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NATIONAL INSTRUMENTS NI PXIe-4136 Single-Channel System Source Measure Unit User Manual

Contents

NATIONAL INSTRUMENTS NI PXIe-4136 Single-Channel System Source Measure Unit

Product Information

The NI PXIe-4136/4137 is a single-channel system source measure unit (SMU). It is designed to provide precise voltage and current measurements and sourcing capabilities for testing and characterization of electronic devices.

Electromagnetic Compatibility Guidelines

The NI PXIe-4136/4137 has been tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. It provides reasonable protection against harmful interference when operated in the intended operational electromagnetic environment.

However, in some installations, harmful interference may occur when the product is connected to a peripheral device or test object, or if used in residential or commercial areas. To minimize interference and ensure optimal performance, it is important to follow the instructions provided in the product documentation when installing and using this product.

Any changes or modifications to the product not approved by National Instruments could void the authority to operate it under local regulatory rules.

Safety Guidelines for Hazardous Voltages

The NI PXIe-4136/4137 can handle hazardous voltages, defined as voltages greater than 42.4 Vpk or 60 VDC to earth ground. When working with hazardous voltages, it is important to take necessary precautions to ensure personal safety.

Verifying the System Requirements

Prior to using the NI-DCPower instrument driver, it is important to ensure that your system meets the necessary requirements. Refer to the product readme, available on the driver software media or online at **ni.com/manuals**, for detailed information on minimum system requirements, recommended system configurations, and supported application development environments (ADEs).

Product Usage Instructions

Unpacking the Kit

Follow the steps below to unpack the kit:

1. Before handling the device, ground yourself using a grounding strap or by holding a grounded object, such as

your computer chassis.

2. Touch the antistatic package to a metal part of the computer chassis.

3. Remove the device from the package and carefully inspect it for any loose components or signs of damage. Do not install a damaged device.

4. Unpack any other items and documentation included in the kit.

5. When the device is not in use, store it in the antistatic package to prevent electrostatic discharge (ESD) damage.

Note: Never touch the exposed pins of connectors.

For detailed installation, configuration, and testing instructions, refer to the NI PXIe-4136/4137 Getting Started Guide available in the product documentation.

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GETTING STARTED GUIDE
NI PXIe-4136/4137
Single-Channel System Source Measure Unit (SMU)

Note
Before you begin, install and configure your chassis and controller.
This document explains how to install, configure, and test the NI PXIe-4136/4137
(NI 4136/4137). The NI 4136/4137 is a single-channel system source measure unit (SMU).
To access NI 4136/4137 documentation, navigate to Start» All Programs» National Instruments» NI-DC Power» Documentation.
Caution Do not operate the NI 4136/4137 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment. This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any changes or modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

- **Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.
- **Caution** To ensure the specified EMC performance, the length of all I/O cables must be no longer than 3 m (10 ft).

Safety Guidelines for Hazardous Voltages

If hazardous voltages are connected to the device, take the following precautions. A hazardous voltage is a voltage greater than 42.4 Vpk voltage or 60 VDC to earth ground.

- **Caution** This module is rated for Measurement Category I. It is intended to carry signal voltages no greater than 250 V. This module can withstand up to 500 V impulse voltage. Do not use this module for connection to signals or for measurements within Categories II, III, or IV. Do not connect to MAINS supply circuits (for example, wall outlets) of 115 VAC or 230 VAC.
- **Caution** Isolation voltage ratings apply to the voltage measured between any channel pin and the chassis ground. When operating channels in series or floating on top of external voltage references, ensure that no terminal exceeds this rating.

Verifying the System Requirements

To use the NI-DCPower instrument driver, your system must meet certain requirements.

Refer to the product readme, which is available on the driver software media or online at **ni.com/manuals**, for more information about minimum system requirements, recommended system, and supported application development environments (ADEs).

Unpacking the Kit

Caution To prevent electrostatic discharge (ESD) from damaging the device, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.

1. Touch the antistatic package to a metal part of the computer chassis.
2. Remove the device from the package and inspect the device for loose components or any other sign of damage.

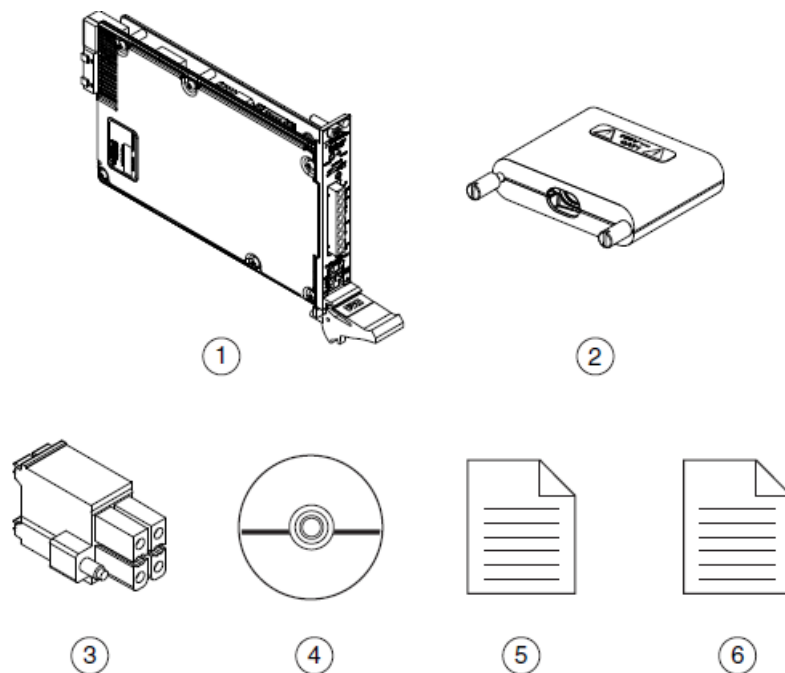   Caution Never touch the exposed pins of connectors.

   Note Do not install a device if it appears damaged in any way.
3. Unpack any other items and documentation from the kit.

   Store the device in the antistatic package when the device is not in use.

Kit Contents

Figure 1. NI 4136/4137 Kit Contents

1. NI PXIe-4136/4137 System SMU Device
2. Output Connector Assembly
3. Safety Interlock Input Connector
4. Driver Software DVD
5. NI PXIe-4136/4137 Getting Started Guide (this document)
6. Maintain Forced-Air Cooling Note to Users

Other Equipment
There are several required items not included in your device kit that you need to operate the NI 4136/4137. Your application may require additional items not included in your kit to install or operate your device.

Required Items

- A PXI Express chassis and chassis documentation. For more information about compatible chassis options, refer to **ni.com**.
- A PXI Express embedded controller or MXI controller system that meets the system requirements specified in this guide and chassis documentation.

Optional Items

- NI screwdriver (part number 781015-01).

Preparing the Environment

Ensure that the environment you are using the NI 4136/4137 in meets the following specifications.

Operating Environment

- **Ambient temperature range**

  0 °C to 55 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
- **Relative humidity range**

  10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)
- **Storage ambient temperature range**

  -40 °C to 70 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.)
- **Maximum altitude**

  2,000 m (800 mbar) (at 25 °C ambient temperature)
- **Pollution Degree**

  2

Indoor use only.
Note Refer to the device specifications on **ni.com/manuals** for complete specifications.

Safety

Caution Always refer to the specifications document for your device before connecting signals. Failure to observe the specified maximum signal ratings can cause shock, a fire hazard, or damage to the devices connected to the NI 4136/4137. NI is not liable for any damage or injuries resulting from incorrect signal connections.

Installing the Software
You must be an Administrator to install NI software on your computer.

1. Install an ADE, such as LabVIEW or Lab Windows™/CVI™.
2. Insert the driver software media into your computer. The installer should open automatically.

   If the installation window does not appear, navigate to the drive, double-click it, and double-click autorun.exe.
3. Follow the instructions in the installation prompts.

   Note Windows users may see access and security messages during installation. Accept the prompts to complete the installation.
4. When the installer completes, select Restart in the dialog box that prompts you to restart, shut down, or restart later.

System Safety Guidelines

Safety Guidelines for System Design and Implementation
The NI 4136/4137 is capable of generating hazardous voltages and working within hazardous voltage systems. It is the responsibility of the system designer, integrator, installer, maintenance personnel, and service personnel to ensure the system is safe during use.

- Ensure operators cannot access the NI 4136/4137, cables, the device under test (DUT) or any other instruments in the system while hazardous voltages are present.
- Operator access points can include, but are not limited to, guards, gates, sliding doors, hinge doors, lids,

covers, and light curtains.

- If using a test fixture enclosure, ensure that it is properly connected to safety ground.
- Ensure that the NI 4136/4137 is properly secured to the chassis using the two front panel mounting screws.
- Double insulate all electrical connections that are accessible by an operator. Double insulation ensures protection if one layer of insulation fails. Refer to IEC 61010-1 for specific insulation requirements.

Safety Interlock System Integration

The NI 4136/4137 includes a safety interlock circuit that places the outputs of the SMU device in a safe state, regardless of the programmed state of the device.

- Do not short the safety interlock pins directly at the connector under any circumstances.
- Confirm on a regular basis that the safety interlock is functioning by performing a safety interlock test.
- Install mechanical detection switches that open the safety interlock circuit when the operator attempts to access the test fixture, disabling the hazardous voltage ranges of the instrument.
- Ensure the mechanical detection switches close the safety interlock circuit only when the operator has properly closed all entry points to the test fixture enclosure, enabling hazardous voltage ranges on the instrument.

Figure 2. System Level Connection, Typical
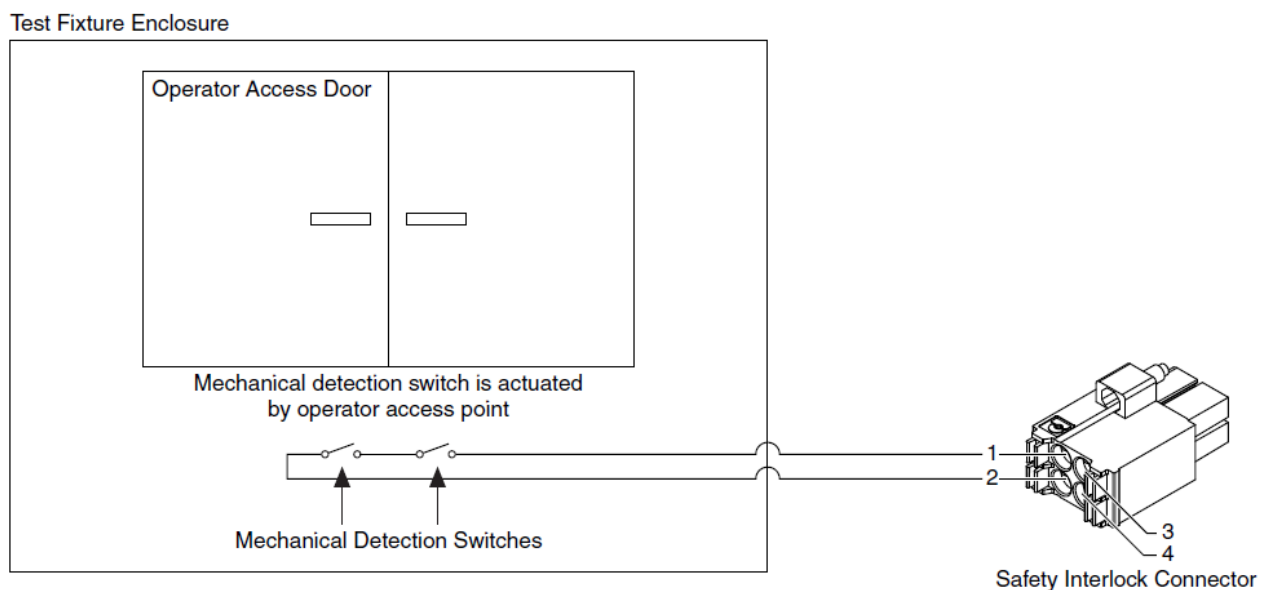
Related Information

Fore more information about the Safety Interlock, refer to the NI DC Power Supplies and SMUs Help.
Testing the Safety Interlock on page 10

Mechanical Detection Switch Recommendations

- Use high-reliability, fail-safe, normally open mechanical detection switches on all access points to the test fixture enclosure.
- Use two normally open switches wired in series so that a single switch failure does not compromise safety protections.
- Isolate switches so the operator cannot trigger or bypass the switches without the use of a tool.
- Ensure the switches' certifications meet your test application requirements. NI recommends UL-certified safety

switches to ensure reliability.

- Install the switches in accordance with the switch manufacturer specifications.
- Test the switches periodically to ensure proper implementation and reliability.

Safety Guidelines for System Operation

Caution Hazardous voltage of up to the maximum voltage of the device may appear at the output terminals if the safety interlock terminal is closed. Open the safety interlock terminal when the output connections are accessible. With the safety interlock terminal open the output voltage level/limit is limited to ±40 VDC, and protection will be triggered if the voltage measured between the device HI and LO terminals exceeds ±(42 Vpk ±0.4 V).

Caution Do not apply voltage to the safety interlock connector inputs. The interlock connector is designed to accept passive normally open contact closure connections only.

To ensure a system containing the NI 4136/4137 is safe for operators, components, or conductors, take the following safety precautions:

- Ensure proper warnings and signage exists for workers in the area of operation.
- Provide training to all system operators so that they understand the potential hazards and how to protect themselves.
- Inspect connectors, cables, switches, and any test probes for any wear or cracking before each use.
- Before touching any of the connections to the high terminal or high sense on the NI 4136/4137, discharge all components connected to the measurement path. Verify with a DMM before interaction with connections.

Installing the NI 4136/4137

Caution To prevent damage to the device caused by ESD or contamination, handle the device using the edges or the metal bracket.

- Ensure the AC power source is connected to the chassis before installing the modules. The AC power cord grounds the chassis and protects it from electrical damage while you install the modules.
- Power off the chassis.
- Inspect the slot pins on the chassis backplane for any bends or damage prior to installation. Do not install a module if the backplane is damaged.
- Remove the black plastic connectors from all the captive screws on the module front panel.
- Identify a supported slot in the chassis. The following figure shows the symbols that indicate the slot types.

Figure 3. Chassis Compatibility Symbols
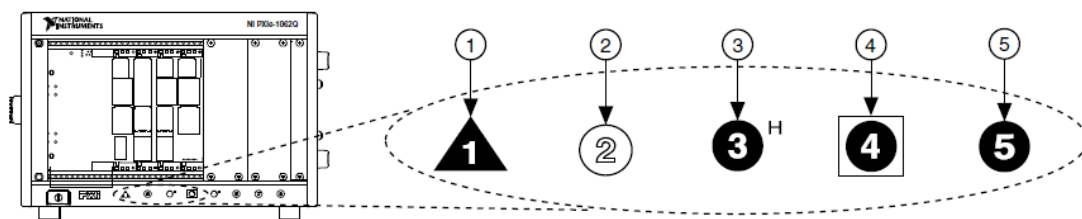
1. PXI Express System Controller Slot

2. PXI Peripheral Slot

3. PXI Express Hybrid Peripheral Slot

4. PXI Express System Timing Slot

5. PXI Express Peripheral Slot

NI 4136/4137 modules can be placed in PXI Express peripheral slots, PXI Express hybrid peripheral slots, or PXI Express system timing slots.

- Touch any metal part of the chassis to discharge static electricity.
- Ensure that the ejector handle is in the unlatched (downward) position.
- Place the module edges into the module guides at the top and bottom of the chassis. Slide the device into the slot until it is fully inserted.

Figure 4. Module Installation
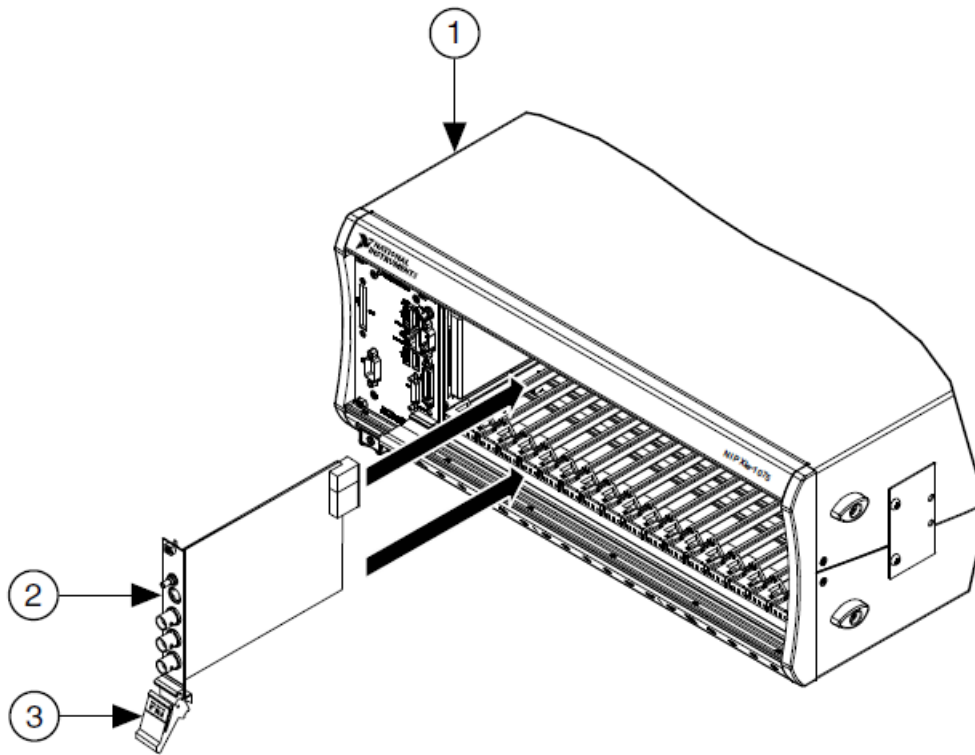
1. Chassis

2. Hardware Module

3. Ejector Handle in Down (Unlatched) Position

- Latch the module in place by pulling up on the ejector handle.
- Secure the device front panel to the chassis using the front-panel mounting screws.
  Note Tightening the top and bottom mounting screws increases mechanical stability and also electrically connects the front panel to the chassis, which can improve the signal quality and electromagnetic performance.
- Cover all empty slots using filler panels or slot blockers to maximize cooling air flow.
- Prepare the output connector and cable to ensure proper grounding. Refer to the following figure for connection information.
    - Open the output connector assembly.

- To expose the cable ground shield, measure and mark your strip length on the cable.
- Use an insulation strip tool to expose the cable ground shield.
- Insert the cable.
- Using strain relief, clamp down on the ground shield.
- Tie the cable drain wire to the grounding screw.
- Ensure that there is no exposed wiring, cable ground shield, or drain wire in the shaded region: 8.89 mm (.350 in.) minimum.
- Close the output connector assembly, and tighten the retention screws to hold it in place.

Figure 5. NI 4136/4137 Output Connector
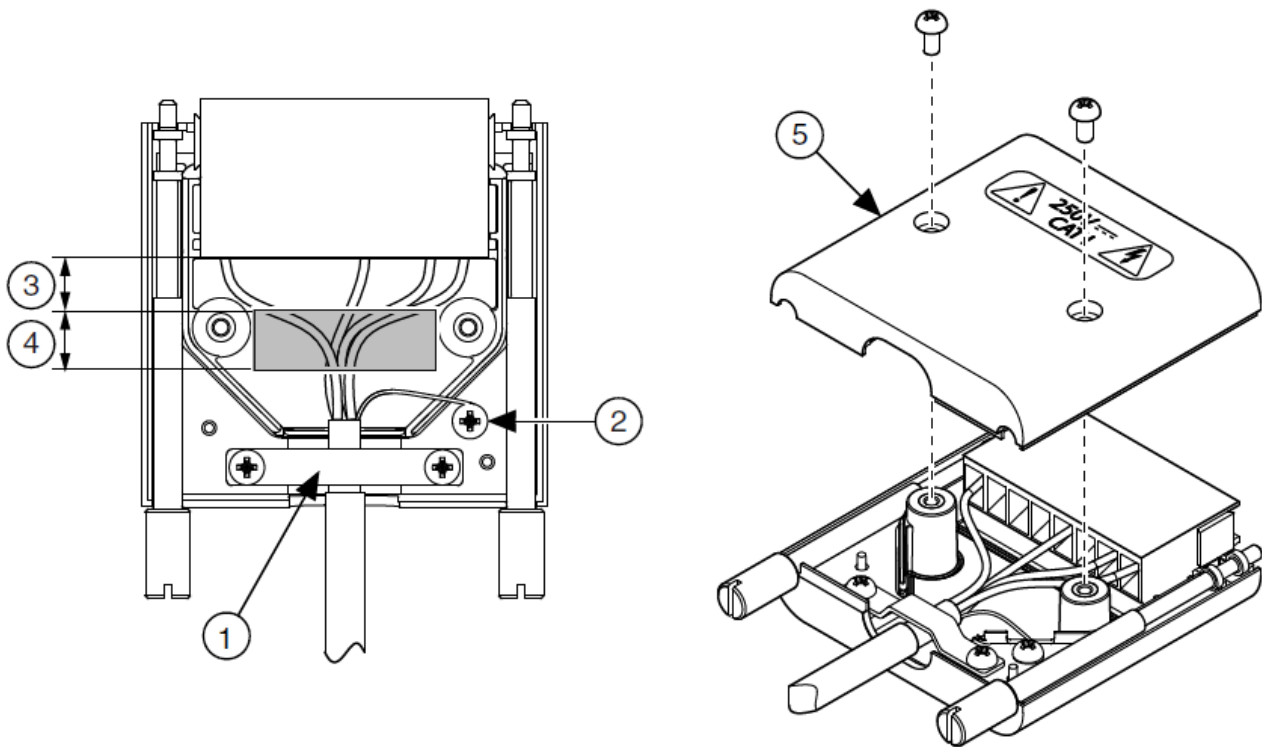
1. Strain Relief Clamped onto Ground Shield
2. Grounding Screw Connected to Drain Wire
3. Region Where Exposed Wiring Is Allowed, 7.62 mm (.300 in.)
4. Region Free from Exposed Wiring, Cable Ground Shield, or Drain Wire, 8.89 mm (.350 in.) Minimum
5. Output Connector Assembly

- Attach output connections.
    - Connect the output connector assembly to the device. Tighten any thumbscrews on the output connector assembly to hold it in place.
- Ensure that the safety interlock connector is wired to a test fixture that ensures operator safety, and prepare the safety interlock cable for insertion into the safety interlock connector.
    - Measure and mark your strip length on the safety interlock cable.
    Note Required wire strip length for the safety interlock cable is 7.5 mm (0.295 in.) minimum and 10 mm (0.394 in.) absolute maximum. Acceptable AWG Range for safety interlock cable is 16-24.
    - Use an insulation strip tool to expose cable of the appropriate length.

- The safety interlock connector accepts both solid and multi-strand conductor cabling. If you are using a multi-stranded cable, twist the strands together before insertion. For additional cabling reliability, strip and tin multi-stranded conductors before insertion.
  - Insert the cable.
  - Inspect for loose strands and tighten any retention screws on the safety interlock connector assembly to hold it in place.
  - Connect the safety interlock connector to the device.
- Power on the chassis.
- Perform the safety interlock test.

Related Information

Configuring the NI 4136/4137 in MAX

Use Measurement & Automation Explorer (MAX) to configure your NI hardware. MAX informs other programs about which devices reside in the system and how they are configured. MAX is automatically installed with NI-DC Power.

1. Launch MAX.
2. In the configuration tree, expand Devices and Interfaces to see the list of installed devices.
   Installed devices appear under the name of their associated chassis.
3. Expand your Chassis tree item.
   MAX lists all devices installed in the chassis. Your default device names may vary.
   Note If you do not see your device listed, press <F5> to refresh the list of installed devices. If the device is still not listed, power off the system, ensure the device is correctly installed, and restart.
4. Record the device identifier MAX assigns to the hardware. Use this identifier when programming the NI 4136/4137.
5. Self-test the device by selecting the device in the configuration tree and clicking Self-Test in the MAX toolbar.
   The MAX self-test performs a basic verification of hardware resources.

Testing the Safety Interlock

In order to ensure safe operation of the NI 4136/4137, periodically test the safety interlock for proper functionality. The recommended test interval is at least once per day of continuous usage.

Testing with an Application Development Environment

1. Disconnect the output connector from the NI 4136/4137 front panel.
2. Ensure that the safety interlock input on the test fixture is closed.
3. Set the niDC Power Output Function property or NIDCPOWER_OUTPUT_FUNCTION attribute to DC Voltage for the NI 4136/4137.
4. Set the voltage level range to 200 V, and set the voltage level to 42.4 V.
5. Set the current limit range to 1 mA, and set the current limit to 1 mA.
6. Initiate the session.

7. Verify that the Voltage Status Indicator is amber.

8. Open the safety interlock input using the test fixture.

9. Verify that the Voltage Status Indicator is red.

10. Reset the device using the niDC Power Reset VI or the niDC Power Reset function.

11. Verify that the Voltage Status Indicator is green.

   Caution If the NI 4136/4137 fails the safety interlock test, discontinue use of the device and contact an authorized NI service representative to request a Return Material Authorization (RMA).

Testing with the NI-DC Power Soft Front Panel

1. Disconnect the output connector from the NI 4136/4137 front panel.

2. Ensure that the safety interlock input on the test fixture is closed.

3. In the NI-DC Power SFP, set Output Function to DC Voltage.

4. Set Voltage Level Range to 200 V, and set Voltage Level to 42.4 V.

5. Set Current Limit to 1 mA, and set Current Limit Range to 1 mA.

6. Ensure that Local sense is selected.

7. Check the Output Enabled checkbox to enable the output.

8. Verify that the Voltage Status Indicator is amber.

9. Open the safety interlock input using the test fixture.

10. Verify that the Voltage Status Indicator is red and that a hazardous voltage error message appears.

11. On the error message dialog, click OK to prompt the NI 4136/4137 to attempt to clear the error and re-initialize the session to default values.

12. Verify that the Voltage Status Indicator is green.

   Caution If the NI 4136/4137 fails the safety interlock test, discontinue use of the device and contact an authorized NI service representative to request a Return Material Authorization (RMA).

Programming the NI 4136/4137

You can generate signals interactively using the NI-DC Power Soft Front Panel (SFP) or you can use the NI-DC Power instrument driver to program your device in the supported ADE of your choice.

Table 1. NI 4136/4137 Programming Options

Application Programming Interface (API)	Location	Description
NI-DC Power SFP	Available from the start menu at **Start**» **All Programs**» **National Instruments**» **NI-DC Power**» **NI-DC Power Soft Front Panel**.	The NI-DC Power SFP acquires, controls, and presents data. The NI-DC Power SFP operates on the PC, to provide additional display capabilities.
NI-DC Power Instrument Driver	LabVIEW—Available on the LabVIEW Functions palette at **Measurement I/O**» **NI-DC Power**.	NI-DC Power configures and operates the device hardware and performs basic acquisition and measurement options using LabVIEW VIs or Lab Windows/CVI functions.
	C or Lab Windows/CVI— Available at **Program Files**» **IVI Foundation**» **IVI**» **Drivers**» **NI-DC Power**.	
	Microsoft Visual C/C++— NI-DC Power does not ship with installed C/C++ examples.	Refer to the *Creating an Application with Microsoft Visual C and C++* topic of the **_NI DC Power Supplies and SMUs Help_** to manually add all required include and library files to your project.

Troubleshooting

If an issue persists after you complete a troubleshooting procedure, contact NI technical support or visit
ni.com/support.

What Should I Do if the NI 4136/4137 Doesn't Appear in MAX?

1. In the MAX configuration tree, click Devices and Interfaces.
2. Expand the Chassis tree to see the list of installed devices, and press <F5> to refresh the list.
3. If the module is still not listed, power off the system, ensure that all hardware is correctly installed, and restart the system.
4. Navigate to the Device Manager.
   Operating System Description
   - Windows 8 R ight-click the Start screen, and select All apps» Control Panel»
   - Hardware and Sound» Device Manager.
   - Windows 7 Select Start» Control Panel» Device Manager.
   - Windows Vista Select Start» Control Panel» System and Maintenance» Device Manager.
   - Windows XP Select Start» Control Panel» System» Hardware» Device Manager.
5. If you are using a PXI controller, verify that a National Instruments entry appears in the system device list.
   Reinstall NI-DCPower and the device if error conditions appear in the list. If you are using an MXI controller,
   right-click PCI-to-PCI Bridge, and select Properties from the shortcut menu to verify that the bridge is enabled.

Why Is the ACCESS LED Off When the Chassis Is On?
The LEDs may not illuminate until the device has been configured in MAX. Before proceeding, verify that the NI 4136/4137 appears in MAX.
If the ACCESS LED fails to illuminate after you power on the PXI Express chassis, a problem may exist with the PXI Express power rails, a hardware module, or the LED.

1. Caution Apply external signals only while the NI 4136/4137 is powered on. Applying external signals while the device is powered off may cause damage. Disconnect any signals from the PXI Express module front panels.

2. Remove any front panel connections from the NI 4136/4137.

3. Power off the PXI Express chassis.

4. Remove the module from the PXI Express chassis and inspect it for damage. Do not reinstall a damaged device.

5. Install the module in a different PXI Express chassis slot from which you removed it.

6. Power on the PXI Express chassis.

7. Verify that the device appears in MAX.

8. Reset the device in MAX and perform a self-test.

If the ACCESS LED still fails to illuminate and failures continue, contact NI technical support or visit **ni.com/support**.

Related Information
For more information about LED status indicator behavior, see the front panel topic for your device in the NI DC Power Supplies and SMUs Help.

Where To Go Next

Located in the hardware kit
EXPLORE the application development environment (ADE) for your application.

Learn LabVIEW Basics
Getting Started with LabWindows/CVI

Located online at ni.com/manuals
LEARN about hardware features or review device specifications.
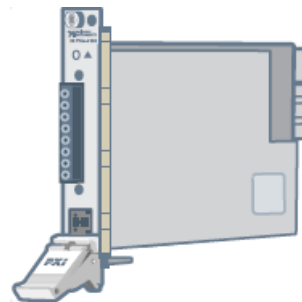
NI PXIe-4136 Specifications* OR
NI PXIe-4137 Specifications*
NI DC Power Supplies and SMUs Help*

Located using the NI Example Finder

CREATE custom applications within an application programming interface (API).

NI-DCPower Soft Front Panel
NI-DCPower Instrument Driver
NI DCPower Examples*
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Documents / Resources

	NATIONAL INSTRUMENTS NI PXIe-4136 Single-Channel System Source Measure Unit [pdf] User Manual NI 4136, NI 4137, NI PXIe-4137, NI PXIe-4136, NI PXIe-4136 Single-Channel System Source Measure Unit, Single-Channel System Source Measure Unit, Source Measure Unit, Measure Unit

References

- **Engineer Ambitiously - NI**
- **Engineer Ambitiously - NI**
- **Calibration Services - NI**
- **Product Certifications - NI**
- **NI Community - National Instruments**
- **Trade Compliance - NI**
- **Product Documentation - NI**
- **Contact Us - NI**
- **What are PXI Source Measure Units (SMUs)? - NI**
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