Configure Axis Properties

The peak current ratings of the Kinetix 6000 AM modules (series A, B, C, and D) are configured at the factory as 150% of continuous current. You can program 460V (series B, C, and D) AM modules and the equivalent IAM (inverter) modules, for up to 250% of continuous inverter current.

Refer to Appendix F on page 257 to recalculate torque and acceleration or deceleration limit values, and paste them into the appropriate Axis Properties dialog box in the Logix Designer application.

Follow these steps to configure Axis properties for motor feedback.

1. Right-click an axis in the Controller Organizer and choose Properties.

The Axis Properties dialog box opens.

Ӯ Axis Properties - Axis_1 📃 🗖 🔀			
Homing Hookup 1 General Motion Plan	une Dynamics Gains Output Limits Offset FaultActions Tag ner Units Drive/Motor MotorFeedback AuxFeedback Conversion		
Amplifier Catalog Number:	2094-AC16-M03		
Motor Catalog Number:	<none> Change Catalog</none>		
Loop Configuration:	Position Servo		
Drive Resolution:	200000 Drive Counts per Motor Rev 💌 Calculate		
🔽 Drive Enable Input Ch	ecking		
🗌 Drive Enable	Input Fault		
Real Time Axis Informati	on		
Attribute 1:	<none></none>		
Attribute 2:	<none></none>		
	OK Cancel Apply Help		

- 2. Click the Drive/Motor tab.
- 3. Click Change Catalog.

The Change Catalog Number dialog box opens.

Change Catalog Number	×
Catalog Number: MPL-A330P-M	ок
MPL-A320P-H MPL-A320P-M	Cancel
MPL-A320P-S MPL-A330P-H MPL-A330P-M	Help
MPL-A330P-S MPL-A420P-H MPL-A420P-M MPL-A420P-S	-
MPL-A430H-H	<u>~</u>
Filters Voltage Family	Feedback Type
<al></al>	

- Select the motor catalog number appropriate for your application.
 To verify the motor catalog number, refer to the motor name plate.
- 5. Click OK.

6. On the Drive/Motor tab, check Drive Enable Input Checking.

When checked (default), means a hard drive-enable input signal is required. Uncheck to remove that requirement.

- 7. Click Apply.
- **8.** Click the Motor Feedback tab and verify the Feedback Type shown is appropriate for your actual hardware configuration.
- **9.** Click the Units tab and edit default values as appropriate for your application.
- **10.** Click the Conversion tab and edit default values as appropriate for your application.

🏷 Ахіs Properties - Ахіs_1	_ 🗆 🗙
Homing Hookup Tune Dynamics Gains Output Limits Offset Fault Ac General Motion Planner Units Drive/Motor* Motor Feedback* Aux Feedback	tions Tag Conversion*
Positioning Mode: Rotary	
Conversion Constant: 200000.0 Drive Counts/1.0 Position Units Based on 200000 Counts/Motor Rev	
Position Unwind: 200000 Drive Counts/Unwind Based on 200000 Counts/Motor Rev	
OK Cancel Apply	Help

In this example, Rotary is chosen from the Positioning Mode pull-down menu.

- **11.** Click Apply if you made changes.
- 12. Click the Fault Actions tab.

Axis Properties - Axis_1					
General Motion Planner Units Drive/Motor* Motor Feedback Aux Feedback Conversion Homing Hookup Tune Dynamics Gains Output Limits Offset Fault Actions Tag					
Drive Enable Input:	Drive Enable Input: Disable Drive 💌 Set Custom Stop Action)				
Drive Thermal:	Disable Drive	•			
Motor Thermal:	Disable Drive	Custom Stop Action Attri	butes		×
Feedback Noise:	Status Only	Name	Value	Units	Туре
Feedback:	Shutdown	StoppingTorque StoppingTimeLimit	291.2458 10.0		REAL
Position Error:	Disable Drive	BrakeEngageDelayTime	0.0		REAL
Hard Overtravel:	Disable Drive	BrakeReleaseDelayTime ResistiveBrakeContactDelay	0.0	17.4	REAL REAL
Soft Overtravel:	Disable Drive	ļ			
Phase Loss:	Shutdown		Close	Cancel	Help
OK Cancel Apply Help					

13. Click Set Custom Stop Action.

The Custom Stop Action Attributes dialog box opens and lets you set delay times for servo motors and RBM modules.

- 14. Configure the delay times.
 - a. Type the Brake Engage Delay Time.
 - b. Type the Brake Release Delay Time.
 - c. Set the Resistive Brake Contact Delay time (0 1000 ms range).
 - **TIP** For recommended motor brake response times, refer to the Kinetix Rotary Motion Specifications Technical Data, publication <u>KNX-TD001</u>. The recommended delay time for 2090-XB33-*xx* and 2090-XB120-*xx* RBM modules is 71 ms.
 - d. Click Close to close the Custom Stop Action Attributes dialog box.
- **15.** Click Apply.
- 16. Repeat step 1 through step 15 for each Bulletin 2094 AM module.

Follow these steps to configure Auxiliary Axis properties.

IMPORTANT Auxiliary feedback is not supported by the Kinetix 6000M IDM units.

1. Right-click an auxiliary axis in the Controller Organizer and choose Properties.

The Axis Properties dialog box opens on the General tab.

If an axis is associated to the auxiliary axis node, set the Axis Configuration on the General tab of the Axis Properties dialog box to Feedback Only.

🍄 Axis Properties - Axi	s_1_Aux	- 🗆 🛛
Homing General Motion Plan	Hookup Fault Acti her Units Drive/Motor Motor Feedb	
Axis Configuration:	Feedback Only	
Motion Group:	UM_Motion	New Group
Associated Module:		
Module:	Drive	
Module Type:	📇 2094-AC16-M03	
Node:	129 (Auxiliary)	
	ОК С	Cancel Apply Help

2. Click the Drive/Motor tab.

The Drive/Motor tab displays the amplifier being used and the Loop Configuration is Aux Feedback Only. This is the only choice if the amplifier is using the primary node for Servo (motor) configuration.

🍄 Axis Properties - Ax	cis_1_Aux	
Homing General Motion Plan	Hookup Fault Actions Tag nner Units Drive/Motor Motor Feedback Aux Feedback Coi	nversion
Amplifier Catalog Number:	2094-AC16-M03	
Motor Catalog Number:	<none> Change Catalog</none>	
Loop Configuration:	Aux Feedback Only	
Drive Resolution:	200000 Drive Counts / Aux Rev 🔽 Calculate	
🔽 Drive Enable Input Ch	necking	
🔲 Drive Enable	linput Fault	
Real Time Axis Informati	ion	
Attribute 1:	<none></none>	
Attribute 2:	<none></none>	
	OK Cancel Apply	Help

3. Click the Aux Feedback tab.

😵 Axis Properties - A	xis_1_Aux		2
Homing		kup Fault Actions	Tag
General Motion Pl	anner Units	Drive/Motor Motor Feedback	Aux Feedback Conversion
Feedback Type:	SRM	•	
Cycles:	1024	per Rev 💌	
Interpolation Factor:	2048		
Feedback Resolution:	2097152	Feedback Counts per Rev	
Feedback Ratio:	1.0	Aux. Rev/Motor Rev	
		OK Cancel	Apply Help

IMPORTANT The Aux Feedback tab must be configured for the auxiliary feedback type being used. In this example, an SRM feedback device is being used.

- **4.** From the Feedback Type pull-down menu, choose the feedback type appropriate for your auxiliary feedback motor.
- 5. Click OK.
- 6. Verify your Logix 5000 program and save the file.

Download the Program

After completing the Logix 5000 configuration you must download your program to the Logix 5000 processor.

Apply Power to the Kinetix 6000 Drive

This procedure assumes that you have wired and configured your Kinetix 6000 system (with or without the LIM module) and your Sercos interface module.



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

Refer to the Line Interface Module Installation Instructions, publication <u>2094-</u><u>IN005</u>, when troubleshooting the LIM module status indicators, and for the location of LIM module circuit breakers, connectors, and status indicators.

Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for connector locations and when troubleshooting the IPIM module and IDM unit status indicators.

Follow these steps to apply power to the Kinetix 6000 drive system.

1. Disconnect the load to the motor.

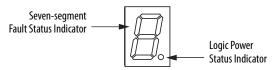


ATTENTION: To avoid personal injury or damage to equipment, disconnect the load to the motor. Make sure each motor is free of all linkages when initially applying power to the system.

2. Determine your source of control power.

If Your Control Power	Then	
ls sourced from a LIM module	 Verify that CB1, CB2, and CB3 are in the OFF position. Apply three-phase input power to the LIM module VAC Line connector. Set CB3 to the ON position. Set CB2 to the ON position. Go to main <u>step 3.</u> 	
ls not sourced from a LIM module	 Apply (95264V AC) control power to the IAM module (CPD connector). Go to main <u>step 3.</u> 	

3. Observe the IAM/AM module logic power status indicator.



If the Logic Power Indicator is ⁽¹⁾	Then
ON	Go to <u>step 4</u> .
Not ON	 Check your control power connections. Go back to main <u>step 2</u>.

(1) If your 2094 drive system includes a Kinetix 6000M IDM system, observe the drive status indicator and verify that it is on.

4. Determine your source of three-phase input power.

lf Your Three-phase Power	Then
ls sourced from a LIM module	 Set CB1 to the ON position. Verify the Hardware Enable Input signal (IOD-2) for each axis is at 0 volts. Remove the connection between IOD-1 and IOD-2 if one exists. ⁽¹⁾ Go to main <u>step 5</u>.
ls not sourced from a LIM module	 Apply 195265V AC (230V) or 324528V AC (460V) input power to the IAM module (IPD connector). Verify the Hardware Enable Input signal (IOD-2) for each axis is at 0 volts. Remove the connection between IOD-1 and IOD-2 if one exists. ⁽¹⁾ Go to main <u>step 5</u>.

(1) The hardware enable input for IDM units is on the IPIM module.

5. Observe the IAM/AM module fault status indicator.

The status indicator first flashes the Sercos node address, then cycles through ring phases until final configuration (phase 4) is reached.

IAM/AM Fault Status Indicator	Status	Do This
Actively cycling (phase 0)	The drive is looking for a closed Sercos ring. Wait for phase 1 or take corrective action until you reach phase 1.	Check fiber-optic connections.
Displaying a fixed 1 (phase 1)	The drive is looking for active nodes. Wait for phase 2 or take corrective action until you reach phase 2.	Check node addressing.
Displaying a fixed 2 (phase 2)	The drive is configuring nodes for communication. Wait for phase 3 or take corrective action until you reach phase 3.	Check program motor and drive configuration against installed hardware.
Displaying a fixed 3 (phase 3)	The drive is configuring device specific parameters. Wait for phase 4 or take corrective action until you reach phase 4.	Check motor catalog number against selection. ⁽¹⁾
Displaying a fixed 4 (phase 4)	The drive is configured and active.	Go to <u>step 6</u> .
Flashing an E followed by two numbers	Drive is faulted.	Go to Kinetix 6000 Drive System Error Codes on page 165.

(1) You can get diagnostic information from the module by highlighting the module name in the Logix Designer application. A Pseudo Key Failure often indicates that the motor selection does not match the motor installed.

6. Observe the status indicators on the front of the IAM/AM module.

Refer to troubleshooting tables for the Drive, Comm, and Bus status indicators in IAM/AM Module Status Indicators on <u>page 170</u>. Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for IPIM module and IDM unit status indicator troubleshooting tables.

7. Observe the three Sercos indicators on the Logix 5000 Sercos module.

Three Sercos Indicators	Status	Do This
Flashing green and red	Establishing communication	Wait for steady green on all three indicators.
Steady green	Communication ready	Go to Test and Tune the Axes on page 155.
Not flashing green and red/ not steady green	Sercos module is faulted	Go to the appropriate Logix 5000 manual for specific instructions and troubleshooting.

Test and Tune the Axes

These procedures assume that you have configured your Kinetix 6000 drive, your Logix 5000 Sercos interface module, and applied power to the system.

For help with using the Logix Designer application, as it applies to testing and tuning your axes with ControlLogix, CompactLogix, or SoftLogix Sercos modules, refer to <u>Additional Resources</u> on <u>page 10</u>.

Test the Axes

Follow these steps to test the axes.

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

The Axis Properties dialog box opens.

🏷 Axis Properties - Axis_1				_ 🗆 🗵
Dynamics Gains Output General Units Conversion Dr	Limits	Offset Feedback H	Fault Actions oming Hookup	Tag * Tune
Test Increment: 2.0 Rev	's		Test <u>M</u> ark	ker
Drive Polarity: Positive			Test <u>F</u> eedb	ack
			Test <u>C</u> ommand &	Feedback
DANGER: These tests may cause axis motion with the controller in program mode. Modifying polarity determined after executing the Test Command & Feedback test may cause axis runaway condition.				
	OK	Cancel	Apply	Help

- 3. Click the Hookup tab.
- **4.** Type 2.0 as the number of revolutions for the test or another number more appropriate for your application.

This Test	Performs this Test
Test Marker ⁽¹⁾	Verifies marker detection capability as you rotate the motor shaft.
Test Feedback ⁽¹⁾	Verifies feedback connections are wired correctly as you rotate the motor shaft. Also, lets you define polarity.
Test Command & Feedback	Verifies motor power and feedback connections are wired correctly as you command the motor to rotate. Also, lets you define polarity.

(1) If testing motor with brake, energize the brake circuit to release the brake prior to test.

5. Apply Hardware Enable Input signal (IOD-2) for the axis you are testing.



ATTENTION: To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD-2) only to the axis you are testing.

IMPORTANT Hardware Enable input for IDM units is on the IPIM module.

6. Click the desired test (Marker/Feedback/Command & Feedback) to verify connections.

The Online Command dialog box opens. Follow the on-screen test instructions. When the test completes, the Command Status changes from Executing to Command Complete.

Online Command - Encoder Test	×
Command Status: Command Complete	OK
Move axis manually in positive direction. Wait for command to complete. Check for errors if command fails.	<u>S</u> top
Check for errors if command fails.	<u>H</u> elp
1	

7. Click OK.

The Online Command - Apply Test dialog box opens (Feedback and Command & Feedback tests only). When the test completes, the Command Status changes from Executing to Command Complete.

Online Command - Apply Test	×
Command Status: Command Complete	OK
Wait for command to complete. Check for errors if command fails.	<u>S</u> top
•	<u>H</u> elp
,	

- 8. Click OK.
- 9. Determine if your test completed successfully.

lf	Then
Your test completes successfully, this dialog box opens. RSLogix 5000 X Apply test completed successfully. Feedback polarity has been updated. OK	 Click OK. Remove Hardware Enable Input ⁽¹⁾ signal (IOD-2). Go to Tune the Axes on page 157.
Your test failed, this dialog box opens. RSLogix 5000 Test command cannot be completed. Command timed out. Test Increment maybe to large. OK Help Error 16382-0	 Click OK. Verify the Bus status indicator turned solid green during the test. Verify that the Hardware Enable Input ⁽¹⁾ signal (IOD-2) is applied to the axis you are testing. Verify conversion constant entered in the Conversion tab. Return to main <u>step 6</u> and run the test again.

(1) The hardware enable input for IDM units is on the IPIM module.

Tune the Axes

The load observer feature (available with drive firmware revision 1.124 or later) can provide good performance without having to tune your axis. Using load observer with auto-tuned gains can maximize system performance. Refer to Appendix D beginning on page 235 for more load observer information.

Follow these steps to tune the axes.

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



ATTENTION: To reduce the possibility of unpredictable motor response, tune your motor with the load removed first, then reattach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click the Tune tab.

Homing Hook TravelLimit:	up Tune Dynamic	s Gains Output Limits Position Units	Offset Fault Actions Tag
Speed:	0.0	Position Units/s	DANGER: This tuning procedure may cause axis
Torque/Force:	100.0	% Rated	motion with the controller in program mode.
Direction:	Forward Uni-directional	<u>•</u>	1
Damping Factor: Tune	Forward Uni-directional Forward Bi-directional Reverse Uni-directional Reverse Bi-directional		
E Po		Velocity Error Integrator Frie	ction Compensation
∏ Ve	locity Feedforward		rque Offset Aput Filter

3. Type values for Travel Limit and Speed.

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

4. From the Direction pull-down menu, choose a setting.

Forward Uni-directional is default.

- 5. Check Tune boxes as appropriate for your application.
- **6.** Apply Hardware Enable Input signal (IOD-2) for the axis you are tuning.



ATTENTION: To avoid personal injury or damage to equipment, apply 24V ENABLE signal (IOD-2) only to the axis you are tuning.

IMPORTANT Hardware Enable input for IDM units is on the IPIM module.

7. Click Start Tuning to auto-tune your axis.

The Online Command - Tune Servo dialog box opens. When the test completes, the Command Status changes from Executing to Command Complete.

Online Command - Tune Servo	×
Command Status: Command Complete OK	
Wait for command to complete after axis motion. Stop)
)
I	

8. Click OK.

The Tune Bandwidth dialog box opens.

Tune Results			×
Position Loop Bandwidth:	24.202887	Hertz	
Load Inertia Ratio:	0.0	Load Inertia/Mo	tor Inertia
	ne Bandwidth determin handwidth. Increasir hstability. OK		

Actual bandwidth values (Hz) depend on your application and can require adjustment once motor and load are connected.

- 9. Record your bandwidth data for future reference.
- 10. Click OK.

The Online Command - Apply Tune dialog box opens. When the test completes, the Command Status changes from Executing to Command Complete.

Online Command - Apply Tune	X
Command Status: Command Complete	ОК
Wait for command to complete. Check for errors if command fails.	<u>S</u> top
7	Help
1	

11. Click OK.

lf	Then
Your test completes successfully, this dialog box opens. RSLogix 5000 Apply tune completed successfully. Tune dependent attributes have been updated. Refer to Help for a list of dependent attributes. OK	 Click OK. Remove the Hardware Enable Input ⁽¹⁾ signal (IOD-2) applied earlier. Go to <u>step 13</u>.
Your test failed, this dialog box opens.	 Click OK. Make an adjustment to motor velocity. Refer to the appropriate Logix 5000 motion module user manual for more information. Return to <u>step 7</u> and run the test again.

12. Determine if your test completed successfully.

(1) The hardware enable input for IDM units is on the IPIM module.

13. Repeat <u>Test and Tune the Axes</u> for each axis.

Configure Drive Parameters and System Variables

This section provides information for accessing and changing parameters not accessible through the Logix Designer application.

IMPORTANT Drive parameters for the Kinetix 6000M IDM system are not accessible through the HIM module or DriveExplorer software.

Tools for Changing Parameters

Most parameters are accessible through the Logix Designer application. Alternatives include the DPI compatible Human Interface Module (HIM) and DriveExplorer software.

Table 100 - Software For Changing Parameters

Method	Description	Cat. No.	Firmware Revision
Software ⁽¹⁾	DriveExplorer software ⁽²⁾	9306-4EXP02ENE	2.01 or later
Software	Serial to SCANport [™] adapter	1203-SSS (Series B)	3.004 or later
HIM module ⁽³⁾	Full numeric LCD HIM	20-HIM-A3	N/A

 Refer to Set the Additional Bus Capacitance Parameter on page 229, for more information on changing parameter values by using DriveExplorer software and 1203-SSS adapter.

(2) Refer to DriveExplorer Getting Results Manual, publication <u>9306-GR001</u>, for instructions.

(3) Compatible catalog numbers include all 20-HIM-Ax.

Change Parameters with DriveExplorer Software

To navigate with DriveExplorer software, refer to the example dialog box below. In this example, the IAM I/O group folder is open, the Analog Outputs parameter group is selected, and the parameter elements are displayed in the box to the right.

IMPORTANT Parameters are read-only when the Sercos ring is active. You must break the Sercos ring to change parameters.

To save changes, perform a nonvolatile save (NVS) prior to cycling power.

Figure 82 - DriveExplorer Software Example

🔯 DriveExplorer Beta			
<u>File Edit Explore Actions H</u> elp			
🗅 🛎 🗔 🕺 🖬 🖻 🎒 🔊 💽 🖇	₽₽		
Devices Devices Devices Devices Devices Devices Devices Oconfig 0000 Devices Devices Devices Devices Devices Devices Digital Outputs Digital Inputs Digital Inputs Diagnostics Diagnostics SCANp Data In SCANp Data Outputs	S N:P.P# * 1: 0.681 * 1: 0.682 R 1: 0.382 * 1: 0.683 1: 0.684 1: 0.383	Name AnaOut Ch1 Selec AnaOut Ch1 Gain AnaOut Ch1 Value AnaOut Ch2 Selec AnaOut Ch2 Gain AnaOut Ch2 Value	Value 40 0.0060 0.0000 84 0.1000 0.0000

Change Parameters with the HIM Module

When using the HIM module to monitor or change parameters, use the up and \land and \lor) to arrive at selections. Refer to the instructions that came with your HIM module for more information.

Follow these steps to monitor or change parameters with the HIM module.

- **1.** Select parameter, and press ↓.
- 2. Select I/O AM1 Group (for IAM module), and press -.
- **3.** Select Analog Outputs, and press ↓.
 - a. Analog Output 1 is displayed, and press 4.
 - b. For Analog Output 2 use arrows to select, and press 4.
- 4. Press Sel.
- **5.** Enter parameter number, and press \rightarrow .

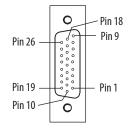
Monitor System Variables with Analog Test Points

There are two analog output test points accessible from the IOD 26-pin connector on the IAM and AM module.

Table 101 - IAM/AM I/O 26-pin (IOD) Connector

IOD Pin	Description	Signal
23	Analog output 0	DACO
24	Analog output common	DAC_COM
25	Analog output 1	DAC1
26	Analog output common	DAC_COM

Figure 83 - Pin Orientation for 26-pin I/O (IOD) Connector



Refer to Analog Outputs on page 69 for signal specifications.

Parameters begin with a variable to identify a specific axis by slot number, as follows:

- IAM module = 0 for parameters 0...999
- 1st AM module = 1 for parameters 1000...1999
- 2nd AM module = 2 for parameters 2000...2999 and so on
- 7th AM module = 7 for parameter 7000...7999

Table 102 - Monitor System Variables

Analog	Controlling Pa	rameter	Scale Parameter	
Output	Parameter Number ⁽¹⁾	Default Value ⁽¹⁾	Parameter Number ⁽¹⁾	Default Value
1	<i>x</i> 681	<i>xx</i> 40	<i>x</i> 682	0.0060
2	<i>x</i> 683	<i>xx</i> 84	<i>x</i> 684	0.1000

(1) x = slot number

The value entered in Scale Parameter scales the analog output so that you can get a full scale reading of the specific parameter for the dynamic range or values you are testing.

For linear scaling specifications, refer to the table on page 69.

Table 103 - Monitor Dynamic System Variables

Attribute	Parameter Number ⁽¹⁾
Velocity feedback	<i>xx</i> 40
Velocity commanded	<i>xx</i> 36
Torque feedback	<i>xx</i> 84
Torque commanded	<i>xx</i> 80

(1) x =slot number.

Troubleshoot the Kinetix 6000 Drive System

This chapter provides troubleshooting tables for your Kinetix[®] 6000 drive system components.

Торіс	Page
Safety Precautions	
Interpret Status Indicators	164
General System Anomalies	
Logix 5000/Drive Fault Behavior	

Safety Precautions

Observe these safety precautions when troubleshooting your Kinetix 6000 drive.



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



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



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

Interpret Status Indicators

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

Kinetix 6000M IDM System Error Codes

The IAM module reports a single, generic IPIM Fault whenever a fault occurs on any IPIM in the same backplane as the IAM module. All IPIM faults result in an open contactor. The Logix 5000[™] Axis Tag for this fault is IPIMFault.

The IPIM module is not a Sercos device, so the IAM module reports any IPIM faults to the Logix 5000 motion subsystem. IPIM faults are reset by performing a fault reset on the IAM module. Issuing a fault reset command to the IAM module also generates a fault reset to all the IPIM modules in the same backplane as the IAM. Detailed information about the IPIM fault status can be obtained by messaging to the IAM module.

Connecting the IPIM module into the Logix 5000 environment as an EtherNet/IP device does not disable fault reporting through the IAM module. Only the IAM fault reporting lets the Logix 5000 motion sub-system take action based on the IPIM module fault status. IPIM faults are also reported over the Ethernet connection. However, IPIM faults must be reset by applying a fault reset instruction to the IAM module. The integration of the IPIM module into the Logix 5000 environment through the EtherNet/IP network provides additional capabilities you can choose to take advantage of in your program.

Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>, for more information on troubleshooting the IDM drive-motor system.

Kinetix 6000 Drive System Error Codes

The following list of problematic symptoms (no error code shown) and faults with assigned error codes is designed to help you resolve anomalies.

When a fault is detected, the seven-segment status indicator displays an E followed by the flashing of the two-digit error code, one digit at a time. This is repeated until the error code is cleared.

Table 104 - Seven-segment Status Indicator Error Codes

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
1			No AC power or auxiliary logic power.	Verify AC control power is applied to the Kinetix 6000 system.
		Power (PWR) indicator not ON	Internal power supply malfunction.	Call your Rockwell Automation sales representative to return module for repair.
No Error Code Displayed		Motor jumps when first enabled	Motor wiring error.	 Check motor wiring. Run Hookup test in the Logix Designer application.
			Incorrect motor chosen.	Verify the proper motor is selected.
		Digital I/O not working correctly	I/O power supply disconnected.	Verify connections and I/O power source.
E00	BusUndervoltage Fault (Blown fuse)	A blown fuse was detected on the inverter PCB	Blown fuse.	Call your Rockwell Automation sales representative to return module for repair.
E04	MotorOvertemp Fault (Motor Overtemp)	Motor thermal switch tripped	 High motor ambient temperature and/or Excessive current 	 Operate within (not above) the continuous torque rating for the ambient temperature 40 °C (104 °F) maximum. Lower ambient temperature, increase motor cooling.
			Motor wiring error.	Check motor wiring at MF connector on the IAM/ AM module.
			Incorrect motor selection.	Verify the proper motor has been selected.
			Motor cables shorted.	Verify continuity of motor power cable and connector.
			Motor winding shorted internally.	Disconnect motor power cables from the motor. If the motor is difficult to turn by hand, consider replacing the motor.
FOF	DriveOvercurrent Fault	Self-protection of the Intelligent Power Module	Kinetix 6000 drive temperature too high.	 Check for clogged vents or defective fan. Make sure cooling is not restricted by insufficient space around the unit.
E05	(Power Fault)		Operation above continuous power rating and/ or product environmental ratings.	Verify ambient temperature is not too high. Operate within the continuous power rating. Reduce acceleration rates. Reduce deceleration rates.
			Kinetix 6000 drive has a short circuit, overcurrent, or failed component.	Remove all power and motor connections, and preform a continuity check from the DC bus to the U, V, and W motor outputs. If a continuity exists, check for wire fibers between terminals, or send drive in for repair.
E06	HardOvertravel Fault (+/- Hard Overtravel)	Axis moved beyond the physical travel limits in the positive/negative direction.	Dedicated overtravel input is inactive.	 Check wiring. Verify motion profile. Verify axis configuration in software.
E07	MotFeedbackFault (Motor Feedback Loss)	The feedback wiring is open, shorted, or missing.		 Check motor encoder wiring. Run Hookup test in the Logix Designer application.

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E09	BusUndervoltage Fault (Bus Undervoltage)	With three-phase power present, the DC bus voltage is below limits.	 DC bus voltage for 460V system is below 275V DC bus voltage for 230V system is below 	 Verify voltage level of the incoming AC power. Check AC power source for glitches or line drop. Install an uninterruptible power supply (UPS) on your AC input.
		DC bus voltage fell below the undervoltage limit while an axis on the follower power rail was enabled.	137V	Disable follower axis before removing power.
			Excessive regeneration of power.	
E10	DriveOvervoltage Fault (Bus Overvoltage)	The DC bus voltage is above limits.	When the motor is driven by an external mechanical power source, it can regenerate too much peak energy through the drive power supply. The system faults to save itself from an overload.	 Change the deceleration or motion profile. Use a larger system (motor and Kinetix 6000 drive). Install shunt module.
			 DC bus voltage for 460V system is over 820V DC bus voltage for 230V system is over 410V 	Verify input is within specifications.
E11	MotFeedbackFault (Illegal Hall State)	State of Hall feedback inputs is incorrect.	Improper connections.	 Verify the Hall wiring at the MF connector on the IAM/AM module. Verify 5V power supply to the encoder.
E16	Softovertravel Fault (+/- Software Overtravel)	Axis position exceeded maximu	ım software setting.	 Verify motion profile. Verify overtravel settings are appropriate.
E18	OverSpeedFault (Overspeed Fault)	Motor speed has exceeded 150 dictated by the lesser of the use	% of maximum rated speed. The 100% trip point is er velocity limits or the motor rated base speed.	Check cables for noise.Check tuning.
E19	PositionErrorFault (Follow Error)	Position error limit was exceeded.		 Increase the feed forward gain. Increase following error limit or time. Check position loop tuning. Verify sizing of system. Verify mechanical integrity of system within specification limits.
E20	MotFeedbackFault (Mtr Fdbk AQB)	Motor Encoder State Error	The motor encoder encountered an illegal transition.	 Use shielded cables with twisted pair wires. Route the feedback away from potential noise sources. Check the system grounds. Replace the motor/encoder.
E21	AuxFeedbackFault (Aux Feedback Comm)	Communication was not establ	ished with an intelligent encoder.	Verify auxiliary encoder wiring.
E30	MotFeedbackFault (Motor Feedback Comm)	Communication was not establ	ished with an intelligent encoder.	 Verify motor selection. Verify the motor supports automatic identification. Verify motor encoder wiring.
E31	DriveHardFault	Excessive motor shaft movement during power up, Sercos ring phase-up, or after a fault reset.		Make sure there is no motor shaft movement during power up, Sercos ring phase-up, or during a fault reset.
			Wiring error.	Check motor power wiring.Check input power wiring.
			Motor internal ground short.	Replace motor.
E34	GroundShortFault (Ground Fault)	Excessive ground current in the converter was detected.	Internal malfunction.	Disconnect motor power cable from drive and enable drive with current limit set to 0. If fault clears, then a wiring error or motor internal anomaly exists. If fault remains, call your sales representative.
			Grounded control power terminal (applies to 230V systems only)	 Remove ground from control power input. Source control power from three-phase input power (refer to diagram on page 190).

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E35	DriveUndervoltage Fault	Converter precharge cycle	Low AC input voltage.	Check input AC voltage on all phases.
255	(Precharge Fault)	failed.	Internal malfunction.	Call your sales representative.
E36	DriveOvertemp Fault (System Overtemperature)	Converter thermal switch tripped.	Excessive heat exists in the power circuitry.	 Reduce acceleration rates. Reduce duty cycle (ON/OFF) of commanded motion. Increase time permitted for motion. Use larger IAM converter module. Check for clogged vents or defective fan. Make sure cooling is not restricted by insufficient space around the unit.
E37	PowerPhaseLoss Fault (Phase Loss Flt)	 One or more phases of the in Axis was enabled when mai common-bus follower axis was a second sec	nput AC power is missing. n (three-phase) power was removed. vas enabled when DC bus power was removed.	 Check input AC voltage on all phases. Disable axis before removing power.
E38	SercosFault (Sercos Ring Flt)	The Sercos ring is not active after being active and operational.	Cable disconnected.	Check that fiber-optic cable is present and connected properly.
E39	DriveHardFault (Self Sense Flt)	Self-sensing Commutation Start-up Error	Motion required for self-sensing start-up commutation was obstructed.	 Verify that there are no impediments to motion at startup, such as hard limits. Increase self-sensing current if high friction or load conditions exist. Check motor or encoder wiring by using wiring diagnostics.
E43	DriveEnableInput Fault (Drive Enable Flt)	Missing Drive Enable Input Signal	 An attempt was made to enable the axis through software while the Drive Enable hardware input was inactive. The Drive Enable input transitioned from active to inactive while the axis was enabled. 	 Disable the Drive Enable Input fault. Verify that Drive Enable hardware input is active whenever the drive is enabled through software.
E49	DriveHardFault (Safe-off HW Flt)	Safe torque-off function mismatch. Drive does not allow motion.	 Loose wiring at STO connector. Cable/header not seated properly in STO connector. Safe torque-off circuit missing +24V DC. 	 Verify wire terminations, cable/header connections, and +24V. Reset error and run proof test. If error persists, return the drive to Rockwell Automation.
E50	SercosFault (Sercos Same ADDR)	Duplicate node address detected on Sercos ring.		Verify that each Sercos drive is assigned a unique node address.
E54	DriveHardFault (Ifbk HW Fault)	Current feedback hardware fau	lt detected.	Replace the module.
E55	OverSpeedFault	The velocity error limit has been exceeded.	Motor has exceeded velocity error limit	Check the cables for noise.
E60	DriveHardFault (Unknown Axis)	Illegal ID bits detected		Replace the module.
E61	AuxFeedbackFault (Aux Fdbk AQB)	Auxiliary Encoder State Error	The auxiliary encoder encountered an illegal transition.	 Use shielded cables with twisted pair wires. Route the feedback away from potential noise sources. Check the system grounds. Replace the motor/encoder.
E62	AuxFeedbackFault (Aux Fdbk Loss)	The feedback wiring is open, shorted, or missing.		Check the motor feedback cable connectors/wiring to the IAM/AM module and servo motor.
E63	AuxFeedbackNoise (Aux Fdbk Noise)	Noise on auxiliary feedback cable.	Recommended grounding, per installation	 Verify grounding. Route feedback cable away from noise sources. Refer to System Design for Control of Electrical
E64	MotorFeedbackNoise (Mtr Fdbk Noise)	Noise on motor feedback cable.	instructions, has not been followed.	Refer to System Design for Control of Electrical Noise Reference Manual, publication <u>GMC-RM001</u> .

Table 104 - Seven-segment Status Indicator Error Codes (continued)

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E65	No Fault Message (condition indicated by on-screen message) (Hookup Fault)	Hookup procedure failed	Motor or feedback device malfunction.	 Check motor power/feedback wiring. Refer to on-screen message for resolution.
E66	No Fault Message (condition indicated by on-screen message) (Atune Flt)	Autotune procedure failed	Motor or feedback device malfunction.	 Check motor power/feedback wiring. Refer to on-screen message for resolution. Perform Hookup in the Logix Designer application. Consult application help screen.
E67	DriveHardFault (Task init)	Operating system failed	Software initialization fault detected due to hardware failure.	 Cycle power. If fault persists, replace module.
E68	DriveHardFault (SCANport [™] Comm)	DPI communication failed	The DPI device or cable is faulty.	Check DPI connections.
E69	DriveHardFault (Objects Init)	Nonvolatile memory is corrupt	due to control board hardware failure.	Load default parameters, save to nonvolatile memory, and recycle power or reset the drive.
E70	DriveHardFault (NV Mem Init)	Nonvolatile memory is corrupt	due to control board software error.	Load default parameters, save to nonvolatile memory, and recycle power or reset the drive.
E71	DriveHardFault (Memory Init)	RAM or nonvolatile memory validation failure		 Cycle power. If fault persists, replace module.
	DriveOvertemp Fault (Drive Overtemp)	Inverter thermal switch tripped	The IAM or an AM module fan failed.	Replace the failed module.
			The cabinet ambient temperature is above rating.	Check the cabinet temperature.
E72			The machine duty cycle requires an RMS current exceeding the continuous rating of the controller.	Change the command profile to reduce speed or increase time.
			The airflow access to the Kinetix 6000 system is limited or blocked.	Check airflow and re-route cables away from the Kinetix 6000 system.
E73	Communicate	Power rail CAN communication	failed.	Check module for proper mount.
E73	(Backplane Comm)	Power rail connection shorted of	or open.	Check power rail and module for foreign objects.
E74	DriveOvercurrent Fault	DC link current exceeds rating.	Motor or transmission malfunction.	 Check for proper motor sizing. Check/replace transmission device. Check/replace motor.
	(Bus OverCurrent)	IAM module not sized properly.		 Check for proper IAM module sizing. Install larger kW rated IAM module.
E75	DriveOvervoltage Fault (Shunt Time Out)	The IAM/AM module, or shunt module has exceeded its shunt resistor continuous rating.		 Use a properly sized shunt or modify duty cycle of the application. System uses internal shunt and requires external shunt for additional capacity.
E76	DriveHardFault (CAN Init)	DPI hardware initialization fault detected.	Control board hardware failure.	 Reset System. If fault persists, replace system module.
E77	DriveHardFault (Module Mismatch)	Either 230V AM module is installed on power rail with 460V IAM module, or 460V AM module is installed on power rail with 230V IAM module.		Replace mismatched module.
E78	DriveHardFault (Sercos Init)	Control hardware fault detected.		Cycle power.If fault persists, replace module.

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
	Duine Onema line and Facilit	Over-temperature fault indicate	or on Bulletin 2094 shunt module is steady red.	Refer to Temperature Fault Status Indicator on page 172.
E79	DriveOvervoltage Fault (Shunt Module Flt)	Shunt-fault indicator on Bulletin 2094 shunt module is steady red.		Refer to Shunt Fault Status Indicator on page 172.
		Bulletin 2094 shunt module is missing from power rail.		 Install missing module on power rail. Fill empty slot with slot-filler module.
E80	DriveHardFault (CPLD Flt)	Control hardware fault detected.		Replace module.
E81	DriveHardFault (Common Bus Flt)	Follower IAM module detected AC input power being applied.		Remove AC input power connections from follower IAM module.
E90	DriveHardFault (Precharge Timeout Flt)	Precharge resistor power exceeds the resistor rating.		Wait for resistor to cool.
E95	IPIMFault (IPIM Module Flt)	A fault has occurred in one or more IPIM modules on the power rail.		Refer to the troubleshooting chapter in the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u> .

Table 104 - Seven-segment Status Indicator Error Codes (continued)

IAM/AM Module Status Indicators

Table 105 - Drive Status Indicator

Drive Status Indicator	Drive Status	Possible Resolution
Off	Normal, no faults	N/A
Steady red	Drive faulted	Refer to seven-segment error code and Kinetix 6000 Drive System Error Codes troubleshooting on <u>page 165</u> .

Table 106 - Comm Status Indicator

Comm Status Indicator	Drive Status	Potential Cause Possible Resolution	
	No communication ⁽¹⁾	Loose fiber-optic connection.	Verify proper fiber-optic cable connections.
Off		Broken fiber-optic cable.	Replace fiber-optic cable.
		Receive fiber-optic cable connected to Sercos transmit connector and vice versa.	Check proper Sercos fiber-optic cable connections.
Flashing green	Establishing communication	System is still in the process of establishing Sercos communication.	Wait for steady green indicator.
		Node address setting on the drive module does not match Sercos controller configuration.	Verify proper node switch setting.
Steady green	Communication ready	No faults or failures. N/A	

(1) Refer to Fiber-optic Cable Installation and Handling Instructions, publication 2090-IN010, for more information.

Table 107 - Bus Status Indicator

Bus Status Indicator	Bus Status	Condition
Off	No power or DC bus is not present.	 Normal when bus power is not applied. Fault exists, refer to seven-segment error code and Kinetix 6000 Drive System Error Codes troubleshooting on page 165.
	Bus power is present in follower IAM.	 Follower IAM module is not configured as CommonBus Follow in the Logix Designer application. After DC bus voltage is applied, a 2.5 second delay before the indicator begins flashing green is normal operation to provide the common-bus leader module time to complete precharge.
Flashing green Bus power is present, axis disabled. No faults. Normal when: • 24V is not applied to Hardware Enable Input (IOD-2). • MSO instruction is not commanded in the Logix Designer application		
Steady green	Bus power is present, axis enabled. No faults.	Normal when: • 24V is applied to Hardware Enable Input (IOD-2). • MSO instruction is commanded in the Logix Designer application.

Shunt Module Status Indicators

Each of the shunt module status indicators provide specific troubleshooting information.

Table 108 - General Shunt Module Troubleshooting

Module	Status	Under These Conditions	
	Fault is latched.	Until fault condition is corrected and cleared.	
Shunt	Fault is cleared.	 Using MASR, MAFR, MGSR instructions or the HIM (red stop button). Only after the DC bus is discharged (bus status indicator is flashing). Drive must be configured with 2094-BSP2 shunt module or Bulletin 1394 external shunt module. 	
IAM/AM	Disabled (for DC bus regulation).	 When the 2094-BSP2 shunt module is used on a 230V system. When either 230V or 460V system is configured with a Bulletin 1394 external shunt module. When configured in Common-bus Follower mode. 	
	Enabled to discharge the DC bus.	Drive (IAM or leader IAM module) three-phase power is remove	
	Disabled from discharging the DC bus.	When configured in Common-bus Follower mode.	

IMPORTANT Under some fault conditions, two reset commands can be required to clear drive and shunt module faults.

Bus Status Indicator	Status	Potential Cause	Possible Resolution	
Flashing	Normal condition when control power is app	Normal condition when control power is applied and bus voltage is less than 60V DC.		
Steady Green	Normal condition when control power is app	Normal condition when control power is applied and bus voltage is greater than 60V DC.		
Off	Control power is not present.	Internal power supply failure.	Replace shunt module.	

Table 109 - Bus Status Indicator

Table 110 - Temperature Fault Status Indicator

Over-Temp Fault Indicator	Status	Potential Cause	Possible Resolution	
Off	Normal condition.		N/A	
	Shunt module internal	Shunt module fan failed.	Replace shunt module.	
Steady Red	temperature exceeds operating temperature specification.	Shunt module temperature exceeds rating.	 Wait for shunt module to cool. Reset faults. Verify IAM module bus regulator configuration. 	
	External over temperature condition.	External temperature switch is open.	 Wait for shunt module to cool. Reset faults. Verify IAM module bus regulator configuration. 	
		TS jumper is not present.	Install jumper.	

Table 111 - Shunt Fault Status Indicator

Shunt Fault Indicator	Status	Potential Cause	Possible Resolution	
Off	Normal condition		N/A	
Steady Red	Shorted internal or external shunt resistor.	Mis-wired shunt jumper or other short on RC connector.	 Correct mis-wire (shorted) condition. If anomaly persists, replace shunt module. 	
		Mis-wired (shorted) external shunt wiring.	· In anomaly persists, replace shuft module.	

Table 112 - All Shunt Module Status Indicators

Shunt Module Status Indicator Status		Potential Cause	Possible Resolution	
 Bus Status Over-Temp Fault Shunt Fault 	All three status indicators flash simultaneously.	Shunt module hardware failure.	 Cycle power. If anomaly persists, replace shunt module. 	

General System Anomalies

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

Condition	Potential Cause	Possible Resolution	
	The position feedback device is incorrect or open.	Check wiring.	
	Unintentionally in Torque mode.	Check to see what primary operation mode was programmed.	
	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.	
	Position loop gain or position controller acceleration or deceleration rate is improperly set.	Run Tune in the Logix Designer application.	
Axis or system is unstable.	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.	
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	Check setups.Run Tune in the Logix Designer application.	
	Mechanical resonance.	Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).	
	Torque Limit limits are set too low.	Verify that current limits are set properly.	
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in the Logix Designer application again.	
You cannot obtain the motor	The system inertia is excessive.	Check motor size versus application need.Review servo system sizing.	
acceleration/deceleration that you want.	The system friction torque is excessive.	Check motor size versus application need.	
	Available current is insufficient to supply the correct acceleration or deceleration rate.	 Check motor size versus application need. Review servo system sizing. 	
	Acceleration limit is incorrect.	Verify limit settings and correct them, as necessary.	
	Velocity Limit limits are incorrect.	Verify limit settings and correct them, as necessary.	
	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.	
	Enable signal has not been applied or the enable wiring is incorrect.	Check the controller.Check the wiring.	
	The motor wiring is open.	Check the wiring.	
Motor does not respond to a velocity command.	The motor thermal switch has tripped.	Check for a fault.Check the wiring.	
	The motor has malfunctioned.	Repair or replace the motor.	
	The coupling between motor and machine has broken (for example, the motor moves, but the load/machine does not).	Check and correct the mechanics.	
	Primary operation mode is set incorrectly.	Check and properly set the limit.	
	Velocity or current limits are set incorrectly.	Check and properly set the limits.	
	Recommended grounding per installation instructions have not been followed.	 Verify grounding. Route wire away from noise sources. Refer to System Design for Control of Electrical Noise, publication <u>GMC-RM001</u>. 	
Presence of noise on command or motor feedback signal wires.	Line frequency present.	Verify grounding.Route wire away from noise sources.	
	Variable frequency can be velocity feedback ripple or a disturbance caused by gear teeth or ballscrew balls, for example. The frequency can be a multiple of the motor power transmission components or ballscrew speeds resulting in velocity disturbance.	 Decouple the motor for verification. Check and improve mechanical performance, for example, the gearbox or ballscrew mechanism. 	

Table 113 - General System Anomalies

Condition	Potential Cause	Possible Resolution	
	The motor connections are loose or open.	Check motor wiring and connections.	
	Foreign matter is lodged in the motor.	Remove foreign matter.	
	The motor load is excessive.	Verify the servo system sizing.	
No rotation	The bearings are worn.	Return the motor for repair.	
	The motor brake is engaged (if supplied).	 Check brake wiring and function. Return the motor for repair.	
	The motor is not connect to the load.	Check coupling.	
Motor overheating	The duty cycle is excessive.	Change the command profile to reduce acceleration or deceleration or increase time.	
-	The rotor is partially demagnetized causing excessive motor current.	Return the motor for repair.	
	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.	
	Loose parts are present in the motor.	 Remove the loose parts. Return motor for repair. Replace motor. 	
Abnormal noise	Through bolts or coupling is loose.	Tighten bolts.	
	The bearings are worn.	Return motor for repair.	
	Mechanical resonance.	Notch filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).	
Erratic operation - Motor locks into	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.	
position, runs without control or with reduced torque.	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.	

Table 113 - General System Anomalies (continued)

Logix 5000/Drive Fault Behavior

These fault actions are configurable from the Axis Properties dialog box, Fault Actions tab in the Logix Designer application.

Drive Fault Action	Definition
Shutdown	The drive disables the axis as defined in Logix 5000/Drive Fault Behavior, Table 115. In addition, the axis in Logix Designer enters the Shutdown state, which disables any axes that are using this axis as a camming or gearing master. In addition, the AxisHomedStatus tag for the faulted axis is cleared. Shutdown is the most severe action to a fault and it is usually reserved for faults that could endanger the machine or operator if power is not removed as quickly as possible.
Disable Drive	The drive disables the axis as defined in Logix 5000/Drive Fault Behavior, Table 115.
Stop Motion	The axis decelerates at the maximum deceleration rate (set in the Logix Designer application>Axis Properties>Dynamics tab). Once the axis has come to a stop, the servo loops remain enabled but no further motion can be generated until the fault is reset. This is the gentlest stopping mechanism in response to a fault. It is usually used for less severe faults.
Status Only	The drive continues to operate. Status is provided by the seven-segment fault status indicator, drive status indicator, and DPI (if used). The application program must handle any motion faults. In general, use this setting in applications where the standard fault actions are not appropriate.

Table 114 - Drive Fault Action Definitions

Only selected faults are programmable. In the Logix 5000/Drive Fault Behavior table on <u>page 176</u>, the controlling attribute is given for programmable fault actions. All faults that are not configurable have a fault action of Shutdown.

Figure 84 - Axis Properties - Fault Actions Tab

	😵 Axis Properties - Ax	is_1		
	General Motion Plan Homing Hookup T	ner Units Drive/M une Dynamics Gair		Aux Feedback Conversion Offset Fault Actions [*] Tag
	Drive Enable Input:	Disable Drive	v	Set Custom Stop Action
Drive Fault Action/Attribute for Motor	Drive Thermal:	Disable Drive	-	
Overtemp fault (E04).	Motor Thermal:	Stop Motion		
	Feedback Noise:	Disable Drive	-	
	Feedback:	Disable Drive	-	
	Position Error:	Disable Drive	•	
	Hard Overtravel :	Disable Drive	Y	
	Soft Overtravel :	Disable Drive	Y	
			OK Cancel	Apply Help

Table 115 - Logix 5000/Drive Fault Behavior

Logix 5000 Fault Message (HIM Message)	ix 5000 Fault Message Error 1 Message) Code Description		Drive Fault Action/ Attribute	Logix Designer Programmable Fault Action?
BusUndervoltageFault (Blown fuse)	E00	A blown fuse was detected in the inverter pcb.	Coast/Disable (open contactor enable relay)	No
MotorOvertempFault (Motor Overtemp)	E04 ⁽¹⁾	The motor thermal switch was tripped. Firmware I ² t protection does not generate a fault, rather it dynamically folds back current when 110% of motor rating is reached. Setting the Motor Thermal fault action to Status Only or Stop Motion bypasses the foldback behavior and allows the fault to occur.	N/A	Yes Motor Thermal
DriveOvercurrentFault (Power Fault)	E05	An instantaneous over-current was detected in the inverter power section.	Coast/Disable (open contactor enable relay)	No
HardOvertravelFault (+/- Hard Overtravel)	E06	Axis moved beyond the physical travel limits in the positive/negative direction. This fault can be configured for status only.	Decel/Disable	Yes Hard Overtravel
MotFeedbackFault (Motor Feedback Loss)	E07	The feedback wiring is open, shorted or missing.	Coast/Disable	No
BusUndervoltageFault	E09	With 3-phase present, the DC bus voltage is below limits. The trip point is 275V and 137V DC for 460V/230V drives respectively.	Coast/Disable (open	No
(Bus Under Voltage)	209	DC bus voltage is below limits when any axis on common-bus follower power rail was enabled.	contactor enable relay)	NO
DriveOvervoltageFault (Bus Overvoltage)	E10	The DC bus voltage is above limits. The trip point is 820V and 410V DC for 460V/ 230V drives respectively.	Coast/Disable (open contactor enable relay)	No
MotFeedbackFault (Illegal Hall State)	E11	State of Hall feedback inputs in incorrect.	Coast/Disable	No
SoftovertravelFault (+/- Software Overtravel)	E16	Axis position exceeded maximum software setting in the positive/negative direction. This fault can be configured for status only.	Decel/Disable	Yes Soft Overtravel
OverSpeedFault (Overspeed Fault)	E18	Axis speed has reached 150% of the maximum rated setting. The 100% trip point is dictated by the lesser of the user velocity limits or the motor rated base speed.	Coast/Disable	No
PositionErrorFault (Follow Error)	E19	Axis position error limit has been exceeded. This fault can be configured for status only.	Decel/Disable	Yes Position Error
MotFeedbackFault (Mtr Fdbk AQB)	E20	Motor encoder has encountered an illegal state transition.	Coast/Disable	No
AuxFeedbackFault (Aux Feedback Comm)	E21	Communication was not established with an intelligent (Stegmann) encoder on the Auxiliary feedback port.	Decel/Disable	No
MotFeedbackFault (Motor Feedback Comm)	E30	Communication was not established with an intelligent (Stegmann) encoder on the Motor feedback port.	Decel/Disable	No
DriveHardFault	E31	Excessive motor shaft movement during power up, Sercos ring phase-up, or after a fault reset.	Coast/Disable	No
GroundShortFault (Ground Fault)	E34	Excessive ground current in the converter was detected.	Coast/Disable (open contactor enable relay)	No
DriveUndervoltageFault (Precharge Fault)	E35	The converter precharge cycle has failed.	Coast/Disable (open contactor enable relay)	No
DriveOvertempFault (System Overtemperature)	E36 ⁽²⁾	Converter internal temperature limit exceeded.	Coast/Disable (open contactor enable relay)	No

Table 115 - Logix 5000/Drive Fault Behavior (continued)

Logix 5000 Fault Message (HIM Message)	Error Code	Description	Drive Fault Action/ Attribute	Logix Designer Programmable Fault Action?
PowerPhaseLossFault		One or two phases of the input AC power are missing.	Coast/Disable (open contactor enable relay)	
(Phase Loss Flt)	E37	 All phases of the input AC power are missing. Axis was enabled when main (three-phase) power was removed. Common-bus follower axis was enabled when DC bus power was removed. 	Decel/Disable	No
SercosFault (Sercos Ring Flt)	E38	The Sercos ring is not active after being active and operational.	Decel/Disable	No
DriveHardFault (Self Sense Flt)	E39	Self-sensing commutation fault detected.	Coast/Disable	No
DriveEnableInputFault (Drive Enable Flt)	E43	Generated when Enable input switches off when drive is enabled.	Decel/Disable	Yes Drive Enable Input
DriveHardFault (Safe-Off HW Flt)	E49	Safe torque-off function mismatch. Drive does not allow motion. Refer to the Kinetix Safe Torque-off Feature Safety Reference Manual, publication <u>GMC-RM002</u> , for more information. Applies to 2094- <i>x</i> Cxx-Mxx-S IAM and 2094- <i>x</i> Mxx-S AM modules with safe torque-off feature.	Coast/Disable (open contactor enable relay)	No
SercosFault (Sercos Same ADDR)	E50	Duplicate node address detected on Sercos ring.	Decel/Disable	No
DriveHardFault (Ifbk HW Fault)	E54	Current feedback hardware fault detected.	Coast/Disable (open contactor enable relay)	No
OverSpeedFault	E55	The velocity error limit has been exceeded.	Coast/Disable	No
DriveHardFault (Unknown Axis)	E60	Invalid module type identified by firmware when applying power.	Coast/Disable (open contactor enable relay)	No
AuxFeedbackFault (Aux Fdbk AQB)	E61	Auxiliary encoder has encountered an illegal state transition.	Coast/Disable	No
AuxFeedbackFault (Aux Fdbk Loss)	E62	The feedback wiring is open, shorted or missing.	Coast/Disable	No
AuxFeedbackNoise (Aux Fdbk Noise)	E63	Presence of noise on auxiliary feedback cable.		Yes Feedback Noise
MotorFeedbackNoise (Mtr Fdbk Noise)	E64	Presence of noise on motor feedback cable.	- Coast/Disable	
No Fault Message (condition indicated by on-screen message)	E65	Hookup procedure failed.	Coast/Disable	No
(Hookup Fault) No Fault Message (condition indicated by on-screen message) (Atune Flt)	E66	Autotune procedure failed.	Coast/Disable	No
DriveHardFault (Task init)	E67	Operating system failed.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (SCANport Comm)	E68	DPI communication failed.	Decel/Disable	No
DriveHardFault (Objects Init)	E69	Nonvolatile memory attribute out of range.	Coast/Disable (open contactor enable relay)	No

Table 115 - Logix 5000/Drive Fault Behavior (continued)

Logix 5000 Fault Message (HIM Message)	Error Code	Description	Drive Fault Action/ Attribute	Logix Designer Programmable Fault Action?
DriveHardFault (NV Mem Init)	E70	Nonvolatile memory corrupted.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Memory Init)	E71	RAM or nonvolatile memory validation failure.	Coast/Disable (open contactor enable relay)	No
DriveOvertempFault (Drive Overtemp)	E72	Inverter temperature limit exceeded. Firmware I ² t protection does not generate a fault, rather it dynamically folds back current when 110% of drive rating is reached. Setting the Drive Thermal fault action to Status Only or Stop Motion bypasses the foldback behavior and allows the fault to occur.	N/A	Yes Drive Thermal
Communicate (Backplane Comm)	E73	Power rail backplane CAN communication failed.	Decel/Disable	No
DriveOvercurrentFault (Bus OverCurrent)	E74	The converter has exceeded its converter rating.	Coast/Disable (open contactor enable relay)	No
DriveOvervoltageFault Shunt Time Out)	E75	The IAM/AM module or shunt module has exceeded its shunt resistor continuous rating. SHUTDOWN for IAM module, DISABLE for AM module. IAM module provides fault handling for shunt module.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Can Init)	E76	Either DPI or backplane CAN initialization failure.	Coast/Disable (open contactor enable relay)	No
DriveHardFault (Module Mismatch)	E77	Generated by IAM module if the power rating of an AM module on the same power rail does not match with IAM module input power rating.	Coast/Disable (open contactor enable relay)	No
DriveHardFault Sercos Init	E78	Control hardware fault detected.	Coast/Disable (open contactor enable relay)	No
DriveOvervoltageFault (Shunt Module Flt)	E79	Power rail mounted shunt module fault. Displayed on IAM module seven-segment fault status indicator.	Coast/Disable (open contactor enable relay)	No
HardwareFault (CPLD Flt)	E80	Control hardware fault detected.	Coast/Disable (open contactor enable relay)	No
HardwareFault (Common Bus Flt)	E81	Common-bus follower IAM module detected AC input power being applied.	Coast/Disable (open contactor enable relay)	No
HardwareFault Precharge Timeout Flt)	E90	Precharge resistor power exceeds the resistor rating.	Coast/Disable (open contactor enable relay)	No
IPIMFault (IPIM Module Flt)	E95	A fault has occurred in one or more IPIM modules on the power rail.	Coast/Disable (open contactor enable relay)	No

(1) The Logix 5000 Motor Thermal Fault Action is tied to the motor thermostat fault. If this is set to Shutdown or Disable (in controller), the drive folds back the current when the I²T calculation indicates that the motor temperature has exceeded 10% of its rated temperature. If it is set to Stop Motion or Status Only, the drive does not fold back the current. The I²T calculation never generates a fault.

(2) The Logix 5000 Drive Thermal Fault Action is tied to the drive thermostat fault. The drive always folds back the current when the l²T calculation indicates that the drive has exceeded 110% of its rating. The l²T calculation never generates a fault.

Remove and Replace the Kinetix 6000 Drive Modules

This chapter provides remove and replace procedures for your Kinetix[®] 6000 drive system components.

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Replace Kinetix 6000 Drive Modules	181
Remove the Power Rail	182
Replace the Power Rail	183



ATTENTION: This drive contains electrostatic discharge (ESD) sensitive parts and assemblies. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control procedures, components can be damaged. If you are not familiar with static control procedures, refer to Guarding Against Electrostatic Damage, publication <u>8000-4.5.2</u>, or any other applicable ESD awareness handbook.

Before You Begin

These tools are required before you begin removal and replacement procedures:

- Screwdriver, 3.5 mm (0.14 in.)
- Voltmeter

Remove Kinetix 6000 Drive Modules

Follow these steps to remove the IAM, AM, and IPIM modules from the Bulletin 2094 power rail.

Verify that all control and input power has been removed from the 1. system.



ATTENTION: To avoid shock hazard or personal injury, assure that all power has been removed before proceeding. This system can have multiple sources of power. More than one disconnect switch can be required to de-energize the system.

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

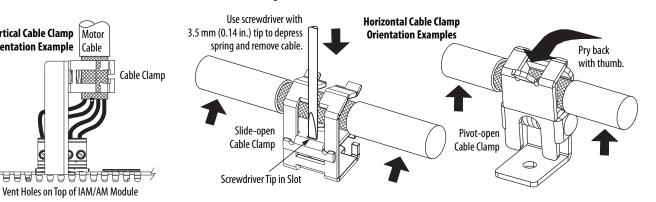


ATTENTION: This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. Do not attempt the procedures in this document unless you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in publication NFPA 70E.

3. Label and remove all connectors from the IAM/AM module you are removing.

To identify each connector, refer to page 58.

4. Remove the motor cable from the cable shield clamp, as shown in these examples.

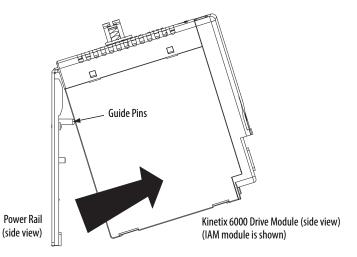


- 5. Loosen the mounting screw (bottom center of each module).
- 6. Grasp the top and bottom of the module with both hands and gently pull the module away from the connectors enough to clear the guide pins (module pivots on top bracket).

Vertical Cable Clamp

Orientation Example

7. Lift the bracket out of the power rail slot and remove the module from the power rail.



TIP This procedure also applies to Bulletin 2094-BSP2 shunt module, 2094-PRF slot-filler module, and 2094-SEPM-B24-S IPIM module.

Follow these steps to replace drives from the Bulletin 2094 power rail.

1. Determine your drive module replacement.

If you are	Then
Replacing a drive module on an existing power rail	Go to <u>step 3</u> .
Replacing a drive module on a new power rail	Go to <u>step 2</u> .

- 2. Prepare to mount your replacement drive module by removing the protective covers from the power rail connectors.
- 3. Hang the mounting bracket from the slot on the power rail.

IMPORTANT Power rails must be in vertical orientation before replacing drive modules for pins to seat properly.

- 4. Align the guide pins on the power rail with the guide pin holes in the back of the drive module (refer to the figure above).
 - **TIP** The IAM module can have two or three power rail connectors and guide pins, the AM module can have one or two, all other modules have only one connector and one guide pin.
- 5. Use 2.26 N•m (20 lb•in) torque to tighten the mounting screw.
- 6. Reconnect the module connectors.
- 7. Reapply power to the system.

Replace Kinetix 6000 Drive Modules

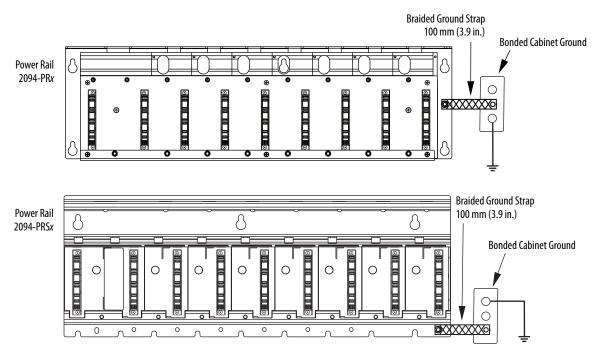
- 8. Verify that the system is operating properly.
 - **TIP** Because parameter settings reside in the Logix Designer application, you do not need to perform any tuning or set-up procedures.

Remove the Power Rail

This procedure assumes you have removed all modules from the power rail.

Follow these steps to remove the power rail.

1. Disconnect the braided grounding strap from the grounding stud on the right side of the power rail.



- 2. Loosen the mounting bolts (removing the bolts is not necessary).
- 3. Lift the power rail up and off of the mounting bolts.

Replace the Power Rail

This procedure assumes you do not need to change the location of the power rail on the panel and you intend to reuse the mounting bolts of the power rail you just removed.

IMPORTANT If you need to change the location of the power rail, or if you are installing a power rail designed for additional or fewer modules than you removed, refer to Kinetix 6000 Power Rail Installation Instructions, publication <u>2094-IN003</u>.



ATTENTION: To avoid damage to the power rail during installation, do not remove the protective covers until the module for each slot is ready for mounting.

Follow these steps to replace the power rail.

1. Align the replacement power rail over the existing mounting bolts.

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

- 2. Tighten the mounting bolts.
- **3.** Reattach the braided grounding strap to the power rail grounding stud (refer to page 182).

Notes:

Interconnect Diagrams

This appendix provides wiring examples and system block diagrams for your Kinetix* 6000 drive system components.

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Axis Module/Linear Motor/Actuator Wiring Examples	205
Kinetix 6000M Integrated Drive-Motor Wiring Example	210
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Interconnect Diagram Notes

This appendix provides wiring examples to assist you in wiring the Kinetix 6000 drive system. These notes apply to the wiring examples on the following pages.

Note	Information
1	For power wiring specifications, refer to Power Wiring Requirements on page 95.
2	For input fuse and circuit breaker sizes, refer to Circuit Breaker/Fuse Options on page 28.
3	Place AC (EMC) line filters as close to the drive as possible and do not route very dirty wires in wireway. If routing in wireway is unavoidable, use shielded cable with shields grounded to the drive chassis and filter case. For AC line filter specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>KNX-TD004</u> .
4	Terminal block is required to make connections.
5	2094-BCxx-Mxx-x (460V) IAM modules require a step-down transformer for single-phase control power input. Source the 2094-ACxx-Mxx-x (230V) IAM module control power from the three-phase input power (line-to-line) with neither leg bonded to ground or neutral potential. The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes is the responsibility of the machine builder.
6	2094-ALxxS and 2094-BLxxS and 2094-XL75S-C2 LIM modules can supply input power for up to eight axes. 2094-XL75S-C1 LIM modules can supply input power for up to sixteen axes. For common-bus systems with more than sixteen axes, multiple LIM modules (or control power transformers) are required. For Kinetix 6000M systems, the control power current needs to be calculated and the LIM module needs to be sized.
7	2094-ALxxS, 2094-BLxxS, and 2094-XL75S-Cx LIM modules are capable of connecting to two IAM modules, providing each IAM module has its own line filter and the maximum current specification is not exceeded.
8	Contactor coil (M1) needs integrated surge suppressors for AC coil operation. Refer to the Kinetix Servo Drives Technical Data, publication KNX-TD003.
9	Drive Enable input must be opened when main power is removed, or a drive fault occurs. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.
10	Cable shield clamp must be used to meet CE requirements. No external connection to ground is required.
11	Default configuration for jumper is for grounded power at user site. Ungrounded sites must jumper the bleeder resistor to prevent high electrostatic buildup. Refer to Determine the Input Power Configuration on page 83 for more information.
12	Leave jumper between PR2 and PR3 as shown to use the internal precharge resistor. Remove jumper when external precharge/circuit is required. For more information, refer to the 8720MC Regenerative Power Supply Installation Manual, publication <u>8720MC-RM001</u> .
13	ATTENTION: Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards IEC 62061 and ISO 13849-1 estimation and safety performance categories.
14	ATTENTION: Wiring the contactor enable relay is required. Refer to Contactor Enable Relay on <u>page 70</u> , for more information. The recommended minimum wire size for wiring the three-phase power enable control circuit to the contactor enable connector is 1.5 mm ² (16 AWG).
15	The Bulletin 2094 axis module referenced is either an individual axis module (catalog number 2094- <i>xMxx-x</i>) or the same axis module that resides within an integrated axis module (catalog number 2094- <i>xCxx-Mxx-x</i>).
16	For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication KNX-TD004.
17	Wire colors are for flying-lead cable and can vary from the premolded cable connectors.
18	Motor power cables (2090-XXNPMF-xxSxx and 2090-CPBM6DF-16AAxx) have a drain wire that must be folded back under the cable shield clamp.
19	MPL-A/B15xx-HMPL-A/B45xx-H, MPL-A15xx-V/EMPL-A2xx-V/E, MPL-A3xx-S/MMPL-A45xx-S/M, MPM-A115xxMPM-A130xx, MPF-A3xxMPF-A45xx, MPS-Axxx, MPAR-Axxx, MPAS-Axxx (ballscrew), and MPAS-A/Bxxx (direct drive) encoders use the +5V DC supply.
20	MPL-B15xx-V/EMPL-B2xx-V/E, MPL-B3xx-S/MMPL-B9xx-S/M, MPL-A5xx, MPM-Bxx, MPM-A165xxMPM-A215xx, MPF-Bxx, MPF-A5xx, MPS-Bxxx, MPAR-Bxxx, and MPAS-Bxxx (ballscrew) encoders use the +9V DC supply.
21	Brake connector pins are labeled plus (+) and minus (-) or F and G respectively. Power connector pins are labeled U, V, W, and GND or A, B, C, and D respectively.

Power Wiring Examples

These examples apply to power wiring configurations with and without the Bulletin 2094 line interface module (LIM), DC common bus wiring, and shunt module wiring.

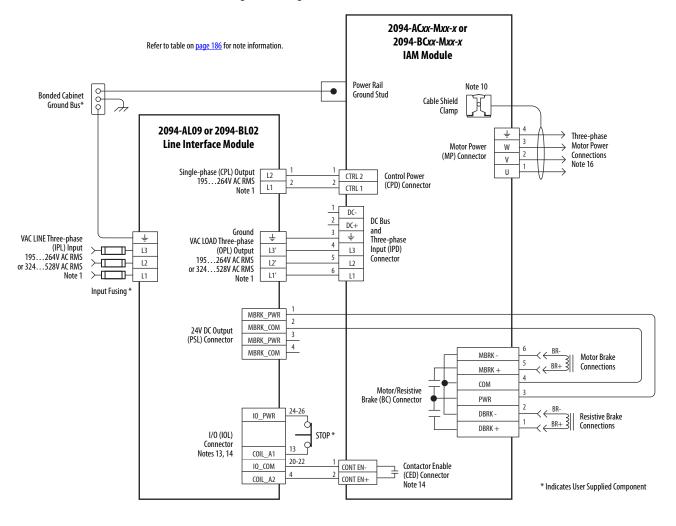


Figure 85 - Single IAM Module with 2094-AL09 or 2094-BL02 LIM Module

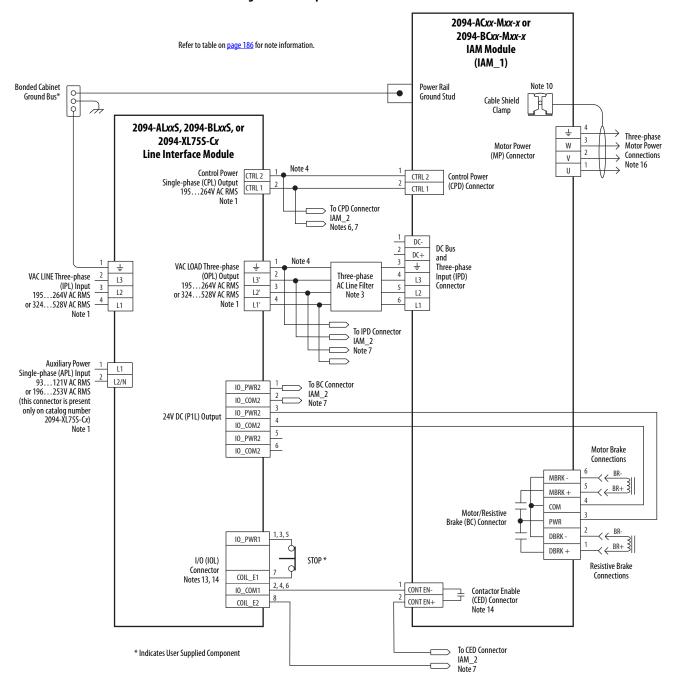
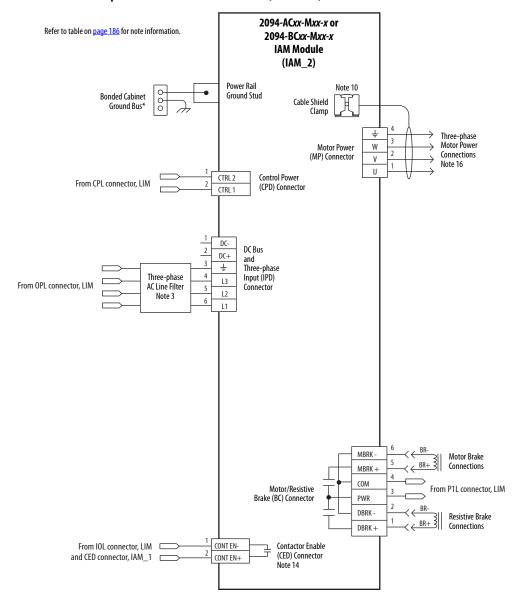


Figure 86 - Multiple IAM Modules with LIM Module



Multiple IAM Modules with LIM Module (continued)

This configuration does not include a LIM module. You must supply input power components. The single-phase and three-phase line filters are wired downstream of fusing and the M1 contactor.



ATTENTION: Wiring the contactor enable (CED) relay is required. To avoid injury or damage to the drive, wire the contactor enable relay into your control string. Refer to Contactor Enable Relay on <u>page 70</u> for more information.

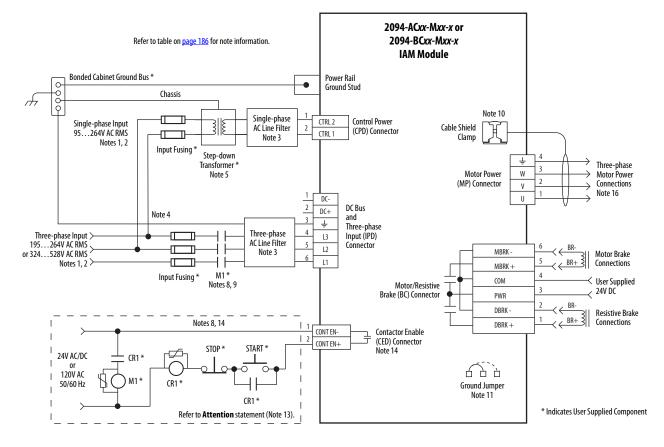
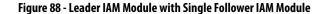
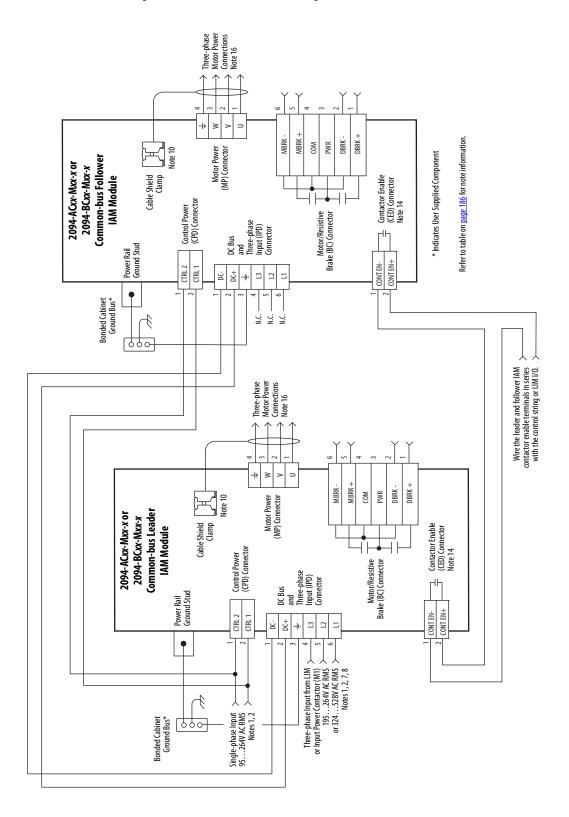


Figure 87 - IAM Module (without LIM module)

DC Common Bus Wiring Examples





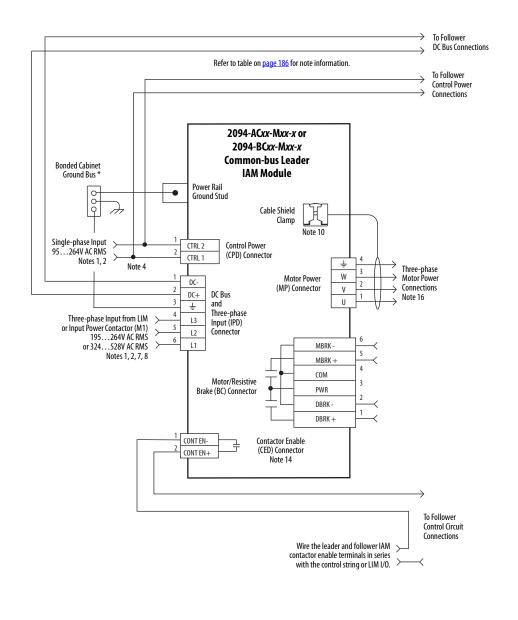
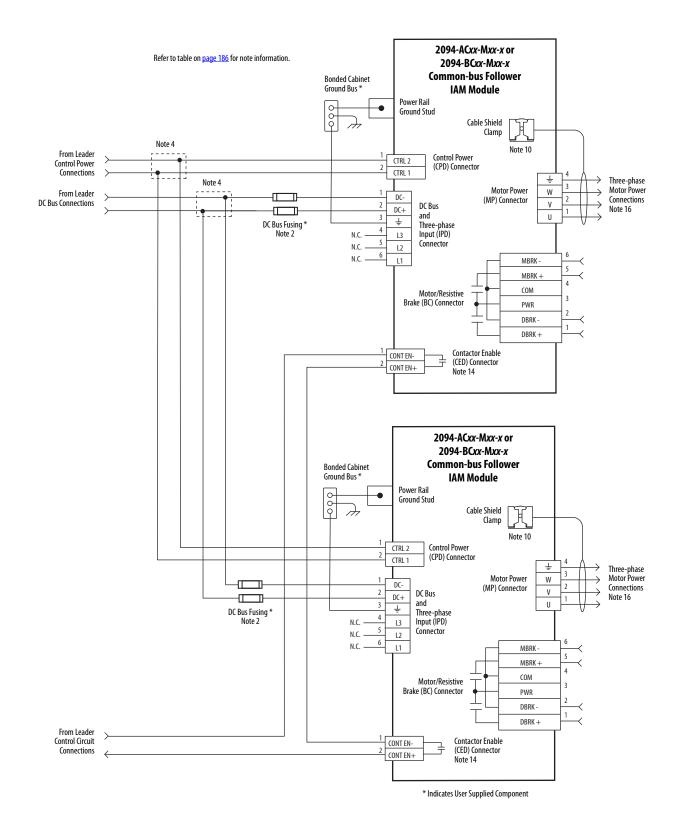


Figure 89 - Leader IAM Module with Multiple Follower IAM Modules



Leader IAM Module with Multiple Follower IAM Modules (continued)

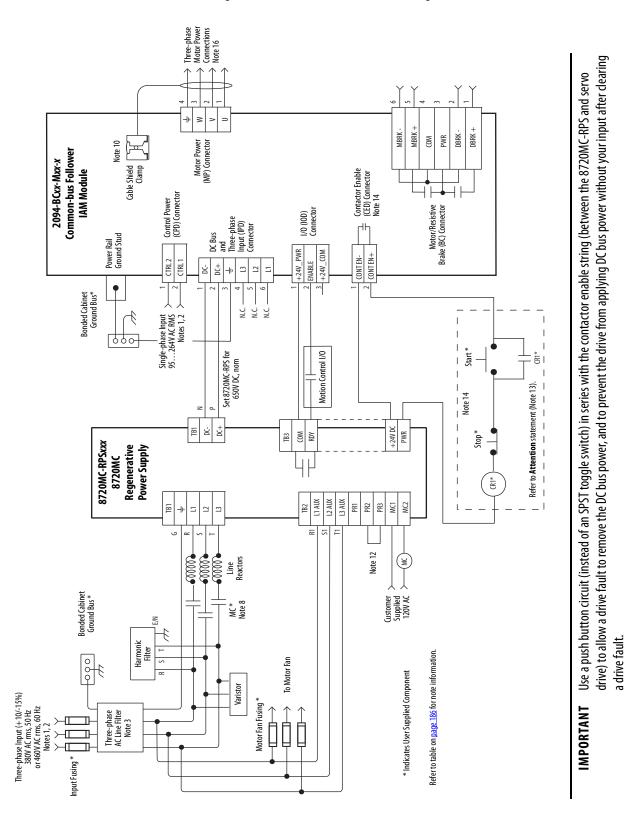
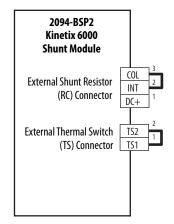


Figure 90 - 8720MC-RPS Leader Drive with Single Follower IAM Module

Shunt Module Wiring Examples

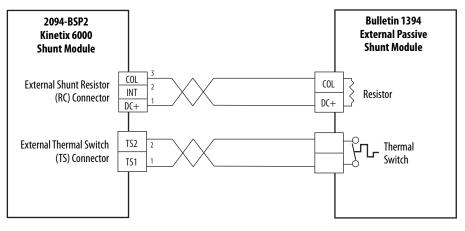
Refer to Kinetix Motion Accessories Technical Data, publication <u>KNX-TD004</u> for the Bulletin 1394 external shunt module catalog numbers available for the Kinetix 6000 drive systems.

Figure 91 - Shunt Module Wired for Internal Operation (default configuration)



Refer to the Kinetix 6000 Shunt Module Installation Instructions, publication 2094-IN004, for additional installation information.

Figure 92 - Shunt Module with External Passive Shunt



IMPORTANT Only passive shunts with a thermal switch are wired to the TS connector on the Kinetix 6000 shunt module. If your external passive shunt does not have a thermal switch, leave the jumper (default configuration) in place on the TS connector.

Refer to the External Shunt Module Installation Instructions, publication 2090-IN004, for additional installation information.

Axis Module/Rotary Motor Wiring Examples

These examples apply to Kinetix 6000 drives with Allen-Bradley[®] rotary motors.

IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with bayonet connectors.

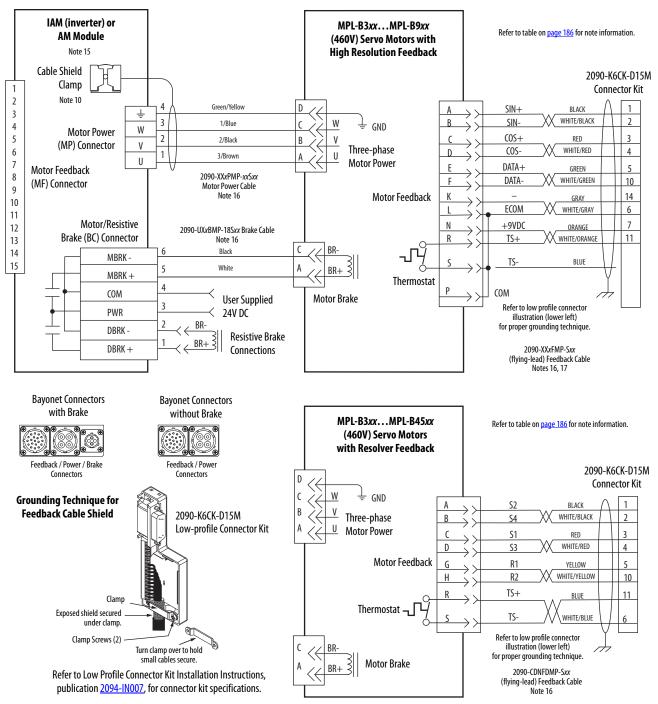
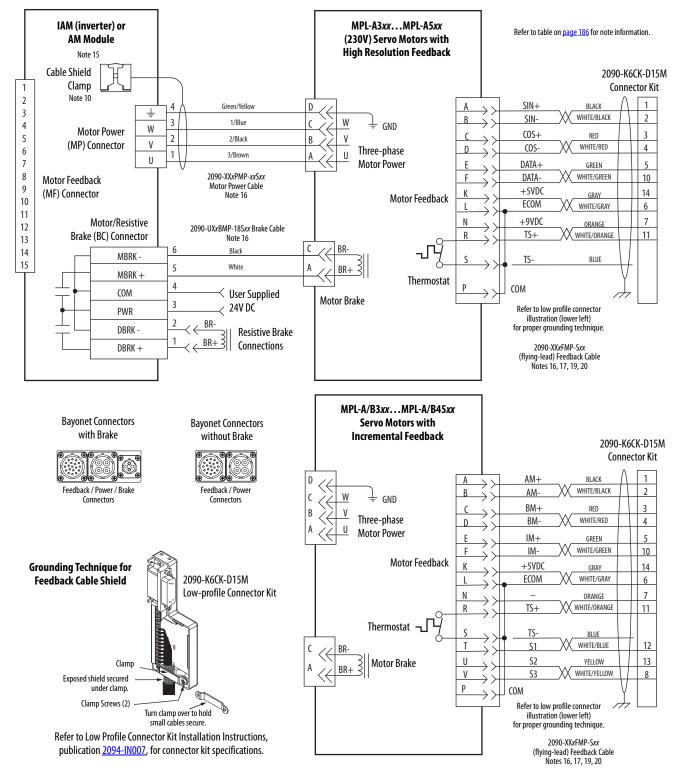


Figure 93 - AM Module with Kinetix MPL-B Rotary Motors

IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with bayonet connectors.





IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with circular DIN (threaded) connectors.

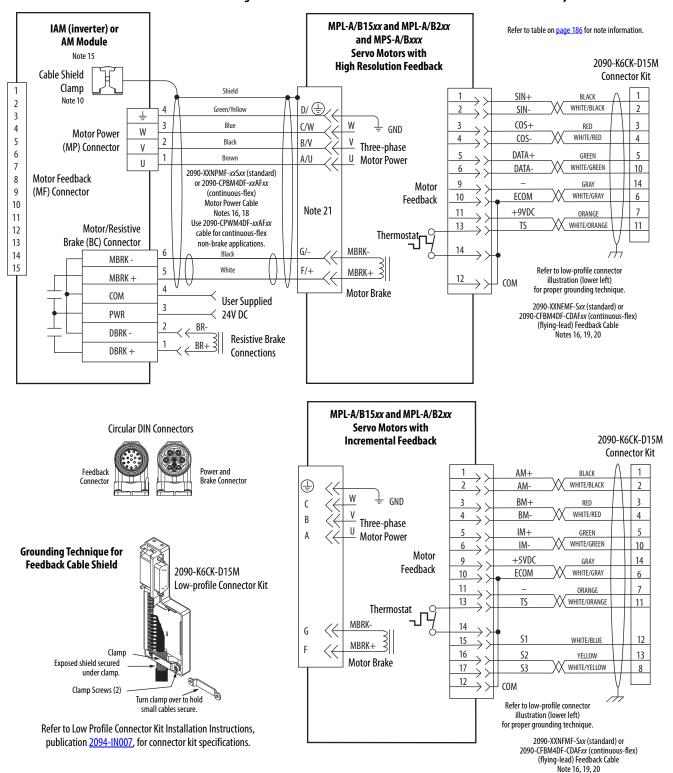


Figure 95 - AM Module with Kinetix MPL-A/B and Kinetix MPS-A/B Rotary Motors

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IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with circular DIN (SpeedTec) connectors.

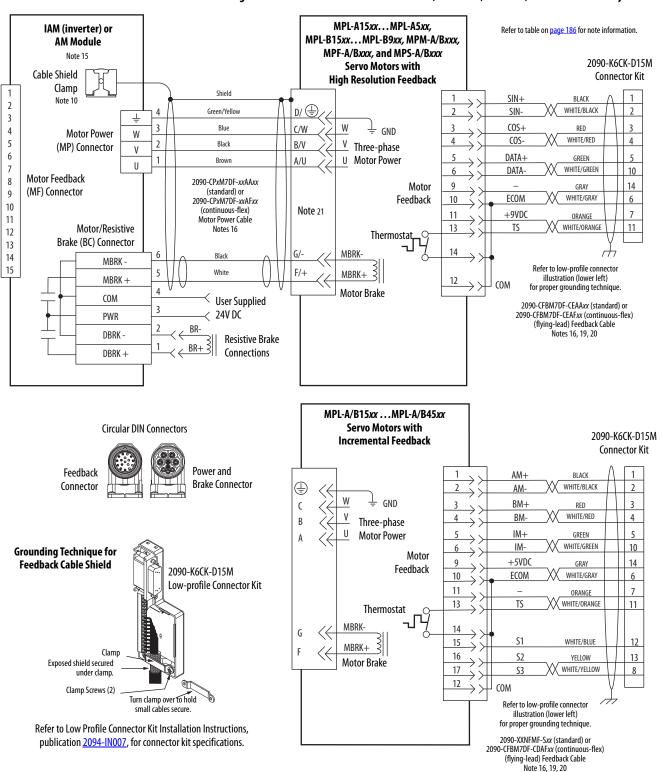


Figure 96 - AM Module with Kinetix MPL-A/B, MPM-A/B, MPF-A/B, and MPS-A/B Rotary Motors

IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with circular DIN (SpeedTec) connectors.

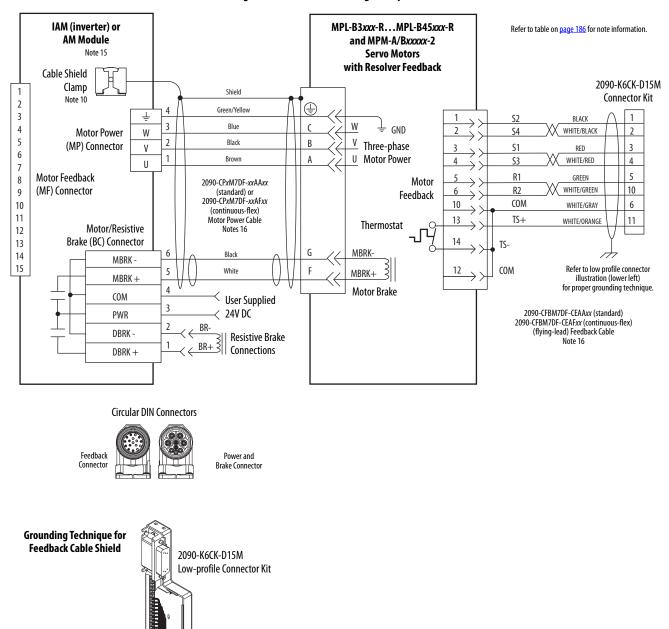


Figure 97 - AM Module Wiring Example with Kinetix MPL-B and MPM-A/B Resolver Motors

1

Turn clamp over to hold small cables secure.

Clam

Exposed shield secured under clamp.

Clamp Screws (2)

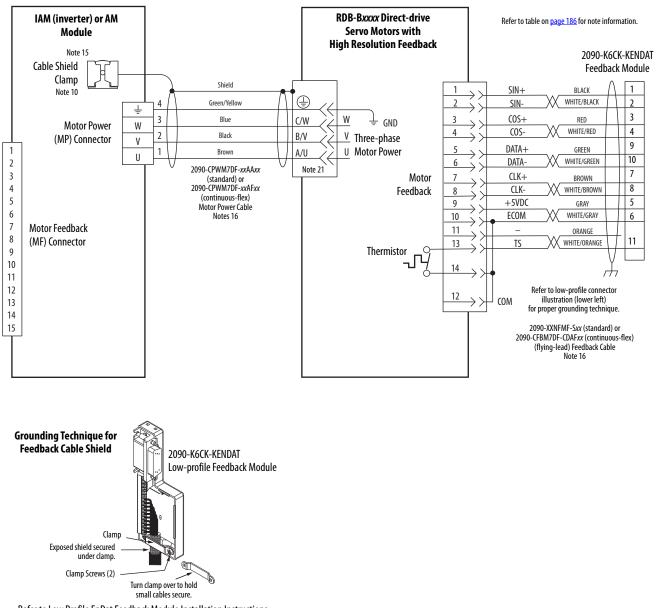


Figure 98 - AM Module with Kinetix RDB Direct-drive Motors

Refer to Low Profile EnDat Feedback Module Installation Instructions, publication 2090-1N020, for connector kit specifications.

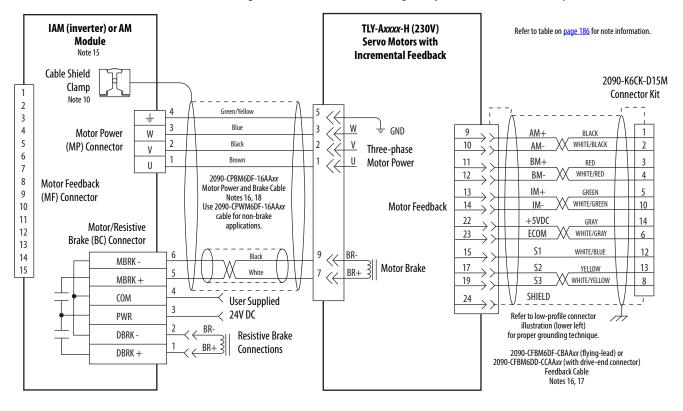
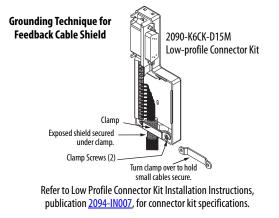


Figure 99 - AM Module (230V) Wiring Example with Kinetix TLY-A Rotary Motors



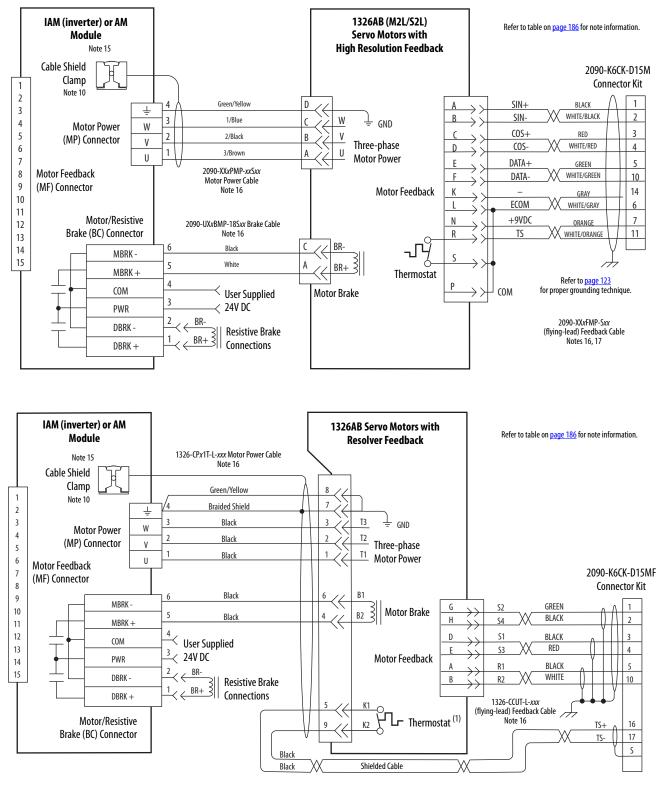


Figure 100 - AM Module (460V) Wiring Examples with 1326AB Motors

(1) When wiring the thermal switch on 1326AB (resolver-based) motors requires the use of the 2090-K6CK-D15MF Low-profile connector kit and wire extension to the power connector. Pins 16, 17, and S are filtered to prevent noise transmission back to the drive. Refer to page 123 for wiring instructions and a diagram.

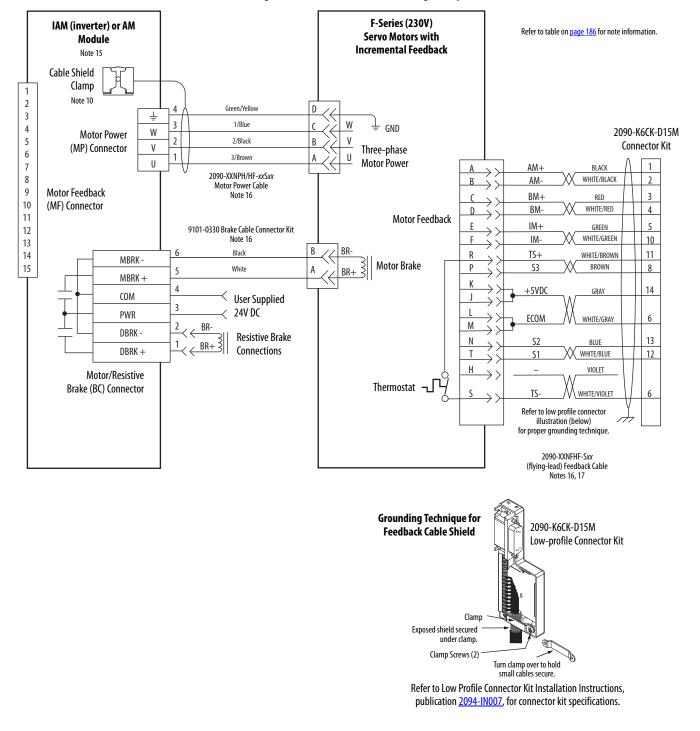


Figure 101 - AM Module (230V) Wiring Example with F-Series Motors

Axis Module/Linear Motor/ Actuator Wiring Examples

These examples apply to Kinetix 6000 drives with Allen-Bradley linear motors and actuators.

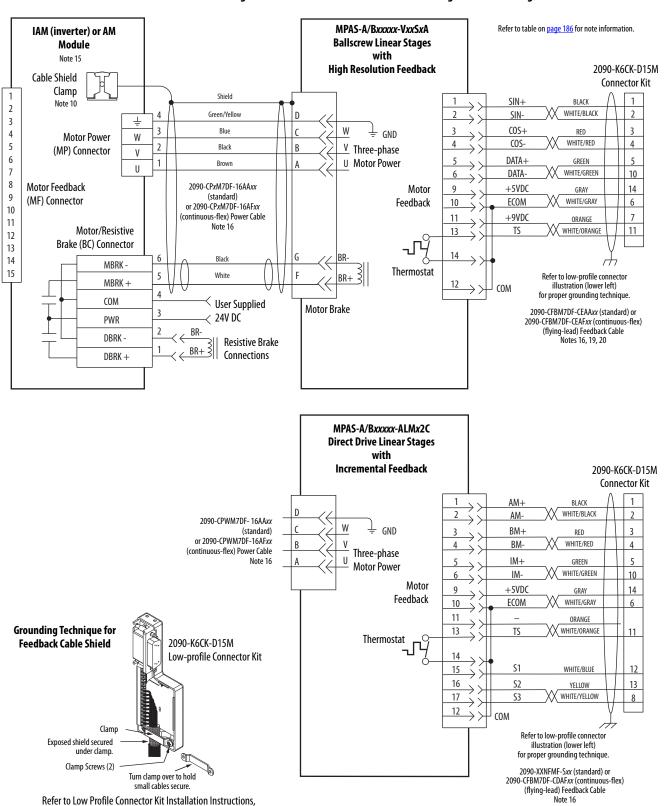


Figure 102 - AM Module with Kinetix MPAS Integrated Linear Stages

publication 2094-IN007, for connector kit specifications.

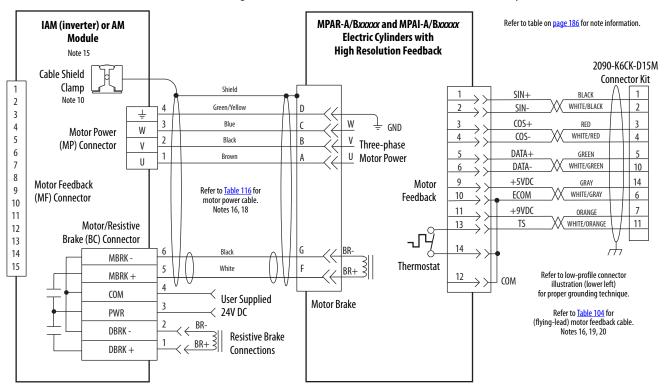
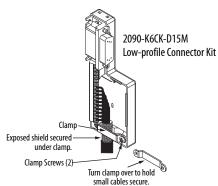


Figure 103 - AM Module with Kinetix MPAR and MPAI Electric Cylinders

Grounding Technique for Feedback Cable Shield



Refer to Low Profile Connector Kit Installation Instructions, publication 2094–IN007, for connector kit specifications.

Table 116 - Kinetix MPAR and MPAI Electric Cylinder Power and Feedback Cables

Electric Cylinder Cat. No.	Frame	Power Cable Cat. No.	Feedback Cable Cat. No.
MPAR-A/B1 <i>xxx</i> (series A) ⁽¹⁾	32	2090-XXNPMF-16S <i>xx</i> (standard) or	2090-XXNFMF-S <i>xx</i> (standard) or
MPAR-A/B2 <i>xxx</i> (series A)	40	(continuous-flex)	(continuous-flex)
MPAR-A/B1 <i>xxx</i> (series B)	32		
MPAR-A/B2xxx (series B)	40		
MPAR-A/B3xxx	63	2090-CP <i>x</i> M7DF-16AA <i>xx</i>	2090-CFBM7DF-CEAAxx
MPAI-A/B2xxxx	64	(standard) or 2090-CPxM7DF-16AFxx	(standard) or 2090-CFBM7DF-CEAF <i>xx</i>
MPAI-A/B3xxxx	83	(continuous-flex)	(continuous-flex)
MPAI-A/B4xxxx	110		
MPAI-B5 <i>xxxx</i>	144		
MPAI-A5xxxx	144	2090-CPxM7DF-14AAxx (standard) or 2090-CPxM7DF-14AFxx (continuous-flex)	2090-CFBM7DF-CEAAxx (standard) or 2090-CFBM7DF-CEAFxx (continuous-flex)

(1) Kinetix MPAR (series A) electric cylinders have threaded (M4) connectors and require threaded (M4) cable connectors.

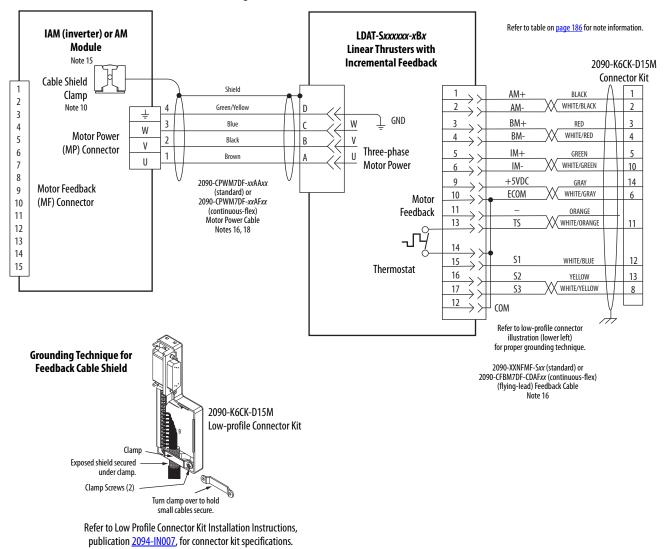


Figure 104 - AM Module with LDAT-Series Linear Thrusters

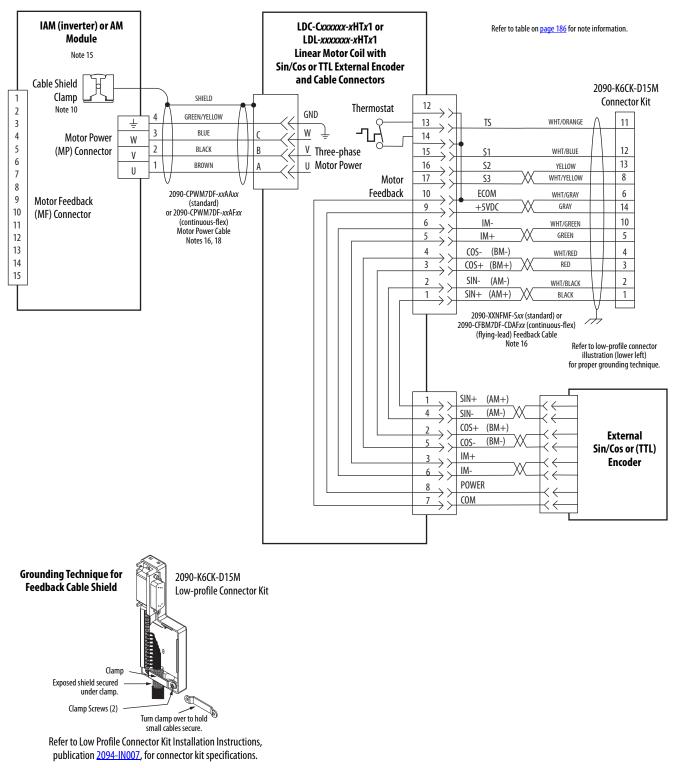


Figure 105 - AM Module with LDC-Series™ or LDL-Series™ Linear Motors (cable connectors)

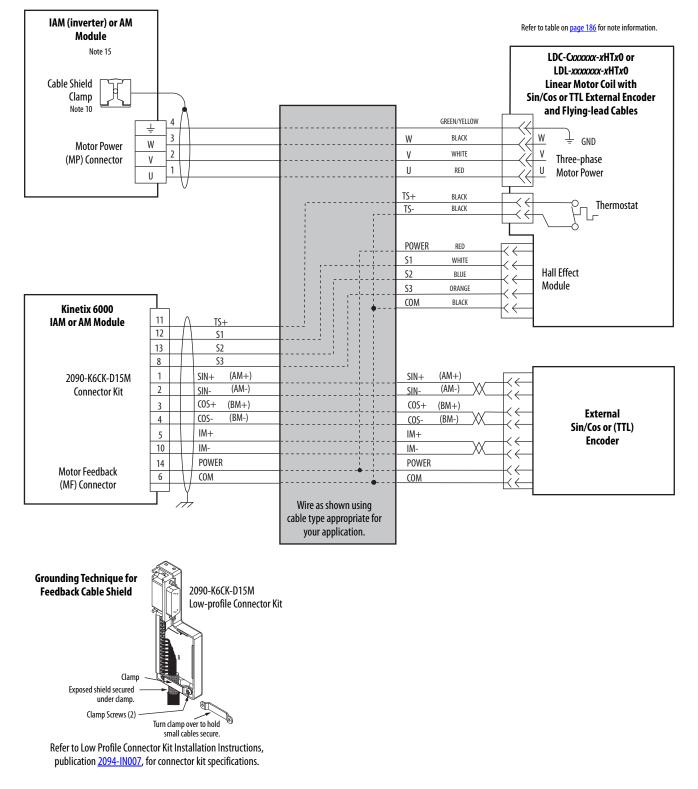


Figure 106 - AM Module with LDC-Series or LDL-Series Linear Motors (flying-lead cables)

Kinetix 6000M Integrated Drive-Motor Wiring Example

This example applies to Kinetix 6000 drives with Kinetix 6000M integrated drive-motor (IDM) systems.

ATTENTION: When using the Kinetix 6000M IDM system, with Kinetix 6000 drives, the IPIM module only forwards the safety-feedback monitoring signals to the adjacent (downstream) drive on the power rail. To avoid personal injury due to unexpected motion, make sure that the safety-feedback connections are fed through each drive on the power rail so that safety devices can recognize when the Kinetix 6000 drive opens the feedback contactor in the cascaded safety string.

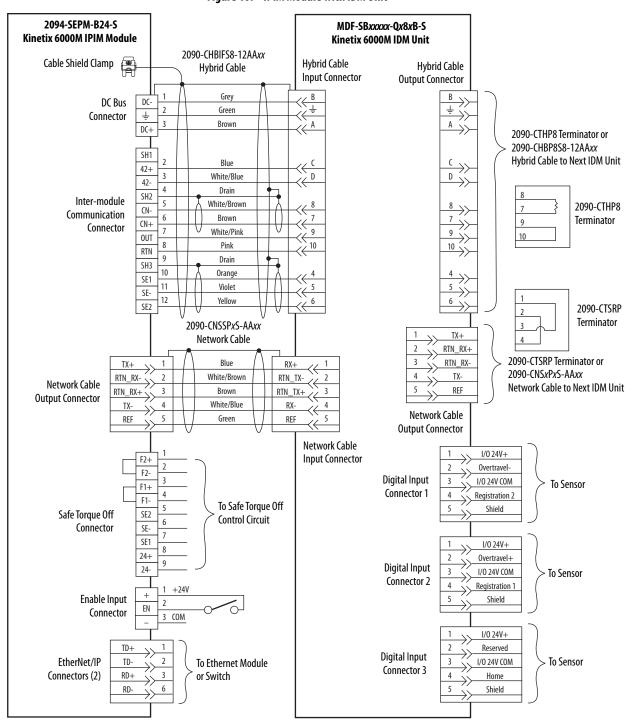


Figure 107 - IPIM Module with IDM Unit

Brake Current Example

The relay output of the Kinetix 6000 (MBRK \pm BC-5 and BC-6) is suitable for directly controlling a motor brake, subject to the relay voltage limit of 30V DC, and the relay current limit as shown below.

Table 117 - Brake Relay Current Limit

Kinetix 6000 IAM/AM Module	B	Brake Current Val	ue, max
Kinetix 6000 IAM/AM Module	Series A	Series B	Series C and D
2094-AC05-Mxx-x, 2094-AC09-M02-x, 2094-AMP5-x, 2094-AM01-x, 2094-AM02-x	1.0 A	N/A	
2094-BC01-Mxx-x, 2094-BC02-M02-x, 2094-BMP5-x, 2094-BM01-x, 2094-BM02-x	1.0 A	3.0 A	3.0 A
2094-AC16-M03-x, 2094-AC32-M05-x, 2094-AM03-x, 2094-AM05-x	1.3 A	N/A	5.0 A
2094-BC04-M03-x, 2094-BC07-M05-x, 2094-BM03-x, 2094-BM05-x	3.0 A	3.0 A	

Table 118 - Coil Currents Rated at <1.0 A

Compatible Brake Motors/Actuators ⁽¹⁾	Coil Current	Compatib
MPL-x1510, MPL-x1520, MPL-x1530	0.430.53 A	TLY-A110T-
MPL- <i>x</i> 210, MPL- <i>x</i> 220, MPL- <i>x</i> 230	0.460.56 A	TLY-A220T-
MPL/MPF-x310, MPL/MPF-x320, MPL/MPF-x330	0.45 0.55 0	TLY-A2530F
MPS-x330, MPM-x115, MDF-SB1003	0.450.55 A	1326AB-B4
MPL-x420, MPL-x430, MPL-x4520, MPL-x4530, MPL-x4540, MPL-x4560		F-4030, F-4
MPF-x430, MPF-x4530, MPF-x4540	0.5760.704 A	
MPS-x4540, MPM-x130, MDF-SB1153, MDF-SB1304	1	

Compatible Brake Motors	Coil Current
TLY-A110T-H, TLY-A120T-H, and TLY-A130T-H	0.180.22 A
TLY-A220T-H and TLY-A230T-H	0.3330.407 A
TLY-A2530P-H, TLY-A2540P-H, and TLY-A310M-H	0.3510.429 A
1326AB-B4 <i>xxx</i>	0.88 A
F-4030, F-4050, and F-4075	0.69 A

Table 119 - Coil Currents Rated at >1.0 A and \leq 1.3 A

Compatible Brake Motors ⁽¹⁾	Coil Current	Compatible Brake Motors	Coil Current
MPL- <i>x</i> B520, MPL- <i>x</i> B540, MPL- <i>x</i> 560, MPL- <i>x</i> 580	1.051.28 A	F-6100, F-6200, and F-6300	1.30 A
MPF- <i>x</i> 540, MPS-B560, MPM- <i>x</i> 165	1.031.20 A	1326AB-B5xxx, and 1326AB-B7xxx	1.20 A

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

Table 120 - Coil Currents Rated at >1.3 A and \leq 3.0 A

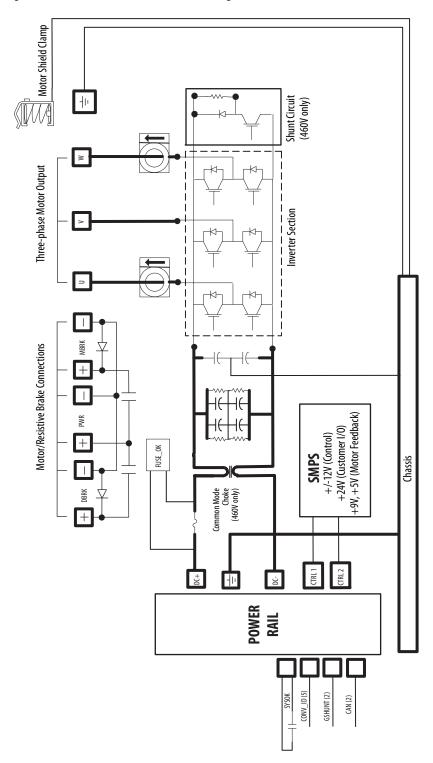
Compatible Brake Motors	Coil Current	
MPL-B640, MPL-B660, MPL-B680	1.912.19 A	
MPL-B860, MPL-B880	2.052.50 A	
MPM- <i>x</i> 215	1.842.25 A	
MPL-B960, MPL-B980	N/A	

IMPORTANT Because the coil current for MPL-B960 and MPL-B980 motors is rated 3.85...4.70 A, an external relay must be used.

System Block Diagrams

This section provides block diagrams of the Kinetix 6000 drive modules. For block diagrams of the LIM module and RBM module, refer to <u>Additional</u> <u>Resources</u> on <u>page 10</u>. for the documentation available for those products.

Figure 108 - IAM/AM Module (inverter) Block Diagram



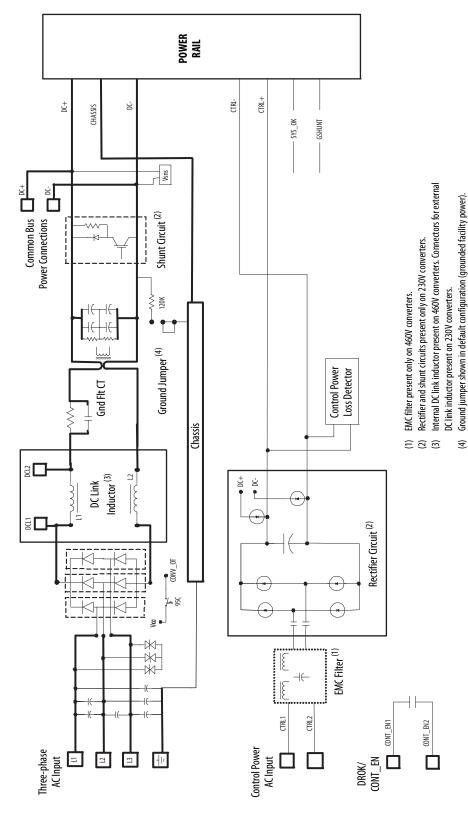


Figure 109 - IAM Module (converter) Block Diagram

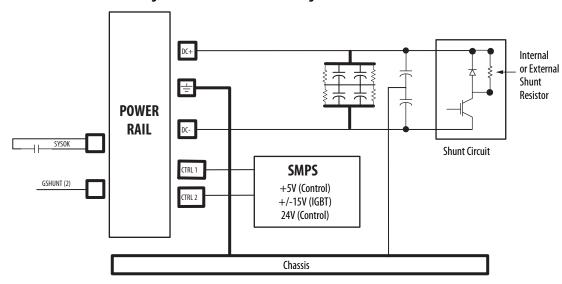


Figure 110 - Shunt Module Block Diagram

Upgrade the Drive Firmware

This appendix provides procedures for upgrading Kinetix[®] 6000 drive firmware by using ControlFLASH[™] or DriveExplorer software.

Торіс	Page
Upgrade Kinetix 6000M System Firmware	215
Upgrade Drive Firmware with ControlFLASH Software	216

Upgrading firmware for the Kinetix 6000M integrated drive-motor (IDM) system is done by using ControlFLASH software. The procedure for upgrading the IDM units uses the Sercos interface, similar to the axis modules. However, upgrading firmware on the IPIM module is accomplished over the EtherNet/IP network.

IMPORTANT DriveExplorer[™] software does not apply to Kinetix 6000M firmware upgrades.

For the firmware upgrade procedure specific to the IDM system, refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication <u>2094-UM003</u>.

Upgrade Kinetix 6000M System Firmware

Upgrade Drive Firmware with ControlFLASH Software

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

Before You Begin

You need the following software and information before you begin.

Description	Cat. No.	Firmware Revision or Software Version
RSLogix 5000 [®] software or	RSLogix 5000 software	15.x or later
Studio 5000 Logix Designer®	Logix Designer application	21. <i>x</i> or later
Controll agiv® Corres module	1756-M <i>xx</i> SE	15.32 or later
ControlLogix [®] Sercos module	1756-L60M03SE	15.4 or later
CompactLogix™ Sercos module	1768-M04SE	15.35 or later
SoftLogix™ Sercos PCI card	1784-PM16SE	15.33 or later
RSLinx [®] software		2.50 or later
ControlFLASH software kit ⁽¹⁾		4.00.09 or later
Catalog number of the targeted IAM/AM m	odule you want to upgrade	•

Network path to the targeted IAM/AM module.

(1) Download the ControlFLASH kit from <u>http://support.rockwellautomation.com/controlflash</u>. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.

For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit User Manual, publication <u>1756-UM105</u>.

IMPORTANT Control power must be present at CPD-1 and CPD-2 prior to upgrading your target drive.

The seven-segment status indicator on the target IAM (inverter) module or AM module must be displaying a fixed 2, 3, or 4 before beginning this procedure.



ATTENTION: To avoid personal injury or damage to equipment during the firmware upgrade due to unpredictable motor activity, do not apply three-phase AC or common-bus DC input power to the drive.

Configure Logix 5000 Communication

This procedure assumes that your communication method to the Logix 5000[™] controller is using the Ethernet protocol. It is also assumed that your Logix 5000 Ethernet module has already been configured.

For more information, refer to the ControlLogix System User Manual, publication <u>1756-UM001</u>.

Follow these steps to configure Logix 5000 communication.

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

 Configure Drivers
 Close

 Ethemet devices
 Add New...

 Configured Drivers:
 Add New...

 Name and Description
 Status

 Configure...
 Startup...

 Start
 Stop

 Delete
 Delete

The Configure Drivers dialog box opens.

- 3. From the Available Drive Types pull-down menu, choose Ethernet devices.
- 4. Click Add New.

The Add New RSLinx Classic Driver dialog box opens.

5. Type the new driver name.

Add New RSLinx Classic Driver	X
Choose a name for the new driver. (15 characters maximum)	ОК
AB_ETH-1	Cancel

6. Click OK.

The Configure driver dialog box opens.

	river: AB_ETH-1	
tion Map	ping	
Station	Host Name	Add New
Station 0	Host Name 10.91.36.82	Add New Delete

7. Type the IP address of your Logix 5000 Ethernet module.

The IP address shown is an example. Yours will be different.

8. Click OK.

The new Ethernet driver appears under Configured Drivers.

	?
	Close
Add New	Help
Status	Т
Running	Configure
Running	_
	Startup
	Start
	Stop
	Delete

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

Upgrade Firmware

Follow these steps to select the drive module to upgrade.

1. Open your ControlFLASH software.

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

- From the Tools menu in the Logix Designer application, choose ControlFLASH.
- Choose Start>Programs>FLASH Programming Tools> ControlFLASH.

The Welcome to ControlFLASH dialog box opens.

: Configuration parameters al). : Path to the target device. a Revision for this update.
]

2. Click Next.

The Catalog Number dialog box opens.

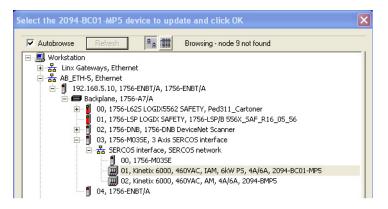
Catalog Number	Fata the estate much a citie to set device.	
Control FLASH	Enter the catalog number of the target device: 2094-BC01-MP5 2094-AM02 2094-AM03 2094-AM05 2094-AMP5 2094-BC01-M01 2094-BC01-M05 2094-BC01-M05 2094-BC01-M05 2094-BC02-M02 2094-BC02-M05 2094-BM01 2094-BM03 2094-BM03 2094-BM05 2095 2095	
	< Back Next > Cancel	Help

3. Select your drive module.

In this example, the 2094-BC01-MP5 IAM module is selected.

4. Click Next.

The Select Device to Update dialog box opens.



- 5. Expand your Ethernet node, Logix 5000 backplane, and EtherNet/IP network module.
- 6. Select the servo drive to upgrade.
- 7. Click OK.

The Firmware Revision dialog box opens.

Control Catalog Number: 2094-BC01-MP5 Serial Number: 00000000 Current Revision: 1.88 Select the new revision for this update: Revisi	
	1.89 Show All Restrictions Current Folder: c:\progra*1\contro~1
	< Back Next > Cancel Help

- 8. Select the firmware revision to upgrade.
- 9. Click Next.

The Summary dialog box opens.



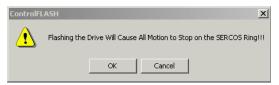
- 10. Confirm the drive catalog number and firmware revision.
- 11. Click Finish.

This ControlFLASH warning dialog box opens.

Control FLASH	update with new firmware. During the update the module will be unable to perform its normal control function. Please make sure that all processes affected by this equipment have been suspended and that all sefue ortical functions are not controlFLASH
	Are you sure you want to begin updating the target device? Yes No
	More Info

12. Click Yes (only if you are ready).

This ControlFLASH warning dialog box opens.



13. Acknowledge the warning and click OK.

The Progress dialog box opens and upgrading begins.

Progress	
Catalog Number: Serial Number: Current Revision: New Revision:	2094-BC01-MP5 00000000 1.88 1.89
Transmitting block	2751 of 5377
	Cancel

The drive module seven-segment

status indicator changes from the fixed 2, 3, or 4 to F, which indicates that upgrading is in progress.

After the upgrade information is sent to the drive, the drive resets and performs diagnostic checking.

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

Progress	
Catalog Number: Serial Number:	2094-BC01-MP5 00000000
Current Revision: New Revision:	1.88 1.89
Transmitting block	5377 of 5377
	Cancel

15. The Update Status dialog box opens and indicates success or failure as described below.

Upgrading Status	lf	
Success	 Update complete appears in a GREEN Status dialog box. Go to <u>step 16</u>. 	
Failure	 Update failure appears in a RED Status dialog box. Refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication <u>1756-QS105</u>, for troubleshooting information. 	

Update Status	×
Catalog Number: 2094-BC01-MP5 Serial Number: 00000000	ОК
Current Revision: 1.88 New Revision: 1.89	View Log
Status: Update complete. Please verify this new	Help
firmware update before using the target device in its intended application.	Repeat

16. Click OK.

Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

- **TIP** Verifying the firmware upgrade is optional.
- 1. Open your RSLinx software.
- 2. From the Communications pull-down menu, choose RSWho.



- 3. Expand your Ethernet node, Logix 5000 backplane, and EtherNet/IP network module.
- 4. Right-click the drive module and choose Device Properties.

_ETH-2\10.91.3	6.169\Backplane\5\SERCOS int	?
Device Name:	2094-BC01-MP5	
Vendor:	Allen-Bradley Company	
Product Type:	115	
Product Code:	93	
Revision:	1.89	
Serial Number:	00000000	
Faults:		
,	,,,	
	Close Help	

The Device Properties dialog box opens.

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

Notes:

DC Common-bus Applications

This appendix provides integration procedures specific to Kinetix[®] 6000 multiaxis drive systems configured for DC common bus. The procedure involves calculating capacitance values and setting the Additional Bus Capacitance parameter by using DriveExplorer[®] software.

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Calculate Total Bus Capacitance	226
Calculate Additional Bus Capacitance	227
Bulletin 2094 Drive Capacitance Values	227
Common Bus Capacitance Example	228
Set the Additional Bus Capacitance Parameter	229

To set the Additional Bus Capacitance parameter by using the Logix Designer application, refer to Appendix E beginning on <u>page 251</u>.

Calculating capacitance, as it applies to the Bulletin 2094 shunt module and Kinetix 6000M IPIM module, is also included in this appendix.

These procedures assume you have mounted and wired your Kinetix 6000 DC common-bus system.

Before you set the Additional Bus Capacitance (Add Bus Cap) parameter in DriveExplorer software or the Logix Designer application, you need to calculate these values:

• Total bus capacitance

Before You Begin

• Additional bus capacitance

Calculate Total Bus Capacitance

Total bus capacitance is the sum of all capacitance values for your Bulletin 2094 common-bus modules. Specifically, this includes the capacitance values for each of these modules:

- Leader IAM (converter and inverter) module
- Each AM and shunt module (if present) on the leader IAM power rail
- Each IPIM module (if present) on the leader IAM power rail
- Each follower IAM (converter and inverter) module
- Each AM module on the follower IAM power rail
- Each IPIM module (if present) on the follower IAM power rail

Refer to Bulletin 2094 Drive Capacitance Values on page 227 for IAM, AM, IPIM, and shunt module capacitance values.

IMPORTANT	If total bus capacitance of your system exceeds the leader IAM module precharge rating and input power is applied, the IAM module seven- segment status indicator displays error code E90 (precharge timeout fault).
	To correct this condition, you must replace the leader IAM module with a larger module or decrease the total bus capacitance by removing AM modules or IPIM modules.

Table 121 - Maximum IAM Module Bus Capacitance

Leader IAM (200V-class) Module	Bus Capacitance, max μF	Leader IAM (400V-class) Modules	Bus Capacitance, max μF
2094-AC05-MP5- <i>x</i>	7145	2094-BC01-MP5- <i>x</i>	4585
2094-AC05-M01-x	7145	2094-BC01-M01- <i>x</i>	4365
2094-AC09-M02-x	15,295	2094-BC02-M02- <i>x</i>	8955
2094-AC16-M03-x	34,400	2094-BC04-M03- <i>x</i>	8955
2094-AC32-M05- <i>x</i>	62,825	2094-BC07-M05-x	17,915

IMPORTANT If your total bus capacitance value exceeds the value in the table above, you must increase the size of the leader IAM module or decrease the total bus capacitance by removing other modules on the power rail.

Calculate Additional Bus Capacitance

Bulletin 2094 Drive

Capacitance Values

Additional bus capacitance is the sum of all follower IAM, AM, and IPIM module capacitance values for your Bulletin 2094 common-bus modules. Specifically, this includes the capacitance values for each of these modules:

- Each follower IAM (converter and inverter) module
- Each AM module on the follower IAM module power rail
- Each IPIM module on the follower IAM module power rail

Enter the additional bus capacitance value in Set the Additional Bus Capacitance Parameter beginning on <u>page 230</u>.

Use these tables when calculating total bus capacitance and additional bus capacitance for your Bulletin 2094 common-bus application.

Table 122 - IAM/AM (200V-class) Modules

IAM Converter (200V-class)	Capacitance μF
2094-AC05-MP5- <i>x</i>	270
2094-AC05-M01- <i>x</i>	270
2094-AC09-M02- <i>x</i>	540
2094-AC16-M03-x	1320
2094-AC32-M05- <i>x</i>	1980

AM Inverter (200V-class)	Capacitance μF
2094-AMP5- <i>x</i>	390
2094-AM01- <i>x</i>	660
2094-AM02- <i>x</i>	780
2094-AM03 <i>-x</i>	1320
2094-AM05- <i>x</i>	2640

Table 123 - IAM/AM (400V-class) Modules

IAM Converter (400V-class)	Capacitance µF
2094-BC01-MP5- <i>x</i>	110
2094-BC01-M01- <i>x</i>	110
2094-BC02-M02- <i>x</i>	220
2094-BC04-M03- <i>x</i>	940
2094-BC07-M05-x	1410

AM Inverter (400V-class)	Capacitance µF
2094-BMP5- <i>x</i>	75
2094-BM01- <i>x</i>	150
2094-BM02- <i>x</i>	270
2094-BM03- <i>x</i>	840
2094-BM05- <i>x</i>	1175

Table 124 - Shunt Module (200/400V-class)

Shunt Module	Capacitance	
(200/400V-class)	μF	
2094-BSP2	470	

Table 125 - IPIM Module (400V-class)

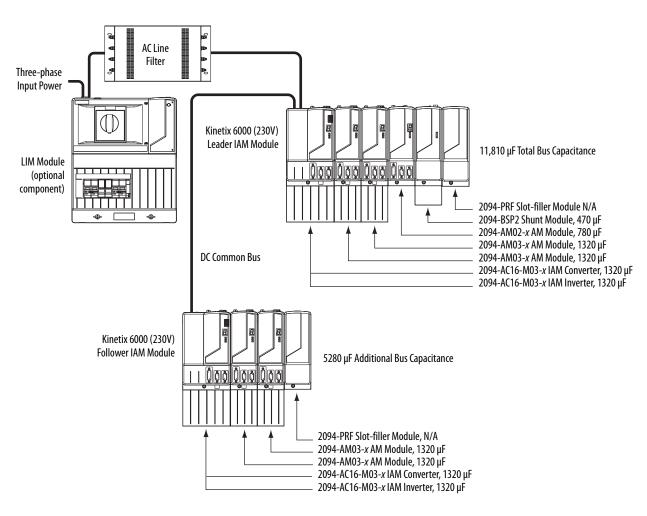
IPIM Module (400V-class)	Capacitance μF	
2094-SEPM-B24-S	840	

Common Bus Capacitance Example

In this example, the sum of the leader IAM power rail modules capacitance (6530 $\mu F)$ and the follower IAM power rail modules capacitance (5280 $\mu F)$ equals 11,810 μF total bus capacitance.

The sum of the follower IAM module power rail equals 5280 μF additional bus capacitance.

Figure 111 - Calculating Common Bus Capacitance



Set the Additional Bus Capacitance Parameter

In this section you set the Add Bus Cap parameter by using DriveExplorer software.

- **TIP** You can also set the Add Bus Cap parameter by changing IDN parameter values. Refer to Appendix E on <u>page 251</u> for more information.
- **TIP** You can use this procedure to change other parameters too, the Analog Output parameters, for example.

The following hardware and software tools are required to provide the necessary communication link between your personal computer and the Kinetix 6200 and Kinetix 6500 drive system running DriveExplorer software.

Table 126 - Kinetix 6000 System Requirements

Description	Cat. No.	Version	
DriveExplorer software ^{(1) (2)}	9306-4EXP02ENE	2.01 or later	
Serial to SCANport [™] adapter ^{(2) (3)}	1203-SSS (Series B)	3.004 or later	
Studio 5000 Logix Designer® application	9324-RI D300xxF	21.0 or later	
RSLogix 5000 [®] software	- 7524-ILD30088E	15.0 or later	

(1) Refer to DriveExplorer Getting Results Manual, publication <u>9306-GR001</u>, for instructions.

Additional information regarding these communication and software tools is available at <u>http://www.ab.com/support/abdrives</u>.

(3) Refer to 1203-SSS (series B) FRN 3.xxx User Manual, publication 20C0MM-UM001, for instructions.



ATTENTION: To avoid personal injury or equipment damage, at least one end of a Sercos fiber-optic cable must be disconnected from the drive. This makes sure that motion does not occur while changes are being made to the Add Bus Cap parameter.

Remove Sercos Communication

Follow these steps to remove (break) Sercos communication.

- 1. Remove three-phase and control power from the Kinetix 6200 and Kinetix 6500 drive system.
- 2. Remove one of the Sercos fiber-optic cables.

Fiber-optic cable connections (Tx and Rx) are on the top of each IAM and AM module.

3. Re-apply three-phase and control power.

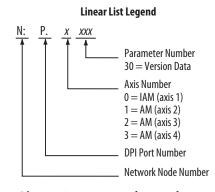
Set the Additional Bus Capacitance Parameter

Follow these steps to set the Additional Bus Capacitance parameter.

- 1. Start your DriveExplorer software.
- 2. From the Explore menu, choose Connect>Local or press CTRL+L.

DriveExplorer software will read your system.

3. Observe the Linear List of parameters as grouped by Node, Port, and Axis hierarchy as shown below.



4. Choose Devices>Node>Product and navigate to the parameter *x:x:x*599 as shown below.

ile <u>E</u> dit E <u>x</u> plore <u>A</u> ctions <u>H</u> elp					
D 🚅 🖬 🐰 🏚 🖻 🎒 🔊 • Tạ	6 🖗 🖶 💻	<i></i>			
⊒- Devices	S N:P.P#	Name	Value	Units	~
Node 1: - 2094D SERVO	1: 0.593	Shunt Ws	10	%	
- 2094D SERVO Config 0000	1: 0.594	Shunt Kl	111	sec	
	1: 0.595	Shunt Ks	130	msec	
⊕ IAM Diags	1: 0.596	Shunt Power	200	watt	
	1: 0.597	Shunt Res	28.75	Ohms	
IAM Group	1: 0.598	Bus Reg ID	1	2011/24/125	
IAM I/O	1: 0.599	Add Bus Cap	0	uF)	
2 - 1203-SSS RS232 DF1	1: 0.600	Reserved	0		
- Custom Views	1: 0.601	Soft Ovrtrvl Act	Drive Action		
New Custom View	* 1:0.602	Pos Err Flt Act	Drive Action		
Compare Results	* 1:0.603	Hard Ovrtrvl Act	Drive Action		
compare reserve	* 1:0.604	Fdbk Nse Flt Act	Status Only		
	* 1.0.605	Dr Therm Elt Act	Drive Action		1

5. Double-click the *x:x:x*599 Add Bus Cap parameter.

599 - Add Bus Cap $\mathbf{\hat{v}}$ Value Edit Advanced 1780 Value чF 1780 Internal Value C Hex • Dec C Oct Min 0 Max 65535 Select <u>D</u>efault Default 0 OK Cancel

The command dialog box for parameter x599 - Add Bus Cap opens.

- 6. Click the Value Edit tab and enter the Add Bus Cap Value (μ F).
- 7. Click OK.

The Add Bus Cap value is changed, but not saved in nonvolatile memory.

Save the Add Bus Cap Parameter to Nonvolatile Memory

Follow these steps to save the Add Bus Cap parameter to nonvolatile memory.

1. From the Actions menu, choose Nonvolatile Memory.

This message dialog box opens.

Non-Volatile Memory - 2094D SERVO Config 000	0 🔀
Save current device values to non-volatile memory.	Save
Recall device values from non-volatile memory.	Recall
Reset device values to defaults.	Load Defaults
Close	

2. Click Save.

The changes are saved to nonvolatile memory and this cautionary message dialog box opens.

Non-Vola	tile Memory - 2094D SERVO	Config 0000
~	Caution	
	This action will overwrite existing saved in the product's	
	Continue	?
	(<u>Yes</u>)	No

3. Click Yes.

The save to nonvolatile memory is complete and this confirmation message dialog box opens.



- 4. Click OK.
- 5. Close the DriveExplorer software.

Verify the Parameter Changes

Follow these steps to verify your parameter change was successful.

TIP Verifying the parameter change is optional.

- 1. Open your DriveExplorer software.
- 2. Cycle the drive control power.
- 3. Reconnect the drive to your DriveExplorer software and read the Add Bus Cap value just like you did in Set the Additional Bus Capacitance Parameter on page 230.

99 - Add Bus (Cap			D
Value <u>E</u> dit Ad <u>v</u> ar	nced			
Value	1780		uF	Read
Internal Value	1780			Deau
C Hex	• Dec	C Oct		
Min	0			
Max	65535			
Default	0			Select <u>D</u> efault
		1		
		OK	Cancel	Apply

4. Verify the new parameter value.

In this example, the new value is 1780 μ F.

5. Close the DriveExplorer software.

Reconnect Sercos Communication

Follow these steps to reconnect Sercos communication.

- 1. Remove three-phase and control power from the Kinetix 6000 drive system.
- 2. Replace the Sercos fiber-optic cable removed earlier.

Fiber-optic cable connections (Tx and Rx) are on the top of each IAM and AM module.

3. Re-apply three-phase and control power.

Notes:

Configure the Load Observer Feature

The load observer feature is a control loop inside the Kinetix[®] 6000 drive (firmware revision 1.124 or later) that estimates the mechanical load on the motor and compensates for it, thereby forcing the motor to behave as if it is unloaded and relatively easy to control. As a result, load observer automatically compensates for disturbances and load dynamics, such as sudden inertia/ torque changes, compliance, backlash, and resonances.

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Set Gains with Sercos IDN Write Messages	248
Compensate for High Frequency Resonances	249

Benefits

You can use load observer with out-of-box controller gains, where the load is unknown and thus the Load Inertia Ratio = 0, or with auto-tuned controller gains, where the Load Inertia Ratio is known or calculated by performing an auto-tune procedure.

When used with out-of-box controller gains, load observer does the following.

- Provides relatively high-performance motion control without tuning
- Automatically compensates for load resonances and machine wear over time

When used with auto-tuned controller gains, load observer does the following.

- Increases controller bandwidth
- Reduces tracking errors, so line speeds can be increased
- Provides tighter control of moving parts, reducing wear and saving material costs

How it Works

Load observer acts on the acceleration signal within the control loops and monitors the Acceleration Reference and the Actual Position Feedback. Load observer models an ideal unloaded motor and generates a load Torque Estimate, in torque units, that represents any deviation in response of the actual motor and mechanics from the ideal model. This deviation represents the reaction torque placed on the motor shaft by the load mechanics. It is estimated in real time and compensated by closed loop operation.

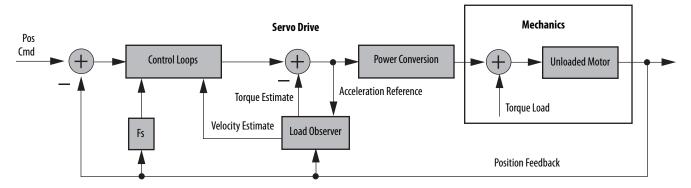


Figure 112 - Load Observer and Control Loop Signals Relationship Block Diagram

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 caused by load observer's aggressive action on the acceleration reference. Together, load observer with the Velocity Estimate setting provides the best overall performance.

Configuration

You can configure the load observer feature in a variety of ways by writing to a set of configuration IDN parameters. The overall behavior of load observer is controlled by Load Observer Configuration (IDN P-431). This parameter is used to select the load observer mode. It can be set to the following values.

Table	e 127 - I	Load O	bserver	Modes
-------	-----------	--------	---------	-------

Mode	Value	Description	
Disabled (default)	0	Load Observer is inactive	
Load Observer Only	1	Provides a Torque Estimate only	This setting is a filtered acceleration feedback with the addition of integral action in the acceleration forward path that is active below the observer bandwidth. This greatly increases the disturbance rejection properties (stiffness) over the acceleration feedback setting. However, it is also fairly aggressive and the observer bandwidth must be decreased for stable operation.
Load Observer with Velocity Estimate	2	Standard Operation: Provides Torque and Velocity Estimates	This setting combines the best of the Load Observer Only and Velocity Estimate Only settings. Separately, load observer removes error, but increases phase lag and is fairly aggressive, whereas velocity estimate provides a smooth response and reduces phase lag, but creates error. Together, they remove error and provide a smooth response. Load observer performs well in situations that require adapting to changing inertia and velocity integrator anti-windup.
Velocity Estimate Only	3	Provides a Velocity Estimate only	This setting creates a filtered velocity feedback signal that is void of phase lag. Less phase lag (delay around the loop) allows for higher performance. However, the signal is modeled at frequencies above the observer bandwidth, producing error in velocity feedback. This generates a fictitiously lower velocity error since velocity error equals velocity command minus velocity feedback. Nevertheless, the steady state error disappears when used in position mode with either the position integrator or the observer integrator. This configuration is not desirable for Velocity mode applications.
Acceleration Feedback	4	Provides acceleration feedback by disconnecting Acceleration Reference to load observer	This setting creates a filtered acceleration feedback signal. This setting is fairly aggressive and the observer bandwidth must be decreased significantly for stable operation. The Load Observer Only setting is similar, but without the additional phase lag (delay) created by necessary filtering.

The following figures illustrate the high-level operation of each observer mode.

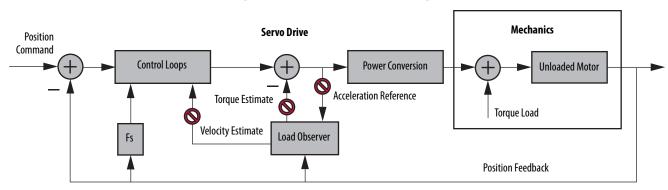


Figure 113 - Load Observer Disabled Configuration (Value 0)

Figure 114 - Load Observer Only Configuration (Value 1)

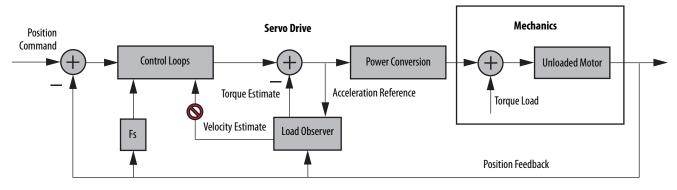


Figure 115 - Load Observer with Velocity Estimate Configuration (Value 2)

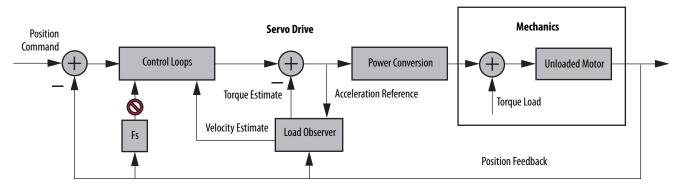
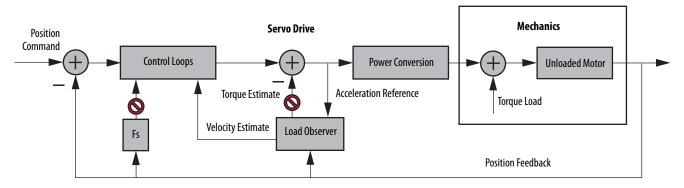


Figure 116 - Velocity Estimate Only Configuration (Value 3)



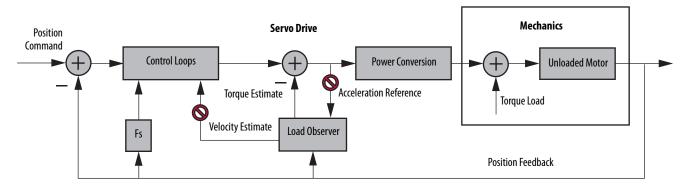
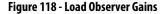


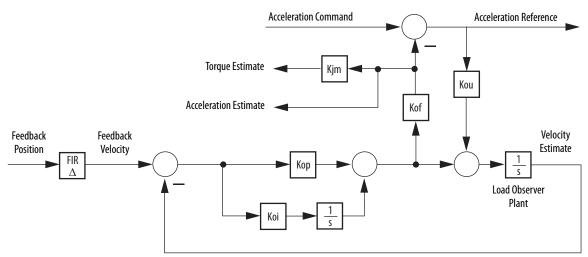
Figure 117 - Acceleration Feedback Configuration (Value 4)

You can configure the load observer feature in a variety of ways by writing to a set of configuration IDN parameters. The overall behavior of load observer is controlled by Load Observer Configuration (IDN P-431). This parameter is used to select the Load Observer mode. Use it to set the IDN values listed in <u>Table 127</u> on page 236

Remaining IDN Parameter Descriptions

Load observer gains that require user interaction are Load Observer Bandwidth (Kop) and Load Observer Integral Bandwidth (Koi). They are set by IDN P-432 and IDN P-433, respectively. Guidelines for setting these gains are provided in the following sections. In general, Kop acts like a velocity integrator without windup and Koi acts a like a position integrator without windup. Typically, Koi = 0.





Load observer gains that do not require user interaction are Load Observer Feedback Gain (Kof) and the Load Observer Input Gain (Kou). They are automatically set internally based on the Load Observer Configuration. However, when in Acceleration Feedback mode, Kof can also be set manually by IDN P-434 with typical values between zero and one.

IDN	Name	Units	Format	Value, min	Value, max
P:0:432	Load Observer Bandwidth (Kop)	Rad/s		0	12,500 (1)
P:0:433	Load Observer Integral Bandwidth (Koi)	Rad/s	16 bit unsigned int		65,535 ⁽²⁾
P:0:434	Load Observer Feedback Gain (Kof)	-	2		200

Table 128 - Load Observer Gain Parameters

(1) This value applies to drive firmware revision 1.124.

(2) This value applies to drive firmware revisions later than 1.124.

IMPORTANT	You must validate the input parameter to the message instruction when executing message instructions to the attributes in <u>Table 128</u> .
	The value being sent is interpreted by the drive as an unsigned 16-bit
	integer. Attempting to write negative values results in the binary-equivalent
	positive value being used by the drive.

The Acceleration Estimate and Torque Estimate signals are read by using IDN-435 and P-436, respectively. Definitions for these IDN parameters are given in the following table.

Table 129 - Load Observer Output Signals

IDN	Name	Units	Format	Value, min	Value, max
P:0:435	Load Observer Acceleration Estimate	Acceleration	32bit signed int	-2 ³¹	2 ³¹ -1
P:0:436	Load Observer Torque Estimate	Torque	16 bit signed int	-2 ¹⁵	2 ¹⁵ -1

When load observer and the torque low-pass filter are both enabled, and the low-pass filter bandwidth is less than 5 times the load observer bandwidth, their interaction can interfere with each other, causing instability. The low-pass filter is always limited to a bandwidth under 389 Hz in drive firmware prior to revision 1.116. As a result, IDN P-065 was added in drive firmware revision 1.116 to override the torque low-pass filter bandwidth limiting. The filter is also bypassed if the override IDN P-065 is set to 1 and the torque low-pass filter bandwidth is set to zero.

Table 130 - Torque Low-pass Filter Bandwidth

IDN P:0:065	Bandwidth in the Logix Designer Application	Actual Bandwidth in Drive				
0 ⁽¹⁾	= 0	389 Hz				
0.,	> 0	Limited to \leq 389 Hz				
1 (2)	= 0	Filter bypassed				
1	> 0	Limited to \leq 10,430 Hz				

(1) Operation before firmware revision 1.116.

(2) Operation with firmware revision 1.116 or later.

Refer to Appendix E on <u>page 251</u> for more information on changing IDN parameter values with read/write messages in the Logix Designer application.

Out-of-Box Gain Settings

This method of setting controller gains works for unknown loads or when an auto-tune is not performed. It produces a relatively high level of performance in 90% of motion applications. Most of the time, there is no need to perform an auto-tune procedure or further optimize gain settings.

TIP Try this method before executing Auto-tune.

Follow these steps to configure the drive for high performance right out of the box. This procedure uses load observer to automatically account for the unknown load. As a result, you must be familiar with creating an axis in the Logix Designer application and accessing drive IDN parameters.

1. Create a new axis with type AXIS_SERVO_DRIVE.

If you need more information to create a new axis, refer to Configure the Kinetix 6000 Drive Modules on page 144.

2. Click the Drive/Motor tab in the Axis Properties dialog box and add a motor.

Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Actio	ns Tag
General	Motion P	lanner	Units	Drive/Motor	Motor	Feedback	Aux F	eedback	Conversion
Amplifier C	atalog Numb	er: 2094	-AM01			~			
Motor Cat	alog Number:	MPLV	A310P-M				Change	Catalog	
Loop Conf	iguration:	Positi	on Servo			~			
Drive Res	olution:	20000	00 D	rive Counts /	Motor Rev	~	Calcu	ilate	

If you need more information to add a motor, refer to Configure Axis Properties on page 149.

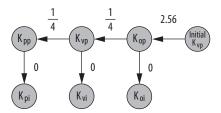
3. Click the Gains tab in the Axis Properties dialog box.

The current Velocity Proportional Gain (Initial Kvp) value is used to recalculate other gain values.

General	M	otion Planner	Units	Drive/Motor	Motor Fe	edback	Aux F	eedback	Conversion
Homing	Hoo	kup Tune	Dynamics	Gains	Output I	imits	Offset	Fault Acti	ons Tag
Position	Gains			1				1anual Adju	st
Propor	tional:	298.6612	1/s						
Integra	al:	0.0	1/ms-s				Se	t Custom Ga	ins
Velocity	Gains			- Fe	edforward Ga	ains			
Propor	tional:	764.5727	1/s		Velocity:	0.0		%	
Integra	al:	0.0	1/ms-s		Acceleration:	0.0		%	

- 4. Make the following calculations:
 - a. Load Observer Bandwidth: Kop = Velocity Proportional Gain x 2.56
 - b. Velocity Loop Bandwidth: Kvp = Kop/4

c. Position Loop Bandwidth: Kpp = Kvp/4



- 5. Configure these settings and values on the Gains tab.
 - a. Position Proportional Gain = Kpp
 - b. Velocity Proportional Gain = Kvp
 - c. Velocity Feedforward Gain = 100%
 - d. Integrator Hold = Disabled

General	Motion	Planner	Units	Drive/Motor	Motor Fe	edback	Aux F	eedback	Co	nversion
Homing	Hookup	Tune	Dynamics	Gains*	Output	Limits	Offset	Fault Act	tions	Tag
Position G Proportio		3316	1/s					1anual Adju]
Integral:	0.0		1/ms-s				Se	t Custom G	ains	J
Velocity G	iains			- Fe	eedforward G	ains				
Proportio	onal: 489.	3265	1/s		Velocity:	100.0		%		
Integral:	0.0		1/ms-s		Acceleration	0.0		%		
Integrator H	old: Disa	abled	~							

- 6. Configure these IDN parameter values.
 - a. IDN P-431 = 2 (load observer with velocity estimate)
 - b. IDN P-432 = Kop
 - c. IDN P-433 = 0
 - d. IDN P-065 = 1

Eile Edit Explore Actions Help	88 =	* & Ø		
- Devices	S N:P.P#	Name	Value	Units
- Node 1: - 2094D SERVO	1:0.930	Reserved	0	
- 0 - 2094D SERVO Config 0000	1:0.931	Load Obs Config	With Vel Est	
Parameter List	1:0.932	Load Obs Bw	1957	rd/s
TANA	1:0.933	Load Obs Int Bw	0	rd/s

- 7. Click the Output tab in the Axis Properties dialog box and verify these settings.
 - a. Load Inertia Ratio = 0

D. Liable Low-pass Output Filter – Olichetke	b.	Enable Low-pass	Output Filter =	Unchecked
--	----	-----------------	-----------------	-----------

General	Motion P	lanner l	Jnits	Drive/Motor	Moto	r Feedback	Aux F	eedback	Conversion	
Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Acti	ions Tag	
Motor Iner	tia:	0.000044		Kg·m^2			N	tanual Adju	st	
Load Inert	ia Ratio:	0.0		Load Inertia/	Motor Inert	ia				
Torque	e/Force Scali	ng:	0.0174	9257	% Rated/	(Position Unit	s/s^2)			
System Acceleration: 5716.			5716.7	13	(Position Units/s^2) at 100% Rated					
Enable	Notch Filter	Frequency								
Notch	Filter Frequer	ncy:	0.0		Hertz					
Enable	Low-pass O	utput Filter								
Low-p	ass Output Fil	lter Bandwidt	η 0.0		Hertz					

8. If required, reduce the Maximum Acceleration and Maximum Deceleration values to meet application requirements and protect the drive and motor from overload.

Acceleration limits, by default, are set to their maximum value, providing the best performance for a Load Inertia Ratio of zero. However, your application loads the motor and it will not be able to accelerate as fast.

General Motion Planne	r Units D	Drive/Motor	Motor	Feedback	Aux F	eedback C	onversion
Homing Hookup Tur	ne Dynamics	Gains	Output	Limits	Offset	Fault Actions	Tag
Maximum Speed:	70.833336	Position Ur	nits/s			Manual Ac	ljust
Maximum Acceleration:	14025.113	Position Ur	nits/s^2				
Maximum Deceleration:	14025.113	Position Ur	nits/s^2				
Maximum Acceleration Jerk:	2776994.8	Position Ur	nits/s^3	= 100%	of Max A	ccel Time Cal	lculate
Maximum Deceleration Jerk:	2776994.8	Position Ur	nits/s^3	= 100%	of Max D	ecel Time Cal	culate

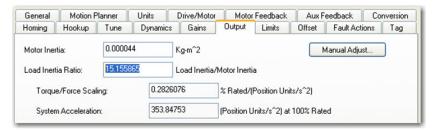
9. Refer to Compensate for High Frequency Resonances on page 249, to tune-out resonant frequencies.

Auto-tune Gain Settings

This procedure explains how to configure the load observer feature after running Auto-tune. This method also works for any existing set of gains where the Load Inertia Ratio is known or manually calculated, for example, when the Load Inertia Ratio > 0.

- **TIP** Try the out-of-box method before executing Auto-tune. Refer to Out-of-Box Gain Settings on page 240.
- 1. Click the Tune tab in the Axis Properties dialog box and perform Autotune.

For variable inertia loads, perform Auto-tune at the point of lowest mechanical inertia. If you manually calculate the Load Inertia Ratio, use the minimum load inertia. 2. Click the Output tab in the Axis Properties dialog box and verify that the Load Inertia Ratio > 0.



3. Click the Gains tab in the Axis Properties dialog box.

The current Position and Velocity gain values are used to recalculate other gain values.

General M	otion Planner	Units	Drive/Motor	Motor Fe	edback	Aux F	eedback	Cor	nversion
loming Hoo	kup Tune	Dynamics	Gains*	Output	Limits	Offset	Fault Act	ions	Tag
Position Gains			n in the second s			h	Manual Adju	ict.	
Proportional:	151.99413	1/s					ranua Muju	194	
Integral:	5.7756	1/ms-s				Se	t Custom Ga	ains	J
Velocity Gains			J D CE6	edforward G	ains				
Proportional:	389.105	1/s		Velocity:	100		%		
Proportional:							-		

- 4. Determine if the mechanical load connected to the motor is rigid or compliant.
 - Rigid systems typically involve high-performance load mechanics that are tightly coupled directly to the motor shaft and there is no lost motion.

Refer to Rigid Mechanical Loads on page 243, for rigid applications.

• Everything else is compliant, including systems with belts and pulleys, long shafts, short shafts with heavy loads, and couplings and gearboxes with backlash and/or lost motion.

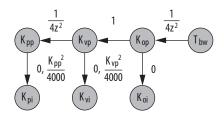
Refer to Compliant Mechanical Loads on <u>page 244</u>, for compliant applications.

Rigid Mechanical Loads

Follow these steps if the load is rigid.

1. Calculate the Load Observer Bandwidth.

Load Observer Bandwidth: Kop = Velocity Proportional Gain



- 2. Configure these IDN parameter values.
 - a. IDN P-431 = 2 (Load Observer with Velocity Estimate)
 - b. IDN P-432 = Kop
 - c. IDN P-433 = 0
 - d. IDN P-065 = 1

File Edit Explore Actions Help	.	* & Ø		
E Devices	S N:P.P#	Name	Value	Units
- Node 1: - 2094D SERVO	1:0.930	Reserved	0	
= 0 - 2094D SERVO Config 0000	1:0.931	Load Obs Config	With Vel Est	
Parameter List	1:0.932	Load Obs Bw	389	rd/s
TANA	1:0.933	Load Obs Int Bw	0	rd/s

 If the Low-pass Output Filter is enabled, verify that the Low-pass Output Filter Bandwidth is ≥ the Velocity Proportional Gain x 2/(2pi).

Sercos IDN P-065 has an impact on how the Low-pass Output Filter functions. Refer to Torque Low-pass Filter Bandwidth on page 239 for more information.

4. Refer to Compensate for High Frequency Resonances on page 249, to tune-out resonant frequencies.

Compliant Mechanical Loads

The compliant setting reduces all of the gains by a factor of (Load Inertia Ratio +1) and then calculates the Load Observer Bandwidth. Typically, this reduction is too conservative, making the loop response sluggish and the error too large. However, it does assure stability.

Follow these steps if the load is compliant.

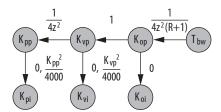
- 1. Make the following calculations to de-tune all gains by a factor of the (Load Inertia Ratio + 1):
 - a. Position Loop Bandwidth: Kpp = Position Proportional Gain/(Load Inertia Ratio + 1)
 - b. Position Integral Bandwidth:

Kpi = Position Integral Gain/(Load Inertia Ratio + 1)²

- c. Velocity Loop Bandwidth: Kvp = Velocity Proportional Gain/(Load Inertia Ratio + 1)
- d. Velocity Integral Bandwidth:

Kvi = Velocity Integral Gain/(Load Inertia Ratio + 1)²

e. Load Observer Bandwidth: Kop = Kvp



- 2. Configure these settings and values on the Gains tab.
 - a. Set the Position Proportional Gain = Kpp
 - b. Position Integral gain = Kpi
 - c. Velocity Proportional Gain = Kvp
 - d. Velocity Integral Gain = Kvi

General	Motion F	Planner	Units	Drive/Motor	Motor Fe	edback	Aux Fe	eedback	Cor	nversion
Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Ac	tions	Tag
Position G Proportio	nal: 9.40		1/s					lanual Adju : Custom G) 1
Integral:	0.02	21	1/ms-s							,
Velocity G	ains			- F	eedforward G	ains				
Proportio	nal: 22.0	844	1/s		Velocity:	100.0		%		
Integral:	0.0		1/ms-s		Acceleration	0.0		%		

To manually increase the gains by some factor to optimize the response, refer to Manual Tuning for Further Optimization on page 246.

- 3. Configure these IDN parameter values.
 - a. IDN P-431 = 2 (Load Observer with Velocity Estimate)
 - b. IDN P-432 = Kop
 - c. IDN P-433 = 0
 - d. IDN P-065 = 1

File Edit Explore Actions Help	P	a	* 8 0		22.0
Devices	S	N:P.P#	Name	Value	Units
- Node 1: - 2094D SERVO		1:0.930	Reserved	0	
= 0 - 2094D SERVO Config 0000		1:0.931	Load Obs Config	With Vel Est	
Parameter List		1:0.932	Load Obs Bw	389	rd/s
TO TAMA		1:0.933	Load Obs Int Bw	0	rd/s

 If the Low-pass Output Filter is enabled, verify that the Low-pass Output Filter Bandwidth ≥ Velocity Proportional Gain x 5/(2pi).

Sercos IDN P-065 has an impact on how the Low-pass Output Filter functions. Refer to Torque Low-pass Filter Bandwidth on page 239 for more information.

5. Refer to Compensate for High Frequency Resonances on page 249, to tune-out resonant frequencies.

Tuning Mode Summary

This table summarizes the primary difference between the two tuning modes.

Table 131 - Tuning Mode Comparison

Tuning Mode	Description
Out-of-box or unknown load Load Inertia Ratio = 0	Load Observer Bandwidth Kop = 4 times the new Velocity Proportional Gain, Kvp
Auto-tuning or known load Load Inertia Ratio > 0	Load Observer Bandwidth = Velocity Proportional Gain

Manual Tuning for Further Optimization

The out-of-box and auto-tune rigid methods achieve relatively high performance. However, the manual tuning method can help to optimize performance for the auto-tune compliant method, or if every ounce of performance is required. It involves incrementally increasing controller gains to the point of marginal stability, then backing them off by a given percentage. Typical ranges for various gains are also given to provide guidelines.

Follow these steps to manually tune your drive.

- 1. Select a factor (N) that you can incrementally increase the gains by in an iterative process, for example, 1.5>N>2.
- 2. Create a trend to monitor Torque Reference.
- 3. Manually tune the velocity loop.
 - a. Make note of the Position and Feedforward Gains.

You must change them temporarily to isolate the velocity loop and later restore them to the original values.

- b. Isolate the velocity loop.
 - Zero out the Position Proportional Gain, Position Integral Gain, and Acceleration Feedforward Gain
 - Set the Velocity Feedforward = 100
- c. While Jogging the axis and monitoring the Torque Reference trend, incrementally increase the following gains simultaneously and stop when the Torque Reference begins to become oscillatory or unstable:
 - Low-pass Output Filter Bandwidth = Low-pass Output Filter Bandwidth x N
 - Load Observer Proportional Gain = Load Observer Proportional Gain x N
 - Load Observer Integral Gain = Load Observer Integral Gain x N
 - Velocity Proportional Gain = Velocity Proportional Gain x N
 - Velocity Integral Gain = Velocity Integral Gain $x N^2$

- d. Decrease the gains by using the previous equations with N = 0.5. A typical range of values for various integral gains are given:
 - 0 ≤ Load Observer Integral Gain ≤ Load Observer Proportional Gain/4
 - $0 \le$ Velocity Integral Gain \le Velocity Proportional Gain²/4000
- e. If the Low-pass Output Filter is enabled, a typical range of values for the Low-pass Output Filter Bandwidth are given:
 - Rigid: Low-pass Output Filter Bandwidth ≥ Velocity Proportional Gain x 2/(2pi)
 - Compliant: Low-pass Output Filter Bandwidth ≥ Velocity Proportional Gain x 5/(2pi)
- 4. Manually tune the position loop.
 - a. Restore the Position and Feedforward Gains to the original values to re-enable the position loop.
 - b. While Jogging the axis and monitoring the Torque Reference trend, incrementally increase the following gains simultaneously and stop when the Torque Reference begins to become oscillatory or unstable:
 - Position Proportional Gain = Position Proportional Gain x N
 - Position Integral Gain = Position Integral Gain $x N^2$
 - c. Decrease the gains by using the previous equations with an N = 0.5. A typical range of values for the Position Integral Gain is given:
 - $0 \le Position Integral Gain \le Position Proportional Gain^2/4000$

Set Gains with Sercos IDN Write Messages

Write the Load Observer Configuration attribute and the Load Observer gains each time the drive gets initialized after applying power.

The Sercos IDN write instruction is accomplished by using RSLogix 5000[°] software or the Logix Designer application. Refer to Appendix E on <u>page 251</u> for more information on changing IDN parameter values by using this method.

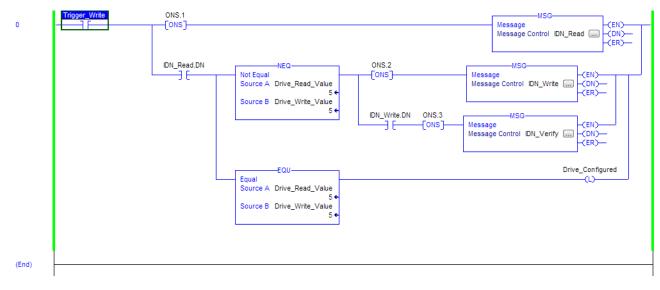
1. Upon initialization of the drive, read the INT value of the configuration of the drive at Sercos IDN P:0:431.

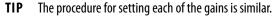
Configuration*	Communication Ta	ag			
Message Type	SERCOS	DN Read		•	
Service Type:	Data		Destin	ation: Drive_Read_Val	ue 🗸
Identification Number:	P • 0	- 431		New Tag	
Element:	7:Operation Value		•		
Data Type:	INT		•		
) Enable ()	Enable Waiting) Start	O Done	Done Length: 0	
) Error Code: Error Path: Error Text:	Extende	ed Erro <mark>r C</mark> ode:		🔲 Timed Out 🗲	

2. If the value is not what you want, latch it and write the new value back to the drive at the same address, again as type INT.

Configuration (Communication Ta	ag			
Message Type	SERCOS	IDN Write		•	
Service Type: Identification Number:	Data P • 0	43	Souri Souri	ce 2	
Element:	7:Operation Valu	e	•]	New Tag	
Data Type:	INT		•		
) Enable C	Enable Waiting	() Start	O Done	Done Length:	0
) Error Code: Error Path: Error Text:	Extend	led Error Code:		Timed Out	+

3. Verify the change with another Sercos IDN Read Message from IDN P:0:431.





Compensate for High Frequency Resonances

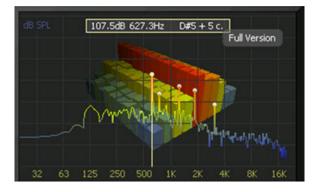
Approximately 15% of all motion applications exhibit a high-frequency resonance that is apparent by an audible high-frequency squealing of the load mechanics.

Follow these steps to identify and reduce the presence of high-frequency resonances.

- 1. Perform the following move sequence by using Motion Direct Commands:
 - a. Enable the axis with an MSO
 - b. Slowly jog the axis with an MAJ
 - c. Stop the axis with an MAS
 - d. Disable the axis with a MSO

IMPORTANT Sometimes an audible resonance is heard before the axis is jogged, making the MAJ and MAS unnecessary.

- 2. Determine if an audible high-frequency resonance exists in your motion application.
 - If an audible high frequency resonance is not present during the move sequence, skip the remaining steps and tuning is complete.
 - If an audible high frequency resonance is present during the move sequence, use an FFT smart phone or tablet application to identify the dominant resonant frequencies.



3. Click the Output tab in the Axis Properties dialog box.

General	Motion F	Planner	Units	Drive/Motor	Motor	Feedback	Aux F	eedback Co	onversion
Homing	Hookup	Tune	Dynamics	Gains*	Output*	Limits	Offset	Fault Actions	Tag
Motor Ine	rtia:	0.00004	4	Kg∙m^2			1	fanual Adjust	
Load Iner	tia Ratio:	0.0		Load Inertia/	Motor Inerti	a			
Torque/Force Scaling:		0.0174	749257 % Rated/(Po		Position Un	its/s^2)			
System Acceleration:		5716.7	5716.713		(Position Units/s^2) at 100% Rated				
🗹 Enable	e Notch Filter	Frequency							
Notch Filter Frequency:		627.3		Hertz					
Enable	e Low-pass O	lutput Filter							
Low-p	ass Output F	ilter Bandwi	dth: 0.0		Hertz				

- a. Check Enable Notch Filter Frequency and set the Notch Filter Frequency to the resonant frequency with the largest amplitude.
- b. If multiple resonances have nearly the same amplitude, set the Notch Filter Frequency to the lowest resonant frequency.
- c. If the problem persists, also check Enable Low-pass Output Filter and set the Low-pass Output Filter Frequency to the next largest resonant frequency.
- d. Click OK.

Change Default IDN Parameter Values

This appendix provides a procedure, specific to the Kinetix[®] 6000 (Sercos) drive systems, for changing IDN parameter values to non-default values when your application does not match the default configuration. The procedure also applies when one or more Kinetix 6000M IDM systems are present.

Торіс	Page
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Change IDN Parameter Values	252

Before You Begin

The Logix 5000[™] processor contains a motion planner that sends real-time and non real-time data to the drive. This drive communication is performed via a set of Sercos interface telegrams. Each telegram has an identification or Ident (IDN) number. All parametric data, such as scaling and loop gains, and realtime loop closure information is configured this way.

Table 132 - IDN Instruction Format in the IEC Standard Document

	Name							
IDN Number	Function/De	n/Description						
	Length in bytes	Minimum input value/ Maximum input value	Scaling/resolution	Units				

There are default parameters in the Logix 5000-to-Kinetix 6000 drive product structure you can reconfigure when the default configuration does not match the Integrated Architecture[™] machine configuration.

By using this procedure, you can change the Additional Bus Capacitance value in common-bus configurations.

TIP You can also set the Additional Bus Capacitance parameter by using DriveExplorer[™] software (refer to <u>Appendix C</u>), the Logix Designer application, or RSLogix 5000[®] software, version 20.00 or later, from I/O configuration>Sercos module>Drive module properties>Power tab (refer to <u>Chapter 6</u>). Use this flowchart to determine if changing your default configuration is required.

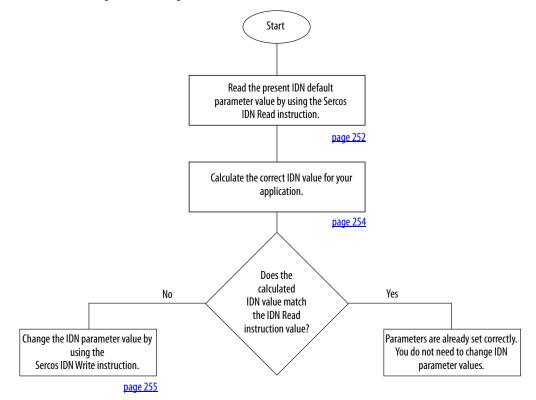


Figure 119 - Configuration Flowchart

Change IDN Parameter Values

In this section you follow the Configuration Flowchart on <u>page 252</u> to determine if you need to use the Sercos IDN Write instruction in the Logix Designer application to change the IDN parameter values.

Read the Present IDN Parameter Value

Follow these steps to read the present IDN value.

- 1. Start your Logix Designer application program.
- 2. Configure a Message Configuration (MSG) instruction to read your present IDN parameter values.

In this example, the Message Configuration (MSG) instruction is set to read the additional bus capacitance of your leader IAM power module.

Message Config	juration - Read_	Add_Bus_Cap			X
Configuration	Communication	[ag]			
Message Type	E SERCOS	IDN Read		•	
Service Type: Identification Number: Element: Data Type:	Data P V ··· 0 7:0peration Value INT	<u>.</u> 99	Dest	ination: Present_Ad	dd_Bus_Ci ♥
O Frankla - O		0.0-4	() D	Davalanath	
 Enable Error Code: Error Path: Error Text: 	· -··	 Start led Error Code: 	🔾 Done	Done Length: I	
		OK	Cancel	Apply	Help

- a. From the Message Type pull-down menu, choose Sercos IDN Read.
- b. From the Identification Number pull-down menus, choose P-0-99.
- 3. Click New Tag.
- 4. The New Tag dialog box opens.

New Tag			×
Name:	Read_Value		ОК
Description:		~	Cancel
			Help
		~	
Usage:	<pre>cnormal></pre>	<u></u>	
Туре:	Base Conne	ction	
Alias For:		~	
Data Type:	INT		
Scope:	K6K_Compatibility	•	
Style:	Decimal	•	
🗖 Open Cor	figuration		

5. Type the name of your Destination tag.

In this example, the tag name is Read_Value.

6. Click OK.

In this example, the MSG instruction reads the P-0-99 IDN value and places it in the destination as specified by the new tag.

7. Click the Communication tab.

8. Click Browse.

Message Configuration	
Configuration Communi	cation Tag
Path: BC02	Browse
BC02	Message Path Browser
Communication Meth	Path: BC02 BC02
Connected	□- I/0 Configuration □- I756 Backplane, 1756-A7 □- I0 [0] 1756-L63 Test_for_IDN_Bus_Capacitance_and_Aux □- II [1] 1756-M085E SERCOS □- SERCOS Network □- IS 2094-BC02-M02 BC02
 Error Code: Error Path: Error Text: 	×
	OK Cancel Help

- 9. Select the Bulletin 2094 module to read the MSG instruction.
- 10. Click OK.

Calculate the New IDN Value

Changing the additional bus capacitance value requires calculations. Determine the sum of all capacitance values for the follower IAM module, each AM module, and each IPIM module on the follower IAM power rail.

Refer to Calculate Additional Bus Capacitance on <u>page 227</u> for more information.

Write the New IDN Parameter Value

Follow these steps to write the new IDN parameter value.

1. Configure a Message Configuration (MSG) instruction to write the IDN parameter value required for your application.

In this example, the Message Configuration (MSG) instruction is set to write the additional bus capacitance of your leader IAM power module.

Message Config	uration - Change	e_Add_Bus_C	ap_Value		×
Configuration (Communication 1	ag			
Message Type	SERCOS	IDN Write		-	
Service	Data		 Source 	: New_Bus_Ca	ap_Value ↓
Type: Identification Number:	P • ··· 0	<u>→</u> 99	Source		(Bytes)
Element:	7:Operation Value	•	•	New Tag	
Data Type:	INT		•		
🔾 Enable 🔾	Enable Waiting	🔾 Start	🔾 Done	Done Length: 0	
O Error Code:	Extend	ed Error Code:		🔲 Timed Out 🗲	
Error Path: Error Text:					
		OK	Cancel	Apply	Help

- a. From the Message Type pull-down menu, choose Sercos IDN Write.
- b. From the Identification Number pull-down menus, choose P-0-99.
- 2. Click New Tag.
- 3. The New Tag dialog box opens.

New Tag			×
Name:	Write_Value		ОК
Description:		~	Cancel
	1000 C		Help
		~	
Usage:	<normal></normal>	~	
Туре:	Base Cor	nection	
Alias For:		-	
Data Type:	INT		
Scope:	🔁 K6K_Compatibility	•	
Style:	Decimal	-	
📕 Open Con	figuration		

4. Type the name of your Source tag.

In this example, the tag name is Write_Value.

5. Click OK.

In this example, the new tag creates a source value (that you entered) that the MSG instruction uses to overwrite the existing P-0-099 IDN value.

6. Click the Communication tab.

The Communication tab opens.

Message Configuration	- Read_Add_Bus_Cap	×
Configuration Communi	cation Tag	
Path: BC02 BC02	Browse	
Communication Meth	Message Path Browser	픠
CIP ODH+	Path: BC02	
CIP With	BC02	
Source ID	E- 🔄 I/O Configuration	
Connected		<
O Error Code:		
Error Path: Error Text:	· · · · · · · · · · · · · · · · · · ·	
		1
	OK Cancel Help	

- 7. Click Browse.
- 8. Select your Bulletin 2094 module.
- 9. Click OK.

The MSG instruction writes the new IDN value to your drive.

- **TIP** To verify your Sercos IDN Write instruction was successful, you can perform another Sercos IDN Read instruction for the IDN in question.
- 10. Click OK to close the Message Configuration dialog box.

Enhanced Peak Performance

This appendix provides procedures and information, specific to Kinetix[®] 6000 drive systems, for enabling the peak enhancement feature in each drive.

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Before You Begin

The peak current ratings of the Kinetix 6000 460V drives (series A, B, C, and D) are configured at the factory as 150% of continuous current. However, you can program 460V (series B, C, and D) AM modules and the equivalent IAM (inverter) modules, for up to 250% of continuous inverter current.

To achieve the enhanced peak performance, you must determine the values of maximum acceleration, deceleration, and torque. This feature is present only in the Kinetix 6000 (series B, C, and D) drives listed in <u>Table 133</u>.

Table 1	33 -	Kinetix	6000	Series	Change
---------	------	---------	------	--------	--------

IAM Module	AM Module	Peak Current Rating					
Cat. No.	Cat. No.	Series A (inverter)	Series B, C, and D (inverter)				
2094-BC01-MP5-S	2094-BMP5-S	150%	250%				
2094-BC01-M01-S	2094-BM01-S	150%	250%				
2094-BC02-M02-S	2094-BM02-S	150%	250%				
2094-BC04-M03-S	2094-BM03-S	150%	250%				
2094-BC07-M05-S	2094-BM05-S	150%	200%				

The default values that populate the AXIS_SERVO_DRIVE properties in the Logix Designer application are calculated for each motor and drive, but assume 150% peak torque in those calculations. For the drive to command more current, you must enter new values for some of those parameters, including the following:

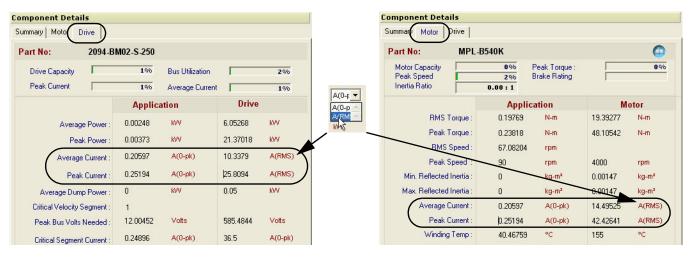
- TorqueLimitBipolar
- TorqueLimitPositive
- TorqueLimitNegative
- MaximumAcceleration
- MaximumDeceleration
- AccelerationLimitBipolar
- AccelerationLimitPositive
- AccelerationLimitNegative

You can access these parameters offline in the Logix Designer application Axis Properties tabs or online as sent to the drive in an SSV instruction.

To calculate the new values, you also need to determine these values:

- Drive electrical data (Motion Analyzer solution page, under Drive tab)
- Motor electrical data (Motion Analyzer solution page, under Motor tab)
- TorqueScaling (the Logix Designer application, Axis Properties, Output tab)

Figure 120 - Drive and Motor Data in Motion Analyzer Software



IMPORTANT

IT The default unit in Motion Analyzer software for drive and motor current is A (0-pk). Because the example formula is in A (RMS), you must change the units in the Drive and Motor tabs to A (RMS).

Pause your mouse over A (0-pk) and use the pull-down menu to change the units to A (RMS). Refer to Figure 120 for an example.

Enhanced Peak Example

Defaul

In this example, the following motor and drive combination is used:

- Drive = 2094-BC02-M02-S
- Motor = MPL-B540K

Table 134 - Example Definitions

Description	Symbol	IDN	Example
Motor continuous current (A _{rms})	I _{mtr, cont}	S:0:0111	14.49525
Motor peak current (A _{rms})	I _{mtr, pk}	S:0:0109	42.42641
Drive continuous current (A _{rms})	I _{dr, cont}	S:0:0112	10.3379
Drive peak current (A)		S:0:0110	150%: 15.5069
Drive peak current (A _{rms})	^I dr, pk	5.0.0110	250%: 25.8094

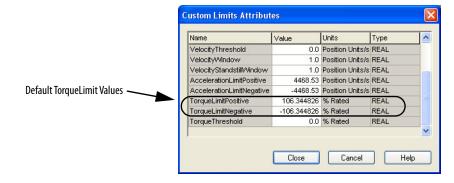
Figure 121 - Example Torque Formula

$$\text{Torque}_{\text{max}} = \frac{\min(I_{\text{mtr, pk}}, I_{\text{dr, pk}})}{I_{\text{mtr, cont}}} = \frac{\min(42.4 \text{ A}_{\text{rms}}, 25.8 \text{ A}_{\text{rms}})}{14.5 \text{ A}_{\text{rms}}} = 178.1\%$$

1. Navigate to Axis Properties and click the Limits tab.

	General Motion Planner	Units D	rive/Motor Motor	Feedback	Aux Feedbac	k Conversio
	Homing Hookup Tune	Dynamics	Gains Output	Limits	Offset Fault	Actions Tag
	Hard Travel Limits				Manual A	Adjust
	Soft Travel Limits				Set Custor	m Limits
	Maximum Positive:	0.0	Position Units			
	Maximum Negative:	0.0	Position Units			
	Position Error Tolerance:	0.87722665	Position Units			
Torque Limit Value —	Position Lock Tolerance:	0.01	Position Units			
	Peak Torque/Force Limit:	106.344826	% Rated			
	Continuous Torque/Force Limit:	100.0	% Rated			

- 2. Overwrite the existing Peak Torque Limit (TorqueLimitBipolar) value. In this example, the calculated value is 178.1.
- 3. Click Set Custom Limits.



4. Overwrite the existing TorqueLimitPositive and TorqueLimitNegative values.

In this example, the calculated values are 178.1 and -178.1 (respectively).

The calculated value for Torque_{max} is the maximum value for the following:

- TorqueLimitBipolar
- TorqueLimitPositive (+)
- TorqueLimitNegative (-)

If you want to limit the torque, adjust the calculated values to a value closer to zero. The values shown are the default values for 150% peak torque with this motor and drive pair.

- **TIP** For more information on system configuration with your Logix 5000 controller and the Logix Designer application, refer to <u>page 133</u>.
- 5. Click the Output tab.

	🍄 Axis Prop	oerties - A	xis							
	General	Motion P		Jnits	Drive/Motor	A CONTRACTOR OF	Feedback			Conversion
Default LoadInertiaRatio Value 🔨	Homing Motor Inerti	Hookup a:	Tune 0.00147	Dynamics	Gains Kg-m^2	Output	Limits	Offset M.	Fault Action anual Adjust	
	Load Inertia	Ratio:	000		Load Inertia/	Motor Inerti				_
	Torque,	'Force Scali	ng:	0.0475	97233	% Rated/(Position Unit	s/s^2]		
Default TorqueScaling Value	System	Acceleratior	ı:	2100.9	1624	(Position L	Jnits/s^2) at	100% Rated	i	
	Enable 1	Notch Filter I	Frequency	14						
	NAMES OF TAXABLE	ilter Frequer	na nanana	0.0		Hertz				
	1010)	.ow-pass Ou	utput Filter ter Bandwidti	r 0.0		Hertz				
	Longo	o o mpon i n	tor banarnan	*		110ite				
					C	OK	Canc			Help

The TorqueScaling and LoadInertiaRatio values are populated after an autotune. If an autotune is not possible, model the system in Motion Analyzer software and enter that value for the LoadInertiaRatio. The default value for the LoadInertiaRatio is 0.0, however for this example, a ratio of 10.20:1 is used (load inertia = 0.015 Kg-m^2).

IMPORTANTTo obtain more accurate results, performing Autotune in the Logix
Designer application is recommended.

To calculate the maximum acceleration and deceleration from $\text{Torque}_{\text{max}}$, use this equation.

Accel_{max} = Torque_{max} •
$$\frac{100}{\text{TorqueScaling}}$$

TIP

If autotune cannot be performed, enter the data for the LoadInertiaRatio, DriveResolution, and ConversionConstant as shown in step 5 through step 9.

- 6. Change the Load Inertia Ratio value to 10.2.
- 7. Click Apply.

The TorqueScaling values update.

	🍄 Axis Pro	perties -	Axis							
	General	Motion F	lanner	Units	Drive/Motor	Motor	Feedback	Aux Fe	edback	Conversion
	Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Action	is Tag
Modified Load Inertia Ratio Value	Motor Iner	tia:	0.00147		Kg·m^2			М	anual Adjust	
	Load Inert	ia Ratio:	10.2		Load Inertia/N	dotor Inertia				
	Torque	e/Force Scal	ing:	0.5330	8904	% Rated/(F	Position Unit	:s/s^2]		
New TorqueScaling value	System	n Acceleratio	n:	187.58	592	(Position U	nits/s^2) at	100% Rate	ł	
used in this example.	🗌 Enable	Notch Filter	Frequency							
	Notch	Filter Freque	ncy:	0.0		Hertz				
	Enable	Low-pass O	utput Filter							
	Low-p	ass Output F	ilter Bandwidt	h: 0.0		Hertz				
	-					OK) [Canc	el	Apply	Help

8. Click the Drive/Motor tab.

	Homing Hookup	Tune Dynam	nics Gains	Output Limits	Offset Fault Act	ions Tag
	General Motion Pla	nner Units	Drive/Motor	Motor Feedback	Aux Feedback	Conversio
	Amplifier Catalog Number	2094-BC02-M02	2	×		
) a a luti an ualua	Motor Catalog Number:	MPL-B540K-M			Change Catalog	
Resolution value	Loop Configuration:	Position Servo		*		
in this example.	Drive Resolution:	200000	Drive Counts /	Motor Rev 💽	Calculate	
	Drive Enable Input Cl	necking				
	🗌 Drive Enable	e Input Fault				
	- Real Time Axis Informa	tion				
	Attribute 1:	<none></none>		~		
	Attribute 2:	<none></none>		~		

The values for DriveResolution and ConversionConstant start out populated with default values, but can be changed for your specific needs. If you plan to change those values, enter the new values into the dialog boxes. Otherwise, use the defaults.

9. Click the Conversion tab.

	🍄 Axis Pro	operties -	Axis							
	Homing	Hookup	Tune	Dynamics	Gains	Output	Limits	Offset	Fault Act	ions Tag
	General	Motion I	Planner	Units	Drive/Motor	Moto	r Feedback	Aux F	eedback	Conversion
ConversionConstant value used	Positionin		Linear		Drive Counts/1	0 Position	n Units	\ \		
	Conversio	n Constant:	200000.		Based on 2000)		
	Position U	nwind:	200000		Drive Counts/L Based on 2000		s/Motor Rev			
						OK	Canc	el	Apply	Help

Enhanced Peak Example Calculation

Based on the values shown, this is the sample calculation.

Accel_{max} = 1.781 •
$$\frac{100}{0.53308904} = 334.09 \text{ PU/s}^{-2}$$

To provide safe headroom, this value needs to be reduced by 15% before being written to the controller. This is the sample calculation.

MaximumAcceleration = MaximumDeceleration = $0.85 \cdot \text{Accel}_{\text{max}} = 283.98 \text{ PU/s}^2$

1. Click the Dynamics tab.

	🍄 Axis Pro	operties - Axis							
	General	Motion Planne	er Units	Drive/Motor	Motor	Feedback	Aux F	Feedback	Conversion
	Homing	Hookup Tu	ne Dynamics	S Gains	Output	Limits	Offset	Fault Action	s Tag
	Maximum	Speed:	56.666668	Position L	Inits/s			Manual	Adjust
Default Acceleration and Deceleration Values	Maximum	Acceleration:	1899.1252	Position L	Inits/s^2)			
	Maximum	Deceleration:	1899.1252	Position L	Inits/s^2)			
	Maximum	Acceleration Jerk:	63647.234	Position L	Jnits/s^3	= 100:	% of Max A		Calculate
	Maximum	Deceleration Jerk:	63647.234	Position L	Inits/s^3	= 100:	% of Max D	ecel Time	Calculate
					ОК	Cano	cel .	Apply (Help

2. Overwrite the existing Maximum Acceleration and Maximum Deceleration values.

In this example, the calculated values are 283.98 for each.

- **3.** Click Calculate for the Maximum Acceleration Jerk and Maximum Deceleration Jerk fields to automatically calculate new values.
- 4. Adjust the new jerk values for your specific application needs.

Setting the values for AccelerationLimitBipolar, AccelerationLimitPositive, and AccelerationLimitNegative requires one more calculation by using this formula.

AccelerationLimitBipolar = AccelerationLimitPositive = -AccelerationLimitNegative AccelerationLimitBipolar = $\frac{2 \cdot MaximumAcceleration}{0.85}$ = 668.18 PU/s²

5. Click the Limits tab.

- 6. Click Set Custom Limits. Custom Limits Attributes Name Value Units Туре Default AccelerationLimitBipolar Value VelocityLimitBipolar 33.333336 Position Units/s REA AccelerationLimitBipolar 8732.302 Position Units/s REAL /elocityLimitPositive 33.333336 Position Units/s REAL VelocityLimitNegative -33.333336 Position Units/s REAL VelocityThreshold 0.0 Position Units/s REAL 1.0 Position Units/s REAL VelocityWindow Default AccelerationLimitPositive and 1.0 Position Units/s REAL 8732.302 Position Units/s REAL VelocityStandstill/Vindow AccelerationLimitNegative Values AccelerationLimitPositive -8732.302 Position Units/s REAL AccelerationLimitNegative Close Cancel Help
 - 7. Overwrite the existing AccelerationLimitBipolar value.

In this example, the calculated value is 668.18.

8. Overwrite the existing AccelerationLimitPositive and AccelerationLimitNegative values.

In this example, the calculated values are +668.18 and -668.18 (respectively).

9. Repeat this process for each IAM and AM module in your system.

Change the Drive Parameter

Before the drive is capable of accepting a command for the new peak current ratings, you need to change a drive parameter. This needs to be done only once, and there are two methods to perform the task.

IMPORTANT The Sercos IDN method that uses the Logix Designer application supports automatic drive replacement (ADR).

Sercos IDN Write Instruction

The Sercos IDN write instruction is accomplished by using the Logix Designer application. Refer to <u>Appendix E</u> on <u>page 251</u> for more information on changing IDN parameter values by using this method.

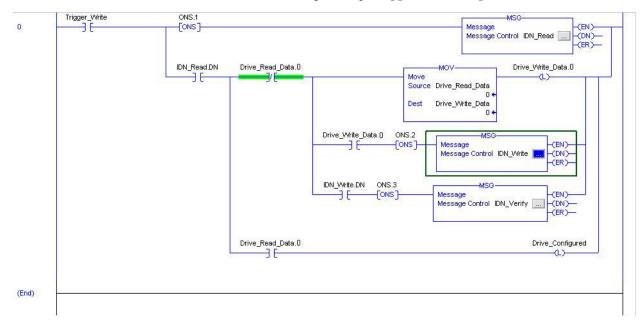
1. On initialization of the drive, read the INT value of the configuration of the drive at Sercos IDN P:0:7.

Configuration	Communication]	Tag		
Message Type	SERCOS	IDN Read	ļ.	-
Service Type: Identification Number:	Data P • · · 0	<u>*</u> 7	✓ Destina	ation: Drive_Read_Data 💌 New Tag
Element:	7:0peration Value	e	-	
Data Type:	INT		•	
🔾 Enable 🛛) Enable Waiting	Start	Done	Done Length: 0
 Enable Error Code: Error Path: Error Text: 	1999 - 1999 - 1999 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	Start led Error Code:	Done	Done Length: 0 └── Timed Out ←

2. If the value of bit zero is zero, latch it and write the new value back to the drive at the same address, again as type INT.

Configuration	Communication	ſag			
Message Type	e: SERCOS	IDN Write	ļ:	-	
Service Type:	Data		Source Source		
Identification Number:	P <u>▼</u> … 0	÷ 7	Length		(Bytes)
Element:	7:Operation Valu	e	•	New Tag	
Data Type:	INT		•		
) Enable () Enable Waiting	Start	Done	Done Length: 0	
Enable Error Code: Error Path: Error Text:		Start Error Code:	Done	Done Length: 0 └── Timed Out ←	

3. Verify change with another Sercos IDN Read Message from IDN P:0:7 and examine bit zero.



Refer to this Logix Designer application example.

DriveExplorer Software

To use DriveExplorer[™] software to change IDN parameter values, you must also have the 1203-SSS Serial to SCANport[™] adapter. Refer to <u>Appendix C</u> on <u>page 225</u> for more information on changing IDN parameter values by using this method.

- 1. Connect a 1203-SSS Serial to SCANport adapter to the drive by using DriveExplorer software.
- 2. Change parameter P507 [Drv Peak Rating] from 150% to 250% (or 200% if applicable).
- 3. Save device values to nonvolatile memory.

Notes:

RBM Module Interconnect Diagrams

This appendix provides Bulletin 2090 Resistive Brake Module (RBM) interconnect diagrams specific to Kinetix[®] 6000 multi-axis servo-drive systems with and without the safe torque-off feature.

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Kinetix 6000 drives with the safe torque-off feature have the -S designation at the end of the catalog number. For example, the 2094-AM01-S AM module includes safe torque-off and the 2094-AM01 AM module does not.

Before You Begin

These procedures assume you have installed your RBM module with the Kinetix 6000 servo-drive system. For RBM module installation instructions, refer to the Resistive Brake Module Installation Instructions, publication 2090-IN009.

IMPORTANT Drive firmware revision 1.071 or later is required to use the RBM module with Kinetix 6000 drives.



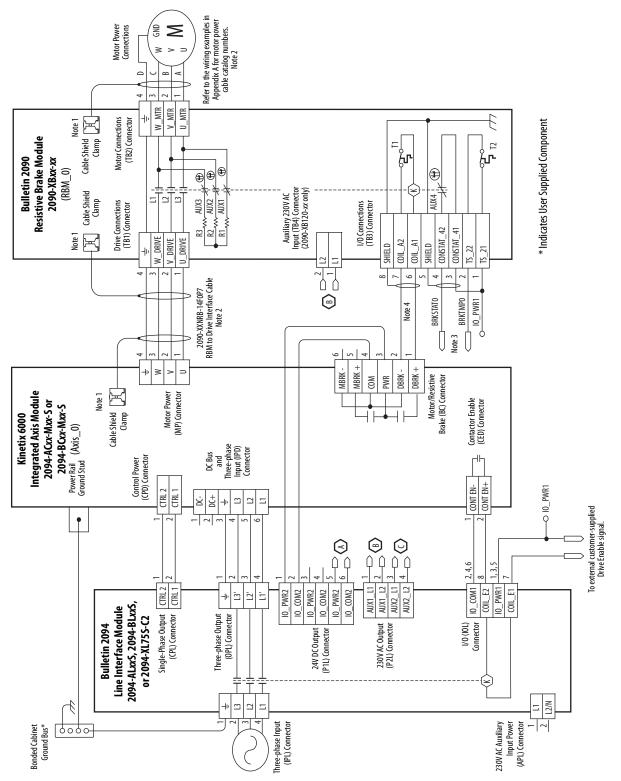
ATTENTION: Use the interconnection diagrams as a general recommendation of how the control circuit can be implemented. Actual applications can vary due to requirements based on the machine builders risk assessment. The machine builder must perform a risk assessment and determine a category level of safety that must be applied to the machine.

For Kinetix 6000 drive systems, you can set the delay time for your RBM module in the Logix Designer application. Refer to Configure Axis Properties on page 149.

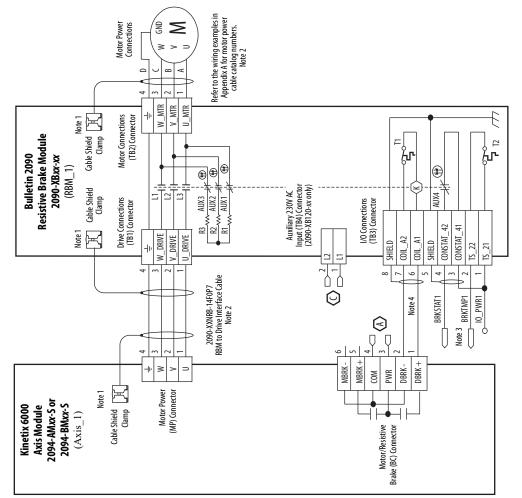
RBM Module Wiring Examples

This example diagram shows 2094-*x*C*xx*-M*xx*-S and 2094-*x*M*xx*-S drives (with safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module.





RBM Wiring Example (continued)



-	codes is the responsibility of the machine builder. Information Gable shield clamp must be used to meet CE requirements. No external connection to ground required. For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication, <u>KNX-TDDO4</u> . The BRKTMPO signal can be wired to a ControlLogix [®] input as overtemp warning in user program. Firmware revision 1.071 or later is required to use the DBRK outputs on the Kinetix 6200 and Kinetix 6500 IAM or AM module. Set the safety relay time delay beyond the time required to stop and disable the axis when running at full speed. Drive Enable Input Checking must be selected when configuring Axis Properties in the Logix Designer application.		ATTENTION: The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these
	or motor cable specifications, refer to the Kinetix Motion Accessories echnical Data, publication <u>KNX-TD004</u> . he BRKTMPO signal can be wired to a ControlLogix [®] input as overtemp raming in user program. rmware revision 1.071 or later is required to use the DBRK outputs on the inetix 6200 and Kinetix 6500 IAM or AM module. et the safety relay time delay beyond the time required to stop and disable he axis when running at full speed. rive Enable Input Checking must be selected when configuring Axis roperties in the Logix Designer application.	able sh onnect	ield clamp must be used to meet CE requirements. No external ion to ground required.
able shield clamp must be used to meet CE requirements. No external onnection to ground required.	he BRKTMPO signal can be wired to a ControlLogix [®] input as overtemp carning in user program. rmware revision 1.071 or later is required to use the DBRK outputs on the inetix 6200 and Kinetix 6500 IAM or AM module. et the safety relay time delay beyond the time required to stop and disable te axis when running at full speed. rive Enable Input Checking must be selected when configuring Axis roperties in the Logix Designer application.	or moto echnica	or cable specifications, refer to the Kinetix Motion Accessories al Data, publication <u>KNX-TD004</u> .
Cable shield clamp must be used to meet CE requirements. No external connection to ground required. For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data , publication <u>KINX-1D004</u> .	rmware revision 1.071 or later is required to use the DBRK outputs on the inetix 6200 and Kinetix 6500 IAM or AM module. Et the safety relay time delay beyond the time required to stop and disable is axis when running at full speed. rive Enable Input Checking must be selected when configuring Axis roperties in the Logix Designer application.	he BRK /arning	TMPO signal can be wired to a ControlLogix [®] input as overtemp j in user program.
Cable shield clamp must be used to meet CE requirements. No external connection to ground required. For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>KNX-TD004</u> . The BRKTMP0 signal can be wired to a ControlLogix [®] input as overtemp warning in user program.	et the safety relay time delay beyond the time required to stop and disable the axis when running at full speed. Trive Enable Input Checking must be selected when configuring Axis roperties in the Logix Designer application.	irmwar inetix 6	e revision 1.071 or later is required to use the DBRK outputs on the 5200 and Kinetix 6500 IAM or AM module.
Cable shield clamp must be used to meet CE requirements. No external connection to ground required. For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>KNX-TD004</u> . The BRKTMP0 signal can be wired to a ControlLogix [®] input as overtemp warning in user program. Firmware revision 1.071 or later is required to use the DBRK outputs on the Kinetix 6200 and Kinetix 6500 IAM or AM module.	rive Enable Input Checking must be selected when configuring Axis roperties in the Logix Designer application.	et the s	safety relay time delay beyond the time required to stop and disable when running at full speed.
Cable shield clamp must be used to meet CE requirements. No external connection to ground required. For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication <u>KNX-TD004</u> . The BRKTMPO signal can be wired to a ControlLogix [®] input as overtemp warning in user program. Firmware revision 1.071 or later is required to use the DBRK outputs on the Kinetix 6200 and Kinetix 6500 IAM or AM module. Set the safety relay time delay beyond the time required to stop and disable the axis when running at full speed.		rive En roperti	able Input Checking must be selected when configuring Axis ies in the Logix Designer application.

* Indicates User Supplied Component

Note

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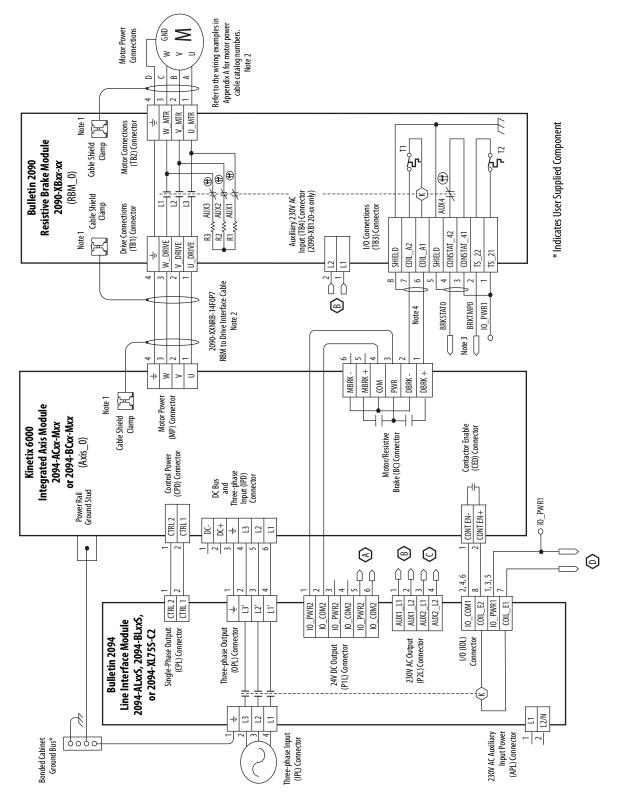
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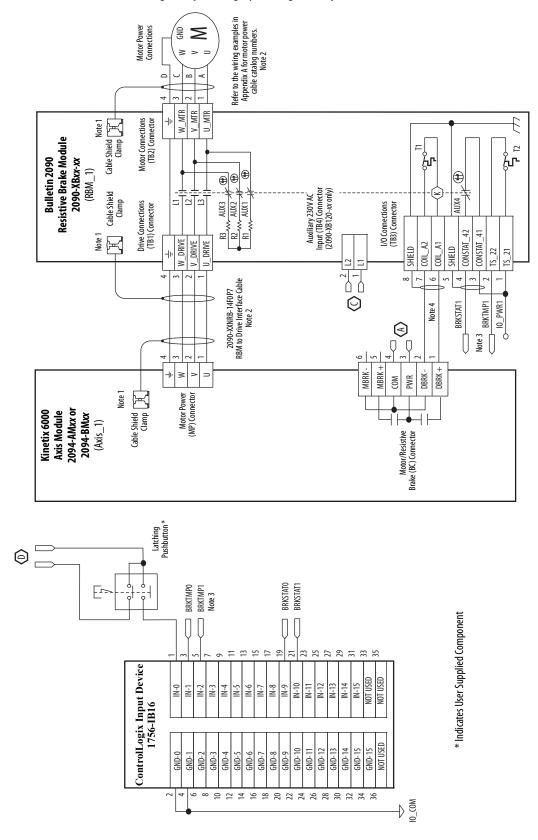
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This example diagram shows 2094-*x*C*xx*-M*xx* and 2094-*x*M*xx* drives (without safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module.



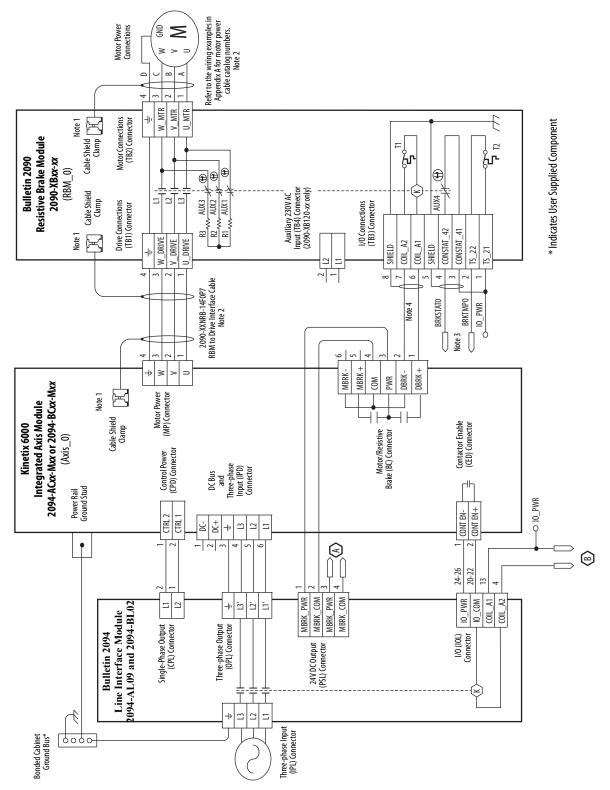


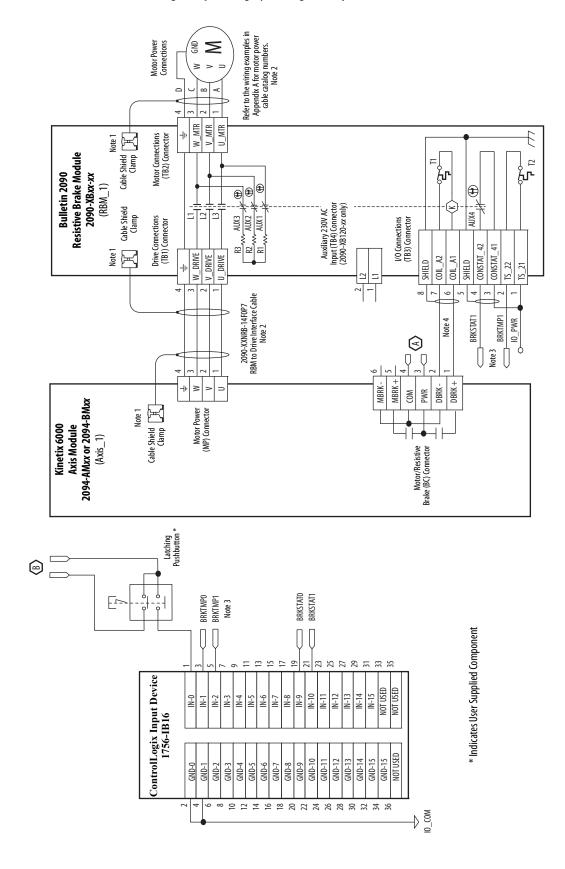


RBM Wiring Example, Category 2 Configuration per ISO 13849 (continued)

This example diagram shows 2094-*x*C*xx*-M*xx* and 2094-*x*M*xx* drives (without safe torque-off) and 2094-AL09 and 2094-BL02 LIM modules wired with the Bulletin 2090 RBM module.



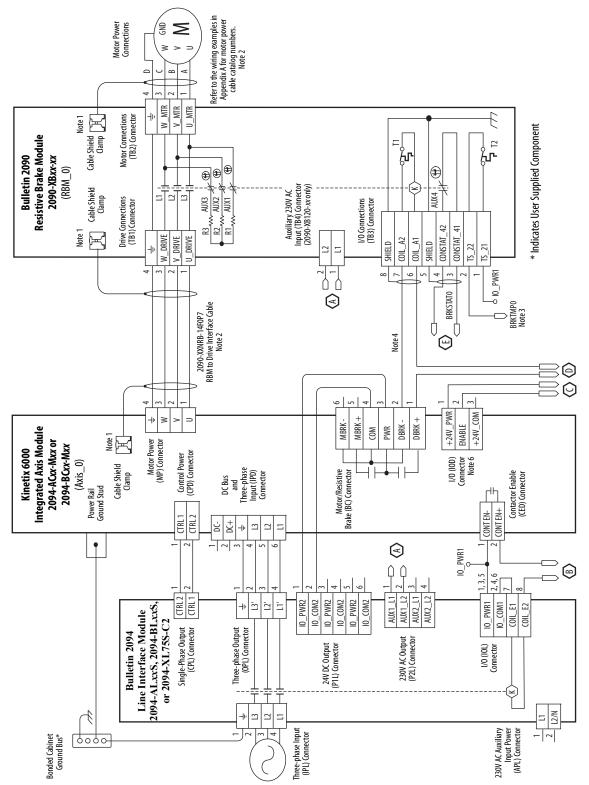


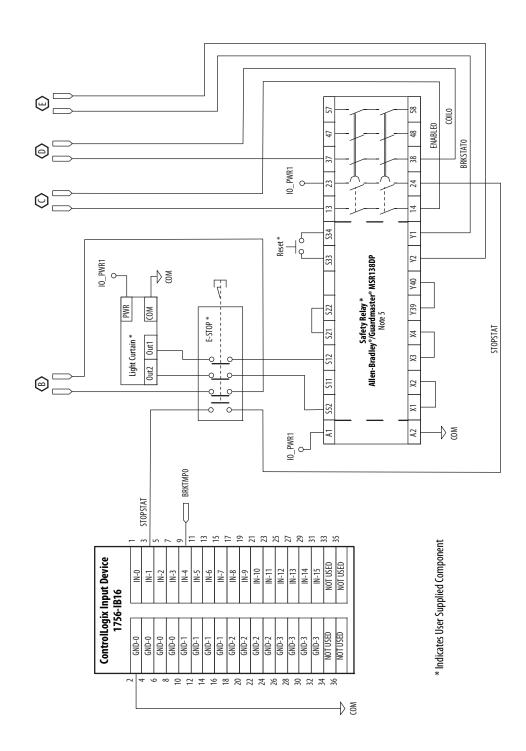


RBM Wiring Example, Category 2 Configuration per ISO 13849 (continued)

This example diagram shows 2094-*x*C*xx*-M*xx* drives (without safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module. The example continues on page 275.



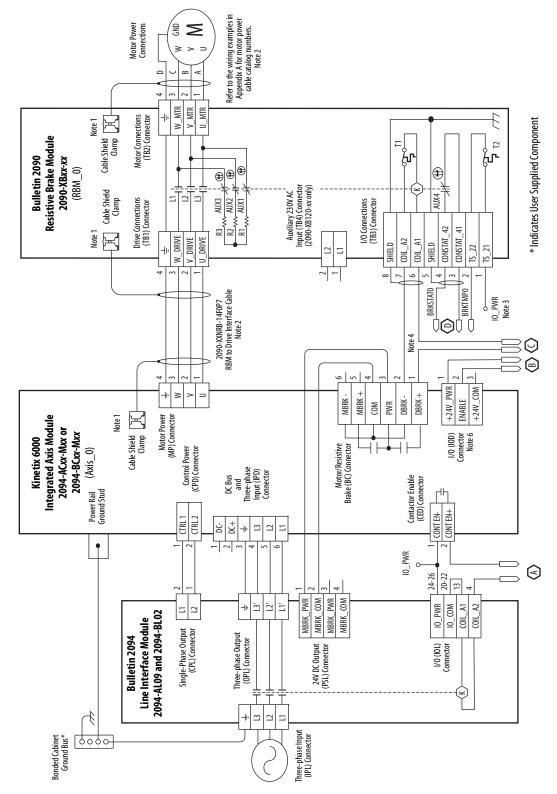


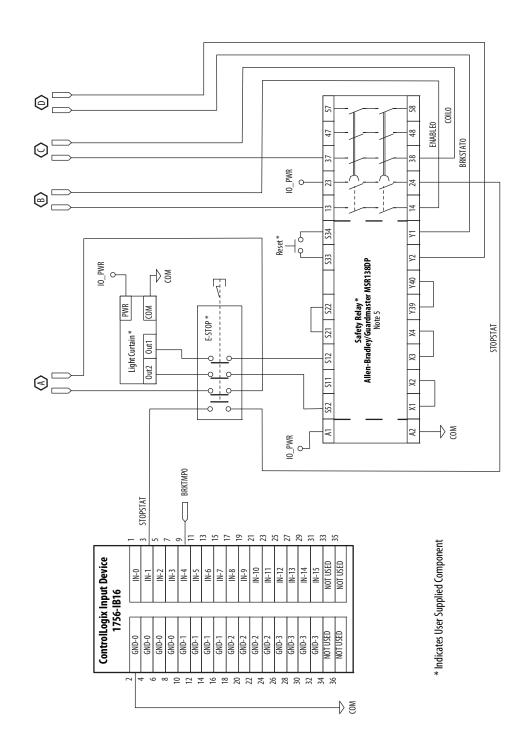


RBM Wiring Example, Category 3 Configuration per ISO 13849 (continued)

This example diagram shows 2094-*x*C*xx*-M*xx* drives (without safe torque-off) and 2094-AL09 and 2094-BL02 LIM modules wired with the Bulletin 2090 RBM module.







RBM Wiring Example, Category 3 Configuration per ISO 13849 (continued)

Notes:

History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

2094-UM001J-EN-P, July 2015

Change

Updated the internal solid-state motor short-circuit protection rating to include 200,000 A (fuses) and 65,000 A (circuit breakers).

Added Mersen HSJ fuses for 2094-BCxx-Mxx-S integrated axis module DC-bus power.

Updated absolute position examples table.

Updated auxiliary feedback encoders table with Bulletin 847H and 847T catalog numbers.

Added IMPORTANT information for calculating the control power current load.

Added error code E31.

Added error code E55.

Added error code E31 fault behavior.

Added error code E55 fault behavior.

Updated notes 19 and 20 with new compatibility for Bulletin MPAS linear actuators.

Added IMPORTANT information regarding message instruction.

2094-UM001I-EN-P, July 2015

Change

Updated Circuit Breaker/Fuse Options section

Updated motor feedback connector pinout tables with 5V/9V footnote

Updated auxiliary feedback connector pinout tables with 5V/9V footnote

Updated Motor Brake Relay with additional motor brake control information

Updated absolute position limit specifications to include all compatible multi-turn encoders

Corrected AM, BM phase error parameter values

Updated the input power section for consistency with other drive-family user manuals and added the impedancegrounded power configuration

Added Bulletin MPS motors and MPAS linear stages to the SpeedTec DIN connector tables

Updated the ControlLogix 1756-ENxT EtherNet/IP module line art with new design

Updated sercos optical power DIP switch settings

Updated error code E05 possible resolutions with 'reduce deceleration rates'

Updated resolver motor feedback pinout with correct wire color for TS+ signal

2094-UM001I-EN-P, July 2015 (continued)

Change

Updated Bulletin MPAS linear stage wiring diagram with SpeedTec DIN cable catalog numbers

Updated linear motor wiring diagram with correct motor feedback pinout

Added ATTENTION statement, corrected Kinetix[®] 6000M IDM catalog number, and added (internal) jumper circuitry to pins 1...4 of the safe torque-off connector

Updated the Configure the Load Observer Feature appendix with changes consistent with publication MOTION-AT005.

2094-UM001H-EN-P, May 2012

Change

Studio 5000™ Logix Designer application is the rebranding of RSLogix™ 5000 software. General references to RSLogix 5000 software have been replaced by the Logix Designer application. References to specific RSLogix 5000 software versions did not change.

Updated references to safe-off (SO) as safe torque-off (STO), per EN61800-5-2.

Updated references to series A and B drives. The 230V drive modules previously labeled as series A are now series A and C. The 460V drives previously labeled as series B are now series B and C.

Added LDAT-Series linear thrusters to system overview table.

Added LDAT-Series linear thrusters to typical system installation diagrams.

Updated System Mounting Requirements for enclosure rating from IP2x to IP54.

Added AC line filter selection table.

Updated safe torque-off (STO) connector pinout table with series C descriptions for safety enable inputs.

Updated motor/resistive brake circuitry diagram and text with changes for the new solid-state relay.

Added the LDAT-Series linear thruster interconnect diagram with Kinetix® 6000 drive.

Added the Configure the Load Observer Feature appendix.

2094-UM001G-EN-P, May 2012

Change

Added acronyms for the Kinetix 6000M integrated drive-motor (IDM) system.

Added the IPIM module to About the Kinetix 6000 Drive System.

Added the Kinetix 6000M integrated drive-motor (IDM) to typical system installation diagrams and catalog number explanation.

Added the IPIM module to Minimum Clearance Requirements.

Added the IPIM module to Establishing Noise Zones.

Added the IPIM module to Determine Mounting Order.

Revised motor power, brake, and feedback cable compatibility tables to include the MPL-A/B15xxx-xx7xAA and MPL-A/B2xxx-ax7xAA low-inertia motors and MPAR-A/B1xxx and MPAR-A/B2xxx electric cylinders with SpeedTec (M7) connectors.

Added IPIM Module Connections with summary of installation connections and links to other diagrams and publications with additional information.

Added Kinetix 6000M Integrated Drive-Motor Sercos Connections

Added Ethernet Cable Connections

Updated the introduction with an overview of IDM system configuration.

Updated the introduction with an overview of the IDM system troubleshooting

2094-UM001G-EN-P, May 2012 (continued)

Change

Updated existing circular DIN (SpeedTec) interconnect diagram with Bulletin MPL-A/B15xxx-xx7xAA and MPL-A/B2xxx-xx7xAA low-inertia motors with SpeedTec (M7) connectors.

Updated the Kinetix MPAI electric cylinders interconnect diagram with frame 64 and 144 cable catalog numbers.

Updated the Kinetix MPAR electric cylinders interconnect diagram with cable catalog number changes for SpeedTec (M7) connector

Added Kinetix 6000M Integrated Drive-Motor Wiring Example.

Added Kinetix MDF catalog numbers to Controlling a Brake Example

Added an overview for IDM system firmware upgrades.

Updated the procedure and tables with IPIM module values.

2094-UM001F-EN-P, March 2011

Change

Corrected formulas used to enable enhanced-peak performance.

2094-UM001E-EN-P, January 2011

Change

Updated system configuration diagrams with power rail and cable clamp redesign features.

Updated communication diagrams with drive-to-drive double-wide configurations.

Updated mounting diagrams with power rail and cable clamp redesign features.

Updated IAM and AM module illustrations with cable clamp redesign features.

Updated power cable catalog numbers with standard (non-flex) SpeedTec DIN cables.

Updated brake cable catalog numbers with standard (non-flex) SpeedTec DIN cables.

Updated feedback cable catalog numbers with standard (non-flex) SpeedTec DIN cables.

Removed Bulletin 1336 external active shunt modules. Added reference to Rockwell Automation Encompass partner solutions.

Added tables to distinguish the dimensional differences between series A and series B drives. Updated dimension drawings with power rail and cable clamp redesign features.

Updated Axis Module/Rotary Motor Wiring Examples with standard (non-flex) SpeedTec DIN motor power and feedback cables.

Updated Axis Module/Linear Motor/Actuator Wiring Examples with standard (non-flex) SpeedTec DIN motor power and feedback cables.

This new appendix provides procedures and information for enabling the peak enhancement feature.

2094-UM001D-EN-P, May 2010

Change	
IAM/AM Module Series Change	
Catalog Number Explanation	
Drive Component Compatibility	
Peak Enhancement Specifications	
Set the Ground Jumper	
MP-Series (Bulletin MPL) Motor Connectors	

2094-UM001D-EN-P, May 2010 (continued)

Change

Motor Power Cable Compatibility

Motor Brake Cable Compatibility

Motor Feedback Cable Compatibility - Bayonet Connectors

Motor Feedback Cable Compatibility - Circular DIN/Plastic Connectors

Configure Axis Properties

IAM Module (460V) Power Specifications (series A and B)

AM Module (inverter) 460V Power Specifications (series A and B)

Product Dimensions

2094-UM001C-EN-P, December 2009

Change

Pinout for the 2090-K6CK-KENDAT feedback module.

Linear scaling specifications for analog outputs.

Input power-cycle capability specifications.

Heidenhain EnDat encoder specifications.

Auxiliary position feedback encoder catalog numbers.

Motor power cable compatibility.

Wiring motor brake connections.

Motor and feedback cable combinations.

Wiring the 2090-K6CK-KENDAT feedback module.

Installing the fiber-optic connector bracket kit.

Maximum feedback cable length specifications for Kinetix MPM rotary motors and Kinetix MPAR electric cylinders; Kinetix RDB direct-drive motors; LDC-Series and LDL-Series linear motors.

Interconnect diagrams for Kinetix MPM rotary motors and Kinetix RDB direct-drive motors.

Interconnect diagrams for Kinetix MPAR electric cylinders; LDC-Series and LDL-Series linear motors.

Coil current ratings for motor brake applications.

Changing default IDN parameter values using Sercos Read and Write instructions.

Wiring examples for Kinetix 6000 drives with and without the safe-off feature.

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Notes:

Rockwell Automation Support

Use these resources to access support information.

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Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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