES	Embedded Ethernet ⁽²⁾	256	Up to 256	100 max nodes
GuardLogix 5580	1756-L82E, 1756-L82ES	Embedded Ethernet ⁽²⁾	256	Up to 256	175 max nodes
	1756-L83E, 1756-L83ES 1756-L84E, 1756-L84ES	Embedded Ethernet ⁽²⁾	256	Up to 256	250 max nodes
	1756-L85E	Embedded Ethernet	256	Up to 256	300 max nodes
	5069-L306ERM, 5069-L306ERMS2	Embedded Ethernet	2	Up to 256	16 max nodes
	5069-L310ERM, 5069-L310ERMS2	Embedded Ethernet	4	Up to 256	24 max nodes
	5069-L320ERM, 5069-L320ERMS2	Embedded Ethernet	8	Up to 256	40 max nodes
	5069-L330ERM, 5069-L330ERMS2	Embedded Ethernet	16	Up to 256	Version 30 and earlier: 50 max nodes Version 31 and later: 60 max nodes
CompactLogix 5380,	5069-L340ERM, 5069-L340ERMS2	Embedded Ethernet	20	Up to 256	Version 30 and earlier: 55 max nodes Version 31 and later: 90 max nodes
Compact GuardLogix 5380	5069-L350ERM, 5069-L350ERMS2	Embedded Ethernet	24	Up to 256	Version 30 and earlier: 60 max nodes Version 31 and later: 120 max nodes
	5069-L380ERM, 5069-L380ERMS2	Embedded Ethernet	28	Up to 256	Version 30 and earlier: 70 max nodes Version 31 and later: 150 max nodes
	5069-L3100ERM, 5069-L3100ERMS2	Embedded Ethernet	32	Up to 256	Version 30 and earlier: 80 max nodes Version 31 and later: 180 max nodes
	1769-L18ERM	Embedded Ethernet	2	Up to 100	8 max nodes
	1769-L27ERM	Embedded Ethernet	4	Up to 100	16 max nodes
CompactLogix 5370, Compact GuardLogix 5370, Armor CompactLogix 5370, Armor Compact GuardLogix 5370	1769-L30ERM, 1769-L30ERMS	Embedded Ethernet	4	Up to 100	16 max nodes
	1769-L33ERM, 1769-L33ERMS 1769-L33ERMO, 1769-L33ERMOS	Embedded Ethernet	8	Up to 100	32 max nodes
	1769-L36ERM, 1769-L36ERMS 1769-L36ERMO, 1769-L36ERMOS	Embedded Ethernet	16	Up to 100	64 max nodes
	1769-L37ERM, 1769-L37ERMS, 1769-L37ERMO, 1769-L37ERMOS,	Embedded Ethernet	16	Up to 100	64 max nodes
	1769-L38ERM, 1769-L38ERMS 1769-L38ERM0, 1769-L38ERMOS	Embedded Ethernet	16	Up to 100	80 max nodes

- (1) For more information on Ethernet communication modules, see 1756 ControlLogix Communication Modules Specifications Technical Data, publication 1756-TD003.
- (2) ControlLogix 5580 and GuardLogix 5580 can also use Ethernet communication modules to communicate on the EtherNet/IP network.
- (3) Multiple controllers can control drives on a common 1756-ENxTx module, so based on the TCP connection limit, up to 128 can be supported.
- (4) Only the drives/axes configured for Position Loop are limited. Frequency Control, Velocity Loop, and Torque Loop configured drives/axes are not limited.
- (5) If more than the maximum number of I/O modules are configured under the embedded Ethernet Port, a Project Verify error notifies you that the maximum number of nodes on the local Ethernet Port has been exceeded.

Integrated Motion on EtherNet/IP Drive Software Options

The following software is required for use with your system:

- Studio 5000 Logix Designer application (see <u>Table 2 on page 11</u> for minimum versions for controllers and <u>Table 4</u> for minimum versions for drives)
- RSLinx[®] Classic software, version 3.51.00 or later
- For PowerFlex[®] 755 drives, you need the Add-on Profile, V18 or later.

Integrated Motion on EtherNet/IP Drives

<u>Table 4</u> lists the EtherNet/IP drives available for integrated motion.

Drive	Description	Supported Axis Configurations ⁽³⁾	Power Ratings 1030V		Minimum Version of the Studio 5000 Logix Designer Application 21.00.00
842E-CM	The 842E-CM is an ultra-high resolution encoder with EtherNet/IP interface with time synchronization for motion control. These encoders provide 18-bit single-turn resolution and 30-bit multi-turn resolution.	Feedback Only			
Kinetix® 350 ⁽¹⁾	The Kinetix 350 drive is a single- axis EtherNet/IP servo drive with Safe Torque Off (STO) functional safety that supports the Integrated Motion on EtherNet/IP network.	Position Velocity Torque	Voltage Ranges 100V AC 1-phase 200V AC 1-phase 200V AC 3-phase 400V AC 3-phase	Output Power 0.40.8 kW 0.53 kW 0.53 kW 13 kW	21.00.00
Kinetix 5500 ⁽¹⁾	The Kinetix 5500 servo drives support the Integrated Motion on EtherNet/IP network. Single- axis and multi-axis, AC, DC, AC/DC, and AC/DC hybrid bus- sharing configurations are possible.	Frequency Control Position Velocity Torque	Voltage Ranges 195264V AC rms 1-phase 195264V AC rms 3-phase 324528V AC rms 3-phase	Output Power 0.21.0 kW 0.37.2 kW 0.614.9 Kw	21.00.00 ⁽⁴⁾ 24.00.00 ⁽⁵⁾
	2198-Hxxx-ERS servo drives support hardwired STO with connections to safety inputs.				
	2198-Hxxx-ERS2 servo drives support integrated STO with connections to the safety controller.				

Drive	Description	Supported Axis Configurations ⁽³⁾			Minimum Version of the Studio 5000 Logix Designer Application
Kinetix 5700 ⁽¹⁾	2198-Sxxx-ERS3 (single-axis) and 2198-Dxxx-ERS3 (dual-axis) series A support hardwired and integrated STO with connections to the safety controller (Version26). Series B also support integrated Timed SS1 safety function and (Version 31).	Frequency Control Feedback Only Position Loop Velocity Loop Torque Loop	Input Voltage Range 324528V AC rms, Output Voltage Range 3-phase 480V AC rms nominal Current Range 2.5192 A	Output Power 1.6112 kW	For 1.660kW ⁽⁶⁾ 26.00.00 For 90112kW 32.00.00
	2198-Pxxx	Non-Regenerative AC/DC Converter	Input Voltage Range 324528V Current Range 1069 A		26.00.00
	2198-Sxxx-ERS4 (single-axis) and 2198-Dxxx-ERS4 (dual-axis) (Version 31) support integrated safe monitor functions with connection to the safety controller.	Frequency Control Feedback Only Position Loop Velocity Loop Torque Loop	Input Voltage Range 324506V AC rms, Output Voltage Range 3-phase 480V AC nominal Current Range 2.5192 A	Output Power 1.6112 kW	For 1.660kW ⁽⁷⁾ 31.00.00 For 90112kW 32.00.00
	2198-RPxxx	Regenerative AC/DC Converter	Input Voltage Range 324528V Current Range 35.3/88.0207.0/312.0 A	Output Power 24140 kW	32.00.00

Table 4 - Integrated Motion EtherNet/IP Drives (continued)

Drive	Description Supported Axis Configurations ⁽³⁾		Power Ratings	Minimum Version of the Studio 5000 Logix Designer Application	
Kinetix 6500 ⁽¹⁾	The Kinetix 6500 drive is a closed-loop modular servo drive. It consists of an integrated axis (IAM) power module and up to seven axis (AM) power modules, each coupled with a Kinetix 6500 control module. The IAM and AM power modules provide power for up to eight axes. The 2094-EN02D-M01-S0 control modules support Safe Torque Off and 2094-EN02D-M01-S1 control modules support safe-speed monitoring.	Feedback Only Position Velocity Torque	Voltage Range 324528V AC rms 3-phase	Continuous Output Power 6.045 kW	21.00.00
PowerFlex 527 ⁽²⁾	The PowerFlex 527 is a single- axis EtherNet/IP AC drive with STO feature that supports the Integrated Motion on EtherNet/IP network. Hardwired STO and Integrated STO are supported. It consists of an integrated axis power module and incremental encoder feedback (sold separately).	Frequency Control Position Velocity	Input Power 100600V AC	Output Power 0.422 kW/0.530 Hp / 0.962.1 A	24.00.00
PowerFlex 755 ⁽²⁾	The PowerFlex 755 Drive EtherNet/IP AC drive is a closed loop drive. It consists of an integrated axis power module with five option slots for communication, I/O, feedback, safety, and auxiliary control power (sold separately). The PowerFlex 755 drive can control a motor in closed loop and open loop mode.	Frequency Control Position Velocity Torque	Input Power 400V AC 480V AC 600V AC 690V AC	Output Power: 0.751250 kW/2.12150 A 11750 Hp/2.12070 A 11400 Hp/1.71430 A 7.51400 kW/121400 A	RSLogix 5000 [®] , version 19.00.00 or later Studio 5000 Logix Designer application, version 21.00.00 or later

(1) For more information on Kinetix servo drives, see Kinetix Servo Drives Specifications Technical Data, publication KNX-TD003.

(2) For more information on PowerFlex drives, see PowerFlex Low Voltage Drives Selection Guide, publication <u>PFLEX-SG002</u>.

(3) For more information about the configuration types, see <u>Configure the Associated Axis and Control Mode on page 47</u> and the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.

(4) Drives with catalog numbers ending in ERS.

(5) Drives with catalog numbers ending in ERS2.

(6) Drives with catalog numbers ending in ERS3.

(7) Drives with catalog numbers ending in ERS4.

Options for PowerFlex 755 Drives

When a PowerFlex 755 drive is used in Integrated Motion on EtherNet/IP mode, the Logix controller and Studio 5000 Logix Designer application are the exclusive owners of the drive (same as Kinetix). An HIM or other drive software tools, such as DriveExplorer[™] and DriveTools[™] SP, cannot be used to control the drive or change configuration settings. These tools can only be used for monitoring.

The PowerFlex 755 drive contains an EtherNet/IP adapter that is embedded on the main control board. This embedded adapter lets you easily configure, control, and collect drive data over Ethernet networks. The drive can operate also in the integrated motion mode or the existing I/O mode.

The PowerFlex 755 drive has five option ports that can accept a combination of options for control, communication, I/O, feedback, safety, and auxiliary control power. Only one safety option module can be installed on a drive.

There are seven types of peripherals:

- HIM
- I/O
- Communications, Ethernet Standard
- Aux Power⁽¹⁾
- Safety⁽²⁾
- Encoder Interface⁽³⁾
- Universal Feedback⁽³⁾

<u>Table 5</u> lists valid peripheral devices and ports for various PowerFlex 755 drives.

- (1) Aux power is not supported for Integrated Motion.
- (2) Only one safety option module can be installed on a drive.
- (3) See Table 6 for supported feedback module combinations.

Drive Catalog Number	Description	Ports
PowerFlex 755-EENET-CM	PowerFlex 755 AC Drive via Embedded Ethernet	4, 5, 6, 7, 8
PowerFlex 755-EENET-CM-S	PowerFlex 755 AC Drive via Embedded Ethernet - Safe Torque Off Option	4 and 5 6 is reserved for safety
PowerFlex 755-EENET-CM-S1	PowerFlex 755 AC Drive via Embedded Ethernet - Safe Speed Monitor Option	4 and 5 6 is reserved for safety
PowerFlex 755-EENET-CM-S3 ⁽¹⁾	PowerFlex 755 AC Drive via Embedded Ethernet - Integrated Safe Torque Off Option ⁽²⁾	4 and 5 6 is reserved for safety
PowerFlex 755-HiPwr-EENET-S4 ⁽¹⁾	PowerFlex 755 AC Drive via Embedded Ethernet - Integrated Safety Functions Option ⁽³⁾	4 and 5 6 is reserved for safety
PowerFlex 755-HiPwr-EENET-CM	PowerFlex 755 High-power AC Drive via Embedded Ethernet	4, 5, 6, 7, 8
PowerFlex 755-EENET-CM-S	PowerFlex 755 High-power AC Drive via Embedded Ethernet - Safe Torque Off Option	4 and 5 6 is reserved for safety
PowerFlex 755-EENET-CM-S1	PowerFlex 755 High-power AC Drive via Embedded Ethernet - Safe Speed Monitor Option	4 and 5 6 is reserved for safety
PowerFlex 755-HiPwr-EENET-CM-S3	PowerFlex 755 High-power AC Drive via Embedded Ethernet - Integrated Safe Torque Off Option	4 and 5 6 is reserved for safety

Table 5 - Peripheral Devices and Ports for PowerFlex 755 Devices That Support Integrated Motion on Ethernet Networks

(1) PowerFlex Drive firmware revision 14 or later required.

(2) Safe Torque Off option module is only available when used with GuardLogix 5580 and Compact GuardLogix 5380 safety controllers.

(3) Integrated Motion support of the Integrated Safety Functions option module is only available when used with GuardLogix 5580 and Compact GuardLogix 5380 safety controllers.

See the manual for your PowerFlex 755 AC Drive safety or communication option for more information on using your specific peripheral device.

Table 6 shows the feedback module combinations that are supported.

Table 6 - Supported Feedback Module Combinations

Option	Supported Module	Catalog Number	Valid Ports
Two Feedback Options	Single Incremental Encoder	20-750-ENC-1	48
	Dual Incremental Encoder	20-750-DENC-1	48
	Universal Feedback Card	20-750-UFB-1	46
Two Feedback Options and	Single Incremental Encoder	20-750-ENC-1	4 and 5
One Safe Torque Off Option	Dual Incremental Encoder	20-750-DENC-1	4 and 5
	Universal Feedback	20-750-UFB-1	4 and 5
	Safe Torque Off	20-750-S	6
Two Feedback Options and	Single Incremental Encoder	20-750-ENC-1	4 and 5
One Safe Speed Monitor Option ⁽¹⁾	Dual Incremental Encoder	20-750-DENC-1	4 and 5
	Universal Feedback	20-750-UFB-1	4 and 5
	Safe Speed Monitor	20-750-S1	6

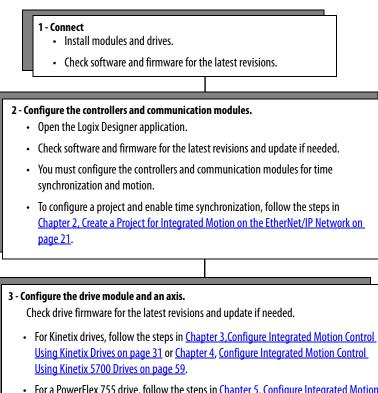
(1) The safe speed monitor option module must be used with the 20-750-DENC-1 Dual Incremental Encoder module or the 20-750-UFB-1 Universal Feedback module.

For more information, see the Installation Instructions for your PowerFlex 750-Series AC Drive.

Configuration and Startup Scenarios

The two ways to get an integrated motion on the EtherNet/IP network solution to run are to connect the hardware first or configure the software first.

Connect Hardware First



 For a PowerFlex 755 drive, follow the steps in <u>Chapter 5, Configure Integrated Motion</u> Using a PowerFlex 755 Drive on page 99.

If you are using a PowerFlex 755 drive and are unfamiliar with the integrated motion interface and attributes, see the Integrated Motion on EtherNet/IP appendix in the PowerFlex 750-Series AC Drives Programming Manual, publication <u>750-PM001</u>.

• For a PowerFlex 527 drive, follow the steps in <u>Chapter 6</u>, <u>Configure Integrated Motion</u> Using a PowerFlex 527 Drive on page 129.

4 - Commission

• Download project.

• Follow steps in <u>Chapter 11, Commission an Axis on page 221</u>.

5 - Program

 Follow steps in <u>Appendix B, Out of Box Configuration for</u> <u>PowerFlex Drives on page 305</u>.

Configure Software First

1 - Configure the controllers and communication modules.

- Open the Logix Designer application.
- Check software and firmware for the latest revisions and update if needed.
- You must configure the controllers and communication modules for time synchronization and motion.
- To build a project and enable time synchronization, follow the steps in <u>Chapter 2, Create a</u> <u>Project for Integrated Motion on the EtherNet/IP Network on page 21</u>.

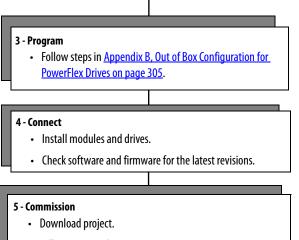
2 - Configure the drive module and configure an axis.

Check drive firmware for the latest revisions and update if needed.

- For Kinetix drives, follow the steps in <u>Chapter 3,Configure Integrated Motion Control Using</u> <u>Kinetix Drives on page 31</u> or <u>Chapter 4, Configure Integrated Motion Control Using Kinetix</u> <u>5700 Drives on page 59</u>.
- For a PowerFlex 755 drive, follow the steps in <u>Chapter 5, Configure Integrated Motion Using</u> <u>a PowerFlex 755 Drive on page 99.</u>

If you are using a PowerFlex 755 drive and are unfamiliar with the integrated motion interface and attributes, see the Integrated Motion on EtherNet/IP appendix in the PowerFlex 750-Series AC Drives Programming Manual, publication <u>750-PM001</u>.

For a PowerFlex 527 drive, follow the steps in <u>Chapter 6</u>, <u>Configure Integrated Motion Using</u> <u>a PowerFlex 527 Drive on page 129</u>.



 Follow steps in <u>Chapter 11, Commission an Axis on</u> page 221.

Help for Selecting Drives and Motors

Motion Analyzer helps you select the appropriate Allen-Bradley[®] drives and motors that are based on your load characteristics and typical motion application cycles. The software guides you through wizard-like screens to collect information specific to your application.

After you enter the information for your application, such as, load inertia, gearbox ratio, feedback device, and brake requirements, the software generates an easy-to-read list of recommended motors, drives, and other support equipment.

You can access Motion Analyzer at <u>https://motionanalyzer.rockwellautomation.com</u>.

Create a Project for Integrated Motion on the EtherNet/IP Network

Торіс	Page
Create a Controller Project	21
Set Time Synchronization	24
Add an Ethernet Communication Module	26

This chapter describes how to configure an integrated motion project in the Logix Designer application.

Create a Controller Project

IMPORTANT For Motion and Safety applications, you must use a GuardLogix[®] or Compact GuardLogix controller.

Follow these instructions to create a project.

1. On the Studio 5000° dialog box, choose Create New Project.



O New Project		-		8 X
Project Types			Search	×
💕 Logix	Comp	actLogix™ Plus 5480 C	ontroller	^
	▲ Control	olLogix® 5570 Control	ller	
	17	756-L71	ControlLogix® 5570 Controller	
	17	756-L72	ControlLogix® 5570 Controller	
	17	756-L73	ControlLogix® 5570 Controller	
	17	756-L74	ControlLogix® 5570 Controller	
	17	756-L75	ControlLogix® 5570 Controller	
	▷ Control	olLogix® 5580 Control	ller	
	Guard	Logix® 5570 Safety Co	ontroller	
	Guard	Logix® 5580 Safety Co	ontroller	
	Studio	o 5000® Logix Emulate	e™ Controller	.
	Name:	Integrated_Motion_C	Control	
	Location:	C:\Users\TLavell\Doc	uments\Studio 5000\Projε ▼	Browse
		Cancel	Back Next	Finish

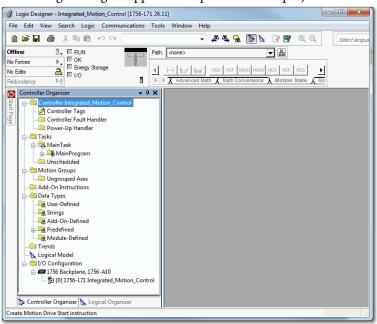
2. Choose a controller, type a name, and click Next.

- 3. Type a Name for the controller.
- 4. Assign a location (optional).
- 5. Click Next.

The Project Configuration dialog box appears.

New Project	he from from and	8 23
1756-L71 Contro Integrated_Motion_C	olLogix® 5570 Controller Control	
Revision:	32 •	
Chassis:	1756-A10 10-Slot ControlLogix Chassis	•
Slot:	0 -	
Security Authority:	No Protection	•
	$\hfill\square$ Use only the selected Security Authority for authentication an authorization	nd
Secure With:	O Logical Name <controller name=""></controller>	
	O Permission Set	*
Description:		
Redundancy:	Enable	
	Cancel Back Next	Finish

- 6. Choose the chassis type.
- 7. Assign the slot location of the controller.
- 8. Assign the Security Authority.
- 9. Type a description (optional).
- 10. Click Finish.



The Logix Designer application opens with new project.

Set Time Synchronization

This technology supports highly distributed applications that require time stamps, sequence of events records, distributed motion control, and increased control coordination. All controllers and communication modules must have time synchronization that is enabled for applications that use integrated motion on the EtherNet/IP[™] network.

Time synchronization in the Logix system is called CIP Sync. CIP Sync provides a mechanism to synchronize clocks between controllers, I/O, and other devices that are connected over CIP[™] networks and the ControlLogix[®] or CompactLogix[™] backplane. The device with the best clock becomes the Grandmaster time source for your system.

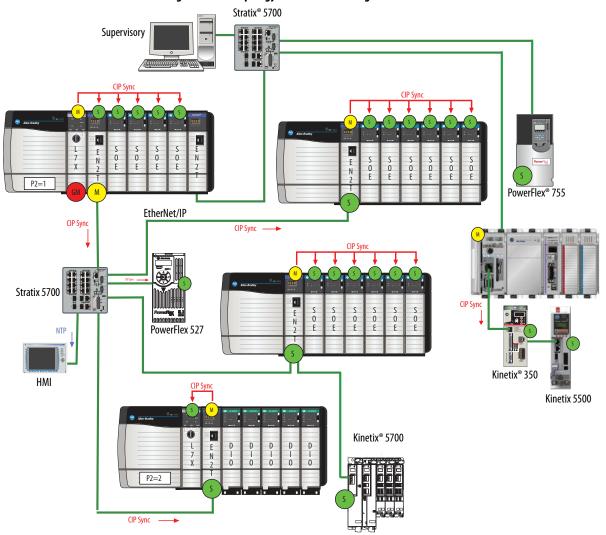


Figure 1 - Star Topology with the ControlLogix Controller as the Grandmaster

GM = Grandmaster (time source)

M = Master

P1 and P2 = Priorities

Priorities are automatically assigned based on their clock quality, which the Best Clock Algorithm determines. In this example, P2=1 is the best quality so it becomes the Grandmaster. If the P2=1 device loses clock quality for some reason, then P2=2 would become the Grandmaster for the system.

S = Slave

The Best Master Clock algorithm determines what device has the best clock. The device with the best clock becomes the Grandmaster time source for your system. All controllers and communication modules must have time synchronization that is enabled to participate in CIP Sync.

See the Integrated Architecture and CIP Sync Configuration Application Technique, publication <u>IA-AT003</u>, for detailed information.

You must enable time synchronization for motion applications. Follow these instructions to enable time synchronization.

- 1. In the Controller Organizer, right-click the controller and choose Properties.
- 2. Click the Date/Time tab.
- 3. Check Enable Time Synchronization.
- 4. Click OK.

Redundar	ncy	Nonvolatile Memory	Capacity		Se	curity	A	Alarm Log	
General	Major Faults	Minor Faults	Date/Time	Adv	vanced	SFC Exec	cution	Project	
(i) The Date a Use these f	fields to configure	d here is Controller local Time attributes of the Co	ntroller.	on local t	ime.				
Date and Time			Ch	iange Da	te and Time	a			
Time Zone:									
	Adjust for I	Daylight Saving (+00:00)							
Time Synchro									
thine officiatio	nize					12			
-	nize e Synchronization	۸	DANGER. If time s online, active axes chassis, or any ot	s in any control of the synch	ontroller in th ronized dev	nis			
-	e Synchronization	*	online, active axes	s in any control of the synch	ontroller in th ronized dev	nis			
Enable Tim	e Synchronization		online, active axes chassis, or any ot may experience u	s in any co ner synch nexpecte	ontroller in ti ronized dev d motion.	nis rice,			
 Enable Tim Is the system Is a synchromic 	e Synchronization n time master	ed 🔒	online, active axes chassis, or any ott may experience u GuardLogix 5560 a may fault if no othe	s in any co ner synch nexpecte and 5570	ontroller in t ronized dev d motion. safety contr	nis rice. ollers			
 Enable Tim Is the system Is a synchromic 	e Synchronization n time master nized time slave ST master detecte	ed 🔒	online, active axes chassis, or any ot may experience u GuardLogix 5560 a	s in any co ner synch nexpecte and 5570	ontroller in t ronized dev d motion. safety contr	nis rice. ollers			
 Enable Tim Is the system Is a synchroid Duplicate C 	e Synchronization n time master nized time slave ST master detecte rship disabled	ed 🔒	online, active axes chassis, or any ott may experience u GuardLogix 5560 a may fault if no othe	s in any co ner synch nexpecte and 5570 ar time ma	ontroller in t ronized dev d motion. safety contr	nis rice, ollers n the			
 Enable Tim Is the system Is a synchroid Duplicate C CST Master 	e Synchronization n time master nized time slave ST master detecte rship disabled	ed 🔒	online, active axes chassis, or any ott may experience u GuardLogix 5560 a may fault if no othe	s in any co ner synch nexpecte and 5570 ar time ma	ontroller in t ronized dev d motion. safety contr aster exists i	nis rice, ollers n the			

Add an Ethernet Communication Module

Although ControlLogix 5580 and GuardLogix 5580 controllers can use Ethernet communication modules, only ControlLogix 5560 and 5570 and GuardLogix 5560 and 5570 controllers require an Ethernet communication module for connection to the Ethernet network. See <u>Controller</u>, <u>Communication</u>, <u>Drive</u>, and <u>Software Options on page 11</u> for more information.

Follow these instructions to add an Ethernet communication module to your project if needed.

IMPORTANT For all communication modules, use the firmware revision that goes with the firmware revision of your controller. See the release notes for the firmware of your controller.

- 1. To add a module, right-click the backplane and choose New Module.
- 2. Clear the Module Type Category Filters select all checkbox.
- 3. Check the Communication checkbox.

On the Select Module Type dialog box, you can filter to the exact type of module you are looking for, which makes your search faster.

4. Under Communications, select the Ethernet module and click Create.

Ente	er Search Text for Module	е Туре	Cle	ar F	ilter	S		Hide Filters	*
	Module	Type Category Filters		•	V	Мо	dule Type Vendor I	Filters	*
	Analog Communication Controller Digital			-	メ	Allen-Bradley Advanced Micro Hardy Process Si Molex Incorporate		0	4 III
•	-	III	F		•		III		
•	Catalog Number	Description					Vendor	Category	*
	1756-EN2F 1756-EN2T 1756-EN2TR 1756-EN2TSC 1756-EN3TR 1756-EN3TR	1756 10/100 Mbps Ethe 1756 10/100 Mbps Ethe	met B met B met B met B	ridg ridg ridg ridg	e, Ti e, 2- e, Ti e, 2-	visted-Pair Media Port, Twisted-P visted-Pair Medi Port, Twisted-P	Allen-Bradley Allen-Bradley Allen-Bradley Allen-Bradley Allen-Bradley	Communication Communication Communication Communication	•

New Module	a lanan daram	×
General* Conne	ection Module Info Internet Protocol Port Configuration Time Sync	
Type: Vendor: Parent: Name: Description:	1756-EN2T 1756 10/100 Mbps Ethemet Bridge, Twisted-Pair Media Allen-Bradley ENET_Module Motion_1	
	T O Host Name:	
Module Definit Revision : Electronic Key Rack Connec Time Sync Co Chassis Size	Slot: 1 v 10.001 nying: Compatible Module ction: Rack Optimization ionnection: None	
Status: Creating	OK Cancel Help	

The New Module configuration tabs appear.

- 5. Type a name for the module.
- 6. If you want, type a description.
- 7. Assign the EtherNet/IP address of the Ethernet module.

For information on how to create an Ethernet network and setting IP addresses for the communication and motion modules, see these manuals:

- EtherNet/IP Network Configuration User Manual, publication <u>ENET-UM001</u>
- PowerFlex[®] 755 Drive Embedded EtherNet/IP Adapter User Manual, publication, <u>750COM-UM001</u>
- Knowledgebase Technote # 66326
- Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication <u>ENET-TD001</u>
- 8. Assign the slot for the module.
- 9. In the module definition area, click Change.

10. Choose an Electronic Keying option.

Module Definition	×
Revision:	10 🔻 001 🍝
Electronic Keying:	Compatible Module
Rack Connection:	None
Time Sync Connection:	None
OK	Cancel Help



ATTENTION: The electronic keying feature automatically compares the expected module, as shown in the configuration tree, to the physical module before communication begins.

When you are using motion modules, set the electronic keying to either `Exact Match' or `Compatible Keying'.

Never use `Disable Keying' with Ethernet communication and motion modules.

For more information about electronic keying, see the ControlLogix Controller User Manual, publication <u>1756-UM001</u>.

11. Choose Time Sync and Motion.

Revision:	10 🔹 001
Electronic Keying:	Compatible Module
Rack Connection:	None
Time Sync Connection:	None 🔻
	None
	Time Sync and Motion
	3
ОК	Cancel Help

IMPORTANT	For CIP Sync time coordination to work in motion control, you must set the Time Sync Connection to Time Sync and Motion on all Ethernet communication modules. The CIP Sync protocol is what enables motion control on the EtherNet/IP network.
	The Time Sync and Motion selection is available only for firmware revision 3 and later. You must be offline to change the Time Sync and Motion selection
	If you are online at a major revision of 1 or 2, you can only change the revision to a 1 or 2. You must go offline to change the module to revision 3 or 4 and return to revision 1 or 2.
IMPORTANT	For CompactLogix 5370 and Compact GuardLogix 5370 controllers, the embedded dual-port Ethernet is automatically set with Time Sync Connection= Time Sync and Motion.
	To enable Integrated Motion, check the `Enable Time Synchronization' checkbox on the controller time/date tab.
12. Click OF	ζ.

IMPORTANT	If you have not enabled time synchronization, you get errors when you try to
	associate an axis.

Notes:

Configure Integrated Motion Control Using Kinetix Drives

Торіс	Page
Add a Kinetix EtherNet/IP Drive	32
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Configure the Axis Properties	46
Configure the Associated Axis and Control Mode	47
Specify the Motor Data Source	50
Display Motor Model Information	54
Assign Motor Feedback	54
Configure the Load Feedback	55
Configure the Master Feedback	57

This chapter provides procedures on how to configure integrated motion control by using the Kinetix[®] 350, Kinetix 5500, and Kinetix 6500 drives. The basic configuration for an integrated motion solution is to associate a drive with motor feedback and an axis configuration type.

For the examples in this chapter, the Kinetix 6500 drive is used and the exceptions for the Kinetix 350, Kinetix 5500 drives noted. See <u>Chapter 4</u>, <u>Configure Integrated Motion Control Using Kinetix 5700 Drives</u>, for Kinetix 5700 configuration information.

See <u>Chapter 8</u>, <u>Configuration Examples for a Kinetix Drive</u>, for examples of axis and feedback configurations.

For information about what attributes are replicated in the drive, see the Integrated Motion on the EtherNet/IP[™] network Reference Manual, publication <u>MOTION-RM003</u>.

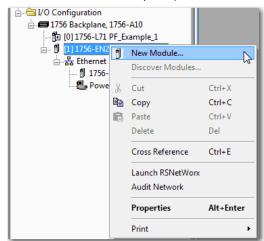
Add a Kinetix EtherNet/IP Drive

See <u>Table 2 on page 11</u> to determine the minimum version of the Studio 5000 Logix Designer[®] application that is required for your drive.

IMPORTANT	•	For complete information on how to configure Kinetix 5500 drives, including drives with integrated safety connections, see the Kinetix 5500 Servo Drives User Manual, publication <u>2198-UM001</u> .
	•	For complete information about how to configure the Kinetix 350 drives, see the Kinetix 350 Single-axis EtherNet/I/P Servo Drive User Manual, publication <u>2097-UM002</u> .
	•	For complete information about to configure the Kinetix 6500 drives, see the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication <u>2094-UM002</u> .

Follow these instructions to add a Kinetix drive your project.

1. Right-click the Ethernet network (node) and choose New Module.



- 2. To filter the selections, check the Motion checkbox.
- 3. Choose the Kinetix 350, Kinetix 5500, or Kinetix 6500 drive.

elect Module Type Catalog Module Discovery Favori	tes					
Enter Search Text for Module Ty	pe	ar Filters			Hide Filters	*
Module Typ	e Category Filters	▲ 🔲	Mod	ule Type Vendor Filte	ers	*
Managed Ethemet Switch MDI to EtherNet/IP Motion Motor Overload		En En	en-Bradley dress+Hauser NUC CORPOR/ NUC Robotics /		•	•
 Catalog Number 	Description			Vendor	Category	*
2094-EN02D-M01-S0 2094-EN02D-M01-S1 2094-SEPM-B24-S 2097-V31PR0-LM 2097-V31PR0-LM	Kinetix 6500 Single Axis Ethem Kinetix 6500 Single Axis Ethem 2094 SERCOS IDM Power Inte Kinetix 350, 2A, 120/240V, No Kinetix 350, 4A, 120/240V, No Kinetix 350, 2A, 240/(lateral III	et Safe Spe rface, 400V Filter Ethem Filter Ethem	ed Monitori , 24A, Safe et Drive et Drive	Allen-Bradley Allen-Bradley Allen-Bradley Allen-Bradley Allen-Bradley	Drive, Motion Safety, Drive, Motion Drive, Motion Drive, Motion	-
47 of 432 Module Types Found					Add to Favorit	es
Close on Create				Create	Close	Help

4. Click Create.

General*	Connection	Time Sync	Module Info	Internet Protocol	Port Configuration	Network	Associated Axes	Power	Di 1
Type:	2004	EN02D-M01-	SO Kinetiy 650	0 Single Avis Ether	net Safe Torque Off	Drive			
Vendor:		Bradley	50 Mileux 050	o single Axis Eulen	let sale forque off	Drive			
Parent:		Module			Ethernet Addres	s			
Name:	CIP	K6K			Private Network	ork:	192.168.1. 21	÷	
Descripti	on:			*	O IP Address:				
				Ŧ) Host Name:				
Module	Definition								
Revisio				Change					
	nic Keying:	2.00	1 patible Module						
Conne		Moti							
	Structure:	<no< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></no<>							

5. Type a Name for the module.

- 6. Type a description, if desired.
- 7. Assign an EtherNet/IP address.

You can establish the Node address of the drive by entering a private IP address via a thumbwheel switch on the drive for Private Network segments. Use the format 192.168.1.xxx, where the last octet, xxx, is the switch setting.

See the EtherNet/IP Network Configuration User Manual, publication <u>ENET-UM001</u>, for information on setting IP addresses and other Ethernet network considerations.

8. Under Module Definition, click Change.



Module Definition	
Revision:	2 🔻 001 🚔
Electronic Keying:	Compatible Module 🔻
Connection:	Motion
Power Structure:	<none></none>
Verify Power Rating on Co	onnection
ок	Cancel Help

The Module Definition dialog box appears.

9. Choose an Electronic Keying option.

Module Definition	X
Revision:	2 🔻 001 🚔
Electronic Keying:	Compatible Module 👻
Connection:	Exact Match Compatible Module
Power Structure:	Disable Keying
Verify Power Rating on Co	onnection
ОК	Cancel Help



ATTENTION: The electronic keying feature automatically compares the expected module, as shown in the configuration tree, to the physical module before communication begins. When you are using motion modules, set the electronic keying to either `Exact Match' or `Compatible Keying'.

Never use `Disable Keying' with motion modules.

For more information about electronic keying, see the Electronic Keying in Logix 5000[™] Control Systems Application Technique, publication LOGIX-AT001.

10. Assign the appropriate Power Structure.

When you select a Kinetix 6500 drive catalog number, you are specifying only a Control Module. To specify the drive, you must assign a power structure. Some of the drives do not require a power structure.

- **TIP** You can locate the power-structure reference numbers by doing the following:
 - Check the hardware
 - See the device documentation
 - Reviewing the purchase order or the bill of materials.

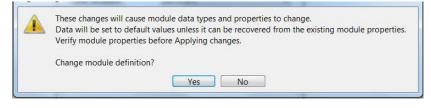
You assign the power structure for the Kinetix 6500 drive only. Kinetix 350 and Kinetix 5500 drives auto-populate the only power structure available.

11. Check the checkbox if you want to verify the power rating on connection.

Module Definition	()) - X-
Revision:	2 🗸 001 🛬
Electronic Keying:	Compatible Module 🔹
Connection:	Motion
Power Structure:	<none></none>
vering rower hading on con	2094-AC05-MP5-M 2094-AC05-M01-M 2094-AC09-M02-M 2094-AC16-M03-M
	2094-AC32-M05-M 2094-BC01-M01-M 2094-BC01-M01-M 2094-BC02-M02-M 2094-BC02-M03-M 2094-BC07-M05-M

12. Click OK.

When you change the Module Definition, related parameters also change. By changing the major revision or power structure, the identity of the drive changes. If your drive is associated to an axis, these changes disassociate the axis.



Configure the Safety Category - Kinetix 5500 Drives

The Safety tab provides you with information about the connection between the owner and the 2198-H*xxx*-ERS2 servo drive. The information comes from the controller.

Connection Type	Requested Packet Interval (RPI) (ms)	Connection Reaction Time Limit (ms)	Max Obs Network De				
Safety Input	10 🌲	40.1		Reset	Advan	ced	
Safety Outpu		60.0		Reset			
Reset Ow							
Configuration S	hership ←	(Hex) Co	ору				
Configuration S	gnature: 3a_ecd7	(Hex) Co	ору				

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

- Servo drive catalog number must be 2198-Hxxx-ERS2 (integrated)
- Servo drive safety network number
- GuardLogix[®] slot number
- GuardLogix safety network number
- Path from the GuardLogix controller to the 2198-Hxxx-ERS2 drive
- Configuration signature

The connection between the GuardLogix controller and the 2198-Hxxx-ERS2 drive is lost if any differences are detected. The yellow yield icon also appears in the controller project tree after you download the program.

For complete information on how to configure a drive with integrated safety connections, see the Kinetix 5500 Servo Drives User Manual, publication <u>2198-UM001</u>.

Configure the Power Options

1. Click the Power tab.

Module Info	Internet Protocol	Port Configuration	Network	Associated Axes	Power	Digital Input	Motion Diagnostics	4
Power Strue	:ture:	2198-H008-ERS				Adva	anced	
		Kinetix 5500, 2.5	A, 195-528	Volt, Safe Torque	Off Drive	2		
Voltage:		400-480 VAC		•				
AC Input Ph	nasing:	Three Phase		•				
Bus Configu	ration:	Standalone	Standalone					
Bus Shari	ng Group:	Standalone	*					
Bus Regulat	tor Action:	Shunt Regulator	•					
Shunt Regu	lator Resistor Type	e: 🔘 External 🏾 🍳	Internal					
External S	Shunt:	<none></none>						

IMPORTANT	Single-phase operation is possible only when Module Properties >
	Power tab > Bus Configuration is configured as Standalone and Voltage
	is configured as 200240V AC.

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

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



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

Attribute	Menu	Description		
Voltage	400-480 VAC	324528 AC rms input voltage		
voltage	200-240 VAC	195264 AC rms input voltage		
AC Input Phasing	Three PhaseSingle Phase	Input power phasing. Kinetix 5500 drives with single-phase operation is limited to 2198-H003 ERSx, 2198-H008-ERSx, and 2198-H015-ERSx.		
	Standalone	Applies to single-axis drives and drives with Shared AC input configurations.		
Bus Configuration ⁽¹⁾	Shared AC/DC	Applies to converter drives with Shared AC/DC and Shared AC/DC Hybrid input configurations.		
	Shared DC	Applies to inverter drives with Shared DC input (common-bus) configurations.		

Attribute	Menu	Description		
	Standalone	Applies to standalone bus configurations.		
Bus-sharing Group	Group1Group2Group3	Applies to any bus-sharing configuration. ⁽²⁾		
Shunt Regulator Action	Disabled	Disables the internal shunt resistor and externa shunt option.		
-	Shunt Regulator	Enables the internal and external shunt options.		
Shupt Degulator Decistor Tupo	Internal	Enables the internal shunt (external shunt option is disabled).		
Shunt Regulator Resistor Type	External	Enables the external shunt (internal shunt option is disabled).		
External Shunt ⁽³⁾	 None 2097-R6 2097-R7 	Selects external shunt option. Only the shunt model that is intended for the drive model is shown.		

(1) Bus Configuration selection is not applicable to all EtherNet/IP drives.

(2) All drives physically connected to the same shared-bus connection system must be part of the same bus-sharing group in the Logix Designer application.

(3) See the Kinetix Servo Drives Specifications Technical Data, publication <u>KNX-TD003</u>, for more information on the Bulletin 2097 external shunt resistors.

3. Click OK.

You can change the overload and voltage limits when you are offline. You cannot change settings while online but the values are displayed. $^{(1)}$

Figure 2 - Kinetix 5500 Offline Display of the Advanced Limits Dialog Box

Advanced User Limits	- Alexandre	X
Converter Thermal Overload Limit:	100.000	%
Bus Regulator Thermal Overload Limit:	100.000	%
Bus Under Voltage Limit:	15.000	%
OK Can	tel Help	

See publication <u>2198-UM001</u>, Kinetix 5500 Servo Drives, for more information.

⁽¹⁾ Not applicable to the Kinetix 350 drive.

Configure Digital Inputs

Use the Digital Input tab to enter digital input values for the drive module. These offline displays are the default values for the Kinetix 6500 and PowerFlex* 755 Ethernet drives. The appearance of the Digital Input tabs of the PowerFlex 755 drives can vary dependent upon the peripheral device configuration. The Kinetix 350 drive does not have a Digital Input tab.

Figure 3 - Digital Input Tab for the Kinetix 5500 Drive

Module Properties: Blank_en	et_1 (2198-H008-ERS2 3.0	001)				- • •
Connection Time Sync Mod	ule Info Internet Protocol	Port Configuration	Network	Associated Axes	Power	Digital Input*
Axis:	1 -					
Axis Name:	<none></none>					
Digital Input 1:	Unassigned	•				
Digital Input 2:	Unassigned	•				
	Unassigned Home	2				
	Registration 1 Registration 2					
	Positive Overtravel Negative Overtravel Home & Registration 1					

Parameter	Description
Digital Input 1 Digital Input 2	Choose one of these values for Digital Input 1 and 2: Unassigned Enable Home Registration 1 Registration 2 Positive Overtravel Negative Overtravel Home and Registration 1

Figure 4 - Digital Input Tab for the Kinetix 6500 Drive

Module Properties: Local (2094-EN02D-M01-S1 2.001)									
Connection Time	Sync Module Info	Internet Protocol	Port Configuration	Network	Associated Axes	Power	Digital Input	• •	
Digital Input 1:	Enable	•							
Digital Input 2:	Home	•							
Digital Input 3:	Registration 1	•							
Digital Input 4:	Registration 2	•							

Parameter	Description
Digital Input 1 Digital Input 2 Digital Input 3 Digital Input 4	 Choose one of these values for Digital Input 1, 2, 3, and 4: Unassigned Enable Home Registration 1 Registration 2 Positive Overtravel Negative Overtravel Regeneration OK

Table 8 - Module Properties: Kinetix 6500 Digital Input Tab Descriptions

Create an Associated Axis

There are two approaches that you can take to create and configure an axis. You can create an axis first and then add the axis to your motion group or you can create your motion group and then add an axis.

The procedure that is outlined in this section takes the approach to create your axis first, add it to your motion group, and then configure the axis.

Create an Axis for a Kinetix Drive

Follow these steps to create an axis.

- 1. To open the Module Properties dialog box, double-click the drive in the Controller Organizer.
- 2. Click the Associated Axes tab.
- 3. Click New Axis.

Module Properties: ENET_Module (2094-EN02D-M01-S0 2.001)									
General*	Connection	Time Sync	Module Info	Internet Protocol	Port Configuration	Network	Associated Axes	Power	Di 🔹 🕨
Axis 1 Moto	: r Feedback De	evice:	<none> Motor Fee</none>	edback Port	•	New Axis	····		
Load	Feedback Dev	vice:	<none></none>		•				
Axis 2	(Auxiliary Ax	dis):	<none></none>		•	New Axis	·		
Mast	er Feedback D	evice:	<none></none>		-				

	0 0	11	
New Tag	1///		×
Name:			Create 🛛
Description:		*	Cancel
		÷	Help
Usage:	<controller></controller>	Ţ	
Туре:	Base Connection	m	
Alias For:		Ŧ	
Data Type:	AXIS_CIP_DRIVE		
Parameter Connection:		-	
Scope:	PF_Example_1	•	
External Access:	Read/Write	•	
Style:		-	
Constant			
Sequencing			
Open AXIS	CIP_DRIVE Configuration		
Open Param	eter Connections		

The New Tag dialog box appears.

Notice that the fields in the next steps are automatically entered for the AXIS_CIP_DRIVE data type.

- 4. Type a Tag name.
- 5. Type a Description, if desired.
- 6. Choose the Tag Type.
- 7. Choose the Data Type AXIS_CIP_DRIVE.
- 8. Choose the Scope.
- 9. Choose the External Access.

For more information about External Data Access Control and Constants, see the Logix5000 Controllers I/O and Tag Data Programming Guide, publication <u>1756-PM004</u>.

10. Click Create.

Establish Feedback Port Assignments

Kinetix 350 and Kinetix 5500 drives have one Motor Feedback Port, which is automatically assigned.

The Kinetix 6500 drive has two feedback ports. Port 1 is reserved for Motor Feedback on the primary axis (Axis_1). Port 2 can be used either as Load Feedback for the primary axis or as a Master Feedback for a secondary feedback only axis (Axis_2).

To establish feedback port assignments for Kinetix 6500 drives, follow these steps.

- 1. To access Module Properties, double-click the Kinetix 6500 drive in the Controller Organizer.
- 2. Click the Associated Axes tab.

Notice that the motor feedback is already configured by default.

General Connection Time Sync	Module Info Internet Protocol Port Configuration Network Associated Axes* Power Digita	l Input M
Axis 1:	К6К_1 • New Axis	
Motor Feedback Device:	Motor Feedback Port	
Load Feedback Device:	<none></none>	
Axis 2 (Auxiliary	<none> New Axis</none>	
Master Feedback Device:	<none></none>	

The AUX Feedback Port (Port 2) of the drive can be optionally used for load feedback of the primary axis (Axis 1) to support Load or Dual Feedback Configuration.

3. From the Load Feedback Device pull-down menu, choose AUX Feedback Port.

1	Module Properties: ENET_Module (2	094-EN02D-M01-S0 2.001)	
	General Connection Time Sync Mo	dule Info Internet Protocol Port Configuration Network Associated As	xes* Power Di 4 →
	Axis 1: Motor Feedback Device:	K6K_1 New Axis	
	Load Feedback Device:	Aux Feedback Port	
	Axis 2 (Auxiliary Axis):	<none> New Axis</none>	
	Master Feedback Device:	<none></none>	

Create a Motion Group

All axes must be added to the Motion Group in your project. If you do not group the axes, they remain ungrouped and unavailable for use. You can only have one Motion Group per Logix controller.

To determine how many axes are supported by your controller system, see <u>Table 3</u> on <u>page 12</u>, <u>Supported Axes by Controller Type</u>.

To create a motion group, follow these instructions.

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

Motion Green			
Ungrou	New Motion Group		=
Axi	Cut	Ctrl+X	
Data Type	Сору	Ctrl+C	
User-D	Paste	Ctrl+V	
Add-On-D	fined		

The New Tag dialog box appears.

New Tag			×
Name:			Create 🗸
Description:		*	Cancel
			Help
		~	
Usage:	<controller></controller>	•	
Туре:	Base Connectio	n	
Alias For:		•	
Data Type:	MOTION_GROUP		
Parameter Connection:		T	
Scope:	Integrated_Motion_Control	•	
External Access:	Read/Write	•	
Style:		-	
Constant			
Sequencing	9		
Open MOT	ION_GROUP Configuration		
Open Para	meter Connections		

- 2. Type a Tag name.
- 3. Type a description, if desired.
- 4. Choose the Tag Type.
- 5. Choose the Scope.
- 6. Choose the External Access.
- 7. Click Create.

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

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

The Motion Group Properties dialog box appears.

9.	Click the Axis Assignment tab and move your axes (created earlier) from
	Unassigned to Assigned.

🕞 Motion Group	Properties	s - Mot	tion_Group_101	
Axis Assignment	Attribute	Tag		
Unas	signed:		Assigned:	
			Axis_1 Axis_2_K5500 CIP_K6K	
	Ndd ->		< Remove	•
	ОК		Cancel Apply	Help

Set the Base Update Period

The Base Update Period is basically the RPI rate for Ethernet communication between the controller and the motion module, a Unicast connection.

There are two alternate update periods that you can configure when using the Axis Scheduling function. See <u>Axis Scheduling on page 145</u> for details.

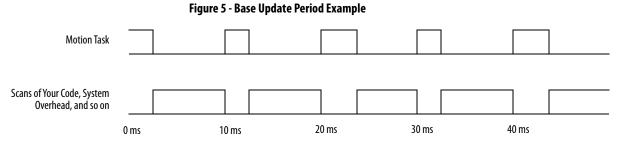
The Base Update Period determines how often the Motion Task runs. When the Motion Task runs, it interrupts most other tasks regardless of their priority. The Motion Task is the part of the controller that takes care of position and velocity information for the axes. To set the Base Update Period, follow these steps.

1. Click the Attribute tab in the Motion Group Properties dialog box.

Axis Assignment Attribut	erties - Motion_Group_101 🛛 🗖 📼 💌
Base Update Period:	2.0 ms (in 0.5 increments.) Axis Schedule
Alternate 1 Update:	2.0 ms
Alternate 2 Update:	2.0 ms
General Fault Type:	Non Major Fault 🔹
Timing Model:	One Cycle
Scan Times (elapsed ti	me):
Max:	(us) Reset Max
Last:	(us)
Average:	(us)
OK	Cancel Apply Help

- 2. Set the Base Update Period to 2.0...32.0 ms.
 - **TIP** Check the Last Scan time values. Typically, the value is less than 50% of the Base Update Period.

For the Kinetix 6500 drive, the minimum Base Update Rate is 1 ms.



In this example, the Base Update Period = 10 ms. Every 10 ms the controller stops scanning your code and whatever else it is doing and runs the motion planner.

The Base Update Period is a trade-off between updating positions of your axes and scanning your code. In general, you do not want the Motion Task to take more than 50% of the overall Logix controller time on average. The more axes that you add to the Motion Group, the more time it takes to run the Motion Task. For the ControlLogix[®] 5570 controller, the incremental impact on the Motion Task is roughly at 6...8 drives/ms. Actual impact can vary depending on axis configuration.

For detailed information on the Axis Scheduling function, Axis Assignment tab, and Alternate Update Period Scheduling, see <u>Axis Scheduling on</u> page 145.

Integrated Architecture Builder

To help you determine motion system performance, use the motion performance calculator in the Integrated Architecture Builder (IAB).

The IAB is a graphical software tool for configuring Logix-based automation systems. It helps you select hardware and generate bills of material for applications that include controllers, I/O, networks, PowerFlex drives, On-Machine[™] cabling and wiring, motion control, and other devices.

You can find the software at <u>http://www.rockwellautomation.com/en/e-tools/configuration.html</u>

Configure the Axis Properties

After you add the drive to your project and create the axes, use the Axis Properties dialog boxes to configure the drive. Notice that the dialog boxes change based on your configuration choices, for example, feedback configuration.

<u>Table 9</u> lists the basic tasks necessary configure a drive.

Category Dialog Box	Perform These Tasks	
General	Assign the axis configuration.	47
	Choose the feedback configuration.	
	Choose the application type, if applicable.	
	Choose the loop response (low, medium, or high), if applicable.	
	 If you have not already done so, you can create and associate an axis to a new Motion Group and associate a drive module to the axis. 	
Motor	• Specify a motor with the Data Source = Nameplate data sheet.	51
	• Specify a motor with the Data Source = Catalog Number.	
	• Select a motor with the Data Source = Motor NV.	
Motor Feedback	Select the Motor Feedback Type.	54
Load Feedback	Select the Load Feedback Type, if applicable.	55
Scaling	 Configure feedback by choosing the load type, by entering the scaling units, and by choosing the Travel mode. 	222
	Enter the Input Transmission and Actuator ratio, if applicable.	

Table 9 - Category Dialog Boxes to Configure Drives

The parameters that you configure on the General category dialog box result in the presentation of attributes and parameters that are available for the combination of your selections. **IMPORTANT** All AXIS_CIP_DRIVE Axis Properties dialog boxes are dynamic. Optional attributes and dialog boxes that are related to each integrated motion axis you create come and go based on what combination of axis characteristics you define.

See the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>, for complete information on Axis Attributes and how to apply Control Modes.

IMPORTANT	Be sure to associate the drive and axis before configuring the axis
	because the drive determines what optional attributes are supported for
	the axis.

If you have already created an axis and associated it with a drive, the Associated Module and Axis are shown on the General category of the Axis Properties dialog box. Otherwise, you can select them here.

Figure 6 - General Category Dialog Box

Axis Properties - K6K_1				 X
Categories:	General			_
Motor Model Motor Feedback Scaling Hookup Tests Polanity Autotune Load - Backlash - Compliance	Axis Configuration: Feedback Configuration. Application Type: Loop Response:	Position Loop Motor Feedback Basic Medium	•	
- Friction - Friction - Observer - Position Loop - Velocity Loop - Acceleration Loop	Assigned Group Motion Group: Update Period:	Motion_Group_101	New Group	
Torque/Current Loop Planner Homing Actions Exceptions Drive Parameters Parameter List Status Faults & Alarms Tag	Associated Module Module: Module Type: Power Structure: Axis Number:	CIP_KRK • 2994-EN020-M01-S0 2994-B007-M05-M 1		
Axis State:		OK	Cancel Apply	Help

The Axis Number field corresponds to the axes listed on the Associated Axes tab of the Module Properties dialog box. Any feedback port assignments that you made on the Associated Axes tab are also mapped to the drive when you associate an axis and a drive.

Now that the axis is associated to the drive module, meaningful values are available for other axis properties.

For more information on Control Modes, see the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>.

1. In the Controller Organizer, double-click the Axis that you want to configure.

Configure the Associated Axis and Control Mode

🧔 Axis Properties - K6K_1			
Categories:	General		
Motor Model Model Motor Feedback Scaling Polarity Autotune Load Backlash Postion Loop Walaystu Loop	Axis Configuration: Feedback Configuration: Application Type: Loop Response:	Position Loop Feedback Only Frequency Control Prostion Loop Velocity Loop Torque Loop Non-Regenerative AC/DC Converter Regenerative AC/DC Converter Low Hamonic AC/DC Converter Low Hamonic AC/DC Converter DC/DC Converter	

The Axis Properties General dialog box appears.

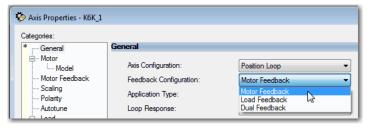
- 2. Choose an Axis Configuration type. For this example, choose Position Loop.
 - **TIP** The associated drive determines what Axis and Feedback Configuration choices are presented.

<u>Table 10</u> compares the axis configuration types for the drives.

Table 10 - Compare the Axis Configuration Types for the Drives

Axis Type	Kinetix 350	Kinetix 5500	Kinetix 6500
Position Loop (P)	Yes	Yes	Yes
Velocity Loop (V)	Yes	Yes	Yes
Torque Loop (T)	Yes	Yes	Yes
Feedback Only (N)	No	Yes	Yes
Frequency Control (F)	No	Yes	No

3. In the Feedback Configuration pull-down menu, choose Motor Feedback.



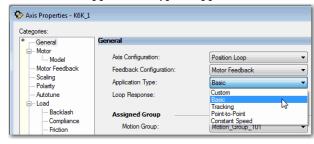
TIP The Kinetix 350 and Kinetix 5500 drives support only Motor Feedback.

<u>Table 11</u> compares the feedback configuration types for the Kinetix drives.

Feedback Type	Axis Type	Kinetix 350	Kinetix 5500	Kinetix 6500
Motor Feedback	Position Loop (P), Velocity Loop (V), Torque Loop (T)	Yes	Yes	Yes
Load Feedback	Position Loop (P), Velocity Loop (V), Torque Loop (T)	No	No	Yes
Dual Feedback	Position Loop (P)	No	No	Yes
Dual Integrator	Position Loop (P)	No	No	No
Master Feedback	Feedback Only (N)	No	Yes	Yes
No Feedback	Velocity Loop (V), Frequency Control (F)	No	Yes	No

Table 11 - Compare the Feedback Configuration Types for the Drives

4. Choose an Application Type, if applicable.



TIP Application Type defines the servo loop configuration automatically. These combinations determine how the calculations are made that can minimize the need for you to perform an Autotune or a Manual Tune.

The Application Type determines the type of motion control application. This attribute is used to set the Gain Tuning Configuration Bits. <u>Table 12</u> illustrates the gains established based on application type.

Table 12 - Customize Gains to Tune

Application Type	Крі	Kvi	ihold	Kvff	Kaff	torqLPF
Custom ⁽¹⁾	-	-	-	-	-	
Basic (V20 and later)	No	No	No	Yes	No	Yes
Basic (V19 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

(1) If you set the type to Custom, you can control the individual gain calculations by changing the bit settings in the Gain Tuning Configuration Bits Attribute.

- 5. Choose a Loop Response, if applicable. 🏷 Axis Properties - K6K_1 Categories: General Motor Axis Configuration: Model Position Loop Motor Feedback Feedback Configuration: Motor Feedback Scaling Application Type: Basic Polarity Autotune Loop Response Medium Load Low Backlash Assigned Group High Motion_Group_101 Compliance Motion Group: Friction
 - TIP Loop Response settings also impact the calculations that are made that can minimize the need for you to perform an Autotune or a Manual Tune. The loop response impacts the spacing between the position and velocity loops and the proportional and integral gains. This response impacts how aggressively a given profile is tracked.

Specify the Motor Data Source

The Motor Data Source is where you tell the axis where the motor configuration values are originating. You can select a motor by catalog number from the Motion Database. You can enter motor data from a nameplate or data sheet, or use the motor data that is contained in the drive or motor nonvolatile memory.

On the Motor dialog box you specify what motor you want to use and where the data is coming from:

- Specify a motor with the Data Source = Nameplate data sheet.
- Specify a motor with the Data Source = Catalog Number.
- Select a motor with the Data Source = Motor NV.

Choose the Catalog Number as the Motor Data Source

To choose a motor from the Motion Database, follow these steps.

- 1. If the Axis Properties dialog box is not open, double-click the axis.
- 2. Go to the Motor dialog box of Axis Properties.

The asterisk next to a category means that you have not applied changes.	Axis Properties - K6K 1 Categories: Garneal Model Model Model Model Garneal Garneal	Motor Device Specif Dete Source: Catalog Number: Motor Type: Units:	Ication Catalog Number • anore> Not Specified • Rev •	(Change Catalog)	Parameters	
	Axis State: Manual Tune			ОК	Cancel Apply	Help

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

Notor Device Specification						
Data Source:	Catalog Number 🗸					
Catalog Number: Motor Type:	Nameplate Datasheet Catalog Number Motor NV Not Specified					
Units:	Rev 👻					

- 4. Click Change Catalog.
- 5. Select a motor.

	Change Catalog Number
	Catalog Number: MPL-B310P-M OK
To reduce the size of the list, use these filters.	MPL-B230P-Hxx4 Cancel MPL-B230P-Vxc2 Help MPL-B310P-H Help MPL-B310P-H Help MPL-B310P-H MPL-B320P-H MPL-B320P-H MPL-B330P-H MPL-B330P-H MPL-B330P-H
	Filters Voltage Family Feedback Type <all> <all></all></all>

Nodel Data Source: Catalog Number Parameters Model Modor Tope: Retay Permanent Magnet Change Catalog Poloty Teedback Catalog Number: MLP.8310P-M Change Catalog Poloty Teedback Motor Type: Retay Permanent Magnet Image Catalog Poloty Teedback Motor Type: Retay Permanent Magnet Image Catalog Poloty Actorne Units: Rev Image Catalog Poloty Actorne Rated Power: 0.77 kW Poloty Companie Rated Power: 0.77 kW Poston Loop Rated Speed: 5000.0 RPM Velocity Loop Rated Current: 1.7 Amps (RMS) Acceleration Loop Rated Torque: 1.58 Nm Motor Overload Limit: Panner Horining Image Speed: 5000.0 % Rated	gories: General	Motor Device Specif	fication				
-actions Drive Parameters - Parameter List - Status - Faulta & Alamna - Tao	Lucci — Model — Model — Model — Model — Hookup Tests — Polarity — Autoture — Load — Gromplance — Friction — Observer — Postion Loop — Velocity Loop — Acceleration Loop — Velocity Loop — Acceleration Loop — Posterion Loop — Velocity Loop — Acceleration Loop — Torque/Current Loop — Ramer — Rameters — Drive Parameters — Draw Parameters — Status & — Stat	Data Source: Catalog Number: Motor Type: Units: Nameplate / Dat Rated Power: Rated Voltage: Rated Speed: Rated Current:	Catalog Number MPL-B310P-M Rotary Permanent Rev tasheet - Phase 0.77 460.0 5000.0 1.7	to Phase parameter kW Vots (RMS) RPM Amps (RMS)	Change Catalog S Pole Count: Max Speed: Peak Current:	8 5000.0 5.02	Amps (RMS)

The Motor category dialog box is now populated with all information that is related to the motor you selected from the Motion Database.

- 6. Click Apply.
 - **TIP** When you use a motor catalog number as the data source, default values are automatically set based on the Application Type and Loop Response settings from the General dialog box.

Choose Nameplate as the Motor Data Source

The Nameplate option requires you to enter the motor specification information from the motor nameplate and the motor data sheet.

1. On the Motor dialog box of Axis Properties, from the Data Source pulldown menu, choose Nameplate data sheet.

Axis Properties - K6K_1			
Categories:			
;General	Motor Device Specif	ication	
* - Motor * Model	Data Source:	Nameplate Datasheet	Parameters
* Motor Feedback Scaling	Catalog Number:	Nameplate Datasheet Catalog Number	Change Catalog
Hookup Tests	Motor Type:	Motor NV	1
Polarity Autotune	Units:	Rev 🔻	

2. Choose a motor type.

Categories:		.		
General	Motor Device Speci	tication		
* - Motor * Model	Data Source:	Nameplate Datasheet -		Parameters.
* Motor Feedback	Catalog Number:	<none></none>	Change Catalog	
····· Scaling ····· Hookup Tests	Motor Type:	Not Specified -		
Polarity	Units:	Not Specified Rotary Permanent Magnet		

<u>Table 13</u> shows the motor types and drives that are compatible.

Motor Type	Kinetix 350	Kinetix 5500	Kinetix 6500
Surface Mount Permanent Magnet	Yes	Yes	Yes
Linear Permanent Magnet	No	Yes	Yes
Rotary Induction	No	Yes	No
Interior Permanent Magnet	No	No	No

Table 13 - Compatible Motor Types

Notice that the motor information fields are initialized to defaults.

tor Device Specification								
Data Source:	Nameplate Dat	asheet 👻		Parameters				
Catalog Number:	<none></none>		Change Catalog					
Motor Type:	Rotary Permanent Magnet							
Units:	nits: Rev +							
Nameplate / Datasheet - Phase to Phase parameters								
Rated Power:	0.0	kW	Pole Count:	8				
Rated Voltage:	0.0	Volts (RMS)						
Rated Speed:	0.0	RPM	Max Speed:	0.0	RPM			
Rated Current:	0.0	Amps (RMS)	Peak Current:	0.0	Amps (RMS)			
Rated Torque:	0.0	N-m	Motor Overload Limit:	100.0	% Rated			

3. Enter the parameter information from the motor Nameplate data sheet and click Apply.

Choose Motor NV as the Motor Data Source

When you choose Motor NV as the data source, the motor attributes are derived from nonvolatile memory of a motor-mounted smart feedback device that is equipped with a serial interface. Only a minimal set of motor and motor feedback (Feedback 1) attributes are required to configure the drive.

1. From the Motor dialog box of Axis Properties, choose Motor NV.

🏷 A	xis Properties - K6K_1			
_	egories: General	Motor Device Speci	ication	
	Motor	Motor Device opean	Realiton	
*	Model	Data Source:	Nameplate Datasheet 🔹	Parameters
	Motor Feedback Scaling	Catalog Number:	Nameplate Datasheet Catalog Number	Change Catalog
	- Hookup Tests	Motor Type:	Motor NV	
	Polarity Autotune	Units:	Rev 👻	

2. Choose the Motor Units that are associated with the motor, either Rev for rotary motor or Meters for linear motor.

No other motor information is needed.

3. Click Apply.

Display Motor Model Information

The Motor Model category displays more information that is based on the motor type you select.

The asterisk next	Axis Properties - K6K_1					
to a category means that you have not applied	Categories: 	Motor Model Phase to Phase F Torque Constant (R):	Parameters	N-m/Amps(RMS)		
changes.	Motor Feedback	Voltage Constant (Ke):	67.89639	Volts(RMS)/KRPM		
	Scaling Hookup Tests	Resistance (Rs):	19.0	Ohms		
	Polarity	Inductance (Ls):	0.093	Henries		
	Autotune	Flux Saturation Profile				
	Backlash	Flux Saturation @ 12.5%:	94.0	% Nominal Inductance		
	Compliance Friction	Flux Saturation @ 25.0%:	85.0	% Nominal Inductance		
	Observer	Flux Saturation @ 37.5%:	75.0	% Nominal Inductance		
	Position Loop Velocity Loop	Flux Saturation @ 50.0%:	64.0	% Nominal Inductance		
	Acceleration Loop	Flux Saturation @ 62.5%:	54.000004	% Nominal Inductance		
	Torque/Current Loop	Flux Saturation @ 75.0%:	45.0	% Nominal Inductance		
	Planner Homing	Flux Saturation @ 87.5%:	39.0	% Nominal Inductance		
	Actions	Flux Saturation @ 100%:	35.0	% Nominal Inductance		

- If the motor data source is Catalog Number, this information is populated automatically.
- If the motor data source is Nameplate data sheet, this information must be entered manually, or by running the optional Motor Analyzer.
- If the motor data source is Motor NV, this dialog box is blank.

Assign Motor Feedback

What appears on the Motor Feedback dialog box is dependent on what you select on the General dialog box for Feedback Configuration.

The Motor Feedback dialog box represents the information for the feedback device that is directly coupled to the motor. This dialog box is available if the feedback configuration that is specified on the General dialog box is anything other than Master Feedback.

If the motor that you select has Catalog Number as the data source, all information on this dialog box with be entered automatically. Otherwise you have to enter the information yourself.

Motor Feedback Device Sp	ecification		
Device Function:	Motor Mounted Feedb	ack	Parameters
Feedback Channel:	Feedback 1		
Туре:	Hiperface	-	
Units:	Rev		

Attributes that are associated with the Motor Feedback dialog box are designated as Feedback 1.

Commutation —		
Alignment:	Motor Offset	
Offset:	Not Aligned Controller Offset	Test Commutation
Polarity:	Motor Offset Self-Sense	

If a permanent magnet motor is selected from the Motion Database, the Commutation Alignment is set to Controller Offset. However, if a permanent magnet motor is specified from Nameplate data sheet, you must specify the Commutation Alignment method. The default is set to Not Aligned.

Table 14 - Commutation Alignment Settings

Туре	Description
Not Aligned	Not Aligned indicates that the motor is not aligned, and that the Commutation Offset value is not valid. If the Commutation Offset is not valid, the drive cannot use it to determine the commutation angle. Any attempt to enable the drive with an invalid commutation angle results in a Start Inhibit condition.
Controller Offset	Controller Offset applies the Commutation Offset value from the controller to determine the electrical angle of the motor.
Motor Offset	The drive derives the commutation that is offset directly from the motor.
Self-Sense	The drive automatically measures the commutation that is offset when it transitions to the Starting state for the first time after a power cycle. This alignment type generally applies to a PM motor equipped with a simple incremental-feedback device.

In most cases, the Commutation Alignment is set to Controller Offset and the Commutation test is run during commissioning to determine the Commutation Offset and Polarity.

See the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>, for more information on axis attributes.

Configure the Load Feedback

The Load Feedback category contains the information from the feedback device that is directly coupled to the load-side of a mechanical transmission or actuator.

Load Feedback Device Sp	ecification		
Device Function: Feedback Channel:	Load-Side Feedback Feedback 2		Parameters
Type: Units:	Not Specified	٣	Device Type cannot be configured until feedback device is defined for this Feedback Channel in Associated Module. Define feedback device.
	For your convenience, you can use to the Module Properties dialog bo associated drive.		

The Load Feedback category is available if the Feedback Configuration that is specified on the General dialog box is Load or Dual.

Load Feedback Device Specification				
Device Function:	Load-Side Feedback			
Feedback Channel:	Feedback 2			
Туре:	Not Specified -			
Units:	Rev 👻			

Attributes that are associated with the Load Feedback category are designated Feedback 2.

X Axis Properties - K6K_1		
Categories:		
* General	Load Feedback Device S	pecification
⊡ Motor	Device Function:	Load-Side Feedback
Motor Feedback	Feedback Channel:	Feedback 2
 Load Feedback Scaling 	Туре:	Digital AqB 🔹
Hookup Tests	Units:	Rev 🔻

Unlike the Motor Feedback category, you must explicitly enter load feedbackdevice information on the Load Feedback category, including the Feedback Type. This entry is required because the Load Feedback device is not built into the motor.

Default values are displayed based on the Feedback Type selected.

Digital AqB		
Cycle Resolution:	1024	Feedback Cycles/Rev
Cycle Interpolation:	4	Feedback Counts per Cycle
Effective Resolution:	4096	Feedback Counts per Rev
Startup Method:	Incremental	•

Configure the Master Feedback

The Master Feedback category is available if the Feedback Configuration that is specified in the General category is Master Feedback. The attributes that are associated with the Master Feedback category are associated with Feedback 1. Again, like the Load Feedback category, you must enter all information.

X Axis Properties - K6K_1					
Categories:					
General	Master Feedback Device Spe	cification			
- Kaster Feedback - Scaling - Hookup Tests - Polarity - Honing - Actions - Drive Parameters - Parameter List - Status - Faunter List - Status - Tag	Device Function: Feedback Channel: Type: Units: Hiperface Cycle Resolution: Cycle Interpolation: Effective Resolution: Statup Method: Tums:	Master Feedback 1 Hperface Rev 1024 2048 2097152 Absolute • 4096	Feedback Cycles/Rev Feedback Counts per Cycle Feedback Counts per Rev	Parametera	
Axis State:					
AND JUGIO.					
Manual Tune			ОК	Cancel Apply	Help

To verify that motor and feedback device are functioning properly, download to the controller, and continue on to <u>Hookup Tests on page 226</u>.

Configure Feedback Only Axis Properties

To create your external encoder module and configure feedback-only axis properties if you are using the 842E-CM integrated motion encoder on the EtherNet/IP network, see <u>Example 7: 842E-CM Integrated Motion Encoder</u> with Master Feedback on page 183.

Configure Integrated Motion Control Using Kinetix 5700 Drives

Торіс	Page
Add a Kinetix 5700 EtherNet/IP Drive	60
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This chapter provides procedures on how to configure integrated motion control by using the Kinetix[®] 5700 drive. The basic configuration for an integrated motion solution is to associate a drive with motor feedback and an axis configuration type.

For information about what attributes are replicated in the drive, see the Integrated Motion on the EtherNet/IP[™] network Reference Manual, publication <u>MOTION-RM003</u>.

See <u>Chapter 8</u>, <u>Configuration Examples for a Kinetix Drive</u>, for Kinetix 5700 configuration information.

For complete information on how to configure Kinetix 5700 drives, including drives with integrated safety connections, see the Kinetix 5700 servo drives User Manual, publication<u>2198-UM002</u>.

Add a Kinetix 5700 EtherNet/IP Drive

See <u>Integrated Motion on EtherNet/IP Drive Software Options on page 13</u> to determine the minimum required version of the Studio 5000 Logix Designer^{*} application for your drive.

Configure the DC-bus Power Supply and Associate an Axis

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

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

The Select Module Type dialog box appears.

2198	3		Cle	ear I	Filter	5		Hide Filter	s 🛠
	Module Ty	pe Category Filters	_	*		Мо	dule Type Vendor	Filters	
	Managed Ethemet Switch MDI to EtherNet/IP	h			V	Allen-Bradley Endress+Hauser			m
1	Motion			_		FANUC CORPOR	RATION		
	Motor Overload			÷	V	FANUC Robotics	America		-
•	1	1	•		•				F.
•	Catalog Number	Description					Vendor	Category	^
	2198-P031	Kinetix 5700 Bus Pow	er Suppl	ly, 1	0A, 3	24-528 Volt	Allen-Bradley	Drive,Motion	
	2198-P070	Kinetix 5700 Bus Powe	er Suppl	ly, 2	5A, 3	24-528 Volt	Allen-Bradley	Drive,Motion	
	2198-P141	Kinetix 5700 Bus Pow					Allen-Bradley	Drive,Motion	
	2198-P208	Kinetix 5700 Bus Pow					Allen-Bradley	Drive,Motion	
	2198-S086-ERS3	Kinetix 5700, 43A, 458						Drive,Motion,	
•	0100 C100 EDC0	Marth. 6700 CEA 460			C N		Allere Die allere	Date Makes (* *
6									
	433 Module Types Found							Add to Fav	

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

This example uses a 2198-P208 DC-bus power supply.

3. Click Create.

General*	General			
Connection Trane Sync Internet Protocol Port Configuration Network Network Power Digital Input Digital Input Diagnosisce	Type: Vendor: Parent: Name: Description: Module Defin Revision: Electronic & Power Stru Connection	Change 3.001 sying: Compatible Module ture: 2198-P208	Ethernet Address	
talus. Creating				OK Cancel Hel

The New Module dialog box appears.

- 4. Configure the new drive.
 - a. Type the drive Name.
 - b. Select a EtherNet/IP address option.
 - In this example, the Private Network address is selected.
 - c. Enter the address of your 2198-P208 DC-bus power supply. In this example, the last octet of the address is 1.
- 5. Click the Power category.

Connection Time Sync					
- Module Info Internet Protocol		2198-P208 Kinetix 5700 Bus Power Supply,	69A, 324-528 Volt	Advanced	
 Port Configuration Network 	Bus Configuration:	Shared AC/DC	-		
Motion	Bus Sharing	Group1	•		
 Associated Axes Power 	Bus Regulator Action:	Shunt Regulator	*		
Digital Input	Shunt Regulator Resistor Type:	💮 External 🥥 Internal			
Diagnostics	External Shunt:	<none></none>	-		

IMPORTANT The Studio 5000 Logix Designer application enforces shared-bus configuration rules for Kinetix 5700 drives.

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

Attribute	Menu	Description
Bus Configuration	Shared AC/DC ⁽¹⁾	Applies to 2198-Pxxx DC-bus power supply (converter) modules.
Bus-sharing Group ⁽²⁾	Group1Group2Group3	Applies to any bus-sharing configuration.
Bus Regulator Action	Disabled	Disables the internal shunt resistor and external shunt option.
	Shunt Regulator	Enables the internal and external shunt options.
Shunt Regulator Resistor Type	Internal	Enables the internal shunt (external shunt option is disabled).
	External	Enables the external shunt (internal shunt option is disabled).
External Shunt ⁽³⁾	 None 2198-R004, 2198-R014 2198-R031, 2198-R127 	Selects external shunt option. Only the shunt catalog number intended for the specific DC-bus power supply is shown.

(1) Shared AC/DC bus configuration is the default selection for DC-bus power supplies.

(2) For more information on bus-sharing groups, refer to Kinetix 5700 servo drives User Manual, publication 2198-UM002.

(3) See the Kinetix Servo Drives Specifications Technical Data, publication <u>KNX-TD003</u>, for more information on the Bulletin 2198 external passive shunt resistors.



ATTENTION: To avoid damage to equipment all modules that are physically connected to the same shared-bus connection system must be part of the same Bus-sharing Group in the Studio 5000 Logix Designer application.

- 7. To close the New Module dialog box, click OK.
- 8. To close the Select Module Type dialog box, click Close.
- 9. Right-click the DC-bus power supply that you created in the Controller Organizer and choose Properties.

The Module Properties dialog box appears.

10. Click the Digital Input category.

General	Digital Input	
- Connection - Time Sync - Module Info - Internet Protocol - Port Configuration - Network - Motion	Axis: Axis Name: Digital Input 1:	1 ▼ <none> Bus Capacitor OK ▼</none>
- Associated Axes - Power - Digital Input* - Diagnostics	Digital Input 2:	Unassigned 🔹

11. From the Digital Input pull-down menu, choose Bus Capacitor OK to monitor your capacitor module status. Alternately, choose Thermal Switch OK to monitor your shunt thermal switch. You can also choose Bus Conditioner OK to monitor your conditioner monitor status, but this option is only available in major revision 10 or later.

In this example, Bus Capacitor OK is chosen.

12. Click the Associated Axes category.

General	Associated Axes			
- Connection				
- Time Sync				
- Module Info	Axis 1:	<none></none>	-	New Adds
- Internet Protocol			(<u> </u>	
Port Configuration				
Network				
Motion				
- Associated Axes				
Power				
- Digital Input*				
Diagnostics				

13. Click New Axis.

The New Tag dialog box appears.

New Tag	trend .	×
Name:	Axis_1	Create 🔫
Description:		Cancel
		Help
	-	
Usage:	<controller></controller>	
Туре:	Base Connection	
Alias For:		
Data Type:	AXIS_CIP_DRIVE	
Parameter Connection:	<u></u>	
Scope:	UM_Controller_K5700 -	
External Access:	Read/Write	
Style:	•	
Constant		
Sequencing	1	
Open AXIS	_CIP_DRIVE Configuration	
Open Parar	neter Connections	

14. Type the axis Name.

AXIS_CIP_DRIVE is the default Data Type.

15. Click Create.

General	Associated Axes			
- Connection - Time Sync - Module Info - Internet Protocol - Port Configuration - Network	Axis 1:	Axis_1	•	New Axis
Motion Associated Axes Power Digital Input Diagnostics				

16. Click Apply.

Configure the Regenerative Bus Supply

Follow these steps to configure the regenerative bus supply.

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

The Select Module Type dialog box appears.

	Select Module Type					
	Catalog Module Discovery Favorites					
Enter 2198-RP here to	2198-RP Clear Filters	Hide Filters *				
refine your search.	Module Type Category Filters A Module Type Vendor Filters	6				
	Analog Analog CIP Motion Converter Dialight	s, Inc. 📃				
	Communication	-				
		4				
	Catalog Number Description	Vendor				
	2198-RP088 Kinetix 5700 Regenerative Bus Supply, 24kW, 35 3A / 88 0A 2198-RP200 Kinetix 5700 Regenerative Bus Supply, 67kW, 100.0A / 200.0A 2198-RP263 Kinetix 5700 Regenerative Bus Supply, 119kW, 176.4A / 263.0A 2198-RP312 Kinetix 5700 Regenerative Bus Supply, 119kW, 176.4A / 263.0A	A Rockwell Aut				
	•	4				
	4 of 603 Module Types Found	Add to Favorites				
	Close on Create Create	Close Help				

- 2. By using the filters, check Motion and Allen-Bradley, and select your 2198-RP*xxx* regenerative bus supply as appropriate for your hardware configuration.
- 3. Click Create.

The New Module dialog box appears.

New Module				
New Module General* Connection Time Sync Module Info Internet Protocol Port Configuration Network Motion Associated Axes Power Digital Input Diagnostics	General Type: Vendor: Parent: Name: Description:	2198-RP088 Kinetix 5700 Regenerative Bus St Rockwell Automation/Allen-Bradley Local		
Status: Creating	Module Defini Revision: Electronic Ke Power Struct Connection:	10.001 eying: Compatible Module ture: 2198-RP088	OK Cancel Help	

- **4.** Configure the new module.
 - a. Type the module Name.
 - b. Select a EtherNet/IP address option.
 In this example, the Private Network address is selected.
 - c. Enter the address of your 2198-RP*xxx* regenerative bus supply. In this example, the last octet of the address is 1.
- 5. Click the Power category.

Module Properties: Loc	al (2198-RP088 10.00	001) ×	
General Connection Time Sync Module Info Internet Protocol Port Configuration Network Motion Associated Axes Power Digital Input Diagnostics	Power Power Structure: Bus Configuration: Bus Sharing	2198-RP088 Kinetix 5700 Regen Bus Power Supply, 35A, 324-506 Volt Shared AC/DC ▼ Group 1 ▼	
Status: Offline		OK Cancel Apply	Help

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

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

Attribute	Menu	Description
Bus Configuration	Shared AC/DC ⁽¹⁾	Applies to 2198-RPxxx regenerative bus supply modules.
Bus-sharing Group	Group1Group2Group3	Applies to any bus-sharing configuration.

(1) Shared AC/DC bus configuration is the default selection for regenerative bus supplies.



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

- 7. To close the New Module dialog box, click OK.
- 8. Your 2198-RP*xxx* regenerative bus supply appears in the Controller Organizer under the Ethernet network in the I/O Configuration folder.



- 9. Click Close to close the Select Module Type dialog box.
- **10.** Right-click the regenerative bus supply that you created in the Controller Organizer and choose Properties.

The Module Properties dialog box appears.

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

11. Click the Digital Input category.

Module Properties: Loc	al (2198-RP088 10.001) 🛛 🗙				
General - Connection - Time Sync - Module Info - Internet Protocol - Port Configuration - Network - Motion - Associated Axes - Power - Digital Input - Diagnostics	Digital Input Axis: Axis Name: Digital Input 1: Digital Input 2: Digital Input 3: Digital Input 4:	1 Axis_1 Enable AC Line Contactor OK Unassigned Enable Bus Capacitor OK Shunt Thermal Switch OK AC Line Contactor OK			
Status: Offline		Bus Conditioner OK	l	OK Cancel	Apply Help

12. From the Digital Input pull-down menu choose Bus Conditioner OK or AC Line Contactor OK to monitor your DC-bus conditioner module status or the M1 contactor status, respectively, depending on your application.

In this example, Bus Capacitor OK is chosen. For descriptions of the digital inputs, see <u>Table 22 on page 79</u>.

13. Click the Associated Axes category.

14. Click New Axis.

New Tag		X
Name:	Axis_1	Create 🗸
Description:		Cancel
		Help
		.
Usage:	<controller></controller>	•
Туре:	Base Connection	
Alias For:		•
Data Type:	AXIS_CIP_DRIVE	
Parameter Connection:		•
Scope:	UM_RegenBus	•
External Access:	Read/Write	•
Style:		•
Constant		
Sequencing	1	
Open AXIS_	CIP_DRIVE Configuration	
Open Paran	neter Connections	

The New Tag dialog box appears.

15. Type the axis Name.

AXIS_CIP_DRIVE is the default Data Type.

16. Click Create.

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

🔺 🚅 Ungrouped Axes Axis_1

General	Associated Axes	
Connection		
- Time Sync		
- Module Info	Axis 1:	Axis_1 View Axis
 Internet Protocol 		
- Port Configuration		
- Network		
Motion		
- Power		
- Digital Input		
Diagnostics		
Diagnosics		
tatus: Offline		OK Cancel Apply Help

- 17. Click Apply.
- 18. Repeat step 1 through step 17 if you have more than one 2198-RPxxx regenerative bus supply.

Continue Inverter Configuration

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

Table 15 - Kinetix 5700 Feedback Axis Summary

Kinetix 5700 Inverter	Inverter Cat. No.	Motor Feedback	Auxiliary Feedback
Single-axis Inverters	2198-S <i>xxx</i> -ERS3 or 2198-S <i>xxx</i> -ERS4	1 (axis 1)	1 (axis 2)
Dual-axis Inverters	2198-Dxxx-ERS3 or 2198-Dxxx-ERS4	2 (axis 1 and 3)	2 (axis 2 and 4)

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

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

The Module Properties dialog box appears.

2. Select the Associated Axes category.

💽 Module Properties: Local (2198-D006-ERS4 9.001) 🛛 🗙

General	Associated Axes	
Connection		
Safety		
Time Sync	Axis 1:	<none> New Axis</none>
Module Info		
Internet Protocol	Motor Feedback Device:	DSL Feedback 1 Port 👻
Port Configuration		
Network	Load Feedback Device:	<none></none>
Motion		
Associated Axes		
Power	Axis 2 (Auxiliary	<none></none>
 Digital Input 		
Motion Diagnostics	Master Feedback Device:	<none></none>
Motion Safety 1		
Actions		
 Primary Feedback 		
Scaling	Axis 3:	<none> New Axis</none>
STO		
SS1	Motor Feedback Device:	DSL Feedback 2 Port
Motion Safety 2		
Actions	Load Feedback Device:	<none></none>
- Primary Feedback		
Scaling		
STO	Axis 4 (Auxiliary	<none></none>
SS1		
	Master Feedback Device:	<none></none>
us: Offline		OK Cancel Apply H

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

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

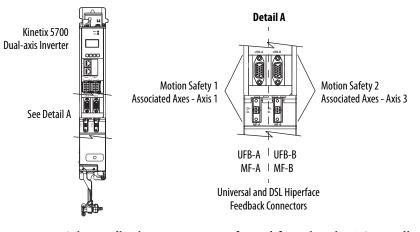


Figure 7 - Dual-axis Inverter Feedback

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

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

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

New Tag		X
Name:	Axis_2	Create 🗸
Description:	×	Cancel Help
Usage:	<controller></controller>	
Туре:	Base Connection	
Alias For:	•	
Data Type:	AXIS_CIP_DRIVE	
Parameter Connection:	•	
Scope:	UM_SafetyController -	
Class:	Standard	
External Access:	Read/Write	
Style:	•	
Constant		
Sequencing		
Open AXIS_	CIP_DRIVE Configuration	
Open Param	neter Connections	

The New Tag dialog box appears.

6. Type the axis Name.

AXIS_CIP_DRIVE is the default Data Type.

7. Click Create.

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

& Axis_1 Axis_2

General	Associated Axes		
Connection			
Safety			
Time Sync	Axis 1:	Axis_2	
- Module Info			
- Internet Protocol	Motor Feedback Device:	DSL Feedback 1 Port 🔹	
- Port Configuration			
- Network	Load Feedback Device:	<none></none>	
Motion			
-Associated Axes			
- Power	Axis 2 (Auxiliary	<none></none>	
- Digital Input			
Motion Diagnostics	Master Feedback Device:	<none></none>	
Motion Safety 1			

- 8. Click Apply.
- 9. Repeat <u>step 1</u> through <u>step 6</u> for each 2198-*xxxx*-ERS*x* servo drive.

Configure the Inverter Drives

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

Follow these steps to configure Kinetix 5700 inverter drives.

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

The Select Module Type dialog box appears.

	Select Module Type Catalog Module Discov	ery Favorites	
	2198	Clear Filters	Show Filters>
This example shows the	Catalog Number	Description	Vendo 🔺
2198-Sxxx-ERSx single-axis inverters	2198-P031	Kinetix 5700 Bus Power Supply, 10A, 324-528 Volt	Rockw
that you can choose from.	2198-P070	Kinetix 5700 Bus Power Supply, 25A, 324-528 Volt	Rockw
	2198-P141	Kinetix 5700 Bus Power Supply, 47A, 324-528 Volt	Rockw
	2198-P208	Kinetix 5700 Bus Power Supply, 69A, 324-528 Volt	Rockw
	2198-S086-ERS3	Kinetix 5700, 43A, 458-747 Volt DC, Network Safety STO	Rockw
	2198-S086-ERS4	Kinetix 5700, 43A, Inverter, Advanced Safety (EtherNet)	Rockw
	2198-S130-ERS3	Kinetix 5700, 65A, 458-747 Volt DC, Network Safety STO	Rockw
	2198-S130-ERS4	Kinetix 5700, 65A, Inverter, Advanced Safety (EtherNet)	Rockw ⊟
	2198-S160-ERS3	Kinetix 5700, 85A, 458-747 Volt DC, Network Safety STO	Rockw
	2198-S160-ERS4	Kinetix 5700, 85A, Inverter, Advanced Safety (EtherNet)	Rocky 👻
	•	III	4
	34 of 553 Module Types	s Found	Add to Favorites
	Close on Create	Create	Close Help

2198	Clear Filters	how Filters≫
Catalog Number	Description	Vendo 🔺
2198-D006-ERS3	Kinetix 5700 Dual Axis, 2.5A, 458-747 Volt DC, Network Safety STO	Rockw
2198-D006-ERS4	Kinetix 5700, 2x2.5A, Dual-Axis Inverter, Advanced Safety (EtherNet)	Rockw ≡
2198-D012-ERS3	Kinetix 5700 Dual Axis, 5A, 458-747 Volt DC, Network Safety STO	Rockw
2198-D012-ERS4	Kinetix 5700, 2x5A, Dual-Axis Inverter, Advanced Safety (EtherNet)	Rockw
2198-D020-ERS3	Kinetix 5700 Dual Axis, 8A, 458-747 Volt DC, Network Safety STO	Rockw
2198-D020-ERS4	Kinetix 5700, 2x8A, Dual-Axis Inverter, Advanced Safety (EtherNet)	Rockw
2198-D032-ERS3	Kinetix 5700 Dual Axis, 13A, 458-747 Volt DC, Network Safety STO	Rockw
2198-D032-ERS4	Kinetix 5700, 2x13A, Dual-Axis Inverter, Advanced Safety (EtherNet)	Rockw
2198-D057-ERS3	Kinetix 5700 Dual Axis, 23A, 458-747 Volt DC, Network Safety STO	Rockw
2198-D057-ERS4	Kinetix 5700, 2x23A, Dual-Axis Inverter, Advanced Safety (EtherNet)	Rockw 🚽
•	III	•

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

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

3. Click Create.

The New Module dialog box appears.

New Module			
General Connection Safety Time Sync Module Info Internet Protocol Port Configuration Network Motion	General Type: Vendor: Parent: Name: Description:	2198-D006-ERS4 Kinetix 5700, 2x2.5A, Dual-Ab Rockwell Automation/Allen-Bradley Local UM_D006	xis Inverter, Advanced Safety (Eth Ethernet Address Private Network: 192.168.1. 6
Associated Axes Power Digital Input Motion Diagnostics Motion Safety 1 Actions Primary Feedback Scaling STO SS1 Motion Safety 2 Actions Primary Feedback Scaling STO SS1 Sto Sto Sto Sto Sto Sto Sto	Module Defin Revision: Electronic Ke Power Struc Safety Appli Connection: Motion Safe Motion Safe	9.001 9.001 2007 2009 2006-ERS4 2198-D006-ERS4 2006-CRS4 2006 2006-CRS4 2006 2006 2006 2006 2006 2006 2007 2007	IP Address: Advanced Safety Network Number: 412C_040E_5324 9/5/2017 1:54:07.652 PM
Status: Creating			OK Cancel Help

- 4. Configure the new drive.
 - a. Type the drive Name.
 - b. Select an EtherNet/IP address option.

In this example, the Private Network address is selected.

- c. Enter the address of your 2198-xxxx-ERSx inverter. In this example, the last octet of the address is 6.
- d. Click Advanced if using network address translation with safety connection to add drive module configured IP address.

The fields to configure in the Module Definition dialog box are dependent on your drive, Studio 5000 Logix Designer application version, and drive firmware revision. Use the following table to navigate to the series of steps that are intended for your drive system.

Table 16 - How to Navigate Module Definition

For Drive Cat. No.	Studio 5000 Logix Designer Application Version	Drive Firmware Revision	Go to:
2198- <i>xxxx</i> -ERS3	30 or earlier	7 or earlier	Configure Module Definition on page 74
2198- <i>xxxx</i> -ERS3 (Series B) 2198-xxxx-ERS4	31 or later	9 or later	Configure Module Definition on page 74

Configure Module Definition

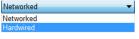
1. Under Module Definition click Change.

The Module Definition dialog box appears.

Module Definition	×		Module Definition	X
Revision: Electronic Keying:	9 001 Compatible Module		Revision: Electronic Keying:	9 001 - Compatible Module
Power Structure:	2198-D006-ERS3		Power Structure:	2198-D020-ERS4 🔻
Verify Power Rating of	n Connection		Verify Power Rating o	n Connection
Safety Application:	Networked	-	Safety Application:	Networked 💌
Connection:	Motion and Safety	-	Connection:	Motion and Safety
Motion Safety 1:	Safe Stop Only - No Feedback	-	Motion Safety 1:	Single Feedback Monitoring
Motion Safety 2:	Safe Stop Only - No Feedback	-	Motion Safety 2:	Single Feedback Monitoring
ОК	Cancel Help	-	ОК	Cancel Help

Depending on the Module Definition revision selection, alternate product features and feedback types can be selected. However, 2198xxxx-ERS4 drives only appear in drive firmware revision 9.001 or later.

2. From the Safety Application pull-down menu, choose between Hardwired for Hardwired STO mode or Networked for an



integrated safety application (see <u>Table 17</u> for definitions).

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

Table 17 - Safety Application Definitions

Safety Application Mode ⁽¹⁾	Safety Functions	Minimum Drive Module Required ⁽²⁾	Drive Module Connection Options	Minimum Controller Required ⁽²⁾
Hardwired	Hardwired STO	2198- <i>xxxx</i> -ERS3	Motion Only	 ControlLogix[®] 5570 CompactLogix[™] 5370
Networked	Integrated STO	2198- <i>xxxx</i> -ERS3	 Motion and Safety Motion Only Safety Only 	GuardLogix [®] 5570 CompactLogix 5370
	Integrated STOTimed SS1	2198- <i>xxxx</i> -ERS3	 Motion and Safety Motion Only Safety Only 	GuardLogix 5570 CompactLogix 5370
	 Integrated STO Timed SS1 Monitored SS1 Controller-based safety functions 	2198- <i>xxxx</i> -ERS4	 Motion and Safety Motion Only Safety Only 	GuardLogix 5580 CompactLogix 5380

(1) For 2198-Dxxx-ERS4 (dual-axis) inverters, you must configure axis 1 and 3 as Networked or Hardwired, they cannot be mixed.

(2) Where a ControlLogix or CompactLogix (non-safety) controller is specified, a GuardLogix or Compact GuardLogix controller is backwards compatible, but not necessary for the specified safety application, function, and connection. Also, GuardLogix 5580 and Compact GuardLogix 5380 controllers are backwards compatible with GuardLogix 5570 and Compact GuardLogix 5370 controllers. 3. From the Connection pull-down menu, choose the Connection mode for your motion application (see <u>Table 18</u> for definitions).

Motion and Safety	•
Motion and Safety	
Motion Only	
Safety Only	

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

Connection Mode	Safety Options	Description
Motion and Safety	Integrated mode	This controller manages the motion connections and integrated STO.
Motion Only	 Hard-wired STO mode Integrated mode if there is a secondary safety controller 	 This controller manages the motion connections. The hard-wired safety inputs control the hard-wired STO. Another controller that has a Safety-only connection to the drive manages the integrated STO.
Safety Only	Integrated mode	 This controller manages the integrated STO. Another controller that has a Motion-only connection to the drive manages the motion connections.

From the Motion Safety *x* pull-down menu, choose the integrated safety type (see <u>Table 19</u> for definitions).

Single Feedback Monitoring
Safe Stop Only - No Feedback
Single Feedback Monitoring
Dual Feedback Monitoring

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

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

Table 19	- Motion	Safetv	Definitions
Tuble 12		Juicty	

Motion Safety Mode	Safety Application Mode	Module Connection Options	Description
STO Only			2198-xxxx-ERS3 (series A and B): STO function only.
Safe Stop Only - No Feedback			 2198-xxxx-ERS4: STO function and Timed SS1 safe stop functions are available. 2198-xxxx-ERS3 (series B): STO function and Timed SS1 safe stop functions are available.
Single Feedback Monitoring	Networked	 Motion and Safety Safety Only 	Primary feedback is used in the safety object for safe monitoring. The feedback can be a SIL rated Hiperface DSL encoder, for example, a VPL-B1003P-Q or W motor used in the DSL Feedback port. This can also be a Sine/Cosine or EnDat device, for example, an MPL-B310P-M motor used in the Universal Feedback port. See the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication 2198-RM001, to evaluate SIL levels possible with one feedback device.
Dual Feedback Monitoring			In addition to primary feedback, an external feedback device is used to improve SIL levels. For example, the Bulletin 842HR type encoder can be used in the Universal Feedback port as a Sine/ Cosine device. See the Kinetix 5700 Safe Monitor Functions Safety Reference Manual, publication <u>2198-RM001</u> , to evaluate SIL levels possible with two feedback devices.

The Safety Network Number (SNN) field populates automatically when the Connection mode includes an integrated Motion and Safety or Safety-only connection. For a detailed explanation of the safety network number, refer to the appropriate GuardLogix controller publication as defined in <u>Additional Resources on page 9</u>.

- 5. To close the Module Definition dialog box, click OK.
- 6. Click Apply.

Configure the Power and Safety Options

1. Click the Power category.

Module Properties: Loc	al (2198-D006-ERS4 9	9.001) ×	
General	Power		
Connection	1 0 1 0 1		
Safety			
- Time Sync	Power Structure:	2198-D006-ERS4	Advanced
Module Info		Kinetix 5700 Dual Axis, 2.5A, 458-747 Volt DC, Networked	
Internet Protocol			
- Port Configuration	Bus Configuration:	Shared DC 🔹	
Network	Bus Sharing	Group 2	
Motion			
Associated Axes			
Power			
- Digital Input			
Motion Diagnostics			
Motion Safety 1			
Actions			
- Primary Feedback			
Scaling			
STO			
-SS1			
Motion Safety 2			
Actions			
Primary Feedback			
Scaling			
STO			
SS1			
Status: Offline		OK Cancel Apply	Help
Status, Onine		OK Cancel Apply	Theip

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

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

Attribute	Menu	Description
	Shared DC ⁽²⁾	Applies to 2198-Sxxx-ERSx and 2198-Dxxx-ERSx inverter drives.
Bus Configuration	Shared DC - Non-CIP Motion Converter ⁽³⁾	Applies to the designated inverter in drive systems that are powered by the 8720MC-RPS regenerative power supply.
Bus Sharing Group ^{(1) (3)}	• Group1	Applies to any bus-sharing configuration.

Table 20 - Power Configuration Options

(1) For more information on bus-sharing groups, refer to the Kinetix 5700 servo drives User Manual, publication 2198-UM002.

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

Group2

Group3...

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



ATTENTION: To avoid damage to equipment all modules that are physically connected to the same shared-bus connection system must be part of the same Bus-sharing Group in the Studio 5000 Logix Designer application.

- 3. To close the Module Properties dialog box, click OK.
- 4. To close the Select Module Type dialog box, click close.

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



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

lf	Then
Your application includes integrated safety	Go to <u>step 6 on page 77</u> .
Your application includes hard-wired safety or has no safety connections	Go to <u>Create an Associated Axis and Establish</u> Feedback Assignments for an Inverter Drive on page <u>80</u> .

The Module Properties dialog box appears.

6. Click the Safety category.

Module Properties:	Local (2198-S086-I	ERS4 9.001) \times

General	Safety				
Connection					
- Time Sync - Module Info	Connection Type	Requested Packet Interval (RPI) (ms)	Connection Reaction Time Limit (ms)	Max Observed Network Delay (ms)	
- Internet Protocol	Safety Input	10 🌻	40.1	Reset	Advanced
- Port Configuration	Safety Output	20	60.0	Reset	

- 7. The connection between the owner and the 2198-*xxxx*-ERS*x* inverter is based on the following:
 - Servo drive safety network number
 - GuardLogix slot number
 - GuardLogix safety network number
 - Path from the GuardLogix controller to the 2198-xxxx-ERSx drive
 - Configuration signature

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

8. Click Advanced.

The Advanced Connection Reaction Time Limit Configuration dialog box appears.

Input		
Requested Packet Interval (RPI):	<u>μο</u>	ms (6 - 500)
Timeout Multiplier:	2	(1-4)
Network Delay Multiplier:	200 🚖	% (10-600)
Connection Reaction Time Limit:	40.1	ms
Output		
Requested Packet Interval (RPI):	20	ms (Safety Task Period)
Timeout Multiplier:	2	(1-4)
Network Delay Multiplier:	200 🚖	% (10-600)
Connection Reaction Time Limit	60.0	ms

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

For more information about the Advanced Connection Reaction Time Limit Configuration, refer to the appropriate GuardLogix or Compact GuardLogix Controllers User Manual, which is listed in <u>Additional</u> <u>Resources on page 9</u>.

- 9. To close the Advanced dialog box, click OK.
- 10. To save the Safety category parameters, click apply.

Configure Digital Inputs

Figure 8 - Digital Input Tab for the Kinetix 5700 Drive

Digital Input	
Axis: Axis Name:	1 V <none></none>
Digital Input 1:	Bus Capacitor OK 🔹
Digital Input 2:	Unassigned 🔹
	Axis: Axis Name: Digital Input 1:

Table 21 - Module Properties: Kinetix 5700 Digital Input Tab Descriptions

Parameter	Description	
Digital Input 1 Digital Input 2 Digital Input 3 Digital Input 4	Choose one of these values for Digital Input 1 and 2: • Unassigned • Enable • Home • Registration 1 • Registration 2 • Positive Overtravel • Negative Overtravel • Regeneration OK • AC Line Contactor OK • Bus Capacitor OK • Bus Conditioner OK • Shunt Thermal Switch OK	

		Drive N		Nodule	
Functions	Description	2198-Pxxx	2198-xxxx-ERSx	2198-RP <i>xxx</i>	
Enable	A 24V DC input is applied to this terminal as a condition to enable each module.	Х	Х	Х	
Home	An active state indicates to a homing sequence that the referencing sensor has been seen. Typically, a transition of this signal is used to establish a reference position for the machine axis.	-	Х	-	
Registration 1	An inactive-to-active transition (also known as a positive transition) or active-to-inactive transition (also known as a negative	-	Х	-	
Registration 2	transition) is used to latch position values for use in registration moves.	-	Х	-	
Positive Overtravel Negative Overtravel	The positive/negative limit switch (normally closed contact) inputs for each axis require 24V DC (nominal).	-	Х	-	
Regeneration OK	In the active state the inverters can be enabled. An inactive state indicates that the Bulletin 8720MC-RPS unit is not ready to supply DC- bus power. The inverters cannot be enabled. When a bus group is supplied by an 8720MC-RPS unit, one inverter in the bus group must be configured in the Logix Designer application as Shared-DC Non-CIP Motion™ Converter and assigned to Regeneration OK. This signal is wired from RDY on the 8720MC-RPS unit and indicates to the Kinetix 5700 drive system that the 8720MC-RPS unit is ready to supply power. Enabled inverters enumerate a Bus Power Sharing fault if the Regeneration OK input goes inactive.	_	x	_	
AC Line Contactor OK	An active indicates that the AC Line Contactor is working correctly and is capable of charging the DC bus.		Х		

		Driv	e Mo	dule
Functions	Description	2198-P <i>xxx</i>	2198-xxxx-ERSx	2198-RPxxx
Bus Capacitor OK	You can configure this input in the Logix Designer application and wire the module status (MS) output from the 2198-CAPMOD-2240 capacitor module to indicate to the inverter that a major fault is present on the capacitor module.	Х	Х	Х
Shunt Thermal Switch OK	When the 2198-R014, 2198-R031, or 2198-R127 external shunt resistor is wired to the DC-bus power supply, this input must be configured in the Logix Designer application to monitor the status of the external shunt module thermal switch and assigned to Shunt thermal switch OK. This function does not apply to the 2198-R004 shunt resistor. You can also use this input to monitor the status of an active shunt module in the system that is connected via the capacitor module or an extension module.	х	Х	x
Bus Conditioner OK	You can configure this input in the Logix Designer application and wire the module status (MS) output from the 2198-DCBUSCOND-RP312 conditioner module to indicate to the inverter that a major fault is present on the conditioner module.	Х	Х	х

Create an Associated Axis and Establish Feedback Assignments for an Inverter Drive

After you establish your Kinetix 5700 inverters in the Studio 5000 Logix Designer application, the feedback options must be defined for each axis. Each physical axis supports motor and auxiliary feedback.

Table 23 - Kinetix 5700 Feedback Axis Summary

Kinetix 5700 Inverter	Inverter Cat. No.	Motor Feedback	Auxiliary Feedback
Single-axis Inverters	2198-S <i>xxx</i> -ERS3 or 2198-S <i>xxx</i> -ERS4	1 (axis 1)	1 (axis 2)
Dual-axis Inverters	2198-Dxxx-ERS3 or 2198-Dxxx-ERS4	2 (axis 1 and 3)	2 (axis 2 and 4)

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

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

The Module Properties dialog box appears.

Axis 1:	<none> New Axis</none>
Motor Feedback Device:	DSL Feedback 1 Port 🔹
Load Feedback Device:	<none></none>
Axis 2 (Auxiliary	<none></none>
Master Feedback Device:	<none></none>
Avia 2	<none></none>
Axis 5.	<none></none>
Materia Facility de Deutero	DSL Feedback 2 Port
Motor Feedback Device:	DSL Feedback 2 Fort
	<none></none>
Load Feedback Device:	
Axis 4 (Auxiliary	<none> New Axis</none>
(ā. (ā.)	
Master Feedback Device:	<none></none>
	Motor Feedback Device: Load Feedback Device: Axis 2 (Auxiliary Master Feedback Device: Axis 3: Motor Feedback Device: Load Feedback Device: Axis 4 (Auxiliary

2. Select the Associated Axes category.

3. Click New Axis.

The New Tag dialog box appears.

New Tag			X
Name:	Axis_2		Create 🗸
Description:			Cancel
		-	Help
Usage:	<controller></controller>	•	
Туре:	Base 🔻	Connection	
Alias For:		•	
Data Type:	AXIS_CIP_DRIVE		
Parameter Connection:		•	
Scope:	UM_SafetyController	•	
Class:	Standard	•	
External Access:	Read/Write	•	
Style:		-	
Constant			
Sequencing	l.		
Open AXIS_	CIP_DRIVE Configuration		
Open Paran	neter Connections		

4. Type the axis Name.

AXIS_CIP_DRIVE is the default Data Type.

5. Click Create.

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

🔺 🗐 Ungrouped Axes Axis_1 Axis_2

General	Associated Axes		
Connection			
Safety			
- Time Sync	Axis 1:	Axis_2 🔹 🔜 New	Axis
Module Info			
-Internet Protocol	Motor Feedback Device:	DSL Feedback 1 Port 🗸	
- Port Configuration			
Network	Load Feedback Device:	<none></none>	
Motion			
-Associated Axes			
Power	Axis 2 (Auxiliary	<none> New</none>	Axis
- Digital Input			
Motion Diagnostics	Master Feedback Device:	<none> 🔻</none>	
Motion Safety 1			

6. Click Apply.

Feedback options must be defined for each axis. Each physical axis supports motor and auxiliary feedback.

The Kinetix 5700 drive has two or four feedback ports. The single-axis inverters support two ports and the dual-axis inverters support four ports. Port 1 is reserved for Motor Feedback on the primary axis (Axis_1). Port 2 can be used either as Load Feedback for the primary axis or as a Master Feedback for a secondary feedback only axis (Axis_2).

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

To establish Feedback Port assignments for K5700 drives, follow these steps.

- To access the Module Properties, double-click the Kinetix 5700 drive in 1. the Controller Organizer.
- 2. Click the Associated Axes category.
- 3. From the Feedback Device pull-down menus, choose either a DSL feedback port or universal feedback port to associate with your axis.

- General	Associated Axes			
- Connection				
- Safety				
- Time Sync	Axis 1:	Axis 2	▼	New Axis
- Module Info	,000 11			
- Internet Protocol	Motor Feedback Device:	DSL Feedback 1 Port	-	
- Port Configuration				
- Network	Load Feedback Device:	Universal Feedback 1 Port	-	
- Motion				
-Associated Axes*		0		
Power	Axis 2 (Auxiliary	<none></none>	▼]	New Axis
- Digital Input				
Diagnostics	Master Feedback Device:	<none></none>	-	
-Motion Safety 1				
Actions				

4. Click Apply.

For more information on configuration of Feedback Properties, refer to the Kinetix 5700 servo drives User Manual, publication 2198-UM002. Chapter 8, <u>Configuration Examples for a Kinetix Drive</u>, also includes a Frequency Control with No Feedback example on <u>page 180</u>.

Create a Motion Group

To determine how many axes your controller system supports, see <u>Table 3 on</u> page 12.

All axes must be added to the Motion Group in your project. If you do not group the axes, they remain ungrouped and unavailable for use.

You must create a Motion Group for an axis to be configured properly.

Follow these steps to configure the motion group.

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

The New	Tag dia	alog boy	x appears.

	New Tag			X
	Name:	UM_Motion		Create 🗸
	Description:		*	Cancel
			~	Help
	Usage:	<controller></controller>	•	
	Туре:	Base Connection	n	
	Alias For:		Ŧ	
•	Data Type:	MOTION_GROUP		
8	Parameter Connection:		Ŧ	
	Scope:	UM_SafetyController	•	
	Class:	Standard	•	
	External Access:	Read/Write	•	
	Style:		•	
	Constant			
	Sequencing			
	Open MOTIO	N_GROUP Configuration		
	Open Param	eter Connections		

- 2. Type a Tag name.
- 3. Type a description, if desired.
- 4. Choose the Tag Type.
- 5. Choose the Scope.
- 6. Choose the External Access.

7. Click Create.

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

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

The Motion Group Properties dialog box appears.

1	Motion Group Properties - UM_Motion	X
	Axis Assignment Attribute Tag	
	Unassigned: Assigned:	
	Axis_1 Axis_2	
	Add> < Remove	
	OK Cancel Apply	Help

9. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.

Set the Base Update Period

The Base Update Period is the RPI rate for Ethernet communication between the controller and the motion module, a Unicast connection.

There are two alternate update periods that you can configure when using the Axis Scheduling function. See <u>Axis Scheduling on page 145</u> for details.

The Base Update Period determines how often the Motion Task runs. When the Motion Task runs, it interrupts most other tasks regardless of their priority. The Motion Task is the part of the controller that takes care of position and velocity information for the axes.

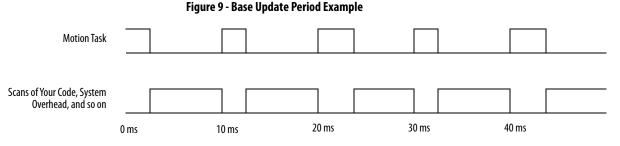
To set the Base Update Period, follow these steps.

1. Click the Attribute tab in the Motion Group Properties dialog box.

🕞 Motion Group Prope	erties - Mo	tion_Group_101 📃 🖃 💌
Axis Assignment Attribu	ite* Tag	
Base Update Period:	6.0	ms (in 0.5 increments.) Axis Schedule
Alternate 1 Update:	5.0	ms
Alternate 2 Update:	5.0	ms
General Fault Type:	Non Maj	or Fault 🔻
Timing Model:	One Cycl	e
Scan Times (elapsed ti	me):	
Max:	(us)	Reset Max
Last:	(us)	
Average:	(us)	

- 2. Set the Base Update Period to 6.0...32.0 ms.
 - **TIP** Check the Last Scan time values. Typically, the value is less than 50% of the Base Update Period.

For the Kinetix 5700 drive, the minimum Base Update Rate is 1 ms.



In this example, the Base Update Period = 10 ms. Every 10 ms the controller stops scanning your code and whatever else it is doing and runs the motion planner.

The Base Update Period is a trade-off between updating positions of your axes and scanning your code. In general, you do not want the Motion Task to take more than 50% of the overall Logix controller time on average. The more axes that you add to the Motion Group, the more time it takes to run the Motion Task.

For the ControlLogix 5560 controller, the incremental impact on the Motion Task is roughly at 2...3 drives/ms. For the ControlLogix 5570 controller, the incremental impact on the Motion Task is roughly at 6...8 drives/ms. Actual impact can vary depending on axis configuration.

For detailed information on the Axis Scheduling function, Axis Assignment tab, and Alternate Update Period Scheduling, see <u>Axis Scheduling on</u> page 145.

Integrated Architecture Builder

To help you determine motion system performance, use the motion performance calculator in the Integrated Architecture Builder (IAB).

The IAB is a graphical software tool for configuring Logix-based automation systems. It helps you select hardware and generate bills of material for applications that include controllers, I/O, networks, PowerFlex[®] drives, On-Machine[™] cabling and wiring, motion control, and other devices.

You can find the software at <u>http://www.rockwellautomation.com/en/e-tools/configuration.html</u>

Configure the Axis Properties

After you add the drive to your project and create the axes, use the Axis Properties dialog boxes to configure the drive. Notice that the dialog boxes change based on your configuration choices, for example, feedback configuration.

<u>Table 24</u> lists the basic tasks necessary configure a drive.

Category Dialog Box	Perform These Tasks	Page
General	Assign the axis configuration.	88
	Choose the feedback configuration.	
	Choose the application type, if applicable.	
	Choose the loop response (low, medium, or high), if applicable.	
	 If you have not already done so, you can create and associate an axis to a new Motion Group and associate a drive module to the axis. 	
Motor	Specify a motor with the Data Source = Nameplate data sheet.	91
	• Specify a motor with the Data Source = Catalog Number.	
	• Select a motor with the Data Source = Motor NV.	
Motor Feedback	Select the Motor Feedback Type.	95
Load Feedback	Select the Load Feedback Type, if applicable.	97
Scaling	Configure feedback by choosing the load type, by entering the scaling units, and by choosing the Travel mode.	222
	Enter the Input Transmission and Actuator ratio, if applicable.	

The parameters that you configure on the General category dialog box result in the presentation of attributes and parameters that are available for the combination of your selections.

IMPORTANT	All AXIS_CIP_DRIVE Axis Properties dialog boxes are dynamic. Optional attributes and dialog boxes that are related to each integrated motion
	axis you create come and go based on what combination of axis characteristics you define.

See the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>, for complete information on Axis Attributes and how to apply Control Modes.

IMPORTANT	Be sure to associate the drive and axis before when configuring the axis because the drive determines what optional attributes are supported for the axis
	the axis.

If you have already created an axis and associated in with a drive, the Associated Module and Axis are shown on the General category of the Axis Properties dialog box. Otherwise, you can select them here.

Figure 10 - General Category Dialog Box

General	General					
Motor Model Analyzer Motor Feedback Scaling Hookup Tests Polanity Autotune Load – Backlash – Compliance	Avis Configuration: Feedback Configuration: Application Type: Loop Response: Venical Load Contol Assigned Group	Position Loop Motor Feedback Basic Medium Disabled	*			
- Friction Observer Position Loop Velocity Loop	Motion Group: Update Period:	UM_Motion 2.0	•	New Group		
Acceleration Loop Torque/Current Loop Planner Homing Actions Exceptions Drive Parameters Parameter List Status Faults & Alarms	Associated Module Module: Module Type Power Structure: Axis Number:	MyKinetxDrive 2199-D020-ERS4 2198-D020-ERS4 1	•			
- Tag s State:	Safety State.		ОК	Cancel	Apply	Help

^^ for an inverter

ss for a converter

The Axis Number field corresponds to the axes listed on the Associated Axes tab of the Module Properties dialog box. Any feedback port assignments that you made on the Associated Axes tab are also mapped to the drive when you associate an axis and a drive.

Configure the Associated Axis and Control Mode

Now that the axis is associated to the drive module, meaningful values are available for other axis properties.

For more information on Control Modes, see the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>.

1. In the Controller Organizer, double-click the Axis that you want to configure.

The Axis Properties General dialog box appears.

🏷 Axis Properties - Axis_1			
Categories:	General		
Motor	Axis Configuration:	Position Loop	-
Motor Feedback	Feedback Configuration:	Feedback Only Frequency Control	
Hookup Tests	Application Type: Loop Response:	Position Loop Velocity Loop Torque Loop	6
Autotuno			

- 2. Choose an Axis Configuration type. For this example, choose Position Loop.
 - **TIP** The associated drive determines what Axis and Feedback Configuration choices are presented.

<u>Table 25</u> compares the axis configuration types for the drives.

Axis Type	Kinetix 5700 Dual-axis Inverter	Kinetix 5700 Single-axis Inverter	Kinetix 5700 DC Bus Supply	Kinetix 5700 Regenerative Bus Supply
Position Loop (P)	Yes	Yes	No	No
Velocity Loop (V)	Yes	Yes	No	No
Torque Loop (T)	Yes	Yes	No	No
Feedback Only (E)	Yes	Yes	No	No
Frequency Control (F)	Yes	Yes	No	No
Non-Regenerative AC/DC Converter (N)	No	No	Yes	No
Regenerative AC/DC Converter (G)	No	No	No	Yes

Table 25 - Compare the Axis Configuration Types for the Drives

3. In the Feedback Configuration pull-down menu, choose Motor Feedback.

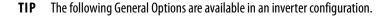
🏷 Axis Properties - Axis_1			
Categories:	General		
Motor Model	Axis Configuration:	Position Loop	-
Scaling Hookup Tests	Feedback Configuration: Application Type:	Motor Feedback Motor Feedback Load Feedback	-
Polarity	Loop Response:	Dual Feedback	

<u>Table 26</u> compares the feedback configuration types for the Kinetix drives.

Feedback Type	Kinetix 5700 Dual-axis Inverter Type	Kinetix 5700 Single-axis Inverter Type	Kinetix 5700 DC Bus Power Supply	Kinetix 5700 Regenerative Bus Supply
Motor Feedback	Position Loop (P), Velocity Loop (V), Torque Loop (T)	Position Loop (P), Velocity Loop(V), Torque Loop (T)	_	—
Load Feedback	Position Loop (P), Velocity Loop (V)	Position Loop (P), Velocity Loop(V)	—	_
Dual Feedback	Position Loop (P)	Position Loop (P)	_	—
Dual Integrator	—	—	—	—
Master Feedback	Feedback Only (E)	Feedback Only (E)	—	_
No Feedback	Frequency Control (F)	Frequency Control (F)	Non-regenerative AC/DC Converter (N)	Regenerative AC/DC Converter (G)

Table 26 - Compare the Feedback Configuration Types for the Drives

4. Choose an Application Type, if applicable.



Categories:			
;General	General		
Motor Model Malyzer Motor Feedback	Axis Configuration: Feedback Configuration: Application Type:	Position Loop Motor Feedback Basic	- -
Hookup Tests Polarity Autotune ⊡ Load Backlash	Loop Response: Vertical Load Contol:	Custom Basic Tracking Point-to-Point Constant Speed	6

The Application Type determines the type of motion control application. This attribute is used to set the Gain Tuning Configuration Bits. <u>Table 27</u> illustrates the gains established based on application type.

Table 27 - Customize Gains to Tune

Application Type	Крі	Kvi	ihold	Kvff	Kaff	torqLPF
Custom ⁽¹⁾	—	—	—	—	—	—
Basic	No	No	No	Yes	No	Yes
Tracking	No	Yes	No	Yes	Yes	Yes
Point-to-Point	Yes	No	Yes	No	No	Yes
Constant Speed	No	Yes	No	Yes	No	Yes

(1) If you set the type to Custom, you can control the individual gain calculations by changing the bit settings in the Gain Tuning Configuration Bits Attribute.

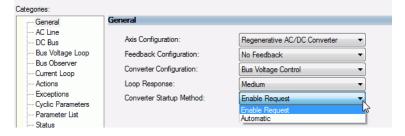
5. Choose a Loop Response, if applicable.

Categories:		
* General	General	
Motor	Axis Configuration:	Position Loop
Motor Feedback	Feedback Configuration:	Motor Feedback
* Scaling Hookup Tests	Application Type:	Basic
Polarity	Loop Response:	Medium
Autotune		Low

- **TIP** Loop Response settings also impact the calculations that are made that can minimize the need for you to perform an Autotune or a Manual Tune. The loop response impacts the spacing between the position and velocity loops and the proportional and integral gains. This response impacts how aggressively a given profile is tracked.
- 6. Choose a Converter Configuration, if applicable.
 - **TIP** The following General Options are available in an converter configuration.

General		
Axis Configuration:	Regenerative AC/DC Converter	•
Feedback Configuration:	No Feedback	-
Converter Configuration:	Bus Voltage Control	Ţ
Loop Response:	Bus Voltage Control	L
Converter Startup Method:	Enable Request	•
	Axis Configuration: Feedback Configuration: Converter Configuration: Loop Response:	Feedback Configuration: No Feedback Converter Configuration: Bus Voltage Control Loop Response: Bus Voltage Control

7. Choose a Converter Startup Method, if applicable.



Specify the Motor Data Source

The Motor Data Source is where you tell the axis where the motor configuration values are originating. You can select a motor by catalog number from the Motion Database. You can enter motor data from a nameplate or data sheet, or use the motor data that is contained in the drive or motor nonvolatile memory.

On the Motor dialog box you specify what motor you want to use and where the data is coming from:

- Specify a motor with the Data Source = Catalog Number.
- Specify a motor with the Data Source = Nameplate data sheet.
- Select a motor with the Data Source = Motor NV.

Choose the Catalog Number as the Motor Data Source

To choose a motor from the Motion Database, follow these steps.

- 1. If the Axis Properties dialog box is not open, double-click the axis.
- 2. Go to the Motor dialog box of Axis Properties.

calegones.						
General	Motor Device Specif	ication				
- Motor						
Model	Data Source:	Nameplate Datasheet 👻		Parameters		
Analyzer Motor Feedback	Catalog Number:	<none></none>	Change Catalog			
Motor Feedback	Motor Type:	Not Specified -				
Hookup Tests						
Polarity	Units:	Rev 🔻				
Autotune						
🖻 - Load						
Backlash						
Compliance =						
Friction						
Observer						
Position Loop						
Velocity Loop						
Acceleration Loop						
Torque/Current Lo						
Planner						
Homing						
Actions						
Exceptions						
Cyclic Parameters						
Parameter List						
Status						
<						
Axis State:	Safety S	ate:				
Manual Tune			ОК	Cancel	Apply	Help

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

Notor Device Specif	ication	
Data Source:	Catalog Number	•
Catalog Number: Motor Type:	Nameplate Datasheet Catalog Number Motor NV Not opecaned	6
Units:	Rev	-

4. Click Change Catalog.

5. Select a motor.

Change Catalog Number
Catalog Number:
MPL-B310P-M OK
MPL-B230P-Exc2 Cancel
MPL-B230P-Vxx2 MPL-B230P-Vxx4
MPL-B310P-M
MPL-B310P-S
MPL-B320P-M MPL-B320P-S
MPL-B330P-M
MPL-B330P-S
Filters Voltage Family Feedback Type

6. The Motor dialog box is now populated with all information that is related to the motor you selected from the Motion Database.

General	*	Motor Device Specif	ication				
Motor Model		Data Source:	Catalog Number	· •		Parameters	
Analyzer Motor Feedback		Catalog Number:	MPF-B310P-M		Change Catalog		
- Scaling		Motor Type:	Rotary Permane	nt Magnet 🔍			
-Hookup Tests -Polarity		Units:	Rev	v			
Autotune		Nameplate / Dat	tasheet - Phase	to Phase parameter	rs		
Load Backlash		Rated Power:	0.77	kW	Pole Count:	8	
Compliance	Ε	Rated Voltage:	460.0	Volts (RMS)			
Friction Observer		Rated Speed:	5000.0	RPM	Max Speed:	5000.0	RPM
Position Loop		Rated Current:	1.7	Amps (RMS)	Peak Current:	5.02	Amps (RMS)
Velocity Loop Acceleration Loop		Rated Torque:	1.58	N-m	Motor Overload Limit:	100.0	% Rated
Torque/Current Lo							
Planner Homing							
Actions							
Exceptions							
Cyclic Parameters Parameter List							
Status	_						
• III	-						
tate:		Safety St	ate:				

- 7. Click Apply.
 - **TIP** When you use a motor catalog number as the data source, default values are automatically set based on the Application Type and Loop Response settings from the General dialog box.

Choose Nameplate as the Motor Data Source

The Nameplate option requires you to enter the motor specification information from the motor nameplate and the motor data sheet.

1. On the Motor dialog box of Axis Properties, from the Data Source pulldown menu, choose Nameplate data sheet.

٧	Axis Properties - Axis_1			
C	ategories:			
	General	Motor Device Specif	reation	
*	····· Model	Data Source:	Nameplate Datasheet	Parameters
*	MOLOF Feedback	Catalog Number:	Nameplate Datasheet	Change Catalog
	Scaling Hookup Tests	Motor Type:	Motor NV	
	···· Polarity ···· Autotune	Units:	Rev	

- 2. Choose a motor type. The following motor types are compatible:
 - Surface Mount Permanent Magnet
 - Linear Permanent Magnet
 - Rotary Induction
 - Interior Permanent Magnet

egories:	_				
General	Motor Device Specifi	cation			
Motor Model	Data Source:	Nameplate Datasheet	•		Parameter
Analyzer Motor Feedback	Catalog Number:	<none></none>		Change Catalog	
Motor Feedback	Motor Type:	Rotary Interior Permanent Magnet	-		
Hookup Tests Polarity	Units:	Not Specified Rotary Permanent Magnet			
Autotune	Name alata / Dat	Rotary Induction Rotary Interior Permanent Magnet	rs		

Notice that the motor information fields are initialized to defaults.

Motor Device Specif	ication				
Data Source:	Nameplate Dat	asheet 💌		Parameters	
Catalog Number:	<none></none>		Change Catalog		
Motor Type:	Rotary Perman	ent Magnet 🔹 🔻			
Units:	Rev	-			
Nameplate / Dat	asheet - Phas	e to Phase paramete	rs		
Rated Power:	0.0	kW	Pole Count:	8	
Rated Voltage:	0.0	Volts (RMS)			
Rated Speed:	0.0	RPM	Max Speed:	0.0	RPM
Rated Current:	0.0	Amps (RMS)	Peak Current:	0.0	Amps (RMS)
Rated Torque:	0.0	N-m	Motor Overload Limit:	100.0	% Rated

3. Enter the parameter information from the motor Nameplate data sheet and click Apply.

Choose Motor NV as the Motor Data Source

When you choose Motor NV as the data source, the motor attributes are derived from nonvolatile memory of a motor-mounted smart feedback device that is equipped with a serial interface. Only a minimal set of motor and motor feedback (Feedback 1) attributes are required to configure the drive.

1. From the Motor dialog box of Axis Properties, choose Motor NV.

🏷 Axis Properties - Axis_1				
Categories:				
General	Motor Device Specif	ication		-
* 🖃 Motor Model	Data Source:	Nameplate Datasheet	Paramet	ters
Motor Feedback Scaling	Catalog Number:	Nameplate Datasheet Catalog Number	Change Catalog	
- Hookup Tests	Motor Type:	Motor NV		
Polarity Autotune	Units:	Rev 👻		

2. Choose the Motor Units that are associated with the motor, either Rev for rotary motor or Meters for linear motor.

No other motor information is needed.

3. Click Apply.

Display Motor Model Information

The Motor Model category displays more information that is based on the motor type you select.

The asterisk next	Axis Properties - Axis_1				
to a category means that you	Categories:	Motor Model Phase to Phase P	arameters		
have not applied changes.	* 🖻 ··· Motor * 👘 ···· Model	Torque Constant (Kt):	1.124	N-m/Amps(RMS)	
changes.	* Motor Feedback	Voltage Constant (Ke):	67.89639	Volts(RMS)/KRPM	
	Scaling Hookup Tests	Resistance (Rs):	19.0	Ohms	
	Polarity	Inductance (Ls):	0.093	Henries	
	* Autotune * Load Backlash	Flux Saturation Profile			
		Flux Saturation @ 12.5%:	94.0	% Nominal Inductance	
	Compliance Friction	Flux Saturation @ 25.0%:	85.0	% Nominal Inductance	
	Observer	Flux Saturation @ 37.5%:	75.0	% Nominal Inductance	
	Position Loop	Flux Saturation @ 50.0%:	64.0	% Nominal Inductance	
	Velocity Loop Acceleration Loop	Flux Saturation @ 62.5%:	54.000004	% Nominal Inductance	
	Torque/Current Loop	Flux Saturation @ 75.0%:	45.0	% Nominal Inductance	
	Planner Homing	Flux Saturation @ 87.5%:	39.0	% Nominal Inductance	
	Actions	Flux Saturation @ 100%:	35.0	% Nominal Inductance	

- If the motor data source is Catalog Number, this information is populated automatically.
- If the motor data source is Nameplate data sheet, this information must be entered manually, or by running the optional Motor Analyzer.
- If the motor data source is Motor NV, this dialog box is blank.

Assign Motor Feedback

What appears on the Motor Feedback dialog box is dependent on what you select on the General dialog box for Feedback Configuration.

The Motor Feedback dialog box represents the information for the feedback device that is directly coupled to the motor. This dialog box is available if the feedback configuration that is specified on the General dialog box is anything other than Master Feedback.

If the motor that you select has Catalog Number as the data source, all information on this dialog box with be entered automatically. Otherwise you have to enter the information yourself.

Notor Feedback Device Specification					
Device Function:	Motor Mounted Feedback	Parameters			
Feedback Channel:	Feedback 1				
Type:	Hiperface 💌				
Units:	Rev				

Attributes that are associated with the Motor Feedback dialog box are designated as Feedback 1.

Commutation			
Alignment:	Motor Offset 🔷		
Offset:	Not Aligned Controller Offset	Degrees	Test Commutation
Polarity:	Motor Offset Self-Sense		
		_	

If a permanent magnet motor is selected from the Motion Database, the Commutation Alignment is set to Controller Offset. However, if a permanent magnet motor is specified from Nameplate data sheet, you must specify the Commutation Alignment method. The default is set to Not Aligned.

Table 28 - Commutation Alignment Settings

Туре	Description
Not Aligned	Not Aligned indicates that the motor is not aligned, and that the Commutation Offset value is not valid. If the Commutation Offset is not valid, the drive cannot use it to determine the commutation angle. Any attempt to enable the drive with an invalid commutation angle results in a Start Inhibit condition.
Controller Offset	Controller Offset applies the Commutation Offset value from the controller to determine the electrical angle of the motor.
Motor Offset	The drive derives the commutation that is offset directly from the motor.
Self-Sense	The drive automatically measures the commutation that is offset when it transitions to the Starting state for the first time after a power cycle. This setting generally applies to a PM motor equipped with a simple incremental-feedback device.

In most cases, the Commutation Alignment is set to Controller Offset and the Commutation test is run during commissioning to determine the Commutation Offset and Polarity.

See the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>, for more information on axis attributes.

Configure the Load Feedback

The Load Feedback category contains the information from the feedback device that is directly coupled to the load-side of a mechanical transmission or actuator.

.oad Feedback Device Sp	ecification		
Device Function:	Load-Side Feedback		Parameters
Feedback Channel:	Feedback 2		
Туре:	Not Specified -	۲	Device Type cannot be configured until feedback device is defined for this Feedback
Units:	Rev 🔻		Channel in Associated Module. Define feedback device.
	For your convenience, you can use t to the Module Properties dialog box associated drive.		

The Load Feedback category is available if the Feedback Configuration that is specified on the General dialog box is Load or Dual.

Load Feedback Device Specification				
Device Function:	Load-Side Feedback			
Feedback Channel:	Feedback 2			
Туре:	Not Specified			
Units:	Rev 🔻			

Attributes that are associated with the Load Feedback category are designated Feedback 2.

Axis Properties - Axis_1		
Categories:		
General	Load Feedback Device Sp	ecification
Motor	Device Function:	Load-Side Feedback
Motor Feedback	Feedback Channel:	Feedback 2
* Load Feedback Scaling	Туре:	Hiperface
Hookup Tests	Units:	Rev

Unlike the Motor Feedback category, you must explicitly enter load feedbackdevice information on the Load Feedback category, including the Feedback Type. This entry is required because the Load Feedback device is not built into the motor.

Default values are displayed based on the Feedback Type selected.

Hiperface		
Cycle Resolution:	1024	Feedback Cycles/Rev
Cycle Interpolation:	2048	Feedback Counts per Cycle
Effective Resolution:	2097152	Feedback Counts per Rev
Startup Method:	Incremental -	

Configure the Master Feedback

The Master Feedback category is available if the Feedback Configuration that is specified in the General category is Master Feedback. The attributes that are associated with the Master Feedback category are associated with Feedback 1. Again, like the Load Feedback category, you must enter all information.

Axis Properties - Axis_1					
Categories: General	Master Feedback Device Spe	ecification			
 Marter Feedback Scaling Hookup Tests Polarty Homing Actions Drive Parameters Parameter List Status Faults & Alams Tag 	Device Function: Feedback Channel: Type: Units: Hiperface Cycle Interpolation: Cycle Interpolation: Effective Resolution: Statup Method: Tums:	2048 Fee	Back Cycles/Rev dback Counts per Cycle aback Counts per Rev	Parameters	
Axis State:	Safety State:				
Manual Tune			ОК	Cancel A	Help

To verify that motor and feedback device are functioning properly, download to the controller, and continue on to <u>Hookup Tests on page 226</u>.

Configure Integrated Motion Using a PowerFlex 755 Drive

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This chapter provides procedures on how to configure integrated motion on the EtherNet/IP[™] network control by using a PowerFlex[®] 755 Embedded EtherNet/IP drive. For PowerFlex 755 configuration examples, refer to <u>Axis</u> <u>Configuration Examples for the PowerFlex 527 Drive on page 209</u>.

Add a PowerFlex 755 Drive

Follow these instructions to add the PowerFlex 755 drive to your project.

1. Right-click the Ethernet network (node) and choose New Module.

🚍 📟 1756 Backplane, 1756-A10			
	ct		
🖶 🖞 [1] 1756-EN2T EN2T_to_PowerFlex	755		
器 Ethernet	٦	New Module	N
		Discover Modules	13
	ж	Cut	Ctrl+X
		Сору	Ctrl+C
	6	Paste	Ctrl+V
		Delete	Del
		Cross Reference	Ctrl+E
		Launch RSNetWorx	
		Audit Network	
		Properties	Alt+Enter
		Print	•

- 2. Clear the small 'select all' checkboxes, Module Type Category, and Vendor Filters.
- 3. In the Module Type Vendors Filters window, check Allen-Bradley.

4. In the Module Type Category Filters window, check Drive.

Ente	er Search Text for Module Ty	pe	Cle	ar F	ilter	•		Hide Filters	*
	Module Typ	e Category Filters		^		Mo	dule Type Vendor I	Filters	
	Digital DPI to DLR Ethemet/IP DPI to EtherNet/IP Drive		(-		Allen-Bradley Endress+Hauser FANUC CORPOF FANUC Robotics			•
•	III		P.		•		m	•	
-	Catalog Number	Description		_			Vendor	Category	
	PowerRex 755-EENET PowerRex 755-EENET-CM PowerRex 755-EENET-C PowerRex 755-EENET-C PowerRex 755-ENETR PowerRex 755-ENETR	PowerFlex 755 AC Drive	via Er via Er	mbe mbe	dded dded	Ethernet - CIP Ethernet - CIP	Allen-Bradley	Drive Drive, Motion Drive, Motion Safety, Drive, Mot Drive	k 📄

- 5. Choose the drive and click create.
- 6. Type a Name for the module.

New Module	0	
General* Cor	nnection Time Sync Module Info Internet Pro	otocol Port Configuration Associated Axes Power Digital Inputs Motion Diagnostics
Type: Vendor: Parent: Name: Description:	PowerFlex 755 EEIET-CM PowerFlex 755 AC Rockwell Automation/Allen-Bradley Local	Onve via Embedded Ethernet - CP Ethernet Address © Physics Network: 192,168.1. 44 2 © Physics Network: 192,168.1. 44 2
New Moduli General [®] Cor Type: Vendor: Parent: Name: Description: Module Defi Revision: Electronic K Power Stru- Connection	Iz 001 Iz 001 Compatible Module dure: https://www.compatible.com Modion	Heat Name:
Status: Creating	1	OK Cancel Help

- 7. Type a description, if desired.
- 8. Assign an EtherNet/IP address.

See these manuals for information about how to configure IP addresses:

- PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication <u>750COM-UM001</u>
- EtherNet/IP Network Configuration User Manual, publication <u>ENET-UM001</u>
- 9. Under Module Definition, click Change.

The Module Definition dialog box appears.

Peripheral Devices:	Revision:	12 * 001 🔅	
	Electronic Keying:	Compatible Module	•
	Power Structure:	<none></none>	
	Verify Power Rating	on Connection	
	Connection:	Motion	



ATTENTION: The electronic keying feature automatically compares the expected module, as shown in the configuration tree, to the physical module before communication begins.

10. From the Electronic Keying pull-down menu, choose an option.



ATTENTION: When using motion modules, the electronic keying must be either `Exact Match' or 'Compatible Keying'. Never use `Disable Keying` with motion modules.

Select a Peripheral Feedback Device and Slot Assignment

Feedback devices on the PowerFlex 755 drives are called peripheral devices. You must assign the port/channel for each device you are using.

Follow these steps to select a feedback device.

1. Right-click on the device and choose New Peripheral Device.

heral Devices: PowerFlex_755Axj~					
	New Peripheral Device	▼ 001 🚔			
	Electronic Keying:	Compatible Module	•		
	Power Structure:	<none></none>	•		
	Verify Power Rating on Connection				
	Connection:	Motion	•		

The peripheral device refers to the type of feedback device you are using with the PowerFlex 755 drive.

2. From the Port pull-down menu, choose the appropriate port/slot.

3. From the Peripheral Device pull-down menu, choose the appropriate catalog number.

Port:	4		
Peripheral Device:	<none></none>		
	<none> 20-750-DENC-1</none>		
	20-750-ENC-1		
	20-750-UFB-1		

4. Click OK.

The device is added. Notice that the feedback device appears.

odule Definition*	Property of	CARL WIT	— ×
Peripheral Devices: PowerFlex_755Axis_1 4 20-750-ENC-1	Revision: Electronic Keying:	12 OU1 Compatible Module	•
	Power Structure:	<none></none>	•
	Connection.	Motion	
	ОК	Cancel Help	

Select an I/O Device

You can also select an I/O card for the peripheral device on port 7.

IMPORTANT You must select a revision of 12 or later for the module definition revision to add an I/O card to port 7 as a peripheral device.

1. Right-click on the drive and choose New Peripheral Device.

*4 20-750-EN	New Peripheral Device Electronic Keying:	001 Compatible Module
	Power Structure:	<pre></pre> < on connection
	Connection:	Motion

2. From the Port pull-down menu, choose Port 7.

IMPORTANT For the I/O card Peripheral Device selection: the 20-750-11xx card supports the configuration of four digital inputs, while the 20-750-22xx cards support the configuration of eight digital inputs. Once you select the Peripheral Device, the Digital Inputs tab allows for configuration of the specified digital inputs.

3. From the Peripheral Device pull-down menu, choose the appropriate catalog number.

This example uses 20-750-2262C-2R.

Peripheral Device Definition	X
Port:	7 •
Peripheral Device:	<none></none>
ОК	<none> 20-750-DENC-1 20-750-ENC-1 20-750-UFB-1 20-750-1132C-2R 20-750-1132D-2R 20-750-1133C-1R2T</none>
	20-750-2262C-2R 20-750-2262D-2R - 20-750-2263C-1R2T

4. Click OK.

The device is added. Notice that the feedback device appears.

Module Definition*	Staron calinas	X
Peripheral Devices: PowerFlex_755Axis ** 40-750-ENC-1 ** 7 20-750-2262C-2R	Revision: Electronic Keying: Power Structure: Verify Power Rating o	12 001 Compatible Module <none></none>
	Connection:	Motion
	ОК	Cancel Help

Assign a Power Structure

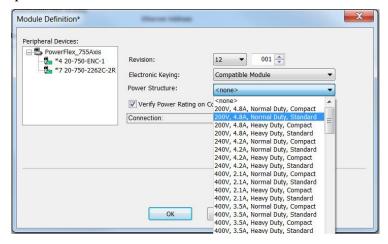
When you select a drive catalog number, you are specifying only a class of drives. You must assign the appropriate power structure that you have installed.

You can locate the power-structure reference numbers in these ways:

- On the actual product, usually on the right side of the drive
- In the device documentation
- On a purchase order

Follow these instructions to complete the drive configuration.

1. From the Power Structure pull-down menu, choose the appropriate power structure.



2. Click OK.

IMPORTANT When you change the major revision on the PowerFlex 755 drive, change the power structure, or change the peripheral feedback device, the axis is no longer associated with the modules.

3. Click Yes.

When you change parameters, other related parameters change as well.



This message always appears after you have changed a configuration. This message is a reminder that when you change the power structure the identity of the drive changes. If your drive is associated to an axis and you change the power structure, the axis is disassociated.

Even though a feedback card has been selected, the drive is not configured. You must associate the axis first, and then you have the options to configure a feedback module.

Porent: I	howerFlex 755-EENET-CM PowerFlex 755 AC D Rockwell Automation/Allen-Bradley Local	Ethernet Address
Name: Description:	Roman Friday (7935Add)	Prinate Network: 192.143.1. 44 The second
Module Definition Revision: Electronic Keyle Power Structur Connection	Change 12.001 rg: Compatible Module	

4. On the General Tab, click OK to apply the changes.

Configure Power Options

Use the settings on the power category to set bus regulator action, select shunt resistor type, and configure limits.

Figure 11 - Power Tab for the PowerFlex 755 Drive

	General* Connection Time Syr	nc Module Info Inter	met Protocol Port Configuration	Associated Axes Power	Digital Input
Catalog Number	Power Structure:	240V, 4.2A, Normal D 20GB4P2	uty, Standard	Advanced	
	Regenerative Power Limit:	-50.000	% Regulator Rated		
	Bus Regulator Action:	Shunt Regulator	▼		
	Shunt Regulator Resistor Type:	External Internal	rnal		
	External Shunt:	<none></none>	*		
	External Shunt Resistance:	79.000	Ohms		
	External Shunt Power:	0.1000	Kilowatts		
	External Shunt Pulse Power:	2.000	Kilowatts		

Table 29 - Module Properties: Power Tab Descriptions

Parameter	Description
Power Structure	Displays the drive catalog number and the drive power rating.
Regenerative Power Limit	Enter a negative percentage value for the regenerative power limit.
Bus Regulator Action	 Get or Set the bus regulator action to a configuration tag. Valid values include the following: Disabled Shunt Regulator CommonBus Follower
Shunt Regulator Resistor Type	Select either an internal or external shunt. Shunt Regulator Resistor Type appears dimmed in online mode and when Bus Regulator Action is disabled (set to CommonBus Follower). The Kinetix® 350 drive does not support this parameter.
External Shunt	These external shunt values are enabled when the Shunt Regulator Resistor Type is set to External. If you select External for the Shunt Regulator Resistor Type, choose the external shunt value. Valid values include the following: • <none> • Custom • The external shunt regulator catalog numbers</none>
External Shunt Resistance	PowerFlex 755 Drive
External Shunt Power	PowerFlex 755 Drive
External Shunt Pulse Power	PowerFlex 755 Drive

Configure Digital Inputs

Use the Digital Input category to enter digital input values for the drive module. The appearance of this category for the PowerFlex 755 drives can vary dependent upon the peripheral device configuration.

Figure 12 - Digital Input Tab for the PowerFlex 755 Drive

Module Properties: Local (PowerFlex 755-EENET-CM 11.001)								
General Connection	Time Sync 1	Module Info	Internet Protocol	Port Configuration	Associated Axes	Power	Digital Input	••
Un	assigned assigned able	- 2						

Table 30 - Module Properties: PowerFlex 755 Digital Input Tab Descriptions

Parameter	Description
Digital Input 1	Choose one of these values for Digital Input 1: • Unassigned • Enable



Module Pr	operties: Blank_enet	t_1 (PowerFlex 755-EENET-CM 12.001)
Connection	Time Sync Module	e Info Internet Protocol Port Configuration Associated Axes Power Digital Inputs Digital O
	Axis:	1 -
	Axis Name:	CIP_K65K
	Digital Input 1:	Unassigned 👻
	Digital Input 2:	Unassigned
	Digital Input 3:	Unassigned 💌
	Digital Input 4:	Unassigned
	Digital Input 5:	Unassigned 👻
	Digital Input 6:	Unassigned
	Digital Input 7:	Unassigned 👻
	Digital Input 8:	Unassigned 🔹

Table 31 - PowerFlex 755 with Digital I/O Peripheral Device Module Properties: Digital Inputs Tab Description

Parameter	Description
Digital Input 1	Choose one of these values for Digital Input 1: • Unassigned • Enable
Digital Input 2 Digital Input 3 Digital Input 4 Digital Input 5 Digital Input 6 Digital Input 7	 Choose one of these values for Digital Input 2, 3, 4, 5, 6, and 7: Unassigned Positive Overtravel Negative Overtravel Regeneration OK Precharge OK
Digital Input 8	Choose one of these values for Digital Input 8:UnassignedMotor Thermostat OK

Configure Digital Outputs

Use the Digital Outputs tab to enter digital output values for the drive module. The Digital Outputs tab applies only to PowerFlex 755 drives that are configured with a Digital I/O card as a peripheral device. The appearance of the Digital Outputs tab can vary dependent upon the peripheral device configuration.

Figure 14 - Digital Outputs Tab for the PowerFlex 755 Drive

puts Motion 4

Table 32 - PowerFlex 755 Module Properties: Digital Outputs Tab Descriptions

Parameter	Description	
Digital Output 1	Choose one of these values for Digital Input 1: • Unassigned • Contactor Enable • Mechanical Brake Engage	
Digital Output 2	Choose one of these values for Digital Output 2: • Unassigned • Contactor Enable	

Create an Associated Axis

There are two approaches that you can take to create and configure an axis. You can create an axis first and then add the axis to your motion group, or you can create your motion group and then add an axis. The procedure that is outlined in this section takes the approach to create your axis first, configure the axis, and then add it to your motion group.

Create an Axis for a PowerFlex 755 Drive

Follow these steps to create an axis.

- 1. Double-click the drive in the Controller Organizer.
- 2. Click the Associated Axes tab.
- 3. Click New Axis.

1	Module Properties: EN2T_to_PowerFlex_755 (PowerFlex 755-EENET-CM 11.001)							
	General Connection Time Sync N	Module Info	Internet Protocol	Port Configuration	Associated Axes	Power Digital Input		
	Axis 1:	<none></none>		▼	New Axis			
	Motor Feedback Device:	<none></none>		•				
	Load Feedback Device:	<none></none>		•				

The New Tag dialog box appears.

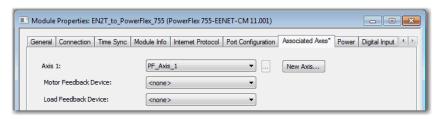
New Tag		×
Name:		Create 🔻
Description:		Cancel
		Help
	-	
Usage:	<controller></controller>	
Туре:	Base Connection	
Alias For:		
Data Type:	AXIS_CIP_DRIVE	
Parameter Connection:		
Scope:	PowerFlex_Trial_Project	
External Access:	Read/Write	
Style:		
Constant		
Sequencing	9	
Open AXIS	_CIP_DRIVE Configuration	
Open Parar	meter Connections	

- 4. Type the name.
- 5. Type a Description, if desired.

The fields in the next steps are automatically entered for the AXIS_CIP_DRIVE data type.

6. Change the Tag Type, Data Type, Scope, and External Access, if needed.

7. Click Create.



For more information about External Data Access Control and Constants, see the Logix 5000[™] Controllers I/O and Tag Data Programming Guide, publication <u>1756-PM004</u>.

Establish Feedback Port Assignments

The ports and channels that you can select are related to what hardware you have installed. You must manually establish the motor feedback (Port/ Channel) assignment for the PowerFlex 755 drive.

Follow these instructions to associate an axis to the drive by using the Module Properties dialog box for the drive.

- 1. Right-click the PowerFlex 755 drive and choose Properties.
- 2. Click the Associated Axes tab.

Module Properties: EN2T_to_PowerFlex.755 (PowerFlex.755-EENET-CM 11.001)							
General Connection Time Sync	Module Info Internet Protocol Port Configuration	Associated Axes Power Digital Input					
Axis 1:	PF_Axis_1	New Axis					
Motor Feedback Device:	<none></none>						
Load Feedback Device:	<none></none>						

3. From the Feedback Device pull-down menus, choose the port and channel combination that is applicable to your hardware configuration, which you installed when you added a peripheral device to your drive.

In this case, Port 4 Channel A is associated with the Motor Feedback device.

1	Module Properties: EN2T_to_PowerFlex_755 (PowerFlex 755-EENET-CM 11.001)							
	General Connection Time Sync	Module Info Internet Protocol Port Configuration Associated Axes* Power Digital Input						
	Axis 1:	PF_Axis_1 New Axis						
	Motor Feedback Device:	<none></none>						
	Load Feedback Device:	Cone> Port + Channel A						

4. To apply the changes and close the dialog box, click OK.

Create a Motion Group

All axes must be added to the Motion Group in your project. If you do not group the axes, they remain ungrouped and unavailable for use.

You must create a Motion Group for an axis to be configured properly.

To determine how many axes your controller system supports, see <u>Table 3 on</u> page 12.

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

New Tag		×
Name:		Create 🗸 🗸
Description:	*	Cancel
		Help
	~	
Usage:	<controller></controller>	
Туре:	Base Connection	
Alias For:		
Data Type:	MOTION_GROUP	
Parameter Connection:	v	
Scope:	PowerFlex_Trial_Project	
External Access:	Read/Write	
Style:		
Constant		
Sequencing	g	
Open MOT	ION_GROUP Configuration	
Open Para	meter Connections	

- 2. Type a name.
- 3. Type a description, if desired.

The fields in the next steps are automatically entered for the Motion_Group data type.

4. Change the Tag Type, Data Type, Scope, and External Access, if needed.

For more information about External Data Access Control and Constants, see the Logix5000 Controllers I/O and Tag Data Programming Guide, publication <u>1756-PM004</u>.

5. Click Create.

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

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

The Motion Group Properties dialog box appears.

7. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.

Government And America - UM_I	Motion 🗖 🗖 💌
Axis Assignment* Attribute Tag	
Unassigned:	Assigned:
	Axis_1 Axis_2_K5500
	Axis_K5500_Velocity PF755
	FF735
Add>	< Remove
ОК	Cancel Apply Help

Set the Base Update Period

The Base Update Period is basically the RPI rate for Ethernet communication between the controller and the motion module, a Unicast connection. It also sets the motor feedback that is returned from the drive in the drive-tocontroller connection.

There are two alternate update periods that you can configure when using Axis Scheduling. See <u>Axis Scheduling on page 145</u> for details.

The Base Update Period is how often the motion planner runs. When the motion planner runs, it interrupts most other tasks regardless of their priority. The motion planner is the part of the controller that takes care of position and velocity information for the axes.

Follow these steps to set the Base Update Period.

1. Click the Attribute tab in the Motion Group Properties dialog box.

🕞 Motion Group Prope	rties - UM_Motion						
Axis Assignment Attribu	te Tag						
Base Update Period:	20 ms (in 0.5 increments.) Axis Schedule						
Alternate 1 Update:	2.0 ms						
Alternate 2 Update:	2.0 ms						
General Fault Type:	Non Major Fault 🔻						
Timing Model:	One Cycle						
Scan Times (elapsed tin	ne):						
Max:	(us) Reset Max						
Last:	(us)						
Average:	(us)						
OK Cancel Apply Help							

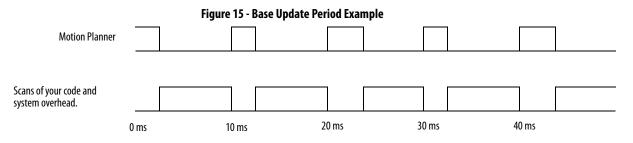
2. Set the Base Update Period to 3.0...32.0 ms.

For the PowerFlex 755 drive, the minimum Base Update Rate 3 ms.

Coarse Update Rate

The position loop for the PowerFlex 755 drive is updated at a rate of 1.024 ms ($1024 \mu s$). During each position loop update, the drive can either read or write data to the embedded Ethernet port, but cannot do both operations during the same update. Therefore the drive can receive only new updates every other position loop update event. To read new information from the Motion Planner, the minimum coarse update rate must be 2.5 ms or greater to be sure that no data packets are lost. In this context, the Motion Planner is the controller. If the PowerFlex 755 drive is operated at a coarse update rate of less than 2.5 ms, data packets can be lost. The drive can also fault if enough data packets are missed consecutively. These conditions result in the drive interpolating between missed updates. We recommend a minimum coarse update rate of 3 ms for the PowerFlex 755 drive.

TIP Check to see if the Last Scan time values on the Attribute tab are less. Typically, the value is less than 50% of the Base Update Period.



In this example, the Base Update Period = 10 ms. Every 10 ms the controller stops scanning your code and whatever else it is doing and runs the motion planner.

The Base Update Period is a trade-off between updating positions of your axes and by scanning your code. For a ControlLogix[®] 5560 controller or GuardLogix[®] 5560 safety controller, you can have 4 axes/ms and 8 axes/ms for the ControlLogix 5570 controller.

For detailed information on the Axis Scheduling function, Axis Assignment tab, and Alternate Update Period Scheduling, see <u>Axis Scheduling on</u> page 145.

Integrated Architecture Builder

To help you determine motion system performance, use the motion performance calculator in the Integrated Architecture Builder (IAB).

The IAB is a graphical software tool for configuring Logix-based automation systems. It helps you select hardware and generate bills of material for applications that include controllers, I/O, networks, PowerFlex drives, On-Machine[™] cabling and wiring, motion control, and other devices.

You can find the software at <u>http://www.rockwellautomation.com/en/e-tools/configuration.html</u>

Configure the Axis Properties

After you add the drive to your project and create the axes, use the Axis Properties dialog boxes to configure the drive. Notice that the dialog boxes change based on your configuration choices, for example, feedback configuration.

<u>Table 33</u> lists the basic tasks necessary configure a drive.

Table 33 ·	 Category 	Dialog	Boxes to	Configure	Drives
------------	------------------------------	--------	----------	-----------	--------

Category Dialog Box	Perform These Tasks	Page
General	Assign the axis configuration.	116
	Choose the feedback configuration.	
	Choose the application type, if applicable.	
	Choose the loop response (low, medium, or high), if applicable.	
	 If you have not already done so, you can create and associate an axis to a new Motion Group and associate a drive module to the axis. 	
Motor	• Specify a motor with the Data Source = Nameplate data sheet.	119
	• Specify a motor with the Data Source = Catalog Number.	
	• Select a motor with the Data Source = Motor NV.	
Motor Feedback	Select the Motor Feedback Type.	125
Scaling	Configure feedback by choosing the load type, by entering the scaling units, and by choosing the Travel mode.	222
	Enter the Input Transmission and Actuator ratio, if applicable.	

The parameters that you configure on the General category dialog box result in the presentation of attributes and parameters that are available for the combination of your selections.

IMPORTANT	All AXIS_CIP_DRIVE Axis Properties dialog boxes are dynamic. Optional attributes and dialog boxes that are related to each integrated motion axis you create come and go based on what combination of axis characteristics you define.

See the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>, for complete information on Axis Attributes and how to apply Control Modes.

IMPORTANT	Be sure to associate the drive and axis before when configuring the axis
	because the drive determines what optional attributes are supported for
	the axis.

If you have already created an axis and associated in with a drive, the Associated Module and Axis are shown on the General category of the Axis Properties

dialog box. Otherwise, you can select them in the dialog box that is shown in Figure 16.

Figure 16 - General Category Dia	loa Box
----------------------------------	---------

🗞 Axis Properties - PF_755	_Axis_1		
Categories:			
* General	General		
Motor Motor Motor Motor Motor Motor Feedback Scaling Hookup Tests Polanty Autotune Load Backlash	Axis Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group:	Postion Loop Motor Feedback Basic Medium UM_Motion New Group	
Compliance Observer Observer Position Loop Velocity Loop Torque/Current Loop Planner Homing Actions Drive Parameter List Status Faults & Alams Tag	Update Period: Associated Module Module: Module Type: Power Structure: Axis Number:	2.0	
Axis State:			
Manual Tune		OK Cancel Apply	Help

The Axis Number field corresponds to the axes listed on the Associated Axes tab of the Module Properties dialog box. Any feedback port assignments that you made on the Associated Axes tab are also mapped to the drive when you associate an axis and a drive.

For more information on how to configure the recommended out-of-box settings for your PowerFlex 755 drive, see <u>Appendix E</u> on <u>page 357</u>.

The axis parameters that you configure on the General dialog box result in the presentation of attributes and parameters that are available for the combination of your selections.

Configure the Associated Axis and Control Mode Now that the axis is associated to the drive, meaningful values are available for other axis configuration properties. The combination of the attributes that are selected when configuring an axis and feedback determines the control mode.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>, for complete information on axis attributes and control modes.

Follow these steps to configure an axis.

1. In the Controller Organizer, double-click the axis that you want to configure.

2. Choose an Axis Configuration.

General	
Axis Configuration:	Position Loop 🗸
Feedback Configuration:	Frequency Control
Application Type:	Velocity Loop
Loop Response:	Torque Loop Medium

TIP The associated drive determines what axis and feedback configuration choices are presented.

Table 34 - Compare the Axis Configuration Types for the Drives

Axis Type	PowerFlex 755
Position Loop (P)	Yes
Velocity Loop (V)	Yes
Torque Loop (T)	Yes
Feedback Only (N)	No
Frequency Control (F)	Yes

3. Choose a Feedback Configuration type.

General	
Axis Configuration:	Position Loop 👻
Feedback Configuration:	Motor Feedback 🔹
Application Type:	Motor Feedback Dual Feedback
Loop Response:	Dual Integral Feedback

<u>Table 35</u> compares the feedback type and loop type.

Table 35 - Compare the Feedback Type and Loop Type

Feedback Type Axis Type		PowerFlex 755
Motor Feedback	Position Loop (P), Velocity Loop (V),Torque Loop (T)	Yes
Motor Feedback	Position Loop (P), Velocity Loop (V)	No
Load Feedback	Position Loop (P), Velocity Loop (V),Torque Loop (T)	No
Dual Feedback	Position Loop (P)	Yes
Dual Integrator	Position Loop (P)	Yes
Master Feedback	Feedback Only (N)	No
No Feedback	Frequency Control (F)	Yes
No Feedback	Velocity Loop (V)	Yes

For a list of available devices, see <u>Table 6 on page 17</u>.

4. Choose an Application Type, if applicable.

General	
Axis Configuration:	Position Loop 🔹
Feedback Configuration:	Motor Feedback 👻
Application Type:	Basic 💌
Loop Response:	Custom Basic
Assigned Group	Tracking Point-to-Point Constant Speed
Motion Group:	CIP_Motion 👻

TIP Application Type defines the servo loop configuration automatically. These combinations determine how the calculations are made, which can reduce the need to perform an Autotune or a Manual Tune.

The Application Type determines the type of motion control application. This attribute is used to set the Gain Tuning Configuration Bits.

<u>Table 36</u> provides the gains established base on the application type.

Table 36 - Customize Gains to Tune

Application Type	Крі	Kvi	ihold	Kvff	Kaff	torqLPF
Custom ⁽¹⁾	-	-	-	-	-	
Basic (V20 and later)	No	No	No	Yes	No	Yes
Basic (V19 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

 If you set the type to Custom, you can control the individual gain calculations by changing the bit settings in the Gain Tuning Configuration Bits Attribute.

- **TIP** For information about other attribute calculations, see the specific attribute description in the Integrated Motion on the EtherNet/IP Reference Manual, publication MOTION-RM003.
- 5. Choose a Loop Response, if applicable.

ieneral	
Axis Configuration:	Position Loop 🔹
Feedback Configuration:	Motor Feedback 🔹
Application Type:	Basic 🔹
Loop Response:	Medium
	Low
Assigned Group	Medium
Motion Group:	High しう CIP_Motion ・

6. Click Apply.

Specify the Motor Data Source

The Motor Data Source is where you tell the axis where the motor configuration values are originating. You can select a motor from the database, nameplate, or nonvolatile memory.

Choose Catalog Number as the Motor Data Source

Follow these steps to identify the specification information that is originating from the Motion Database.

- 1. If the Axis Properties dialog box is not open, double-click the axis.
- 2. Click the Motor tab of the Axis Properties dialog box.
- 3. From the Data Source pull-down menu, choose Catalog Number.

🍄 Axis Properties - B15_P	PF755	
Categories: General Motor	Motor Device Specification Data Source: Nameplate Datasheet	
Analyzer Motor Feedback Scaling Hookup Tests Polanty	Catalog Number: Datasheet	

- 4. Click Catalog Number.
- 5. Click Change Catalog.
- 6. Select a motor and click OK.

Change Catalog Number	×
Catalog Number:	
MPL-B310P-M	ОК
MPL-8230P-Hox4 MPL-8230P-Vox2 MPL-8230P-Vox4 MPL-8230P-Vox4	Cancel
MPL-B310P-H MPL-B310P-M MPL-B310P-S	нер
MPL-B320P-H MPL-B320P-M	
MPL-B320P-S MPL-B330P-H	
Filters	
Voltage Family Feed	dback Type
(all>	> •

The Motor dialog box is populated with all information that is related to the motor you selected from the Motion Database.

Gronneral	Aotor Device Specifi	cation				
Model	Data Source:	Catalog Number			arameters	
Motor Feedback	Catalog Number:	MPL-B310P-M		Change Catalog		
Scaling Hookup Tests	Motor Type:	Rotary Permane	nt Magnet			
Polarity Autotune	Units:	Rev				
Load	Nameplate / Data	asheet - Phase	to Phase parameter	rs		
Compliance	Rated Power:	0.77	kW	Pole Count:	8	
Friction	Rated Voltage:	460.0	Volts (RMS)			
Observer Position Loop	Rated Speed:	5000.0	RPM	Max Speed:	5000.0	RPM
Velocity Loop	Rated Current:	1.7	Amps (RMS)	Peak Current:	5.02	Amps (RMS)
Acceleration Loop	Rated Torque:	1.58	N-m	Motor Overload Limit:	100.0	% Rated
Torque/Current Loop						
Homing						
Actions						
Drive Parameters						
Parameter List Status						
Faults & Alarms						
····· Tag						

Figure 17 - Motor Dialog Box

7. Click Apply.

Motor Model Dialog Box

The Motor Model dialog box displays the Motor Model Phase to Phase parameters. The parameters that are available depends on the Motor Data Source. Nameplate data sheet is the only Motor Data Source that lets you input the values. The Motor Analyzer is helpful when configuring the Motor Model dialog box parameters.

See <u>Display Motor Model Information on page 123</u>.

Motor Analyzer Dialog Box

The Motor Analyzer provides the Dynamic Motor Test for an AC drive, such as the PowerFlex 755 drive.

See Motor Analyzer Dialog Box on page 123.

Choose Nameplate as the Motor Data Source

The Nameplate option requires you to enter the motor specification information. You can find the information on the hardware nameplate or product data sheets.

1. From the Motor dialog box of Axis Properties, choose Nameplate data sheet.

X Axis Properties - PF_755	_Axis_1		- • •
Categories: General *	Motor Device Specif		
 Model Analyzer Motor Feedback Scaling Hookup Tests Polarity Autotune 	Data Source: Catalog Number: Motor Type: Units:	Namepiate Datasheet Parameters	

2. Choose a motor type.

🏷 A	xis Properties - K6K_1				
Cat	egories:				
	General	Motor Device Speci	fication		
* 8	- Motor Model	Data Source:	Nameplate Datasheet 💌		Parameters
*	Analyzer Motor Feedback	Catalog Number:	<none></none>	Change Catalog	
	Scaling	Motor Type:	Not Specified		
	Hookup Tests Polarity	Units:	Not Specified Rotary Permanent Magnet		
	- Autotune		Rotary Induction		

Table 37 shows the motor types that are available.

Table	37 -	Motor	Types
-------	------	-------	-------

Motor Type	PowerFlex 755	PowerFlex 527	
Rotary Permanent Magnet	Yes	No	
Linear Permanent Magnet	No	No	
Rotary Induction	Yes	Yes	

Notice that the motor information fields display zeros.

Axis Properties - K6K_1						- • ×
Categories:						
General	Motor Device Speci	fication				
* Motor * Model - Model - Analyzer * Motor Feedback - Scaling	Data Source: Catalog Number: Motor Type:	Nameplate Data <none> Rotary Induction</none>		Change Catalog	Parameters	
Hookup Tests	Units:	Rev	~			
Polarity Autotune * = Load	Nameplate / Da	tasheet - Phas	e to Phase paramete	rs		
Backlash	Rated Power:	0.0	kW	Pole Count:	4	
Compliance	Rated Voltage	. 0.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
Observer	Rated Speed:	0.0	RPM			
Velocity Loop	Rated Current:	0.0	Amps (RMS)			
- Torque/Current Loop - Planner - Homing - Actions - Drive Parameter J - Parameter List - Status - Faults & Alarms - Tag				Motor Overload Limit:	100.0	% Rated
Axis State:						
Manual Tune				ОКС	Cancel	Apply Help

General	Motor Device Specifi	cation				
- Motor						
Model	Data Source:	Nameplate Data	sheet 👻		Parameters	
Analyzer Motor Feedback	Catalog Number:	<none></none>		Change Catalog		
- Scaling	Motor Type:	Rotary Induction	•			
- Hookup Tests - Polarity	Units:	Rev				
Autotune	Nameplate / Dat	asheet - Phase	to Phase paramete	rs		
- Load Backlash	Rated Power:	0.025	kW	Pole Count:	4	
Compliance	Rated Voltage:	20.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
Observer Position Loop	Rated Speed:	1600.0	RPM			
Velocity Loop	Rated Current:	0.22	Amps (RMS)			
- Torque/Current Loop				Motor Overload Limit:	100.0	% Rated
Homing						
Actions						
- Drive Parameters - Parameter List						
- Status						
Faults & Alarms						
Tag						
State:						

3. Enter the parameter information from the motor Nameplate data sheet.

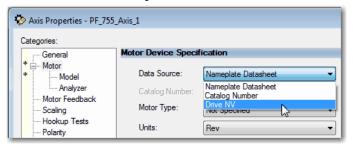
4. Click Apply.

Choose Drive NV as the Motor Data Source

When you choose Drive NV, the motor attributes are derived from the nonvolatile memory of a drive. Only a minimal set of motor and motor feedback (Feedback 1) attributes are required to configure the drive.

Follow these instructions to choose a data source.

1. From the Data Source pull-down menu, choose Drive NV.



2. From the Units pull-down menu, choose Revolutions or Meters.

🏷 Axis Properties - PF_755	😓 Axis Properties - PF_755_Axis_1						
Categories:							
General	Motor Device Spec	ification					
* Motor * Model Motor Feedback Scaling	Data Source:	Drive NV	Parameters				
Hookup Tests Polarity	Units:	Rev 🔻					

Display Motor Model Information

The Motor Model dialog box displays more information that is based on the motor, axis, and feedback configuration types you choose.

The asterisk next	Axis Properties - PF_755_Axis_1				
to a category	Categories:	Motor Model Phase to Phase Pa	arameters		
To a category means that you have not applied changes.	General Motor Motor Motor Hokap Tests Hokap Tests Homy Homy Paston Loop Homor Pasanetes Paraneter List Paraneter List Pasaneter List	Motor Model Phase to Phase Pr Votage Constant (%e): Restance (%s): Inductance (La):	33.948196 4.7 0.025	Vols(RMS)/KRPM Ohms Hennes	
	Faults & Alarms				

- If the motor data source is Catalog Number, the fields are populated automatically from the database and the fields are read-only.
- If the motor data source is Nameplate data sheet, you can enter the information.
 - TIP You can leave the default values, go online, and run a Motor Test to get the proper values from the drive.

See Hookup Tests on page 226.

- If the motor data source is Drive NV, the data comes from the nonvolatile memory of the drive.
- If you select Catalog Number, Motor NV, or Drive NV, the values display as read-only.

Motor Analyzer Dialog Box

hav

The Motor Analyzer provides the following three tests:

- Dynamic Motor
- Static Motor
- Calculate Model

The tests analyze motor parameters for rotary and linear induction motors and permanent magnet motors. The parameters that appear on the tests are dependent on the motor type you choose.

> If the motor you are using is a Permanent Magnet, the Dynamic Motor is the TIP only test that appears.

Axis Properties - PF_755	Axis_1						
Categories:							
General	Analyze Motor to Determine Motor Model						
Motor Model Model Model Motor Feedback Scaling Hookup Tests Polaitty Autotune	Dynamic Motor Test Static Motor Test Calculate Model Start Stop Test State:	_					
Load Backlash Compliance Observer Position Loop Velocity Loop Torque/Current Loop		it Test Results 0 Ohms Ohms 0 Ohms Ohms					
Planner Homing Actions	,	0 Ohms Ohms 0 Amps Amps					
- Drive Parameters - Parameter List - Status - Faults & Alams - Tag		u Amps Amps 0 RPM RPM					
Axis State: Manual Tune OK Cancel Apply Help							

Figure 18 - Motor Analyzer Dialog Box

Table 38 - Motor Analyzer Parameters

Parameter	Description
Motor Resistance	Specifies the phase-to-phase, resistance of a permanent magnet motor.
Motor Inductance	Specifies the phase-to-phase, inductance of a permanent magnet motor.
Motor Rotary Voltage Constant	Specifies the voltage, or back-EMF, constant of a rotary permanent-magnet motor in phase-to-phase RMS Volts per KRPM.
Motor Stator Resistance	Specifies the Y circuit, phase-neutral, winding resistance of the stator as shown as R1 in the IEEE motor model.
Motor Stator Leakage Reactance	Specifies the Y circuit, phase-neutral, leakage reactance of the stator winding, at rated frequency, as shown as X1 in the IEEE motor model.
Motor Torque Constant	Specifies the torque constant of a rotary permanent-magnet motor in Newton- meters per RMS amp.
Motor Rotor Leakage Reactance	Specifies the Y circuit, phase-neutral, equivalent stator-referenced leakage inductance of the rotor winding, at rated frequency, as shown as X2 in the IEEE motor model.
Motor Flux Current	Id Current Reference that is required to generate full motor flux. The No Load Motor Rated Current that is commonly found in Induction Motor data sheets closely approximates the value of the Motor Flux Current. The Kinetix 350 does not support this parameter.
Rated Slip	Rated Slip is the amount of slip at motor rated current (full load) and motor rated frequency.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>, for complete information on Axis Attributes Motor Feedback.

Assign Motor Feedback

The PowerFlex 755 drive requires a peripheral feedback device. As with all parameters, the types of feedback available are dependent on what you select on the General dialog box for Feedback Configuration.

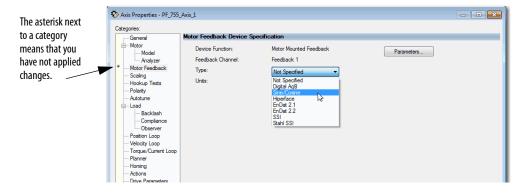
For a list of available devices, see <u>Table 6. Supported Feedback Module</u> <u>Combinations, on page 17</u>.

Axis Configuration Type	Parameters
Frequency Control	No Feedback
Position Loop	 Motor Feedback, one mounted device Dual Feedback, two mounted devices Dual Integral Feedback, two mounted devices
Velocity Loop	 No Feedback Motor Feedback, mounted device
Torque Loop	Motor Feedback, mounted device

The Motor Feedback dialog box contains the information for the feedback device. This category dialog box is not available for Frequency axis configuration and is dependent on the axis configuration type and the motor selection.

Select a Feedback Type and Units. The type of feedback available depends on the axis and feedback configurations.

1. From the Type pull-down menu, choose the appropriate type of motor feedback.



- 2. Click Apply and OK to exit the Motor Feedback dialog box.
- 3. Set the commutation alignment type and the percentage of offset.

Commutation —		
Alignment:	Motor Offset	
Offset: Polarity:	Not Aligned Controller Offset Motor Offset Self-Sense	Test Commutation

TIP All commutation attributes apply only to permanent magnet motors.

If you are using a motor that is not in the database, the default is Not Aligned. If the motor is in the database, the alignment is set to Controller Offset.

Table 39 - Commutation Alignment Types

Туре	Description
Not Aligned	Not Aligned indicates that the motor is not aligned, and that the Commutation Offset value is not valid. If the Commutation Offset is not valid, the drive cannot use the value to determine the commutation angle. Any attempt to enable the drive with an invalid commutation angle results in a Start Inhibit condition.
Controller Offset	It applies the Commutation Offset value from the controller to determine the electrical angle of the motor.
Motor Offset	The drive derives the commutation that is offset directly from the motor.
Self-Sense	The drive automatically measures the commutation that is offset when it transitions to the Starting state for the first time after a power cycle. This process generally applies to a PM motor equipped with a simple incremental feedback device.

4. Go online with the controller and click Test Commutation.

When the test is complete, you see the status of the polarity.

The AXIS_CIP_DRIVE axis properties Motor Feedback category recognizes the support of selectable Effective Resolution as defined in the Add-on Profile (AOP) schema for version 28 controller projects. The Motor Feedback category also lets you select between the choices that are presented. Logix Designer application version 28 modifies the feedback types that define support for the 20-bit fixed Effective Resolution in current PowerFlex 755 schemas. The default selection for Nameplate data sheet is 20 bit. Version 28 modifies the feedback type to add the new 24-bit fixed Effective Resolution to the schema. You must select the Effective Resolution field to configure for 24 bit. This modification is in addition to the new SSI Digital support that was added for Major Revision 12 of the PowerFlex 755 drives. An example of the Motor Feedback category for version 28 with selectable Effective Resolution is shown in the following figure.

🏷 Axis Properties - Axis_1					- • •
Categories:					
General	Motor Feedback Device Spe	cification			
Motor Model	Device Function:	Motor Mounted Feedb	ack	Parameters	
Analyzer	Feedback Channel:	Feedback 1			
Motor Feedback	Type:	Hiperface	~		
Hookup Tests	Units:	Rev			
Polanty	Hiperface				
Autotune	Cycle Resolution:	1024	Feedback Cycles/Rev		
Backlash	Cycle Interpolation:	16384	Feedback Counts per Cycle		
Compliance	Effective Resolution:	16777216 -	Feedback Counts per Rev		
Position Loop	Startup Method:	Absolute -			
Velocity Loop	Tums:	4096			
Torque/Current Loop					
Homing					
Actions					
Drive Parameters	Commutation				
	Alignment:	Not Aligned 👻			
Faults & Alarms	Offset:	0.0	Degrees		
Tag	Oliber.	0.0	Degrees	Test Commutation	
Axis State:					
Manual Tune			ОК	Cancel Apply	Help

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>, for more information on axis attributes.

Notes:

Configure Integrated Motion Using a PowerFlex 527 Drive

Торіс	Page
Set the Network Configuration	130
Add a PowerFlex 527 Drive	130
Configure the PowerFlex 527 Drive	132
Create an Axis for a PowerFlex 527 Drive	138
Create the Motion Group	139
Configure the Axis Properties	140
Configure the Associated Axis and Control Mode	142

This chapter provides procedures on how to configure integrated motion on the EtherNet/IP[™] network control by using a PowerFlex[®] 527 Adjustable Frequency AC drive.

You can include the drive in your Logix Designer application by adding it to a configured EtherNet/IP module or controller and by adding it under the I/O configuration tree. See <u>Create a Controller Project on page 21</u> for more information.

TIP Before you begin, verify that you know the catalog number for each drive component, the Logix module, or controller that is used in your motion control application.

For more information and examples on PowerFlex 527 axis configuration in Logix Designer application, see <u>Axis Configuration Examples for the</u> <u>PowerFlex 527 Drive on page 209</u>.

For more information on how to configure the recommended out-of-box settings for your PowerFlex 527 drive, see <u>Appendix C</u> on <u>page 339</u>.

For examples of how to test and tune the PowerFlex 527 axes, see the PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u>.

Set the Network Configuration

You can set the network configuration by using the LCD display and drive keypad.

 When the LCD display is showing the Device/Axis state, use the keypad to navigate to SETTINGS -> NETWORK. Then choose either STATIC IP or DHCP.

The default setting is STATIC IP.

- 2. If you chose STATIC IP, then you must configure the following settings:
 - IP address
 - Gateway
 - Subnet mask

If you chose DHCP, the DHCP server automatically configures the three previously listed settings.

Settings are stored in nonvolatile memory. The IP address can also be changed through the Module Configuration dialog box in RSLinx[®] Classic software. Changes to the IP address take effect after power is cycled or reset. The drive is programmed from the factory to a static IP address of 192.168.1.180.

After setting the network configuration, you can view the drive status information in Studio 5000 Logix Designer[®] or RSLinx Classic and use it in your Logix Designer application.

Add a PowerFlex 527 Drive

IMPORTANT To configure PowerFlex 527 drives, you must be using the Studio 5000 Logix Designer application, version 24.00 or later.

Follow these instructions to add the PowerFlex 527 drive to your project.

1. Right-click the Ethernet network (node) and choose New Module.



2. Clear the small 'select all' checkboxes, Module Type Category, and Vendor Filters.

Alternatively, you can simply type "527" into the search box and choose the drive.

3. In the Module Type Vendor Filters window, check Allen-Bradley.

4. In the Module Type Category Filters window, check Drive.

Enter	r Search Text for Module Ty	Clea	r Filters			Hide Filter	s 🛠
	Module Typ	e Category Filters	•		Nodule Type Vendo	r Filters	
	Digital DPI to DLR Ethemet/IP DPI to EtherNet/IP Drive DSI to EtherNet/IP			Allen-Bradley Endress+Haus FANUC CORP FANUC Roboti Mettler-Toledo	ORATION		
•	Catalog Number	Description			Vendor	Category	•
F	PowerFlex 525-E PowerFlex 525-E2P PowerFlex 525-EENET PowerFlex 525-EENET-M	PowerFlex 525 via 22-COMM-E PowerFlex 525 via E2P PowerFlex 525 via Embedded E PowerFlex 525 Multi-Drive via E	Ethernet	Bhamat	Allen-Bradley Allen-Bradley Allen-Bradley Allen-Bradley	Drive Drive Drive Drive	
_	PowerFlex 527-STO CIP	PowerFlex 527 AC Drive - CIP I			Allen-Bradley	Drive.Motion.Safe	tv
	PowerFlex 70 EC-E	AC Drive via 20-COMM-E			Allen-Bradley	Drive	-
•		III					F

5. Choose the PowerFlex 527 drive and click create.

The Module Properties dialog box appears.

New Module	and the second							- X
General* Conne	ection Safety	Time Sync	Module Info	Internet Protocol	Port Configuration	Network	Associated Axes	Pc 1
Type: Vendor: Parent: Name: Description: Module Defini Revision: Electronic Key ConnectKey ConnectKey	Allen-Bradley ENET_Module Drive_4 tion	1.001 Compatible M Motion and Si <none></none>	Change	Ether P T I I I I I I I I I I I I I	er:	192.168 	·	
Status: Creating					ОК		Cancel	Help

- 6. Configure the new drive.
 - a. Type the drive Name.
 - b. Type a description, if desired.
 - c. Select an EtherNet/IP address option. In this example, the Private Network address is selected.
 - d. Enter the address of your PowerFlex 527 drive. In this example, the last octet of the address is 25.
- 7. Proceed to <u>Configure the PowerFlex 527 Drive on page 132</u> to continue configuring your drive.

Configure the PowerFlex 527 Drive

After you have added a PowerFlex 527 drive to your project, you must configure the type of safety connection suitable for your application. See the following sections for instructions on configuration of the drive for the different types of safety connections.

- Configure the Drive with Hard-wired Safety Connections on page 132
- Configure the Drive with Integrated Safety Connections on page 134

Connection Mode	Controller Needed	Description
Motion only	ControlLogix [®] 5570, GuardLogix [®] 5570, CompactLogix [™] 5370, ControlLogix 5580, CompactLogix 5380, or Compact GuardLogix 5370 ⁽¹⁾	Hard-wired Safe Torque Off (STO) connections are possible. This controller manages Motion. Another controller that has a Safety only connection to the drive manages Safety.
Motion and Safety	GuardLogix 5570, GuardLogix 5580, Compact GuardLogix 5370 ⁽¹⁾ , or Compact GuardLogix 5380	This controller manages Motion and Safety.
Safety only	GuardLogix 5570, GuardLogix 5580, Compact GuardLogix 5370, or Compact GuardLogix 5380	This controller manages Safety. Another controller that has a Motion only connection to the drive manages Motion.

(1) Catalog numbers containing the letter M.

Configure the Drive with Hard-wired Safety Connections

Follow these steps to configure the PowerFlex 527 drives with hard-wired safety.

- Make sure that you have completed the steps in <u>Add a PowerFlex 527</u> <u>Drive on page 130</u> before proceeding.
- 2. Under Module Definition, click Change.



The Module Definition dialog box appears.

Module Definition	X				
Revision:	001				
Electronic Keying:	Compatible Module				
Connection:	Motion and Safety				
Power Structure:	Motion and Safety Motion only				
Verify Power Rating on Co					
ОК	Cancel Help				

a. From the Electronic Keying pull-down menu, choose an option.



ATTENTION: When using motion modules, the electronic keying must be either `Exact Match' or `Compatible Keying'. Never use `Disable Keying` with motion modules.

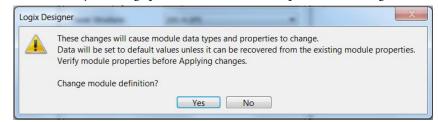
- b. From the Connection pull-down menu, choose the Connection mode for your motion application.
 In this example, choose Motion only.
 - **TIP** When 'Safety' appears in the Connection mode, integrated safety is implied.
- c. From the Power Structure pull-down menu, choose the appropriate power structure.

ſ	Module Definition*		x
	Revision:	001	
Ľ	Electronic Keying:	Compatible Module	•
ľ	Connection:	Motion only	•
l	Power Structure:	25C-A-2P5	-
	Verify Power Rating on Cor	<none> 25C-V-2P5 25C-V-4P8 25C-V-6P0</none>	
		25C-A-2P5 25C-A-4P8 25C-A-8P0 25C-A-011 25C-B-2P5	
L		25C-B-5P0 25C-B-8P0	ŀ

d. To make sure that the proper power structure that is defined in the profile is the same as the connected drive, check the Verify Power Rating On Connection checkbox. If the two do not match, a connection error occurs, which indicates a power mismatch.

Verify that Power Rating on Connection is checked by default. It is enabled in offline mode.

When you change parameters, other related parameters change as well.



This message always appears after you have changed a configuration. This message is a reminder that when you change the power structure the identity of the drive changes. If your drive is associated to an axis and you change the power structure, the axis is disassociated.

- 3. To close the Logix Designer dialog box, click OK.
- 4. To close the Module Definition dialog box, click OK.
- 5. To close the Module Properties dialog box, click OK.

Your PowerFlex 527 drive appears in the Controller Organizer under the Ethernet controller in the I/O configuration folder.

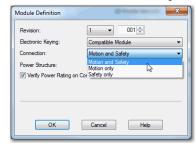
Configure the Drive with Integrated Safety Connections

To configure the PowerFlex 527 drives with integrated safety, follow these steps.

- Make sure that you have completed the steps in <u>Add a PowerFlex 527</u> <u>Drive on page 130</u> before proceeding.
- 2. Under Module Definition, click Change.

D an dalama	Change
Revision:	1.001
Electronic Keying:	Compatible Module
Connection:	Motion and Safety
Power Structure:	<none></none>

The Module Definition dialog box appears.



a. From the Electronic Keying pull-down menu, choose an option.



ATTENTION: When using motion modules, the electronic keying must be either `Exact Match' or `Compatible Keying'.

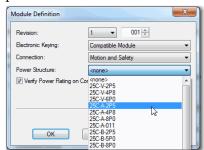
Never use `Disable Keying` with motion modules.

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

In this example, choose Motion and Safety.

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

The Safety Network Number (SNN) field populates automatically when the Connection mode includes an integrated Motion and Safety or Safety-only connection. For a detailed explanation of the safety network number, see the appropriate GuardLogix and Compact GuardLogix Controller Systems Safety Reference Manual, which is listed in <u>Additional Resources on page 9</u>. c. From the Power Structure pull-down menu, choose the appropriate power structure.



d. To make sure that the proper power structure that is defined in the profile is the same as the connected drive, check the Verify Power Rating On Connection check-box. If the two do not match, a connection error occurs, which indicates a power mismatch.

Verify that Power Rating on Connection is checked by default. It is enabled in offline mode.

- 3. to close the Module Definition dialog box, click OK.
- 4. Click the Safety tab.

Module Propert	Module Properties: ENET_Module (PowerFlex 527-STO CIP Safety 1.001)								
General Connec	tion Safety Time	Sync Module Info I	nternet Protocol Port C	onfiguration Network Associ	ated Axes Por				
Connection Type	Requested Packet Interval (RPI) (ms)	Connection Reaction Time Limit (ms)	Max Observed Network Delay (ms)]					
Safety Input Safety Output	10 \$ 20	40.1 60.0	Reset	Advanced					
Configuration O Reset Ov Configuration S ID: d(Date: 5	wnership: mership • gnature: 13a_ecd7 /22/2015	(Hex)	Сору	-					
Status: Offline			ОК	Cancel Apply	Help				

The connection between the controller and the PowerFlex 527 drive is based on the following:

- Drive catalog number must be PowerFlex 527 (integrated)
- Drive Safety Network Number (SNN)
- GuardLogix slot number
- GuardLogix safety network number
- Path from the GuardLogix controller to the PowerFlex 527 drive
- Configuration signature

If any differences are detected, the connection between the GuardLogix controller and the PowerFlex 527 drive is lost. If the connection is lost, the yellow icon appears in the controller organizer after you download the program.

5. Click Advanced.

The Advanced Connection Reaction Time Limit Configuration dialog box appears.

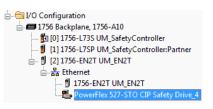
Advanced Connection Reaction Time Limit Co	nfiguration						
Input							
Requested Packet Interval (RPI):	ms (6 - 500)						
Timeout Multiplier: 2	(1-4)						
Network Delay Multiplier: 200	% (10-600)						
Connection Reaction Time Limit: 40.1	ms						
Output							
Requested Packet Interval (RPI): 20	ms (Safety Task Period)						
Timeout Multiplier: 2	(1-4)						
Network Delay Multiplier: 200	% (10-600)						
Connection Reaction Time Limit: 60.0	ms						
OK Cancel Help							

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

For more information about the Advanced Connection Reaction Time Limit Configuration, see the GuardLogix or Compact GuardLogix user manual, which is listed in <u>Additional Resources on page 9</u>.

- 6. To close the Advanced Connection Reaction Time Limit Configuration dialog box, click OK.
- 7. To close the Module Properties dialog box, click OK.

Your PowerFlex 527 drive appears in the Controller Organizer under the Ethernet controller in the I/O Configuration folder.



Configure Power Options

To configure power options, follow these steps.

1. Click the Power tab.

Module Properties: UM_EN2T (PowerFlex 527-STO	CIP Safety 1.001)			- • ×
Connection Safety Time Sync	Module Info Interne	et Protocol Port Conf	iguration Network	Associated Axes	Power Digit + >
Power Structure:	25C-V-2P5			Advanced	
	1P 110V 2.5A 0.4kW				
PWM Frequency:	4 Khz	•			
Regenerative Power Limit:	100.000	% Regulator Rated			
Bus Regulator Action:	Adjustable Frequence	y 🔻			
Shunt Regulator Resistor Type:	🔿 External 🛛 🔘 Inte	rnal			
External Shunt:	<none></none>	-			
External Shunt Resistance:	60.000	Ohms			
External Shunt Power:	0.2000	Kilowatts			
External Shunt Pulse Power:	2.000	Kilowatts			
Status: Offline		0	Cancel	Apply	Help

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

Attribute	Menu	Description
PWM Frequency	 2 kHz 4 kHz 8 kHz 	The value sets the carrier frequency for the pulse-width modulation (PWM) output to the motor.
Bus Regulator Action	Disabled	This selection disables the internal DC bus voltage regulation feature of the drive. Select this option if there is an external regenerative brake or regenerative line supply that is connected to the drive DC bus.
	Shunt Regulator	This selection is used when either an external shunt resistor is connected to the drive or the internal IGBT is controlling the power dissipation to the resistor.
	Adjustable Frequency (Default)	This selection allows the drive to either change the torque limits or ramp rate of the velocity to control the DC bus voltage. This option is not recommended for positioning applications because it overrides the velocity and the system overshoots or does not stop.
	Shunt then Adjustable Frequency	This selection allows the Shunt resistor to absorb as much energy as it is designed for. The Shunt resistor then transitions to adjustable frequency control if the limit of the resistor has been reached.
	Adjustable Frequency then Shunt	This selection allows for adjustable frequency control of the DC bus. If adjustable frequency control cannot maintain the DC bus within limits, the shunt resistor is activated.
Shunt Regulator	Internal	Not applicable for PowerFlex 527 drives.
Resistor Type	External	Enables the external shunt (internal shunt option is disabled).

3. Click OK.

Configure Digital Inputs

Figure 19 - Digital Inputs Tab for the PowerFlex 527 Drive with Digital I/O Device

Parameter	Description
Digital Input 1 Digital Input 2 Digital Input 3 Digital Input 4	Choose one of these values for Digital Input 1, 2, 3, and 4: • Unassigned • Enable • Home ⁽¹⁾ • Registration 1 ⁽¹⁾ • Registration 2 ⁽¹⁾ • Positive Overtravel • Negative Overtravel

Table 40 - PowerFlex 527 Module Properties: Digital Input Tab Descriptions

(1) Home, Registration 1, and Registration 2 are only available for Digital Input 1 and Digital Input 2.

Create an Axis for a PowerFlex 527 Drive

Once you have added a drive, selected the power structure, and assigned a feedback device, you can create and configure an axis. You must apply the changes and exit the Associated Axis dialog box before the option to create an axis becomes available.

There are two approaches that you can take to create and configure an axis. You can create an axis first and then add the axis to your motion group, or you can create your motion group and then add an axis. The procedure that is outlined in this section takes the approach to create your axis first, and then add it to your motion group.

- 1. Double-click the PowerFlex 527 drive in the controller organizer.
- 2. Click the Associated Axes tab.
- 3. Click New Axis.

Module Properties: ENET_Modu	ule (PowerFlex 527-STO CIP Safety 1.001)	
General Connection Safety Ti	me Sync Module Info Internet Protocol Port Configuration Network	Associated Axes Por
Axis 1:	<none></none>	
Motor Feedback Device:	Motor Feedback Port	

New Tag		X
INEW Tag		
Name:	1	Create 🗸 🔻
Description:		Cancel Help
	Ψ	
Usage:	<controller></controller>	
Туре:	Base Connection	
Alias For:	T	
Data Type:	AXIS_CIP_DRIVE	
Parameter Connection:	.	
Scope:	PF527_Test 🗸	
Class:	Standard 🔹	
External Access:	Read/Write 👻	
Style:		
Constant		
Sequencin	ng	
Open AXIS	S_CIP_DRIVE Configuration	
Open Para	ameter Connections	

The New Tag dialog box appears.

- 4. Type the name.
- 5. Type a Description, if desired.

The fields in the next steps are automatically entered for the AXIS_CIP_DRIVE data type.

6. Click OK.

Create the Motion Group

To determine how many axes your controller system supports, see <u>Table 3 on</u> page 12.

All axes must be added to the Motion Group in your project. If you do not group the axes, they remain ungrouped and unavailable for use.

You must create a Motion Group for an axis to be configured properly.

Follow these steps to configure the motion group.

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

New Tag		×
Name:	[Create 🗸 🔻
Description:		Cancel
		Help
	-	
Usage:	<controller></controller>	
Туре:	Base Connection	
Alias For:		
Data Type:	MOTION_GROUP	
Parameter Connection:		
Scope:	PF527_Test 👻	
Class:	Standard 🗸	
External Access:	Read/Write	
Style:		
Constant		
Sequencing		
Open MOT	ON_GROUP Configuration	
Open Paran	neter Connections	

The New Tag dialog box appears.

- 2. Type the new motion group name.
- 3. Click Create.

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

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

The Motion Group Properties dialog box appears.

5. Click the Axis Assignment tab and move your axes (created earlier) from Unassigned to Assigned.

		Properties - UM_Motion 📃 🔲 🛋
Axis Assignment*	Attribute Ta	9
Unass	igned:	Assigned:
		Axis_1
Ac	ld>	< Remove
	ОК	Cancel Apply Help

- 6. Click the Attributes tab and edit the default values as appropriate for your application.
- 7. Click OK.

To get the minimum motion group base-update rate, see <u>Motion Group</u> <u>Base Update Rate on page 342</u>.

Configure the Axis Properties

After you add the drive to your project and create the axes, use the Axis Properties dialog boxes to configure the drive. Notice that the dialog boxes change based on your configuration choices, for example, feedback configuration.

<u>Table 41</u> lists the basic tasks necessary configure a drive.

Table 41 - Category Dialog Boxes to Configure Drives

Category Dialog Box	Perform These Tasks	Page
General	Assign the axis configuration.	142
	Choose the feedback configuration.	
	Choose the application type, if applicable.	
	Choose the loop response (low, medium, or high), if applicable.	
	 If you have not already done so, you can create and associate an axis to a new Motion Group and associate a drive module to the axis. 	
Motor	Specify a motor with the Data Source	210
	For more information and examples on PowerFlex 527 axis configuration in Logix Designer application, see <u>Axis Configuration Examples for the</u> <u>PowerFlex 527 Drive</u> .	
Motor Feedback	Select the Motor Feedback Type.	214
	For more information and examples on PowerFlex 527 axis configuration in Logix Designer application, see <u>Axis Configuration Examples for the</u> <u>PowerFlex 527 Drive</u> .	
Scaling	Configure feedback by choosing the load type, by entering the scaling units, and by choosing the Travel mode.	222
	Enter the Input Transmission and Actuator ratio, if applicable.	

The parameters that you configure on the General category dialog box result in the presentation of attributes and parameters that are available for the combination of your selections.

IMPORTANT	All AXIS_CIP_DRIVE Axis Properties dialog boxes are dynamic. Optional
	attributes and dialog boxes that are related to each integrated motion
	axis you create come and go based on what combination of axis
	characteristics you define.

See the Integrated Motion Reference Manual, publication <u>MOTION-RM003</u>, for complete information on Axis Attributes and how to apply Control Modes.

IMPORTANT	Be sure to associate the drive and axis before when configuring the axis
	because the drive determines what optional attributes are supported for
	the axis.

If you have already created an axis and associated in with a drive, the Associated Module and Axis are shown on the General category of the Axis Properties dialog box. Otherwise, you can select them in the dialog box that is shown in Figure 20.

General General Motor Motor Model Axis Configuration: Position Loop ▼ Motor Feedback ▼ Motor Feedback ▼ Motor Feedback ▼ Motor Feedback ▼ Polarity Application Type: Basic ▼ Polarity Loop Response: Motor Group Medium Polarity Assigned Group Postion Loop Motor Group: Postion Loop Woton Group: Velocky Loop Update Period: Planner Module Marring Associated Module Anner Module	Motor					
Model Axis Configuration Position Loop ▼ Moter Feedback Feedback Configuration Moter Feedback ▼ Scaling Application Type: Basic ▼ Motor Feetis Loop Response: Medium ▼ Autorine ▼ ■ ■ Position Occmpliance ▼ ■ Position Loop Moton Group: UM_Motion ▼ Position Loop Update Period: 2.0 ■ Planner ■ ■ ■ Moming Associated Module ■ ■		- Aller and a second				
Motor Feedback Feedback Configuration: Motor Feedback Scaling Application Type: Basic Fockup Tests Loop Response: Medium Polarity Autotine Load Backash Ognplance Postion Loop Postion Loop Motion Group: Velocity Loop Update Period: 20 Image: State Stat		Axis Configuration:	Position Loop	*		
Scaling Application Type: Basic Hockup Tests Loop Response: Medium Polarity Load BackVash Compliance Compliance Position Loop Motion Group UM_Motion New Group Torque/Current Loop Update Period: 2.0 Homing Associated Module		Feedback Configuration:	Motor Feedback	•		
Polarity Loop Response: Medium ▼ Autotune Load Backligh Compliance Compliance Position Loop Motion Group Velocity Loop Torque_Current Loop Planner Homing Associated Module Associated Module	Scaling	Application Type:	Basic	•		
Autorune Load Backlaph Assigned Group Position Compliance Position Loop Motion Group UM_Motion Velocity Loop Update Period 20 Partner Planter Homing Associated Module		Loop Response	Medium	•		
Backlash Compliance Assigned Group Postion Loop Motion Group: UM_Motion ✓ Velocity(Loop Update Period: 20 ✓ Planner Associated Module Actions ✓			C			
Compliance Assigned Group -Position Loop Motion Group: -Velocity Loop UM_Motion Torque/Current Loop Update Penod: Planner						
Velocity Loop Update Period: 20		Assigned Group				
Torque/Current Loop Update Period: 20		Motion Group:	UM_Motion	•	New Group	
Planner Homing Associated Module Actions Actions		Update Period:	2.0			
Actions						
Exceptions Module: Drive_4			<u> </u>			
	Exceptions		-	•		
Parameter List Power list						
Status Power Structure: 25C-A-2P5 Faults & Alarma			24			
Tag Axis Number		Axis Number	1	•		

The Axis Number field corresponds to the axes listed on the Associated Axes tab of the Module Properties dialog box. Any feedback port assignments that you made on the Associated Axes tab are also mapped to the drive when you associate an axis and a drive.

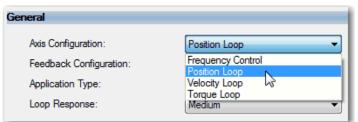
Configure the Associated Axis and Control Mode

Now that the axis is associated to the drive, meaningful values are available for other axis configuration properties. The combination of the attributes that are selected when configuring an axis and feedback determines the control mode.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>, for complete information on axis attributes and control modes.

Follow these steps to configure an axis.

- 1. In the Controller Organizer, double-click the axis that you want to configure.
- 2. Choose an Axis Configuration.



TIP The associated drive determines what axis and feedback configuration choices are presented.

Figure 20 - General Category Dialog Box

Axis Type	PowerFlex 527
Position Loop (P)	Yes
Velocity Loop (V)	Yes
Torque Loop (T)	No
Feedback Only (N)	No
Frequency Control (F)	Yes

Table 42 - Compare the Axis Configuration Types for the Drives

3. Choose a Feedback Configuration type.

General	
Axis Configuration:	Position Loop 🔹
Feedback Configuration:	Motor Feedback 🗸
Application Type:	Motor Feedback Dual Feedback
Loop Response:	Dual Integral Feedback

<u>Table 43</u> compares the feedback type and loop type.

Table 43 - Compare the Feedback Type and Loop Type

Feedback Type	Axis Type	PowerFlex 527
Motor Feedback	Position Loop (P), Velocity Loop (V),Torque Loop (T)	No
Motor Feedback	Position Loop (P), Velocity Loop (V)	Yes
Load Feedback	Position Loop (P), Velocity Loop (V),Torque Loop (T)	No
Dual Feedback	Position Loop (P)	No
Dual Integrator	Position Loop (P)	No
Master Feedback	Feedback Only (N)	No
No Feedback	Frequency Control (F)	Yes
No Feedback	Velocity Loop (V)	No

4. Choose an Application Type, if applicable.

ieneral				
Axis Configuration:	Position Loop 👻			
Feedback Configuration:	Motor Feedback 🔹			
Application Type:	Basic 👻			
Loop Response:	Custom Basic			
Assigned Group Motion Group:	Tracking Point to-Point Constant Speed CIP_Motion ▼			

TIP Application Type defines the servo loop configuration automatically. These combinations determine how the calculations are made, which can reduce the need to perform an Autotune or a Manual Tune.

The Application Type determines the type of motion control application. This attribute is used to set the Gain Tuning Configuration Bits.

Table 44 provides the gains established base on the application type.

Table 44 - Customize Gains to Tune

Application Type	Крі	Kvi	ihold	Kvff	Kaff	torqLPF
Custom ⁽¹⁾	-	-	-	-	-	
Basic (V20 and later)	No	No	No	Yes	No	Yes
Basic (V19 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

(1) If you set the type to Custom, you can control the individual gain calculations by changing the bit settings in the Gain Tuning Configuration Bits Attribute.

- **TIP** For information about other attribute calculations, see the specific attribute description in the Integrated Motion on the EtherNet/IP Reference Manual, publication <u>MOTION-RM003</u>.
- 5. Choose a Loop Response, if applicable.

ieneral				
Axis Configuration:	Position Loop			
Feedback Configuration:	Motor Feedback 🔹			
Application Type:	Basic 💌			
Loop Response:	Medium			
	Low			
Assigned Group	Medium High			
Motion Group:	CIP_Motion			

6. Click Apply.

Axis Scheduling

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Axis Scheduling Configuration	150
Configure the Update Periods	151
Motion Utilization	158

This chapter describes how to configure the Axis Scheduling feature that is in the Motion Group properties dialog box.

Axis Scheduling provides a way for you to configure drives to run at different update rates. Axis Scheduling can improve the performance of your controllers. You can use Axis Scheduling with integrated motion drives and virtual axes. By using Axis Scheduling, you can optimize your controller, network, and drive performance. For smaller controller applications (CompactLogix[™]), you can expect to see a significant improvement in system performance.

Many applications have motion drives with different performance requirements. At the simplest level, motion drives can be assigned into a 'fast' and 'slow' update rate groupings.

- The 'fast' group typically includes high-speed coordinated process positioning drives with aggressive PCAM or interpolation profiles and auxiliary functions like registration position/velocity phase correction.
- The 'slow' group typically includes non-coordinated motion drives used for automatic machine reconfiguration, non-coordinated point-to-point motion process drives, or coordinated drives with less aggressive PCAM or gearing functions.

Axis Scheduling is compatible with these products:

- ControlLogix[®] 5580 controllers
- GuardLogix[®] 5580 controllers
- CompactLogix[™] 5380 controllers
- Compact GuardLogix 5380 controllers
- ControlLogix 5570 controllers
- GuardLogix 5570 controllers
- CompactLogix 5370 controllers
- Compact GuardLogix 5370 controllers
- All Integrated Motion EtherNet/IP[™] drives, for example, Kinetix[®], PowerFlex[®], and other third-party drives

Axis Scheduling can improve ControlLogix and CompactLogix EtherNet/IP Integrated Architecture[®] Motion system performance by reducing average Logix controller and EtherNet/IP network utilization. Axis Scheduling supports three separate controller/network motion drive update rates per controller, one rate for high-performance drives, and two additional rates for lower performance drives.

For example, suppose that you have a robot that removes product from a conveyor belt. There are three precision axes on the robot and four generalpurpose axes on the conveyor belt. If you configure the controller to run all seven axes at 2 ms to control the precision axes, this setting takes the network utilization of your controller too high. In the past, one option would have been to run all seven axes at 8 ms, but this setting is not fast or precise enough for the robot axes. So you have had to add a second controller and Ethernet module to get the performance you needed. Axis Scheduling lets you configure the axes at different rates that are based on the needs of the application, which balances the motion performance and network utilization of your controller.

With Axis Scheduling, you can configure the axes on the robot to run at a faster base-update rate (2 ms) than the rate of the conveyor (8 ms).

With the ability to configure three update periods, the four conveyor axes can run as one channel, which appears to the controller as one drive. The axes are updated round-robin style; every 2 ms, three of the robot axes and one of the conveyor axes are updated.

During the next update, three robot axes are updated and then the next conveyor axis is updated; eventually all conveyor axes are updated and the process starts again. The controller updates four axes every update period. The controller can handle the load of four axes easier than a load of seven axes. This capability improves the performance of the controller.

About Axis Scheduling

Timing Model

The general timing model for the integrated motion on the EtherNet/IP network I/O connection data exchange is described in this section. The Timing Model field on the Attribute tab of the Motion Group Properties dialog box is shown as One Cycle or Two Cycle. See Figure 21 for an example.

Base Update Period:	2.0 ms (in 0.5 increments.) Axis Schedul	le
Alternate 1 Update:	2.0 ms	
Alternate 2 Update:	2.0 ms	
General Fault Type:	Non Major Fault 👻	
Timing Model:	One Cycle	
Scan Times (elapsed	time): (us) Reset Max	
Last:	(us)	
	(su) (su)	

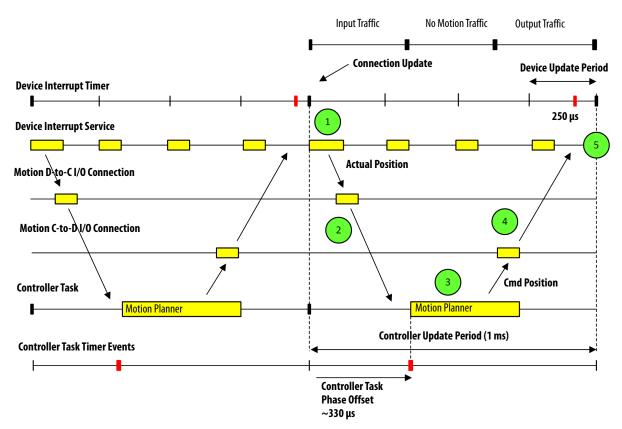
Figure 21 - Timing Model Attribute Examples

Base Update Period	2.0 📄 ms (in 0.5 increments.) Axis Schedu
Alternate 1 Update:	2.0 ms
Alternate 2 Update:	2.0 ms
General Fault Type:	Non Major Fault 🔻
Timing Model:	Two Cycle
Scan Times (elapse	time):
Joan nines (elapse	
Max:	(us) Reset Max
Max:	(us) Reset Max
Max:	(us) Reset Max (us)

One Cycle Timing

The Controller Update Period paces data exchange between the device and the controller with one Device-to-Controller data packet that is sent for every Controller-to-Device data packet received. The Controller-to-Device Connection packets are sent periodically according to the configured Controller Update Period. The Device Update Period, which is the update period at which the device performs its control calculations, is typically much faster than the Controller Update Period. The basic integrated motion on the EtherNet/IP network 1-cycle timing model is shown in Figure 22.

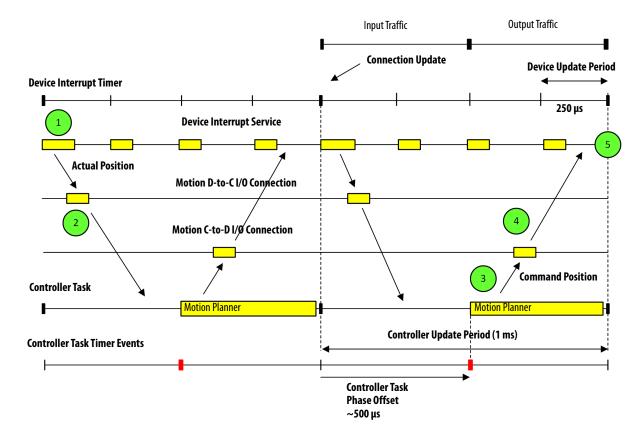




Two Cycle Timing

The Two Cycle Timing Model that is shown in Figure 23 begins with the device transmitting the D-to-C connection packet to the controller at the beginning of the update cycle. In this case, the Controller Task does not start until half way through the update cycle. This start point allows more time for the D-to-C connection packet to reach the controller before the Motion Planner task runs. Unlike the One Cycle Timing Model, the C-to-D connection packet is not transmitted back to the device until the next time the Motion Planner task runs. This delay again allows more time for the C-to-D connection packet to reach the device. It takes two connection cycles to complete the I/O data transaction with the device.

Figure 23 - Integrated Motion on the EtherNet/IP Network Two Cycle Timing Model



Axis Scheduling Configuration

In the Studio 5000 Logix Designer application, you use the Axis Schedule Panel, accessible from the Attribute tab of the Motion Group Properties dialog box, to configure the update periods. The Axis Schedule Panel provides a Base Update Period and two alternatives. Information such as Estimated Utilization and Actual Utilization appear on this panel.

🗣 Axis Schedule			
Update Period and Sched	ule		
Base:		Alternate 1:	Alternate 2:
4.0 • ms (in 0.5 ind	rements)	8.0 v ms	20.0 v ms
Axis_000 Axis_003 Axis_005 axis_01_produced Axis_013_Consumed Axis_04 Axis_06 Axis_12_FB_CE	>>	Axis_001 Axis_014_Consumed axis_02_produced Axis_09_FB_CE Axis_10_CTP Axis_11_CTP Axis_11_FB_HA	<pre>aixs_03_produced Axis_002 Axis_008 Axis_015_Consumed Axis_10_FB_CE</pre>
Estimated Utilization - Mo	otion	Actual Utiliza	tion - Motion
Logix Controller:	25.5 %	Logix Contro	oller:
Task I/O Cycle:	52.4 %	Task I/O Cy	de:
Connection I/O Cycle:	32.0 %		
Communications:	23.7 %		
Ethernet Media:	3.5 %		
		OK Cancel	Apply Help

The alternative rates for lower performance drives provide a way for multiple drives to be 'multiplexed' through one drive update channel. Axis Scheduling allows multiple drives to be updated by using the same amount of controller and network capacity as used in updating one non-multiplexed drive.

For more information on how to configure a motion group for Kinetix drives, see <u>Create a Motion Group on page 42</u>. For more information on how to configure a motion group for PowerFlex drives, see <u>Create a Motion Group on page 111</u>.

Configure the Update Periods Follow these steps to configure the update periods:

- **TIP** To change all update rates to the same value, refer to the example on page 155.
- 1. Double-click the Motion Group.

The Motion Group Properties dialog box appears.

🕞 Motion Group Propertie	s - Mot	ion_Group_101	
Axis Assignment Attribute	Tag		
Unassigned:		Assigned:	
Axis_00 Axis_01 Axis_02 Axis_02 Axis_08 Axis_09 Axis_10 Axis_10 Axis_10 Axis_11 Axis_12 Axis_12 Axis_12 Axis_14 Axis_15	A III V	Axis_000 Axis_001 Axis_002 Axis_002 Axis_005 Axis_005 Axis_007 Axis_008 axis_01_produced Axis_013_Consumed Axis_014_Consumed axis_02_produced axis_03_produced Axis_04	E
Add ->		<- Remove	
ОК		Cancel Apply	Help

- 2. Assign axes to the group if necessary.
- 3. Click Apply.
- 4. Go to the Attribute tab.

Base Update Period	: 4.0 ms (in 0.5 increments.) Axis Sched
Alternate 1 Update:	8.0 ms
Alternate 2 Update:	20.0 ms
General Fault Type:	Non Major Fault 💌
Timing Model:	One Cycle
Scan Times (elapse	d time):
Max:	(us) Reset Max
Last:	(us)
Average:	(us)

5. Choose a Base Update Period.

In this example, the Base Update Period is 4.0 ms and the Alternate 1 and 2 Update Periods are 8 ms and 20 ms. The base period acts as the anchor value for the axis scheduling feature.

The Alternate Update Periods are multiples of the base. You can edit the Base Update Period when the controller is offline and is read-only when the controller is online. The alternate rates on the Attribute tab are readonly.

6. To go to the Axis Schedule Panel, click the Axis Schedule.

1	🕞 Motion Group Properties - Motion_Group_101 👘 💼 📧				
	Axis Assignment Attribut	e Tag			
	Base Update Period:	4.0 ×	ms (in 0.5 increments.)	Axis Schedule	
	Alternate 1 Update:	8.0	ms		

The Axis Schedule Panel appears.

😵 Axis Schedule			
Update Period and Schedu	ıle —		
Base:		Alternate 1:	Alternate 2:
4.0 🔻 ms (in 0.5 inc	rements)	8.0 • ms	20.0 🔻 ms
Axis_000 Axis_001 Axis_002 Axis_003 Axis_005 Axis_007 Axis_007 Axis_013_consumed Axis_013_consumed Axis_014_consumed Axis_02_produced axis_02_produced axis_04	▲ ■ >> <<		>>
Estimated Utilization - Mo	tion	Actual Utiliza	ation - Motion
Logix Controller:	35.6 %	Logix Contr	troller:
Task I/O Cycle:	81.1 %	Task I/O C	Cyde:
Connection I/O Cycle:	44.4 %		
Communications:	38.0 %		
Ethernet Media:	5.6 %		
		OK Cancel	Apply Help

The axes that you assigned in the Axis Assignment tab appear in the Base column.

7. To assign the axes to the Alternate Update Periods, use the positioning arrows.

😪 Axis Schedule			
Update Period and Schedul	e		
Base:		Alternate 1:	Alternate 2:
4.0 • ms (in 0.5 incre	ements)	8.0 v ms	20.0 🕶 ms
Axis_000 Axis_003 Axis_005 axis_01_produced Axis_013_Consumed Axis_04 Axis_06 Axis_12_FB_CE	>>	Axis_001 Axis_007 Axis_014_Consumed axis_02_produced Axis_09_FB_CE Axis_10_CIP Axis_11_FB_HA	Axis_002 Axis_015_Consumed axis_03_produced Axis_10_FB_CE
Estimated Utilization - Moti	ion	Actual Utilizat	tion - Motion
Logix Controller:	25.5 %	Logix Contro	ller:
Task I/O Cycle:	52.4 %	Task I/O Cyc	de:
Connection I/O Cycle:	32.0 %		
Communications:	23.7 %		
Ethernet Media:	3.5 %		
		OK Cancel	Apply Help

The axes appear in the Alternate columns.

8. Choose the Alternate 1 Update Period.

The multipliers range from 2...32, so if the base update rate is 2.0, the values in the alternate rates are 4, 6, 8, 10, 12...32. If the base update rate is 3.0, the values are 6, 9, 12, 15, and so on.

If you change the Base rate to a value that the Alternate rate value is not a multiple of, a warning flag appears next to the Alternate rate.

Axis Schedule				
Update Period and Sched	ule			
Base:		Alternate 1:		Alternate 2:
6.0 🔻 ms (în 0.5 inc	rements)	8.0 🔻 ms 🔻		20.0 🔻 ms 🔻
Axis_000 Axis_003 Axis_005 axis_01_produced Axis_013_Consumed Axis_04 Axis_06 Axis_12_FB_CE	>>	Axis_001 Axis_014_Consumed axis_02_produced Axis_09_FB_CE Axis_10_FB_CE Axis_10_CIP Axis_11_FB_HA	>>	Axis_002 Axis_015_Consumed axis_03_produced Axis_10_FB_CE
Estimated Utilization - Mo	otion	Actual Utilizat	tion - Motic	n
Logix Controller:	19.8 %	Logix Contro	ller:	
Task I/O Cycle:	40.7 %	Task I/O Cyc	de:	
Connection I/O Cycle:	23.8 %			
Communications:	18.7 %			
Ethernet Media:	2.7 %			
		OK Cancel	Ap	ply Help

Once an alternate rate is set on the Axis Schedule Panel, the Base Update Period for the group on the Attribute tab becomes disabled. You can still set the base update rate on the Axis Schedule Panel.

A warning appears and the value is set to either 0.5 or 32 if you enter a value outside of the acceptable range.

Logix Desig	gner X
1	Error: Failed to modify properties for the Base Update Period. Alternate Update Periods need to be a multiple of the Base Update Period. Please select new Alternate Update Periods
Error 28312-	OK Help

TIP If the Base Update Period is too small, the controller does not have time to execute non-motion related Ladder Logic.

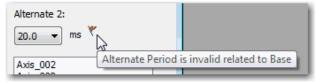
As a result, the configuration sets the lower limit on the Base Update Period that is based on the number of axes in the group.

You can use Integrated Architecture Builder (IAB) to determine the performance information that is based on your system configuration.

Too many axes per base rate can indicate one of the following:

- There is not enough time for the motion task to execute, which results in a motion task overlap error.
- There are high-application program scan times, which affect all logic: program logic that supports motion applications and general program logic.
- 9. Choose the Alternate 2 update period.

If the base update rate is changed to a value that invalidates the alternate update rates, a warning tool tip appears.



If you click OK or Apply, a warning box appears that tells you that you must select valid alternate update rates before you apply any changes.

10. Update the periods as required.

11. Click Apply.

The Alternate update rates appear on the Attribute tab.

Government Motion Group Prope	erties - Motion_Group_101
Axis Assignment Attribu	ite Tag
Base Update Period:	4.0 ms (in 0.5 increments.) Axis Schedule
Alternate 1 Update:	8.0 ms
Alternate 2 Update:	20.0 ms
General Fault Type:	Non Major Fault 💌
Timing Model:	One Cycle
Scan Times (elapsed tir	me):
Max:	(us) Reset Max
Last:	(us)
Average:	(us)
ОК	Cancel Apply Help

The following example shows what happens on the various dialog boxes when all update rates are changed to the same value.

1. To change all rates to the same value, for example 4 ms, go to the Axis Schedule Panel.

Axis Schedule				
Update Period and Schedu	ile			
Base:		Alternate 1:		Alternate 2:
4.0 🔻 ms (in 0.5 incr	ements)	4.0 v ms		4.0 v ms
Axis_000 Axis_003 Axis_005 axis_01_produced Axis_013_Consumed Axis_04 Axis_06 Axis_12_FB_CE	>> <<	Axis_001 Axis_014_Consumed axis_02_produced Axis_09_FB_CE Axis_10_CTP Axis_11_FB_HA	>>	Axis_002 Axis_008 Axis_015_Consumed axis_03_produced Axis_10_FB_CE
Estimated Utilization - Mo	tion	Actual Utilizat	ion - Motio	n
Logix Controller:	35.6 %	Logix Contro	ller:	
Task I/O Cycle:	81.1 %	Task I/O Cyc	:le:	
Connection I/O Cycle:	44.4 %			
Communications:	38.0 %			
Ethernet Media:	5.6 %			
		OK Cancel	App	ply Help

	erties - Motion_Group_101
Axis Assignment Attribu	ite Tag
Base Update Period:	4.0 ms (in 0.5 increments.) Axis Schedule
Alternate 1 Update:	4.0 ms
Alternate 2 Update:	4.0 ms
General Fault Type:	Non Major Fault 🔻
Timing Model:	One Cycle
Scan Times (elapsed ti	me):
Max:	(us) Reset Max
Last:	(us)
Average:	(us)
OF	Cancel Apply Help

After you have made all update periods in the Axis Schedule Panel, the update period values are the same and the Base Update Period is now active. The Alternate Update Periods are always read-only.

2. Change the Base Update Period.

Go Motion Group Prop	erties - Motion_Group_101
Axis Assignment Attribu	ute* Tag
Base Update Period:	5.0 ms (in 0.5 increments.) Axis Schedule
Alternate 1 Update:	4.0 ms
Alternate 2 Update:	4.0 ms
General Fault Type:	Non Major Fault 👻
Timing Model:	One Cycle
Scan Times (elapsed ti	ime):
Max:	(us) Reset Max
Last:	(us)
Average:	(us)
0	Cancel Apply Help

The Base Update Period on the Attribute tab becomes active.

Axis Assignment Attribu	te Tag		2
Base Update Period:	5.0	ms (in 0.5 increments.)	Axis Schedule
Alternate 1 Update:	5.0	ms	
Alternate 2 Update:	5.0	ms	
General Fault Type:	Non Majo	or Fault 🔻	
Timing Model:	One Cycle	•	
Scan Times (elapsed tir	ne):		
Max:	(us)	Reset Max	
Last:	(us)		
Average:	(us)		

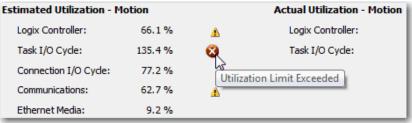
After you click Apply (or OK), the values in the alternate fields change to match the base.

The values are also changed in the Axis Schedule Panel.

🗣 Axis Schedule				
Update Period and Sched	ule			
Base:		Alternate 1:		Alternate 2:
5.0 v ms (in 0.5 inc	crements)	5.0 v ms		5.0 • ms
Axis_000 Axis_003 Axis_005 axis_01_produced Axis_013_Consumed Axis_04 Axis_06 Axis_12_FB_CE	>>	Axis_001 Axis_014,Consumed axis_014,Consumed axis_02_produced Axis_09_FB_CE Axis_10_CIP Axis_11_FB_HA	>>>	Axis_002 Axis_015_Consumed axis_03_produced Axis_10_FB_CE
Estimated Utilization - Mo	otion	Actual Utiliza	tion - Moti	on
Logix Controller:	28.5 %	Logix Contro	oller:	
Task I/O Cycle:	64.9 %	Task I/O Cy	de:	
Connection I/O Cycle:	35.5 %			
Communications:	30.4 %			
Ethernet Media:	4.4 %			
		OK Cancel	Ap	pply Help

Motion Utilization

The following values are updated in real time as you change your configuration. You can see how the utilization metrics are responding to your configuration changes and you can modify your configuration.



- The yellow warning icons indicate that the value is at the borderline of the controller capabilities.
- The red X next to the Task I/O Cycle and Connection I/O Cycle warnings indicates that the value has reached beyond what the motion task cycle can handle.

If you are reaching utilization limits and you only have the Base Update Period that is assigned to axes, start to assign axes to the Alternate Update Periods.

Parameter	Description
Estimated Utilization - Motion	Estimated utilization assumes basic default configuration with no active motion planner activity, no transmission statistics, and no cyclic read or write. The estimated percent of time the controller spends on motion while online.
Logix Controller	The estimated percentage of time of the Logix controller that a motion task consumes. If this value exceeds 50%, a warning icon appears. If this value exceeds 80%, an error icon appears.
Task I/O Cycle	The estimated percentage of time available in the update cycle Motion Task to process input, run motion planner, and send output to motion devices. If this value exceeds 100%, a warning icon appears. If this value exceeds (200 connection I/O cycle Cycle)%, an error icon appears.
Connection I/O Cycle	The estimated percentage of time available in the update cycle for input and output data transmission over the motion connection. If this value exceeds 80%, a warning icon appears. If the value exceeds 100%, an error icon appears.
Communications	Shows the estimated percentage of time of the communications controller that the motion connection packets consume. If this value exceeds 50%, a warning icon appears. If this value exceeds 100%, an error icon appears.
Ethernet Media	Shows the estimated percentage of Ethernet media bandwidth that motion- connection packet traffic uses. If the value exceeds 50%, a warning icon appears. If the values exceed 100%, an error icon appears.
Actual Utilization - Motion	Actual utilization is based on measurements that are made by the Logix controller. Actual utilization values can be substantially higher than estimated utilization values depending on factors such as active motion planner activity, transmission statistics, and cyclic read or write data.
Logix Controller	Shows the actual percentage of time of the Logix controller that the motion task consumes.
Task I/O Cycle	Shows the actual percentage of time available in the update cycle for motion task to process input, run motion planner, and send output to motion devices.

Table 45 - Utilization Parameter Descriptions

Topic	Page
Example 1: Position Loop with Motor Feedback Only	159
Example 2: Position Loop with Dual Feedback	163
Example 3: Feedback Only	167
Example 4: Kinetix 5500 Drive, Velocity Loop with Motor Feedback	172
Example 5: Kinetix 350 Drive, Position Loop with Motor Feedback	176
Example 6: Kinetix 5700 Drive, Frequency Control with No Feedback	180
Example 7: 842E-CM Integrated Motion Encoder with Master Feedback	183

Configuration Examples for a Kinetix Drive

This chapter provides typical axis-configuration examples when using Kinetix[®] 350, Kinetix 5500, Kinetix 6500, and Kinetix 5700 drives. The differences between the Kinetix drives are noted where applicable.

Kinetix 5700 drive configurations are similar to the examples in this chapter. For more examples of how to configure the Kinetix 5700 drive, see the Kinetix 5700 Servo Drives User Manual, publication <u>2198-UM002</u>.

Example 1: Position Loop with Motor Feedback Only

In this example, you create an AXIS_CIP_DRIVE and a Kinetix 6500 drive, which includes the control module and a power structure. You then connect the motor feedback cable to the Motor Feedback port of the Kinetix 6500 drive.

- 1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Position Loop.
- 3. From the Feedback Configuration pull-down menu, choose Motor Feedback.

The axis and feedback configurations determine the control mode.

For more information on the control modes, see the Integrated Motion on the EtherNet/IP network Reference Manual, publication <u>MOTION-RM003</u>.

🍄 Axis Properties - Axis_1				
Categories:				
- General	General			
Motor Model Motor Feedback Scaling Hookup Tests	Axis Configuration: Feedback Configuration: Application Type:	Position Loop Motor Feedback Basic	• •	
Polarity	Loop Response:	Medium	•	
Autotune Load Backlash Gompliance Observer Observer	Assigned Group Motion Group: Update Period:	Motion_Group_101 2.0	•	New Group
 Velocity Loop Acceleration Loop Torque/Current Loop Planner Homing Actions 	Associated Module Module: Module Type: Power Structure: Axis Number:	CIP_K6K 2094-EN02D-M01-S0 2094-AC09-M02-M 1	• •	The type of drive you selected and the power structure you assigned via the Kinetix 6500 Module Properties. For more information, see <u>Add a Kinetix EtherNet/IP</u> <u>Drive on page 32</u> .
Drive Parameters Parameter List Status Faults & Alams Tag	The newly created Kinetix 6500 drive r the default. The Axis Number defaults the primary axis of the drive. Axis Num for configuring a Feedback Only axis.	to 1, indicating		
Axis State: Manual Tune			ОК	Cancel Apply Help

Figure 24 - Example 1: General Dialog Box, Position Loop with Motor Feedback Only

TIP After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.

When you select the Position Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

4. Choose Catalog Number as the Motor Data Source.

5. Click Change Catalog and choose your motor.

In this case, a MPL-B310P-M motor was chosen.

Figure 25 - Exam	ple 1: Position Loo	p with Motor Feedback Onl	y, Motor Dialog Box

🏷 Axis Properties - K6K_1						
Categories:						
General	Motor Device Specif	ication				
* Motor * Model * Motor Feedback	Data Source: Catalog Number:	Catalog Number MPL-B310P-M		Change Catalog	Parameters	
Scaling Hookup Tests	Motor Type:	Rotary Permaner	it Magnet 👻	Charige Catalog		
Polarity Autotune	Units:	Rev				
* 🖃 ··· Load	Nameplate / Dat	asheet - Phase	to Phase paramete	rs		
Compliance	Rated Power:	0.77	kW	Pole Count:	8	
Friction Observer	Rated Voltage:	460.0	Volts (RMS)			
Position Loop	Rated Speed:	5000.0	RPM	Max Speed:	5000.0	RPM
···· Velocity Loop	Rated Current:	1.7	Amps (RMS)	Peak Current:	5.02	Amps (RMS)
Acceleration Loop Torque/Current Loop	Rated Torque:	1.58	N-m	Motor Overload Limit:	100.0	% Rated
Planner Homing						
Actions						
- Drive Parameters						
····· Parameter List ····· Status						
Tag						
Axis State:						
Manual Tune				ОК	Cancel	Apply Help

Click Change Catalog to choose motors from the motion database. When you specify your motor this way, the motor specification data is automatically entered for you.

If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You have to input the specification data or add a custom motor to the Motion Database that can be selected.

For more information, see <u>Choose Nameplate as the Motor Data Source</u> on page 52.

itegories: :General	Scaling to Convert	Motion from	Controlle	r Units to U	ser Defined U	nits			
- Motor	Load Type:	Direct Coup	lad Datas	_			Paramet		
Model		Direct Coup	ieu notary	•			Paramet	ers	
Motor Feedback	Transmission								
Scaling Hookup Tests	Ratio I:0:	1		: 1	Rev				
Polarity	Actuator								
Autotune	Туре:	<none></none>							
Load									
Backlash	Lead:	1.0		Millimeter/F	lev 👻				
Compliance	Diameter:	1.0		Millimeter					
···· Friction	c - t -								
Observer	Scaling								
Position Loop	Units:	Position Uni	ts						
····· Velocity Loop	Scaling:	1.0		Position Units	per	1.0		Motor Rev	-
Acceleration Loop Torque/Current Loop	Travel								
Planner		[
Homing	Mode:	Unlimited	•						
Actions	Range:	1000.0		Position Units					
Drive Parameters	Unwind:	1.0				1.0		Cycle	
Parameter List				Position Units	per	1.0		Cycle	
···· Status	Soft Trave	el Limits							
····· Faults & Alarms	Maximu	m Positive:	0.0		Position Units				
····· Tag	Mavimu	m Negative:	0.0		Position Units				
	Maximu	mineyauve.	0.0		r osition orits				

Figure 26 - Example 1: Position Loop with Motor Feedback Only, Scaling Dialog Box

- 6. Choose the Load Type.
- 7. Enter the Scaling Units.
- 8. Choose the Travel Mode.

For more information about Scaling, see Scaling on page 222.

9. Click Apply.

You are now finished configuring the axis for Position Loop with Motor Feedback.

Example 2: Position Loop with Dual Feedback

In this example, you create an AXIS_CIP_DRIVE and a Kinetix 6500 drive, which includes the control module and a power structure. You must configure both feedback ports. You must have two feedback cables that are connected to the Kinetix 6500 drive for one axis.

You connect the Motor Feedback cable to the Motor Feedback port, and the Load Feedback cable to the Aux Feedback port of the Kinetix 6500 drive.

- 1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Position Loop.
- 3. From the Feedback Configuration pull-down menu, choose Dual Feedback.

The axis and feedback configurations determine the control mode.

For more information on the control modes, see the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.

Figure 27 -	- Example 2	Position	Loop with	Dual Feedbac	k, General	Dialog Box
					,	

Axis Properties - Axis_1			
Categories:			
general	General		
- Motor			
Model	Axis Configuration:	Position Loop 👻	
Motor Feedback	Feedback Configuration:	Motor Feedback 🔹	
Scaling Hookup Tests	Application Type:	Basic 💌	
Polarity	Loop Response:	Medium 👻	
Autotune			
🖶 ··· Load	Assigned Group		
Backlash Compliance	Motion Group:	Motion_Group_101	New Group
Friction	Update Period:	2.0	
Observer			
Position Loop	Associated Module		
Acceleration Loop	Module:	CIP_K6K 👻	
Torque/Current Loop	Module Type:	2094-EN02D-M01-S0	The type of drive you selected and the power
Planner Homing	Power Structure:	2094-BC02-M02-M	structure you assigned via the Kinetix 6500 Module
Actions	Axis Number:	1	Properties. For more information, see Add a Kinetix EtherNet/IP
Drive Parameters Parameter List			Drive on page 32.
Status			
Faults & A The newly Tag the defaul the prima	created Kinetix 6500 drive module nam t. The Axis Number defaults to 1, indicat ry axis of the drive. Axis Number 2 is usec ıring a Feedback Only axis.	ng	
Manual Tune		ок	Cancel Apply Help

IMPORTANT After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as being a Position Loop with Dual Feedback axis, the Motor, Motor Feedback, and Load dialog boxes become available.

- 4. From the Data Source pull-down menu, choose Catalog Number.
- 5. Click Change Catalog and choose your motor.

In this case, a MPL-B310P-M motor was chosen.

	Figure 28 - Exam	ple 2: Position Loop	p with Dual Feedback	, Motor Dialog Box
--	------------------	----------------------	----------------------	--------------------

Axis Properties - K6K_1						
Categories:						
General	Motor Device Speci	ication				
* 🖃 ···· Motor * 🚽 ····· Model	Data Source:	Catalog Number	-		Parameters	
* Motor Feedback Scaling	Catalog Number:	MPL-B310P-M		Change Catalog		
Hookup Tests	Motor Type:	Rotary Permane	nt Magnet 👻			
Polarity Autotune	Units:	Rev	~			
* Load	Nameplate / Da	tasheet - Phase	to Phase paramete	ers		
Compliance	Rated Power:	0.77	kW	Pole Count:	8	
Friction	Rated Voltage	460.0	Volts (RMS)			
Position Loop	Rated Speed:	5000.0	RPM	Max Speed:	5000.0	RPM
···· Velocity Loop	Rated Current:	1.7	Amps (RMS)	Peak Current:	5.02	Amps (RMS)
Acceleration Loop Torque/Current Loop	Rated Torque:	1.58	N-m	Motor Overload Limit:	100.0	% Rated
Planner						
Homing Actions						
Drive Parameters						
···· Parameter List						
Status						
Faults & Alams Tag						
. ag						
]					
Axis State:						
Manual Tune				ОК	Cancel	Apply Help

When you select the Data Source for the motor specification, the MPL-B310P-M motor is in the Motion Database, so you can select it by Catalog Number. Notice that the specification data for this motor is automatically entered for you.

If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You must input the specification data.

For more information, see <u>Choose Nameplate as the Motor Data Source</u> on page 52.

On the Motor Feedback dialog box, the information is automatically filed in based on your selections on the Motor dialog box.

> Axis Properties - Axis_1				
	lotor Feedback Device Spe	cification		
* Motor * Model	Device Function:	Motor Mounted F	eedback Parameters	
* Motor Feedback	Feedback Channel:	Feedback 1		
····· Scaling ····· Hookup Tests	Туре:	Hiperface		
Polarity	Units:	Rev		
Autotune	Hiperface			
* 🖃 Load Backlash	Cycle Resolution:	1024	Feedback Cycles/Rev	
Compliance	Cycle Interpolation:	2048	Feedback Counts per Cycle	
Friction	Effective Resolution:	2097152	Feedback Counts per Rev	
Position Loop	Startup Method:	Absolute	•	
···· Velocity Loop	Tums:	4096		
Acceleration Loop				
Torque/Current Loop Planner				
Homing				
Actions	Commutation			
Drive Parameters Parameter List		.	The drive gets the commutation that is	
Status	Alignment:	Motor Offset	offcat diractly from the motor	
Faults & Alarms	Offset:	0.0	Degre Offset directly from the motor.	
Tag	Polarity:	Normal	*	
xis State:				
Manual Tune			OK Cancel Apply	Help

Figure 29 - Example 2: Position Loop with Dual Feedback, Motor Feedback Dialog Box

For information about Commutation, see <u>Assign Motor Feedback on</u> page 54 and <u>Applying the Commutation Hookup Test on page 232</u>.

The axis is now configured as the primary feedback. The next task is to configure Feedback 2 on the Load Feedback dialog box.

6. To assign the Load Feedback device, click the Define feedback device hyperlink or go to the Module Properties of the drive.

Figure 30 - Example 2: Position Loop with Dual Feedback, Load Feedback Dialog Box, Load-side Feedback

Axis Properties - Axis_1				
Categories:				
* General	Load Feedback Device S	pecification		
General General General Model Model Model Mode Feedback Mass Feedback Gass Feedback Gass Feedback Gass Polaty Acture General General	Device Survivor S Device Survivor Survivor Feedback Channel: Type: Units:	Load-Side Feedback Feedback 2 Not Specified	Parameters	this Feedback
Axis State:				
Manual Tune			OK Cancel	Apply Help

- 7. From the Load Feedback Device pull-down menu, choose Aux Feedback Port.
- 8. To apply your changes and return to the Load Feedback dialog box, click OK.

Module Properties: ENET_Module (2094-EN02D-M01-S0 2.001)							
General Connection Time Sync Mo	dule Info Internet Protocol Port Configuration Network Associated Axes* Power Di						
Axis 1:	CIPAxis New Axis						
Motor Feedback Device:	Motor Feedback Port						
Load Feedback Device:	<none></none>						
Axis 2 (Auxiliary Axis):	<pre><none> Aux Feedback Port </none></pre>						
Master Feedback Device:	<none></none>						
itatus: Offline	OK Cancel Apply Help						

9. Choose the Feedback Type and Units.

🍄 Axis Properties - CIPAxis		
Categories:		
* General	Load Feedback Device Specification	
Motor Motor Motor Feedback Model Motor Feedback Mokup Tests Polarity Autotune Load Gandation Compliance Friction Observer Position Loop Velocity Loop Acceleration Loop Planner Homing Actions Drive Parameter List Status Fauts & Alams Tag	Device Function: Feedback Channel: Feedback Channel: Feedback 2 Type: Sine/Cosine Cycle Resolution: Cycle Resolution: Cycle Interpolation: Startup Method: Default values for Resolution and Interpolation are automatically provided. You must enter the actual resolution of load-side feedback device. Parameters	-
Axis State: Manual Tune	OK Cancel Apply	Help

%	Axis Properties - CIPAxi	s	-	-	_				1
Ca	tegories:								
*	General	Scaling to Convert I	Aotion from C	Controller Units to Us	er Defined Uni	its			
	- Motor								
	Model	Load Type:	Direct Couple	ed Rotary 🔻			Parameters		
*	Motor Feedback	Transmission							
*	Load Feedback	Ratio I:0:	1	: 1	Rev				
	Scaling Hookup Tests	Actuator							
	Hookup Tests Polarity								
	Autotune	Туре:	<none></none>	Ψ					
	E- Load	Lead:	1.0	Millimeter/R	ev 👻				
	Backlash	Diameter:	1.0	Millimeter					
	Compliance		1.0	Millimeter					
	Friction	Scaling					The Scaling va	lues are in Load Feedb	ack units.
	Observer	Units:	Load Feedba	ack	7. –				_
	Position Loop	Scaling:	1.0	Load Feedback	, per	1.0	Load Rev	-	
	····· Velocity Loop	-	1.0	Ludu i ceubaci	, per	1.0	Load Nev		
	Acceleration Loop	Travel							
	Torque/Current Loop	Mode:	Unlimited	•					
	Planner	Damas	1000.0	Load Feedback					
	Homing Actions	Range:		Load Feedbaci					
	Actions Drive Parameters	Unwind:	1.0	Load Feedbac	< per	1.0	Cycle		
	Parameter List	Soft Travel	Limits						
	Status		n Positive:	0.0	Load Feedback				
					Load геедраск				
	Tag	Maximun	n Negative:	0.0	Load Feedback				
	-]							
Axi	is State:								
Μ	anual Tune				ОК		Cancel Apply	Help	

Figure 33 - Example 2: Position Loop with Dual Feedback, Scaling Dialog Box

You are now finished configuring the axis as Position Loop axis with Dual Feedback.

10. To apply your changes and close Axis Properties, click OK.

Example 3: Feedback Only

In this example, you create a half axis AXIS_CIP_DRIVE type by using the AUX Feedback port of the drive for Master Feedback. You must connect the Master Feedback device cable to the Aux Feedback port of the Kinetix 6500 drive.

- **TIP** You can use feedback only axes, for example, as a master reference for gearing, with PCAM moves, and MAOC output CAMs.
- 1. From the Axis Configuration pull-down menu, choose Feedback Only.
- 2. From the Feedback Configuration pull-down menu, choose Master Feedback.

This selection determines the control mode.

For more information, see the Integrated Motion on the EtherNet/IP network Reference Manual, publication <u>MOTION-RM003</u>.

3. From the Module pull-down menu, choose the associated module that you want to use for the Master Feedback device.

Axis Properties - Axis_1		
Categories:		
General G	General Axis Configuration: Feedback Configuration:	Feedback Only ▼ Master Feedback ▼
Homing Actions Drive Parameters Parameter List Status Faults & Alams Tag	Assigned Group Motion Group: Update Period:	Motion_Group_101 New Group 2.0
	Associated Module Module: Module: Power Structure: Axis Number:	CIP_K6K 2094-EN02D-M01-S0 2094-AM05-M 2
		The Axis Number is set to 2, because Axis 1 is already assigned to the primary axis of the drive.
Axis State: Manual Tune		OK Cancel Apply Help

Figure 34 - Example 3: Feedback Only with Master Feedback, General Dialog Box

4. To associate the drive with the axis, click the Define feedback device hyperlink.

ntis Properties - Axis_1		
Categories:		
Gonordi	Master Feedback Device Specification	
 Master Feedback Scaling 	Device Function: Master Feedback Parameters	
- Hookup Tests	Feedback Channel: Feedback 1	
Polarity Homing	Type: Not Specified Very Device Type cannot be configured until feedback device is defined for this Feedback	
- Actions	Units: Rev Channel in Associated Module. Define feedback device.	
- Parameter List	Ň	
- Status - Faults & Alarms		
- Tag	Foodbook 1 is the lowing wort for this ovie that is	
	Feedback 1 is the logical port for this axis that is	
	assigned to physical Port 2, or Aux Feedback	
	port of the Kinetix 6500 drive.	
Axis State:		
Manual Tune	OK Cancel Apply H	elo
		cih

Figure 35 - Example 3: Feedback Only with Master Feedback, Master Feedback Dialog Box

5. From the Axis 2 (Auxiliary Axis) pull-down menu, choose Axis_IV_Feedback Only to associate the axis.

Figure 36 - E	Example 3: Ma	aster Feedba	ack Dialog Box

Module Properties: ENET_Module (2	094-EN02D-M01-S0 2.001)
General Connection Time Sync Mo	dule Info Internet Protocol Port Configuration Network Associated Axes* Power Di
Axis 1:	Axis_III_Position
Motor Feedback Device:	Motor Feedback Port
Load Feedback Device:	<none></none>
Axis 2 (Auxiliary Axis):	Axis_IV_FeedbackOnly
Master Feedback Device:	Aux Feedback Port 🔹
Status: Offline	OK Cancel Apply Help

- 6. From the Master Feedback Device pull-down menu, choose Aux Feedback Port to map the port to the device.
 - **TIP** The available ports are different for the Kinetix 5700 drives.

7. To apply your changes and return to Axis Properties, click OK.

🏷 Axis Properties - Axis_I	V_FeedbackOnly		- • •
Categories:	_		
General	Master Feedback Device Specification		
 Master Feedback Scaling Hookup Tests Polarity Homing Actions Drive Parameter List Status Faults & Alarms Tag 	Device Function: Master Feedback 1 Feedback Channel: Feedback 1 Type: Digital AqB Units: Rev Digital AqB Cycle Resolution: Cycle Interpolation: 4 Effective Resolution: 4096 Startup Method: Incremental Default values are completed for you.	Parameters	
Axis State:			
Manual Tune		OK Cancel	Apply Help

Figure 37 - Example 3: Feedback Only with Master Feedback, Master Feedback Dialog Box

- 8. From the Type pull-down menu, choose Digital AqB as the feedback type.
- 9. From the Units pull-down menu, choose Rev.

10. In the appropriate field, type the resolutions of your specific feedback device.

Axis Properties - Axis_IV_	FeedbackOnly						
Categories:							
General Marter Feedback	Scaling to Convert	Motion from (Controller Units to Us	er Defined Un	its		
Scaling	Load Type:	Direct Coup	oled Rotary 🔻		Pa	arameters	
Hookup Tests	Transmission						
···· Polarity ···· Homing	Ratio I:0:	1	: 1	Rev			
Actions	Actuator						—
Drive Parameters	Туре:	<none></none>	*				
Parameter List Status	Lead:	1.0	Millimeter/R	ev 👻			
Faults & Alarms Tag	Diameter:	1.0	Millimeter	-			
Tag	Scaling						—
	Units:	Position Uni	ts				
	Scaling:	1.0	Position Units	per	1.0	Feedback Rev	-
	Travel						
	Mode:	Unlimited	•				
	Range:	1000.0	Position Units				
	Unwind:	1.0	Position Units	per	1.0	Cycle	
	Soft Trave	Limits					
	Maximun	n Positive:	0.0	Position Units			
	Maximun	n Negative:	0.0	Position Units			
Axis State:							
Manual Tune				ОК	Car	ncel Apply	Help

Figure 38 - Example 3: Feedback Only with Master Feedback, Scaling Dialog Box

- 11. From the Load Type pull-down menu, choose your load type.
- 12. Enter the Scaling Units.
- From the Mode pull-down menu, choose your Travel mode.
 For more information about Scaling, see <u>Scaling on page 222</u>.
- 14. Click Apply.

You are now finished configuring an axis for Feedback Only.

Example 4: Kinetix 5500 Drive, Velocity Loop with Motor Feedback

In this example, you are configuring a Kinetix 5500 servo drive, catalog number 2098-H025-ERS, with motor feedback by using a Rotary Permanent Magnet motor, catalog number VPL-A1001M-P.

You must connect the Motor Feedback cable to the Motor Feedback port of the Kinetix 5500 drive and then configure the feedback port.

1. Once you have added the drive to your project and created an AXIS_CIP_DRIVE, open the Axis Properties.

Axis Properties - Axis_2	K5500	
Categories:		
* General	General	
Motor Motor Motor Feedback Scaling Hookup Tests Polarity Load Compliance Friction Observer Velocity Loop	Axis Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group: Update Period: Associated Module	Velocity Loop Motor Feedback Basic Medium Motion_Group_101 2.0
Acceleration Loop Torque/Current Loop Planner Homing Actions Drive Parameters Parameter List Status Faults & Alams Tag	Associated Module Module: Module Type: Power Structure: Axis Number: The newly created Kinetix 52 the default. The Axis Number the axis of the drive.	
Axis State: Manual Tune		OK Cancel Apply Help

Figure 39 - Example 4: Velocity Loop with Motor Feedback, General Dialog Box

TIP After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.

After you select Velocity Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

- 2. Click the Motor dialog box.
- 3. Choose Catalog Number as the Motor Data Source.

4. Click Change Catalog and choose your motor, for example, catalog number VPL-B0631T-C.

٩	Axis Properties - Axis_2_	K5500					
С	tegories:						
Γ	····· General	Motor Device Specif	ication				
4	E. Motor	Data Source:	Catalog Number	• • •		Parameters	
4	Motor Feedback	Catalog Number:	VPL-B0631T-C		Change Catalog		
	Scaling	Motor Type:	Rotary Permane	nt Magnet 🛛 👻			
	····· Hookup Tests ····· Polarity	Units:	Rev	▼			
	Autotune	Nameplate / Dat	tasheet - Phase	to Phase parameter	'S		
	E Load	Rated Power:	0.31	kW	Pole Count:	8	
	Friction	Rated Voltage:	480.0	Volts (RMS)			
	····· Observer ····· Velocity Loop	Rated Speed:	8000.0	RPM	Max Speed:	8000.0	RPM
	Acceleration Loop	Rated Current:	0.85	Amps (RMS)	Peak Current:	2.97	Amps (RMS)
	····· Torque/Current Loop ····· Planner	Rated Torque:	0.46	N-m	Motor Overload Limit:	100.0	% Rated
	····· Homing						
	Actions Drive Parameters						
	Parameter List						
	····· Status						
	Faults & Alarms						
	i Tag						
]					
A	is State:						
	Ianual Tune				ОК	Cancel	Apply Help

When you select the Catalog Number for the motor specification, the VPL-B0631T-C motor is in the Motion Database. The specification data for this motor is automatically completed for you.

If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You must input the specification data or add a custom motor to the Motion Database that can be selected.

For more information, see <u>Choose Nameplate as the Motor Data Source</u> on page 52.

5. Click the Motor Feedback dialog box.

🏷 Axis Properties - Axis_2	K5500		- • •
Categories:			
General General General General Motor Motor Motor Motor Feedback General Motor Motor Feedback General Motor Model Motor Feedback General Motor General Motor Motor General Motor General Motor General Motor General Motor General Genera	Motor Feedback Device Spec Device Function: Feedback Channel: Type: Units: Hiperface DSL Cycle Resolution: Cycle Interpolation: Effective Resolution:	cification Motor Mounted Feedback Parameters Feedback 1 Image: Colspan="2">Image: Colspan="2" Image: Colspa="" Image: Colspan="" Image: Colspan="2" Image: Colspan="2" Image:	
Velocity Loop Acceleration Loop Torque/Current Loop Planner Homing Actions Drive Parameters	Startup Method: Tums: Commutation	Absolute 1	
Parameter List Status Faults & Alarms Tag	Alignment: Offset:	Motor Offset Degrees	
Axis State: Manual Tune		OK Cancel	Apply Help

Figure 41 - Example 4: Velocity Loop with Motor Feedback, Motor Feedback Dialog Box

With this drive and motor combination, the Motor-Mounted Feedback that is available is the Hiperface DSL type. The data is automatically populated based on that selection. You can assign the commutation alignment.

Commutation —		
Alignment:	Motor Offset 🛛 🔻	
Offset:	Not Aligned Controller Offset Motor Offset	Degrees

6. To adjust the Scaling attributes, click the Scaling dialog box.

٩	Axis Properties - Axis_2_	K5500								
Ca	tegories:									
	: General	Scaling to Convert I	Aotion from (Controller	Units to U	ser Defined Ur	nits			
*	Motor									
*	···· Model	Load Type:	Direct Coup	led Rotary	•			Paramet	ters	
	Analyzer	Transmission								_
*	Motor Feedback Scaling	Ratio I:0:	1	:	1	Rev				
	Hookup Tests	Actuator								-
	····· Polarity	Туре:	<none></none>		-					
	···· Autotune	Lead:	1.0		Millimeter/F					
1	- Load				Millimeter/F	iev 👻				
	Compliance	Diameter:	1.0		Millimeter	-				
	Friction Observer	Scaling								_
	····· Velocity Loop	Units:	Position Uni	te						
	Acceleration Loop									
	Torque/Current Loop	Scaling:	1.0	F	osition Units	per	1.0		Motor Rev	T
		Travel								_
	····· Homing	Mode:	Unlimited	•						
	Actions									
	···· Drive Parameters	Range:	1000.0	F	Position Units					
	····· Parameter List	Unwind:	1.0		Position Units	per	1.0		Cycle	
	···· Status	C-A T	12	'	OSIGOTI OTIKS					
	Faults & Alarms	Soft Travel								
	i Tag	Maximum	Positive:	0.0		Position Units				
		Maximum	Negative:	0.0		Position Units				
A	is State:									
	Ianual Tune					ОК		Cancel	Apply	Help

Figure 42 - Example 4: Velocity Loop with Motor Feedback, Scaling Dialog Box

- 7. Choose the Load Type.
- 8. Enter the Scaling Units.
- 9. Choose the Travel Mode.

For more information about Scaling, see <u>Scaling on page 222</u>.

10. Click Apply.

You are now finished configuring the Kinetix 5500 axis for Velocity Loop with Motor Feedback.

Example 5: Kinetix 350 Drive, Position Loop with Motor Feedback

In this example, create a project with a CompactLogix[™] controller, for example, 1769-L36ERM. You are configuring a Kinetix 350 drive, catalog number 2097-V33PR6-LM, with motor feedback by using a Rotary Permanent Magnet motor, catalog number MPAR-A1xxxB-V2A.

You must connect the Motor Feedback cable to the Motor Feedback port of the Kinetix 350 drive and then configure the feedback port.

1. Once you have added the drive to your project and created an AXIS_CIP_DRIVE, open the Axis Properties.

> Axis Properties - ax_CI	IP_P1_on_K350_elect_cylinder		
Categories:			
* General	General		
- Motor	Axis Configuration:		
Model	-	Position Loop	_
Motor Feedback	Feedback Configuration:	Motor Feedback	
Hookup Tests	Application Type:	Basic	•
Polarity	Loop Response:	Medium	▼
Autotune		L	
E Load	Assigned Group		
Compliance	Motion Group:	Motion_grp	New Group
Position Loop	Update Period:	2.0	
Velocity Loop			
····· Torque/Current Loo	P Associated Module		
Homing	Module:	K350_12A_240v	
* Actions	Module Type:	2097-V33PR6-LM	Displays the type of drive you selected the Kinetix 350 Module Properties.
Drive Parameters	Power Structure:	2097-V33PR6-LM	For more information, see <u>Add a Kinetix EtherNet/IP</u>
····· Parameter List ····· Status	Axis Number:	1	Drive on page 32.
Faults & Alams	Adds Number.		
Tag			
	The newly created Kinetix 350 drive		
	default. The Axis Number defaults t axis of the drive.	to T, indicating the	
	axis of the drive.		
Axis State:			
Manual Tune			OK Cancel Apply Help

Figure 43 - Example 5: Position Loop with Motor Feedback, General Dialog Box

- **TIP** After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.
- 2. Click the Motor dialog box.
- 3. Choose Catalog Number as the Motor Data Source.

4. Click Change Catalog and choose your motor, for example, catalog number MPAR-A1xxxB-V2A.

Axis Properties - ax_CIP_	P1_on_K350_elect_cylin	der				
Categories:						
* General	Motor Device Specif	ication				
* 🖃 ··· Motor * 🕴 ····· Model	Data Source:	Catalog Number	•		Parameters	
* Motor Feedback * Scaling	Catalog Number:	MPAR-A1xxxB-V	2A	Change Catalog		
Hookup Tests	Motor Type:	Rotary Permaner	nt Magnet 🔹 👻			
Polarity Autotune	Units:	Rev	-			
* 🖃 ··· Load	Nameplate / Dat	tasheet - Phase	to Phase paramete	rs		
Compliance	Rated Power:	0.113	kW	Pole Count:	8	
Position Loop Velocity Loop	Rated Voltage:	230.0	Volts (RMS)			
Torque/Current Loop	Rated Speed:	3150.0	RPM	Max Speed:	3150.0	RPM
Planner	Rated Current:	0.81	Amps (RMS)	Peak Current:	2.05	Amps (RMS)
* Homing	Rated Torque:	0.34	N-m	Motor Overload Limit:	100.0	% Rated
Drive Parameters						
····· Parameter List ····· Status						
Faults & Alarms						
Tag						
Axis State:						
Manual Tune				ОК	ancel	Apply Help

Figure 44 - Example 5: Position Loop with Motor Feedback, Motor Dialog Box

When you select the Catalog Number for the motor specification, the MPAR-A1xxxB-V2A motor is in the Motion Database. The specification data for this motor is automatically completed for you.

If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You must input the specification data or add a custom motor to the Motion Database that can be selected.

For more information, see <u>Choose Nameplate as the Motor Data Source</u> on page 52.

5. Click the Motor Feedback dialog box.

Axis Properties - ax_CIP_P1_on_K350_elect_cylinder							
Categories:							
* General	Motor Feedback Device Specification						
 Conversional Motor Motor Feedback Scaling Hookup Tests Polarity Autotune Backlash Compliance Position Loop Velocity Loop Torque/Current Loop Planner Homing Actions Drive Parameters Parameter List Status Faults & Alarms 	Device Function: Feedback Channel: Type: Units: Hiperface Cycle Resolution: Cycle Interpolation: Effective Resolution: Startup Method: Turns:	Motor Mounted Feedb Feedback 1 Hiperface Rev 128 2048 262144 Absolute • 4096	Aack Parameters Feedback Cycles/Rev Feedback Counts per Cycle Feedback Counts per Rev				
I Tag	Offset:	0.0	Degrees				
Axis State:							
Manual Tune OK Cancel Apply Help							

Figure 45 - Example 5: Position Loop with Motor Feedback, Motor Feedback Dialog Box

With this drive and motor combination, the data is automatically populated based on that selection.

6. To adjust the Scaling attributes, click the Scaling dialog box.

ø	Axis Properties - ax_CIP_	P1_on_K350_elect_cylin	der					
С	ategories:							
R	General Scaling to Convert Motion from Controller Units to User Defined Units							
*	MOLOF FEEdback	Load Type: Transmission	Linear Actuator	▼			Parameters	
1	 Scaling Hookup Tests 	Ratio I:O:	1	: 1	Rev			
	····· Polarity	Actuator —						-
4	Autotune	Type:	Screw	-				
	Backlash	Lead:	3.0	Millimeter/F	lev 🔻			
	Compliance	Diameter:	1.0	Millimeter	-			
	····· Position Loop ····· Velocity Loop	Scaling						
	Torque/Current Loop	Units:	Position Units					
	Planner Homing	Scaling:	1.0	Position Units	per	1.0	Load Millimeter	
4	* Actions	Travel						
	····· Drive Parameters ····· Parameter List	Mode:	Limited	•				
	Status	Range:	1000.0	Position Units				
	Faults & Alams Tag	Unwind:	1.0	Position Units	per	1.0	Cycle	
		Soft Travel	Limits					
		Maximum	Positive: 0.0	0	Position Units			
		Maximum	Negative: 0.0)	Position Units			
A	xis State:							
	Manual Tune				ОК		Cancel Apply	Help

Figure 46 - Example 5: Position Loop with Motor Feedback

The default load type is linear actuator.

- 7. Enter the Scaling Units.
- 8. Enter the Travel Range.

For more information about Scaling, see <u>Scaling on page 222</u>.

9. Click OK.

You are now finished configuring the Kinetix 350 axis for Position Loop with Motor Feedback.

Example 6: Kinetix 5700 Drive, Frequency Control with No Feedback

In this example, create a project with a ControlLogix^{*} controller, for example, 1756-L73S. You are configuring a Kinetix 5700 drive, catalog number 2198-D006-ERS3, with no feedback by using a HPK-Series High-power Servo motor.

- 1. Once you have added the drive to your project and created an AXIS_CIP_DRIVE, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Frequency Control.

At the Feedback Configuration pull-down menu, No Feedback is the only option.

Ø	Axis Properties - Axis_1			- • •
c	Categories:			
	 General Motor Model Analyzer Scaling Hookup Tests Polarity Planner 	General Axis Configuration: Feedback Configuration:	Frequency Control	Defines the controller Control Mode. See the Integrated Motion on the EtherNet/ IP Network Reference Manual, publication, <u>MOTION-RM003</u> .
	Frequency Control Actions Drive Parameters Parameter List Status Faults & Alams Tag	Assigned Group Motion Group: Update Period: Associated Module	Motion_Group_101	New Group
		Module: Module Type: Power Structure: Axis Number:	UM_D006 2198-D006-ERS3 2198-D006-ERS3 1	Displays the type of drive you selected and power structure you assigned via the Kinetix 5700 drive Module Properties. See <u>Add a Kinetix 5700 EtherNet/IP Drive on page 60</u> .
		default. The Axis Numb the primary axis of the used only for configurir	tix 5700 drive name is the er defaults to 1, indicating drive. Axis Number 2 is ng a Feedback Only axis.	
	ivis State: Manual Tune	Safety State:	ОК	Cancel Apply Help

Figure 47 - Example 6: Frequency Control with No Feedback, General Dialog Box

3. From the Data Source pull-down menu, choose a data source.

In this case, the data source is Catalog Number and the Motion Database provides values for these fields.

See the <u>Display Motor Model Information on page 54</u> for more information about data sources.

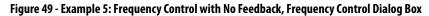
Figure 48 - Example 6: Frequency Control with No Feedback, Motor Dialog Box

General	Motor Device Specification							
- Motor	Data Source:	Catalog Number	•	-	Parameters			
- Analyzer Scaling	Catalog Number:	HPK-B1307C-M		Change Catalog				
- Hookup Tests	Motor Type:	Rotary Induction	Ψ					
- Polarity - Planner	Units:	Rev						
- Frequency Control	Nameplate / Dat	sheet · Phase	to Phase paramete	rs				
- Actions - Drive Parameters	Rated Power:	17.1	kW	Pole Count:	4			
- Parameter List	Rated Voltage:	400.0	Volts (RMS)	Rated Frequency:	50.0	Hertz		
- Status - Faults & Alarms	Rated Speed:	1465.0	RPM	Max Speed:	3000.0	RPM		
- Tag	Rated Current:	34.2	Amps (RMS)	Peak Current:	80.0	Amps (RMS)		
				Motor Overload Limit:	100.0	% Rated		
s State:	Safety Sti							

4. From the Frequency Control Method pull-down menu, choose the appropriate method.

This example uses Basic Volts/Hertz.

5. Click Apply.



General	Frequency Control		
Motor Model Analyzer	Frequency Control Method:	Basic Volts/Hertz 400.0	Parameters
- Scaling	Maximum Voltage;		Volts (RMS)
-Hookup Tests	Maximum Frequency:	110.0	Hertz
- Polarity	Break Voltage:	200.0	Volts (RMS)
- Planner Frequency Control	Break Frequency:	25.0	Hertz
- Actions	Start Boost:	3.8558066	Volta (RMS)
- Drive Parameters	Run Boost:	3.8558066	Volts (RMS)
- Parameter List	Limits		
- Status - Faults & Alams	Velocity Limit Positive.	100.0	Postion Units/s
- Tag	Velocity Limit Negative:	-100.0	Poston Units/s
	Acceleration Limit:	4.883333	Poston Unts/s ²
	Deceleration Limit:	4 883333	Position Units/a ^{*2}
los State:	Safety State:		

6. From the Load Type pull-down menu, choose the appropriate load type.

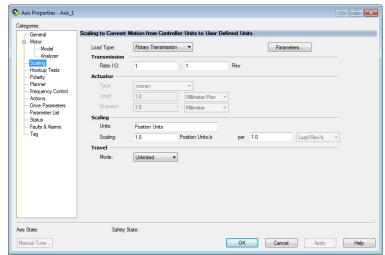


Figure 50 - Example 6: Frequency Control with No Feedback, Scaling Dialog Box Conversion Units

- 7. Enter the Transmission Ratio.
- 8. From the Actuator Type pull-down menu, choose the appropriate actuator, if applicable.
- 9. Enter the Diameter dimensions.
- 10. Enter the Scaling Units.

See the <u>Scaling on page 222</u> for more information.

- 11. From the Travel Mode pull-down menu, choose the appropriate travel mode.
- 12. Click Apply.

You are now finished configuring the axis for Frequency Control with No Feedback.

Example 7: 842E-CM Integrated Motion Encoder with Master Feedback

In this example, create a project with a ControlLogix controller, for example, 1756-L73. You are configuring an 842E-CM encoder, catalog number 842-CM-M, with feedback only.

1. In the Controller Organizer, right-click Ethernet under the I/O Configuration folder and choose New Module.

The Select Module Type dialog box appears.

Figure 51 - Example 7: Select Module Type Dialog Box

	Module Discovery Favor	les	Clear Filters		Hide Filters 🔝
	Module Typ Analog Communications Adapter Controller Digital alog Number 842E-CM-M 842E-CM-S		Allen-Brain FANUC	+Hauser CORPORATION Robotics America Foledo Vendor esol Allen-Bradley	
 2 of 4 	436 Module Types Found		III		Add to Favorites

- 2. Select your 842E-CM encoder as appropriate for your actual hardware configuration.
- 3. Click Create.

The New Module dialog box appears.

Figure 52 - Example 7: New Module Dialog Box

	Connection	Time Sync	Module Into	Internet Protocol	Port Configuration	Network	Associated Axes	Motion Dia
Type: Vendor: Parent: Name: Descripti	842E Allen- UM_E CM_	CM-M Multi T Bradley			H4 Count Resolution, Ethernet Addres Private Netw IP Address: Host Name:	. 409 s	192. 168. 1. 23	
Revisio Electro Conne	nic Keying:	1.00 Com Moti	1 patible Module	ihange				

- 4. Configure the 842E-CM encoder.
 - a. Type the encoder Name.
 - b. Select an EtherNet/IP address option.
 In this example, the Private Network address is selected.
 - c. Enter the address of your EtherNet/IP[™] module.
 In this example, the last octet of the address is 23.
- 5. To close the New Module dialog box, click OK.
- 6. To close the Select Module, click Close.

Type dialog box.

7. Right-click the 842E-CM encoder that you created and choose Properties.

The Module Properties dialog box appears.

8. Configure the Associated Axis tab and the motion group for your 842E-CM encoder.

In this example, the feedback-only axis is named Master_Fdbk.

- 9. In the Controller Organizer, right-click the feedback-only axis and choose Properties.
- 10. Select the General category.

Figure 53 - Example 7: 842E-CM Integrated Motion Encoder with Master Feedback, General Dialog Box

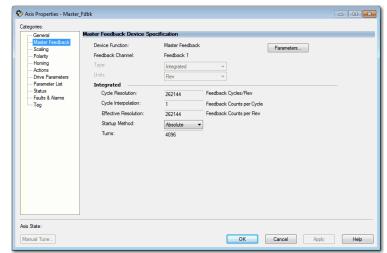
Categories:			
* General	General		
	Axis Configuration:	Feedback Only	
Polarity Homing	Feedback Configuration:	Master Feedback 🔹	
Actions Drive Parameters Parameter List			
Status	Assigned Group		
Faults & Alarms Tag	Motion Group:	Motion_Group_101 New Group	2
-	Update Period:	6.0	
	Associated Module		
	Module:	CM_Encoder	
	Module Type:	842E-CM-M	
	Power Structure:	N/A	
	Axis Number:	1 -	
Axis State:			

11. From the Module pull-down menu, choose the 842E-CM encoder to associate with your Feedback Only axis.

The Module Type field populates with the chosen encoder catalog number.

12. Select the Master Feedback category.

Figure 54 - Example 7: 842E-CM Integrated Motion Encoder with Master Feedback, Master Feedback Dialog Box



The Type and Units appear dim. The Cycle Resolution, Cycle Interpolation, Effective Resolution, and Turns are automatically completed with values from the AOP schema. The selections for the Master Feedback category are automatic to make sure that valid values are entered.

13. Click OK.

Notes:

Axis Configuration Examples for the PowerFlex 755 Drive

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This chapter provides example axis configurations when using a PowerFlex® 755 drive.

The following six examples are typical axis-configuration applications for the PowerFlex 755 drive:

- Position Loop with Motor Feedback
- Position Loop with Dual Feedback
- Velocity Loop with Motor Feedback
- Velocity Control with No Feedback
- Frequency Control with No Feedback
- Torque Loop with Feedback

Example 1: Position Loop with Motor Feedback Via a UFB Feedback Device

This example describes how to create an AXIS_CIP_DRIVE axis that is associated to a PowerFlex 755 drive with motor feedback via a universal feedback device, catalog number 20-750-UFB-1.

TIP Remember that you already assigned the feedback device when you added the drive to your project.

See <u>Create an Axis for a PowerFlex 755 Drive on page 109</u> for more information about feedback devices.

- 1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Position Loop.

When you choose the configuration type, it determines the Control Mode.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.



ø	Axis Properties - PF755			
с	ategories:			
ł		General		
	Motor Model Model Model Motor Feedback Scaing Polarty Autotune Compliance Congliance Observer Position Loop Velocity Loop Torque/Current Loop	Axis Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group: Update Period:	20	
н	Planner Homing	name is the default	PF755_1 PowerRex 755-EENET-CM 200V. 4.8A. Nomal Duty, Standard 1 PowerFlex 755 drive module t. The Axis Number defaults primary axis of the drive.	Module type shows you the type of drive you selected and power structure you assigned to via the PowerFlex 755 drive Module Properties. See <u>Add a PowerFlex 755</u> <u>Drive on page 99</u> .
	xis State: Manual Tune		ed only for configuring a	Cancel Apply Help

- 3. From the Feedback Configuration pull-down menu, choose Motor Feedback.
 - **TIP** After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as being a Position Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

Categories:						
General	Motor Device Specif	ication				
Hotor Model	Data Source:	Catalog Number	•		Parameters	
Analyzer	Catalog Number:	MPL-B310P-M		Change Catalog		
Load Feedback	Motor Type:	Rotary Permaner	nt Magnet 🔹 👻			
Scaling Hookup Tests	Units:	Rev	Ŧ			
Polarity	Nameplate / Dat	asheet - Phase	to Phase paramete	ers		
Autotune Load	Rated Power:	0.77	kW	Pole Count:	8	
Backlash Compliance	Rated Voltage:	460.0	Volts (RMS)			
Observer	Rated Speed:	5000.0	RPM			
Position Loop	Rated Current:	1.7	Amps (RMS)	Peak Current:	5.02	Amps (RMS)
Torque/Current Loop				Motor Overload Limit:	100.0	% Rated
Planner Homing						
Actions						
Drive Parameters Parameter List						
Status						
Faults & Alams Tag						
Axis State:						

Figure 56 - Example 1: Position Loop with Motor Feedback, Motor Dialog Box

- 4. Choose Catalog Number as the Data Source.
- 5. Click Change Catalog and choose a motor.

When you select the Catalog Number for the motor specification, the MPL-B310P-M motor is in the Motion Database. The specification data for this motor is automatically entered for you. If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You have to enter the specification data on your own.

The Motor Feedback dialog box is automatically filled based on your motor selection.

🍄 Axis Properties - Powerf	Flex_Axis_1				
Categories:		_			
* General	Motor Feedback Device Spec	cification			
Hotor Motor Motor Motor Motor Feedback Graing Hookup Tests Polarity	Device Function: Feedback Channel: Type: Units: Hiperface	Motor Mounted Feedb Feedback 1 Hiperface Rev	Back Parameters		
Autotune Autotune Compliance Compliance Conserver Observer Position Loop Torque/Current Loop Planner Homing Actions Drive Parameters	Cycle Resolution: Cycle Interpolation: Effective Resolution: Startup Method: Tums:	1024 Feedback Cycles/Rev 1024 Feedback Counts per Cycle 1048576 Feedback Counts per Rev Absolute • 4096		er Cycle	
Parameter List Status Faults & Alarms Tag	Algnment: Offset:	Not Aligned	Degrees	Test Commutation	
Axis State: Manual Tune			ОК	Cancel Apply	Help

Figure 57 - Example 1: Position Loop with Motor Feedback, Motor Feedback Dialog Box

6. Choose the Commutation Alignment.

For more information about Commutation, see <u>Assign Motor Feedback</u> on page 54 and <u>Applying the Commutation Hookup Test on page 232</u>.

General	Scaling to Convert I	Aotion from (Controlle	er Units to Use	r Defined Uni	its		
Motor Model Analyzer	Load Type: Transmission	Direct Coupl	led Rotan	/ -		F	arameters	
Motor Feedback Scaling	Ratio I:0:	1		: 1	Rev			
Hookup Tests	Actuator							
Polarity Autotune	Туре:	<none></none>		-				
E Load	Lead:	1.0		Millimeter/Rev	v - v			
Backlash	Diameter:	1.0		Millimeter	-			
Compliance Observer	Scaling							
Position Loop	Units:	Position Unit	s					
····· Velocity Loop ····· Torque/Current Loop	Scaling:	1.0		Position Units	per	1.0	Motor Rev .	-
Planner	Travel							
Homing Actions	Mode:	Unlimited	•					
Drive Parameters	Range:	1000.0		Position Units				
Parameter List Status	Unwind:	1.0		Position Units	per	1.0	Cycle	
- Faults & Alarms	C Soft Travel	Limits						
Tag	Maximun	Positive:	0.0		Position Units			
	Maximun	Negative:	0.0	F	Position Units			

Figure 58 - Example 1: Position Loop with Motor Feedback, Scaling Dialog Box

- 7. From the Load Type pull-down menu, choose your type of load.
- 8. Enter the Scaling Units.
- From the Travel Mode pull-down menu, choose your Travel Mode.
 For more information about Scaling, see <u>Scaling on page 222</u>.
- 10. Click Apply and OK to exit Axis Properties.

The axis is now configured for Position Loop with Motor Feedback.

Example 2: Position Loop with Dual Motor Feedback Via a UFB Feedback Device

This example describes how to create an AXIS_CIP_DRIVE axis that is associated to a PowerFlex 755 drive with dual motor feedback via a universal feedback device, catalog number 20-750-UFB-1.

TIP Remember that you already assigned the feedback device when you added the drive to your project.

See <u>Create an Axis for a PowerFlex 755 Drive on page 109</u> for more information about feedback devices.

- 1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Position Loop.
- 3. From the Feedback Configuration pull-down menu, choose Dual Feedback.

When you choose the configuration type, it determines the Control Mode.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.

Figure 59 - Example 2: Position Loop with Dual Feedback, General Dialog Box

Naxis Properties - Power	Flex_Axis_1						
Categories:							
General	General						
Motor Model Analyzer Motor Feedback Load Feedback Scaling	Axis Configuration: Feedback Configuration: Application Type: Loop Response;	Position Loop Dual Feedback Motor Feedback Dual feedback Dual feedback Dual feedback					
Hockup Tests Polarity Autotune Load Gompliance Observer Position Loop Velocity Loop	Assigned Group Motion Group: Update Period: Associated Module Module:	Motion_Group_101 2.0	Displays the type of drive you selected and power structure you assigned to via the PowerFlex 755 drive Module Properties.				
Torque/Current Loop Planner Homing Actions	Module Type: Power Structure: Avis Number	PowerFlex 755-EENET-CM 240V, 4.2A, Normal Duty, Standard	See <u>Add a PowerFlex 755 Drive</u> on page 99.				
Parameter List Status Faults & Alarms Tag	Satus Faults & Alarms Tag Number defaults to 1, indicating the primary axis of the drive. Axis Number 2						
Axis State: IS	used only for configurin	ig a Feedback Unly axis.	Cancel Apply Help				

IMPORTANT After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as being a Position Loop with Dual Feedback axis, the Motor Feedback, and Load Feedback dialog boxes become available. 4. From the Data Source pull-down menu, choose Catalog Number.

🍄 Axis Properties - PowerF	lex_Axis_1					
Categories:						
General	Motor Device Speci	fication				
Motor	Data Source:	Catalog Number	•		Parameters	
Analyzer	Catalog Number:	MPL-B310P-M		Change Catalog		
Motor Feedback	Motor Type:	Rotary Permanen				
Scaling			t Magnet			
Hookup Tests	Units:	Rev				
Polarity	Nameplate / Da	tasheet - Phase	to Phase paramete	rs		
Autotune	Rated Power:	0.77	kW	Pole Count:	8	
Backlash	Rated Voltage	460.0	Volts (RMS)			
Compliance	Rated Speed:	5000.0	RPM			
Position Loop	Rated Current:	1.7	Amps (RMS)	Peak Current:	5.02	Amps (RMS)
Velocity Loop				Motor Overload Limit:	100.0	% Rated
Torque/Current Loop Planner						
Homing						
Actions						
Drive Parameters						
Parameter List Status						
- Faults & Alarms						
Tag						
Axis State:						
Manual Tune				ОК	Cancel	Apply Help

Figure 60 - Example 2: Position Loop with Dual Feedback, Motor Dialog Box

5. Click Change Catalog and choose your motor.

In this case, a MPL-B310P-M motor was chosen.

When you select the Catalog Number for the motor specification, the MPL-B310P-M motor is in the Motion Database. The specification data for this motor is automatically entered for you. If the motor you are using is not listed in Change Catalog, then it is not in the Motion Database. You have to enter the specification data on your own.

The Motor Feedback dialog box is automatically filled based on your motor selection.

Figure 61 - Exam	ple 2: Position Loo	p with Dual Feedback	, Motor Feedback Dialog Box

ا∛	Axis Properties - PowerF	lex_Axis_1				
Cat	egories:					
*	- General	Motor Feedback Device Spec	rification			
*	Motor Model	Device Function:	Motor Mounted Feedb	ack	Parameters	
	Analyzer	Feedback Channel:	Feedback 1			
*	Motor Feedback Scaling	Type:	Hiperface	-		
	Hookup Tests	Units:	Rev	-		
	Polarity	Hiperface				
*	Autotune	Cycle Resolution:	1024	Feedback Cycles/Rev		
	Backlash	Cycle Interpolation:	1024	Feedback Counts per	Cycle	
	Compliance Observer	Effective Resolution:	1048576	Feedback Counts per	Rev	
	Position Loop	Startup Method:	Absolute -			
	Velocity Loop	Tums:	4096			
	Torque/Current Loop Planner					
	Homing					
	Actions					
	Drive Parameters	Commutation				
	Parameter List	Alignment:	Not Aligned 👻			
	Faults & Alarms	Offset:	_			
	Tag	Uffset:	0.0	Degrees	Test Commutation	
Axi	s State:					
M	anual Tune			ОК	Cancel Apply	Help

6. Choose the Commutation Alignment.

For more information about Commutation, see <u>Applying the</u> <u>Commutation Hookup Test on page 232</u>.

On the Motor Feedback dialog box, the information is automatic based on your selections on the Motor dialog box.

Axis Properties - Powe Categories:	rFlex_TL				
General Motor Model Motor Model Analyzer Motor Feedback Scaling Hookup Tests Polarity	Motor Feedback Device Sp Device Function: Feedback Channel: Type: Units:	Motor Mounted Feedback Feedback 1 Not Specified Rev	fe	Parameters Device Type cannot be configured until eedback device is defined for this Feedback Dannel in Ascoulded Module. Define feedback device.	
		have not defined a feed iys a link to the module		device, the motor dialog box ition for the drive.	

The axis is now configured as a Position Loop with two feedback devices. The next task is to configure Feedback 2 on the Load Feedback dialog box.

Follow these instructions to define the Load feedback.

1. From the Load Feedback dialog box, click the Define feedback device hyperlink.

Axis Properties - Power	Flex_TL		
Categories:			
* General	Load Feedback Device Sp	ecification	
Hotor Model Analyzer Motor Feedback Scaling Hookup Tests Polarity Autoure Compliance Compliance Observer Positon Loop Torque/Current Loop	Device Function: Feedback Channel: Type: Units:	Load-Side Feedback Feedback 2 Not Specified ▼ Rev ▼	Feedback device is defined for this Feedback
Axis State: Manual Tune			OK Cancel Apply Help

Figure 62 - Example 2: Load-side Feedback, Load Feedback Dialog Box

- 2. Click Associated Axes in Module Properties dialog box.
- 3. From the Load Feedback Device pull-down menu, choose the appropriate port/channel for the Load Feedback Device.

Figure 63 - Example 2: PowerFlex 755 Module Properties, Associated Axis Tab

Module Prop	oerties: EN	NET_Modul	e (PowerFlex	755-EENET-CM 1	1.001)					×
General Con	nection	Time Sync	Module Info	Internet Protocol	Port Configurati	on	Associated Axes*	Power	Digital Input	••
Axis 1:			PowerFl	ex_Axis_1	▼		New Axis			
Motor Fee	edback De	vice:	Port 4 C	hannel A	•	-				
Load Fee	dback Dev	/ice:	Port 4 C	hannel B	-					

- 4. From the Type pull-down menu, choose the type of feedback.
- 5. From the Units pull-down menu, choose the appropriate units.
- 6. Click Apply.



🍄 Axis Properties - PowerF	lex_Axis_1				
Categories:					
General	Load Feedback Device Spec	ification			
General Motor Model Analyzer Motor Feedback Load Feedback Load Feedback Load Feedback Colling Hookup Tests Polarity Autoure Load Backlash Complance Observer Position Loop Velocity Loop Portion_Current Loop Planner Homing Actions Other Parameters Parameter List Satus Faults & Alams Tag	Load Feedback Device Spec Device Function: Feedback Channel: Type: Units: Sine/Cosine Cycle Resolution: Cycle Interpolation: Effective Resolution: Startup Method:	fication Load-Side Feedbar Feedback 2 Sine./Cosine Rev 1024 1024 1048576 Incremental ▼	sk	Parameters	_
Axis State:					
Manual Tune			ОК	Cancel Apply	Help

	Scaling to Convert	Motion from C	Controller Units to User	Defined Un	its		
Motor Model	Load Type:	Direct Coupl	ed Rotary 🔻		F	arameters	
- Analyzer	Transmission						
Motor Feedback	Batio I:0:	1	· 1				
Scaling	Actuator						
- Hookup Tests - Polarity							
- Autotune	Туре:	<none></none>	*				
- Load	Lead:	1.0	Millimeter/Rev	-			
- Backlash	Diameter:	1.0	Millimeter	-			
Compliance	Scaling						
Observer Observer	Units:	Position Unit					
· Velocity Loop							
- Torque/Current Loop	Scaling:	1.0	Position Units	per	1.0	Motor Rev 🔷	
Planner	Travel						
Homing	Mode:	Unlimited	•				
- Actions - Drive Parameters	Range:	1000.0					
Drive Parameters Parameter List							
- Status	Unwind:	1.0	Position Units	per	1.0	Cycle	
Faults & Alarms	Soft Trave	el Limits					
- Tag	Maximu	m Positive:	0.0 Po:	ition Units			
	Mavim	m Negative:	0.0 Pos				
			0.0				

Figure 65 - Example 2: Position Loop with Dual Feedback, Scaling Dialog Box

- 7. From the Load Type pull-down menu, choose your load type.
- 8. Enter the Scaling Units.
- 9. From the Travel Mode pull-down menu, choose a Travel Mode.

See <u>Scaling on page 222</u> for more information about Scaling.

10. Click Apply and OK to exit Axis Properties.

You are now finished configuring a PowerFlex 755 drive axis as Position Loop with Dual Feedback.

Example 3: Velocity Loop with Motor Feedback Via a UFB Feedback Device

This example describes how to create two AXIS_CIP_DRIVE axes that are associated to a PowerFlex 755 drive with dual motor feedback via a universal feedback device, catalog number 20-750-UFB-1.

- **TIP** Remember that you already assigned the feedback device when you added the drive to your project.
- 1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
- 2. Connect the Feedback Port 1 with one feedback cable that is connected to the PowerFlex 755 drive.
- 3. From the Axis Configuration pull-down menu, choose Velocity Loop.
- 4. From the Feedback Configuration pull-down menu, choose Motor Feedback.

Figure 66 - Example 3: Velocity Loop with Motor Feedback, General Dialog Box

Axis Properties - PowerF Categories:	lex_TL General		
 General Motor Model Analyzer Motor Feedback Scaling Hookup Tests Polarity Autotune Load Compliance Observer Velocity Loop Torque/Current Loop Planner Homing Actions Drive Parameters Parameter List Status Faults & Alams Tag 	Axis Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group: Update Period: Associated Module Module: Module: Module Type: Power Structure: Axis Number: The newly created PowerFlex 7 name is the default. The Axis N 1, indicating the primary axis of Number 2 is used only for confi	2.0 PF755_Torque_Feedback PowerFlex 755-EENET-CM-S1 240V, 4.2A, Normal Duty, Standard 1 '55 drive module umber defaults to of the drive. Axis	The selections determine the Control Mode. See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication, <u>MOTION-RM003</u> .
Axis State: Manual Tune		ОК	Cancel Apply Help

IMPORTANT After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This change can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as a Velocity Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

General	Motor Device Specifi	cation				
Motor Model	Data Source:	Nameplate Data	sheet 👻		Parameters	
Analyzer	Catalog Number:	<none></none>		Change Catalog		
Motor Feedback Scaling	Motor Type:	Rotary Induction	•			
Hookup Tests	Units:	Rev	•			
Autotune	Nameplate / Data	asheet - Phase	to Phase parameter	rs		
- Load Backlash	Rated Power:	0.025	kW	Pole Count:	4	
Compliance	Rated Voltage:	20.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
Observer Position Loop	Rated Speed:	1600.0	RPM			
Velocity Loop	Rated Current:	0.22	Amps (RMS)			
Torque/Current Loop				Motor Overload Limit:	100.0	% Rated
- Planner Homing						
Actions						
Drive Parameters						
Parameter List						
Faults & Alarms						
Tag						

Figure 67 - Example 3: Velocity Loop with Motor Feedback, Motor Dialog Box

- 5. From the Data Source pull-down menu, choose Nameplate data sheet.
- 6. From the Motor Type pull-down menu, choose Rotary Induction.
- 7. Enter the parameters by using the information from the motor Nameplate or data sheet and click Apply.

Axis Properties - Power	Flex_Axis_1				
Categories:					
General	Motor Model Phase to Phase	Parameters			
Model Model Analyzer Motor Feedback Scaling Hookup Tests Polarty	Rated Flux Current: Rated Slip Speed: Stator Leakage (X1): Rotor Leakage (X2):	0.0 1300.0 0.0 0.0	Amps (RMS) RPM Ohms Ohms		
Actorne Lood Lood Lood Lood Conplance Observer Velocity Loop Planner Homing Actoria Drive Parameters Parameter List Status Faults & Alams Tag	Stator Resistance (R1):	0.0	Ohns		
Axis State:					
Manual Tune			ОК	Cancel Appl	y Help

8. Enter the parameters on the Motor Model dialog box by using the information from the motor Nameplate or data sheet and click Apply.

Figure 68 - Example 3: Motor Feedback Dialog Box, Velocity Loop with Motor Feedback

Axis Properties - PF_755_Axis_1	
Categories:	
Ceneral Motor Feedback Device Specification	
Motor Function: Mater Mourted Feedback Type: Motor Neurone Hookup Tests Hookup Te	Parameters
Axis State:	
Manual Tune	OK Cancel Apply Help

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

The fields are populated with the data that relates to the motor and feedback types you chose.

Gonora	Motor Feedback Device Spe	cification			
Motor Motor Analyzer Motor Feedbacki Scaling Hookup Tests Polarity Autorne Load Load Load Loadupterext Loop Planner Honing Actions Drave Parameters Drave Parameters Status Faults Alams Tag	Device Function: Feedback Channel: Type: Units: Sime/Cosine Cycle Resolution: Cycle Interpolation: Effective Resolution: Startup Method: Turns:	Motor Mounted Feedb Feedback 1 Sine/Cosine Rev 1024 1024 1024 1024 1048576 Absolute V 1	eck Feedback Cycles/Rev Feedback Counts per Cy Feedback Counts per Re		
s State:			ОК	Cancel Apply	Help

Figure 69 - Example 3: Velocity Loop with Motor Feedback, Motor Feedback Dialog Box

10. Click Scaling.

Figure 70 - Example 3: Velocity Loop with Motor Feedback, Scaling Dialog Box

- Motor		-							
Model	Load Type:	Direct Coup	iled Rota	ny 🔻			Paramet	ers	
Analyzer	Transmission								
Motor Feedback Scaling	Ratio I:0:	1		: 1	Rev				
Hookup Tests	Actuator								
Polarity	Type:	<none></none>		-					
Autotune		1.0		Millimeter/F					
Load					Nev +				
Backlash Compliance	Diameter:	1.0		Millimeter	-				
Observer	Scaling								
Position Loop	Units:	Position Un	ts						
Velocity Loop		10		Position Units		1.0		(
Torque/Current Loop	Scaling:	1.0		Position Units	per	1.0		Motor Rev 👻	
Planner	Travel								
Homing	Mode:	Unlimited	-						
Actions	Range:	1000.0		, Position Units					
Drive Parameters Parameter List									
	Unwind:	1.0		Position Units	per	1.0		Cycle	
Faults & Alarms	Soft Travel	Limits							
Tag	Maximum	n Positive:	0.0						
	Maximun	n Negative:	0.0		Position Units				

- 11. From the Load Type pull-down menu, choose the appropriate load type.
- 12. Enter the Scaling Units.
- 13. From the Travel Mode pull-down menu, choose the appropriate Travel Mode.

See <u>Scaling on page 222</u> for more information.

14. Click Apply and OK to exit Axis Properties.

You are now finished configuring the axis as Velocity Loop with Motor Feedback.

Example 4: Velocity Loop with No Feedback

In this example, you create an AXIS_CIP_DRIVE configured for a Velocity Loop with No Feedback axis and associate the axis to the PowerFlex 755 drive.

- 1. From the Axis Configuration pull-down menu, choose Velocity Loop.
- 2. From the Feedback Configuration pull-down menu, choose No Feedback.

- Motor	x_Axis_1 General		
General General	General		
- Motor	Seneral		
Model Analyzer Scaling Hookup Tests Polanty Load Compliance Velocity Loop Torque/Current Loop Planner Actions Drive Parameters Parameter List Status Faults & Alams Tag	Axis Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group: Update Period: Associated Module Module: Module Type: Power Structure: Axis Number: The newly created PowerFlex 755 d name is the default. The Axis Numb to 1, indicating the primary axis of t	er defaults	
	Axis Number 2 is used only for confi Feedback Only axis.		
Axis State:	L		
Manual Tune		ОК	Cancel Apply Help

Figure 71 - Example 4: Velocity Loop with No Feedback, General Dialog Box

3. From the Data Source pull-down menu, choose Nameplate data sheet.

Axis Properties - Powerf Categories:	Motor Device Spe	ification	
 Model Analyzer Scaling Hodel Analyzer Scaling Hoden Hoden Autoture Compliance Observer Velocity Loop Torque/Currert Loop Planner Actions Drive Parameters Paranter Status Faults & Alarms Tag 		Drive NV Rev elect No Feedback, the back dialog box does not	Parameters In this case, the drive has already been configured for the motor by the DriveExecutive [™] software or the HIM configuration tools.
Axis State: Manual Tune			OK Cancel Apply Help

Figure 72 - Example 4: Velocity Loop with No Feedback, Motor Dialog Box

Figure 73 - Example 4: Velocity Loop with No Feedback, Scaling Dialog Box

Axis Properties - PowerFlex_Axis Categories: General Scalin	-	Action from Controlle	r Units to User De	fined Units		-	
* Motor I La - Model La - Model La - Modup Tests - Polarity A - Load - Compliance - Observer - Velocity Loop	ad Type: ransmission - Ratio I:O: ctuator Type: Lead: Diameter:	Direct Coupled Rotary 1 <none> 1.0 1.0</none>) Rev	Parameters		
	caling Units: Scaling: ravel Mode:	Position Units 1.0 Unlimited	Position Units/s	per 1.0	M	otor Rev/s v	
vis State: Manual Tune			denomina have fixed controller	tor of the S units = [N internally s	back = [No I Scaling factor Notor Rev/s] I simulates the Feedback]).	is forced to because the	Те

- 4. From the Load Type pull-down menu, choose the appropriate load type.
- 5. Enter the Scaling Units.
- 6. From the Travel Mode pull-down menu, choose the appropriate Travel Mode.

See <u>Scaling on page 222</u> for more information.

7. Click Apply.

ategories:				
- General	Characteristics of Motor Load			
Motor	Load Inertia/Mass			
Analyzer	Load Coupling:	Rigid	•	
Scaing Hookup Tests	Use Load Ratio			
Polarity	Load Ratio:	0.0		
Autotune				
E- Load				
Compliance				
Observer Velocity Loop				
Torque/Current Loop	Inertia/Mass Compensati	on		
Planner	System Inertia:	0.0	% Rated/(Rev/s^2)	
Actions	System Acceleration:	0.0	Rev/s ² @100 % Rated	
- Drive Parameters	System Acceleration.	0.0	Hev/s 2@100 % Rated	
Parameter List Status				
	Active Load Compensatio	n		
Tag	Torque Offset:	0.0	% Rated	
xis State:				

Figure 74 - Example 4: Velocity Loop with No Feedback, Load Dialog Box

- 8. From the Load Coupling pull-down menu, choose the appropriate load coupling.
- 9. Enter the System Inertia.
- 10. Enter the Torque Offset, if applicable.

For more information about the load characteristics, see <u>Load on</u> page 239.

11. Click Apply.

You are now finished configuring an axis as Velocity Loop with No Feedback.

Example 5: Frequency Control with No Feedback

In this example, you are configuring an axis for Frequency Control with No Feedback.

- 1. Once you have created the AXIS_CIP_DRIVE axis, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Frequency Control.
- 3. From the Feedback Configuration pull-down menu, choose No Feedback.

	Figure 75 - Example 5: Fregu	iency Control with No Feedback,	General Dialog Box
--	------------------------------	---------------------------------	--------------------

Axis Properties - Power	Flex_Axis_1		
Categories:			
General G	General Axis Configuration: Feedback Configuration:	Frequency Control	Defines the controller Control Mode. See the Integrated Motion on the EtherNet/ IP Network Reference Manual, publication, <u>MOTION-RM003</u> .
Frequency Control Actions Drive Parameters Parameter List Status Faults & Alarms Tag	Assigned Group Motion Group: Update Period: Associated Module Module:	CIP_Motion CIP_PowerFlex	New Group Displays the type of drive you selected and power
	name is the default. T	PowerFlex 755-EENET-CM 240V. 4.2A, Normal Duty, Standard 1 werFlex 755 drive module the Axis Number defaults to hary axis of the drive. Axis	– structure you assigned via the PowerFlex 755 drive Module Properties. See <u>Add a PowerFlex 755 Drive on page 99</u> .
Axis State: Manual Tune		y for configuring a Feedback	Cancel Apply Help

4. From the Data Source pull-down menu, choose a data source.

In this case, Nameplate data sheet is the Data Source.

See the <u>Specify the Motor Data Source on page 50</u> for more information about Data Sources.

Figure 76 - Example 5: Frequency Control with No Feedback, Motor Dialog Box

ntering Axis Properties - Powerf	Flex_Axis_1					
Categories:						
* General	Motor Device Specifi	cation				
* Motor * Model	Data Source:	Nameplate Datash	eet 👻		Parameters	
Analyzer Scaling	Catalog Number:	<none></none>		Change Catalog		
Hookup Tests	Motor Type:	Rotary Induction	•			
Polarity Planner	Units:	Rev	-			
Frequency Control	Nameplate / Data	asheet - Phase t	o Phase parameter	's		
Actions Drive Parameters	Rated Power:	0.0	kW	Pole Count:	4	
Parameter List	Rated Voltage:	0.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
	Rated Speed:	0.0	RPM			
Tag	Rated Current:	0.0	Amps (RMS)			
				Motor Overload Limit:	100.0	% Rated
Axis State:						
Manual Tune				ОК	Cancel	Apply Help

In this case, the data source is Catalog Number and the Motion Database provides values for these fields.

See the <u>Display Motor Model Information on page 54</u> for more information about data sources.

ategories:	Motor Model Phase to Phas	e Parameters			
General Model Model Model Model Model Model Model Model Analyzer Scaling Hokup Tests Polanty Planner Pranner Frequency Control Actions Drive Parameters Status Faults & Alarms Tag	Motor Model Phase to Phase Votage Constant (Ke): Resistance (Ra): Inductance (La):	67 89639 19.0 0.093	Vots(RMS)/KRPM Ohms Hennies		
xis State:					
Manual Tune			ОК	Cancel	Apply Help

Figure 77 - Example 5: Frequency Control with No Feedback, Motor Model Dialog Box

- 5. From the Frequency Control Method pull-down menu, choose the appropriate method.
- 6. Click Apply.

Figure 78 - Example 5: Frequency Control with No Feedback, Frequency Control Dialog Box

egories:					
General	Frequency Control				
Model Analyzer Scaling Hookup Tests Polanity Planner Frequency Control Actions Drive Parameters Status	Frequency Control Method: Basic Volts/Hertz Maximum Voltage: Maximum Frequency: Break Voltage: Break Voltage: Break Frequency: Start Boost: Pun Boost:	Basic Volts/Hetz Basic Volts/Hetz Fan/Purp Volts/Hetz Sensoless Vector Sensoless Vector 230.0 30.0 8.5 8.5	Volts (RMS) Hertz Volts (RMS) Hertz Volts (RMS) Volts (RMS)	meters	
— Faults & Alarms — Tag	Limits Velocity Limit Positive: Velocity Limit Negative:	0.0	Position Units/s Position Units/s		
s State:					

Figure 79 - Example 5: Frequency Control Method, Basic Volts/Hertz

egories:				
General	Frequency Control			
Motor Model	Frequency Control Method:	Basic Volts/Hertz	Parameters	
Analyzer	Basic Volts/Hertz			
Scaling	Maximum Voltage:	460.0	Volts (RMS)	
— Hookup Tests — Polarity	-	130.0	Hertz	
Planner	Maximum Frequency:			
Frequency Control	Break Voltage:	230.0	Volts (RMS)	
Actions	Break Frequency:	30.0	Hertz	
Drive Parameters	Start Boost:	8.5	Volts (RMS)	
···· Parameter List ···· Status	Run Boost:	8.5	Volts (RMS)	
···· Faults & Alams	Han book.	0.0	voita (rivio)	
···· Tag	Limits			
-	Velocity Limit Positive:	0.0	Position Units/s	
	Velocity Limit Negative:	0.0	Position Units/s	
	volocity Linit Hoguive.	0.0	r oation chitava	
State:				

X Axis Properties - Power	Flex_Axis_1							- • •
Categories:								
General	Scaling to Convert	Motion from Cont	roller Units to Use	r Define	d Units			
Model	Load Type:	Linear Actuator	•			Paramete	ers	
Analyzer	Transmission							
* Scaling Hookup Tests	Ratio I:O:	1	: 1	R	lev			
Polarity	Actuator							
Planner	Type:	<none></none>	•					
Frequency Control Actions	Lead:	1.0	Millimeter/Rev	-				
····· Drive Parameters ····· Parameter List	Diameter:	1.0	Millimeter	-				
Status	Scaling							-
Faults & Alams	Units:	Position Units						
Tag	Scaling:	1.0	Position Units/s		per 1.0		Load Meter/s	Y
	Travel							
	Mode:	Unlimited	-					
Axis State:								
Aus State.								
Manual Tune					ОК	Cancel	Apply	Help

Figure 80 - Example 5: Frequency Control with No Feedback, Scaling Dialog Box Conversion Units

- 7. From the Load Type pull-down menu, choose the appropriate load type.
- 8. Enter the Transmission Ratio.
- 9. From the Actuator Type pull-down menu, choose the appropriate actuator.
- 10. Enter the Diameter dimensions.
- 11. Enter the Scaling Units.

See the <u>Scaling on page 222</u> for more information.

- 12. From the Travel Mode pull-down menu, choose the appropriate travel mode.
- 13. Click Apply.

You are now finished configuring the axis for Frequency Control with No Feedback.

Example 6: Torque Loop with Feedback

In this example, you are configuring the axis for Torque Loop with feedback.

- 1. Once you have created the AXIS_CIP_DRIVE axis, open the Axis Properties.
- 2. From the Axis Configuration pull-down menu, choose Torque Loop.
- 3. From the Feedback Configuration pull-down menu, choose Motor Feedback.

X Axis Properties - Power	Flex_TL		
Categories:			
General General	General		
Motor Model Malyzer Motor Feedback	Axis Configuration: Feedback Configuration:	Torque Loop Motor Feedback	Defines the controller Control Mode. See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication, <u>MOTION-RM003</u> .
Hookup Tests			
Polarity Compliance Torque/Current Loop Homing Actions Drive Parameters	Assigned Group Motion Group: Update Period:	MG • 2.0	New Group
- Parameter List - Status - Status - Faults & Alarms - Tag	Associated Module Module: Module Type: Power Structure: Axis Number:	PF755_Torque_Feedback PowerFlex 755-EENET-CM-S1 240V, 4.2A, Normal Duty, Standard 1	Displays the type of drive you selected and power structure you assigned via the PowerFlex 755 drive Module Properties. See <u>Add a PowerFlex 755 Drive on page 99</u> .
Avis State:	The newly created PowerFlex 755 dr name is the default. The Axis Numbe 1, indicating the primary axis of the Number 2 is used only for configurin Feedback Only axis.	r defaults to drive. Axis	
Manual Tune		ОК	Cancel Apply Help

Figure 82 - Example 6: Torque Loop with Motor Feedback, Motor Dialog Box

🍄 Axis Properties - Power	Flex_TL					- • ×
Categories:						
* General	Motor Device Specifi	cation				
* 🖃 ··· Motor ···· Model	Data Source:	Nameplate Datas	sheet 💌	F	Parameters	
Analyzer Motor Feedback	Catalog Number:	<none></none>		Change Catalog		
Scaling	Motor Type:	Rotary Induction	-			
Hookup Tests Polarity	Units:	Rev				
E Load	Nameplate / Dat	asheet - Phase	to Phase paramete	rs		
Torque/Current Loop	Rated Power:	0.0	kW	Pole Count:	4	
* Homing	Rated Voltage:	0.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
Drive Parameters	Rated Speed:	0.0	RPM			
Parameter List	Rated Current:	0.0	Amps (RMS)			
				Motor Overload Limit:	100.0	% Rated
Tag						
Axis State:						
Manual Tune				ОК С	Cancel	Apply Help

Axis Properties - Power	lex_TL			
Categories:	Motor Feedback Device Sp	vecification		
General Model Model Model Model Model Model Model Notor Feedback Scaling Hockup Tests Polarity Load Load Load Compliance Torque-Current Loop Homing Actions Drive Parameter Status Faulte & Alams Tag	Device Function: Feedback Channel: Type: Units:	Notor Mounted Feedback Feedback 1 Not Specified Digtal AgB Brank Cenne Enfort 2:1 ESPU 2:2 Stahl 551	Parametes	
Axis State:		0	K Cancel Apply	Help

Figure 83 - Example 6: Torque Loop with Motor Feedback, Feedback Type

4. From the Type pull-down menu, choose the appropriate feedback type.

Figure 84 - Example 6: Torque Loop with Motor Feedback, Feedback Type

ntering Axis Properties - Pow	erFlex_TL			- • •
Categories:	Motor Feedback Device Spe	cification		
Corola C	Device Function: Feedback Channel: Type: Units: Sine/Cosine Cycle Resolution:	Motor Mounted Feedback 1 Sine/Cosine Rev 1024 1024 1048576 Incremental ▼	ack Parameters Feedback Cycles/Rev Feedback Counts per Cycle Feedback Counts per Rev	
Axis State: Manual Tune			OK Cancel App	ly Help

- General	Scaling to Convert I	Motion from	Controll	er Units to Use	r Defined Un	its		
Motor Model Analyzer	Load Type: Transmission Batio 1:0:	Direct Coup Direct Coup Rotary Tran Linear Actu	iled Rota led Rotar		Bev	_	Parameters	_
Scaling		Linear Actu	ator	6	nev			
····· Hookup Tests ····· Polarity	Actuator	<none></none>		~				
Load	Lead:	1.0		Millimeter/Re				
Compliance Torque/Current Loop	Diameter:	1.0		Millimeter				
····· Homing ····· Actions	Scaling							
Drive Parameters	Units:	Position Uni	ts					
Parameter List	Scaling:	1.0		Position Units	per	1.0	Motor Rev	-
Faults & Alarms	Travel							_
Tag	Mode:	Unlimited	•					
	Range:	1000.0		Position Units				
	Unwind:	1.0		Position Units	per	1.0	Cycle	
	Soft Trave	Limits						
	Maximur	n Positive:	0.0	F	osition Units			
	Maximur	n Negative:	0.0	F	osition Units			

Figure 85 - Example 6: Torque Loop with Motor Feedback, Scaling Load Type

5. From the Load Type pull-down menu, choose the appropriate load type.

Figure 86 - Example 6: Torque Loop with Motor Feedback, Scaling Conversions

۵	Axis Properties - PowerF	lex_TL									
C	tegories:										
*	General	Scaling to Convert	Aotion from (Controlle	r Units to U	lser Defin	ed Uni	its			
*	E- MOLOI										
	Model	Load Type:	Rotary Tran	smission	•				Paramet	ers	
*	Analyzer Motor Feedback	Transmission									-
*		Ratio I:O:	1		: 1		Rev				
	Hookup Tests	Actuator									_
	- Polarity	Type:	<none></none>		-						
	E-Load	Lead:	1.0		Millimeter/F	Rev 🔻					
	- Torque/Current Loop	Diameter:	1.0		Millimeter						
	- Homing		1.0		willimeter	*					
	- Actions	Scaling Units:	-								_
	 Drive Parameters Parameter List 	Units:	Position Unit	-							
	- Status	Scaling:	1.0		Position Units		per	1.0		Load Rev	Ŧ
	- Faults & Alarms	Travel									
	- Tag	Mode:	Unlimited	•							
		Range:	1000.0		Position Units						
		Unwind:	1.0		Position Units		per	1.0		Cycle	
		🔄 Soft Travel	Limits								
		Maximun	Positive:	0.0		Position U	Inits				
		Maximun	Negative:	0.0		Position U	Inits				
L											
A	is State:										
						_		_			
I	lanual Tune						ОК		Cancel	Apply	Help

- 6. Enter the Transmission Ratio.
- 7. Enter the Scaling Units.
- 8. From the Travel Mode pull-down menu, choose the appropriate travel mode.

See the <u>Scaling on page 222</u> for more information.

9. Click Apply.

You are now finished configuring the axis for Torque Loop with Motor Feedback.

Axis Configuration Examples for the PowerFlex 527 Drive

Торіс	Page
Example 1: Frequency Control with No Feedback	210
Example 2: Velocity Control with Motor Feedback	214
Example 3: Position Control with Motor Feedback	217

This chapter provides example axis configurations when using a PowerFlex[®] 527 drive.

The following examples are typical axis-configuration applications for the PowerFlex 527 drive:

- Frequency Control with No Feedback
- Velocity Control with Motor Feedback
- Position Control with Motor Feedback

Example 1: Frequency Control with No Feedback

The PowerFlex 527 drives support basic Volts/Hertz (V/Hz), Fan/Pump Volts/ Hertz, Sensorless Vector Control (SVC), and Sensorless Vector Control (SVC) Economy frequency control methods.

Follow these steps to configure the induction motor axis properties.

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

The General and Associated Module dialog box appears.

Figure 87 - Example 1: Frequency Control with No Feedback, General Dialog Box

Axis Properties - Axis_1			×
Categories:			
Categories: - General - Mode - Mode - Analyzer * - Scaing - Polanty - Planner - Frequency Control - Actions - Drive Parameters - Parameter List - Status - Faults & Alams - Tag	General Axis Configuration: Feedback Configuration: Assigned Group Motion Group: Update Period: Associated Module Module: Module: Nodule: Power Structure: Axis Number:	Frequency Control No Feedback UM_Motion 2.0 Drive_4 PowerRex 527-STO CIP Safety 25C-V-2P5 1	
Axis State:	Safety State:		
Manual Tune	sarty state.	OK Cancel Appl	y Help

- 3. From the Axis Configuration pull-down menu, choose Frequency Control.
- 4. From the Module pull-down menu, your PowerFlex 527 drive.

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

5. Click Apply.

6. Select the Motor category.

The Motor Device Specification dialog box appears.

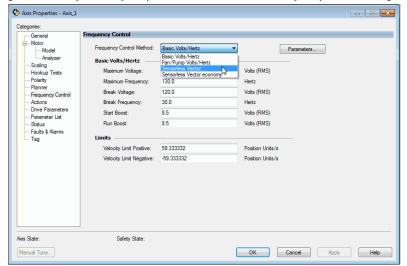
Figure 88 - Example 1: Frequency Control with No Feedback, Motor Device Specification Dialog Box

Axis Properties - Axis_1 Categories:						
* General	Motor Device Specifi	cation				
Motor Model Analyzer Scaling Hookup Tests Polarity Planner Frequency Control	Data Source: Catalog Number: Motor Type: Units:	Nameplate Data <none> Rotary Induction Rev</none>		Change Catalog	Parameters	
- Actions - Orive Parameter - Parameter List - Status - Faults & Alarms - Tag	Rated Power: Rated Voltage: Rated Speed: Rated Current:	1.0 460.0 1780.0 3.2	to Phase parameter kW Vots (RMS) RPM Amps (RMS)	rs Pole Count: Rated Frequency: Motor Overload Limit:	4 60.0	Hertz % Rated
Axis State:	Safety Sta	te:				
Manual Tune				ОК	Cancel	Apply Help

- 7. From the Data Source pull-down menu, choose Nameplate data sheet. This selection is the default setting.
- 8. From the Motor Type pull-down menu, choose Rotary Induction.
- 9. From the motor nameplate or data sheet, enter the phase-to-phase values.
- 10. Click Apply.
- 11. Select the Frequency Control category.

The Frequency Control dialog box appears.

Figure 89 - Example 1: Frequency Control with No Feedback, Frequency Control Dialog Box



12. From the Frequency Control Method pull-down menu, choose the method appropriate for your application.

13. If you chose the Basic Volts/Hertz method, enter the nameplate data for your motor in the Basic Volts/Hertz fields.

If you chose the Sensorless Vector method, the Basic Volts/Hertz fields are dimmed.

- 14. Click Apply.
- 15. If you chose the Sensorless Vector or Sensorless Vector Economy method, select the Motor > Analyzer category.
- 16. The Analyze Motor to Determine Motor Model dialog box appears.

Figure 90 - Example 1: Frequency Control with No Feedback, Analyze Motor to Determine Motor Model Dialog Box

Axis Properties - Axis_1					
Categories:					
	nalyze Motor to Determine Motor Model				
Motor Model Analyzer Scaling Hookup Tests	Dynamic Motor Test Static Motor Test Calc Start Stop Stop Stop	ulate Model			
Polarity Planner Frequency Control Actions	Test State:		1		
Drive Parameters Parameter List Status	Model Parameters	Current		Test Results	
Faults & Alams	Motor Stator Resistance:		Ohms	Ohms	
Tag	Motor Stator Leakage Reactance:		Ohms	Ohms	
	-			Ohms	
	Motor Rotor Leakage Reactance:		Ohms		
	Motor Flux Current:		Amps	Amps	
	Rated Slip Speed:	20.0	RPM	RPM	
	Accept Test Results				
Avis State:	Safety State:				
Manual Tune			OK	Cancel Apply	Help

- 17. Click the Static Motor Test tab.
- 18. To run the test and measure Motor Stator Resistance, click Start. If you choose the Basic Volts/Hertz category, you can skip this test.

Some out-of-box settings must be applied here. See <u>Appendix C</u>, <u>PowerFlex* 527 Out-of-Box Configuration on page 339</u> for more information.

19. Select the Actions category.

The Actions to Take Upon Conditions dialog box appears.

Figure 91 - Example 1: Frequency Control with No Feedback, Actions to Take Upon Conditions **Dialog Box**

General	Actions to Take Upon Conditions			
- Motor	our and a second second			
Model	Stop Action: Current Decel & Disa	ble 🔻		Parameters
Analyzer				
Scaling				
Hookup Tests	Inverter Overload Action: <none></none>	-		
Polarity	Power Loss Action: Disable & Coast	•		
Planner	unders a doda			
Frequency Control				A DANGER: Modifying Exception
Actions				Action settings may require
Drive Parameters	Exceptions			programmatically stopping or
Parameter List				disabling the axis to protect
Status	Exception Condition	Action		personnel, machine, and property.
Faults & Alarms	Bus Overvoltage Factory Limit	StopDrive 🖉		Refer to user manual for additional
Tag	Bus Power Loss	StopDrive 🖉	Ī	information.
	Bus Regulator Thermal Overload Factory Li	mit StopDrive 🖉]	1
	Bus Undervoltage User Limit	StopDrive 🖉	I	
	Control Module Overtemperature Factory Li	mit StopDrive 🖉	J.	
	Converter AC Single Phase Loss	StopDrive 🖉	I	
	Converter Ground Current Factory Limit	StopDrive 🖉	J	
	Converter Pre-Charge Failure	StopDrive 🖉	I	
	Decel Override	StopDrive 🖉		
	Enable Input Deactivated	StopDrive 🖉		
	Excessive Position Error	StopDrive 🖉		
	Excessive Velocity Error	StopDrive 🖉		Page Number
	1			

From this dialog box, you can program actions and change the action for exceptions (faults). See the PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u> for more information.

Some out-of-box settings must be applied here. See <u>Appendix C</u>, PowerFlex® 527 Out-of-Box Configuration on page 339 for more information.

20. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.

Pa	arameter Group:	Al	•	Associated Page	
E	Name			Associated Page	
E		Δ	Value	Unit	7.
	ActuatorDiameter		1.0		
	ActuatorDiameterUnit		Millimeter		
	ActuatorLead		1.0		
	ActuatorLeadUnit		Millimeter/Rev		
Г	ActuatorType		<none></none>		
	AverageVelocityTimebase		0.25	S	
	BreakFrequency		30.0	Hz	
	BreakVoltage				
_ L	ConversionConstant		100000.0		
	CurrentVectorLimit				
_ L					
L					
_ L					
L					
L					
_ L					
L					
L					
L	MaximumAcceleration		2.0766666	Position Units/s ²	
		A chuatori, eaduint A chuatori yee A verage Velocity Timeba Breal Frequency Breal Votage Conversion Constant Current Votori, and Frequency Controlletho Induction Motor That-defre Induction Motor That-defre Induction Motor That-defre Induction Motor That-defre Induction Motor That-defre	A clustor LeadUnit A clustor Type A verage Velocity Timebase BreakFrequency BreakVotage ConversionConstant CurrentVectorLimit FrequencyControlNethod InductionMotorFlucturrent InductonMotorFlucturrent InductonMotorFlucturrent InductonMotorRotorLeakageReactance InductonMotorRotorLeakageReactance InductonMotorStatorResistance InductonMotorStatorResistance	Actuatort.esdUnit Millimeter/Rev ActuatorType ActuatorType AverageVincelyTimebase 0.25 Break/requency 30.0 Break/requency 30.0 Break/requency 30.0 ConversionConstant 100000.0 CurrentVectorLimit 100.0 InductionMotorFluxCurrent 0.0 InductionMotorRotre.esageReactance 0.0 InductionMotorRotre.esageReactance 0.0 InductionMotorStatorRestance 0.0 InductonMotorRotre.esageReactance 0.0 InductonMotorRotre.esageReactance 0.0 InductonMotorStatorRestance 0.0 InductorRotre.esageReactance 0.0 InductorRotre.esageReactance 0.0 InductorRotre.esageReactance 0.0 InductorRotrestanceStatorRestance 0.0 InductorRotrestanceStatorRestance 0.0 InductorRotrestatorRestance 0.0 InductorRotrestanceStatorRestance 0.0 InductorRotrestanceStatorRestance 0.0 InductorRotrestan	Actuator/Lead/unit Millimeter/Rev Actuator/Type <none> Actuator/Type <none> Average/Velocht/Timebase 0.25 Break/Requency 300 Break/Requency 300 Break/Requency 1000 Votas (RMS) ConversionConstant CurrentVectorLimit 1000 FrequencyControlMethod Sensoriess Vector InductionMotorFlucturent 0.0 MudcionMotorRuled/ESpeed 200 MudcionMotorRuled/Speed 00 MudcionMotorStatorResistance 0.0 MudcionMotorStatorResistance 0.0 Werter/Overbad/Action crone> Load/T</none></none>

From this dialog box, you can program actions and change the action for exceptions (faults). See the PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u> for more information.

Example 2: Velocity Control

with Motor Feedback

To obtain the best performance from the drive, regardless of which control method you are using, configure the recommended out-of-box settings. These settings are described in <u>Appendix C</u>, <u>PowerFlex* 527</u> <u>Out-of-Box Configuration on page 339</u>.

- 21. Click OK.
- 22. Repeat steps $1 \dots 21$ for each induction motor axis.

Follow these steps to configure the induction motor axis properties.

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

The General and Associated Module dialog box appears.

Figure 93 - Example 2: Velocity Control with Motor Feedback, General Dialog Box

Axis Properties - Axis_1			- • •
Categories:			
* General	General		
Mate Model Analyzer Model Analyzer Mator Feedback Scaling Holokup Tests Polarty Autoure Load Load Load Moming Drove Parameters Pranneter List Status Faults & Alems Tag	Aris Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group: Update Period: Associated Module Module Type: Power Structure: Aris Number:	Velocity Loop Motor Feedback Basic Medum UM_Motion 2.0 Im Drive_4 PowerRex 527-STO CIP Safety 25C-V-2P5 1 Velocity Television 1 Velocity Loop New Group	
Axis State:	Safety State:		
Manual Tune		OK Cancel App	ly Help

- 3. From the Axis Configuration pull-down menu, choose Velocity Loop.
- 4. From the Module pull-down menu, your PowerFlex 527 drive.

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

5. Click Apply.

6. Select the Motor category.

The Motor Device Specification dialog box appears.

Figure 94 - Example 2: Velocity Control with Motor Feedback, Motor Device Specification Dialog Box

Data Source:					
bata obaroo.	Nameplate Data	sheet 💌	F	arameters	
Catalog Number:	<none></none>		Change Catalog		
Motor Type:	Rotary Induction	-			
Units:	Rev				
Nameplate / Dat	asheet - Phase	to Phase parameters			
Rated Power:	0.025	kW	Pole Count:	4	
Rated Voltage:	230.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
Rated Speed:	1600.0	RPM			
Rated Current:	0.25	Amps (RMS)			
			Motor Overload Limit:	100.0	% Rated
	Motor Type: Units: Nameplate / Data Rated Power: Rated Voltage: Rated Speed:	Motor Type: Rotary Induction Units: Rev Nameplate / Datasheet - Phase Rated Power: 0.025 Rated Voltage: 230.0 Rated Speed: 1600.0	Motor Type: Relative induction Units: Rev Rated Power: 0.025 Rated Power: 0.025 Rated Votage: 230.0 Vots (RMS) Reted Speed:	Motor Type: Rotary Induction Units: Rev Rated Power: 0.025 Rated Power: 0.025 Rated Voltage: 20.0 Voltage: 0.026 Rated Seed: 1600.0 Rated Current: 0.281 Amps (RIMS) Amps (RIMS)	Motor Type: Rotary Induction Units: Rev Nameplate / Datasheet - Phase to Phase parameters Rated Power: 0.225 Rated Voltage: 223.0 Volts (RMS) Rated Frequency: 60.0 RPM Rated Current: 0.28 Amps (RMS) Amps (RMS)

- 7. From the Data Source pull-down menu, choose Nameplate data sheet. This selection is the default setting.
- 8. From the Motor Type pull-down menu, choose Rotary Induction.
- 9. From the motor nameplate or data sheet, enter the phase-to-phase values.
- 10. Click Apply.
- 11. Select the Motor Feedback category.

Figure 95 - Example 2: Velocity Control with Motor Feedback, Motor Feedback Device Specification Dialog Box

🏷 Axis Properties - Axis_1						
Categories:	Motor Feedback Device Specification					
Hodor Hodor Hodol Analyzer Analyzer Analyzer Analyzer Analyzer Analyzer Analyzer Caraling Actourse Load Compliance Velocity Loop Torque/Current Loop Plannee Horing Actions Onvie Parameters Parameter List Satus Faults Alams Tag	Device Function: Feedback Channel: Type: Units: Digital Aq8 Cycle Resolution: Oycle Interpolation: Effective Resolution: Startup Method:	4 Feedback	Cycles/Rev c Cycles/Rev c Courts per Cycle c Courts per Rev			
Axis State: Manual Tune	Safety State:	C	OK Cancel Apply	Help		

- 12. Enter the specifications of your encoder into the fields.
- 13. Click Apply.

- 14. Select the Scaling category and edit the values as appropriate for your application.
- 15. If you changed any settings, click Apply.
- 16. Select the Actions category.

The Actions to Take Upon Conditions dialog box appears.

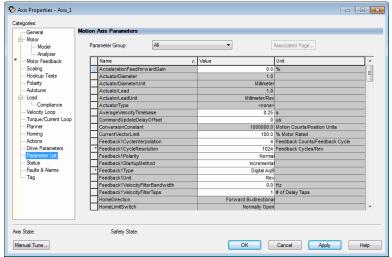
From this dialog box, you can program actions and change the action for exceptions (faults).

Some out-of-box (OOB) settings must be applied here. See <u>Appendix C</u> on <u>page 339</u> for more information.

17. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.





From this dialog box, you can program actions and change the action for exceptions (faults). See the PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u> for more information.

To obtain the best performance from the drive, regardless of which control method you are using, configure the recommended out-of-box settings. These settings are described in the PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u>.

- 18. Click OK.
- 19. Repeat steps $1 \dots 18$ for each induction motor axis.

Example 3: Position Control with Motor Feedback

Follow these steps to configure the induction motor axis properties.

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

The General and Associated Module dialog box appears.

Figure 97 - Example 3: Position Control with Motor Feedback, General Dialog Box

Axis Properties - Axis_1			
Categories:			
*General	General		
Constant Model Mod	Avis Configuration: Feedback Configuration: Application Type: Loop Response: Assigned Group Motion Group: Update Period: Associated Module Module: Module Type: Power Structure: Avia Number:	Postion Loop • Mator Feedback • Basic • Medum • UM_Mation • 2.0 • Drive_4 • PowerRex 527-STO CIP Safety 25C-V-2P5 1 •	
Axis State:	Safety State:		
Manual Tune		OK Cancel Apply	Help

- 3. From the Axis Configuration pull-down menu, choose Position Loop.
- 4. From the Module pull-down menu, your PowerFlex 527 drive.

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

- 5. Click Apply.
- 6. Select the Motor category.

The Motor Device Specification dialog box appears.

Figure 98 - Example 3: Position Control with Motor Feedback, Motor Device Specification Dialog Box

General	Motor Device Specif	ication				
Motor	Data Source:	Nameplate Data	isheet 🔻	-	Parameters	
Analyzer	Catalog Number:	<none></none>		Change Catalog		
Motor Feedback	Motor Type:	Rotary Induction				
Hookup Tests	Units:	Rev	••			
Autotune	Nameplate / Dat	asheet - Phase	to Phase parameter	·s		
- Load	Rated Power:	0.025	kW	Pole Count:	4	
Compliance	Rated Voltage:	230.0	Volts (RMS)	Rated Frequency:	60.0	Hertz
Position Loop	Rated Speed:	1600.0	RPM			
Torque/Current Loop	Rated Current:	0.25	Amps (RMS)			
Planner		0120	11100 (1110)	Motor Overload Limit:	100.0	% Rated
Homing Actions						
Drive Parameters						
Parameter List						
Faults & Alarms						
Tag						

- 7. From the Data Source pull-down menu, choose Nameplate data sheet. This selection is the default setting.
- 8. From the Motor Type pull-down menu, choose Rotary Induction.
- 9. From the motor nameplate or data sheet, enter the phase-to-phase values.
- 10. Click Apply.
- 11. Select the Motor Feedback category.

Figure 99 - Example 3: Position Control with Motor Feedback, Motor Feedback Device Specification Dialog Box

🏷 Axis Properties - Axis_1				
Categories:		_		
Celegories: General Motor Motor Motor Motor Motor Scaling Hookup Tests - Polatry - Autoture - Load - Dasklash - Complance - Postion Loop - Valcody Loop - Valcody Loop - Valcody Loop - Torque-Currert Loop - Ponning - Actions - Drive Parameter List - Status - Faults & Alams - Tag	Motor Feedback Device Spec Device Function: Feedback Channel: Type: Units: Digital Ag8 Cycle Resolution: Cycle Resolution: Effective Resolution: Startup Method:	Affication Motor Mounted Feedb Feedback 1 Digital AgB Rev 1024 4 4096 Incremental •	ack Parameters	
Axis State: Manual Tune	Safety State:		OK Cancel App	ly Help

- 12. Enter the specifications of your encoder into the fields.
- 13. Click Apply.
- 14. Select the Scaling category and edit the values as appropriate for your application.

Figure 100 - Example 3: Position Control with Motor Feedback, Scaling to Convert Motion from Controller Units to User-defined Units Dialog Box

Giornoliai	Scaling to Convert	Motion from	Controller	Units to U	ser Defined Ur	nits		
Motor Model Motor Feedback	Load Type: Transmission	Rotary Tran Direct Coup Rotary Tran	led Rotary	-			Parameters	
* Scaling	Ratio I:0:	Linear Actu	ator	~3	Rev			
Hookup Tests	Actuator							
···· Polarity		<none></none>		-				
Autotune		1.0		Milimeter/F	ev 👻			
Backlash		1.0		Milmeter				
Compliance		1.0		IVIIIIIIIELEI				
Position Loop	Scaling							
Velocity Loop	Units:	Position Uni	ts					
Torque/Current Loop Planner	Scaling:	1.0	F	osition Units	per	1.0	Load Rev	-
Homing	Travel							
Actions	Mode:	Unlimited	•					
Drive Parameters Parameter List		1000.0	F					
Status		1.0				1.0		
Faults & Alarms						1.0		
· Tag	Soft Trave	l Limits						
			0.0					
			0.0					
xis State:	Safety S							

15. If you changed any settings, click Apply.

16. Select the Actions category.

The Actions to Take Upon Conditions dialog box appears.

Figure 101 - Example 3: Position Control with Motor Feedback, Actions to Take Upon Conditions Dialog Box

Polaty Addruce Ad	General	Actions to Take Upon Con	ditions				
Congination Invetor Overload Action: orone> orone>	Model	Stop Action:	Current Decel & Disable	•		Parameters	
Additione Additione Additione Additione Additione Additione Backdash Compliance Exceptions Exception Condition Action Action Action Compliance Action Bus Breaker Action Bus Breaker Action Bus Action Action	Motor Feedback Scaling Hookup Tests			•			
Pottoriu Logo Exception Condition Action Action personnel, machine, and properly. Velocity Logo Buis Power Loss StopDrive Image: Construct Construction Refer to user manual for additional information. Planner Buis Power Loss StopDrive Image: Construction Refer to user manual for additional information. Planner Buis Regulator Thermail Overload Factory Limit StopDrive Image: Construction Construct	Autotune Load Backlash	Exceptions				Action settings may programmatically st	y require topping or
		Exception Condition		Action		personnel, machin	e, and property.
Torque/Current Loop Planner Parner Bus Regulator Thermal Overload Factory Limt StopDrive ■ Information Bus Regulator Thermal Overload Factory Limt StopDrive ■ Information Bus Indervictage User Limt StopDrive ■ Information Bus Indervictage User Limt StopDrive ■ Information Inf		Bus Overvoltage Fac	tory Limit	StopDrive	-	Refer to upor man	al for additional
Planner Planner Bus Regulator Thermal Overlad Pactory Limit StopDrive w Homing Bus Undervotage User Linit StopDrive soporter Converter AC Single Plase Loss StopDrive v Drive Parameter Converter AC Single Plase StopDrive w Stabus Converter Paccharge Palure StopDrive w Stabus Converter Paccharge Palure StopDrive w Tag Enable Input Deschvated StopDrive w Tag				StopDrive			
Honing Bus Underviculage User Linit StopOrive Control Module Overtemperature Factory Linit StopOrive Control Module Overtemperature StopOrive Converter AC Single Phase Loss StopOrive StopOrive StopOrive StopOrive Converter AC Single Phase StopOrive StopOrive Converter Pro-Charge Faulte StopOrive StopOrive StopOrive Converter Pro-Charge Faulte StopOrive StopOrive Converter Pro-Charge Faulte StopOrive Converter Pro-Charge Faulte StopOrive Converter Tag Enable Input Desctivated StopOrive Converter StopOrive Conver		Bus Regulator Therm	al Overload Factory Limit	StopDrive		1	
Autom Control Module Overtemperature Factory Limit StopDrive w Ome Parameter Los Single Phase Loss StopDrive w Parameter List Converter Sround Current Factory Limit StopDrive w Statu Converter Pre-Change Faiure StopDrive w Faunde Admain Deed Override StopDrive w Tag Enable Input Deschvated StopDrive w	Homing	Bus Undervoltage Us	er Limit	StopDrive			
Drive Parameters Converter AC Single Phase Loss StopDrive ✓ Parameter Lit Converter AC Single Phase Loss StopDrive ✓ Status Converter Pre-Charge Paire StopDrive ✓ -Faxds & Alams Decel Override StopDrive ✓ Tag Enable Input Desctivated StopDrive ✓	Actions	Control Module Overt	emperature Factory Limit	StopDrive			
Parameter List Converter Ground Current Factory Limit StopDrive Status Converter Pre-Charge Failure StopDrive StopDrive Tag Tag Enable Input Deschated StopDrive v							
Status Converter Pre-Charge Falure StopOnive Fauts & Alarms Decel Override StopOnive Tag Enable Input Deactorated StopOnive Excessive Position Error StopOnive	Parameter List			StopDrive			
Faults & Nama Decel Override StopDrive Tag Enable Input Desctivated StopDrive Excessive Position Error	Status			StopDrive			
Tag Enable Input Deactivated StopDrive Excessive Position Error StopDrive	- Faults & Alarms	Decel Override		StopDrive			
Excessive Position Error StopDrive	Tag	Enable Input Deactiva	ted	StopDrive			
		Excessive Position Er	ror	StopDrive			
		Excessive Velocity Er	rror	StopDrive			

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

Some out-of-box (OOB) settings must be applied here. See <u>Appendix C</u>, <u>PowerFlex* 527 Out-of-Box Configuration on page 339</u> for more information.

17. Select the Parameter List category.

The Motion Axis Parameters dialog box appears.

Figure 102 - Example 3: Position Control wit	th Motor Feedback, Motion Axis Parameters Dial	og
Box		

General Mo	otion Axis Parameters				
Motor Model Analyzer	Parameter Group:	All	•	Associated Page	
Motor Feedback	Name	۵	Value	Unit	1
Scaling	AccelerationFeedfory	ardGain	0.0	96	
Hookup Tests	ActuatorDiameter		1.0		- 8
Polarity	ActuatorDiameterUnit		Millimeter		
Autotune	ActuatorLead		1.0		
Load	ActuatorLeadUnit		Millimeter/Rev		
Backlash	ActuatorType		<none></none>		
Compliance	AverageVelocityTimet	ase	0.25	s	
Position Loop	BacklashReversalOff	set	0.0	Position Units	
Velocity Loop	CommandUpdateDelay	Offset	0	us	
Torque/Current Loop	ConversionConstant		100000.0	Motion Counts/Position Units	
Planner	CurrentVectorLimit		100.0	% Motor Rated	
Homing	Feedback1CycleInterp	olation	4	Feedback Counts/Feedback Cycle	
Actions	Feedback1CycleReso	lution	1024	Feedback Cycles/Rev	
Drive Parameters	Feedback1Polarity		Norma		
Parameter List	Feedback1StartupMet	hod	Incrementa		
Status	Feedback1Type		Digital AqB		
Faults & Alarms	Feedback1Unit		Rev		
Tag	Feedback1VelocityFilt		159.15492		
	Feedback1VelocityFilt	erTaps		# of Delay Taps	
	HomeDirection		Forward Bi-directional		-
State:	Safety State:				

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

To obtain the best performance from the drive, regardless of which control method you are using, configure the recommended out-of-box settings. These settings are described in <u>Appendix C</u> on <u>page 339</u>.

- 18. Click OK.
- 19. Repeat steps $1 \dots 18$ for each induction motor axis.

Commission an Axis

Торіс	Page
Scaling	222
Hookup Tests	226
Polarity	235
Autotune	235
Load	239
Load Observer	241
Adaptive Tuning	243
Load Ratio Data from Motion Analyzer	249
Test an Axis with Motion Direct Commands	249

This chapter discusses how to commission an axis for a motion application. Commissioning includes the following:

- Off-line Scaling settings
- How to download a project
- How to run a Hookup Test
- How to perform Tuning
- How to use the Motion Direct Commands

You must commission the axis after you have followed the steps in these sections:

Section	Page
Configure Integrated Motion Control Using Kinetix Drives	21
Configure Integrated Motion Control Using Kinetix 5700 Drives	59
Configure Integrated Motion Using a PowerFlex 755 Drive	99
Configure Integrated Motion Using a PowerFlex 527 Drive	129

Scaling

Axis motion can be specified in whatever units you want. In the Scaling dialog box, you configure the motion control system to convert between raw internalmotion units. For example, Feedback Counts or Planner Counts can be converted to your preferred unit of measure, be it revolutions, degrees, meters, or inches.

This conversion involves three key Scaling Factor attributes, Conversion Constant, Motion Resolution, and Position Unwind. If you use the Scaling dialog box, the software calculates the Scaling Factors for you. The only task that you do is select the Load Type that best matches the mechanical linkage between the motor and the load.

There are four Load types:

- Direct Coupled Rotary The load is directly coupled to the linear motor moving mass.
- Direct Coupled Linear The load is directly coupled to the linear motor moving mass.
- Rotary Transmission The rotational load is coupled to the motor through a geared transmission.
- Linear Actuator

The linear load is coupled to a rotary motor through a rotary to linear mechanical system.

This figure shows the default Scaling dialog box for a Direct Coupled Rotary load type. By default, the Scaling dialog box is set for 1 'Position Unit' per Motor Rev.

🗞 Axis Properties - CIPAxis										- • •
Categories:										
Gronieran	Scaling to Convert I	Aotion from (Controller	Units to U	ser Defin	ed Uni	its			
Motor Model	Load Type:	Direct Coup	led Rotary	•				Parame	ters	
Motor Feedback	Transmission									
<mark>Scaling</mark> Polarity	Ratio I:0:	1		1		Rev				
Autotune	Actuator									_
Load	Type:	<none></none>		-						
Position Loop	Lead:	1.0		Millimeter/F	ev 👻					
Velocity Loop	Diameter:	1.0		Millimeter	~					
Torque/Current Loop Planner	Scaling									
Homing	Units:	Position Uni	s							
Actions Drive Parameters	Scaling:	1.0	P	osition Units		per	1.0		Motor Rev	Y
Parameter List	Travel									
Status Faults & Alarms	Mode:	Unlimited	•							
Tag	Range:	1000.0	F	osition Units						
	Unwind:	1.0	F	osition Units		per	1.0		Cycle	
	Soft Travel	Limits								
	Maximur	Positive:	0.0		Position U	Inits				
	Maximum	Negative:	0.0		Position U	Inits				
Axis State:										
Manual Tune						OK		Cancel	Apply	Help

When you click Parameters, you see values for the Conversion Constant and the Motion Resolution, each having a value of 1 million. These values are generated from the software calculator.

;General	Motion Axis Parameters				
- Motor Model	Parameter Group:	Scaling	•	Associated Page	
Motor Feedback	r arameter Group.	Cooming		addition 1 age	
Scaling	Name	Δ	Value	Unit	
Polarity	ActuatorDiameter		1.0		
Autotune	ActuatorDiameterUni	t	Millimeter		
- Load	ActuatorLead	•	1.0		
Backlash	ActuatorLeadUnit		Millimeter/Rev		
Position Loop	ActuatorType		<none></none>		
····· Velocity Loop	ConversionConstant		100000.0	Motion Counts/Position Units	
Torque/Current Loop	LoadType		Direct Coupled Rotary		
···· Planner	MotionResolution		> 1000000	Motion Counts/Motor Rev	
····· Homing	MotionScalingConfigu	ration	Control Scaling		
···· Actions	MotionUnit		Motor Rev		E
···· Drive Parameters	PositionScalingDenor	ninator	1.0	Motor Rev	
····· Parameter List	PositionScalingNume	rator		Position Units	
···· Status	PositionUnits		Position Units		
Faults & Alarms	PositionUnwind			Motion Counts/Unwind Cycle	
IIII Tag	PositionUnwindDeno			Unwind Cycles	
	PositionUnwindNume	rator		Position Units	
	ScalingSource		From Calculator	/	
	SoftTravelLimitCheck		No		
	SoftTravelLimitNegat			Position Units	
	SoftTravelLimitPositiv	'e	0.0	Position Units	*
xis State:					

In most cases, the software scaling calculator generates Scaling Factor values that are suitable for the application. But in rare cases, like applications that require online product recipe changes, you can set the Scaling Source attribute to Direct Scaling Factor Entry. This attribute allows you to enter the Scaling Factors.

Direct Coupled Rotary

For a Direct Coupled Rotary load type, you can express Scaling Units for the rotary motor, for example, Degrees.

Here is an example of Direct Coupled Rotary load that is scaled in Degrees and the resulting values for the Conversion Constant and Motion Resolution.

Units:	Degrees					
Scaling:	360	Degrees	per	1.0	Motor Rev	
ConversionCo	nstant		10	100.0 Ma	tion Counts/Degrees	
ConversionCo LoadType	nstant	Dire	10 ct Coupled Rota		tion Counts/Degrees	

Direct Coupled Linear

For a Direct Coupled Linear load type, you can express Scaling Units for the linear motor, for example, Inches.

Here is an example of Direct Coupled Linear load that is scaled in Inches and the resulting values for the Conversion Constant and Motion Resolution.

Scaling						- 1
Units:	Units: Inches					
Scaling:	1.0	Inches	per	25.4	Motor Rev	-
						_
ConversionCo	onstant		254000	000.0 Motion	Counts/Inches	
LoadType		Di	irect Coupled Rota	ary		
MotionResolut	tion		100	0000 Motion	Counts/Motor Rev	

For more information about Conversion Constant and Motion Resolution, see the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.

Rotary Transmission

For a Rotary Transmission load type, you enter the Transmission ratio mechanical system. When you allow the software scaling calculator to compute the Scaling Factors by using the Transmission Ratio, it reduces the risks of cumulative errors due to irrational numbers.

Here is an example of Rotary Transmission load that is scaled in Packages (three packages per Load Revolution) and the resulting values for the Conversion Constant and Motion Resolution.

🏷 Axis Properties - CIPAxis					
Categories:					
General	Scaling to Convert Mo	ation from Control	ler Units to User	Defined Units	
Motor Model	Load Type:	Rotary Transmission	•		Parameters
Motor Feedback	Transmission — Batin I:0:	3	: 1	Rev	
Polarity Autotune	Actuator	5			
E- Load	Type:	<none></none>	-		
Backlash	Lead:	1.0	Millimeter/Rev	~	
Velocity Loop	Diameter:	1.0	Millimeter		
Torque/Current Loop Planner	Scaling			Scaling	Units for Rotary Transmission
Homing Actions	Units:	Packages	-	load typ	e is expressed in terms of Load
Drive Parameters	-	3.0	Packages		ions, for example, Packages.
Parameter List Status	Travel				ions, ior example, i denagest
	Mode:	Cyclic •			
Tag		1000.0	Packages		
	Unwind:	1.0	Packages	per 1.	0 Cycle
	Soft Travel L	imits			
	Maximum P	ositive: 0.0	Pa	:kages	
	Maximum N	legative: 0.0	Pa	:kages	
Axis State:					
Axis State:					
Manual Tune				ОК	Cancel Apply Help
ConversionConstan	nt				Motion Counts/Packages
LoadType			Rotary Tra		
MotionResolution				300000	Motion Counts/Load Rev

Linear Actuator

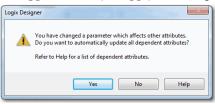
With the Linear Actuator load type, you can specify the characteristics of the linear actuator mechanics by the Actuator Type.

🏷 Axis Properties - CIPAxis						- • •
Categories:						
General	Scaling to Convert Mot	ion from Controlle	er Units to User Defi	ned Units		
Motor	Load Type:	inear Actuator	•		Parameters	
Model		Inear Actuator	•		Parameters	
Scaling	Transmission					
Polarity	Ratio I:0: 3		: 1	Rev		
Autotune	Actuator					
🖃 - Load	Type: §	crew	•			
Backlash Position Loop	Lead: 5	0	Millimeter/Rev -			
Velocity Loop						
Torque/Current Loop		.0	Millimeter 👻			
Planner	Scaling					
Homing	Units: L	oad Feedback				
Actions Drive Parameters	Scaling: 1	.0	Load Feedback	per 1	Load Millimeter	-
Parameter List	Travel					
Status	Mode:	imited 👻				
Faults & Alarms						
Tag	Range: 1	000.0	Load Feedback			
	Unwind: 1	.0	Load Feedback	per 1	LO Cycle	
	Soft Travel Lim	its				
	Maximum Po	sitive: 0.0				
	Maximum Ne					
			Load re	CUDACK		
Axis State:						
Manual Tune				OK	Cancel Apply	Help
ConversionConsta	nt			10000.	0 Motion Counts/Load Feed	back
LoadType			Linea	r Actuate	pr	
MotionResolution				1000	0 Motion Counts/Load Millim	eter

Changing Scaling Factors

Changing Scaling configuration factors can have a significant impact on the calculations of factory defaults for scaling dependent-axis configuration attributes.

If you change a scaling factor that impacts other attributes, the following dialog box appears when you apply the change.



This dialog box gives you the choice to recalculate factory defaults for scaling dependent attributes.

- 1. To recalculate and apply all dependent attribute values, click Yes.
- 2. To apply only changes to the scaling attributes, click No.

Once you have applied your configurations, the factory defaults for dynamic configuration attributes, for example, gain, limits, and filter settings are automatically computed. The calculations are based on your drive and motor configuration settings and selection for application type and loop response.

The factory defaults yield a stable operational system that can then be tailored to the specific requirements for many types of machine applications.

You can use Autotune to improve performance if the gain set provided to you by the factory defaults does not satisfy the configuration requirements of your system.

See <u>Autotune on page 235</u>.

Hookup Tests

Use the Hookup Tests dialog box to perform the following:

- Check your cabling
- Adjust motor and feedback polarity
- Establish your sense of positive motion direction
- If applicable, check encoder marker and commutation function

To run any of the Hookup Tests, you must first download your program.



ATTENTION: These tests can actively move the axis even with the controller in remote Program mode:

- Before you do the tests, make sure no one is in the way of the axis.
- Changing motor or feedback after performing the Hookup Test can result in an axis-runaway condition when the drive is enabled.
- To avoid personal injury or damage to equipment, you must remove the load from each axis as uncontrolled motion can occur when an axis with an integral motor brake is released during the test.

The type of drive and the combination of the Axis and Feedback configuration types you choose determine what Hookup tests are available.

Table 46 - Types of Hookup Tests

Test	Description
Marker	Checks that the drive gets the marker pulse. You must manually move the axis for this test.
Motor and Feedback	Tests the polarity of the motor, motion, load, and motor feedback.
Motor Feedback	Tests the polarity of the motor feedback.
Load Feedback	Test the load feedback polarity of the motor.
Commutation	Tests the commutation offset and polarity of a drive.
Master Feedback	Test the master feedback polarity.

<u>Table 47</u> lists the Hookup Tests that is based on axis configuration and drive type.

Table 47 - Types of Hookup Tests

Axis Type	Feedback Type	Drive ⁽¹⁾	Master Feedback	Motor and Feedback	Motor Feedback	Load Feedback	Marker	Commutation
Feedback Only	Master Feedback	Kinetix [®] 5500	х				х	
		Kinetix 5700	х				х	х
		Kinetix 6500	х				х	
Frequency Control	No Feedback	Kinetix 5500		х				
		Kinetix 5700		Х				х
		PowerFlex [®] 527		х				
		PowerFlex 755		х				
Position Loop	Motor Feedback	Kinetix 350		х	х		x	
		Kinetix 5500		х	х		x	
		Kinetix 5700		х	x		x	х
		Kinetix 6500		х	x		x	х
		PowerFlex 527		Х	х		x	
		PowerFlex 755		х	х		x	х
	Load Feedback	Kinetix 5700		х	x	х	х	х
		Kinetix 6500		х	х	х	x	
	Dual Feedback	Kinetix 5700		х	х	х	x	х
		Kinetix 6500		Х	х	х	x (motor)	x (motor)
		PowerFlex 755		х	х	х	x (motor)	x (motor)
	Dual Integrated Feedback	PowerFlex 755		x	x	X	x (motor)	x (motor)
Velocity Loop	Motor Feedback	Kinetix 350		х	x		x	
		Kinetix 5500		х	х		x	
		Kinetix 5700		х	x		x	х
		Kinetix 6500		Х	х		х	х
		PowerFlex 527		х	х		x	
		PowerFlex 755		х	x		x	х
	Load Feedback	Kinetix 5700		х	x	х	х	х
		Kinetix 6500		х	х	х	x	х
Torque Loop	No Feedback	PowerFlex 755		х				
	Motor Feedback	Kinetix 350		х	x		x	
		Kinetix 5500		х	х		x	
		Kinetix 5700		х	х		х	х
		Kinetix 6500		х	х		х	х
		PowerFlex 755		х	х		х	х
	Load Feedback	Kinetix 6500		x	х	x	х	х

(1) For the Kinetix 5700 drive, see the Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002.

Run a Motor and Feedback Test

The Motor and Feedback Test is the most commonly used Hookup Test because it automatically tests both the motor and feedback wiring and determines correct polarity values.



ATTENTION: These tests make the axis move even with the controller in remote Program mode. Before you do the tests, make sure no one is in the way of the axis.

Follow these steps to perform a Motor and Feedback Hookup Test.

1. Go to the Hookup Tests dialog box.

Axis Properties - PF527_/	lvis_1
Categories:	
General General Motor Analyzer Motor Feedback Scaling Hookup Tests Polanty Autoure Compliance	Test Motor and Feedback Device Wiring Motor and Feedback Marker Test Distance: 1.0 • Position Units Start Stop DANGER: Starting test with controller in Program or Run Mode initiates axis motion. Test State: Ready Pressing Start initiates motion.
	Watch motion direction during test. Current Test Results Motor Feedback Polarity: Normal
- Faults & Alarms - Taults & Alarms - Tag	Motor Polarity: Normal Motion Polarity: Normal Accept Test Results +
Axis State: Stopped	Safety State: Not Configured (Torque Permitted) OK Cancel Apply Help

Remember that a blue arrow next to a field means that when you change its value the new value automatically gets written to the controller when you leave the field.

2. Enter the Test Distance.

The Test Distance is the distance that the test moves the axis.

3. To run the Motor and Feedback test, click Start.

Logix Designer - Motor Feedback Test	×
Test State: Executing	ОК
Move axis in forward direction. Checking for feedback counts.	Stop Help

4. The axis moves on its own to test for feedback polarity and proper wiring. To check for proper rotation direction, watch the axis.

Logix Designer - Motor and Feedback Test	
Test State: Passed	ОК
Test complete.	Stop Help

The drive determines that the feedback device is working properly and the test passed.

5. Click OK.

Logix Designer
Did the axis move in the forward direction?
Yes No Cancel

6. If your axis moved in a forward direction, click yes and you see that the test result is Normal.

If the motor does not move in the forward direction, according to your application the test result is inverted. When you accept test results the Current shows inverted.

See the Polarity on page 235.

If you are satisfied with the results, you can accept the test results.

	Current	Test Results
Motor Feedback Polarity:	Normal	Normal
Motor Polarity:	Normal	Normal
Motion Polarity:	Normal	Normal
Accept Test Results		

The test can pass but give you results that you are not expecting. In this case, you can have a wiring problem.

See the related drive documentation that is listed in the <u>Additional</u> <u>Resources on page 9</u>.

- 7. Click Yes or No depending on whether the axis moved in the forward direction for your application.
- 8. Click Accept Results, if the test ran successfully.

Run a Motor Feedback Test

The Motor Feedback Test checks the polarity of the motor feedback. Follow these steps to perform a Motor Feedback test.

Axis Properties - PF527_A	xis,1 💿 🖸 🔀
Categories:	
Gonordi	Test Motor and Feedback Device Wiring
Motor Model Analyzer Motor Feedback Scaling Hookup Tests Polarty Autotune Load L_Compliance Velocity Loop	Mator and Feedback Motor Feedback Marker Test Distance: 1.0 Position Units Start Stop DANGER: When manually moving the axis, observe standard safety precautions when interacting with equipment. Test State: Ready Move axis in forward direction during test. Start them ready. If motor brake is present, starting test releases brake.
- Forus & James - Forus - Current Loop - Planner - Homing - Actions - Drive Parameters - Parameter List - Status - Faults & Alarms	Current Test Results Motor Feedback Polarity: Normal
Tag	Accept Test Results
Axis State: Stopped	Safety State: Not Configured (Torque Permitted) OK Cancel Apply Help

1. From the Hookup Tests dialog box, click the Motor Feedback tab.

- 2. Enter the Test Distance.
- 3. Click Start.

Run a Marker Test

The Marker Test checks that the drive receives the marker pulse from the position feedback device. You must manually move the axis for this test. Follow these steps to perform a Marker test.

- 1. From the Hookup Tests dialog box.
- 2. Click the Marker tab.

egories:			
General	Test Motor and Feedback Device Wiring		
- Motor	Motor and Feedback Motor Feedback Marker		
Model	Motor and Feedback Motor Feedback Marker		
Analyzer			
Motor Feedback			
Scaling Hookup Tests	Start Stop	<u> </u>	DANGER: When manually moving the axis,
Polarity	- Start Stap	<u> </u>	observe standard safety precautions when
Autotune			interacting with equipment.
- Load	Test State: Ready		If motor brake is present, starting test releases brake.
Compliance	Move axis through marker during test.	_	releases brake.
Velocity Loop	Start test when ready.		
Torque/Current Loop			
Planner	1		
Homing			
Actions Drive Parameters			
Parameter List			
Status			
Faults & Alams			
Tag			
-			
	Safety State: Not Configured (Torque Permitted)		

3. To check for the marker pulse, click Start.

4. Manually move the axis until you get the marker pulse.

Logix Designer - Marker Test	×
Test State: Executing	ОК
Move axis to generate marker pulse. Checking for marker pulse.	Stop Help

The drive receives the marker pulse and the test passed.

Logix Designer - Marker Test	X
Test State: Passed	ОК
Test complete.	Stop Help

5. Click OK.

Applying the Commutation Hookup Test

The Commutation Test determines an unknown Commutation Offset and potentially the unknown polarity of the startup commutation wiring. The Commutation Test can be used also to verify both a known Commutation Offset and the polarity startup commutation wiring. This test is applied to third-party or custom Permanent Magnet motors that are not available as a Catalog Number in the Motion Database.

TIP For linear stages, make sure that there is enough available travel, otherwise the commutation test produces a fault.

When a motor needs a Commutation Offset and you are not using Catalog number as the Motor Data Source, you cannot enable the axis.

There are several different cases where the Commutation Hookup Test can be applied to a PM motor:

- <u>Unknown Commutation Offset</u>
- <u>Verification of Known Commutation Offset</u>
- Non-standard or Incorrect Wiring

Unknown Commutation Offset

The primary use for the Commutation Hookup Test is the case where the machine is equipped with a PM motor that has an unknown Commutation Offset.

The Commutation Offset, and potentially Commutation Polarity, can be unknown for different reasons, including an unprogrammed 'smart encoder' or any generic third-party encoder where Commutation Offset is unknown.

TIP The Kinetix 350 and the Kinetix 5500 drives do not support the Commutation Polarity attribute.

Verification of Known Commutation Offset

Another use of the Commutation Test is to verify that the motor is wired correctly and has the expected Commutation Offset. A machine engineer can decide not to correct for a wiring error in software but rather flag a wiring error so that it can be physically corrected. Incorrect wiring of the motor power phases, encoder signal wiring, or commutation signal wiring can show up as an unexpected Commutation Offset.

For example, suppose that a motor was wired in a 'WUV' sequence instead of the normal 'UVW' sequence. The motor would still rotate in the correct direction, but the Commutation Test indicate that the Commutation Offset was off by a factor of 120 electrical degrees.

After running the Motor and Feedback Hookup Tests, you can run the Commutation Test to determine the specific Commutation Offset and Commutation Polarity. The drive executes the Commutation Test, which includes motor rotation in the positive direction by at least one revolution. The results of the Commutation Test are reported back to compare against the known Commutation Offset and Commutation Polarity to determine if a wiring issue exists.

Non-standard or Incorrect Wiring

The Commutation Test can also be applied to a PM motor that is wired in a non-standard manner or incorrectly. If there is incorrect wiring, it is sometimes desirable to mitigate the problem via software. You can use software mitigation on larger machines where changes to the wiring would be difficult due to the size and location of the wiring.

After running the Motor and Feedback Hookup Tests, you can run the Commutation Test to determine the specific Commutation Offset and Commutation Polarity. The drive executes the Commutation Test, which includes motor rotation in the positive direction by at least one revolution. The results of the Commutation Test are reported back for review. If the results are satisfactory, you can accept the results as part of the stored axis configuration of the controller to establish the correct wiring polarity.

Run a Commutation Test

Set the Motor and Feedback Polarity by using the Motor and Feedback Test before running the Commutation Test. This setting helps make sure that the motor spins in the correct direction for the Commutation Test for monitoring the Commutation Angle.

TIP Run the Motor and Feedback Test first to determine that your feedback is working. If the Feedback is not working, the Commutation Test gives you incorrect results or the test times out.

Follow these steps to run a commutation test.

- 1. To run the Commutation Test to determine the Commutation Offset and Commutation Polarity, click Start.
 - **TIP** The Kinetix 350, Kinetix 5500, and PowerFlex 527 drives do not support the Commutation Polarity attribute.

🏷 Axis Properties - K6K_Axis	
Categories:	
General	Test Motor and Feedback Device Wiring
	Motor and Feedback Motor Feedback Commutation Marker Start Stop DANGER: Starting test with controller in Program or Run Mode initiates axis motion. Test State: Ready
Friction Observer Position Loop	Pressing start initiates motion. Start test when ready.
Velocity Loop Acceleration Loop Torque/Current Loop Planner Homing Actions	Current Test Results Commutation Offset: 0.0 Degrees Degrees Commutation Polarity: Normal
 Drive Parameters Parameter List Status Faults & Alarms Tag 	Accept Test Results •
Axis State: Stopped Manual Tune	OK Cancel Apply Help

The drive executes the Commutation Test, which includes motor rotation in the positive direction by at least one revolution.

The results of the Commutation Test appear.

2. If the results are satisfactory, click Accept Test Results.

Commutation Offset and Polarity results are stored in the controller as part of the axis configuration that is sent to the drive during initialization.

Polarity

If you have run the Motor and Feedback Hookup Test, the settings on the Polarity dialog box are already correct for the application. If the polarity settings are known and cables to the motor and feedback devices are prefabricated and tested, the polarity settings can be entered on this dialog box.

Motion, Motor, and Feedback Polarity					
Motion Polarity:	Normal	Inverted			
Motor Polarity:	Normal	Inverted			
Feedback 1 Polarity:	Normal	Inverted			
DANGER: Mo	difying polarity	setting may cause unexpected motion.			

The axis is now ready for operation. You can use Direct Commands to initiate axis motion or you can run your application program. If you find that the dynamic performance of your axis does not meet your system requirements, use Autotune to improve performance.

Autotune

Once you have set the parameters and performed tasks in the General, Motor, Motor Feedback, Scaling, Hookup Test, and Polarity dialog boxes, you are ready to Autotune, if necessary.

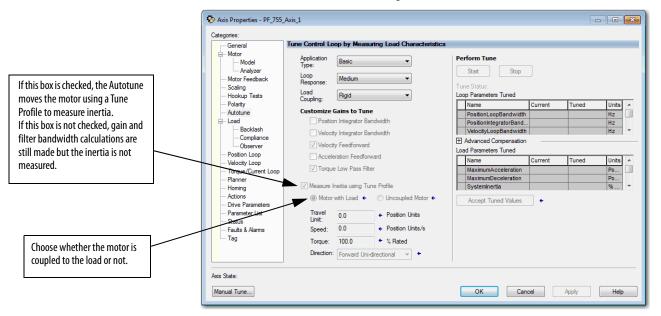
Typically you do not need to use Autotune or Manual Tune. Once you select your drive and use the Motion Database as the data source, the defaults often provide adequate tuning performance. If not, use autotune to adjust the parameters. For detailed tuning information, see the Motion System Tuning Application Technique, publication <u>MOTION-AT005</u>.



ATTENTION: When you tune an axis, it moves even with the controller in Remote Program mode. In that mode, your code is not in control of the axis. Before you tune an axis, make sure no one is in the way of the axis.

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

To use the Autotune feature, use the following steps.



1. Click the Autotune dialog box.

To configure the Tune Profile, you enter the Travel Limit, Speed, Torque, and Direction.

Motor with Load ← ○ Uncoupled Motor ←		
0.0	← Position Units	
0.0	← Position Units/s	
100.0	 % Rated 	
Forward Uni-dir	rectional 👻 🗧	
	0.0 0.0 100.0	

- 2. Set the Travel Limit that is based on the travel constraints of the machine.
- 3. Set the Speed to the expected operation speed.
- 4. Set the Torque to the level you want to apply to the motor during the Autotune.

The default of 100% Rated Torque usually give good results.

5. Set the Direction that is based on machine constrains.

Unidirectional tune profile measures inertia and friction. Bidirectional tune profile adds measurement of active torque loading.

TIP Blue arrows next to a field means that these values are immediately applied. Once you put a value in the field and then leave that field, it is automatically sent to the controller.

6. Click Start.

This message appears if you have edits that have not been applied. If you do not save edits that are pending, Autotune does not run.

Logix Desig	Pending edits must be saved prior to executing online command. Save pending edits?
	Yes No

The Autotune status displays Success. A tune configuration fault can occur if any number of attributes are zero.

Fault	Description		
Tune Configuration Fault	A tune configuration fault can occur if any number of attributes are zero. This fault occurs only when you use Nameplate Data as the motor data source. The following attributes are checked for zero:		
	 Tuning Torque Conversion Constant Drive Model Time Constant System Damping (Damping Factor) Rotary Motor Inertia Linear Motor Mass The Kinetix 350 drive does not support this attribute. Motor Rated Continuous Current PM Motor Linear Voltage Constant Rotary Motor Rated Speed Linear Motor Rated Speed 		

The Autotune profile accelerates and decelerates the motor according to the Tune Direction.

Once the Autotune is finished, the test state changes.

Logix Designer - Autotune	×
Test State: Success	ОК
Test complete.	Stop Help

7. Click OK.

After completing the Autotune profile, the measurements that are made during this process are used to update the fields in the Gains Tuned and Inertia Tuned grids.

Check your Tune Status

,						
	Tur	ne Status: Success				
	Loop Parameters Tuned					
		Name	Current	Tuned	Units	*
	*	PositionLoopBandwidth	19.469685	19.479559	Hz	
		PositionIntegratorBand	0.0	0.0	Hz	
	*	VelocityLoopBandwidth	77.87874	77.918236	Hz	Ŧ
	±.	Advanced Compensation				
Any value that has an	Load Parameters Tuned					
asterisk in the leftmost		Name	Current	Tuned	Units	*
column has another value		MaximumAcceleration	14087.599	14087.599	Po	
from its tuned value.		MaximumDeceleration	14087.599	14087.599	Po	
		SystemInertia	0.01434175	0.01434175	%	Ŧ
		Accept Tuned Values	•			

8. You can compare existing and tuned values for your gains and inertias with the prospective tune values.

Tune Status: Success Loop Parameters Tuned			column, a to	does not fit in the pol tip appears to proplete value. You
Name	Current Tuned U	nits 🔺	🦳 can also cha	ange the column
* PositionLoopBandwidth PositionIntegratorBand		2	widths.	
* VelocityLoopBandwidth	10/60695	z -	,	
+ Advanced Compensation				
	Tune Status: Success Loop Parameters Tuned			
	Name	Current	Tuned	Units 🔺
	* PositionLoopBandwidt	h 19.469685	19.479559	Hz
	PositionIntegratorBand	0.0	0.0	Hz
	* VelocityLoopBandwidt	h 77.87874	77.918236	Hz 🔻
	Advanced Compensation	n		

9. Choose to accept the new values and apply them to the controller.



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

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

See When to Manually Tune an Axis on page 275.

Load

The Load dialog box contains the characteristics of the motor load. You can also use the values that are provided by autotune. The Autotune automatically sets most of these values:

- If you use the Catalog Number as the Data Source, the Motor Inertia, Total Inertia, and System Inertia are pre-populated with the correct values.
- If you know what the Load Ratio values are, you can enter that information on the Load dialog box or you can use the values that are provided by Autotune.

Figure 103 - Kinetix 6500 Load Dialog Box

ø	Axis Properties - K6K_2				
Ca	ategories:				
	g General	Characteristics of Motor Load			
	Motor Model	Load Inertia/Mass			
	Motor Feedback	Load Coupling:	Rigid	-	
	Scaling Hookup Tests	V Use Load Ratio		_	
	Polarity	Load Ratio:	0.0	Load Inertia/Motor Inertia	
	Autotune	Motor Inertia:	0.000044	Kg-m^2	
	Backlash	Total Inertia:	0.000044	Kg-m^2	
	Compliance Friction Observer	Inertia/Mass Compensation			
	Position Loop	System Inertia:	0.014468295	% Rated/(Rev/s^2)	
	Velocity Loop	System Acceleration;	6911.6646	Rev/s^2 @100 % Rated	
	Acceleration Loop Torque/Current Loop	eyeten needetaaten.		nevis 2 @ lub /s haled	
	Planner	Active Load Compensation			
	Homing				
	Actions	Torque Offset:	0.0	% Rated	
	Drive Parameters Parameter List				
	Status				
	Faults & Alarms				
	Tag				
A	is State:				
ŀ	Manual Tune			OK Cancel A	pply Help

Table 48 - Load Inertia/Mass Parameter Descriptions

Parameter	Description		
Load Coupling	Lets you control how tightly the system is physically coupled. Your choices are the following:		
	Rigid (default)Compliant		
	Load Coupling appears dimmed when the axis is Servo On.		
Inertia Compensation	Inertia compensation controls relate to rotary motors.		
Load Ratio	The value of the Load Ratio attribute represents the ratio of the load inertia or mass to the motor inertia, or mass.		
Motor Inertia	The Motor Inertia attribute is a float that specifies the unloaded inertia of a rotary motor.		
Total Inertia	Total Inertia represents the combined inertia of the rotary motor and load in engineering units.		
Inertia/Mass Compensation	Inertia compensation controls relate to rotary motors. Mass compensation controls relate to linear motors.		
System Acceleration	System Inertia is recalculated anytime the System Acceleration changes: • System Inertia = 0, if System Acceleration = 0 • System Inertia = 1/System Acceleration • Units are Rev/s^2 @100% Rated		

Parameter	Description
System Inertia	 The torque or force-scaling gain value converts commanded acceleration into equivalent rated torque/force. Properly set, this value represents the total system inertia or mass. System Inertia is a read-only field that is based on Total Inertia. The software recalculates System Acceleration anytime the dependent attributes change: If the data Source is Motor Catalog Number, the System Acceleration value is read directly from the motion database. If the Data Source is Nameplate data sheet, the System Acceleration value is calculated If the Data Source is Drive NV or Motor NV, this field is blank.
Torque Offset	The Torque Offset attribute provides a torque bias when performing closed-loop control.
Mass Compensation	Mass compensation controls relate to linear motors.
Motor Mass	The mass of the motor displays in Kg units. This control is calculated based on the load inertia ratio. Generally it is not equal to 0 for Kinetix drives.
Total Mass	Total Mass represents the combined mass of the linear motor and load in engineering units.
Load Backlash	This parameter provides backlash configuration options for the load of the motor. The Kinetix 350 does not support this parameter.
Load Compliance	 The Torque Low Pass Filter Bandwidth attribute is the break frequency for the second order low pass filter that is applied to the torque reference signal. The Torque Notch Filter Frequency attribute is the center frequency of the notch filter that is applied to the toque reference signal. A value of 0 for this attribute disables this feature. The Torque Lag Filter Gain attribute sets the high frequency gain of the torque reference Lead-Lag Filter. A value greater than one results in a lead function and value less than one results in a lag function. A value of 1 disables the filter. The Torque Lag Filter Bandwidth attribute sets the pole frequency for the torque reference Lead-Lag Filter. A value of 0 disables the filter. The Kinetix 350 does not support this parameter.
Load Friction • Sliding Friction Compensation is the value that is added to the curren command to offset the effects of coulomb friction. • Compensation Window defines a window around the command posit The Kinetix 350 does not support this parameter.	
Load Observer	This parameter configures the operation of the Load Observer. The Kinetix 5500, Kinetix 5700, and Kinetix 6500 drives natively support this parameter.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>, for detailed descriptions of the AXIS_CIP_DRIVE attributes.

Load Observer

The Load Observer feature is a control loop inside the drive that estimates the mechanical load on the motor and compensates for it. This feature lets the control loops to treat the motor as if it is unloaded and relatively easy to control. The Load Observer automatically compensates for disturbances and load dynamics, such as sudden inertia changes, compliance, backlash, and resonances that are within the bandwidth of the Load Observer.

Benefits of Load Observer

You can use the Load Observer with out-of-box control loop gains, where the load is unknown and thus the Load Inertia Ratio is equal to zero. You can also use the Load Observer with auto-tuned control loop gains, where the Load Inertia Ratio is known or calculated by performing an autotune procedure.

When you enable Load Observer with the recommended out-of-box control loop gains, the Load Observer perform the following:

- Provides relatively high-performance motion control without tuning
- Minimizes the need to retune to account for machine wear over time
- Automatically compensates for changes in vibration and resonance that are within the bandwidth of the Load Observer
- Mitigates periodic identification of in-band resonance to compensate for them

When you use autotuned control loop gains, the Load Observer performs the following:

- Increases system bandwidth
- Reduces tracking errors, so that line speeds can increase
- Provides tighter control of moving parts, which reduces wear and saves on material costs

How Load Observer Functions

The Load Observer acts on the acceleration signal within the control loops and monitors the Acceleration Reference and the Actual Position feedback. The Load Observer models an ideal unloaded motor and generates a load Torque Estimate that represents any deviation in response of the actual motor and mechanics from the ideal model. This deviation represents the reaction torque that is placed on the motor shaft by the load mechanics. Closed-loop operation compensates the deviation, which is estimated in real time. See Figure 104 on page 242 for an example Load Observer block diagram.

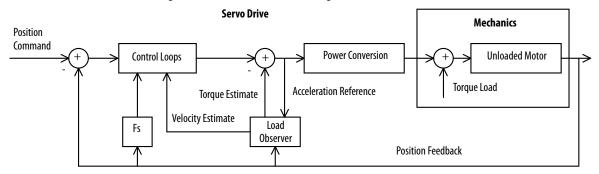


Figure 104 - Load Observer Block Diagram

The Load Observer also generates a Velocity Estimate signal that you can apply to the velocity loop. The Velocity Estimate has less delay than the Velocity Feedback signal derived from the actual feedback device. It also helps to reduce high frequency output noise that the aggressive action of the Load Observer on the acceleration reference causes. Together, Load Observer with Velocity Estimate provides the best overall performance for positioning applications. <u>Table 49</u> describes the Load Observer configuration settings.

Table 49 - Load	Observer	Configuration	Settinas

Configuration	Description
Disabled	Load Observer is inactive.
Load Observer Only	Provides a torque estimate only.
Load Observer with Velocity Estimate	The standard Load Observer operation. Provides torque and velocity estimates.
Velocity Estimate Only	Provides only a velocity estimate.
Acceleration Feedback	Provides acceleration feedback by disconnecting the Acceleration Reference to the Load Observer.

Load Observer Configuration

This section applies to only the Load Observer feature for the Kinetix 5500, Kinetix 5700, and Kinetix 6500 drives. Click the Observer tab in the Axis Properties dialog box. Here, the Load Observer mode can be selected with the Configuration pull-down menu. See Table 27 for descriptions of each setting. If Load Observer is enabled, the recommended Configuration setting is Load Observer with Velocity Estimate for positioning applications. Access to Load Observer bandwidth (Kop) and Load Observer Integral Bandwidth (Koi) is also shown. Typically, Koi = 0.

Gains are limited to 500 Hz in drive firmware revision 2.160 and earlier. In drive firmware revision 2.170 and later, the gain limits are increased to 10,430

X Axis Properties - CIP_K6	к				
Categories:					
General	Load Observer				
General Motor Motor Feedback Motor Feedback General Hookup Tests Polarty Autorne Compliance Friction General Compliance Friction Compliance Friction Compliance Friction Compliance Friction Compliance Friction F	Load Observer Configuration: Bendwidth: Integrator Bandwidth:	Load Observer w 311.51495 0.0	Hertz	Parameters Kop Koi	
Tag Axis State: Manual Turne	Safety State:		ОК	Cancel Apply	Help

Hz. <u>Table 50</u> summarizes the primary difference between the two tuning modes.

Table 50 - CIP Load Observer Tuning Mode Differences

Tuning Mode	Description (Hz)
Out-of-box or unknown load Load ratio = 0	Load Observer Bandwidth (Kop) = 4 * Velocity Loop Bandwidth (Kvp)
Autotuning or known load Load ration > 0	Load Observer Bandwidth (Kop) = Velocity Loop Bandwidth (Kvp)

The Load Observer can be configured in various ways by using the Load Observer Configuration attribute. The standard configuration is Load Observer with Velocity Estimate. This configuration approximates the load torque and minimizes the phase lag associated with the velocity feedback.

Figure 105 - Load Observer with Velocity Estimate: Kinetix 6500 Drive

Load Observer						
Configuration:	Load Observer	Load Observer with Velocity Estimate 🔻				
Bandwidth:	311.51495	Hertz				
Integrator Bandwidth:	0.0	Hertz				

For more information, see the Motion System Tuning Application Technique, publication <u>MOTION-AT005</u>.

Adaptive Tuning

The Adaptive Tuning feature is an algorithm inside of the drive. This feature continuously adjusts or adapts various filler parameters and control loop gains to compensate for unknown and changing load conditions while the drive is running. Its primary functions are as follows:

- Automatically adjust torque loop notch and low pass filter parameters to suppress resonance
- Automatically de-tune control loop gains to avoid instability when it is detected

For detailed tuning information, see the Motion System Tuning Application Technique, publication <u>MOTION-AT005</u>.

Benefits of Adaptive Tuning

When Adaptive Tuning is enabled with recommended out-of-box control loop settings, Adaptive Tuning performs the following:

- Automatically suppresses changing resonances
- Minimizes periodic identification of resonance and retuning
- Mitigates the need for a tuning expert
- Reduces decommissioning time, especially for high axis count
- Minimizes the power consumption, machine vibration, and errors

How Adaptive Tuning Functions

Adaptive Tuning is always running in the background to detect motor side resonances. Every few seconds, Adaptive Tuning analyzes the frequency response of torque loop signals to identify, track, and measure resonances. Adaptive Tuning also analyzes the frequency response of the command signal to make sure that dominant command frequencies are not mistaken for resonances. This process is known as command rejection. The action that is taken to change tuning parameters largely depends on the adaptive tuning mode of operation. Relevant parameters are summarized in the table followed by detailed descriptions of how they work in various modes of operation.

Parameter Name	Description	Default Value	Range/Units	
Torque Notch Filter Low Frequency Limit	Adaptive Tuning identifies resonances that are not associated with the command between these low and high frequency limits with magnitudes above this tuning threshold.	Torque Loop Bw	202000 Hz	
Torque Notch Filter High Frequency Limit	inaginaues above ans taning aresnola.	2000	202000 Hz	
Torque Notch Filter Tuning Threshold		5	0100% of motor rated torque	
Torque Notch Filter Frequency Estimate	Adaptive Tuning sets this frequency estimate equal to the center frequency of the identified resonance with the highest magnitude.	Torque Notch Filter Frequency or 0 when disabled	202000 Hz	
Torque Notch Filter Magnitude Estimate	Adaptive Tuning sets this magnitude estimate equal to the magnitude of the identified resonance with the highest magnitude.	0	0100% of motor rated torque	

Table 51 - Adaptive Tuning Attributes

Parameter Name	Description	Default Value	Range/Units
Torque Low Pass Filter Bandwidth Estimate	In modes with Gain Stabilization, Adaptive Tuning incrementally decreases this bandwidth estimate from its default value in 200 Hz increments to suppress additional resonances above the low frequency limit if necessary. Additional resonances are resonances that notch filters do not already suppress.	Torque Low Pass Filter BW or 1500 when disabled	202000 Hz
Adaptive Tuning Gain Scaling Factor	In modes with Gain Stabilization, Adaptive Tuning incrementally decreases this gain scaling factor from its default value to stabilize the system if necessary. Resonances that not already suppressed by filters or caused by filter bandwidths that are too close to the closed-loop bandwidth cause instability.	1	0 - max float
Adaptive Tuning Configuration	Controls the Adaptive Tuning feature mode of operation.	Disabled	0 = Disabled 1 = Tracking Notch Filter 2 = Gain Stabilization 3 = Tracking Notch Filter and Gain Stabilization

Table 51 - Adaptive Tuning Attributes

For the purposes of this manual, resonances are characterized as follows:

- HF resonances are above the low frequency limit
- LF resonances are below the low frequency limit
- MF resonances are slightly above the low frequency limit

Adaptive Tuning Configuration

The modes of adaptive tuning operation include:

- Disabled
- Notch Filter Tuning
- Gain Stabilization
- Notch Filter Tuning and Gain Stabilization

You access adaptive tuning from the Compliance tab on the Load Category page.

Disabled

As previously stated, Adaptive Tuning is always running in the background to identify motor side resonances, even when the feature is disabled.

E Load	Adaptive Tuning		
Compliance	Adaptive Tuning Configuration:	Disabled 🗸	
Friction Observer	Torque Notch Filter High Frequency Limit:	2000.0	Hertz
Velocity Loop	Torque Notch Filter Low Frequency Limit:	20.0	Hertz
Acceleration Loop Torque/Current Loop	Torque Notch Filter Tuning Threshold:	5.0	% Motor Rated

No action is taken to compensate for the identified resonances in this mode. The result is status only, which lets you create custom Ladder Logic to react to changes. This function is useful for condition monitoring, diagnostics, and preventative maintenance purposes in tracking HF resonances that changes over time. In Disabled mode, the high frequency limit, low frequency limit, and turning threshold are dim. As a result, you have to enable Adaptive Tuning to change these settings. The Adaptive Tuning output parameters can be monitored in the Drive Parameters tab of the Axis Properties dialog box.

Categories:										
General	Drive	Drive Parameters to Controller Mapping								
Motor Model	Parameters to be read each cycle:					Para	ameters to be written each cy	cle:		
Analyzer Motor Feedback			Name	Value	~			Name	Value	*
Scaling		1	TorqueNotchFilterFrequencyEsti	0.0				VelocityTrim	0.0	
Hookup Tests		V	TorqueNotchFilterMagnitudeEsti	0.0				TorqueTrim	0.0	
Polarity		1	TorqueLowPassFilterBandwidth	0.0				AccelerationFeedforwardGain	0.0	
Autotune		1	AdaptiveTuningGainScalingFactor	0.0				VelocityLoopBandwidth	3.7027178	

Notch Filter Tuning

Typically the Torque Notch Filter Frequency on the Compliance tab of the Axis Properties dialog box is applied to the torque notch filter. In this mode, the Torque Notch Filter Frequency Estimate is applied to the torque notch filter instead.

Autotune	Adaptive Tuning		
Backlash	Adaptive Tuning Configuration:	Notch Filter Tuning 🗸 🗸	
* Compliance Friction	Torque Notch Filter High Frequency Limit:	2000.0	Hertz
Observer	Torque Notch Filter Low Frequency Limit:	312.23672	Hertz
Position Loop Velocity Loop	Torque Notch Filter Tuning Threshold:	5.0	% Motor Rated

Gain Stabilization

Adaptive Tuning performs two primary functions in modes with Gain Stabilization.

Autotune Load	Adaptive Tuning		
Backlash	Adaptive Tuning Configuration:	Gain Stabilization 👻	
* Compliance	Torque Notch Filter High Frequency Limit:	2000.0	Hertz
Observer	Torque Notch Filter Low Frequency Limit:	312.23672	Hertz
Position Loop Velocity Loop	Torque Notch Filter Tuning Threshold:	5.0	% Motor Rated

Adaptive Tuning enables and tunes the low pass filter to suppress resonances if any are identified above the low frequency limit. Typically the Torque Low Pass Filter Bandwidth that is visible on the Compliance tab of the Axis properties dialog box is applied to the low pass torque filter. With Adaptive Tuning, the Torque Low Pass Filter Bandwidth Estimate is applied to the torque low pass filter instead. The bandwidth estimate is incrementally decreased from its default value until the identified HF resonances are suppressed or an LF resonance or instability occurs.

Adaptive Tuning detunes control loop gains to suppress any remaining resonances and stabilize the system. The Adaptive Tuning Gain Scaling factor scales the following gains:

- Load Observer Bandwidth
- Load Observer Integrator Bandwidth
- Velocity Loop Bandwidth
- Velocity Loop Integrator Bandwidth
- Position Loop Bandwidth

Position Loop Integrator Bandwidth

The actual control loop gains are the values that are shown in the Axis Properties dialog box multiplied by the gain scaling factor. The scaling factor is incrementally decreased from its default value until the system is stable. When Gain Stabilization is not enabled, the scaling factor is reset to its default value of 1 so that control loop gains are not affected.

Gain Stabilization is good for situation where there are more resonances than there are notch filters and for keeping the axis stable. Instability and audible noise is caused from the following situations:

- HF resonances that filters do not already suppress
- MF resonances that filters suppress where the filter bandwidths are too close to the closed-loop bandwidth
- LF resonances that result when Load Observer is not applied with the recommended out-of-box settings
- LF resonances that result from classical instability

IMPORTANT We do not recommend that you enable Gain Stabilization on vertical loads as detuning can cause load drops.

Notch Filter Tuning and Gain Stabilization

Adaptive Tuning applies the Notch Filter Tuning if necessary, followed by Gain Stabilization, if necessary.

	Autotune	Adaptive Tuning		
	Backlash	Adaptive Tuning Configuration:	Notch Filter Tuning and Gain Stabilization 🔻	
*	<mark>Compliance</mark> Friction	Torque Notch Filter High Frequency Limit:	2000.0	Hertz
	Observer	Torque Notch Filter Low Frequency Limit:	312.23672	Hertz
	Position Loop Velocity Loop	Torque Notch Filter Tuning Threshold:	5.0	% Motor Rated

Notch Filter Tuning sets the torque notch filter to suppress an HF resonance with the largest magnitude if one exists. Gain Stabilization applies the low pass filter to suppress additional HF resonances if they exist. This function is useful for suppressing more HF resonances than there are notch filters. If the system is unstable, Gain Stabilization incrementally detunes control loops until the system is stable.

The torque notch filter is set to suppress it if it is the only HF resonance or if it is the once with the largest magnitude. If not, the low pass filter is set to suppress it and any other HF resonances. The system is detuned if one or more of the following conditions exist:

- The torque notch filter was set to suppress the MF resonance. The width of the torque notch filter is wide enough or its frequency is close enough to the closed-loop bandwidth to cause instability
- The torque low pass filter was set to suppress the MF resonance, but its bandwidth is close enough to the closed-loop bandwidth to cause instability

• Any additional unsuppressed resonances are present.

Status Bits

The Adaptive Tuning status bits shown in <u>Table 52</u> let you create custom Ladder Logic to trap errors, debug, and react to changes. This function is useful for condition monitoring, diagnostics, and preventative maintenance purposes.

Table 52 - Adaptive Tuning Status Bits

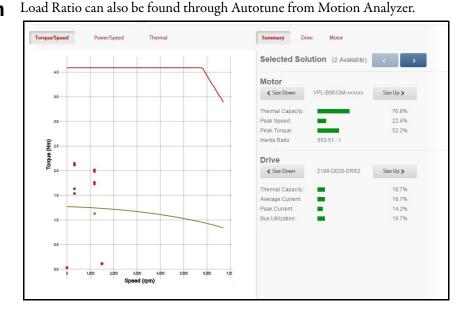
Name	Bit	Description
Torque Notch Filter Frequency Detected Status	0	Set when resonances are identified between the low and high frequency limits with magnitudes above the tuning threshold. Normally, this bit is clear. This bit is also cleared when the axis transitions to the Running state.
Torque Notch Filter Tune Unsuccessful Status	1	Set when the tracking notch filters do not eliminate all identified resonances. Normally, this bit is clear. This bit is also cleared when the axis transitions to the Running state or when Adaptive Tuning transitions from Disable mode to one of the Tracking Notch modes while in the running state.
Torque Notch Filter Multiple Frequencies Status	2	Set when multiple resonances are identified between the low and high frequency limits with magnitudes above the tuning threshold. Normally, this bit is clear. This bit is also cleared when the axis transitions to the Running state.
Torque Notch Filter Frequency Below Limit Status	3	Set when resonances are identified below the low frequency limit with magnitudes above the tuning threshold. Normally, this bit is clear. This bit is also cleared when the axis transitions to the Running state.
Torque Notch Filter Frequency Above Limit Status	4	Set when resonances are identified above the high frequency limit with magnitudes above the tuning threshold. Normally, this bit is clear. This bit is also cleared when the axis transitions to the Running state.
Adaptive Tune Gain Stabilization Status	5	Set when the gain scaling factor is not equal to one. This setting indicates that the Adaptive Tuning is controlling the low pass filter and adjusting servo loop gains to stabilize the system. Normally, this bit is clear. This bit is also cleared when the axis transitions to the Running state.

<u>Table 53</u> describes when output parameters are reset to the default values.

Table 53 - Adaptive Tuning Reset Behavior

Parameter	When Reset to Default Value
Torque Notch Filter Frequency Estimate	Disabled, Gain Stabilization
Torque Notch Filter Magnitude Estimate	When a resonance is not identified
Torque Low Pass Filter Bandwidth Estimate	Disabled, Tracking Notch Filter
Adaptive Tuning Gain Scaling Factor	Disabled, Tracking Notch Filter

Load Ratio Data from Motion Analyzer



If you do not want to run the Autotune, you can manually enter the load ratio from other sources such as Motion Analyzer.

Thermal Capacity:		76.8%
Peak Speed:	-	22.4%
Peak Torque:		52.2%
Inertia Ratio	553.51 : 1	

See <u>Help for Selecting Drives and Motors on page 20</u> for more information about the Motion Analyzer.

Motion direct commands let you issue motion commands while you are online without having to write or execute an application program. You must be online to execute a Motion Direct Command. There are several ways to access the Motion Direct Command.

Motion Direct Commands (MDC) are useful when you are commissioning or troubleshooting a motion application. During commissioning, you can configure an axis and monitor the behavior by using Trends in the Controller Organizer. Use of Motion Direct Commands can fine-tune the system with or without load to optimize its performance. When testing and/or troubleshooting, you can issue Motion Direct Commands to establish or reestablish conditions such as Home. Often during initial development, test the system in small manageable areas. These tasks include the following:

- Home to establish initial conditions
- Incrementally Move to a physical position
- Monitor system dynamics under specific conditions

Test an Axis with Motion Direct Commands

Access Motion Direct Commands for an Axis or Group

To access the Motion Direct Commands for the Motion Group or axis, rightclick the Group or Axis in the Controller Organizer and choose Motion Direct Commands.

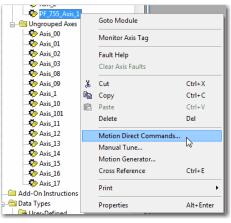


Figure 106 - Motion Direct Commands Dialog Box

mmands:	Motion Ax	tis Jog		
	Axis:	K6K_Axis		-
MAFR	Label		Operand	
MAS	Direction		Forward	
- Re MAH	Speed		0	
CAM 🗞	Speed Unit	ts	Units per sec	
MAD MAM	Accel Rate	•	100	
	Accel Units	s	Units per sec2	
- Re MAG	Decel Rate	e	100	
	Decel Units	s	Units per sec2	
Re MRP	Profile		Trapezoidal	
Motion Group	Accel Jerk		100	
MGS	Decel Jerk		100	
🗞 MGSD	Jerk Units		% of Time	
🗣 MGSR	Merge		Disabled	
Motion Event			otion command with controller in may cause axis motion.	
xis State: Stopped				
xis State: Stopped				
xis Fault: No Faults				
	ted			

The content of the Motion Direct Command dialog box varies, depending on the command you have chosen. In the Command list, you can either type the mnemonic and the list advances to the closest match or you can choose a command from the Axis pull-down menu. Choose the desired command and its dialog box appears.

Commands:	Motion Servo On			
Motion State With MSD With MSD With MSF With MASD With MASD With MASR With MDD With MDF With MASR With MASR	Axis: K	Axis_015_Consumed Axis_15 Axis_16 Axis_16 Axis_17 Axis_17 Axis_101 Axis_101 Axis_101	Data Type	
Axis State: Axis Fault: Start Inhibited: Motion Group Shutdown		Execute	Close	Help

You can access an axis by using the pull-down list. Axis status indicators are in this dialog box.

This dialog box is an example of axis indicator values.

Commands:	Moti	Motion Servo On			
🧐 MSO 🥎 MSF	Axis:	Axis_23	•		
	E				
「一家 MAS 「「家 MAH 」「家 MAH 」「家 MAJ 」「家 MAG 」「家 MCD					
Re MRP	-	DANGER: Executing motion command with controller in Program or Run Mode may cause axis motion.	1		
		Safe Torque Off bypassed			
Axis State: Running	3	Safety State: Not Running (Torque F	Permitted)		
Axis Fault: No Faul	ts				
Start Inhibited: Not Inh	ibited				
Motion Group Shutdow		Execute Close	Help		

IMPORTANT The device spins at the command velocity once you execute an MDS command if you use a PowerFlex 755 drive in Velocity Mode with Flying Start Enable set to true.

For more information about the Flying Start Attribute, see the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.

Understanding STO Bypass When Using Motion Direct Commands

For complete information about Motion Direct Commands in motion control systems including the Safe Torque Off feature, see the publications that are listed in the <u>Additional Resources on page 9</u>.

The drive does not allow motion while the safety controller is in Program mode by default. This condition applies only if a safety connection between the GuardLogix safety controller and the drive was established at least once after the drive was received from the factory.

The drive does not allow motion because the Safety Task is not executed while the GuardLogix^{*} safety controller is in Program mode. This condition applies to applications that run in a single-safety controller (with Motion and Safety connections). The standard controller can transition to Program mode while the safety controller stays in Run mode and continues to execute the Safety Task. This transition occurs when an integrated safety drive has a Motion connection to a standard controller and a separate Safety connection to a dualsafety controller.

However, applicable drive systems are designed with a bypass feature for the STO function in single-safety controller configurations. You can use the Motion Direct Command (MDC) feature to allow motion while following all necessary and prescribed steps per machine safety operating procedures.



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

ATTENTION: It is your responsibility to maintain machine safety integrity while executing Motion Direct Commands. One alternative is to provide Ladder Logic for Machine Maintenance mode that leaves the controller in Run mode with safety functions executing.

<u>Table 54</u> defines which drive supports the type of STO functionality.

Drive	Mechanism	Axis Status	STO Configuration
Kinetix 350 servo drive	Hard-wired	GuardStatus	None
Kinetix 5500 2198-Hxxx-ERS servo drives	Hard-wired	GuardStatus	None
Kinetix 5500 2198-Hxxx-ERS2 servo drives	Integrated	SafetyStatus	Logix Designer application
Kinetix 5700 2198-xxxx-ERS3 servo drives	Hard-wired	GuardStatus	None
Kinetix 5700 2198-xxxx-ERS4 servo drives	Integrated	SafetyStatus	Logix Designer application
Kinetix 6500 servo drives with 2094-EN02D- M01-S0, Safe Torque Off control module	Hard-wired	GuardStatus	Webpage
Kinetix 6500 servo drives with 2094-EN02D- M01-S1, Safe speed monitoring	Hard-wired	GuardStatus	Webpage
PowerFlex 755 drive with Safe Torque Off Option module (20-750-S0)	Hard-wired	GuardStatus	Webpage
PowerFlex 755 drive with Safe Speed Monitor Option module (20-750-S1)	Hard-wired	GuardStatus	Webpage
PowerFlex 755 drive with Integrated Safety - Safe Torque Off Option module (20-750-S3)	Integrated	SafetyStatus	Logix Designer application
PowerFlex 527 drive	Hard-wired	GuardStatus	None
	Integrated	SafetyStatus	Logix Designer application

Table 54 - Drives That Support Safe Torque Off (STO)

For detailed information on the Safe Torque Off function, see one of the following publications:

- Kinetix 5500 Servo Drives User Manual, publication 2198-UM001
- Kinetix 5700 Multi-axis Servo Drives User Manual, publication <u>2198-UM002</u>
- PowerFlex 527 Adjustable Frequency AC Drive User Manual, publication <u>520-UM002</u>
- PowerFlex 750-Series Safe Speed Monitor Option Module Safety Reference Manual, publication <u>750-RM001</u>
- PowerFlex 750-Series Safe Torque Off Option Module User Manual, publication <u>750-UM002</u>
- PowerFlex 755 Integrated Safety Safe Torque Off Option User Manual, publication <u>750-UM004</u>

Notes:

Homing

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Homing puts your equipment at a specific starting point for operation. This starting point is called the home position. Typically, you home your equipment when you reset it for operation.

When using integrated motion on the EtherNet/IPTM network, all active and passive homes are setting absolute positions as long as an absolute device is being used.

See the Integrated Motion on the EtherNet/IP network Reference Manual, publication <u>MOTION-RM003</u>, for more details about the Homing attributes.

Guidelines for Homing

To configure the homing procedure, you specify the mode (active or passive) and sequence. Based on those selections, you can also choose the home position, an offset for the home position, the direction, and speed. For switchbased sequences, you can also select whether the limit switch is normally open or normally closed.

Table 55 describes guidelines for homing procedures.

Guideline	Description
To move an axis to the home position, use Active homing.	 Active homing turns on the servo loop and moves the axis to the home position. Active homing also does the following: Stops any other motion. Uses a trapezoidal profile.
For a Feedback-only device, use Passive homing.	 Passive homing does not move the axis: Use passive homing to calibrate a Feedback-only axis to its marker. If you use passive homing on a servo axis, turn on the servo loop and use a move instruction to move the axis.
For single-turn equipment, consider homing to a marker.	The marker homing sequence is useful for single-turn rotary and linear encoder applications because these applications have only one encoder marker for full axis travel.
For multi-turn equipment, home to a switch or switch and marker.	 These homing sequences use a home limit switch to define the home position: You need a home limit switch if the axis moves multiple revolutions when it runs. Otherwise, the controller cannot tell which marker pulse to use. For the most precise homing, use both the switch and marker.
lf your equipment can't back up, use unidirectional homing.	 With unidirectional homing, the axis doesn't reverse direction to move to the Home Position. For greater accuracy, consider using an offset: Use a Home Offset that is in the same direction as the Home Direction. Use a Home Offset that is greater than the deceleration distance. If the Home Offset is less than the deceleration distance does the following: The axis simply slows to a stop. The axis doesn't reverse direction to move to the Home Position. In this case, the MAH instruction doesn't set the process compete bit. On a rotary axis, the controller adds one or more revolutions to the move distance. This addition makes sure that the move to the Home Position is unidirectional.
Choose a starting direction for the homing sequence.	Decide which direction you want to start the homing sequence in: • Positive direction—choose a Forward direction. • Negative direction—choose a Negative direction.

Table 55 - Guidelines for the Homing Procedures

Active Homing

When the axis Homing mode is configured as Active, the physical axis is first activated for servo operation. As part of this process, all other motion in process is canceled and appropriate status bits cleared. The axis is then homed by using the configured Home Sequence, which can be Immediate, Switch, Marker, or Switch-Marker. The latter three Home Sequences result in the axis being jogged in the configured Home direction. Then, after the homing sequence is complete, the position is redefined. Based on detection of the home event, the axis is automatically moved to the configured Home Position.

IMPORTANT	The control moves the axis to the unwind position of zero. This movement
	occurs only when unidirectional active homing is performed on a rotary axis
	and the Home Offset value is less than the deceleration distance when the
	home event is detected. This process helps make sure that the resulting
	move to the Home Position is unidirectional.

Passive Homing

When the axis Homing mode is configured as Passive, the MAH instruction redefines the actual position of a physical axis on the next occurrence of the encoder marker or home sensor. The sequence determines the homing steps. You must set the homing sequence to marker or switch. Passive homing is most commonly used to calibrate Feedback Only axes to their markers or switch. Passive homing is identical to active homing to an encoder marker or switch except that the motion controller does not command any axis motion.

After initiating passive homing (MAH), the axis must be moved past the encoder marker or trip the home switch for the homing sequence to complete properly. In this case, you must set the homing sequence to marker or switch. The motion controller cannot directly command motion for physical Feedback Only axes and must be accomplished via other means.

For closed-loop Servo axes, when configured for Passive Homing, only set the Sequence to Immediate. Then when the MAH is executed, it simply sets the actual position to that of the Position value set in the Homing parameters. There is no physical motion with these settings.

Examples

This section contains examples of active and passive homing.

Active Homing

The examples in <u>Table 56</u> show different ways to use active homing.

Table 56 - Active Homing Examples

Sequence	Description		
Active immediate home	This sequence sets the axis position to the Home Position without moving the axis. If feedback isn't enabled, this sequence enables feedback.		
Active home to switch in forward bidirectional	The switch homing sequence is useful for multi-turn rotary and linear applications.		
	Active Bidirectional Home with Switch then Marker		
	Homing Vel 1 Axis Position 2 Return Vel 1: Home Limit Switch Detected 2: Home Limit Switch Cleared		
	3: Home Position These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the home limit switch and stops.		
	 The axis reverses direction and moves at the Home Return Speed until it clears the home limit switch and then stops. The axis moves back to the home limit switch or it moves to the Offset position. The axis moves at the Home Return Speed. If the axis is a Rotary Axis, the move back to the Home Position takes the shortest path (that is, no more than a half revolution). 		
	If the axis is past the home limit switch at the start of the homing sequence, the axis reverses direction and starts the return leg of the homing sequence.		
	Use a Home Return Speed that is slower than the Home Speed to increase the homing accuracy. The accuracy of this sequence depends on the return speed and the delay to detect the transition of the home limit switch.		
	Uncertainty = Home Return Speed x delay to detect the home limit switch. Example : Suppose that your Home Return Speed is 0.1 in./s and it takes 10 ms to detect the home limit switch.		
	Example: Suppose that your Home Return Speed is 0.1 in./s and it takes to fits to detect the nome limit switch. Uncertainty = 0.1 in./s x 0.01 s = 0.001 in.		
	The mechanical uncertainty of the home limit switch also affects the homing accuracy.		

Table 56 - Active Homing Examples (continued)

Sequence	Description
Active home to marker in forward bidirectional	The marker homing sequence is useful for single-turn rotary and linear encoder applications because these applications have one encoder marker only for full axis travel.
	Active Bidirectional Home with Marker
	Homing Vel
	Axis Position
	Axis Position
	Return Vel
	1: Encoder Marker Detected
	2: Home Position
	These steps occur during the sequence.
	1. The axis moves in the Home Direction at the Home Speed to the marker and stops.
	2. The axis moves back to the marker or it moves to the Offset position. The axis moves at the Home Return Speed. If the axis is a Rotary Axis, the move back to the Home Position takes the shortest path (that is, no more than a half
	revolution).
	The accuracy of this homing sequence depends on the homing speed and the delay to detect the marker transition.
	Uncertainty = Home Speed x delay to detect the marker.
	Example : Suppose that your Home Speed is 1 in/s and it takes 1 <symbol>m<symbol>s to detect the marker. Uncertainty = 1 ln./s x 0.000001 s = 0.000001 in.</symbol></symbol>
Active home to switch and marker in forward	This sequence is the most precise active homing sequence available.
bidirectional	Active Bidirectional Home with Switch then Marker
	_
	Homing Vel
	1
	Axis Position
	3 Return Vel
	1: Home Limit Switch Detected
	2: Home Limit Switch Cleared 3: Encoder Marker Detected
	4: Home Position
	These steps occur during the sequence.
	1. The axis moves in the Home Direction at the Home Speed to the home limit switch and stops.
	 The axis reverses direction and moves at the Home Return Speed until it clears the home limit switch. The axis continues to move at the Home Return Speed until it gets to the marker.
	4. The axis moves back to the marker or it moves to the Offset position. The axis moves at the Home Return Speed. If the
	axis is a Rotary Axis, the move back to the Home Position takes the shortest path (that is, no more than ½ revolution). If the axis is past the home limit switch at the start of the homing sequence, the axis reverses direction and starts the return
	leg of the homing sequence.
Active home to switch in forward unidirectional	This active homing sequence is useful for when an encoder marker is not available and either unidirectional motion is
	required or proximity switch is being used.
	These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the home limit switch.
	2. If it's in the same direction as the Home Direction, the axis moves to the Home Offset position.

Table 56 - Active Homing Examples (continued)

Sequence	Description		
Active home to marker in forward unidirectional	 This active homing sequence is useful for single-turn rotary and linear encoder applications when unidirectional motion is required. These steps occur during the sequence. The axis moves in the Home Direction at the Home Speed to the marker. If it's in the same direction as the Home Direction, the axis moves to the Home Offset position. 		
Active home to switch and marker in forward unidirectional	 This active homing sequence is useful for multi-turn rotary applications when unidirectional motion is required. These steps occur during the sequence. The axis moves in the Home Direction at the Home Speed to the home limit switch. The axis continues to move at the Home Speed until it gets to the marker. If it's in the same direction as the Home Direction, the axis moves to the Home Offset position. 		
Active Home to Torque	The Home to Torque Level sequence is a type of homing used when a hard stop is going to be used as the home position, as in a linear actuator. Torque Level homing is similar to Home Switch homing, with the exception that the torque level is used instead of the home		
	switch input. This graphic depicts the Position/Velocity for Torque Level Homing.		
	Torque Level Homing		
	Homing Vel 1		
	Axis Position		
	Return Vel		
	1: End of Travel / Hard Stop 2: Homing Torque Above Threshold = TRUE 3: Homing Torque Above Threshold = FALSE 4: Home Position		
	Torque Level-Marker homing is similar to Home Switch-Marker homing, with the exception that the torque level is used instead of the home switch input. This graphic depicts the Position/Velocity for Torque Level-Marker Homing. Torque Level - Marker Homing		
	Homing Vel 1		
	Aris Position		
	4 Return Vel 1: End of Travel / Hard Stop 2: Homing Torque Above Threshold = TRUE 3: Homing Torque Above Threshold = FALSE and Arm Regestration for Encoder Marker 4: Encoder Marker Detected 5: Home Position		

Passive Homing

The examples in <u>Table 57</u> show different ways to use passive homing.

Table 57 - Passive Homing Examples

Sequence	Description	
Passive Immediate Home	This sequence is the simplest passive homing sequence type. When this sequence is berformed, the controller immediately assigns the Home Position to the current axis actual-position. This homing sequence produces no axis motion.	
Passive Home with Switch	This passive homing sequence is useful for when an encoder marker is not available or a proximity switch is being used. When this sequence is performed in the Passive Homing mode, an external agent moves the axis until the home switch is detected. The Home Position is assigned to the axis position at the moment that the limit switch is detected. If you are using a Home Offset, then the Home Position is offset from the point where this value detects the switch.	
Passive Home with Marker	This passive homing sequence is useful for single-turn rotary and linear encoder applications. When this sequence is performed in the Passive Homing mode, an external agent moves the axis until the marker is detected. The home position is assigned to the axis position at the precise position where the marker was detected. If you are using a Home Offset, then the Home Position is offset from the point where this value detects the marker.	
Passive Home with Switch then Marker	This passive homing sequence is useful for multi-turn rotary applications. When this sequence is performed in the Passive Homing mode, an external agent moves the axis until the home switch and then the first encoder marker is detected. The home position is assigned to the axis position at the precise position where the marker was detected. If you are using a Home Offset, then the Home Position is offset from the point where this value detects the marker.	

Absolute Position Recovery (APR)

APR is the recovery of the absolute position of an axis that has been machinereferenced after a power cycle or reconnection. The APR feature maintains the machine reference or absolute position through power cycles, program downloads, and even firmware updates under certain conditions. The terms Absolute Position and Machine Reference Position are synonymous.

Absolute position is established by a homing procedure that is initiated by successful execution of an MAH instruction. Once the homing procedure has successfully established a machine reference, the Axis Homed bit is set in the Motion Status attribute, indicating that actual position and command position now have meaning regarding the associated machine.

It is good application programming-practice to qualify dynamic machine operation by homing all axes in the machine before operating the machine. Otherwise, absolute moves to a specific position cannot have any relationship to the position of the axis on the actual machine.

APR Terminology

Table 58 describes terminology that is related to the APR feature.

Term	Description
Absolute Feedback Position	Position value that is read from an absolute feedback device.
Incremental Feedback Position	Position value that is read from an incremental feedback device.
Feedback Position	Value that is read from a feedback device, absolute, or incremental.
Absolute Position Absolute Machine Reference Position Machine Reference Position	 Position registers in the Logix 5000™ controllers after the following instructions have been executed on a machine with an absolute or an incremental feedback device: MAH, machine home MRP, machine redefine position
A machine home/reference	Establishes a Machine Reference Offset as follows: HomeOffset = ConfiguredHomePosition - AbsoluteFeedbackPosition AbsoluteMachineReferencePosition = AbsoluteFeedback Position + HomeOffset
Absolute Position Recovery (APR)	Recovers the Absolute Machine Reference Position by maintaining the Home Offset through various scenarios as described on <u>page 263</u> .

Table 58 - APR Terminology Descriptions

Position Recovery Considerations for Logix5000 Controllers

There are differences in the way the ControlLogix[®] 5560, GuardLogix[®] 5560, and the ControlLogix 5570 controllers recover machine position:

- The ControlLogix 5560 and GuardLogix 5560 controllers have a battery and use a memory card to save information.
- The ControlLogix 5570 controller has a 1756-ESM*xxx* module and uses a memory card to save information.

- The ControlLogix 5560 and GuardLogix 5560 series A controllers have a battery to recover the position after a power cycle but does not support APR.
- The ControlLogix 5560 and GuardLogix 5560 series B controllers recover the position after a download or restore from CompactFlash software card or a firmware update from the ControlFLASH[™] software. A battery is not required.
- The ControlLogix 5570 controller with a ControlLogix Controller Energy Storage Module (ESM) works the same as the GuardLogix 5560 series B controller with a battery.
- The ControlLogix 5570 controller without a ControlLogix Controller Energy Storage Module (ESM) works like a ControlLogix 5560 series B controller without a battery.

Absolute Feedback Device

The absolute feedback device permits absolute position be retained through a power cycle. These devices take various forms, but they can all maintain an absolute feedback position while power to the drive and feedback device is off.

When power is turned back on, the drive reads the feedback referenced absolute position from the feedback device. By applying a saved absolute offset to this absolute feedback position, the motion control system can recover the machine referenced absolute position.

Most drive products provide this capability. However, Absolute Position is lost if the drive is swapped out or drive firmware is updated. Integrated motion on the EtherNet/IP network lets you recover Absolute Position through power cycles, program downloads, and firmware updates.

SERCOS Versus Integrated Motion on Ethernet Networks

For a SERCOS axis with absolute feedback, the drive scaling function and absolute position are maintained in the drive. Therefore, the drive scaling function and absolute position can be easily restored in the control after a power cycle or download of a new project. This restoration is accomplished by reading the position from the drive.

By contrast, an integrated motion on the EtherNet/IP network axis supports controller-based scaling where absolute position is maintained in the firmware of the controller. Without the work of the APR feature, absolute position would be lost after a power cycle or project download.

APR Scenarios



ATTENTION: Whenever memory becomes corrupt, you lose position even if you have it stored on a memory card.

<u>Table 59 on page 265</u> provides detailed information on when the APR feature recovers absolute position. The following assumptions must be considered. In each of these cases, the APR feature restores absolute position and preserves the state of the Axis Homed bit. This feature indicates that the axis has a machine referenced absolute position.

- All relevant axes are integrated motion axes.
- Yes, indicates that machine reference is recovered (for Axes that have been homed).
- No, indicates that machine reference is not recovered (for Axes that have been homed).

<u>Table 59</u> describes the scenarios whether the APR feature recovers absolute position. In each case that is marked Yes, the APR feature restores absolute position and preserves the state of the Axis Homed bit. This mark indicates that the axis has a machine referenced absolute position.

Table 59 - APR Recovery Scenarios

Controller	Event	Machine Reference Retained
	Controller removal and insertion under power (RIUP) with a battery ⁽¹⁾ .	Yes
	Controller power cycle with battery.	Yes
	Controller firmware update.	Yes
	Controller update from memory card.	Yes
	Swap two controllers with the same catalog numbers (memory card also swapped).	Yes
	Steps 1.Axes are homed. 2.Project is saved to memory card. 3.Axes are moved and rereferenced. 4.System is restored from memory card. Result The system absolute position is restored to rereferenced positions and the Home bit remains set.	Yes
	Steps1.Axes are homed.2.Project is saved to memory card.3.Same memory card is used on machines 2, 3, 4, for example.4.Axes are homed on machines 2, 3, 4, for example, at different positions.5.System restore from memory card on each machine.ResultThe system absolute position on each machine becomes restored correctly at its respective position and the Home bit remains set.	Yes
	Change controller (memory card not swapped).	No
	Change controller without a memory card.	No
	Controller power cycle without battery.	No
	Controller removal and insertion under power (RIUP) without battery.	No
	Take the controllers out of two systems with a battery or energy storage module and swap controller. There is no memory card on either controller.	No
	 Controller remains powered. Power cycle drives. Change feedback device but not motor. 	No
	Steps 1. Axes are homed. 2. Project is saved to a memory card. 3. Memory becomes corrupt. 4. System restores from the memory card. Result The system absolute position is lost, the axes must be rehomed, and the Home bit is cleared.	No
	Controller power cycle or removal and insertion under power without a battery or energy storage module.	No
	 Controller and drives remained powered. Hardware feedback failure on an axis. 	No
	 Battery Backed Controller. User program that runs with an axis that is not homed. 	No

Table 59 - APR Recovery Scenarios

Controller and drives remained powered	Event	Machine Reference Retained
	Disconnect and reconnect the Ethernet cable.	Yes
	Disconnect and reconnect the same feedback and/or motor cable on an axis.	Yes
	Inhibit or uninhibit an axis or drive.	Yes
Battery backed controller	Event	Machine Reference Retained
	Save to a memory card with a homed axis and you initiate the restore.	Yes
	RIUP controller.	Yes
	Cycle power-on controller.	Yes
	Cycle power-on controller that is configured to restore user program from a memory card on power-up.	Yes
	RAM memory becomes corrupt and the user program is restored from the memory card. The machine must be referenced again if RAM memory becomes corrupt. There is no way to retrieve the machine reference positions from a memory card after machine memory becomes corrupt.	No
	User program that runs with a homed axis and you manually restore the user program from a memory card. If you reset the machine reference by using MAH or MRP after storing the user program to a memory card, the MAH and MRP changes are not lost. The APR is not restored to the reference stored on the memory card. The APR is restored to the reference stored in RAM.	Yes
	Battery backed controller: Restore by taking the memory card to another controller. If the other controller has the exact same Axis ID and scaling constants as the memory card, and has homed axes, the APR is not restored to the reference stored on the card. The APR is restored to the reference stored in RAM. The Axis ID attribute is automatically generated when you create an axis in the last remarked.	Yes
	Logix Designer application. See The Axis ID attribute description in the Integrated Motion on the EtherNet/IP network Reference Manual, publication <u>MOTION-RM003</u> for more information.	
Change controller	Event	Machine Reference Retained
	Transfer the memory card from the first controller to the second with the following preconditions.	Yes
	1. Empty the second controller. There is no user program in the second controller.	
	2. The user program has been saved on a memory card with integrated motion on the EtherNet/IP network axes homed.	
	Transfer the memory card from the first controller to the second with the following preconditions.	Yes
	1. The second controller has the same user program with the controller being swapped.	
	2. The second controller has its axes homed.	
Same controller	Event	Machine Reference Retained
	Reload the same user program from a memory card. This scenario assumes that the axis is homed in RAM before reload.	Yes
	Update controller firmware from memory card.	Yes
Controller remains powered or power cycled with battery and power cycle drives	Event	Machine Reference Retained
with pattery and power cycle drives	Change the drive with the same or different catalog number.	Yes
······································	change the unive with the same of unreferit catalog humber.	105

Table 59 - APR Recovery Scenarios

Download same program with no hardware changes	Event	Machine Reference Retained
	Change the name of an axis.	Yes
	Download the same program to the controller.	Yes
	Save As with another filename.	Yes
	Partial Export and then import an axis.	Yes
	Added application logic.	Yes
	Download a project of an existing axis.	Yes
Download same program and no hardware changes	Event	Machine Reference Retained
	Add an axis.	No for the new axis.
	Copy or cut and paste or drag/drop axis into the same project or another project.	No for the new or pasted axis.
	Export and then import into the same or another project. Tip: Save the project as an .ACD file to recover the absolute position.	No
	There are changes to the axis scaling attributes.	No
Position feedback	Event	Machine Reference Retained
	The position feedback device was disconnected or reconnected.	Yes
Feedback device	Event	Machine Reference Retained
	The position feedback device was disconnected or reconnected.	Yes
	The feedback device changed.	No
	The position feedback device was swap.	No
	The position feedback device failed.	No
	The position feedback polarity changed.	No
	The Feedback mode changed.	No

When any of these conditions occur, the Axis Homed bit, if set, is cleared indicating that axis position is no longer referenced to the machine. To flag the condition that the Axis Homed bit has been been cleared and that the machine referenced absolute position has been lost, an APR Fault is generated. This fault is recoverable and can be cleared via any Fault Reset or Shutdown Reset instruction.

Restore	Event	Machine Reference Retained
	Restore from the memory card.	Yes
Inhibit or Uninhibit	Event	Machine Reference Retained
	Inhibit or uninhibit an axis.	Yes
	Inhibit or uninhibit an I/O module.	Yes
Studio 5000 Logix Designer Application	Event	Machine Reference Retained
project	Import or export the project download.	No
	Download the project download of new or copied axis.	No

Table 59 - APR Recovery Scenarios

Drive	Event	Machine Reference Retained
	The drive cycled power with incremental feedback.	No
	The drive firmware updated with incremental feedback.	No
	Change the drive.	Yes
	Cycle power to the drive.	Yes
	Cycle power to the drive with absolute feedback.	Yes
	Change the motor, if the motor does not contain a feedback device.	Yes
	The drive firmware was update with absolute feedback.	Yes
	The drive was disconnected or reconnected.	Yes
	The drive was Inhibited or Uninhibited.	Yes
	The drive was swapped with the same feedback.	Yes
Scaling	Event	Machine Reference Retained
	Scaling signature has changed. The scaling signature changed. This change includes Transmission, Linear Actuator, Motion Resolution, and Motion Unit attribute changes.	No

(1) The term Battery in this table assumes the ControlLogix 5560 or GuardLogix 5560 controller with a battery or a ControlLogix 5570 controller and a 1756-ESMxxx Energy Storage Module. ControlLogix 5580, GuardLogix 5580, CompactLogix[™] 5380, and Compact GuardLogix 5380 controllers have embedded energy storage modules.

APR Faults

APR faults are generated during the events and when one of the conditions that are defined in the following <u>APR Fault Conditions</u> is present.

APR Fault Conditions

The axis must be in the homed state for an APR Fault to occur. The Axis Homed Status Bit must be set.

Attribute Changes

A Motion Resolution or an Axis Feedback Polarity attribute has been changed and downloaded to the controller. This change can also happen during the execution of an SSV.

Axis Feedback Changes

The feedback device has been replaced. This change creates an Axis Feedback Serial Number mismatch APR fault.

Axis Feedback mode has changed, for example, axis with feedback changed to axis without feedback or vice versa and downloaded to the controller.

- A user program is downloaded.
- A user program and tags are restored from the memory card.
 - Manual Restore
 - Power-up restore, when configured
- Firmware is updated via ControlFLASH software.
- An SSV to either change Feedback Polarity or one of the attributes, which results in a change to the Motion Resolution attribute.

APR Fault Generation

A project download, restore from a memory card, or a ControlFLASH firmware update after one of these events can cause an APR fault:

- Axis configuration
 - Change in any of the axis attributes that impacts the absolute machine position.
- Attribute changes
 - Offline edits of the axis attributes or configuration do not cause an APR fault until after download occurs.
 - Online edits of certain attributes result in an immediate APR fault. Changing the axis feedback device or feedback polarity without downloading the project also generates an immediate APR fault.
- Axis hardware change or malfunction.
- Axis hardware resource insufficiency.
 - Hardware resource insufficiencies are detected only during download or ControlFLASH firmware update.
- Reconnection of the drive axis.

When an APR fault occurs, the actual position of the axis is set to the feedback reference position of the axis. This value is read from the absolute encoder of the axis. The APR Fault clears the axis homed status bit.

Downloading of a Project

The following checks are made during a download of a project:

- 1. Does the Axis exist? If not, then it is a new axis and no APR fault occurs or is generated.
- 2. Does the Scaling Signature match the saved Scaling Signature?
- 3. Does the Feedback Serial Number match the saved Feedback Serial Number?

If these three checks pass, absolute position is restored.

During operation, the system monitors changes to that following attributes. These attributes do not affect the Scaling Signature or result in the loss of the absolute machine reference and therefore do not generate an APR Fault.

- Conversion Constant
- Position Unwind
- Travel Mode

Care must be taken when changing these values so that the new values are correctly related to the Position Unit of the product and the mechanics of the system. This correlation is typically done as part of a product recipe change. For example, when you are wrapping regular sized candy bars and then you must change and make king sized bars, you would change the conversion constant.

If the Axis Homed status bit is clear, the APR function is bypassed and there is no attempt to restore absolute position. The clear status bit indicates that position has not been absolutely referenced to the machine.

There are two types of APR Faults: Standard APR Faults and RA Specific Faults. APR Faults display in the Axis Properties dialog box, Faults and Alarms.

Value	Exception	Description
1	Memory Write Error	Error in saving absolute position data to nonvolatile memory.
2	Memory Read Error	Error in reading absolute position data from nonvolatile memory.
3	Feedback Serial Number Mismatch	Position Feedback Serial Number does not match saved Feedback Serial Number.
4	Buffer Allocation Fault	Caused when there is not enough RAM memory left to save APR data.
5	Scaling Configuration Changed	Scaling attribute configuration for this axis does not match the saved scaling configuration.
6	Feedback Mode Change	Feedback Mode has changed and does not match the saved Feedback Mode configuration.

Table 60 - Standard APR Fault Descriptions

Table 61 - Rockwell Automation Specific Fault Descriptions

Value	Exception	Description
1	Persistent Media Fault	 (L6x) - Means that all six sectors that are reserved for APR in persistent memory are marked as bad. This fault condition is not recoverable: After you get this fault, the APR feature stops working until you replace the ControlLogix 5560 or GuardLogix 5560 controller. You never get this error when using a ControlLogix 5570 controller.
2	Firmware Error	Used to trap unexpected firmware errors.

Scaling

Scaling parameters changes can potentially generate an APR fault because internal constants computed from these two parameters can generate a motion resolution change. If this change happens, an APR fault is generated.

Gonora	Scaling to Convert	Aotion from (Controller Units	to User D	Defined Uni	ts		
- Motor Model	Load Type:	Direct Coup	led Rotary 🔻				Parameters	
- Motor Feedback	Transmission							
* Scaling Polarity	Ratio I:0:	1	: 1		Rev			
- Autotune	Actuator							
E-Load	Type:	<none></none>	-					
Backlash Position Loop	Lead:	1.0	Millim	eter/Rev	-			
- Velocity Loop	Diameter:	1.0	Millim	eter	-			
- Torque/Current Loop	Scaling		7 -				/	
- Homing	Units:	Position Un					/	
- Actions	Scaling:	1.0 4	Position	I leas	per	1.0 4	Motor Rev	
- Drive Parameters	-	1.0	Position	Units	per	1.0 -	Motor Rev	Ÿ
- Parameter List	Travel							
- Status - Faults & Alarms	Mode:	Cyclic	-					
- Tag	Range:	1000.0	Position	Units				
	Unwind:	1.0	Position	Units	per	1.0	Cycle	
	Soft Travel	Limits						
	Maximun	Positive:	0.0	Posi	tion Units			
	Maximun	Negative:	0.0	Posi	tion Units			
			0.0		0011-011100			
Axis State:								
AND JIGIC.					_			
Manual Tune					ОК		Cancel Apply	Help

Online Scaling

Any change or SSV message that results in a motion resolution change can generate an APR fault.

Axis Properties - CIPAxis Categories:					
General	Motion Axis Parameter	5			
Motor	Parameter Group:	Scaling	•	Associated Page.	
Scaling	Name		∆ Value	Unit	A
Polarity	ActuatorDiamete	r		10	
Autotune	ActuatorDiamete	rUnit		Millimeter	
- Load	ActuatorLead			1.0	
Backlash	ActuatorLeadUni	t	Milli	neter/Rev	
Position Loop	ActuatorType			<none></none>	
Velocity Loop	ConversionCons	tant /	2	000000.0 Motion Counts/P	osition Units
Torque/Current Loop	LoadType	/	Direct Coupl		
Planner	MotionResolution	K		1000000 Motion Counts/M	lotor Rev
Homing	MotionScalingCon	nfiguration		ol Scaling	=====
···· Actions	MotionUnit		I	Motor Rev	
···· Drive Parameters	PositionScalingD			2.0 Motor Rev	
Parameter List	PositionScalingN	umerator		1.0 Position Units	
Status	PositionUnits			tion Units	
Faults & Alarms	PositionUnwind			2000000 Motion Counts/U	nwind Cycle
i Tag	PositionUnwindD			1.0 Unwind Cycles	
	PositionUnwindN	umerator		1.0 Position Units	
	ScalingSource		From	Calculator	
	SoftTravelLimitCh			No	
	SoftTravelLimitNe			0.0 Position Units	
	SoftTravelLimitPo	sitive		0.0 Position Units	*
Axis State:					
Manual Tune			ОК	Cancel	Apply Help

Resetting an APR Fault

There are three ways to reset an APR Fault:

- Instruction execution:
 - Executing an MAFR
 - Executing an MGSR
 - Executing an MASR
 - Executing an MCSR
- Do the following from the Controller Organizer:
 - Clear the group fault, the software executes an MGSR
 - Clear the axis fault, the software executes an MASR
- Download the same project a second time

Absolute Position Loss without APR Faults

The Absolute Position Recovery is not retained after the following:

- A project is exported, saved as an .L5K, and imported (downloaded)
- A major non-recoverable fault (MNRF)
- A power loss
 - **TIP** When you perform an import/export on a project in the RSLogix 5000[®] software, version 19 or earlier, the axis absolute position is not recovered on download to the controller.

The APR can potentially be restored from a memory card on a ControlLogix 5560 or GuardLogix 5560 controller (if a battery is not present) or on a ControlLogix 5570 controller (if a 1756-ESM*xxx* module is not present) as described on <u>page 262</u>.

- A download of an axis that does not have its home bit set
- Power cycling of an incremental encoder

Behavior of APR for Incremental Encoders

APR for incremental encoders means Absolute Machine Reference Position Retention. When an incremental encoder is homed, the homed bit is set. An APR fault is generated and the home axis bit clears when any of the events or conditions that generate an APR fault for an absolute encoder occur.

For example, the behavior of APR faults for an incremental encoder is identical to that of an absolute encoder. The exception to this behavior is when an incremental encoder is power cycled and its position comes up as 0. Its Absolute Machine Reference Position is lost. An APR fault is not generated.

Saving an ACD File Versus Upload of a Project

The following is an example of a sequence of events that can generate an APR fault.

- 1. Make an online change to an axis attribute that generates an APR fault.
- 2. Rehome the axis.

This action is normally done so APR restores axes positions after a download.

- 3. Save your project.
- 4. Download your project.

You still get an APR fault because saving the project only uploads the tags, not the changed attributes.

IMPORTANT You must upload the project for the changed attributes to be saved and to help prevent an APR fault on a subsequent download.

Manual Tune

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Monitor Tags with the Quick Watch Window	285
Use Motion Generator	286

If Autotune does not meet your system specifications, the manual tuning feature lets you customize your tuning parameters. Manual Tuning lets you manually improve motion performance by adjusting system bandwidth, damping factor, and drive loop gains, filters, and compensations via direct online control. Perform a manual tune when you are online with a controller to get a real-time tune of an axis.

If you are not sure that you must Manual Tune, use this process:

- If the software calculation defaults are acceptable, tuning is complete.
- If the software calculation defaults are not acceptable, perform an Autotune. If the Autotune results are acceptable, tuning is complete. See <u>Autotune on page 235</u> for details.
- If the Autotune results are not acceptable, perform a Manual Tune by using sliders to run equations.

Axis Configuration Types

Manual Tune applies to Position Loop and Velocity Loop axis configurations. Manual Tune is not available for any other axis configurations. If you change the axis configuration to a value other than Position Loop or Velocity Loop while Manual Tune is opened, the contents of the Manual Tune expander becomes disabled. This condition also applies to the Additional Tune functions.

When to Manually Tune an Axis

Current Tuning Configuration

Manual Tune displays the current tuning configuration. All parameters on the Manual Tuning dialog box are available while online.

TIP In the RSLogix 5000[®] software, version 20 and later you can make edits when online. In the RSLogix 5000 software, version 19 and earlier, changes can only be made when online and the SERVO is enabled.

When you adjust the sliders, you can see what gains were updated. When servo is on, the left area of the dialog box lights up. This option gives you real manual tuning capability. When you expand the Tuning Configuration, you are reminded of the application type and coupling (loop response affects the system damping) you selected. These values are governing the displayed values.

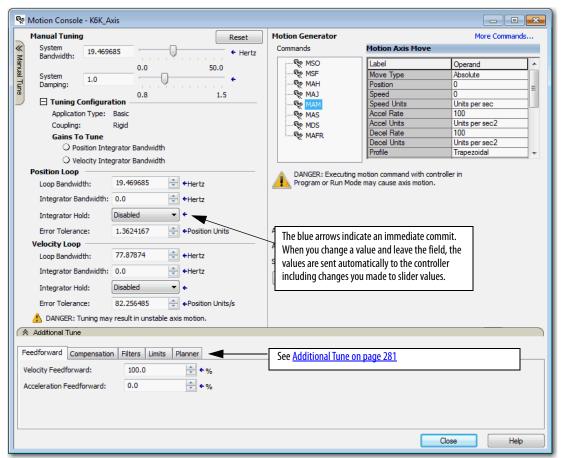
There are three Loop Response settings on the General dialog box.

Gene	eral					onse relates to the
1	Axis Configuration:	Positi	ion Loop	-	-	alues for System
F	Feedback Configuration:	Moto	r Feedback		Damping.	
ļ	Application Type:	Basic	;		Low = 1.5	
l	Loop Response:	Medi	um		Medium =	
,	Assigned Group — Motion Group:	Low Media High MG	JM		High = 0.8	
	Motion Console -	K6K_Axis				
	Manual Tuning				Reset	
~	System Bandwidth:	0.0]0		+ Hertz	System Damping is for
Manual Tune	Custom	1.0	0.0	50.0		setting the axis Bandwidth and Error Tolerance values.
D	Tuning Cor	figuration	0.0	1.5		
	Application 1	Type: Basic				
	Coupling:	Rigid				
	Gains To T O Positi	une ion Integrato	r Bandwidth			
	O Veloc	ity Integrato	r Bandwidth			

Loop Responses

This dialog box is where you can enter values for system bandwidth and system damping, which affect the loop gains. You can also individually modify the gains with sliders, bandwidth parameters, or manual changes. The gains and filters that you have tuned by using either default factory values or Autotune are your initial values in the Manual Tune dialog box. Coupling displays how tightly set or how you chose the system to tune.

The Motion Console dialog box displays Manual Tuning and Motion Generator. Use the left of the dialog box to test in an inactive state. As you perform the tune, you can test in an active state with Motion Generator.





ATTENTION: Before you tune or test axis motion, make sure no one is in the way of the axis.

Typically motion does not occur in Program mode but you can test an axis in Remote Program mode by using Motion Direct Commands.

When you tune an axis, your code is **not** in control of the axis.

The tuning procedure tunes the proportional gains. Typically, tune the proportional gains first and see how your equipment runs.

Follow these instructions to tune an axis manually.

- 1. To open Manual Tune, do one of the following:
 - Double-click an axis while online with a controller.
 - Right-click an axis and choose Manual Tune.
 - Click Manual Tune in the lower left of any category dialog box.

The Manual Tune dialog box appears.

😽 Motion Console - K6K_A	Axis					
Manual Tuning		Reset	Motion Generator		Ma	re Commands
System 19.469	685	+ Hertz	Commands	Motion Axis Mo	ve	
System 1.0	0.0	► Hertz 50.0	- Re MSO	Label	Operand	<u>^</u>
System 1.0			Re MSF	Move Type	Absolute	
g Damping:		a a a a a a 🕺 👘 👘	- Re MAH	Position	0	=
Tuning Configura	0.8	1.5	CAM 🦃	Speed	0	
Application Type:			MAM	Speed Units Accel Bate	Units per s	sec
				Accel Units	Units per s	2
Coupling:	Rigid		MDS ••• WAFR	Decel Bate	100	3002
Gains To Tune			MARK	Decel Units	Units per s	sec2
	egrator Bandwidth			Profile	Trapezoid	al 👻
	egrator Bandwidth			,		
Position Loop Loop Bandwidth:	19.469685	 ←Hertz 	DANGER: Executing m Program or Run Mode			
Integrator Bandwidth:						
Integrator Hold:	Disabled 👻	•				
Error Tolerance:	1.3624167	←Position Units	Axis State: Stopped			
Velocity Loop			Axis Fault: No Faults			
Loop Bandwidth:	77.87874		Start Inhibited: Not Inhibited	đ		
Integrator Bandwidth:		←Hertz	Execute Disab	e Axis		
Integrator Hold:	Disabled -	÷				
Error Tolerance:	82.256485	←Position Units/s				
	y result in unstable ax	is motion.				
Additional Tune						
Feedforward Compensatio	n Filters Limits F	Planner				
Velocity Feedforward:	100.0	€%				
Acceleration Feedforward:	0.0	€%				
·					Close	Help

- **TIP** When the Manual Tune dialog box appears, you can find that you cannot see the entire console. You can create more space for the console by reducing the size of the Controller Organizer or by adjusting the toolbars.
- 2. Adjust your settings according to your application.
- 3. When you change a value, it is sent to the controller immediately.
- 4. Execute a command.
- 5. Watch the result.
- 6. Make the necessary adjustments and execute a command.

TIP You can click Reset to return to default values.

Motion Generator and Motion Direct Commands

The commands on the Motion Generator give you basic control of a closed-loop servo axis.

	Motion Console - K6K_A	xis			1
	Motion Generator	M. H C	More Co	ommands	
	Commands	Motion Servo O	Commands, als	o called ins	tructions.
Manual Tune Tab	Axis State: Stopped Axis State: No Faults Start Inhibited: No Inhibits	e may cause axis mol	controller in ion.	Help	

The following instructions are available on the Motion Generator dialog box.

Command	Description		
MDS	Motion Drive Start		
MS0	Motion Servo On		
MSF	Motion Servo Off		
MAH	Motion Axis Home		
MAJ	Motion Axis Jog		
MAM	Motion Axis Move		
MAS	Motion Axis Stop		
MAFR	Motion Axis Fault Reset		

Table 62 - Available Instructions

When you click the More Commands link on the Motion Generator, you are taken to the Motion Direct Commands dialog box. In this dialog box, you can observe the effects of the manual tune. You can turn the axis on and off, home and move the axis, and reset faults.

mmands:	Motion Axis	s Jog
- Re MDS	Avis:	K6K_Axis
MAFR	Label	Operand
- Re MAS	Direction	Forward
- No MAH	Speed	0
NAJ	Speed Units	Units per sec
- Re MAM	Accel Rate	100
Re MAG	Accel Units	Units per sec2
Re MCD	Decel Rate	100
	Decel Units	Units per sec2
Re MRP	Profile	Trapezoidal
Motion Group	Accel Jerk	100
🧐 MGS	Decel Jerk	100
😪 MGSD	Jerk Units	% of Time
···· ኛቃ MGSR ···· ኛቃ MGSP	Merge	Disabled
Mation Event		ER: Executing motion command with controller in am or Run Mode may cause axis motion.
xis State: Stopped xis Fault: No Fault		
tart Inhibited: Not Inhib		

Follow these instructions to use a Motion Direct Command.

1. Select MSO (Motion Servo On) and click Execute.

Commands:	Motion Se	ervo On	
- & MSS - & MASD - & MASD - & MASD - & MASD - & MASD - & MASD - & MAS - & MAS - & MAS - & MAS - & MAJ - & MAJ - & MAG		K6K_Axis GER: Executing motion command with co ram or Run Mode may cause axis motion	
Axis State: Stopped Axis Fault: No Faults Start Inhibited: Not Inhibit	ed		

2. Click Reset.

Reset restores all values that were there when you first opened Manual Tune.

3. Select MAM (Motion Axis Move) and click Execute.

Commands:	Motion Ax	tis Move		
Motion State	Axis:	K6K_Axis		•
🧐 MSO 🗣 MSF	Label		Operand	•
NASD	Move Type	e	Absolute	
- Re MASR	Position		0	
- Re MDO	E Speed		0	
- Re MDF	Speed Unit	ts	Units per sec	E
- Re MDS	Accel Rate		100	
Se MAFR	Accel Units		Units per sec2	
Motion Move	Decel Rate		100	
Motion Move	Decel Units	S	Units per sec2	
	Profile		Trapezoidal	
HAM 🦃	Accel Jerk		100	
	Decel Jerk		100	
🧤 MAM 🗣 MAG	Jerk Units		% of Time	
🗞 MCD			on command with controller in ay cause axis motion.	
Axis State: Stopped Axis Fault: No Fault	s			
	s			

4. Click Execute.

Your drive moves according to your configuration settings.

- 5. Adjust your settings, if desired.
- 6. Select another command and click Execute.

Additional Tune

The Additional Tune section gives you access to additional tuning parameters, typically needed for more advanced servo loop settings. Additional Tune provides access to five parameter tabs:

- Feedforward
- Compensation
- Filters
- Limits
- Planner
 - TIP You may have to turn all your toolbars off to see the complete screen. When you are done, choose View>Toolbars>Factory Defaults, or turn on the toolbars you want to see.

The type of drive you are using determines the attributes that appear on the tabs. You may not see all options that are shown in the following sections for your specific application.

See the Integrated Motion on the EtherNet/IP network Reference Manual, publication <u>MOTION-RM003</u>, for detailed information about the AXIS_CIP_DRIVE attributes.

Feedforward Parameters

The Feedforward tab lets you adjust velocity and acceleration feedforward.

Additional	Tune			
Feedforward	Compensation	Filters	Limits	Planner
Velocity Feedf	orward:	100.0		÷
Acceleration F	eedforward:	0.0		+

Attribute ⁽¹⁾	Description
Velocity Feedforward	A command signal that is a scaled version of the command velocity profile.
Acceleration	A signal that is a scaled version of the command acceleration profile.

Compensation Parameters

The Compensation tab lets you input scaling gain and friction offset values.

Additional Tune					
Feedforward Compensation	Filters Limits P	lanner			
System Inertia:	0.01434175		Backlash Compensation Window:	0.0	← Position Units
Torque Offset:	0.0	≑ 🗲 % Rated	Load Observer Configuration:	Disabled	
Friction Compensation:	0.0	≑ 🗲 % Rated	Load Observer Bandwidth:	0.0	🔶 🗲 Hertz
Friction Compensation Window:	0.0	←Position Units	Load Observer Integrator Bandwidth:	0.0	+ Hertz

Attribute ⁽¹⁾	Description
System Inertia	Torque or force scaling gain value that converts commanded acceleration into equivalent rated torque/force.
Torque Offset	Provides a torque bias when performing closed-loop control.
Friction	Value that is added to the current/torque command to offset the effects of coulomb friction.
Friction Compensation	Value that is added to the current/torque command to offset the effects of friction. The Kinetix® 350 drive does not support this parameter.
Backlash Compensation	Defines a window around the command position.
Load Observer Configuration	Configures the operation of the Load Observer.
Load Observer Bandwidth	Determines the proportional gain, Kop, of the load observer.
Load Observer Integral Bandwidth	Determines the load observer integral gain, Koi, that together with the Kop, multiplies the integrated error signal within the observer.

Filters Parameters

The Filters tab lets you input torque values.

🔿 Additional Tune	
Feedforward Compensation Filter	S Limits Planner
Torque Low Pass Filter Bandwidth:	389.3937 🔶 🗲 Hertz
Torque Notch Filter Frequency:	0.0
Torque Lag Filter Gain:	1.0
Torque Lag Filter Bandwidth:	0.0 🔿 🔶 Hertz

Attribute ⁽¹⁾	Description
Torque Low Pass Filter Bandwidth	Break frequency for the second order low pass filter that is applied to the torque reference signal.
Torque Notch Filter Frequency	Center frequency of the notch filter that is applied to the toque reference signal.
Torque Lag Filter Gain	Sets the high frequency gain of the torque reference Lead-Lag Filter.
Torque Lag Filter	Sets the lag filter that is applied to the torque reference filter.
Adaptive Tuning Configuration	Configured advanced gain tuning options. The modes for the adaptive tuning include: • Disabled • Notch Filter Tuning • Gain Stabilization • Notch Filter Tuning and Gain stabilization
Torque Notch Filter High Frequency Limit	The high frequency limit for vibration suppression. The value must be greater than the Torque Notch Filter Low Frequency Limit value. The default Torque Notch Filter High Frequency limit is 2000 Hertz
Torque Notch Filter Low Frequency Limit	The low frequency limit for vibration suppression. The value must be less than the Torque Notch Filter High Frequency Limit value. The value is tied to the drive model time constant based on motor, drive, and feedback type. The default Torque Notch Filter Low Frequency limit is 100 Hz.
Torque Notch Filter Tuning Threshold	Enter a threshold value for the resonance frequency that the tuning algorithm identifies. The magnitude of an identified natural resonance frequency must be higher than this threshold value to be applied to the Torque Notch Filter Frequency estimate. The default value is 5.0% Motor Rated.

Limits Parameters

The Limits tab lets you input peak, velocity, and acceleration or deceleration values.

Additional Tune					
Feedforward Compensation	Filters Limits	Planner			
Peak Torque Limit Positive:	288.62973	🔶 ← % Rated	Velocity Limit Positive:	150.0	← Position Units/s
Peak Torque Limit Negative:	-288.62973	≑ ፍ % Rated	Velocity Limit Negative:	-150.0	← Position Units/s
Acceleration Limit:	40250.28	← Position Units/s^2			
Deceleration Limit:	40250.28	← Position Units/s^2			

Attribute ⁽¹⁾	Description
Peak Torque Limit	Floating point that is based on calculations using Max Motor Torque, Max Drive Torque, Motor Peak Current, Motor Rated Current, and Drive Peak Current attributes.
Velocity Limit	Positive or Negative velocity reference value.
Acceleration	Defines the maximum acceleration (increase in speed) allowed for the acceleration reference value into the acceleration summing junction. The Kinetix 350 does not support this attribute.
Deceleration	Defines the maximum deceleration (decrease in speed) allowed for the acceleration reference signal into the acceleration summing junction.

(1) The attributes that you can edit depend on your drive configuration.

Planner Parameters

The Planner tab lets you input the maximum values for acceleration and deceleration.

eedforward Compensa	ation Filters L	imits Planner			
aximum Speed:	70.833336	← Position Units/s	Maximum Acceleration Jerk:	2801794.3	✦ Position Units/s^3
laximum Acceleration:	14087.599	Position Units/s^2	Maximum Deceleration Jerk:	2801794.3	Position Units/s^3
1aximum Deceleration:	14087.599	← Position Units/s^2			

Attribute ⁽¹⁾	Description
Maximum	The value of the Maximum Speed attribute that is used by various motion instructions to determine the steady-state speed of the axis.
Maximum Acceleration and Maximum Deceleration	The Maximum Acceleration and Maximum Deceleration values frequently used by motion instructions, for example, MAJ, MAM, and MCD, to determine the acceleration/deceleration rate to apply to the axis.

Configure Torque Values

More advanced servo loop settings typically require additional tuning parameters such as torque values. The type of drive you are using determines the values that appear.

Follow these steps to configure torque values:

- 1. Right-click an axis and click Manual Tune.
- 2. In the bottom left corner of the Manual Console dialog box, click Additional Tune to display the additional tune tabs.
- 3. To access the torque values, click the Filters tab.
- 4. Adjust the torque values as desired.
- 5. After you adjust the values, click Additional Tune to close the tabs.

Monitor Tags with the Quick Watch Window

The Quick Watch window lets you monitor the tags in your program while you are executing commands. To open Quick Watch, press ALT+3 or choose it from the View menu.

N	😵 Motion Console - K6K_Axis 💿 💷 🎫									
	Manual Tuning		[Reset Mot	ion Generator		More Commands			
(¥ Manu	System 19.469 Bandwidth:	685	50.0	• Hertz	mmands ·····ඥ MSO ·····ඥ MSF	Motion Servo Off				
Manual Tune	System 1.0 Damping:	0.8								
	Tuning Configuration	n			МАМ					
	Position Loop		Le I		MAS					
	Loog Bandwidth:	19.469685			····· 🧐 MDS ····· 🚱 MAFR					
	Integrator Bandwidth:	0.0	+Hertz		MAFR					
	Integrator Hold:	Disabled	* *							
	Error Tolerance:	1.3624167		its 🔒		ting motion command with controller in				
	Velocity Loop			🚨	Program or Run	Mode may cause axis motion.				
	Loop Bandwidth:	77.87874	←Hertz							
	Integrator Bandwidth:	0.0								
	Integrator Hold:	Disabled	▼ €	Axis	State: Stoppe	d				
	Error Tolerance:	82.256485	←Position Un	its/s Axis	Fault: No Fau	lts				
	DANGER: Tuning mar	y result in unsta	able axis motion.	Start	Start Inhibited: Not Inhibited					
					Execute	Disable Axis				
(Additional Tune									
						Close	Help			
Watch										
Д.Q.	ick Watch	₹ Ent	er Quick Watch List I	Vame]					
	Name 📰 🛆 Scop	e	Value 🔶	Force Mask 🛛 🗧	Description					
	+ K6K_Axis Cont	roller	{}	{}						
	K6K_Axis.Wat Cont	roller	0							
	K6K_Axis.Moti Cont	roller	0							

You create Quick Watch Lists by choosing Quick Watch from the pull-down menu.

Watch									
🖗 Quick Watch	- Ent	Enter Quick Watch List Name							
Durrent Routine	-	Value	+	Force Mask	+	Description			
Quick Watch			{ }	{	}				
			0						
K6K_Axis.Wat Controller			0						

Once you name a Quick Watch List, it available in the ACD, L5K, and L5X files. Make sure to name your lists. Lists that do not have names are lost when you close the software.

This example assumes the following:

- The servo is off, with session Online
- Axis State: Stopped
- Axis Faults: No Faults
- 1. Choose MSO (Motion Servo On).

This selection readies the drive for motion, and enables the servo loop.

2. Click Execute.

The axis state goes to Servo = On.

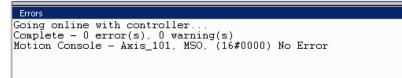
-	Motion Console	- K6K_A	xis							
	Manual Tuning			Reset	Motion Generator				More Commands	
~	System Bandwidth:	19.403085		-0	+ Hertz	Commands		Motion Servo ()n	
Manual	banamaan		0.0		50.0	MSO				
al Ti	System Damping:	1.0			•	Re MSF Re MAH				
Tune			0.8		1.5	- Re MAJ				
		Tuning Configuration				Re MAM				
	Position Loop Loop Bandwidt	÷.	19,469685	*		Re MAS				
	1.1					Re MAFR				
	Integrator Ban			-	 ←Hertz 					
	Integrator Hold:		Disabled	•	• •]		
	Error Tolerance	e:	1.3624167	-	 Position Units 			notion command wit		
	Velocity Loop					Program	or Run Mode	may cause axis mo	otion.	
	Loop Bandwidt		77.87874	* *						
	Integrator Ban	ndwidth:	0.0	-	 ←Hertz 					
	Integrator Hole	d:	Disabled	•	+	Axis State:	Running			
	Error Tolerance	e:	82.256485	-	←Position Units/s	Axis Fault:	No Faults			
	1 DANGER: Tu	ining ma	result in unsta	ble axi	s motion.	Start Inhibited:	Not Inhibite	d		
						Execute	Diabl	le Axis		
						Execute	Disab	IE AAIS		
(¥	Additional Tune									
									Close	Help
		_		_						

The Motion Console dialog box displays the following:

- Axis State: Running
- Axis Faults: No Faults

Use Motion Generator

The Results window displays the following message.



3. Select MAH (Motion Axis Home) and click Execute.

Use this step to execute the Homing command to establish a feedback positional reference, if a Position loop is being tuned.

The axis state goes Servo-On, and the controller performs the Axis Home procedure, which is based on the configured Home settings.

The Motion Console dialog box appears:

- Axis State: Running
- Axis Faults: No Faults

Manual Tuning		Reset Moti	ion Generato	Dr	More Commands
System Bandwidth: 19.479	← Hertz Con	nmands	Motion Servo	Motion Servo On	
System 1.0 Damping: 1.0 Position Loop Loop Bandwidth: Integrator Bandwidth: Integrator Hold: Error Tolerance:	0.8 19.479559 +Hertz	1.5		xecuting motion command wi	
Velocity Loop		🔎	Program or	Run Mode may cause axis m	btion.
Loop Bandwidth:	77.918236 🚔 +Hertz				
Integrator Bandwidth:	0.0 🔶 e fiertz				
Integrator Hold:	Disabled 🔻 🗲	Axis	State: Ru	unning	
Error Tolerance:	57.55035 🚔 «Position	n Units/s Axis-	Eault:		
1 DANGER: Tuning may	/ result in unstable axis motion.		Execute V	alues are immediately	eld means that these applied. Once you put a nen leave that field, it is ne controller.
Additional Tune					Close Help
ors lete - 0 error(s),					

The Results window displays No Error.

4. Choose MAM (Motion Axis Move).

This step initiates an Axis-Move at the selected speed, acceleration/ deceleration, profile, and endpoint position and lets you observe the axis response.

Before executing this MAM Move, you can initiate a method to observe the axis response during the move. Some examples include the following:

- Watch-window: Quick Watch tag name = Axis_y.ActualPosition or = Axis_y.ActualVelocity
- New Trend with Tags: Axis_y.ActualPosition or = Axis_y.ActualVelocity
- Axis Properties: Status dialog box = Axis_y.ActualPosition or = Axis_y.ActualVelocity
- 5. Click Execute.

% I	😵 Motion Console - K6K, Axis									
	Manual Tuning		Reset	Motion Generator		More Commands				
*	System 19,479	559	+ Hertz	Commands	Motion Axis Move					
Manual Tune	Bandwidth:	0.0	50.0	Re MSO	Label	Operand				
iual	System 1.0	0.0	50.0	- Re MSF	Move Type	Absolute				
로	Damping:			👽 MAH	Position	0.0				
9		0.8	1.5	😵 MAJ	Speed	0.0				
	🗄 Tuning Configuratio	n		····· 🥸 MAM	Speed Units	Units per sec				
	Position Loop			🗣 MAS	Accel Rate	100.0				
	Loop Bandwidth:	19.479559	←Hertz	🗣 MDS	Accel Units Decel Bate	Units per sec2				
	Integrator Bandwidth:	0.0	+Hertz	- Re MAFR	Decel Units	Units per sec2				
	integrator banamaan		stield2		Profile	N 111				
	Integrator Hold:	Disabled 🔹	•		Frome	Irapezoidal +				
	Error Tolerance:	1.1574671		A DANGER: Execution m	notion command with contro	lerin				
	Velocity Loop		1		may cause axis motion.					
	Loop Bandwidth:	77.918236	€Hertz							
	Integrator Bandwidth:	0.0	 Hertz 							
	Integrator Hold:	Disabled 💌	•	Axis State: Running						
	Error Tolerance:	57.55035	←Position Units/s	Axis Fault: No Faults						
	A DANGER: Tuning may	y result in unstable axi	s motion.	Start Inhibited: Not Inhibited						
				Execute Disab	le Axis					
(N	Additional Tune									
	Additional Tune									
					a	ose Help				
Erro	rs									
	otion Console - K6K Axis, MSO, (16#0000) No Error									
lotic	tion Console - K6K_Axis, MAH, (16#0000) No Error									
lotic	on Console - K6K_A:	kis, MAM, (16#00	000) No Error							

The controller performs a controlled axis move.

The Motion Console dialog box appears:

- Axis State: Running
- Axis Faults: No Faults

The Results window displays No Error.

6. Observe and verify the Axis response.

The axis motion moves according to the configured MAM settings:

- If the settings and response are satisfactory, then tuning is finished and you can close Manual Tune.
- If the settings or responses are not satisfactory, stay in Manual Tune and adjust the parameters.

Status, Faults, and Alarms

Торіс	Page
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Data Monitor	292
Drive Status Indicators	292
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Troubleshoot Faults	293
Manage Motion Faults	293
Configure the Exception Actions for AXIS_CIP_DRIVE	294
Inhibit an Axis	297

There are four ways to find and view faults and alarms:

- Fault and Alarm Log
- QuickView[®] Pane
- Tag Monitor, see the individual fault-related attributes
- Drive Status Indicators

Faults and Alarms Dialog Box

The Faults and Alarms dialog box displays the status of faults and alarms in the controller for an axis. The display is read-only except for the ability to clear logs. Fault and alarm entries are displayed only when you are online with a controller.

When online, check or clear the checkboxes in the Show row to show or hide the specified group of entries. Only the last 25 faults and alarms display.

|--|

Figure 107 - Faults and Alarms Log

🗞 Axis Properties - K6K_Axis 💿 🔍					
Categories:					
	ults and Alarms Log				
- Motor	Date/Time	△ Source	Condition	Action	End State
Model	12/31/1969 20:46	17.392 Faults Cleared	Connection Reset	No Action	No Action
Motor Feedback		03.253 Faults Cleared	Fault Log Reset	No Action	No Action
Scaling	12/31/1997 19:46	:03.276 No Alarms	Alarm Log Reset	Alarm Off	
Hookup Tests					
Polarity					
En Load					
Backlash					
Compliance					
Friction					
Observer					
Position Loop					
Velocity Loop					
Acceleration Loop					
Torque/Current Loop					
Planner					
Homing					
Actions					
Drive Parameters					
Parameter List					
Status					
Faults & Alarms					
i Tag	Show 🔽 Faults	✓ Alarms Resets			Clear Log
Axis State: Stopped					
			ОК		
Manual Tune			OK	Cancel	Apply Help

<u>Table 63</u> describes the parameters for the Faults and Alarms dialog box.

Parameter Description	
Indicator	Displays the following icons to indicate the state of a fault or alarm: Alarm On Alarm Off Fault Occurred Reset Occurred
Date/Time	Displays the date and time the event occurred. The time stamp is the workstation setting.
Source	Displays the source of the event, for example: • Safety Fault • Module Fault • Group Fault • Axis Fault • Axis Alarm
Condition	 Displays detailed information specific to the event category and code. For drive exception conditions, the information is the same text that is used for the condition. This field can contain more information when the Subcode field has been used for that entry. The field is a more detailed entry if both codes are used in the log, for example: Group Sync Failure Bus Overvoltage UL All Axis Faults Motor Overspeed Axis Init Fault
Action	Displays the action command that was executed in response to the event as configured in the axis. For instance, in many cases this display indicates that a command sent to a drive, for example: Planned Stop Ramped Stop Limited Stop Coast No Action Alarm Off Alarm On

Parameter	Description	
End State	Displays the action result that is returned from the axis, which can be more detailed than the command sent. For instance, a send of disable can result in either Holding, Shutdown or other status, for example:	
	 Stopped - Hold Stopped - Disable Shutdown Shutdown Reset 	
Faults	Toggles between faults; display or hide.	
Alarms	Toggles between alarms; display or hide.	
Clear Log Clears both the fault and alarm logs in the controller for this axis.		

Table 63 - Faults and Alarms Dialog Box Descriptions

QuickView Pane

The QuickView pane gives you a quick summary of faults and alarms that are related to the axis you select in the Controller Organizer. The information includes the type of axis, description, axis state, faults, and alarms.

🔤 🎶 Axis 1 - 192.168.1.31				
Туре	AXIS_CIP_DRIVE			
Description				
Axis State	Stopped			
Update Period	2.0 ms			
Axis Fault	No Faults			
Module Faults	No Faults			
Group Fault	No Faults			
Motion Fault	No Faults			
Initialization Fault	No Faults			
Attribute Error	No Faults			
Guard Fault	No Faults			
Guard Lock Status	Unlocked			
Start Inhibited	Not Inhibited			
Motor Catalog	MPL-A310P-M			
		P.		

Data Monitor

The Data Monitor is where you can read and write the values that are assigned to specific tags, both online and offline.

You can do the following:

- Type a tag description.
- Change the display style of a value.
- Change a force mask value.
- Sort your tags alphabetically.

Scope: 🛱 Kinetix_6500 👻 Show: All Tags				
Name 📰 🛆	Value 🗲	Force Mask 🗧 🗧	Style	Data Type
-K6K_Axis	{}	{}		AXIS_CIP_DRIVE
- K6K_Axis.AxisFault	16#0000_0000		Hex	DINT
K6K_Axis.AxisFault.0	0		Decimal	BOOL
-K6K_Axis.AxisFault.1	0		Decimal	BOOL
-K6K_Axis.AxisFault.2	0		Decimal	BOOL
-K6K_Axis.AxisFault.3	0		Decimal	BOOL
K6K_Axis.AxisFault.4	0		Decimal	BOOL
K6K_Axis.AxisFault.5	0		Decimal	BOOL
K6K_Axis.AxisFault.6	0		Decimal	BOOL
K6K_Axis.AxisFault.7	0		Decimal	BOOL
K6K_Axis.AxisFault.8	0		Decimal	BOOL

Drive Status Indicators	For complete information on drive status indicators, refer to the publications listed in <u>Additional Resources on page 9</u> .

Connection Faults and Errors

The Connection tab provides you with information about the connection condition between the controller and a module. The information comes from the controller.

You can configure the controller so that a loss of connection causes a major fault. Fault codes are as follows:

		Configure the controller so that a loss of connection to this module causes a major fault.
		Displays the fault code that is returned from the controller and provides details about the fault.

Table 64 describes common connection errors.

Table 64 - Common Connection Errors

Error	Description
Connection Request Error	The controller is attempting to make a connection to the module and has received an error. The connection was not made.
Service Request Error	The controller is attempting to request a service from the module and has received an error. The service was not performed successfully.
Module Configuration Invalid	The configuration in the module is invalid. Module Configuration Rejected - invalid power structure.
Electronic Keying Mismatch	Electronic Keying is enabled and some part of the keying information differs between the software and the module.

Troubleshoot Faults

The controller has these types of motion faults.

Table 65 - Motion Faults

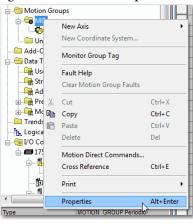
Туре	Description	Example
Instruction error	 Caused by a motion instruction: Instruction errors do not affect controller operation. Review the error code in the motion control tag to see why an instruction has an error. Fix instruction errors to optimize execution time and make sure that your code is accurate. See Error Codes (ERR) for Motion Instructions, publication MOTION-RM002. 	A Motion Axis Move (MAM) instruction with a parameter out of range.
Fault	 Caused by an anomaly with the servo loop: You choose whether motion faults cause major faults. Can shut down the controller if you do not correct the fault condition. 	 Loss of feedback. Actual position that exceeds an overtravel limit.

Manage Motion Faults

By default, the controller runs when there is a motion fault. As an option, you can configure motion faults to cause a major fault and shut down the controller.

To configure a fault type, follow these steps:

1. Right-click Motion Group and choose Properties.



2. Click the Attribute tab.

3. From the General Fault Type pull-down menu, choose the general fault type.

If you want any motion fault to cause a major fault and shut down the controller, choose Major Fault. If you choose Non-Major Fault, you must write application code that enables the controller to handle the motion fault.

🕞 Motion Group Prope	rties - MG	
Axis Assignment Attribu	te Tag	
Base Update Period:	2.0 🚔 ms (in 0.5 inc	crements.) Axis Schedule
Alternate 1 Update:	2.0 ms	
Alternate 2 Update:	2.0 ms	
General Fault Type:	Non Major Fault 🔻	
Timing Model:	One Cycle	
Scan Times (elapsed tir	ne):	
Max:	(us) Reset Max	
Last:	(us)	
Average:	(us)	
OK	Cancel	Apply Help

Configure the Exception Actions for AXIS_CIP_DRIVE

Use exception actions to set how an axis responds to different types of faults. The types of faults depend on the type of axis and how you configure it.

The drive the axis is associated with controls the available actions for each Exception. When a fault or alarm occurs, the corresponding fault or alarm axis attributes are set.

See Exception, Fault, and Alarm Attributes in the Integrated Motion on the EtherNet/IP Network Reference Manual, publication <u>MOTION-RM003</u>.

ieneral	Action to Take Upon Exception Condition				
Motor					
Model	Exception Condition	Action			
Motor Feedback	Bus Overvoltage Factory Limit	Disable	-		
Scaling	Bus Power Blown Fuse	Disable	-		
Hookup Tests	Bus Regulator Failure	Disable	-		
Polarity	Bus Regulator Thermal Overload Factory Limit	Disable	-		
Autotune	Bus Regulator Thermal Overload User Limit	Disable	-		
Load	Bus Undervoltage Factory Limit	Disable	-		DANGER: Modifying Exception
Backlash	Bus Undervoltage User Limit	Disable	-	· 🔨	Action settings may require
Compliance	Commutation Startup Failure	Disable	-	<u> </u>	programmatically stopping or
Friction	Control Module Overtemperature Factory Limit	Disable	-		disabling the axis to protect
Observer	Controller Initiated Exception	Disable	-		personnel, machine, and proper
Position Loop	Converter AC Power Loss	Disable	-		Refer to user manual for addition
Velocity Loop	Converter AC Single Phase Loss	Disable	-		information.
Acceleration Loop	Converter Ground Current Factory Limit	Disable	-		1
Torque/Current Loop	Converter Overtemperature Factory Limit	Disable	-		
Planner	Converter Pre-Charge Failure	Disable	-		
Homing	Converter Pre-charge Overload Factory Limit	Disable	-		
Actions	Converter Thermal Overload Factory Limit	Disable	-		
Exceptions	Converter Thermal Overload User Limit	Disable	-		
Cyclic Parameters	Enable Input Deactivated	Disable	-		
Parameter List	Excessive Position Error	Disable	-		
Status	Excessive Velocity Error	Disable	-		
Faults & Alarms	Feedback Data Loss Factory Limit	Disable			
Tag					
Parameter List Status Faults & Alarms	Excessive Velocity Error	Disable	•		

To configure the Exception Actions, open the Axis Properties Exceptions dialog box.

Options for each of the actions and the list of Exceptions can change based on how you configure the drive. If an exception is not possible for a specific drive (as defined by the profile of the drive), then that exception is not shown in this list.

The drive can restrict the list of actions that are taken. When a previously selected entry is no longer supported due to a configuration change, most of the entries default to Disable. In the few cases where Disable does not apply, the default is Fault Status Only. For example, Disable does not apply with a Feedback Only type configuration.

Figure 108 - Action Parameter Group Dialog Box

General	Motion Axis Parameters				
Motor	_				
Model	Parameter Group:	Actions	•	Associated Page	
Motor Feedback					
Scaling	Name	Δ	Value	Unit	
Hookup Tests	FeedbackDataLossUserLi	imit	4	Data Packets	
Polarity	FeedbackSignalLossUser	Limit	100.0	% FL Voltage Drop	
Autotune	InverterOverloadAction		<none></none>		
Load	InverterThermalOverloadU	JserLimit	110.0	% Inverter Rated	
Backlash	MechanicalBrakeControl		Automatic		
···· Compliance	MechanicalBrakeEngageD	elay	0.0	s	
Friction	MechanicalBrakeReleasel	Delay	0.0	s	
Observer	MotorOverloadAction	MotorOverloadAction			
Position Loop	MotorThermalOverloadUs	MotorThermalOverloadUserLimit		% Motor Rated	
Velocity Loop	ProgrammedStopMode	ProgrammedStopMode			
Acceleration Loop	ResistiveBrakeContactDe	lay	0.0		
Torque/Current Loop	ShutdownAction		Disable		
Planner	StoppingAction		Current Decel & Disable		
Homing	StoppingTimeLimit		1.0		
Actions	StoppingTorque			% Motor Rated	
Drive Parameters	VelocityStandstil/Window			Position Units/s	
Parameter List	VelocityThreshold		75.0	Position Units/s	
Status Faults & Alarms					
Tag					
-	,				
State: Unconnecte	1				
State: Unconnecte	1		ОК	Cancel Apply	

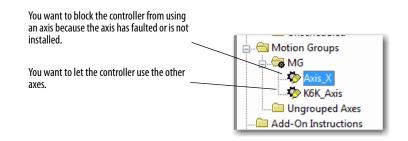
Task	Choose	Description
Shut down the axis and let it coast to a stop.	Shutdown	 Shutdown is the most severe action. Use it for faults that could endanger the machine or the operator if you do not remove power quickly and completely. A fault happens when the following occurs: Axis servo action is disabled Servo amplifier output is zeroed Appropriate drive enable output is deactivated OK contact of the servo module opens. Use this contact to open the E-stop string to the drive power supply
Stop the axis and let the drive stop the axis where you use the Stopping Action attribute to configure how to stop the drive.	Disable	 A fault happens when the following occurs: Axis servo action is disabled Servo amplifier output is zeroed Appropriate drive enable output is deactivated Drive switches to local servo loop control and the axis are slowed to a stop using the Stopping Torque The servo action and the power structure are disabled if the axis doesn't stop in the stopping time
Leave the servo loop on and stop the axis at its Maximum Deceleration rate.	Stop Planner	Use this fault action for less severe faults. It is the gentlest way to stop. Once the axis stops, you must clear the fault before you can move the axis. The exception is Hardware Overtravel and Software Overtravel faults, where you can jog or move the axis off the limit.
		 A fault happens when the following occurs: Axis slows to a stop at the Maximum Deceleration Rate without disabling servo action or the servo module Drive Enable output Control of the servo loop of the drive is maintained Axis slows to a stop at the Maximum Deceleration rate without disabling the drive
Write your own application code to handle the fault.	Fault Status Only	Use this fault action only when the standard fault actions are not appropriate. With this fault action, you must write code to handle the motion faults. For Stop Motion or Status Only, the drive must stay enabled for the controller to continue to control the axis. Select Status Only to let motion continue only if the drive itself is still enabled and tracking the command reference.
	lgnore	Ignore instructs the device to ignore the exception condition. For some exceptions that are fundamental to the operation of the axis, it is not possible to Ignore the condition.
	Alarm	Alarm action instructs the device to set the associated bit in the Axis Alarm word, but does not otherwise affect axis behavior. For some exceptions that are fundamental to the operation of the device, it is not possible to select this action o any other action that leaves device operation unaffected.

Table 66 - Action Tasks and Related Faults

Inhibit an Axis

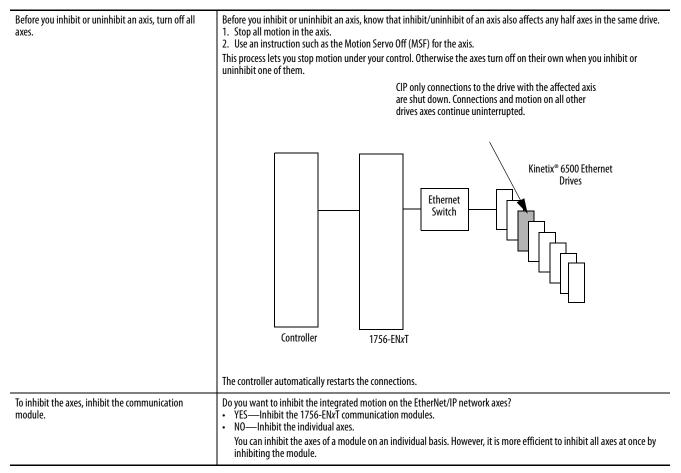
IMPORTANT You can inhibit an axis only if the axis has been previously synched to the group. If the axis has not been synched to the group, you cannot inhibit the axis.

Inhibit an axis when you want to block the controller from using an axis because the axis has faulted or is not installed. You can also inhibit an axis to let the controller use other axes.



See <u>Example: Inhibit an Axis on page 298</u> and <u>Example: Uninhibit an Axis on page 299</u> for more information.

Table 67 - Inhibit Axes



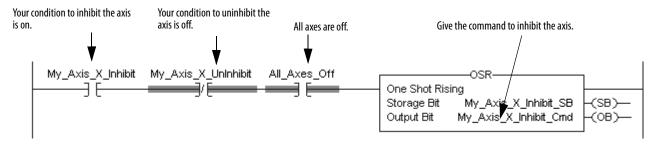
Example: Inhibit an Axis

Important: If you inhibit an axis on a drive, you inhibit all action on the drive, including any half axes. Verify that you are aware of all action on a drive before inhibiting the axis.

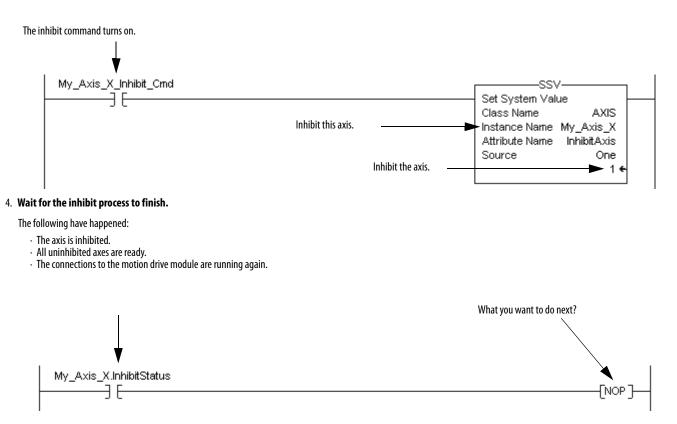
1. Verify that all axes are off.



2. Trigger the inhibit with a one-shot instruction.



3. Inhibit the axis.



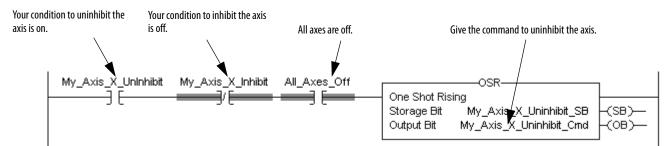
Example: Uninhibit an Axis

Important: If you inhibit an axis on a drive, you inhibit all action on the drive, including any half axes. Verify that you are aware of all action on a drive before inhibiting the axis.

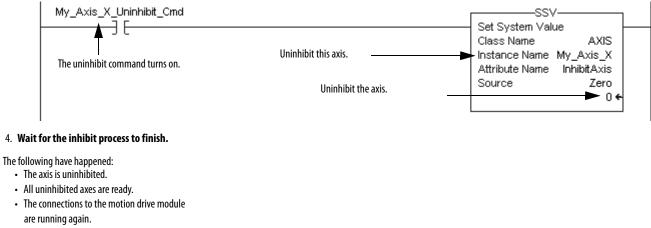
1. Verify that all axes are off.



2. Trigger the uninhibit with a one-shot instruction.



3. Uninhibit the axis.





Digital I/O Status Indicators

Use the Status category to:

- Display the status of the axis
- View the current state of the axis and CIP SafetyTM drive
- Manually adjust axis drive attributes

The status tab displays the following:

- Position Data (Actual and Command)
- Velocity Data (Actual and Command)
- Axis status indicators
 - The indicators light up if the state has been reached. For example, if the Torque Limit is reached, the light next to that limit turns blue.
- Digital I/O status indicators
 - The indicators light up if the state has been reached. For example, if Registration 1 is reached, the light next to Registration 1 turns blue.

You can view the status of the digital I/O indicators in the Status category of the Axis Properties window. An example of the Status category is shown in the following figure.

General	Motion Status				
·· Motor ··· Model ··· Analyzer ·· Motor Feedback ·· Scaling	Actual Position: Command Position:		Velocity: nd Velocity:		
- Hookup Tests - Polarity - Autotune - Load 	DC Bus Up DC Bus Unload AC Power Loss	Power Structure Enabled Tracking Command Shutdown	 Position Lock Velocity Lock Standstill 	Torque Limit Current Limit Thermal Limit	
Observer Position Loop Position Loop Velocity Loop Torque/Current Loop Planner Homing Actions Otive Parameters Parameter List Status Faults & Alams Tag	Digital 1/0 Cable Registration 1 Registration 2	Home Positive Overtravel Negative Overtravel	Mechanical Brake Regenerative Power Contactor Enable Pre-Charge	 Bus Capactor Shunt Thermal Switch Feedback Thermostat Motor Thermostat 	
State:					

The following two tables detail the meaning of the status indicators per the axis tags.

Bit	Required/ Optional	Name	Digital I/O	Axis Status	Description
0	R	Enable Input	Off	0	Enable is not active
			On	1	Enable is active
1	R/E	Home Input	Off	0	Home is not active
			On	1	Home is active
2	R/E	Registration 1 Input	Off	0	Reg 1 is not active
			On	1	Reg 1 is active

Bit	Required/ Optional	Name	Digital I/O	Axis Status	Description
3	0/E	Registration 2 Input	Off	0	Reg 2 is not active
			On	1	Reg 2 is active
4	R/P	Positive Overtravel OK	Off	0	Overtravel Fault
		Input	On	1	No Overtravel Fault
5	R/P	Negative Overtravel OK	Off	0	Overtravel Fault
		Input	On	1	No Overtravel Fault
6	0/E	Feedback 1 OK Thermostat	Off	0	Feedback 1 Thermostat Fault
			On	1	No Feedback 1 Thermostat Fault
7	0/D	Resistive Brake Release	Off	0	Motor connected to Brake Resistor
		Output	On	1	Motor connected to Inverter
8	0/D	Mechanical Brake Release	Off	0	Brake is Engaged
		Output	On	1	Brake is Released
9	0/D	Motor Thermostat OK	Off	0	Thermostat Fault
		Input	On	1	No Thermostat Fault
103 1	-	Reserved	-	-	-

Notes:

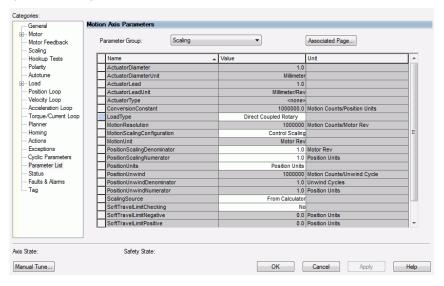
Parameter Group Dialog Boxes

Торіс	Page
Parameter Dialog-box Listings	303

This appendix describes the parameter group dialog-boxes. You can access all parameters that are associated with each category dialog box by clicking Parameters on the dialog box.

Each Parameter dialog-box list can contain more attributes than the associated category dialog box. In some cases, attributes that are contained on the Parameter List dialog box are not contained on the associated category dialog box.

Figure 109 - Scaling Parameters



You can configure advanced parameters only on the dialog box for that group. Not all parameters can be set on each category dialog box.

Parameter Dialog-box Listings

This dialog box is an example of the parameters available for an axis that is configured as a Position Loop. There are six parameters that you can set on the Position Loop and Position Loop Parameter Group dialog boxes.

> Axis Properties - CIP_K6	к										
Categories:											
General	Position Lo	ор									
⊡ ··· Motor	Gains										
Model	Ban	dwidth:	0.0		Hertz		Га	rameters			
Scaling		grator Bandwidth:	0.0		Hertz					Click Parameters	to open th
Polarity		-		-						Parameter Grou	n listina
Autotune		grator Hold:	_		•					i didineter didu	p insting.
E Load	Velo	ocity Feedforward:	0.0	1	%						
Position Loop											
Velocity Loop	Limits										
Torque/Current Loop	Егго	r Tolerance:	0.0)	Position	Units					
Planner	Loc	k Tolerance:	0.0)	Position	Units					
Axis Properties -	CIP_K6K										
Categories:											
General	Motie	on Axis Paramel	ters								
⊡ Motor		Parameter Group:	1	Position Loop		•	ſ	Associated Page			
Model		Parameter Group:		Position Loop		•	l	Associated Fage			
Scaling	iun.	Name			∆ Valu	e		Unit			
Polarity		PositionErrorT	Folerance				0.0	Position Units			
Autotune		PositionIntegra		idth				Hz			
Backlash	,	PositionIntegra PositionLockT			_		Disableo	Position Units			
Position Loop		PositionLoopE						Hz			
···· Velocity Loop		VelocityFeedf	forwardGai	n			0.0	%			
Torque/Curren	nt Loop			\sim							
Planner Homing					$\backslash \square$						
Actions						On this dialoo	g box, the lis	t includes the	parameters	s	
Drive Paramet					11	that are on th	ne Position L	oop dialog box	and more		
Parameter List						advanced par	rameters.	1 5			
Status Faults & Alarm											
Tag	10										
		,									
										_	
Name		Δ	Value			Unit				T	
PositionErrorToleran	ice					0.0 Positio	on Units			Help	1
PositionIntegratorBa	ndwidth					0.0 Hz					,
PositionIntegratorHo			Disabled			-					
PositionLockToleran						Positio	on Units				
PositionLoopBandw			Disabled Enabled	12		Hz					
VelocityFeedforwar		_	Lindbied			0.0 %					
- Clockyr Coarbi Wal	a dam		_		_	0.0				-	

On this dialog box, the list includes the parameters that are on the Position Loop dialog box and more advanced parameters.

Figure 110 - Frequency Control Parameters

🏷 Axis Properties - CIP_K6	к6К	- • •
Categories:		
* General	Motion Axis Parameters	
- Motor Model	Parameter Group: Frequency Control Associated Page	
- Polarity	Name 🛆 Value Unit	
- Planner	BreakFrequency 30.0 Hz	
- Frequency Control	BreakVoltage 230.0 Volts (RMS)	
- Actions	FrequencyControlMethod Basic Volts/Hertz	
 Drive Parameters 	MaximumFrequency 130.0 Hz	
- Parameter List	MaximumVoltage 460.0 Volts (RMS)	
Status	RunBoost 8.5 Volts (RMS)	
- Faults & Alarms	StartBoost 8.5 Volts (RMS)	
- Tag		

Торіс	Page					
Program a Velocity Profile and Jerk Rate						
Enter Basic Logic	316					
Choose a Motion Instruction	318					
Troubleshoot Axis Motion	321					
Programming with the MDSC Function	329					
PowerFlex Out-of-Box Configuration	332					
Setting the ACO/AVO Attributefor PF527 Drives Only	336					

This appendix describes how to program a velocity profile and jerk rate.

Program a Velocity Profile and Jerk Rate

You can use either of these motion profiles for various instructions:

- Trapezoidal profile for linear acceleration and deceleration
- S-curve profiles for controlled jerk

Definition of Jerk

The Jerk is the rate of change of acceleration or deceleration.

The jerk parameters apply only to S-curve profile moves that use these instructions:

• MAJ	•	MCS
• MAM	•	MCCD
• MAS	•	мссм
• MCD	•	MCLM

For example, if acceleration changes from 0 to 40 mm/s^2 in 0.2 seconds, the jerk is:

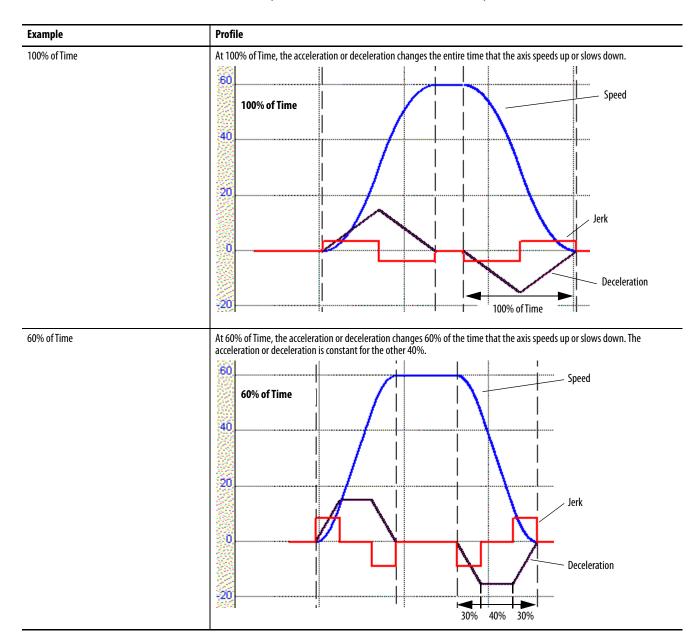
$$(40 \text{ mm/s}^2 - 0 \text{ mm/s}^2) / 0.2 \text{ s} = 200 \text{ mm/s}^3$$

Choose a Profile

lf You Want	Choose This Profile	Consideration
 Fastest acceleration and deceleration times More flexibility in programming subsequent motion 	Trapezoidal	Jerk doesn't limit the acceleration and deceleration time: • The Acceleration and Deceleration rates control the maximum change in Velocity. • Your equipment and load get more stress
	Aerocity	 than with an S-curve profile. Jerk is considered infinite and is shown as a vertical line.
	Accel	
	Time	
		—
Smoother acceleration and deceleration that reduces the stress on the equipment and load	S-curve	Jerk limits the acceleration and deceleration time: • It takes longer to accelerate and decelerate than a trapezoidal profile.
	Velocity	 If the instruction uses an S-curve profile, the controller calculates acceleration, deceleration, and jerk when you start the instruction. The controller calculates triangular acceleration and deceleration profiles.
		—

Consider cycle time and smoothness when you choose a profile.

Use % of Time for the Easiest Programming of Jerk



Use % of Time to specify how much of the acceleration or deceleration time has jerk. You don't have to calculate actual jerk values.

Velocity Profile Effects

Table 68 summarizes the differences between profiles.

Table 68 - Profile Differences

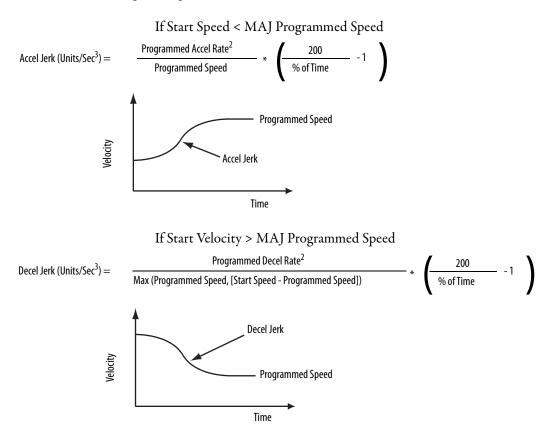
Profile	ACC/DEC	Motor	Priority of Control			
Туре	Time	Stress	Highest to Lowest			
Trapezoidal	Fastest	Worst	Acc/Dec	Velocity	Position	
S-curve	2X Slower	Best	Jerk	Acc/Dec	Velocity	Position

Jerk Rate Calculation

If the instruction uses or changes an S-curve profile, the controller calculates acceleration, deceleration, and jerk when you start the instruction.

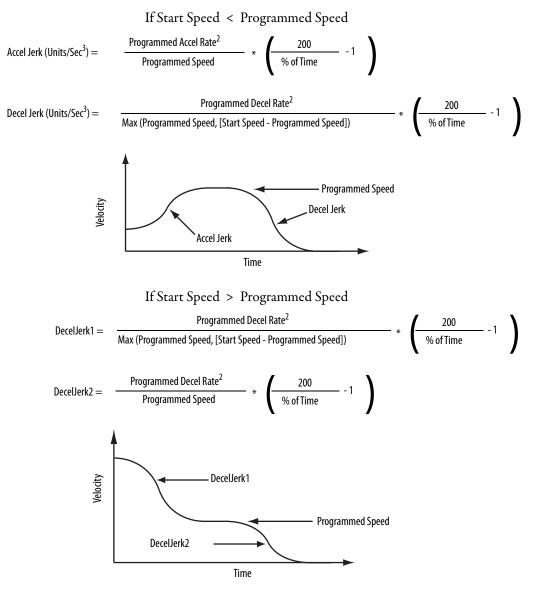
The system has a Jerk priority planner. In other words, Jerk always takes priority over acceleration and velocity. Therefore, you always get the programmed Jerk. If a move is velocity-limited, the move does not reach the programmed acceleration and/or velocity.

Jerk Parameters for MAJ programmed in units of % time are converted to engineering units as follows:

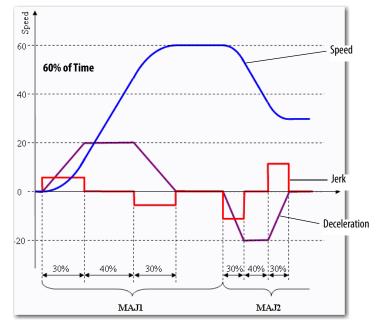


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Jerks for programmed moves, such as MAM or MCLM instructions, in units of % time are converted to engineering units as follows:



DecelJerk1 is used while Current Speed > Programmed Speed DecelJerk2 is used while Current Speed < Programmed Speed



The same '% of time' jerk can result in different slopes for the acceleration profile than on the deceleration profile, dependent on the Speed parameter of the instruction.

The motion planner algorithm adjusts the actual jerk rate so that both the acceleration profile and the deceleration profile contain at least the '% of time' ramp time. If the Start Speed is close to the programmed Speed parameter, the actual percentage of ramp time can be higher than the programmed value.

In most cases, the condition is:

if: (start Speed is == 0.0) OR (start Speed is > 2 * max Speed).

then: you get **programmed** percentage of ramp time

else: you get higher than programmed percentage of ramp time

Conversion from % Time to Engineering Units

If you want to convert % of Time to Engineering Units, use these equations.

For Accel Jerk:

$$j_{a} [\% \text{ of Time}] = \frac{2}{1 + \frac{j_{a} [EU/s^{3}] v_{max} [EU/s]}{a_{max} [EU/s^{2}]}} 100$$

For Decel Jerk:

$$j_{d} [\% \text{ of Time}] = \frac{2}{1 + \frac{j_{d} [EU/s^{3}] v_{max} [EU/s]}{d_{max} [EU/s^{2}]}} 100$$

Jerk Programming in Units/Sec³

If you want to specify the jerk in 'Units/sec³' instead of '% of time', adjust your jerk value as follows so that you get the value that you programmed.

Tomporary (pood -	Programmed Decel Rate ²
Temporary Speed =	Desired Decel Jerk value in Units/Sec ³
Start Speed	- Programmed Speed
Max (Programmed	Speed, Temporary Speed)
else .	e Decel Jerk in Units/Sec ³ = Desired Decel Jerk in Units/Sec ³ e Decel Jerk in Units/Sec ³ = Desired Decel Jerk in Units/Sec ³ * k

Unique Program Considerations

If you program a move by using the % of Time units, the programming software computes an Accel Jerk = a^2/v where a = the programmed Accel Rate and v = programmed Speed.

Therefore, the higher the programmed speed, the lower the computed Jerk. The system has a Jerk priority planner. In other words, Jerk always takes priority over acceleration and velocity.

Therefore, you always get the programmed Jerk. If a move is velocity-limited, the move does not reach the programmed acceleration and/or velocity. Once you reach the velocity limit for the length of the move, as the velocity is increased, the move takes longer and longer to complete.

Decel Jerk is computed similarly to the Accel Jerk described previously. The only difference is that instead of a^2/v , Decel Jerk = d^2/v , where d = the programmed **Decel Rate**.

EXAMPLE Example #1

Start Speed = 8.0 in/sec Desired Speed = 5.0 in/sec Desired Decel Rate = 2.0 in/sec² Desired Decel Jerk = 1.0 in/sec³ Temporary Speed = (Desired Decel Rate)² / Desired jerk value in Units/Sec³ = 2.0^2 / 1.0 == 4.0 in/sec k = (8.0 - 5.0) / max(5.0, 4.0) = 3.0 / 5.0 == 0.6 Because k < 1, we can enter the desired Decel jerk directly in the faceplate Instruction faceplate Decel jerk in Units/Sec³ = 1.0 in/sec³

EXAMPLE Example #2

Start Speed = 13.0 in/sec Desired Speed = 5.0 in/sec Desired Decel Rate = 2.0 in/sec² Desired Decel Jerk = 1.0 in/sec³ Temporary Speed = (Desired Decel Rate)² / Desired jerk value in Units/Sec³ = 2.0^2 / 1.0 == 4.0 in/sec k = (13.0 - 5.0) / max(5.0, 4.0) = 8.0 / 5.0 == 1.6 Because k > 1, we have to calculate the Decel jerk to use on the instruction faceplate as: Instruction faceplate Decel jerk in Units/Sec³ = = 1.0 in/sec³ * 1.6 == 1.6 in/sec³

Which revision do you have?

- 15 or earlier: % of Time is fixed at 100.
- 16 or later: % of Time defaults to 100% of time on projects that are converted from earlier versions. For new projects, you must enter the Jerk value.

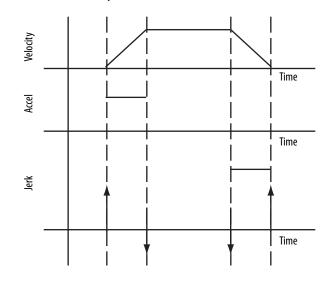
Profile Operand

This operand has two profile types:

- Trapezoidal Velocity Profile
- <u>S-curve Velocity Profile</u>

Trapezoidal Velocity Profile

The trapezoidal velocity profile is the most commonly used profile because it provides the most flexibility in programming subsequent motion and the fastest acceleration and deceleration times. Acceleration and deceleration specify the change in velocity per unit time. Jerk is not a factor for trapezoidal profiles. Therefore, it is considered infinite and is shown as a vertical line in the following graph.



Trapezoidal Accel/Decel Time

S-curve Velocity Profile

S-curve velocity profiles are most often used when the stress on the mechanical system and load must be minimized. The acceleration and deceleration time is balanced against the machine stress with two additional parameters, acceleration jerk and deceleration jerk.

The acceleration profile can be set to almost pure rectangular, see <u>Trapezoidal</u> <u>Accel/Decel Time on page 313</u> (fastest and highest stress), or to triangular, see <u>Programmable S-curve Accel/Decel Time, Acceleration Jerk = 60% of Time</u> <u>on page 315</u> (slowest, lowest stress), dependent on the Jerk settings.

The typical acceleration profile is a trade-off between stress and speed, as shown in <u>S-curve Accel/Decel Time, Backward Compatibility Setting:</u> Acceleration Jerk = 100% of Time on page 316.

Either you specify the Jerk (either in Units/sec³ or as a percentage of maximum) or it is calculated from the percentage of time. (Percentage of time is equal to the percentage of ramp time in the acceleration/deceleration profile).

$$j_{a} [EU/s^{3}] = \frac{a_{max}^{2} [EU/s^{2}]}{v_{max} [EU/s]} \left(\frac{200}{j_{a} [\% \text{ of time}]} - 1\right)$$

$$j_{a} [EU/s^{3}] = \frac{d_{max}^{2} [EU/s^{2}]}{v_{max} [EU/s]} \left(\frac{200}{j_{a} [\% \text{ of time}]} - 1\right)$$

Backward Compatibility

The Jerk of 100% of time produces triangular acceleration and deceleration profiles. These profiles are ones that would have been previously produced as shown in <u>S-curve Accel/Decel Time, Backward Compatibility Setting:</u> <u>Acceleration Jerk = 100% of Time on page 316</u>.

Small Jerk rates, rates less than 5% of time, produce acceleration and deceleration profiles close to rectangular ones, such as the one shown in <u>Trapezoidal Accel/Decel Time on page 313</u>.

IMPORTANT	Higher values of the % of Time result in lower values of Jerk Rate Limits and,
	therefore, slower profiles. See the following table for reference.

Table 69 - Velocity Versus Jerk

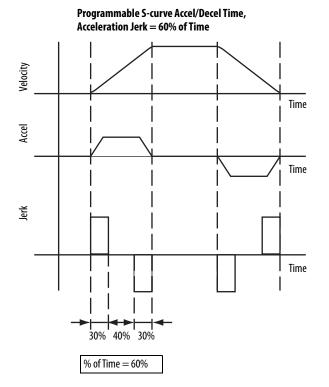
	Trapezoidal Velocity Profile ⁽¹⁾	S-shaped Velocity Profile with 1< = Jerk <100% of Time ⁽²⁾	S-shaped Velocity Profile with Jerk = 100% of Time ⁽³⁾
Accel/Decel Jerk in Units/sec ³	ω	$\frac{\text{Max Accel}^2}{\text{Max Velocity}} \text{to } \infty$	Max Accel ² Max Velocity
Accel/Decel Jerk in % of Maximum	_	0100%	—
Accel/Decel Jerk in % of Time	0%	1100%	100%

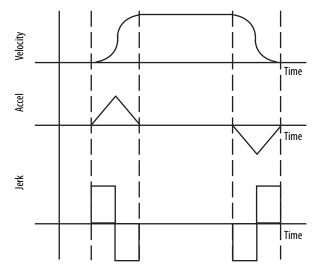
(1) The example on page 313 (labeled Trapezoidal Accel/Decel Time) uses a rectangular acceleration profile.

(2) The example on page 315 (labeled Programmable S-curve Accel/Decel Time, Acceleration Jerk = 60% of Time) uses a trapezoidal acceleration profile.

(3) The example on page 316 (labeled S-curve Accel/Decel Time, Backward Compatibility Setting: Acceleration Jerk = 100% of Time) uses a triangular acceleration profile.

Calculations are performed when an Axis Move, Change Dynamics, or an MCS^{m} Stop of StopType = Move or Jog is initiated.



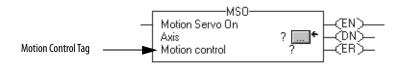


S-curve Accel/Decel Time, Backward Compatibility Setting: Acceleration Jerk = 100% of Time

Enter Basic Logic

The controller gives you a set of motion control instructions for your axes:

- Use these instructions just like the rest of the Studio 5000 Logix Designer[®] application instructions. You can program motion control in these programming languages:
 - Ladder diagram (LD)
 - Structured Text (ST)
 - Sequential Function Chart (SFC)
- Each motion instruction works on one or more axes.
- Each motion instruction needs a motion control tag. The tag uses a MOTION_INSTRUCTION data type. The tag stores the status information of the instruction.



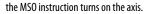


ATTENTION: Use the tag for the motion control operand of motion instruction only once. Unintended operation of the control variables can happen if you reuse the same motion control tag in other instructions.

Example Motion Control Program

This figure is an example of Ladder Logix that homes, jogs, and moves an axis.

If Initialize_Pushbutton = on and the axis = off (My_Axis_X.ServoActionStatus = off) then



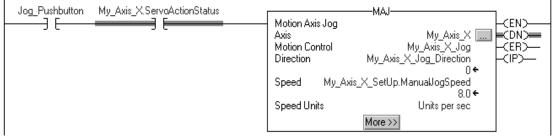
Initi	alize_Pushbutton	My_Axis_X.ServaActionStatus]/[]	 Motion Servo On Axis		CEN)
			Motion Control	My_Axis_X_On	(ER)—

If *Home_Pushbutton* = on and the axis hasn't been homed (*My_Axis_X.AxisHomedStatus* = off) then the MAH instruction homes the axis.



If *Jog_Pushbutton* = on and the axis = on (*My_Axis_X.ServoActionStatus* = on) then

the MAJ instruction jogs the axis forward at 8 units/s.



If Jog_Pushbutton = off then

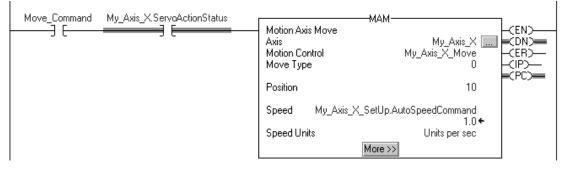
the MAS instruction stops the axis at 100 units/s².

Make sure that *Change Decel* is *Yes*. Otherwise, the axis decelerates at its maximum speed.

Jog_Pushbutton		MAS	.
//	Motion Axis Stop		- <en></en>
	Axis	My_Axis_X 🛄	- <dn>— </dn>
	Motion Control	My_Axis_X_MAS	- <er>— </er>
	Stop Type	Jog	H <ip> </ip>
	Change Decel	Yes	⊢ <pc>— </pc>
	Decel Rate	My_Axis_X_SetUp.ManuaUogDecel	
		100.0 +	
	Decel Units	Units per sec2	
		<< Less	

If *Move_Command* = on and the axis = on (*My_Axis_X.ServoActionStatus* = on) then

the MAM instruction moves the axis. The axis moves to the position of 10 units at 1 unit/s.



Download a Project

Follow these steps to download your program to a controller.

- 1. With the keyswitch, place the controller in Program or Remote Program mode.
- 2. From the Communications menu, choose Download.
- 3. Confirm that you wish to complete the download procedure.
- 4. Click Download.
- Once the download is complete, place the controller in Run/Test mode. After the project file is downloaded, status and compiler messages appear in the status bar.

Choose a Motion Instruction

Use <u>Table 70</u> to choose an instruction and see if it is available as a Motion Direct Command.

Table 70 - Available Motion Direct Commands

If You Want To	And	Use This Instruction	Motion Direct Command
Change the state of an axis	Enable the drive and activate the axis loop.	MSO Motion Servo On	Yes
	Disable the drive and deactivate the axis loop.	MSF Motion Servo Off	Yes
	Force an axis into the shutdown state and block any instructions that initiate axis motion.	MASD Motion Axis Shutdown	Yes
	Reset the axis from the shutdown state.	MASR Motion Axis Shutdown Reset	Yes
	Activate the drive control loops for the Integrated Motion on EtherNet/IP network axis and run the motor at the specified speed.	MDS Motion Drive Start	
	Clear all motion faults for an axis.	MAFR Motion Axis Fault Reset	Yes

If You Want To	And	Use This Instruction	Motion Direct Command
ontrol axis position	Stop any motion process on an axis.	MAS Motion Axis Stop	Yes
	Home an axis.	MAH Motion Axis Home	Yes
	Jog an axis.	MAJ Motion Axis Jog	Yes
	Move an axis to a specific position.	MAM Motion Axis Move	Yes
	Start electronic gearing between two axes.	MAG Motion Axis Gear	Yes
	Change the speed, acceleration, or deceleration of a move or a jog that is in progress.	MCD Motion Change Dynamics	Yes
	Change the command or actual position of an axis.	MRP Motion Redefine Position	Yes
	Calculate a Cam Profile that is based on an array of cam points.	MCCP Motion Calculate Cam Profile	No
	Start electronic camming between two axes.	MAPC Motion Axis Position Cam	No
	Start electronic camming as a function of time.	MATC Motion Axis Time Cam	No
	Calculate the slave value, slope, and derivative of the slope for a cam profile and master value.	MCSV Motion Calculate Slave Values	No
nitiate action on all axes	Stop motion of all axes.	MGS Motion Group Stop	Yes
	Force all axes into the shutdown state.	MGSD Motion Group Shutdown	Yes
	Transition all axes to the ready state.	MGSR Motion Group Shutdown Reset	Yes
	Latch the current command and actual position of all axes.	MGSP Motion Group Strobe Position	Yes
rm and disarm special event hecking functions, such as	Arm the watch-position event checking for an axis.	MAW Motion Arm Watch Position	Yes
registration and watch position	Disarm the watch-position event checking for an axis.	MDW Motion Disarm Watch Position	Yes
	Arm the module registration-event checking for an axis.	MAR Motion Arm Registration	Yes
	Disarm the module registration-event checking for an axis.	MDR Motion Disarm Registration	Yes
	Arm an output cam for an axis and output.	MAOC Motion Arm Output Cam	No
	Disarm one or all output cams connected to an axis.	MDOC Motion Disarm Output Cam	No

Table 70 - Available Motion Direct Commands

Table 70 - Available Motion Direct Commands

If You Want To	And	Use This Instruction	Motion Direct Command
Tune an axis and run diagnostic tests for your control system. These tests	Run a tuning motion profile for an axis	MRAT Motion Run Axis Tuning	No
include the following:Motor/encoder hookup testEncoder hookup test	Run one of the diagnostic tests on an axis.	MRHD Motion Run Hookup Diagnostic	No
Marker test Control multi-axis coordinated motion	Start a linear coordinated move for the axes of a coordinate system.	MCLM Motion Coordinated Linear Move	No
	Start a circular move for the axes of a coordinate system.	MCCM Motion Coordinated Circular Move	No
	Change in path dynamics for the active motion on a coordinate system.	MCCD Motion Coordinated Change Dynamics	No
	Stop the axes of a coordinate system or cancel a transform.	MCS Motion Coordinated Stop	No
	Shut down the axes of a coordinate system.	MCSD Motion Coordinated Shutdown	No
	Start a transform that links two coordinate systems together. This transform is like bidirectional gearing.	MCT Motion Coordinated Transform ⁽¹⁾	No
	Calculate the position of one coordinate system regarding another coordinate system.	MCTP Motion Calculate Transform Position ⁽¹⁾	No
	Transition the axes of a coordinate system to the ready state and clear the axis faults.	MCSR Motion Coordinated Shutdown Reset	No

(1) You can only use this instruction with ControlLogix $^{\circ}$ 5560 or GuardLogix $^{\circ}$ 5560 controllers.

Troubleshoot Axis Motion

This section helps you troubleshoot some situations that could happen while you are running an axis.

Example Situation	Page
Why Does My Axis Accelerate When I Stop It?	321
Why Does My Axis Overshoot Its Target Speed?	322
Why Is There a Delay When I Stop and Then Restart a Jog?	325
Why Does The Axis Reverse Direction When Stopped and Started?	327

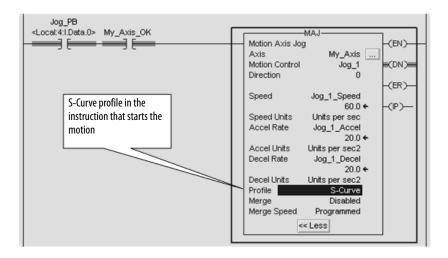
Why Does My Axis Accelerate When I Stop It?

While an axis is accelerating, you try to stop it. The axis accelerates for a short time before it starts to decelerate.

Example

You start a Motion Axis Jog (MAJ) instruction. Before the axis gets to its target speed, you start a Motion Axis Stop (MAS) instruction. The axis continues to speed up and then eventually slows to a stop.

Look For

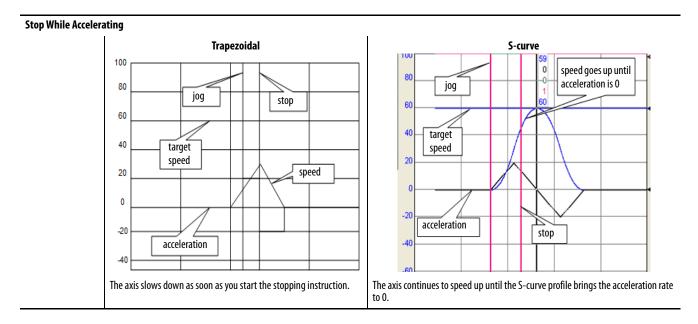


Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis:

- An S-curve profile has to get acceleration to 0 before the axis can slow down.
- The time that it takes depends on the acceleration and speed.
- In the meantime, the axis continues to speed up.

The following trends show how the axis stops with a trapezoidal profile and an S-curve profile.



Corrective Action

If you want the axis to slow down right away, use a trapezoidal profile.

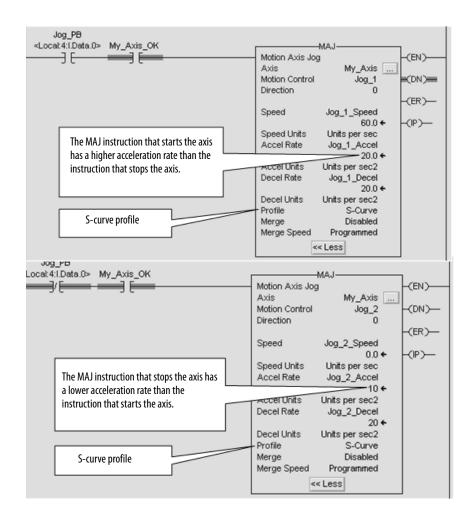
Why Does My Axis Overshoot Its Target Speed?

While an axis is accelerating, you try to stop the axis or change its speed. The axis accelerates and goes past its initial target speed. Eventually it starts to decelerate.

Example

You start a Motion Axis Jog (MAJ) instruction. Before the axis gets to its target speed, you try to stop it with another MAJ instruction. The speed of the second instruction is set to 0. The axis continues to speed up and overshoots its initial target speed. Eventually it slows to a stop.

Look For



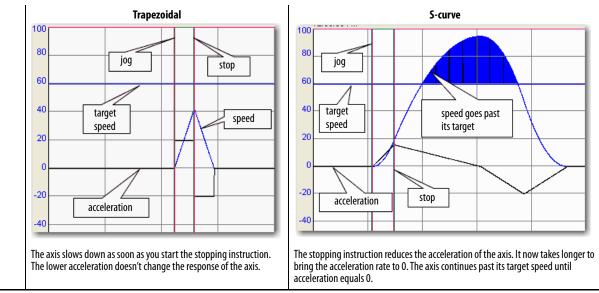
Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis:

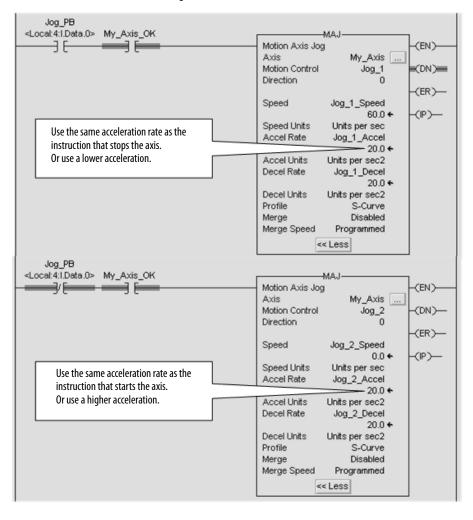
- An S-curve profile has to get acceleration to 0 before the axis can slow down.
- If you reduce the acceleration, it takes longer to get acceleration to 0.
- In the meantime, the axis continues past its initial target speed.

The following trends show how the axis stops with a trapezoidal profile and an S-curve profile.

Stop While Accelerating and Reduce the Acceleration Rate



Corrective Action



Use a Motion Axis Stop (MAS) instruction to stop the axis or configure your instructions like this example.

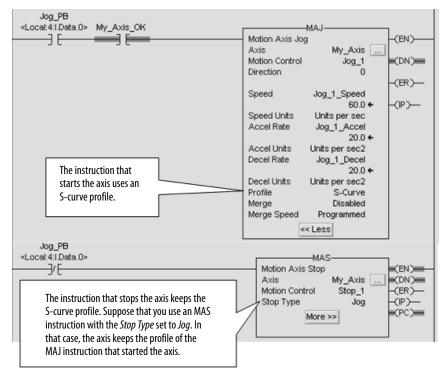
Why Is There a Delay When I Stop and Then Restart a Jog?

While an axis is jogging at its target speed, you stop the axis. Before the axis stops completely, you restart the jog. The axis continues to slow down before it speeds up.

Example

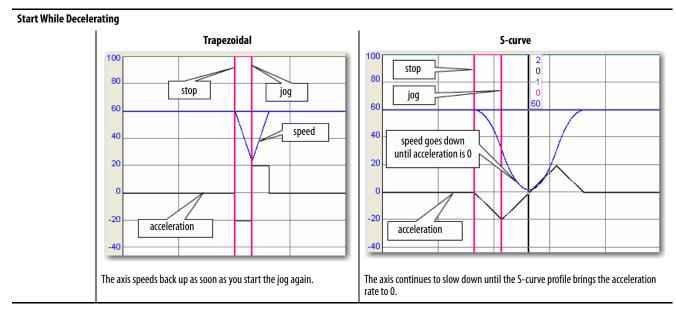
You use a Motion Axis Stop (MAS) instruction to stop a jog. While the axis is slowing down, you use a Motion Axis Jog (MAJ) instruction to start the axis again. The axis doesn't respond right away. It continues to slow down. Eventually it speeds back up to the target speed.

Look For



Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis. An S-curve profile has to get acceleration to 0 before the axis can speed up again. The following trends show how the axis stops and starts with a trapezoidal profile and an S-curve profile.



Corrective Action

If you want the axis to accelerate right away, use a trapezoidal profile.

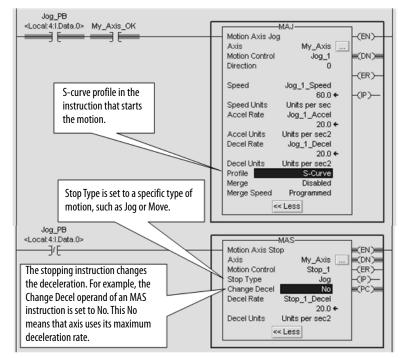
Why Does The Axis Reverse Direction When Stopped and Started?

While an axis is jogging at its target speed, you stop the axis. Before the axis stops completely, you restart the jog. The axis continues to slow down and then reverses direction. Eventually the axis changes direction again and moves in the programmed direction.

Example

You use a Motion Axis Stop (MAS) instruction to stop a jog. While the axis is slowing down, you use a Motion Axis Jog (MAJ) instruction to start the axis again. The axis continues to slow down and then moves in the opposite direction. Eventually it returns to its programmed direction.

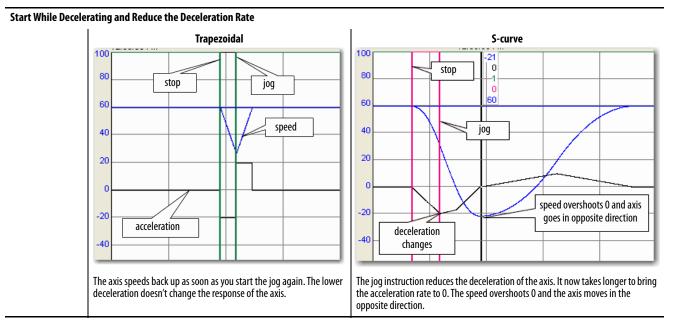
Look For



Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis:

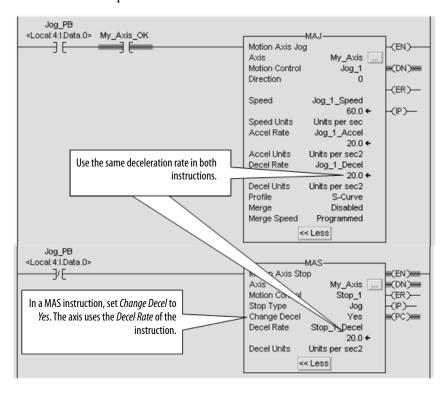
- An S-curve profile has to get acceleration to 0 before the axis can speed up again.
- If you reduce the acceleration, it takes longer to get acceleration to 0.
- In the meantime, the axis continues past 0 speed and moves in the opposite direction.



The following trends show how the axis stops and starts with a trapezoidal profile and an S-curve profile.

Corrective Action

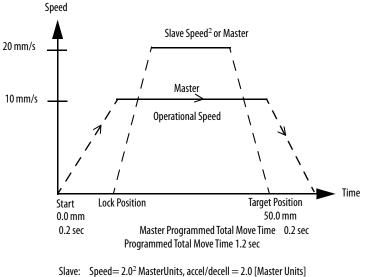
Use the same deceleration rate in the instruction that starts the axis and the instruction that stops the axis.



Programming with the MDSC Function

Figure 111 shows an example of programming motion with the MDSC functionality. In this example, we illustrate a 50.0 mm move.

Figure 111 - Slave Speed Control from Master with Lock Position, MDSC Time Based



Lock Position = 10.0

Revision	Operand	Units	Туре	Profile
V19 and earlier	Speed	Units/sec	Rate	Trapezoidal, S-curve
(PJerk)	Accel/Decel	Units/sec ²	Rate	
	Jerk	Units/sec ³	Rate	
		% of time	Time	
	Speed, Accel/Decel, and Jerk	% of max % of units/sec	Rate	
For instruction	ons: MAM, MAJ, MCD, and MAS			
V20	Speed	Units/sec	Rate	Trapezoidal, S-curve
		Sec	Time	Trapezoidal, S-curve
		Master units	Feedback	Trapezoidal, S-curve
	Accel/Decel	Units/sec ²	Rate	Trapezoidal, S-curve
		Sec	Time	Trapezoidal, S-curve
		Master units	Feedback	Trapezoidal, S-curve
	Jerk	Units/sec ²	Rate	Trapezoidal, S-curve
		Sec	Time	Trapezoidal, S-curve
		Master units	Feedback	Trapezoidal, S-curve
For instruction	ons, MDSC, MAM, MAJ, and MATC			

In <u>Figure 112</u>, we are programming rate. The controller calculates the time of the move: Speed and Accel/Decel as units = units (seconds).

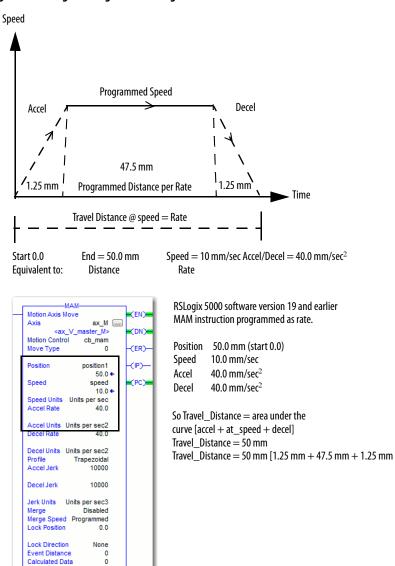
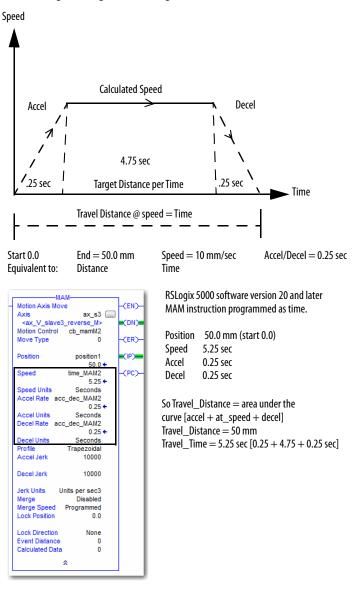


Figure 112 - Programming Rate in RSLogix 5000° Software Version 19 and Earlier

\$

In <u>Figure 113</u>, we are programming time. The controller calculates the speed of the move: Speed and Accel/Decel as time [seconds].

Figure 113 - Programming Time in RSLogix 5000 Software Version 20 and Later



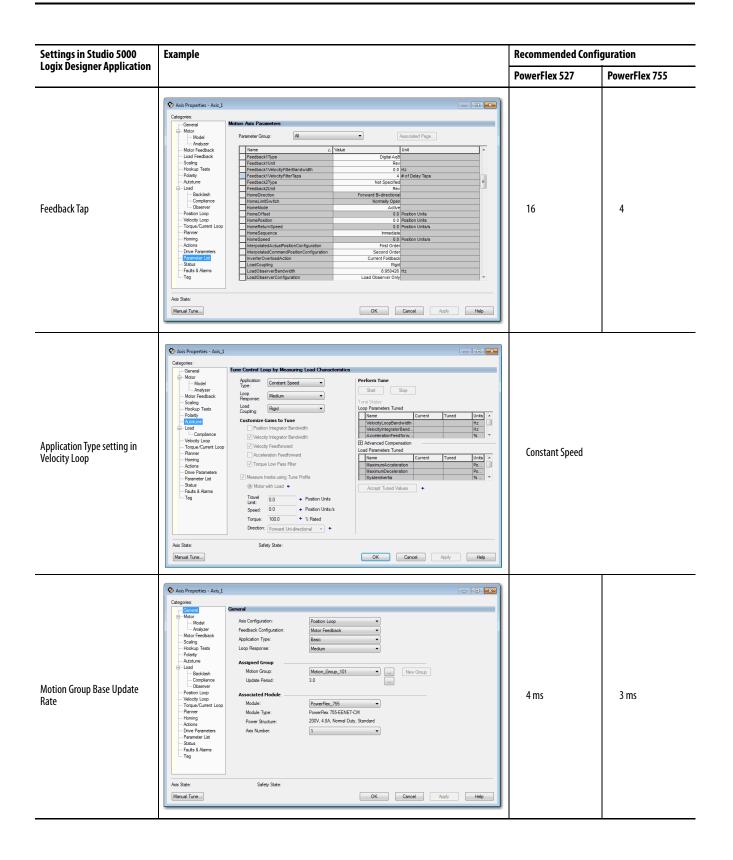
PowerFlex Out-of-Box Configuration

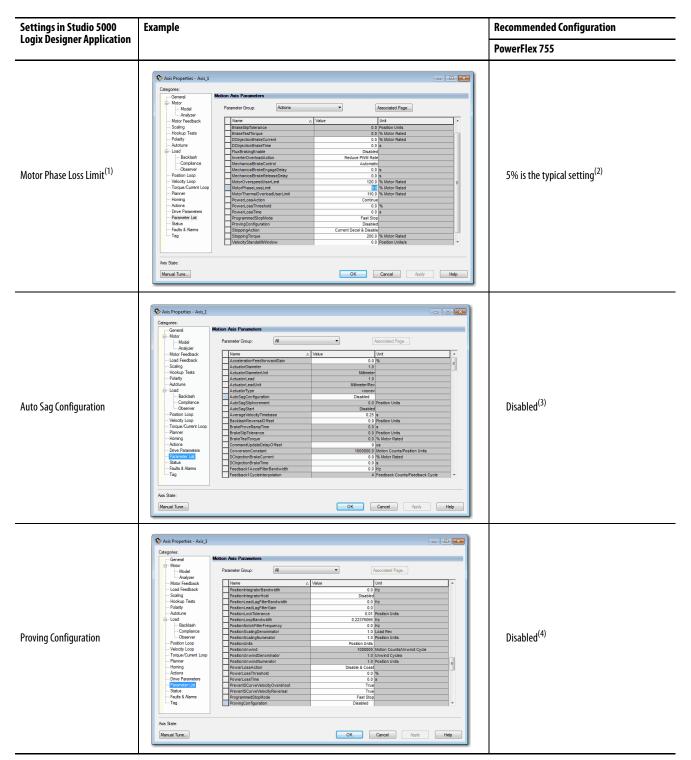
Apply these out-of-box settings first before configuring for your application. This information applies to only the PowerFlex[®] drive.

Settings in Studio 5000	Example	Recommended Configuration	
Logix Designer Application		PowerFlex 527	PowerFlex 755
Ramp Velocity Limit	Chair Properties - Axis 1 Image: Characteristics of Molion Flammer Categories: Model - Mole - Avalyser Maximum Speed: - Soding Expression - Mole - Avalyser Maximum Speed: - Loopiance Maximum Speed: - Complance Maximum Speed: - Torgue-Current Loop Maximum Deceleration Jekt: - Torgue-Current Loop - Torgue-Current Loop - Trage - Torgue-Current Loop - Torge Adamere - Torg	120% of Motor Rated S Motors	peed for Induction
Current Vector Limit	Avs State: Safety State: Mercual Ture: OK Cancel Acoty Heb OK Cancel Cancel Acoty Heb OK Cancel Acoty Heb OK Cancel Cancel Acoty Heb OK Cancel Cancel Acoty Heb OK Cancel Acoty Heb OK Cancel Cancel Acoty Heb OK Cancel Constant OK Cancel C	180% of Motor Rated C	urrent

Recommended Out-of-Box Settings

Settings in Studio 5000	Example	Recommended Configuration	
Logix Designer Application		PowerFlex 527	PowerFlex 755
Torque Limits	Axis Properties - Axis 1 Celegones: More Model More Feedback Bandwidth: 0 Hetz Peak Torque Lint Positive: Viceorglaces Peak Torque Lint Negative: Points Atmente Torque Current Loop Peak Torque Lint Negative: Peak Torque Lint Negative: Pack State: Status Status Status Status OK Concel Apply	200% of Motor Rate	d Torque
Velocity Error Tolerance	Aix Properties - Axis 1 Image: Calegodes: Calegodes: Sore Actions In Take Upon Conditions Mode: Analysis Mode: Sore Actions: Calegodes: Sore Actions: Calegodes: Overside Action: Compliance Power Loss Action: Deception Condition Action Bass Bradiant Thermal Overload Factory Line Boothree Action ethings may result for additioned there are and property: Bass Bradiant Thermal Overload Factory Line Boothree Control Hoodian Control Hoothree Convertier AC Single Thermal Overload Factory Line Boothree Convertier AC Single Thermal Overload Factory Line Boothree Convertier AC Single Thermal Overload Factory Line Boothree Convertier Ac Single Thermal Overload Factory Line Boothree Convertier AC Single Thermal Overload Factory Line Boothree Convertier Ac Single Thermal Overload Factory Line Boothree Convertier AC Single Therm	Change action to ala	ITTI





(1) You must use a value of 1% for MotorPhaseLossLimit if your configuration includes a Rotary Permanent Magnet Motor.

(2) Change this parameter to 1% for only Rotary Permanent Magnet Motor configurations.

(3) Auto Sag Configuration must be disabled for the out-of-box configuration to avoid unexpected operation. If you enable this parameter, it opens the Auto Sag Slip Increment and Auto Sag Start parameters for editing.

(4) Proving Configuration must be disabled for the out-of-box configuration to avoid unexpected operation. If you enable this parameter, it opens the Brake Prove Ramp Time, Brake Slip Tolerance, and Brake Test Torque parameters for editing.

Setting the ACO/AVO

Only

Attributefor PF527 Drives

IMPORTANT If your configuration includes a Rotary Permanent Magnet motor, you must change the Phase-Loss limit to 1 ms for operation. If you do not change the Phase-Loss limit to 1 ms, the Commutation Test for the Rotary PM could fail and generate a Motor Phase-Loss Limit fault. Also, the instruction MSO for the Rotary PM can fail and generate a Motor Phase-Loss Limit fault.

The attribute ACO/AVO (Analog Current Output/Analog Voltage Output) can be used to set the analog output of the PowerFlex 527 drive to either current (mA) or voltage (V).

Make sure that the Analog Out jumper (J2) is also set to the same value.

essage Configuration - m1	
Configuration* Communication Tag Message Lype: CIP Generic Service Set Attribute Single Type: Set Attribute Single Service Set Attribute Single Service 10 Glass: 42 Instance: 1 Attribute: A64	Element
) Enable () Enable Waiting () Start) Error Coda: Extended Error Coda: rror Path:	◯ Done Done Length: 0 ☐ Timed Out ←
rror Text:	Cancel Apply Help

Table 72 - ACO/AVO: MSG

Parameter	Value	Description
Service Code	0x10	Get Attribute Single
Class	0x42	Analog Output
Instance	1	-
Attribute	0xA64	Voltage/Current Mode
Data Type	SINT	Unsigned Short Integer

Table 73 - ACO/AVO: Values

Value	Definition
0	Voltage (V)
1	Current (mA)

	The following terms and abbreviations are used throughout this manual. For definitions of terms that are not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication <u>AG-7.1</u> .
Absolute Position Retention (APR)	While Homing creates an absolute machine reference position, the APR bit is designed to retain the absolute position.
Axis	A logical element of a motion control system that exhibits some form of movement. Axes can be rotary or linear, physical, or virtual, controlled, or observed.
Bus Regulator	Used to limit the rise in DC Bus voltage level that occurs when decelerating a motor.
CIP™	Common Industrial Protocol.
CIP Sync	Defines extensions to CIP Common objects and device profiles to support time synchronization over CIP Networks.
Closed-loop	A method of control where there is a feedback signal that is used to drive the actual dynamics of the motor to match the commanded dynamics by servo action. In most cases, there is a literal feedback device to provide this signal, but in some cases the signal is derived from the motor excitation, for example, sensorless operation.
Converter	A device that generally converts AC input to DC output. A Converter is also commonly called the Drive Power Supply. In the context of a drive system, the Converter is responsible for converting AC Main input into DC Bus power.
Course (Base) Update Period	The base update period of the update task of the motion group, which is specified in milliseconds.
Cyclic Data Block	A high priority real-time data block that is an integrated motion on the EtherNet/IP™ network connection transfers on a periodic basis.
Drive	A device that is designed to control the dynamics of a motor.
Event Data Block	A medium priority real-time data block that an integrated motion on the EtherNet/IP network connection transfers only after a specified event occurs. Registration and marker input transitions are typical drive events.
Get/Read	A Get/Read involves the retrieval of an attribute value from the perspective of Controller side of the interface.
Integrated Motion on the EtherNet/ IP network I/O Connection	The I/O connection is the periodic bidirectional, Class 1, CIP connection between a controller and a drive that is defined as part of the integrated motion on the EtherNet/IP network standard.
Integrated Motion on the EtherNet/ IP Network Drive	

Inverter	A device that generally converts DC input to AC output. An Inverter is also commonly called the Drive Amplifier. In the context of a drive system, the Inverter is responsible for controlling the application of DC Bus power to an AC motor.
Motion	Any aspect of the dynamics of an axis. In the context of this document, it is not limited to servo drives but encompasses all forms of drive-based motor control.
Motion Group	A user-defined grouping of motion axes. A motion group has configuration parameters and status attributes that apply to all axes in the group.
Multiplexing	The method by which multiple signals are combined into one signal for transmission.
Multiplex Update Multiplier	Number of multiplexed drives that determines the multiplex update period.
Multiplex Update Period	Task update period for a Multiplexed Axis.
Open-loop	A method of control where there is no application of feedback to force the actual motor dynamics to match the commanded dynamics. Examples of open-loop control are stepper drives and variable-frequency drives.
Safe Torque Off (STO)	Provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When the command to allow torque ceases from the GuardLogix [®] controller, all drive output-power transistors are released from the On-state.
	For complete information about the Safe Torque Off feature, see the Kinetix [®] Multi-axis servo EtherNet/IP drive User Manual, publication <u>2198-UM002</u> .
Service Data Block	A lower priority real-time data block associated with a service message from the controller that an integrated motion on the EtherNet/IP network connection transfers on a periodic basis. Service data includes service request messages to access attributes, run a drive-based motion planner, or perform various drive diagnostics.
Set/Write	A Set/Write involves setting an attribute to a specified value from the perspective of the Controller side of the interface.
Shunt Regulator	A specific Bus Regulator method that switches the DC Bus across a power dissipating resistor to dissipate the regenerative power of a decelerating motor.
Synchronized	A condition where the local clock value on the drive is locked onto the master clock of the distributed System Time. When synchronized, the drive and controller devices can use time stamps that are associated with an integrated motion on the EtherNet/IP network connection data.

System Time	The absolute time value as defined in the CIP Sync standard in the context of a distributed time system where all devices have a local clock that is synchronized with a common master clock. In the context of integrated motion on the EtherNet/IP network, System Time is a 64-bit integer value in units of microseconds or nanoseconds with a value of 0 corresponding to January 1, 1970.
Time Offset	The System Time Offset value that is associated with the integrated motion on the EtherNet/IP network connection data that is associated with the source device. The System Time Offset is a 64-bit offset value that is added to the local clock of a device to generate System Time for that device.
Time Stamp	A system time stamp value that is associated with the integrated motion on the EtherNet/IP network connection data. The time stamp conveys the absolute time when the associated data was captured, or can be also used to determine when associated data is applied.
Variable Frequency Drive (VFD)	A class of drive products that seek to control the speed of a motor, typically an induction motor, through a proportional relationship between drive output voltage and commanded output frequency. Frequency drives are, therefore, sometimes referred to as Volts/Hertz drives.
Vector Drive	A class of drive products that seek to control the dynamics of a motor via closed-loop control. These dynamics include, but are not limited to, closed- loop control of both torque and flux vector components of the motor stator current relative to the rotor flux vector.

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Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444 Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640 Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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