Configure Axis Properties

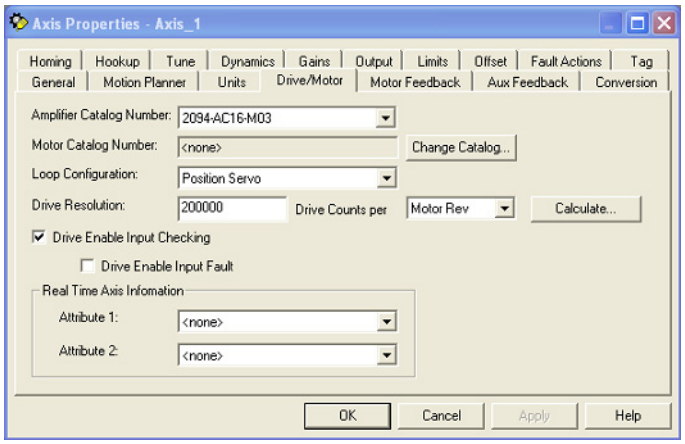
The peak current ratings of the Kinetix 6000 AM modules (series A, B, C, and D) are configured at the factory as 150% of continuous current. You can program 460V (series B, C, and D) AM modules and the equivalent IAM (inverter) modules, for up to 250% of continuous inverter current.

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.

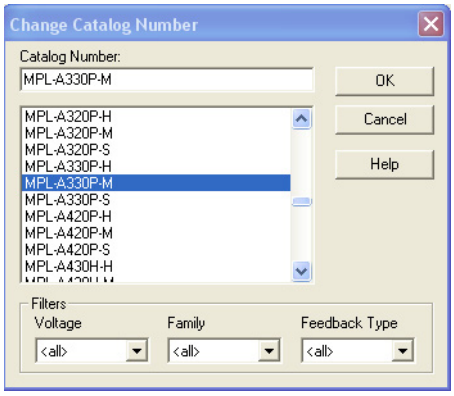
1. Right-click an axis in the Controller Organizer and choose Properties.

   The Axis Properties dialog box opens.



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

   The Change Catalog Number dialog box opens.



4. Select the motor catalog number appropriate for your application.

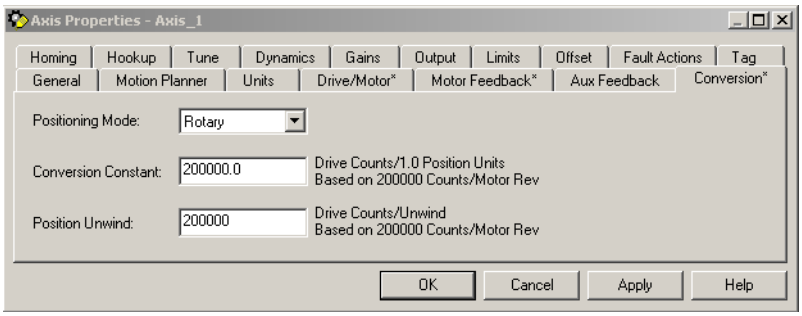
   To verify the motor catalog number, refer to the motor name plate.

5. Click OK.

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

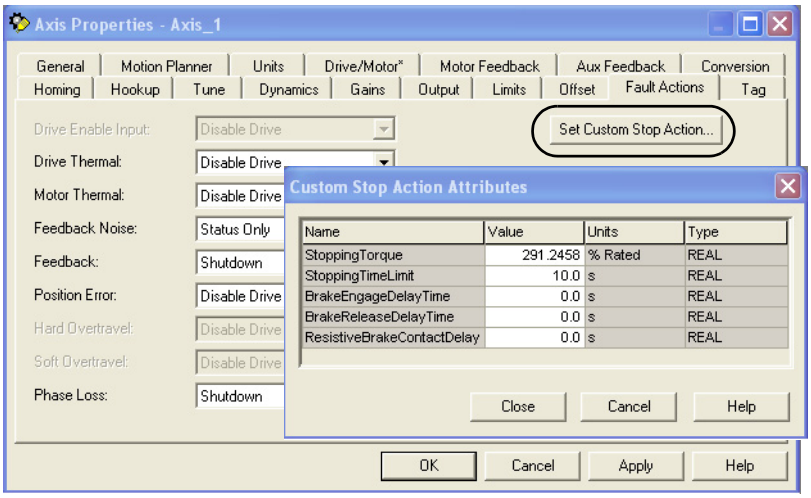
   When checked (default), means a hard drive-enable input signal is required. Uncheck to remove that requirement.

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.



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.



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 KNX-TD001.
    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.

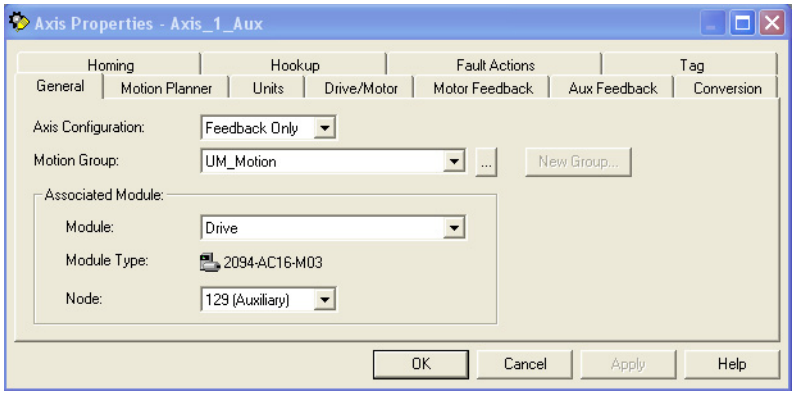
Follow these steps to configure Auxiliary Axis properties.

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.

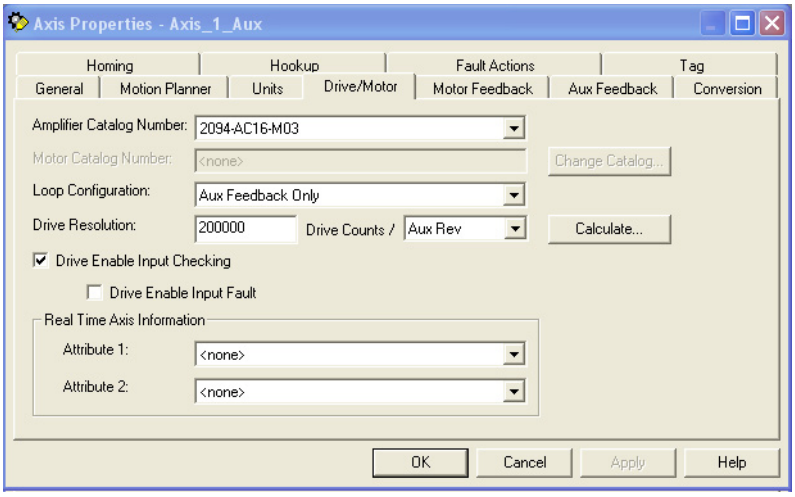
   The Axis Properties dialog box opens on the General tab.

   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.

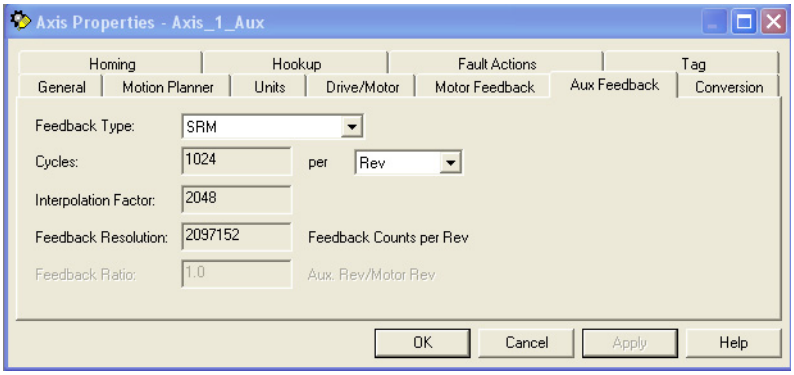


2. Click the Drive/Motor tab.

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.



3. Click the Aux Feedback tab.



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 2094-IN005, 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 2094-UM003, 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.

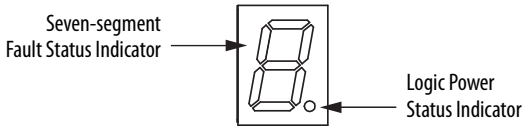
1. Disconnect the load to the motor.

   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
Is sourced from a LIM module	1. Verify that CB1, CB2, and CB3 are in the OFF position. 2. Apply three-phase input power to the LIM module VAC Line connector. 3. Set CB3 to the ON position. 4. Set CB2 to the ON position. 5. Go to main step 3.
Is not sourced from a LIM module	1. Apply (95…264V AC) control power to the IAM module (CPD connector). 2. Go to main step 3.

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



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

(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.

If Your Three-phase Power	Then
Is sourced from a LIM module	1. Set CB1 to the ON position. 2. 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) 3. Go to main step 5.
Is not sourced from a LIM module	1. Apply 195…265V AC (230V) or 324…528V AC (460V) input power to the IAM module (IPD connector). 2. 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) 3. Go to main step 5.

(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 step 6.
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 page 170. Refer to the Kinetix 6000M Integrated Drive-Motor System User Manual, publication 2094-UM003, 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.

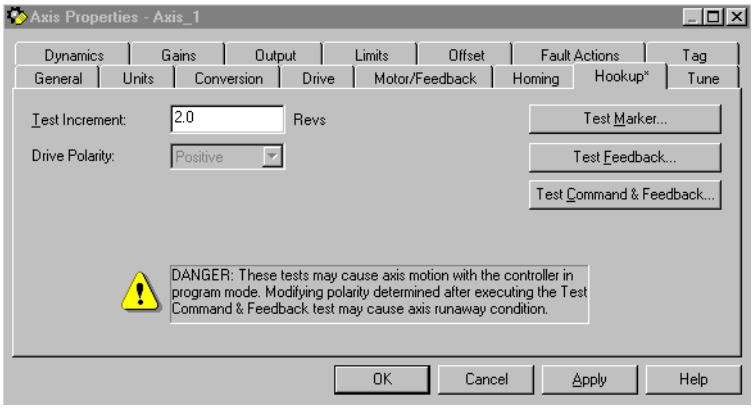
For help with using the Logix Designer application, as it applies to testing and tuning your axes with ControlLogix, CompactLogix, or SoftLogix Sercos modules, refer to Additional Resources on page 10.

Test the Axes

Follow these steps to test the axes.

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

   The Axis Properties dialog box opens.



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.

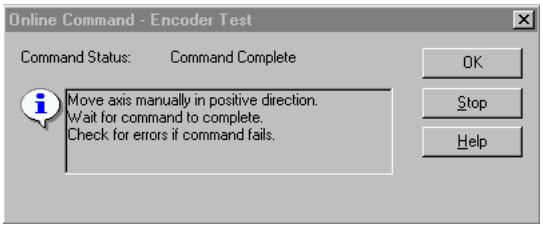
5. Apply Hardware Enable Input signal (IOD-2) for the axis you are testing.

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.

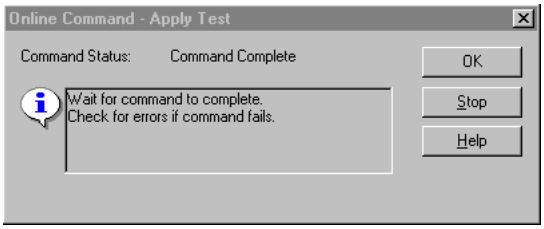
6. Click the desired test (Marker/Feedback/Command & Feedback) to verify connections.

   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.

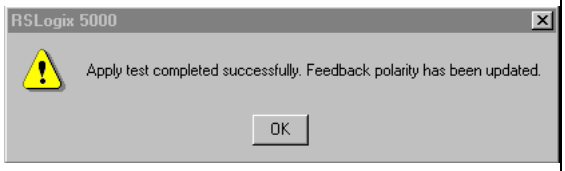
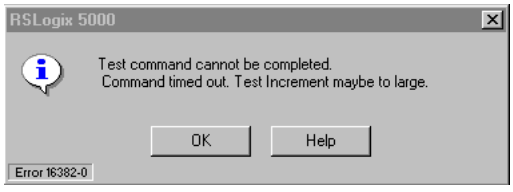


7. Click OK.

   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.



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

If	Then
Your test completes successfully, this dialog box opens. 	1. Click OK. 2. Remove Hardware Enable Input (1) signal (IOD-2). 3. Go to Tune the Axes on page 157.
Your test failed, this dialog box opens. 	1. Click OK. 2. Verify the Bus status indicator turned solid green during the test. 3. Verify that the Hardware Enable Input (1) signal (IOD-2) is applied to the axis you are testing. 4. Verify conversion constant entered in the Conversion tab. 5. Return to main step 6 and run the test again.

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

Tune the Axes

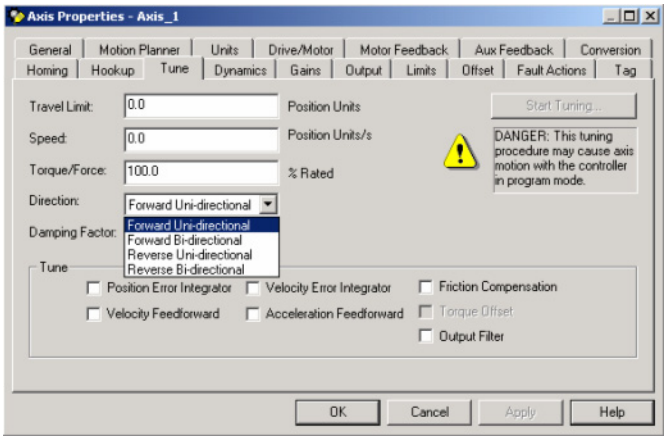
The load observer feature (available with drive firmware revision 1.124 or later) can provide good performance without having to tune your axis. Using load observer with auto-tuned gains can maximize system performance. Refer to Appendix D beginning on page 235 for more load observer information.

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 re-attach the load and perform the tuning procedure again to provide an accurate operational response.

2. Click the Tune tab.



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.

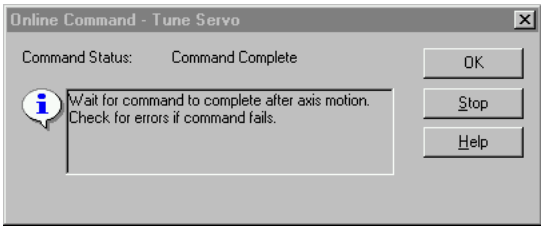
6. Apply Hardware Enable Input signal (IOD-2) for the axis you are tuning.

> **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.

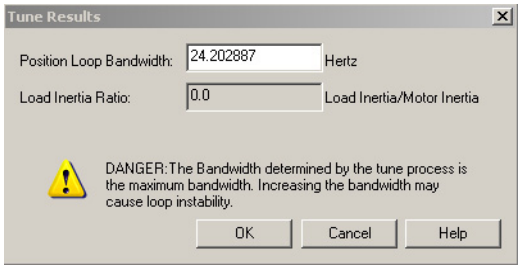
7. Click Start Tuning to auto-tune your axis.

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



8. Click OK.

   The Tune Bandwidth dialog box opens.

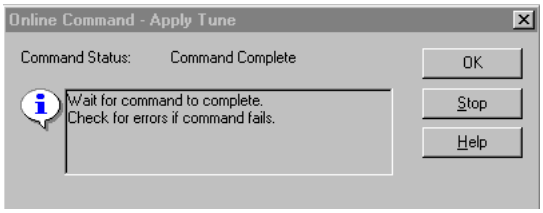


   Actual bandwidth values (Hz) depend on your application and can require adjustment once motor and load are connected.

9. Record your bandwidth data for future reference.

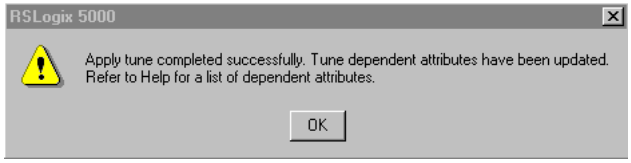
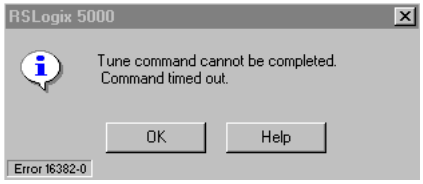
10. Click OK.

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



11. Click OK.

12. Determine if your test completed successfully.

If	Then
Your test completes successfully, this dialog box opens. 	1. Click OK. 2. Remove the Hardware Enable Input (1) signal (IOD-2) applied earlier. 3. Go to step 13.
Your test failed, this dialog box opens. 	1. Click OK. 2. Make an adjustment to motor velocity. 3. Refer to the appropriate Logix 5000 motion module user manual for more information. 4. Return to step 7 and run the test again.

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

13. Repeat Test and Tune the Axes 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
	Serial to SCANport™ adapter	1203-SSS (Series B)	3.004 or later
HIM module (3)	Full numeric LCD HIM	20-HIM-A3	N/A

(1) 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 9306-GR001, for instructions.
(3) Compatible catalog numbers include all 20-HIM-Ax.

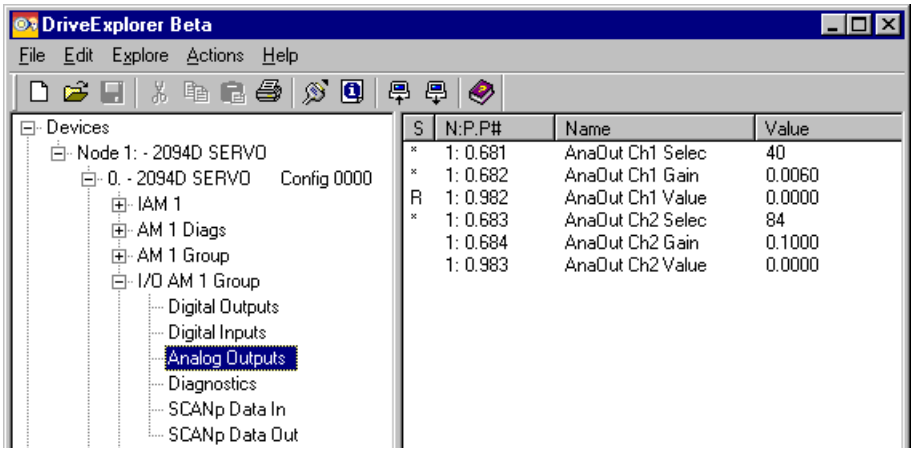
Change Parameters with DriveExplorer Software

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



Change Parameters with the HIM Module

When using the HIM module to monitor or change parameters, use the up and ∧ and ∨) 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 ↵.
   b. For Analog Output 2 use arrows to select, and press ↵.
4. Press Sel.
5. Enter parameter number, and press ↵.

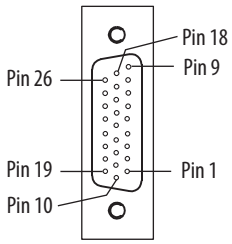
Monitor System Variables with Analog Test Points

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	DAC0
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 Output	Controlling Parameter		Scale Parameter	
	Parameter Number (1)	Default Value (1)	Parameter Number (1)	Default Value
1	*x*681	*xx*40	*x*682	0.0060
2	*x*683	*xx*84	*x*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	*xx*40
Velocity commanded	*xx*36
Torque feedback	*xx*84
Torque commanded	*xx*80

(1) *x* = slot number.

Troubleshoot the Kinetix 6000 Drive System

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

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 2094-UM003, 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
No Error Code Displayed		Power (PWR) indicator not ON	No AC power or auxiliary logic power.	Verify AC control power is applied to the Kinetix 6000 system.
			Internal power supply malfunction.	Call your Rockwell Automation sales representative to return module for repair.
		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.
E05	**DriveOvercurrent Fault** (Power Fault)	Self-protection of the Intelligent Power Module (IPM) is indicating a major power related fault condition.	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.
			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.
			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.

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

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 137V	• 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.		Disable follower axis before removing power.
E10	**DriveOvervoltage Fault** (Bus Overvoltage)	The DC bus voltage is above limits.	Excessive regeneration of power. 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 maximum software setting.		• Verify motion profile. • Verify overtravel settings are appropriate.
E18	**OverSpeedFault** (Overspeed Fault)	Motor speed has exceeded 150% of maximum rated speed. The 100% trip point is dictated by the lesser of the user 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 established with an intelligent encoder.		Verify auxiliary encoder wiring.
E30	**MotFeedbackFault** (Motor Feedback Comm)	Communication was not established 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.
E34	**GroundShortFault** (Ground Fault)	Excessive ground current in the converter was detected.	Wiring error.	• Check motor power wiring. • Check input power wiring.
			Motor internal ground short.	Replace motor.
			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).

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

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E35	**DriveUndervoltage Fault** (Precharge Fault)	Converter precharge cycle failed.	Low AC input voltage.	Check input AC voltage on all phases.
			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 input AC power is missing. • Axis was enabled when main (three-phase) power was removed. • common-bus follower axis was 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 fault 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 instructions, has not been followed.	• Verify grounding. • Route feedback cable away from noise sources. • Refer to System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001.
E64	**MotorFeedbackNoise** (Mtr Fdbk Noise)	Noise on motor feedback cable.		

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.
E72	**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.
			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** (Backplane Comm)	Power rail CAN communication failed.		Check module for proper mount.
		Power rail connection shorted or open.		Check power rail and module for foreign objects.
E74	**DriveOvercurrent Fault** (Bus OverCurrent)	DC link current exceeds rating.	Motor or transmission malfunction.	• Check for proper motor sizing. • Check/replace transmission device. • Check/replace motor.
			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.

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

Error Code	Fault Message - Logix Designer (HIM)	Anomaly or Symptom	Potential Cause	Possible Resolution
E79	**DriveOvervoltage Fault** (Shunt Module Flt)	Over-temperature fault indicator on Bulletin 2094 shunt module is steady red.		Refer to Temperature Fault Status Indicator on page 172.
		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 2094-UM003.

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 page 165.

Table 106 - Comm Status Indicator

Comm Status Indicator	Drive Status	Potential Cause	Possible Resolution
Off	No communication (1)	Loose fiber-optic connection.	Verify proper fiber-optic cable connections.
		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
Shunt	Fault is latched.	Until fault condition is corrected and cleared.
	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 removed.
	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.

Table 109 - Bus Status Indicator

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

Table 110 - Temperature Fault Status Indicator

Over-Temp Fault Indicator	Status	Potential Cause	Possible Resolution
Off	Normal condition.		N/A
Steady Red	Shunt module internal temperature exceeds operating temperature specification.	Shunt module fan failed.	Replace shunt module.
		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.	

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.

Table 113 - General System Anomalies

Condition	Potential Cause	Possible Resolution
Axis or system is unstable.	The position feedback device is incorrect or open.	Check wiring.
	Unintentionally in Torque mode.	Check to see what primary operation mode was programmed.
	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.
	Position loop gain or position controller acceleration or deceleration rate is improperly set.	Run Tune in the Logix Designer application.
	Improper grounding or shielding techniques are causing noise to be transmitted into the position feedback or velocity command lines, causing erratic axis movement.	Check wiring and ground.
	Motor Select limit is incorrectly set (servo motor is not matched to axis module).	• Check setups. • Run Tune in the Logix Designer application.
	Mechanical resonance.	Notch filter or output filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
You cannot obtain the motor acceleration/deceleration that you want.	Torque Limit limits are set too low.	Verify that current limits are set properly.
	Incorrect motor selected in configuration.	Select the correct motor and run Tune in the Logix Designer application again.
	The system inertia is excessive.	• Check motor size versus application need. • Review servo system sizing.
	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.
Motor does not respond to a velocity command.	The axis cannot be enabled for 1.5 seconds after disabling.	Disable the axis, wait for 1.5 seconds, and enable the axis.
	Enable signal has not been applied or the enable wiring is incorrect.	• Check the controller. • Check the wiring.
	The motor wiring is open.	Check the wiring.
	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.
Presence of noise on command or motor feedback signal wires.	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 GMC-RM001.
	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 (continued)

Condition	Potential Cause	Possible Resolution
No rotation	The motor connections are loose or open.	Check motor wiring and connections.
	Foreign matter is lodged in the motor.	Remove foreign matter.
	The motor load is excessive.	Verify the servo system sizing.
	The bearings are worn.	Return the motor for repair.
	The motor brake is engaged (if supplied).	• 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.
Abnormal noise	Motor tuning limits are set too high.	Run Tune in the Logix Designer application.
	Loose parts are present in the motor.	• Remove the loose parts. • Return motor for repair. • Replace motor.
	Through bolts or coupling is loose.	Tighten bolts.
	The bearings are worn.	Return motor for repair.
	Mechanical resonance.	Notch filter can be required (refer to Axis Properties dialog box, Output tab in the Logix Designer application).
Erratic operation - Motor locks into position, runs without control or with reduced torque.	Motor power phases U and V, U and W, or V and W reversed.	Check and correct motor power wiring.
	Sine, Cosine or Rotor leads are reversed in the feedback cable connector.	Check and correct motor feedback wiring.

Logix 5000/Drive Fault Behavior

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

Table 114 - Drive Fault Action Definitions

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.

Only selected faults are programmable. In the Logix 5000/Drive Fault Behavior table on page 176, 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

Drive Fault Action/Attribute for Motor Overtemp fault (E04).

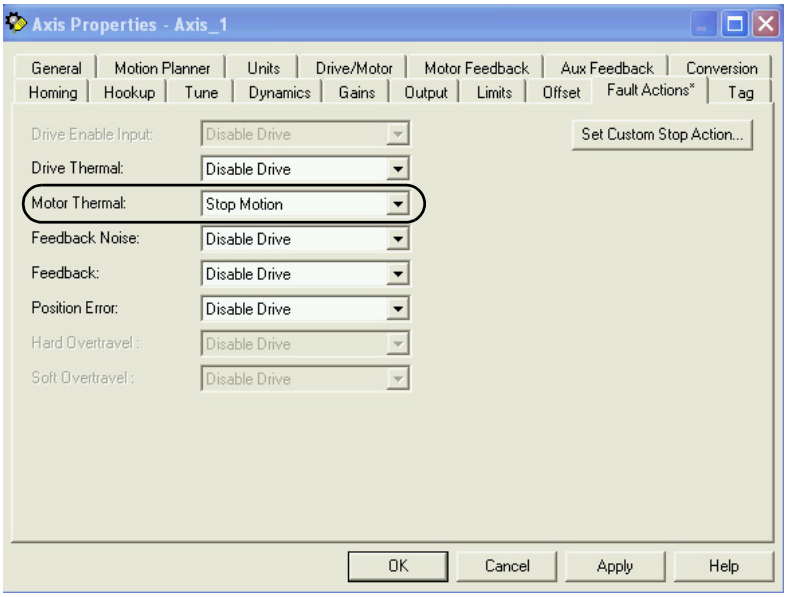


Table 115 - Logix 5000/Drive Fault Behavior

Logix 5000 Fault Message (HIM Message)	Error 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^2t 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 (Bus Under Voltage)	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. DC bus voltage is below limits when any axis on common-bus follower power rail was enabled.	Coast/Disable (open 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 (Phase Loss Flt)	E37	One or two phases of the input AC power are missing.	Coast/Disable (open contactor enable relay)	No
		• 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	
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 GMC-RM002, for more information. Applies to 2094-*xCxx*-M*xx*-S IAM and 2094-*xMxx*-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.	Coast/Disable	Yes Feedback Noise
MotorFeedbackNoise (Mtr Fdbk Noise)	E64	Presence of noise on motor feedback cable.		
No Fault Message (condition indicated by on-screen message) (Hookup Fault)	E65	Hookup procedure failed.	Coast/Disable	No
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^2t 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 I^2T 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 I^2T 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 I^2T calculation indicates that the drive has exceeded 110% of its rating. The I^2T 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.

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

Before You Begin

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.

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

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

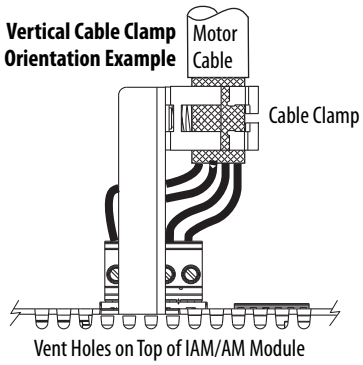
2. Wait five minutes for the DC bus to discharge completely before proceeding.

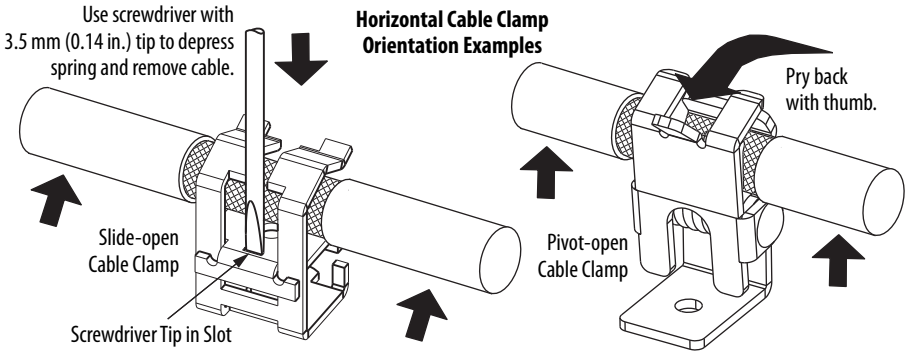
> **ATTENTION:** This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove this unit. Do not attempt the procedures in this document unless you are qualified to do so and 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.

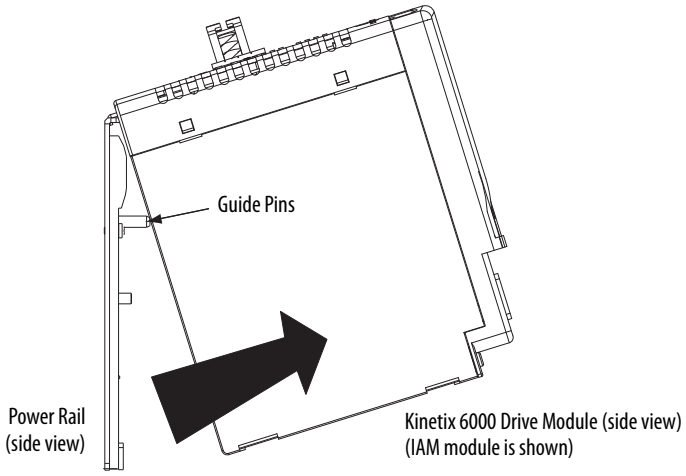
4. Remove the motor cable from the cable shield clamp, as shown in these examples.





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).

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.

Replace Kinetix 6000 Drive Modules

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 step 3.
Replacing a drive module on a new power rail	Go to step 2.

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.

8. Verify that the system is operating properly.

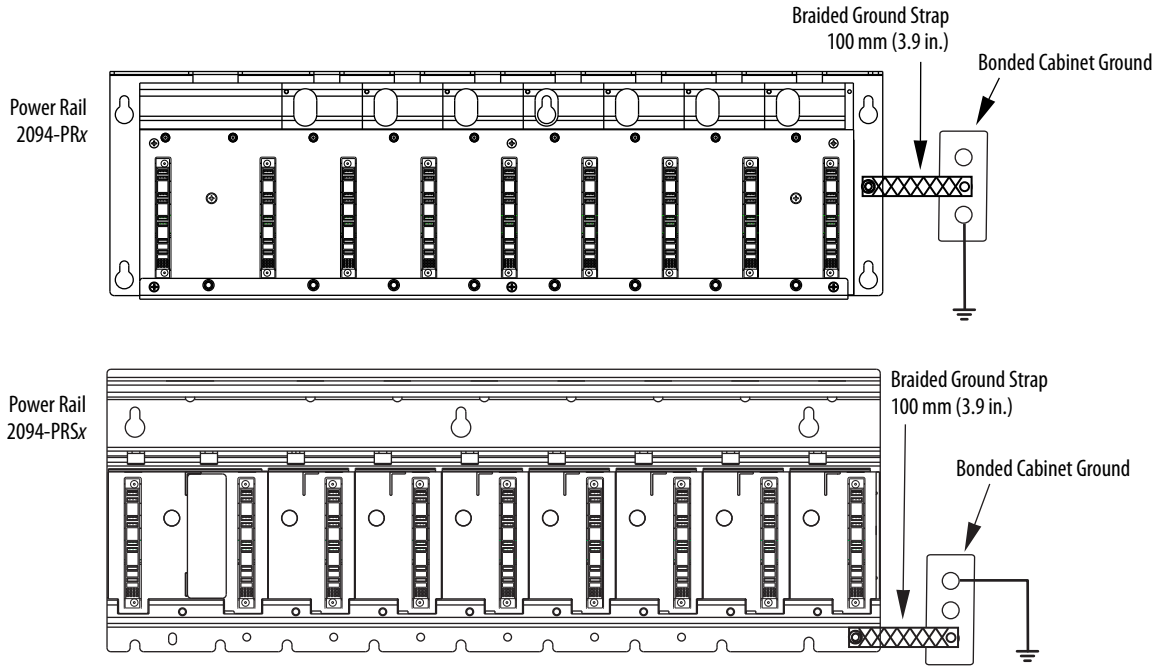
   TIP Because parameter settings reside in the Logix Designer application, you do not need to perform any tuning or set-up procedures.

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 2094-IN003.

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.

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 KNX-TD004.
4	Terminal block is required to make connections.
5	2094-BC*xx*-M*xx*-*x* (460V) IAM modules require a step-down transformer for single-phase control power input. Source the 2094-AC*xx*-M*xx*-*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-AL*xx*S and 2094-BL*xx*S 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-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S-C*x* 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 8720MC-RM001.
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 page 70, 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-*x*M*xx*-*x*) or the same axis module that resides within an integrated axis module (catalog number 2094-*x*C*xx*-M*xx*-*x*).
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-*xx*S*xx* and 2090-CPBM6DF-16AA*xx*) have a drain wire that must be folded back under the cable shield clamp.
19	MPL-A/B15*xx*-H…MPL-A/B45*xx*-H, MPL-A15*xx*-V/E…MPL-A2*xx*-V/E, MPL-A3*xx*-S/M…MPL-A45*xx*-S/M, MPM-A115*xx*…MPM-A130*xx*, MPF-A3*xx*…MPF-A45*xx*, MPS-A*xxx*, MPAR-A*xxx*, MPAS-A*xxx* (ballscrew), and MPAS-A/B*xxx* (direct drive) encoders use the +5V DC supply.
20	MPL-B15*xx*-V/E…MPL-B2*xx*-V/E, MPL-B3*xx*-S/M…MPL-B9*xx*-S/M, MPL-A5*xx*, MPM-B*xx*, MPM-A165*xx*…MPM-A215*xx*, MPF-B*xx*, MPF-A5*xx*, MPS-B*xxx*, MPAR-B*xxx*, and MPAS-B*xxx* (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

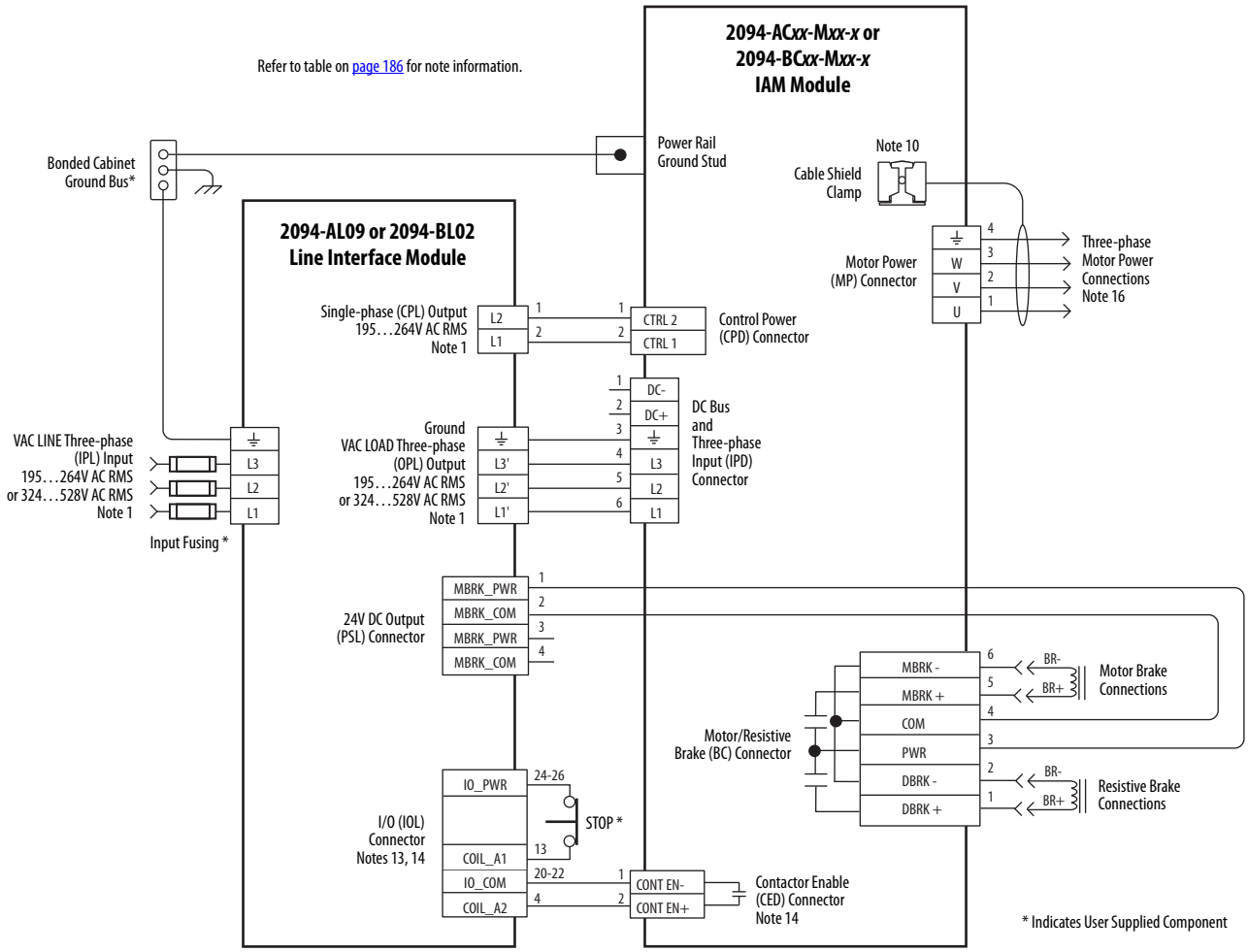
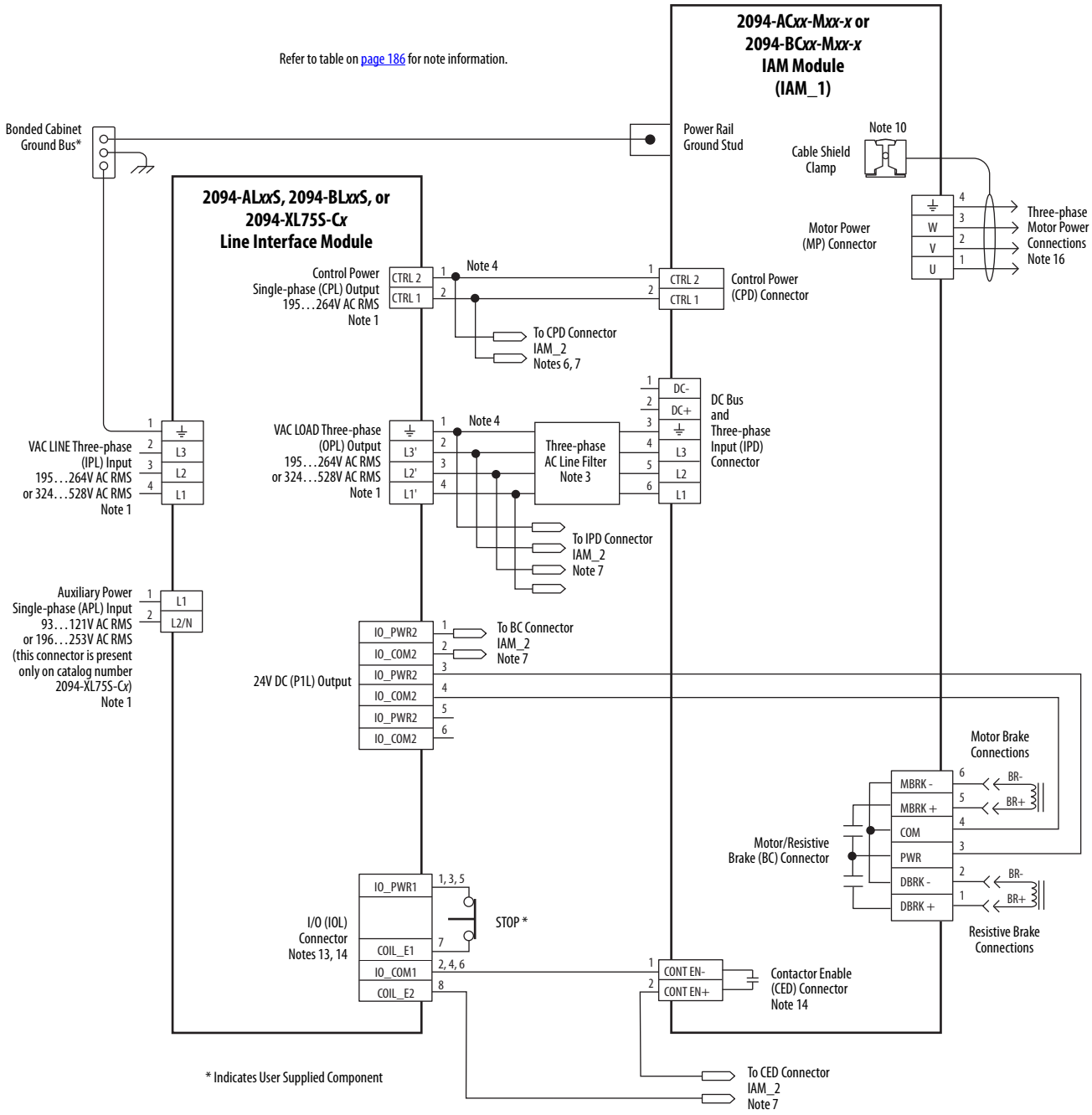
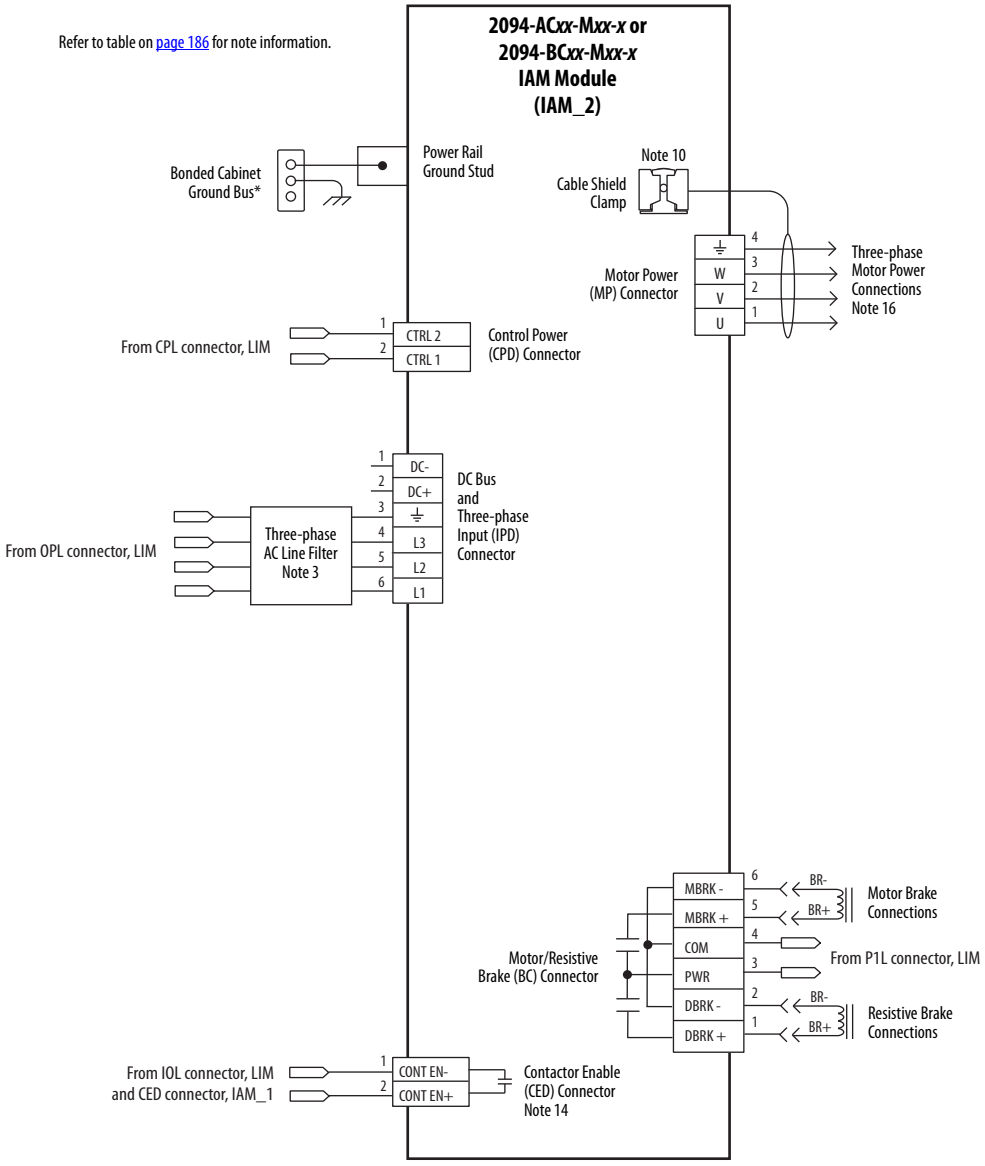


Figure 86 - Multiple IAM Modules with LIM Module



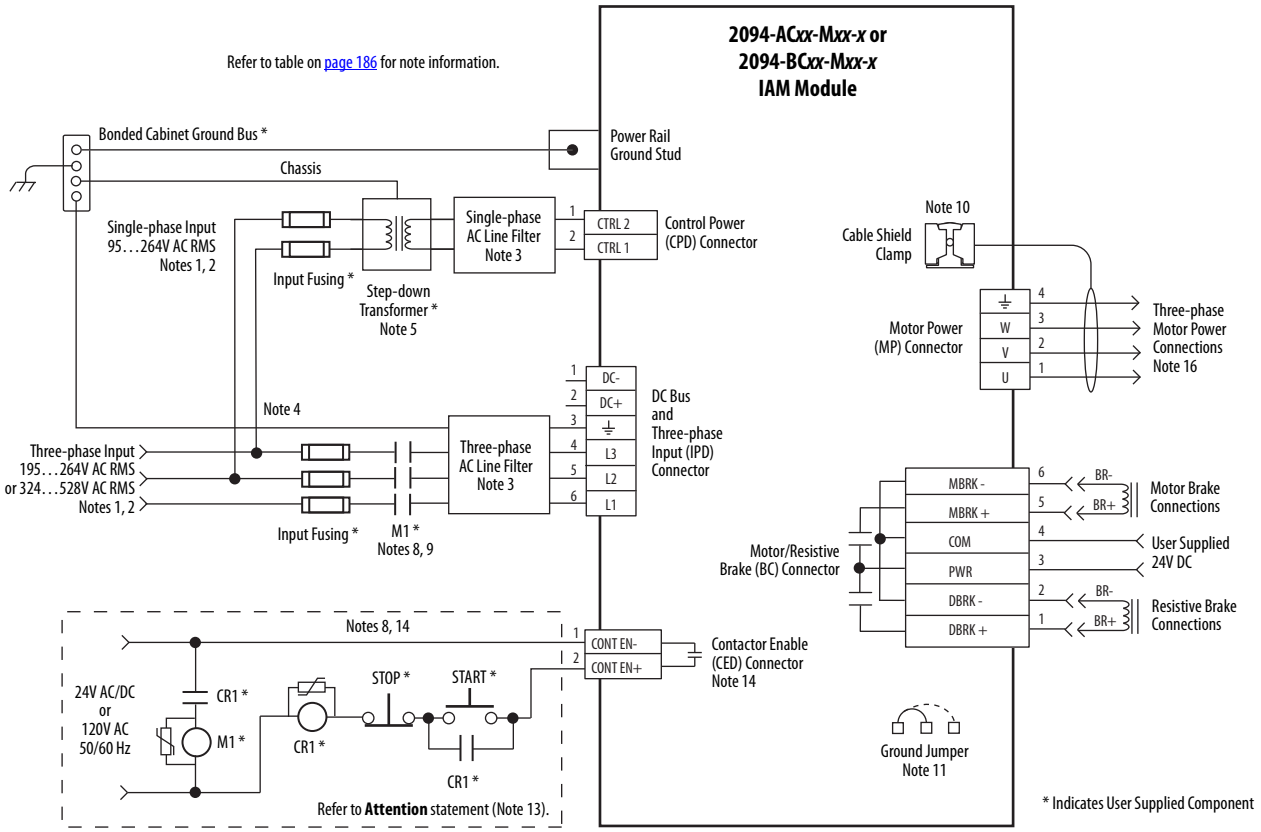
Multiple IAM Modules with LIM Module (continued)



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 page 70 for more information.

Figure 87 - IAM Module (without LIM module)



DC Common Bus Wiring Examples

Figure 88 - Leader IAM Module with Single Follower IAM Module

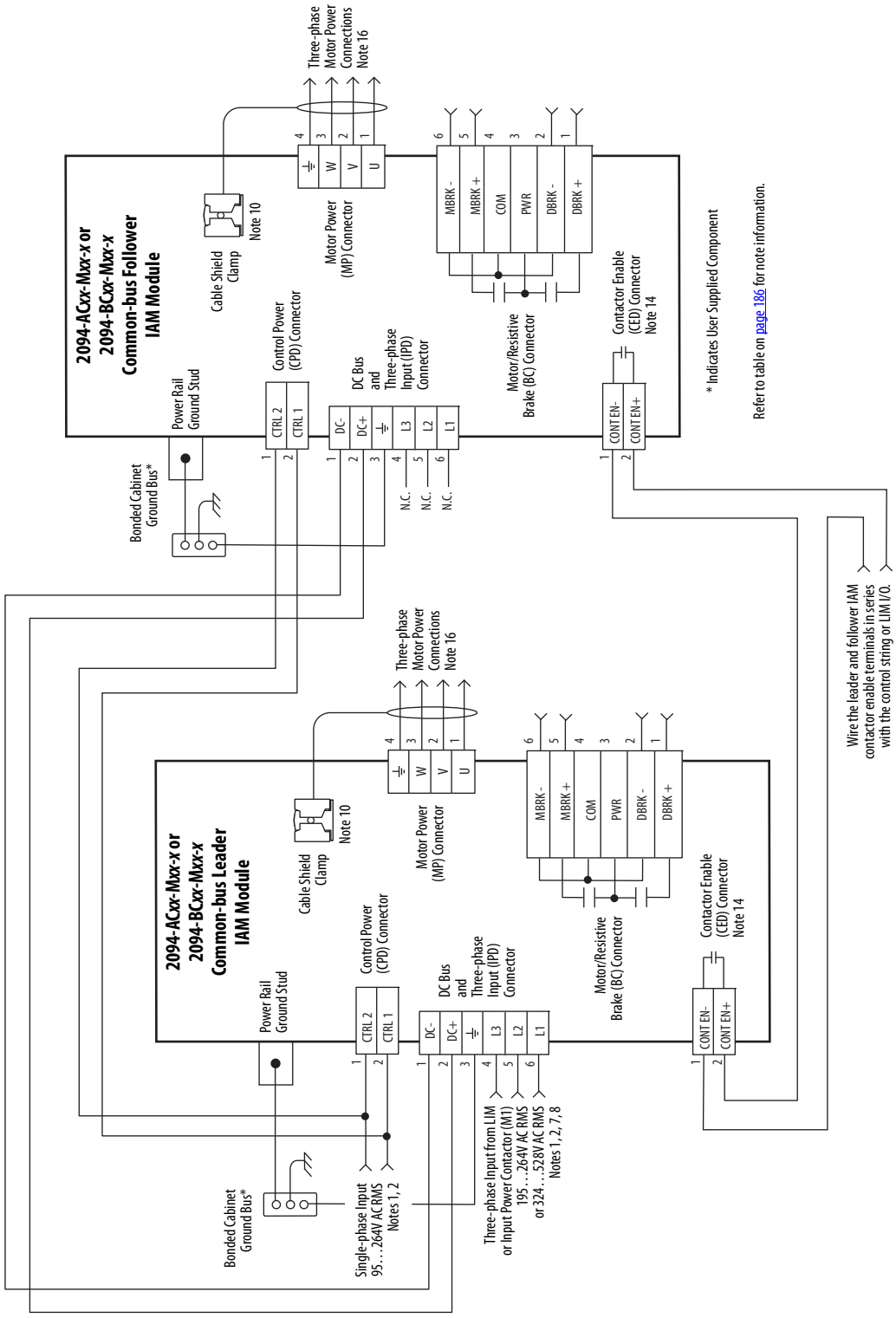
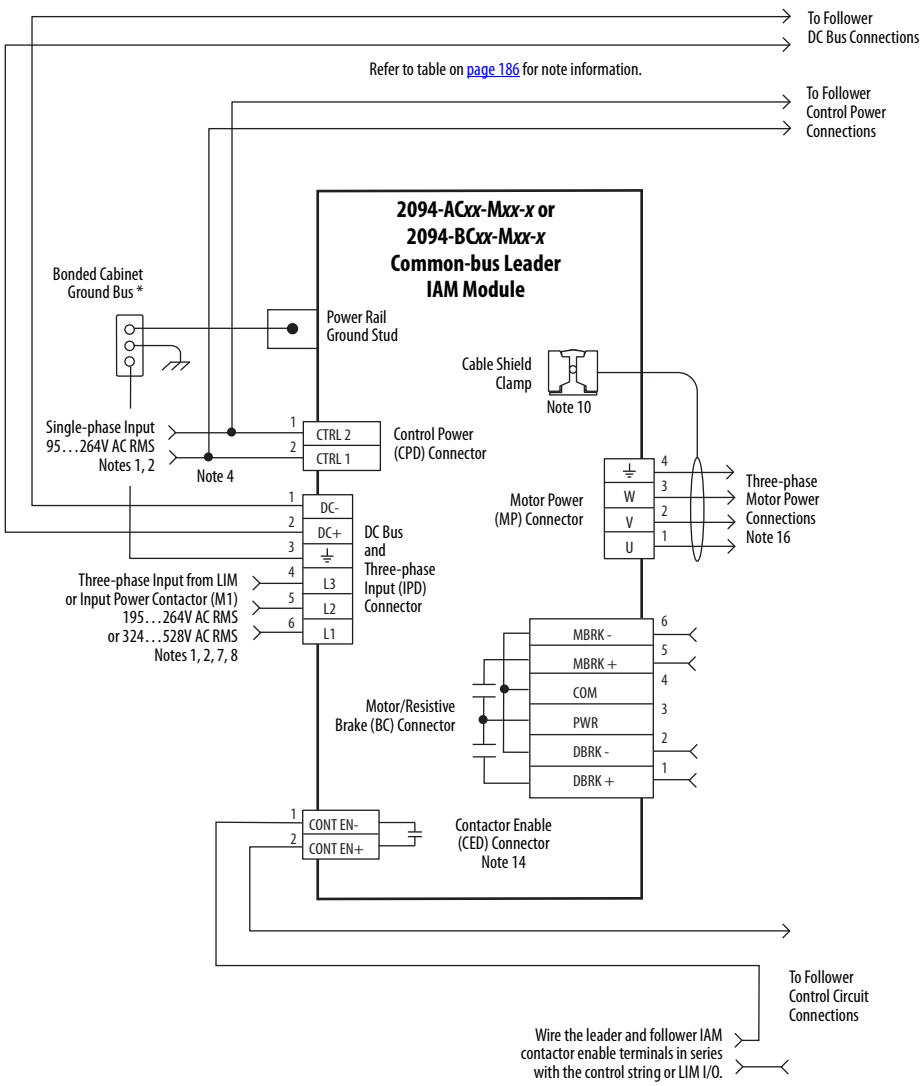


Figure 89 - Leader IAM Module with Multiple Follower IAM Modules



Leader IAM Module with Multiple Follower IAM Modules (continued)

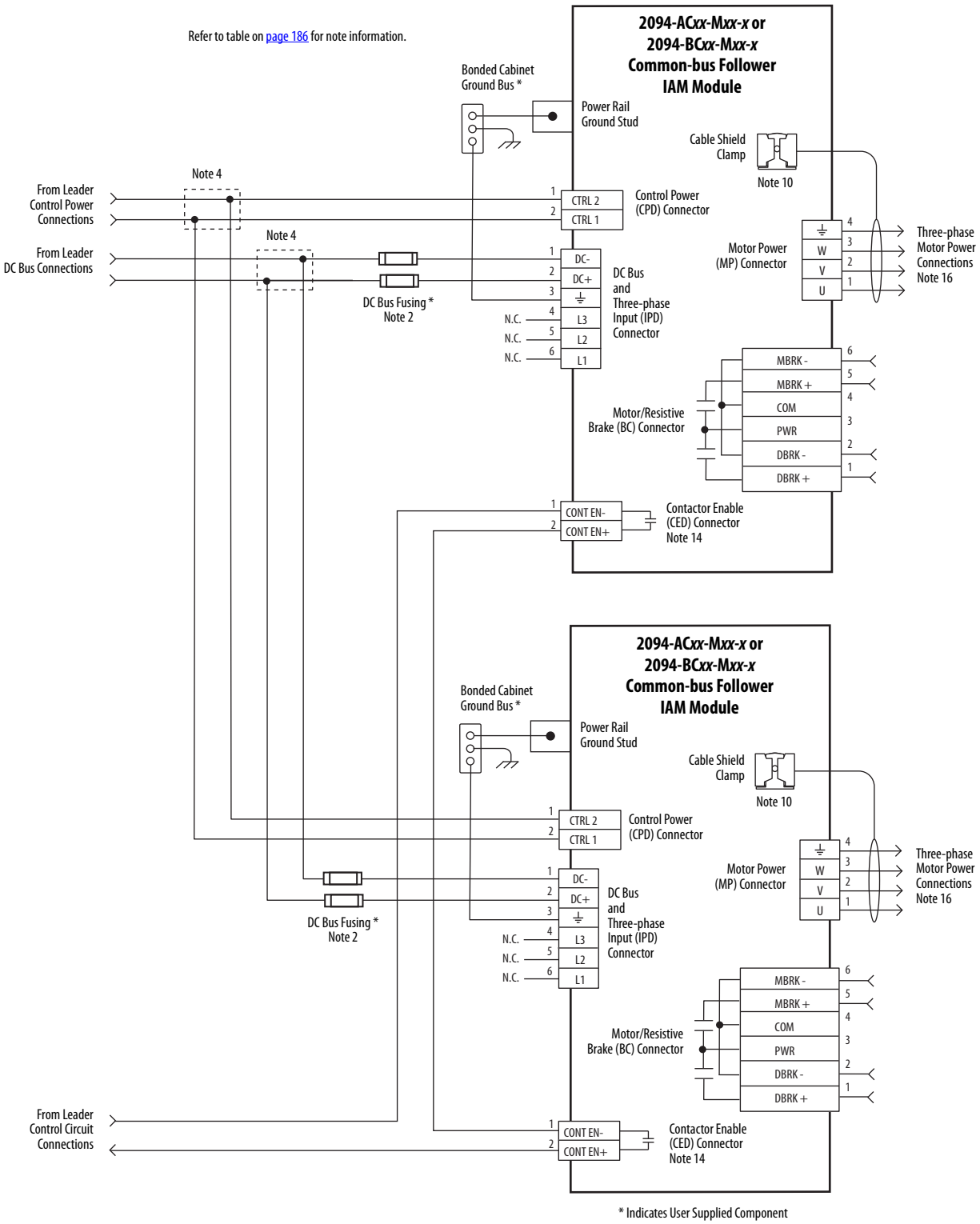
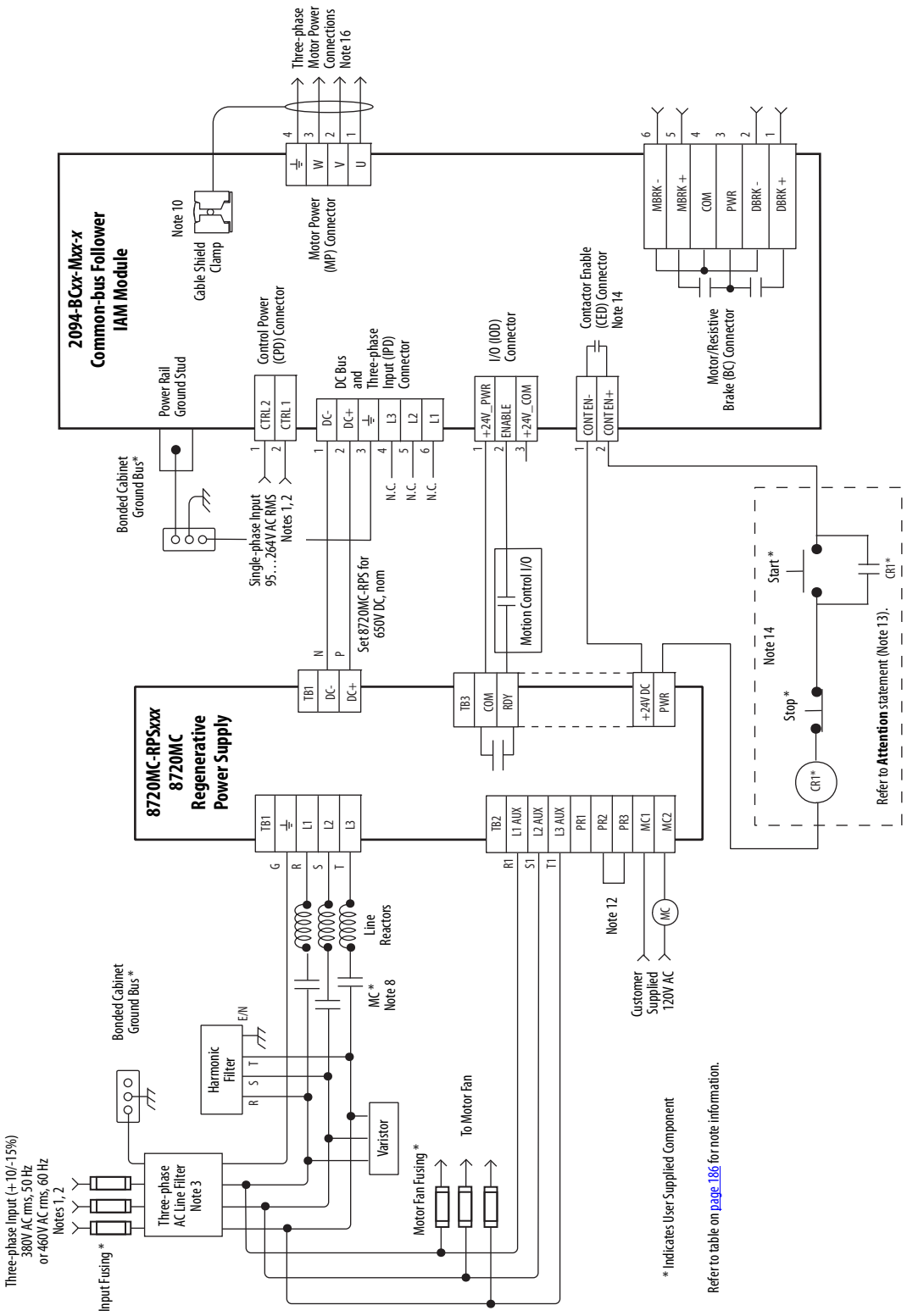


Figure 90 - 8720MC-RPS Leader Drive with Single Follower IAM Module

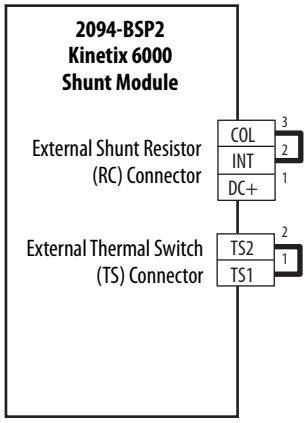


IMPORTANT Use a push button circuit (instead of an SPST toggle switch) in series with the contactor enable string (between the 8720MC-RPS and servo drive) to allow a drive fault to remove the DC bus power, and to prevent the drive from applying DC bus power without your input after clearing a drive fault.

Shunt Module Wiring Examples

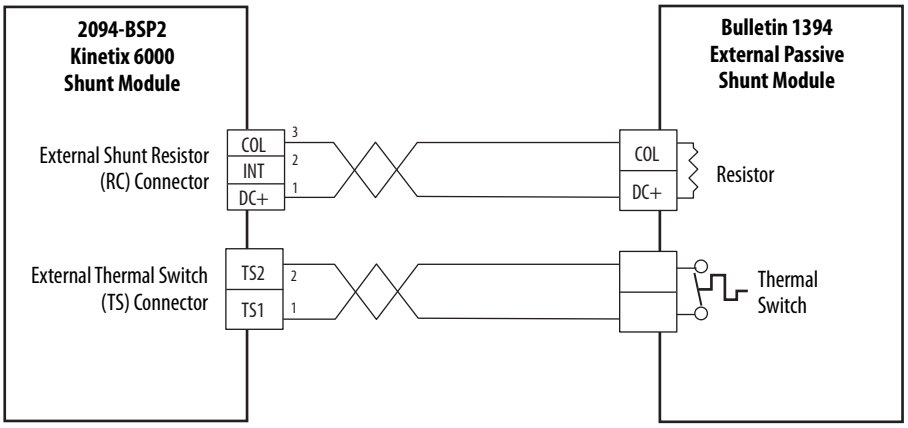
Refer to Kinetix Motion Accessories Technical Data, publication KNX-TD004 for the Bulletin 1394 external shunt module catalog numbers available for the Kinetix 6000 drive systems.

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.

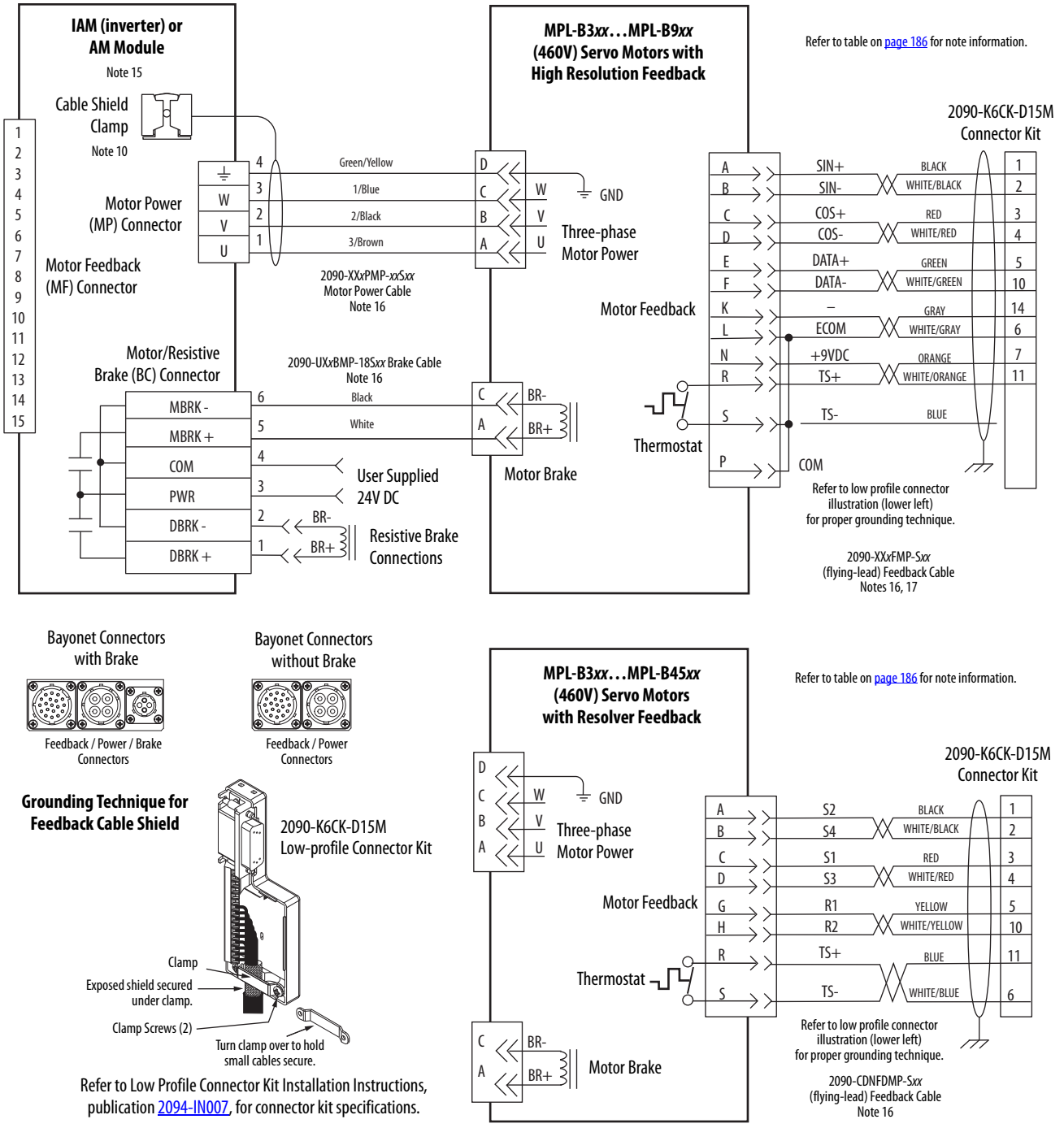
Refer to the External Shunt Module Installation Instructions, publication 2090-IN004, for additional installation information.

Axis Module/Rotary Motor Wiring Examples

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

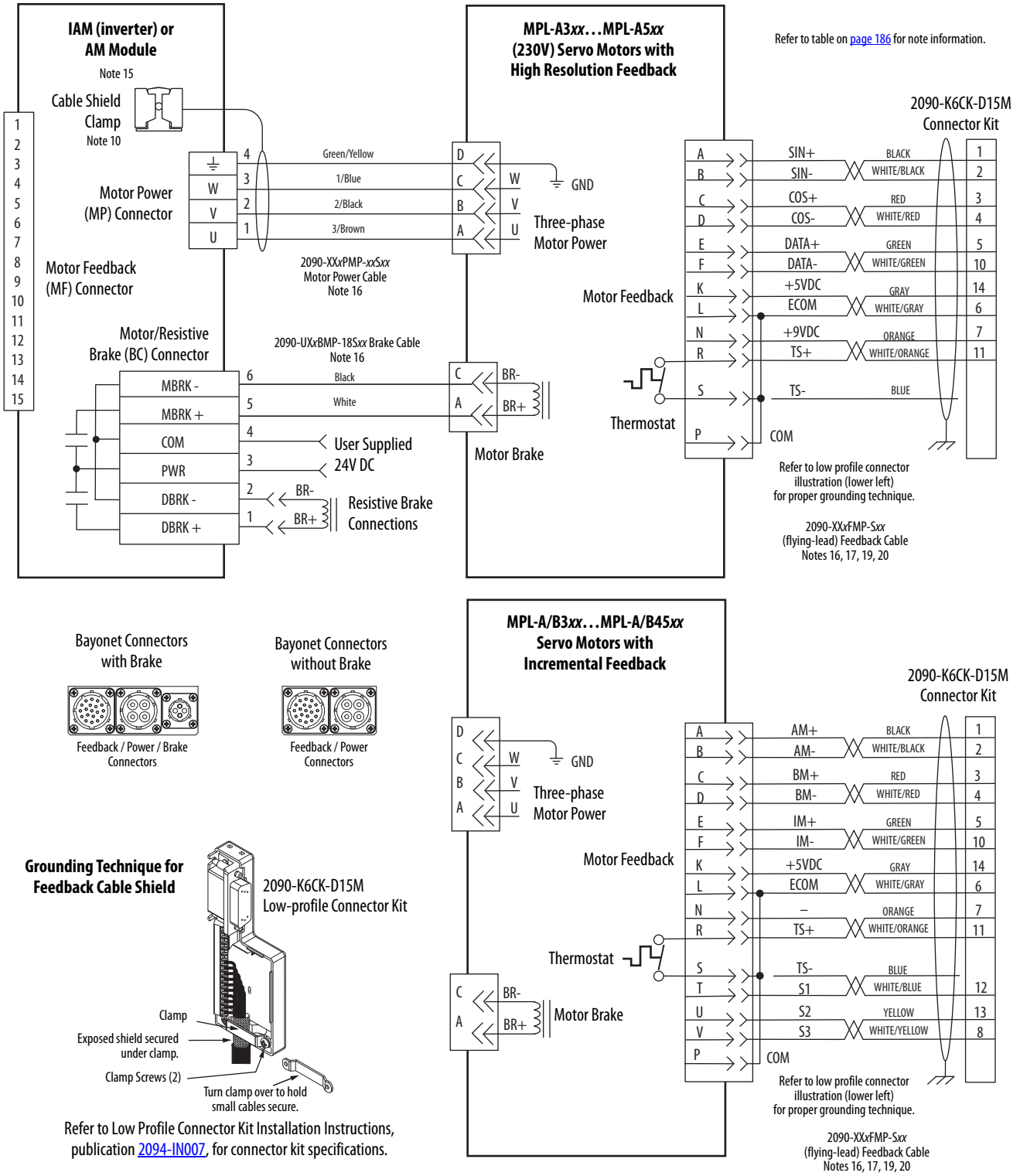
IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with bayonet connectors.

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



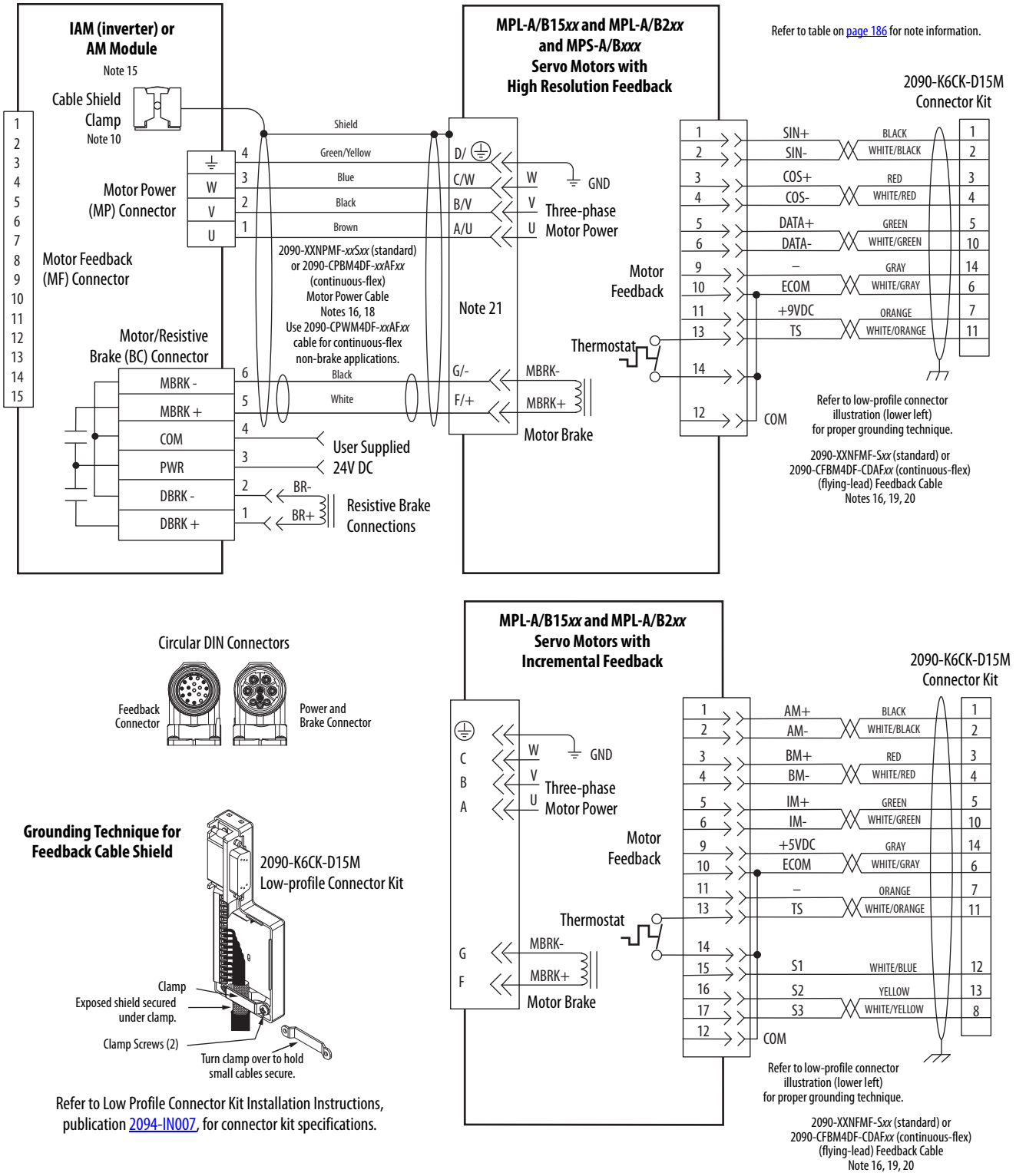
IMPORTANT The Kinetix MPL motor wiring examples on this page apply to motors equipped with bayonet connectors.

Figure 94 - AM Module Wiring Example with Kinetix MPL-A/B Rotary Motors



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

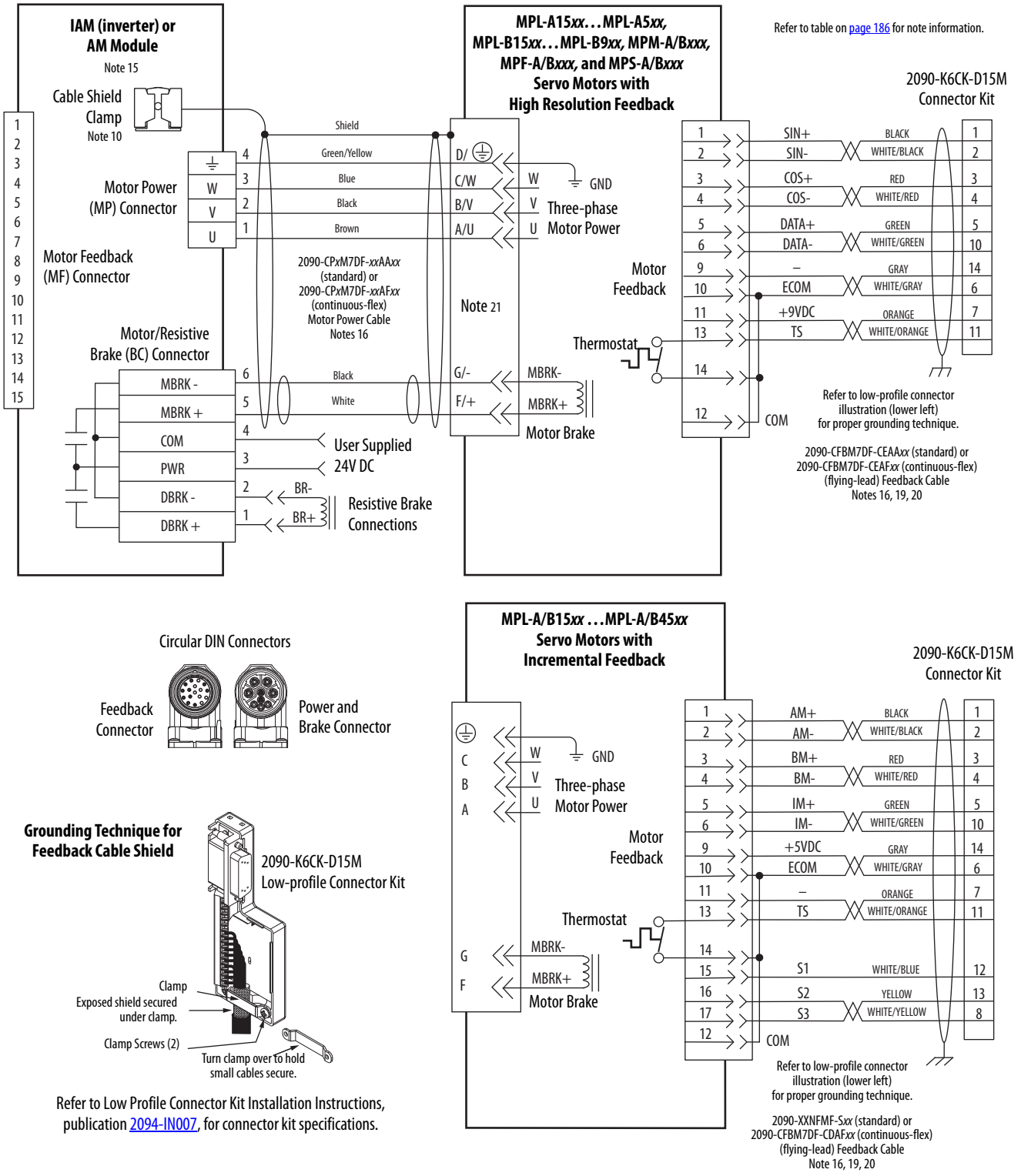
Figure 95 - AM Module with Kinetix MPL-A/B and Kinetix MPS-A/B Rotary Motors



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

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

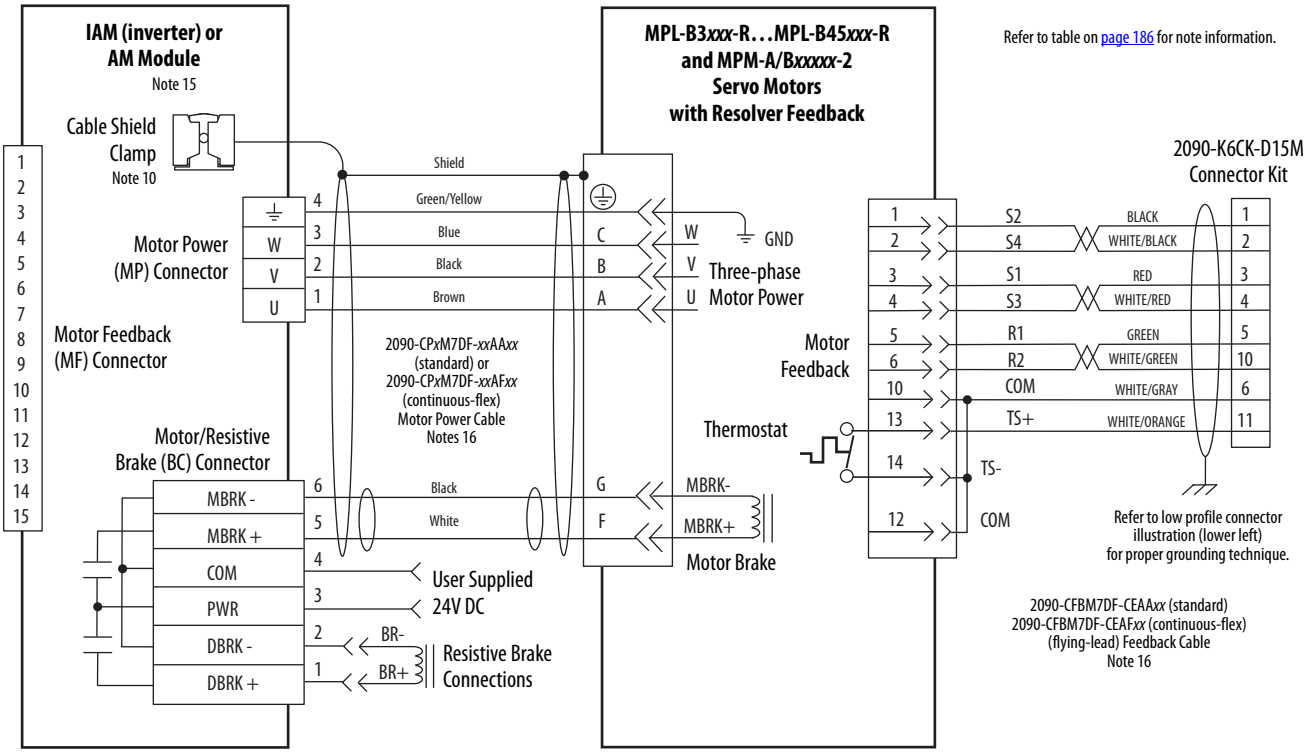
Figure 96 - AM Module with Kinetix MPL-A/B, MPM-A/B, MPF-A/B, and MPS-A/B Rotary Motors



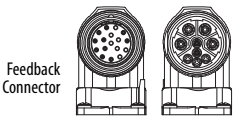
Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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

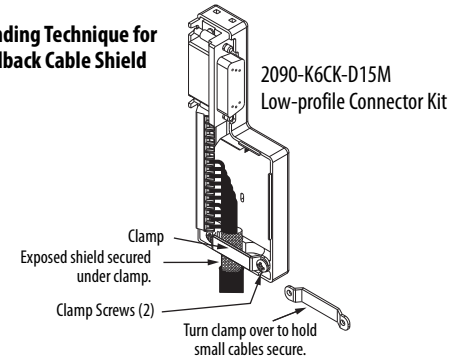
Figure 97 - AM Module Wiring Example with Kinetix MPL-B and MPM-A/B Resolver Motors



Circular DIN Connectors

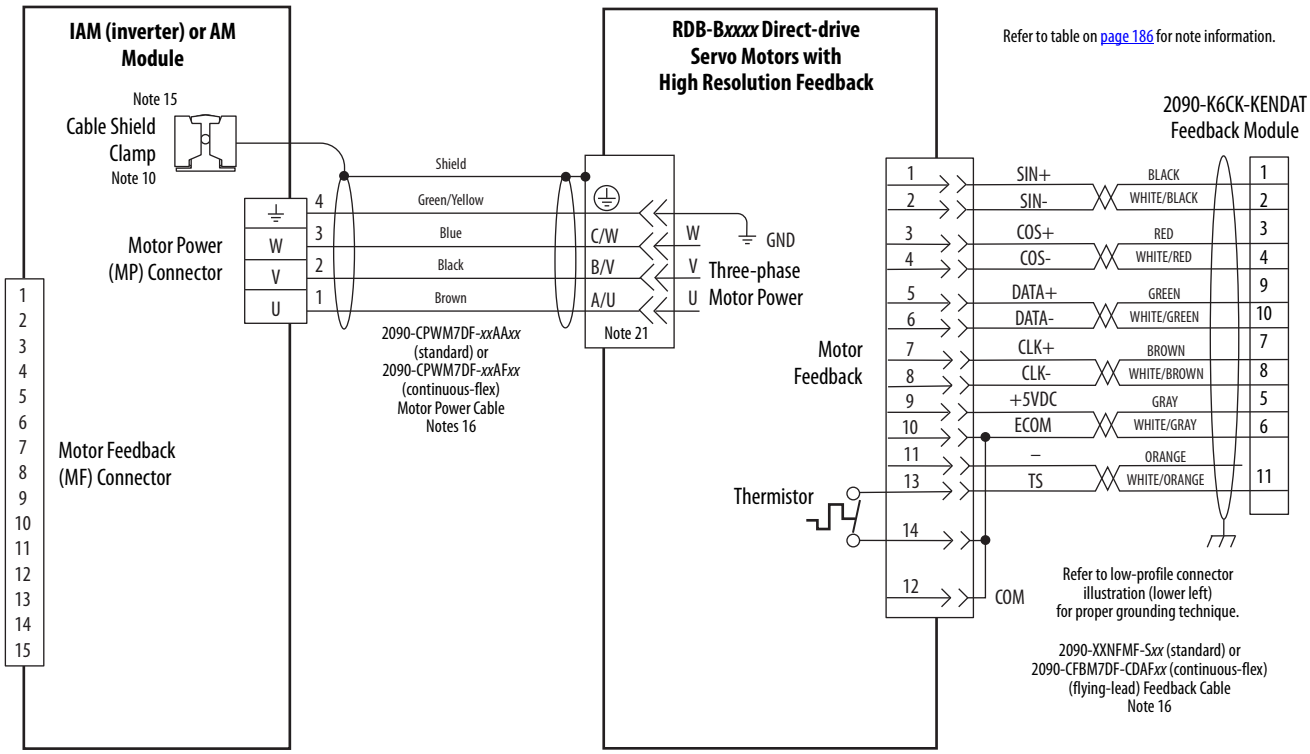


Grounding Technique for Feedback Cable Shield

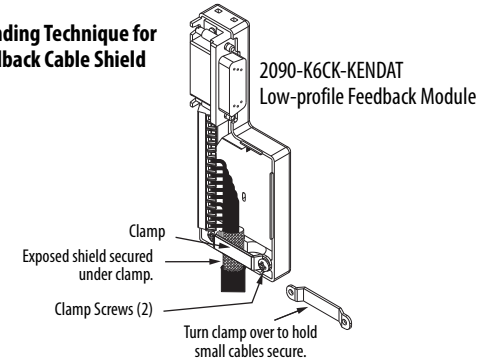


Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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

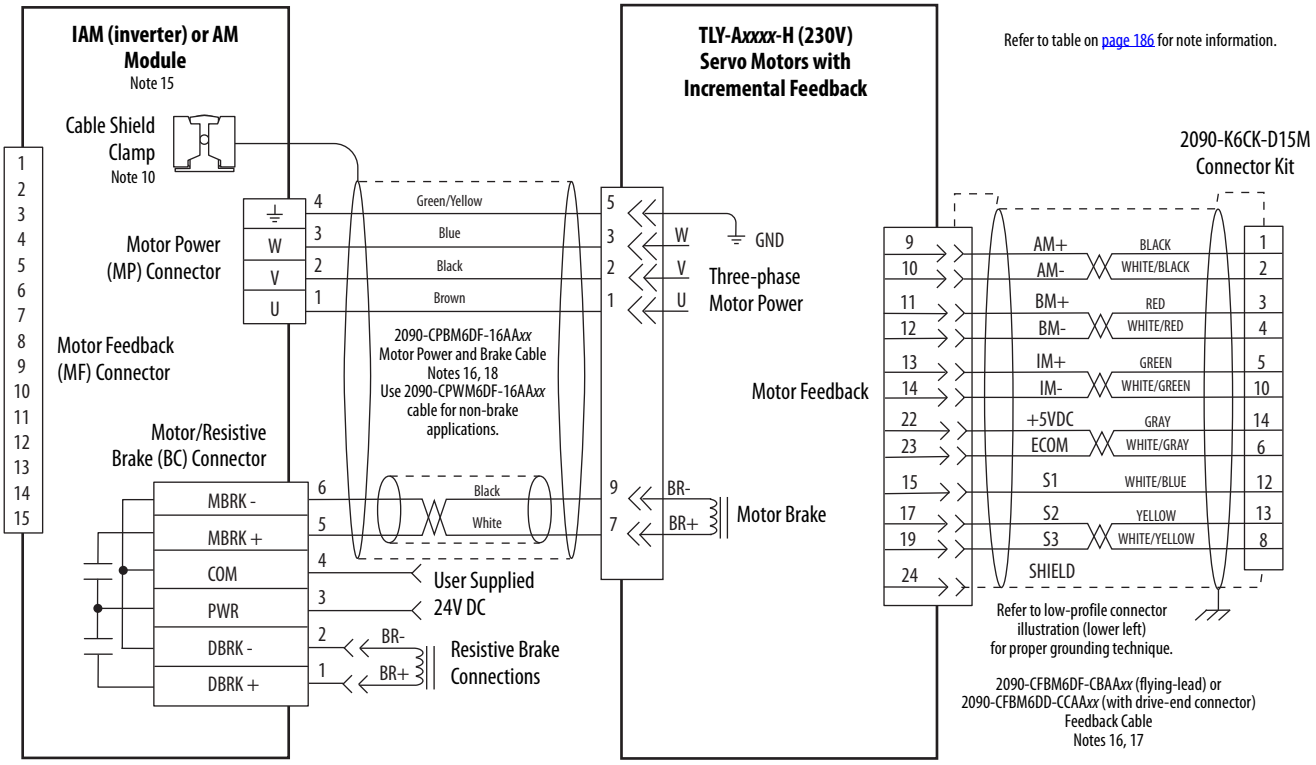


Grounding Technique for Feedback Cable Shield

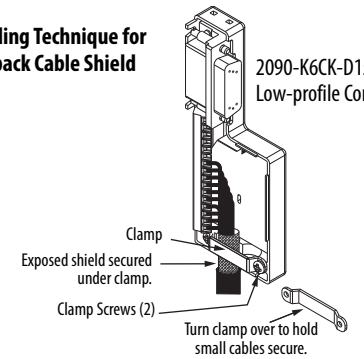


Refer to Low Profile EnDat Feedback Module Installation Instructions, publication 2090-IN020, for connector kit specifications.

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

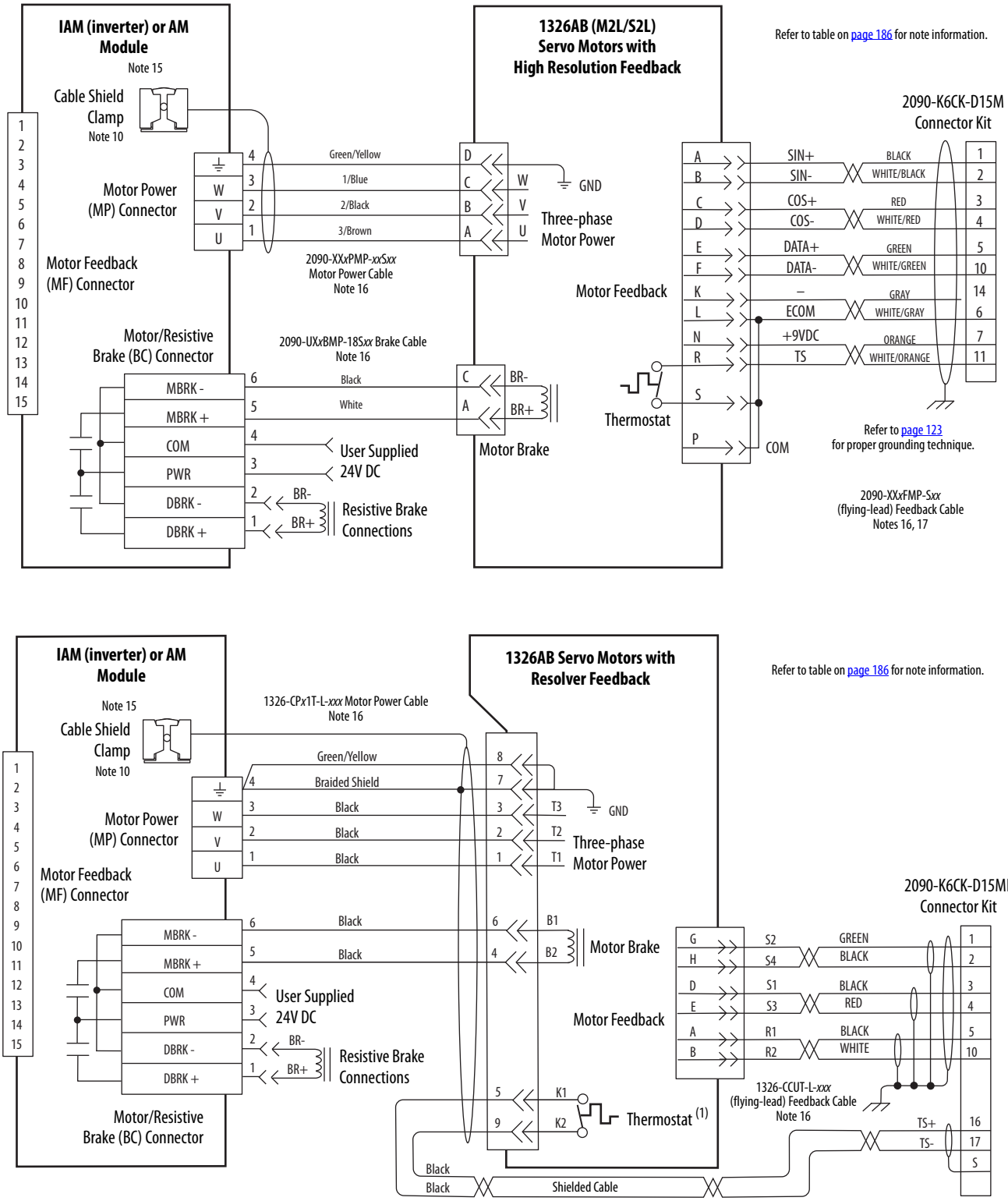


Grounding Technique for Feedback Cable Shield



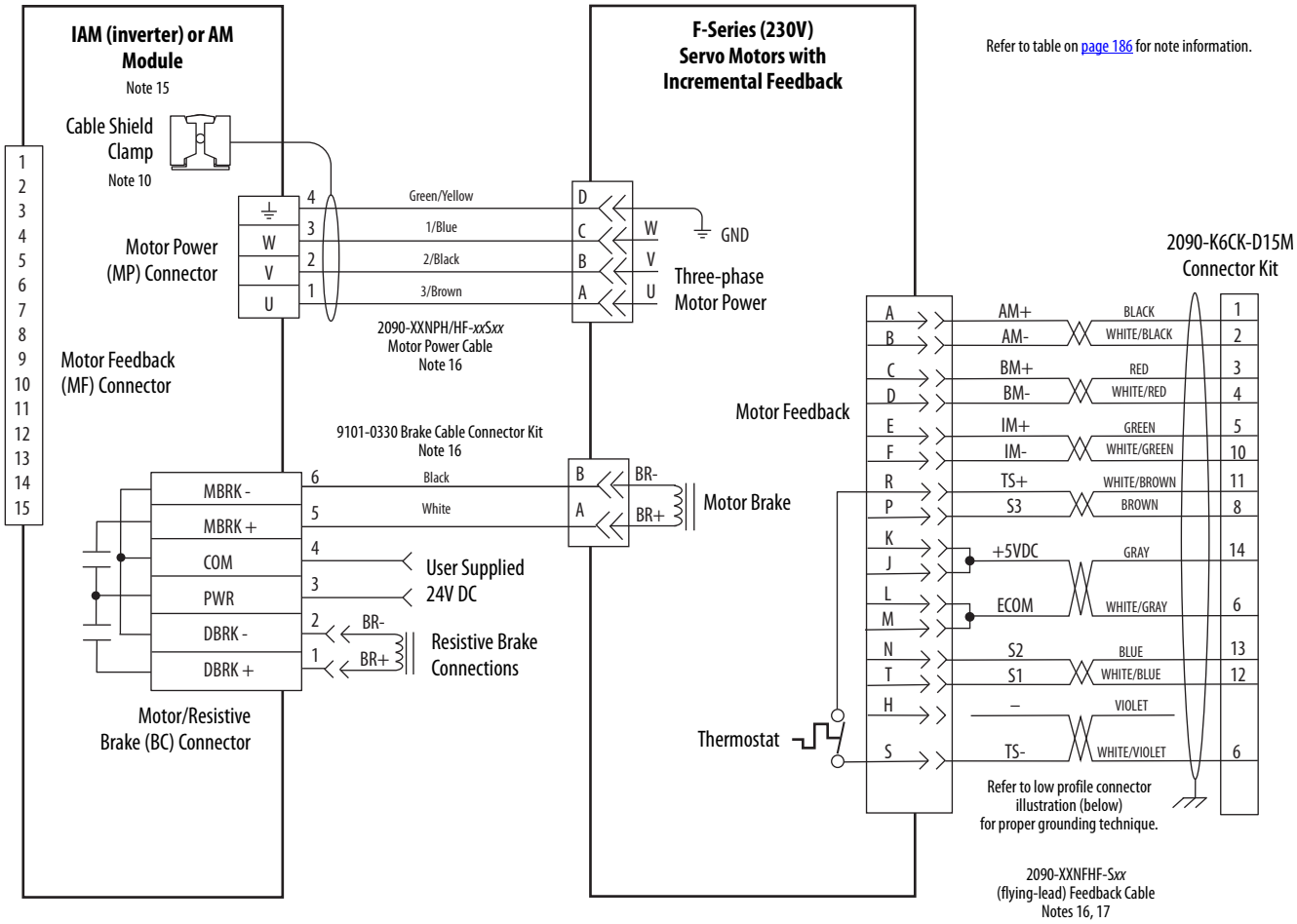
Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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

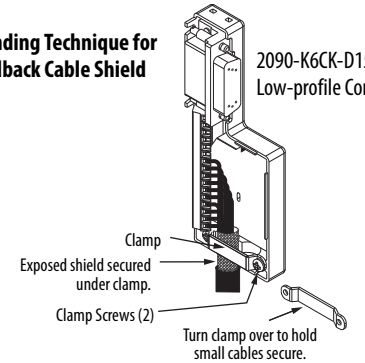


(1) When wiring the thermal switch on 1326AB (resolver-based) motors requires the use of the 2090-K6CK-D15MF Low-profile connector kit and wire extension to the power connector. Pins 16, 17, and S are filtered to prevent noise transmission back to the drive. Refer to page 123 for wiring instructions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

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



Grounding Technique for Feedback Cable Shield

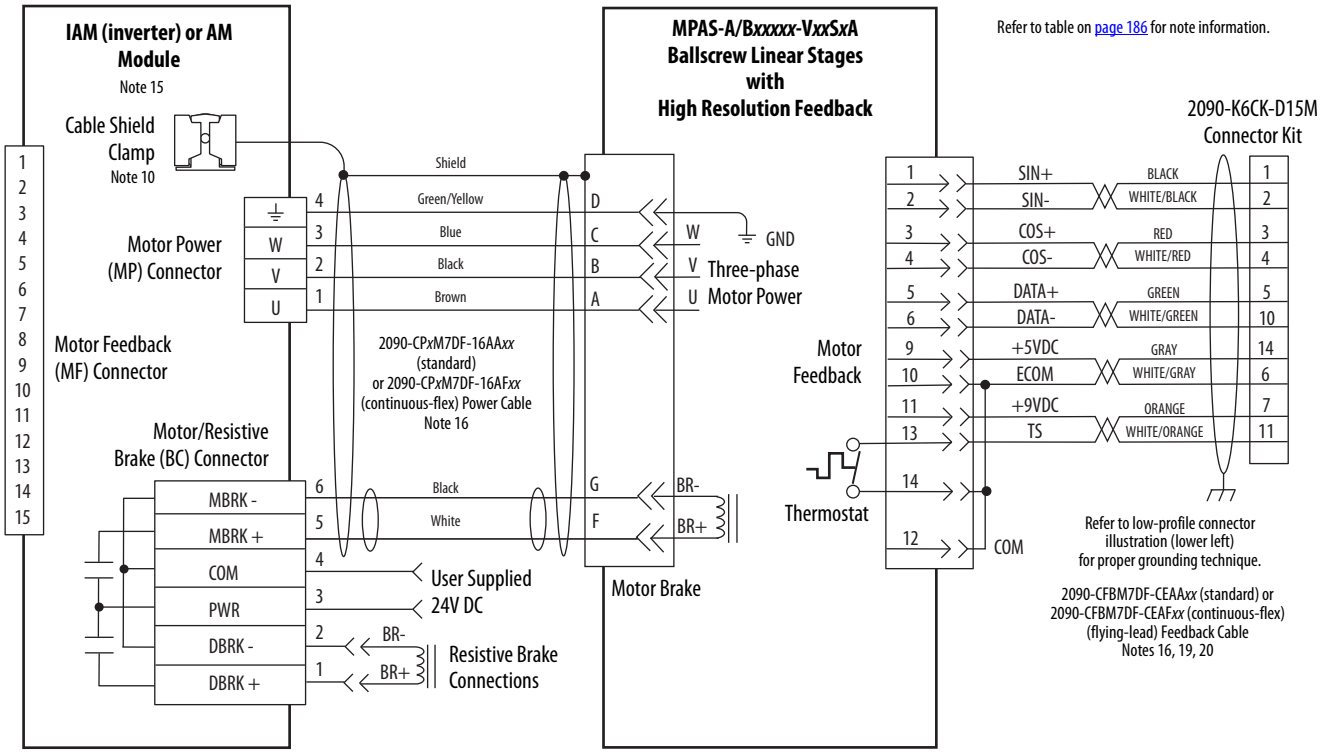


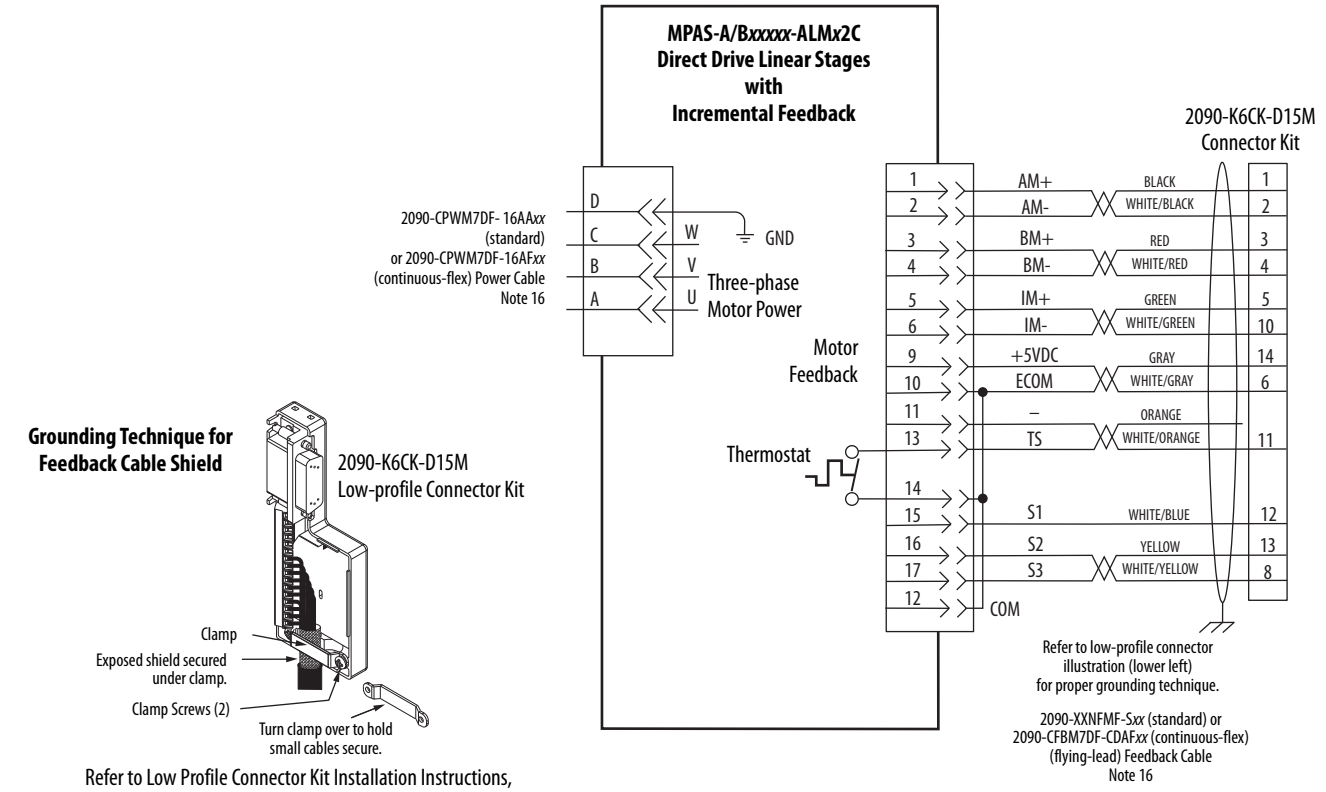
Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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

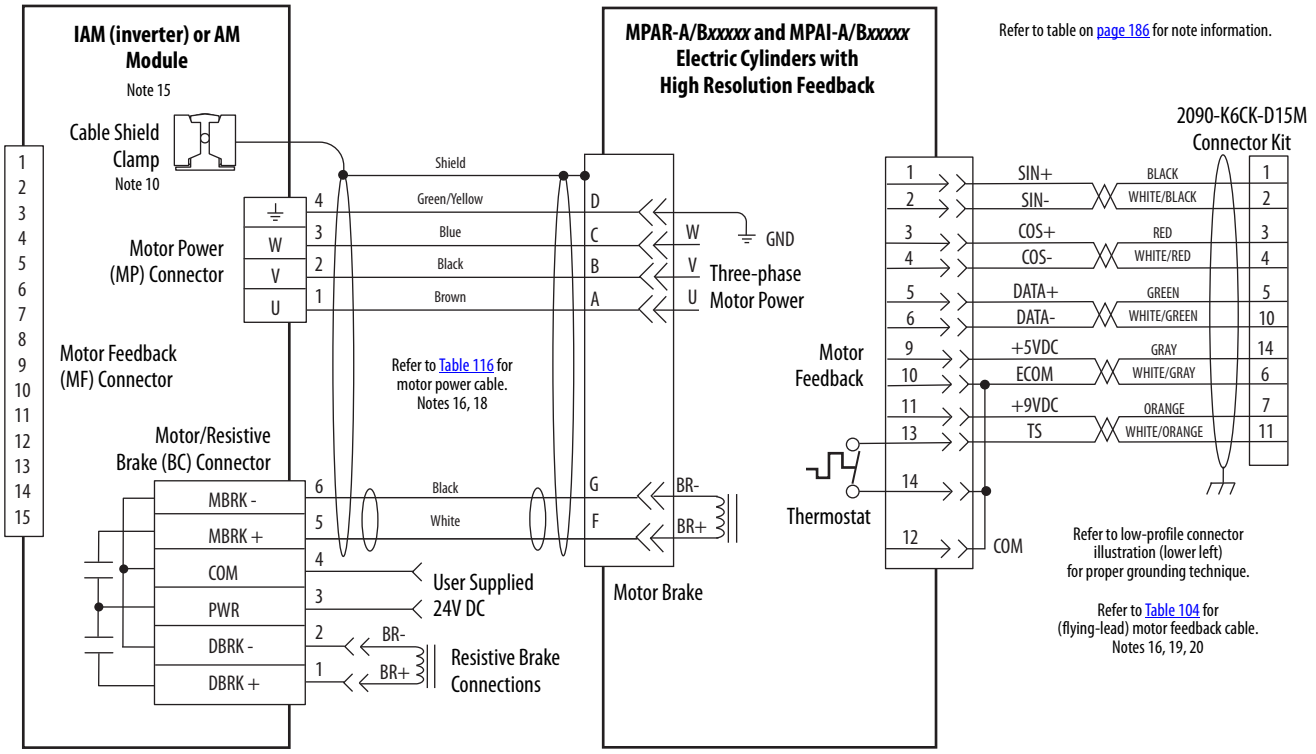




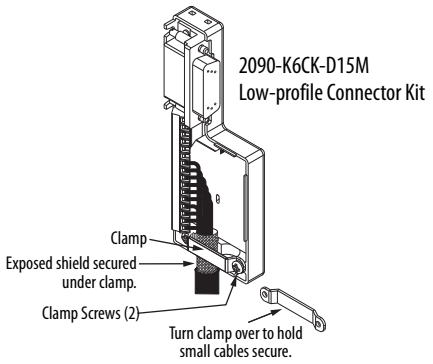
Grounding Technique for Feedback Cable Shield

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

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



Grounding Technique for Feedback Cable Shield



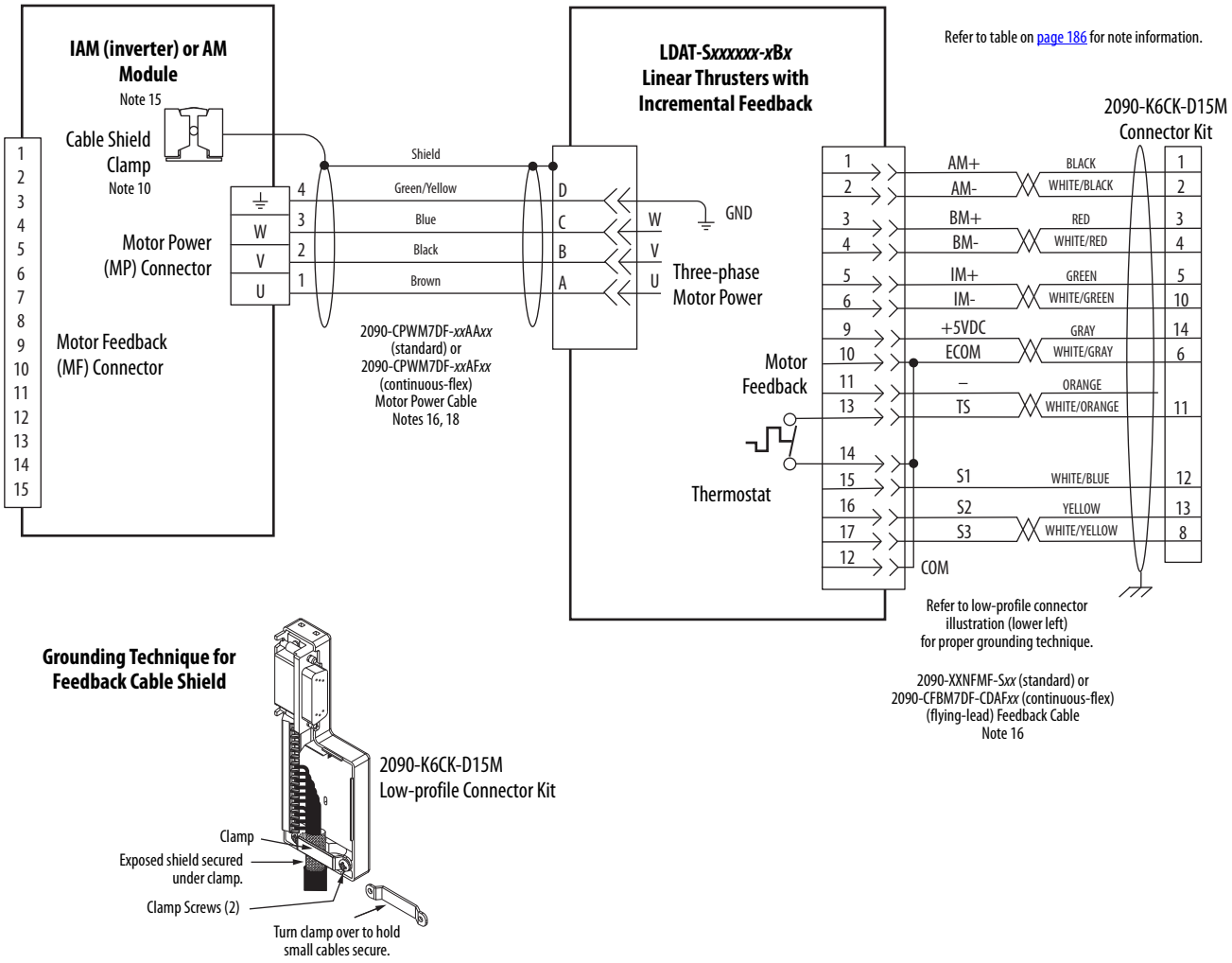
Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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*xxx* (series A) (1)	32	2090-XXNPMF-16S*xx* (standard) or 2090-CP*x*M4DF-16AF*xx* (continuous-flex)	2090-XXNFMF-S*xx* (standard) or 2090-CFBM4DF-CDAF*xx* (continuous-flex)
MPAR-A/B2*xxx* (series A)	40		
MPAR-A/B1*xxx* (series B)	32	2090-CP*x*M7DF-16AA*xx* (standard) or 2090-CP*x*M7DF-16AF*xx* (continuous-flex)	2090-CFBM7DF-CEAA*xx* (standard) or 2090-CFBM7DF-CEAF*xx* (continuous-flex)
MPAR-A/B2*xxx* (series B)	40		
MPAR-A/B3*xxx*	63		
MPAI-A/B2*xxxx*	64		
MPAI-A/B3*xxxx*	83		
MPAI-A/B4*xxxx*	110		
MPAI-B5*xxxx*	144		
MPAI-A5*xxxx*	144	2090-CP*x*M7DF-14AA*xx* (standard) or 2090-CP*x*M7DF-14AF*xx* (continuous-flex)	2090-CFBM7DF-CEAA*xx* (standard) or 2090-CFBM7DF-CEAF*xx* (continuous-flex)

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

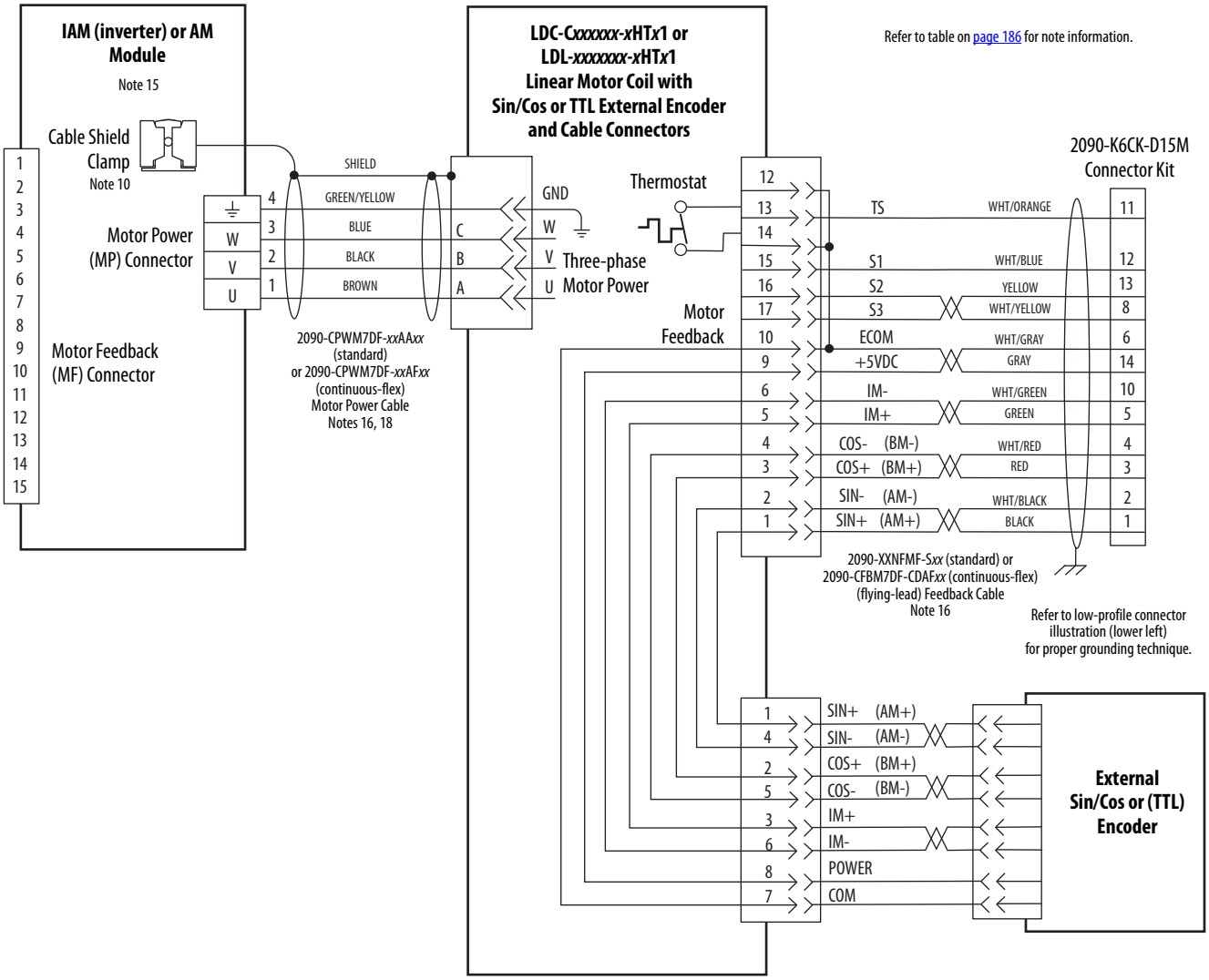
Figure 104 - AM Module with LDAT-Series Linear Thrusters



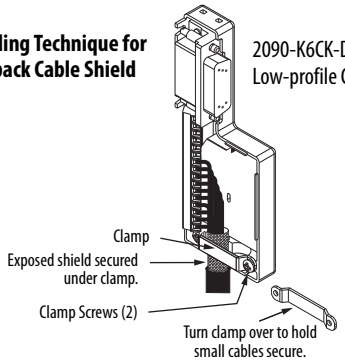
Grounding Technique for Feedback Cable Shield

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

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

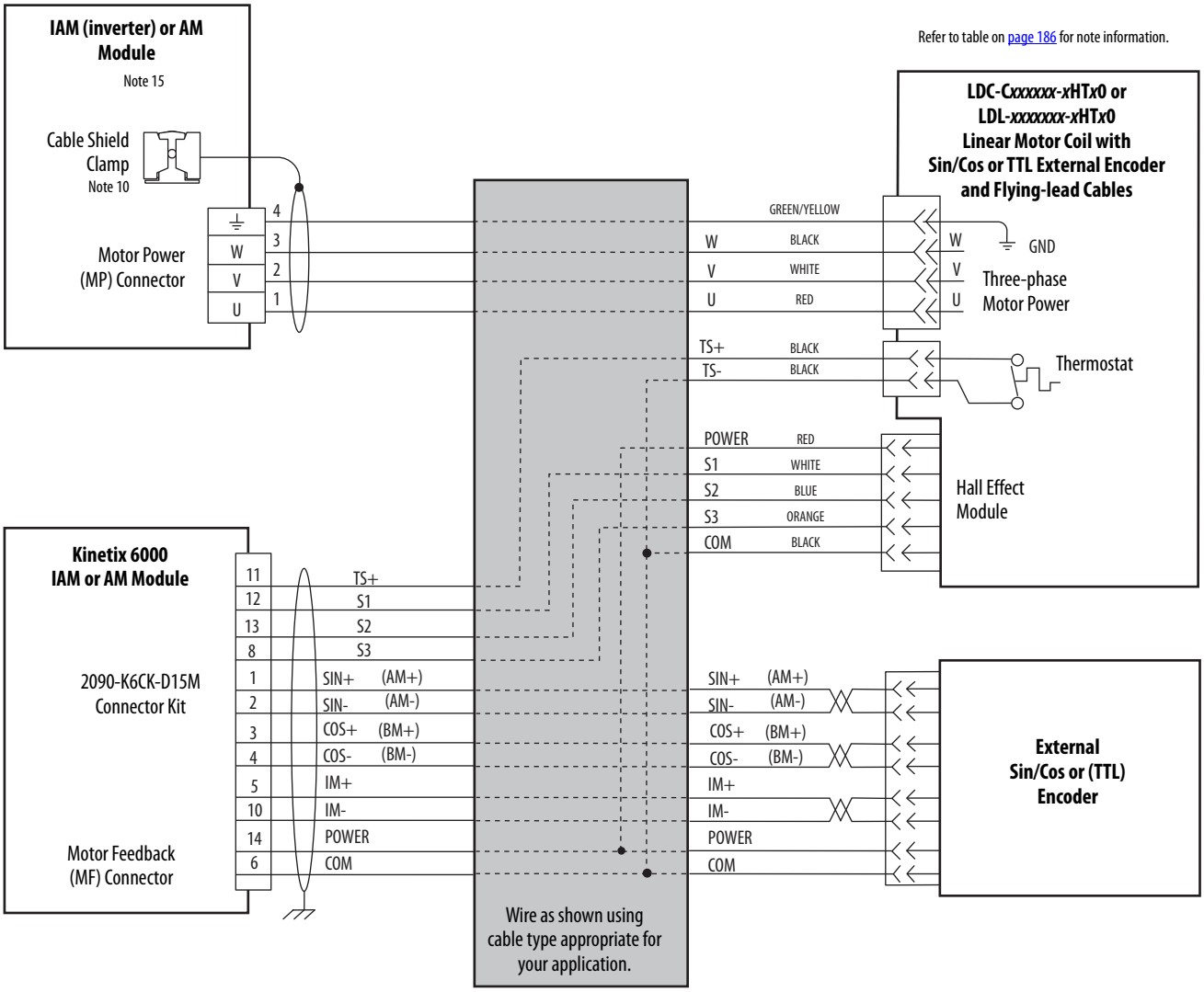


Grounding Technique for Feedback Cable Shield

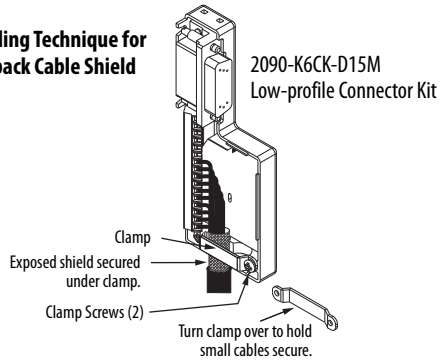


Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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



Grounding Technique for Feedback Cable Shield



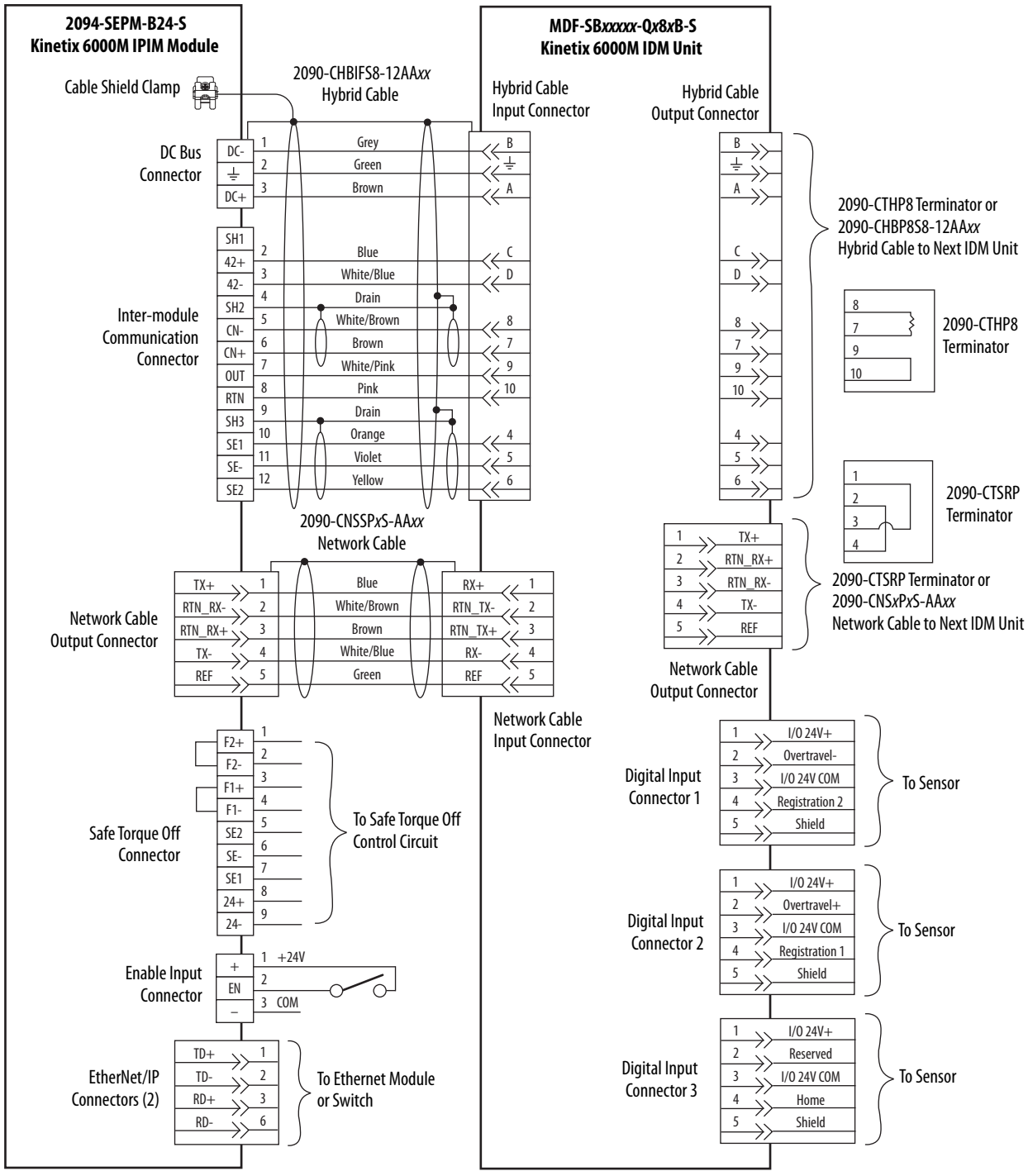
Refer to Low Profile Connector Kit Installation Instructions, publication 2094-IN007, for connector kit specifications.

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± 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	Brake Current Value, max		
	Series A	Series B	Series C and D
2094-AC05-M*xx*-*x*, 2094-AC09-M02-*x*, 2094-AMP5-*x*, 2094-AM01-*x*, 2094-AM02-*x*	1.0 A	N/A	3.0 A
2094-BC01-M*xx*-*x*, 2094-BC02-M02-*x*, 2094-BMP5-*x*, 2094-BM01-*x*, 2094-BM02-*x*		3.0 A	
2094-AC16-M03-*x*, 2094-AC32-M05-*x*, 2094-AM03-*x*, 2094-AM05-*x*	1.3 A	N/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
MPL-*x*1510, MPL-*x*1520, MPL-*x*1530	0.43…0.53 A
MPL-*x*210, MPL-*x*220, MPL-*x*230	0.46…0.56 A
MPL/MPF-*x*310, MPL/MPF-*x*320, MPL/MPF-*x*330	0.45…0.55 A
MPS-*x*330, MPM-*x*115, MDF-SB1003	
MPL-*x*420, MPL-*x*430, MPL-*x*4520, MPL-*x*4530, MPL-*x*4540, MPL-*x*4560	0.576…0.704 A
MPF-*x*430, MPF-*x*4530, MPF-*x*4540	
MPS-*x*4540, MPM-*x*130, MDF-SB1153, MDF-SB1304	

Compatible Brake Motors	Coil Current
TLY-A110T-H, TLY-A120T-H, and TLY-A130T-H	0.18…0.22 A
TLY-A220T-H and TLY-A230T-H	0.333…0.407 A
TLY-A2530P-H, TLY-A2540P-H, and TLY-A310M-H	0.351…0.429 A
1326AB-B4*xxx*	0.88 A
F-4030, F-4050, and F-4075	0.69 A

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

Compatible Brake Motors (1)	Coil Current
MPL-*x*B520, MPL-*x*B540, MPL-*x*560, MPL-*x*580	1.05…1.28 A
MPF-*x*540, MPS-B560, MPM-*x*165	

Compatible Brake Motors	Coil Current
F-6100, F-6200, and F-6300	1.30 A
1326AB-B5*xxx*, and 1326AB-B7*xxx*	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 ≤ 3.0 A

Compatible Brake Motors	Coil Current
MPL-B640, MPL-B660, MPL-B680	1.91…2.19 A
MPL-B860, MPL-B880	2.05…2.50 A
MPM-*x*215	1.84…2.25 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 Additional Resources on page 10. for the documentation available for those products.

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

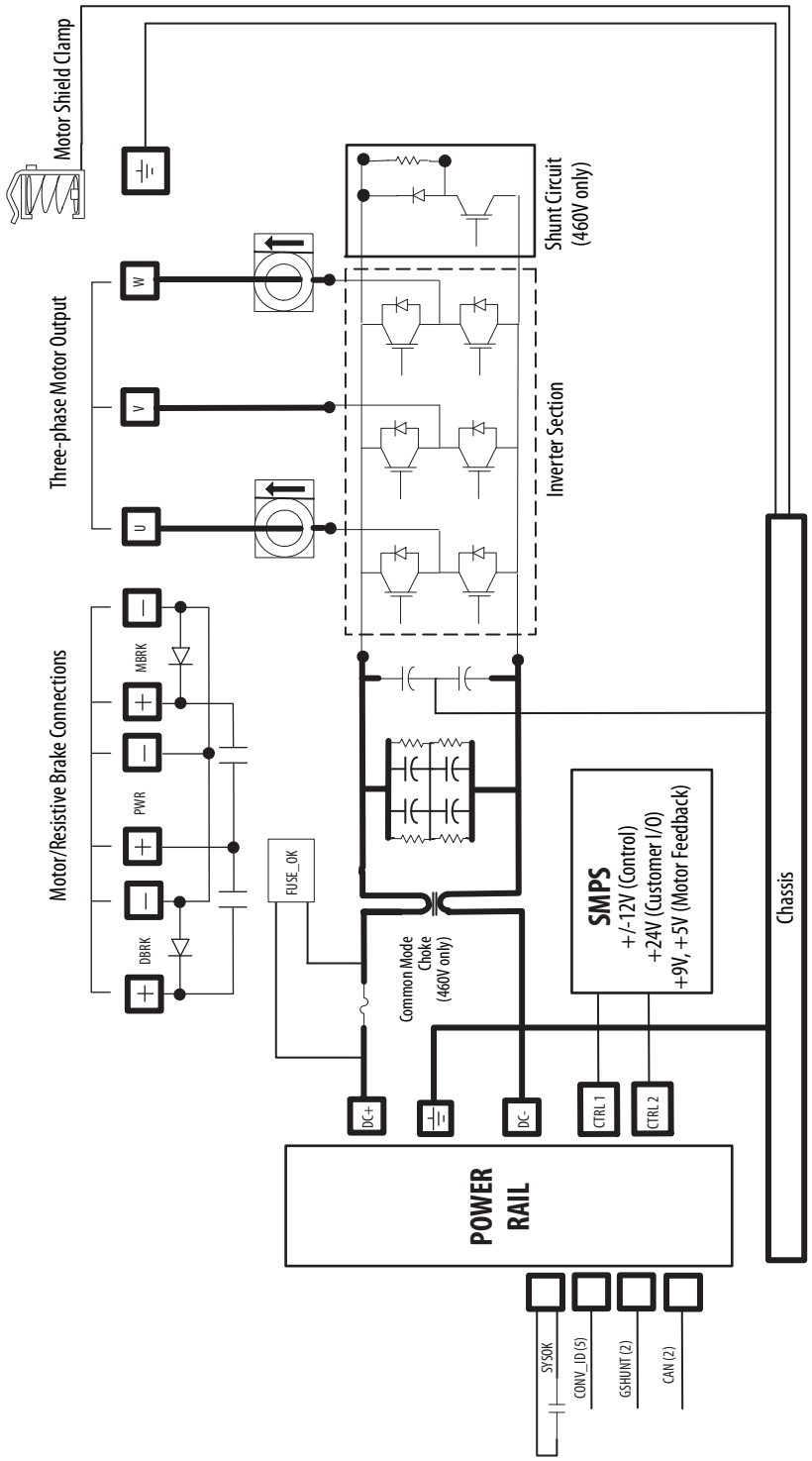
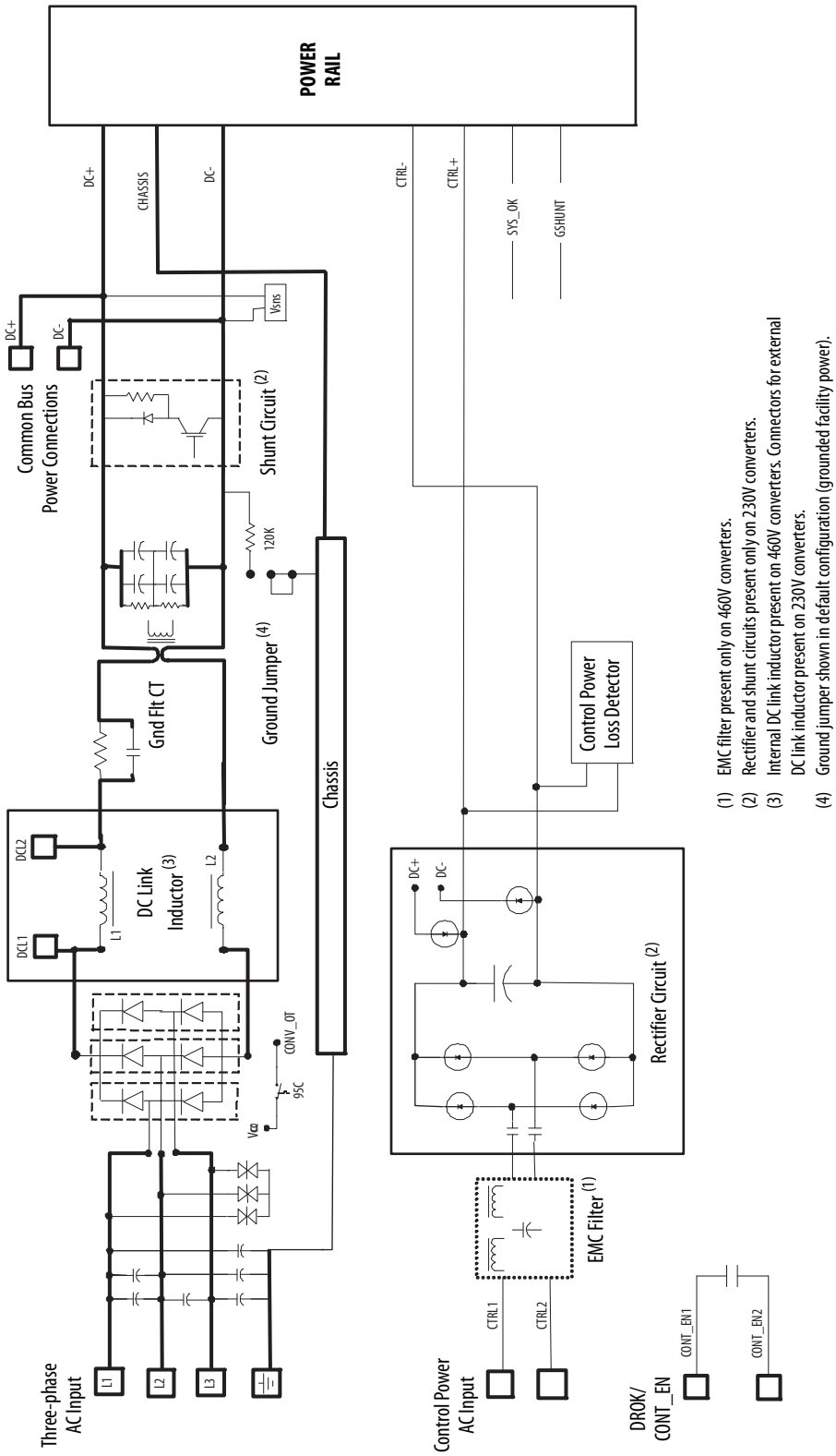
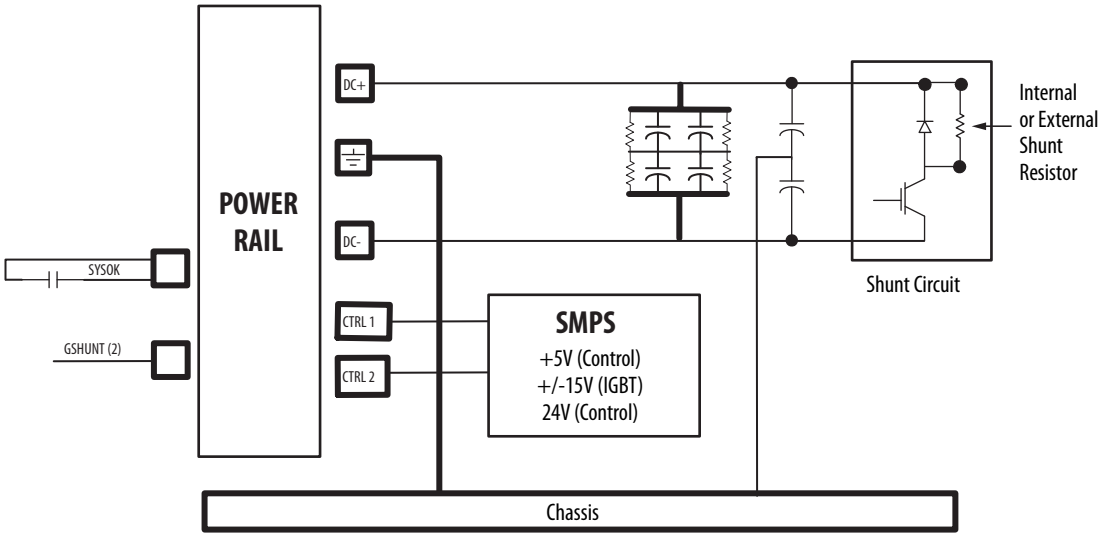


Figure 109 - IAM Module (converter) Block Diagram



(1) EMC filter present only on 460V converters.
(2) Rectifier and shunt circuits present only on 230V converters.
(3) Internal DC link inductor present on 460V converters. Connectors for external DC link inductor present on 230V converters.
(4) Ground jumper shown in default configuration (grounded facility power).

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.

Upgrade Kinetix 6000M System Firmware

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 2094-UM003.

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 Studio 5000 Logix Designer®	RSLogix 5000 software	15.*x* or later
	Logix Designer application	21.*x* or later
ControlLogix® Sercos module	1756-M*xx*SE	15.32 or later
	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 module you want to upgrade		
Network path to the targeted IAM/AM module.		

(1) Download the ControlFLASH kit from http://support.rockwellautomation.com/controlflash. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.
For more ControlFLASH information (not drive specific), refer to the ControlFLASH Firmware Upgrade Kit User Manual, publication 1756-UM105.

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

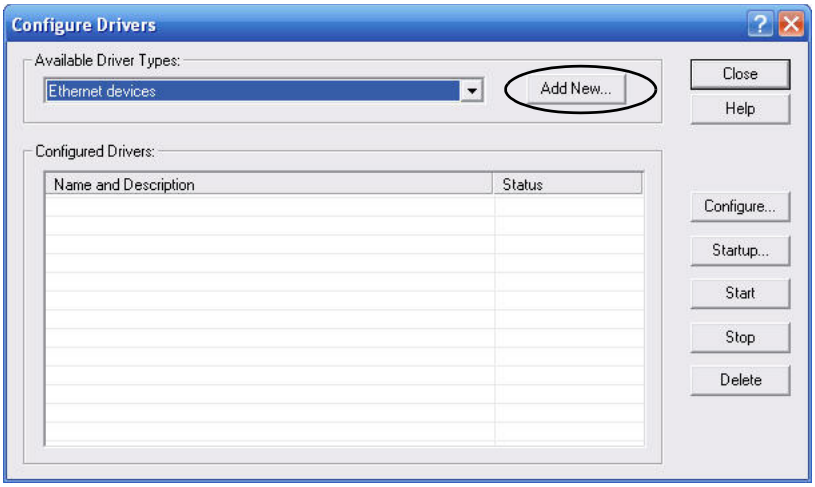
This procedure assumes that your communication method to the Logix 5000™ controller is using the Ethernet protocol. It is also assumed that your Logix 5000 Ethernet module has already been configured.

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

Follow these steps to configure Logix 5000 communication.

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

   The Configure Drivers dialog box opens.

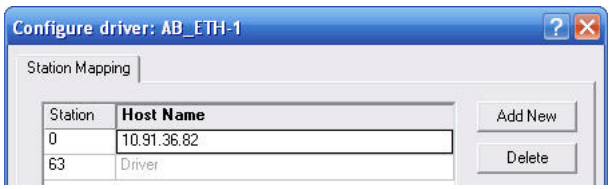


3. From the Available Drive Types pull-down menu, choose Ethernet devices.
4. Click Add New.

   The Add New RSLinx Classic Driver dialog box opens.
5. Type the new driver name.

6. Click OK.

   The Configure driver dialog box opens.

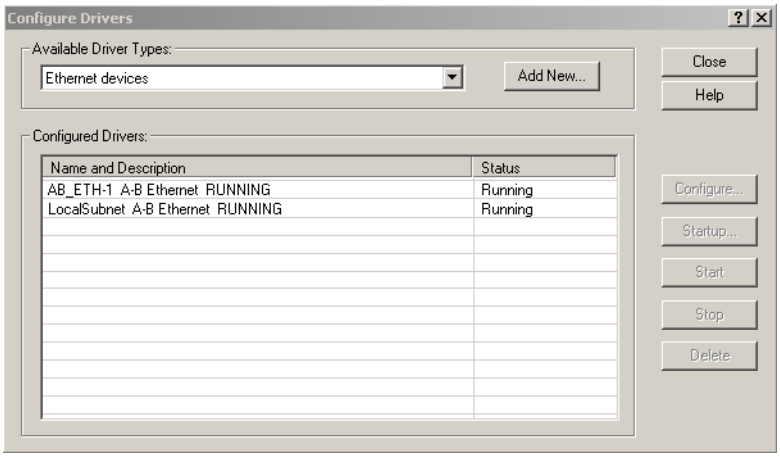


7. Type the IP address of your Logix 5000 Ethernet module.

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

8. Click OK.

   The new Ethernet driver appears under Configured Drivers.



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.

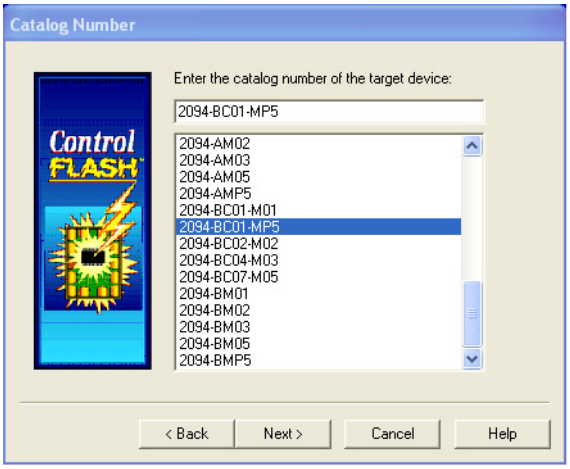
   You can access the ControlFLASH software by either of these methods:

   - 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.

2. Click Next.

   The Catalog Number dialog box opens.

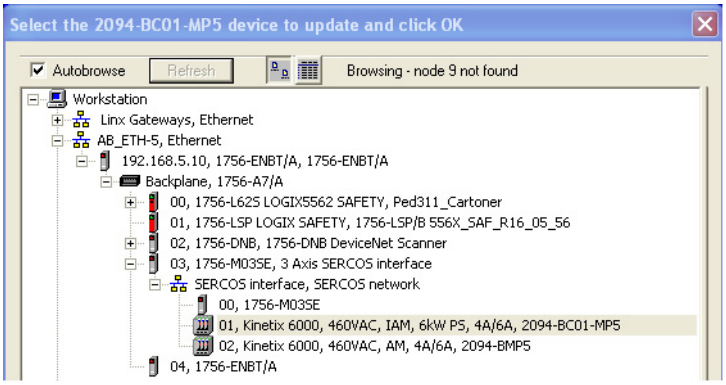


3. Select your drive module.

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

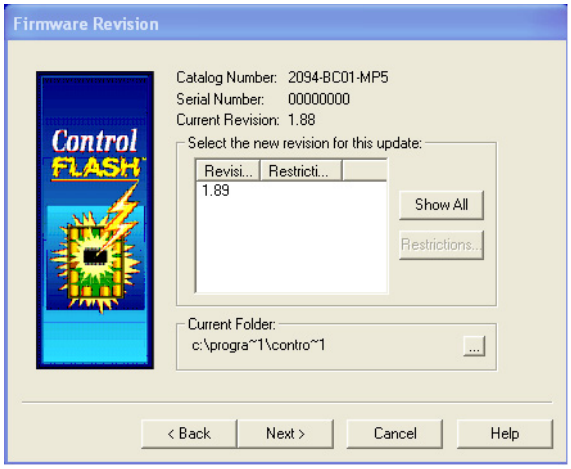
4. Click Next.

The Select Device to Update dialog box opens.



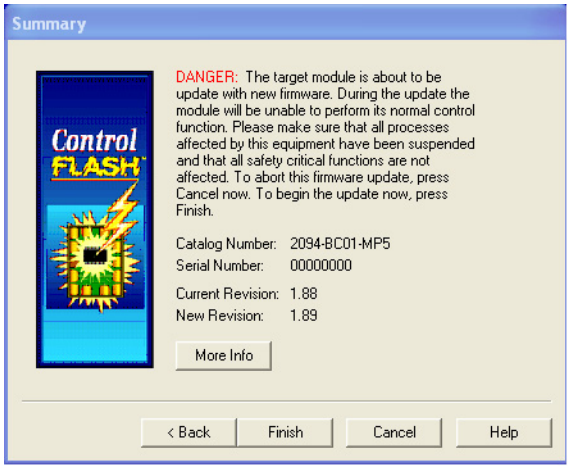
5. Expand your Ethernet node, Logix 5000 backplane, and EtherNet/IP network module.
6. Select the servo drive to upgrade.
7. Click OK.

   The Firmware Revision dialog box opens.



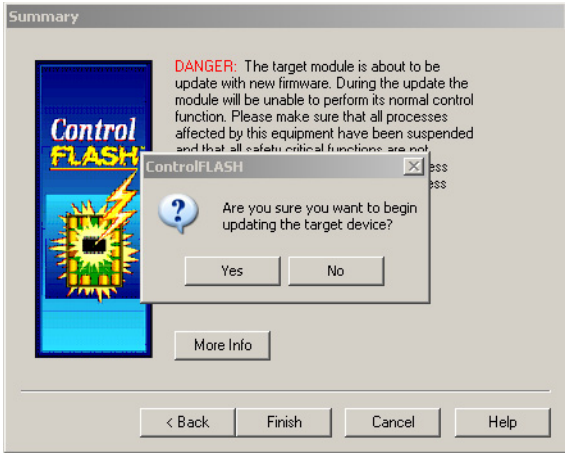
8. Select the firmware revision to upgrade.
9. Click Next.

The Summary dialog box opens.



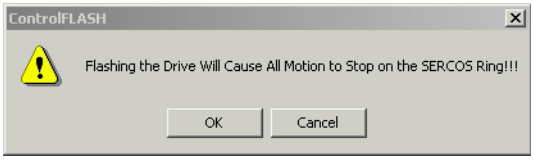
10. Confirm the drive catalog number and firmware revision.
11. Click Finish.

    This ControlFLASH warning dialog box opens.



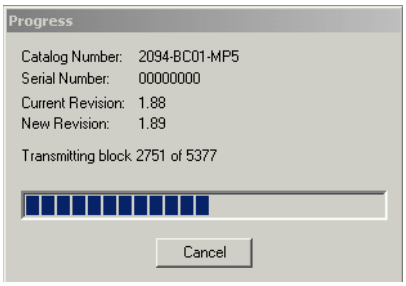
12. Click Yes (only if you are ready).

    This ControlFLASH warning dialog box opens.



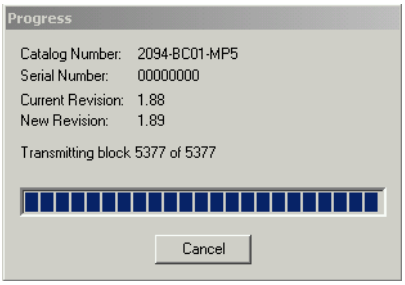
13. Acknowledge the warning and click OK.

The Progress dialog box opens and upgrading begins.



The drive module seven-segment status indicator changes from the fixed 2, 3, or 4 to F, which indicates that upgrading is in progress.

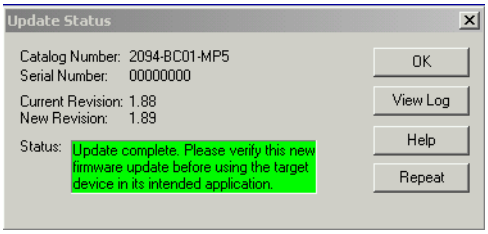
After the upgrade information is sent to the drive, the drive resets and performs diagnostic checking.



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

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

Upgrading Status	If
Success	1. Update complete appears in a GREEN Status dialog box. 2. Go to step 16.
Failure	1. Update failure appears in a RED Status dialog box. 2. Refer to ControlFLASH Firmware Upgrade Kit Quick Start, publication 1756-QS105, for troubleshooting information.



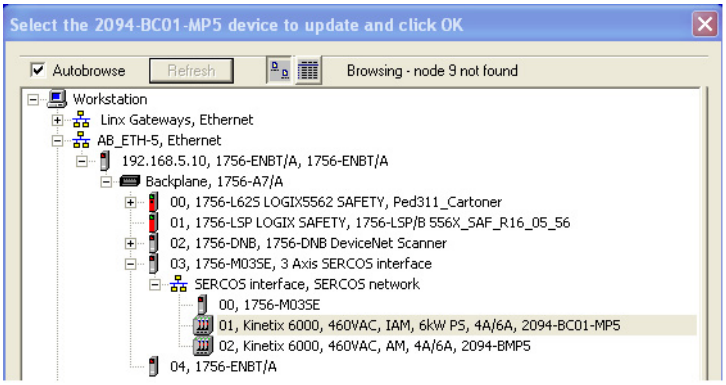
16. Click OK.

Verify the Firmware Upgrade

Follow these steps to verify your firmware upgrade was successful.

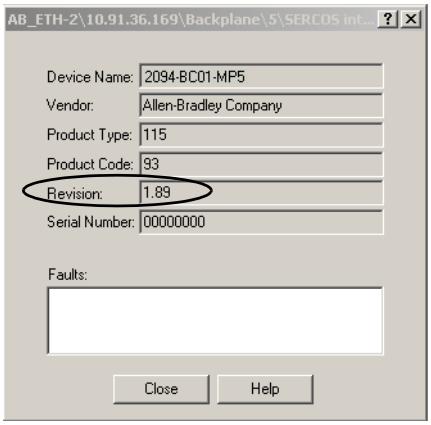
TIP Verifying the firmware upgrade is optional.

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.

   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 multi-axis drive systems configured for DC common bus. The procedure involves calculating capacitance values and setting the Additional Bus Capacitance parameter by using DriveExplorer® software.

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

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

Before You Begin

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
- 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-*x*	7145	2094-BC01-MP5-*x*	4585
2094-AC05-M01-*x*		2094-BC01-M01-*x*	
2094-AC09-M02-*x*	15,295	2094-BC02-M02-*x*	8955
2094-AC16-M03-*x*	34,400	2094-BC04-M03-*x*	8955
2094-AC32-M05-*x*	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

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 page 230.

Bulletin 2094 Drive Capacitance Values

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-*x*	270
2094-AC05-M01-*x*	
2094-AC09-M02-*x*	540
2094-AC16-M03-*x*	1320
2094-AC32-M05-*x*	1980

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

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

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

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

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

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

Table 125 - IPIM Module (400V-class)

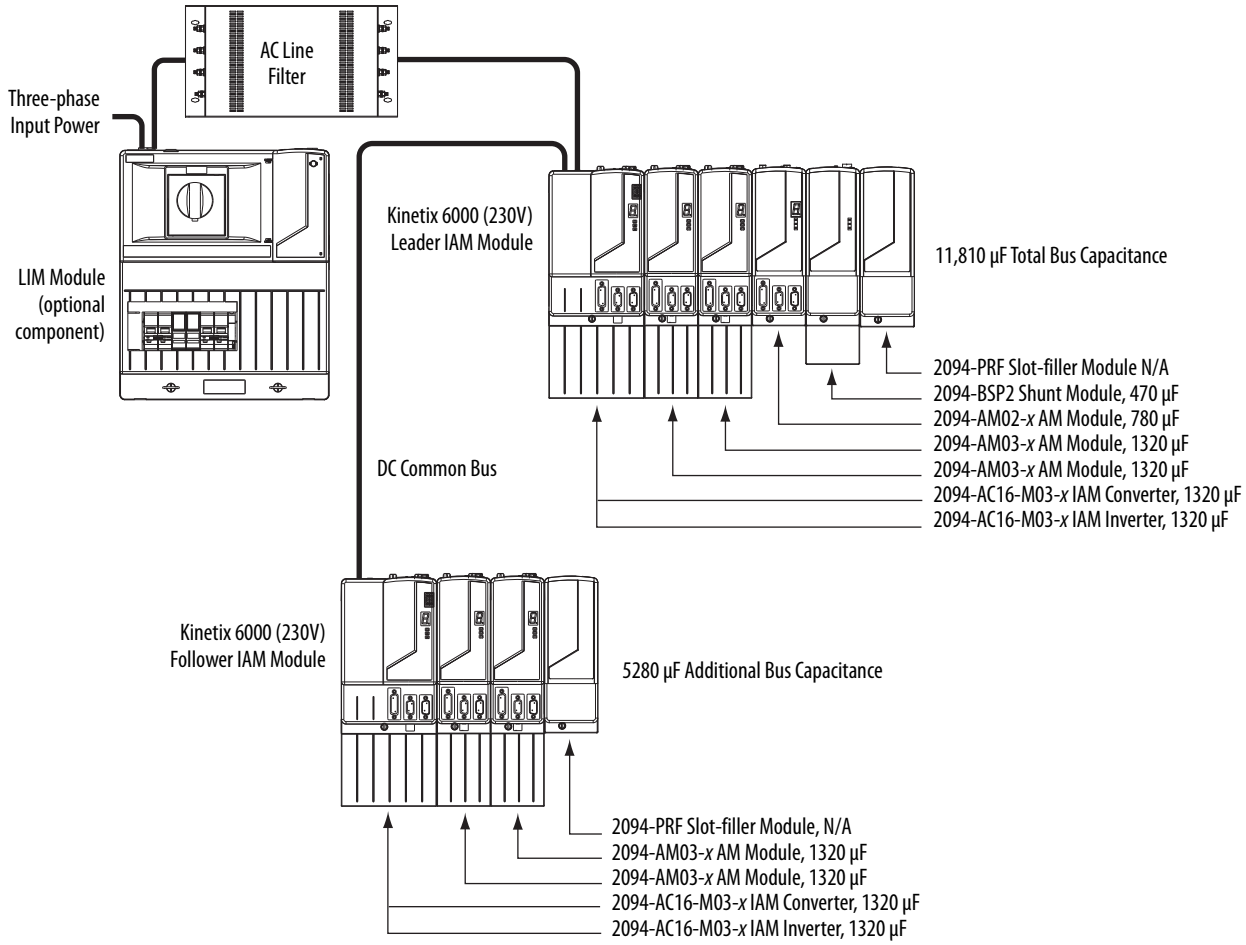
IPIM Module (400V-class)	Capacitance µF
2094-SEPM-B24-S	840

Common Bus Capacitance Example

In this example, the sum of the leader IAM power rail modules capacitance (6530 µF) and the follower IAM power rail modules capacitance (5280 µF) 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 page 251 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-RLD300*xx*E	21.0 or later
RSLogix 5000® software		15.0 or later

(1) Refer to DriveExplorer Getting Results Manual, publication 9306-GR001, for instructions.
(2) Additional information regarding these communication and software tools is available at http://www.ab.com/support/abdrives.
(3) Refer to 1203-SSS (series B) FRN 3.*xxx* User Manual, publication 20COMM-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.

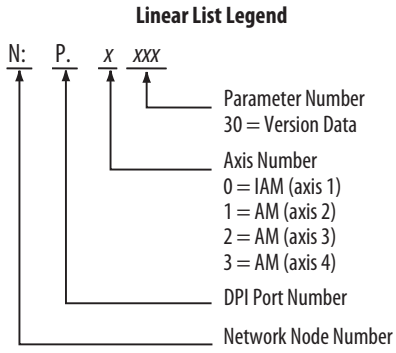
   Fiber-optic cable connections (Tx and Rx) are on the top of each IAM and AM module.
3. Re-apply three-phase and control power.

Set the Additional Bus Capacitance Parameter

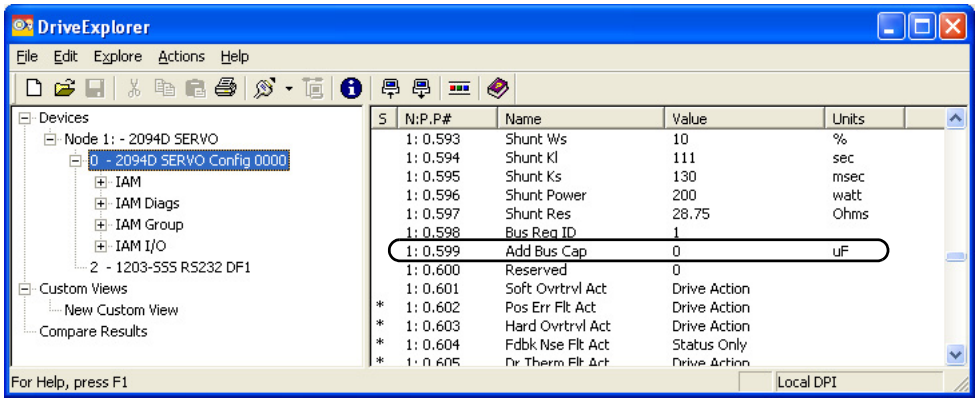
Follow these steps to set the Additional Bus Capacitance parameter.

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.

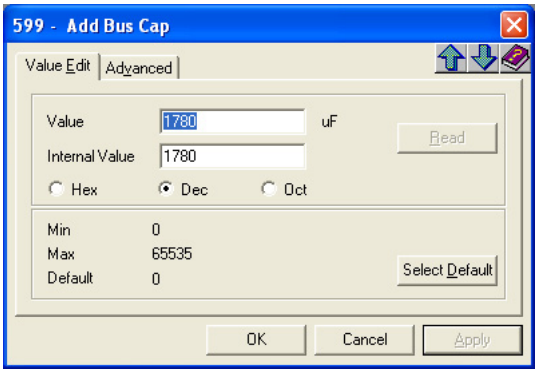


4. Choose Devices>Node>Product and navigate to the parameter *x:x:x*599 as shown below.



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

The command dialog box for parameter *x*599 - Add Bus Cap opens.



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

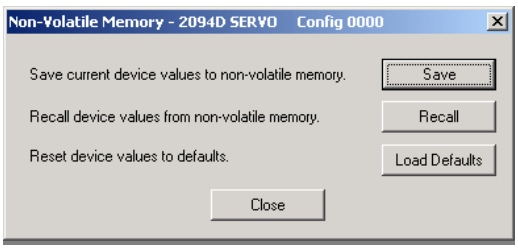
   The Add Bus Cap value is changed, but not saved in nonvolatile memory.

Save the Add Bus Cap Parameter to Nonvolatile Memory

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

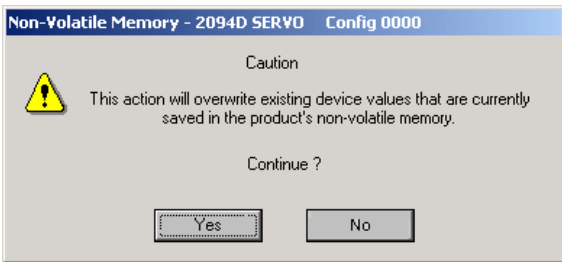
1. From the Actions menu, choose Nonvolatile Memory.

   This message dialog box opens.



2. Click Save.

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



3. Click Yes.

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

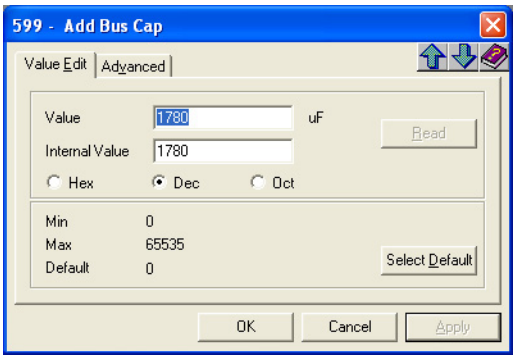
4. Click OK.
5. Close the DriveExplorer software.

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.



4. Verify the new parameter value.

   In this example, the new value is 1780 µF.
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.

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

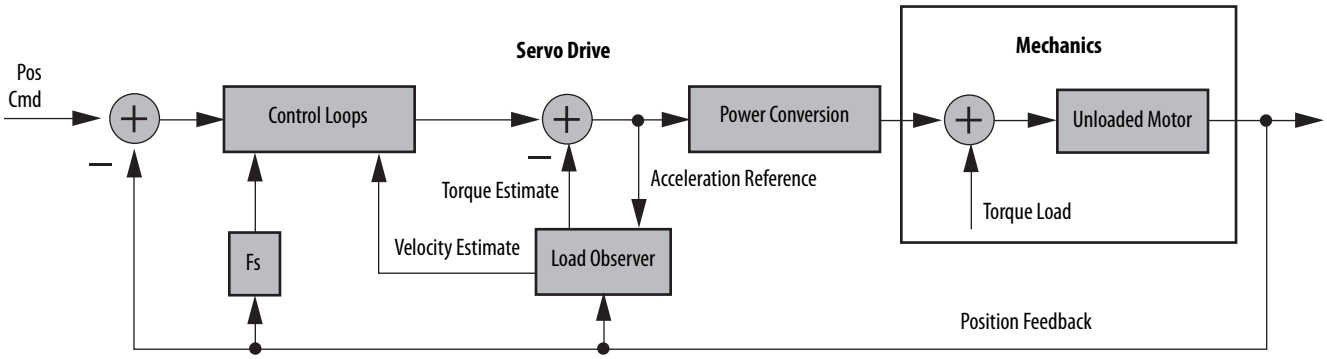
When used with auto-tuned controller gains, load observer does the following.

- 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 127 - Load Observer 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)

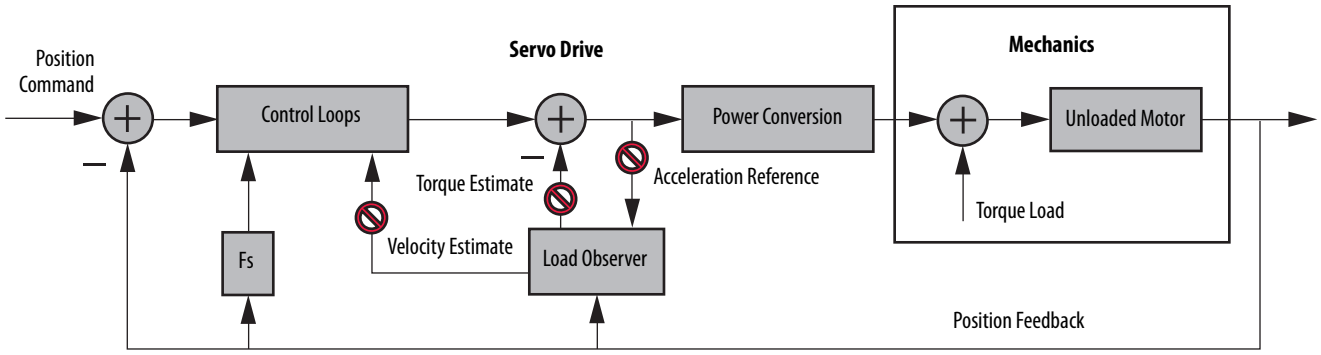


Figure 114 - Load Observer Only Configuration (Value 1)

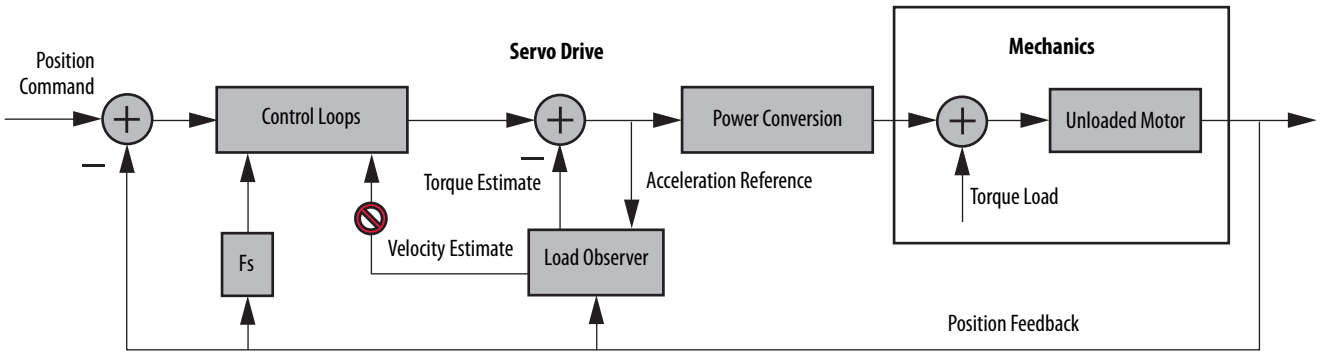


Figure 115 - Load Observer with Velocity Estimate Configuration (Value 2)

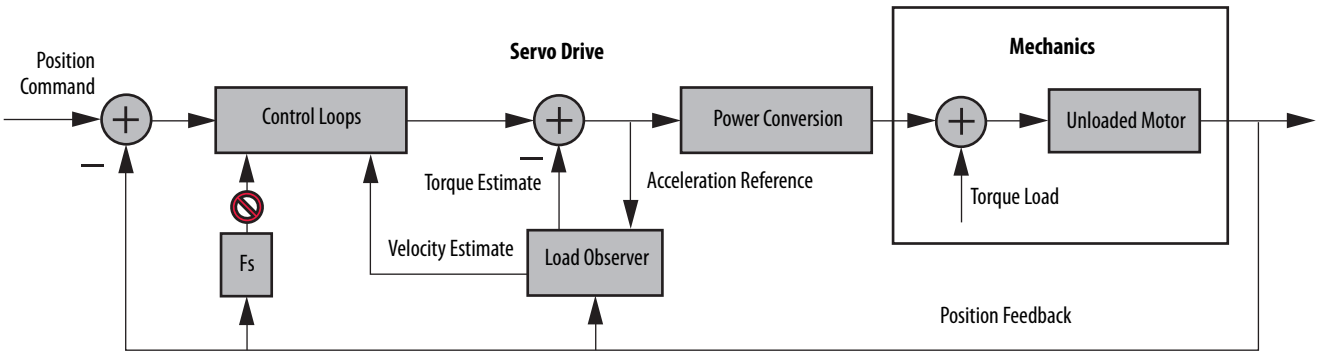


Figure 116 - Velocity Estimate Only Configuration (Value 3)

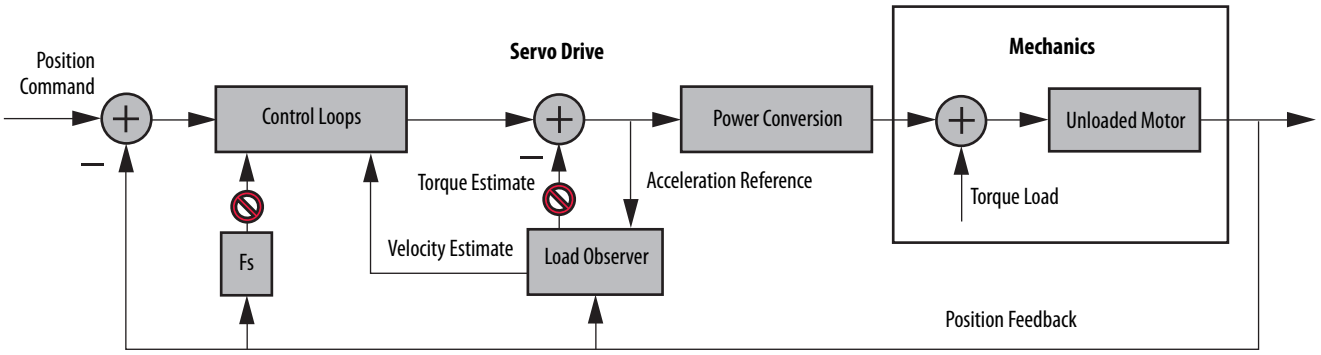
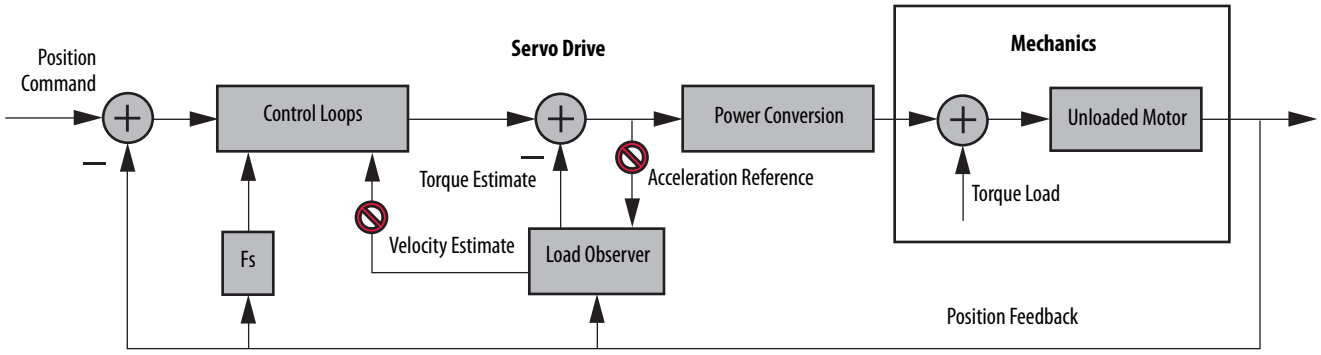


Figure 117 - Acceleration Feedback Configuration (Value 4)

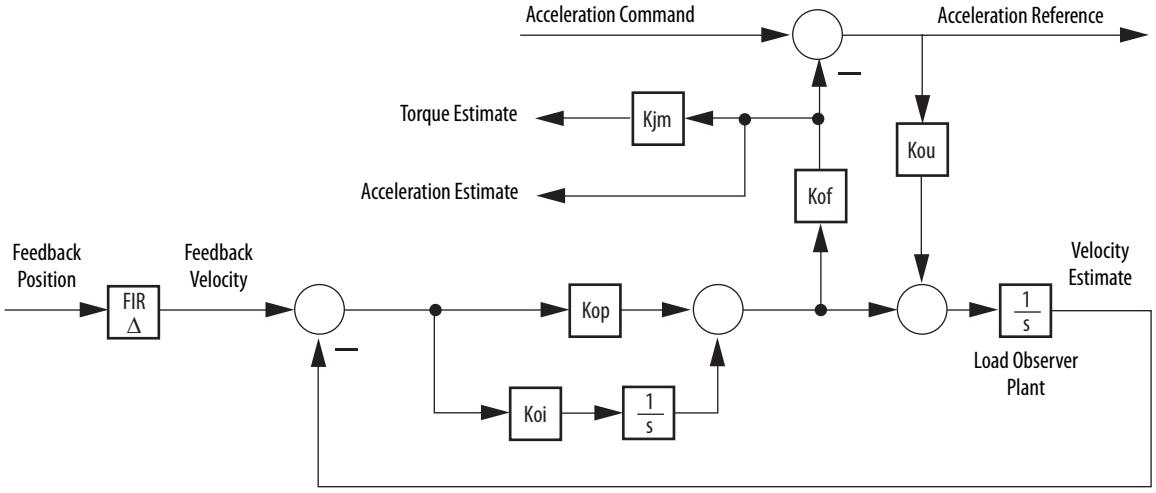


You can configure the load observer feature in a variety of ways by writing to a set of configuration IDN parameters. The overall behavior of load observer is controlled by Load Observer Configuration (IDN P-431). This parameter is used to select the Load Observer mode. Use it to set the IDN values listed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

Figure 118 - Load Observer Gains



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.

Table 128 - Load Observer Gain Parameters

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

(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 Table 128.

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	Limited to ≤ 389 Hz
1 (2)	= 0	Filter bypassed
	> 0	Limited to ≤ 10,430 Hz

(1) Operation before firmware revision 1.116.
(2) Operation with firmware revision 1.116 or later.

Refer to Appendix E on page 251 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.

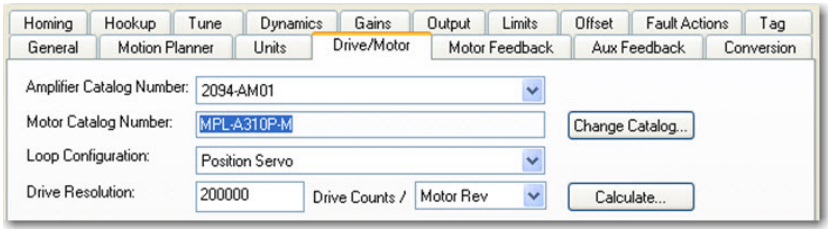
TIP Try this method before executing Auto-tune.

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.

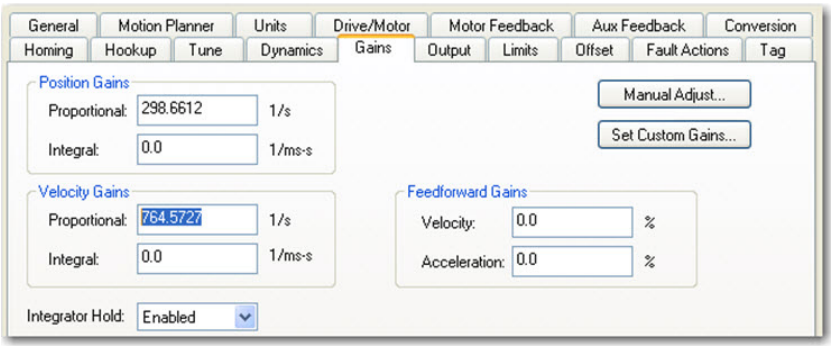
2. Click the Drive/Motor tab in the Axis Properties dialog box and add a motor.



   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.

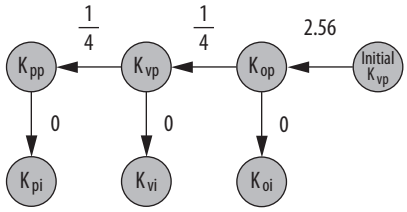


4. Make the following calculations:

   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



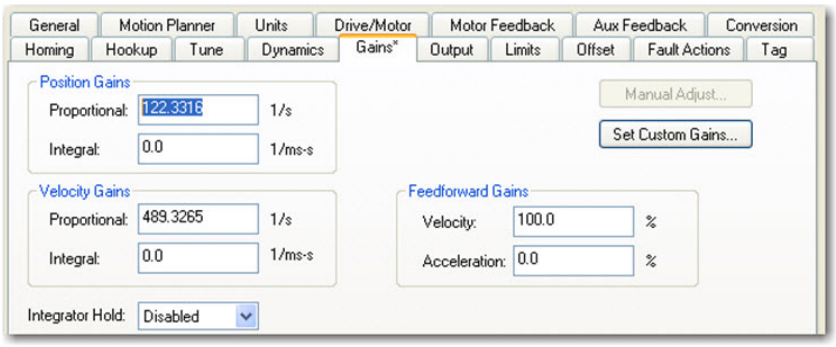
5. Configure these settings and values on the Gains tab.

   a. Position Proportional Gain = Kpp

   b. Velocity Proportional Gain = Kvp

   c. Velocity Feedforward Gain = 100%

   d. Integrator Hold = Disabled



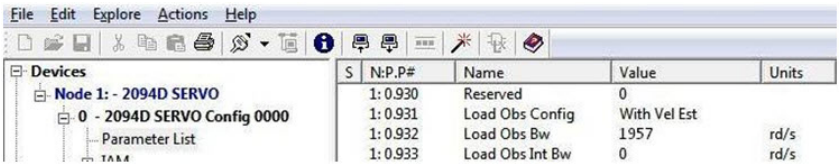
6. Configure these IDN parameter values.

   a. IDN P-431 = 2 (load observer with velocity estimate)

   b. IDN P-432 = Kop

   c. IDN P-433 = 0

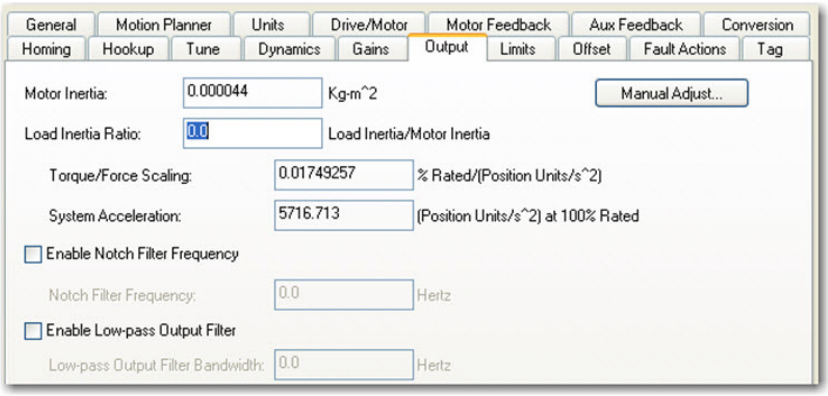
   d. IDN P-065 = 1



7. Click the Output tab in the Axis Properties dialog box and verify these settings.

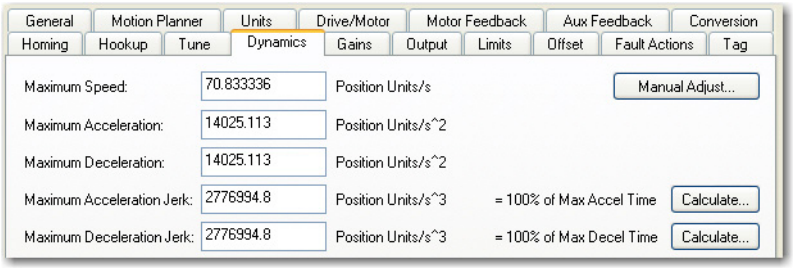
   a. Load Inertia Ratio = 0

b. Enable Low-pass Output Filter = Unchecked



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.



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

Auto-tune Gain Settings

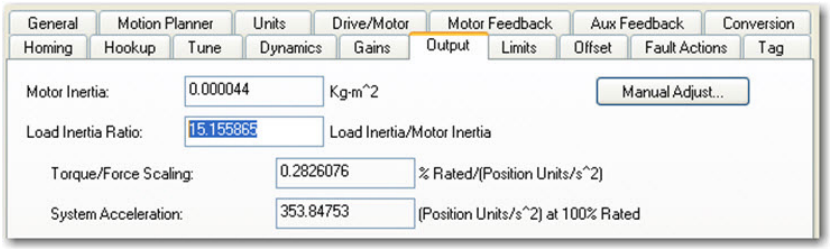
This procedure explains how to configure the load observer feature after running Auto-tune. This method also works for any existing set of gains where the Load Inertia Ratio is known or manually calculated, for example, when the Load Inertia Ratio > 0.

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 Auto-tune.

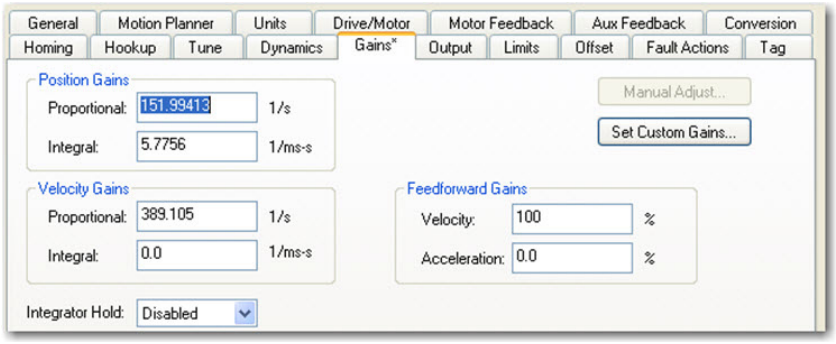
   For variable inertia loads, perform Auto-tune at the point of lowest mechanical inertia. If you manually calculate the Load Inertia Ratio, use the minimum load inertia.

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.



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.

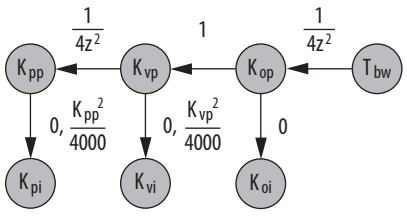
     Refer to Compliant Mechanical Loads on page 244, for compliant applications.

Rigid Mechanical Loads

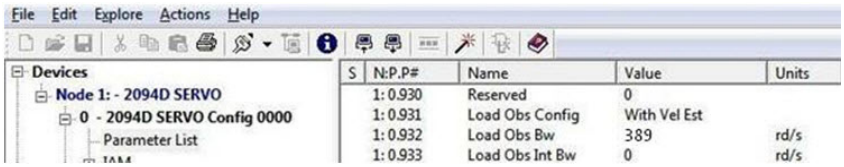
Follow these steps if the load is rigid.

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



3. 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.

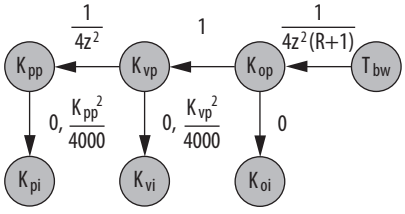
4. Refer to Compensate for High Frequency Resonances on page 249, to tune-out resonant frequencies.

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



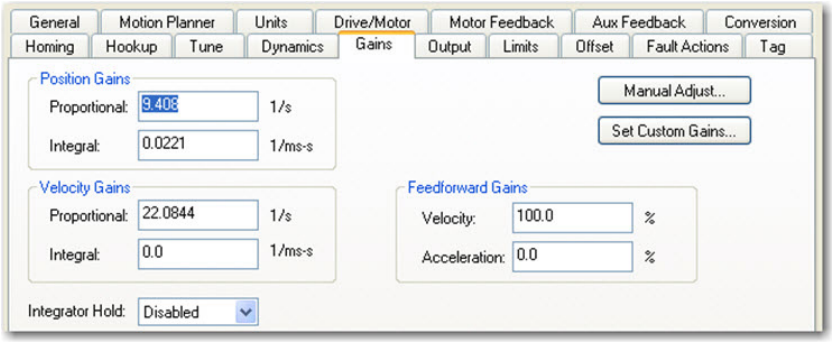
2. Configure these settings and values on the Gains tab.

   a. Set the Position Proportional Gain = Kpp

   b. Position Integral gain = Kpi

   c. Velocity Proportional Gain = Kvp

   d. Velocity Integral Gain = Kvi



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

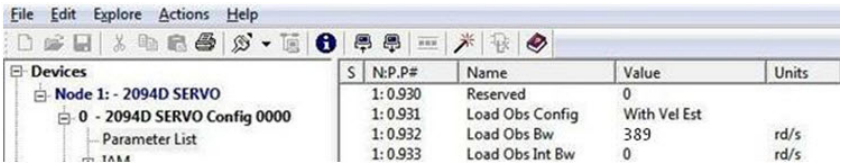
3. Configure these IDN parameter values.

   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



4. 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 ≤ Velocity Integral Gain ≤ Velocity Proportional Gain^2/4000

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:

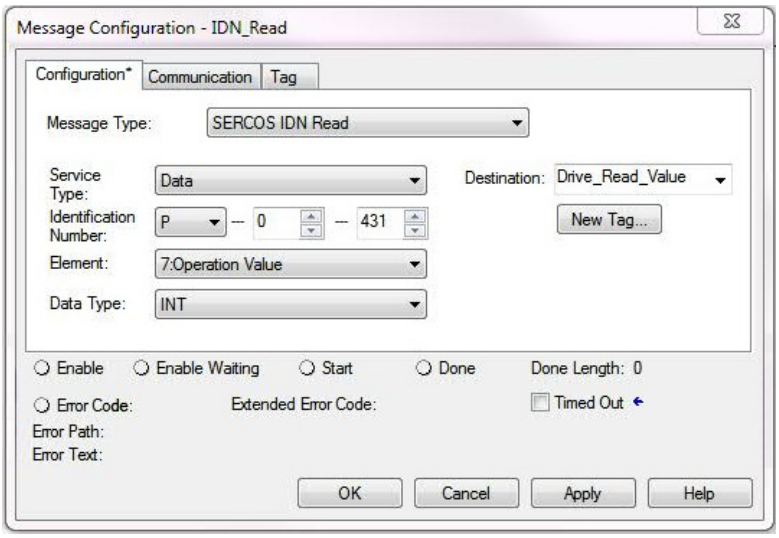
      0 ≤ Position Integral Gain ≤ Position Proportional Gain^2/4000

Set Gains with Sercos IDN Write Messages

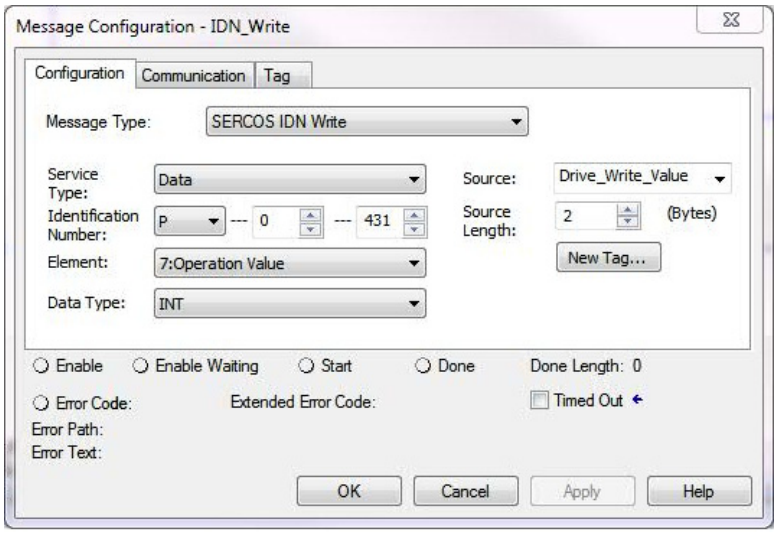
Write the Load Observer Configuration attribute and the Load Observer gains each time the drive gets initialized after applying power.

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

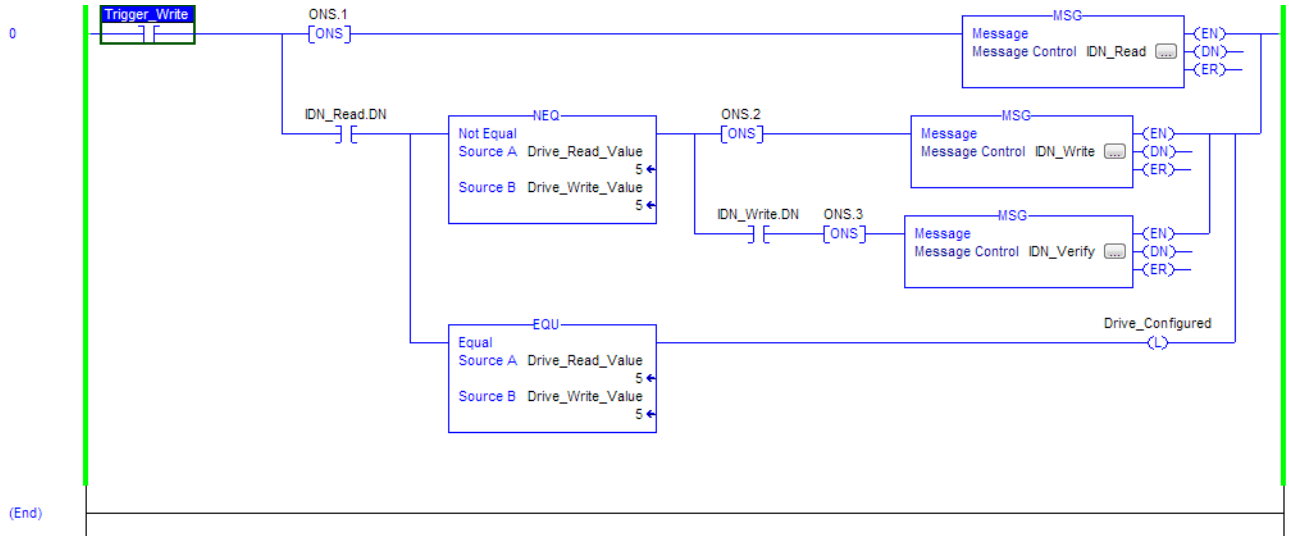
1. Upon initialization of the drive, read the INT value of the configuration of the drive at Sercos IDN P:0:431.



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.



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



TIP The procedure for setting each of the gains is similar.

Compensate for High Frequency Resonances

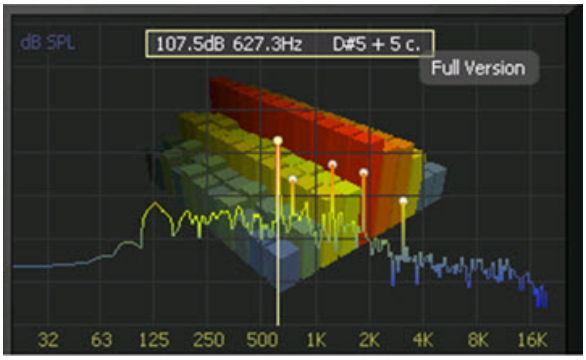
Approximately 15% of all motion applications exhibit a high-frequency resonance that is apparent by an audible high-frequency squealing of the load mechanics.

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

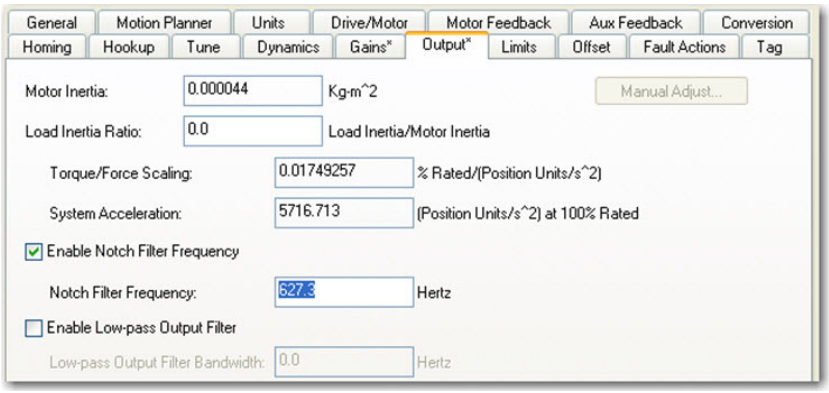
1. Perform the following move sequence by using Motion Direct Commands:
   a. Enable the axis with an MSO
   b. Slowly jog the axis with an MAJ
   c. Stop the axis with an MAS
   d. Disable the axis with a MSO

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.



   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.

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 real-time loop closure information is configured this way.

Table 132 - IDN Instruction Format in the IEC Standard Document

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

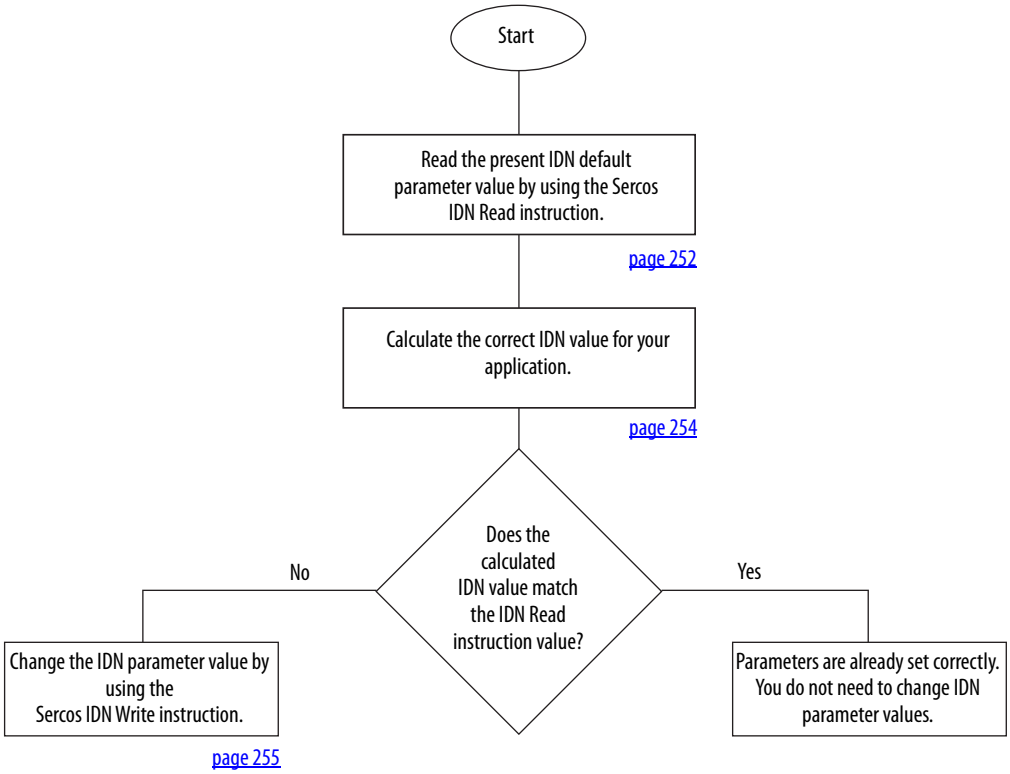
There are default parameters in the Logix 5000-to-Kinetix 6000 drive product structure you can reconfigure when the default configuration does not match the Integrated Architecture™ machine configuration.

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 Appendix C), 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 Chapter 6).

Use this flowchart to determine if changing your default configuration is required.

Figure 119 - Configuration Flowchart



Change IDN Parameter Values

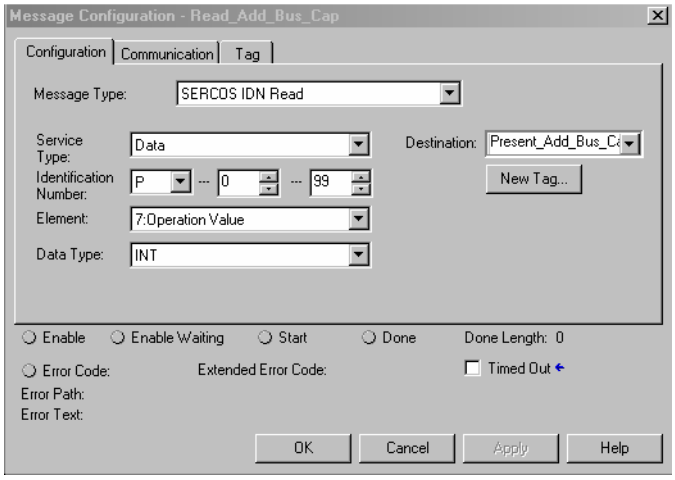
In this section you follow the Configuration Flowchart on page 252 to determine if you need to use the Sercos IDN Write instruction in the Logix Designer application to change the IDN parameter values.

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.

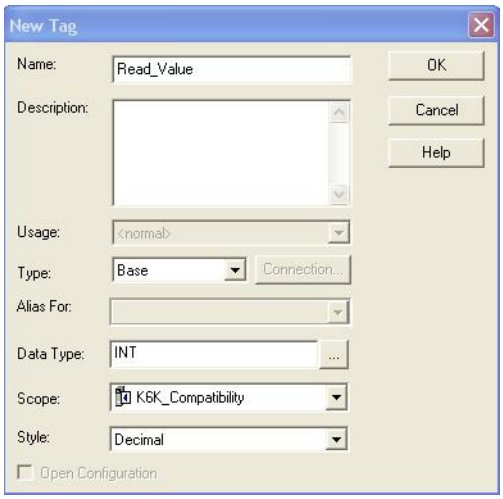


a. From the Message Type pull-down menu, choose Sercos IDN Read.

b. From the Identification Number pull-down menus, choose P-0-99.

3. Click New Tag.

4. The New Tag dialog box opens.



5. Type the name of your Destination tag.

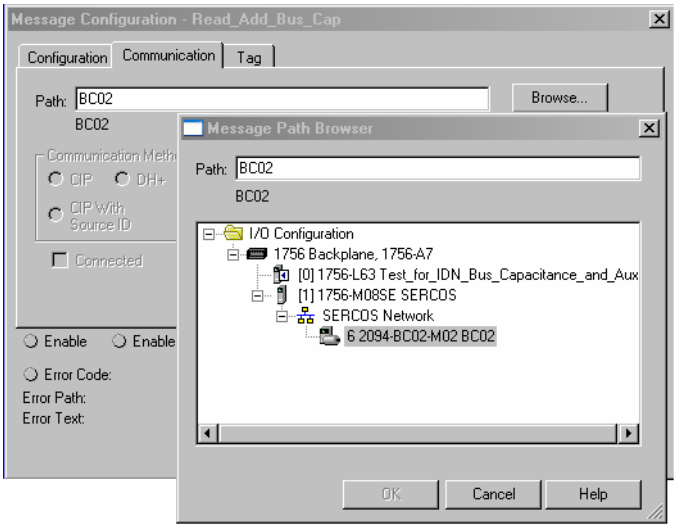
   In this example, the tag name is Read_Value.

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.



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.

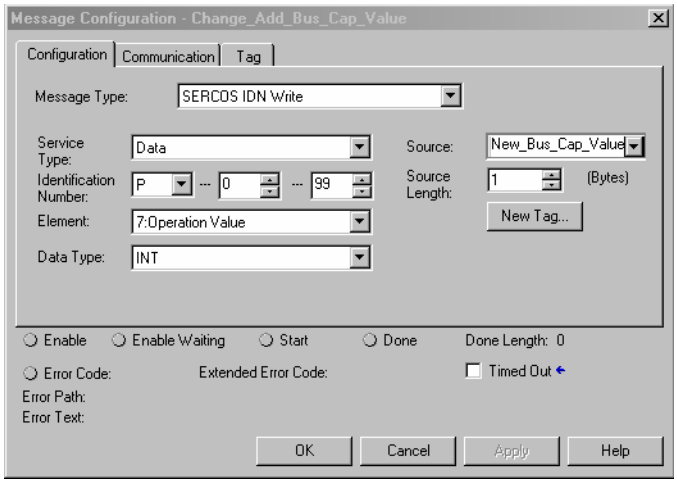
Refer to Calculate Additional Bus Capacitance on page 227 for more information.

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.

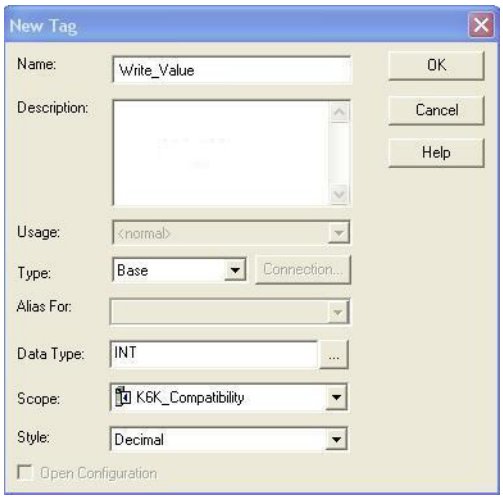


   a. From the Message Type pull-down menu, choose Sercos IDN Write.

   b. From the Identification Number pull-down menus, choose P-0-99.

2. Click New Tag.

3. The New Tag dialog box opens.



4. Type the name of your Source tag.

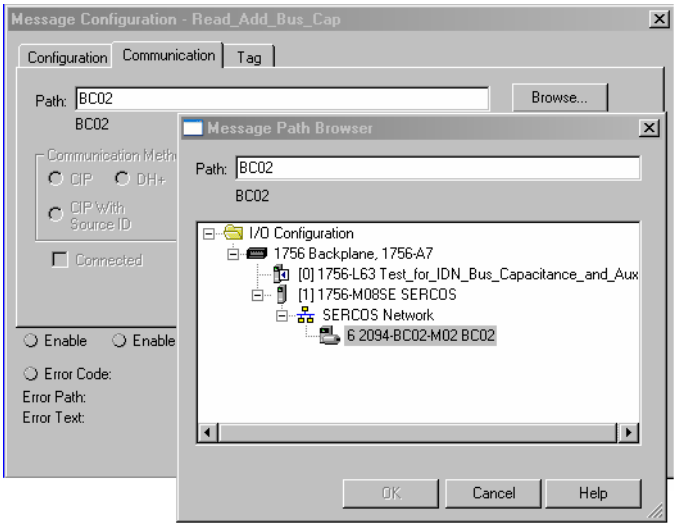
   In this example, the tag name is Write_Value.

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.



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.

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 Table 133.

Table 133 - Kinetix 6000 Series Change

IAM Module Cat. No.	AM Module Cat. No.	Peak Current Rating	
		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:

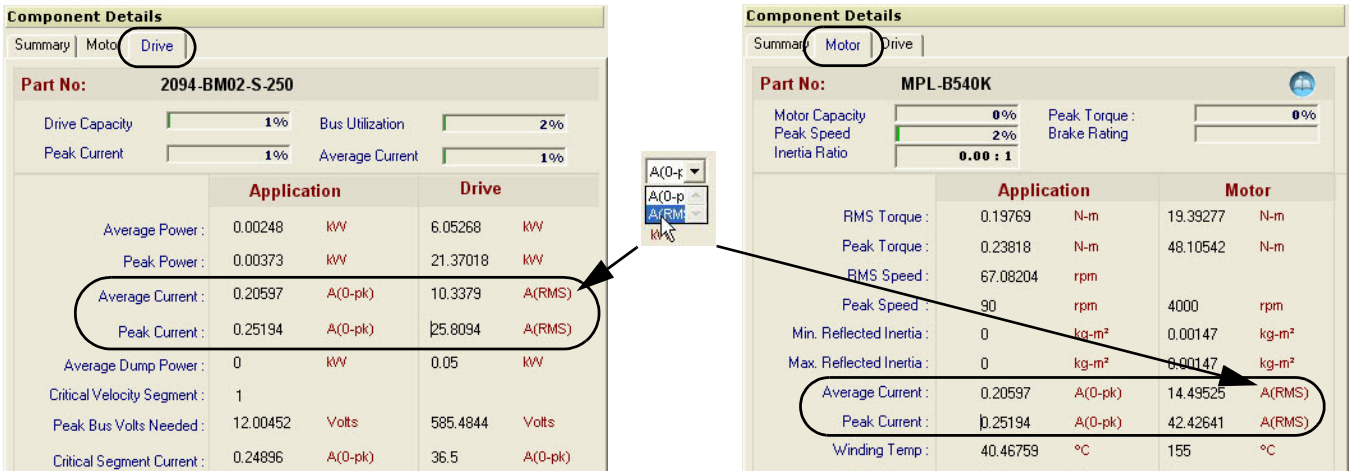
- TorqueLimitBipolar
- TorqueLimitPositive
- TorqueLimitNegative
- MaximumAcceleration
- MaximumDeceleration
- AccelerationLimitBipolar
- AccelerationLimitPositive
- AccelerationLimitNegative

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 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

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

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

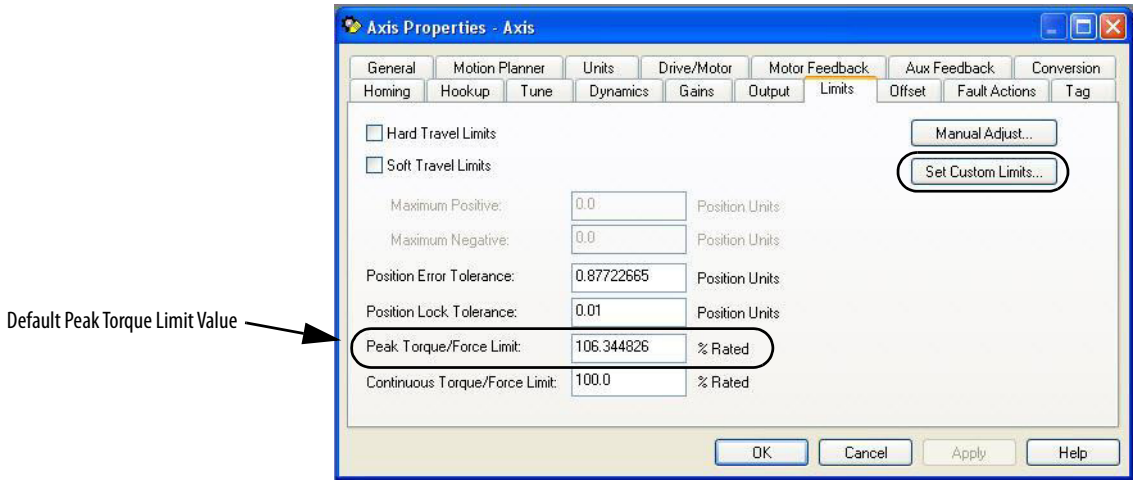
Table 134 - Example Definitions

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_{rms})	$I_{dr, pk}$	S:0:0110	150%: 15.5069
			250%: 25.8094

Figure 121 - Example Torque Formula

$$Torque_{max} = \frac{\min(I_{mtr, pk}, I_{dr, pk})}{I_{mtr, cont}} = \frac{\min(42.4\ A_{rms}, 25.8\ A_{rms})}{14.5\ A_{rms}} = 178.1\%$$

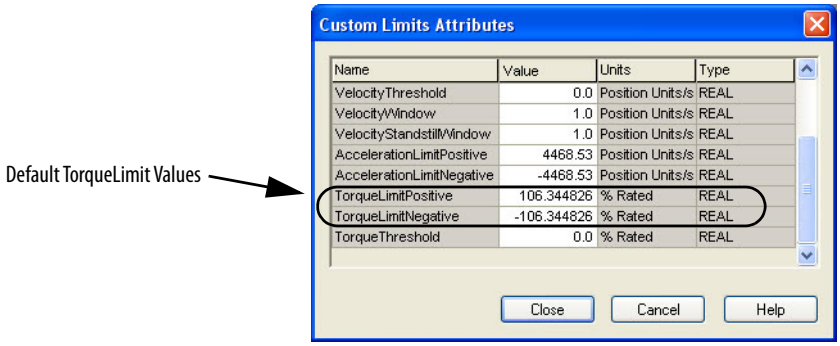
1. Navigate to Axis Properties and click the Limits tab.



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).

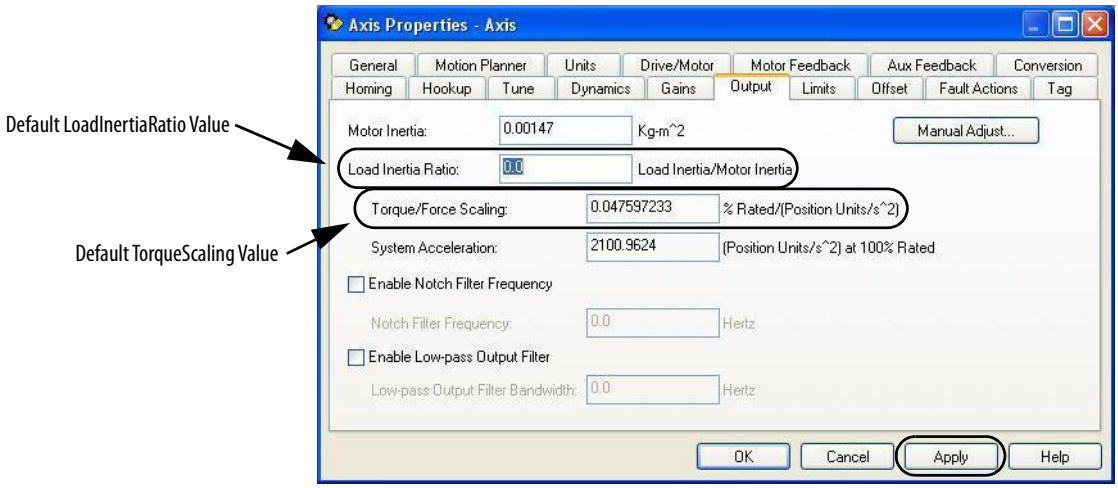
   The calculated value for $Torque_{max}$ is the maximum value for the following:

   - 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 page 133.

5. Click the Output tab.



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).

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

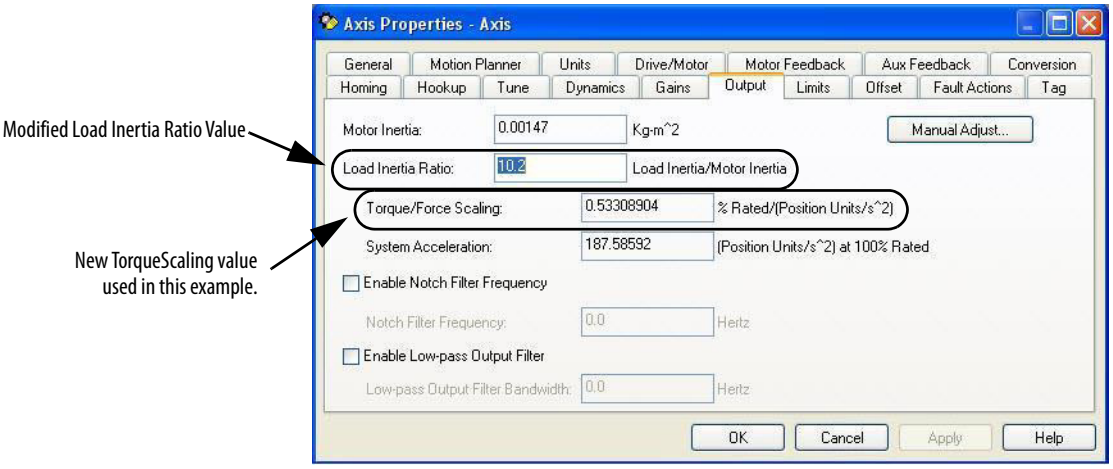
To calculate the maximum acceleration and deceleration from $Torque_{max}$, use this equation.

$$Accel_{max} = Torque_{max} \bullet \frac{100}{TorqueScaling}$$

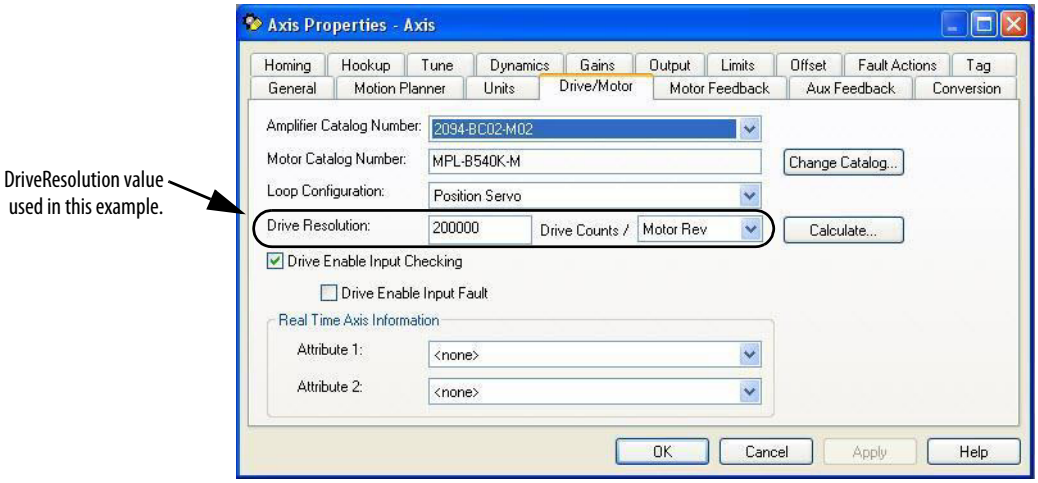
TIP If autotune cannot be performed, enter the data for the LoadInertiaRatio, DriveResolution, and ConversionConstant as shown in step 5 through step 9.

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

   The TorqueScaling values update.

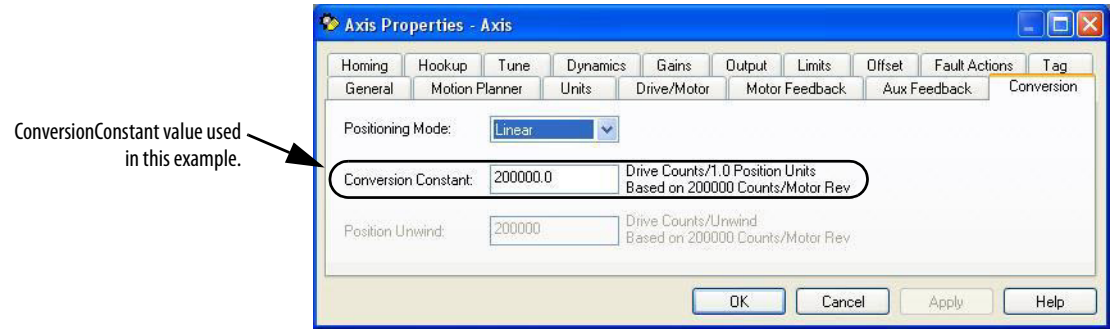


8. Click the Drive/Motor tab.



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.



Enhanced Peak Example Calculation

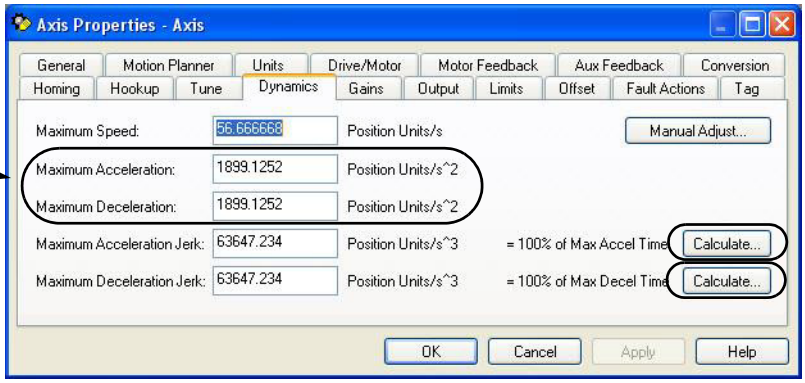
Based on the values shown, this is the sample calculation.

$$Accel_{max} = 1.781 \bullet \frac{100}{0.53308904 \ \frac{\%_{rated}}{PU/s^2}} = 334.09 \ PU/s^2$$

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

$$MaximumAcceleration = MaximumDeceleration = 0.85 \bullet Accel_{max} = 283.98 \ PU/s^2$$

1. Click the Dynamics tab.



Default Acceleration and Deceleration Values

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.

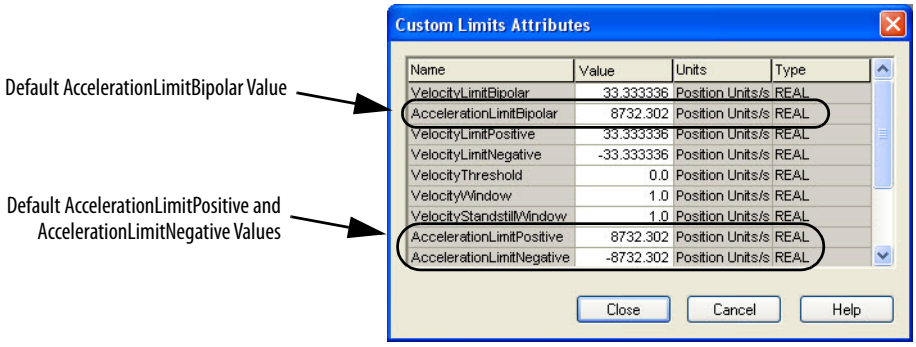
   Setting the values for AccelerationLimitBipolar, AccelerationLimitPositive, and AccelerationLimitNegative requires one more calculation by using this formula.

$$AccelerationLimitBipolar = AccelerationLimitPositive = -AccelerationLimitNegative$$

$$AccelerationLimitBipolar = \frac{2 \bullet MaximumAcceleration}{0.85} = 668.18 \ PU/s^2$$

5. Click the Limits tab.

6. Click Set Custom Limits.



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

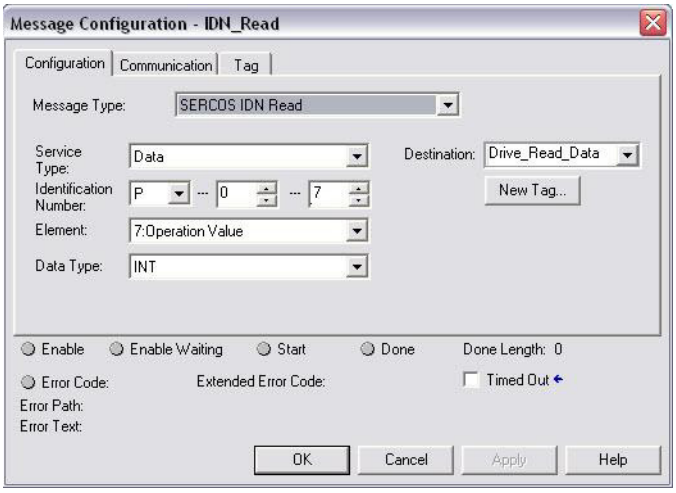
Before the drive is capable of accepting a command for the new peak current ratings, you need to change a drive parameter. This needs to be done only once, and there are two methods to perform the task.

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

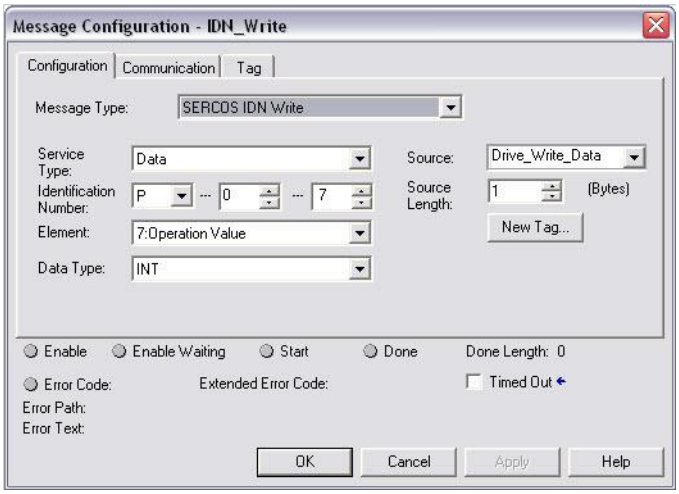
Sercos IDN Write Instruction

The Sercos IDN write instruction is accomplished by using the Logix Designer application. Refer to Appendix E on page 251 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.

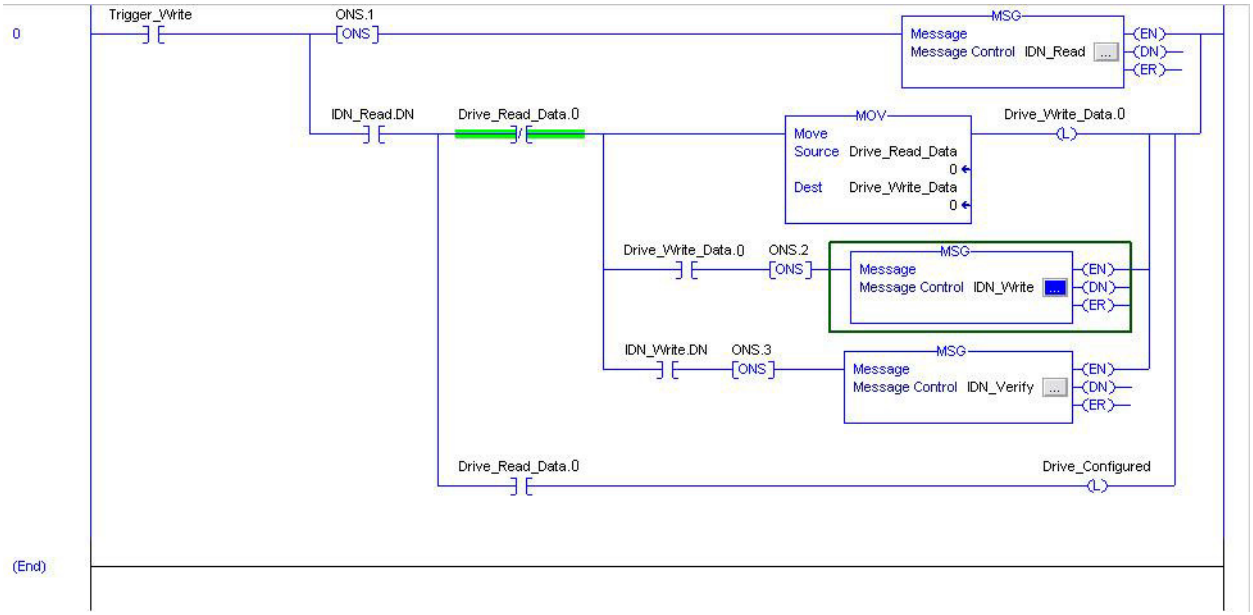


2. If the value of bit zero is zero, latch it and write the new value back to the drive at the same address, again as type INT.



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 Appendix C on page 225 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.

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.

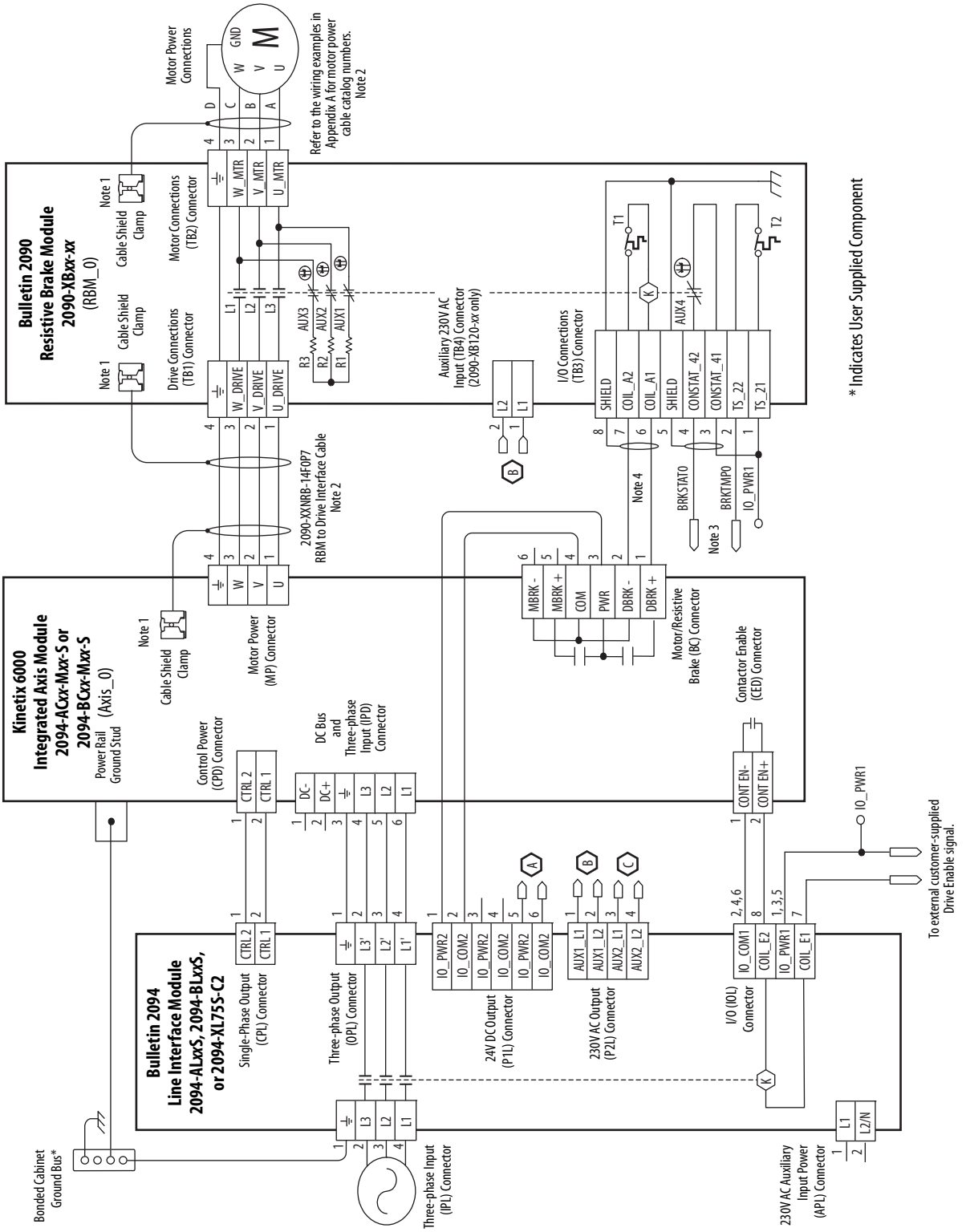
ATTENTION: Use the interconnection diagrams as a general recommendation of how the control circuit can be implemented. Actual applications can vary due to requirements based on the machine builders risk assessment. The machine builder must perform a risk assessment and determine a category level of safety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

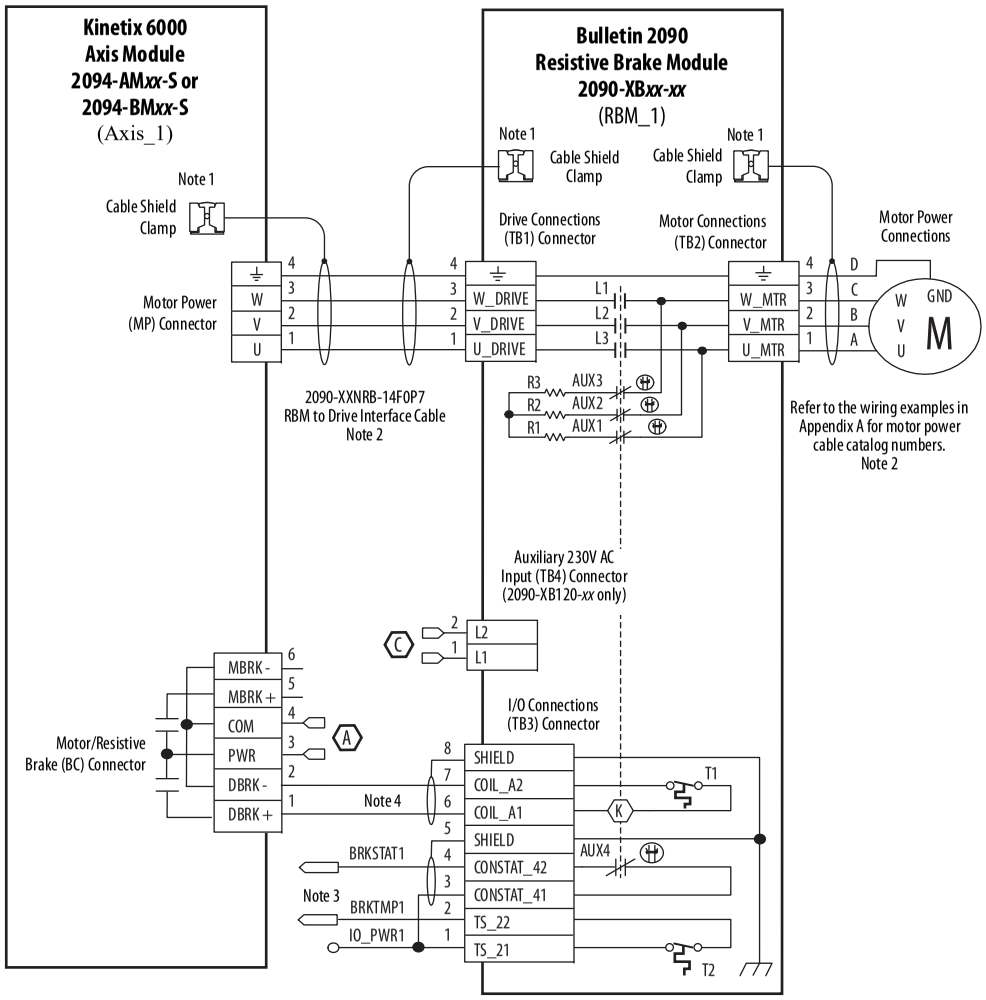
RBM Module Wiring Examples

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.

Figure 122 - RBM Wiring Example



RBM Wiring Example (continued)



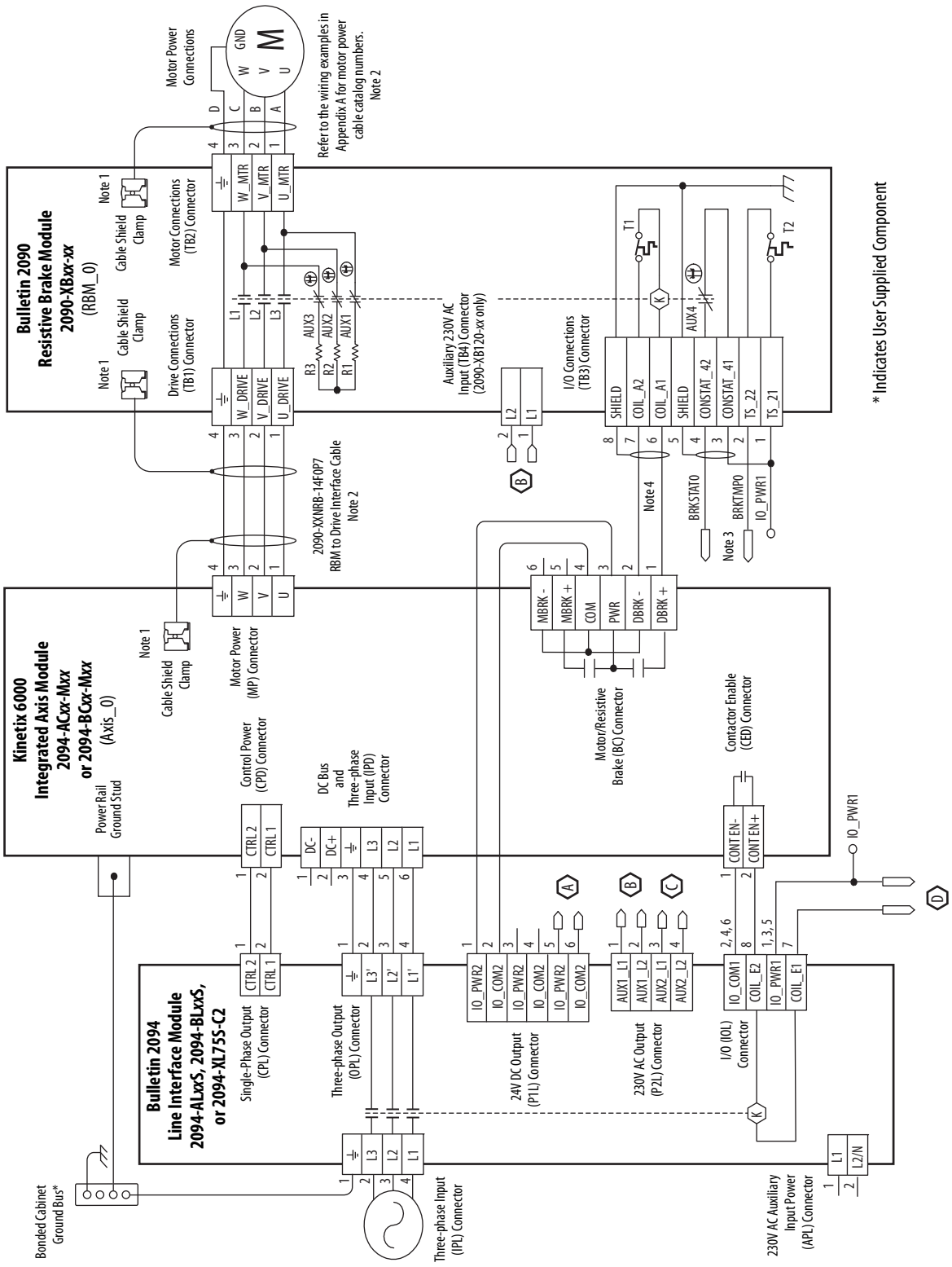
* Indicates User Supplied Component

ATTENTION: 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.

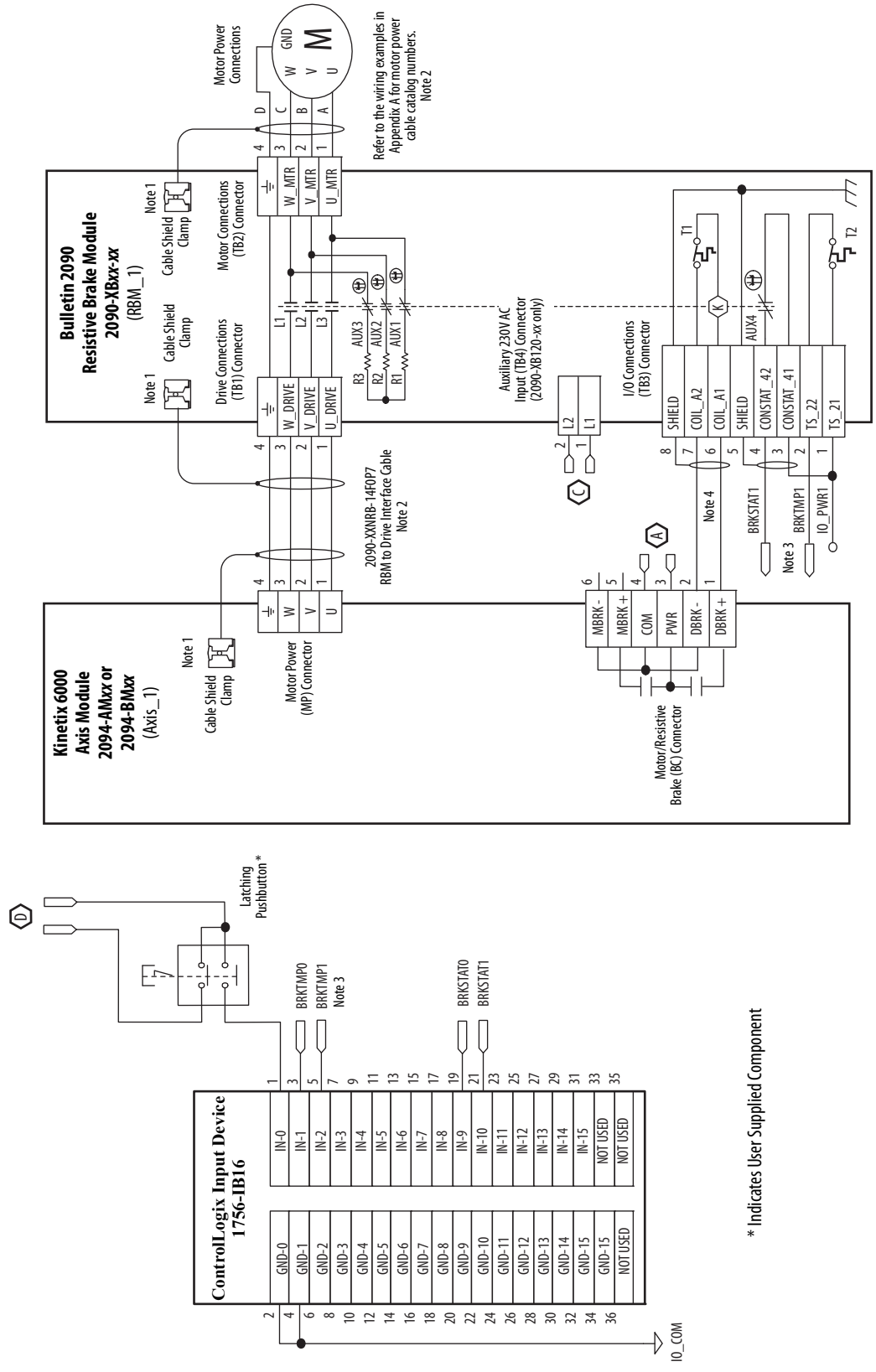
Note	Information
1	Cable shield clamp must be used to meet CE requirements. No external connection to ground required.
2	For motor cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication KNX-TD004.
3	The BRKTMP0 signal can be wired to a ControlLogix® input as overtemp warning in user program.
4	Firmware revision 1.071 or later is required to use the DBRK outputs on the Kinetix 6200 and Kinetix 6500 IAM or AM module.
5	Set the safety relay time delay beyond the time required to stop and disable the axis when running at full speed.
6	Drive Enable Input Checking must be selected when configuring Axis Properties in the Logix Designer application.

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.

Figure 123 - RBM Wiring Example, Category 2 Configuration per ISO 13849

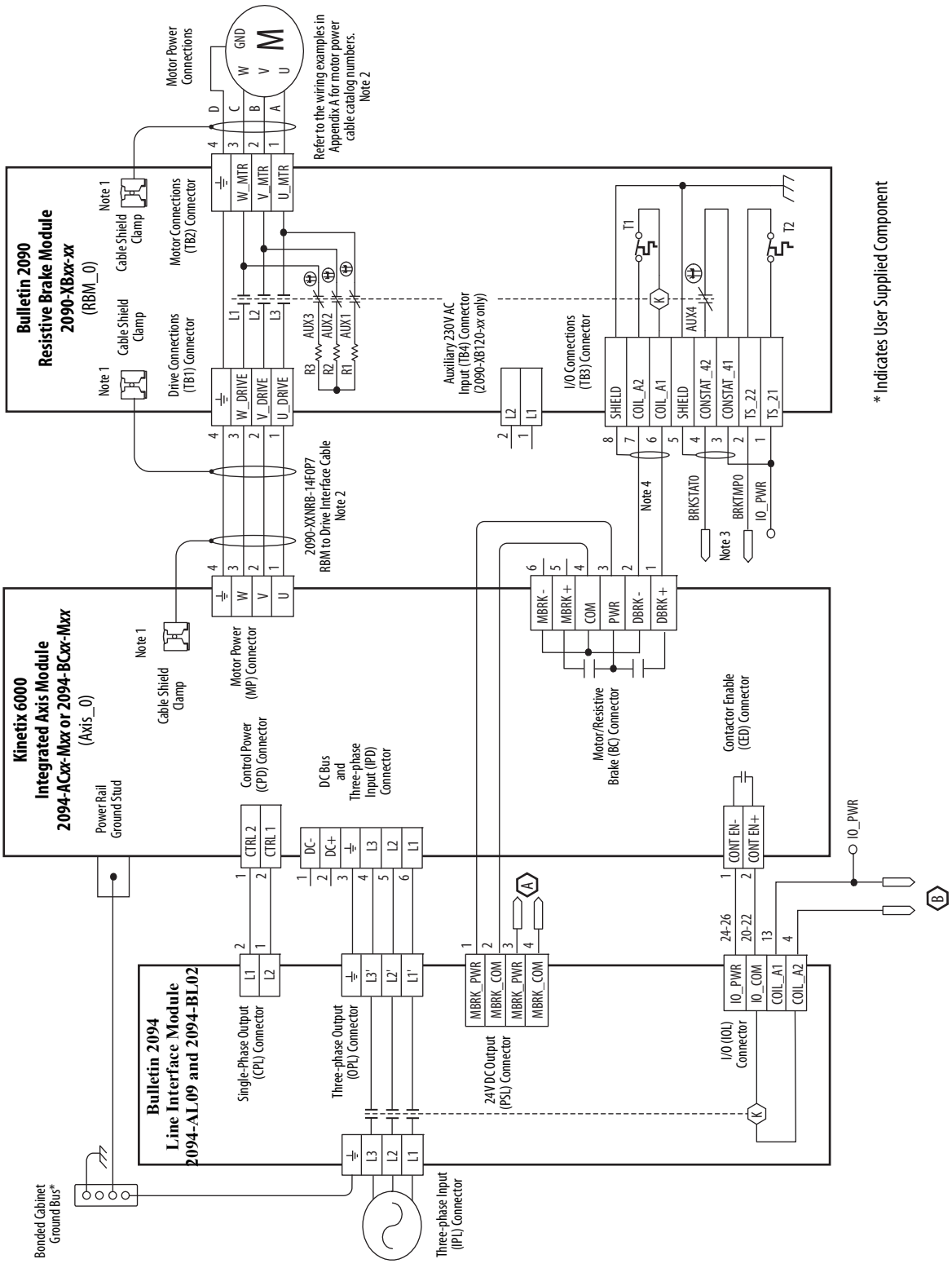


RBM Wiring Example, Category 2 Configuration per ISO 13849 (continued)

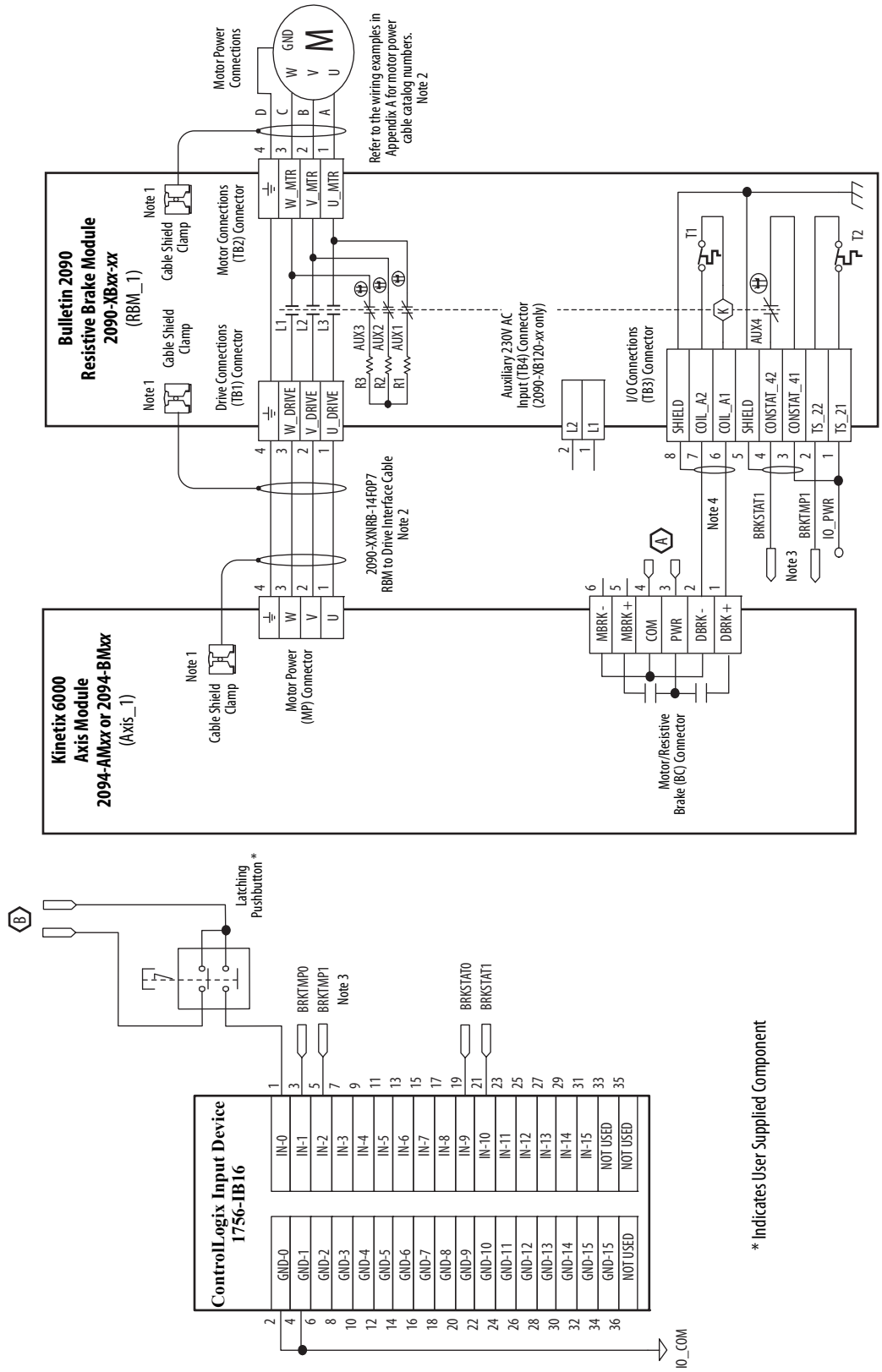


This example diagram shows 2094-*x*C*xx*-M*xx* and 2094-*x*M*xx* drives (without safe torque-off) and 2094-AL09 and 2094-BL02 LIM modules wired with the Bulletin 2090 RBM module.

Figure 124 - RBM Wiring Example, Category 2 Configuration per ISO 13849

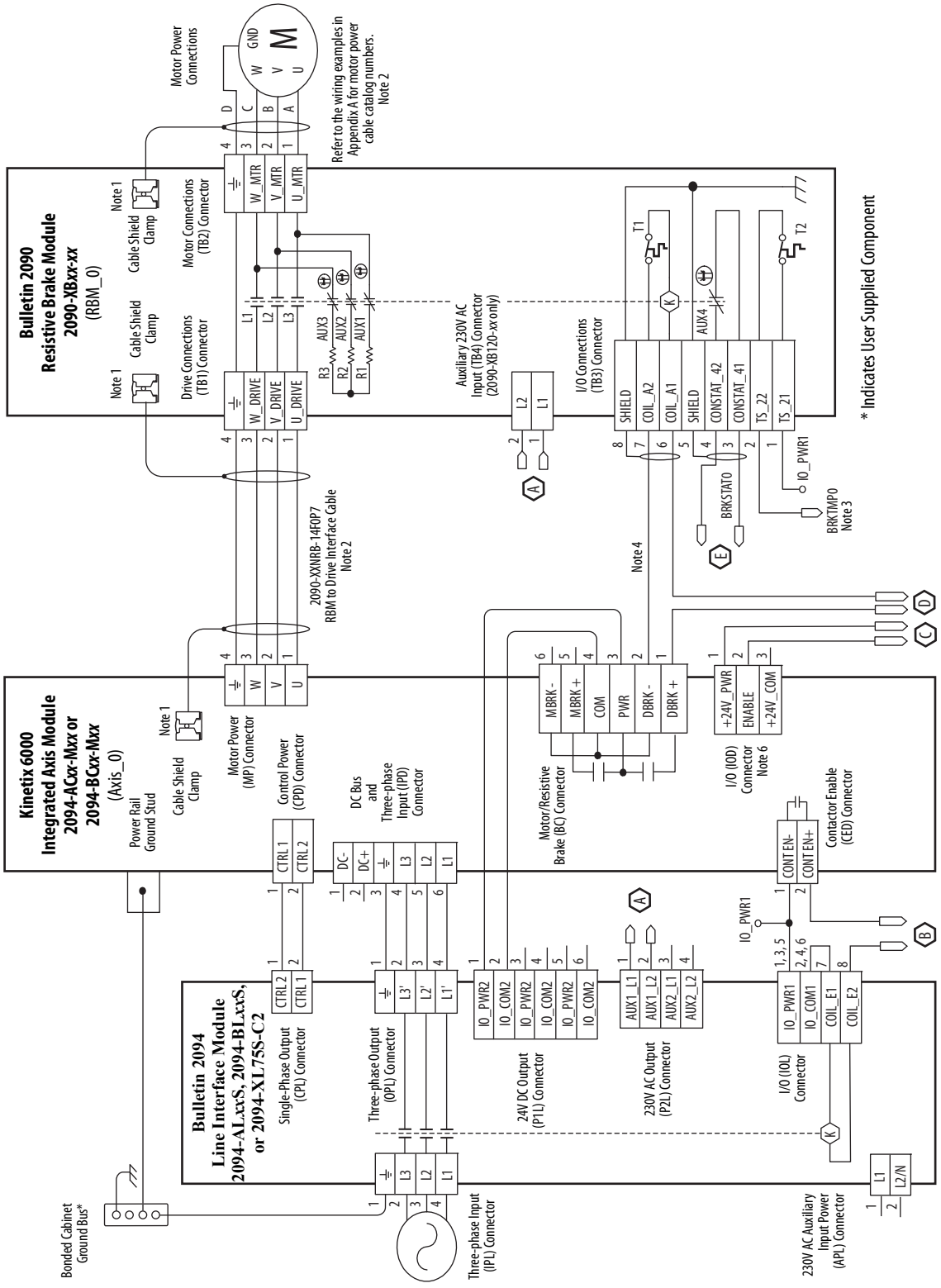


RBM Wiring Example, Category 2 Configuration per ISO 13849 (continued)

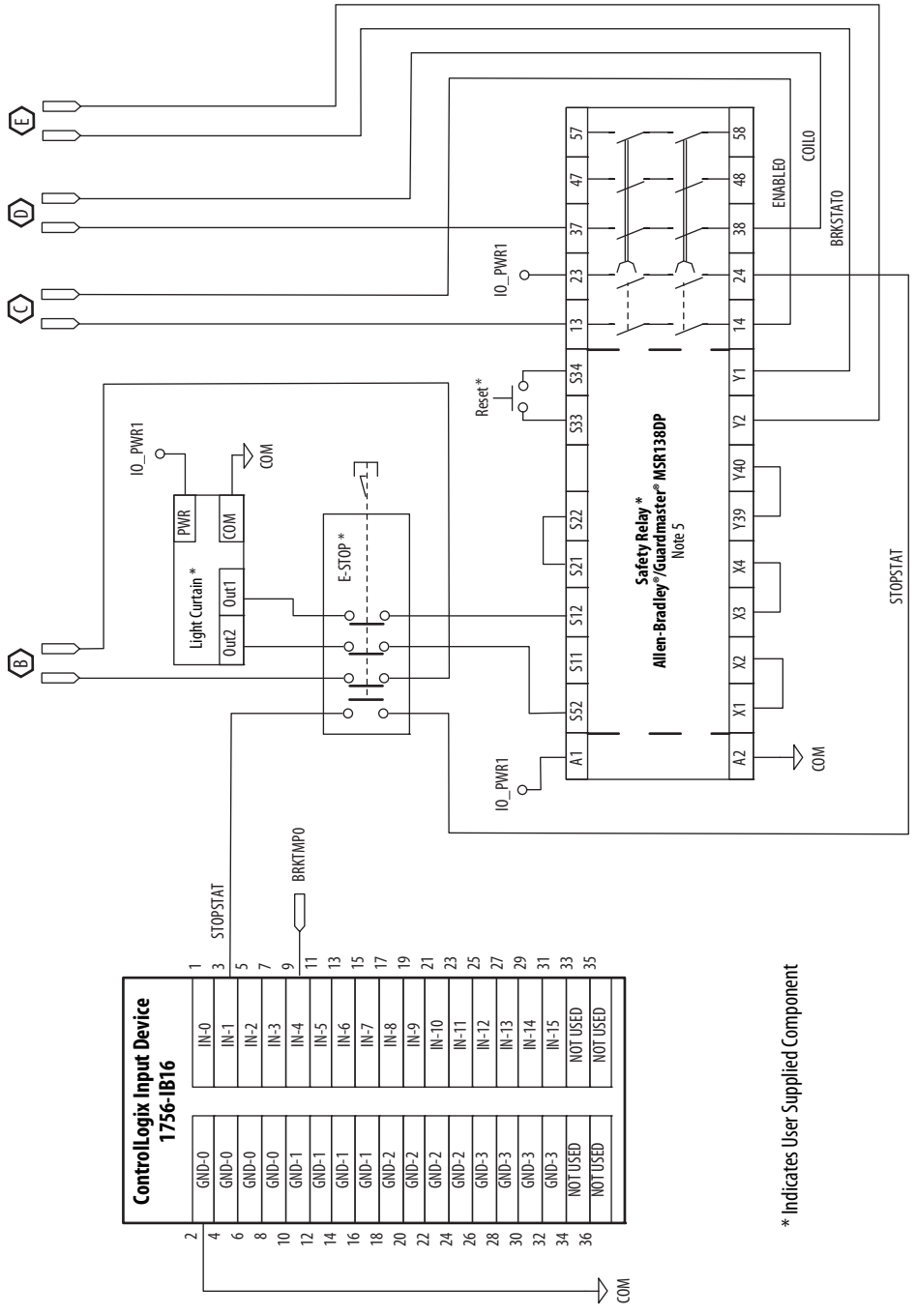


This example diagram shows 2094-*x*C*xx*-M*xx* drives (without safe torque-off) and 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S LIM modules wired with the Bulletin 2090 RBM module. The example continues on page 275.

Figure 125 - RBM Wiring Example, Category 3 Configuration per ISO 13849

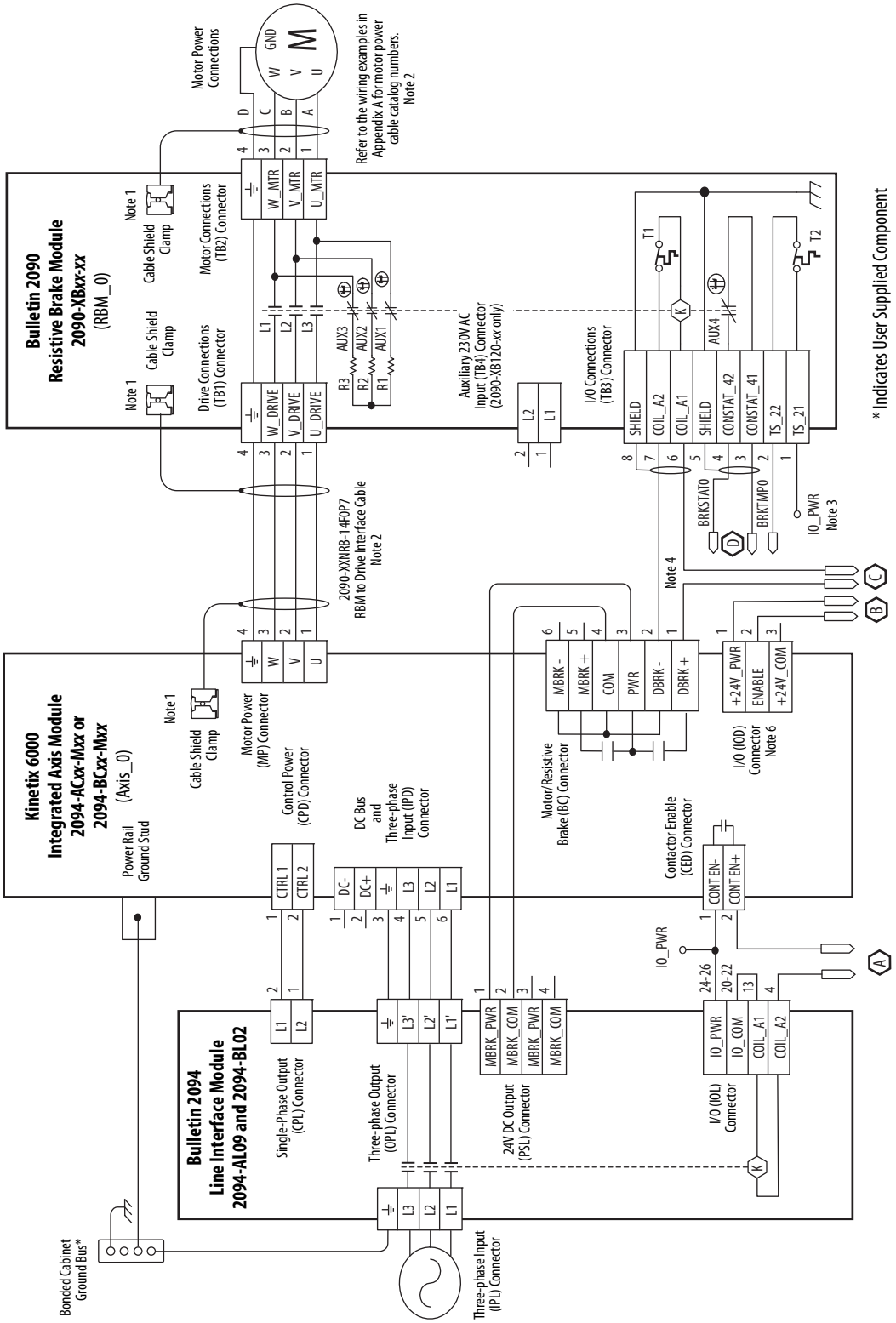


RBM Wiring Example, Category 3 Configuration per ISO 13849 (continued)

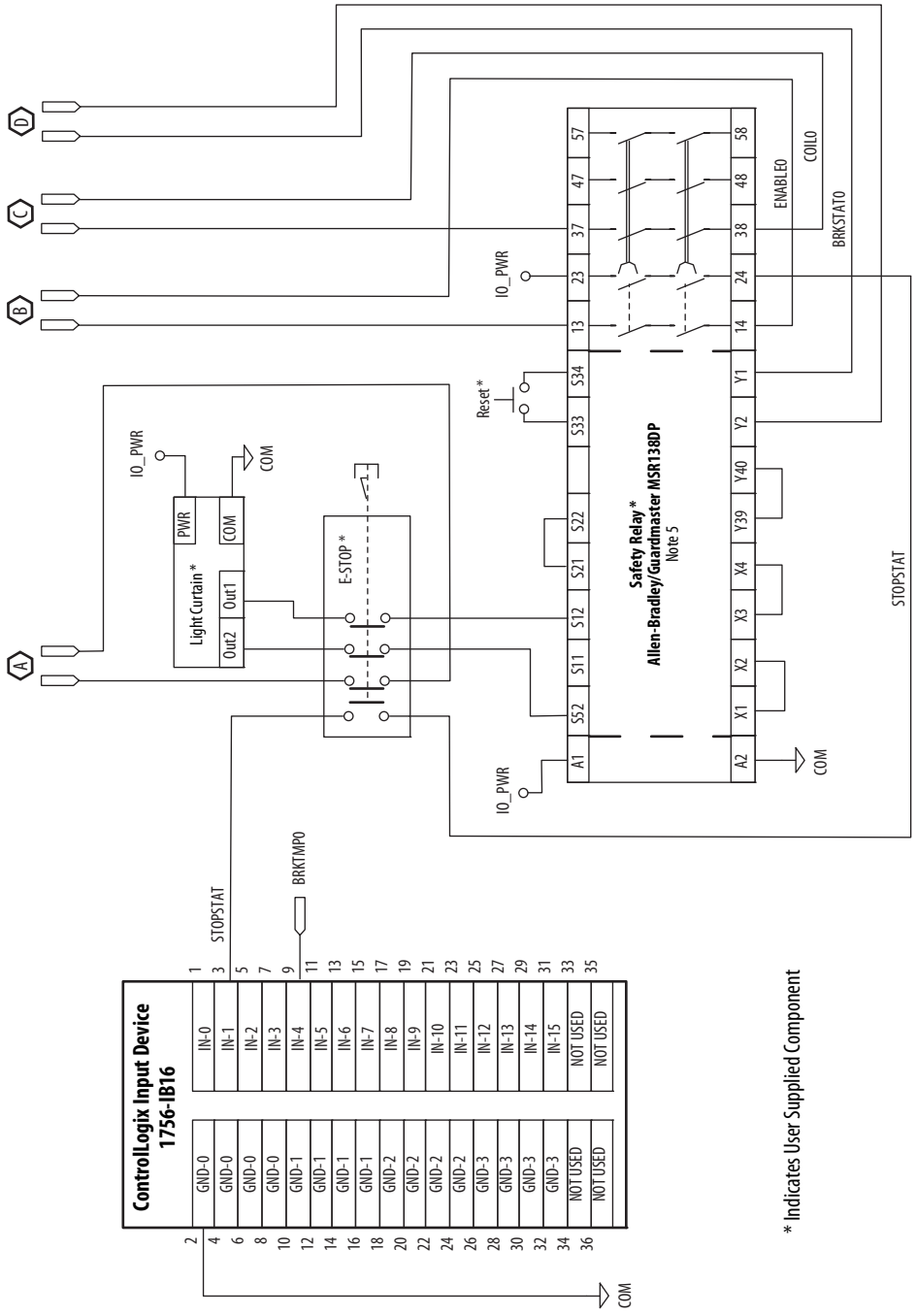


This example diagram shows 2094-*x*C*xx*-M*xx* drives (without safe torque-off) and 2094-AL09 and 2094-BL02 LIM modules wired with the Bulletin 2090 RBM module.

Figure 126 - RBM Wiring Example, Category 3 Configuration per ISO 13849



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-BC*xx*-M*xx*-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 impedance-grounded power configuration
Added Bulletin MPS motors and MPAS linear stages to the SpeedTec DIN connector tables
Updated the ControlLogix 1756-EN*x*T 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 IP2*x* 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/B15*xxx-xx*7*x*AA and MPL-A/B2*xxx-xx*7*x*AA low-inertia motors and MPAR-A/B1*xxx* and MPAR-A/B2*xxx* 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/B15*xxx-xx*7*x*AA and MPL-A/B2*xxx-xx*7*x*AA 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.

Numerics

A

B

C

D

E

F

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Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
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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Waste Electrical and Electronic Equipment (WEEE)

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Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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