



Allen-Bradley

Ultra3000 Digital Servo Drives

Catalog Numbers

2098-DSD-005, -010, and -020

2098-DSD-xxxX

2098-DSD-xxx-SE

2098-DSD-xxx-DN

2098-DSD-xxxX-DN

2098-DSD-030, -075, and -150

2098-DSD-xxxX

2098-DSD-xxx-SE

2098-DSD-xxx-DN

2098-DSD-xxxX-DN

**2098-DSD-HV030, -HV050, -HV100, -HV150,
and -HV220**

2098-DSD-HVxxxX

2098-DSD-HVxxx-SE

2098-DSD-HVxxx-DN

2098-DSD-HVxxxX-DN

Integration Manual

**Rockwell
Automation**

ALLEN-BRADLEY • ROCKWELL SOFTWARE

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication [SGI-1.1](#) available from your local Rockwell Automation sales office or online at <http://literature.rockwellautomation.com>) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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

<p>WARNING</p> 	<p>Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.</p>
<p>IMPORTANT</p>	<p>Identifies information that is critical for successful application and understanding of the product.</p>
<p>ATTENTION</p> 	<p>Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.</p>
<p>SHOCK HAZARD</p> 	<p>Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.</p>
<p>BURN HAZARD</p> 	<p>Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.</p>

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About This Publication

This manual provides power-up procedures, system integration, and troubleshooting tables for the Ultra3000 Digital Servo Drives. The purpose of this manual is to assist you in the integration of your Ultra3000 servo drive as a standalone drive by using Ultraware software or with a Logix controller by using RSLogix 5000 software.

System Integration Architecture

Drive Type	Catalog Numbers	Command Interface	Software
SERCOS interface drive	2098-DSD-xxx-SE and 2098-DSD-HVxxx-SE	Fiber-optic SERCOS interface	RSLogix 5000
Analog drive	2098-DSD-xxx and 2098-DSD-HVxxx	Analog command interface	Ultraware or RSLogix 5000 ⁽¹⁾
Digital drive with DeviceNet interface	2098-DSD-xxx-DN and 2098-DSD-HVxxx-DN	DeviceNet communication interface	Ultraware and RSNetWorx
Indexing DeviceNet drives	2098-DSD-xxxX-DN and 2098-DSD-HVxxxX-DN	Standalone control	
Indexing drive	2098-DSD-xxxX and 2098-DSD-HVxxxX		

⁽¹⁾ Use RSLogix 5000 software when the 1756-M02AE analog module controls the Ultra3000 drive.

Who Should Use This Manual

This manual is intended for engineers or programmers directly involved in the operation, field maintenance, and integration of the Ultra3000 servo drives.

If you do not have a basic understanding of the Ultra3000 drives, contact your local Rockwell Automation sales representative before using this product for information on available training courses.

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps
- Numbered lists provide sequential steps or hierarchical information
- Abbreviations for the Ultra3000 drives are used throughout this manual

Ultra3000 Drive	Abbreviation
Ultra3000 drive with SERCOS interface	Ultra3000-SE
Ultra3000 drive with DeviceNet interface	Ultra3000-DN
Ultra3000 drive with Indexing	Ultra3000X
Ultra3000 analog	Ultra3000

Additional Resources

The following documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Ultra3000 Digital Servo Drives Installation Manual, publication 2098-IN003	The instructions needed for the installation and wiring of the Ultra3000 drives.
Ultraware CD Installation Instructions, publication 2098-IN002	Ultraware software installation instructions.
Ultraware User Manual, publication 2098-UM001	Information on configuring your Ultra3000 drive by using Ultraware software.
Ultra3000 DeviceNet Reference Manual, publication 2098-RM001	Information on communicating with Ultra3000 drives by using the DeviceNet network.
DeviceNet Media Design and Installation Guide, publication DNET-UM072	Information on how to design and install a DeviceNet network cable system.
Kinetix Motion Control Selection Guide, publication GMC-SG001	Specifications, motor/servo-drive system combinations, and accessories for Kinetix motion control products.
Motion Analyzer CD, publication PST-SG003	Drive and motor sizing with application analysis software.
Resistive Brake Module Installation Instructions, publication 2090-IN009	Information on installing and wiring Bulletin 2090 resistive brake modules.
MP-Series Integrated Linear Stages User Manual, publication MP-UM001	Information on installing and wiring MP-Series integrated linear stages.
ControlLogix Motion Module Programming Manual, publication 1756-RM086	Detailed information on the use of ControlLogix motion features and application examples.
ControlLogix SERCOS interface Module Installation Instructions, publication 1756-IN572	ControlLogix SERCOS interface module installation instructions.
Synchronous Serial Interface (SSI) Servo Module Installation Instructions, publication 1756-IN595	Information on mounting and wiring the 1756-M02AS servo module.
Analog Encoder (AE) Servo Module Installation Instructions, publication 1756-IN047	Information on mounting and wiring the 1756-M02AE servo module.
ControlLogix Controllers User Manual, publication 1756-UM001	Information on installing, configuring, programming, and operating a ControlLogix system.
CompactLogix SERCOS interface Module Installation Instructions, publication 1768-IN005	CompactLogix SERCOS interface module installation instructions.
CompactLogix Controllers User Manual, publication 1768-UM001	Information on installing, configuring, programming, and operating a CompactLogix system.
Logix5000 Controllers Motion Instructions Reference Manual, publication 1756-RM007	Instructions needed to program a motion application.
Motion Modules in Logix5000 Control Systems User Manual, publication LOGIX-UM002	Information on configuring and troubleshooting your ControlLogix and CompactLogix SERCOS interface modules.
Fiber Optic Cable Installation and Handling Instructions, publication 2090-IN010	Information on proper handling, installing, testing, and troubleshooting fiber-optic cables.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
EMC Noise Management DVD, publication GMC-SP004	
Rockwell Automation Configuration and Selection Tools, website http://ab.com/e-tools	Online product selection and system configuration tools, including AutoCAD (DXF) drawings.
Rockwell Automation Product Certification link, website http://ab.com	Declarations of conformity currently available from Rockwell Automation.
National Electrical Code, published by the National Fire Protection Association of Boston, MA	Article on wire sizes and types for grounding electrical equipment.
Rockwell Automation Industrial Automation Glossary, publication AG-7.1	Glossary of industrial automation terms and abbreviations.

You can view or download publications at <http://literature.rockwellautomation.com>. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Commissioning Your Ultra3000 Drive

This chapter provides you with information to apply power and configure your Ultra3000 servo drive.

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Introduction

These procedures assume you have completed mounting, wiring, and connecting your Ultra3000 drive as described in the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

For installation information regarding equipment and accessories not included here, refer to Additional Resources on page 8 for the information available for those products.

General Startup Precautions

These precautions apply to all of the procedures in this chapter. Be sure to read and thoroughly understand them before proceeding.

ATTENTION



This product contains stored energy devices. To avoid hazard of electrical shock, verify that all voltages on the system bus network have been discharged before attempting to service, repair, or remove this unit. Only qualified personnel familiar with solid state control equipment and safety procedures in publication NFPA 70E or applicable local codes should attempt this procedure.

ATTENTION



This drive contains ESD (electrostatic discharge) 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 Service Bulletin, publication [8000-4.5.2](#), or any other applicable ESD awareness handbook.

Understanding the Serial Connection

If your personal computer has a serial port, use a 2090-UXPC-D09:xx serial cable or similar null modem cable with wiring as described in the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

If your personal computer has USB ports, use a USB to serial adapter (catalog number 9300-USBS) to convert your RS-232 port to USB. The 2090-UXPC-D09:xx serial cable is still needed between the 9300-USBS converter and the Ultra3000 drive.

USB Communication Rate Compatibility

USB Converter	Communication Rate
USB 1.0	1200, 2400, 4800, 9600, or 19,200, bps
USB 2.0	1200, 2400, 4800, 9600, 19,200, or 38,400 bps

IMPORTANT

The USB converter must be setup as COM1, COM2, COM3, or COM4 and must match the serial port configuration in Ultraware software for the converter and Ultra3000 drive to communicate.

If RSLinx software is running on your personal computer, shutdown the program from the system tray to avoid conflicts between applications.

Configuring Your Ultra3000 Drive and Ultra3000 Drive with Indexing

The procedures in this section are listed in this table and apply to Ultra3000 drives and Ultra3000 drives with indexing.

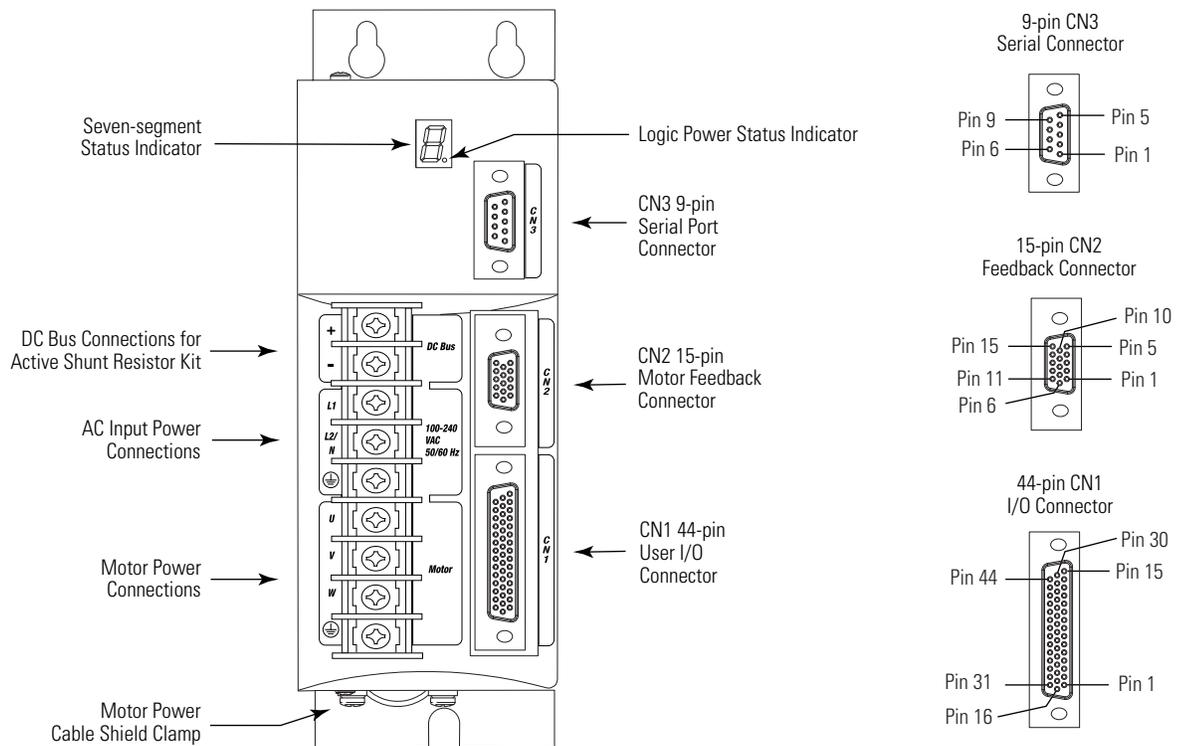
Ultra3000 Drive Configuration Procedures

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Front Panel Connections

Use this figure to locate the front panel connections on the Ultra3000 230V drives (500 W, 1 kW, and 2 kW).

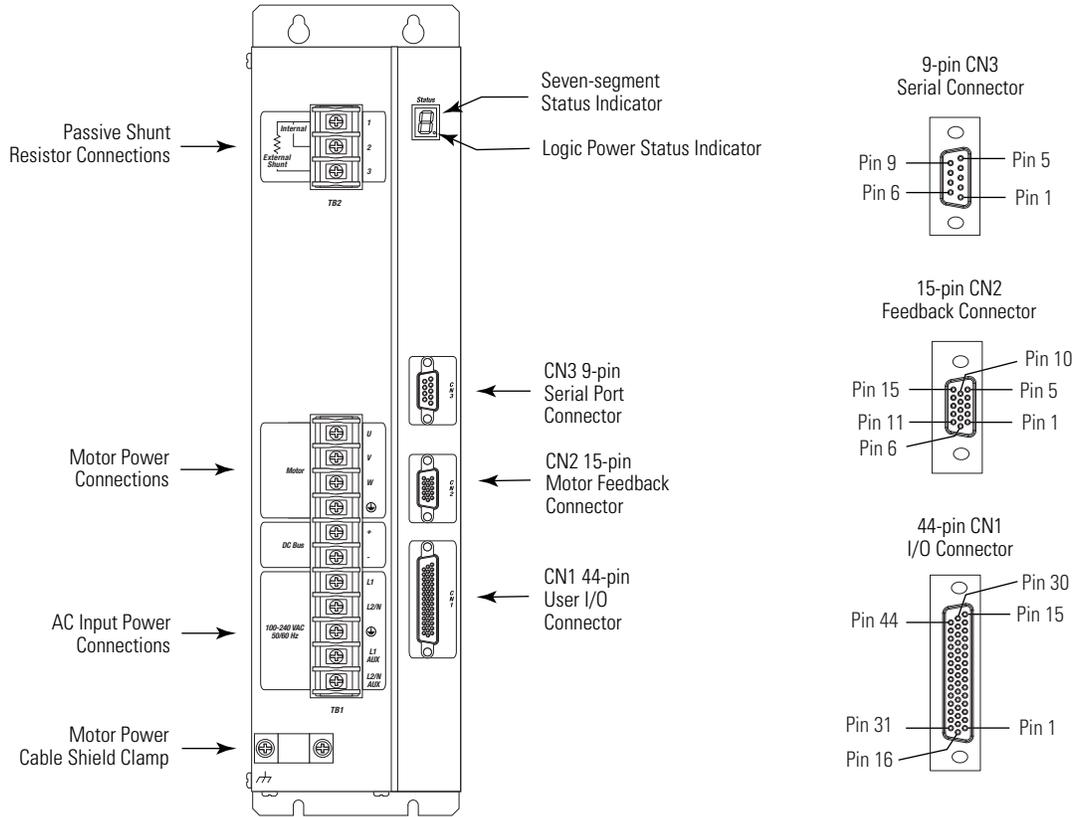
Front Panel Connections for 2098-DSD-005, 2098-DSD-005X, 2098-DSD-010, 2098-DSD-010X, 2098-DSD-020, and 2098-DSD-020X Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000 230V drives (3 kW).

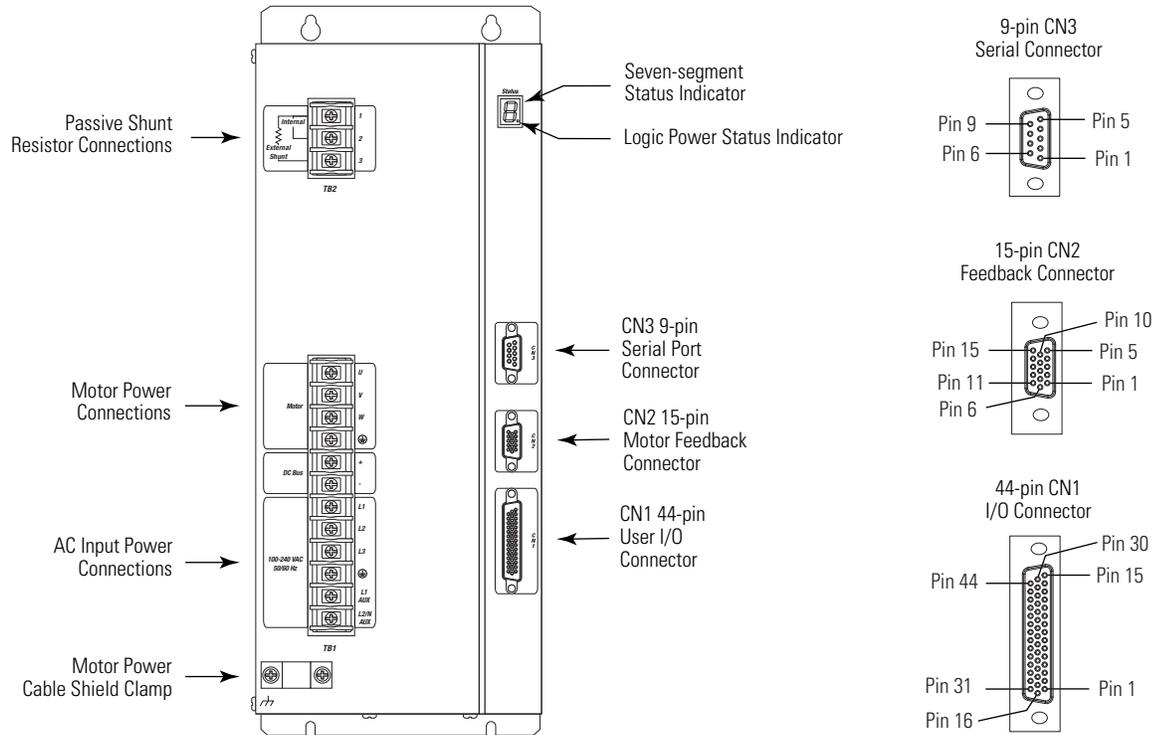
Front Panel Connections for 2098-DSD-030 and 2098-DSD-030X Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000 230V drives (7.5 and 15 kW).

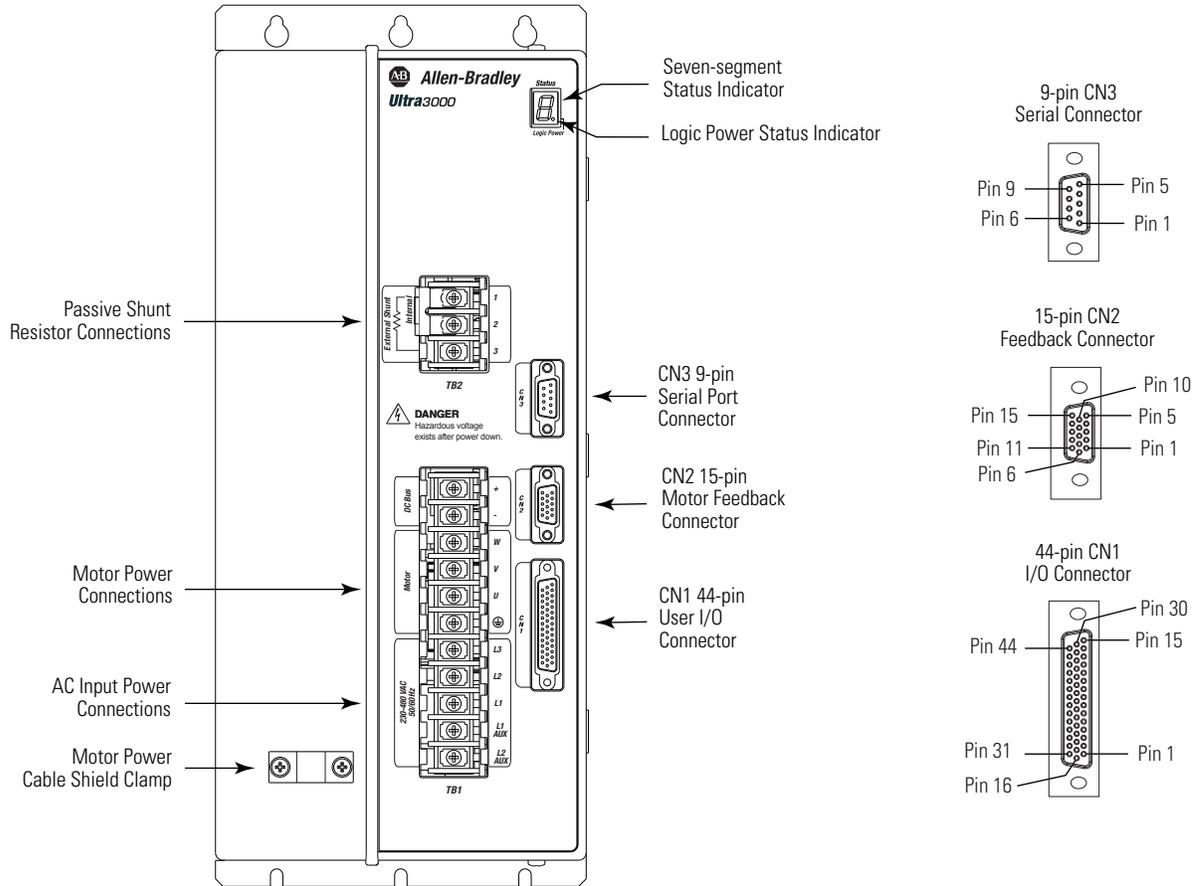
Front Panel Connections for 2098-DSD-075, 2098-DSD-075X, 2098-DSD-150, and 2098-DSD-150X Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000 460V drives (3 kW, 5 kW, 10 kW, 15 kW, and 22 kW).

Front Panel Connections for 2098-DSD-HVxxx and 2098-DSD-HVxxxX Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Apply Power To Your Ultra3000 Drive

This procedure assumes you have wired your Ultra3000 system, verified the wiring, and are ready to begin using your Ultraware software.

ATTENTION



High voltage exists in ac line filters. The filter must be grounded properly before applying power. Filter capacitors retain high voltages after power removal. Before handling the equipment, voltages should be measured to determine safe levels. Failure to observe this precaution could result in personal injury.

Follow these steps to apply power to your Ultra3000 drive.

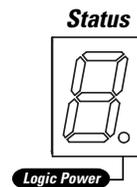
1. Disconnect any load to the motor, making sure the motor is free of all linkages when initially applying power to the system.

ATTENTION



To avoid damage to the drive due to improper sequencing of input power and the Drive Enable (Input 1) signal, do not apply the Drive Enable signal without first applying input power.

2. Apply input power to the Ultra3000 drive and observe the front panel Logic Power status indicator.



If the Logic Power status indicator is	Then
ON	Go to step 3.
Not ON	<ol style="list-style-type: none"> 1. Check your input power connections. 2. Repeat step 2.

3. Observe the front panel seven-segment status indicator on your Ultra3000 drive.

Seven-segment Status Indicator	Status	Do This
Actively cycling segments in a full circle	The drive is ready.	Go to Detect Your Ultra3000 Drive on page 16.
Flashing E followed by two numbers	The drive is faulted.	Go to Error Codes on page 98.

Detect Your Ultra3000 Drive

This procedure assumes you have successfully applied power to your drive. These steps are designed to make sure that your Ultra3000 drive is communicating with your Ultraware software.

Follow these steps to detect your Ultra3000 drive.

1. Start your Ultraware software.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on starting the Ultraware software.

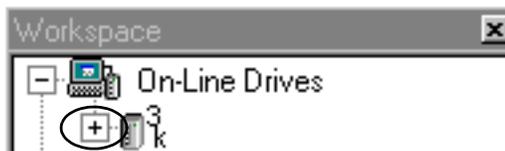
2. Create a new file.

The software will scan for online drives.

3. Click Stop Scanning when your drive is detected or wait for the scanning to time out.

4. Look for the Ultra3000 icon under the On-Line Drives tree.

The Ultra3000 icon indicates that your drive is detected.



5. Click the [+] next to the Ultra3k icon to expand the branch menu.

If your Ultra3000 drive	Then
Is detected and listed under the On-Line Drives tree	<ol style="list-style-type: none"> 1. The software and hardware are communicating and the system is ready. 2. Go to Select a Motor on page 21.
Is not detected	<ol style="list-style-type: none"> 1. Check your serial cable connections. 2. Use Recover Communications (in Ultraware) to establish a connection. 3. Go to main step 1 of this section.

Understanding the Workspace and Drive Branches

This section provides a description of the Ultraware workspace and various drive branches.

Click the [+] next to 3k Drive to expand the parameter group.

Double-click the 3k Drive icon in the Ultraware workspace to display the various drive branches.

Configure drive parameters for an off-line drive.

Open the Control Panel dialogs to issue motion commands.

Execute commands to clear faults, reset the drive, or reset the EEPROM.

Monitor the status of an online drive.

Parameter	Value
Name	
Auto Motor Iden	Disabled
Motor Model	MPL-A310P-H
Motor Forward Dir	Normal
Displayed Units	Metric
Operation Modes	
Operation Mode	Analog Velocity Input
Oper Mode Override	Analog Velocity Input
Machine Cycle	
Communications	
Current Limits	
Position Limits	
Speed Functions	
Position Functions	

Status	Value	Units
Drive Enabled	⚡	
In Position	⚡	
In Position Window	⚡	
Up To Speed	⚡	
In Speed Window	⚡	

Mode Configuration Branch

Click the [+] next to Mode Configuration to select the drive's command source.

- Mode Configuration
 - Analog
 - Preset
 - Follower
 - Indexing
 - Homing
- Motor
- Tuning
- Encoders
- Digital Inputs
- Digital Outputs
- Analog Outputs
- Monitor
- Oscilloscope
- Faults
- Service Info

Motor Branch

Use the Motor Branch to:

- select a motor for the associated online or offline Ultra3000 drive. Once you select a motor, the status values associated with the selected motor appear in the Status pane of this dialog.
- monitor the status as related to the selected motor.
- perform diagnostics on the motor.

Diagnostic commands are not available for SERCOS drives.

Tuning Branch

Use the Tuning Branch to:

- configure Velocity and Position Regulator Gains that are used in tuning.
- monitor Velocity, Position, and Current loop status.
- open dialogs where you can execute commands for autotuning, manual position tuning, and manual velocity tuning.

Encoders Branch

Use the Encoders Branch to:

- define the motor and auxiliary encoders.
- configure the motor encoder and optional auxiliary encoder.

Digital Inputs Branch

Use the Digital Inputs Branch to:

- assign functionality to digital inputs.
- monitor the status of digital inputs.

Digital Outputs Branch

Use the Digital Outputs Branch to:

- assign functionality to digital outputs.
- set both active and inactive brake delays.
- monitor the status of digital outputs and the digital relay.
- open other dialogs where you can override the state of digital outputs and the relay.

Analog Outputs Branch

Use the Analog Outputs Branch to:

- assign drive signals to analog outputs.
- monitor the status of analog outputs.
- open a dialog where you can monitor and override the analog output value.

Monitor Branch

Use the Monitor Branch to:

- view a collection of statuses.
- open the Monitor Setup dialog where you can select the collection of statuses to display in this dialog.
- load a monitor previously saved.
- save a monitor for later use.

Oscilloscope Branch

Use the Oscilloscope Branch to trace one of four drive signals by:

- configuring the oscilloscope by selecting the drive signal to trace.
- executing commands that run the oscilloscope's tracing function continuously or in response to the configured trigger.
- monitoring the oscilloscope as it traces the selected drive signal.

Faults Branch

Use the Faults Branch to:

- set fault limits.
- monitor fault status.
- execute the Clear Faults command.
- open a dialog where you can review the drive's fault history.
- enable or disable faults.

TIP

For more information on setting fault limits, refer to Appendix C, *Minimizing the Effects of Feedback Signal Loss* on page 141.

Service Information Branch

Use the Service Information Branch to:

- modify the size of an off-line drive file before transferring the configuration to an online drive.
- display and monitor service information about the drive.
- display the firmware version of the drive.

Select a Motor

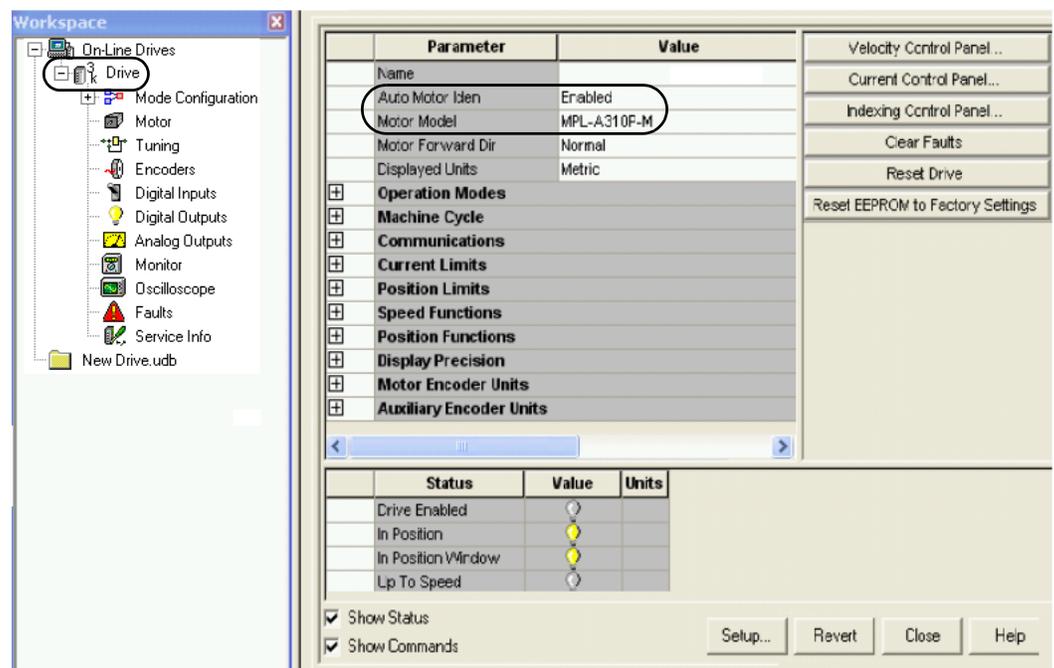
This procedure assumes you have power applied to your drive and the drive is detected by the Ultraware software.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on selecting a motor.

Follow these steps to select a motor.

1. Double-click the Ultra3000 icon (Ultra3k) under the On-Line Drives tree.

The Ultra3000 Drive properties dialog opens.



Actual values depend on your application. Auto Motor Iden default value is Enabled and remains Enabled if motor with intelligent encoder is detected or selected. Value changes to Disabled if motor without intelligent encoder is selected.

2. Check the Motor Model parameter value.

If motor is	Value (motor cat. no.)	Go To
An Allen-Bradley motor with intelligent encoder	Is recognized by the Ultraware software	Assign Digital Inputs on page 22.
	Is not recognized by the Ultraware software	Go to Error Codes in Chapter 2 and refer to troubleshooting for E30.
Not an Allen-Bradley motor with intelligent encoder		Step 3.

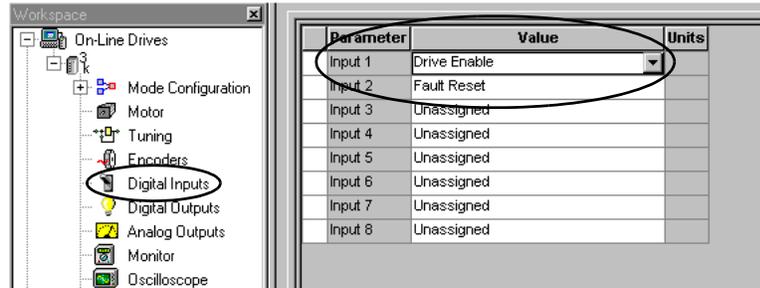
3. From the Motor Model pull-down menu, choose your motor.

Assign Digital Inputs

Follow these steps to assign Digital Inputs 1 and 2.

1. Double-click the Digital Inputs branch.

The Digital Inputs properties dialog opens.



2. Verify that Input 1 value is set to Drive Enable (this is default).

ATTENTION



To avoid fault action or damage to the drive due to improper sequencing of input power and the Drive Enable signal, you must assign one of the eight inputs as Drive Enable (Input 1 is the default setting).

3. Configure remaining digital inputs as required by your application.
4. Close the Digital Inputs properties dialog.

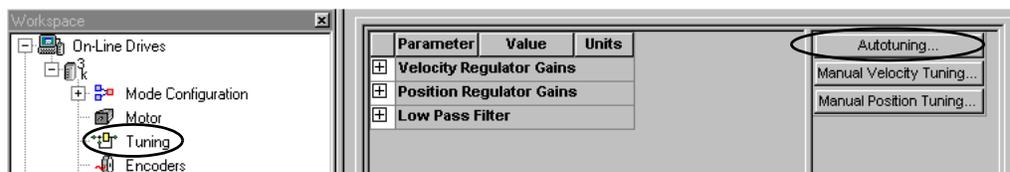
Tune Your Motor

This procedure assumes your drive is detected and you have selected a motor. In this procedure you will autotune your motor.

Follow these steps to autotune your motor.

1. Double-click the Tuning branch.

The Tuning properties dialog opens.



2. Click Autotuning.

The Autotuning dialog opens.

3. Apply 12...24V to input 1.

Input 1 was configured as Drive Enable in a previous step (Drive Enabled light turns yellow).

ATTENTION



To avoid damage to the drive due to improper sequencing of input power and the Drive Enable signal, do not apply Drive Enable signal without first applying input power.

4. Make the appropriate autotune settings for your application.

5. Click Start Autotune.

The motor responds and the tuning process is complete (Autotune Complete light turns yellow). Actual values depend on your application.

Parameter	Value	Units
Autotune Settings		
Motor Direction	Bi-Directional	
Maximum Distance	1000000	Counts
Step Current	10	%
Velocity Regulator Gains		
P	413	
I	137	
D	0	

Status	Value	Units
Drive Enabled		
Autotune Complete		
Autotune Failed		

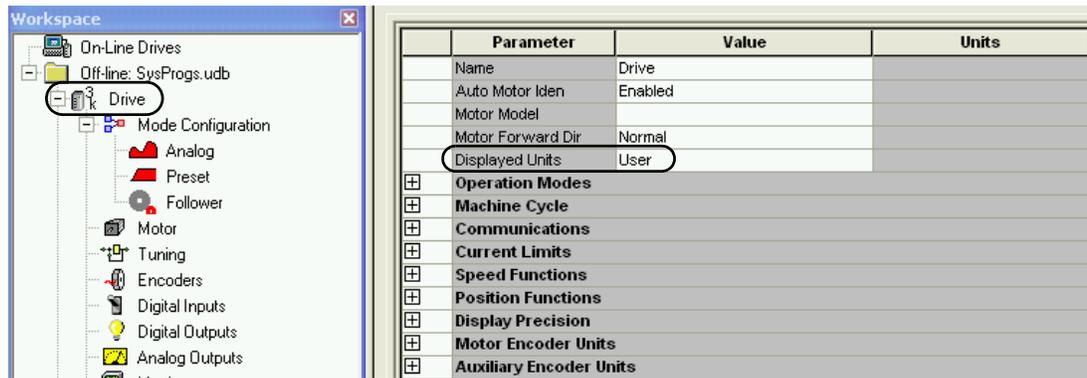
6. Close the Tuning properties dialog.

Configure Displayed Units

The default value setting for Displayed Units is metric. English units are also an option. For values of your own choosing, select User. User units is similar to setting up an application conversion constant. This is useful when the application requires the use of a transmission or other equipment. For example, if motor encoder activity is being measured in counts and the number of revolutions (rpm) is more meaningful, you can change counts to rpm. You can make similar settings for auxiliary encoder units.

1. Double-click the Ultra3000 icon (Ultra3k) under the On-Line Drives tree.

The Ultra3000 Drive properties dialog opens.



2. Click the Value field next to Display Units and choose User.
3. Click the [+] next to Motor Encoder Units.

Use these parameter settings for an incremental encoder. To display velocity in rpm divide 8000 counts/rev by 60 seconds/minute or 133.333. For position and acceleration use 8000.

Motor Encoder Units		
Velocity Label	RPM	
Velocity Scale	133.333	Counts/sec per User Units
Position Label	Revs	
Position Scale	8000	Counts per User Units
Acceleration Label	Revs/sec/sec	
Acceleration Scale	8000	Counts/s ² per User Units
Auxiliary Encoder Units		

Use these parameter settings for a Stegmann encoder. To display velocity in rpm divide 1,048,576 counts/rev by 60 seconds/minute or 17476.267. For position and acceleration use 1048576. Ultraware software may truncate or convert the number into scientific notation.

Motor Encoder Units		
Velocity Label	RPM	
Velocity Scale	17476.3	Counts/sec per User Units
Position Label	Revs	
Position Scale	1.04858E+006	Counts per User Units
Acceleration Label	Revs/sec/sec	
Acceleration Scale	1.04858E+006	Counts/s ² per User Units
Auxiliary Encoder Units		

The Indexing parameters now list the position as revs and acceleration/deceleration as revs/sec/sec as defined above. These examples are for rotary motors directly coupled to the machine.

Test Your Motor (non-indexing move)

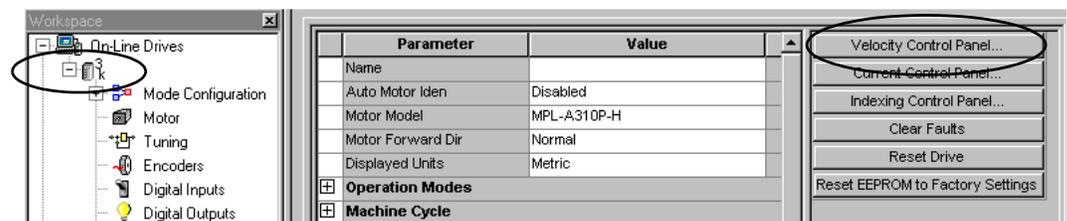
This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have selected a motor. In this procedure you will enable the drive and set the motor velocity to test the motor.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on using the velocity control panel.

Follow these steps to jog the motor at a constant speed.

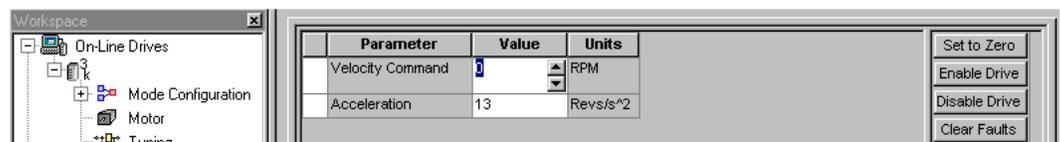
1. Double-click the U3k icon.

The drive properties dialog opens.



2. Click Velocity Control Panel.

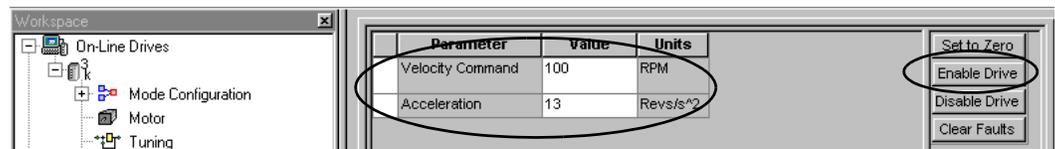
The velocity control panel dialog opens.



3. Apply 12...24V dc to input 1.

Input 1 was configured as Drive Enable in a previous step.

4. Click Enable Drive.

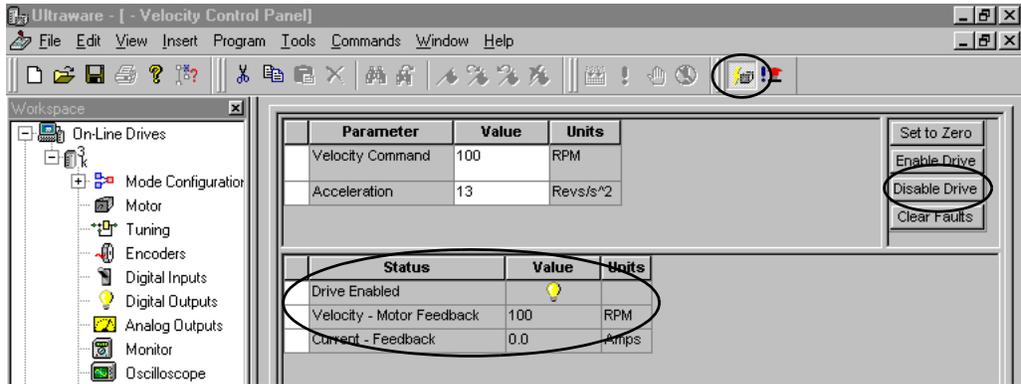


5. In the Velocity Command box, enter an appropriate low speed.

6. Press Enter.

The motor should be turning at the velocity you entered in step 5.

7. Observe the Status table.



- Drive Enable status = lamp is on (yellow)
- Velocity - Motor Feedback status = the value you entered in step 5

8. Click Disable Drive.

The motor stops.

9. Close the velocity control panel.

The drive is software disabled and the enable icon in the toolbar is no longer illuminated.

Test Your Motor (indexing move)

This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have selected a motor. In this procedure you will enable the drive and make an incremental move to test the motor.

IMPORTANT

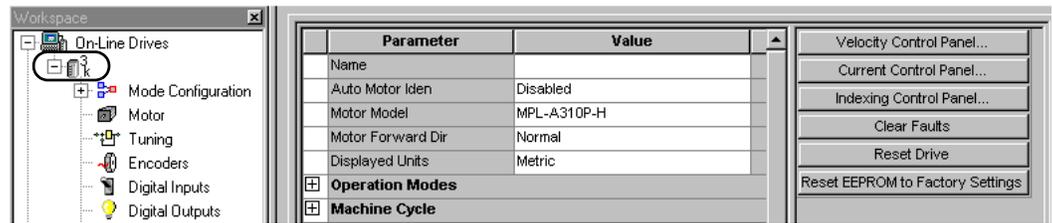
If you do not have an Ultra3000X indexing drive, you cannot access the indexing functions.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on using the indexing control panel.

Follow these steps to test your motor.

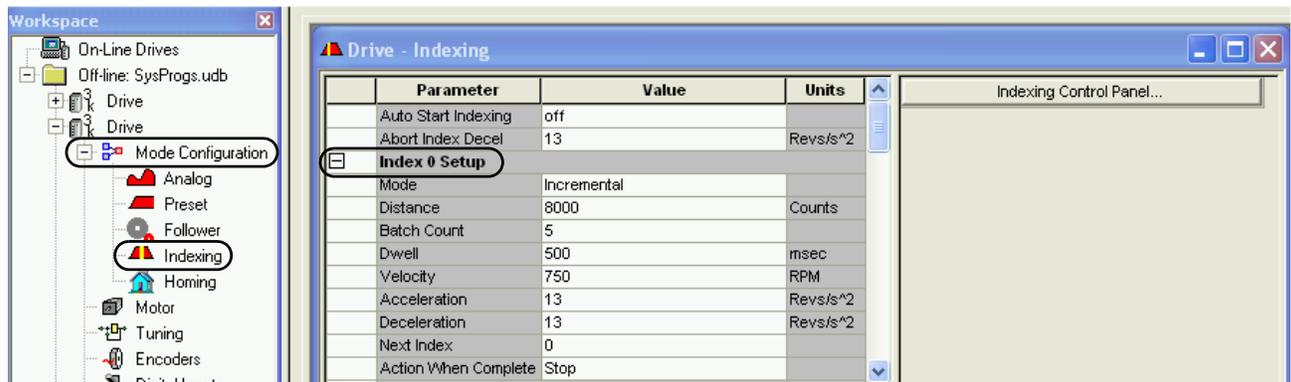
1. Double-click the U3k icon.

The drive properties dialog opens.



- Expand the Mode Configuration branch and double-click Indexing.

The Indexing Setup dialog opens.

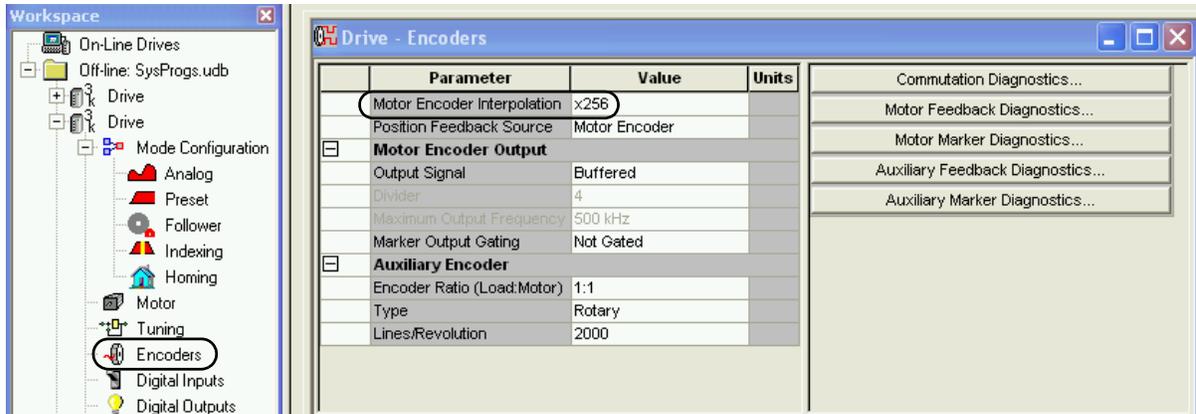


- Expand Index 0 Setup.
- Configure your incremental move with the following values for Index 0.
 - Mode = Incremental
 - Distance = 8000 counts
 - Batch count = 5
 - Dwell = 500 ms
 - Velocity = 750 rpm
 - Acceleration = 13 Rev/s²
 - Deceleration = 13 Rev/s²
 - Next Index = 0
 - Action When Complete = Stop

In this example, the Bulletin MPL motor uses an incremental, 2000 ppr (pulse per revolution) feedback device. Therefore, the Ultra3000 drive uses quadrature or 2000 ppr x 4 to equal 8000 counts per revolution.

If a Bulletin MPL motor with high-resolution feedback is used (catalog number MPL-A310P-M, for example), the feedback device

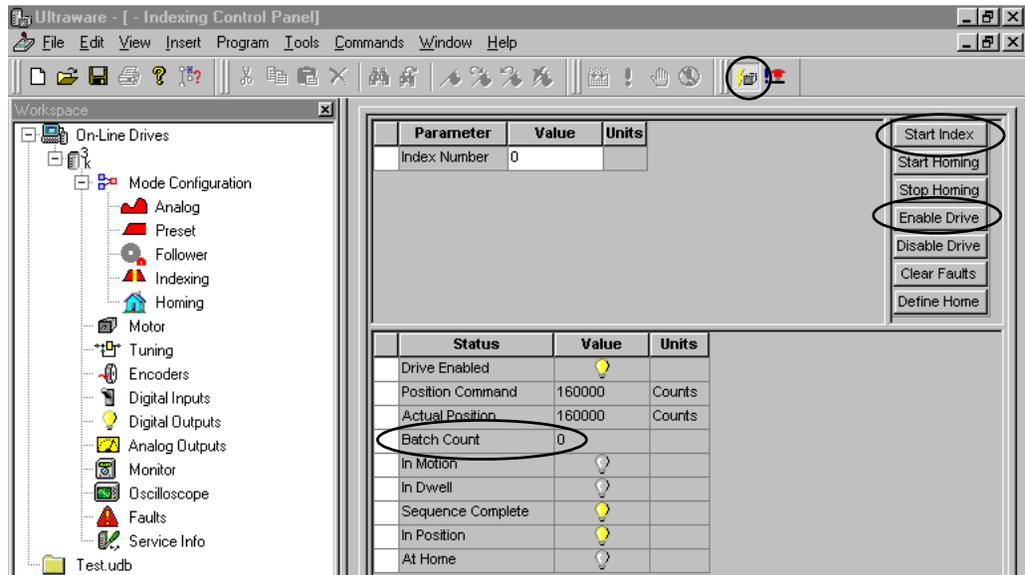
is 1024 ppr (pulses per revolution). However, the interpolation factor, as set in the Encoders tab of the Workspace, determines the counts per revolution. Default interpolation is x256 which totals 1024 x 256 or 262,144 counts per revolution.



These settings may not be appropriate for your application.

5. Click Indexing Control Panel in the drive properties dialog.

The indexing control panel dialog opens and the software enable icon should be on.



6. Click Enable Drive.

The Drive Enabled lamp is on (yellow).

7. Click Start Index.

Your incremental move begins. Observe the Batch Count value count down from 5...0 while your move is running. Also, observe the Position Command and Actual Position values following the incremental index 0 count setup for each move.

8. Close the indexing control panel dialog.

The drive is software disabled and the toolbar Enable icon is no longer on.

9. Close the Indexing mode dialog.

Indexing and Non-indexing Move Examples

This section provides examples of indexing and non-indexing moves you can make with your Ultra3000 drive by using Ultraware software.

Ultra3000 Drive Configuration Procedures

Procedure	Page
Analog Velocity Mode (non-indexing)	29
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Analog Velocity Mode (non-indexing)

This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have tested a motor. In this procedure you will run the drive in Analog Velocity mode.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on Analog Velocity mode.

Follow these steps to run your drive in Analog Velocity mode.

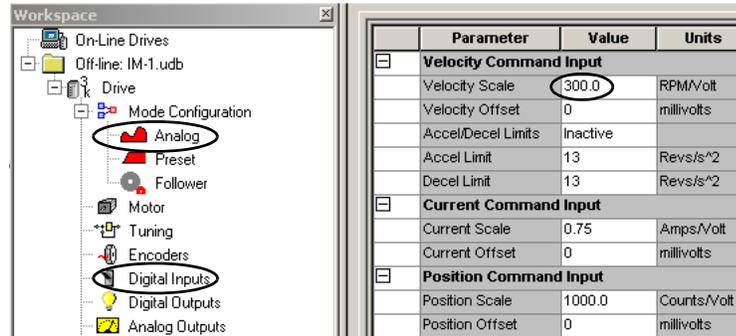
1. Double-click the U3k icon.

The drive properties dialog opens.

2. Expand the Operation Modes parameter and verify the Operation Mode is Analog Velocity Input.

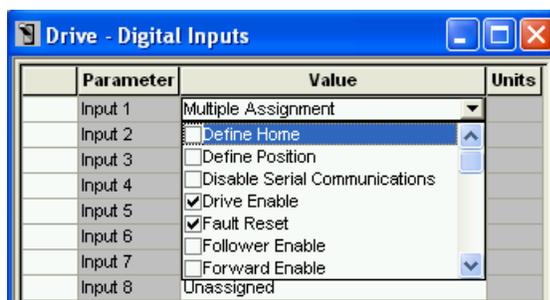
	Parameter	Value	Units
	Name	Drive	
	Auto Motor Iden	Enabled	
	Motor Model		
	Motor Forward Dir	Normal	
	Displayed Units	Metric	
[-]	Operation Modes		
	Operation Mode	Analog Velocity Input	
	Oper Mode Override	Analog Velocity Input	
[+]	Machine Cycle		

3. Close the Drive Branch dialog.
4. Expand the Mode Configuration branch and double-click Analog. The Analog Setup dialog opens.



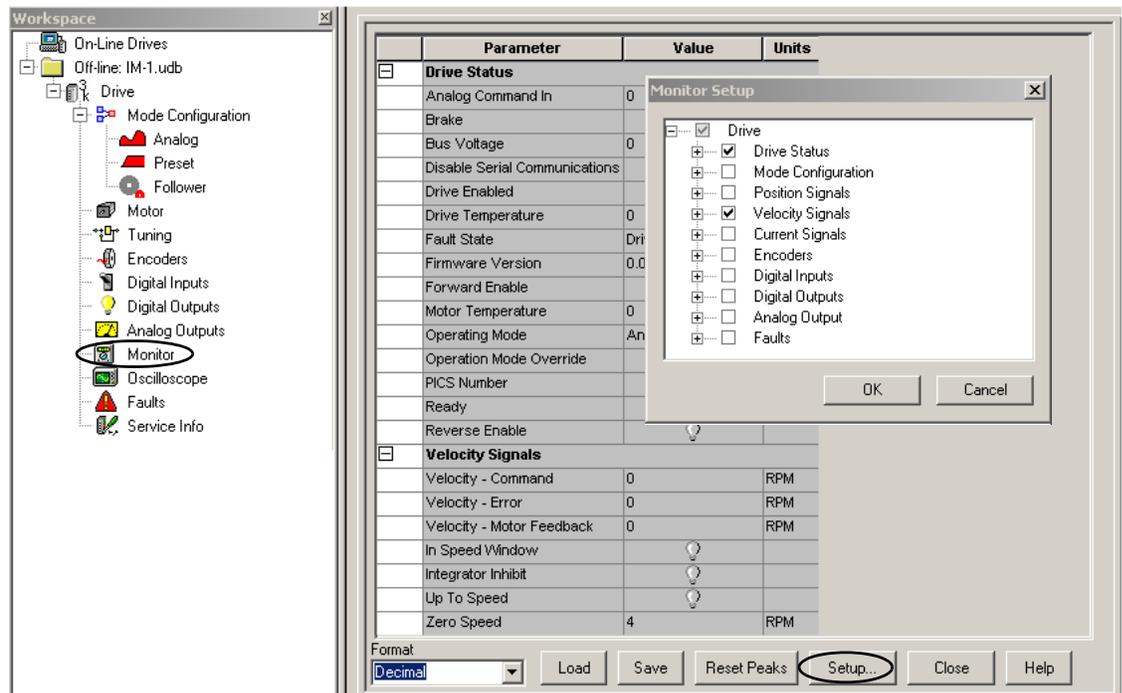
5. In the Velocity Scale box, enter 300.0 and verify Velocity Offset is set to 0.
6. Double-click the Digital Inputs branch.
 - a. Verify that Input 1 is configured as Drive Enable input (factory default).
 - b. Verify that Input 2 is configured as the Fault Reset input.

If more digital inputs are required for an application than are available in Ultraware software, you can combine inputs for multiple assignments. In this example both Drive Enable and Fault Reset are combined in Input 1. To reset a fault, toggle 12...24V dc to Input 1 or CN1-31. Then re-energize 12...24V dc to Input 1 or CN1-31 to keep the drive enabled.



- Double-click the Monitor branch.

The (default) Drive Status parameters display.



- Click Setup.

The Monitor Setup dialog opens.

- In the Monitor Setup dialog, check Velocity Signals.

- Click OK.

The Monitor Status dialog closes.

- Apply 12...24V dc to input 1.

Input 1 was configured as Drive Enable in a previous step. Make sure the Enable icon in the toolbar is active. This means the drive can enable.

- Observe the drive responding to a 0...±10V dc analog signal applied to CN1-25 and CN1-26 (1V dc = 300 rpm, per the setup).

- Analog Command voltage
- Velocity Command rpm (300 rpm/analog input voltage)
- Velocity - Motor Feedback

- Remove the 12...24V dc (Drive Enable) from input 1.

- Close the Monitor and Digital Inputs branch dialogs and the Analog mode configuration dialog.

Analog Position Mode (non-indexing)

This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have tested a motor. In this procedure you will run the drive in Analog Position mode.

Refer to the Ultraware User Manual, publication 2098-UM001, for more information on Analog Position mode.

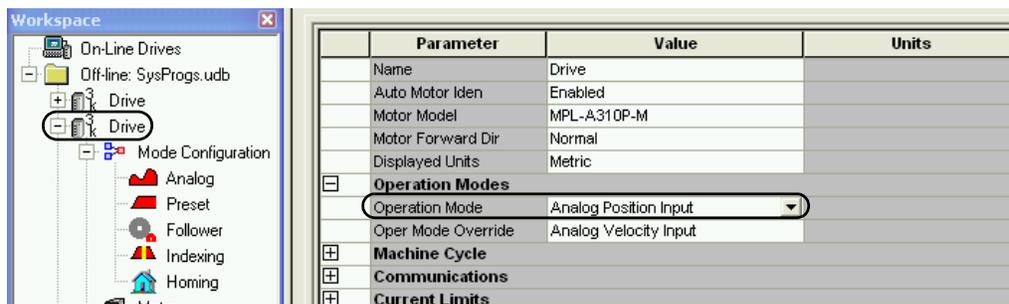
Follow these steps to run your drive in Analog Position mode.

1. Double-click the U3k icon.

The drive properties dialog opens.

2. Expand the Operation Modes parameter.

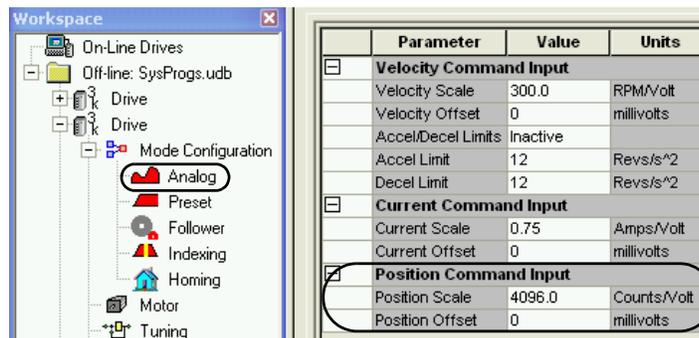
Verify the Operation Mode is Analog Position Input.



3. Close the Drive branch dialog.

4. Expand the Mode Configuration branch and double-click Analog.

The Analog Setup dialog opens.

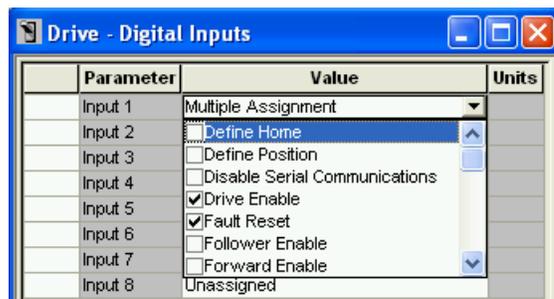


5. Enter the Position Scale value appropriate for your application.

In this example, the motor is catalog number MPL-A310P-M with 1024 ppr multiplied by an interpolation factor of 8, or 8192 counts per motor revolution. With a Position Scale value of 4096 counts per volt the motor will turn one revolution for every 2V dc.

6. Double-click the Digital Inputs branch.
 - a. Verify that Input 1 is configured as Drive Enable input (factory default).
 - b. Verify that Input 2 is configured as the Fault Reset input.

If more digital inputs are required for an application than are available in Ultraware software, you can combine inputs for multiple assignments. In this example both Drive Enable and Fault Reset are combined in Input 1. To reset a fault, toggle 12...24V dc to Input 1 or CN1-31. Then re-energize 12...24V dc to Input 1 or CN1-31 to keep the drive enabled.



7. Double-click the Monitor branch.
The (default) Drive Status parameters display.

Parameter	Value	Units
Drive Status		
Analog Command In	-3	millivolts
Brake		
Bus Voltage	166	Volts
Disable Serial Communications		
Drive Enabled		
Drive Temperature	0	
Fault State	Drive Ready	
Firmware Version	1.45	
Forward Enable		
Motor Temperature	0	
Operating Mode	Disabled	
Operation Mode Override		
PICS Number	1JBB1P05	
Ready		
Reverse Enable		
Position Signals		
Position - Command	0	
Position - Error	0	
Position - Motor Feedback	0	
Position - Auxiliary Encoder	1	
In Position		
In Position Window		
Position - Error Peak -	-216	
Position - Error Peak +	333	
Posn Compare 1		
Posn Compare 2		
Negative Overtravel Input		
Positive Overtravel Input		
Negative Overtravel		
Positive Overtravel		

8. Click Setup.

The Monitor Setup dialog opens.

9. In the Monitor Setup dialog, check Position Signals.**10.** Click OK.

The Monitor Status dialog closes.

11. Apply 12...24V dc to input 1.

Input 1 was configured as Drive Enable in a previous step. Make sure the Enable icon in the toolbar is active. This means the drive can enable.

12. In the Monitor dialog, observe the Drive Status and Position Signals parameters.

- Drive Enabled lamp is ON (yellow)
- 1V dc = 4096 counts or 1/2 motor revolution
- Supply 0...±10V dc to CN1-25 and CN1-26 and observe Position Command and Position-Motor Feedback

13. Remove the 12...24V dc (Drive Enable) from input 1.**14.** Close the Monitor dialog and the Analog mode configuration dialog.*Preset Velocity Control (non-indexing)*

This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have tested a motor. In this procedure you will run the drive by using preset velocity control.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on preset velocity control.

Follow these steps to use preset velocity control.

1. Double-click the U3k icon.

The drive properties dialog opens.

2. Expand the Operation Modes parameter.

- Click the current setting and use the pull-down menu to change the Operation Mode to Preset Velocity.

Parameter	Value
Name	Drive
Auto Motor Iden	Enabled
Motor Model	
Motor Forward Dir	Normal
Displayed Units	Metric
Operation Modes	
Operation Mode	Preset Velocity
Oper Mode Override	Analog Velocity Input
Machine Cycle	

- Close the Drive Branch dialog.
- Expand the Mode Configuration branch and double-click Preset. The Preset setup dialog opens.

Parameter	Value	Units
Preset Velocities		
Preset 0	10	RPM
Preset 1	100	RPM
Preset 2	1000	RPM
Preset 3	0	RPM
Preset 4	-10	RPM
Preset 5	-100	RPM
Preset 6	-1000	RPM
Preset 7	0	RPM
Preset Velocity Input Limits		
Accel/Decel Limits	Inactive	
Acceleration	13	Revs/s ²
Deceleration	13	Revs/s ²

- Enter the Preset Velocity values as shown in the table above or otherwise appropriate to your application.
- Set the Preset Velocity Input Limits value to Inactive.
- Close the Preset dialogs.
- Double-click the Digital Inputs branch.
- Click the Value fields and use the pull-down menus to change the input values as described below.

Parameter	Value	Units
Input 1	Drive Enable	
Input 2	Unassigned	
Input 3	Unassigned	
Input 4	Unassigned	
Input 5	Unassigned	
Input 6	Preset Select 2	
Input 7	Preset Select 1	
Input 8	Preset Select 0	

11. Using this table, determine the sequence of these three inputs that correspond to the preset velocity entered.

Preset Selects	Binary Code						Selected Preset or Index
	5	4	3	2	1	0	
Select up to 64 locations via preselect inputs 5...0 by using BCD format. (codes for preset selects 1 and 0 are shown)	0	0	0	0	0	0	Preset 0 or Index 0 is selected.
	0	0	0	0	0	1	Preset 1 or Index 1 is selected.
	0	0	0	0	1	0	Preset 2 or Index 2 is selected.
	0	0	0	0	1	1	Preset 3 or Index 3 is selected.
	↓						↓
	1	1	1	1	1	1	Preset 64 or Index 64 is selected.

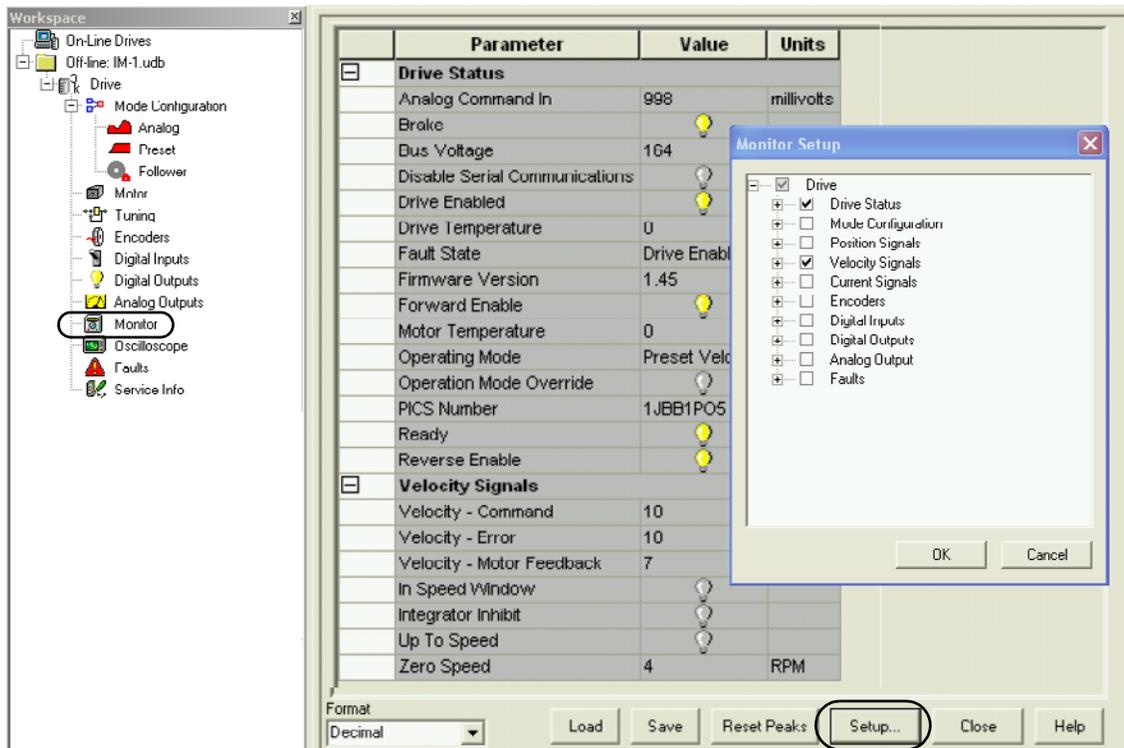
12. Apply 12...24V dc to input 1.

Input 1 was configured as Drive Enable in a previous step.

- a. Verify the toolbar Enable icon is active, indicating the drive is enabled.
- b. Verify the Drive Enabled lamp is ON (yellow)
- c. If none of the Preset Selects are ON, observe the motor running at the selected speed (rpm) for Preset 0 (10 rpm in this example).

13. Double-click the Monitor branch.

The (default) Drive Status parameters display.



14. Click Setup.

The Monitor Setup dialog opens.

15. In the Monitor Setup dialog, check Velocity Signals.**16.** Click OK.

The Monitor Status dialog closes and the setup changes take affect.

17. Observe that Velocity - Command matches what was entered in Preset Velocity 0.**18.** Observe the Velocity - Motor Feedback continually updating to maintain the commanded velocity.**19.** Apply 12...24V dc to Preset Select 0 configured as Digital Input 8 (CN1-38).

The Velocity - Command now matches Preset 1 (100 rpm in this example).

20. Remove the 12...24V dc (Drive Enable) from input 1.**21.** Close the Monitor Status dialog and Digital Inputs dialog.*Preset Position Control (indexing move)*

This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have tested a motor. In this procedure you will run the drive by using preset position control.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on preset position control.

Follow these steps to use preset position control.

1. Double-click the U3k icon.

The drive properties dialog opens.

2. Expand the Operation Modes parameter.

- Click the current setting and use the pull-down menu to change the Operation Mode to Preset Position.

Name	thermal test
Auto Motor Iden	Enabled
Motor Model	MPL-A310P-M
Motor Forward Dir	Normal
Displayed Units	Metric
Operation Modes	
Operation Mode	Preset Position
Oper Mode Override	Analog Velocity Input
Machine Cycle	
Communications	
Current Limits	
Position Limits	
Speed Functions	
Position Functions	
Display Precision	
Motor Encoder Units	
Auxiliary Encoder Units	

- Close the Drive Branch dialog.
- Expand the Mode Configuration branch and double-click Preset. The Preset setup dialog opens.

Preset Position 0 Setup		
Position	8192	Counts
Velocity	750	RPM
Acceleration	12	Revs/s ²
Deceleration	12	Revs/s ²
Preset Position 1 Setup		
Position	4096	Counts
Velocity	750	RPM
Acceleration	12	Revs/s ²
Deceleration	12	Revs/s ²

- Enter the Preset Velocity values as shown in the table above or otherwise appropriate to your application.
- Double-click the Digital Inputs branch.
- Click the Value fields and use the pull-down menus to change the input values as described below.

Parameter	Value	Units
Input 1	Multiple Assignment	
Input 2	Unassigned	
Input 3	Unassigned	
Input 4	Unassigned	
Input 5	Define Position	
Input 6	Preset Select 2	
Input 7	Preset Select 1	
Input 8	Preset Select 0	

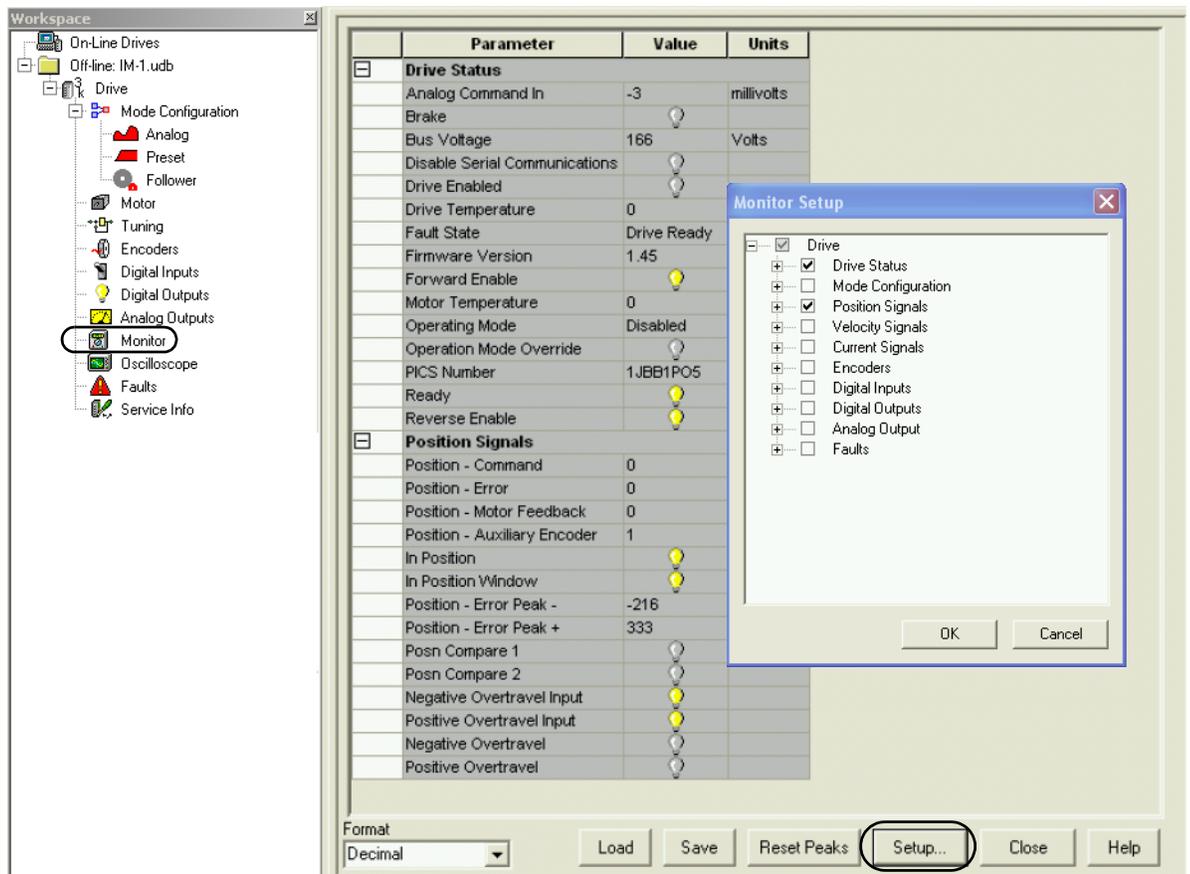
- Using this table, determine the sequence of these three inputs that correspond to the preset positions entered.

Preset Selects	Binary Code						Selected Preset or Index
	5	4	3	2	1	0	
Select up to 64 locations via preselect inputs 5...0 by using BCD format. (codes for preset selects 1 and 0 are shown)	0	0	0	0	0	0	Preset 0 or Index 0 is selected.
	0	0	0	0	0	1	Preset 1 or Index 1 is selected.
	0	0	0	0	1	0	Preset 2 or Index 2 is selected.
	0	0	0	0	1	1	Preset 3 or Index 3 is selected.
				↓			↓
	1	1	1	1	1	1	Preset 64 or Index 64 is selected.

In this example, Preset Position 0 and 1 are configured so Preset Select 0 is either off (Preset Position 0) or on (Preset Position 1).

- Double-click the Monitor branch.

The (default) Drive Status parameters display.



- Click Setup.

The Monitor Setup dialog opens.

12. In the Monitor Setup dialog, check Position Signals.

13. Click OK.

The Monitor Status dialog closes and the setup changes take affect.

14. Apply 12...24V dc to input 1.

Input 1 was configured as Drive Enable in a previous step.

- a. Verify the toolbar Enable icon is active, indicating the drive is enabled.
- b. Verify the Drive Enabled lamp is ON (yellow)
- c. If none of the Preset Selects are ON, observe the motor move to Preset Position 0.

In this example, 1 revolution (8192 counts).

15. Apply 12...24V dc to Preset Select 0 configured as Digital Input 8 (CN1-38).

The motor moves to Preset Position 1 (4096 counts).

TIP

Preset Positions are absolute and not incremental position.

16. Close the Preset, Monitor Branch, and Digital Inputs dialog.

Master Follower and Preset Gear Ratios (non-indexing move)

This procedure assumes you have applied power to your drive, the Ultraware software is running, the drive is detected, and you have tested a motor.

An external auxiliary encoder is powered by the Ultra3000 drive through pins CN1-1 and CN1-2. The encoder signals are wired to pins CN1-4...CN1-9. In this procedure, you will run the drive in Follower-Auxiliary Encoder mode.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on Position Follower mode.

Follow these steps to run the drive in Follower-Auxiliary Encoder mode.

1. Double-click the U3k icon.

The drive properties dialog opens.

2. Expand the Operation Modes parameter.

- Click the current setting and use the pull-down menu to change the Operation Mode to Follower: Auxiliary Encoder.

	Parameter	Value	Units
	Name	Drive	
	Auto Motor Iden	Enabled	
	Motor Model		
	Motor Forward Dir	Normal	
	Displayed Units	Metric	
[-]	Operation Modes		
	Operation Mode	Follower: Auxiliary Encoder	
	Oper Mode Override	Analog Velocity Input	
[+]	Machine Cycle		
[+]	Communications		
[+]	Current Limits		
[+]	Speed Functions		
[+]	Position Functions		
[+]	Display Precision		
[+]	Motor Encoder Units		
[+]	Auxiliary Encoder Units		

- Close the Drive Branch dialog.
- Expand the Mode Configuration branch.
- Double-click Follower.
- Enter the Gear Ratio preset values as shown in the table below or according to your specific application.

	Parameter	Value	Units
	Slew Limit Enable	Inactive	
	Slew Limit	13	Revs/s^2
[-]	Gear Ratios (Master:Follower)		
	Preset 0	1:1	
	Preset 1	2:1	
	Preset 2	1:2	
	Preset 3	5:1	
	Preset 4	1:5	
	Preset 5	10:1	
	Preset 6	1:10	
	Preset 7	1:1	

- Close the Mode Configuration dialog.
- Double-click the Digital Inputs branch.
- Use the pull-down menu to change the input values.

	Parameter	Value	Units
	Input 1	Drive Enable	
	Input 2	Unassigned	
	Input 3	Unassigned	
	Input 4	Unassigned	
	Input 5	Unassigned	
	Input 6	Preset Select 2	
	Input 7	Preset Select 1	
	Input 8	Preset Select 0	

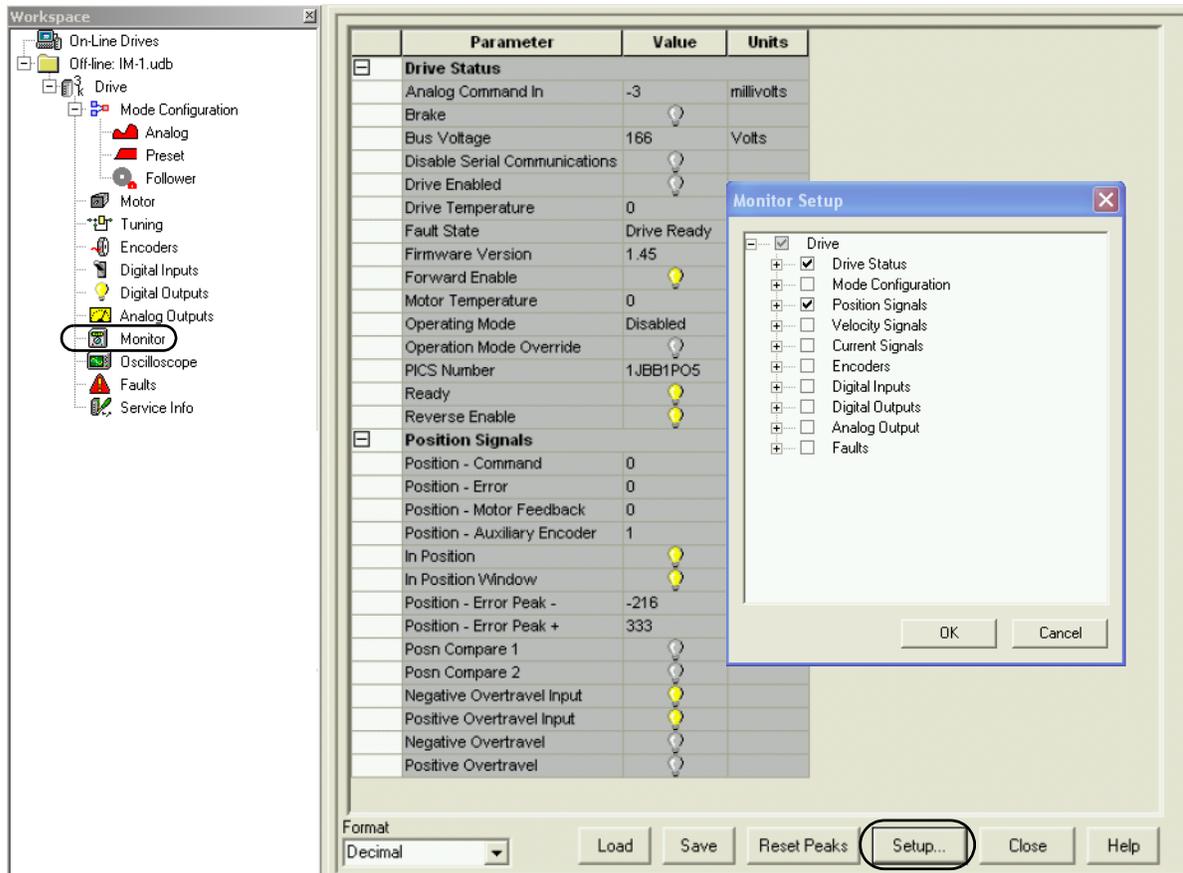
11. Using this table, determine the sequence of these three inputs that correspond to the preset gear ratios entered.

Preset Selects	Binary Code						Selected Preset or Index
	5	4	3	2	1	0	
Select up to 64 locations via preselect inputs 5...0 by using BCD format. (codes for preset selects 1 and 0 are shown)	0	0	0	0	0	0	Preset 0 or Index 0 is selected.
	0	0	0	0	0	1	Preset 1 or Index 1 is selected.
	0	0	0	0	1	0	Preset 2 or Index 2 is selected.
	0	0	0	0	1	1	Preset 3 or Index 3 is selected.
	↓	↓	↓	↓	↓	↓	↓
	1	1	1	1	1	1	Preset 64 or Index 64 is selected.

In this example, preset gear ratio 0 and 1 are configured.

12. Double-click the Monitor branch.

The (default) Drive Status parameters display.



13. Click Setup.

The Monitor Setup dialog opens.

14. In the Monitor Setup dialog, check Position Signals.

15. Click OK.

The Monitor Status dialog closes and the setup changes take affect.

16. Apply 12...24V dc to input 1.

Input 1 was configured as Drive Enable in a previous step.

- Verify the toolbar Enable icon is active, indicating the drive is enabled.
- Verify the Drive Enabled lamp is ON (yellow)
- If none of the Presets are ON, move the auxiliary encoder and observe the motor rotate at Preset 0 Gear Ratio or 1:1.

17. Apply 12...24V dc to Preset Select 0 which is configured for Digital Input 8 or pin CN1-38.

Notice that the auxiliary encoder uses Preset 1 as the Gear Ratio or 2:1. This means for every two revolutions of the auxiliary encoder, the motor rotates 1 revolution.

	Parameter	Value	Units
☐	Drive Status		
	Analog Command In	999	millivolts
	Brake		
	Bus Voltage	165	Volts
	Disable Serial Communications		
	Drive Enabled		
	Drive Temperature	0	%
	Fault State	Drive Enable	
	Firmware Version	1.45	
	Forward Enable		
	Motor Temperature	0	%
	Operating Mode	Follower: Aux	
	Operation Mode Override		
	PICS Number	1JBB1P05	
	Ready		
	Reverse Enable		
☐	Position Signals		
	Position - Command	7823	Counts
	Position - Error	0	Counts
	Position - Motor Feedback	7822	Counts
	Position - Auxiliary Encoder	16705	Counts
	In Position		
	In Position Window		
	Position - Error Peak -	-54	Counts
	Position - Error Peak +	53	Counts
	Posn Compare 1		
	Posn Compare 2		
	Negative Overtravel Input		
	Positive Overtravel Input		
	Negative Overtravel		
	Positive Overtravel		

18. Remove the 12...24V dc (Drive Enable) from input 1.**19.** Close the Monitor Branch and Digital Inputs dialog.

Incremental Indexing (indexing move)

This procedure assumes you have applied power to your indexing drive, the Ultraware software is running, the drive is detected, and you have tested a motor. In this procedure you will run the drive in Incremental Indexing mode.

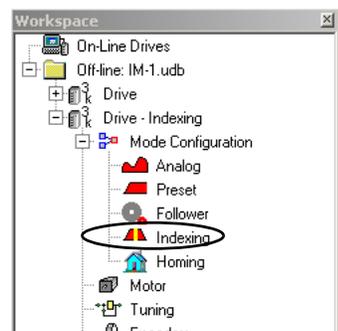
Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on incremental indexing moves.

Follow these steps to set parameters for an incremental indexing move.

1. Double-click the U3k icon.
The drive properties dialog opens.
2. Expand the Operation Modes parameter.
3. Click the current setting and use the pull-down menu to change the Operation Mode to Indexing.

	Parameter	Value	Units
	Name	Drive - Indexing	
	Auto Motor Iden	Enabled	
	Motor Model		
	Motor Forward Dir	Normal	
	Displayed Units	Metric	
[-]	Operation Modes		
	Operation Mode	Indexing	
	Oper Mode Override	Analog Velocity Input	
[+]	Machine Cycle		

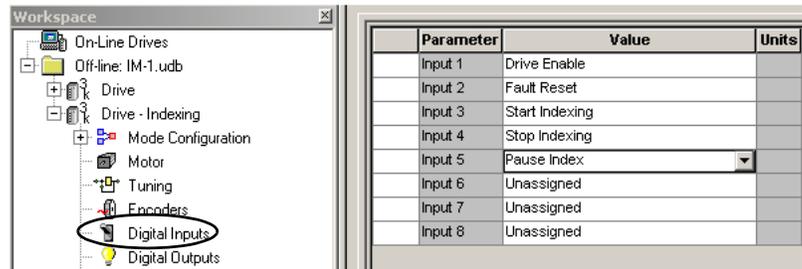
4. Close the Drive Branch dialog.
5. Expand the Mode Configuration branch.
6. Double-click Indexing.
7. Enter the Index 0 parameter values.



	Parameter	Value	Units
	Auto Start Indexing	off	
	Abort Index Decel	13	Rev
[-]	Index 0 Setup		
	Mode	Incremental	
	Distance	4000	Cou
	Batch Count	10	
	Dwell	1000	mse
	Velocity	400	RPM
	Acceleration	12000	Rev
	Deceleration	3000	Rev
	Next Index	0	
	Action When Complete	Stop	

8. Close the Indexing Parameters dialog.
9. Double-click the Digital Inputs branch.

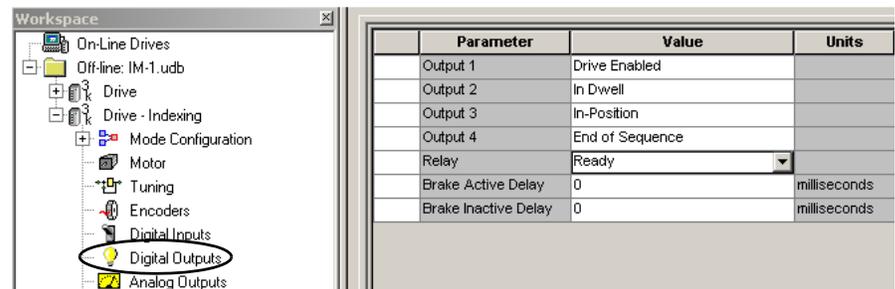
10. Use the pull-down menu to change the input values.



11. Close the Digital Inputs dialog.

12. Double-click the Digital Outputs branch.

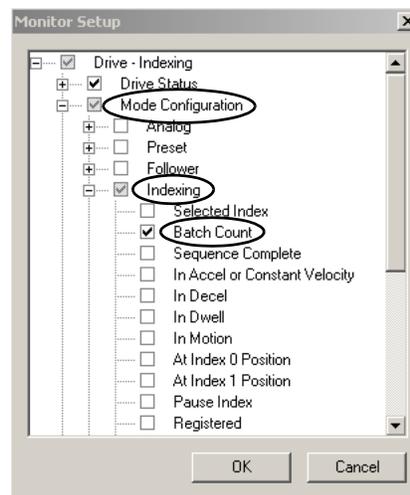
13. Use the pull-down menu to change the output values.



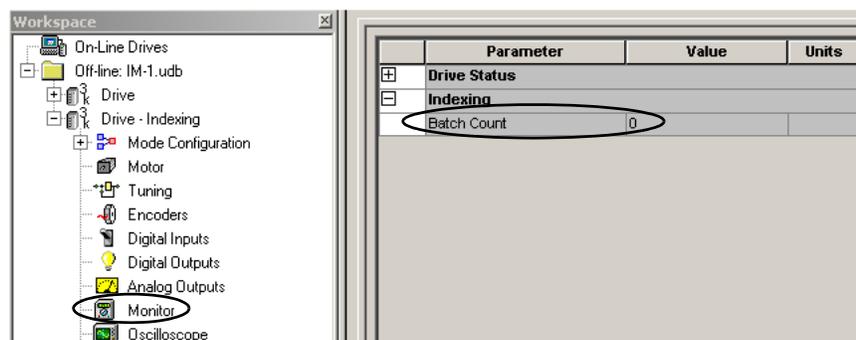
14. Close the Digital Outputs dialog.

Follow these steps to verify the number of indexing moves by using drive signals.

1. Double-click the Monitor branch.
2. Click Setup.
3. Expand the Mode Configuration branch/the Indexing branch/and check Batch Count.



4. Click OK.
5. Apply 12...24V dc to input 1.
Input 1 was configured as Drive Enable in a previous step.
6. Apply 12...24V dc to input 3 to the indexing move.



7. Double-click the Monitor branch and watch Batch Count count down from 10 to 0.
8. Observe Outputs 2 and 3 for axis in dwell and in position.
9. Observe Output 4 when the Indexing move is complete.
10. Remove the 12...24V dc (Drive Enable) from input 1.

Follow these steps to use the stop indexing feature.

1. Apply 12...24V dc to input 1.
Input 1 was configured as Drive Enable in a previous step.
2. Apply 12...24V dc to input 3 to the indexing move.
3. Apply 12...24V dc to input 4 and verify that the indexing move has stopped.
4. Apply 12...24V dc to input 3 (again) and verify the original indexing move is re-initiated.
5. Apply 12...24V dc to input 5 and verify the index move is paused.
6. Double-click the Digital Outputs branch.
7. Observe that Output 4 is not illuminated, indicating end of sequence has not been reached.

	Status	Value	Units
	Output 1 State		
	Output 2 State		
	Output 3 State		
	Output 4 State		
	Relay State		

8. Close the Digital Outputs dialog.
9. Observe the Monitor branch to see that the Batch Count value is held at the remaining value.
10. Remove the 12...24V dc from Input 5 and verify the indexing move continues.
11. Close the dialogs.
12. Remove the 12...24V dc (Drive Enable) from input 1.

Absolute Indexing (indexing move)

This procedure assumes you have applied power to your indexing drive, the Ultraware software is running, the drive is detected, and you have tested a motor. In this procedure you will run the drive in Absolute Indexing mode.

Refer to the Ultraware User Manual, publication [2098-UM001](#), for more information on absolute indexing moves.

Follow these steps to set parameters for an absolute indexing move.

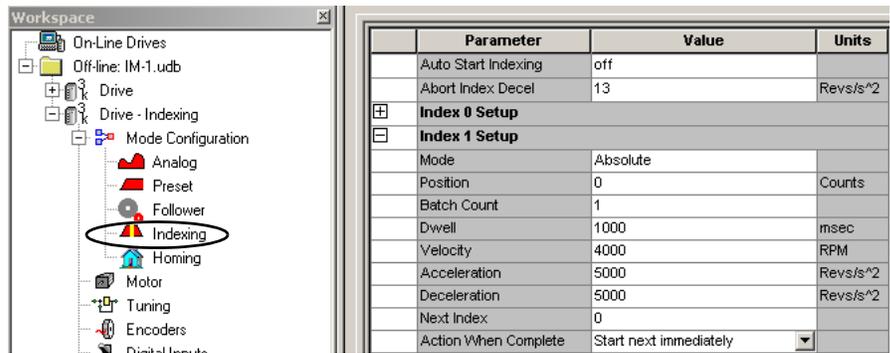
1. Double-click the U3k icon.
The drive properties dialog opens.
2. Expand the Operation Modes parameter.
3. Click the current setting and use the pull-down menu to change the Operation Mode to Indexing.

	Parameter	Value	Units
	Name	Drive - Indexing	
	Auto Motor Iden	Enabled	
	Motor Model		
	Motor Forward Dir	Normal	
	Displayed Units	Metric	
[-]	Operation Modes		
	Operation Mode	Indexing	
	Oper Mode Override	Analog Velocity Input	
[+]	Machine Cycle		

4. Close the Drive Branch dialog.
5. Expand the Mode Configuration branch.
6. Double-click Indexing.
7. Enter the Index 0 parameter values as shown in the table below.

	Parameter	Value	Units
	Auto Start Indexing	off	
	Abort Index Decel	13	Revs/s ²
[-]	Index 0 Setup		
	Mode	Absolute	
	Position	8000	Counts
	Batch Count	1	
	Dwell	1000	msec
	Velocity	450	RPM
	Acceleration	500	Revs/s ²
	Deceleration	500	Revs/s ²
	Next Index	1	
	Action When Complete	Start next immediately	

8. Enter the Index 1 parameter values as shown in the table below.



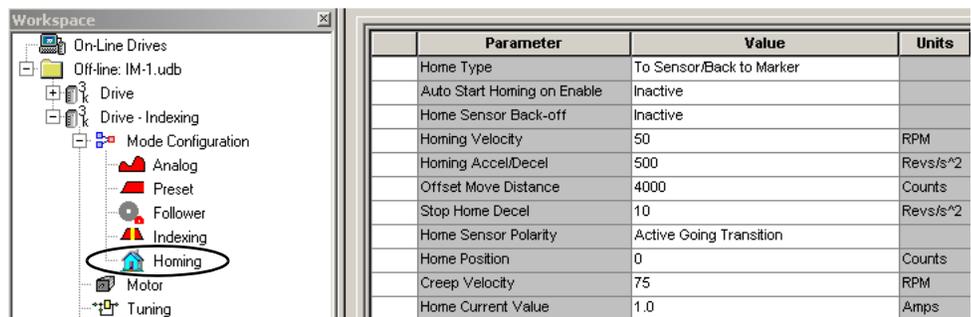
Parameter	Value	Units
Auto Start Indexing	off	
Abort Index Decel	13	Revs/s ²
Index 0 Setup		
Mode	Absolute	
Position	0	Counts
Batch Count	1	
Dwell	1000	msec
Velocity	4000	RPM
Acceleration	5000	Revs/s ²
Deceleration	5000	Revs/s ²
Next Index	0	
Action When Complete	Start next immediately	

9. Close the Indexing Parameters dialog.

10. Expand the Mode Configuration branch.

11. Double-click Homing.

12. Enter the Homing parameter values as shown in the table below.



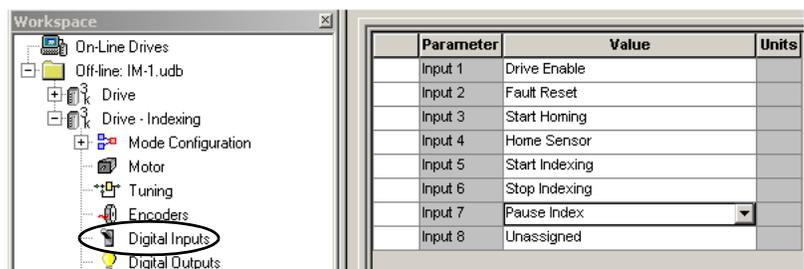
Parameter	Value	Units
Home Type	To Sensor/Back to Marker	
Auto Start Homing on Enable	Inactive	
Home Sensor Back-off	Inactive	
Homing Velocity	50	RPM
Homing Accel/Decel	500	Revs/s ²
Offset Move Distance	4000	Counts
Stop Home Decel	10	Revs/s ²
Home Sensor Polarity	Active Going Transition	
Home Position	0	Counts
Creep Velocity	75	RPM
Home Current Value	1.0	Amps

13. Close the Homing Parameters dialog.

14. Close the Mode Configuration dialog.

15. Double-click the Digital Inputs branch.

16. Use the pull-down menu to change the input values.

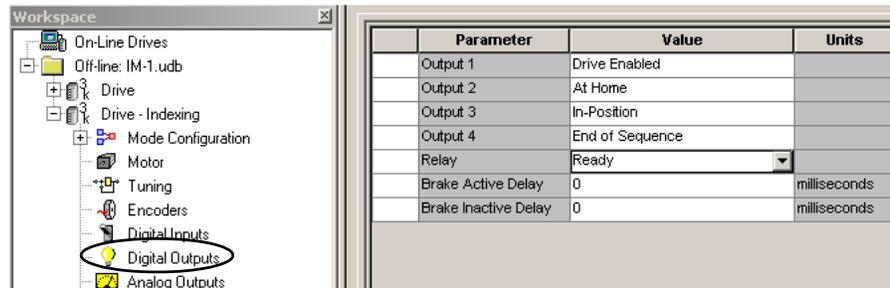


Parameter	Value	Units
Input 1	Drive Enable	
Input 2	Fault Reset	
Input 3	Start Homing	
Input 4	Home Sensor	
Input 5	Start Indexing	
Input 6	Stop Indexing	
Input 7	Pause Index	
Input 8	Unassigned	

17. Close the Digital Inputs dialog.

Follow these steps to use digital outputs to indicate an event has occurred.

1. Double-click the Digital Outputs branch.
2. Use the pull-down menu to change the output values.



3. Close the Digital Outputs dialog.
4. Apply 12...24V dc to input 1.
Input 1 was configured as Drive Enable in a previous step.
5. Apply 12...24V dc to input 3 (momentarily) to start the homing routine.
6. Apply 12...24V dc to input 4 (momentarily) to simulate a homing sensor.
The drive goes into reverse to find the marker and completes the homing routine.
7. Double-click the Digital Outputs branch.
8. Observe Digital Outputs status.

	Status	Value	Units
	Output 1 State	💡	
	Output 2 State	💡	
	Output 3 State	💡	
	Output 4 State	💡	
	Relay State	💡	

- Output 1 is on because the drive is enabled.
 - Output 2 is on because the drive has been homed.
 - Output 3 is on because the motor is in position.
9. Apply 12...24V dc to input 5 and observe Digital Outputs 2 and 3 change states.
 10. Apply 12...24V dc to input 6 (momentarily) to stop the indexing move.

- 11.** Turn off input 5.
- 12.** Apply 12...24V dc to input 4 (momentarily again) to restart the indexing move.
- 13.** Turn off input 4.
- 14.** Apply 12...24V dc to input 7 to pause the indexing move.
- 15.** Remove the 12...24V dc and observe the index move continue.
- 16.** Close the dialogs.
- 17.** Remove the 12...24V dc (Drive Enable) from input 1.

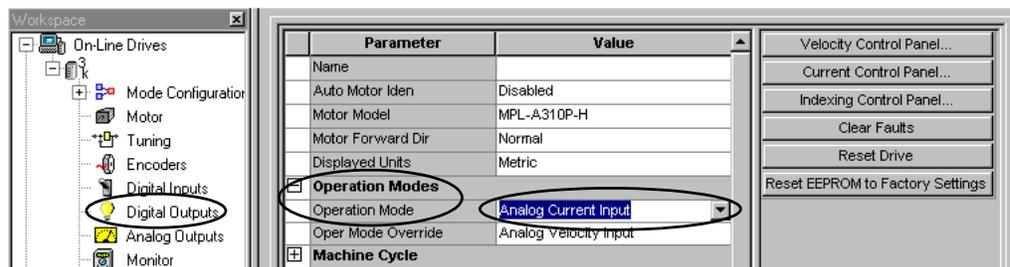
Configuring Your Ultra3000 Drive with RSLogix 5000 Software

In this section you will configure your Ultra3000 drive by using Ultraware software, configure the Logix analog motion module by using RSLogix 5000 software, and test/tune your axis.

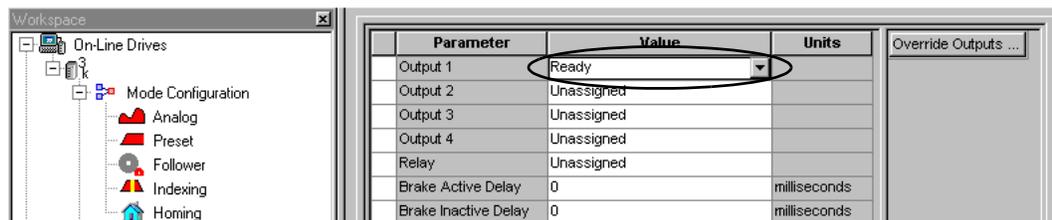
Configure Your Ultra3000 Drive

Follow these steps to configure your Ultra3000 drive.

1. Apply power to your Ultra3000 drive
Refer to the section Apply Power To Your Ultra3000 Drive.
2. Start your Ultraware software and make sure your Ultra3000 drive is detected.
Refer to the section Detect Your Ultra3000 Drive.
3. Select a motor.
Refer to the section Select a Motor.
4. Expand Operation Modes in the Drive properties dialog.
5. From the Operation Mode pull-down menu, choose Analog Current Input.



6. Double-click Digital Outputs.
The Digital Output properties dialog opens.



7. From the Output 1 pull-down menu, choose Ready.

Configuring Your Logix Analog Motion Module

This procedure assumes that you have finished configuring your Ultra3000 drive.

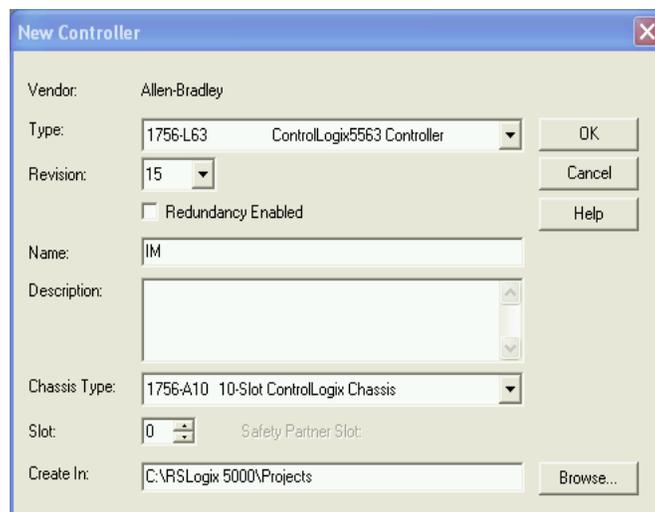
For help using RSLogix 5000 software as it applies to configuring the Logix analog modules, refer to Additional Resources on page 8.

Configure Your Logix Controller

Follow these steps to configure your Logix controller.

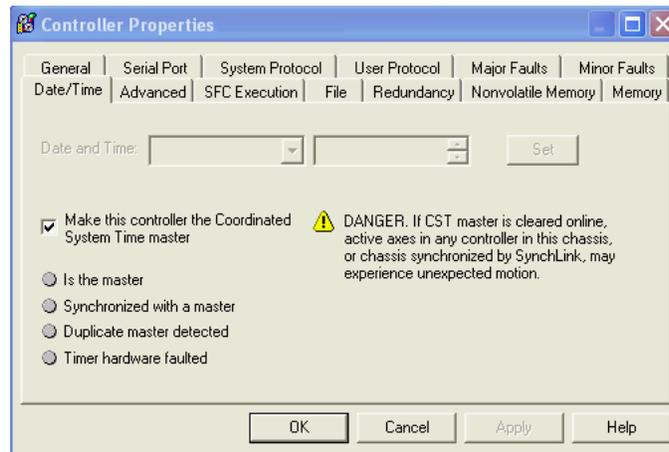
1. Apply power to your Logix chassis containing the analog motion module and open your RSLogix 5000 software.
2. From the File menu, choose New.

The New Controller dialog opens. The ControlLogix 1756-L63 controller was used in this example.



3. Configure the new controller.
 - a. From the Type pull-down menu, choose your controller.
 - b. From the Revision pull-down menu, choose your RSLogix 5000 software version.
 - c. In the Name box, name your file.
 - d. From the Chassis Type pull-down menu, choose your Logix chassis.
 - e. Enter the Logix processor slot.
4. Click OK.
5. From the Edit menu, choose Controller Properties.

The Controller Properties dialog opens.



6. Click the Date/Time tab.
7. Check the Make this controller the Coordinated System Time master checkbox.

IMPORTANT

Only one Logix processor can be assigned as the Coordinated System Time master.

8. Click OK.

Configure Your Logix Module

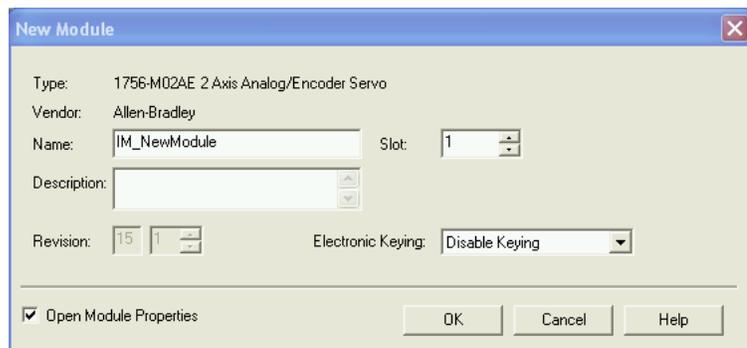
Follow these steps to configure your Logix module.

1. In the Explorer dialog, right-click I/O Configuration and choose New Module.

The Select Module dialog opens.

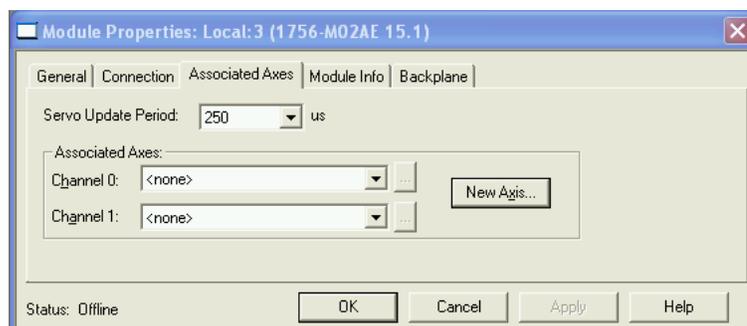
2. Expand the Motion category and select 1756-M02AE, 1756-HYD02, 1756-M02AS, or 1784-PM02AE as appropriate for your actual hardware configuration.
3. Click OK.

Your new module appears under the I/O Configuration folder in the Explorer dialog and the New Module dialog opens.



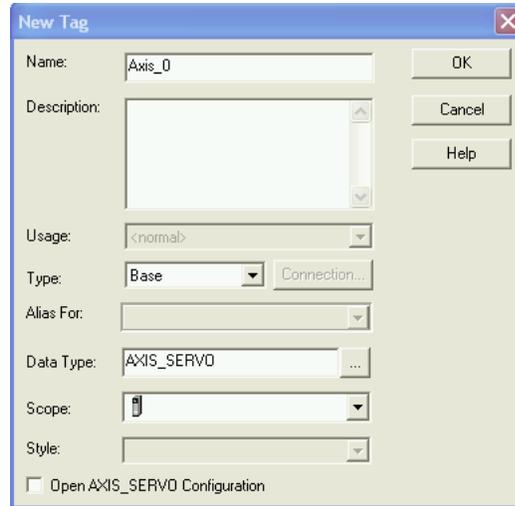
4. Configure the new module.
 - a. In the Name box, enter your module name
 - b. Enter the module slot.
 - c. From the Electronic Keying pull-down menu, choose your keying option
5. Click OK.

Your new module appears under the I/O Configuration folder in the Explorer dialog and the Module Properties dialog opens.

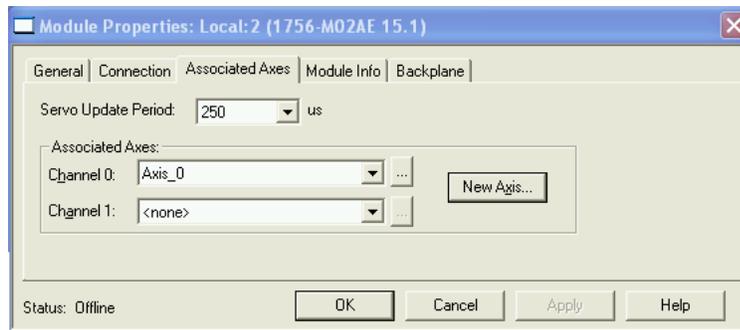


6. Click the Associated Axes tab.
7. Click New Axis.

The New Tag dialog opens.



8. Configure the new tag.
 - a. In the Name box, enter your axis name.
 - b. From the Data Type pull-down menu, choose AXIS_SERVO.
9. Click OK.
10. From the Channel 0 pull-down menu, choose your axis.



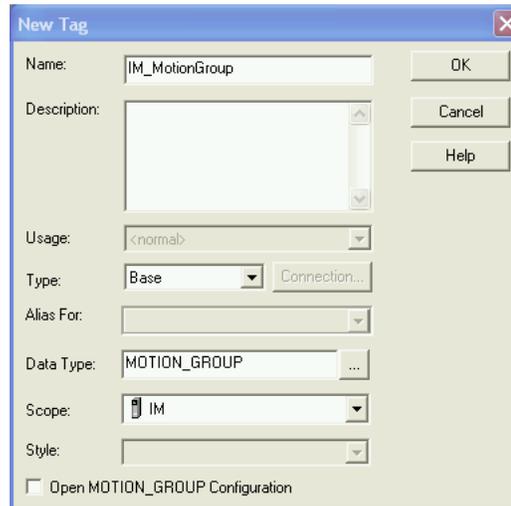
11. Click OK.

Configure the Motion Group

Follow these steps to configure the motion group.

1. In the Explorer dialog, right-click Motion Groups and choose New Motion Group.

The New Tag dialog opens.



2. In the Name box, enter your motion group name.
3. Click OK.

The new group appears under the Motion Group folder.

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

The Motion Group Properties dialog opens.

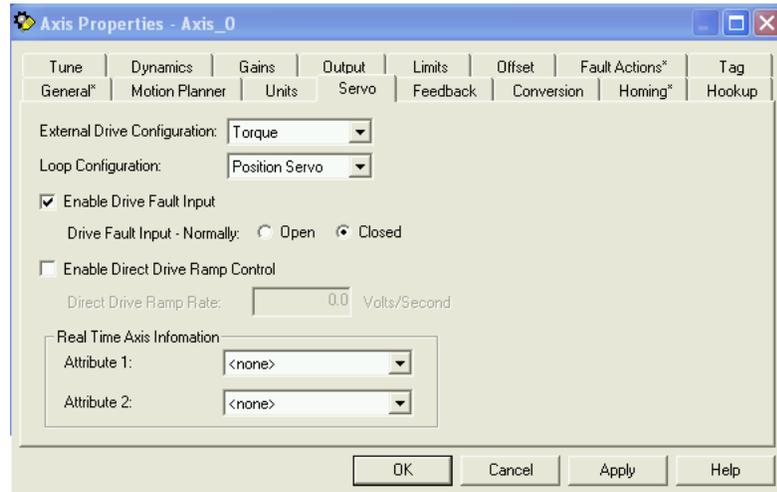


5. Click the Axis Assignment tab and move your axis (created earlier) from Unassigned to Assigned.
6. Click the Attribute tab and edit the default values as appropriate for your application.
7. Click OK.

Configure Axis Properties

Follow these steps to configure axis properties.

1. In the Explorer dialog, right-click an axis and choose Properties. The Axis Properties dialog opens.



2. Click the Servo tab.
 - a. From the External Drive Configuration pull-down menu choose Torque.

In Torque mode, both position and velocity loops are closed in the Logix controller. In Velocity mode, only the position loop is closed in the Logix controller.
 - b. Check the Enable Drive Fault Input checkbox.
 - c. Select Drive Fault Input - Normally Closed.
3. Click the Units tab and edit the default values as appropriate for your application.
4. Click the Conversion tab and edit the default values as appropriate for your application.
5. Click OK.
6. Verify your Logix program and save the file.

Download Your Program

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

Testing and Tuning Your Axis

This procedure assumes that you have configured your Ultra3000 drive and the analog motion module.

IMPORTANT

Before proceeding with testing and tuning your axis, verify that the seven-segment status indicator is actively cycling in a full circle.

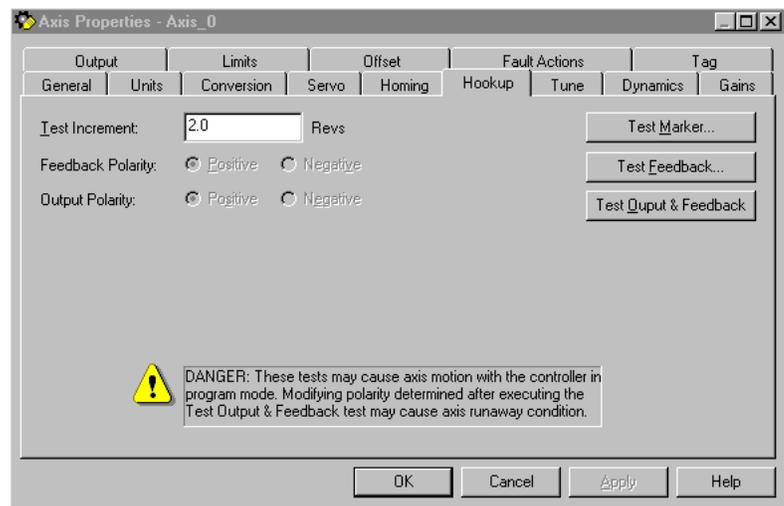
For help using RSLogix 5000 software as it applies to the analog Logix modules, refer to Additional Resources on page 8.

Test Your Axis

Follow these steps to test your axis.

1. Remove the load from your axis.
2. In your Motion Group folder, right-click the axis and choose Properties.

The Axis Properties dialog opens.



3. Click the Hookup tab.

- In the Test Increment box, enter 2.0 as the number of revolutions for the test (or another number more appropriate for your application).

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

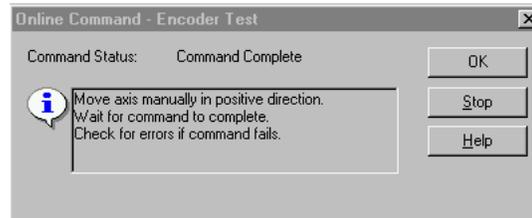
- Apply Drive Enable (Input 1) signal (CN1-31) for the axis you are testing.

ATTENTION


To avoid personal injury or damage to equipment, apply 24V Drive Enable signal (CN1-31) only to the axis you are testing.

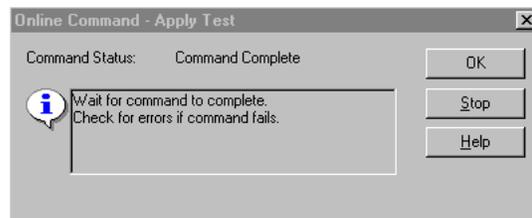
- Click the desired test (Marker/Feedback/Command & Feedback) to verify connections.

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



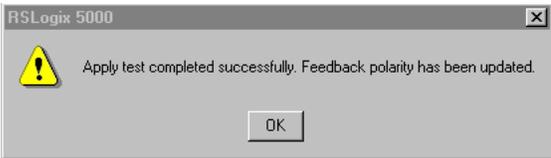
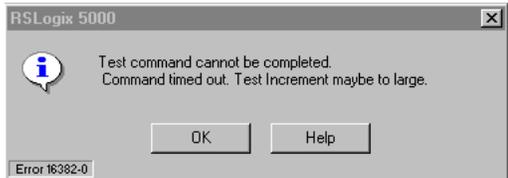
- Click OK.

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



- Click OK.

9. Determine if your test completed successfully.

If	Then
<p>Your test completes successfully, this dialog appears.</p> 	<ol style="list-style-type: none">1. Click OK.2. Remove Drive Enable signal (CN1-31).3. Go to Tune Your Axis.
<p>Your test failed, this dialog appears.</p> 	<ol style="list-style-type: none">1. Click OK.2. Verify that the main three-phase bus power is up.3. Verify that the Drive Enable signal (CN1-31) is applied to the axis you are testing.4. Verify conversion constant entered in the Conversion tab.5. Return to step 6 and run the test again.

Tune Your Axis

Follow these steps to tune your axis.

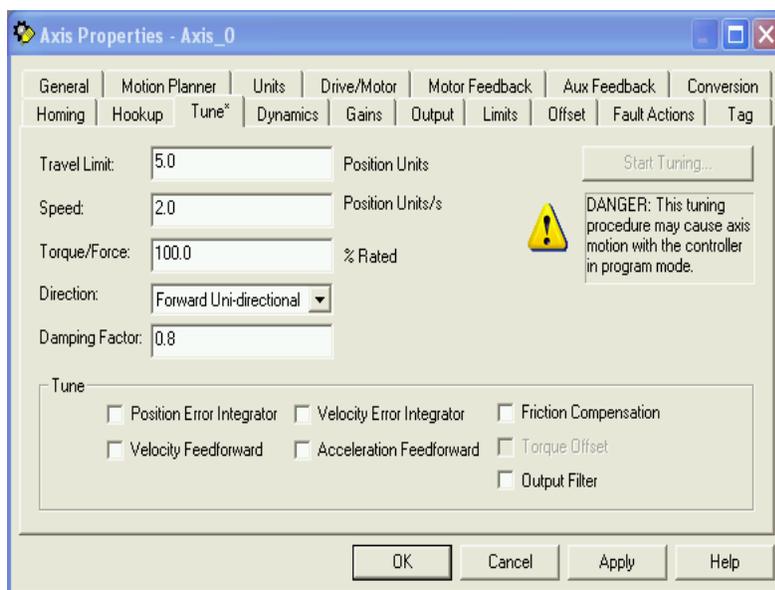
1. Verify that the load is still removed from the axis being tuned.

ATTENTION



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

2. Click the Tune tab.



3. In the Travel Limit and Speed boxes, enter values.
In this example, Travel Limit = 5 and Speed = 2. Actual value of programmed units depends on your application.
4. From the Direction pull-down menu, choose your direction (Forward Uni-directional is default).
5. Check the Tune boxes appropriate for your application.
6. Apply Drive Enable (Input 1) signal (CN1-31) for the axis you are tuning.

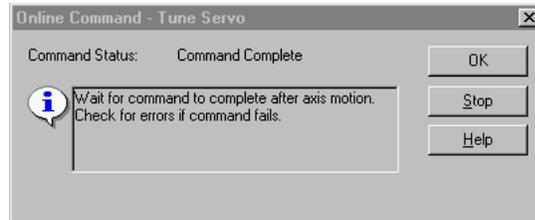
ATTENTION



To avoid personal injury or damage to equipment, apply 24V Drive Enable signal (CN1-31) only to the axis you are tuning.

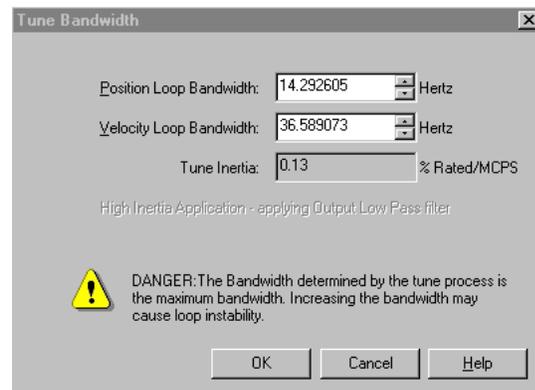
7. Click Start Tuning to auto-tune your axis.

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



8. Click OK.

The Tune Bandwidth dialog opens.



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

Record your bandwidth data for future reference.

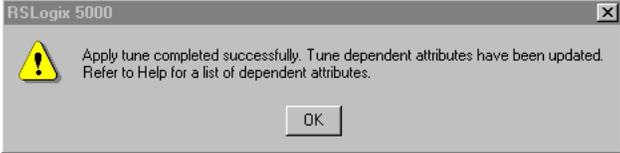
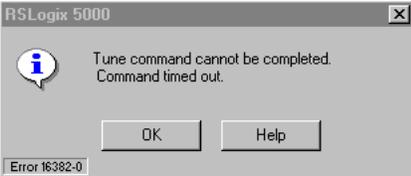
9. Click OK.

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



10. Click OK.

11. Determine if your test completed successfully.

If	Then
<p>Your test completes successfully, this dialog appears.</p>  <p>The screenshot shows a dialog box titled 'RSLogix 5000' with a yellow warning icon. The text inside reads: 'Apply tune completed successfully. Tune dependent attributes have been updated. Refer to Help for a list of dependent attributes.' There is an 'OK' button at the bottom.</p>	<ol style="list-style-type: none"> 1. Click OK. 2. Remove Drive Enable (Input 1) signal (CN1-31) applied earlier. 3. You are finished tuning your Ultra3000 drive.
<p>Your test failed, this dialog appears.</p>  <p>The screenshot shows a dialog box titled 'RSLogix 5000' with an information icon. The text inside reads: 'Tune command cannot be completed. Command timed out.' There are 'OK' and 'Help' buttons at the bottom. The error code 'Error 16382-0' is visible in the bottom left corner.</p>	<ol style="list-style-type: none"> 1. Click OK. 2. Make an adjustment to motor velocity. 3. Refer to the appropriate Logix motion module setup and configuration manual for more information. 4. Return to step 7 and run the test again.

Configuring Your Ultra3000 Drive with SERCOS

The procedures in this section are listed in this table and apply to Ultra3000-SE drives with SERCOS interface.

Ultra3000 Drive Configuration Procedures

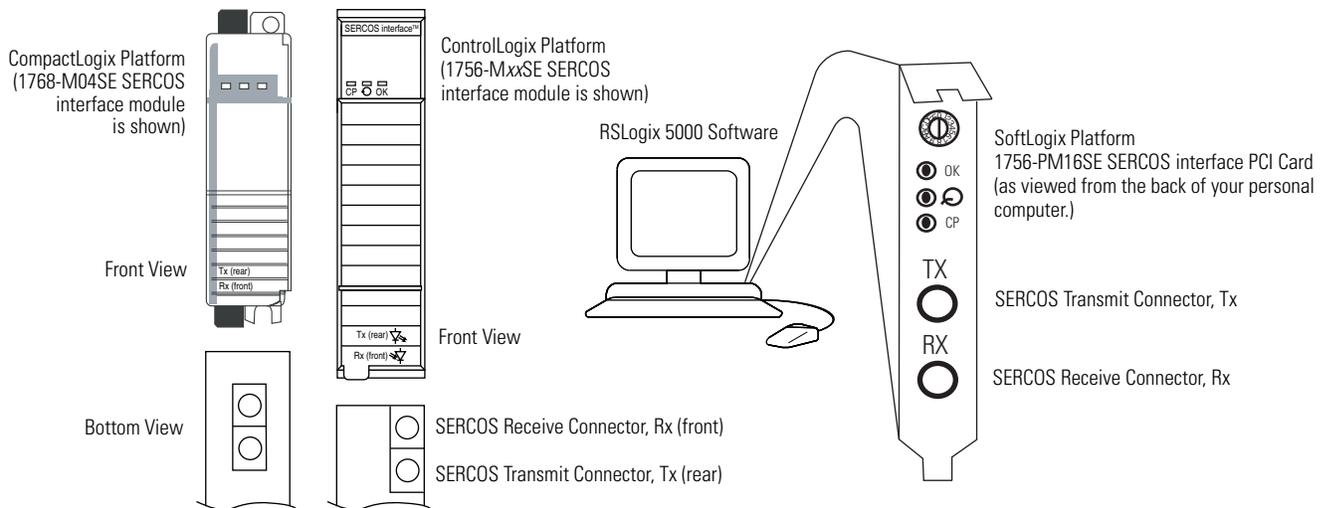
Procedure	Page
Configure Your Ultra3000-SE Drive	70
Configuring Your Logix SERCOS interface Module	72
Download Your Program	80
Apply Power to Your Ultra3000 Drive with SERCOS	81
Testing and Tuning Your Axis	83

These procedures assume you have connected the fiber-optic cables between your Ultra3000-SE drive and the SERCOS interface module.

Front Panel Connections

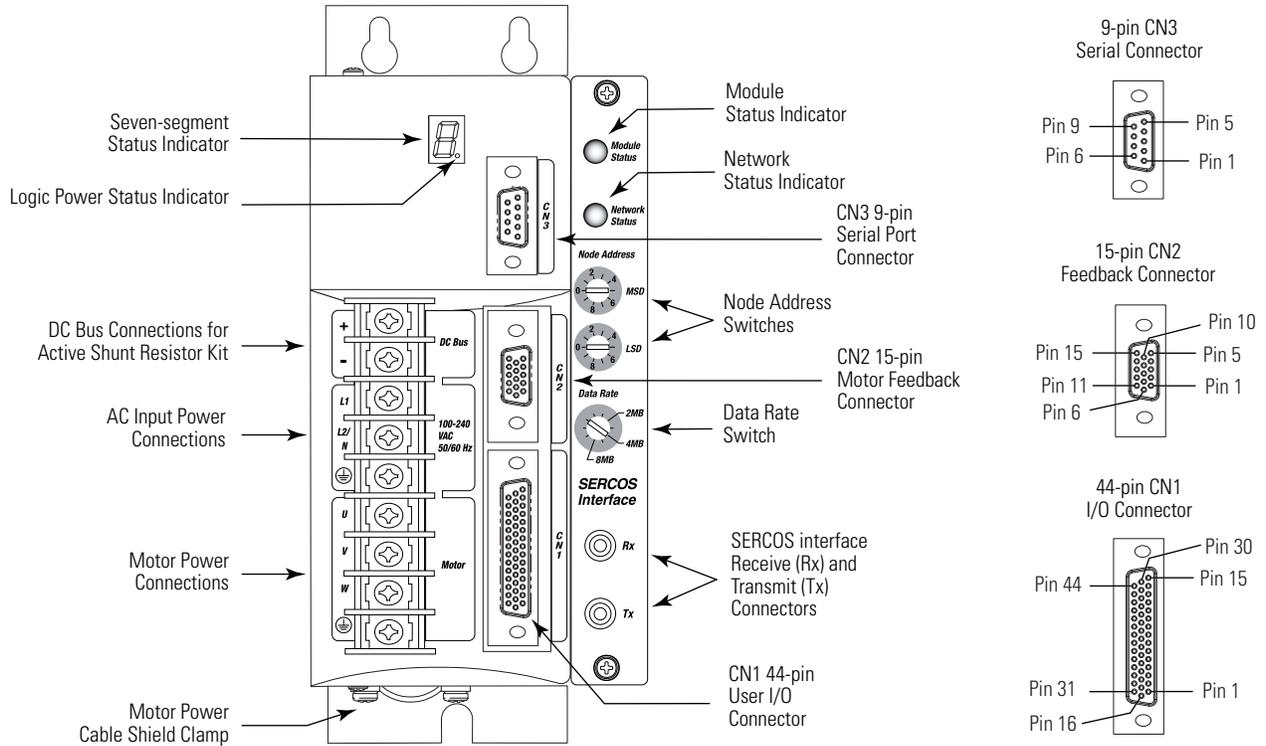
Use this figure to locate the SERCOS ring status indicators and fiber-optic cable connections on your SERCOS interface module or PCI card.

CompactLogix, ControlLogix, and SoftLogix SERCOS Connector Locations



Use this figure to locate the front panel connections on the Ultra3000-SE 230V drives (500W, 1 kW, and 2 kW).

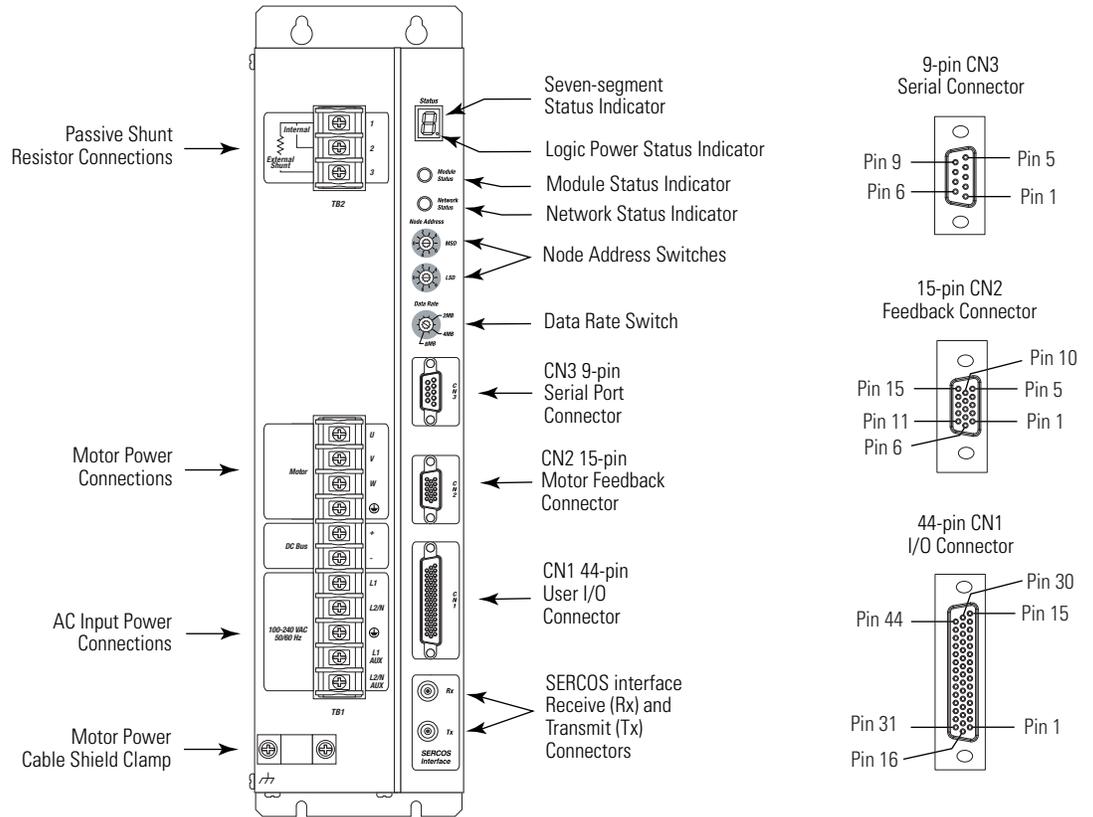
Front Panel Connections for 2098-DSD-005-SE, 2098-DSD-010-SE, and 2098-DSD-020-SE Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000-SE 230V drive (3 kW).

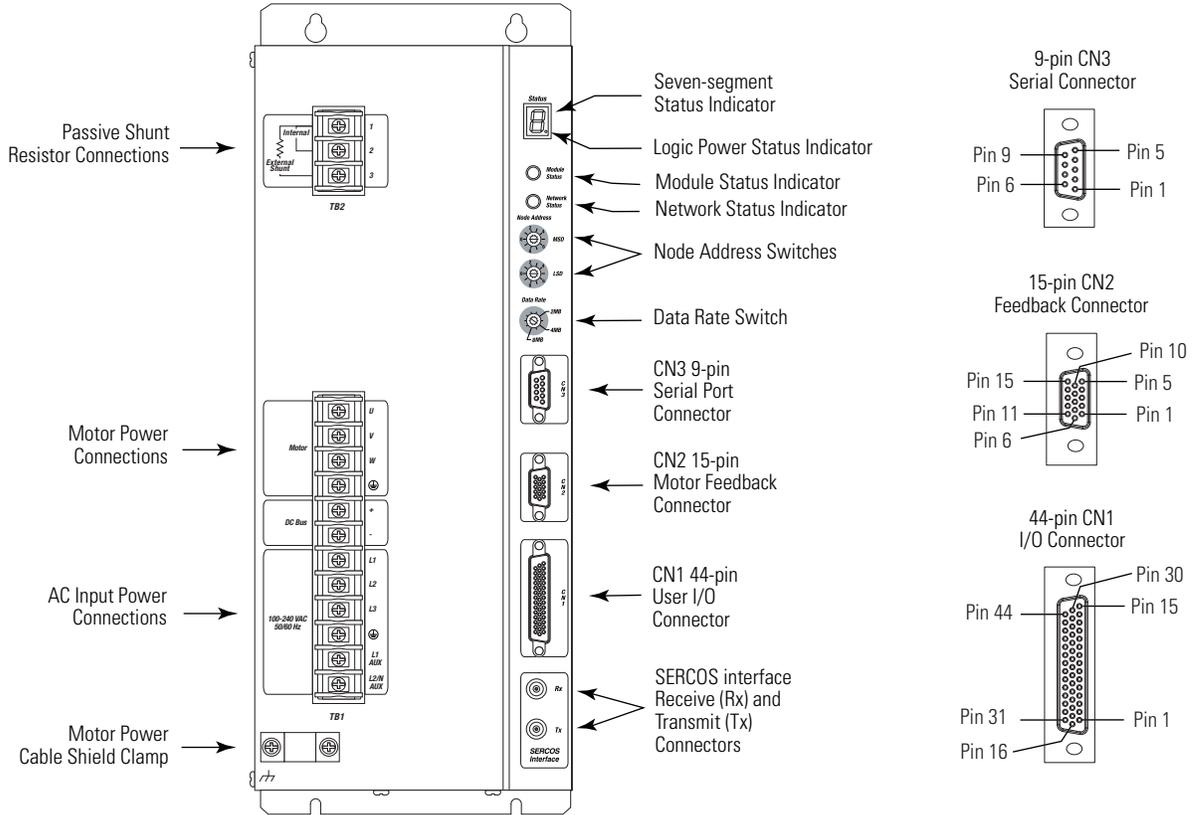
Front Panel Connections for 2098-DSD-030-SE Drive



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000-SE 230V drives (7.5 and 15 kW).

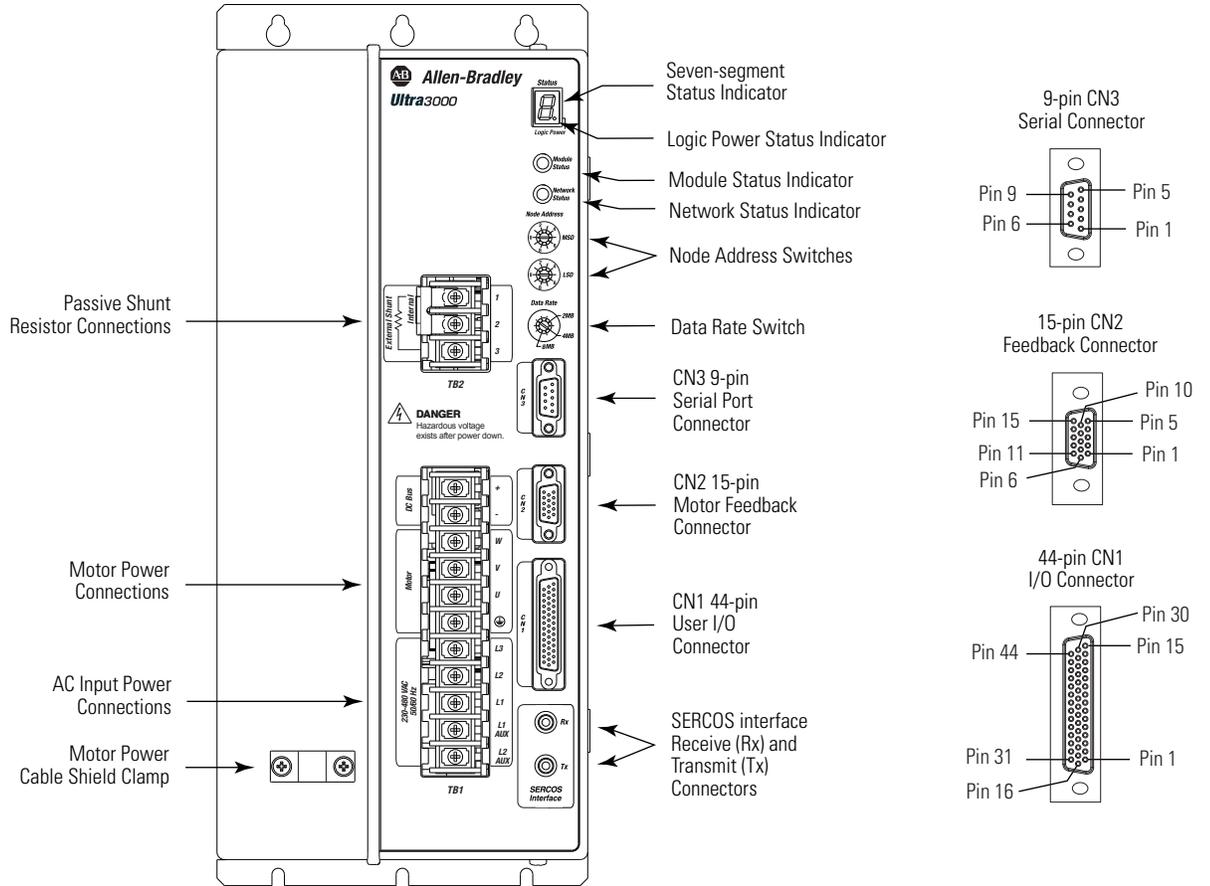
Front Panel Connections for 2098-DSD-075-SE and 2098-DSD-150-SE Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication 2098-IN003.

Use this figure to locate the front panel connections on the Ultra3000-SE 460V drives (3 kW, 5 kW, 10 kW, 15 kW, and 22 kW).

Front Panel Connections for 2098-DSD-HVxxx-SE Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Configure Your Ultra3000-SE Drive

Follow these steps to configure your Ultra3000-SE drive.

1. Verify that there is no power applied to the drive and that the SERCOS fiber-optic cables are correctly plugged into the Tx and Rx connectors.

To verify your fiber-optic cable connections, refer to Fiber-optic Ring Connections on page 71.

2. Set the node address for each drive in your system.

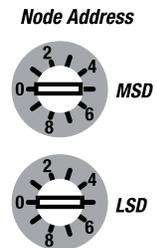
Valid node addresses are 01...99. The MSD rotary switch sets the most significant digit and the LSD rotary switch sets the least significant digit.

Refer to the figures on pages 66...69 for switch locations. Refer to this table for examples.

Node Address	MSD Switch	LSD Switch
10	1	0
11	1	1
12	1	2

Use the MSD and LSD rotary switches on the SERCOS panel of the drive to set node addresses.

For an example, refer to Ultra3000-SE Drive Node Addressing on page 71.



IMPORTANT

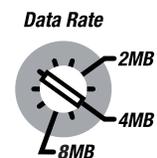
Whenever the node address setting is changed, you must cycle power for the change to register in the drive.

3. Set the data rate.

Valid data rates are 4 and 8 MB. The 2 MB setting does not apply.

Refer to the figures on pages 66...69 for switch locations.

Use the Data Rate rotary switch on the SERCOS panel of the drive to set the data rate.



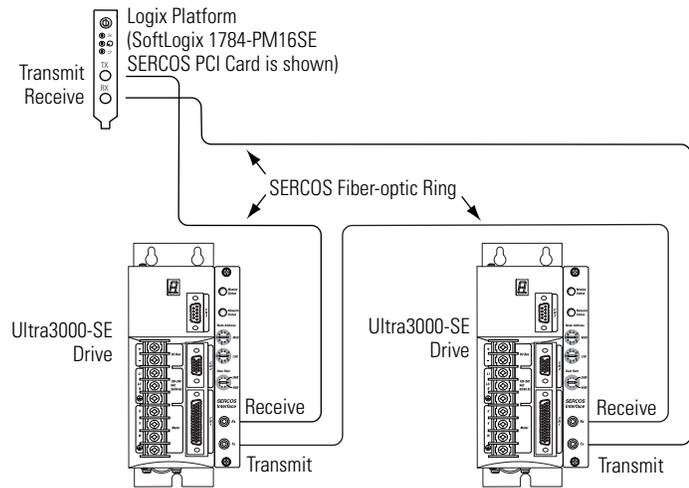
4. Verify Input 1 (CN1-31) is configured as Drive Enable and tied to 12...24V dc.

5. If using Overtravel inputs, verify that 12...24V dc is tied to CN1-37 and CN1-38.

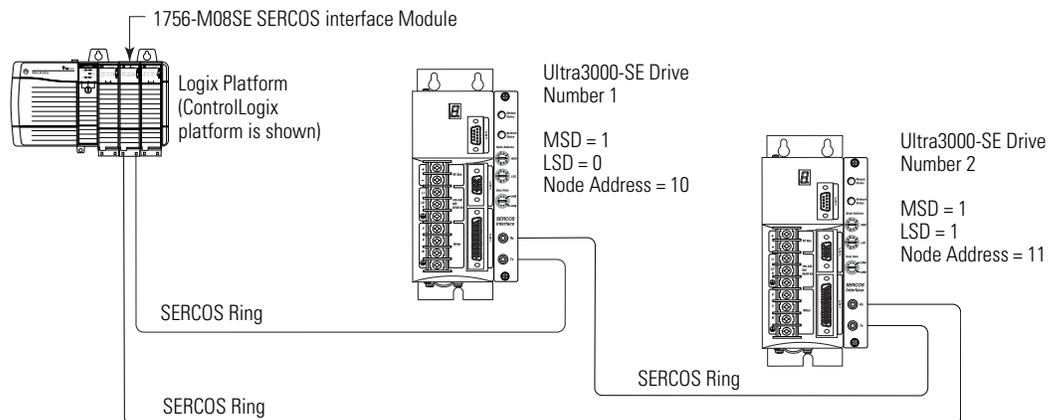
IMPORTANT

Without CN1-37 and CN1-38 inputs applied, the drive/system will fault.

Fiber-optic Ring Connections



Ultra3000-SE Drive Node Addressing



Configuring Your Logix SERCOS interface Module

This procedure assumes that you have configured the Ultra3000-SE communication rate.

IMPORTANT

In order for the Ultra3000 drive to communicate with the SERCOS interface module (indicated by the three status indicators on the module going solid green), your RSLogix 5000 software must be version 11.0 or later.

For help using RSLogix 5000 software as it applies to configuring the ControlLogix, CompactLogix, or SoftLogix SERCOS modules, refer to Additional Resources on page 8.

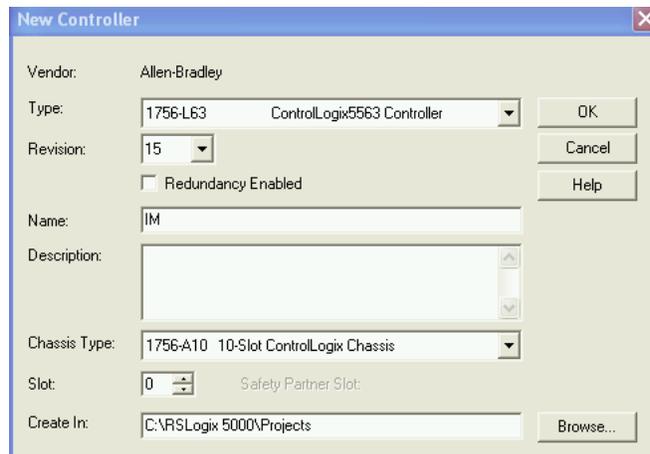
Configure Your Logix Controller

Follow these steps to configure your Logix controller.

1. Apply power to your Logix chassis containing the SERCOS interface module and open your RSLogix 5000 software.

2. From the File menu, choose New.

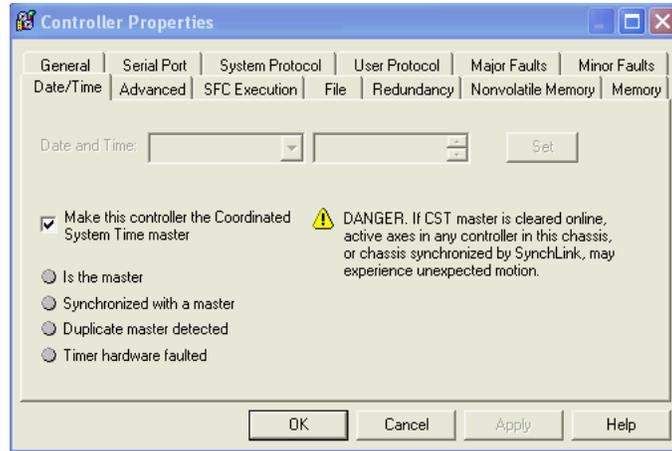
The New Controller dialog opens.



3. Configure the new controller.
 - a. From the Type pull-down menu, choose your controller.
 - b. From the Revision pull-down menu, choose your RSLogix 5000 software version.
 - c. In the Name box, name your file.
 - d. From the Chassis Type pull-down menu, choose your Logix chassis.
 - e. Enter the Logix processor slot.

4. Click OK.
5. From the Edit menu, choose Controller Properties.

The Controller Properties dialog opens.



6. Click the Date/Time tab.
7. Check the Make this controller the Coordinated System Time master checkbox.

IMPORTANT

Only one Logix processor can be assigned as the Coordinated System Time master.

8. Click OK.

Configure Your Logix Module

Follow these steps to configure your Logix module.

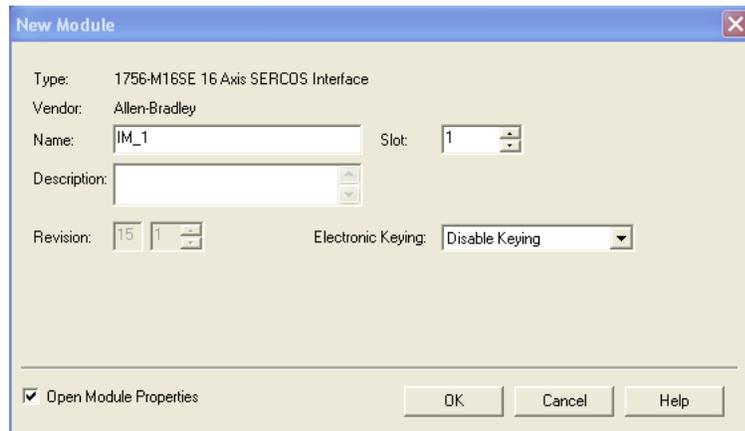
1. In the Explorer dialog, right-click I/O Configuration and choose New Module.

The Select Module dialog opens.

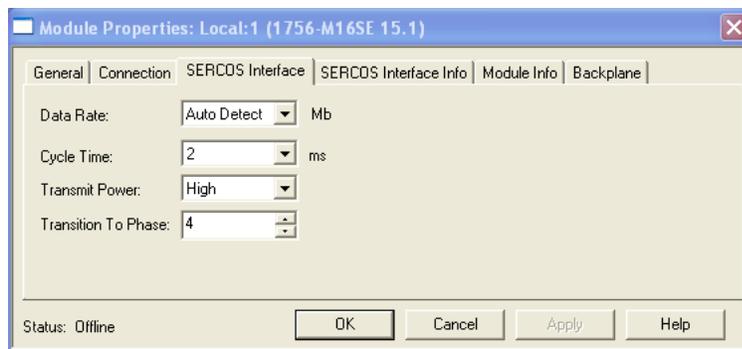
2. Expand the Motion category and select 1756-MxxSE, 1756-L60M03SE, 1768-M04SE, or 1784-PM16SE as appropriate for your actual hardware configuration.
3. Click OK.

Your new module appears under the I/O Configuration folder in the Explorer dialog.

The New Module dialog opens.



4. Configure the new module.
 - a. In the Name box, name your file.
 - b. In the Slot box, enter the slot where your module resides.
 - c. From the Electronic Keying pull-down menu, choose an electronic keying option (choose Disable Keying if unsure).
 - d. Check the Open Module Properties checkbox.
 5. Click OK.
- Your new module appears under the I/O Configuration folder in the Explorer dialog and the Module Properties dialog opens.
6. Click the SERCOS Interface tab and reference the table below.



Logix SERCOS Module	Number of Axes	Data Rate
1756-M03SE or 1756-L60M03SE	Up to 3	4 or 8 Mbps
1756-M08SE	Up to 8	
1756-M16SE or 1784-PM16SE	Up to 16	
1768-M04SE	Up to 4	

7. Verify that the Data Rate setting matches the Data Rate (communication rate) switch setting on the Ultra3000-SE drive.
8. Set the Cycle Time according to this table.

Data Rate	Number of Axes	Cycle Time
4 Mbps	Up to 4	1 ms
	Up to 8	2 ms
	No support for axes 9...16	
8 Mbps	Up to 8	1 ms
	Up to 16	2 ms

The number of axes/module is limited to the number of axes as shown in step 6.

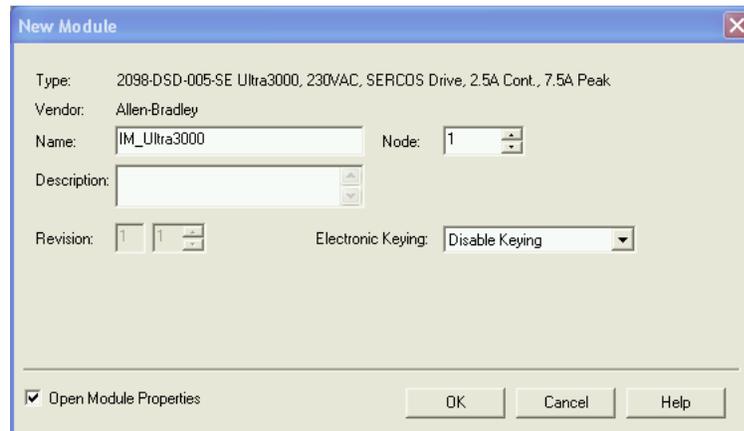
9. Verify that Transmit Power is set to High.
10. Set Transition to Phase.
Transition to Phase default setting is 4 (phase 4). The Transition to Phase setting will stop the ring in the phase specified.
11. Click OK.
12. Repeat steps 1...11 for each Logix module.

Configure Your Ultra3000-SE Drive

Follow these steps to configure your Ultra3000-SE drive.

1. Right-click your new module and choose New Module.
The Select Module dialog opens.
2. Expand the Drives category and select 2098-DSD-xxx-SE or 2098-DSD-HVxxx-SE drive as appropriate for your actual hardware configuration.
3. Click OK.

The New Module dialog opens.

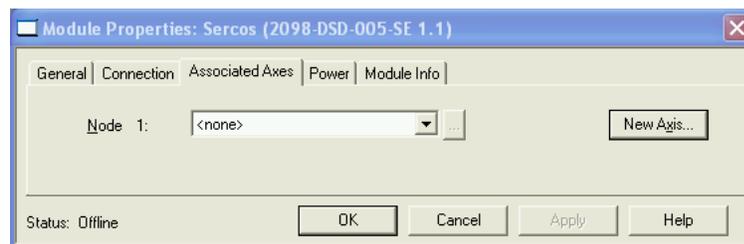


4. Configure the new module.
 - a. In the Name box, enter your module name.
 - b. In the Node box, enter the node address.

Set the node address in the software to match the node address setting on the drive.

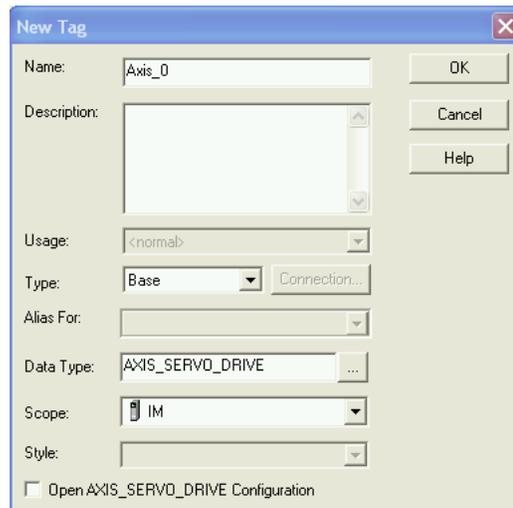
Refer to Configure Your Ultra3000-SE Drive, step 2, on page 70.

- c. From the Electronic Keying pull-down menu, choose an electronic keying option (choose Disable Keying if unsure).
 - d. Check the Open Module Properties checkbox.
5. Click OK.
6. Click the Associated Axes tab.



7. Click New Axis.

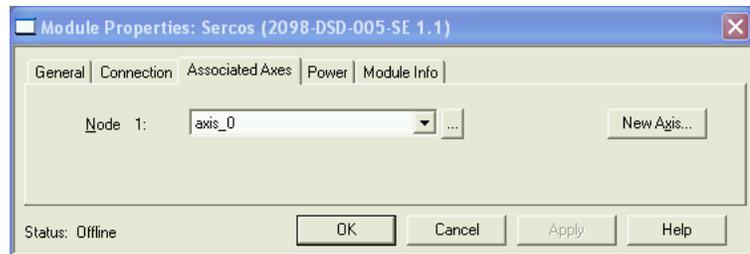
The New Tag dialog opens.



8. Configure the new tag.
 - a. In the Name box, enter your module name.
 - b. In the Data Type pull-down menu, choose AXIS_SERVO_DRIVE.
9. Click OK.

The axis appears under the Ungrouped Axes folder in the Explorer dialog.

10. From the Node 1 pull-down menu, choose the node address for your axis.



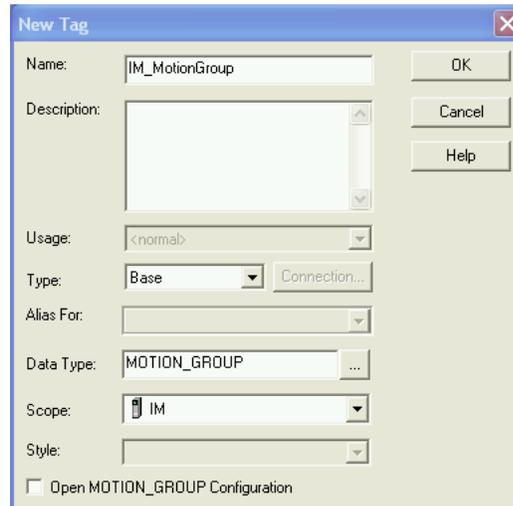
11. Click OK.

Configure the Motion Group

Follow these steps to configure the motion group.

1. In the Explorer dialog, right-click Motion Groups and choose New Motion Group.

The New Tag dialog opens.



2. In the Name box, enter the new motion group name.
3. Click OK.

The new group appears under Motion Group folder.

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

The Motion Group Properties dialog opens.

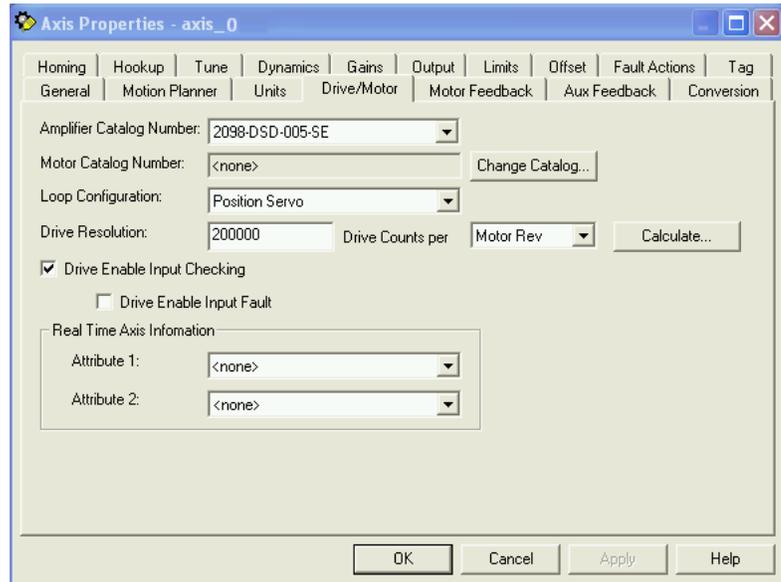


5. Click the Axis Assignment tab and move your axis (created earlier) from Unassigned to Assigned.
6. Click the Attribute tab and edit the default values as appropriate for your application.
7. Click OK.

Configure Axis Properties

Follow these steps to configure axis properties.

1. In the Explorer dialog, right-click an axis and choose Properties. The Axis Properties dialog opens.



2. Click the Drive/Motor tab.
 - a. From the Amplifier Catalog Number pull-down menu, choose the Ultra3000 amplifier (2098-DSD-xxx-SE or 2098-DSD-HVxxx-SE).

- b. Click Change Catalog to set the motor catalog number.

To verify the amplifier and motor catalog numbers, refer to the amplifier and motor name plates.

- c. Check the Drive Enable Input Checking checkbox.

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

3. Click the Motor Feedback tab and verify that the Feedback Type shown is appropriate for your actual hardware configuration.
4. Click the Units tab and edit default values as appropriate for your application.
5. Click the Conversion tab and edit default values as appropriate for your application.

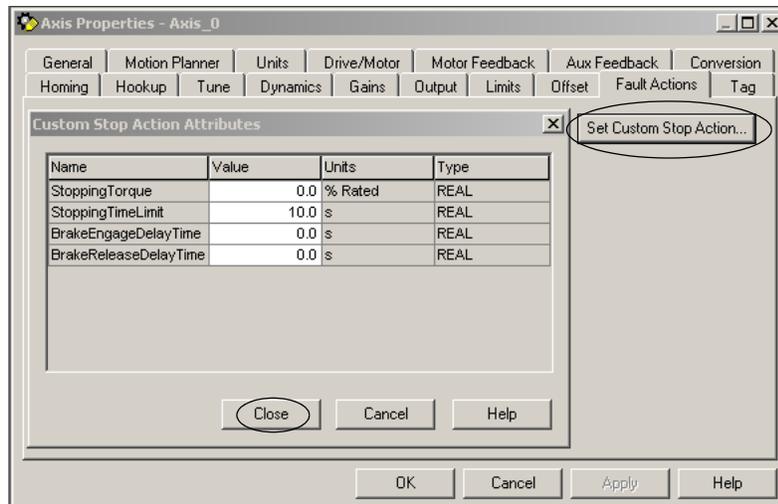
6. Click the Fault Actions tab.

TIP

For more information on setting fault limits, refer to Appendix C, Minimizing the Effects of Feedback Signal Loss on page 141.

7. Click the Set Custom Stop Action.

The Custom Stop Action Attributes dialog opens.



8. Set the appropriate values.

- a. Set the Brake Engage Delay Time.

Use this setting to hold motor torque on load until the delay time has expired (brake is engaged).

- b. Set the Brake Release Delay Time.

Use this setting to make sure no motor movement occurs until the delay time has expired (brake is released).

- c. Click Close.

9. Click OK.

10. Verify your Logix program and save the file.

Download Your Program

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

Apply Power to Your Ultra3000 Drive with SERCOS

This procedure assumes that you have configured your Ultra3000-SE drive and your SERCOS interface module.

ATTENTION



High voltage exists in ac line filters. The filter must be grounded properly before applying power. Filter capacitors retain high voltages after power removal. Before handling the equipment, voltages should be measured to determine safe levels. Failure to observe this precaution could result in personal injury.

Follow these steps to apply power to your Ultra3000-SE drive.

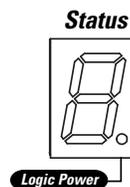
1. Disconnect any load to the motor, making sure that the motor is free of all linkages when initially applying power to the system.

ATTENTION



To avoid damage to the drive due to improper sequencing of input power and the Drive Enable signal, do not issue the Drive Enable command from RSLogix 5000 software without first applying input power.

2. Apply input power to the Ultra3000-SE drive and observe the front panel Logic Power status indicator.



If the Logic Power Status Indicator is	Then
ON	Go to step 3.
Not ON	<ol style="list-style-type: none"> 1. Check your input power connections. 2. Repeat step 2.

3. Observe the front panel seven-segment status indicator on your Ultra3000-SE drive.

The status indicator cycles through SERCOS phases until final configuration (phase 4) is reached.

Seven-segment 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 4.
Flashing E followed by two numbers	Drive is faulted.	Go to Error Codes on page 98.

⁽¹⁾ You can get diagnostic information from the module by highlighting the module name in RSLogix 5000 software. A Pseudo Key Failure often indicates that the motor selection does not match the motor installed.

4. Observe the module status indicator.

Module Status Indicator	Status	Do This
Steady green	The drive is enabled.	Go to step 5.
Flashing green	The drive is disabled.	Go to step 5.
Not steady green/ not flashing green	The drive is faulted.	Go to SERCOS Module Status Indicator troubleshooting on page 104.

5. Observe the network status indicator.

Network Status Indicator	Status	Do This
Flashes green	Establishing communication with network.	Wait for steady green.
Steady green	Communication is ready.	Go to step 6.
Not steady green/ not flashing green	The drive is faulted.	Go to SERCOS Network Status Indicator troubleshooting on page 104.

6. Observe the three SERCOS indicators on the 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 Testing and Tuning Your Axis on page 83.
Not flashing green and red/ not steady green	SERCOS module is faulted.	Go to the appropriate Logix manual for specific instructions and troubleshooting.

Testing and Tuning Your Axis

This procedure assumes that you have configured your Ultra3000-SE drive, your SERCOS interface module, and applied power to the system.

IMPORTANT

Before proceeding with testing and tuning your axis, verify that the Ultra3000-SE status indicators are as described in this table.

Status Indicator	Indication	Status
Seven-segment	Displaying a fixed 4 (phase 4)	The drive is ready.
Module	Flashing green	The drive is disabled.
Network	Steady green	SERCOS communication is ready.

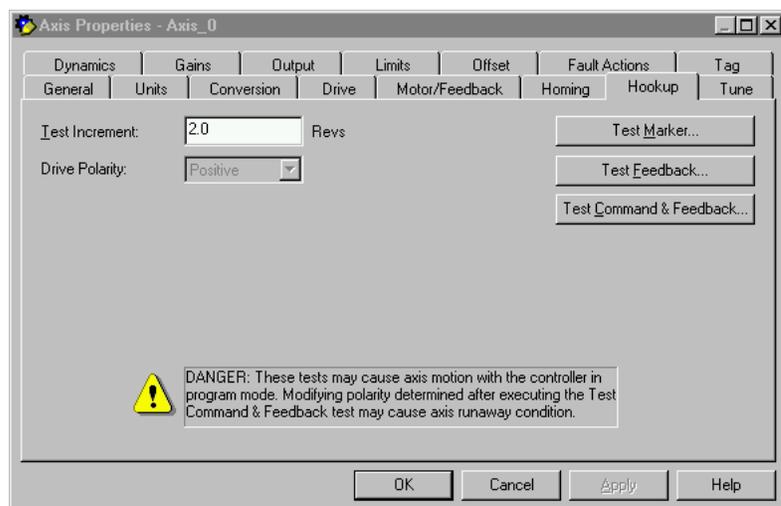
For help using RSLogix 5000 software as it applies to testing and tuning your axes with the ControlLogix, CompactLogix, or SoftLogix SERCOS modules, refer to Additional Resources on page 8.

Test Your Axis

Follow these steps to test your axis.

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

The Axis Properties dialog opens.



3. Click the Hookup tab.

- In the Test Increment box, enter 2.0 as the number of revolutions for the test (or another number more appropriate for your application).

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

- Apply Drive Enable (Input 1) signal (CN1-31) for the axis you are testing.

This step is required only if you checked the box for Drive Enable Input Checking, in the Drive/Motor tab, Axis Properties dialog.

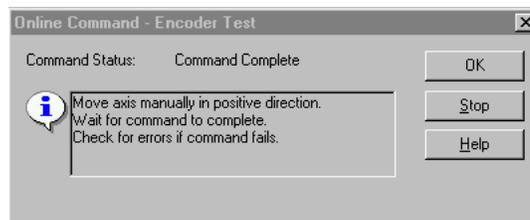
ATTENTION



To avoid personal injury or damage to equipment, apply 24V Drive Enable signal (CN1-31) only to the axis you are testing.

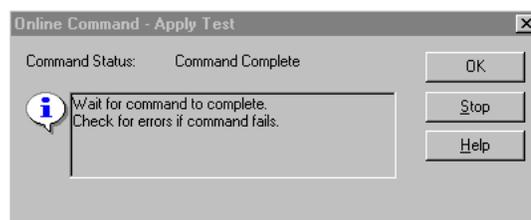
- Click the desired test (Marker/Feedback/Command & Feedback) to verify connections.

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

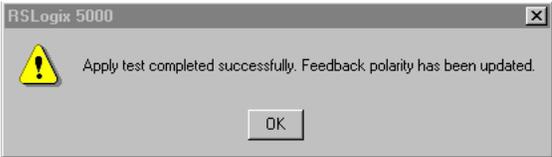
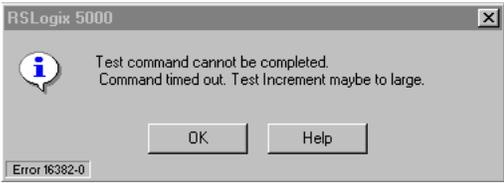


- Click OK.

The Online Command - Apply Test dialog 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
<p>Your test completes successfully, this dialog appears.</p> 	<ol style="list-style-type: none"> 1. Click OK. 2. Remove Drive Enable signal (CN1-31). 3. Go to Tune Your Axis on page 86.
<p>Your test failed, this dialog appears.</p> 	<ol style="list-style-type: none"> 1. Click OK. 2. Verify that the main three-phase bus power is up. 3. Verify that the Drive Enable signal (CN1-31) 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.

Tune Your Axis

Follow these steps to tune your axis.

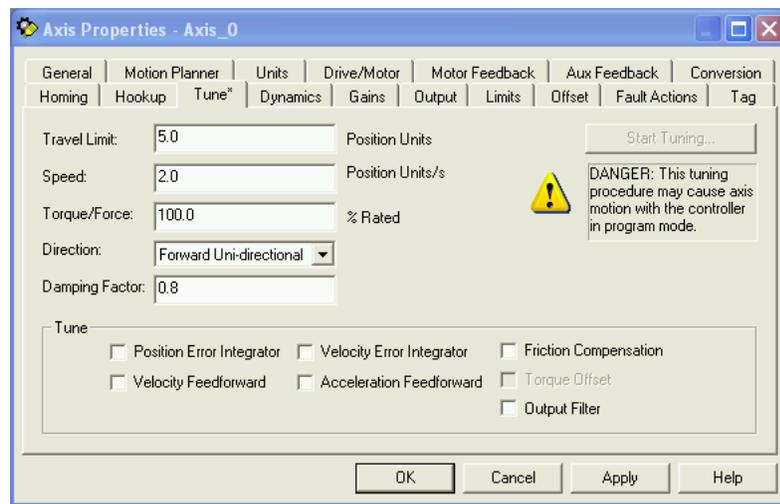
1. Verify that the load is still removed from the axis being tuned.

ATTENTION



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

2. Click the Tune tab.



3. In the Travel Limit and Speed boxes, enter appropriate values.
In this example, Travel Limit = 5 and Speed = 2. The actual value of programmed units depend on your application.
4. From the Direction pull-down menu, choose the appropriate direction (Forward Uni-directional is default).
5. Check the Tune boxes appropriate for your application.
6. Apply Drive Enable (Input 1) signal (CN1-31) for the axis you are tuning.

This step is required only if you checked the box for Drive Enable Input Checking, in the Drive/Motor tab, Axis Properties dialog.

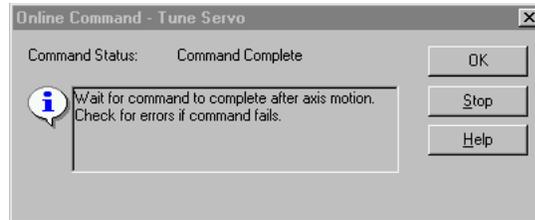
ATTENTION



To avoid personal injury or damage to equipment, apply 24V Drive Enable signal (CN1-31) only to the axis you are tuning.

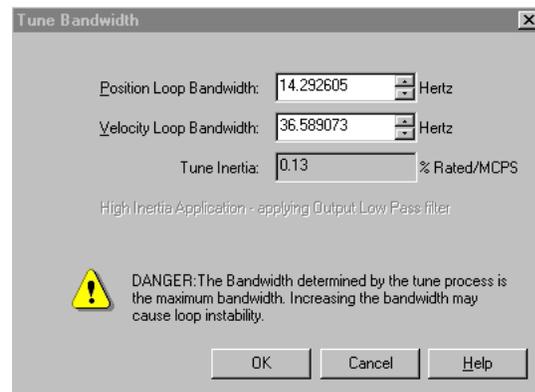
7. Click Start Tuning to auto-tune your axis.

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



8. Click OK.

The Tune Bandwidth dialog opens.

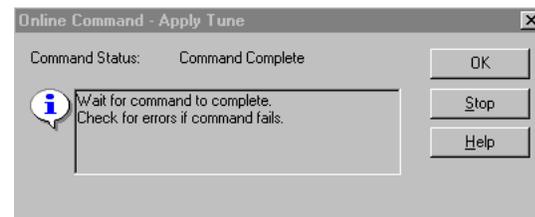


Actual bandwidth values (Hz) depend on your application and may require adjustment once motor and load are connected.

9. Record your bandwidth data for future reference.

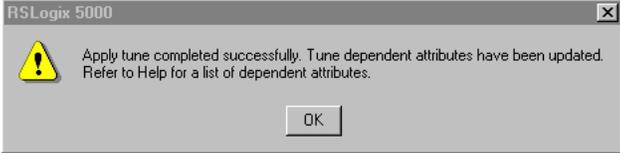
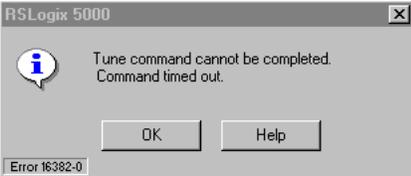
10. Click OK.

The Online Command - Apply Tune dialog 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
<p>Your test completes successfully, this dialog appears.</p>  <p>The screenshot shows a dialog box titled "RSLogix 5000" with a yellow warning icon. The text inside reads: "Apply tune completed successfully. Tune dependent attributes have been updated. Refer to Help for a list of dependent attributes." There is an "OK" button at the bottom.</p>	<ol style="list-style-type: none"> 1. Click OK. 2. Remove Drive Enable (Input 1) signal (CN1-31) applied earlier. 3. You are finished tuning your axis.
<p>Your test failed, this dialog appears.</p>  <p>The screenshot shows a dialog box titled "RSLogix 5000" with an information icon. The text inside reads: "Tune command cannot be completed. Command timed out." There are "OK" and "Help" buttons at the bottom. The error code "Error 16382-0" is visible in the bottom left corner.</p>	<ol style="list-style-type: none"> 1. Click OK. 2. Make an adjustment to motor velocity. 3. Refer to appropriate Logix motion module setup and configuration manual for more information. 4. Return to step 7 and run the test again.

Configuring Your Ultra3000 Drive with DeviceNet

The procedures in this section are listed in this table and apply to Ultra3000-DN drives with indexing.

Ultra3000 Drive Configuration Procedures

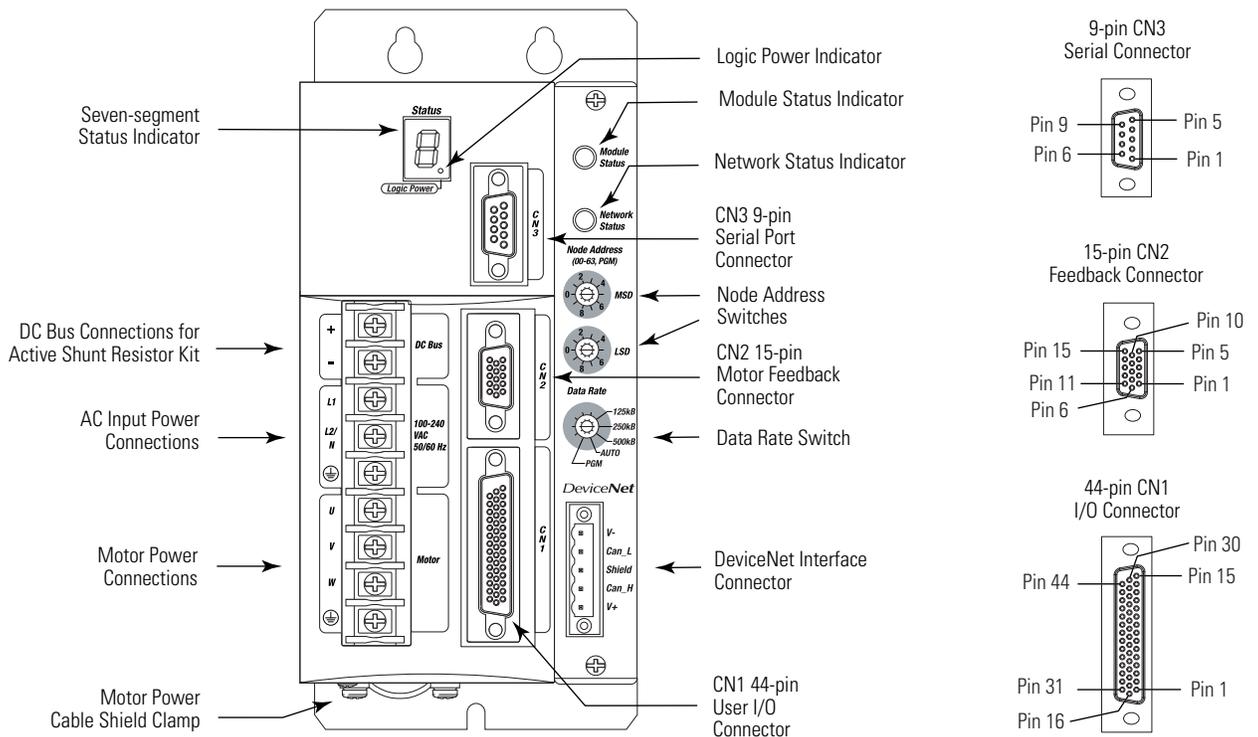
Procedure	Page
Configure Your Ultra3000 Drive with DeviceNet	93
Apply Power to Your Ultra3000 Drive with DeviceNet	94

These procedures assume you have completed wiring the DeviceNet interface connector on your Ultra3000-DN drive.

Front Panel Connections

Use this figure to locate the front panel connections on the Ultra3000-DN 230V drives (500W, 1 kW, and 2 kW).

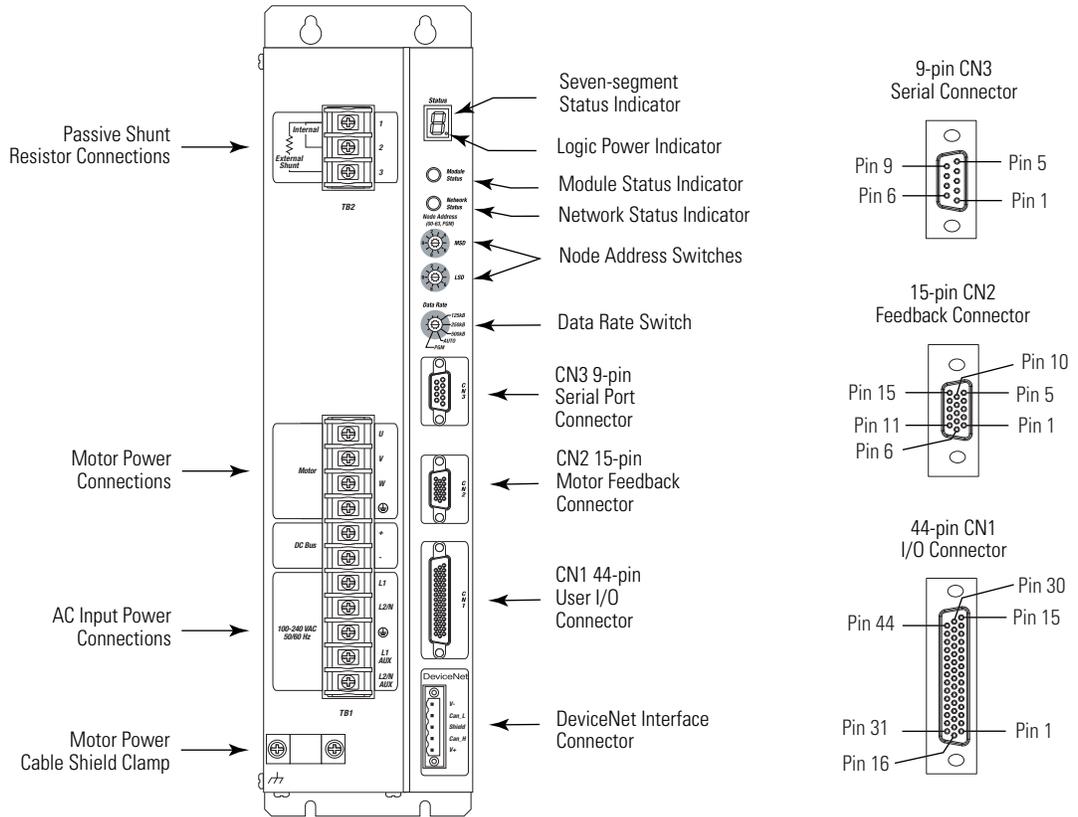
Front Panel Connections for 2098-DSD-005-DN, 2098-DSD-005X-DN, 2098-DSD-010-DN, 2098-DSD-010X-DN, 2098-DSD-020-DN, and 2098-DSD-020X-DN Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000-DN 230V drives (3 kW).

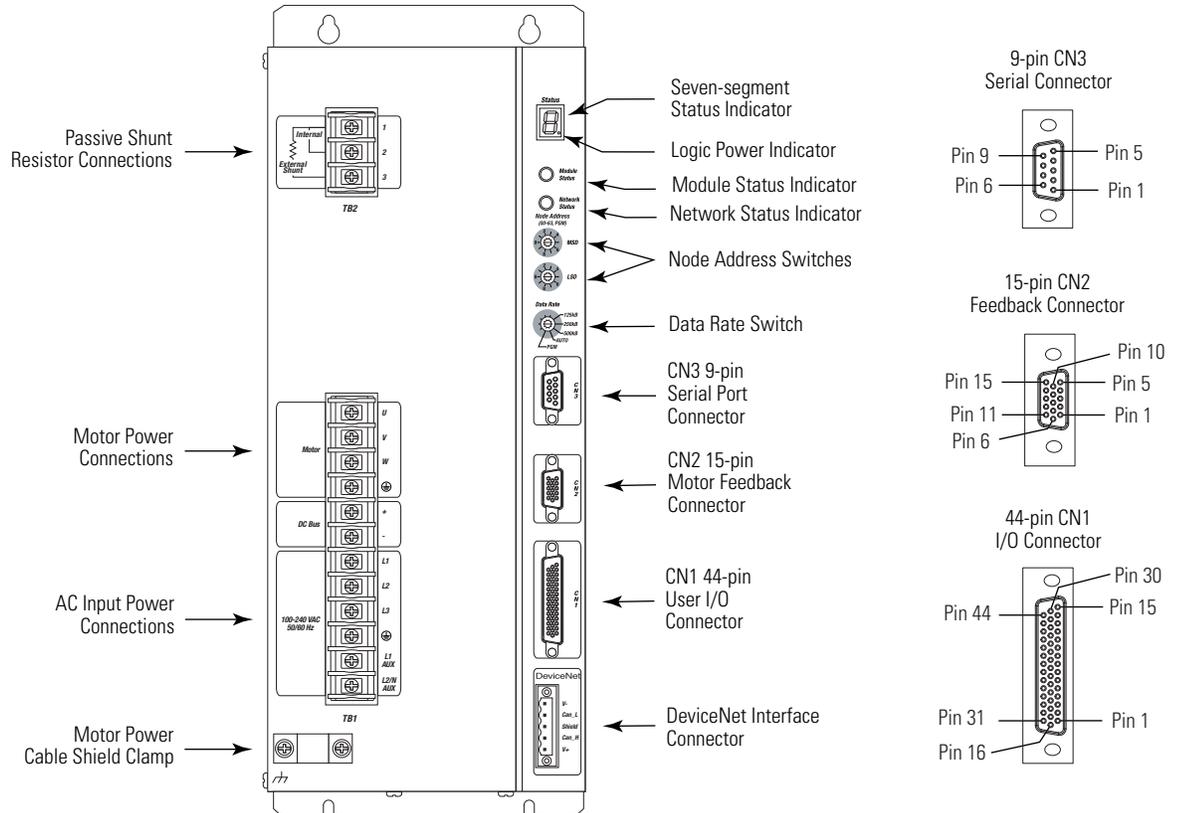
Front Panel Connections for 2098-DSD-030-DN and 2098-DSD-030X-DN Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000-DN 230V drives (7.5 and 15 kW).

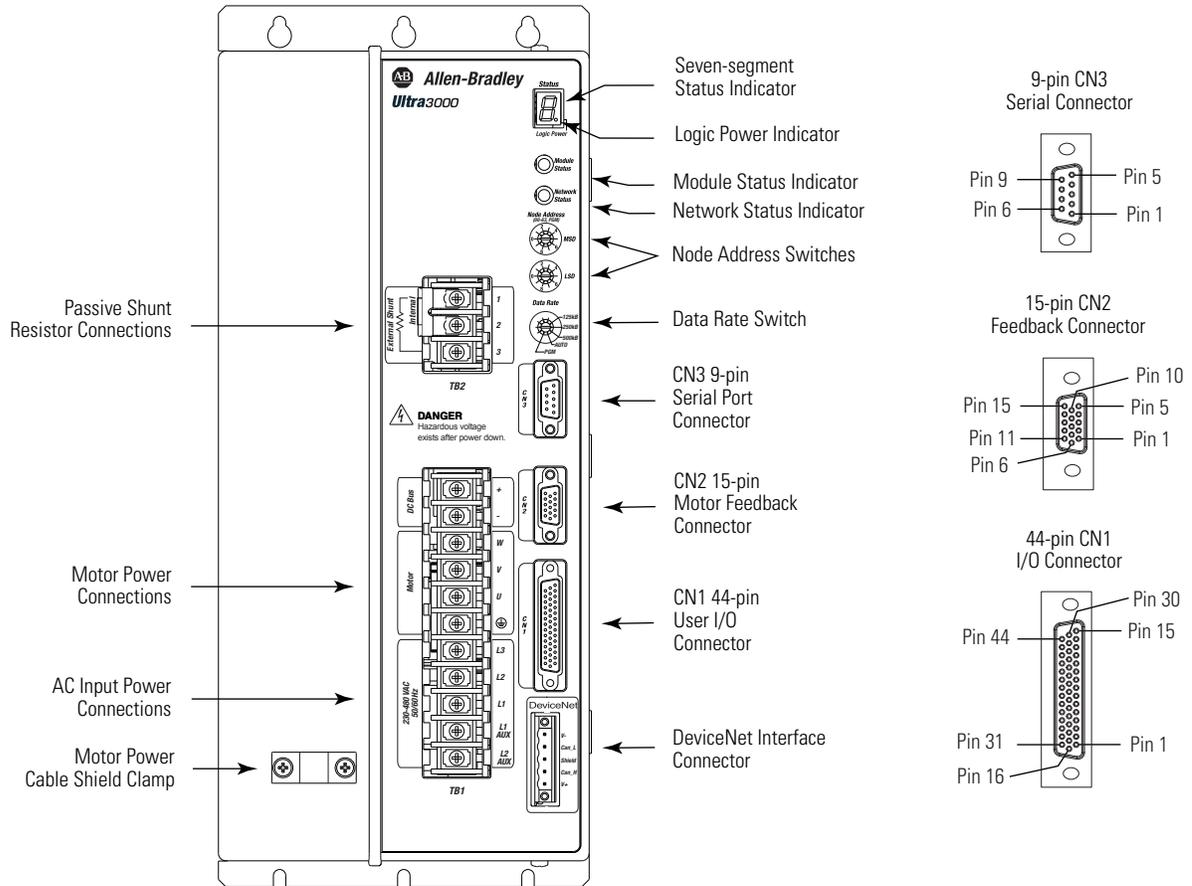
Front Panel Connections for 2098-DSD-075-DN, 2098-DSD-075X-DN, 2098-DSD-150-DN, and 2098-DSD-150X-DN Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Use this figure to locate the front panel connections on the Ultra3000-DN 460V drives (3 kW, 5 kW, 10 kW, 15 kW, and 22 kW).

Front Panel Connections for 2098-DSD-HVxxx-DN and 2098-DSD-HVxxxX-DN Drives



For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual, publication [2098-IN003](#).

Configure Your Ultra3000 Drive with DeviceNet

Follow these steps to configure your Ultra3000-DN drive.

1. Verify that there is no power applied to the drive and that the DeviceNet cable is connected.

Refer to the figures on pages 89...92 for switch locations.

2. Set the node address for each drive in your system.

Valid node addresses are 00...63 and PGM. The MSD rotary switch sets the most significant digit and the LSD rotary switch sets the least significant digit.

Refer to the figures on pages 89...92 for the switch locations. Refer to this table for examples.

Node Address	MSD Switch	LSD Switch
10	1	0
11	1	1
12	1	2

Use the MSD and LSD rotary switches on the DeviceNet drive panel to set node addresses.

Node Address
(00-63, PGM)



Selecting an invalid node address (> 63) sets the node address according to a non-volatile parameter stored in the drive.

3. Set the data rate.

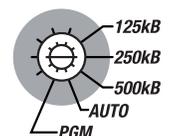
Valid data rates are 125, 250, and 500 Kbps, AUTO, and PGM.

Refer to the figures on pages 89...92 for the switch location.

Selecting AUTO automatically matches the device data rate to the rate of the network. Selecting PGM sets the data rate according to a non-volatile parameter stored in the drive.

Use the Data Rate rotary switch on the DeviceNet drive panel to set the data rate.

Data Rate



Apply Power to Your Ultra3000 Drive with DeviceNet

This procedure assumes you have wired your Ultra3000-DN system, verified the wiring, and are ready to begin using Ultraware software.

ATTENTION	High voltage exists in ac line filters. The filter must be grounded properly before applying power. Filter capacitors retain high voltages after power removal. Before handling the equipment, voltages should be measured to determine safe levels. Failure to observe this precaution could result in personal injury.
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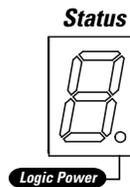
Follow these steps to apply power to your Ultra3000-DN drive.

1. Disconnect any load to the motor, making sure the motor is free of all linkages when initially applying power to the system.

ATTENTION	To avoid damage to the drive due to improper sequencing of input power and the Drive Enable signal, you must assign one of the eight inputs as Drive Enable (Input 1 is the default setting).
------------------	---



2. Apply input power to the Ultra3000-DN drive and observe the front panel Logic Power status indicator.



If the Logic Power status indicator is	Then
ON	Go to step 3.
Not ON	<ol style="list-style-type: none"> 1. Check your input power connections. 2. Repeat step 2.

3. Observe the front panel seven-segment status indicator on your Ultra3000-DN drive.

Seven-segment Status Indicator	Status	Do This
Actively cycling segments in a full circle	The drive is ready.	Go to step 4.
Flashing E followed by two numbers	The drive is faulted.	Go to Error Codes on page 98.

4. Observe the module status indicator.

Module Status Indicator	Status	Do This
Steady green	The drive is ready.	Go to step 5.
Not steady green	The drive is faulted.	Go to DeviceNet Module Status Indicator on page 109.

5. Observe the network status indicator.

Network Status Indicator	Status	Do This
Off	Establishing communication with network.	Wait for flashing or steady green.
Flashing or steady green	Communication is ready.	Go to step .
Not flashing or steady green	The drive is faulted.	Go to DeviceNet Network Status Indicator on page 109.

For further commissioning procedures, refer to the following table for procedures.

Ultra3000 Drive Configuration Procedures

Procedure	Page
Detect Your Ultra3000 Drive	16
Understanding the Workspace and Drive Branches	17
Select a Motor	21
Tune Your Motor	22
Configure Displayed Units	23
Test Your Motor (non-indexing move)	25
Test Your Motor (indexing move)	26
Indexing and Non-indexing Move Examples	29

Refer to the Ultra3000 with DeviceNet Reference Manual, publication [2098-RM001](#), for information on communicating with the Ultra3000 drives using DeviceNet.

Troubleshooting Your Ultra3000 Servo Drive

Introduction

This chapter provides troubleshooting tables for your Ultra3000 servo drive.

Topic	Page
Safety Precautions	97
General Troubleshooting	98
Troubleshooting for SERCOS Drives	104
Troubleshooting for DeviceNet Drives	109

Safety Precautions

Observe the following safety precautions when troubleshooting your Ultra3000 servo drive.

ATTENTION

DC bus capacitors may 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 listed on the drive warning label. Failure to observe this precaution could result in severe bodily injury or loss of life.

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. If you do not correct a drive or system malfunction, it could result in personal injury and/or damage to the equipment as a result of uncontrolled machine system operation.

Test equipment (such as an oscilloscope or chart recorder) must be properly grounded. Failure to include an earth ground connection could result in a potentially fatal voltage on the oscilloscope chassis.

General Troubleshooting

Refer to the Error Codes section below to identify problems, potential causes, and appropriate actions to resolve the problems. If problems persist after attempting to troubleshoot the system, please contact your Rockwell Automation sales representative for further assistance.

Determine Ultra3000 Drive Status

Ultra3000 Drives with the Logic Power Status Indicator ON	Status Indicator	Then
2098-DSD-xxx, 2098-DSD-xxxX, 2098-DSD-HVxxx, or 2098-DSD-HVxxxX	Actively cycling segments in a full circle	Your Ultra3000 drive is ready.
2098-DSD-xxx-DN, 2098-DSD-xxxX-DN, 2098-DSD-HVxxx-DN, 2098-DSD-HVxxxX-DN		Your Ultra3000 drive is ready.
2098-DSD-xxx-SE or 2098-DSD-HVxxx-SE drive	Displaying a fixed 4	Your Ultra3000 drive is ready.
All Ultra3000 drives	Flashing E followed by two numbers	Your Ultra3000 drive has an error. Proceed to the section Error Codes below.
	Flashing L	Your Ultra3000 drive is in an Overtravel condition and motion restrictions are in effect.

Error Codes

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

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

Seven-segment Status Indicator Error Codes

Error Code	Problem or Symptom	Possible Cause	Action/Solution
	Power (PWR) indicator not ON	No ac power or auxiliary logic power.	Verify ac power or auxiliary +5V logic power is applied to the Ultra3000.
		Internal power supply malfunction.	Call your Allen-Bradley representative.
	Power (PWR) indicator is ON, but seven-segment status indicator is OFF. Note: This only applies to Ultra3000 models 2098-DSD-005, 2098-DSD-010, and 2098-DSD-020.	Externally applied +5V auxiliary power supply voltage is too low.	Verify that the external +5V auxiliary power supply (as measured at the drive terminals) reads between 5.10V and 5.25V.
	Motor jumps when first enabled	Motor wiring error.	Check motor wiring.
		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.
E01	Non-Volatile Memory Endurance Exceeded	Range of motion and number of home position definitions during the product life exceeds the maximum allowed (applies only to systems with absolute feedback).	This is an unrecoverable fault, the drive must be sent back to the factory.

Error Code	Problem or Symptom	Possible Cause	Action/Solution
E02	Velocity Exceeds Position Rollover /2	The velocity command or feedback exceeds half the machine cycle length per millisecond (applies only when the machine cycle position rollover is enabled).	Increase machine cycle size or reduce velocity profile.
E03	Absolute Feedback Range Exceeded	The motor position exceeds +/- 2047 revolutions from the home position (applies only to systems with absolute feedback).	<ul style="list-style-type: none"> Decrease application range of motion. Upgrade firmware. This error only applies to firmware versions prior to 1.10.
E04	Motor Overtemperature	Motor thermostat trips due to: <ul style="list-style-type: none"> High motor ambient temperature and/or Excessive current 	<ul style="list-style-type: none"> Operate within (not above) the continuous torque rating for the ambient temperature (40°C maximum). Lower ambient temperature, increase motor cooling.
		Motor wiring error.	Check motor wiring.
		Incorrect motor selection.	Verify the proper motor has been selected.
E05	IPM Fault	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, it may need to be replaced.
		Ultra3000 temperature too high.	<ul style="list-style-type: none"> Check for clogged vents or defective fan. Ensure cooling is not restricted by insufficient space around the unit.
		Operation above continuous power rating.	<ul style="list-style-type: none"> Verify ambient temperature is not too high. Operate within the continuous power rating. Reduce acceleration rates.
		Ultra3000 has a bad IPM output, short circuit, or overcurrent.	Remove all power and motor connections, and perform a continuity check from the dc bus to the U, V, and W motor outputs. If a continuity exists, check for wire fibers between terminals, or send drive in for repair.
		An attempt was made to enable the drive without waiting at least 1.0 second after applying the main ac power. Note: This only applies to Ultra3000 models 2098-DSD-005, 2098-DSD-010, and 2098-DSD-020 (when using an external +5V auxiliary power supply).	Wait at least 1.0 second after the main ac is applied before enabling the drive.
E06	Hardware Overtravel (SERCOS only)	Dedicated overtravel input is inactive.	<ul style="list-style-type: none"> Check wiring. Verify motion profile.
E07	RESERVED		Call your local Allen-Bradley representative.
E08	RESERVED		
E09	Bus Undervoltage	Low ac line/ac power input.	<ul style="list-style-type: none"> 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.

Error Code	Problem or Symptom	Possible Cause	Action/Solution
E10	Bus Overvoltage	Excessive regeneration of power. When the motor is driven by an external mechanical power source, it may regenerate too much peak energy through the Ultra3000's power supply. The system faults to save itself from an overload.	<ul style="list-style-type: none"> Change the deceleration or motion profile. Use a larger system (motor and Ultra3000). Use a resistive shunt. If a shunt is connected, verify the wiring is correct and shunt fuse is not blown.
		Excessive ac input voltage.	Verify input is within specifications.
E11	Illegal Hall State	Incorrect phasing.	Check the Hall phasing.
		Bad connections.	<ul style="list-style-type: none"> Verify the Hall wiring. Verify 5V power supply to the encoder.
E12	Home Search Failed	Home sensor and/or marker is outside the overtravel limits.	<ul style="list-style-type: none"> Check wiring. Reposition the overtravel limits or sensor.
E13	Home Position In Limit	Home sensor, marker, or final home position exceeds a hardware overtravel limit.	<ul style="list-style-type: none"> Reposition the overtravel limits or home sensor. Adjust the final home position.
E14	SERCOS Hardware Fault (SERCOS drives only)	A fault was detected with the operation of the drive's internal SERCOS hardware.	Contact your local Allen-Bradley representative.
	DeviceNet Communications Network problem (DeviceNet drives only)	DeviceNet communications network is broken	Troubleshoot DeviceNet communications.
E15	Excessive Electrical Cycle Length	Electrical cycle length exceeds maximum lines per electrical cycle	Replace the linear motor/encoder.
E16	Software Overtravel (SERCOS only)	Programmed overtravel limit has been exceeded.	<ul style="list-style-type: none"> Verify motion profile. Verify overtravel settings are appropriate.
E17	User-specified Current Fault	User-specified average current level has been exceeded.	Increase to a less restrictive setting.
E18	Overspeed Fault	Motor speed has exceeded 125% of maximum rated speed.	<ul style="list-style-type: none"> Check cables for noise. Check tuning.
E19	Excess Position Error	Position error limit was exceeded.	<ul style="list-style-type: none"> Increase the feedforward gain. Increase following error limit or time. Check position loop tuning.

Error Code	Problem or Symptom	Possible Cause	Action/Solution
E20	Motor Encoder State Error	The motor encoder encountered an illegal transition.	<ul style="list-style-type: none"> • Replace the motor/encoder. • Use shielded cables with twisted pair wires. • Route the feedback away from potential noise sources. • Check the system grounds. • Verify that the unbuffered encoder signals are not subjected to EMI in the CN1 cable. Remove these signals from the CN1 cable if they are not being used. • Verify that the motor has a high-frequency bond to the drive's enclosure panel. • Verify that any stage connected to the motor shaft (for example using a ball screw) has a high-frequency bond to the machine frame and the drive's enclosure panel.
		Bad encoder.	Replace motor/encoder.
E21	Auxiliary Encoder state error	The auxiliary encoder encountered an illegal transition.	<ul style="list-style-type: none"> • Use shielded cables with twisted pair wires. • Route the encoder cable away from potential noise sources. • Faulty encoder, replace encoder. • Check the ground connections.
		Setup time violation for Step/Direction or CW/CCW input.	Check timing of Step/Direction or CW/CCW inputs to determine if setup time requirements are being met.
E22	Motor Thermal Protection Fault	The internal filter protecting the motor from overheating has tripped.	<ul style="list-style-type: none"> • Reduce acceleration rates. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use larger Ultra3000 and motor. • Check tuning.
E23	IPM Thermal Protection Fault	The internal filter protecting the drive from over heating has tripped.	<ul style="list-style-type: none"> • Reduce acceleration rates. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use larger Ultra3000 and motor. • Check tuning.
E24	Excess Velocity Error	Velocity error limit was exceeded.	<ul style="list-style-type: none"> • Increase time or size of allowable error. • Reduce acceleration. • Check tuning.
E25	Sensor Not Assigned	Homing or registration motion was attempted without a sensor assigned.	Assign a sensor to a digital input.
E26	User-specified Velocity Fault	User-specified velocity level was exceeded.	Increase to a less restrictive setting.
E27	Axis Not Homed	Absolute positioning was attempted without homing.	Verify homing sequence.

Error Code	Problem or Symptom	Possible Cause	Action/Solution
E28	Motor Parameter Error	Parameter loaded from smart encoder or received from SERCOS controller is incompatible with the drive.	<ul style="list-style-type: none"> Select a different motor through the SERCOS controller. Select a different motor.
E29	Encoder Output Frequency Exceeded	Encoder output frequency exceeds the maximum user-specified value. This only applies when the encoder output is synthesized by the drive.	<ul style="list-style-type: none"> Increase the encoder output maximum frequency parameter. Decrease the encoder interpolation parameter. Increase the encoder output divider parameter.
E30	Encoder Communication Fault	Communication was not established with an intelligent encoder.	<ul style="list-style-type: none"> Verify motor selection. Verify the motor supports automatic identification. Verify motor encoder wiring.
E31	Encoder Data	Encoder data is corrupted.	Replace the motor/encoder.
E32	Sine/Cosine Encoder Frequency Limit Exceeded	Maximum frequency of the sine/cosine circuitry has been exceeded.	<ul style="list-style-type: none"> Decrease velocity. Use encoder with lower resolution (before interpolation).
E33	Absolute Position Exceeds Position Rollover	<p>Motion is commanded to a position outside the position rollover range.</p> <ul style="list-style-type: none"> An absolute index is initiated that specifies a position outside the position rollover range. A homing cycle is initiated with the home position outside the position rollover range. A define home is initiated with the home position outside the position rollover range. A preset position is initiated that specifies a position outside the position rollover range. 	Set motion command to a position within the position rollover range.
E34	Ground Fault	Wiring error.	Check motor 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 remains, call your Allen-Bradley representative. If fault clears, then a wiring error or motor internal problem exists.
E35	Precharge Fault	Low ac input voltage.	Check input ac voltage on all phases.
		Internal malfunction.	Call your Allen-Bradley representative.
E36	Power Circuitry Overtemperature	Excessive heat exists in the power circuitry.	<ul style="list-style-type: none"> Reduce acceleration rates. Reduce duty cycle (ON/OFF) of commanded motion. Increase time permitted for motion. Use larger Ultra3000 and motor. Check tuning.
E37	AC Line Loss	One or more phases of the input ac power is missing.	Check input ac voltage on all phases.

Error Code	Problem or Symptom	Possible Cause	Action/Solution
E39	Self-sensing Commutation Startup Error	Motion required for self-sensing startup commutation was obstructed.	<ul style="list-style-type: none"> • 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 using wiring diagnostics.
E40	230V Shunt Protection Fault	Ineffective shunt resistor Excessive regeneration	<ul style="list-style-type: none"> • Verify that the shunt resistor (internal or external) is connected.
E41	460V Shunt Protection Fault	Ineffective shunt resistor Excessive regeneration	<ul style="list-style-type: none"> • If an external shunt resistor is connected, verify that the shunt fuse is not blown. • If a non Allen-Bradley external shunt resistor is used, verify that the resistance value is within specifications. • Verify that the motor is not being driven mechanically, causing the motor to behave as a generator.
E42	Motor Keying Error (SERCOS drives only)	The motor physically connected to the drive differs from the motor specified in the user program.	Select the correct motor in the user program.
E43	Drive Enable Input (SERCOS drives only)	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Disable the Drive Enable Input fault. • Verify that Drive Enable hardware input is active whenever the drive is enabled through software.
E44	Lost motion fault (only applies to applications with Stegmann feedback devices)	Detection occurs during a fault reset. Absolute position in the drive is incorrect and the motion has been lost due to line loss condition.	<ul style="list-style-type: none"> • Cycle power. • Cycle power and re-home drive if drive was homed in the same power cycle that the lost motion fault occurred.
E50	Duplicate Node Fault (SERCOS drives only)	Duplicate node address detected on SERCOS ring.	Verify that each SERCOS drive is assigned a unique node address.
All others	RESERVED		Call your local Allen-Bradley representative.

Troubleshooting for SERCOS Drives

These troubleshooting tables apply to Ultra3000-SE drives (2098-DSD-xxx-SE and 2098-DSD-HV.xxx-SE).

SERCOS Module Status Indicator

SERCOS Module Status Indicator	Status	Potential Cause	Possible Resolution
Steady green	Normal	Drive is enabled.	Normal operation when drive is enabled.
Flashing green	Standby	Drive is not enabled.	Normal operation when drive is disabled.
Flashing red-green	DC Bus Undervoltage	The dc bus voltage is low.	<ul style="list-style-type: none"> Normal operation when using auxiliary power (main ac power is not applied). When using main ac power, refer to the section Error Codes to continue troubleshooting.
Flashing red	Minor fault	Drive is faulted, but the fault can be cleared.	Refer to the section Error Codes to continue troubleshooting.
Steady red	Unrecoverable fault	Drive is faulted, and the fault cannot be cleared.	Contact your local Allen-Bradley representative.

SERCOS Network Status Indicator

SERCOS Network Status Indicator	Status	Potential Cause	Possible Resolution
Steady green	Communication ready	No faults or failures.	N/A
Flashing green	Establishing communication	System is still in the process of establishing SERCOS communication.	Wait for steady green status indicator.
		Node address setting on the drive module does not match SERCOS controller configuration.	Verify proper node switch setting.
Flashing red	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.

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

Understanding Drive Fault Behavior

The following RSLogix 5000 fault actions are configurable from the Axis Properties dialog, Fault Actions tab.

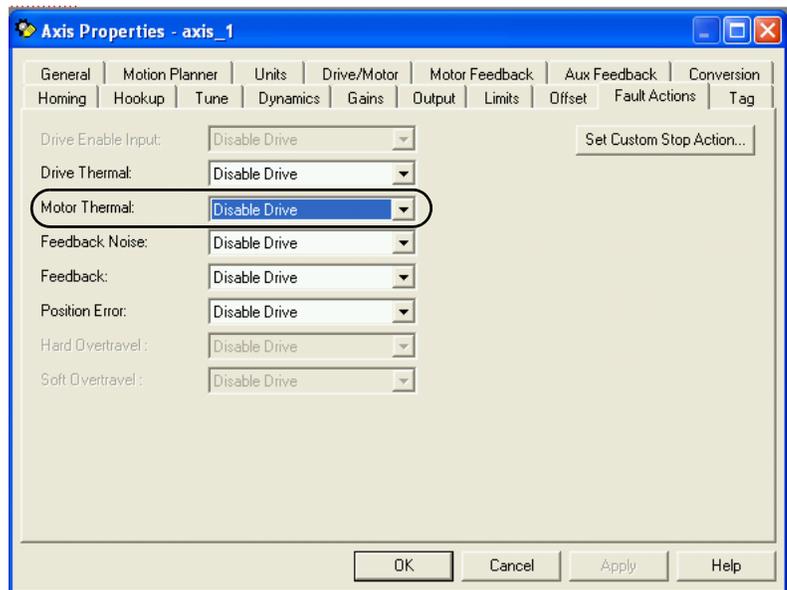
RSLogix 5000 Drive Fault Action Definitions

Drive Fault Action	Definition
Shutdown	The drive disables and the contactor enable relay opens. Uncontrolled stop, motor coasts to a stop.
Disable Drive	The drive is disabled. Uncontrolled Stop, motor coasts to a stop.
Stop Motion	N/A. Drive continues to operate. Status is provided by the Module Status Indicator.
Status Only	Drive continues to operate. Status is provided by the Module Status Indicator.

Ultraware software handles all hard faults by disabling the drive. RSLogix 5000 software provides the four fault handling options, however, for the Ultra3000 drives, only Shutdown and Disable Drive are active settings and both result in a coast-to-stop condition. Disable Drive is the default fault action for all attributes and only selected faults are programmable. In the Drive Fault Behavior table on page 106, the controlling attribute is given for programmable fault actions.

RSLogix 5000 Axis Properties - Fault Actions Tab

Default setting for Motor Overtemperature fault (E04).



Refer to Appendix C, beginning on page 141, for information on how to reduce unexpected motion as a result of feedback signal loss and setting the Position Error fault action.

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

Drive Fault Behavior

Software Fault Message	Error Code	Description	Drive Fault Action/Attribute	RSLogix 5000 Programmable Fault Action?
RSLogix 5000 (Ultraware)				
DriveHardFault (Non-Volatile Memory Endurance Exceeded)	E01	Range of motion and number of home position definitions during the product life exceeds the maximum allowed (applies only to systems with absolute feedback).	DISABLE	NO
DriveHardFault (Velocity Exceeds Position Rollover /2)	E02	The velocity command or feedback exceeds half the machine cycle length per millisecond (applies only when the machine cycle position rollover is enabled).	DISABLE	NO
DriveHardFault (Absolute Feedback Range Exceeded)	E03	The motor position exceeds +/- 2047 revolutions from the home position (applies only to systems with absolute feedback).	DISABLE	NO
MotorOvertempFault (Motor Overtemperature)	E04	The motor thermal switch was tripped.	DISABLE/ Motor Thermal	YES
DriveHardFault (IPM Fault)	E05	A problem in the drive power structure was detected. Motor cables shorted, motor winding shorted internally, temperature too high, operation above continuous power rating, or has a bad IPM output, short circuit, or overcurrent.	DISABLE	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.	DISABLE/ Hard Overtravel	YES
MotFeedbackFault (Channel BM Line Loss)	E07	The feedback wiring is open, shorted or missing.	DISABLE	NO
MotFeedbackFault (Channel AM Line Loss)	E08	The feedback wiring is open, shorted or missing.	DISABLE	NO
DriveUndervoltageFault (Bus Undervoltage)	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.	DISABLE	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.	DISABLE	NO
CommutationFault (Illegal Hall State)	E11	State of Hall inputs is incorrect.	DISABLE	NO
DriveHardFault (Home Search Failed)	E12	Home sensor and/or marker is outside the overtravel limits.	DISABLE	NO
DriveHardFault (Home Position In Limit)	E13	Home sensor, marker, or final home position exceeds a hardware overtravel limit.	DISABLE	NO
SERCOSFault (SERCOS or DeviceNet Communications Network problem)	E14	SERCOS or DeviceNet communications network is broken	DISABLE	NO
DriveHardFault (Excessive Electrical Cycle Length)	E15	Configuration information is not valid.	N/A	NO
SoftOvertravelFault (+/- Software Overtravel)	E16	Programmed positive/negative overtravel limit has been exceeded.	DISABLE Soft Overtravel	YES

Software Fault Message	Error Code	Description	Drive Fault Action/Attribute	RSLogix 5000 Programmable Fault Action?
RSLogix 5000 (Ultraware)				
DriveHardFault (User-specified Current Fault)	E17	User-specified average current level has been exceeded.	DISABLE	NO
OverspeedFault (Overspeed Fault)	E18	Motor speed has exceeded 125% of maximum rated speed.	DISABLE	NO
PositionErrorFault (Excess Position Error)	E19	Axis position error limit has been exceeded. This fault can be configured for status only.	DISABLE Position Error	YES
MotFeedbackFault (Motor Encoder State Error)	E20	The motor encoder encountered an illegal transition.	DISABLE	NO
AuxFeedbackNoiseFault (Auxiliary Encoder State Error)	E21	The auxiliary encoder encountered an illegal transition.	DISABLE	NO
OverloadFault (Motor Thermal Protection Fault)	E22	The internal filter protecting the motor from overheating has tripped.	DISABLE	NO
DriveOvertempFault (IPM Thermal Protection Fault)	E23	The internal filter protecting the drive from over heating has tripped.	DISABLE Drive Thermal	YES
DriveHardFault (Excess Velocity Error)	E24	Velocity error limit was exceeded.	DISABLE	NO
DriveHardFault (Sensor Not Assigned)	E25	Homing or registration motion was attempted without a sensor assigned.	DISABLE	NO
DriveHardFault (User-specified Velocity Fault)	E26	User-specified velocity level was exceeded.	DISABLE	NO
DriveHardFault (Axis Not Homed)	E27	Absolute positioning was attempted without homing.	DISABLE	NO
DriveHardFault (Motor Parameter Error)	E28	Parameter loaded from smart encoder or received from SERCOS controller is incompatible with the drive.	DISABLE	NO
DriveHardFault (Encoder Output Frequency Exceeded)	E29	Encoder output frequency exceeds the maximum user-specified value. This only applies when the encoder output is synthesized by the drive.	DISABLE	NO
DriveHardFault (Encoder Communication Fault)	E30	Communication was not established with an intelligent (i.e. Stegmann) encoder on the motor feedback port.	DISABLE	NO
DriveHardFault (Encoder Data)	E31	Encoder data is corrupted.	DISABLE	NO
DriveHardFault (Sine/Cosine Encoder Frequency Limit Exceeded)	E32	Maximum frequency of the sine/cosine circuitry has been exceeded.	DISABLE	NO
DriveHardFault (Absolute Position Exceeds Position Rollover)	E33	Absolute position exceeds position rollover.	DISABLE	NO
DriveHardFault (Ground Fault)	E34	Excessive ground current in the converter was detected.	DISABLE	NO

Software Fault Message	Error Code	Description	Drive Fault Action/Attribute	RSLogix 5000 Programmable Fault Action?
RSLogix 5000 (Ultraware)				
DriveHardFault (Precharge Fault)	E35	The converter pre-charge cycle has failed.	DISABLE	NO
DriveHardFault (Power Circuitry Overtemperature)	E36	Excessive heat exists in the power circuitry.	DISABLE	NO
DriveHardFault (AC Line Loss)	E37	One or more phases of the input ac power is missing.	DISABLE	NO
SERCOSFault (SERCOS Ring Fault)	E38	The SERCOS ring is not active after being active and operational.	DISABLE	NO
DriveHardFault (Self-sensing Commutation Startup Error)	E39	Self-sense commutation fault detected.	DISABLE	NO
DriveHardFault (230V Shunt Protection Fault)	E40	Ineffective shunt resistor.	DISABLE	NO
DriveHardFault (460V Shunt Protection Fault)	E41	Ineffective shunt resistor.	DISABLE	NO
ConfigFault (Motor Keying Error)	E42	The motor physically connected to the drive differs from the motor specified in the user program.	N/A	NO
DriveEnableInputFault (Drive Enable Input)	E43	Generated when Enable input switches off when drive is enabled.	DISABLE Drive Enable Input	YES
DriveHardFault (Unknown Fault)	E44	Lost motion fault (only applies to applications with Stegmann feedback devices)	DISABLE	NO
SERCOSFault (Duplicate Node Fault)	E50	Duplicate node address detected on SERCOS ring.	DISABLE	NO
RESERVED	All Others			

Troubleshooting for DeviceNet Drives

These troubleshooting tables apply to Ultra3000-DN drives (2098-DSD-xxx-DN, 2098-DSD-xxxX-DN, 2098-DSD-HVxxx-DN, or 2098-DSD-HVxxxX-DN).

DeviceNet Module Status Indicator

Module Status Indicator	Status	Potential Cause	Possible Resolution
Off	Not powered	No power	There is no power going to the device.
Steady-green	Operational	Normal operation	Normal operation - no action needed.
Flashing-green	Device is in stand-by	Processing or waiting for input	Normal operation - no action needed.
Flashing-red	Recoverable fault	Not operational	Power cycle or reset the drive.
Steady-red	Unrecoverable fault	Drive problem	1. Check drive for power-up error. 2. Replace drive.
Flashing-red/ Flashing-green	Self testing	Self-test in progress	The device is in self test, wait.

DeviceNet Network Status Indicator

Network Status Indicator	Status	Potential Cause	Possible Resolution
Off	<ul style="list-style-type: none"> Not powered Not online 	<ul style="list-style-type: none"> No power going to the device Failed Duplicate MAC ID check 	<ol style="list-style-type: none"> Check the Module Status indicator to verify that the drive is powered. Check that one or more nodes are communicating on the network. Check that at least one other node on the network is operational and the data rate is the same as the drive.
Flashing-green	<ul style="list-style-type: none"> Online Not connected 	<ul style="list-style-type: none"> Passed Duplicate MAC ID check No connection established 	No action is needed. The indicator is flashing to signify that there are no open communication connections between the drive and any other device. Any connection (I/O or explicit message) made to the drive over DeviceNet will cause the indicator to stop flashing and remain Steady-ON for the duration of any open connection.
Steady-green	<ul style="list-style-type: none"> Online Connected 	One or more connections established	No action needed. This condition is normal.
Flashing-red	<ul style="list-style-type: none"> Online Time-out 	I/O connection timed out	<ol style="list-style-type: none"> Re-initiate I/O messaging by the master controller. Reduce traffic or errors on the network so that messages can get through within the necessary time frame.
Steady-red	Network Failure	<ul style="list-style-type: none"> Failed Duplicate MAC ID check Bus-off 	<ol style="list-style-type: none"> Ensure that all nodes have unique addresses. If all node addresses are unique, examine network for correct media installation. Ensure that all nodes have the same Data Rate.

Node Problems

Give particular attention to the task of setting initial addresses and data rates. Survey the network to ensure all assignments are known. Some nodes can be logically assigned to a group of devices, but physically located away from those devices. One incorrect node can cause other nodes to appear to be bus-off (steady-red indicator). If a node goes bus-off and the device is reset only to go bus-off again, the problem is likely not with the device, but rather the setting of the address, data rate, or a network-wide problem related to topology, grounding, intermittent power/data connections, or electrical noise. If a scanner goes bus-off, nodes will not reallocate (Flashing-green or red) even if they are functioning correctly.

Device Failure - Indicator Status Check

A steady-red Module Status indicator can mean an error. If the Network Status indicator goes steady-red at power-up, it could mean there is a Duplicate MAC ID. The user response is to test all devices for unique addresses. If a steady-red indicator remains on after the Duplicate MAC ID test shows all devices to have a unique node address, it means a bus-off error.

Follow these steps to resolve the error.

1. Check data rate settings.
2. If symptom persists, replace node address (with another address and correct data rate).
3. If symptom persists, replace tee tap.
4. If symptom persists, check topology.
5. If symptom persists, check power for noise with oscilloscope or power disturbance analyzer.

Scanner Problems

If using a scanner, check the scan list, data rate, and addresses of devices. Verify series and revision of the scanner is the latest. If the scanner is bus-off, recycle the 24V supply and then reset the scanner.

If the scanner goes bus-off again, the problem is some combination of these issues.

- Defective node device
- Incorrect node data rate
- Bad network topology
- Faulty wiring
- Faulty scanner
- Faulty power supply
- Bad grounding
- Electrical noise

Power Supply Problems

If a single power supply is used, add up the current requirements of all devices drawing power from the network. This total should be considered the minimum current rating in selecting the power supply used.

In addition, check these symptoms.

- Length and current level in trunk and drop cables
- Size and length of the cable supplying power to the trunk
- Voltage measured at the middle and ends of the network
- Noise in network power measured with an oscilloscope

Cable Installation and Design Problems

Cable installation and design refers to the physical layout and connections on the network. Walk the network if possible to determine the actual layout and connections. Network management software displays only a logical record of the network.

Make sure you have a diagram of the physical layout and a record of the information in these tables.

Cable Checks	Power Checks
Number of nodes.	Break the earth ground of the V- and Shield and verify >1.0 Mohm to frame ground with power supply off.
Individual drop lengths.	Use a multi-meter to check for short circuit between CAN_H and CAN_L, or CAN (H or L) to Shield, V- or V+.
Branched drop length.	Total power load and at its distribution points.
Cumulative drop length.	Spot check power for noise.
Total trunk length.	
Power supply cable length and gauge.	
Terminator locations and size.	

Adjusting the Physical Network Configuration

Try these methods to improve the efficiency of your physical network configuration.

- Shortening the overall length of the cable system
- Moving the power supply in the direction of an overloaded cable section
- Moving devices from an overloaded cable section to a less loaded section
- Moving higher current loads closer to the power supply
- Adding another power supply to an overloaded network
- Moving the power supply from the end to the middle of the network

Interconnect Diagrams

Introduction

This appendix provides you with interconnect diagrams for your Ultra3000 servo drive.

Topic	Page
Introduction	113
Wiring Examples	114
Power Interconnect Diagrams	115
Shunt Module Interconnect Diagrams	119
Ultra3000 Drives/Rotary Motors and Actuators Wiring Examples	122
Ultra3000 Drives/Linear Actuators Wiring Examples	127
Control String Examples (120V ac)	128
Controlling a Brake Example	131
Ultra3000 Drive to Logix Analog Module Diagrams	133
Ultra3000 Drive to IMC-S Compact Controller Diagram	136

Wiring Examples

This appendix provides wiring examples to assist you in wiring the Ultra3000 drive system. The notes in this table apply to the power, shunt, motor, actuator, and control string interconnect diagrams.

ATTENTION



The National Electrical Code and local electrical codes take precedence over the values and methods provided. Implementation of these codes are the responsibility of the machine builder.

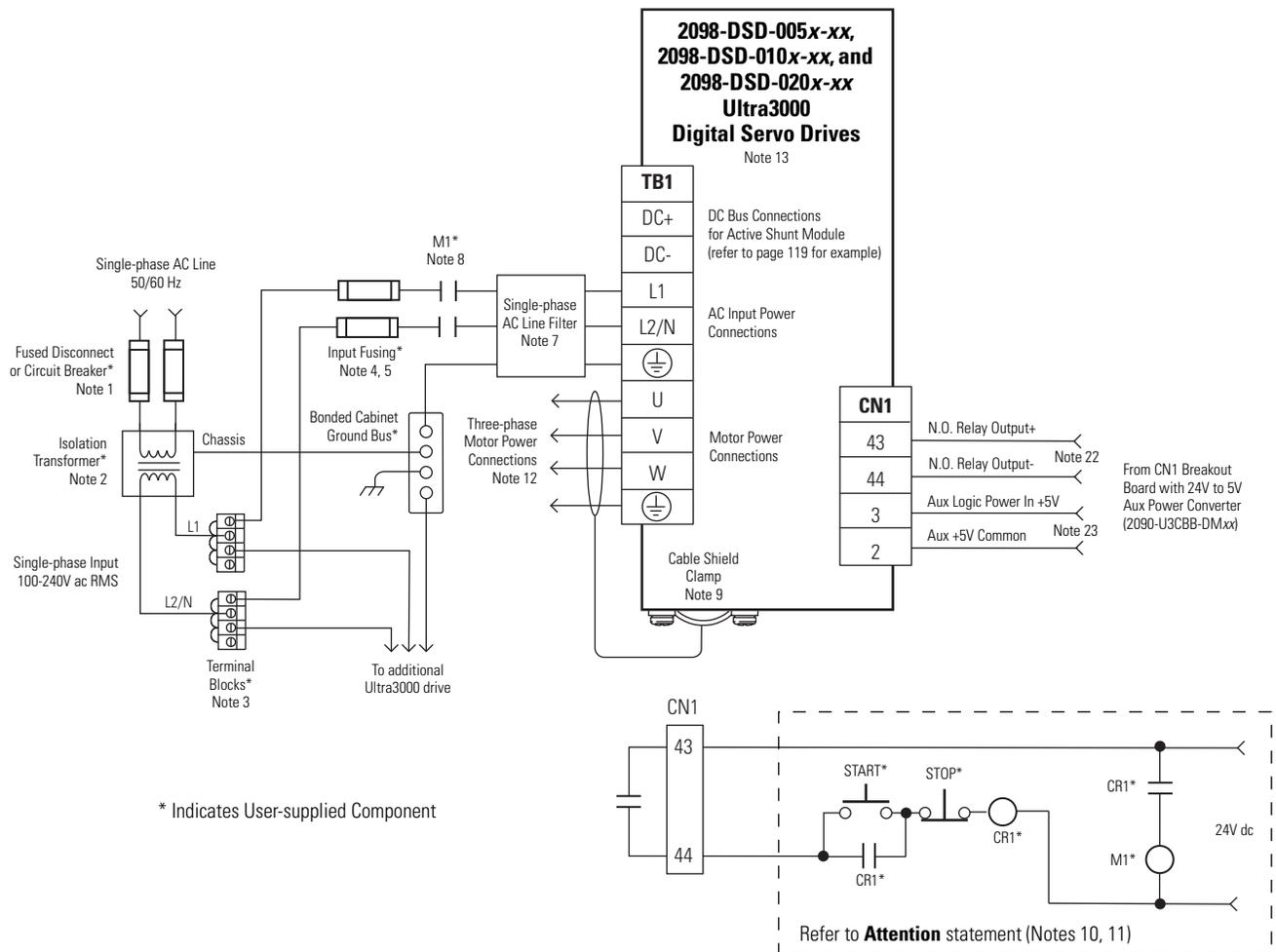
Note	Information
1	A disconnecting device is required for maintenance and safety. If a grounded neutral is used instead of L2, only L1 may be switched or fused.
2	An isolation transformer is optional. If the transformer secondary has a neutral connection, neutral must be bonded to ground. Multiple drive modules may be powered from one transformer or other ac supply source.
3	Do not daisy chain drive module power connections. Make separate connections directly to the ac supply.
4	For power wiring specifications, refer to the Ultra3000 Installation Manual, publication 2098-IN003 .
5	For input fuse sizes, refer to the Ultra3000 Installation Manual, publication 2098-IN003 .
6	May be used to maintain power to logic section of drive and status indicators when main ac input power is removed. A separate ac line source may be used if voltage is between 88...265V ac (rms) on 2098-DSD-xxx (230V drives) or 207...528V ac (rms) on 2098-DSD-HVxxx (460V drives). In this configuration, a separate line filter for logic power may be required.
7	Place ac (EMC) line filter 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 Ultra3000 Installation Manual, publication 2098-IN003 .
8	Drive Enable input must be opened before main power is removed and auxiliary power is present, or a drive fault will occur. A delay of at least 1.0 second must be observed before attempting to enable the drive after main power is restored.
9	Cable shield clamp must be used in order to meet CE requirements. No external connection to chassis ground required.
10	<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> ATTENTION  </div> <div> <p>Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication SHB-900.</p> </div> </div>
11	The recommended minimum wire size for wiring the safety circuit is 1.5 mm ² (16 AWG).
12	For motor cable specifications and drive/motor cable combinations, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001 .
13	The Ultra3000 drive referenced is either a 2098-DSD-xxx or 2098-DSD-xxxX (Ultra3000 with indexing), 2098-DSD-xxx-SE (SERCOS interface), 2098-DSD-xxx-DN (DeviceNet interface), or 2098-DSD-xxxX-DN (DeviceNet with indexing) 230V drive.
14	The Ultra3000 drive referenced is either a 2098-DSD-HVxxx or 2098-DSD-HVxxxX (Ultra3000 with indexing), 2098-DSD-HVxxx-SE (SERCOS interface), 2098-DSD-HVxxx-DN (DeviceNet interface), or 2098-DSD-HVxxxX-DN (DeviceNet with indexing) 460V drive.
15	Wire colors are for flying-lead cable and may vary from premolded cable connectors.
16	Motor power cables (2090-XXNPMF-xxSxx and 2090-CPBM6DF-16AAxx) have a drain wire that must be folded back under the cable shield clamp.
17	Only the MPG-Bxxx encoder uses the +5V dc supply. MPL-B3xx...MPL-B9xx and 1326AB (M2L/S2L) encoders use the +9V dc supply.
18	Only the MPL-A5xx encoders use the +9V dc supply. MPG-Axxx and MPL-A3xx, MPL-A4xx, MPL-A45xx encoders use the +5V dc supply.
19	MPL-A15xx, MPL-A2xx, MPF-A3xx, MPF-A4xx, MPF-A45xx, MPS-Axxx, and MPAS-Axxx encoders use the +5V dc supply. MPL-B15xx, MPL-B2xx, MPF-A5xx, MPF-Bxxx, MPS-Bxxx, and MPAS-Bxxx encoders use +9V dc.
20	Brake connector pins for MPF-A/B5xx motors are labeled plus (+) and minus (-). All other MP-Series brake connector pins are labeled F and G. Power connector pins on MPF-A/B5xx motors are labeled U, V, W, and GND. All other MP-Series power connector pins are labeled A, B, C, and D.
21	Use a flyback diode or MOV for noise suppression of the motor brake coil. Refer to Controlling a Brake Example on page 131.
22	Relay Output (CN1, pins 43 and 44) must be configured as Ready in Ultraware software.
23	The preferred method for supplying auxiliary power is by using the 12-pin or 44-pin drive-mounted breakout board with 24V to 5V auxiliary power converter (2090-U3CBB-DM12 or -DM44). Auxiliary +5V power is required to maintain encoder position when the main ac power is disconnected.

Power Interconnect Diagrams

This is the power wiring diagram with 24V dc control string for 2098-DSD-005x-xx, 2098-DSD-010x-xx, and 2098-DSD-020x-xx Ultra3000 drives (non-SERCOS drives only). To avoid a separate 5V dc auxiliary logic power supply, the 24V to 5V converter breakout board (catalog number 2090-U3CBB-DMxx) is used to wire the control interface (CN1) connector. For the control string diagram with 120V ac input refer to the figure on page 128.

For SERCOS drives, input line contactor is part of the PLC program and output control.

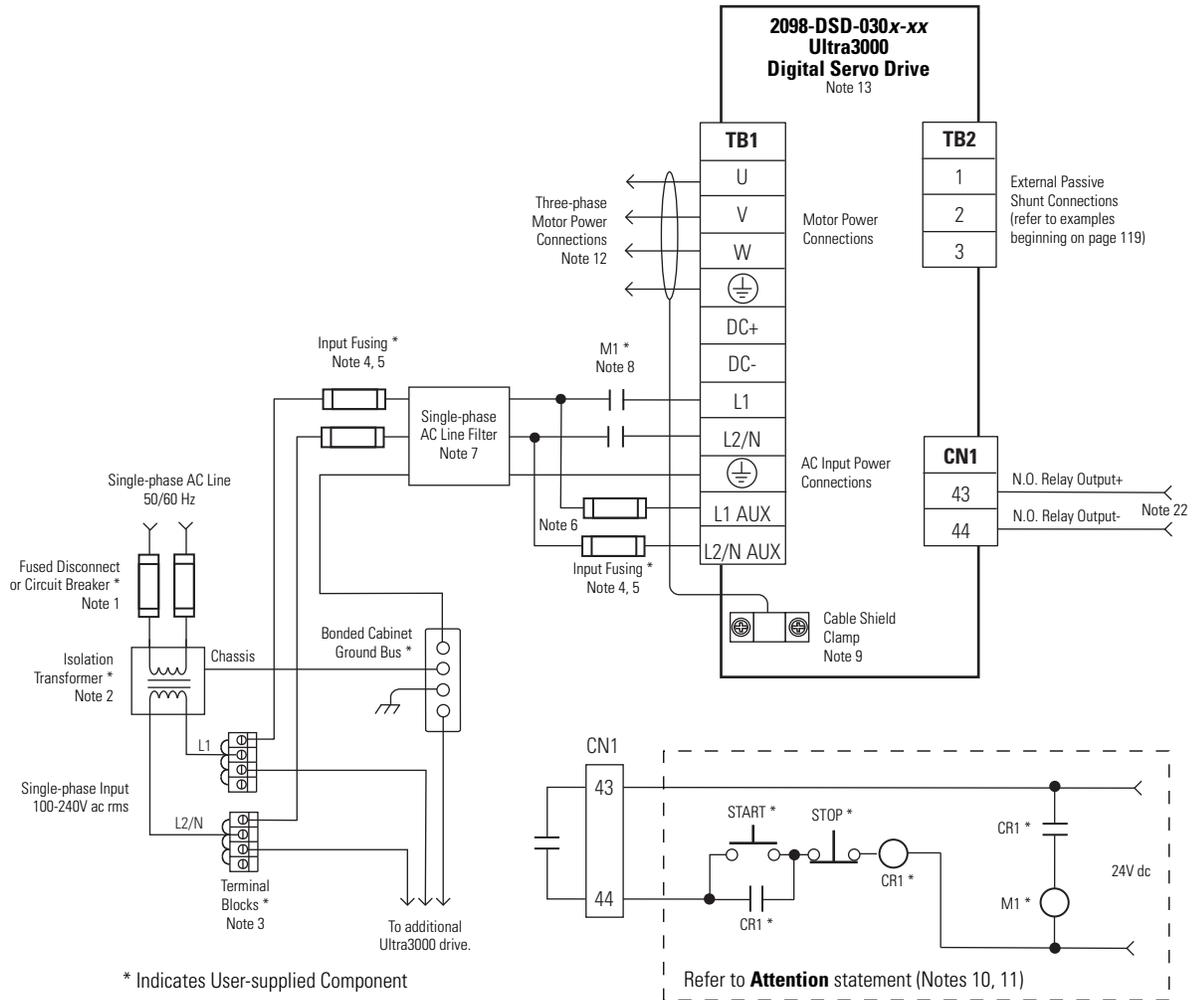
Typical Power Wiring of Ultra3000 (230V) System



This is the power wiring diagram with 24V dc control string for the 2098-DSD-030x-xx drive (non-SERCOS drives only). For the control string diagram with 120V ac input refer to the figure on page 129.

For SERCOS drives, input line contactor is part of the PLC program and output control.

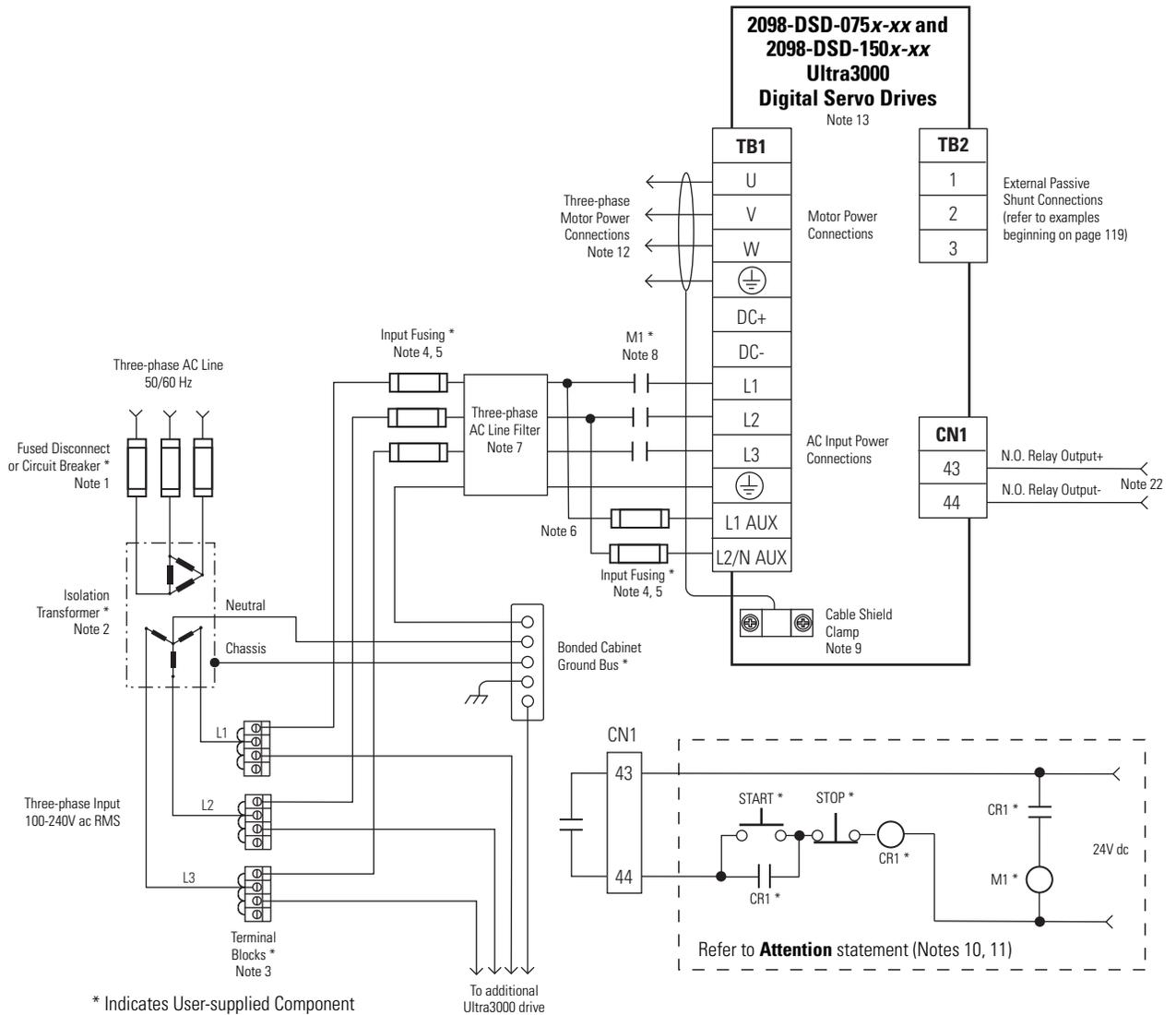
Typical Power Wiring of Ultra3000 (230V) System



This is the power wiring diagram with 24V dc control string for 2098-DSD-075x-xx and 2098-DSD-150x-xx Ultra3000 drives (non-SERCOS drives only). For the control string diagram with 120V ac input refer to the figure on page 130.

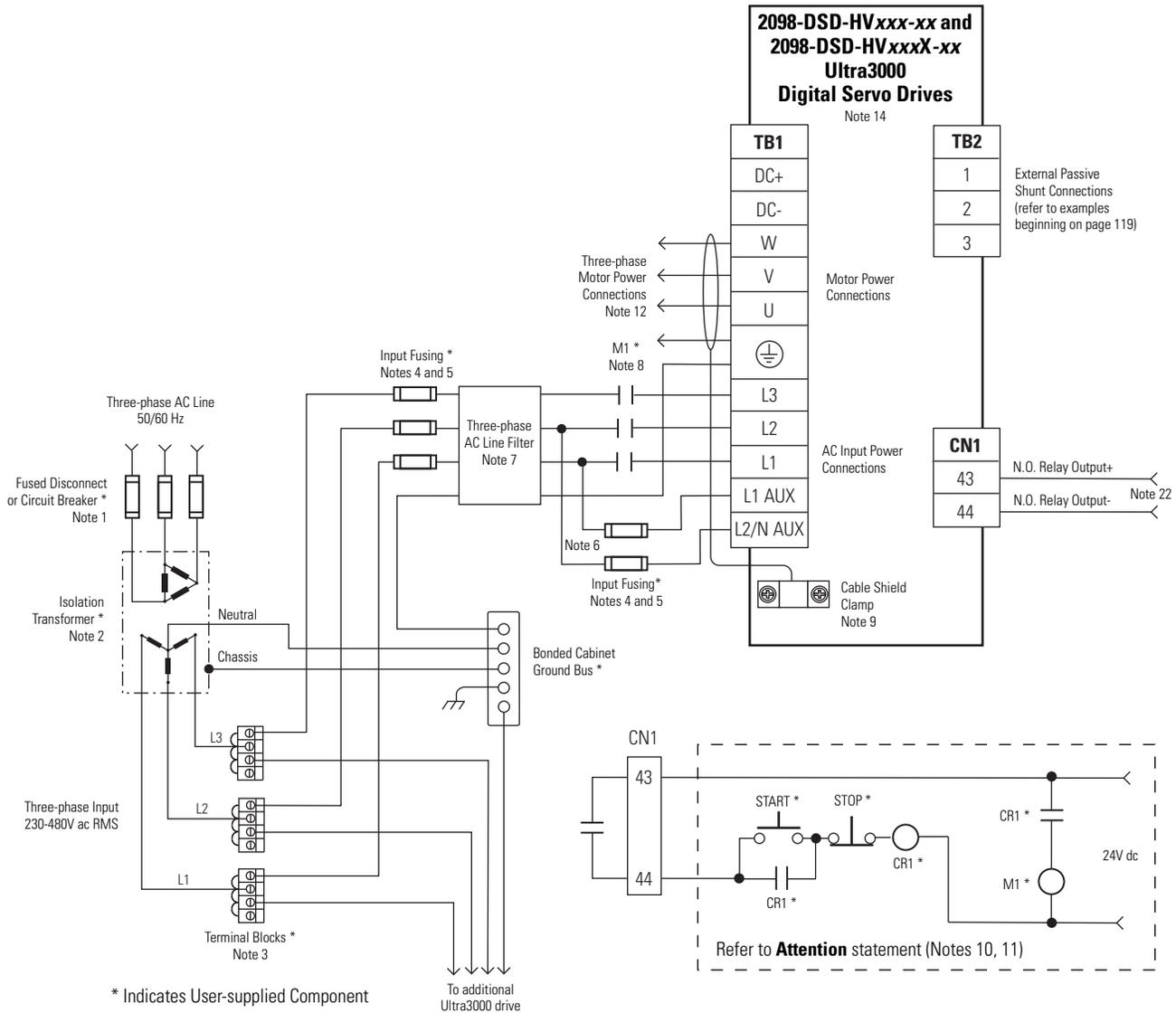
For SERCOS drives, input line contactor is part of the PLC program and output control.

Typical Power Wiring of Ultra3000 (230V) System



This is the power wiring diagram with 24V dc control string for 2098-DSD-HVxxx-xx and 2098-DSD-HVxxxX-xx Ultra3000 drives. For the control string diagram with 120V ac input refer to the figure on page 130.

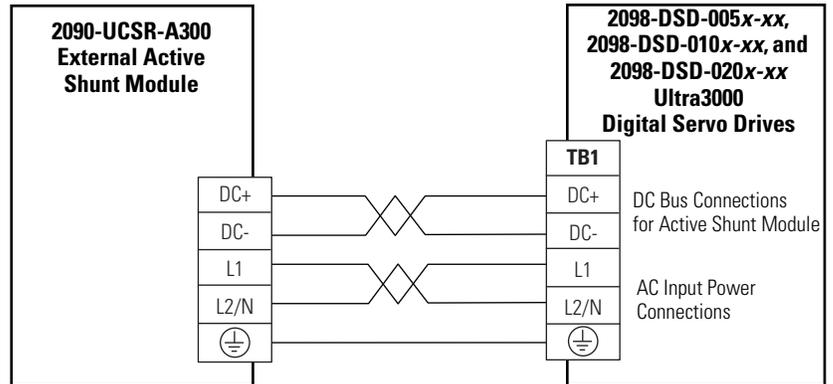
Typical Power Wiring of Ultra3000 (460V) System



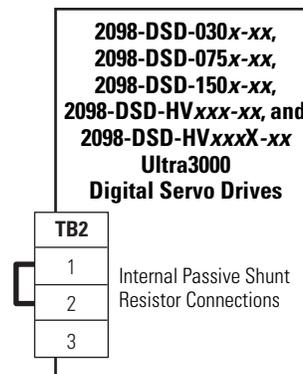
Shunt Module Interconnect Diagrams

This section contains the interconnect diagrams for Ultra3000 drives with active and passive shunt modules.

External Active Shunt Module Interconnect Diagram



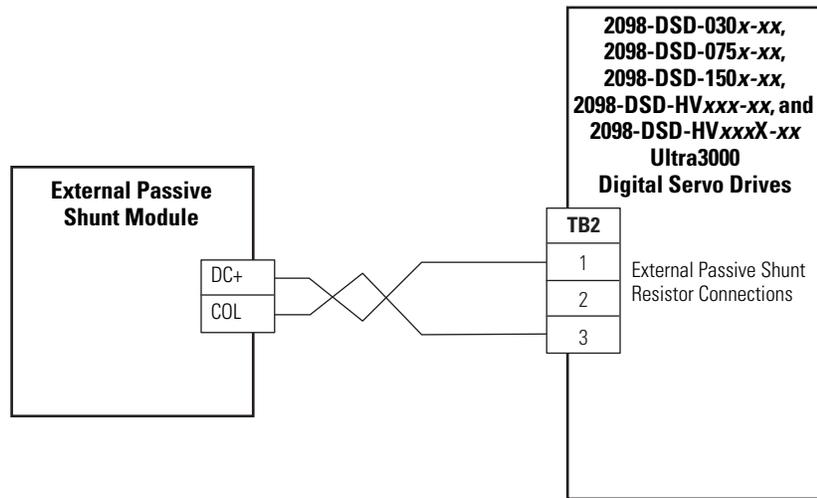
Internal Passive Shunt Interconnect Diagram (default configuration)



IMPORTANT

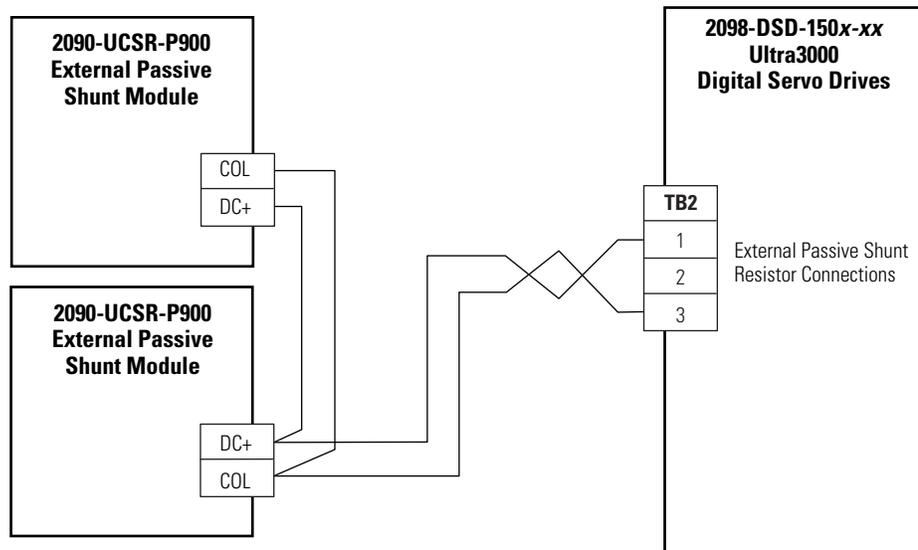
Internal shunt operation is only present on the drives listed in the figure above.

External Passive Shunt (single-shunt) Diagram



In this figure, the 2098-DSD-150x-xx Ultra3000 drive is wired with two external passive shunt resistors. When two 900 W shunt modules are connected in parallel, the shunt capacity is doubled for a total of 1800 W of continuous power dissipation.

External Passive Shunt (two-shunt) Diagram



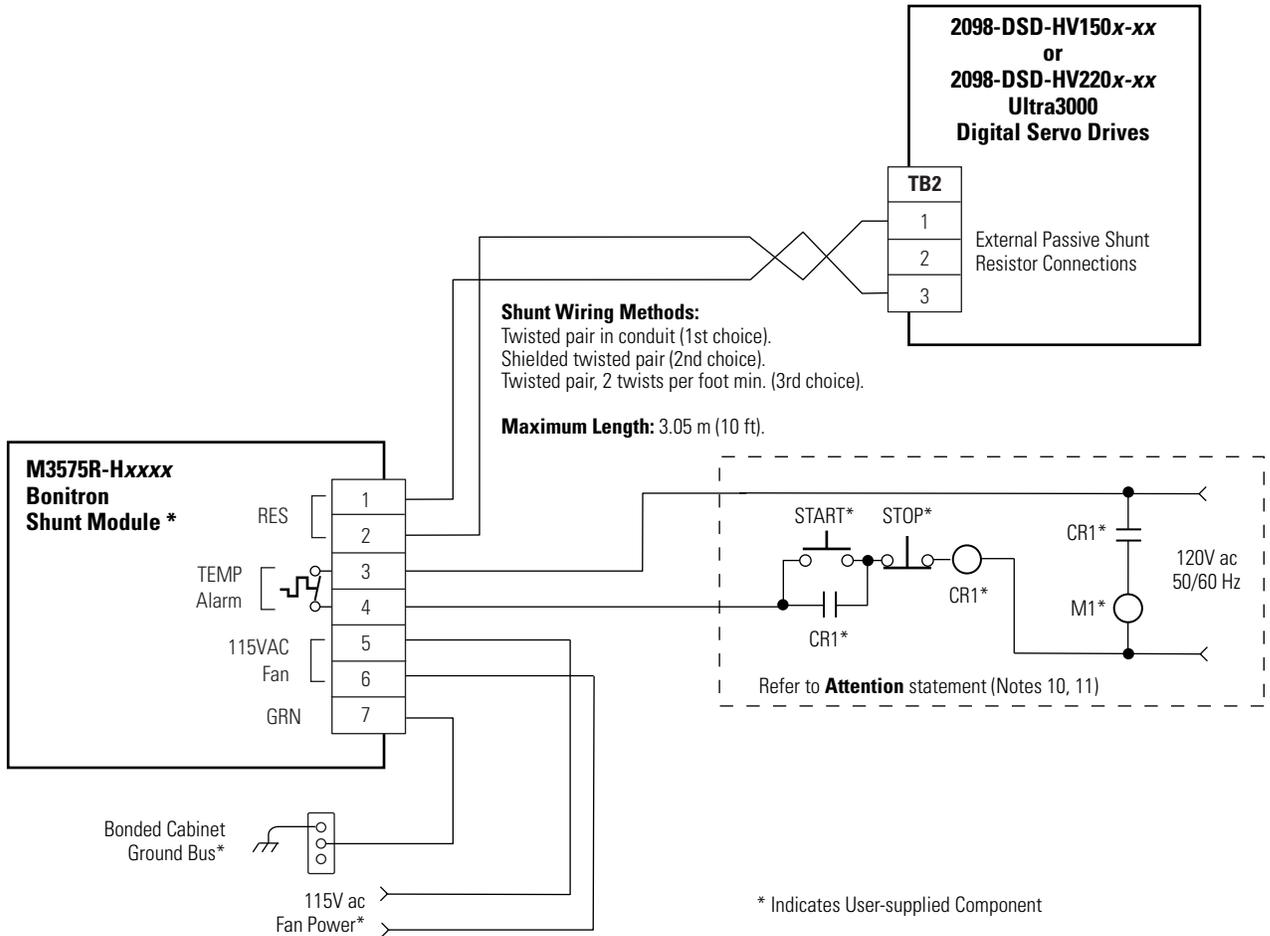
ATTENTION



To avoid damage to your external shunt module, verify that the proper 230V or 460V fuse is installed prior to applying power. Refer to Passive Shunt Modules Installation Instructions, publication [2090-IN004](#), for more information.

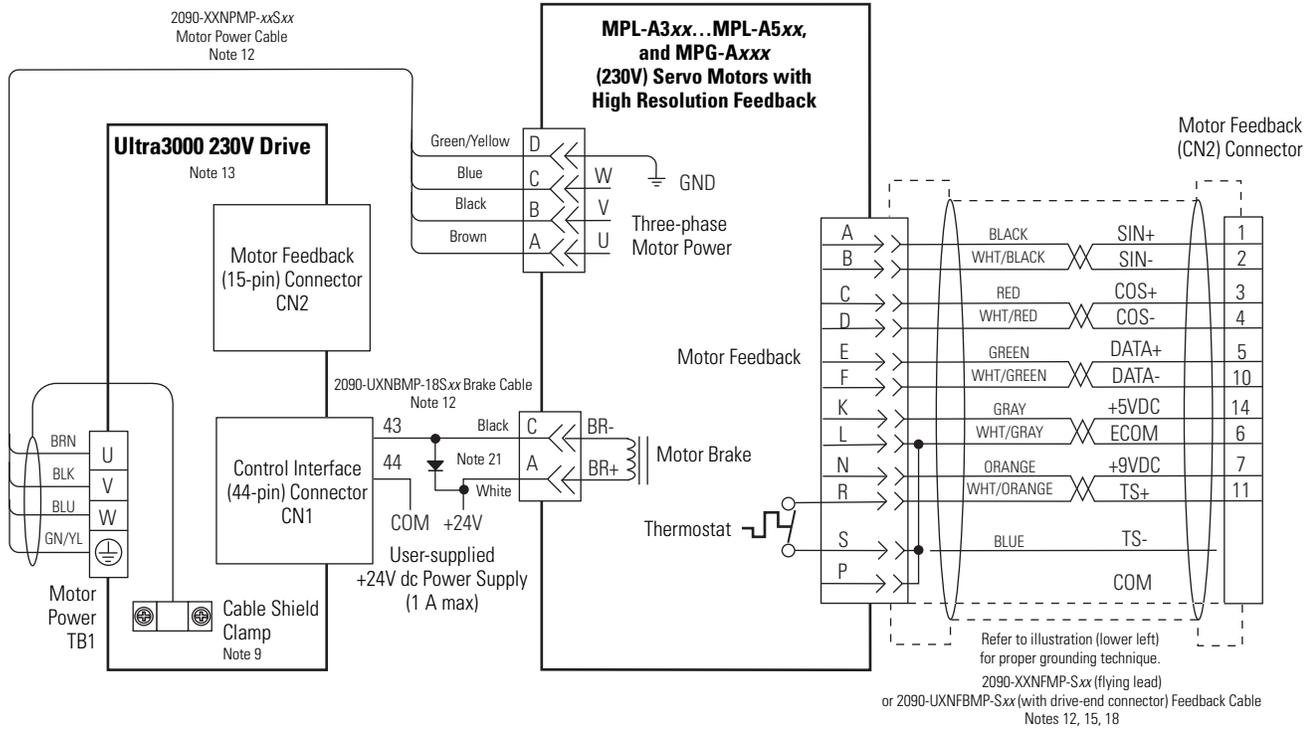
In this figure, the 2098-DSD-HV150x-xx or 2098-DSD-HV220x-xx Ultra3000 drive is wired to a Bonitron shunt module.

External Passive Shunt (Bonitron shunt) Diagram

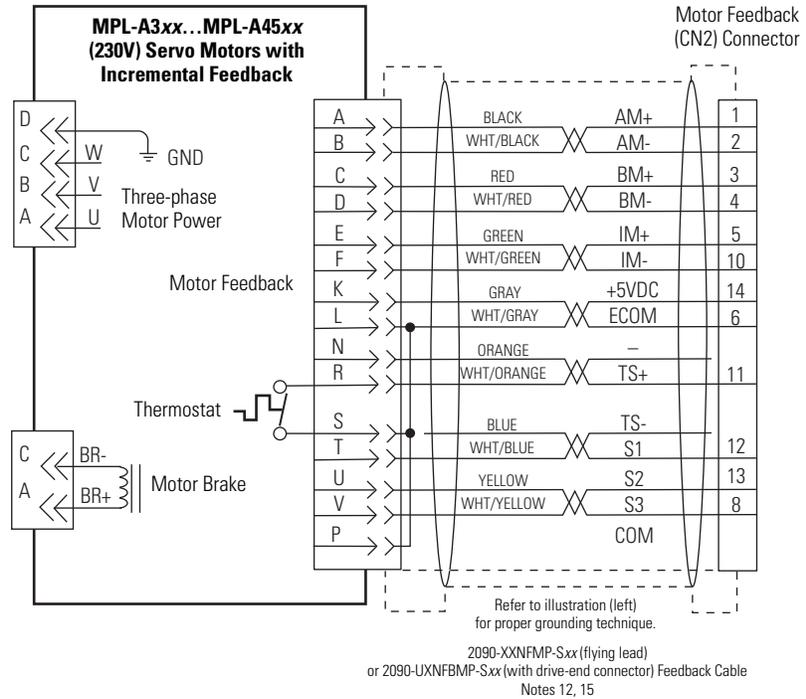
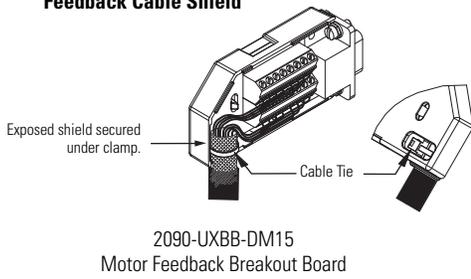


Ultra3000 Drives/Rotary Motors and Actuators Wiring Examples

Wiring Examples with MPL-A and MPG-A (MP-Series) Motors/Actuators



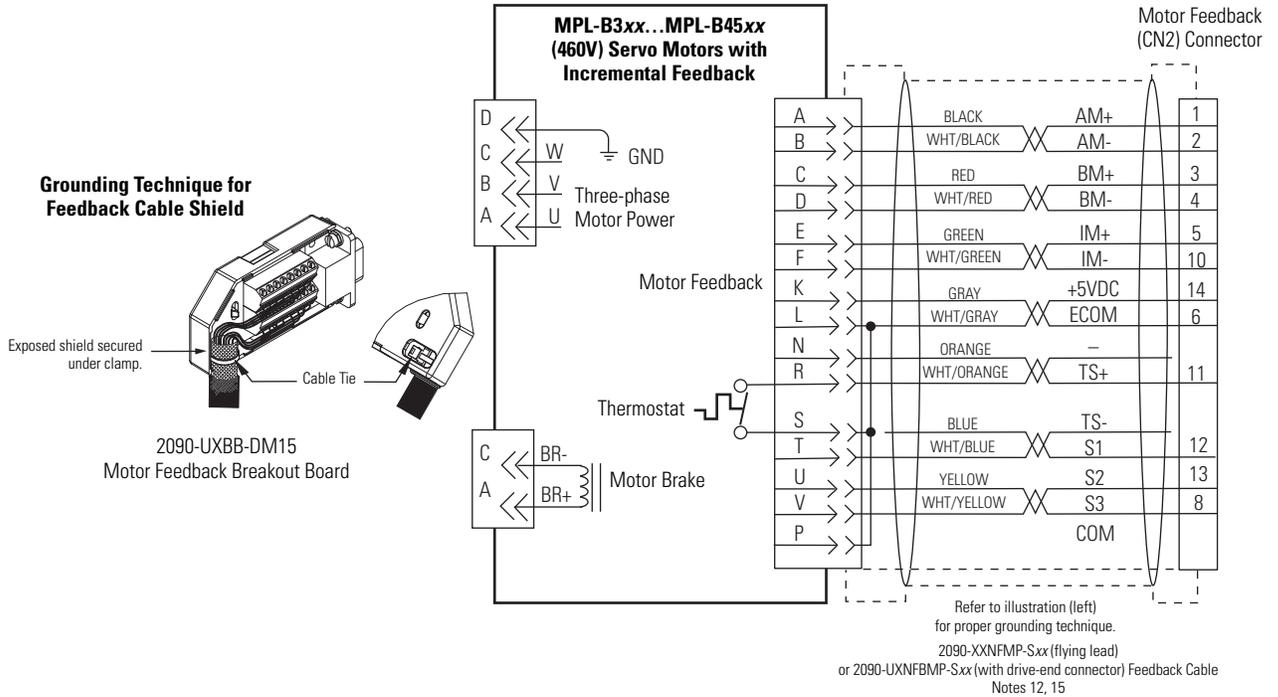
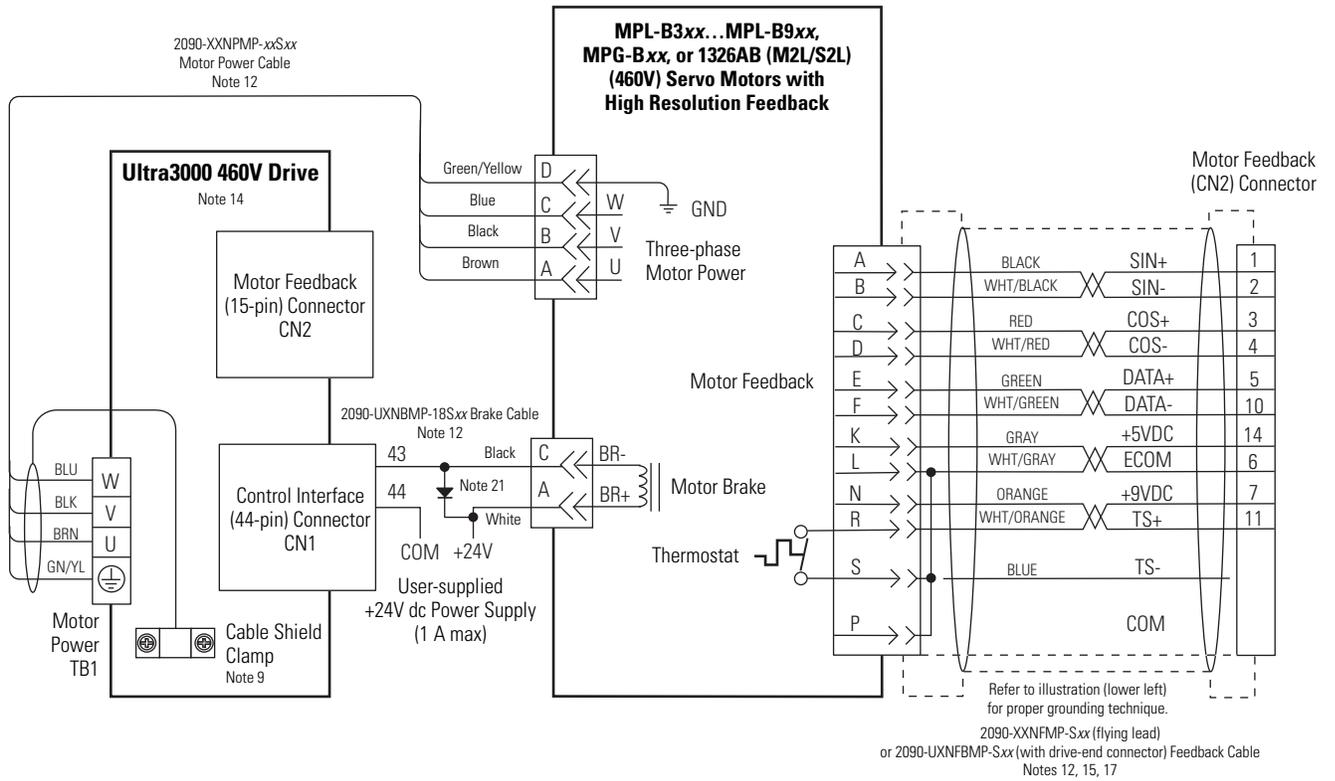
Grounding Technique for Feedback Cable Shield



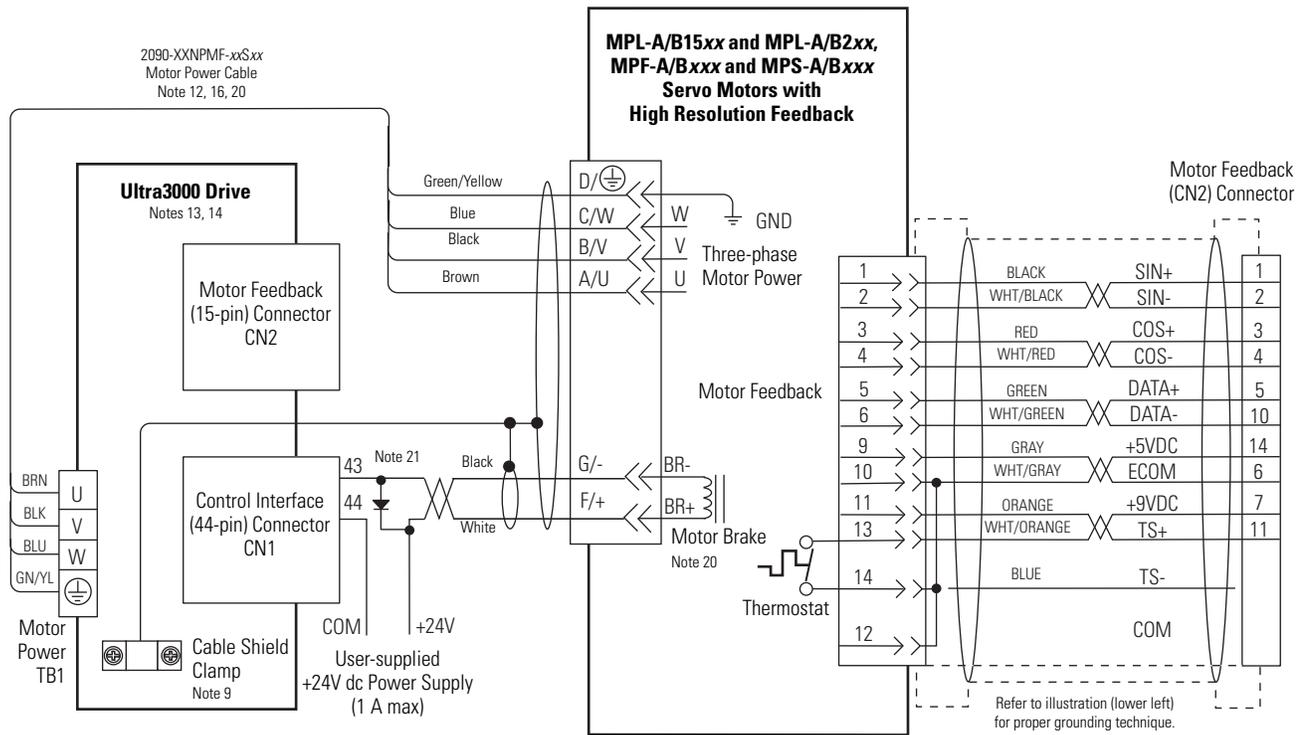
IMPORTANT

MPF-A5xxx motors are not compatible with 2098-DSD-005, 2098-DSD-010, and 2098-DSD-020 Ultra3000 drives.

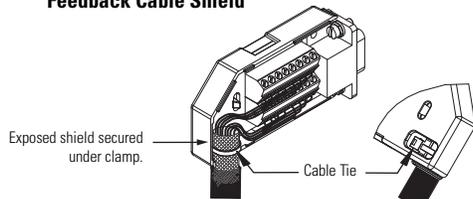
Wiring Examples with MPL-B, MPG-B, and 1326AB Motors/Actuators



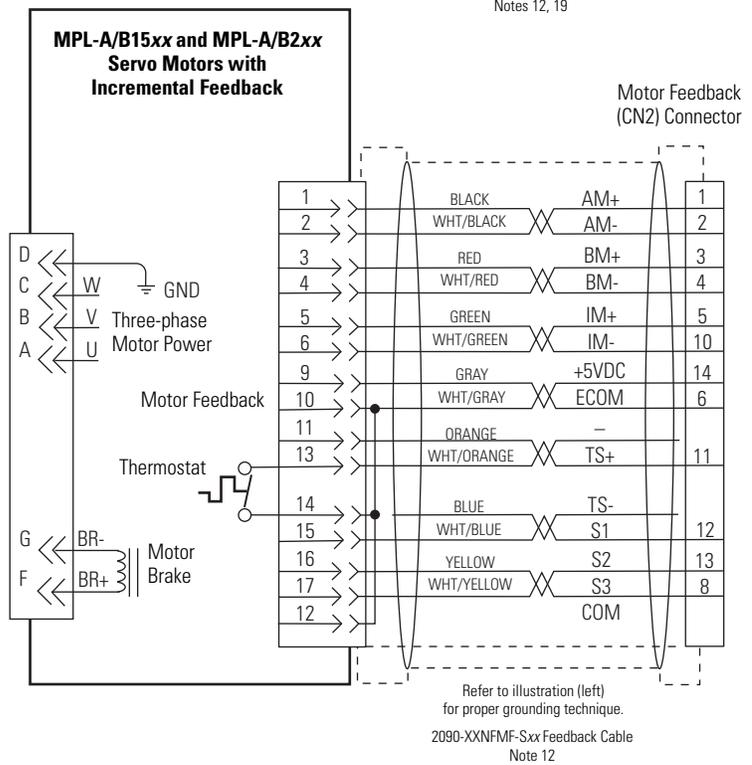
Wiring Examples with MPL-A/B, MPF-A/B, and MPS-A/B (MP-Series) Motors



Grounding Technique for Feedback Cable Shield



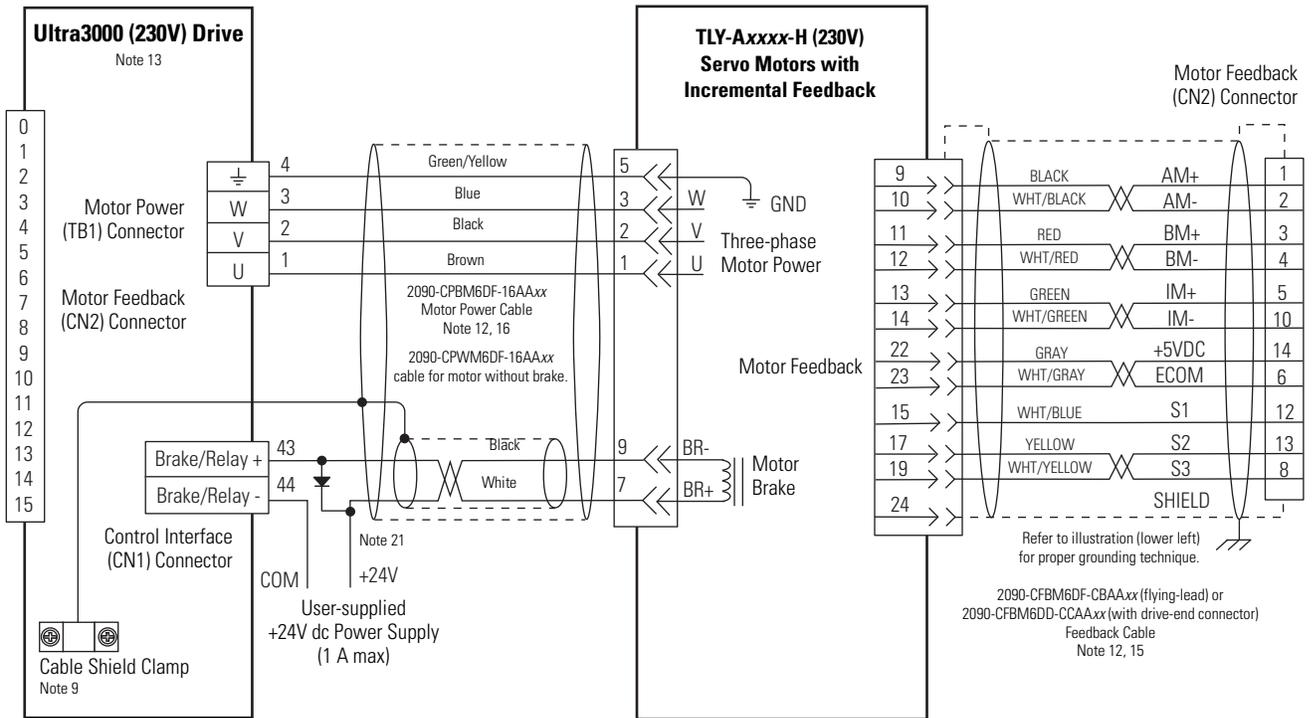
2090-UXBB-DM15 Motor Feedback Breakout Board



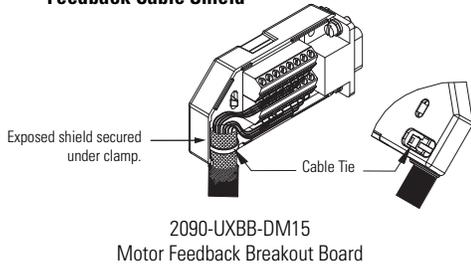
IMPORTANT

MPF-A5xxx motors are not compatible with 2098-DSD-005, 2098-DSD-010, and 2098-DSD-020 Ultra3000 drives.

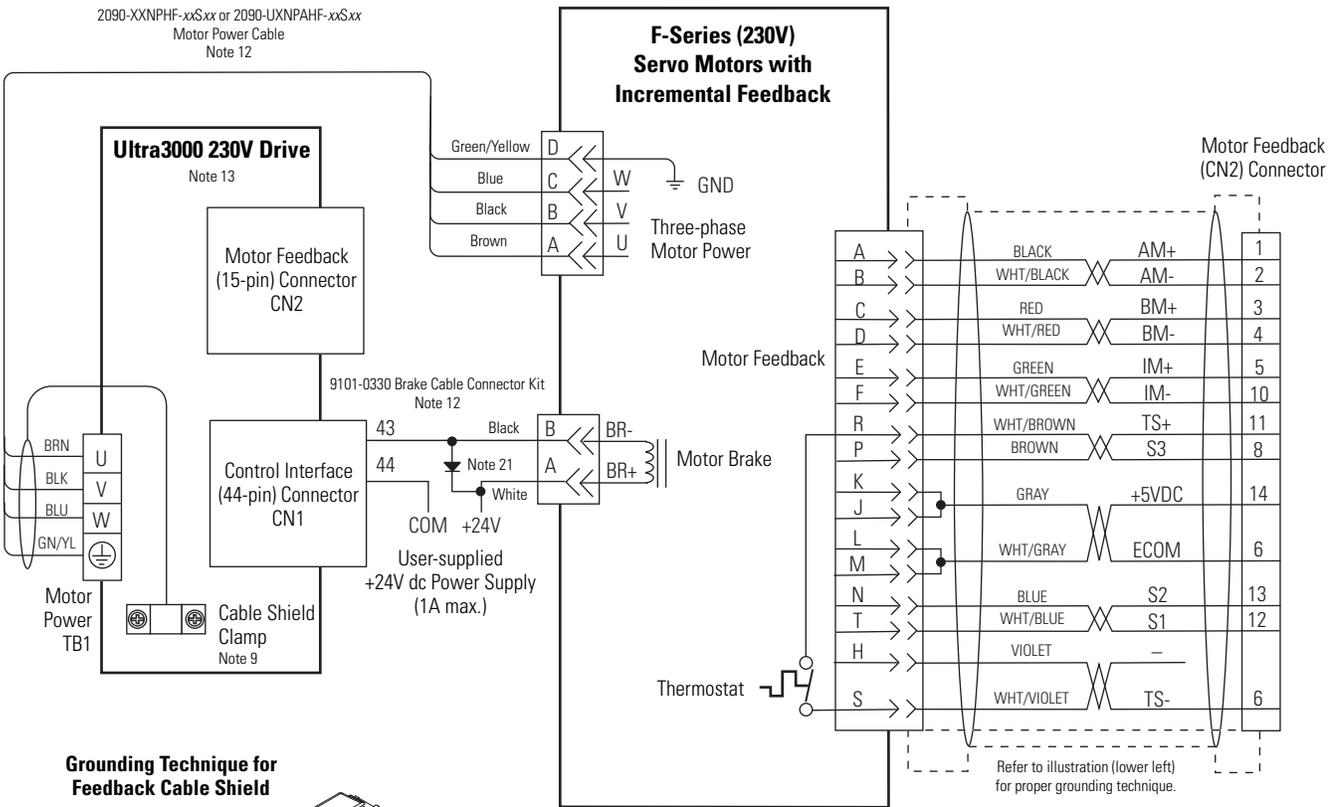
Wiring Example with TLY-A (TL-Series) Motors



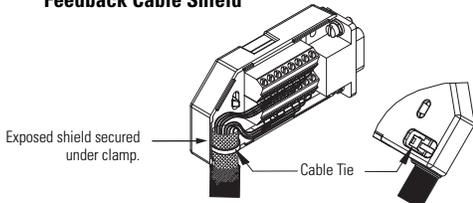
Grounding Technique for Feedback Cable Shield



Wiring Examples with F-Series (230V) Motors



Grounding Technique for Feedback Cable Shield

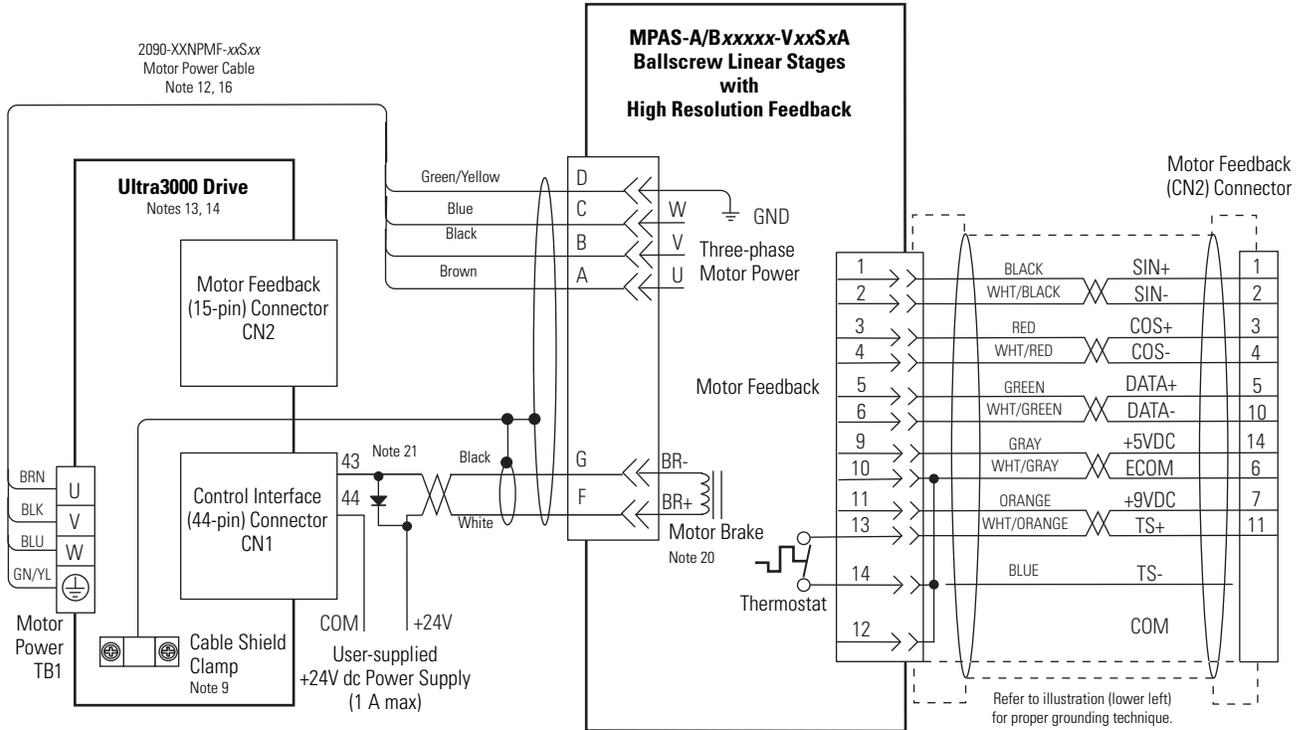


2090-UXBB-DM15
Motor Feedback Breakout Board

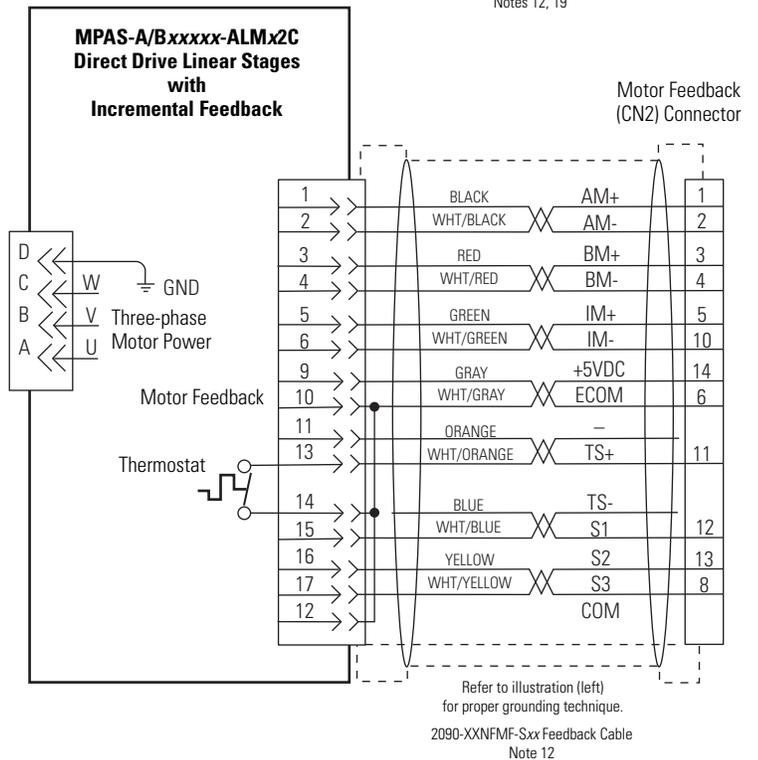
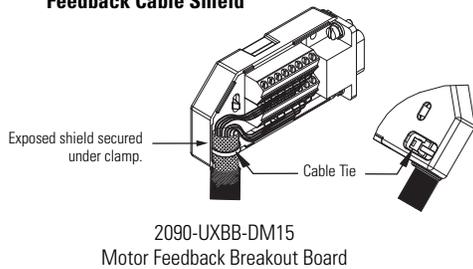
Refer to illustration (lower left) for proper grounding technique.
2090-XXNFHF-Sxx (flying lead)
or 2090-UXNFBHF-Sxx (with drive-end connector)
Feedback Cable
Notes 12, 15

Ultra3000 Drives/Linear Actuators Wiring Examples

Wiring Example with MPAS-A/B (MP-Series) Linear Stages



Grounding Technique for Feedback Cable Shield



Control String Examples (120V ac)

This section provides information to assist you in using the configurable Drive Ready output in a control string with 120V ac input voltage.

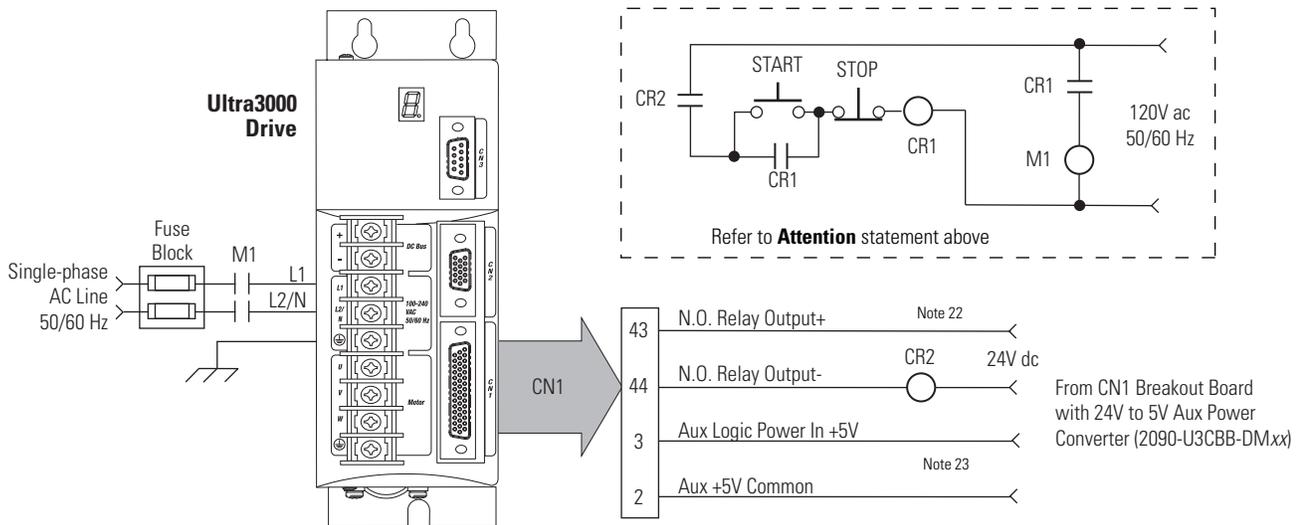
In this example, the 2098-DSD-005x-xx, 2098-DSD-010x-xx, or 2098-DSD-020x-xx Ultra3000 drive is wired to the 120V ac control string.

ATTENTION



Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication [SHB-900](#).

120V ac Single-phase Control String Example



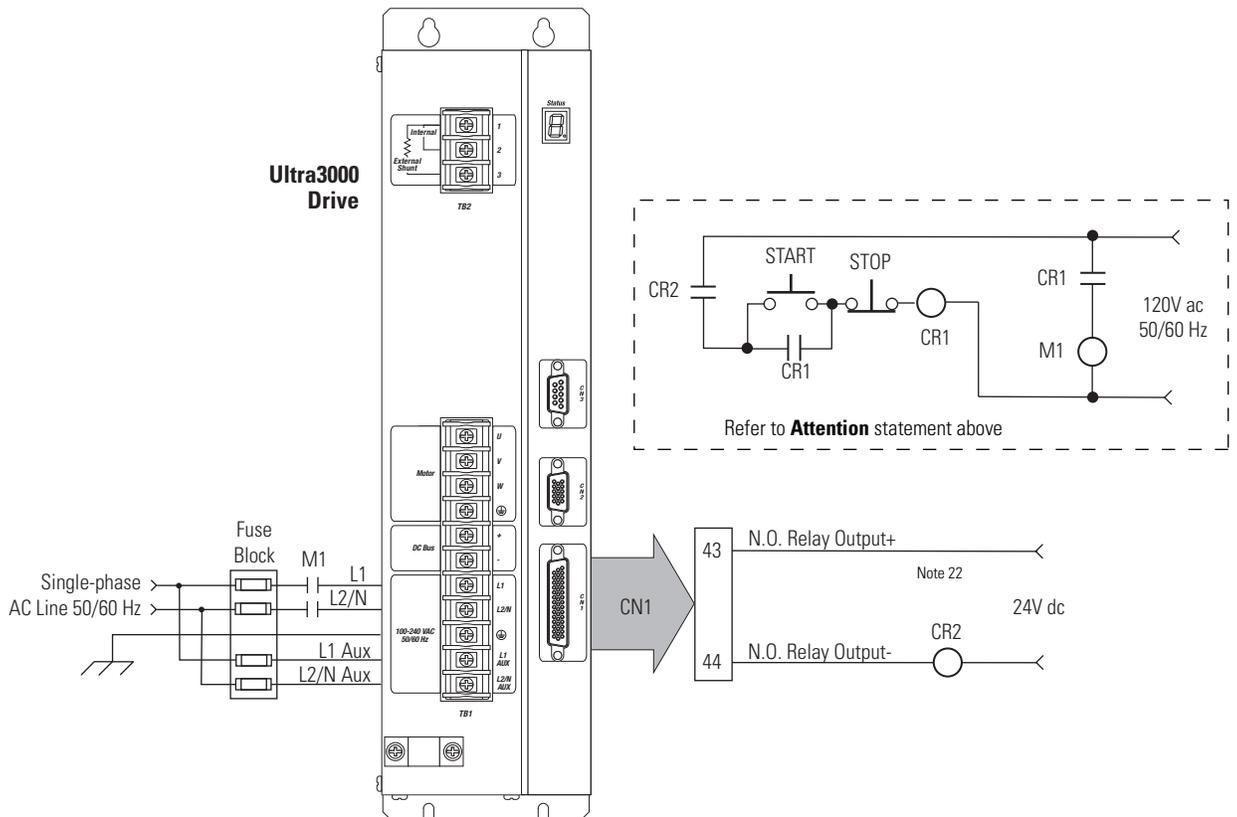
In this example, the 2098-DSD-030x-xx Ultra3000 drive is wired to the 120V ac control string.

ATTENTION



Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication [SHB-900](#).

120V ac Single-phase Control String Example



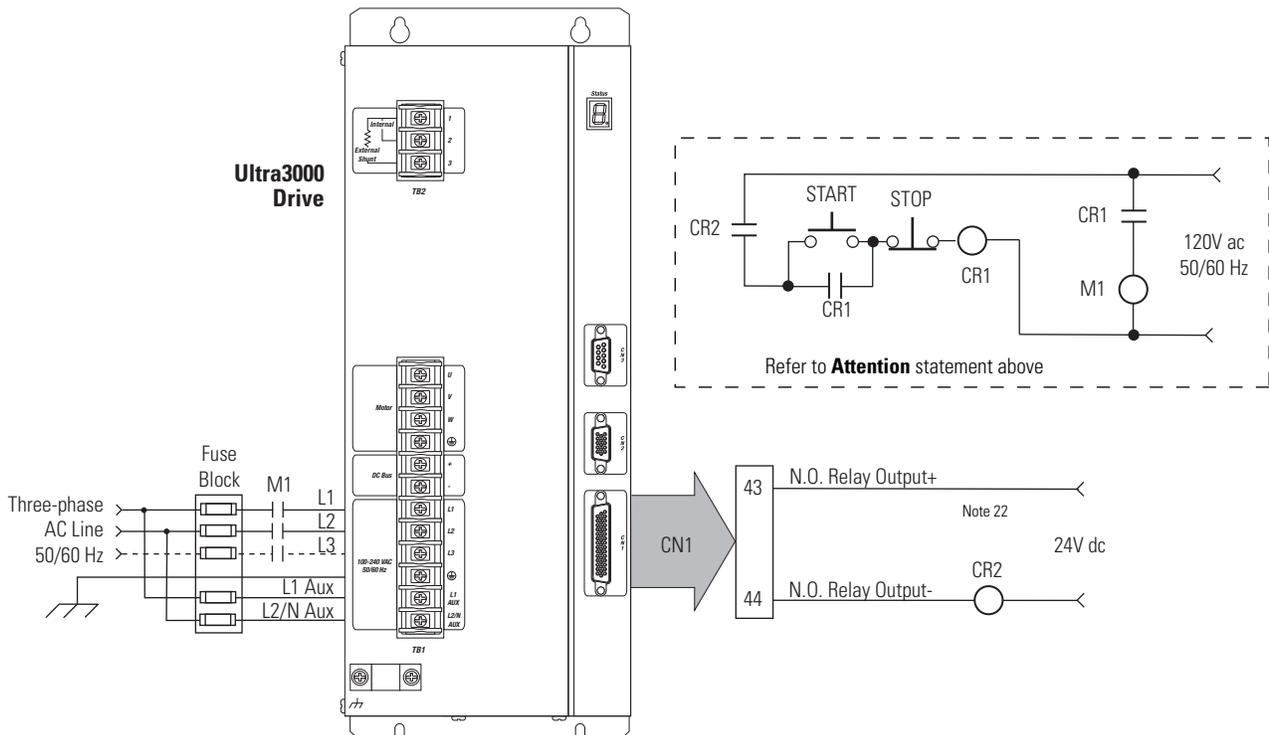
In this example, the 2098-DSD-075x-xx, 2098-DSD-150x-xx, 2098-DSD-HVxxx-xx, and 2098-DSD-HVxxxX-xx Ultra3000 drive is wired to the 120V ac control string.

ATTENTION



Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication [SHB-900](#).

120V ac Three-phase Control String Example



Controlling a Brake Example

The relay output of the Ultra3000 drive (pins CN1-43 and CN1-44) is suitable for directly controlling a motor brake, subject to the relay voltage limit of 30V dc, and the relay current limit of 1 A dc. For brake requirements outside of these limits, an external relay must be used. If a transistor output is used, a control relay is also required.

Coil Currents Rated at < 1.0 A

Compatible Brake Motors ⁽¹⁾	Coil Current
MPL-x1510, MPL-x1520, MPL-x1530	0.43...0.53 A
MPL-x210, MPL-x220, MPL-x230	0.46...0.56 A
MPL/MPF-x310, MPL/MPF-x320, MPL/MPF-x330	0.45...0.55 A
MPS-x330	
MPL-x420, MPL-x430, MPL-x4520, MPL-x4530, MPL-x4540, MPL-B4560	0.576...0.704 A
MPF-x430, MPF-x4530, MPF-x4540	
MPS-x4540	0.88 A
1326AB-B4xxx	
F-4030, F-4050, and F-4075	0.69 A

Compatible Brake Motors/Actuators	Coil Current
MPG-x004	0.30...0.36 A
MPG-x010	0.41...0.49 A
MPG-x025	
MPG-x050	0.45...0.55 A
MPG-x110	0.90...1.10 A
TLY-A110-H, TLY-A120-H, and TLY-A130-H	0.18...0.22 A
TLY-A220-H and TLY-A230-H	0.333...0.407 A
TLY-A2530-H and TLY-A2540-H	0.351...0.429 A
TLY-A410-H	0.648...0.792 A

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

Coil Currents Rated at >1.0 A and ≤1.3 A

Compatible Brake Motors	Coil Current
MPL-x520, MPL-x540, MPL-x560, MPL-x580 ⁽¹⁾	1.05...1.28 A
MPF-x540 ⁽¹⁾	
MPS-B560	

Compatible Brake Motors	Coil Current
F-6100, F-6200, and F-6300	1.30 A
1326AB-B5xxx and 1326AB-B7xxx	1.20 A

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

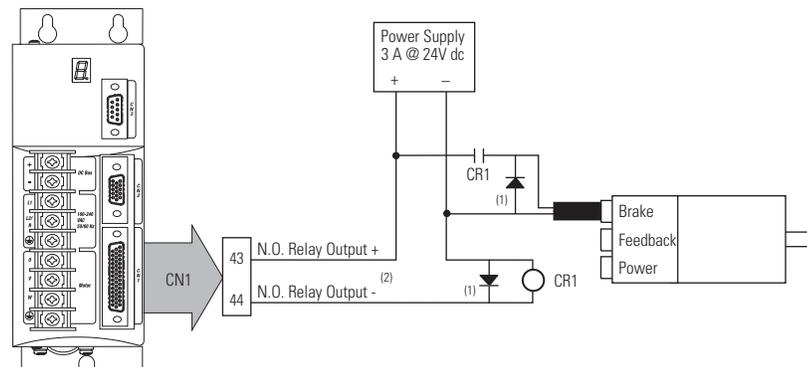
Coil Currents Rated at >1.3 A and ≤3.0 A

Compatible Brake Motors	Coil Current
MPL-B640, MPL-B660, and MPL-B680	1.91...2.19 A
MPL-B860 and MPL-B880	
MPL-B960 and MPL-B980	

A separate power source is required to disengage the brake. Removing power causes the brake to engage, but may also cause electrical arcing to occur at the relay contacts until the brake power dissipates. A customer-supplied diode or metal oxide varistor (MOV) is recommended to prevent arcing. Use of an MOV can also reduce the time to mechanically engage the brake.

IMPORTANT

Electrical arcing may occur at the relay contacts until the brake power dissipates. A customer-supplied diode or metal oxide varistor (MOV) is recommended to prevent arcing.

Example Configuration Controlling a Motor Brake

(1) Flyback diode (1N4004 rated 1.0 A @ 400V dc) suppresses collapsing field of brake coil.

(2) For non-SERCOS drive, the relay output (CN1-43 and CN1-44) must be configured as a brake.

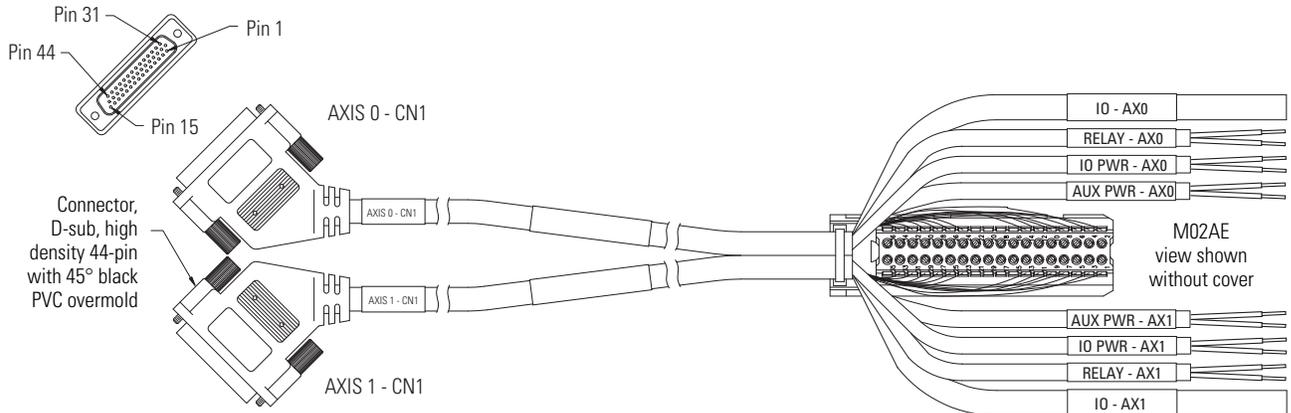
For more information on minimizing electrical noise, refer to the System Design for Control of Electrical Noise Reference Manual, publication [GMC-RM001](#).

Ultra3000 Drive to Logix Analog Module Diagrams

This section provides information to assist you in wiring the Ultra3000 drive CN1 (44-pin) cable connector with either the ControlLogix 1756-M02AE servo module or SoftLogix 1784-PM02AE motion card.

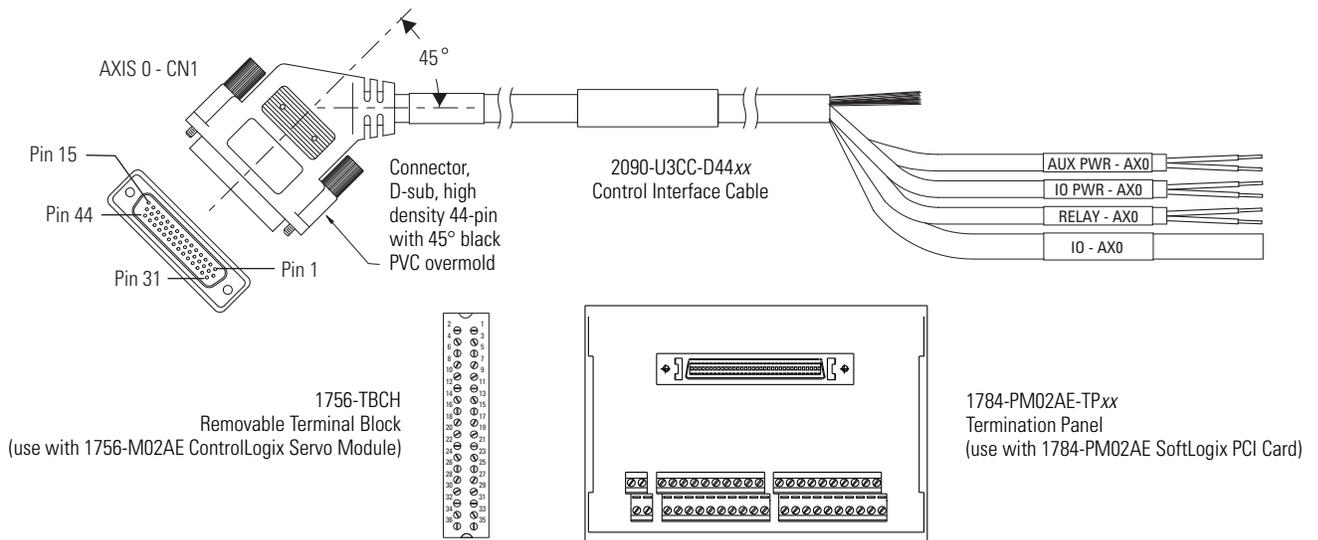
Use the 2090-U3AE-D44xx control interface cable (shown below) when connecting two Ultra3000 drives to the 1756-M02AE servo module. This cable includes the 1756-TBCH pre-wired terminal block. Refer to for the interconnect diagram.

2090-U3AE-D44xx Two Axis Cable

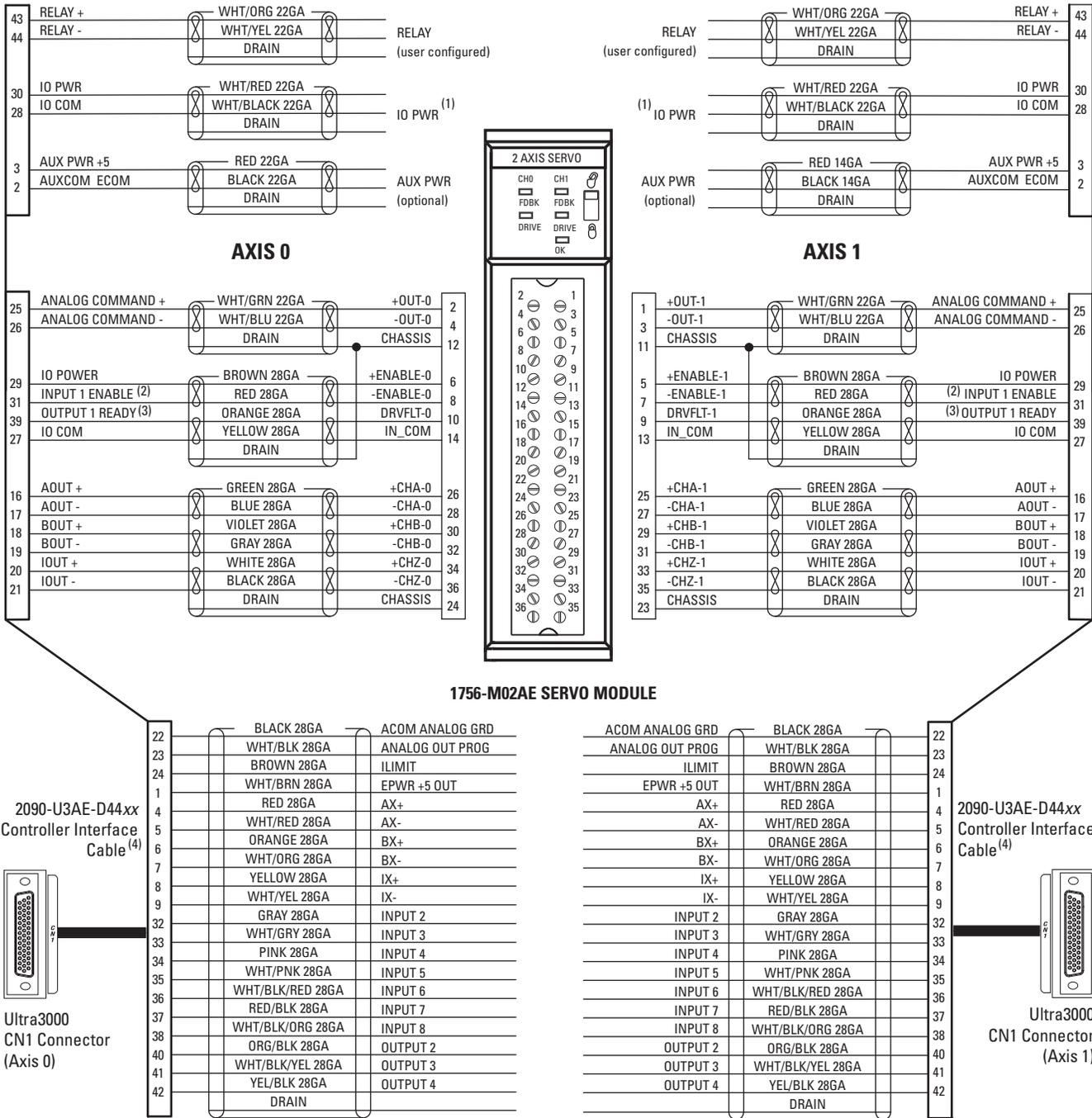


Use the 2090-U3CC-D44xx control interface cable (shown below) when connecting a single Ultra3000 drive to either the 1756-M02AE (ControlLogix) servo module or 1784-PM02AE (SoftLogix) PCI card. The 1756-TBCH removable terminal block is required when wiring to the ControlLogix module. The 1784-PM02AE-TPxx termination panel is required when wiring to the SoftLogix PCI Card. Refer to for the interconnect diagram.

Control Interface Cable and Terminations

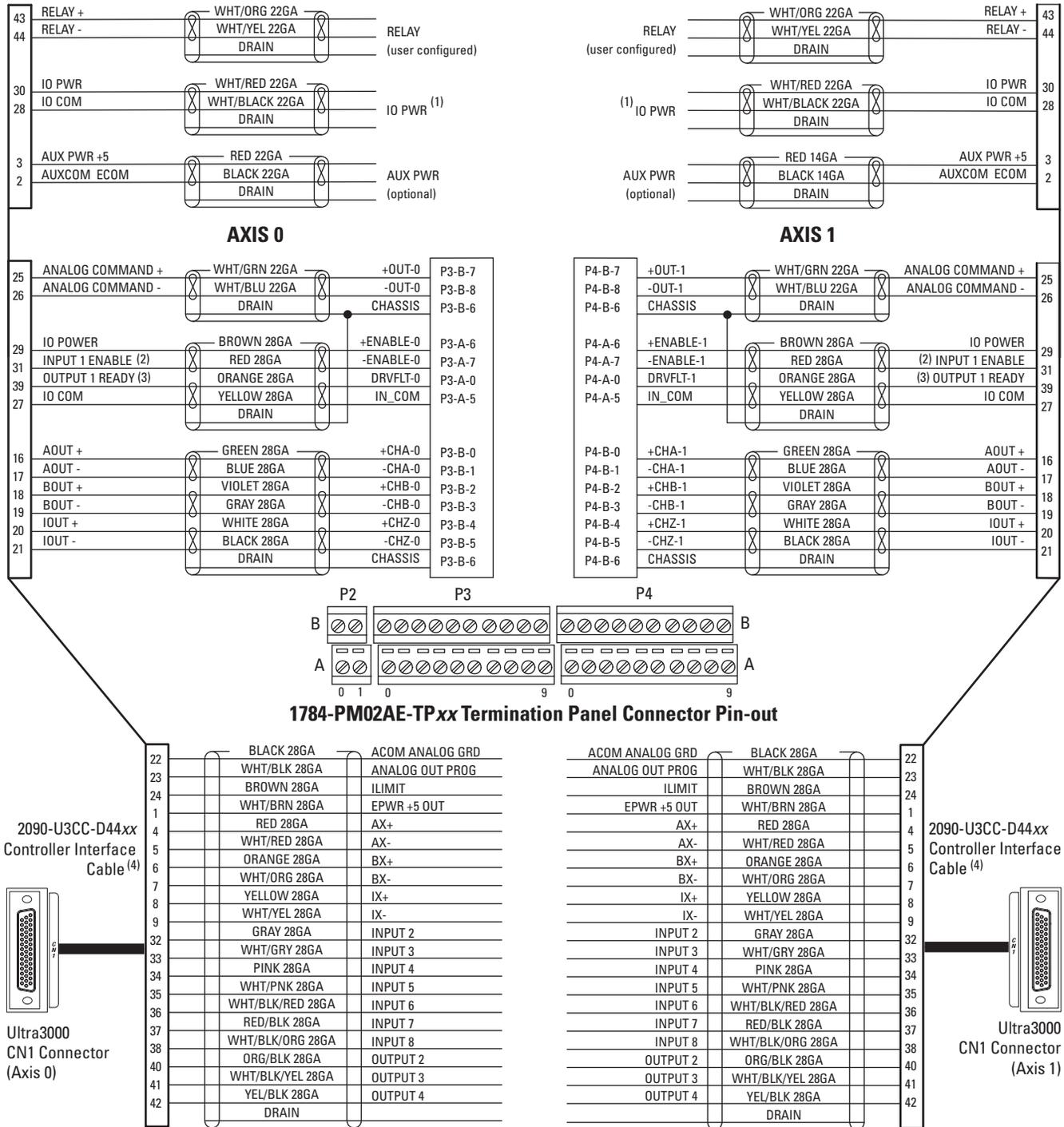


Ultra3000 Drive to ControlLogix Servo Module Interconnect Diagram



- (1) I/O power (pins 28 and 30) must be connected to user-supplied 12...24V dc.
- (2) Input 1 (pin 31) must be configured as Drive Enable using Ultraware software.
- (3) Output 1 (pin 39) must be configured as Ready using Ultraware software.
- (4) This cable does not carry the unbuffered motor encoder signals (CN1 pins 10...15). Contact your Allen-Bradley sales representative if these signals are required for your application.

Ultra3000 Drive to SoftLogix PCI Card Interconnect Diagram

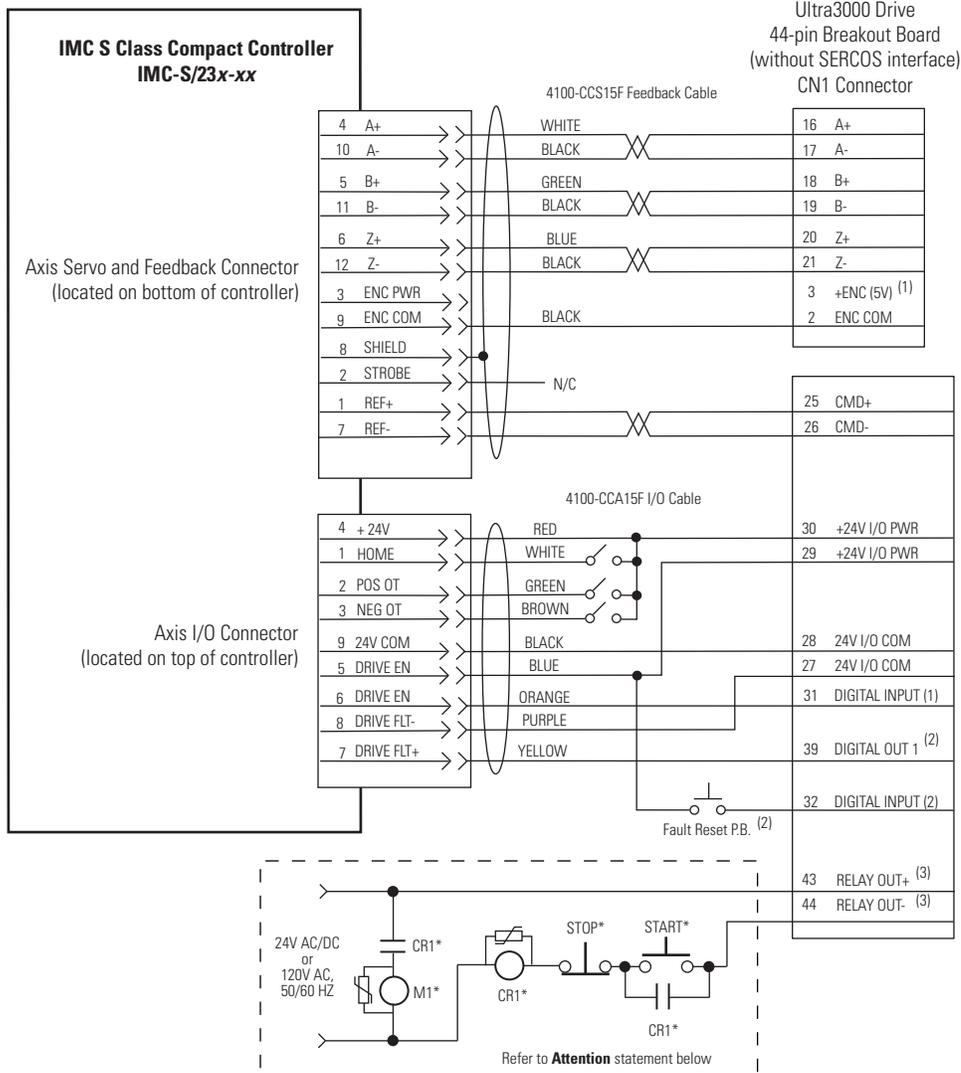


- (1) I/O power (pins 28 and 30) must be connected to user-supplied 12...24V dc.
- (2) Input 1 (pin 31) must be configured as Drive Enable using Ultraware software.
- (3) Output 1 (pin 39) must be configured as Ready using Ultraware software.
- (4) This cable does not carry the unbuffered motor encoder signals (CN1 pins 10...15). Contact your Allen-Bradley sales representative if these signals are required for your application.

Ultra3000 Drive to IMC-S Compact Controller Diagram

This section provides information to assist you in wiring the IMC-S/23x-xx Compact Controller when connecting the 4100-CCS15F feedback cable and 4100-CCA15F I/O cable to your Ultra3000 drive.

Ultra3000 Drive to IMC-S/23x-xx Compact Controller Configuration



(1) The preferred method for supplying the auxiliary +5V is by using the 12- or 44-pin drive mounted breakout board with 24V to 5V auxiliary power converter (catalog number 2090-U3CBB-DM12 or -DM44). Auxiliary +5V power is required to maintain encoder position with an external position controller during a controlled stop condition.

(2) Drive Enable and Fault Reset are configured in Ultraware software.

(3) Relay Output (CN1, pins 43 and 44) must be configured as Ready in Ultraware software.

ATTENTION



Implementation of safety circuits and risk assessment is the responsibility of the machine builder. Please reference international standards EN1050 and EN954 estimation and safety performance categories. For more information refer to Understanding the Machinery Directive, publication SHB-900.

Understanding Motor Feedback Signals and Outputs

Introduction

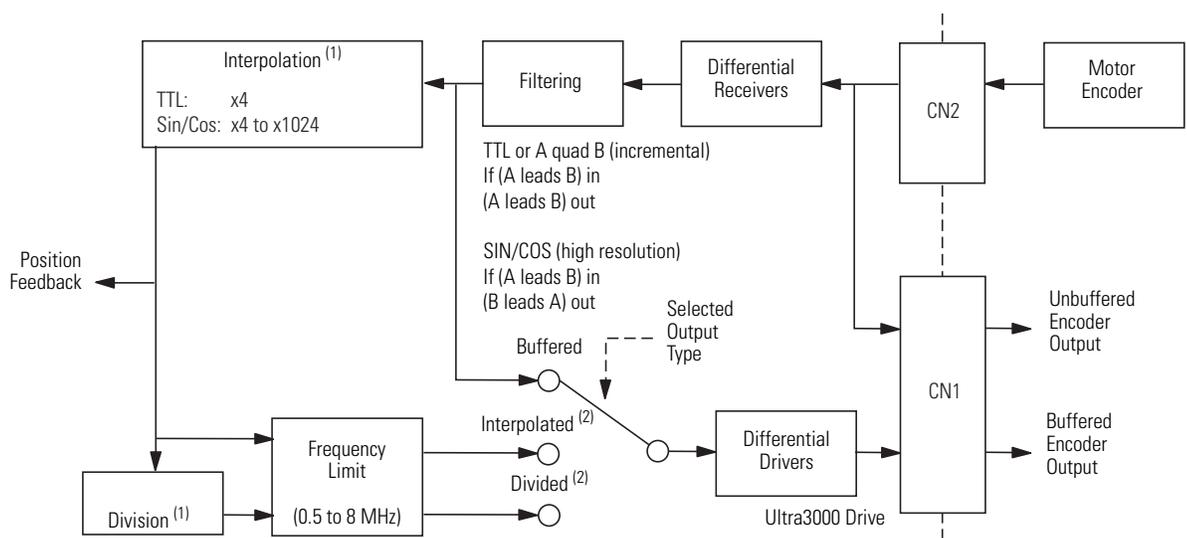
This appendix provides you with motor encoder input signal information and drive encoder output information specific to the Ultra3000 servo drives.

Topic	Page
Introduction	137
Unbuffered Encoder Outputs	138
Incremental Encoder Outputs	138
High Resolution Encoder Outputs	139

The Ultra3000 drive is compatible with motors equipped with both incremental A quad B or high resolution (Stegmann Hiperface) SIN/COS encoders.

The buffered motor encoder outputs use RS-485 differential drivers and have a maximum signal frequency of 2.5 MHz. The drivers can drive a 2V differential voltage into a 100 ohm load. Use the block diagram below to follow the motor encoder input through CN2 to the buffered and unbuffered outputs on CN1.

Motor Encoder Outputs



(1) Interpolation and division operations are performed in firmware and the resulting output frequency is updated at 250 μ s intervals.

(2) Interpolated and divided output not available on Ultra3000 SERCOS drives.

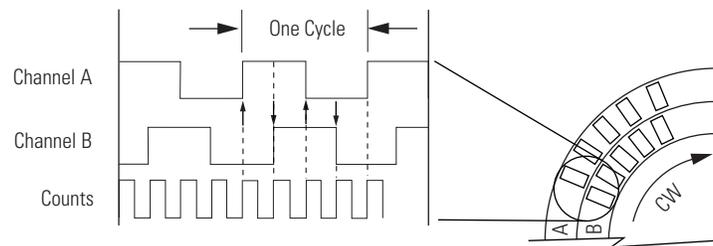
Unbuffered Encoder Outputs

The unbuffered outputs available from the drive (CN1-10 through CN1-15) are tied directly to the incoming (incremental or high resolution) encoder signals (CN2-1 through CN2-6). The unbuffered outputs are not filtered or conditioned.

Incremental Encoder Outputs

Incremental encoder counts are generated in the drive by counting the (high to low and low to high) transitions of the incoming A and B encoder signals. In the channel A signal has two transitions, as does the channel B signal, which results in x4 interpolation (4 transitions/line equals 4 counts/line). For example, typical 2000 line/rev encoder output becomes 8000 counts/rev in the drive. Counts are not directly available at the encoder outputs, only the A quad B representation.

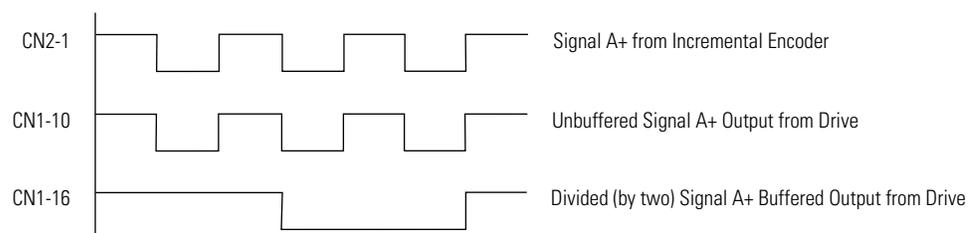
Incremental Encoder Counts



The incremental buffered outputs (listed below) are available from the drive (CN1-16 through CN1-21) and software selectable.

- **Buffered Outputs** are a filtered representation of the original incoming encoder (CN2) signals. Buffered outputs have the same number of cycles/rev as found on CN2.
- **Interpolated Outputs** are the same as buffered outputs when using an incremental encoder. The only interpolation performed on an A quad B signal is the drive's internal counting of transitions (4 counts/line). Because counts are not available outside the drive, selecting this in software is the same as selecting buffered (as described above).
- **Divided Outputs** are the same as buffered outputs, except when divided is selected in the software, the lines/rev are then reduced by the value of the divisor chosen in the software (as shown in the figure below).

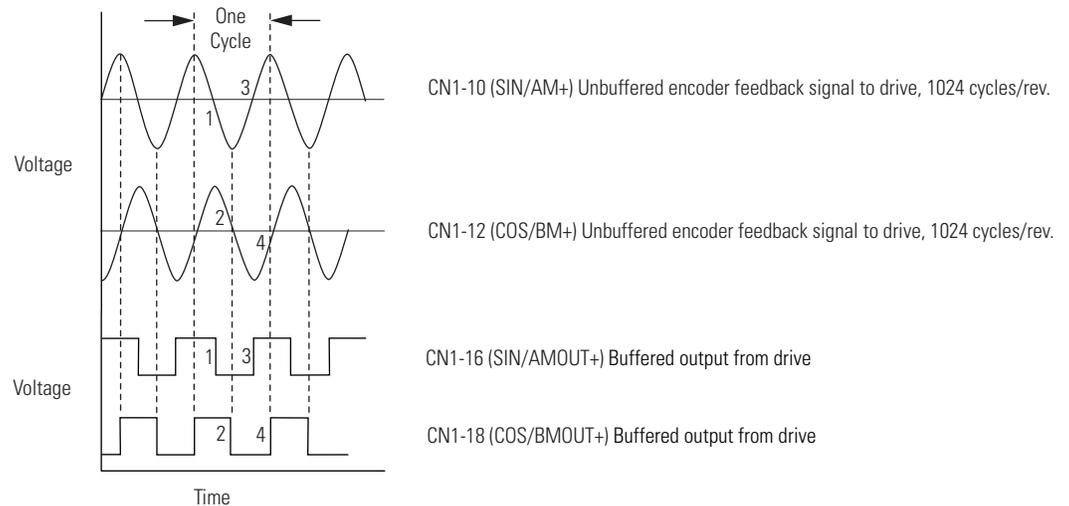
Incremental Encoder Divided



High Resolution Encoder Outputs

When the incoming encoder feedback on CN2 is a high resolution (SIN/COS) signal, the drive is capable of generating more than just 4 counts/cycle (as with incremental encoders). The Ultra3000 drive is capable of breaking the SIN/COS encoder signals into as many as 1024 counts/cycle. For example, a 1024 cycle/rev SIN/COS encoder can result in 1024 x 1024 (high resolution) counts/rev.

Absolute High Resolution Encoder Signals



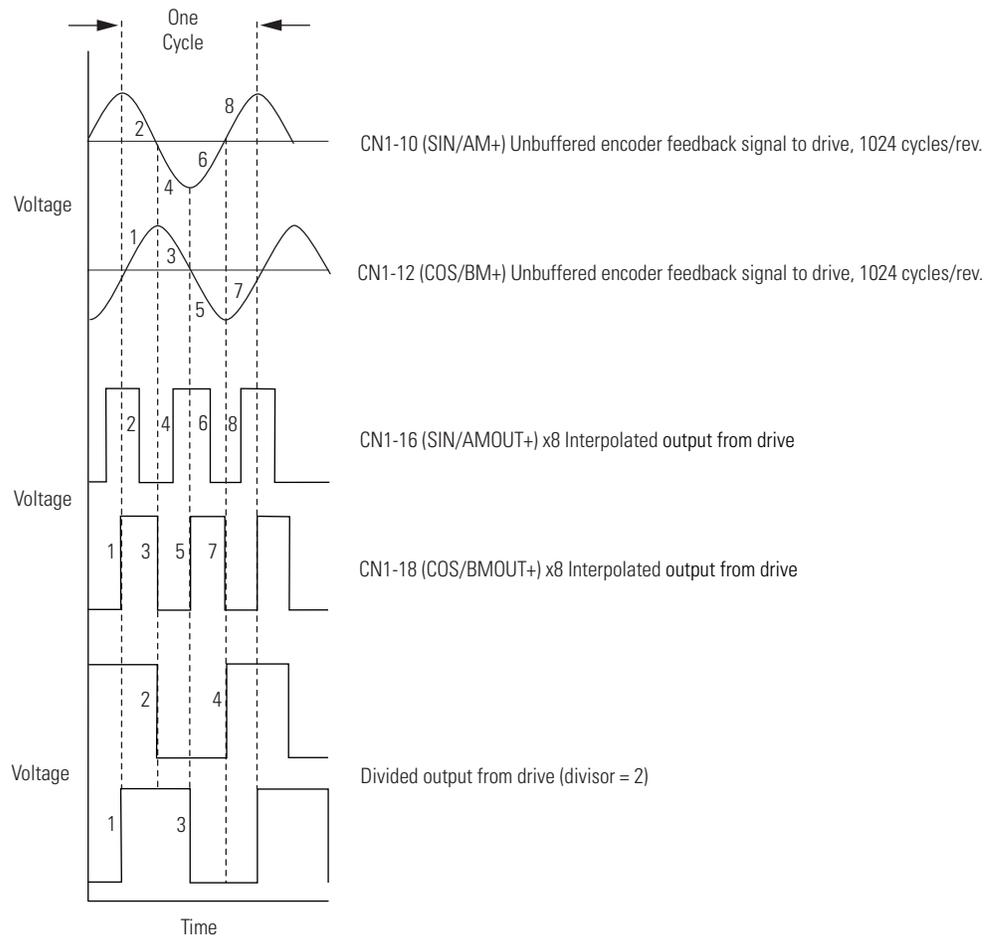
The high resolution buffered outputs (listed below) are available from the drive (CN1-16 through CN1-21) and software selectable.

- **Buffered Outputs** are conditioned SIN/COS signals resulting in a square wave (A quad B) signal (refer to). This signal will have the same number of cycles/rev as the incoming SIN/COS encoder signals found on CN2.
- **Interpolated Outputs** are square wave (A quad B) signals reflecting the interpolation value chosen in software. The minimum interpolation value allowed is x4, which gives the same output as selecting buffered (as described above).
- **Divided Outputs** are the result of a divisor (selected in software) and an interpolation value (also selected in software). For example, with an interpolation value of x8 and a divisor of 2, the CN1 buffered output will be the (x4) square wave representation of the original incoming SIN/COS signal from CN2.

IMPORTANT

The interpolation value selected in software is what the drive uses internally to close the feedback loops regardless of any divisor value chosen to condition the signals present on CN1.

Interpolated and Divided Absolute High Resolution Encoder Counts



Minimizing the Effects of Feedback Signal Loss

Introduction

This appendix contains information on how to reduce unexpected motion as a result of feedback signal loss.

Topic	Page
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Setting Position Error Limits in Ultraware and RSLogix 5000 Software	142
Setting Velocity Error Limits in Ultraware Software	144
Configuring Fault Actions in RSLogix 5000 Software	145
Position and Velocity Error Limit Adjustment Example with Ultraware Software	147
Position Error Limit Adjustment Example with RSLogix 5000 Software	154
Additional Methods	166

ATTENTION

To avoid personal injury or damage to equipment due to unexpected motion, you must configure the associated motion system parameters and attributes to minimize the effects of feedback signal loss on the system.

In the event of feedback signal loss, unexpected motion may occur. When the feedback signal is lost, the position feedback remains stationary, regardless of the actual axis position and the drive command position. In an effort to compensate for the discrepancy between the position feedback and the drive command position, the drive attempts to maintain axis motion, which quickly results in an increase of position and velocity error. Once the position error reaches or exceeds your specified limit, the drive indicates an Excess Position Error (E19) to alert you of the fault condition. Similarly, an Excess Velocity Error (E24) is indicated once your specified velocity error limit is reached or exceeded.

These system fault indications are intended to alert you of the fault conditions and to aid you in safely bringing the system to a stop. By optimizing the sensitivity threshold and the response time of the drive to position and velocity error fault conditions, you can quickly and safely disable the drive and be alerted by a fault indication to proceed with other safety measures when the feedback signal is lost.

Setting Position Error Limits in Ultraware and RSLogix 5000 Software

Parameters for setting the position and velocity error limits according to the specific needs of the user application exist in both the Ultraware and the RSLogix 5000 software. Adjust these limit settings to be as close to the maximum position and velocity error excursion limit values of the application as possible, but wide enough to avoid nuisance fault tripping. This lets the drive detect abnormal operating conditions and proceed to proper fault handling as quickly as possible. The method and the degree of adjustment will vary depending on the application and on whether Ultraware or RSLogix 5000 software is used.

Minimizing the Position Error Limit Setting

By minimizing the position error limit setting, the amount of motion that can take place before the condition of Excess Position Error (E19) is met can be restricted to a safe value. This safe value is dictated by the application and is defined by you. Adjustment of the position error limit setting is performed by using RSLogix 5000 or Ultraware software, depending on the application.

Setting Position Error Limit Parameters

Software	Application	Parameter
RSLogix 5000	SERCOS	Position Error Tolerance, Axis Properties, Limits tab
	Non-SERCOS	
Ultraware	Non-SERCOS	Following Error Limit, Faults branch

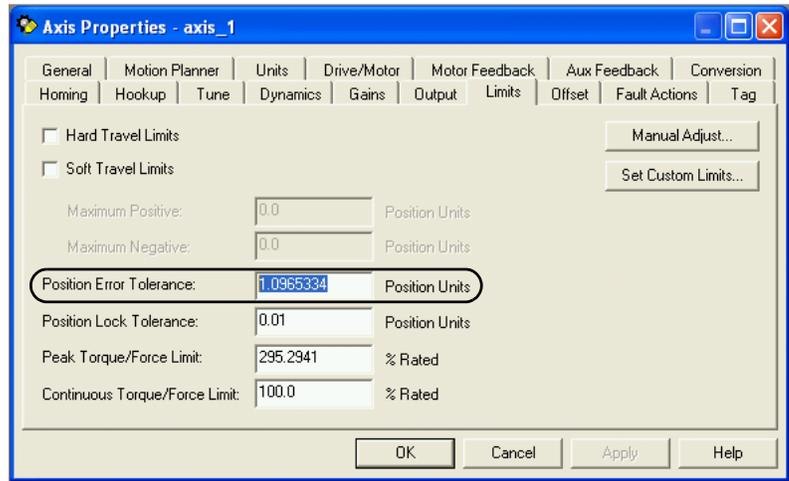
Adjust the Position Error Tolerance parameter if using RSLogix 5000 software. This parameter is found in the Limits tab of the Axis Properties dialog. The range for this parameter is 0...2147483647 position units, with a default value determined by the motor or encoder device selected.

You can convert a value, expressed in position units, to a number of axis revolutions by using the raw feedback count, interpolation factor, drive count, and conversion properties of the motor or encoder device and of RSLogix 5000 software Axis Properties settings. In the RSLogix 5000 software, the TTL encoder device interpolation factor is fixed at 4, so 2000 raw feedback counts per revolution results in 8000 interpolated feedback counts per revolution. For sin/cos encoder devices, the interpolation factor is fixed at 2048. The SR encoder devices produce 1024 raw feedback counts per revolution, while the SK encoder devices produce 128 raw feedback counts per revolution. The resulting range of interpolated feedback counts per revolution is 262144...2097152, depending on which sin/cos encoder device is used. Interpolated feedback counts are converted to drive counts by using the Drive Resolution ratio constant found in the Drive/Motor tab of the Axis Properties dialog. Drive counts are converted to position

units by using the Conversion ratio constant found in the Conversion tab of the Axis Properties dialog.

The Position Error Tolerance parameter ride-through time setting is fixed at 10 ms and is not adjustable through RSLogix 5000 software. This setting defines the duration of time for which the position error limit setting must be reached or exceeded before an Excess Position Error (E19) is asserted.

RSLogix 5000 Position Error Tolerance Parameter



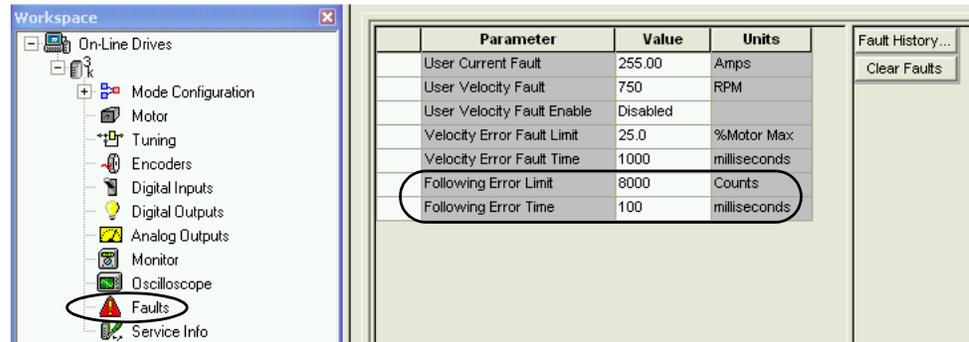
Adjust the Following Error Limit parameter if using Ultraware software. This parameter is found in the Faults branch of the main menu. The range for this parameter is 0...2147483647 interpolated feedback counts, with a default value of 8000 interpolated feedback counts.

You can convert a value expressed in interpolated feedback counts to a number of axis revolutions by using the raw feedback count and interpolation factor (if any) properties of the motor or encoder device and of the Ultraware software Encoder branch. In Ultraware software, the TTL encoder device interpolation factor is fixed at 1, so 2000 raw feedback counts per revolution will result in 2000 interpolated feedback counts per revolution. For the sin/cos encoder devices, the interpolation factor is variable from 4 to 1024. The SR encoder devices produce 1024 raw feedback counts per revolution, while the SK encoder devices produce 128 raw feedback counts per revolution. The resulting range of interpolated feedback counts per revolution is 512...1048576, depending on which sin/cos encoder device is used. Interpolated feedback counts are the units used for the position and velocity error limit parameters in the Ultraware software.

Adjust the Following Error Time parameter to specify a ride-through time for the position error parameter. This setting defines the duration of time for which the position error limit setting must be reached or exceeded before an Excess Position Error (E19) is asserted. The range

for the Following Error Time parameter is 0...65,535 ms, with a default value of 100 ms.

Ultraware Following Error Parameters



Parameter	Value	Units
User Current Fault	255.00	Amps
User Velocity Fault	750	RPM
User Velocity Fault Enable	Disabled	
Velocity Error Fault Limit	25.0	%Motor Max
Velocity Error Fault Time	1000	milliseconds
Following Error Limit	8000	Counts
Following Error Time	100	milliseconds

Setting Velocity Error Limits in Ultraware Software

The position error limit and time parameters let you define a tight window of error tolerance for the system. In some instances, however, the nature of the application requires a large tolerance value, and your specified window of error tolerance becomes too wide to be effective in quickly stopping unexpected motion. When this happens, you can implement additional protection in the Ultra3000 drive safety strategy by adjusting the velocity error limit setting.

Minimizing the Velocity Error Limit Setting

By minimizing the velocity error limit setting, you can restrict the amount of velocity error to a safe value before a condition of Excess Velocity Error (E24) is reached. This means that if an unexpected motion event related to feedback loss occurs and is not quickly terminated by the Excess Position Error (E19) response, an Excess Velocity Error (E24) condition will occur and be used to achieve the same rapid termination of the unexpected motion. Adjustment of the velocity error limit setting is readily available in the Ultraware software only. The RSLogix 5000 software velocity error limit setting is fixed at 25% of the maximum motor speed, with a fixed ride-through time setting of 1000 ms.

For Ultra3000 drives used with RSLogix 5000 software, the VelocityError attribute is available to you as a tag in the Controller Tags branch of the main workspace window, but the VelocityErrorTime attribute is not. You can incorporate the VelocityError attribute into your RSLogix 5000 application and manually configure fault-handling routines that monitor this attribute. You can also simulate the VelocityErrorTime attribute with an additional code fragment and incorporate it into your fault-handling

routines. This technique lets you specify velocity error limit settings in cases where the default settings do not suit the application.

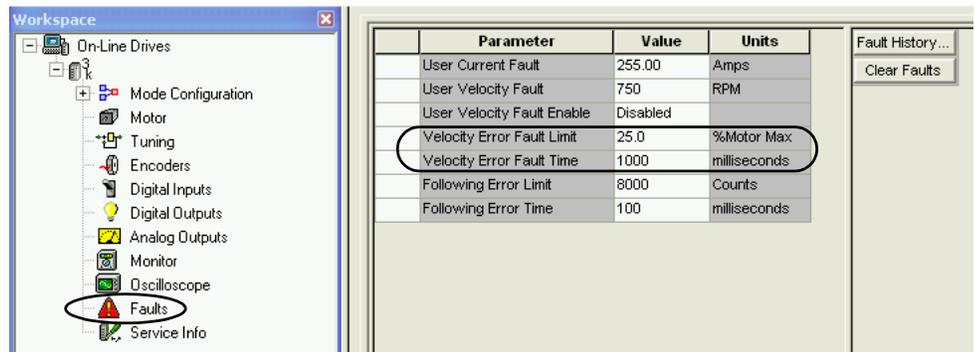
IMPORTANT

To make use of the VelocityError attribute, you must select it as one of the two RealTimeAxis Information attributes under the Drive/ Motor tab in the Axis Properties dialog.

For Ultra3000 drives used with Ultraware software, you can configure the Velocity Error Fault Limit parameter found in the Faults branch of the main menu. The range for this parameter is 1...100% of maximum motor speed, with a default value of 25%. Adjust the Velocity Error Fault Time parameter to specify a ride-through time for the Velocity Error Fault Limit parameter. The range for this parameter is 0...65,535 ms, with a default value of 1000 ms.

The Velocity Error Fault Limit parameter is being monitored even when the drive is used in position mode. In this case, the velocity command is the output of the position loop, not the rate of change of the position command. If the position error is large, the output of the position loop, which is also the velocity command, is large. This results in a large velocity error.

Ultraware Velocity Error Fault Parameters



Parameter	Value	Units
User Current Fault	255.00	Amps
User Velocity Fault	750	RPM
User Velocity Fault Enable	Disabled	
Velocity Error Fault Limit	25.0	%Motor Max
Velocity Error Fault Time	1000	milliseconds
Following Error Limit	8000	Counts
Following Error Time	100	milliseconds

Configuring Fault Actions in RSLogix 5000 Software

The sole purpose of adjusting the position and velocity error limit settings to within a tighter range is to detect a position or velocity error fault condition early. This lets you proceed with an appropriate fault action and reduce the distance and duration of unexpected motion. When the position error limit setting is met or exceeded, an Excess Position error (E19) is indicated by the drive. When using Ultraware software, this results in the drive disabling and the axis coasting to a stop. However, when using RSLogix 5000 software, this results in a corresponding fault action that you configure. The response to an Excess Velocity error (E24) in Ultraware software, is the same as that of E19, but is not readily programmable in RSLogix 5000 software. When necessary, you can program fault actions resulting from excess velocity error with additional code.

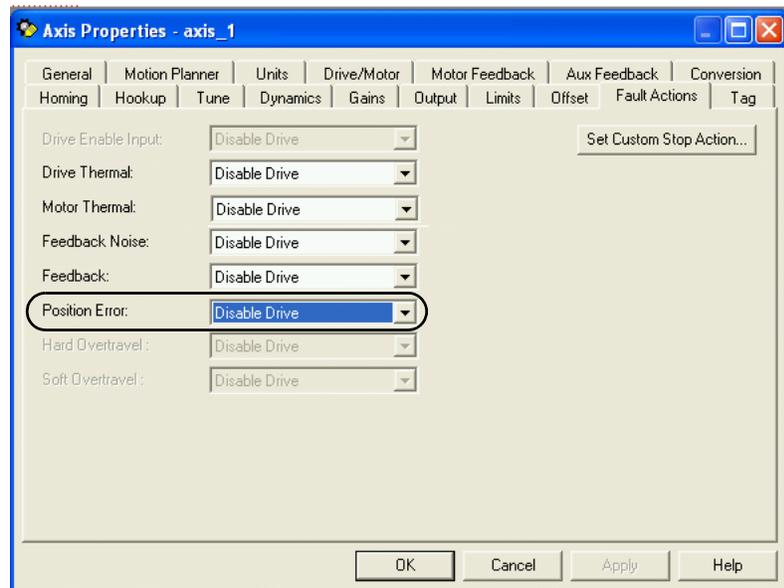
When configuring the fault actions to minimize unexpected motion, you can select Shutdown or Disable Drive for the Position Error attribute found in the Fault Actions tab of the Axis Properties dialog. In the event of feedback signal loss, either of these settings will result in the drive disabling and the axis coasting to a stop. Selecting the Status Only or Stop Motion fault action causes the drive to simply assert a fault indication, but motion continues when the feedback signal is lost. Axis motion continues until the velocity error fault condition is met, which may take some time. Therefore, selecting the Status Only or Stop Motion fault actions is not recommended as an effective Ultra3000 unexpected motion drive safety strategy.

TIP

The Feedback attribute found in the Fault Actions tab of the Axis Properties dialog does not result in any action for the Ultra3000 drive, regardless of the setting. The Feedback Noise attribute does not result in any action due to a position or velocity error fault and should be configured independently, based on the application need.

ATTENTION

To avoid personal injury or damage to equipment due to unexpected motion, the Position Error attribute found in the Fault Actions tab of the Axis Properties dialog must be set to Shutdown or Disable Drive. This results in the drive disabling and the axis coasting to a stop. Further safety measures must also be taken to make sure that, under worst-case conditions, the coasting motion is brought to a safe stop by hardware over-travel limits or other methods.

RSLogix 5000 Axis Properties - Fault Actions Tab

Position and Velocity Error Limit Adjustment Example with Ultraware Software

This example uses Ultraware software and an Ultra3000 indexing drive (catalog number 2098-DSD-030X) with an MP-Series (230V) motor (catalog number MPL-A330P-S) and appropriate power and feedback cables to illustrate position and velocity error limit setting optimization.

A simple motion application is used in this example to perform a repeating clockwise-counterclockwise incremental axis move and observe the default Ultraware position and velocity error limit settings. Then, with the motion application running, you can observe the actual application position and velocity error excursion limit values using the oscilloscope feature of Ultraware software. Based on these excursion limit values, you can adjust the default position and velocity error limit settings to closely match the needs of the application under normal operating conditions. Finally, with the new position and velocity error limit settings in place, you test the system to make sure that it is still functional and that no nuisance faults occur.

Create and Run a Sample Application in Ultraware Software

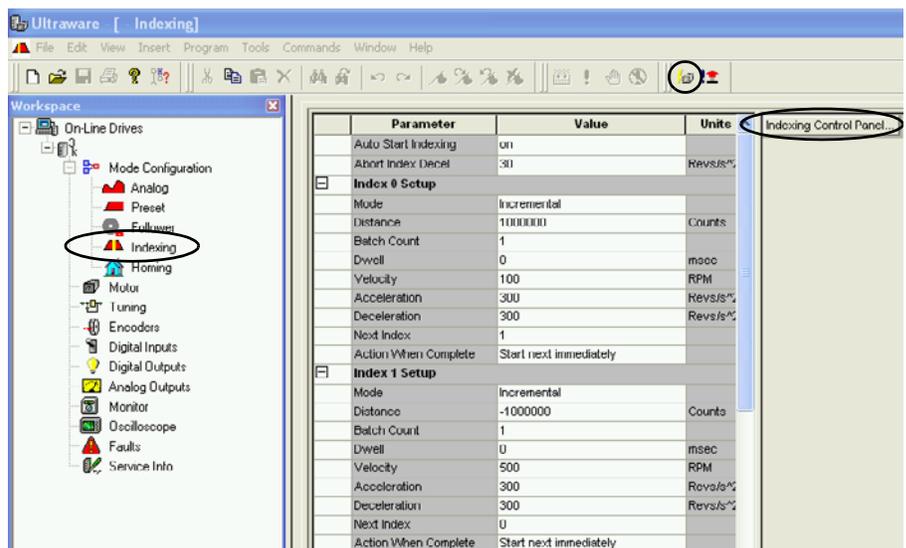
Follow these steps to change the default values in Ultraware software.

1. Open your Ultraware software.

For help detecting your drive and navigating Ultraware software, refer to Chapter 1.

2. From the workspace, expand Mode Configuration and double-click Indexing.

The indexing dialog opens with default motion profile values.

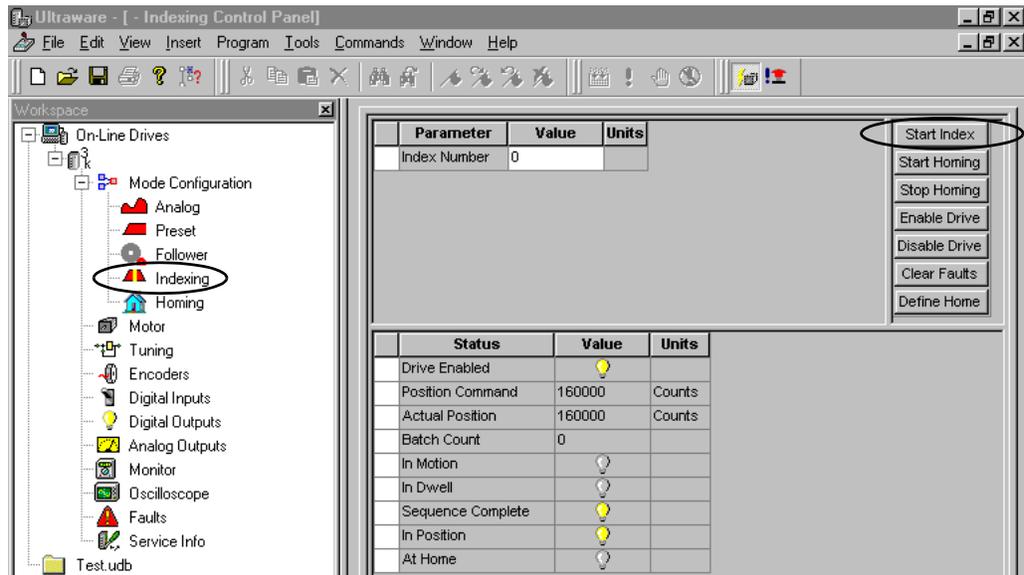


3. Expand Index 0 Setup and Index 1 Setup.

For this example, the default values were replaced with the values shown.

4. Click the Drive Enable icon to enable the Ultra3000 drive.
5. Click Indexing Control Panel.

The indexing control panel dialog opens.



ATTENTION



To avoid injury or damage caused by unexpected motion, make sure that all system and user safety measures are taken before running the application.

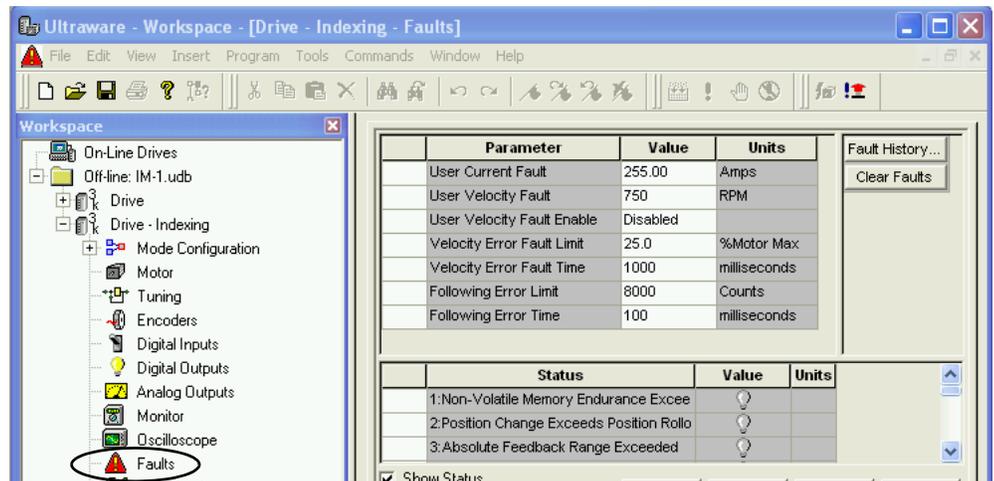
6. Click Start Index.

The application begins. Keep the application running while observing the default Following Error and Velocity Error Fault limit settings in Ultraware software to understand the significance of their values and units.

Understanding Error Limit Settings in Ultraware Software

With the motion application configured and operational, observe the default Following Error and Velocity Error Fault limit settings in Ultraware software to understand the significance of their values and units.

Ultraware Faults Branch



The Following Error Limit setting is in units of interpolated counts and can be related to actual position error in units of raw feedback counts and axis revolutions by referring to the motor and encoder properties found in the Motor and Encoders branches of Ultraware software.

In this example, the motor encoder provides 1024 raw counts per motor axis revolution with an interpolation constant of 1024. This creates a total of 1048576 interpolated counts per motor axis revolution. Therefore, the default 8000 interpolated-count position-error limit setting allows for maximum position error of 0.76% of a full motor axis revolution before the condition of Excess Position Error (E19) is reached.

The Velocity Error Fault Limit setting is in units of percent of maximum motor speed and can be related to actual velocity by referring to the motor properties under the Motor branch. In this example, the motor is rated for a maximum speed of 5000 rpm. Therefore, the default 25% setting allows for as much as 1250 rpm of velocity error before the condition of Excess Velocity Error (E24) is reached.

Optimal Following Error Limit/Time and Velocity Error Fault Limit/Time settings are chosen based on your knowledge of the system requirements and the maximum system position and velocity error excursion limit values. The default limit settings may not be optimal for every application. You must understand the application needs and adjust these default limit settings as appropriate.

Use the Oscilloscope Feature

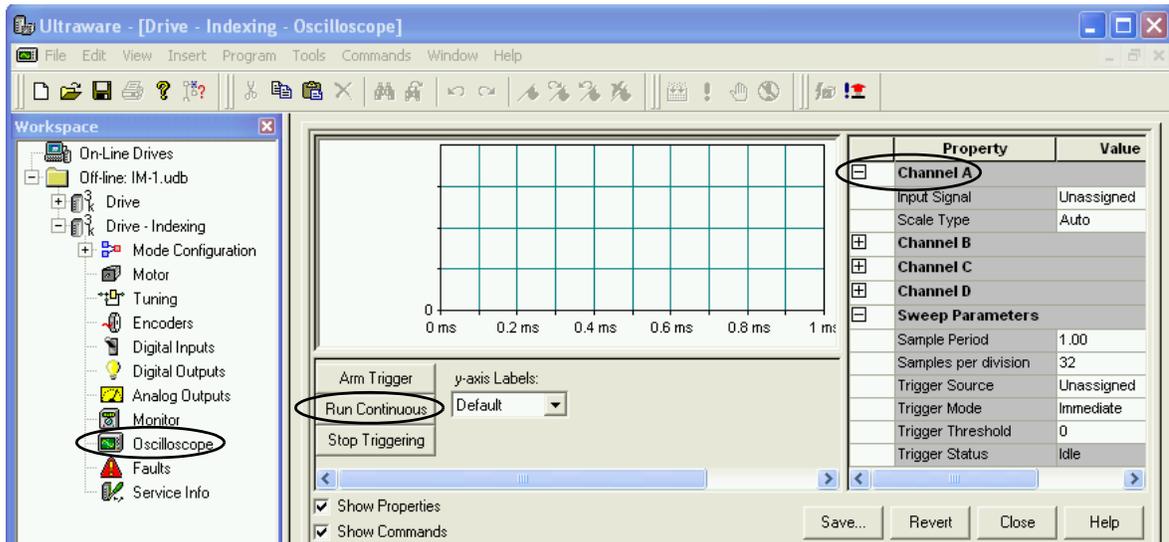
Once the system is running, the default position and velocity error limit values can be monitored and optimized via the oscilloscope branch.

IMPORTANT

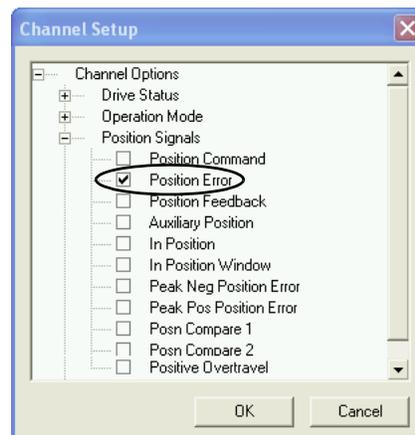
Since RSLogix 5000 software already provides an efficient plotting utility, do not use this feature with a SERCOS drive. Using the Ultraware oscilloscope feature, along with RSLogix 5000 software, creates a substantial drive processor load and may interfere with normal drive operation.

Follow these steps to configure the oscilloscope branch.

1. Double-click the Oscilloscope branch and expand the Channel A tab on the right side of the dialog.



2. Click the Input Signal default value and use the pull-down menu to select Position Error from the Channel Setup menu.



3. Click OK.
4. Click the Scale Type default value and select Auto.
5. Click the Run Continuous trigger setting and observe the main dialog.

The Position Error signal of the running system is displayed. It is likely that the signal is highly dynamic, and the auto-scaling feature of Ultraware automatically adjusts the dialog scaling to fit the signal for every sampling and trigger instance.

6. Click the Scale Type value and select Auto.

	Property	Value	Units
<input type="checkbox"/>	Channel A		
	Input Signal	Position Error	
	Scale Type	Auto	
<input type="checkbox"/>	Channel B		

7. Click Run Continuous and observe the main oscilloscope window.

The Position Error signal of the running system is displayed. It is likely that this signal is highly dynamic, and the auto-scaling feature of Ultraware software automatically adjusts the oscilloscope window vertical scale to fit the entire signal waveform for every sampling instance.

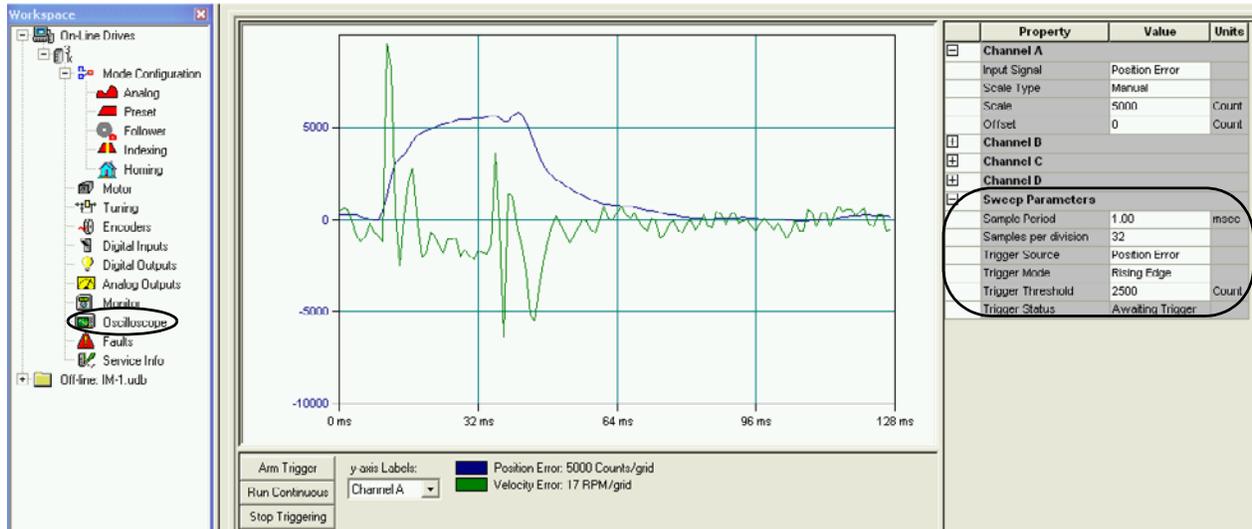
8. If a fixed scale is desired, Click the Scale Type value again and select Manual.

The Scale and Offset fields appear.

	Property	Value	Units
<input type="checkbox"/>	Channel A		
	Input Signal	Position Error	
	Scale Type	Manual	
	Scale	0	Count
	Offset	0	Count

9. Enter values (in counts) in the Scale and a Offset fields that results in the entire periodic Position Error signal waveform visible in the oscilloscope window.

Steps 8 and 9 are purely for the purpose of visualization. Fixing the vertical scale of the oscilloscope window lets you observe the amplitude excursion limits of the Position Error signal from a fixed range of reference.



10. Repeat steps 1...6 for Channel B and view the Velocity Error signal.

Access the Velocity Error signal in the Velocity Signals group in the same Channel Options pull-down menu. Make sure to use the Auto scale setting for Channel B. Both signals should be visible in the main oscilloscope window. You can toggle between Channel A and Channel B on the y-axis scale with the y-axis Labels field pull-down menu.

Using the Trigger Feature

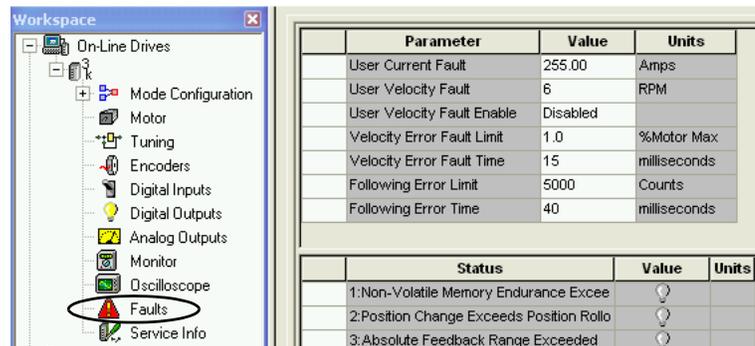
The bottom-right portion of the screen contains trigger level settings for oscilloscope Channel A and B. You can specify the level settings, in interpolated drive counts, to trigger on actual Position Error signal amplitude levels. You can use the trigger feature to capture significant Position Error amplitude events during normal system operation and to get very accurate application excursion limits. Using the trigger feature is an alternative to visually extracting the Position Error excursion limits.

Interpreting the Results

Once the actual position and velocity error excursion limit values are known, you can adjust the default Following Error Limit/Time and Velocity Error Fault Limit/Time settings to be just above these actual application extremes. This makes sure that any feedback loss events causing abnormal position and velocity error amplitude increase are detected and addressed by the drive in a timely manner.

In this example, the worst case Position Error is greater than 5000 counts, for around 32 ms, and the worst case Velocity Error is greater than 22 rpm, for around 8 ms. The position and velocity error limit settings in the Faults branch can be adjusted, according to these observations, to 5000 counts for 40 ms and 50 rpm (or 1% of 5000) for around 15 ms, respectively. The settings take effect as soon as they are entered.

Ultraware Faults Branch



Parameter	Value	Units
User Current Fault	255.00	Amps
User Velocity Fault	6	RPM
User Velocity Fault Enable	Disabled	
Velocity Error Fault Limit	1.0	%Motor Max
Velocity Error Fault Time	15	milliseconds
Following Error Limit	5000	Counts
Following Error Time	40	milliseconds

Status	Value	Units
1: Non-Volatile Memory Endurance Exceed		
2: Position Change Exceeds Position Rollo		
3: Absolute Feedback Range Exceeded		

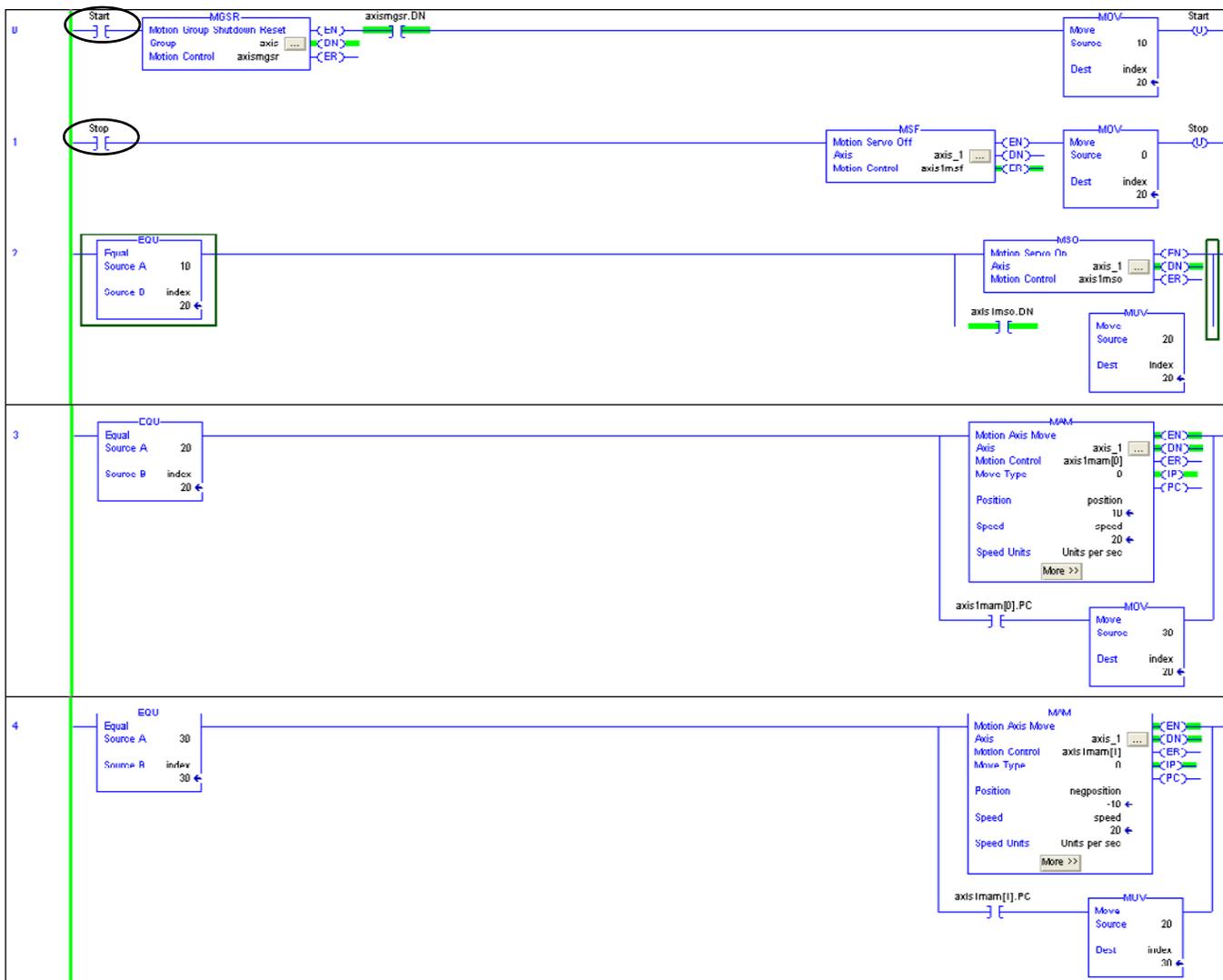
The new position and velocity error limit settings are significantly lower than the default settings. Once the system is operating with new settings in place, no nuisance faults should occur. If faults E19 or E24 occur during normal system operation, the excursion limit values were not accurately extracted and the appropriate steps need to be repeated.

Position Error Limit Adjustment Example with RSLogix 5000 Software

This example uses RSLogix 5000 software, a ControlLogix controller (catalog number 1756-L63), and an Ultra3000i indexing drive (catalog number 2098-DSD-030X) with a 230V MP-Series motor (catalog number MPL-A330P-S) and appropriate power and communication cables to illustrate position error limit setting optimization. A simple motion application is used in this example to perform a repeating clockwise-counterclockwise incremental axis move.

In this example, you will observe the default position error limit setting in RSLogix 5000 software and, with the motion application running, observe the actual application position error excursion limit values. This is done by using the trending feature of the RSLogix 5000 software. Based on these excursion limit values, you can adjust the default position error limit settings to closely match the needs of the application under normal operating conditions. Finally, with the new position error limit setting in place, you can test the system to make sure that it is still functional and that no nuisance faults occur.

Ladder Logic Diagram for Position Error Limit Adjustment



In the ladder logic example diagram, the Start input (when activated) enables the axis for motion. The Stop input disables the axis. A repeating sequence of two MAM commands is performed to move the axis an incremental distance in one direction and then return the axis to its original position.

Run the RSLogix 5000 Software Example Program

Follow these steps to run the example program.

1. Open your RSLogix 5000 software and create an application as shown in the ladder logic example diagram on page 154.
2. Download your program to the Logix controller.
3. Check to make sure the software is online and in Run mode.

ATTENTION

Make sure that all system and user safety measures are taken before starting the motion application.



4. Right-click the Start input in the ladder logic diagram and select Toggle Bit.

The motion application begins to run. While the application is running, the ladder logic diagram displays the state of the motion application by highlighting active ladder logic elements as they are used by the application.

5. With the motion application configured and operational, proceed to Observe the Default Position Error Tolerance Limit Setting on page 156.

Observe the Default Position Error Tolerance Limit Setting

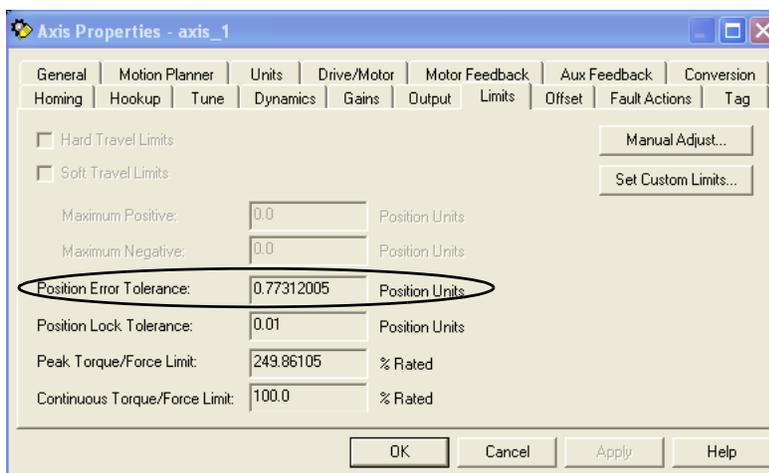
To understand the significance of the default Position Error Tolerance limit setting, observe the default value in RSLogix 5000 software.

TIP

The Position Error Tolerance limit setting, units and conversion settings, and real-time axis attribute settings are accessible through the Axis Properties dialog.

Follow these steps to observe the Position Error Tolerance setting.

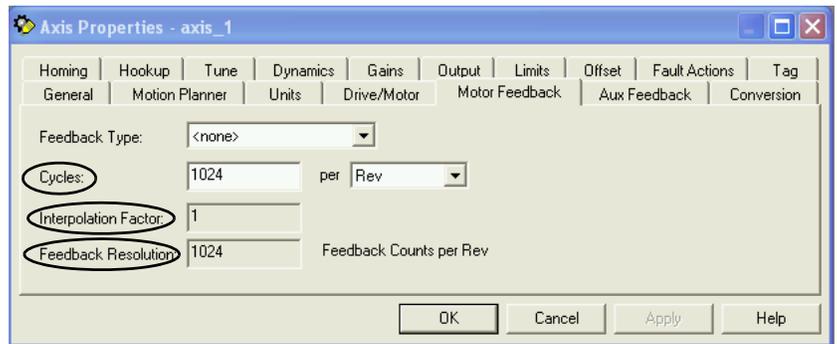
1. Right-click your axis in the Explorer dialog and choose Properties. The Axis Properties dialog opens.



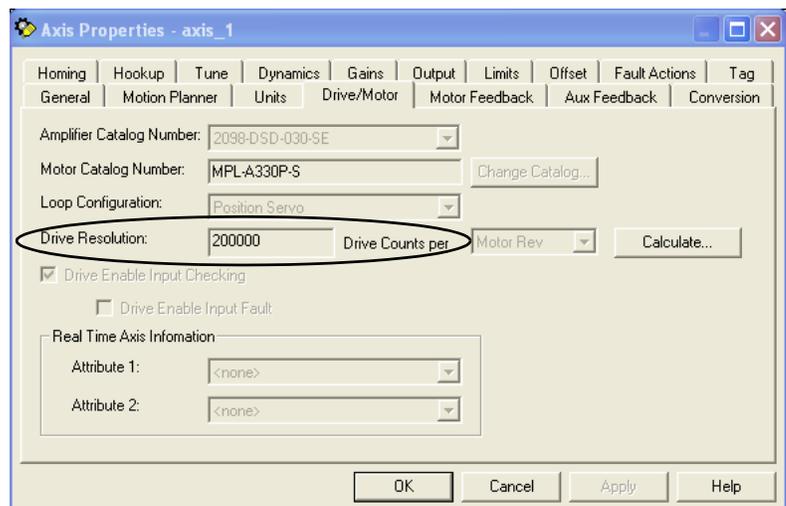
2. Click the Limits tab.

In this example, the default setting for Position Error Tolerance is 0.77312005 position units. This value can be related to position error in units of raw, interpolated, and drive resolution feedback counts and axis revolutions. Refer to the feedback cycles, interpolation factor, drive resolution, and conversion constant properties found under the Motor Feedback, Drive/Motor, and Conversion tabs of the Axis Properties menu.

- Click the Motor Feedback tab.



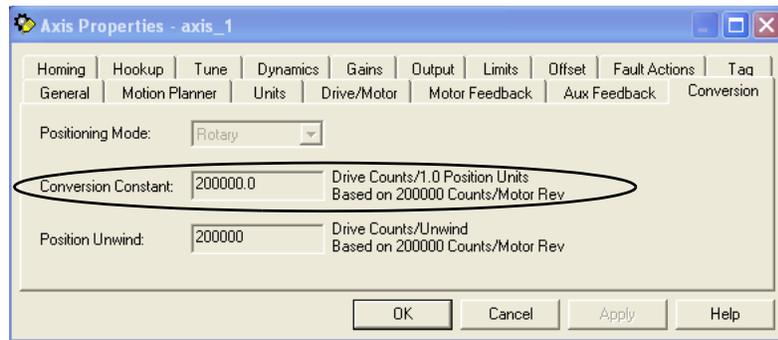
- Observe the Cycles, Interpolation Factor, and Feedback Resolution values.
- Click the Drive/Motor tab.



- Observe the Drive Resolution value.

For the MPL-A330P-S motor used in this example, 1024 raw feedback counts per 1 axis revolution are used to generate 2097152 (1024 x 2048) interpolated feedback counts per 1 axis revolution by using an interpolation factor of 2048. These interpolated feedback counts are converted to 200,000 drive resolution counts per 1 axis revolution by setting the Drive Resolution parameter in the Drive/Motor dialog to 200,000.

7. Click the Conversion tab.



8. Observe the Conversion Constant value.

The Conversion tab shows how the user-defined position units relate to drive resolution counts, and, therefore, to raw and interpolated feedback counts and axis revolutions.

Summary

In this example, the Position Error Tolerance limit setting of 0.77312005 position units at 200,000 drive resolution counts per 1 position unit results in approximately 154,624 drive resolution counts ($0.77312005 \times 200,000$) of allowable position error. Because in this case, 1 position unit is also equal to one axis revolution, the Position Error Tolerance limit setting is equal to approximately 77.3% (0.77312005) of 1 axis revolution.

The optimal Position Error Tolerance limit setting is chosen based on your knowledge of the system requirements and the maximum system position error excursion limit values. The default limit setting shown above may not be optimal for every application. You must understand the application needs and adjust this default limit setting as appropriate.

TIP

The Dynamics tab provides additional limit parameters, such as maximum speed, acceleration, and deceleration of the drive and motor system. These limits are specified in the same position units.

Trending Excursion Limits of the Position Error Parameter

With the motion application running, you can trend the position error parameter. The trending feature of RSLogix 5000 software lets you plot drive parameters in real-time and view them in graphical form. Before trending of any drive parameter is possible, the Real Time Axis Attribute field, found under the Axis Properties dialog, Drive/Motor tab, must be configured to specify which of the numerous drive parameters (tags) should be made available from the drive to the RSLogix 5000 software and Logix controller for the purpose of trending.

TIP

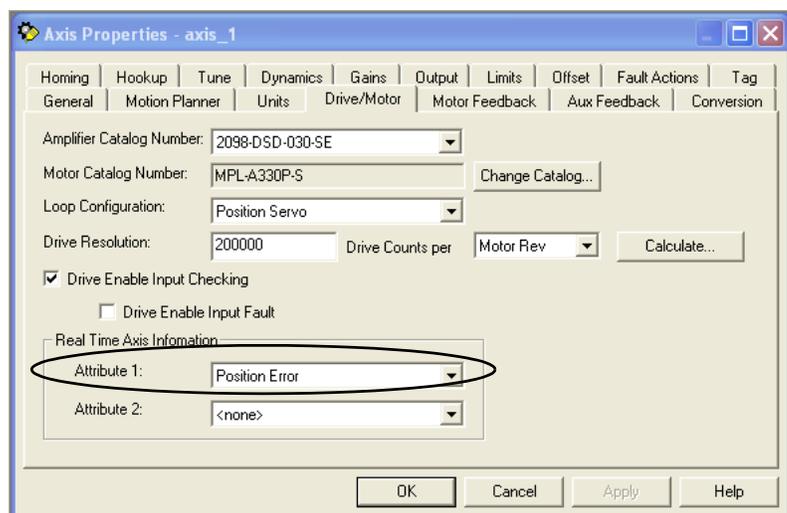
The trending feature is accessible through the Controller Tags branch in the RSLogix 5000 workspace dialog. Right-click the parameter tag that you wish to trend and select Trend (parameter).

Configure the Position Error Parameter Tag for Trending

Follow these steps to configure the position error parameter tag for trending in RSLogix 5000 software.

1. Set the Logix controller to the Offline mode.
2. Right-click your axis of interest in the Explorer dialog and choose Properties.

The Axis Properties dialog opens.



3. Click the Drive/Motor tab.

4. From the Attribute 1 pull-down menu, choose the Position Error parameter.

This configures the Logix controller to receive the position error parameter data from the drive.

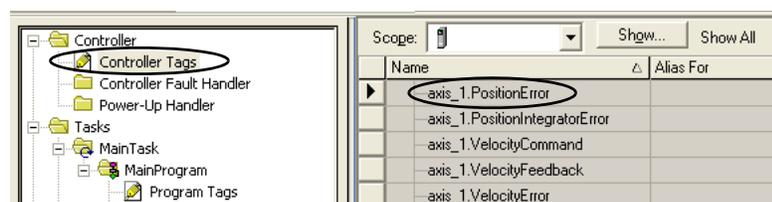
5. Click OK.

Locate the Position Error Parameter Tag and Configure It for Trending

Once the system is running and the Logix controller is configured to receive position error parameter data from the drive, the position error characteristics of the Ultra3000 drive and motor system can be monitored by using the trending feature of RSLogix 5000 software.

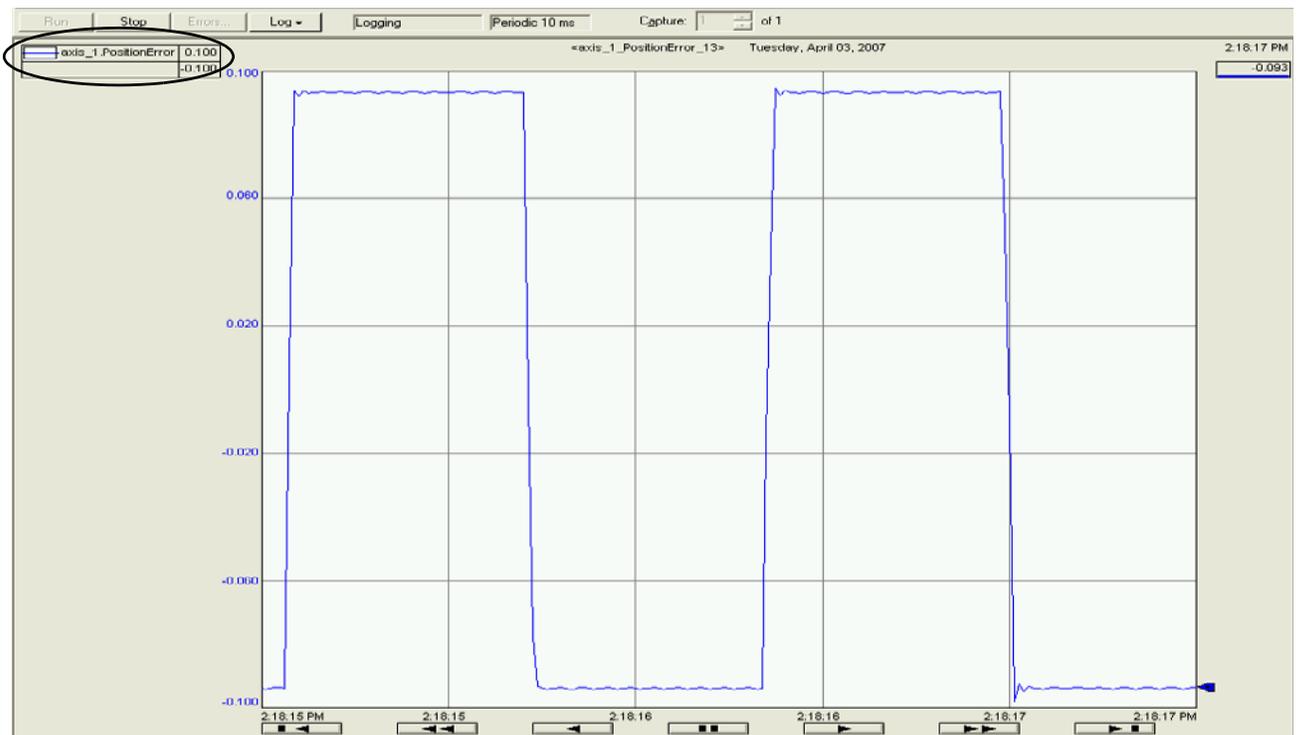
Follow these steps to locate the Position Error parameter tag and configure it for trending in RSLogix 5000 software.

1. Set the Logix controller to the Online mode.
2. Download the program to the controller when prompted.
3. Start your application.
In this example, the Start input is used (right-click and choose Toggle Bit).
4. Double-click Controller Tags in the Explorer dialog and choose Position Error.
5. Expand the axis_x tag list for your axis and scroll down to the Position Error parameter.



6. Right-click the PositionError parameter tag and choose Trend Axis_x.PositionError.

The RSLogix 5000 trending window opens and the position error signal of the running Ultra3000 drive/motor system becomes visible.



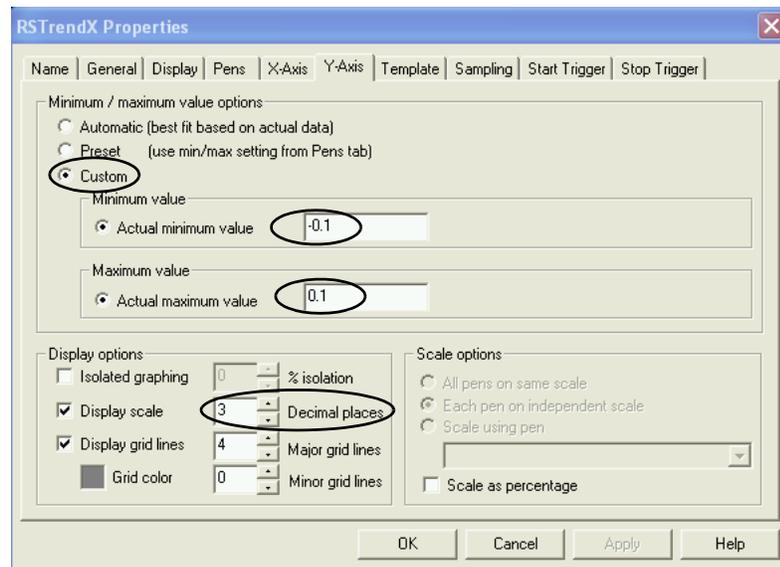
The default trending dialog settings are sufficient to display the position-error waveform. However, you may need to adjust the default dialog settings so you can capture and extract the position error excursion limit values of the running application more easily.

Change the Default Trending Dialog Settings

You can change the X or Y scales of the trending dialog (time base and amplitude, respectively) or the sampling period of the acquisition cycle by using the RSTrendX chart properties control panel.

Follow these steps to change the default trending dialog settings.

1. Right-click the trending dialog and choose Chart Properties.
The RSTrendX Properties dialog opens.



2. Click the Y-Axis tab.
3. Under Display options, change the number of decimal places to 3 (or more), depending on the resolution needed for your application.
4. Click Apply.
5. Click OK to close the RSTrendX dialog.
6. Observe the trending dialog waveform again.
Make note of the positive and negative excursion limit values for position error waveform.
7. Right-click the trending window and click the Y-Axis tab.
The Y-Axis tab opens again.
8. Under Minimum/maximum value options, click Custom.
9. Set the Minimum and Maximum values to capture the positive and negative excursion limit range observed in your application.

10. Click OK to accept the new trending dialog settings.

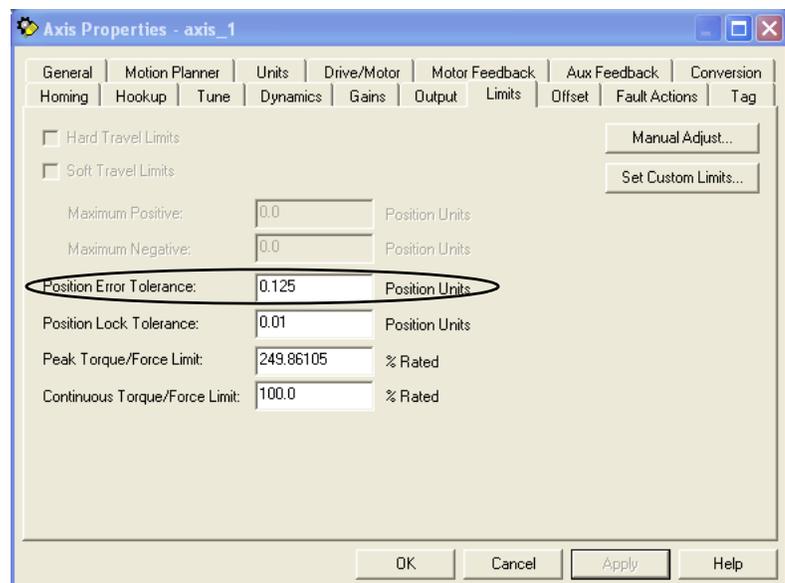
In this example, the Y-Axis scaling was adjusted to show a range of -0.10 (min) to 0.10 (max) position units, with 3 decimal places of resolution. If the waveform is not symmetrical, the minimum and maximum values may be different from each other.

Set the New Position Error Limit

Follow these steps to adjust the default Position Error Tolerance limit setting based on your knowledge of the position error excursion limit values of the application.

1. Set the Logix controller to the Offline mode.
2. Right-click your axis in the Explorer dialog and choose Properties.

The Axis Properties dialog opens.



3. Click the Limits tab.
4. Change the Position Error Tolerance limit setting according to your minimum and maximum excursion limit values obtained earlier.

In this example the new Position Error Tolerance setting is 0.125 position units, just above the 0.10 position units observed in the trending dialog. This position error margin is added to avoid nuisance trips. Values above this new limit setting will cause a position error fault (E19).

5. Click OK.

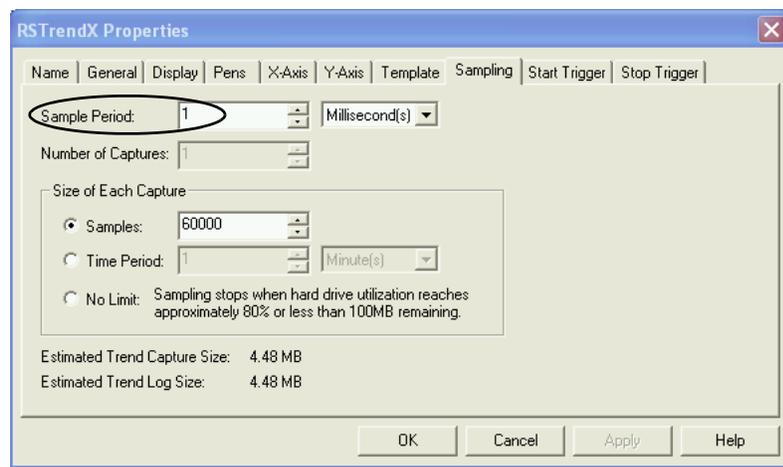
Verify the New Position Error Limit

You can use the RSLogix 5000 trigger feature to detect parameter tag events which meet or exceed your new Position Error Tolerance limit setting. After configuring the trigger feature, you can verify that the new settings are not exceeded by the system under normal operating conditions.

Follow these steps to set up the trigger feature and verify the new Position Error Tolerance limit setting.

1. Right-click the trending dialog and choose Chart Properties.

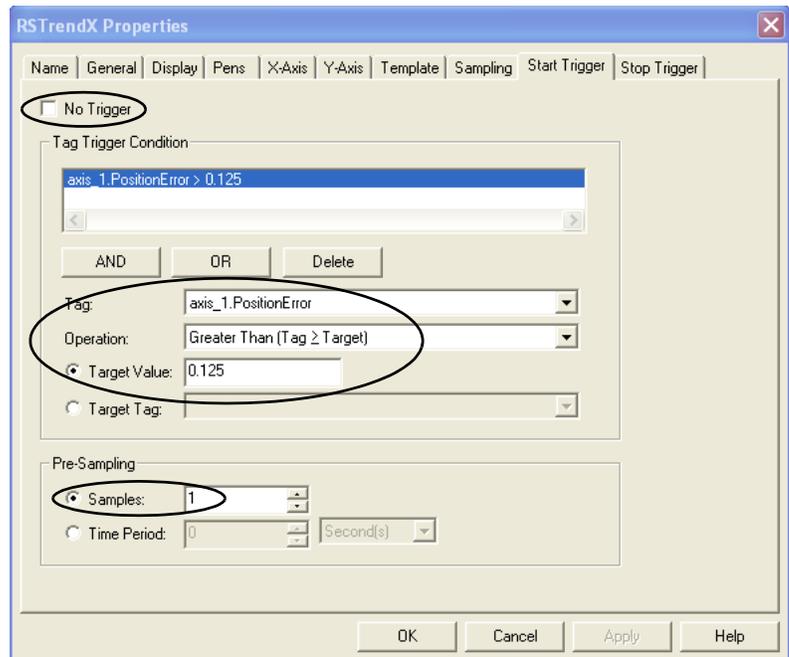
The RSTrendX Properties dialog opens.



2. Click the Sampling tab.
3. Adjust the Sampling Period to provide sufficient resolution to visualize your application.

A sampling period of 1.0 ms is used in this example.

- Click the Start Trigger tab.



- Uncheck the No Trigger checkbox.
- From the Tag pull-down menu, choose axis_x.PositionError.
- From the Operation pull-down menu, choose Greater Than (Tag \ge Target).

The trigger is now set to when the parameter exceeds the target value.

- Click Target Value and enter the new limit.
In this example, the target value is 0.125 position counts.
- Click Samples and set the value to 1 (single sample).
This speeds up the trigger response time.
- Click OK.

Visualize the New Position Error Limit

Follow these steps to visualize the new position error limit.

1. Set the Logix processor to online operation.
2. Download the program to the controller when prompted.
3. Right-click the Start bit in your program and choose Toggle Bit.
4. Click Run and observe the trending dialog.

No waveform (no trigger events) indicates the new position error limit threshold is not exceeded.

The new Position Error Tolerance limit settings are verified when no trigger events occur in the application under normal operating conditions. If trigger events occur, it is likely that the excursion limit values are not properly captured and need to be determined again. Repeat the excursion limit extraction process and assure that absolute (global) positive and negative excursion limit values are captured.

Additional Methods

It is good practice to make sure that your application can maintain the physical speed and position limits of the overall system. Use these additional safety measures to guard against unexpected motion.

- Hardware over-travel protection
- Dynamic braking circuit
- Bulletin 2090 resistive brake module (RBM)

Exporting and Importing Drive Setup Files

This appendix provides you with procedures for exporting and importing drive setup files used with Ultra3000, Ultra3000X with indexing, Ultra3000-DN DeviceNet, and Ultra3000X-DN DeviceNet with indexing servo drives.

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Export a Drive Setup File	167
Import a Drive Setup File	169

Introduction

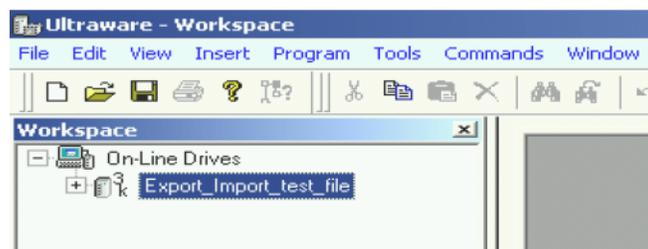
Drive setup files contain all the configuration data used by Ultraware software to run a particular application. In the event you are replacing your Ultra3000 drive you can reuse the original setup file. Follow these procedures to export the setup file to a temporary location and then import that same file and associate it with the replacement drive.

Export a Drive Setup File

Follow these steps to export a drive setup file.

1. Open your Ultraware software and go online with the replacement Ultra3000 drive.

Refer to Detect Your Ultra3000 Drive on page 16, for more information on starting the Ultraware software and detecting your drive.

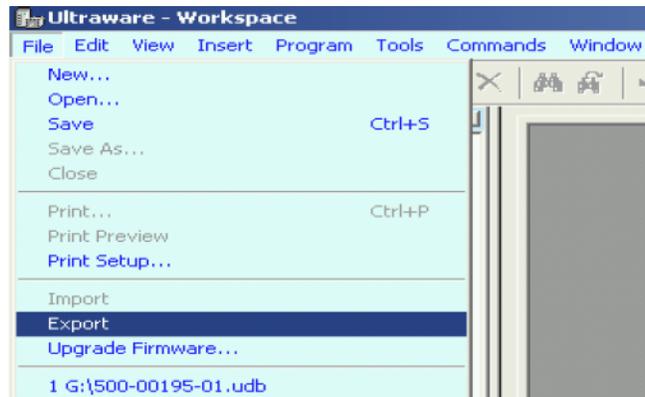


2. Select the drive setup file.

In this example, Export_Import_test_file is selected.

3. Choose Export from the File menu.

If Export is grey and cannot be chosen, then you haven't selected a file to export.



The Export To: dialog opens.

4. Browse to a location to temporarily store the drive setup file.



5. Name the file.

The file is assigned the .uxf (Ultraware Exchange File) extension.

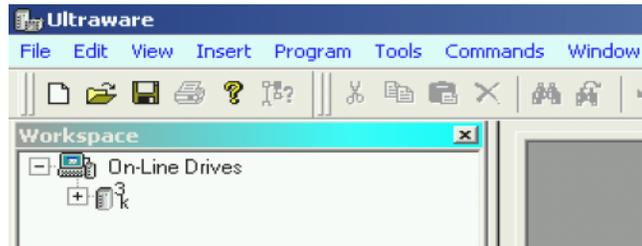
6. Click Save.

Import a Drive Setup File

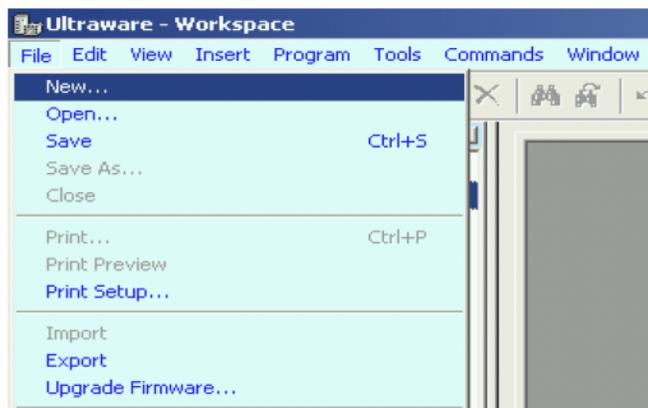
Follow these steps to import a drive setup file.

1. Open your Ultraware software and go online with the replacement Ultra3000 drive.

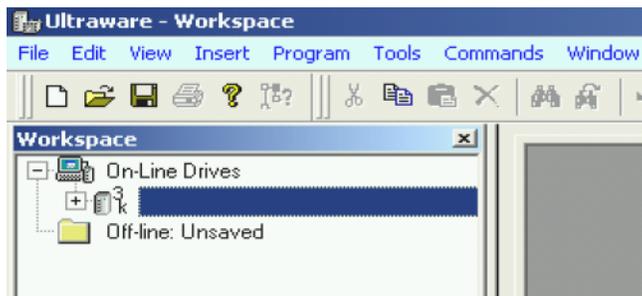
Refer to Detect Your Ultra3000 Drive on page 16, for more information on starting the Ultraware software and detecting your drive.



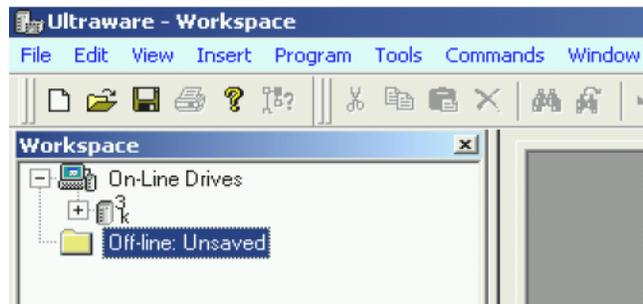
2. From the File menu, choose New to create an offline place to put the drive setup file.



An Off-line: Unsaved folder is created.

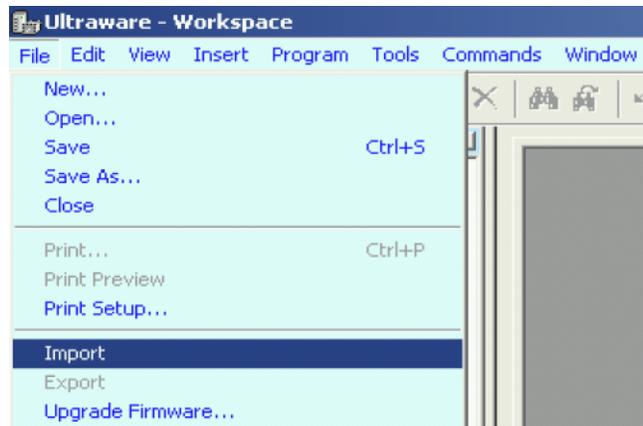


3. Select the Off-line: Unsaved folder.

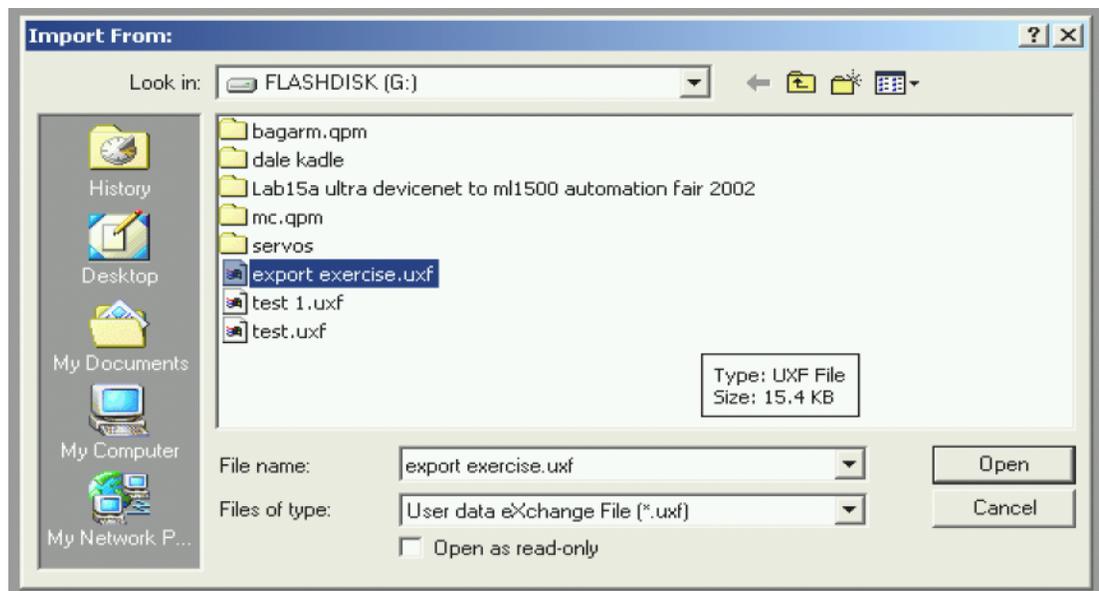


4. From the File menu, choose Import.

If Import is grey and cannot be chosen, then you haven't selected the Off-line: Unsaved folder.



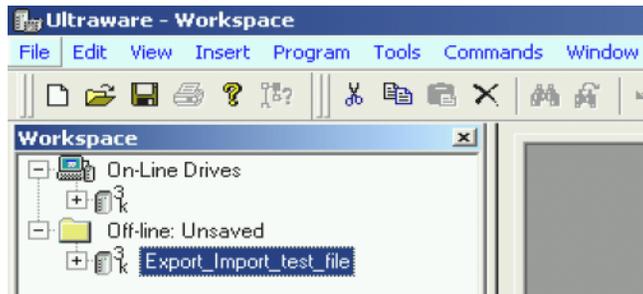
The Import From: dialog opens.



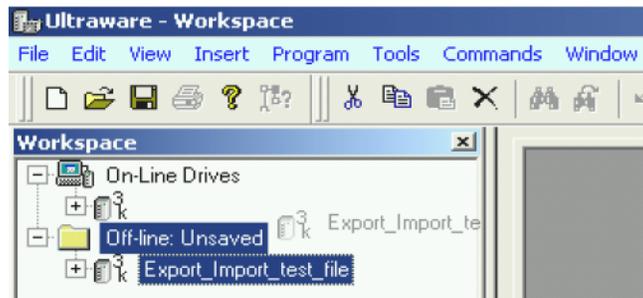
5. Choose the drive setup file that you saved earlier.

In this example, export exercise.uxf is the file to import.

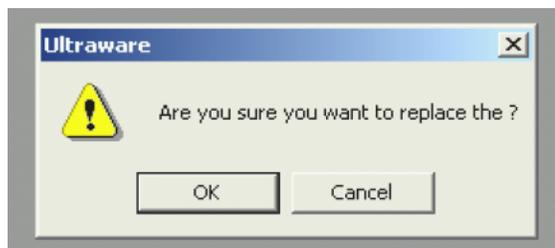
The drive setup file appears under the Off-line: Unsaved folder.



6. Drag and drop the drive setup file onto the online drive.



This Ultraware dialog opens.



7. Click OK.

The file loads and you are ready to restart the application.

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Publication 2098-IN005C-EN-P — March 2008

Supersedes Publication 2098-IN005B-EN-P — August 2004

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