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NI 9930 Motion Control Accessories User Guide

Note If you are a new user of LabVIEW or are unfamiliar with LabVIEW, refer to the *Getting Started with LabVIEW* manual for information about LabVIEW and LabVIEW terminology.

This document explains how to use the NI 9930 motion control accessories with the NI 9512 C Series drive interface module and selected position command servo drives.

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NI 9930M Motion Control Accessory for Mitsubishi Servo Drives

The NI 9930M motion control accessory allows easy connection between the NI 9512 C Series drive interface module and the Mitsubishi MR-J2 or Mitsubishi MR-J3 servo drive.

What You Need to Get Started

You need the following items to get started.

Hardware

- ❑ NI 9930M Motion Control Accessory and NI 951x Y-cable.
  (NI part number 781824-01)
- ❑ NI 9512 C Series stepper drive interface module.
  (NI part number 779944-01)
- ❑ NI real-time controller and chassis that support the RIO Scan Interface.

Tip To determine if your controller and chassis support the RIO Scan Interface go to `ni.com/info` and enter `rdsoftwareversion`.

- ❑ 24 V power supply (such as the NI PS-15) for the CompactRIO controller.
  (NI part number 781093-01)

Note Refer to the controller operating instructions for power supply requirements.

NATIONAL INSTRUMENTS

- ❑ 24 V power supply (such as the NI PS-15) for the NI 9930M. This supply also powers the NI 9512 and any drive I/O.
  (NI part number 781093-01)

Note Refer to the *NI 9512 Operating Instructions and Specifications* and the drive manual to verify that the selected power supply meets the system requirements.

- ❑ Ethernet connection and cable for the CompactRIO controller.
- ❑ 50- or 20-pin MDR cables to connect the accessory to the drive.
  - – One 50-pin MDR cable for MR-J3 drives
    (NI part number 194604-02)
  - – Two 20-pin MDR cables for MR-J2 drive
    (NI part number 194466-02)
- ❑ Mitsubishi MR-J2 or MR-J3 position-command servo drive.
- ❑ Servo motor, encoder, power supply, and associated cables to connect the motor and encoder to the drive.

Software

- ❑ LabVIEW 2009 SP1 or later
- ❑ LabVIEW 2009 SP1 Real-Time Module or later
- ❑ LabVIEW 2009 SP1 NI SoftMotion Module or later
- ❑ NI-RIO 3.4.0 or later

Figure 1 shows a simplified connection diagram.

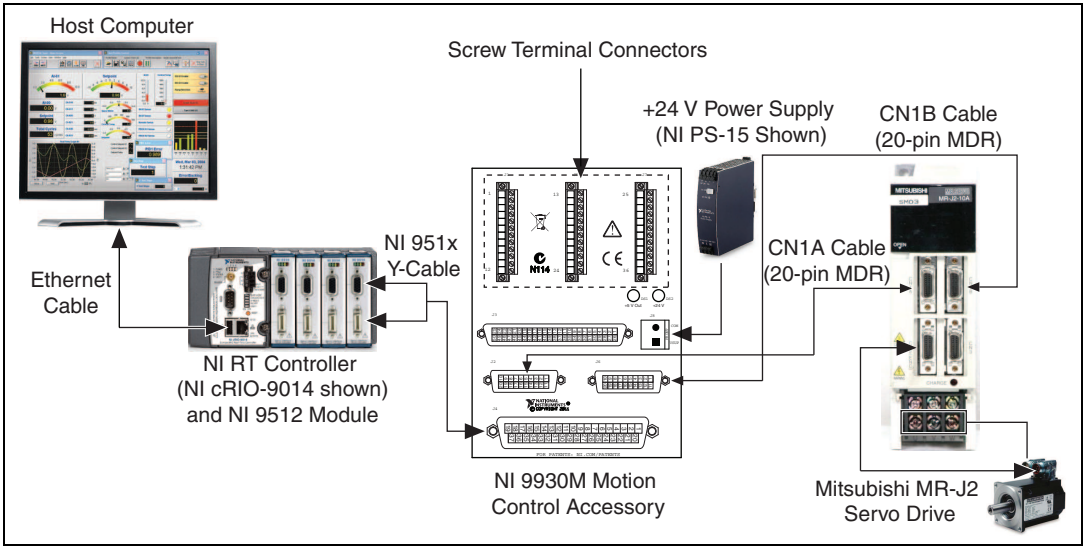


Figure 1. NI 9930M Connection Accessory with to MR-J2 Drive Connections

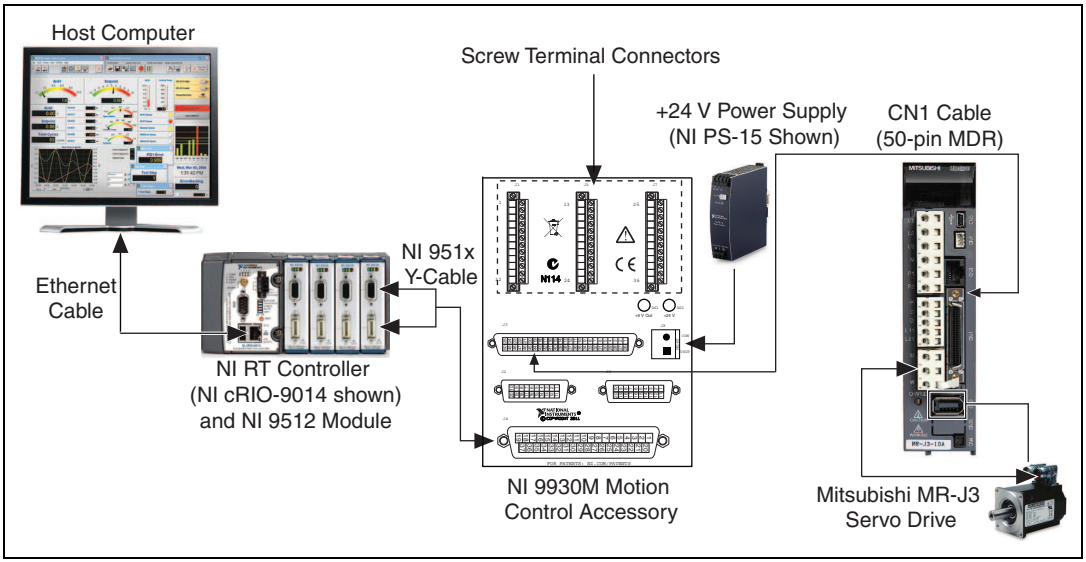
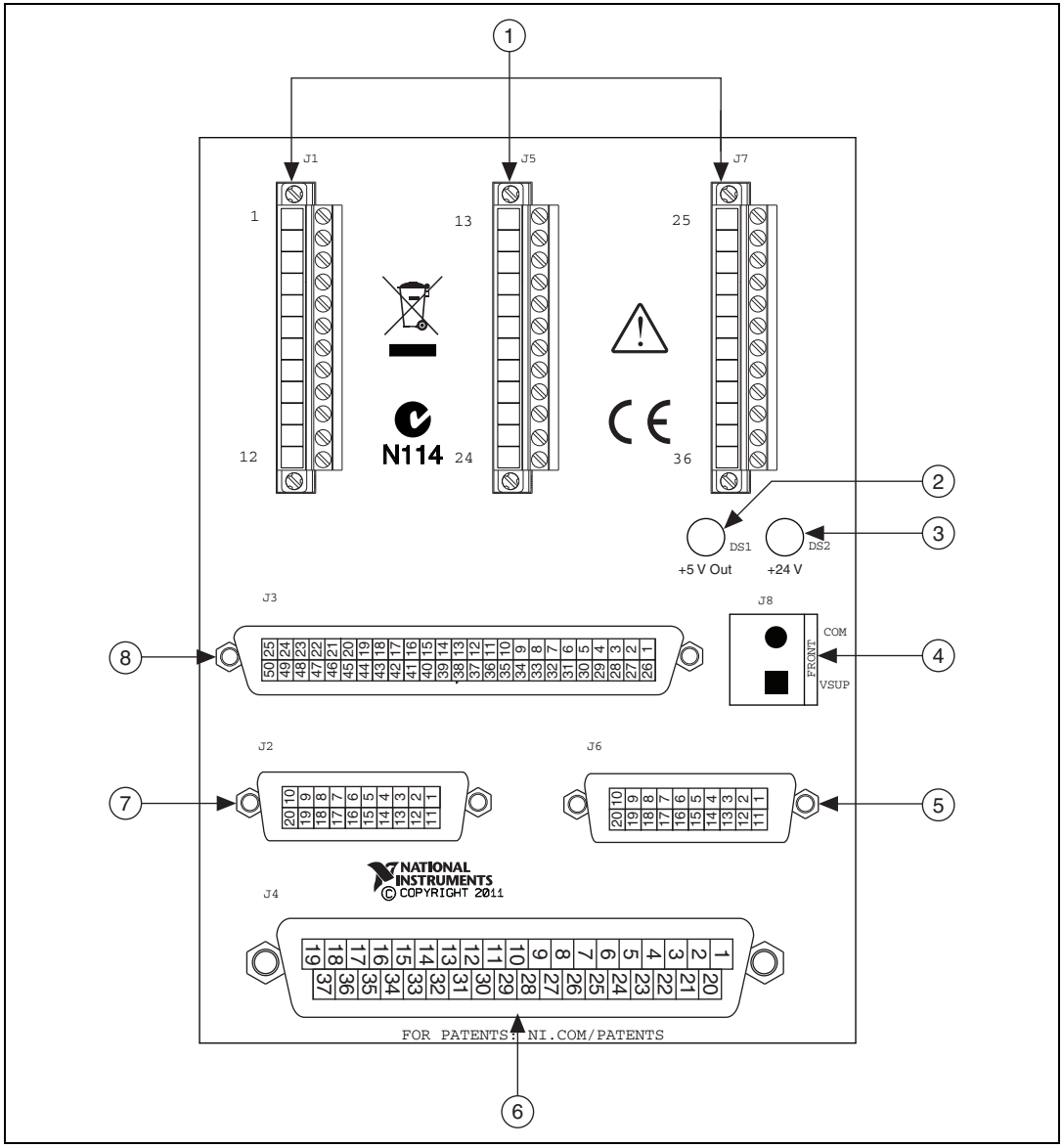


Figure 2. NI 9930M Connection Accessory with to MR-J3 Drive Connections

Figure 3 shows an overview of the connectors on the NI 9930M connection accessory.



1	J1, J5, J7: User I/O Screw Terminal Connectors	5	J6: CN1B Connector (for MR-J2 Drive)
2	DS1: +5 V Power LED (from NI 9512)	6	J4: NI 9512 Connector
3	DS2: +24 V Power LED	7	J2: CN1A Connector (for MR-J2 Drive)
4	J8: + 24 V Power Supply Connector	8	J3: CN1 Connector (for MR-J3 Drive)

Figure 3. NI 9930M Connection Accessory Connectors

Hardware Installation and Configuration

Step 1: Set Up the CompactRIO System

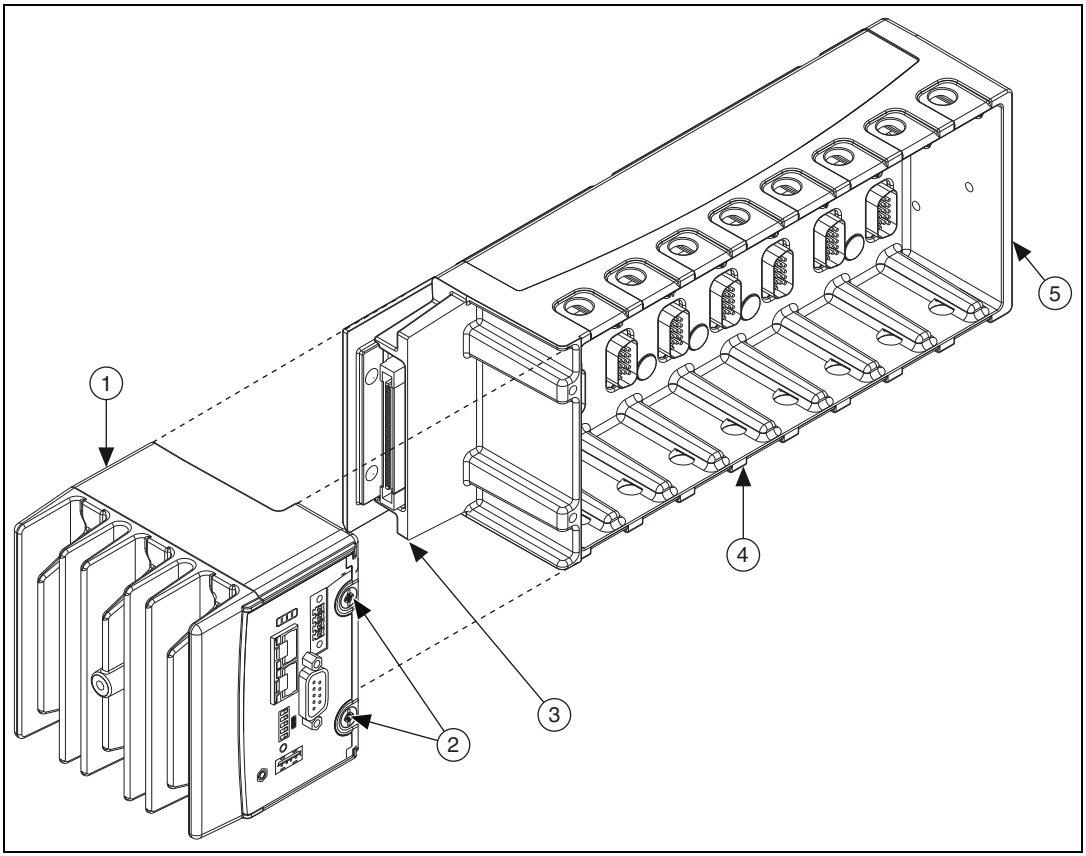
Complete the following steps to set up the CompactRIO hardware.

1. Install the real-time CompactRIO controller on the chassis if you are not using an integrated controller and chassis.

Note Write down the controller serial number before installing the controller onto the chassis. You will be unable to read the serial number after you install the controller.

   a. Make sure that no power is connected to the controller or the chassis.

   b. Align the controller with the chassis as shown in Figure 4.



1 Controller	4 Reconfigurable Embedded Chassis
2 Captive Screws	5 Grounding Screw
3 Controller Slot	

Figure 4. Installing the Controller on the Chassis (Eight-Slot Chassis Shown)

c. Slide the controller onto the controller slot on the chassis. Press firmly to ensure the chassis connector and the controller connector are mated.

d. Using a number 2 Phillips screwdriver, tighten the two captive screws on the front of the controller.

2. Connect the controller to a power supply and an Ethernet network on the same subnet as the development computer. Refer to the controller operating instructions for information about wiring the controller to the power supply and Ethernet network.

Note Do not plug in or turn on any power to the system until after you complete *Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive*.

3. Install the NI 9512 module in slot 1, 2, 3, or 4 of the chassis.

Step 2: Connect the NI 9930M Connection Accessory

The NI 9930M connection accessory contains connections for the NI 9512 C Series module, the Mitsubishi MR-J2 or MR-J3 servo drive, and a 24 V power supply for NI 9512 module and drive I/O.

1. Connect the NI 9512 module to the NI 9930M J4 connector using the NI 951x Y cable.
2. Connect the NI 9930M to the drive.
   - **Mitsubishi MR-J2**—Connect the J2 connector to the CN1A connector on the drive, and the J6 connector to the CN1B connector on the drive using two 20-pin MDR cables.
   - **Mitsubishi MR-J3**—Connect the J3 connector to the CN1 connector on the drive using one 50-pin MDR cable.
3. Connect a 24 V power supply to the Vsup and COM terminals on the NI 9930M accessory J8 connector. Figure 3 shows the location of the power supply input.
4. Connect pin 2 (EMG - emergency stop input signal) and pin 1 (COM) to an emergency stop switch. Refer to the drive manual for more information about emergency stop switch requirements.

Note If the emergency stop functionality is not required, connect the EMG input directly to COM to bypass any external safety circuitry.

Note You cannot enable the drive if you do not connect the EMG input to an emergency stop switch or directly to COM.

5. Connect pin 15 (LSP - forward rotation stroke end/forward limit) and pin 14 (LSN - reverse rotation stroke end/reverse limit) to pin 13 (COM), or configure the drive to ignore limit inputs.

Note These configuration settings disable limits for initial setup and testing purposes. National Instruments recommends connecting and enabling limits in your final application. Refer to the drive documentation for limit input requirements.

6. Connect pin 9 (COM) to pin 10 (LG - control common).

Note Not connecting pin 9 and pin 10 will result in unpredictable behavior.

7. Connect any additional I/O, such as limits, DIO, position compare outputs, position capture inputs, and so on, using the NI 9930M screw terminal connectors. The J1 and J5 connectors allow connection to the drive I/O signals, and the J7 connector provides connection to the NI 9512 I/O signals. Refer to the drive or the NI 9512 module documentation for specific signal connection requirements.

Figure 5 shows the screw terminal connector pinouts.

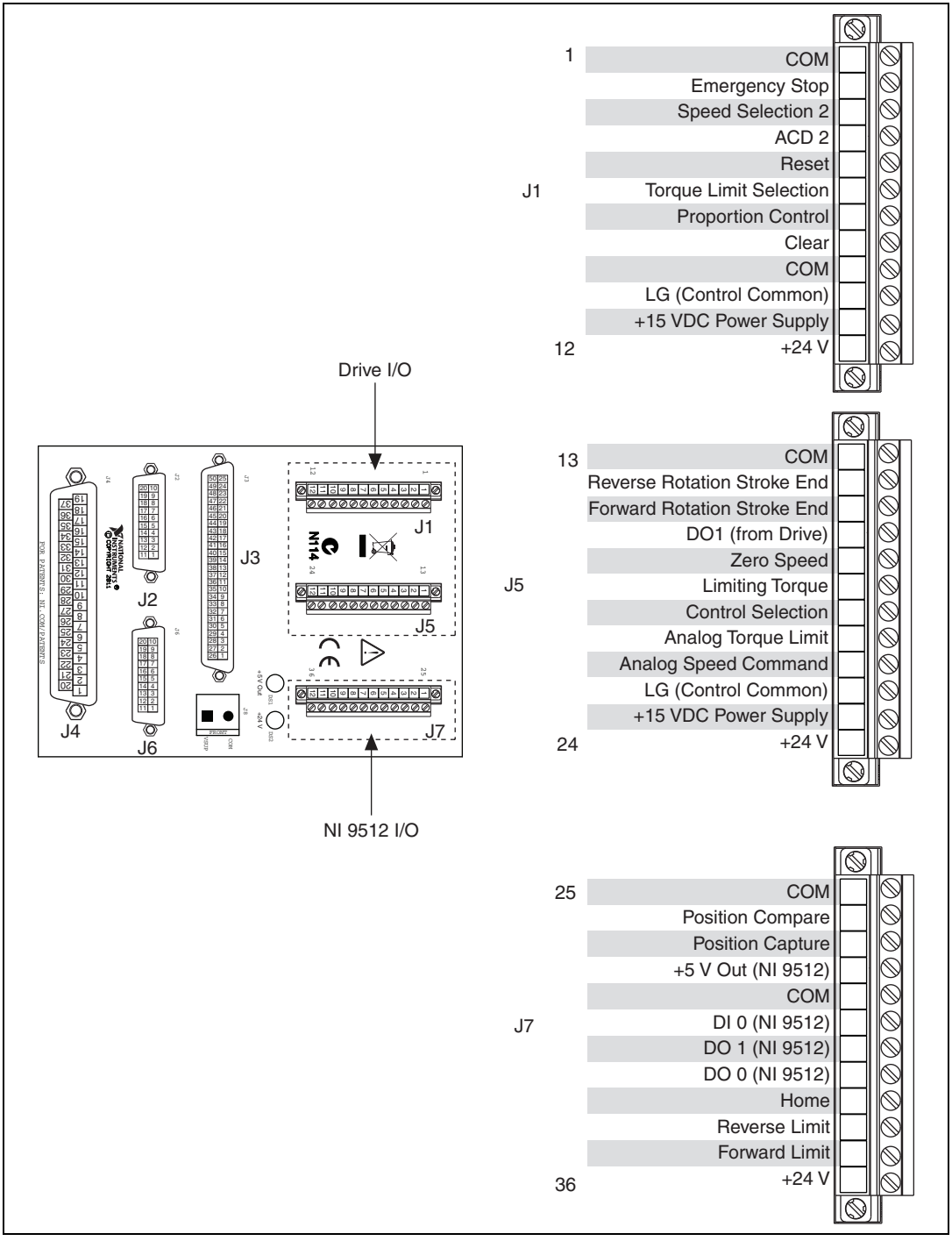


Figure 5. NI 9930M I/O Connectors

Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive

This section covers the minimum drive settings and connections to allow the motor to move. Refer to the drive manual for additional information about drive parameters and signal information.

1. Power on the drive and configure the drive for position control mode. These parameters differ depending on the drive. Refer to the drive manual for information about how to set drive parameters.
   - **Mitsubishi MR-J2**—Set parameter P 21 to 1 (signed pulse train).
   - **Mitsubishi MR-J3**—Set parameter PA 01 to 0 (position control) and PA 13 to 1 (step and direction). You may also need to set parameter PA 05 (pulses per rev) to the appropriate setting for your encoder.
2. Ensure that the drive encoder output pulses and electronic gear parameters are set to the default values:

   Mitsubishi MR-J2

   a. Set parameter P 27 to 4000 pulses per rev. If you change this from the default value, you must also change the value specified for the encoder **Counts per rev** in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section.

   b. Set parameter 3 and parameter 4 to 1. This disables any electronic gearing settings.

   Mitsubishi MR-J3

   a. Set parameter PA 15 to 4000 pulses per rev. If you change this from the default value, you must also change the value specified for the encoder **Counts per rev** in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section.

   b. Set parameter PA 05 to 0. This disables the number of command input pulses per servo motor revolution parameter.

   c. Set parameter PA 06 and parameter PA 07 to 1. This disables any electronic gearing setting.
3. Connect the motor and encoder to the drive. Refer to the documentation specific to your drive for motor and encoder connection information.

Tip An incorrectly connected encoder may cause NI SoftMotion to return error `-77076` (`NIMCDM_driveReadyNotActiveError`). Verify the encoder connections if you see this error.

4. Connect the drive power. Refer to the drive documentation for power connections and specifications.
5. Apply power to all the hardware once all connections are made and continue to the next section.

Software Installation and Configuration

This section covers installing and configuring the software for the NI 9512 C Series drive interface module. It assumes that all required software from the *What You Need to Get Started* section is installed.

Step 1: Install Software on and Configure the NI RT Controller

Complete the following steps to configure the controller and install software on it.

Note The Measurement & Automation Explorer (MAX) user interface may not match these steps exactly depending on which version of MAX you are using.

1. Launch MAX on the development computer by clicking the MAX icon on the desktop, or by selecting **Start»All Programs»National Instruments»Measurement & Automation**.
2. Select the controller under **Remote Systems** in the **Configuration** pane. If you do not see the controller, you may need to disable the firewall on the development computer. Go to `ni.com/info` and enter `RIOMAXTroubleshoot` for more information.

3. Verify that the **Serial Number** in the **General Settings** section matches the serial number on the device.
4. If you do not want to format the disk on the controller, eliminating all installed software and files, skip to step 14.
5. Set the **Safe Mode** switch on the controller to the **On** position.
6. Power on the controller. If it is already powered on, press the **Reset** button on the controller to reboot it.
7. Right-click the controller under **Remote Systems** in the **Configuration** pane in MAX and select **Format Disk**.
8. (Optional) Enable the **Keep Network Settings** checkbox if you want to retain the same target name and IP address.
9. Click **Format** to start formatting the disk.
10. When MAX finishes formatting the disk, set the **Safe Mode** switch to the **Off** position and click **OK**.
11. Select the **System Settings** tab and type a descriptive name for the system in the **Hostname** field.
12. (Optional) Complete this step only if the target has an empty IP address (0.0.0.0). Select the **Network Settings** tab and select **DHCP or Link Local** from the **Configure IPv4 Address** list to assign an IP address or select the **Static** to specify a static IP address in the **IPv4 Address** section.
13. Click **Save** on the toolbar and let MAX reboot the system.
14. When the new system name appears under **Remote Systems**, expand the controller item in the tree, right-click **Software**, and select **Add/Remove Software**.
15. Select a recommended software set that includes NI-RIO 3.4.0 or later.

Note If you are using the NI SoftMotion Module 2010 SP1 or earlier, also select **LabVIEW NI SoftMotion Module Scan Engine Support** from the list.

16. Click **Next**.
17. Select **LabVIEW NI SoftMotion Module** from the add-ons list.
18. Click **Next** to install the selected software on the controller. Click **Help** if you need information about installing recommended software sets.
19. When the software installation completes, click **Finish** to reboot the controller.
20. Close MAX.

Step 2: Creating a Project and Adding an NI SoftMotion Axis

Complete the following steps to create a LabVIEW project.

1. Launch LabVIEW by selecting **Start»All Programs»National Instruments»LabVIEW**.
2. Click the **Empty Project** link in the **Getting Started** window to display the **Project Explorer** window. You can also select **File»New Project** to display the **Project Explorer** window.
3. Select **Help** and make sure that **Show Context Help** is checked. You can refer to the context help throughout the tutorial for information about items on the block diagram.

4. Right-click the top-level project item in the **Project Explorer** window and select **New»Targets and Devices** from the shortcut menu to display the **Add Targets and Devices** dialog box. Refer to Figure 6 for more information.

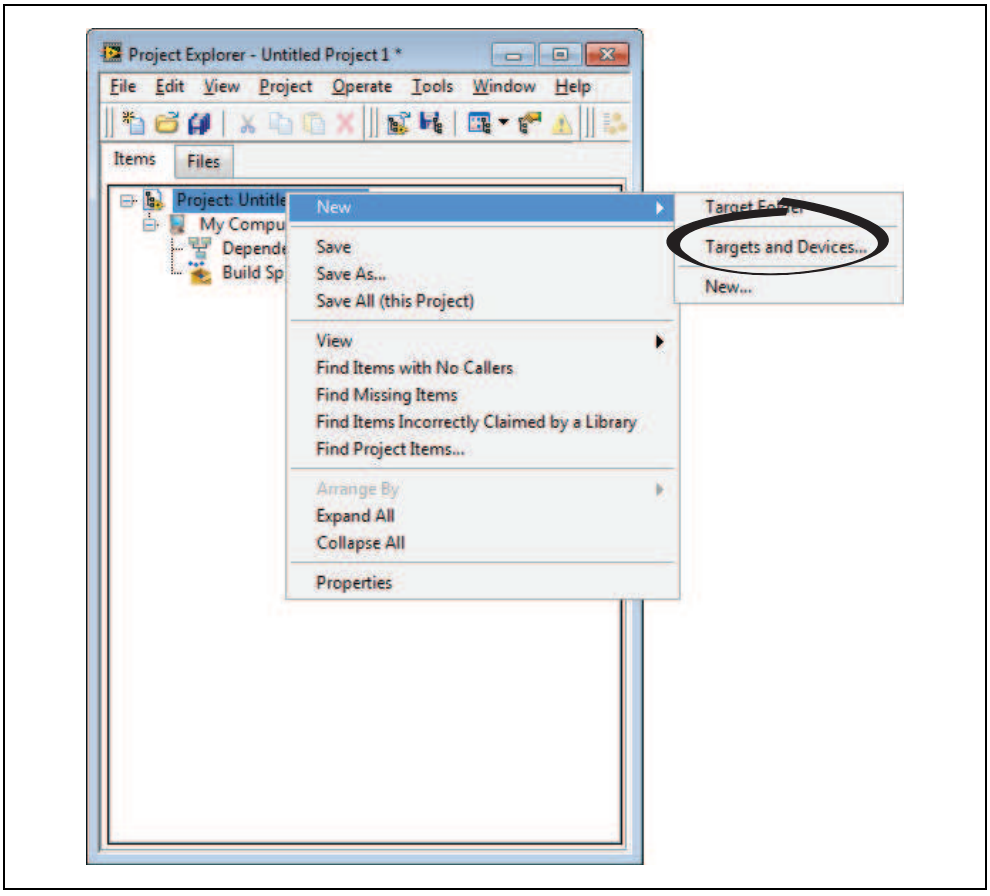


Figure 6. Adding a New Target

5. Make sure that the **Existing target or device** radio button is selected.
6. Expand **Real-Time CompactRIO**.
7. Select the CompactRIO controller to add to the project and click **OK**.
8. If you have LabVIEW FPGA installed, the **Select Programming Mode** dialog box appears. Select **Scan Interface** to put the system into Scan Interface mode, then click **Continue**.

Tip Use the **CompactRIO Chassis Properties** dialog box to change the programming mode in an existing project. Right-click the CompactRIO chassis in the **Project Explorer** window and select **Properties** from the shortcut menu to display this dialog box.

9. Click **Discover** in the **Discover C Series Modules?** dialog box if it appears.
10. Click **Continue**.

11. Right-click the controller item in the **Project Explorer** window and select **Properties** from the shortcut menu to display the **RT Target Properties** dialog box. Select **Scan Engine** from the **Category** list to display the Scan Engine page.
12. Set the **Scan Period** to 10 ms or lower, then click **OK** to close the **RT Target Properties** dialog box.
13. If you did not reformat the CompactRIO device in *Step 1: Install Software on and Configure the NI RT Controller*, expand the real-time target. If an axis already exists on the target, right-click the axis and select **Remove from Project**, or temporarily associate it with different hardware using the **Axis Manager** dialog box. You cannot associate two axes with the same hardware device. Refer to Figure 8 to view a project with an axis on the target.
14. Right-click the controller item in the **Project Explorer** window and select **New»NI SoftMotion Axis** from the shortcut menu to open the **Axis Manager** dialog box, shown in Figure 7.
15. Click **Add New Axis** to create an NI SoftMotion axis associated with the NI 9512 module. Axes are automatically bound to an available module. You can double-click the axis name to rename the axis and give it a descriptive name.

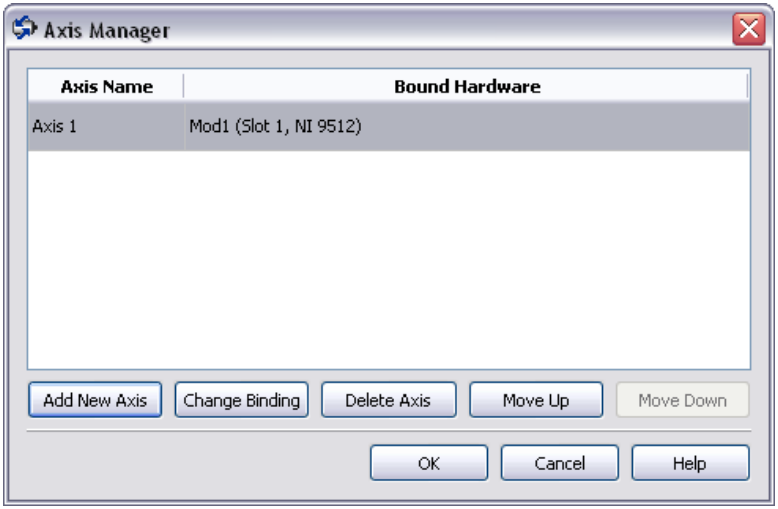


Figure 7. Axis Manager Dialog Box

16. Click **OK** to close the **Axis Manager** dialog box. The new axis is added to the **Project Explorer** window.

Note You cannot associate more than one axis with the same C Series module.

When you have finished these steps your LabVIEW project should look similar to the image in Figure 8.

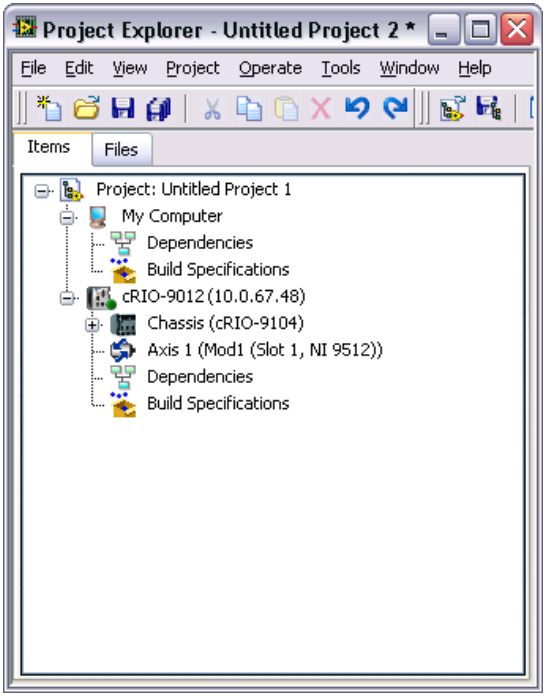


Figure 8. Project Explorer Window with Modules in Scan Interface Mode

Step 3: Configure the NI 9512 C Series Module

Complete the following steps to configure the axis I/O settings for use with the Mitsubishi MR-J2 or MR-J3 servo drive.

1. Right-click the axis in the **Project Explorer** window and select **Properties** from the shortcut menu to open the **Axis Configuration** dialog box.

Figure 9 shows the parts of the **Axis Configuration** dialog box for NI 9512 C Series module.

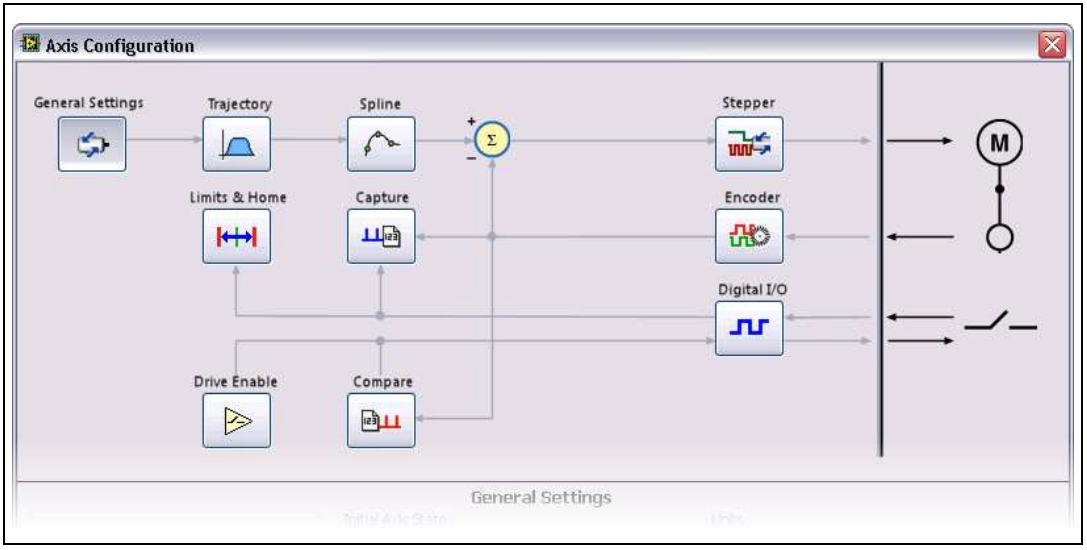


Figure 9. Axis Configuration Dialog Box

Note The **Axis Configuration** dialog box user interface may not match this image exactly depending on which version of the LabVIEW NI SoftMotion Module you are using.

2. On the General Settings page set the **Loop Mode** to **Closed-Loop**.
3. Click the Encoder button and configure the Units and Counts Per Unit.
   a. Make the following changes in the **Active State** section:
      - Set the **Line State** for **A** to **High**.
      - Set the **Line State** for **B** to **Low**.
      - Set the **Line State** for **Index** to **High**.
   b. In the **Index Reference Criteria** section set the **Line State** for **A** and **B** to **Inactive**.
   c. Type **rev** in the **Units** text box.
   d. Set the **Counts per rev** to 4000. This assumes the default drive setting for encoder pulses per rev. Refer to *Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive* in the *Hardware Installation and Configuration* section for more information.

When you are finished the Encoder Settings page will look similar to Figure 10.

Figure 10. Axis Configuration Encoder Page

4. Click the **Stepper** button to open the **Stepper** page. Configure the stepper output and steps per rev settings:
   a. Set **Output Mode** to **Step and Direction**.
   b. Set **Output Type** to **Differential**.
   c. Set **Active State** to **Low**.
   d. Set **Steps Per rev** depending on the encoder resolution. For example, if you are using an encoder with 131,072 pulses per revolution, set **Steps Per rev** to 131,072.

      When you are finished the Stepper Settings page will look similar to Figure 11.

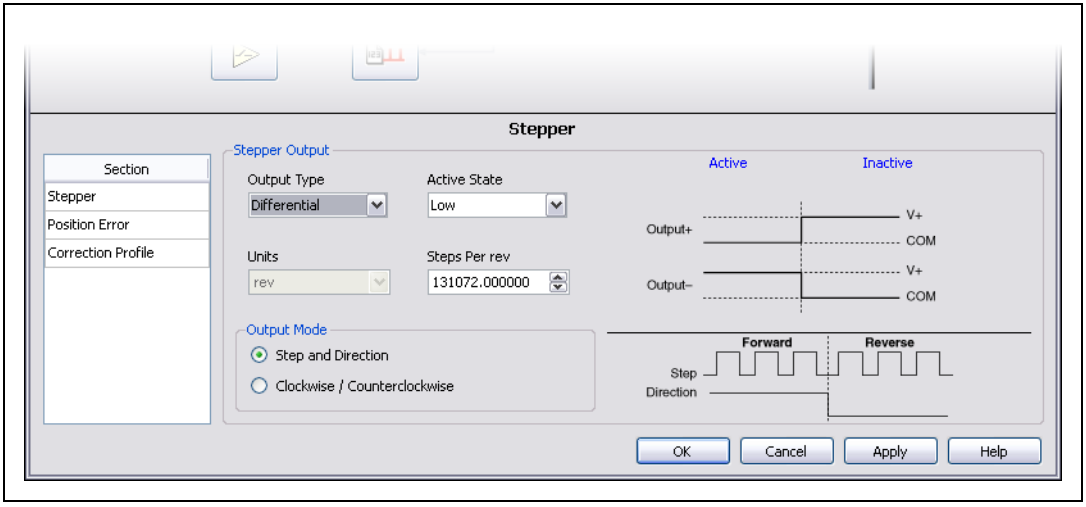


Figure 11. Axis Configuration Stepper Page

e. In the **Position Error** section, change the **Position Error Limit** to an acceptable value for your system. Exceeding the specified position error limit causes NI SoftMotion to disable the drive and turn off the Drive Enable signal.

5. Click the **Digital I/O** button to open the **Digital I/O** page and map the following status inputs.
   a. Map DI 1 to **Servo/Drive Ready**. This signal is active when the drive is enabled.
      1) Double-click the text in the **Mapping** column and select **Servo/Drive Ready** from the dropdown list.
      2) Ensure that the DI 1 settings match the following:
         - **Input Type**—Sourcing
         - **Active State**—On
         - **Digital Filter**—50 µs
   b. Map DI 2 to **In-Position**. The **In-Position** signal from the drive is active when the current position is within a user-specified distance from the target position. This is a drive setting.
      1) Double-click the text in the **Mapping** column and select **In-Position** from the dropdown list.
      2) Ensure that the DI 2 settings match the following:
         - **Input Type**—Sourcing
         - **Active State**—On
         - **Digital Filter**—50 µs
   c. Map DI 3 to **Drive Fault/Alarm**. When the **Drive Fault/Alarm** signal is active, the module does not generate command signals.
      1) Double-click the text in the **Mapping** column and select **Drive Fault/Alarm** from the dropdown list.
      2) Ensure that the DI 3 settings match the following:
         - **Input Type**—Sourcing
         - **Active State**—Off
         - **Digital Filter**—50 µs
   d. (Optional) Configure a digital output to use for the Alarm Clear signal, if required. Position command drives often require an Alarm Clear signal from the module to the drive. This signal clears the alarm or fault outputs on the drive. This functionality is not available using a mappable digital output. However, you can use a digital output to implement this functionality in your code. Complete the following steps to use a digital output as an Alarm Clear output:
      1) Determine the required pulse time and active state for the Alarm Clear signal. This information is in the specifications for the position command drive.
      2) Select an available digital output.
      3) Configure the digital output **Active State**, **Safe State**, and **Output Type** as required by the drive.
      4) In your application VI add code to pulse the digital output line for the appropriate amount of time to clear the alarm output. Do not clear the alarm on the drive until the alarm condition is resolved.

Note If you are configuring a digital output to use as the Alarm Clear signal, you must connect the configured output from the J7 screw terminal connector to the drive Clear signal on the J1 screw terminal connector.

When you are finished the Digital I/O Settings page will look similar to Figure 12.

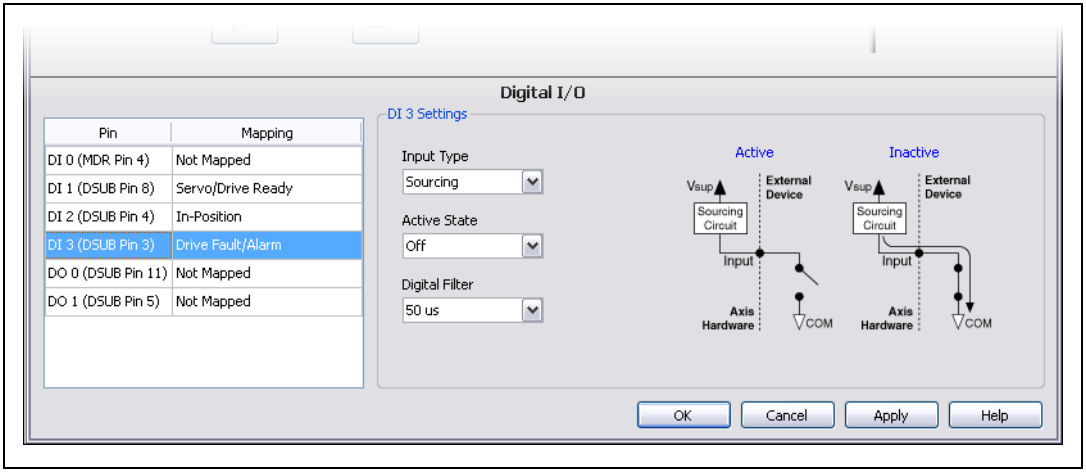


Figure 12. Axis Configuration Digital I/O Page

6. Open the **Trajectory** page and enable the **In-Position** checkbox. This allows the In-Position input to be used as a criteria for move complete. When this signal is included in the move complete criteria, the move is only complete if the In-Position signal is active.
7. Click the **Drive Enable** button and configure the Drive Enable output settings.
   a. Place a checkmark in the **Enable** checkbox.
   b. Set **Output Type** to **Sinking**.
   c. Set **Active State** to **On**.
   d. Set **Safe State** to **Off**.
8. Complete the following additional steps if you do not have limits and home connected at this time:
   a. Open the **Limits & Home** page.
   b. In the **Forward Limit** and **Reverse Limit** sections ensure that the settings match the following:

Note These configuration settings disable limits for initial setup and testing purposes. National Instruments recommends connecting and enabling limits in your final application.

- Clear the **Enable** checkbox from both **Forward Limit** and **Reverse Limit**.
- Set the **Active State** for both **Forward Limit** and **Reverse Limit** to **Off**. This prevents a limit warning even though limits are turned off.

   c. Open the **Home** section and clear the **Enable** checkbox.
9. Configure any additional I/O settings according to your system requirements, such as position compare or position capture signals.
10. Click **OK** to close the **Axis Configuration** dialog box.
11. Right-click the controller item in the **Project Explorer** window and select **Deploy All** to deploy the axis information.
12. Click **Apply** in the **Conflict Resolution** dialog box when it appears. The NI Scan Engine must be in Active mode to move the axis.
13. Select **File»Save Project** to save the project.

Step 4: Enable and Test the Drive Using LabVIEW

Use the Interactive Test Panel to test and debug your motion system and configuration settings on the selected axis. With the Interactive Test Panel you can perform a simple straight-line move and monitor feedback position and position error information, move and I/O status information, change move constraints, get information about software errors and faults, and view position or velocity plots of the move.

Complete the following steps to test your setup after configuring the axis using the **Axis Configuration** dialog box.

1. Right-click the axis in the **Project Explorer** window and select **Interactive Test Panel** from the shortcut menu.
2. On the **Move** tab set **Target Position** to 25 revolutions.
3. On the **Move Constraints** tab set **Velocity** to 1 revolution/sec. Using the encoder counts per revolution and stepper steps per revolution values specified in this tutorial the motor will move 25 revolutions at 60 RPM. Click the **Help** button for detailed information about the items available in this dialog box.

4. Click the **Enable** button to enable the drive.
5. Click the **Start** button on the bottom of the dialog box to start the move with the configured options.
6. Use the **Status** and **Plots** tabs to monitor the move while it is in progress.

Finalize your motion system setup by connecting and configuring additional I/O such as limits as required by your system using the screw terminal connectors on the NI 9930M accessory.

NI 9930P Motion Control Accessory for Panasonic Servo Drives

The NI 9930P motion control accessory allows easy connection between the NI 9512 C Series drive interface module and the Panasonic Minas A or Minas A5 servo drive.

What You Need to Get Started

You need the following items to get started.

Hardware

- ❑ NI 9930P Motion Control Accessory and NI 951x Y-cable.
  (NI part number 781823-01)
- ❑ NI 9512 C Series stepper drive interface module.
  (NI part number 779944-01)
- ❑ NI real-time controller and chassis that support the RIO Scan Interface.

Tip To determine if your controller and chassis support the RIO Scan Interface go to `ni.com/info` and enter `rdsoftwareversion`.

- ❑ 24 V power supply (such as the NI PS-15) for the CompactRIO controller.
  (NI part number 781093-01)

Note Refer to the controller operating instructions for power supply requirements.

- ❑ 24 V power supply (such as the NI PS-15) for the NI 9930P. This supply also powers the NI 9512 and any drive I/O.
  (NI part number 781093-01)

Note Refer to the *NI 9512 Operating Instructions and Specifications* and the drive manual to verify that the selected power supply meets the system requirements.

- ❑ Ethernet connection and cable for the CompactRIO controller.
- ❑ 50-pin MDR cable to connect the accessory to the drive.
  (NI part number 194604-02)
- ❑ Panasonic Minas A or Minas A5 position-command servo drive.

Note The Panasonic Minas A drive product numbers start with M*x*DA, and the Panasonic Minas A5 drive product numbers start with M*x*DH.

- ❑ Servo motor, encoder, power supply, and associated cables to connect the motor and encoder to the drive.

Software

- ❑ LabVIEW 2009 SP1 or later
- ❑ LabVIEW 2009 SP1 Real-Time Module or later
- ❑ LabVIEW 2009 SP1 NI SoftMotion Module or later
- ❑ NI-RIO 3.4.0 or later

Figure 13 shows a simplified connection diagram.

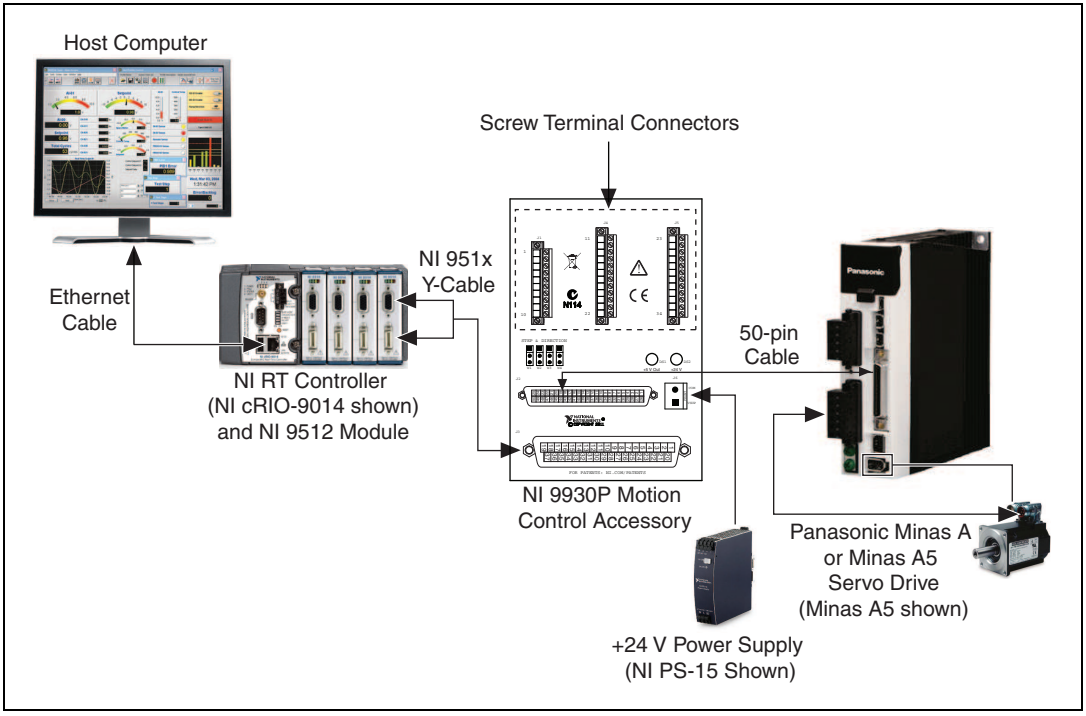
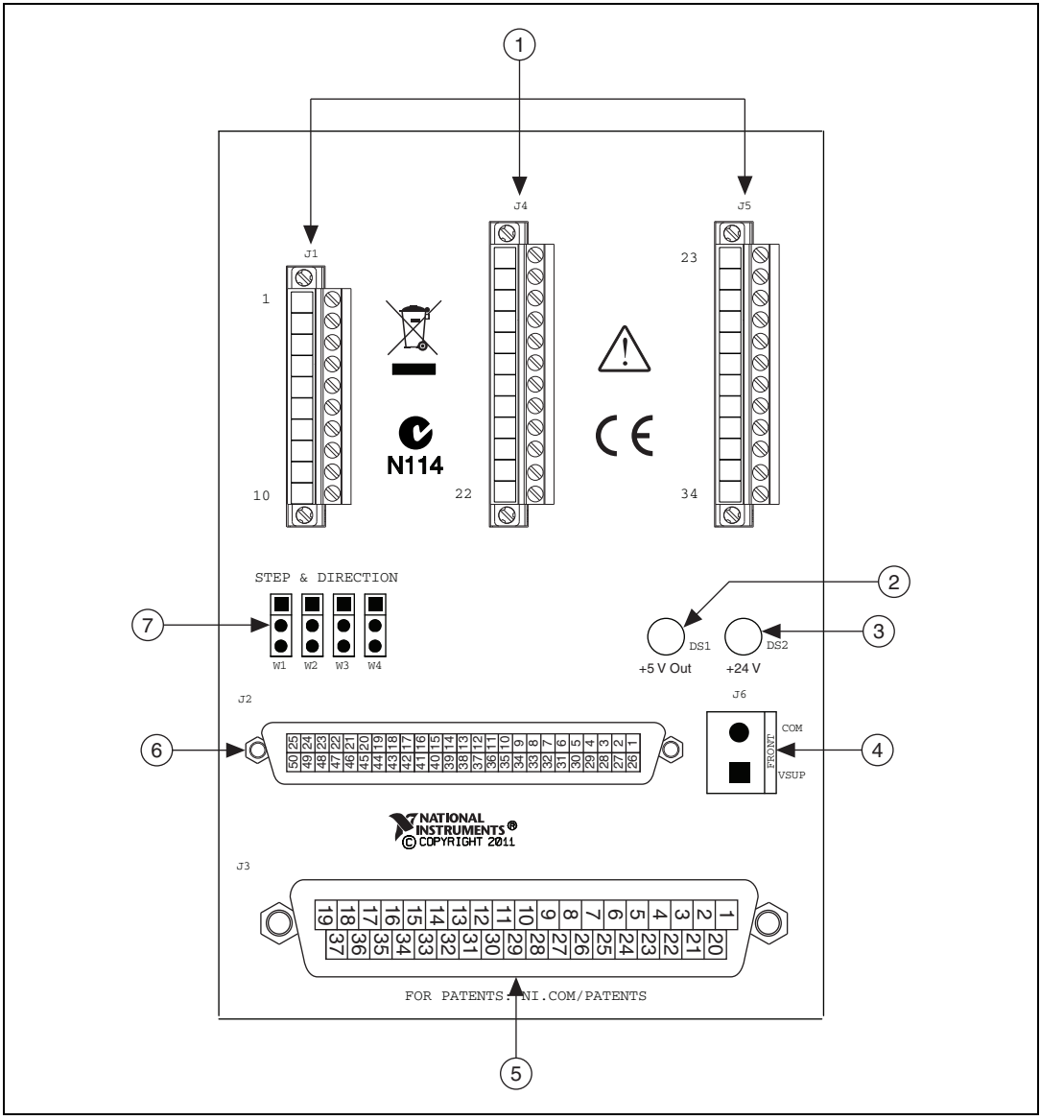


Figure 13. NI 9930P Connection Accessory Connections

Figure 14 shows an overview of the connectors on the NI 9930P connection accessory.



1	J1, J4, and J5: User I/O Screw Terminal Connectors	5	J3: NI 9512 Connector
2	DS1: +5 V Power LED (from NI 9512)	6	J2: Minas A or Minas A5 Connector
3	DS2: +24 V Power LED	7	W1, W2, W3, and W4: Step and Direction Input Jumpers
4	J6: + 24 V Power Supply Connector		

Figure 14. NI 9930P Connection Accessory Connectors

Hardware Installation and Configuration

Step 1: Set Up the CompactRIO System

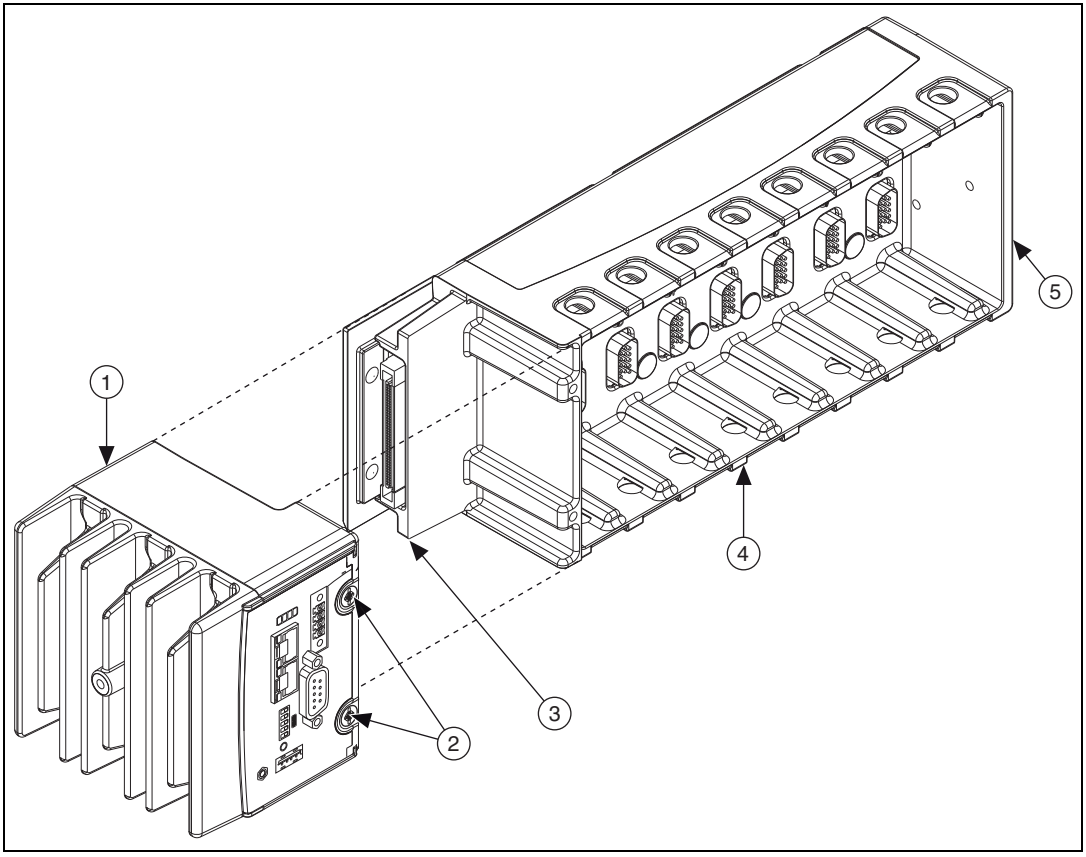
Complete the following steps to set up the CompactRIO hardware.

1. Install the real-time CompactRIO controller on the chassis if you are not using an integrated controller and chassis.

Note Write down the controller serial number before installing the controller onto the chassis. You will be unable to read the serial number after you install the controller.

   a. Make sure that no power is connected to the controller or the chassis.

   b. Align the controller with the chassis as shown in Figure 15.



1	Controller	4	Reconfigurable Embedded Chassis
2	Captive Screws	5	Grounding Screw
3	Controller Slot		

Figure 15. Installing the Controller on the Chassis (Eight-Slot Chassis Shown)

   c. Slide the controller onto the controller slot on the chassis. Press firmly to ensure the chassis connector and the controller connector are mated.

   d. Using a number 2 Phillips screwdriver, tighten the two captive screws on the front of the controller.

2. Connect the controller to a power supply and an Ethernet network on the same subnet as the development computer. Refer to the controller operating instructions for information about wiring the controller to the power supply and Ethernet network.

Note Do not plug in or turn on any power to the system until after you complete *Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive*.

3. Install the NI 9512 module in slot 1, 2, 3, or 4 of the chassis.

Step 2: Connect the NI 9930P Connection Accessory

The NI 9930P connection accessory contains connections for the NI 9512 C Series module, the Panasonic Minas A or Minas A5 servo drive, and a 24 V power supply for NI 9512 module and drive I/O.

1. Connect the NI 9512 module to the NI 9930P J3 connector using the NI 951x Y cable.
2. Connect the NI 9930P J2 connector to the drive I/F (Minas A) or X4 (Minas A5) connector using the 50-pin MDR cable.
3. Configure the Step and Direction Input jumpers. The default setting, shown in Figure 16, configures the step and direction inputs as low-speed 500K inputs. This setting is compatible with either the Minas A or Minas A5 drive.

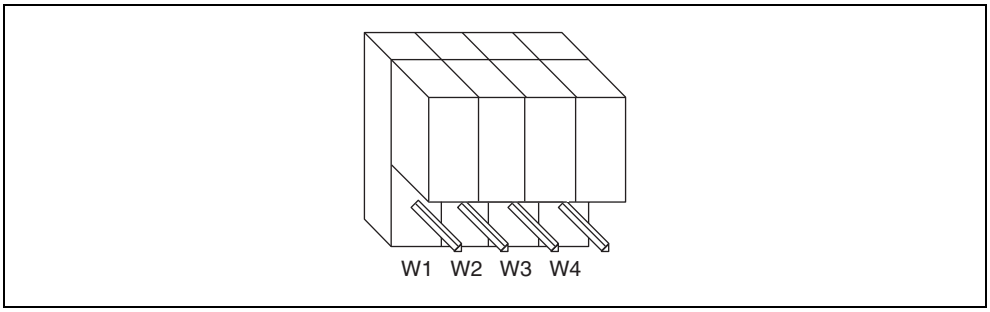


Figure 16. NI 9930P Step and Direction Input Jumper Default Configuration

The Minas A5 drive also supports high-speed 4M RS-422 step and direction inputs. To use these inputs, move the jumpers to the bottom position.

Caution The Minas A drive does not support high-speed RS-422 step and direction inputs. Do *not* change the jumper setting when using the NI 9930P with a Minas A drive.

4. Connect a 24 V power supply to the Vsup and COM terminals on the NI 9930P accessory J6 connector. Figure 14 shows the location of the power supply input.
5. Connect any additional I/O, such as limits, DIO, position compare outputs, position capture inputs, and so on, using the NI 9930P screw terminal connectors. The J1 and J4 connectors allow connection to the drive I/O signals, and the J5 connector provides connection to the NI 9512 I/O signals. Refer to the drive or the NI 9512 module documentation for specific signal connection requirements.

Figure 17 shows the screw terminal connector pinouts.

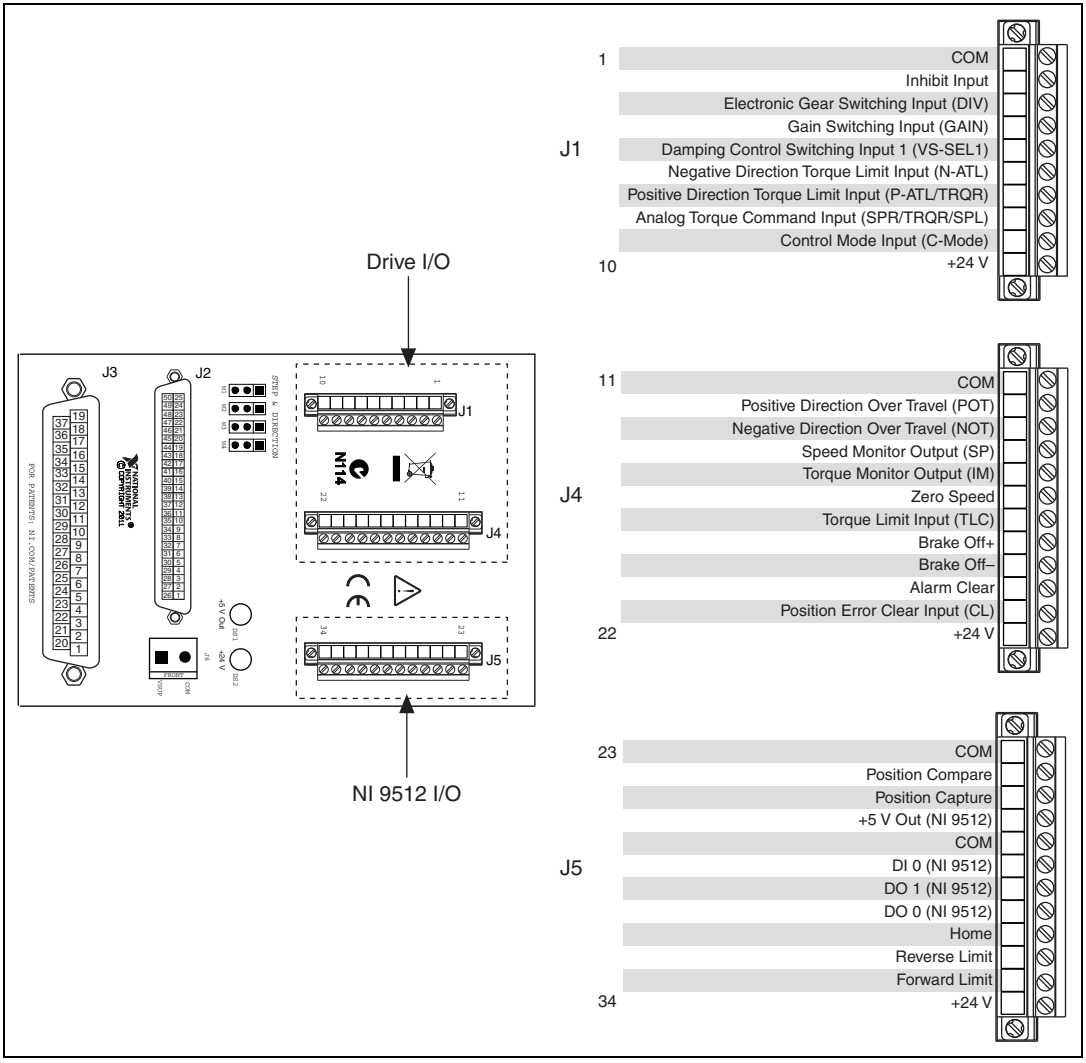


Figure 17. NI 9930P I/O Connectors

Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive

This section covers the minimum drive settings and connections to allow the motor to move. Refer to the drive manual for additional information about drive parameters and signal information.

1. Power on the drive and configure the drive for position control mode. These parameters differ depending on the drive. Refer to the drive manual for information about how to set drive parameters.
   - **Panasonic Minas A**—Set parameter PA_r02 to 0 (position control) and parameter PA_r42 to 3 (step and direction).
   - **Panasonic Minas A5**—Set parameter PR0.07 to 3 (pulse train + signal).

2. Ensure that the drive encoder output pulses and electronic gear parameters are set to the default values:

   Panasonic Minas A

   a. Set parameter PA_r44 to 2500 pulses per rev. If you change this from the default value, you must also change the value specified for the encoder counts per rev in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section.

   b. Set parameters PA_r46, PA_r47, and PA_r4B to 10000 and parameter PA_r4A to 0. This sets any electronic gearing to a 1:1 ratio.

   Panasonic Minas A5

   a. Set parameter PR0.08 to 10000. This specifies the number of command pulses for one motor revolution. If you change this from the default value, you must also change the value specified for **Steps per rev** in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section.

   b. Set parameter PR0.11 to 2500 pulses per rev. This specifies the number of encoder pulses per revolution. If you change this from the default value, you must also change the value specified for the encoder **Counts per rev** in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section by multiplying the specified value by four.

3. Connect the motor and encoder to the drive. Refer to the documentation specific to your drive for motor and encoder connection information.

Tip An incorrectly connected encoder may cause NI SoftMotion to return error `-77076` (`NIMCDM_driveReadyNotActiveError`). Verify the encoder connections if you see this error.

4. Connect the drive power. Refer to the drive documentation for power connections and specifications.
5. Apply power to all the hardware once all connections are made and continue to the next section.

Software Installation and Configuration

This section covers installing and configuring the software for the NI 9512 C Series drive interface module. It assumes that all required software from the *What You Need to Get Started* section is installed.

Step 1: Install Software on and Configure the NI RT Controller

Complete the following steps to configure the controller and install software on it.

Note The Measurement & Automation Explorer (MAX) user interface may not match these steps exactly depending on which version of MAX you are using.

1. Launch MAX on the development computer by clicking the MAX icon on the desktop, or by selecting **Start»All Programs»National Instruments»Measurement & Automation**.
2. Select the controller under **Remote Systems** in the **Configuration** pane. If you do not see the controller, you may need to disable the firewall on the development computer. Go to `ni.com/info` and enter `RIOMAXTroubleshoot` for more information.
3. Verify that the **Serial Number** in the **General Settings** section matches the serial number on the device.
4. If you do not want to format the disk on the controller, eliminating all installed software and files, skip to step 14.
5. Set the **Safe Mode** switch on the controller to the **On** position.

6. Power on the controller. If it is already powered on, press the **Reset** button on the controller to reboot it.
7. Right-click the controller under **Remote Systems** in the **Configuration** pane in MAX and select **Format Disk**.
8. (Optional) Enable the **Keep Network Settings** checkbox if you want to retain the same target name and IP address.
9. Click **Format** to start formatting the disk.
10. When MAX finishes formatting the disk, set the **Safe Mode** switch to the **Off** position and click **OK**.
11. Select the **System Settings** tab and type a descriptive name for the system in the **Hostname** field.
12. (Optional) Complete this step only if the target has an empty IP address (0.0.0.0). Select the **Network Settings** tab and select **DHCP or Link Local** from the **Configure IPv4 Address** list to assign an IP address or select the **Static** to specify a static IP address in the **IPv4 Address** section.
13. Click **Save** on the toolbar and let MAX reboot the system.
14. When the new system name appears under **Remote Systems**, expand the controller item in the tree, right-click **Software**, and select **Add/Remove Software**.
15. Select a recommended software set that includes NI-RIO 3.4.0 or later.

Note If you are using the NI SoftMotion Module 2010 SP1 or earlier, also select **LabVIEW NI SoftMotion Module Scan Engine Support** from the list.

16. Click **Next**.
17. Select **LabVIEW NI SoftMotion Module** from the add-ons list.
18. Click **Next** to install the selected software on the controller. Click **Help** if you need information about installing recommended software sets.
19. When the software installation completes, click **Finish** to reboot the controller.
20. Close MAX.

Step 2: Creating a Project and Adding an NI SoftMotion Axis

Complete the following steps to create a LabVIEW project.

1. Launch LabVIEW by selecting **Start»All Programs»National Instruments»LabVIEW**.
2. Click the **Empty Project** link in the **Getting Started** window to display the **Project Explorer** window. You can also select **File»New Project** to display the **Project Explorer** window.
3. Select **Help** and make sure that **Show Context Help** is checked. You can refer to the context help throughout the tutorial for information about items on the block diagram.

4. Right-click the top-level project item in the **Project Explorer** window and select **New»Targets and Devices** from the shortcut menu to display the **Add Targets and Devices** dialog box. Refer to Figure 18 for more information.

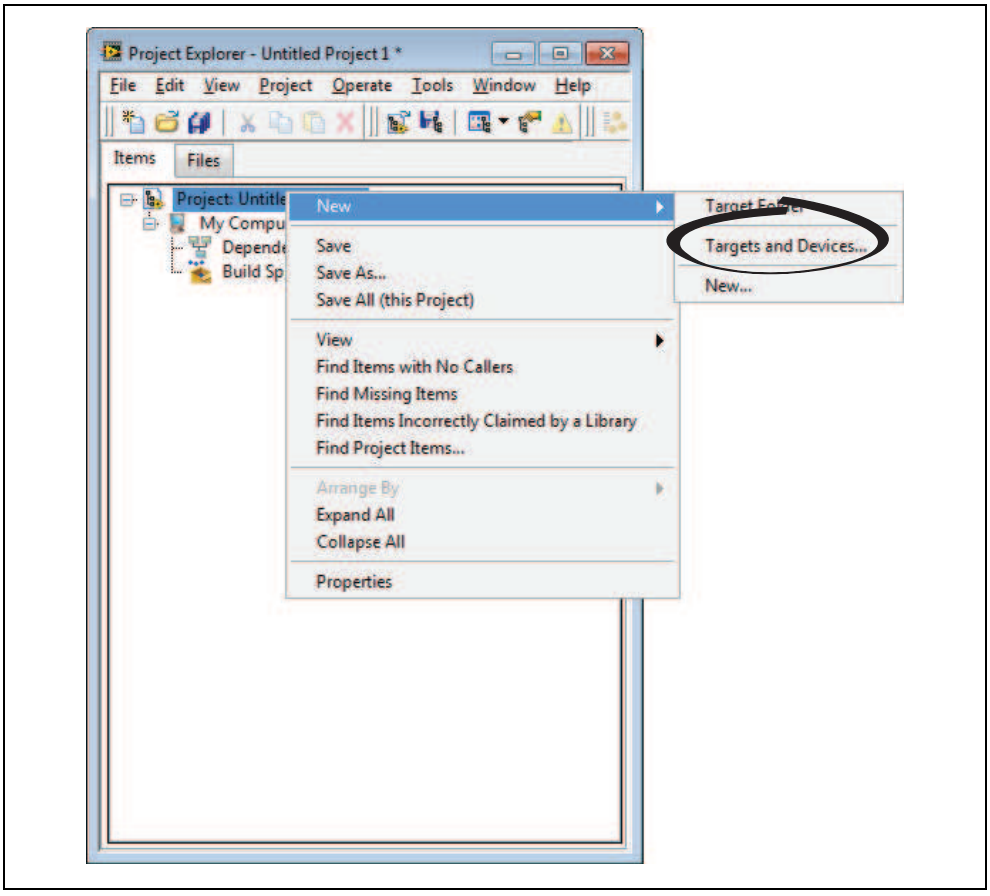


Figure 18. Adding a New Target

5. Make sure that the **Existing target or device** radio button is selected.
6. Expand **Real-Time CompactRIO**.
7. Select the CompactRIO controller to add to the project and click **OK**.
8. If you have LabVIEW FPGA installed, the **Select Programming Mode** dialog box appears. Select **Scan Interface** to put the system into Scan Interface mode.

Tip Use the **CompactRIO Chassis Properties** dialog box to change the programming mode in an existing project. Right-click the CompactRIO chassis in the **Project Explorer** window and select **Properties** from the shortcut menu to display this dialog box.

9. Click **Discover** in the **Discover C Series Modules?** dialog box if it appears.
10. Click **Continue**.
11. Right-click the controller item in the **Project Explorer** window and select **Properties** from the shortcut menu to display the **RT Target Properties** dialog box. Select **Scan Engine** from the **Category** list to display the Scan Engine page.

12. Set the **Scan Period** to 10 ms or lower, then click **OK** to close the **RT Target Properties** dialog box.
13. If you did not reformat the CompactRIO device in *Step 1: Install Software on and Configure the NI RT Controller*, expand the real-time target. If an axis already exists on the target, right-click the axis and select Remove from Project, or temporarily associate it with different hardware using the **Axis Manager** dialog box. You cannot associate two axes with the same hardware device. Refer to Figure 20 to view a project with an axis on the target.
14. Right-click the controller item in the **Project Explorer** window and select **New»NI SoftMotion Axis** from the shortcut menu to open the **Axis Manager** dialog box, shown in Figure 19.
15. Click **Add New Axis** to create an NI SoftMotion axis associated with the NI 9512 module. Axes are automatically bound to an available module. You can double-click the axis name to rename the axis and give it a descriptive name.

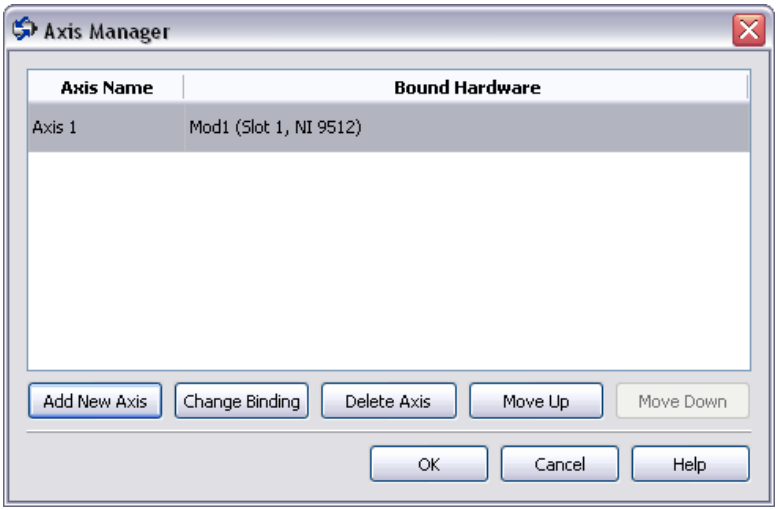


Figure 19. Axis Manager Dialog Box

16. Click **OK** to close the **Axis Manager** dialog box. The new axis is added to the **Project Explorer** window.

Note You cannot associate more than one axis with the same C Series module.

When you have finished these steps your LabVIEW project should look similar to the image in Figure 20.

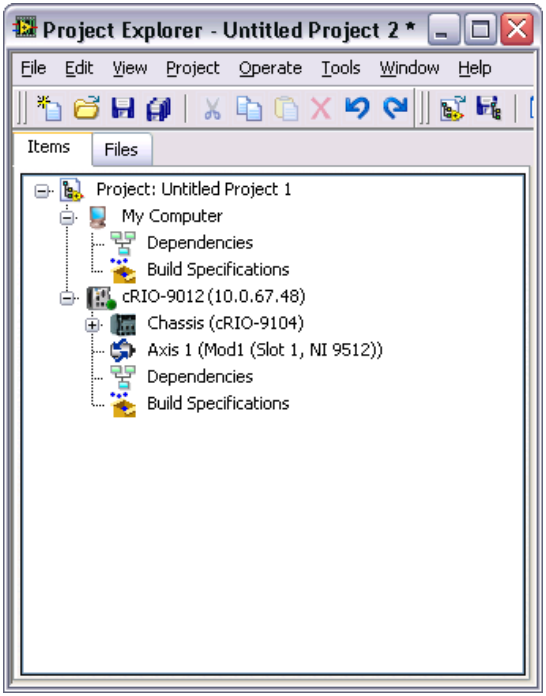


Figure 20. Project Explorer Window with Modules in Scan Interface Mode

Step 3: Configure the NI 9512 C Series Module

Complete the following steps to configure the axis I/O settings for use with the Panasonic Minas A or Minas A5 drive.

1. Right-click the axis in the **Project Explorer** window and select **Properties** from the shortcut menu to open the **Axis Configuration** dialog box.

   Figure 21 shows the parts of the **Axis Configuration** dialog box for NI 9512 C Series module.

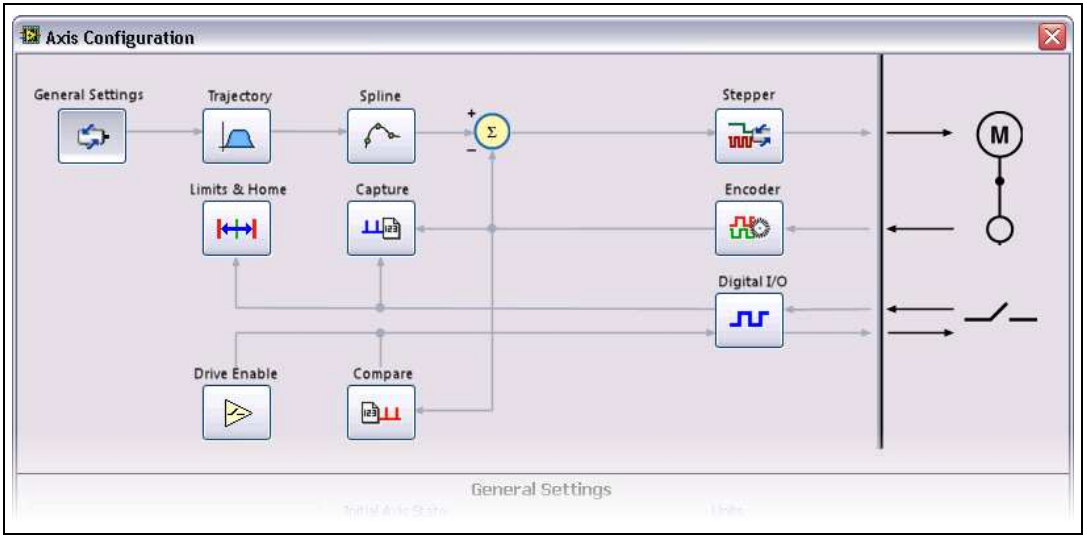


Figure 21. Axis Configuration Dialog Box

Note The **Axis Configuration** dialog box user interface may not match this image exactly depending on which version of the LabVIEW NI SoftMotion Module you are using.

2. On the General Settings page set the **Loop Mode** to **Closed-Loop**.
3. Click the Encoder button and configure the Units and Counts Per Unit.
   a. Make the following changes in the **Active State** section:
      - Set the **Line State** for **A** to **High**.
      - Set the **Line State** for **B** to **Low**.
      - Set the **Line State** for **Index** to **High**.
   b. In the **Index Reference Criteria** section set the **Line State** for **A** and **B** to **Inactive**.
   c. Type **rev** in the **Units** text box.
   d. Set the **Counts per rev** to the correct value based on your encoder resolution.

Note NI SoftMotion uses x4 encoding, so the encoder resolution needs to be converted to quadrature counts per revolution before entering the information into the **Axis Configuration** dialog box. If your encoder does not supply resolution in quadrature counts per revolution, determine quadrature counts per revolution by multiplying the encoder resolution in encoder lines or periods by four. Encoder counts per revolution is also referred to as counts per index. For example, a 500 line encoder has 2,000 quadrature counts per revolution.

When you are finished the Encoder Settings page will look similar to Figure 22.

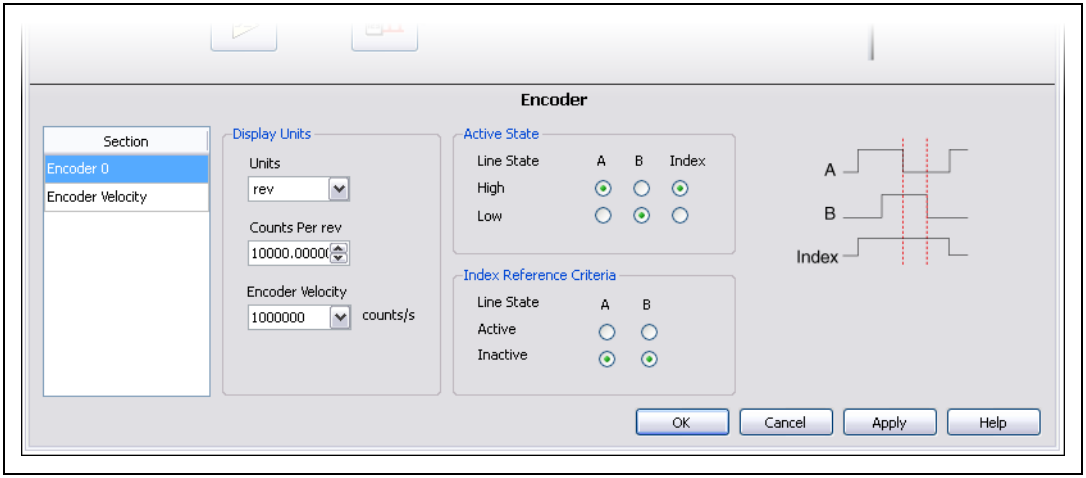


Figure 22. Axis Configuration Encoder Page

4. Click the **Stepper** button to open the **Stepper** page. Configure the stepper output and steps per rev settings:
   a. Set **Output Mode** to **Step and Direction**.
   b. Set **Output Type** to **Differential**.
   c. Set **Active State** to **Low**.
   d. Set **Steps Per rev** depending on the encoder resolution. For example, if you are using an encoder with 2500 pulses per revolution, set **Steps Per rev** to 2500.

      When you are finished the Stepper Settings page will look similar to Figure 23.

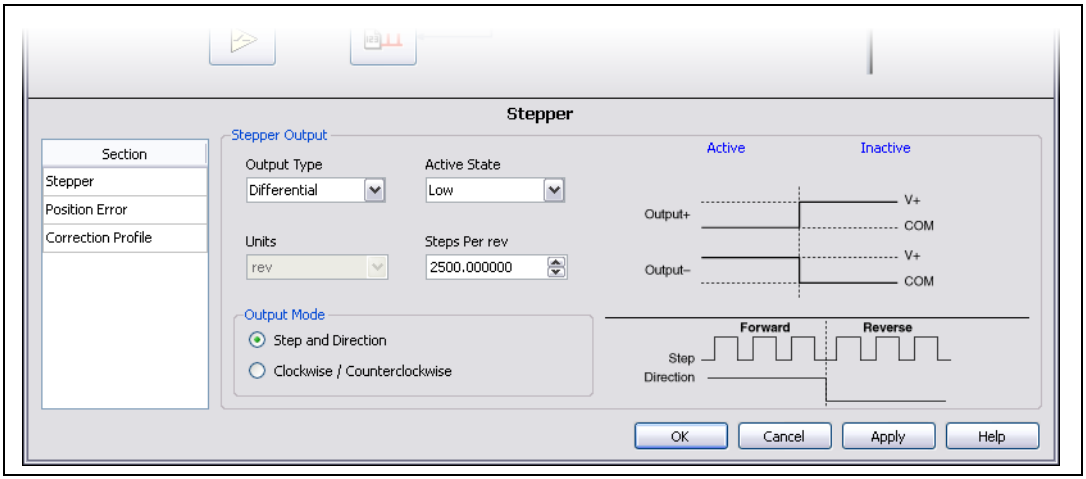


Figure 23. Axis Configuration Stepper Page

   e. In the **Position Error** section, change the **Position Error Limit** to an acceptable value for your system. Exceeding the specified position error limit causes NI SoftMotion to disable the drive and turn off the Drive Enable signal.

5. Click the **Digital I/O** button to open the **Digital I/O** page and map the following status inputs.
   a. Map DI 1 to **Servo/Drive Ready**. This signal is active when the drive is enabled.
      1) Double-click the text in the **Mapping** column and select **Servo/Drive Ready** from the dropdown list.
      2) Ensure that the DI 1 settings match the following:
         - **Input Type**—Sourcing
         - **Active State**—On
         - **Digital Filter**—50 µs
   b. Map DI 2 to **In-Position**. The **In-Position** signal from the drive is active when the current position is within a user-specified distance from the target position. This is a drive setting.
      1) Double-click the text in the **Mapping** column and select **In-Position** from the dropdown list.
      2) Ensure that the DI 2 settings match the following:
         - **Input Type**—Sourcing
         - **Active State**—On
         - **Digital Filter**—50 µs
   c. Map DI 3 to **Drive Fault/Alarm**. When the **Drive Fault/Alarm** signal is active, the module does not generate command signals.
      1) Double-click the text in the **Mapping** column and select **Drive Fault/Alarm** from the dropdown list.
      2) Ensure that the DI 3 settings match the following:
         - **Input Type**—Sourcing
         - **Active State**—Off
         - **Digital Filter**—50 µs
   d. (Optional) Configure a digital output to use for the Alarm Clear signal, if required. Position command drives often require an Alarm Clear signal from the module to the drive. This signal clears the alarm or fault outputs on the drive. This functionality is not available using a mappable digital output. However, you can use a digital output to implement this functionality in your code. Complete the following steps to use a digital output as an Alarm Clear output:
      1) Determine the required pulse time and active state for the Alarm Clear signal. This information is in the specifications for the position command drive.
      2) Select an available digital output.
      3) Configure the digital output **Active State**, **Safe State**, and **Output Type** as required by the drive.
      4) In your application VI add code to pulse the digital output line for the appropriate amount of time to clear the alarm output. Do not clear the alarm on the drive until the alarm condition is resolved.

Note If you are configuring a digital output to use as the Alarm Clear signal, you must connect the configured output from the J5 screw terminal connector to the drive Alarm Clear signal on the J4 screw terminal connector.

When you are finished the Digital I/O Settings page will look similar to Figure 24.

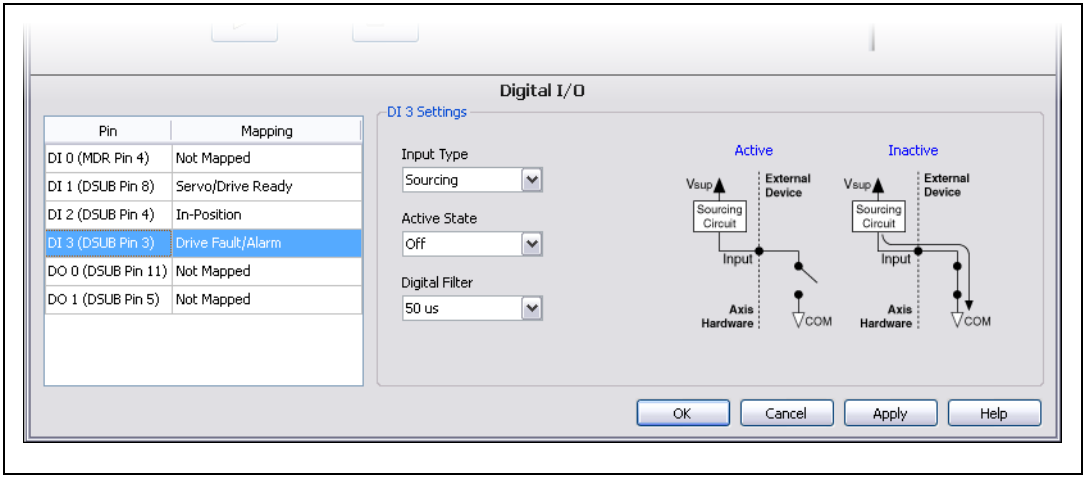


Figure 24. Axis Configuration Digital I/O Page

6. Open the **Trajectory** page and enable the **In-Position** checkbox. This allows the In-Position input to be used as a criteria for move complete. When this signal is included in the move complete criteria, the move is only complete if the In-Position signal is active.
7. Click the **Drive Enable** button and configure the Drive Enable output settings.
   a. Place a checkmark in the **Enable** checkbox.
   b. Set **Output Type** to **Sinking**.
   c. Set **Active State** to **On**.
   d. Set **Safe State** to **Off**.
8. Complete the following additional steps if you do not have limits and home connected at this time:
   a. Open the **Limits & Home** page.
   b. In the **Forward Limit** and **Reverse Limit** sections ensure that the settings match the following:

Note These configuration settings disable limits for initial setup and testing purposes. National Instruments recommends connecting and enabling limits in your final application.

- Clear the **Enable** checkbox from both **Forward Limit** and **Reverse Limit**.
- Set the **Active State** for both **Forward Limit** and **Reverse Limit** to **Off**. This prevents a limit warning even though limits are turned off.

   c. Open the **Home** section and clear the **Enable** checkbox.
9. Configure any additional I/O settings according to your system requirements, such as position compare or position capture signals.
10. Click **OK** to close the **Axis Configuration** dialog box.
11. Right-click the controller item in the **Project Explorer** window and select **Deploy All** to deploy the axis information.
12. Click **Apply** in the **Conflict Resolution** dialog box when it appears.
13. Select **File»Save Project** to save the project.

Step 4: Enable and Test the Drive Using LabVIEW

Use the Interactive Test Panel to test and debug your motion system and configuration settings on the selected axis. With the Interactive Test Panel you can perform a simple straight-line move and monitor feedback position and position error information, move and I/O status information, change move constraints, get information about software errors and faults, and view position or velocity plots of the move.

Complete the following steps to test your setup after configuring the axis using the **Axis Configuration** dialog box.

1. Right-click the axis in the **Project Explorer** window and select **Interactive Test Panel** from the shortcut menu.
2. On the **Move** tab set **Target Position** to 25 revolutions.
3. On the **Move Constraints** tab set **Velocity** to 1 revolution/sec. Using the encoder counts per revolution and stepper steps per revolution values specified in this tutorial the motor will move 25 revolutions at 60 RPM. Click the **Help** button for detailed information about the items available in this dialog box.

4. Click the **Enable** button to enable the drive.
5. Click the **Start** button on the bottom of the dialog box to start the move with the configured options.
6. Use the **Status** and **Plots** tabs to monitor the move while it is in progress.

Finalize your motion system setup by connecting and configuring additional I/O such as limits as required by your system using the screw terminal connectors on the NI 9930P accessory.

NI 9930Y Motion Control Accessory for Yaskawa Servo Drives

The NI 9930Y motion control accessory allows easy connection between the NI 9512 C Series drive interface module and the Yaskawa Sigma II and Sigma V servo drive.

What You Need to Get Started

You need the following items to get started.

Hardware

- ❑ NI 9930Y Motion Control Accessory and NI 951x Y-cable.
  (NI part number 781822-01)
- ❑ NI 9512 C Series stepper drive interface module.
  (NI part number 779944-01)
- ❑ NI real-time controller and chassis that support the RIO Scan Interface.

Tip To determine if your controller and chassis support the RIO Scan Interface go to `ni.com/info` and enter `rdsoftwareversion`.

- ❑ 24 V power supply (such as the NI PS-15) for the CompactRIO controller.
  (NI part number 781093-01)

Note Refer to the controller operating instructions for power supply requirements.

- ❑ 24 V power supply (such as the NI PS-15) for the NI 9930M. This supply also powers the NI 9512 and any drive I/O.
  (NI part number 781093-01)

Note Refer to the *NI 9512 Operating Instructions and Specifications* and the drive manual to verify that the selected power supply meets the system requirements.

- ❑ Ethernet connection and cable for the CompactRIO controller.
- ❑ 50-pin MDR cable to connect the accessory to the drive.
  (NI part number 194604-02)
- ❑ Yaskawa Sigma-II or Sigma-V position-command servo drive.

Note The Yaskawa Sigma-II drive product numbers start with SGDH, and the Yaskawa Sigma-V drive product numbers start with SGDV.

- ❑ Servo motor, encoder, power supply, and associated cables to connect the motor and encoder to the drive.

Software

- ❑ LabVIEW 2009 SP1 or later
- ❑ LabVIEW 2009 SP1 Real-Time Module or later
- ❑ LabVIEW 2009 SP1 NI SoftMotion Module or later
- ❑ NI-RIO 3.4.0 or later

Figure 25 shows a simplified connection diagram.

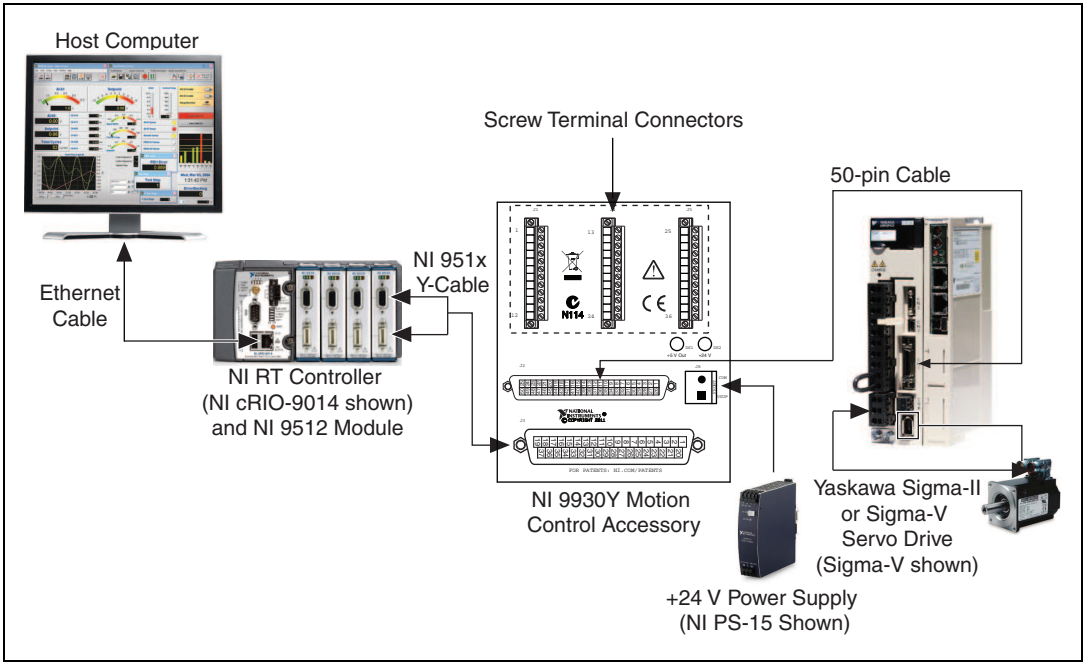
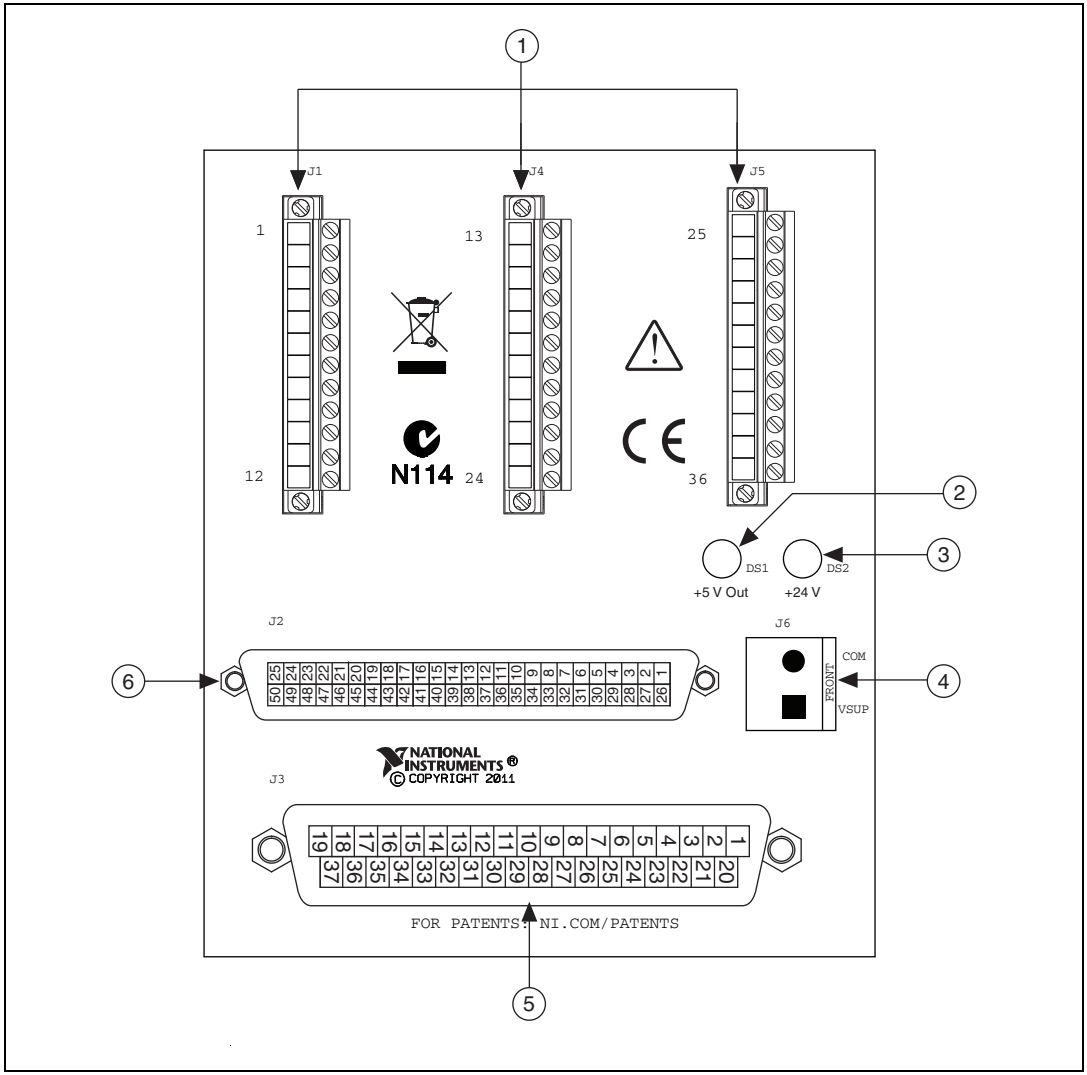


Figure 25. NI 9930Y Connection Accessory Connections

Figure 26 shows an overview of the connectors on the NI 9930Y connection accessory.



1	J1, J4, and J5: User I/O Screw Terminal Connectors	4	J6: + 24 V Power Supply Connector
2	DS1: +5 V Power LED (from NI 9512)	5	J3: NI 9512 Connector
3	DS2: +24 V Power LED	6	J2: Sigma-II and Sigma-V Connector

Figure 26. NI 9930Y Connection Accessory Connectors

Step 1: Set Up the CompactRIO System

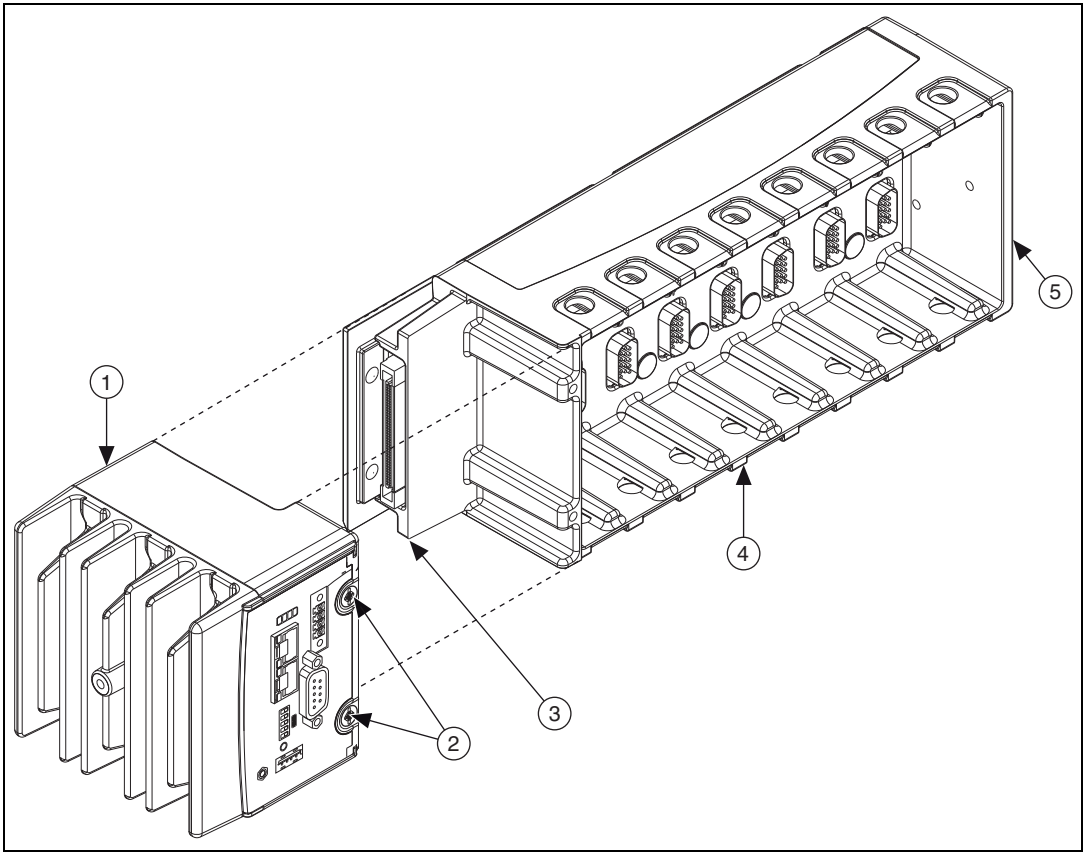
Complete the following steps to set up the CompactRIO hardware.

1. Install the real-time CompactRIO controller on the chassis if you are not using an integrated controller and chassis.

Note Write down the controller serial number before installing the controller onto the chassis. You will be unable to read the serial number after you install the controller.

   a. Make sure that no power is connected to the controller or the chassis.

   b. Align the controller with the chassis as shown in Figure 27.



1	Controller	4	Reconfigurable Embedded Chassis
2	Captive Screws	5	Grounding Screw
3	Controller Slot		

Figure 27. Installing the Controller on the Chassis (Eight-Slot Chassis Shown)

   c. Slide the controller onto the controller slot on the chassis. Press firmly to ensure the chassis connector and the controller connector are mated.

   d. Using a number 2 Phillips screwdriver, tighten the two captive screws on the front of the controller.

2. Connect the controller to a power supply and an Ethernet network on the same subnet as the development computer. Refer to the controller operating instructions for information about wiring the controller to the power supply and Ethernet network.

Note Do not plug in or turn on any power to the system until after you complete *Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive*.

3. Install the NI 9512 module in slot 1, 2, 3, or 4 of the chassis.

Step 2: Connect the NI 9930Y Connection Accessory

The NI 9930Y connection accessory contains connections for the NI 9512 C Series module, the Yaskawa Sigma-II or Sigma-V servo drive, and a 24 V power supply for NI 9512 module and drive I/O.

1. Connect the NI 9512 module to the NI 9930Y J3 connector using the NI 951x Y cable.
2. Connect the NI 9930Y J2 connector to the drive CN1 connector using the 50-pin MDR cable.
3. Connect a 24 V power supply to the Vsup and COM terminals on the NI 9930Y accessory J6 connector. Figure 26 shows the location of the power supply input.
4. Connect pin 15 (P-OT - Forward Drive Prohibit Input) and pin 14 (N-OT - Reverse Drive Prohibit Input) to pin 13 (COM).

Note These configuration settings disable limits for initial setup and testing purposes. National Instruments recommends connecting and enabling limits in your final application. Refer to the drive documentation for limit input requirements.

5. Connect any additional I/O, such as limits, DIO, position compare outputs, position capture inputs, and so on, using the NI 9930Y screw terminal connectors. The J1 and J4 connectors allow connection to the drive I/O signals, and the J5 connector provides connection to the NI 9512 I/O signals. Refer to the drive or the NI 9512 module documentation for specific signal connection requirements.

Figure 28 shows the screw terminal connector pinouts.

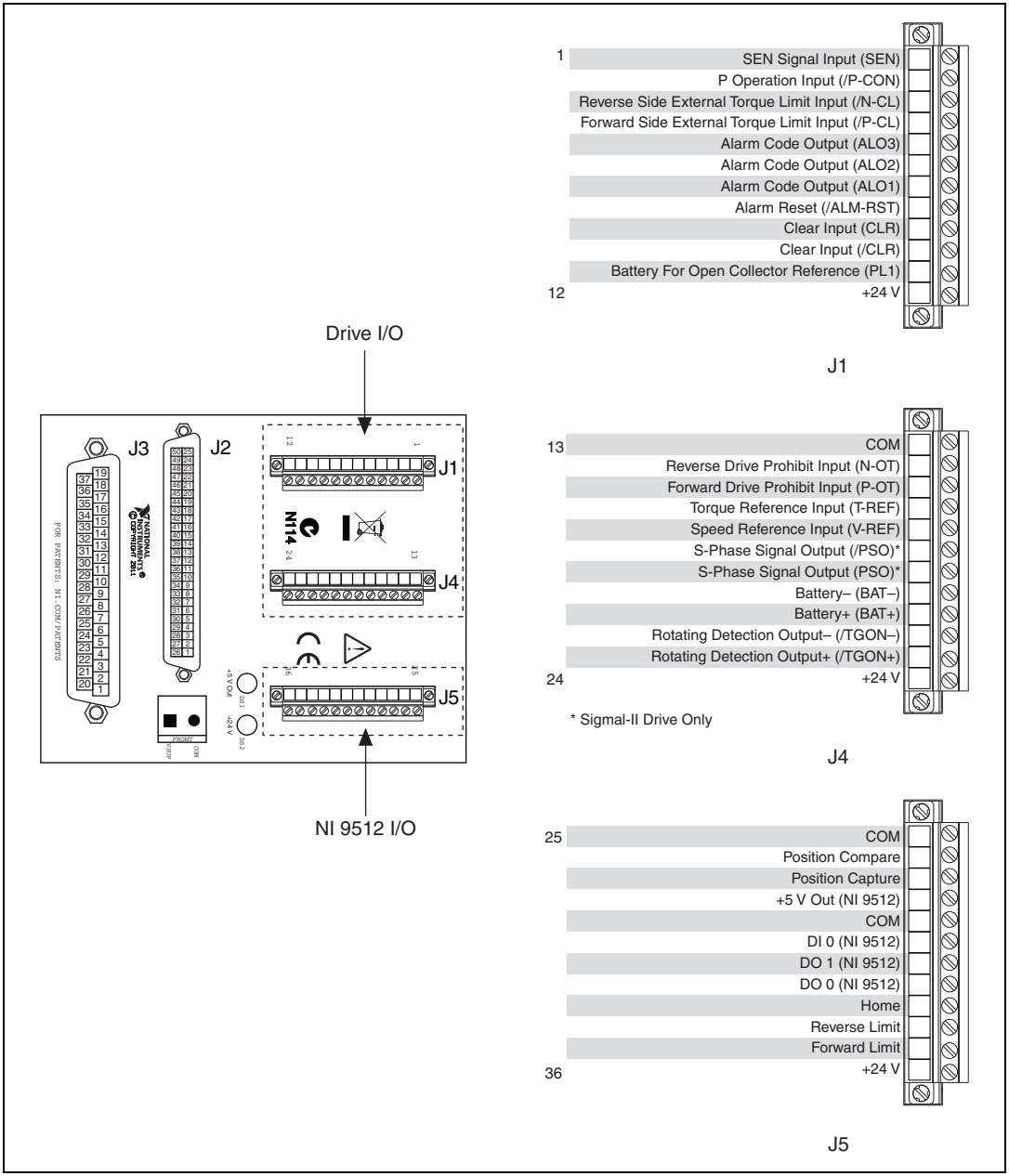


Figure 28. NI 9930Y I/O Connectors

Step 3: Configure the Drive and Connect the Motor and Encoder to the Drive

This section covers the minimum drive settings and connections to allow the motor to move. Refer to the drive manual for additional information about drive parameters and signal information.

1. Configure the drive for position control mode by setting parameter Pn000 to n.0010. This parameter is the same for the Sigma-II and Sigma-V drive.
2. Ensure that the drive encoder output pulses and electronic gear parameters are set to the default values:

   Yaskawa Sigma-II

   a. Set parameter Pn200 to n.0000.

   b. Set parameter Pn202 to 4 and parameter Pn203 to 1. This specifies a one to four ratio of steps to counts.

   c. Set parameter Pn201 to 2048. This is the maximum allowable value for this parameter when you are using an incremental encoder. If you change this value, you must also change the value specified for the encoder **Counts per rev** in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section by multiplying the value specified here by four.

   Yaskawa Sigma-V

   a. Set parameter Pn20E to 4 and parameter Pn210 to 1. This specifies a one to four ratio of steps to counts.

   b. Set parameter Pn212 to 2048. If you change this value, you must also change the value specified for the encoder **Counts per rev** in *Step 3: Configure the NI 9512 C Series Module* of the *Software Installation and Configuration* section by multiplying the value specified here by four.
3. Connect the motor and encoder to the drive. Refer to the documentation specific to your drive for motor and encoder connection information.

Tip An incorrectly connected encoder may cause NI SoftMotion to return error `-77076` (`NIMCDM_driveReadyNotActiveError`). Verify the encoder connections if you see this error.

4. Connect the drive power. Refer to the drive documentation for power connections and specifications.
5. Plug in the hardware once all connections are made and continue to the next section.

Software Installation and Configuration

This section covers installing and configuring the software for the NI 9512 C Series drive interface module. It assumes that all required software from the *What You Need to Get Started* section is installed.

Step 1: Install Software on and Configure the NI RT Controller

Complete the following steps to configure the controller and install software on it.

Note The Measurement & Automation Explorer (MAX) user interface may not match these steps exactly depending on which version of MAX you are using.

1. Launch MAX on the development computer by clicking the MAX icon on the desktop, or by selecting **Start»All Programs»National Instruments»Measurement & Automation**.
2. Select the controller under **Remote Systems** in the **Configuration** pane. If you do not see the controller, you may need to disable the firewall on the development computer. Go to `ni.com/info` and enter `RIOMAXTroubleshoot` for more information.

3. Verify that the **Serial Number** in the **General Settings** section matches the serial number on the device.
4. If you do not want to format the disk on the controller, eliminating all installed software and files, skip to step 14.
5. Set the **Safe Mode** switch on the controller to the **On** position.
6. Power on the controller. If it is already powered on, press the **Reset** button on the controller to reboot it.
7. Right-click the controller under **Remote Systems** in the **Configuration** pane in MAX and select **Format Disk**.
8. (Optional) Enable the **Keep Network Settings** checkbox if you want to retain the same target name and IP address.
9. Click **Format** to start formatting the disk.
10. When MAX finishes formatting the disk, set the **Safe Mode** switch to the **Off** position and click **OK**.
11. Select the **System Settings** tab and type a descriptive name for the system in the **Hostname** field.
12. (Optional) Complete this step only if the target has an empty IP address (0.0.0.0). Select the **Network Settings** tab and select **DHCP or Link Local** from the **Configure IPv4 Address** list to assign an IP address or select the **Static** to specify a static IP address in the **IPv4 Address** section.
13. Click **Save** on the toolbar and let MAX reboot the system.
14. When the new system name appears under **Remote Systems**, expand the controller item in the tree, right-click **Software**, and select **Add/Remove Software**.
15. Select a recommended software set that includes NI-RIO 3.4.0 or later.

Note If you are using the NI SoftMotion Module 2010 SP1 or earlier, also select **LabVIEW NI SoftMotion Module Scan Engine Support** from the list.

16. Click **Next**.
17. Select **LabVIEW NI SoftMotion Module** from the add-ons list.
18. Click **Next** to install the selected software on the controller. Click **Help** if you need information about installing recommended software sets.
19. When the software installation completes, click **Finish** to reboot the controller.
20. Close MAX.

Step 2: Creating a Project and Adding an NI SoftMotion Axis

Complete the following steps to create a LabVIEW project.

1. Launch LabVIEW by selecting **Start»All Programs»National Instruments»LabVIEW**.
2. Click the **Empty Project** link in the **Getting Started** window to display the **Project Explorer** window. You can also select **File»New Project** to display the **Project Explorer** window.
3. Select **Help** and make sure that **Show Context Help** is checked. You can refer to the context help throughout the tutorial for information about items on the block diagram.

4. Right-click the top-level project item in the **Project Explorer** window and select **New»Targets and Devices** from the shortcut menu to display the **Add Targets and Devices** dialog box. Refer to Figure 29 for more information.

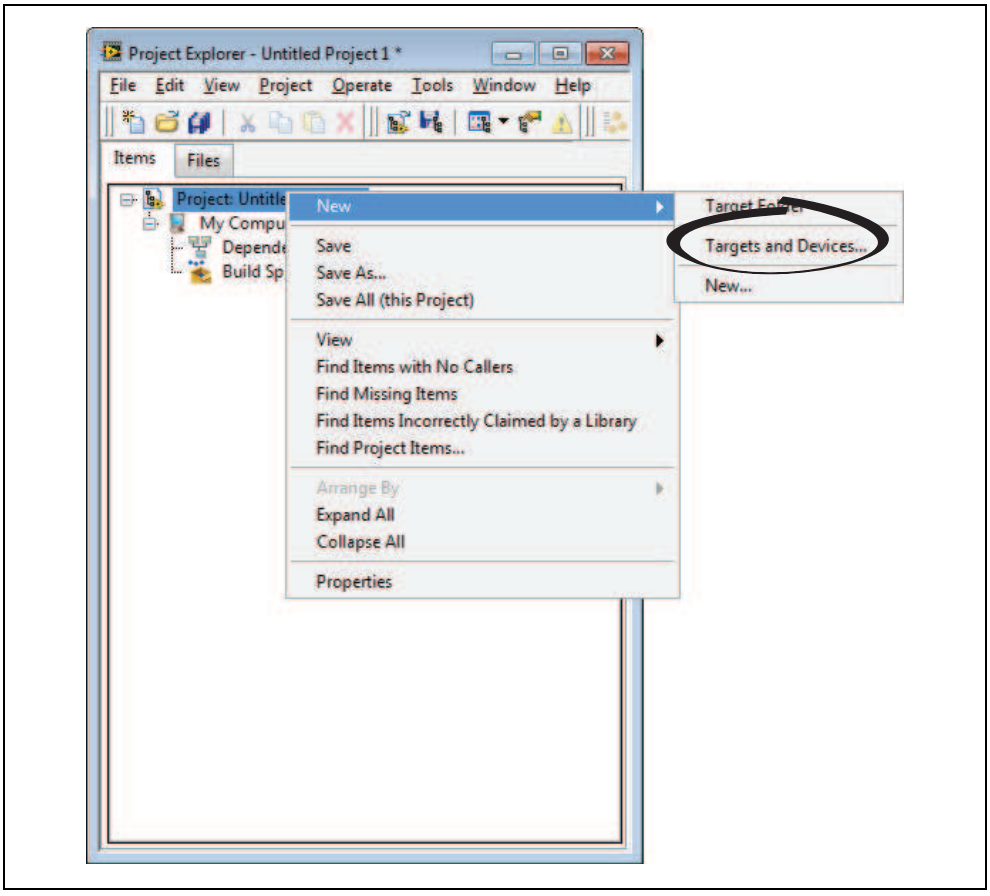


Figure 29. Adding a New Target

5. Make sure that the **Existing target or device** radio button is selected.
6. Expand **Real-Time CompactRIO**.
7. Select the CompactRIO controller to add to the project and click **OK**.
8. If you have LabVIEW FPGA installed, the **Select Programming Mode** dialog box appears. Select **Scan Interface** to put the system into Scan Interface mode.

Tip Use the **CompactRIO Chassis Properties** dialog box to change the programming mode in an existing project. Right-click the CompactRIO chassis in the **Project Explorer** window and select **Properties** from the shortcut menu to display this dialog box.

9. Click **Discover** in the **Discover C Series Modules?** dialog box if it appears.
10. Click **Continue**.
11. Right-click the controller item in the **Project Explorer** window and select **Properties** from the shortcut menu to display the **RT Target Properties** dialog box. Select **Scan Engine** from the **Category** list to display the Scan Engine page.

12. Set the **Scan Period** to 10 ms or lower, then click **OK** to close the **RT Target Properties** dialog box.
13. If you did not reformat the CompactRIO device in *Step 1: Install Software on and Configure the NI RT Controller*, expand the real-time target. If an axis already exists on the target, right-click the axis and select **Remove from Project**, or temporarily associate it with different hardware using the **Axis Manager** dialog box. You cannot associate two axes with the same hardware device. Refer to Figure 31 to view a project with an axis on the target.
14. Right-click the controller item in the **Project Explorer** window and select **New»NI SoftMotion Axis** from the shortcut menu to open the **Axis Manager** dialog box, shown in Figure 30.
15. Click **Add New Axis** to create an NI SoftMotion axis associated with the NI 9512 module. Axes are automatically bound to an available module. You can double-click the axis name to rename the axis and give it a descriptive name.

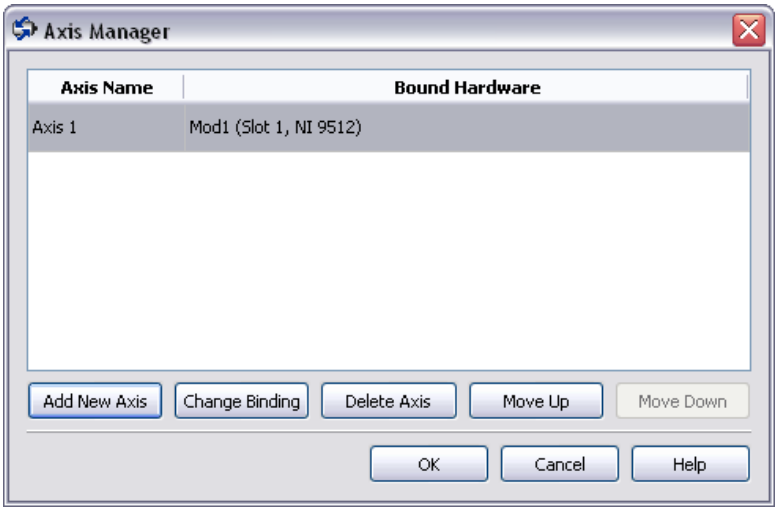


Figure 30. Axis Manager Dialog Box

16. Click **OK** to close the **Axis Manager** dialog box. The new axis is added to the **Project Explorer** window.

Note You cannot associate more than one axis with the same C Series module.

When you have finished these steps your LabVIEW project should look similar to the image in Figure 31.

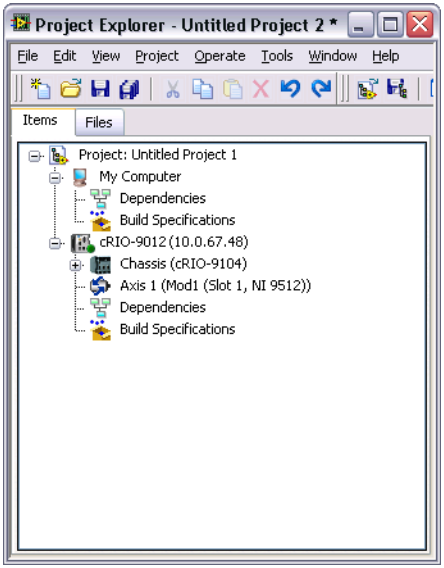


Figure 31. Project Explorer Window with Modules in Scan Interface Mode

Step 3: Configure the NI 9512 C Series Module

Complete the following steps to configure the axis I/O settings for use with the Yaskawa Sigma II or Sigma V drive.

1. Right-click the axis in the **Project Explorer** window and select **Properties** from the shortcut menu to open the **Axis Configuration** dialog box.

   Figure 32 shows the parts of the **Axis Configuration** dialog box for NI 9512 C Series module.

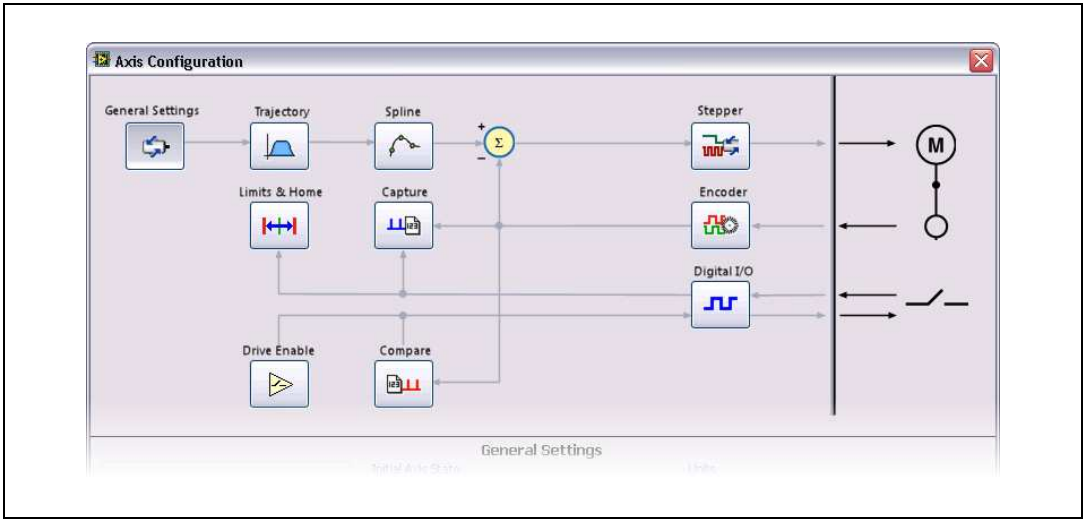


Figure 32. Axis Configuration Dialog Box

Note The **Axis Configuration** dialog box user interface may not match this image exactly depending on which version of the LabVIEW NI SoftMotion Module you are using.

2. On the General Settings page set the **Loop Mode** to **Closed-Loop**.
3. Click the Encoder button and configure the Units and Counts Per Unit.
   a. Make the following changes in the **Active State** section:
      - Set the **Line State** for **A** to **High**.
      - Set the **Line State** for **B** to **High**.
      - Set the **Line State** for **Index** to **High**.
   b. In the **Index Reference Criteria** section set the **Line State** for **A** and **B** to **Inactive**.
   c. Type **rev** in the **Units** text box.
   d. Set the **Counts per rev** to the correct value based on your encoder resolution.

Note NI SoftMotion uses x4 encoding, so the encoder resolution needs to be converted to quadrature counts per revolution before entering the information into the **Axis Configuration** dialog box. If your encoder does not supply resolution in quadrature counts per revolution, determine quadrature counts per revolution by multiplying the encoder resolution in encoder lines or periods by four. Encoder counts per revolution is also referred to as counts per index. For example, a 500 line encoder has 2,000 quadrature counts per revolution.

When you are finished the Encoder Settings page will look similar to Figure 33.

Figure 33. Axis Configuration Encoder Page

4. Click the **Stepper** button to open the **Stepper** page. Configure the stepper output and steps per rev settings:
   a. Set **Output Mode** to **Step and Direction**.
   b. Set **Output Type** to **Differential**.
   c. Set **Active State** to **Low**.
   d. Set **Steps Per rev** depending on the encoder resolution. For example, if you are using an encoder with 2048 pulses per revolution, set **Steps Per rev** to 2048.

When you are finished the Stepper Settings page will look similar to Figure 34.

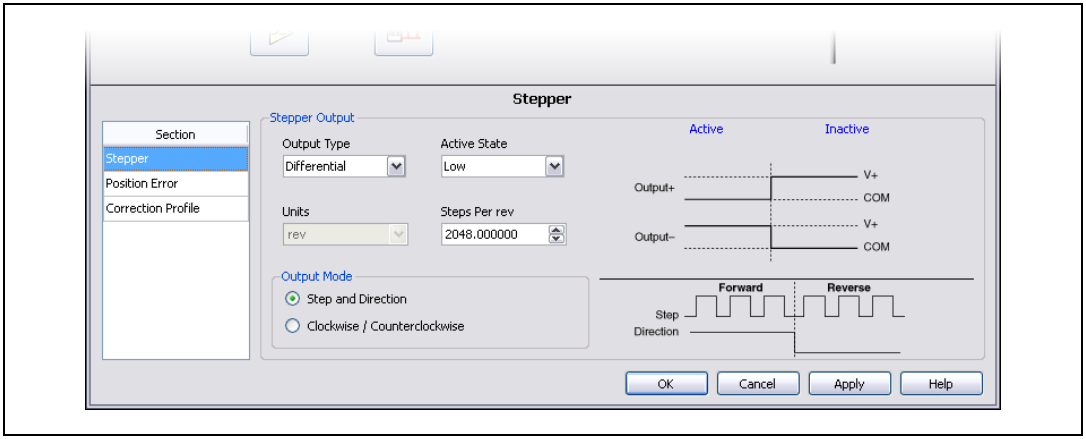


Figure 34. Axis Configuration Stepper Page

e. In the **Position Error** section, change the **Position Error Limit** to an acceptable value for your system. Exceeding the specified position error limit causes NI SoftMotion to disable the drive and turn off the Drive Enable signal.

5. Click the **Digital I/O** button to open the **Digital I/O** page and map the following status inputs.

a. Map DI 1 to **Servo/Drive Ready**. This signal is active when the drive is enabled.

1) Double-click the text in the **Mapping** column and select **Servo/Drive Ready** from the dropdown list.

2) Ensure that the DI 1 settings match the following:

- **Input Type**—Sourcing
- **Active State**—On
- **Digital Filter**—50 µs

b. Map DI 2 to **In-Position**. The **In-Position** signal from the drive is active when the current position is within a user-specified distance from the target position. This is a drive setting.

1) Double-click the text in the **Mapping** column and select **In-Position** from the dropdown list.

2) Ensure that the DI 2 settings match the following:

- **Input Type**—Sourcing
- **Active State**—On
- **Digital Filter**—50 µs

c. Map DI 3 to **Drive Fault/Alarm**. When the **Drive Fault/Alarm** signal is active, the module does not generate command signals.

1) Double-click the text in the **Mapping** column and select **Drive Fault/Alarm** from the dropdown list.

2) Ensure that the DI 3 settings match the following:

- **Input Type**—Sourcing
- **Active State**—Off
- **Digital Filter**—50 µs

d. (Optional) Configure a digital output to use for the Alarm Clear signal, if required. Position command drives often require an Alarm Clear signal from the module to the drive. This signal clears the alarm or fault outputs on the drive. This functionality is not available using a mappable digital output. However, you can use a digital output to implement this functionality in your code. Complete the following steps to use a digital output as an Alarm Clear output:

1) Determine the required pulse time and active state for the Alarm Clear signal. This information is in the specifications for the position command drive.

2) Select an available digital output.

3) Configure the digital output **Active State**, **Safe State**, and **Output Type** as required by the drive.

4) In your application VI add code to pulse the digital output line for the appropriate amount of time to clear the alarm output. Do not clear the alarm on the drive until the alarm condition is resolved.

Note If you are configuring a digital output to use as the Alarm Clear signal, you must connect the configured output from the J5 screw terminal connector to the drive Alarm Clear signal on the J1 screw terminal connector.

When you are finished the Digital I/O Settings page will look similar to Figure 35.

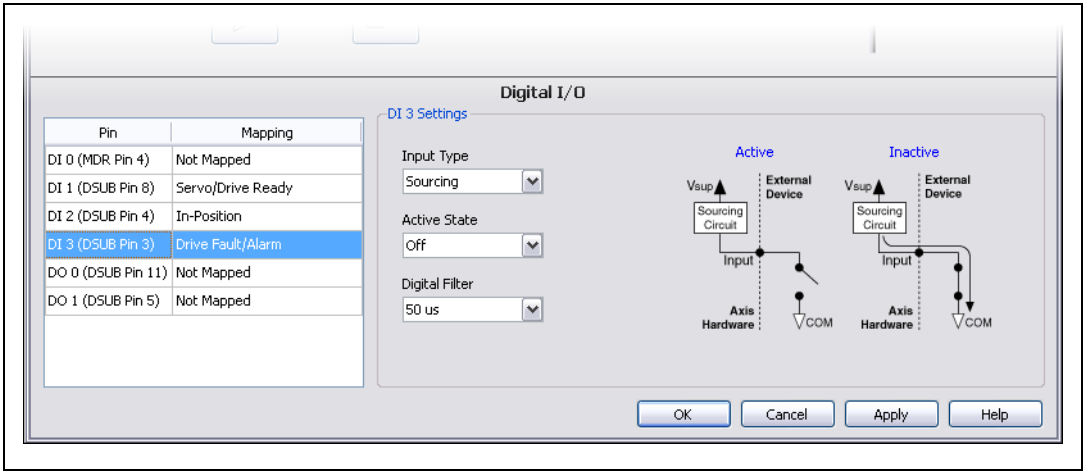


Figure 35. Axis Configuration Digital I/O Page

6. Open the **Trajectory** page and enable the **In-Position** checkbox. This allows the In-Position input to be used as a criteria for move complete. When this signal is included in the move complete criteria, the move is only complete if the In-Position signal is active.

7. Click the **Drive Enable** button and configure the Drive Enable output settings.

a. Place a checkmark in the **Enable** checkbox.

b. Set **Output Type** to **Sinking**.

c. Set **Active State** to **On**.

d. Set **Safe State** to **Off**.

8. Complete the following additional steps if you do not have limits and home connected at this time:
   a. Open the **Limits & Home** page.
   b. In the **Forward Limit** and **Reverse Limit** sections ensure that the settings match the following:

Note These configuration settings disable limits for initial setup and testing purposes. National Instruments recommends connecting and enabling limits in your final application.

   - Clear the **Enable** checkbox from both **Forward Limit** and **Reverse Limit**.
   - Set the **Active State** for both **Forward Limit** and **Reverse Limit** to **Off**. This prevents a limit warning even though limits are turned off.

   c. Open the **Home** section and clear the **Enable** checkbox.
9. Configure any additional I/O settings according to your system requirements, such as position compare or position capture signals.
10. Click **OK** to close the **Axis Configuration** dialog box.
11. Right-click the controller item in the **Project Explorer** window and select **Deploy All** to deploy the axis information.
12. Click **Apply** in the **Conflict Resolution** dialog box when it appears.
13. Select **File»Save Project** to save the project.

Step 4: Enable and Test the Drive Using LabVIEW

Use the Interactive Test Panel to test and debug your motion system and configuration settings on the selected axis. With the Interactive Test Panel you can perform a simple straight-line move and monitor feedback position and position error information, move and I/O status information, change move constraints, get information about software errors and faults, and view position or velocity plots of the move.

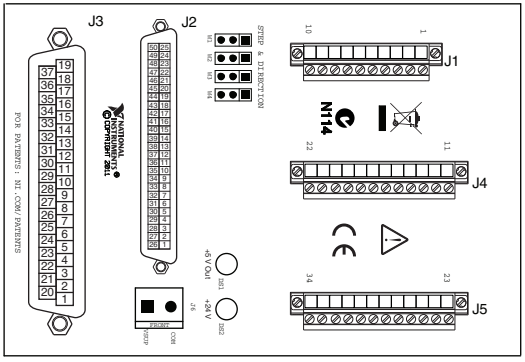
Complete the following steps to test your setup after configuring the axis using the **Axis Configuration** dialog box.

1. Right-click the axis in the **Project Explorer** window and select **Interactive Test Panel** from the shortcut menu.
2. On the **Move** tab set **Target Position** to 25 revolutions.
3. On the **Move Constraints** tab set **Velocity** to 1 revolution/sec. Using the encoder counts per revolution and stepper steps per revolution values specified in this tutorial the motor will move 25 revolutions at 60 RPM. Click the **Help** button for detailed information about the items available in this dialog box.

4. Click the **Enable** button to enable the drive.
5. Click the **Start** button on the bottom of the dialog box to start the move with the configured options.
6. Use the **Status** and **Plots** tabs to monitor the move while it is in progress.

Finalize your motion system setup by connecting and configuring additional I/O such as limits as required by your system using the screw terminal connectors on the NI 9930Y accessory.

This section contains pinouts for the 37-pin Dsub connector to the NI 9512 module and the MDR connectors to the drive for each NI 9930 accessory.



Forward Limit	1	20		Reverse Limit
Home	2	21		Reserved
COM	3	22		+24 V
DI 0	4	23		Reserved
COM	5	24		COM
Index+	6	25		Phase A+
Index–	7	26		Phase A–
COM	8	27		Phase B+
+5 V Out	9	28		Position Capture
Position Compare	10	29		Phase B–
Reserved	11	30		Reserved
reserved	12	31		Reserved
DO 0	13	32		COM
+24 V	14	33		Enable (Servo On)
DI 1 (Servo Ready)	15	34		DI 3 (Drive Fault)
Dir+	16	35		Dir–
COM	17	36		DI 2 (In-Position)
Step+	18	37		Step–
DO 1	19			

J3 - NI 9512 Connector

COM	50	25	COM
Phase B–	49	24	Index–
Phase B+	48	23	Index+
SIGNH2*	47	22	Phase A–
SIGNH1*	46	21	Phase A+
PULSH2*	45	20	NC
PUSLH1*	44	19	NC
Speed Monitor Output (SP)	43	18	Negative Direction Torque Limit Input (N-ATL)
Torque Monitor Output (IM)	42	17	COM
COM	41	16	Positive Direction Torque Limit Input (P-ATL/TRQR)
Torque Limit Input (TLC)	40	15	COM
DI 2 (In-Position)	39	14	Analog Torque Command Input (SPR/TRQR/SPL)
COM	38	13	COM
DI 3 (Drive Fault)	37	12	Zero Speed
COM	36	11	Brake Off+
DI 1 (Servo Ready)	35	10	Brake Off–
COM	34	9	Positive Direction Over Travel (POT)
Inhibit Input	33	8	Negative Direction Over Travel (NOT)
Control Mode Input (C-MODE)	32	7	+24 V
Alarm Clear	31	6	SIGN2
Position Error Clear Input (CL)	30	5	SIGN1
Enable (Servo On)	29	4	PUSL2
Electronic Gear Switching Input 1 (DIV)	28	3	PULS1
Gain Switching Input (GAIN)	27	2	NC
Damping Control Switching Input 1 (VS-SEL1)	26	1	NC

* High-speed 4M RS-422 Inputs Available on Minas A5 Drive Only

J2 - Minas A or Minas A5 Connector

Figure 36. NI 9930P I/O Connectors

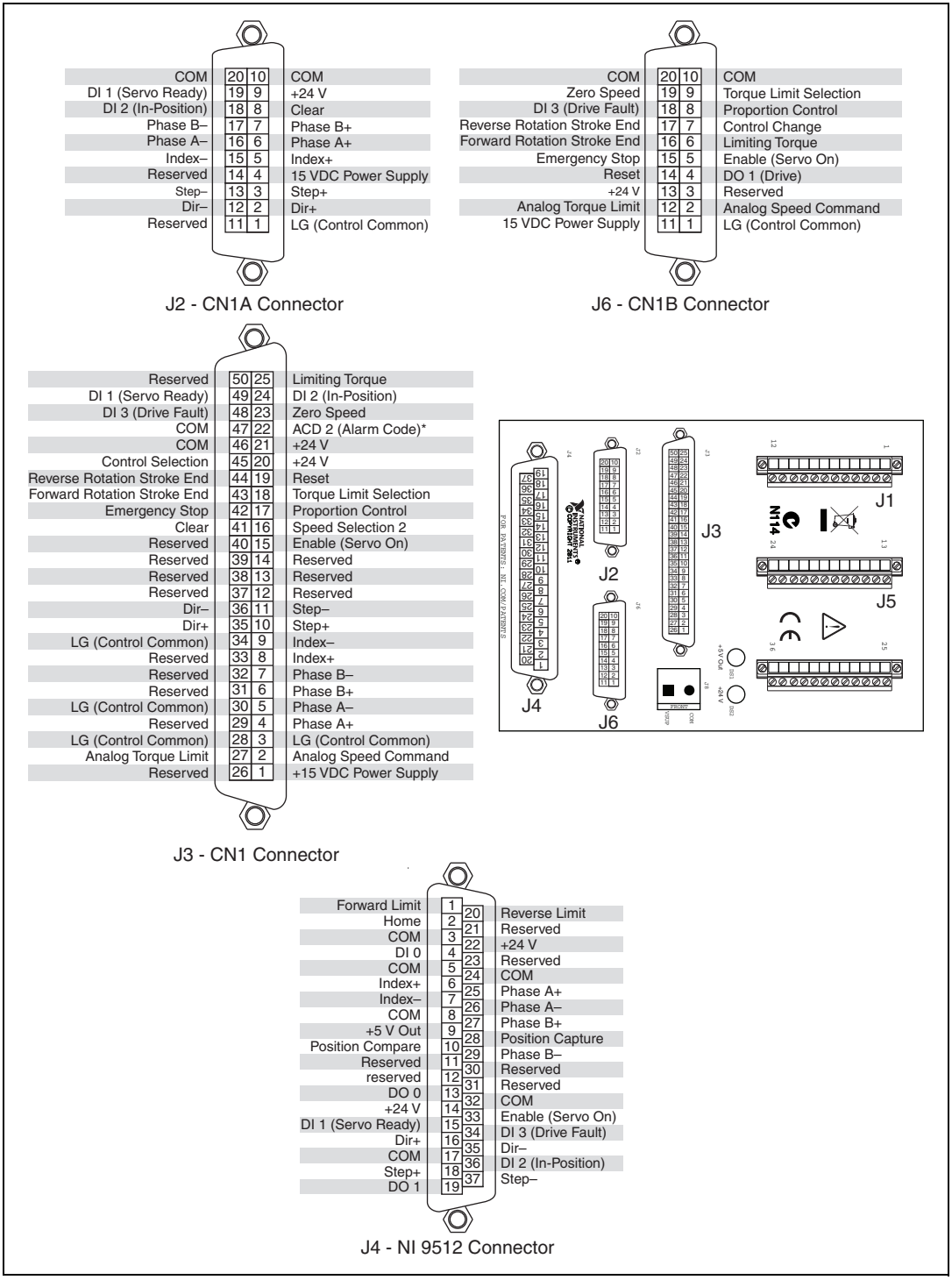
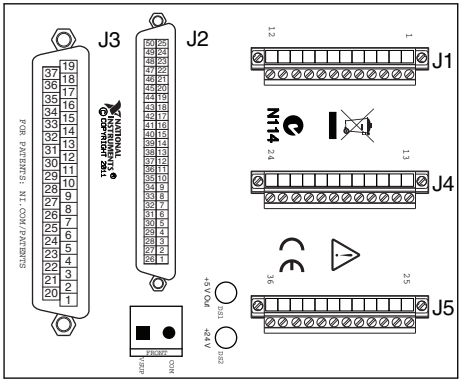


Figure 37. NI 9930M I/O Connectors



Forward Limit	1	20	Reverse Limit
Home	2	21	Reserved
COM	3	22	+24 V
DI 0	4	23	Reserved
COM	5	24	COM
Index+	6	25	Phase A+
Index–	7	26	Phase A–
COM	8	27	Phase B+
+5 V Out	9	28	Position Capture
Position Compare	10	29	Phase B–
Reserved	11	30	Reserved
reserved	12	31	Reserved
DO 0	13	32	COM
+24 V	14	33	Enable (Servo On)
DI 1 (Servo Ready)	15	34	DI 3 (Drive Fault)
Dir+	16	35	Dir–
COM	17	36	DI 2 (In-Position)
Step+	18	37	Step–
DO 1	19		

J3 - NI 9512 Connector

NC	50	25	Speed Match Detection Output+ (/V-CMP+)
S-Phase Signal Output (/PSO)*	49	24	NC
S-Phase Signal Output (PSO)*	48	23	NC
Reverse Side External Torque Limit Input (/N-CL)	47	22	Battery– (BAT–)
Forward Side External Torque Limit Input (/P-CL)	46	21	Battery+ (BAT+)
Alarm Reset (/ALM-RST)	45	20	PG Frequency Dividing Output C-Phase (/PCO)
Reverse Rotation Stroke End	44	19	PG Frequency Dividing Output C-Phase (PCO)
Reverse Drive Prohibit Input (N-OT)	43	18	Battery For Open Collector Reference (PL3)
Forward Drive Prohibit Input (P-OT)	42	17	NC
P Operation Input (/P-CON)	41	16	NC
Servo ON Input (/S-ON)	40	15	Clear Input (CLR)
Alarm Code Output (ALO3)	39	14	Clear Input (/CLR)
Alarm Code Output (ALO2)	38	13	Battery For Open Collector Reference (PL2)
Alarm Code Output (ALO1)	37	12	Reference Code Input (/SIGN)
PG Dividing Output B-Phase (/PBO)	36	11	Reference Code Input (SIGN)
PG Dividing Output B-Phase (PBO)	35	10	NC
PG Dividing Output A-Phase (/PAO)	34	9	Torque Reference Input (T-REF)
PG Dividing Output A-Phase (PAO)	33	8	Reference Pulse Input (/PULS)
Servo Alarm Output– (ALM–)	32	7	Reference Pulse Input (PULS)
Servo Alarm Output+ (ALM+)	31	6	NC
Servo-Ready Output– (/S-RDY–)	30	5	Speed Reference Input (V-REF)
Servo-Ready Output+ (/S-RDY+)	29	4	SEN Signal Input (SEN)
Rotating Detection Output– (/TGON–)	28	3	Battery For Open Collector Reference (PL1)
Rotating Detection Output+ (/TGON+)	27	2	COM
Speed Match Detection Output– (/V-CMP–)	26	1	COM

* Sigmal-II Drive Only

J2 - Sigma-II or Sigma-V Connector

Figure 38. NI 9930Y I/O Connectors

Related Documentation

The following documents contain additional information that you may find helpful. All referenced documents ship with the product and are available at `ni.com/manuals`.

- Operating instructions for the controller and C Series modules.
- Applicable drive manual.
- *Getting Started with NI 951x C Series Modules and LabVIEW*—Use this document to learn about using the NI 951x modules with LabVIEW, including information about the LabVIEW NI SoftMotion Module. To access this document, select **Start»All Programs» National Instruments»LabVIEW»LabVIEW Manuals» Getting_Started_NI_951x_Modules_LabVIEW.pdf**.
- *LabVIEW NI SoftMotion Module Help*—Use this help file to learn about using the NI SoftMotion Module in LabVIEW including information about function blocks and using the NI SoftMotion Module with the LabVIEW Project. To access this help file from LabVIEW, select **Help» LabVIEW Help**, then expand the *LabVIEW NI SoftMotion Module* book on the **Contents** tab.

Worldwide Support and Services

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