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
Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley® does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

**ATTENTION**

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

**IMPORTANT**

Identifies information that is critical for successful application and understanding of the product.
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Preface

Introduction

Read this preface to familiarize yourself with the rest of the manual. This preface contains the following topics:

- Who Should Use this Manual
- Purpose of this Manual
- Contents of this Manual
- Product Receiving and Storage Responsibility
- Related Documentation
- Conventions Used in this Manual
- Allen-Bradley Support

Who Should Use this Manual

This manual is intended for engineers or programmers directly involved in the operation, field maintenance, and integration of the Ultra™3000 Digital Servo Drives (DSD).

If you do not have a basic understanding of the Ultra3000, contact your local Allen-Bradley representative for information on available training courses before using this product.

Purpose of this Manual

This manual provides power up procedures, system integration, and troubleshooting tables for the Ultra3000. The purpose of this manual is to assist you in the integration of your Ultra3000 as a stand alone drive using Ultraware or with a Logix controller using RSLogix® 5000 software as outlined in the table below.

<table>
<thead>
<tr>
<th>Drive Type</th>
<th>Catalog Numbers</th>
<th>Command Interface</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERCOS interface™ drive</td>
<td>2098-DSD-xxx-SE and -HVxxx-SE</td>
<td>Fiber-optic SERCOS ring</td>
<td>RSLogix 5000</td>
</tr>
<tr>
<td>Analog drive</td>
<td>2098-DSD-xxx-SE</td>
<td>Analog command interface</td>
<td>Ultraware or RSLogix 5000</td>
</tr>
<tr>
<td>Digital drive with DeviceNet™</td>
<td>2098-DSD-xxx-DN and -HVxxx-DN</td>
<td>DeviceNet communication interface</td>
<td></td>
</tr>
<tr>
<td>Indexing drive</td>
<td>2098-DSD-xxxX-SE and -HVxxxX</td>
<td>Stand alone control</td>
<td>Ultraware</td>
</tr>
<tr>
<td>Indexing DeviceNet drives</td>
<td>2098-DSD-xxx-DX-DN and -HVxxx-DX-DN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Contents of this Manual

Refer to the following listing for the descriptive contents of this installation manual.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>Preface</td>
<td>Describes the purpose, background, and scope of this manual. Also specifies the audience for whom this manual is intended.</td>
</tr>
<tr>
<td>1</td>
<td>Commissioning Your Ultra3000</td>
<td>Provides steps to follow when configuring your Ultra3000 and when applying power to the Ultra3000 for the first time.</td>
</tr>
<tr>
<td>2</td>
<td>Troubleshooting Your Ultra3000</td>
<td>Provides diagnostic aids that help isolate problems with your drive.</td>
</tr>
<tr>
<td>Appendix A</td>
<td>Interconnect Diagrams</td>
<td>Provides power and signal interconnect diagrams between the Ultra3000 and shunt modules, servo motors, and input power.</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Understanding Motor Feedback Signals and Outputs</td>
<td>Provides motor encoder input signal information and drive encoder output information specific to the Ultra3000 drives.</td>
</tr>
</tbody>
</table>

Product Receiving and Storage Responsibility

You, the customer, are responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the item(s) you receive against your purchase order. If any items are obviously damaged, it is your responsibility to refuse delivery until the freight agent has noted the damage on the freight bill. Should you discover any concealed damage during unpacking, you are responsible for notifying the freight agent. Leave the shipping container intact and request that the freight agent make a visual inspection of the equipment.

Store the product in its shipping container prior to installation. If you are not going to use the equipment for a period of time, store using the following guidelines.

- Use a clean, dry location
- Maintain an ambient temperature range of -40 to 70° C (-40 to 158° F)
- Maintain a relative humidity range of 5% to 95%, non-condensing
- Store it where it cannot be exposed to a corrosive atmosphere
- Store it in a non-construction area
**Related Documentation**

The following documents contain additional information concerning related Allen-Bradley products. To obtain a copy, contact your local Allen-Bradley office or distributor.

<table>
<thead>
<tr>
<th>For:</th>
<th>Read This Document:</th>
<th>Catalog Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructions needed for the installation and wiring of the Ultra3000</td>
<td>Ultra3000 Digital Servo Drives Installation Manual</td>
<td>2098-IN003x-EN-P</td>
</tr>
<tr>
<td>Ultraware Installation Instructions</td>
<td>Ultraware CD Installation Instructions</td>
<td>2098-IN002x-EN-P</td>
</tr>
<tr>
<td>Information on configuring your Ultra3000 using Ultraware</td>
<td>Ultraware User Manual</td>
<td>2098-UM001x-EN-P</td>
</tr>
<tr>
<td>Information on communicating with the Ultra3000 using DeviceNet</td>
<td>Ultra3000 DeviceNet Reference Manual</td>
<td>2098-RM001x-EN-P</td>
</tr>
<tr>
<td>Information on attaching Ultra3000 drives to a DeviceNet network</td>
<td>DeviceNet Cable System Planning and Installation Manual</td>
<td>DN-6.7.2</td>
</tr>
<tr>
<td>A description and specifications for the Ultra Family including motors and motor accessories</td>
<td>Kinetix® Motion Control Selection Guide</td>
<td>GMC-SG001x-EN-P</td>
</tr>
<tr>
<td>Drive and motor sizing with application analysis software</td>
<td>Motion Analyzer CD (v4.1 or above)</td>
<td>PST-SG003x-EN-C</td>
</tr>
<tr>
<td>More detailed information on the use of ControlLogix® motion features and application examples</td>
<td>ControlLogix Motion Module Programming Manual</td>
<td>1756-RM086x-EN-P</td>
</tr>
<tr>
<td>ControlLogix SERCOS interface module installation instructions</td>
<td>3, 8 or 16 Axis SERCOS interface Module Installation Instructions</td>
<td>1756-IN572x-EN-P</td>
</tr>
<tr>
<td>ControlLogix Analog Encoder Servo module installation instructions</td>
<td>Analog Encoder (AE) Servo Module Installation Instructions</td>
<td>1756-IN047x-EN-P</td>
</tr>
<tr>
<td>SoftLogix SERCOS interface PCI card installation instructions</td>
<td>16 Axis PCI SERCOS interface Card Installation Instructions</td>
<td>1784-IN041x-EN-P</td>
</tr>
<tr>
<td>SoftLogix Analog Encoder PCI card installation instructions</td>
<td>PCI 2 Axis Servo Card Installation Instructions</td>
<td>1784-IN005x-EN-P</td>
</tr>
<tr>
<td>The instructions needed to program a motion application</td>
<td>Logix Controller Motion Instruction Set Reference Manual</td>
<td>1756-RM007x-EN-P</td>
</tr>
<tr>
<td>Information on configuring and troubleshooting your ControlLogix motion module</td>
<td>ControlLogix Motion Module Setup and Configuration Manual</td>
<td>1756-UM006x-EN-P</td>
</tr>
<tr>
<td>Information on configuring and troubleshooting your SoftLogix PCI card</td>
<td>SoftLogix Motion Card Setup and Configuration Manual</td>
<td>1784-UM003x-EN-P</td>
</tr>
<tr>
<td>Information on proper handling, installing, testing, and troubleshooting fiber-optic cables</td>
<td>Fiber Optic Cable Installation and Handling Instructions</td>
<td>2090-IN010x-EN-P</td>
</tr>
<tr>
<td>Information, examples, and techniques designed to minimize system failures caused by electrical noise</td>
<td>System Design for Control of Electrical Noise Reference Manual</td>
<td>GMC-RM001x-EN-P</td>
</tr>
<tr>
<td>For declarations of conformity (DoC) currently available from Rockwell Automation</td>
<td>Rockwell Automation Product Certification website</td>
<td><a href="http://www.ab.com/certification/ce/docs">www.ab.com/certification/ce/docs</a></td>
</tr>
<tr>
<td>An article on wire sizes and types for grounding electrical equipment</td>
<td>National Electrical Code</td>
<td>Published by the National Fire Protection Association of Boston, MA.</td>
</tr>
<tr>
<td>A glossary of industrial automation terms and abbreviations</td>
<td>Allen-Bradley Industrial Automation Glossary</td>
<td>AG-7.1</td>
</tr>
</tbody>
</table>
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
- Words that you type or select appear in bold
- When we refer you to another location, the section or chapter name appears in italics
- Abbreviations for the Ultra3000 drives, shown in the table below, are used throughout this manual

<table>
<thead>
<tr>
<th>Ultra3000 Drive</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra3000 with SERCOS interface</td>
<td>Ultra3000-SE</td>
</tr>
<tr>
<td>Ultra3000 with DeviceNet interface</td>
<td>Ultra3000-DN</td>
</tr>
</tbody>
</table>
Allen-Bradley Support

Allen-Bradley offers support services worldwide, with over 75 Sales/Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Allen-Bradley representatives in every major country in the world.

Local Product Support

Contact your local Allen-Bradley representative for:

- Sales and order support
- Product technical training
- Warranty support
- Support service agreements

Technical Product Assistance

If you need to contact Allen-Bradley for technical assistance, please review the information in the chapter Troubleshooting Status Indicators first, then call your local Allen-Bradley representative or Rockwell Automation Technical Support at (440)-646-5800. For the quickest possible response, please have the catalog numbers of your products available when you call.

Comments Regarding this Manual

To offer comments regarding the contents of this manual, go to www.ab.com/manuals/gmc and download the Motion Control Problem Report form. Mail or fax your comments to the address/fax number given on the form.
Commissioning Your Ultra3000

Chapter Objectives

This chapter provides you with information to apply power and configure your Ultra3000. This chapter includes these sections:

- General Startup Precautions
- Before You Begin
- Configuring Your Ultra3000 and Ultra3000 with Indexing
- Configuring Your Ultra3000 with SERCOS interface Drive
- Configuring Your Ultra3000 with DeviceNet Drive

Note: Some of the procedures in this chapter include information regarding integration with other products.

General Startup Precautions

The following precautions pertain 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 Allen-Bradley publication 8000-4.5.2, *Guarding Against Electrostatic Damage* or any other applicable ESD Protection Handbook.
Before You Begin

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-EN-P).

Use the table below to determine where to begin configuring your Ultra3000 drive.

<table>
<thead>
<tr>
<th>If you are configuring this drive:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2098-DSD-xxx, -xxxX, HVxxx, or HVxxxX</td>
<td>Go to Configuring Your Ultra3000 and Ultra3000 with Indexing</td>
</tr>
<tr>
<td>2098-DSD-xxx-SE or HVxxx-SE</td>
<td>Go to Configuring Your Ultra3000 Drive</td>
</tr>
<tr>
<td>2098-DSD-xxx-DN, -xxxX-DN, HVxxx-DN, or HVxxxX-DN</td>
<td>Go to Configuring Your Ultra3000 with DeviceNet Drive</td>
</tr>
</tbody>
</table>

Configuring Your Ultra3000 and Ultra3000 with Indexing

The procedures in this section apply to Ultra3000 drives (2098-DSD-xxx, -xxxX, HVxxx, or HVxxxX) and describe how to:

- Apply power to your Ultra3000 drive
- Detect your Ultra3000 drive
- Understand the workspace and drive branches in Ultraware
- Select your motor
- Tune your motor
- Test your motor (non-indexing move)
- Test your motor (indexing move)
- Make indexing and non-indexing moves
- Configure your Ultra3000 drive with the Logix servo module
Front Panel Connections

This section provides front panel connection information for your Ultra3000 and Ultra3000 with indexing drive.

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

**Figure 1.1**
Ultra3000 Front Panel Connections for 2098-DSD-005, -005X, -010, -010X, -020, and -020X

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000 230V drives (3 kW).

**Figure 1.2**
*Ultra3000 Front Panel Connections for 2098-DSD-030 and -030X*

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000 230V (7.5 and 15 kW).

Figure 1.3
Ultra3000 Front Panel Connections for 2098-DSD-075, -075X, -150, and -150X

For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000 460V drives (3W, 5 kW, 10 kW, 15 kW, and 22 kW).

**Figure 1.4**
**Ultra3000 Front Panel Connections for 2098-DSD-HVxxx and HVxxxX**

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Applying Power To Your Ultra3000 Drive

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

To apply power to your Ultra3000 drive:

1. Disconnect any load to the motor. Ensure 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 Drive Enable signal without first applying input power.

2. Apply input power to the Ultra3000 and observe the front panel Logic Power indicator LED as shown in the figure below.

Figure 1.5
Logic Power and Status LED Display

<table>
<thead>
<tr>
<th>If the Logic Power LED is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Go to main step 3.</td>
</tr>
<tr>
<td>Not ON</td>
<td>1. Check your input power connections.</td>
</tr>
<tr>
<td></td>
<td>2. Repeat main step 2.</td>
</tr>
</tbody>
</table>
3. Observe the front panel seven segment Status LED display as shown in Figure 1.5.

<table>
<thead>
<tr>
<th>If the Status LED display on your:</th>
<th>Is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2098-DSD-xxx, -xxxxX, -HVxxxx, or -HVxxxxX drive</td>
<td>Actively cycling segments in a full circle</td>
<td>The drive is ready. Go to Detecting Your Ultra3000 Drive on page 1-8.</td>
</tr>
<tr>
<td></td>
<td>Flashing an E followed by two numbers</td>
<td>Go to Error Codes on page 2-2.</td>
</tr>
</tbody>
</table>

**Detecting Your Ultra3000 Drive**

This procedure assumes you have successfully applied power to your drive. By following these steps you will ensure that your Ultra3000 drive is communicating with your Ultraware software. To detect your Ultra3000 drive:

1. Start your Ultraware software. Refer to the Ultraware User Manual (publication 2098-UM001x-EN-P) for more information on starting the Ultraware software.

2. Create a new file. Ultraware will scan for on-line drives.

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

4. Look for the Ultra3000 icon (Ultra3k) under the On-Line Drives tree. The Ultra3000 icon indicates that your drive is detected.

**Figure 1.6**

Ultra3000 Icon

5. Click on the [+] next to the Ultra3k icon to expand the branch menu (as indicated in the window above).
6. Understanding the Workspace and Drive Branches

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

<table>
<thead>
<tr>
<th>If your Ultra3000 drive:</th>
<th>Then:</th>
</tr>
</thead>
</table>
| Is detected and listed under the On-Line Drives tree | 1. The software and hardware are communicating and the system is ready.  
2. Go to the section Selecting a Motor. |
| Is not detected | 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. |

Click on the + next to the (3k) drive to expand the parameter group. 
Double-click on the (3k) drive in the Ultraware workspace to display the various drive branches.
Configure the drive parameters for an off-line or on-line drive.
Open the Control Panel windows to issue motion commands.
Execute commands to clear faults, reset the drive, or reset the EEPROM.
Monitor the status of an on-line drive.
Mode Configuration Branch

Motor Branch

Use the Motor Branch to:

- Select a motor for the associated on-line or off-line Ultra3000 drive. Once you select a motor, the status values associated with the selected motor appears in the Status pane of this window.
- Monitor the status as related to the selected motor.
- Perform diagnostics on the motor

Note: 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 windows 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 windows 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 window 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 window where you can select the collection of statuses to display in this window.
- 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 window where you can review the drive’s fault history
- Enable or disable user faults.

Service Information Branch

Use the Service Information Branch to:

- Modify the size of an off-line drive file before transferring the configuration to an on-line drive.
- Display and monitor service information about the drive.
- Display the firmware version of the drive.
Selecting a Motor

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

Note: Refer to the Ultraware User Manual (publication 2098-UM001x-EN-P) for more information on selecting a motor.

To select a motor:

1. Double click on the Ultra3000 icon (Ultra3k) under the On-Line Drives tree. The Ultra3000 Drive properties window opens.

   ![Ultra3000 Drive properties window]

   Note: Actual values depend on your application.

2. Double click on the Motor branch. The motor branch property window opens.

   ![Motor branch property window]

3. **If you have this motor:**

<table>
<thead>
<tr>
<th>then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>An Allen-Bradley motor with an intelligent encoder</td>
</tr>
<tr>
<td>All others</td>
</tr>
</tbody>
</table>

4. In the box next to Motor Model, select the model number of your motor.

5. Close the Motor properties window.
Assigning Digital Inputs

To assign Digital Inputs 1 and 2:


2. Set Input 1 value to **Drive Enable**.

**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. Set Input 2 value to **Fault Reset**.

Tuning Your Motor

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

To autotune your motor:

1. Double-click on the Tuning branch. The Tuning branch properties window opens.


3. Apply 12-24V to input 1. Input 1 was configured as Drive Enable in a previous step (Drive Enabled light turns yellow).

4. Select appropriate autotune settings for your application.

5. Select Start Autotune. The motor responds and the tuning process is complete (Autotune Complete light turns yellow).

Note: Actual values depend on your application.

6. Close the Tuning properties window.

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.
Testing 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.

Note: Refer to the Ultraware User Manual (publication 2098-UM001x-EN-P) for more information on using the velocity control panel.

To test your motor:

1. Double-click the U3k icon. The drive properties window opens.

   ![Drive Properties Window]

   Note: Actual values depend on your application.

2. Select Velocity Control Panel (as indicated in the window above). The velocity control panel window opens.

   ![Velocity Control Panel Window]

3. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

4. Select Enable Drive (as indicated in the window below).

   ![Enable Drive Window]

5. Enter an appropriate low speed in the velocity command value field.

6. Press Enter.

7. Observe the motor. The motor should be turning at the velocity you entered in step 5.
8. Observe the Status table (as indicated below).

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

9. Select **Disable Drive**. The motor stops.

10. Close the velocity control panel.

11. Select the **Enable** icon from the Ultraware toolbar.
Testing 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.

Note: Refer to the *Ultraware User Manual* (publication 2098-UM001x-EN-P) for more information on using the indexing control panel.

To test your motor:

1. Double-click the U3k icon. The drive properties window opens.

2. Select **Indexing Control Panel** (as indicated in the window above). The indexing control panel window opens.

3. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

4. Set the value of **Index Number** to 0.

5. Expand the **Mode Configuration** branch (as indicated in the window below) and double-click on Indexing. The Indexing Setup window opens.
6. 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
   - Action When Complete = Stop
   - Leave other defaulted parameters as is

   Note: These settings may not be appropriate for your application.

7. Select **Indexing Control Panel**. The indexing control panel opens.

8. Select **Enable Drive**.

9. Select **Start Index**. Your incremental move begins.

10. Observe the Batch Count value count down from 5 to 0 while your move is running.

11. Close the indexing control panel window.

12. Close the indexing mode window.

13. Select the **Enable** icon from the Ultraware toolbar.
Indexing and Non-Indexing Move Examples

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

**Analog Velocity Mode (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. In this procedure you will run the drive in analog velocity mode.

Note: Refer to the *Ultraware User Manual* (publication 2098-UM001x-EN-P) for more information on analog velocity mode.

To run your drive in analog velocity mode:

1. Double-click the U3k icon. The drive properties window opens.

2. Expand the **Operation Modes** parameter. Verify the Operation Mode is Analog Velocity Input.

3. Close the Drive Branch user window.

4. Expand the **Mode Configuration** branch. Double-click Analog. The Analog Setup window opens.

5. Set the **Velocity Scale** to 300.0 RPM/Volt. Verify **Velocity Offset** is 0 millivolts.
6. Double-click on the **Digital Inputs** branch.
   - Verify that Input 1 is configured as **Drive Enable** input (factory default).
   - Verify that Input 2 is configured as the **Fault Reset** input.

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

8. Select **Setup**. The Monitor Setup window opens. Check **Velocity Signals**.

9. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

10. Observe the drive respond to a ±10V dc analog signal applied to CN1-25 and -26.
    - Analog Command voltage
    - Velocity Command rpm (300 rpm/analog input voltage)

11. Remove the 12-24V dc (Drive Enable) from input 1.
Preset Velocity Control (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. In this procedure you will run the drive using preset velocity control.

Note: Refer to the *Ultraware User Manual* (publication 2098-UM001x-EN-P) for more information on preset velocity control.

To use preset velocity control:

1. Double-click the U3k icon. The drive properties window opens.

2. Expand the **Operation Modes** parameter. Click on the current setting and use the drop down arrow to change the Operation Mode to **Preset Velocity**.

3. Close the Drive Branch user window.

4. Expand the **Mode Configuration** branch and double-click on Preset. The Preset setup window opens.

5. Enter the Preset Velocity values as shown in the table above.

6. Set the Preset Velocity Input Limits value to **Inactive**, as shown in the table above.

7. Close the user windows.
8. Double-click the **Digital Inputs** branch. Use the drop-down arrows to change the input values as shown in the table below.

9. Select a preset location by placing 12-24V dc on the assigned preset input according to the table below.

<table>
<thead>
<tr>
<th>Preset Selects</th>
<th>Binary Code</th>
<th>Selected Preset or Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 4 3 2 1 0</td>
<td></td>
</tr>
<tr>
<td>0 0 0 0 0 0</td>
<td>Preset 0 or Index 0 is selected.</td>
<td></td>
</tr>
<tr>
<td>0 0 0 0 0 1</td>
<td>Preset 1 or Index 1 is selected.</td>
<td></td>
</tr>
<tr>
<td>0 0 0 0 1 0</td>
<td>Preset 2 or Index 2 is selected.</td>
<td></td>
</tr>
<tr>
<td>0 0 0 1 1 1</td>
<td>Preset 3 or Index 3 is selected.</td>
<td></td>
</tr>
<tr>
<td>1 1 1 1 1 1</td>
<td>Preset 64 or Index 64 is selected.</td>
<td></td>
</tr>
</tbody>
</table>

Select up to 64 locations via preselect inputs 5 through 0 using BCD format. (codes for preset selects 1 and 0 are shown)

10. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

11. Observe the motor running at the selected speed (rpm).

12. Double-click the **Monitor** branch. Select **Setup** and expand the **Velocity Signals** branch.
13. Check **Velocity - Command** and click **OK**.

14. Go to the **Monitor Branch** and verify the **Velocity - Command** signal coincides with the selected preset value.

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

**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. Also assumed is an external auxiliary incremental encoder wired to CN1-1 and -2 (power) and CN1-4, through -9 (encoder signals). In this procedure you will run the drive in position follower (Master Encoder) mode.

Note: Refer to the *Ultraware User Manual* (publication 2098-UM001x-EN-P) for more information on position follower mode.

To run the drive in position follower mode:

1. Double-click the U3k icon. The drive properties window opens.

2. Expand the **Operation Modes** parameter. Click on the current setting and use the drop down arrow to change the Operation Mode to **Follower: Auxiliary Encoder**.

3. Close the Drive Branch user window.

4. Expand the **Mode Configuration** branch. Double-click on **Follower**.
5. Enter the Gear Ratio preset values as shown in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preset 0</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Preset 1</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>Preset 2</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Preset 3</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Preset 4</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Preset 5</td>
<td>10.1</td>
<td></td>
</tr>
<tr>
<td>Preset 6</td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>Preset 7</td>
<td>1.1</td>
<td></td>
</tr>
</tbody>
</table>

6. Close the **Mode Configuration** window.

7. Double-click the **Digital Inputs** branch. Use the drop-down arrows to change the input values as shown in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input 1</td>
<td>Drive Enable</td>
<td></td>
</tr>
<tr>
<td>Input 2</td>
<td>Unsigned</td>
<td></td>
</tr>
<tr>
<td>Input 3</td>
<td>Preset Select 0</td>
<td></td>
</tr>
<tr>
<td>Input 4</td>
<td>Preset Select 1</td>
<td></td>
</tr>
<tr>
<td>Input 5</td>
<td>Preset Select 2</td>
<td></td>
</tr>
<tr>
<td>Input 6</td>
<td>Unsigned</td>
<td></td>
</tr>
<tr>
<td>Input 7</td>
<td>Unsigned</td>
<td></td>
</tr>
<tr>
<td>Input 8</td>
<td>Unsigned</td>
<td></td>
</tr>
</tbody>
</table>

8. Using BCD format (refer to the table on page 1-23) apply 12-24V dc to assigned inputs 3, 4, and 5 to select your preset.


10. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

11. Verify the rotation of the auxiliary encoder results in a corresponding move of the axis.

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

Note: Refer to the Ultraware User Manual (publication 2098-UM001x-EN-P) for more information on incremental indexing moves.

To set parameters for an incremental indexing move:

1. Double-click the U3k icon. The drive properties window opens.

2. Expand the Operation Modes parameter. Click on the current setting and use the drop down arrow to change the Operation Mode to Indexing.

3. Close the Drive Branch user window.

4. Expand the Mode Configuration branch. Double-click on Indexing.

5. Enter the Index 0 parameter values as shown in the table below.

6. Close the Indexing Parameters user window.
7. Double-click the **Digital Inputs** branch. Use the drop-down arrows to change the input values as shown in the table below.


9. Double-click the **Digital Outputs** branch. Use the drop-down arrows to change the output values as shown in the table below.

To verify the number of indexing moves using drive signals:

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

![Monitor Setup diagram](image)

2. Select OK.

3. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

4. Apply 12-24V dc to input 3 to the indexing move.

![Workspace diagram](image)

5. Double-click on the Monitor branch and watch Batch Count count down from 10 to 0.

6. Observe Outputs 2 and 3 for axis in dwell and in position.

7. Observe Output 4 when the Indexing move is complete.

8. Remove the 12-24V dc (Drive Enable) from input 1.
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. Observe that Output 4 is not illuminated, indicating end of sequence has not been reached.

<table>
<thead>
<tr>
<th>Status</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 1 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 2 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 3 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 4 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay State</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


8. Observe the **Monitor** branch to see that the Batch Count value is held at the remaining value.

9. Remove the 12-24V dc from Input 5 and verify the indexing move continues.

10. Close the user windows.

11. 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.

Note: Refer to the Ultraware User Manual (publication 2098-UM001.x-EN-P) for more information on absolute indexing moves.

To set parameters for an absolute indexing move:

1. Double-click the U3k icon. The drive properties window opens.

2. Expand the **Operation Modes** parameter. Click on the current setting and use the drop down arrow to change the Operation Mode to **Indexing**.

3. Close the Drive Branch user window.

4. Expand the **Mode Configuration** branch. Double-click on **Indexing**.

5. Enter the Index 0 parameter values as shown in the table below.
6. Enter the Index 1 parameter values as shown in the table below.

7. Close the Indexing Parameters user window.

8. Expand the **Mode Configuration** branch. Double-click on **Homing**.

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

10. Close the Homing Parameters user window.

11. Close the Mode Configuration user window.

12. Double-click the **Digital Inputs** branch. Use the drop-down arrows to change the input values as shown in the table below.

To use digital outputs to indicate an event has occurred:

1. Double-click the **Digital Outputs** branch. Use the drop-down arrows to change the output values as shown in the table below.

2. Close the Digital Outputs user window.

3. Apply 12-24V dc to input 1. Input 1 was configured as Drive Enable in a previous step.

4. Apply 12-24V dc to input 3 (momentarily) to start the homing routine.

5. 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.


<table>
<thead>
<tr>
<th>Status</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 1 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 2 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 3 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 4 State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay State</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 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.

7. Apply 12-24V dc to input 5 and observe Digital Outputs 2 and 3 change states.

8. Apply 12-24V dc to input 6 (momentarily) to stop the indexing move. Turn off input 5.

9. Apply 12-24V dc to input 4 (momentarily again) to restart the indexing move. Turn off input 4.
10. Apply 12-24V dc to input 7 to pause the indexing move. Remove the 12-24V dc and observe the index move continue.

11. Close the user windows.

12. Remove the 12-24V dc (Drive Enable) from input 1.
Configuring Your Ultra3000 Drive with Logix

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

Configuring Your Ultra3000 Drive

To configure your Ultra3000 drive:

1. Apply power to your Ultra3000 drive (refer to the section Applying Power To Your Ultra3000 Drive).

2. Start your Ultraware software and ensure your Ultra3000 drive is detected (refer to the section Detecting Your Ultra3000 Drive).

3. Select a motor (refer to the section Selecting a Motor).

4. Expand Operation Modes in the Drive properties window.

5. Select Analog Current Input as the operation mode (as indicated in the window below).


7. Select Ready as the value of Output 1.
Configuring Your Logix Analog Motion Module

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

For greater detail on the RSLogix 5000 software as it applies to ControlLogix and SoftLogix modules, refer to the table below for the appropriate publication.

<table>
<thead>
<tr>
<th>For: Detailed information on configuring and troubleshooting your ControlLogix motion module</th>
<th>Refer to this Document: ControlLogix Motion Module Setup and Configuration Manual</th>
<th>Publication Number: 1756-UM006x-EN-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>For: Detailed information on configuring and troubleshooting your SoftLogix PCI card</td>
<td>Refer to this Document: SoftLogix Motion Card Setup and Configuration Manual</td>
<td>Publication Number: 1784-UM003x-EN-P</td>
</tr>
</tbody>
</table>

If you have already configured your Logix module using one of the setup and configuration manuals listed above, go directly to Testing and Tuning Your Axis (page 1-41). If not, go to Configuring Your Logix Controller beginning below.

Configuring Your Logix Controller

To configure your Logix controller:

1. Apply power to your Logix chassis/PC containing the analog motion module and open your RSLogix 5000 software.

   - Select controller type
   - Name the file
   - Select the ControlLogix chassis size
   - Select the ControlLogix processor slot

3. Select OK.

5. Select the **Date and Time** tab. The following window opens.

6. Check the box **Make this controller the Coordinated System Time master**.

7. Select **OK**.

**Configuring Your Logix Module**

To configure your Logix module:

1. Right-click on I/O Configuration in the explorer window and select **New Module**. The Select Module Type window opens.

2. Select **1756-M02AE** or **1784-PM02AE** as appropriate for your actual hardware configuration.

- Name the module
- Select the slot where your module resides
- Select an Electronic Keying option.

4. Select Next until the following window opens.


- Name the axis
- Select AXIS_SERVO as the Data Type
6. Select **OK**.

7. Assign your axis to a node address (as shown in the window below).

![Configure Module Properties](image)

8. Select **Finish**.

**Configuring the Motion Group**

To configure the motion group:

1. Right-click **Motion Groups** in the explorer window and select **New Motion Group**. The New Tag window opens.

![Configure New Tag](image)

2. Name the new motion group.

3. Select **OK**. New group appears under Motion Group folder.
4. Right-click on the new motion group and select **Properties**. The Motion Group Properties window opens.

5. Select the **Axis Assignment** tab and move your axis (created earlier) from *Unassigned* to *Assigned*.

6. Select the **Attribute** tab and edit the default values as appropriate for your application.

7. Select **OK**.

**Configuring Axis Properties**

To configure axis properties:

1. Right-click on an axis in the explorer window and select **Properties**. The Axis Properties window opens.

2. Select the **Servo** tab.
3. Select **Torque** as the External Drive Configuration.

4. Check the box **Enable Drive Fault Input** and select **Normally Closed**.

5. Select the **Units** tab and edit default values as appropriate for your application.

6. Select the **Conversion** tab and edit default values as appropriate for your application.

7. Select **OK**.

8. Verify your Logix program and save the file.

**Downloading 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 and the analog motion module.

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

For greater detail on the RSLogix 5000 software as it applies to ControlLogix and SoftLogix modules, refer to the table below for the appropriate publication.

<table>
<thead>
<tr>
<th>For: Detailed information on configuring and troubleshooting your ControlLogix motion module</th>
<th>Refer to this Document</th>
<th>Publication Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ControlLogix Motion Module Setup and Configuration Manual</td>
<td>1756-UM006x-EN-P</td>
<td></td>
</tr>
<tr>
<td>Detailed information on configuring and troubleshooting your SoftLogix PCI card</td>
<td>SoftLogix Motion Card Setup and Configuration Manual</td>
<td>1784-UM003x-EN-P</td>
</tr>
</tbody>
</table>

If you have already tested and tuned your axis using one of the setup and configuration manuals listed above, you are finished commissioning your drive. If not, go to Testing Your Axis beginning below.

Testing Your Axis

To test your axis:

1. Remove the load from your axis.

2. Right-click on the axis in your Motion Group folder in the explorer window and select Axis Properties. The Axis Properties window opens.
3. Select the **Hookup** tab.

![Image of Ultra3000 setup](image)

4. Select **2.0** as the number of revolutions for the test (or another number more appropriate for your application).

<table>
<thead>
<tr>
<th>This Test:</th>
<th>Performs this Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Marker</td>
<td>Verifies marker detection capability as you rotate the motor shaft.</td>
</tr>
<tr>
<td>Test Feedback</td>
<td>Verifies feedback connections are wired correctly as you rotate the motor shaft.</td>
</tr>
<tr>
<td>Test Command &amp; Feedback</td>
<td>Verifies motor power and feedback connections are wired correctly as you command</td>
</tr>
<tr>
<td></td>
<td>the motor to rotate. Also, allows you to define polarity.</td>
</tr>
</tbody>
</table>

5. 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.
6. Select the **Test** (Marker/Feedback/Command & Feedback) button to verify connections. The Online Command window opens. Follow the on-screen test instructions. When the test completes, the Command Status changes from *Executing* to *Command Complete*.

![Online Command - Encoder Test](image1)

7. Select **OK**.

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

![Online Command - Apply Test](image2)

9. Select **OK**.

<table>
<thead>
<tr>
<th>If:</th>
<th>Then:</th>
</tr>
</thead>
</table>
| Your test completes successfully, this window appears: | 1. Select **OK**.  
2. Remove Drive Enable signal (CN1-31).  
3. Go to *Tuning Your Axis*. |
| ![Image](image3) | |
| Your test failed, this window appears: | 1. Select **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. |
| ![Image](image4) | |
Tuning Your Axis

To tune your axis:

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

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

2. Select the **Tune** tab.

3. Enter values for Travel Limit and Speed. In this example, Travel Limit = 5 and Speed = 2.

   Note: Actual value of programmed units depend on your application. For more information, contact Allen-Bradley technical support.

4. Check **Tune** boxes as appropriate for your application.

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

   To avoid personal injury or damage to equipment, apply 24V Drive Enable signal (CN1-31) only to the axis you are tuning.
6. Select the **Start Tuning** button to auto-tune your axis. The Online Command - Tune Servo window opens. When the test completes, the Command Status changes from **Executing** to **Command Complete**.

![Online Command - Tune Servo window](image)

7. Select **OK**. The Tune Bandwidth window opens.

![Tune Bandwidth window](image)

Note: 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.

8. Select **OK**.

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

![Online Command - Apply Tune window](image)
10. Select **OK**.

<table>
<thead>
<tr>
<th>If:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your test completes successfully, this window appears:</td>
<td>1. Select <strong>OK</strong>.</td>
</tr>
<tr>
<td></td>
<td>2. Remove Drive Enable (Input 1) signal (CN1-31) applied earlier.</td>
</tr>
<tr>
<td></td>
<td>3. You are finished tuning your Ultra3000.</td>
</tr>
<tr>
<td><img src="image1" alt="RSLogix 5000" /></td>
<td></td>
</tr>
<tr>
<td><img src="image2" alt="RSLogix 5000" /></td>
<td></td>
</tr>
<tr>
<td>Your test failed, this widow appears:</td>
<td>1. Select <strong>OK</strong>.</td>
</tr>
<tr>
<td><img src="image3" alt="RSLogix 5000" /></td>
<td>2. Make an adjustment to motor velocity.</td>
</tr>
<tr>
<td><img src="image4" alt="RSLogix 5000" /></td>
<td>3. Refer to appropriate Logix motion module setup and configuration manual for more information.</td>
</tr>
<tr>
<td><img src="image5" alt="RSLogix 5000" /></td>
<td>4. Return to step 6 and run the test again.</td>
</tr>
</tbody>
</table>
Configuring Your Ultra3000 with SERCOS interface Drive

The procedures in this section apply to Ultra3000-SE drives (2098-DSD-xxx-SE and -HV.xxx-SE) and describe how to:

- Configure your Ultra3000-SE drive
- Configure your SERCOS interface module using RSLogix 5000 software
- Download your program to your Logix controller
- Apply power to your Ultra3000-SE drive
- Test and tune your motor using RSLogix 5000 software.

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

Front Panel Connections

This section provides front panel connection information for your Ultra3000-SE and the ControlLogix SERCOS interface module or SoftLogix SERCOS PCI card.

Use the figure below to locate the SERCOS ring LEDs and fiber-optic cable connections on your SERCOS interface module.

Figure 1.7 ControlLogix and SoftLogix SERCOS Connector Locations

---

SERCOS interface TM

Front View

Bottom View

ControlLogix 1756-MxxSE SERCOS Interface Module

SERCOS Receive Connector, Rx (front)
SERCOS Transmit Connector, Tx (rear)

SoftLogix 1784-PM16SE SERCOS interface PCI Card
(as viewed from the back of your PC)

SERCOS Transmit Connector, Tx
SERCOS Receive Connector, Rx

RSLogix 5000
Use the figure below to locate the front panel connections on the Ultra3000-SE 230V drives (500W, 1 kW, and 2 kW).

**Figure 1.8**
Ultra3000-SE Front Panel Connections for 2098-DSD-005-SE, -010-SE, and -020-SE

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000-SE 230V drive (3 kW).

**Figure 1.9**
*Ultra3000-SE Front Panel Connections for 2098-DSD-030-SE*

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000-SE 230V drives (7.5 and 15 kW).

**Figure 1.10**
Ultra3000-SE Front Panel Connections for 2098-DSD-075-SE and -150-SE

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000-SE 460V drives (3 kW, 5 kW, 10 kW, 15 kW, and 22 kW).

Figure 1.11
Ultra3000-SE Front Panel Connections for 2098-DSD-HVxxx-SE

For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual (publication 2098-IN003x-EN-P).
Configuring Your Ultra3000 Drive

Use the following procedures to configure your Ultra3000-SE drive (2098-DSD-xxx-SE and -HV:xxx-SE).

To configure your Ultra3000-SE drive:

1. Verify that there is no power applied to the drive, and the SERCOS fiber-optic cables are correctly plugged into the Tx and Rx connectors. To verify your fiber-optic cable connections, refer to the Ultra3000 Digital Servo Drives Installation Manual (publication 2098-IN003x-EN-P).

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 figures 1.8-1.11 for the location of the switches. Refer to the table below for examples.

<table>
<thead>
<tr>
<th>For this Node Address:</th>
<th>Set the MSD switch to:</th>
<th>Set the LSD switch to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Use the MSD and LSD rotary switches on the SERCOS panel of the drive to set node addresses. Refer to Figure 1.13 for node address setting examples.

3. Set the data rate. Valid data rates are 2M, 4M, and 8M baud. Refer to figures 1.8-1.11 for the location of the switch.

Use the Data Rate rotary switch on the SERCOS panel of the drive to set the data rate.
Refer to Figure 1.12 for an example of the fiber-optic connections between the Ultra3000-SE drive(s) and the SoftLogix PCI card. Although Figure 1.12 only illustrates the SERCOS fiber-optic ring with the SoftLogix PCI card, node addressing for SoftLogix is done the same way as shown in the node addressing example with ControlLogix (Figure 1.13).

4. Verify CN1-31 (Input 1) 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 -38.

**IMPORTANT** Without CN1-37 and -38 inputs applied, the drive/system will fault.
Configuring Your Logix SERCOS interface Module

This procedure assumes that you have configured the Ultra3000-SE baud rate and optical power switches.

For greater detail on the RSLogix 5000 software as it applies to ControlLogix and SoftLogix modules, refer to the table below for the appropriate publication.

<table>
<thead>
<tr>
<th>For: Detailed information on configuring and troubleshooting your ControlLogix motion module</th>
<th>Refer to this Document: ControlLogix Motion Module Setup and Configuration Manual</th>
<th>Publication Number: 1756-UM006x-EN-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed information on configuring and troubleshooting your SoftLogix PCI card</td>
<td>SoftLogix Motion Card Setup and Configuration Manual</td>
<td>1784-UM003x-EN-P</td>
</tr>
</tbody>
</table>

If you have already configured your Logix controller using one of the setup and configuration manuals listed above, go directly to Applying Power To Your Ultra3000 with SERCOS (page 1-61). If not, go to Configuring Your Logix Controller beginning below.

Configuring Your Logix Controller

To configure your Logix controller:

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

   - Select controller type
   - Name the file
   - Select the ControlLogix chassis size
   - Select the ControlLogix processor slot

3. Select OK.

5. Select the Date and Time tab. The following window opens.

6. Check the box Make this controller the Coordinated System Time master.

**IMPORTANT** Only one ControlLogix processor can be assigned as the Coordinated System Time master.

7. Select OK.

**Configuring Your Logix Module**

To configure your Logix module:

1. Right-click on I/O Configuration in the explorer window and select New Module. The Select Module Type window opens.

2. Select 1756-M.xxSE or 1784-PM16SE as appropriate for your actual hardware configuration.

- Name the module
- Select the slot where your module resides
- Select an Electronic Keying option.

4. Select **Next** until the following window opens.
5. Select **Data Rate**, **Cycle Time**, and **Optical Power** settings.
   - Ensure the Data Rate setting matches Data Rate (baud rate) switch as set on the Ultra3000-SE drive, or use the Auto Detect setting.
   - Set the Cycle Time according to the table below.

<table>
<thead>
<tr>
<th>Logix SERCOS Module</th>
<th>Ultra3000-SE Drive Series</th>
<th>Data Rate Mbit/s</th>
<th>SERCOS Ring Cycle Time ms</th>
<th>Number of Axes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1756-M08SE (Series A)</td>
<td>A or B</td>
<td>4</td>
<td>0.5</td>
<td>N/A</td>
</tr>
<tr>
<td>1756-M08SE (Series B)</td>
<td>B only</td>
<td>8</td>
<td>0.5</td>
<td>N/A</td>
</tr>
<tr>
<td>1756-M16SE or 1784-PM16SE</td>
<td>A or B</td>
<td>4</td>
<td>0.5</td>
<td>N/A</td>
</tr>
<tr>
<td>1756-M16SE or 1784-PM16SE</td>
<td>B only</td>
<td>8</td>
<td>0.5</td>
<td>N/A</td>
</tr>
</tbody>
</table>

   - Set the Transmit Power setting to High.

6. Select **Finish**. Your new SERCOS module appears under the I/O Configuration folder in the explorer window.

**Configuring Your Ultra3000-SE**

To configure your Ultra3000-SE drive:

1. Right-click on your new module and select **New Module**. The Select Module Type window opens.

2. Select **2098-DSD-xxx-SE** or **-HVxxx-SE** drive as appropriate for your actual hardware configuration.

- Name the module
- Set the Base Node address

  Note: Set the node address in the software to match the node address setting on the drive. Refer to *Configuring Your Ultra3000 Drive*, step 2, on page 1-52.

- Electronic Keying option

4. Select **Next** until the following window appears.

![Module Properties Window](image)

5. Select the **New Axis** button. The New Tag window opens.

- Name the axis
- Select **AXIS_SERVO_DRIVE** as the Data Type

6. Assign your axis to a node address (as shown in the window below).

![Module Properties Window](image)
7. Select **Next. Bus Regulator Catalog Number** (shunt option) does not apply. Select `<none>`.

    **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-IN004x-EN-P) for more information.

8. Select **Finish**.

**Configuring the Motion Group**

To configure the motion group:

1. Right-click Motion Groups in the explorer window and select **New Motion Group**. The New Tag window opens.

2. Name new motion group.

3. Select **OK**. New group appears under Motion Group folder.

4. Right-click on the new motion group and select **Properties**. The Motion Group Properties window opens.

![Motion Group Properties window]

5. Select the **Axis Assignment** tab and move your axis (created earlier) from *Unassigned* to *Assigned*.

6. Select the **Attribute** tab and edit the default values as appropriate for your application.

7. Select **Ok**.
Configuring Axis Properties

To configure axis properties:

8. Right-click on an axis in the explorer window and select **Axis Properties**. The Axis Properties window opens.

![Axis Properties Window]

9. Select the **Drive/Motor** tab.
   - Set the Ultra3000 Amplifier (2098-DSD-xxx-SE or -HVxxx-SE)
   - Set the Motor Catalog Number
   - Set Loop Configuration to Position Servo
   
   Note: For amplifier and motor catalog numbers refer to the amplifier and motor name plate.

10. Select the **Motor Feedback** tab and verify the Feedback Type shown is appropriate for your actual hardware configuration.

11. Select the **Units** tab and edit default values as appropriate for your application.

12. Select the **Conversion** tab and edit default values as appropriate for your application.
13. Select the **Fault Actions** tab and click on the Set Custom Stop Action... tab. The Custom Stop Action Attributes window opens.

- Set the Brake Engage Delay Time
- Set the Brake Release Delay Time
- Select **Close**

14. Select **OK**.

15. Verify your Logix program and save the file.

**Downloading Your Program**

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

**Applying Power To Your Ultra3000 with SERCOS**

This procedure assumes 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.
To apply power to your Ultra3000-SE drive:

1. Disconnect any load to the motor. Ensure 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 without first applying input power.

2. Apply input power to the Ultra3000-SE and observe the front panel Logic Power indicator LED as shown in the figure below.

   **Figure 1.14**
   Logic Power and Status LED Display

<table>
<thead>
<tr>
<th>If the Logic Power LED is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Go to main step 3.</td>
</tr>
<tr>
<td>Not ON</td>
<td>1. Check your input power connections.  2. Repeat main step 2.</td>
</tr>
</tbody>
</table>

3. Observe the front panel seven segment Status LED display as shown in Figure 1.14.

<table>
<thead>
<tr>
<th>If the Status LED display on your:</th>
<th>Is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2098-DSD-xxx-SE or -HV.xxx-SE drive</td>
<td>Displaying a fixed 4</td>
<td>The drive is ready. Go to main step 4.</td>
</tr>
<tr>
<td></td>
<td>Flashing an E followed by two numbers</td>
<td>Go to Error Codes on page 2-2.</td>
</tr>
</tbody>
</table>

4. Observe the module status LED.

<table>
<thead>
<tr>
<th>If the module status LED:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is steady green</td>
<td>The drive is enabled. Go to step 5.</td>
</tr>
<tr>
<td>Flashes green</td>
<td>The drive is disabled. Go to step 5.</td>
</tr>
<tr>
<td>Is not steady green/ not flashing green</td>
<td>Go to SERCOS Module Status LED on page 2-8.</td>
</tr>
</tbody>
</table>
5. Observe the network status LED.

<table>
<thead>
<tr>
<th>If the network status LED:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashes green</td>
<td>Establishing communication with network (wait for steady green).</td>
</tr>
<tr>
<td>Illuminates steady green</td>
<td>Communication is ready. Go to step 6.</td>
</tr>
<tr>
<td>Is not steady green/ not flashing green</td>
<td>Go to DeviceNet Network Status LED on page 2-12.</td>
</tr>
</tbody>
</table>

6. Observe the three SERCOS LEDs on the SERCOS module.

<table>
<thead>
<tr>
<th>If the three SERCOS LEDs:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash green and red</td>
<td>Establishing communication (wait for steady green on all three LEDs).</td>
</tr>
<tr>
<td>Illuminates steady green</td>
<td>Communication ready. Go to Testing and Tuning Your Axis.</td>
</tr>
<tr>
<td>Is not flashing green and red/ not steady green</td>
<td>Go to the appropriate Logix motion module setup and configuration manual for specific instructions and troubleshooting.</td>
</tr>
</tbody>
</table>

Testing and Tuning Your Axis

This procedure assumes that you have configured your Ultra3000-SE, 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 LEDs are as described in the table below.

<table>
<thead>
<tr>
<th>Status LED:</th>
<th>Must be:</th>
<th>Status:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seven Segment</td>
<td>Displaying a fixed 4</td>
<td>The drive is ready.</td>
</tr>
<tr>
<td>Module</td>
<td>Is steady green or Flashes green</td>
<td>The drive is enabled.</td>
</tr>
<tr>
<td>Network</td>
<td>Illuminates steady green</td>
<td>SERCOS Communication is ready.</td>
</tr>
</tbody>
</table>
For greater detail on the RSLogix 5000 software as it applies to ControlLogix and SoftLogix modules, refer to the table below for the appropriate publication.

<table>
<thead>
<tr>
<th>For:</th>
<th>Refer to this Document</th>
<th>Publication Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed information on configuring and troubleshooting your ControlLogix motion module</td>
<td>ControlLogix Motion Module Setup and Configuration Manual</td>
<td>1756-UM006x-EN-P</td>
</tr>
<tr>
<td>Detailed information on configuring and troubleshooting your SoftLogix PCI card</td>
<td>SoftLogix Motion Card Setup and Configuration Manual</td>
<td>1784-UM003x-EN-P</td>
</tr>
</tbody>
</table>

If you have already tested and tuned your axis using one of the setup and configuration manuals listed above, you are finished commissioning your drive. If not, go to *Testing Your Axis* beginning below.

**Testing Your Axis**

To test your axis:

1. Verify the load was removed from your motor(s).

2. Right-click on the axis in your Motion Group folder in the explorer window and select **Axis Properties**. The Axis Properties window opens.

3. Select the **Hookup** tab.

![Axis Properties - Axis_0.png](image-url)
4. Select 2.0 as the number of revolutions for the test (or another number more appropriate for your application).

<table>
<thead>
<tr>
<th>This Test:</th>
<th>Performs this Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Marker</td>
<td>Verifies marker detection capability as you rotate the motor shaft.</td>
</tr>
<tr>
<td>Test Feedback</td>
<td>Verifies feedback connections are wired correctly as you rotate the motor shaft.</td>
</tr>
<tr>
<td>Test Command &amp; Feedback</td>
<td>Verifies motor power and feedback connections are wired correctly as you command the motor to rotate. Also, allows you to define polarity.</td>
</tr>
</tbody>
</table>

5. 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.

6. Select the Test (Marker/Feedback/Command & Feedback) button to verify connections. The Online Command window opens. Follow the on-screen test instructions. When the test completes, the Command Status changes from Executing to Command Complete.

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

9. Select OK.

<table>
<thead>
<tr>
<th>If:</th>
<th>Then:</th>
</tr>
</thead>
</table>
| Your test completes successfully, this window appears: | 1. Select OK.  
2. Remove Drive Enable signal (CN1-31).  
3. Go to Tuning Your Axis. |
| Your test failed, this widow appears:                      | 1. Select 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. |
Tuning Your Axis

To tune your axis:

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

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

2. Select the **Tune** tab.

3. Enter values for Travel Limit and Speed. In this example, Travel Limit = 5 and Speed = 2.

   Note: Actual value of programmed units depend on your application. For more information, contact Allen-Bradley technical support.

4. Check **Tune** boxes as appropriate for your application.

5. 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.
6. Select the **Start Tuning** button to auto-tune your axis. The Online Command - Tune Servo window opens. When the test completes, the Command Status changes from *Executing* to *Command Complete*.

![Online Command - Tune Servo](image)

7. Select **OK**. The Tune Bandwidth window opens.

![Tune Bandwidth](image)

Note: 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.

8. Select **OK**.

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

![Online Command - Apply Tune](image)
10. Select **OK**.

<table>
<thead>
<tr>
<th>If:</th>
<th>Then:</th>
</tr>
</thead>
</table>
| Your test completes successfully, this window appears: | 1. Select **OK**.  
2. Remove Drive Enable (Input 1) signal (CN1-31) applied earlier.  
3. You are finished tuning your axis. |

| Your test failed, this widow appears: | 1. Select **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 6 and run the test again. |
Configuring Your Ultra3000 with DeviceNet Drive

The procedures in this section apply to Ultra3000-DN drives (2098-DSD-xxx-DN, -xxx-X-DN, -HVxxx-DN, and -HVxxx-X-DN) and describe how to:

- Configure your Ultra3000-DN drive
- Apply power to your Ultra3000-DN drive

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

Front Panel Connections

This section provides front panel connection information for your Ultra3000-DN drive.

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

Figure 1.15
Ultra3000-DN Front Panel Connections for 2098-DSD-005-DN, -005X-DN, -010-DN, -010X-DN, -020-DN, and -020X-DN

For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000-DN 230V drives (3 kW).

Figure 1.16
Ultra3000-DN Front Panel Connections for 2098-DSD-030-DN and -030X-DN

For CN1, CN2, and CN3 connector pin-out information, refer to the Ultra3000 Digital Servo Drives Installation Manual (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000-DN 230V drives (7.5 and 15 kW).

**Figure 1.17**
**Ultra3000-DN Front Panel Connections**
for 2098-DSD-075-DN, -075X-DN, -150-DN, and -150X-DN

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Use the figure below to locate the front panel connections on the Ultra3000-DN 460V drives (3 kW, 5 kW, 10 kW, 15 kW, and 22 kW).

**Figure 1.18**
Ultra3000-DN Front Panel Connections for 2098-DSD-HVxxx-DN and HVxxx-DN

For CN1, CN2, and CN3 connector pin-out information, refer to the *Ultra3000 Digital Servo Drives Installation Manual* (publication 2098-IN003x-EN-P).
Configuring Your Ultra3000 with DeviceNet

Use the following procedures to configure your Ultra3000-DN drive (2098-DSD-xxx-DN, -xxx-X-DN, -HVxxx-DN, and -HVxxx-X-DN) using Ultraware software and apply power to the drive.

To configure your Ultra3000-DN drive:

1. Verify that there is no power applied to the drive, and the DeviceNet cable is connected (refer to figures 1.15-1.18 for the connector location).

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 figures 1.15-1.18 for the switch locations. Refer to the table below for examples.

<table>
<thead>
<tr>
<th>For this Node Address:</th>
<th>Set the MSD switch to:</th>
<th>Set the LSD switch to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: 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 kps, 250 kps, 500 kps, AUTO, and PGM. Refer to figures 1.15-1.18 for the switch location.

Note: 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 MSD and LSD rotary switches on the DeviceNet panel of the drive to set node addresses.

Use the Data Rate rotary switch on the DeviceNet panel of the drive to set the data rate.
Applying Power To Your Ultra3000 with DeviceNet

This procedure assumes you have wired your Ultra3000-DN 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.

To apply power to your Ultra3000-DN drive:

1. Disconnect any load to the motor. Ensure 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 and observe the front panel Logic Power indicator LED as shown in the figure below.

Figure 1.19
Logic Power and Status LED Display

<table>
<thead>
<tr>
<th>If the Logic Power LED is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Go to main step 3.</td>
</tr>
<tr>
<td>Not ON</td>
<td>1. Check your input power connections.</td>
</tr>
<tr>
<td></td>
<td>2. Repeat main step 2.</td>
</tr>
</tbody>
</table>
3. Observe the front panel seven segment Status LED display as shown in Figure 1.19.

<table>
<thead>
<tr>
<th>If the Status LED display on your:</th>
<th>Is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2098-DSD-xxxx-DN, -xxxxX-DN, -HV-xxxx-DN, or HV-xxxxX-DN drive</td>
<td>Actively cycling segments in a full circle</td>
<td>The drive is ready. Go to step 4.</td>
</tr>
<tr>
<td></td>
<td>Flashing an E followed by two numbers</td>
<td>Go to Error Codes on page 2-2.</td>
</tr>
</tbody>
</table>

4. Observe the module status LED.

<table>
<thead>
<tr>
<th>If the module status LED:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is steady green</td>
<td>The drive is ready. Go to step 5.</td>
</tr>
<tr>
<td>Is not steady green</td>
<td>Go to SERCOS Module Status LED on page 2-8.</td>
</tr>
</tbody>
</table>

5. Observe the network status LED.

<table>
<thead>
<tr>
<th>If the network status LED:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is off</td>
<td>Establishing communication with network (wait for flashing or steady green).</td>
</tr>
<tr>
<td>Is flashing or steady green</td>
<td>Communication is ready. Go to step 6.</td>
</tr>
<tr>
<td>Is not flashing or steady green</td>
<td>Go to DeviceNet Network Status LED on page 2-12.</td>
</tr>
</tbody>
</table>

6. For further commissioning procedures, refer to the following sections beginning on page 1-8.
   - Detecting Your Ultra3000 Drive
   - Understanding the Workspace and Drive Branches
   - Selecting a Motor
   - Tuning Your Motor
   - Testing Your Motor (Non-Indexing Move)
   - Testing Your Motor (Indexing Move)
   - Indexing and Non-Indexing Move Examples

Refer to the Ultra3000 with DeviceNet Reference Manual (publication 2098-RM001x-EN-P) for information on communicating to the Ultra3000 using DeviceNet.
Chapter Objectives

This chapter provides a description of maintenance and troubleshooting activities for the Ultra3000. This chapter includes these sections:

- Safety Precautions
- General Troubleshooting
- Troubleshooting for SERCOS Drives
- Troubleshooting for DeviceNet Drives

Safety Precautions

Observe the following safety precautions when troubleshooting your Ultra3000 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 Allen-Bradley representative for further assistance. To determine if your Ultra3000 drive has an error, refer to the table below.

If the Logic Power LED is ON and the Status LED display on your:

<table>
<thead>
<tr>
<th>Is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2098-DSD-xxx, -xxxX, -HVxxx, or -HVxxxX drive</td>
<td>Actively cycling segments in a full circle</td>
</tr>
<tr>
<td>2098-DSD-xxx-DN, -xxxX-DN, -HVxxx-DN, -HVxxx-X-DN drive</td>
<td>Displaying a fixed 4</td>
</tr>
<tr>
<td>2098-DSD-xxx-SE or -HVxxx-SE drive</td>
<td>Flashing E followed by two numbers</td>
</tr>
<tr>
<td>All drives</td>
<td>Flashing L</td>
</tr>
</tbody>
</table>

Error Codes

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

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

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Problem or Symptom</th>
<th>Possible Cause(s)</th>
<th>Action/Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>E01</td>
<td>Non-Volatile Memory Endurance Exceeded</td>
<td>Range of motion and number of home position definitions during the product life exceeds the maximum allowed (applies only to systems with absolute feedback).</td>
<td>This is an unrecoverable fault, the drive must be sent back to the factory.</td>
</tr>
<tr>
<td>E02</td>
<td>Velocity Exceeds Position Rollover /2</td>
<td>The velocity command or feedback exceeds half the machine cycle length per millisecond (applies only when the machine cycle position rollover is enabled).</td>
<td>Increase machine cycle size or reduce velocity profile. This error only applies to firmware versions prior to 1.10.</td>
</tr>
<tr>
<td>Error Code</td>
<td>Problem or Symptom</td>
<td>Possible Cause(s)</td>
<td>Action/Solution</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>E03</td>
<td>Absolute Feedback Range Exceeded</td>
<td>The motor position exceeds +/- 2047 revolutions from the home position (applies only to systems with absolute feedback).</td>
<td>• Decrease application range of motion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Upgrade firmware.</td>
</tr>
<tr>
<td>E04</td>
<td>Motor Overtemperature</td>
<td>Motor thermostat trips due to:</td>
<td>• Operate within (not above) the continuous torque rating for the ambient temperature (40°C maximum).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• High motor ambient temperature and/or</td>
<td>• Lower ambient temperature, increase motor cooling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Excessive current</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motor wiring error.</td>
<td>Check motor wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incorrect motor selection.</td>
<td>Verify the proper motor has been selected.</td>
</tr>
<tr>
<td>E05</td>
<td>IPM Fault</td>
<td>Motor cables shorted.</td>
<td>Disconnect motor power cables from the motor. If the motor is difficult to turn by hand, it may need to be replaced.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Motor winding shorted internally.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ultra3000 temperature too high.</td>
<td>• Check for clogged vents or defective fan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Ensure cooling is not restricted by insufficient space around the unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation above continuous power rating.</td>
<td>• Verify ambient temperature is not too high.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Operate within the continuous power rating.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reduce acceleration rates.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ultra3000 has a bad IPM output, short circuit, or overcurrent.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An attempt was made to enable the drive without waiting at least 1.0 second after applying the main AC power. Note: This applies to 2098-DSD-005, -010, and -020 Ultra3000 models only (when using an external +5V auxiliary power supply).</td>
<td>Wait at least 1.0 second after the main AC is applied before enabling the drive.</td>
</tr>
<tr>
<td>E06</td>
<td>Hardware Overtravel (SERCOS only)</td>
<td>Dedicated overtravel input is inactive.</td>
<td>• Check wiring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Verify motion profile.</td>
</tr>
<tr>
<td>E07</td>
<td>RESERVED</td>
<td>Call your local Allen-Bradley representative.</td>
<td></td>
</tr>
<tr>
<td>E08</td>
<td>RESERVED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E09</td>
<td>Bus Undervoltage</td>
<td>Low AC line/AC power input.</td>
<td>• Verify voltage level of the incoming AC power.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check AC power source for glitches or line drop.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Install an uninterruptible power supply (UPS) on your AC input.</td>
</tr>
<tr>
<td>Error Code</td>
<td>Problem or Symptom</td>
<td>Possible Cause(s)</td>
<td>Action/Solution</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 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. | • 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.                                                                 | • 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.                      | • 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. | • 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) | 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.                                  | • 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.                            | • Check cables for noise.  
• Check tuning.                                                                         |
| E19        | Excess Position Error               | Position error limit was exceeded.                                              | • Increase the feedforward gain.  
• Increase following error limit or time.  
• Check position loop tuning.                                                          |
<table>
<thead>
<tr>
<th>Error Code</th>
<th>Problem or Symptom</th>
<th>Possible Cause(s)</th>
<th>Action/Solution</th>
</tr>
</thead>
</table>
| E20        | Motor Encoder State Error              | The motor encoder encountered an illegal transition.                             | • 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.                           | • Use shielded cables with twisted pair wires.  
• Route the encoder cable away from potential noise sources.  
• Bad 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.            | • 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 overheating has tripped.            | • 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.                                               | • Increase time or size of allowable error.  
• Reduce acceleration.  
• Check tuning. |
<p>| 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.                                                         |</p>
<table>
<thead>
<tr>
<th>Error Code</th>
<th>Problem or Symptom</th>
<th>Possible Cause(s)</th>
<th>Action/Solution</th>
</tr>
</thead>
</table>
| E28       | Motor Parameter Error                      | Parameter loaded from smart encoder or received from SERCOS controller is incompatible with the drive. | • 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. | • 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.                   | • 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       | Maximum frequency of the sine/cosine circuitry has been exceeded.                | • Decrease velocity.  
• Use encoder with lower resolution (before interpolation).                                                |
| E33       | Absolute Position Exceeds Position Rollover| Motion is commanded to 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.                                                                                  |
| E35       | Precharge Fault                           | Low AC input voltage.                                                             | Call your Allen-Bradley representative.                                                                     |
| E36       | Power Circuitry Overtemperature           | Excessive heat exists in the power circuitry.                                    | • Reduce acceleration rates.  
• Reduce duty cycle (ON/OFF) of commanded motion.  
• Increase time permitted for motion.  
• Use larger Ultra3000 and motor.  
• Check tuning. |
<p>| E37       | AC Line Loss                              | One or more phases of the input AC power is missing.                             | Check input AC voltage on all phases.                                                                      |
| E38       | RESERVED                                  |                                                                                  | Call your local Allen-Bradley representative.                                                              |</p>
<table>
<thead>
<tr>
<th>Error Code</th>
<th>Problem or Symptom</th>
<th>Possible Cause(s)</th>
<th>Action/Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>E39</td>
<td>Self-sensing Commutation Startup Error</td>
<td>Motion required for self-sensing startup commutation was obstructed.</td>
<td>• Verify that there are no impediments to motion at startup, such as hard limits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increase self-sensing current if high friction or load conditions exist.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check motor or encoder wiring using wiring diagnostics.</td>
</tr>
<tr>
<td>E40</td>
<td>230V Shunt Protection Fault</td>
<td>Ineffective shunt resistor</td>
<td>• Verify that the shunt resistor (internal or external) is connected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excessive regeneration</td>
<td>• If an external shunt resistor is connected, verify that the shunt fuse is not blown.</td>
</tr>
<tr>
<td>E41</td>
<td>460V Shunt Protection Fault</td>
<td>Ineffective shunt resistor</td>
<td>• If a non Allen-Bradley external shunt resistor is used, verify that the resistance value is within specifications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excessive regeneration</td>
<td>• Verify that the motor is not being driven mechanically, causing the motor to behave as a generator.</td>
</tr>
<tr>
<td>E42</td>
<td>Motor Keying Error (SERCOS drives only)</td>
<td>The motor physically connected to the drive differs from the motor specified in the user program.</td>
<td>Select the correct motor in the user program.</td>
</tr>
<tr>
<td>E43</td>
<td>Drive Enable Input (SERCOS drives only)</td>
<td>• An attempt was made to enable the axis through software while the Drive Enable hardware input was inactive.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The Drive Enable input transitioned from active to inactive while the axis was enabled.</td>
<td>• Disable the Drive Enable Input fault.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Verify that Drive Enable hardware input is active whenever the drive is enabled through software.</td>
</tr>
<tr>
<td>E50</td>
<td>Duplicate Node Fault (SERCOS drives only)</td>
<td>Duplicate node address detected on SERCOS ring.</td>
<td>Verify that each SERCOS drive is assigned a unique node address.</td>
</tr>
<tr>
<td>All others</td>
<td>RESERVED</td>
<td></td>
<td>Call your local Allen-Bradley representative.</td>
</tr>
</tbody>
</table>
## Troubleshooting for SERCOS Drives

### SERCOS Module Status LED

Use the table below for troubleshooting the SERCOS Module Status LED on your Ultra3000 (2098-DSD-xxx-SE or -HVxxx-SE).

<table>
<thead>
<tr>
<th>If the SERCOS Module Status LED is:</th>
<th>Status is:</th>
<th>Potential Cause is:</th>
<th>Possible Resolution is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady Green</td>
<td>Normal</td>
<td>Drive is enabled.</td>
<td>Normal operation when drive is enabled.</td>
</tr>
<tr>
<td>Flashing Green</td>
<td>Standby</td>
<td>Drive is not enabled.</td>
<td>Normal operation when drive is disabled.</td>
</tr>
<tr>
<td>Flashing Red-Green</td>
<td>DC Bus Undervoltage</td>
<td>The DC bus voltage is low.</td>
<td>• Normal operation when using auxiliary power (main AC power is not applied).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• When using main AC power, refer to the section Error Codes to continue troubleshooting.</td>
</tr>
<tr>
<td>Flashing Red</td>
<td>Minor fault</td>
<td>Drive is faulted, but the fault can be cleared.</td>
<td>Refer to the section Error Codes to continue troubleshooting.</td>
</tr>
<tr>
<td>Steady Red</td>
<td>Unrecoverable fault</td>
<td>Drive is faulted, and the fault cannot be cleared.</td>
<td>Contact your local Allen-Bradley representative.</td>
</tr>
</tbody>
</table>

### SERCOS Network Status LED

Use the table below for troubleshooting the SERCOS Network Status LED on your Ultra3000 (2098-DSD-xxx-SE or -HVxxx-SE).

<table>
<thead>
<tr>
<th>If the SERCOS Network Status LED is:</th>
<th>Status is:</th>
<th>Potential Cause is:</th>
<th>Possible Resolution is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady Green</td>
<td>Communication ready</td>
<td>No faults or failures.</td>
<td>N/A</td>
</tr>
<tr>
<td>Flashing Green</td>
<td>Establishing communication</td>
<td>System is still in the process of establishing SERCOS communication.</td>
<td>Wait for steady green LED status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Node address setting on the drive module does not match SERCOS controller configuration.</td>
<td>Verify proper node switch setting.</td>
</tr>
<tr>
<td>Flashing Red</td>
<td>No communication ¹</td>
<td>Loose fiber optic connection.</td>
<td>Verify proper fiber optic cable connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Broken fiber optic cable.</td>
<td>Replace fiber optic cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receive fiber optic cable connected to SERCOS transmit connector and vice versa.</td>
<td>Check proper SERCOS fiber optic cable connections.</td>
</tr>
</tbody>
</table>

¹ Refer to Fiber Optic Cable Installation and Handling Instructions (publication 2090-IN010x-EN-P) for more information.
Understanding Logix/Drive Fault Behavior

This section provides the Ultra3000-SE drive fault actions and indicates whether the fault action is programmable.

The following drive fault action definitions apply:

<table>
<thead>
<tr>
<th>Drive Fault Action</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disable Drive</td>
<td>The drive is disabled. Uncontrolled Stop, motor coasts to a stop.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Fault Message RSLogix (Ultraware)</th>
<th>Error Code</th>
<th>Description</th>
<th>Drive Fault Action</th>
<th>RSLogix Programmable Fault Action?</th>
</tr>
</thead>
<tbody>
<tr>
<td>DriveHardFault (Non-Volatile Memory Endurance Exceeded)</td>
<td>E01</td>
<td>Range of motion and number of home position definitions during the product life exceeds the maximum allowed (applies only to systems with absolute feedback).</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Velocity Exceeds Position Rollover /2)</td>
<td>E02</td>
<td>The velocity command or feedback exceeds half the machine cycle length per millisecond (applies only when the machine cycle position rollover is enabled).</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Absolute Feedback Range Exceeded)</td>
<td>E03</td>
<td>The motor position exceeds +/- 2047 revolutions from the home position (applies only to systems with absolute feedback).</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>MotorOvertempFault (Motor Overtemperature)</td>
<td>E04</td>
<td>The motor thermal switch was tripped.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>DriveHardFault (IPM Fault)</td>
<td>E05</td>
<td>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.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>HardOvertravelFault (+/- Hard Overtravel)</td>
<td>E06</td>
<td>Axis moved beyond the physical travel limits in the positive/negative direction. This fault can be configured for status only.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>MotFeedbackFault (Channel BM Line Loss)</td>
<td>E07</td>
<td>The feedback wiring is open, shorted or missing.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>MotFeedbackFault (Channel AM Line Loss)</td>
<td>E08</td>
<td>The feedback wiring is open, shorted or missing.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveUndervoltageFault (Bus Undervoltage)</td>
<td>E09</td>
<td>With 3 phase present, the DC bus voltage is below limits. The trip point if 275V and 137V DC for 460V/230V drives respectively.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveOvervoltageFault (Bus Overvoltage)</td>
<td>E10</td>
<td>The DC bus voltage is above limits. The trip point is 820V and 410V dc for 460V/230V drives respectively.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>CommutationFault (Illegal Hall State)</td>
<td>E11</td>
<td>State of Hall inputs is incorrect.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Home Search Failed)</td>
<td>E12</td>
<td>Home sensor and/or marker is outside the overtravel limits.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Home Position In Limit)</td>
<td>E13</td>
<td>Home sensor, marker, or final home position exceeds a hardware overtravel limit.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>Fault Message RSLogix (Ultraware)</td>
<td>Error Code</td>
<td>Description</td>
<td>Drive Fault Action</td>
<td>RSLogix Programmable Fault Action?</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>--------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>SERCOSFault (SERCOS or DeviceNet Communications Network problem)</td>
<td>E14</td>
<td>SERCOS or DeviceNet communications network is broken</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Excessive Electrical Cycle Length)</td>
<td>E15</td>
<td>Configuration information is not valid.</td>
<td>N/A</td>
<td>NO</td>
</tr>
<tr>
<td>SoftOvertravelFault (+/- Software Overtravel)</td>
<td>E16</td>
<td>Programmed positive/negative overtravel limit has been exceeded.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>DriveHardFault (User-Specified Current Fault)</td>
<td>E17</td>
<td>User-Specified average current level has been exceeded.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>OverspeedFault (Overspeed Fault)</td>
<td>E18</td>
<td>Motor speed has exceeded 125% of maximum rated speed.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>PositionErrorFault (Excess Position Error)</td>
<td>E19</td>
<td>Axis position error limit has been exceeded. This fault can be configured for status only.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>MotFeedbackFault (Motor Encoder State Error)</td>
<td>E20</td>
<td>The motor encoder encountered an illegal transition.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>AuxFeedbackNoiseFault (Auxiliary Encoder State Error)</td>
<td>E21</td>
<td>The auxiliary encoder encountered an illegal transition.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>OverloadFault (Motor Thermal Protection Fault)</td>
<td>E22</td>
<td>The internal filter protecting the motor from overheating has tripped.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>DriveOvertempFault (IPM Thermal Protection Fault)</td>
<td>E23</td>
<td>The internal filter protecting the drive from over heating has tripped.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>DriveHardFault (Excess Velocity Error)</td>
<td>E24</td>
<td>Velocity error limit was exceeded.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Sensor Not Assigned)</td>
<td>E25</td>
<td>Homing or registration motion was attempted without a sensor assigned.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (User-Specified Velocity Fault)</td>
<td>E26</td>
<td>User specified velocity level was exceeded.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Axis Not Homed)</td>
<td>E27</td>
<td>Absolute positioning was attempted without homing.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Motor Parameter Error)</td>
<td>E28</td>
<td>Parameter loaded from smart encoder or received from SERCOS controller is incompatible with the drive.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Encoder Output Frequency Exceeded)</td>
<td>E29</td>
<td>Encoder output frequency exceeds the maximum user specified value. This only applies when the encoder output is synthesized by the drive.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Encoder Communication Fault)</td>
<td>E30</td>
<td>Communication was not established with an intelligent (i.e. Stegmann) encoder on the motor feedback port.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault (Encoder Data)</td>
<td>E31</td>
<td>Encoder data is corrupted.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
</tbody>
</table>
## Troubleshooting Your Ultra3000

<table>
<thead>
<tr>
<th>Fault Message RSLogix</th>
<th>Error Code</th>
<th>Description</th>
<th>Drive Fault Action</th>
<th>RSLogix Programmable Fault Action?</th>
</tr>
</thead>
<tbody>
<tr>
<td>DriveHardFault</td>
<td>E32</td>
<td>Maximum frequency of the sine/cosine circuitry has been exceeded.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E33</td>
<td>Absolute position exceeds position rollover.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E34</td>
<td>Excessive ground current in the converter was detected.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E35</td>
<td>The converter pre-charge cycle has failed.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E36</td>
<td>Excessive heat exists in the power circuitry.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E37</td>
<td>One or more phases of the input AC power is missing.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>SERCOSFault</td>
<td>E38</td>
<td>The SERCOS ring is not active after being active and operational.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E39</td>
<td>Self-sense commutation fault detected</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E40</td>
<td>Ineffective shunt resistor</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>DriveHardFault</td>
<td>E41</td>
<td>Ineffective shunt resistor</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>ConfigFault</td>
<td>E42</td>
<td>The motor physically connected to the drive differs from the motor specified in the user program.</td>
<td>N/A</td>
<td>NO</td>
</tr>
<tr>
<td>DriveEnableInputFault</td>
<td>E43</td>
<td>Generated when Enable input switches off when drive is enabled.</td>
<td>DISABLE</td>
<td>YES</td>
</tr>
<tr>
<td>SERCOSFault</td>
<td>E50</td>
<td>Duplicate node address detected on SERCOS ring.</td>
<td>DISABLE</td>
<td>NO</td>
</tr>
<tr>
<td>RESERVED</td>
<td>All Others</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Troubleshooting for DeviceNet Drives

DeviceNet Module Status LED

Use the table below for troubleshooting the DeviceNet Module Status LED on your Ultra3000 (2098-DSD-xxx-DN, -xxxX-DN, -HVxxx-DN, or -HVxxxX-DN).

<table>
<thead>
<tr>
<th>If the Module Status LED is:</th>
<th>Status is:</th>
<th>Potential Cause is:</th>
<th>Possible Resolution is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Not powered</td>
<td>No power</td>
<td>There is no power going to the device.</td>
</tr>
<tr>
<td>Steady-Green</td>
<td>Operational</td>
<td>Normal operation</td>
<td>Normal operation - no action needed.</td>
</tr>
<tr>
<td>Flashing-Green</td>
<td>Device is in stand-by</td>
<td>Processing or waiting for input</td>
<td>Normal operation - no action needed.</td>
</tr>
<tr>
<td>Flashing-Red</td>
<td>Recoverable fault</td>
<td>Not operational</td>
<td>Power cycle or reset the drive.</td>
</tr>
<tr>
<td>Steady-Red</td>
<td>Unrecoverable fault</td>
<td>Drive problem</td>
<td>1. Check drive for power-up error. 2. Replace drive.</td>
</tr>
<tr>
<td>Flashing-Red/Green</td>
<td>Self testing</td>
<td>Self-test in progress</td>
<td>The device is in self test, wait.</td>
</tr>
</tbody>
</table>

DeviceNet Network Status LED

Use the table below for troubleshooting the DeviceNet Network Status LED on your Ultra3000 (2098-DSD-xxx-DN, -xxxX-DN, -HVxxx-DN, or -HVxxxX-DN).

<table>
<thead>
<tr>
<th>If the Network Status LED is:</th>
<th>Status is:</th>
<th>Potential Cause is:</th>
<th>Possible Resolution is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>• Not powered</td>
<td>• No power going to the device</td>
<td>1. Check the Module Status LED to verify that the drive is powered. 2. Check that one or more nodes are communicating on the network. 3. Check that at least one other node on the network is operational and the data rate is the same as the drive.</td>
</tr>
<tr>
<td></td>
<td>• Not on-line</td>
<td>• Failed Duplicate MAC ID check</td>
<td></td>
</tr>
<tr>
<td>Flashing-green</td>
<td>• On-line</td>
<td>• Passed Duplicate MAC ID check</td>
<td>No action is needed. The LED 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 LED to stop flashing and remain Steady-ON for the duration of any open connection.</td>
</tr>
<tr>
<td></td>
<td>• Not connected</td>
<td>• No connection established</td>
<td></td>
</tr>
<tr>
<td>Steady-green</td>
<td>• On-line</td>
<td>One or more connections established</td>
<td>No action needed. This condition is normal.</td>
</tr>
<tr>
<td></td>
<td>• Connected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flashing-red</td>
<td>• On-line</td>
<td>I/O connection timed out</td>
<td>1. Re-initiate I/O messaging by the master controller. 2. Reduce traffic or errors on the network so that messages can get through within the necessary time frame.</td>
</tr>
<tr>
<td></td>
<td>• Time-out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steady-red</td>
<td>Network Failure</td>
<td>• Failed Duplicate MAC ID check</td>
<td>1. Ensure that all nodes have unique addresses. 2. If all node addresses are unique, examine network for correct media installation. 3. Ensure that all nodes have the same Data Rate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Bus-off</td>
<td></td>
</tr>
</tbody>
</table>
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 LED). 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 - LED Status Check

A Steady-Red Module Status LED can mean an error. If the Network Status LED 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 LED remains on after the Duplicate MAC ID test shows all devices to have a unique node address, it means a Bus-off error. Do the following:

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:

- 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 the:

- 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. Ensure that you have a diagram of the physical layout and a record of the information from the tables below.

<table>
<thead>
<tr>
<th>Cable Checks</th>
<th>Power Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of nodes.</td>
<td>Break the earth ground of the V- and Shield and verify &gt;1.0 Mohm to frame ground with power supply off.</td>
</tr>
<tr>
<td>Individual drop lengths.</td>
<td>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+.</td>
</tr>
<tr>
<td>Branched drop length.</td>
<td>Total power load and at its distribution points.</td>
</tr>
<tr>
<td>Cumulative drop length.</td>
<td>Spot check power for noise.</td>
</tr>
<tr>
<td>Total trunk length.</td>
<td></td>
</tr>
<tr>
<td>Power supply cable length and gauge.</td>
<td></td>
</tr>
<tr>
<td>Terminator locations and size.</td>
<td></td>
</tr>
</tbody>
</table>

Adjusting the Physical Network Configuration

Ways to improve the efficiency of your physical network configuration include:

- 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


Chapter Objectives

This appendix contains the following interconnect diagrams:

- Power Interconnect Diagrams
- Shunt Module Interconnect Diagrams
- Ultra3000/Motor Interconnect Diagrams
- Control String Examples (120V ac)
- Controlling a Brake Example
- Ultra3000 to Logix Cable and Interconnect Diagrams
- Ultra3000 to IMC-S Compact Cable and Interconnect Diagram
**Ultra3000 Interconnect Diagram Notes**

The notes in the table below apply to the power, drive/motor, shunt, and 120V ac control string interconnect diagrams.

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.

<table>
<thead>
<tr>
<th>Note</th>
<th>Information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>Do not daisy chain drive module power connections. Make separate connections directly to the AC supply.</td>
</tr>
<tr>
<td>4</td>
<td>For power wiring specifications, refer to the <em>Ultra3000 Installation Manual</em> (publication 2098-IN003x-EN-P).</td>
</tr>
<tr>
<td>5</td>
<td>For input fuse sizes, refer to the <em>Ultra3000 Installation Manual</em> (publication 2098-IN003x-EN-P).</td>
</tr>
<tr>
<td>6</td>
<td>May be used to maintain power to logic section of drive and status LEDs when main AC input power is removed. A separate AC line source may be used if voltage is between 88-265V acRMS on 2098-DSD-xxx (230V drives) or 207-528V acRMS on 2098-DSD-HVxxx (460V drives).</td>
</tr>
<tr>
<td>7</td>
<td>For AC line filter specifications, refer to the <em>Ultra3000 Installation Manual</em> (publication 2098-IN003x-EN-P).</td>
</tr>
<tr>
<td>8</td>
<td>Drive Enable input must be opened when 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.</td>
</tr>
<tr>
<td>9</td>
<td>Cable shield clamp must be used in order to meet CE requirements. No external connection to chassis ground required.</td>
</tr>
<tr>
<td>10</td>
<td>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 <em>Understanding the Machinery Directive</em> (publication SHB-900).</td>
</tr>
<tr>
<td>11</td>
<td>The recommended minimum wire size for wiring the safety circuit to the contactor enable connector is 1.5 mm² (16 AWG).</td>
</tr>
<tr>
<td>12</td>
<td>For motor cable specifications and drive/motor cable combinations, refer to the <em>Motion Control Selection Guide</em> (publication GMC-SG001x-EN-P).</td>
</tr>
<tr>
<td>13</td>
<td>The Ultra3000 referenced is either a 2098-DSD-xxx or -xxxX (Ultra3000 with indexing), -xxx-SE (SERCOS interface), -xxx-DN (DeviceNet interface), -xxxX-DN (DeviceNet with indexing) 230V drive.</td>
</tr>
<tr>
<td>14</td>
<td>The Ultra3000 referenced is either a 2098-DSD-HVxxx or -HVxxxX (Ultra3000 with indexing), -HVxxx-SE (SERCOS interface), -HVxxx-DN (DeviceNet interface), -HVxxxxX-DN (DeviceNet with indexing) 460V drive.</td>
</tr>
<tr>
<td>15</td>
<td>Wire colors are for flying lead cable (2090-XXNFxx-Sxx) and may vary from the premolded connector cable (2090-UXNFBxx-Sxx). Wires without terminations at the drive are not shown for clarity.</td>
</tr>
<tr>
<td>16</td>
<td>If flying lead feedback cable has a drain wire, it must be folded back and clamped with the cable shield (CN2 breakout board 2090-UXBB-DM15).</td>
</tr>
<tr>
<td>17</td>
<td>Only the MPG-Bxxx encoder uses the +5V dc supply. MPL-Bxxx and 1326AB (M2L/S2L) encoders use the +9V dc supply.</td>
</tr>
<tr>
<td>18</td>
<td>Only the MPL-ASxx and MPF-ASxx encoders use the +9V dc supply. MPG-ASxx encoders use the +5V dc supply.</td>
</tr>
<tr>
<td>19</td>
<td>Use a flyback diode for noise suppression of the motor brake coil. For more information, refer to <em>System Design for Control of Electrical Noise Reference Manual</em> (publication GMC-RM001x-EN-P).</td>
</tr>
<tr>
<td>20</td>
<td>Relay Output (CN1, pins 43 and 44) must be configured as Ready in Ultraware software.</td>
</tr>
<tr>
<td>21</td>
<td>The preferred method for supplying the auxiliary power is by using the 12- or 44-pin drive-mounted breakout board with 24V to 5V auxiliary power converter (catalog number 2090-U3CB0-DM12 or -DM44). Auxiliary +5V power is required to maintain encoder position when the main AC power is disconnected.</td>
</tr>
</tbody>
</table>
Power Interconnect Diagrams

The Ultra3000 (2098-DSD-005x-xx, -010x-xx, and -020x-xx) power wiring with 24V dc control string (non-SERCOS drives only) is shown in the figure below. To avoid a separate 5V dc auxiliary logic power supply, the 24V to 5V converter breakout board (2090-U3CBB-DMxx) is used to wire the control interface (CN1) connector. For the control string diagram with 120V ac input refer to Figure A.16.

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

Figure A.1
Typical Power Wiring of Ultra3000 System
(2098-DSD-005x-xx, -010x-xx, and -020x-xx)
The Ultra3000 (2098-DSD-030x-xx) power wiring with 24V dc control string (non-SERCOS drives only) is shown in the figure below. For the control string diagram with 120V ac input refer to Figure A.17.

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

Figure A.2
Typical Power Wiring of Ultra3000 System
(2098-DSD-030x-xx)
The Ultra3000 (2098-DSD-075x-xx and -150x-xx) power wiring with 24V dc control string (non-SERCOS drives only) is shown in the figure below. For the control string diagram with 120V ac input refer to Figure A.18.

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

**Figure A.3**
*Typical Power Wiring of Ultra3000 System (2098-DSD-075x-xx and -150x-xx)*
The Ultra3000 (2098-DSD-HVxxx-xx and -HVxxxxX-xv) power wiring with 24V dc control string is shown in the figure below. For the control string diagram with 120V ac input refer to Figure A.18.

**Figure A.4**
**Typical Power Wiring of Ultra3000 System**
(2098-DSD-HVxxx-xx and -HVxxxxX-xv)
Shunt Module Interconnect Diagrams

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

Active Shunt Module Diagrams

In the figure below, the Ultra3000 (2098-DSD-005x-xx, -010x-xx, or -020x-xx) is shown wired with the 2090-UCSR-A300 active shunt module.

Figure A.5
External Active Shunt Module Interconnect Diagram

Passive Shunt Module Diagrams

In the Figure A.6, the Ultra3000 is shown wired for internal shunt operation. This is the factory default jumper setting.

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

Figure A.6
Internal Shunt Interconnect Diagram
In the figure below, the Ultra3000 is shown wired with an external passive shunt resistor.

**Figure A.7**
External Passive Shunt Module Interconnect Diagram

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

**Figure A.8**
External Passive Shunt Module Interconnect Diagram
In the figure below, the Ultra3000 (2098-DSD-HV150x-xx or -HV220x-xx) is shown wired to a Bonitron shunt module.

**Figure A.9**
External Passive Shunt Module Interconnect Diagram
Ultra3000/Motor Interconnect Diagrams

This section contains the motor power, brake, and feedback signal interconnect diagrams between the Ultra3000 and MP-Series, 1326AB-(M2L/S2L), F-, H-, N-, and Y-Series motors.

In the figure below, the Ultra3000 (460V) is shown connected to MP-Series or 1326AB (M2L/S2L) servo motors.

Figure A.10
Ultra3000 to MP-Series or 1326AB (M2L/S2L) Motor Configuration
In the figure below, the Ultra3000 (230V) is shown connected to MP-Series (low inertia and integrated gear) 230V servo motors.

**Figure A.11**
**Ultra3000 to MP-Series (230V) Motor Configuration**

**MPL-A and MPG-A (230V) SERVO MOTORS WITH HIGH RESOLUTION FEEDBACK**

**MPL-A (230V) SERVO MOTORS WITH INCREMENTAL FEEDBACK**

**IMPORTANT**  MPL-A5xxx motors are not compatible with Ultra3000 (2098-DSD-005, -010, -020) drives.

Publication 2098-IN005B-EN-P — August 2004
In the figure below, the Ultra3000 (230V) is shown connected to MP-Series food grade servo motors.

**Figure A.12**

Ultra3000 to MP-Series Food Grade Motor Configuration

---

**IMPORTANT**

MPF-A5xxx motors are not compatible with Ultra3000 (2098-DSD-005, -010, -020) drives.
In the figure below, the Ultra3000 (230V) is shown connected to H- and F-Series (230V) servo motors.

**Figure A.13**

Ultra3000 to H- and F-Series (230V) Motor Configuration
In the figure below, the Ultra3000 (230V) is shown connected to N-Series (230V) servo motors.

**Figure A.14**
**Ultra3000 to N-Series (230V) Motor Configuration**
In the figure below, the Ultra3000 (230V) is shown connected to Y-Series (230V) servo motors.

**Figure A.15**

**Ultra3000 to Y-Series (230V) Motor Configuration**
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.

The 120V ac control string wired to the Ultra3000 (2098-DSD-005x-xx, -010x-xx, or -020x-xx) drives is shown in the figure below.

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).

Figure A.16
120V ac Single-Phase Control String Example
The 120V ac control string wired to the Ultra3000 (2098-DSD-030x-xx) drives is shown in the figure below.

**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).

**Figure A.17**

120V ac Single-Phase Control String Example
The 120V ac control string wired to the Ultra3000 (2098-DSD-075x-xx, -150x-xx, -HVxxx-xx, and -HVxxX-xv) drives is shown in the figure below.

**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).

**Figure A.18**

120V ac Three-Phase Control String Example
Controlling a Brake Example

The relay output of the Ultra3000 is suitable for directly controlling a motor brake, subject to the relay voltage limit of 30V dc, and the relay current limit of 1A 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.

The following table lists Allen-Bradley motors that are compatible with the internal relay output (CN1, pins 43 and 44), when used for controlling a brake. All other motors require an external control relay.

<table>
<thead>
<tr>
<th>Compatible Brake Motors</th>
<th>Brake Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-4030, -4050, and -4075</td>
<td>0.88A</td>
</tr>
<tr>
<td>H-3007 and -3016</td>
<td>0.60A</td>
</tr>
<tr>
<td>H-4030, -4050, and -4075</td>
<td>0.69A</td>
</tr>
<tr>
<td>N-2302, and -2304</td>
<td>0.29A</td>
</tr>
<tr>
<td>N-3406, -3412, -4214, and -4220</td>
<td>0.36A</td>
</tr>
<tr>
<td>N-5630, -5637, and -5647</td>
<td>0.71A</td>
</tr>
<tr>
<td>Y-1002 and -1003</td>
<td>0.26A</td>
</tr>
<tr>
<td>Y-2006 and -2012</td>
<td>0.31A</td>
</tr>
<tr>
<td>Y-3023</td>
<td>0.37A</td>
</tr>
<tr>
<td>MPL/MPF-310, -320, -330</td>
<td>0.50A</td>
</tr>
<tr>
<td>MPL-x420, -x430, -x4520, -x4530, -x4540</td>
<td>0.64A</td>
</tr>
<tr>
<td>MPF-x430, -x4530, -x4540</td>
<td>0.64A</td>
</tr>
<tr>
<td>MPG-x004 1</td>
<td>0.33A</td>
</tr>
<tr>
<td>MPG-x010 1</td>
<td>0.45A</td>
</tr>
<tr>
<td>MPG-x025 1</td>
<td>0.50A</td>
</tr>
<tr>
<td>MPG-x050 1</td>
<td>1.0A</td>
</tr>
<tr>
<td>MPG-x110 1</td>
<td>1.0A</td>
</tr>
<tr>
<td>1326AB-B4xxx</td>
<td>0.88A</td>
</tr>
</tbody>
</table>

1 Applies to 230V and 460V motors.

Figure A.19 shows an example configuration using Digital Output 1 and an external control relay to control a motor brake which exceeds internal relay ratings.

**Figure A.19**
Example Configuration Controlling a Motor Brake

1 Flyback diode (1N4004 rated 1.0A @ 400V dc) suppresses collapsing field of brake coil.
2 Digital Output 1 (pin 39) configured as Brake in Ultraware software.
3 For Digital Output 1 specifications, refer to the Ultra3000 Installation Manual (publication 2098-IN003x-EN-P).

**IMPORTANT**
Flyback diodes must be used when controlling a brake coil with the relay or digital output.
Ultra3000 to Logix Cable and Interconnect Diagrams

This section provides information to assist you in wiring the Ultra3000 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 Figure A.22 for the interconnect diagram.

**Figure A.20**
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 Figure A.23 for the interconnect diagram.

**Figure A.21**
Control Interface Cable and Terminations
**Ultra3000 to ControlLogix Servo Module Interconnect Diagram**

**Figure A.22**

**1756-M02AE SERVO MODULE**

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHA-0</td>
</tr>
<tr>
<td>2</td>
<td>CHA+</td>
</tr>
<tr>
<td>3</td>
<td>DRV FLT-1</td>
</tr>
<tr>
<td>4</td>
<td>DRV FLT-0</td>
</tr>
<tr>
<td>5</td>
<td>+CHB-1</td>
</tr>
<tr>
<td>6</td>
<td>+CHB+</td>
</tr>
<tr>
<td>7</td>
<td>+CHZ-1</td>
</tr>
<tr>
<td>8</td>
<td>+CHZ+</td>
</tr>
<tr>
<td>9</td>
<td>CHANALOG COM+</td>
</tr>
<tr>
<td>10</td>
<td>CHANALOG COM-</td>
</tr>
<tr>
<td>11</td>
<td>CHASSIS</td>
</tr>
<tr>
<td>12</td>
<td>RELAY +</td>
</tr>
<tr>
<td>13</td>
<td>RELAY -</td>
</tr>
<tr>
<td>14</td>
<td>AUX PWR</td>
</tr>
<tr>
<td>15</td>
<td>AUX PWR +5</td>
</tr>
<tr>
<td>16</td>
<td>AUXCOM EOM</td>
</tr>
<tr>
<td>17</td>
<td>AUXCOM EOM+</td>
</tr>
<tr>
<td>18</td>
<td>AUXCOM EOM-</td>
</tr>
<tr>
<td>19</td>
<td>RELAY +</td>
</tr>
<tr>
<td>20</td>
<td>RELAY -</td>
</tr>
<tr>
<td>21</td>
<td>AUX PWR</td>
</tr>
<tr>
<td>22</td>
<td>AUX PWR +5</td>
</tr>
<tr>
<td>23</td>
<td>CHASSIS</td>
</tr>
</tbody>
</table>

**Cable**

- **2090-U3AE-D44xx Controller Interface**
  - **Ultra3000 CN1 Connector (Axis 0)**
  - **Ultra3000 CN1 Connector (Axis 1)**

**Notes**

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.

**Publication 2098-IN005B-EN-P — August 2004**
### Ultra3000 to SoftLogix PCI Card Interconnect Diagram

**AXIS 0**

- **IO PWR**: WHT/RED 22GA
- **IO COM**: WHT/BLK 22GA
- **AUX PWR**: BLACK 22GA
- **AUXCOM**: BLACK 22GA
- **CN1 Connector**: Ultra3000

**AXIS 1**

- **IO PWR**: WHT/RED 22GA
- **IO COM**: WHT/BLK 22GA
- **AUX PWR**: BLACK 14GA
- **AUXCOM**: BLACK 14GA

---

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 to IMC-S Compact Cable and Interconnect 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.

Figure A.24
Ultra3000 to IMC-S/23x-xx Compact Controller Configuration

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.

Drive Enable and Fault Reset are configured in Ultraware software.

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

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

Chapter Objectives

This appendix contains motor encoder input signal information and drive encoder output information specific to the Ultra3000 drives. The following motor encoder types are included:

- High resolution SIN/COS encoders
- Incremental A quad B encoders
Introduction

The Ultra3000 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.

Figure B.1
Motor Encoder Outputs

1 Interpolation and division operations are performed in firmware and the resulting output frequency is updated at 250 µs intervals.
2 Interpolated and divided output not available on SERCOS drives.

Unbuffered Encoder Outputs

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

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 Figure B.2 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.

Figure B.2
Incremental Encoder Counts

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

Figure B.3
Incremental Encoder Divided

<table>
<thead>
<tr>
<th>CN2-1</th>
<th>Signal A+ from Incremental Encoder</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN1-10</td>
<td>Unbuffered Signal A+ Output from Drive</td>
</tr>
<tr>
<td>CN1-16</td>
<td>Divided (by two) Signal A+ Buffered Output from Drive</td>
</tr>
</tbody>
</table>
High Resolution Encoder Output

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.

Figure B.4
Absolute High Resolution Encoder Signals

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

- **Buffered Outputs** are conditioned SIN/COS signals resulting in a square wave (A quad B) signal (refer to Figure B.4). 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.
Figure B.5
Interpolated and Divided Absolute High Resolution Encoder Counts

- CN1-10 (SIN/AM+) Unbuffered encoder feedback signal to drive, 1024 cycles/rev.
- CN1-12 (COS/BM+) Unbuffered encoder feedback signal to drive, 1024 cycles/rev.
- CN1-16 (SIN/AMOUT+) x8 Interpolated output from drive
- CN1-18 (COS/BMOUT+) x8 Interpolated output from drive
- Divided output from drive (divisor = 2)
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