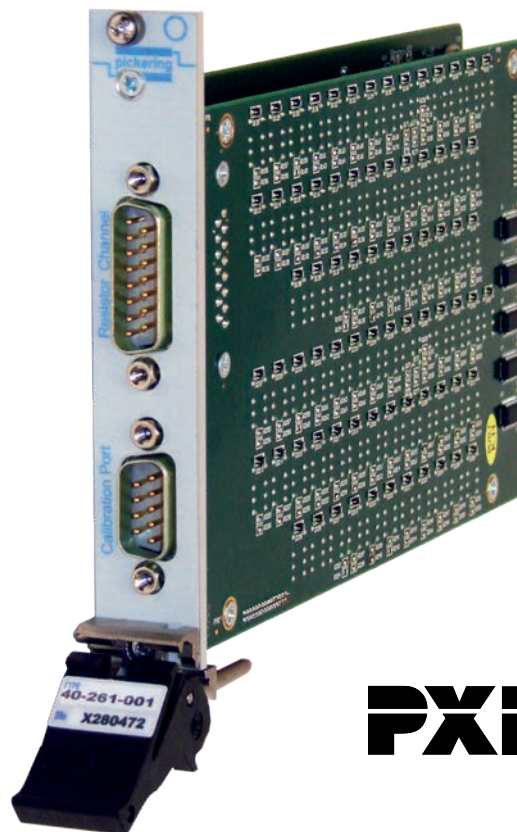




40-261 User Manual

PXI Precision Programmable Resistor Module



PXI

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ISO 9001
Reg No. FM38792

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For Technical Support please contact Pickering Interfaces either by phone, the website or via e-mail.

WARRANTY

All products manufactured by Pickering Interfaces are warranted against defective materials and workmanship for a period of three years, excluding programmable power supplies, from the date of delivery to the original purchaser. Any product found to be defective within this period will, at the discretion of Pickering Interfaces be repaired or replaced.

Products serviced and repaired outside of the warranty period are warranted for ninety days.

Extended warranty and service are available. Please contact Pickering Interfaces by phone, the website or via e-mail.

ENVIRONMENTAL POLICY

Pickering Interfaces operates under an environmental management system similar to ISO 14001.

Pickering Interfaces strives to fulfil all relevant environmental laws and regulations and reduce wastes and releases to the environment. Pickering Interfaces aims to design and operate products in a way that protects the environment and the health and safety of its employees, customers and the public. Pickering Interfaces endeavours to develop and manufacture products that can be produced, distributed, used and recycled, or disposed of, in a safe and environmentally friendly manner.

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PRODUCT SAFETY

SAFETY SYMBOLS

The following safety symbols may be used on the product and throughout the product documentation.

MEANING / DESCRIPTION	SYMBOL
PROTECTIVE EARTH (GROUND) To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode.	
DANGEROUS VOLTAGE To indicate hazards arising from dangerous voltages.	
WARNING / CAUTION An appropriate safety instruction should be followed or caution to a potential hazard exists. Refer to the relevant instructions detailed within the product manual.	
HEAVY If this product is heavy reference should be made to the safety instructions for provisions of lifting and moving.	
STATIC SENSITIVE To indicate that static sensitive devices are present and handling precautions should be followed.	

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WARNINGS AND CAUTIONS

WARNING - HAZARDOUS ENVIRONMENTS

This product is not specifically designed for use in hazardous environments, for example in explosive atmospheres. If the product is to be used in hazardous environments we recommend that the user ensures suitable protective measures are taken.

SYMBOL



WARNING - DANGER OF ELECTRIC SHOCK

This module may contain hazardous voltages. Before removing the module from the rack remove all supplies and disconnect user I/O signals.

Unused slots in the host chassis are populated with blanking plates to prevent access to user I/O signals that may be present. Blanking panels are available to order from Pickering in a variety of slot widths. If the product is not used in this manner for example by using an extender card then additional care must be taken to avoid contact with exposed signals.

Not to be used in safety critical circuits, refer to the Pickering Interfaces' terms & conditions of sale.

This module must not be used for the switching of Mains Circuits. For the switching of voltages up to the module's full specification, Secondary Circuit power supplies and the Device Under Test must be fully isolated from the Mains Circuit and the safety earth.

The host chassis must be correctly installed and be connected to mains or factory safety ground, please refer to your chassis installation manual.

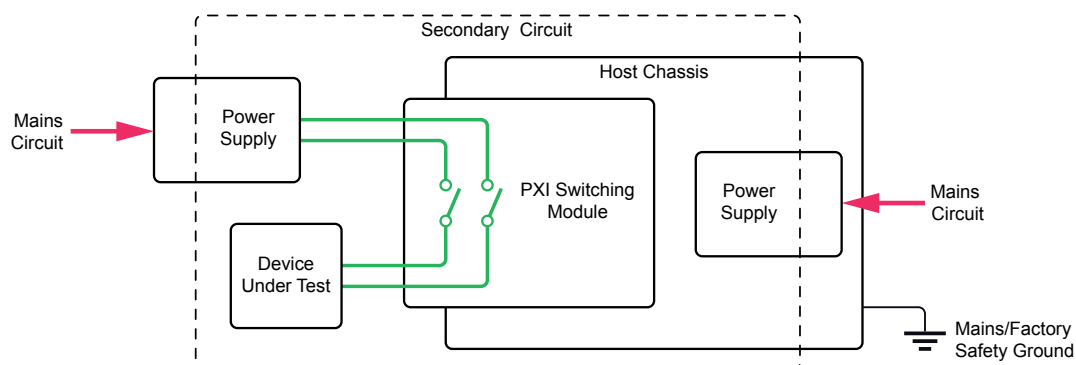


Diagram Showing Separation Between The Mains Circuit and Secondary Circuit / DUT

For the purposes of this document, a Mains Circuit is an installation classified as Overvoltage Category II up to 300V. Separation between the Secondary Circuit and Mains Circuit is achieved by a transformer in which the primary windings are separated from the secondary windings by reinforced insulation, double insulation, or a screen connected to the protective conductor terminal.

SYMBOL



CAUTION - HANDLING OF ELECTROSTATIC-SENSITIVE DEVICES

Certain semiconductor devices used in this equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their unterminated state, or sub-assemblies containing these devices:

1. Persons removing sub-assemblies from equipment using these devices must be earthed by a wrist strap and a resistor at the point provided on the equipment.
2. Soldering irons used during the repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer.
3. Outer clothing worn must be unable to generate static charges.
4. Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags.

SYMBOL



CAUTION - PRODUCT DOCUMENTATION	SYMBOL
Suitably qualified & trained users should ensure that the accompanying documentation is fully read and understood before attempting to install or operate the product.	

SAFETY INSTRUCTIONS

SAFETY INSTRUCTIONS
All cleaning and servicing requires the equipment to be isolated and disconnected from the power source and user I/O signals (refer to the Maintenance Section). • Appropriate manual handling procedures should be followed as dictated by the weight of the individual module or the combined weight of the modules & chassis. • Should a fault occur with the module or chassis, immediately isolate and disconnect the incoming power to the chassis and the user I/O signals. • Ensure the equipment is installed, operated and maintained by trained and authorised personnel. • For suitably equipped products in the event of an emergency press the red “emergency stop” button situated on the front of the unit.

SECTION 1 - TECHNICAL SPECIFICATION

- Precision Variable Resistance From 1.5Ω
- 2 Channels Per Module
- Fine Setting Resolution <2mΩ or 15mΩ
- Short and Open Circuit Simulation
- Low Thermo-electric EMF Errors
- Simple Calibration With External DMM
- VISA, IVI & Kernel Drivers Supplied for Windows
- Supported by PXI or LXI Chassis
- 3 Year Warranty

The 40-261 is a new generation of PXI programmable resistors that features high setting resolution with excellent stability and accuracy through the use of innovative switching networks and software correction techniques. Two versions are available:

- 2 channel, 1.5Ω to 2.9kΩ range, <2mΩ precision
- 2 channel, 10Ω to 36kΩ range, <15mΩ precision

The use of innovative technology ensures all resistance values can be set – no missing values due to switch resistance or resistor tolerance.

This makes the 40-261 ideal for simulating sensors that require accurate control and fine setting values. Applications include air bag squib, strain gauge and temperature dependent resistor emulation.

The channels are fully isolated from the chassis ground and each other, allowing use in floating systems.

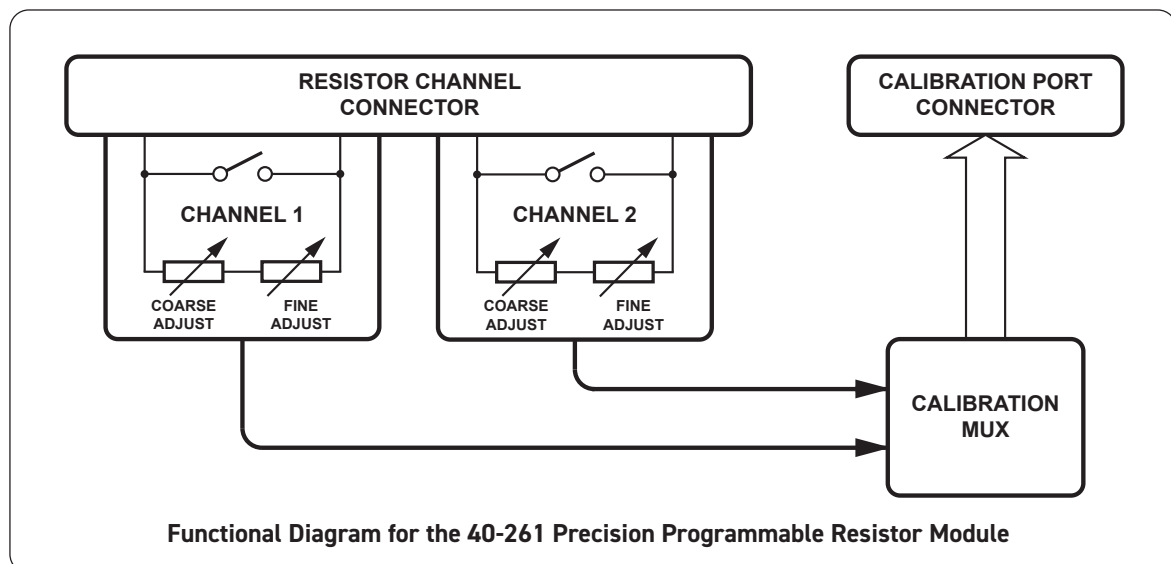
The 40-261 provides a convenient system for resistance calibration using an external DMM connected to the calibration port. It allows cascading so one DMM can be used to calibrate multiple modules. Calibration can be performed while the UUT is connected to the module.



Use of special switching techniques reduces measurement errors caused by thermo-electric EMFs to a minimum.

The 40-261 occupies one 3U PXI slot and can be supplied with other resistance ranges.

For applications requiring a higher starting resistance the 40-260 offers a solution with three channels in each module.



Specification

Resistor Channels	
Configuration:	2 resistor channels per module.
Resistance Range	
40-261-001:	1.5Ω to 2.9kΩ
40-261-002:	10Ω to 36kΩ
Resistance resolution:	<2mΩ, (40-261-001) <15mΩ, (40-261-002) continuous resolution, no missing settings.
Accuracy:	±0.08% ±70mΩ from 12°C to 32°C Typical temperature coefficient: 4mΩ per °C (low resistance settings)
Short Circuit Setting:	<0.1Ω initial
Open Circuit Setting:	>10°Ω
Maximum power:	100mW
Maximum Voltage:	100V* or as limited by power
Thermo-electric emf:	<2μV 1.5Ω to 18Ω (40-261-001) 10Ω to 220Ω (40-261-002) <5μV >18Ω (40-261-001) >220Ω (40-261-002)
Resistance - power off:	Open circuit
Number of Operations:	100 million (10mA)
Operating time:	3ms typical

* For full voltage rating, signal sources must be fully isolated from mains supply and safety earth.

Calibration Channel	
Function:	Supports 4 terminal measurements of all the channels in the module. Modules can be cascaded together to permit single DMM to support multiple modules with resistor channel connected to UUT.
DMM:	DMM with 10mA source current measurement capability recommended.

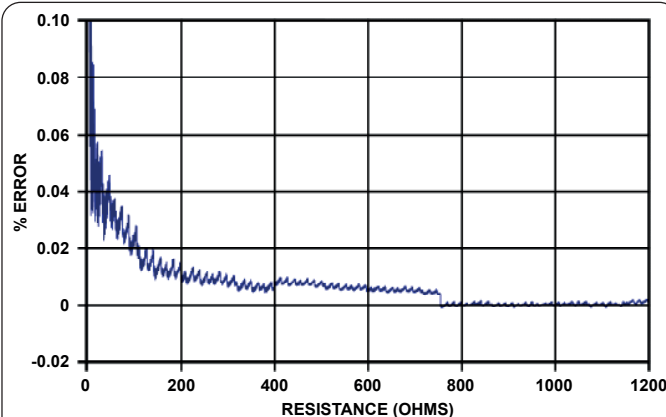
Software Support

Supplied with software that accepts a resistance instruction.

Power Requirements

+3.3V	+5V	+12V	-12V
0	0.2A	0	0

The 40-261 uses innovative techniques which are the subject of protected Pickering Interfaces intellectual property rights.



Typical accuracy of 40-261 over the entire resistance range measured at 21°C

Performance is measured in 10mΩ increments by making a resistance call (in Ohms) to the module and then measuring the actual resistance with a DMM. Vertical axis shows the reading error as % of the requested value.

Mechanical Characteristics

Single slot 3U PXI (CompactPCI card).

3D models for all versions in a variety of popular file formats are available on request.

Connectors

PCI Interface: 33MHz, 32-bit address, 16 bit data.

Resistor channel signals via front panel 15-pin male D-Type connector. Calibration connection via front panel 9-pin male D-Type connector. For pin outs please refer to the operating manual.

Operating/Storage Conditions

Operating Conditions

Operating Temperature:	0°C to +55°C
Humidity:	Up to 90% non-condensing
Altitude:	5000m

Storage and Transport Conditions

Storage Temperature:	-20°C to +75°C
Humidity:	Up to 90% non-condensing
Altitude:	15000m

PXI & CompactPCI Compliance

The module is compliant with the PXI Specification 2.2. Local Bus, Trigger Bus and Star Trigger are not implemented.

Uses a 33MHz 32-bit backplane interface.

Safety & CE Compliance

All modules are fully CE compliant and meet applicable EU directives: Low-voltage safety EN61010-1:2010, EMC Immunity EN61326-1:2013, Emissions EN55011:2009+A1:2010.

Product Order Codes

2 Channel Precision Resistor 1.5Ω to 2.9kΩ	40-261-001
---	-------------------

2 Channel Precision Resistor 10Ω to 36kΩ	40-261-002
---	-------------------

Accessories:

Calibration port to DMM lead (shrouded 4mm bayonet plug):

For a single module (1x9 pin D-type) **40-975-009-SL1**

For two modules (2x9 pin D-types) **40-975-009-SL2**

For three modules (3x9 pin D-types) **40-975-009-SL3**

(calibration leads capable of supporting a greater number of modules are available, please contact sales office)

Mating Connectors & Cabling

For connection accessories for the 40-261 please refer to the **90-010D** 15-pin D-Type and **90-003D** 9-pin D-Type Connector Accessories data sheets where a complete list and documentation can be found for accessories, or refer to the Connection Solutions catalog.

Other Resistor Modules

Pickering Interfaces manufacture a range of variable resistor modules in the PXI format. If you have a requirement for a variable resistor module please contact your local sales office with the information below and we will advise you on the best solution for your application.

Lowest Resistance †	
Highest Resistance	
Resistance Resolution	
Overall Accuracy	
Maximum Power/Current	
Number of Channels (variable resistors)	

† Resistance is as measured across the user connector terminals, minimum resistance must have a non-zero value.

Product Customization

Pickering PXI modules are designed and manufactured on our own flexible manufacturing lines, giving complete product control and enabling simple customization to meet very specific requirements.

Customization can include:

- Alternative resistance range
- Alternative resolution
- Different number of channels
- Different performance specifications

All customized products are given a unique part number, fully documented and may be ordered at any time in the future. Please contact your local sales office to discuss.

Chassis Compatibility

This PXI module must be used in a suitable chassis. It is compatible with the following chassis types:

- All chassis conforming to the 3U PXI and 3U Compact PCI (cPCI) specification
- Legacy and Hybrid Peripheral slots in a 3U PXI Express (PXIe) chassis
- Pickering Interfaces LXI or LXI/USB Modular Chassis

Chassis Selection Guide

Standard PXI or hybrid PXIe Chassis from any Vendor:

- Mix our 1000+ PXI switching & simulation modules with any vendor's PXI instrumentation
- Embedded or remote Windows PC control
- Real-time Operating System Support
- High data bandwidths, especially with PXI Express
- Integrated module timing and synchronization

Pickering LXI or LXI/USB Modular Chassis—only accept our 1000+ PXI Switching & Simulation Modules:

- Ethernet or USB control enables remote operation
- Low-cost control from practically any controller
- LXI provides manual control via Web browsers
- Driverless software support
- Power sequencing immunity
- Ethernet provides chassis/controller voltage isolation
- Independence from Windows operating system



Connectivity Solutions

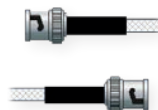
We provide a full range of supporting cable and connector solutions for all our switching products—20 connector families with 1200+ products. We offer everything from simple mating connectors to complex cables assemblies and terminal blocks. All assemblies are manufactured by Pickering and are guaranteed to mechanically and electrically mate to our modules.



Connectors & Backshells



Multiway Cable Assemblies



RF Cable Assemblies



Connector Blocks

We also offer customized cabling and have a free online **Cable Design Tool** that can be used to create custom cable solutions for many applications.

Visit: pickeringtest.com/cdt to start your design.

Mass Interconnect

We recommend the use of a mass interconnect solution when an Interchangeable Test Adapter (ITA) is required for a PXI or LXI based test system. Our modules are fully supported by both Virginia Panel and MacPanel.

Pickering Reed Relays

We are the only switch provider with in-house reed relay manufacturing capability via our sister company, Pickering Electronics. These instrument grade reed relays feature **SoftCenter®** technology, ensuring long service life and repeatable contact performance.

To learn more, please go to: pickeringrelay.com



Programming

Pickering provide kernel, IVI and VISA (NI & Keysight) drivers which are compatible with all Microsoft supported versions of Windows and popular older versions. For a list of all supporting operating systems, please see: pickeringtest.com/os

The VISA driver is also compatible with Real-Time Operating Systems such as LabVIEW RT. For other RTOS support contact Pickering. These drivers may be used with a variety of programming environments and applications including:

- **Pickering Interfaces Switch Path Manager**
- **National Instruments** products (LabVIEW, LabWindows/CVI, Switch Executive, MAX, TestStand, VeriStand, etc.)
- **Microsoft Visual Studio** products (Visual Basic, Visual C+)
- **Keysight** VEE and OpenTAP
- **Mathworks** Matlab
- **Marvin** ATEasy
- **MTQ Testsolutions** Tecap Test & Measurement Suite

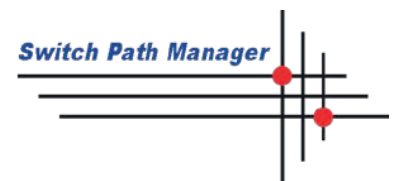
Drivers for popular Linux distributions are available, other environments are also supported, please contact Pickering with specific enquiries. We provide Soft Front Panels (SFPs) for our products for familiarity and manual control, as well as comprehensive documentation and example programs to help you develop test routines with ease.

To learn more about software drivers and development environments, please go to:

pickeringtest.com/software

Signal Routing Software

Our signal routing software, Switch Path Manager, automatically selects and energizes switch paths through Pickering switching systems. Signal routing is performed by simply defining test system endpoints to be connected together, greatly accelerating Test System software development. To learn more, please go to: pickeringtest.com/spm



Diagnostic Relay Test Tools

eBIRST Switching System Test Tools are designed specifically for our PXI, PCI or LXI products, these tools simplify switching system fault-finding by quickly testing the system and graphically identifying the faulty relay.

To learn more, please go to: pickeringtest.com/ebirst

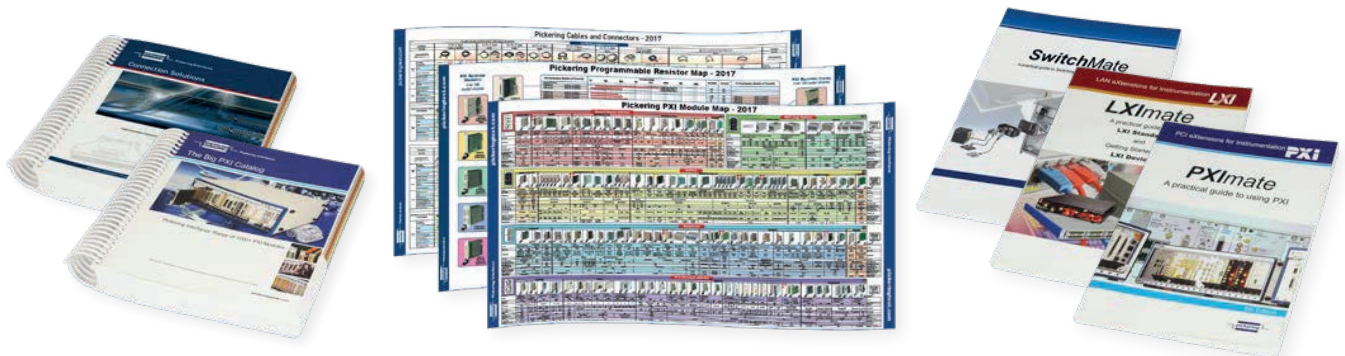


Three Year Warranty & Guaranteed Long-Term Support

All standard products manufactured by Pickering Interfaces are warranted against defective materials and workmanship for a period of three years from the date of delivery to the original purchaser. Extended warranty and service agreements are available for all our modules and systems with various levels to suit your requirements. Although we offer a 3-year warranty as standard, we also include guaranteed long-term support—with a history of supporting our products for typically 15-20 years. To learn more, please go to: pickeringtest.com/support

Available Product Resources

We have a large library of product resources including success stories, product and support videos, articles, as well as complete product catalogs and product reference maps to assist when looking for the switching, simulation and cable and connector solutions you need. We have also published handy reference books on Switching Technology and for the PXI and LXI standards.



To view, download or request any of our product resources, please visit: pickeringtest.com/resources

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SECTION 2 - TECHNICAL DESCRIPTION

FUNCTIONAL DESCRIPTION

A functional block diagram is provided in Figure 2.1. The Module is powered by the 5V supply via Compact PCI connector J1. The interface to the 2 programmable resistor channels is via a front panel mounted 15-pin D-type plug, connection to the Calibration Port is via a front panel mounted 9-pin D-type plug. The module comprises a mother and daughter PCB populated with precision resistor networks arranged as two separate channels switched by electro-mechanical relays. Also there is a multiplexer arrangement to allow a selected channel to be routed to the Calibration Port for connection to a DMM. The control coils of the electro-mechanical relays are enabled via control signals from relay drivers U1 to U5 on the module's daughter card. The relay drivers are addressed by the PLX device U1 to output the required signal.

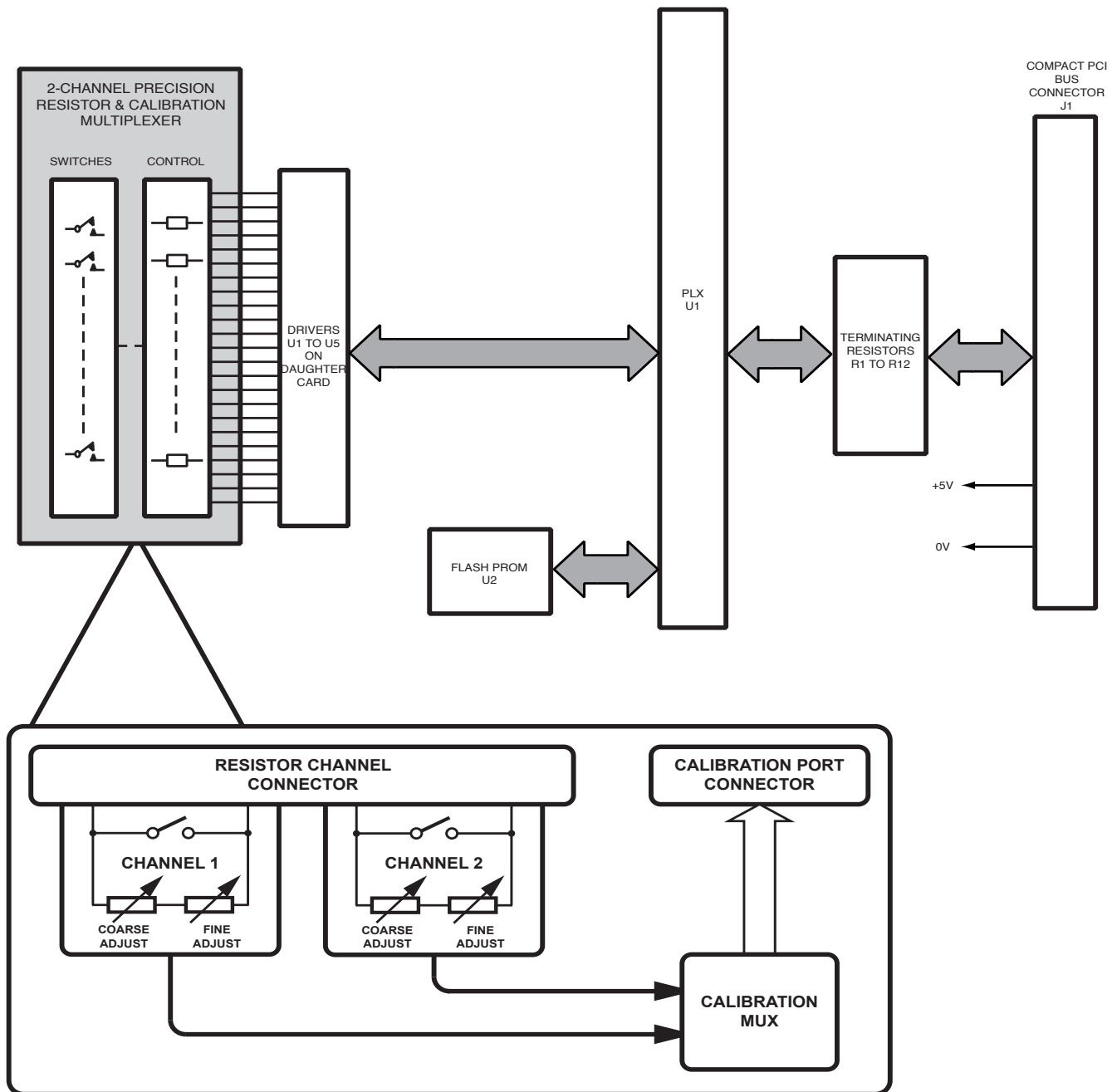


Figure 2.1 -Precision Programmable Resistor Module 40-261: Functional Block Diagram

GUIDANCE ON USING THE MODULE

The 40-261 behaves as a precise but adjustable in value resistor. The circuit elements in the design use switch resistors with electro-mechanical relays. It can be used to simulate the type of variable resistor found in many control systems that indicate the value of a parameter, such as temperature, strain or pressure.

The 40-261 responds directly to a request for a particular value of resistance and is therefore very easy to use in a system. Applications programs are easily generated to convert, for example, temperature requests to resistance values for different types of RTD that are to be emulated.

Each resistor channel has two “input” connections and two “output” connections. There is no significance in the label “input” and “output” other than to identify them. The two contacts on each terminal make it easy to connect resistors together and to perform 4 terminal measurements on the channel as shown in Figure 2.2.

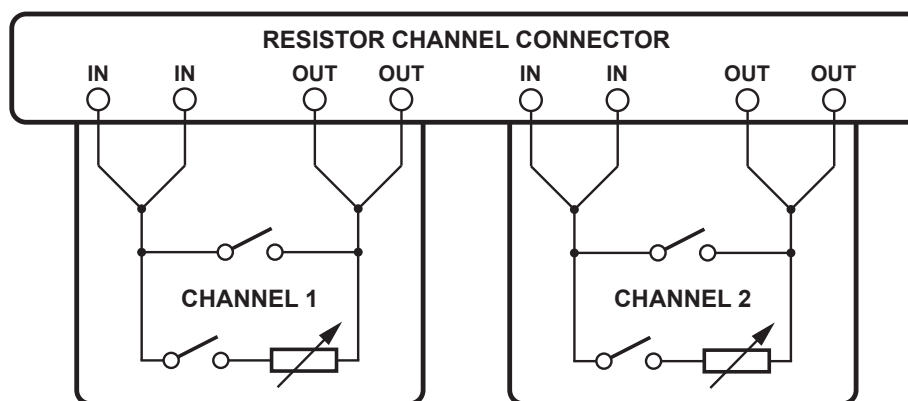


Figure 2.2 - Each resistor channel has two “input” and two “output” connections to simplify connecting it to a system and allow accurate 4 terminal measurements to be made.

Potentiometer Operation

The 40-261 can be used to simulate a potentiometer by using the two channels connected in series. The user should decide on the value of the potentiometer to be simulated and program two channels so that the sum of their resistances is always the same. For example, if a 5k Ω potentiometer is needed with a wiper position at 1k Ω , set one channel to 1k Ω and the other to 4k Ω .

Calibration Port

The calibration port is a convenient way of measuring the resistance of a channel without having to use an external switching network to connect a DMM to each channel in turn. It is used when the module is calibrated in the factory for the purpose of generating a file of correction data that ensures each channel can be set to the requested value.

Users can use the Calibration Port for the same purpose. With a DMM connected to the calibration port, preferably with the optional cable assembly, the calibration port MUX can be switched to each channel in turn to allow the resistance to be measured using a 4 terminal measurement method. To measure the complete channel the UUT should be disconnected from the Resistor Channel connector.

In some very sensitive applications the user may want to verify the resistor channel values before commencing a test. The 40-261 accuracy is specified over a range of temperatures and is stable with time

During the measurement process the UUT can remain connected to the resistor channels since it is automatically isolated during the process.

The calibration port is designed so that it can be daisy chained with other resistor modules (for example multiple modules of 40-261). A cable assembly can be purchased as an accessory for this purpose or the user can make their own as shown in Figure 2.3.

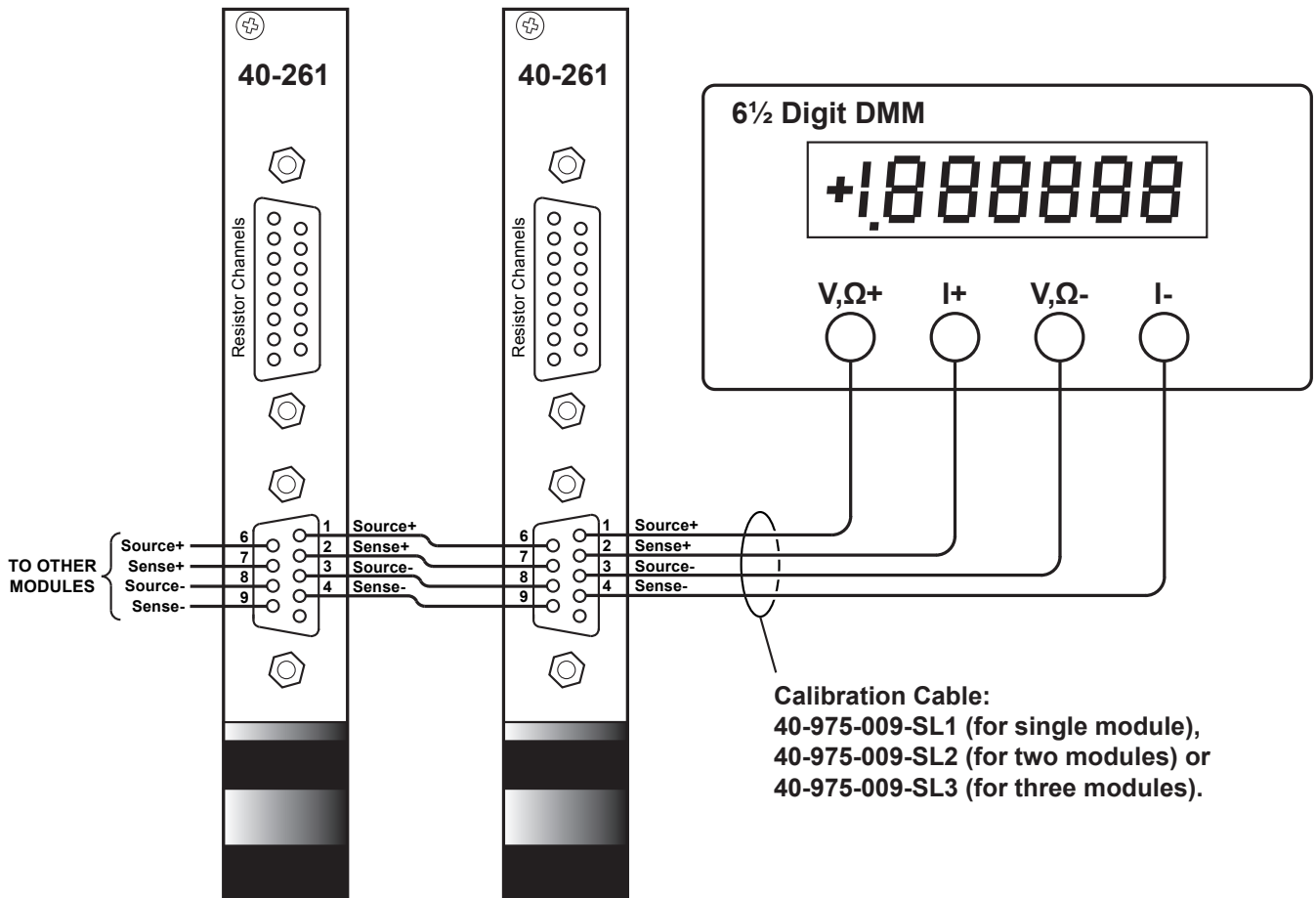


Figure 2.3 - The calibration port can be daisy chained between modules to allow one DMM to support multiple modules for calibration or measurement purposes.

This feature is particularly useful when in system monitoring or calibration is needed since one DMM can sequentially access all the channels in a system without any additional switching.

Calibration Data

The 40-261 contains a Factory Calibration data table which cannot be overwritten by the user. It is created when Pickering Interfaces manufacture the module.

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SECTION 3 - INSTALLATION

Refer to the Warnings and Cautions at the front of this manual



Modular products require installation in a suitable PXI/LXI chassis. The module is designed for indoor use only.

PREOPERATION CHECKS (UNPACKING)



1. Check the module for transport damage and report any damage immediately to Pickering Interfaces. Do not attempt to install the product if any damage is evident.
2. Position the chassis relative to any other equipment the module(s) will connect with. Ensure the chassis is not connected to the electrical supply.
3. Ensure that the designated area for the chassis containing the module is of flat and solid construction to withstand and support the combined weight of the module(s) and chassis.

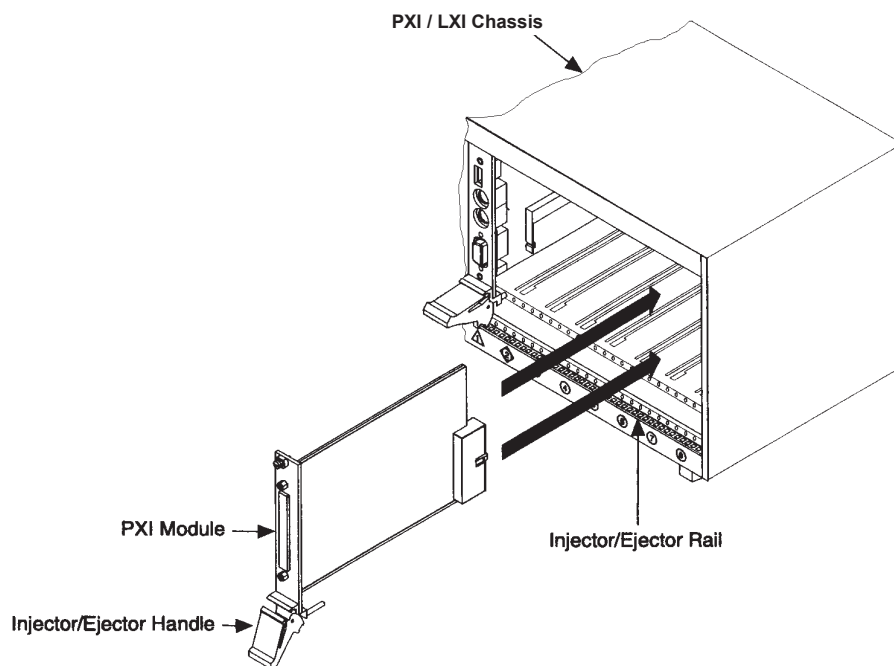


Figure 3.1 - Installing the Module into a PXI/cPCI/LXI Chassis

HARDWARE INSTALLATION ELECTRICAL CONNECTION (CHASSIS)



1. The chassis must be electrically installed in accordance with local regional electrical codes by a qualified engineer.

2. The chassis must be grounded.



Electrostatic discharge can damage the components on the module. To avoid such damage in handling the board refer to page VII.



Ensure that there is adequate ventilation.

The module should be installed in accordance with the following procedure:



1. Ensure that the system is turned OFF but still connected to mains so that it remains grounded.
2. Choose an appropriate slot in the rack.
3. Remove the blanking plate for the chosen slot.
4. Ensure that the injector/ejector handle is in its downward position. Align the module with the card guides on the top and bottom of the slot.

Do not raise the injector/ejector handle whilst inserting the module as the module will not insert properly.
5. Hold the handle whilst slowly sliding the module into the card guides until the handle catches on the injector/ejector rail (refer to Figure 3.1).
6. Raise the injector/ejector handle until the module firmly seats into the backplane. The front panel of the module should be flush with the front panel of the chassis.
7. Secure the front panel of the module using both screws to the chassis front panel mounting rails.
8. In a system employing a remote control interface to connect an external controller to a PXI chassis or to link multiple chassis, power-up the system as follows:
 - a. For a system comprising an external controller and one chassis, power up the chassis before powering up the external controller.
 - b. For a system comprising more than one chassis, turn ON the last chassis in the system followed by the penultimate, etc, and finally turn ON the external controller or chassis containing the system controller.
9. For Pickering Interfaces modular LXI installation there is no requirement to use any particular power up sequence.

SOFTWARE INSTALLATION

First install the appropriate Pickering PXI switch card drivers by running the installer program Setup.exe (provided in a compressed zip file), either from the CD-ROM supplied, or by downloading the latest version from our website pickeringtest.com - the recommended method. Setup is accompanied by a ReadMe file containing additional installation information. A single installation covers all cards in the System 40, System 45 and System 50 ranges.

When installation completes, the installed drivers' ReadMe file is offered for display. It can also be displayed later using a shortcut on the Programs>>Pickering menu.

If you are not a LabVIEW user you should choose the "full" version, and once that has been installed run the LabVIEW Runtime Engine installer via the shortcut on the Programs>>Pickering menu. In the absence of LabVIEW the Runtime Engine is required to support the Pickering Test Panels application.

TESTING OPERATION

After installation of the hardware and Pickering PXI Driver software package start the General Soft Front Panel (GSFP) using the desktop icon or via the Start menu (**Start Menu-> Pickering Interfaces Ltd -> General Soft Front Panel**).



Figure 3.2 - General Soft Front Panel Icon

A selector panel will appear, listing all installed Pickering PCI, PXI or LXI switch cards and resistor cards. Click on the card you wish to control, and a graphical control panel is presented allowing operation of the card. Panels can be opened simultaneously for all the installed cards.

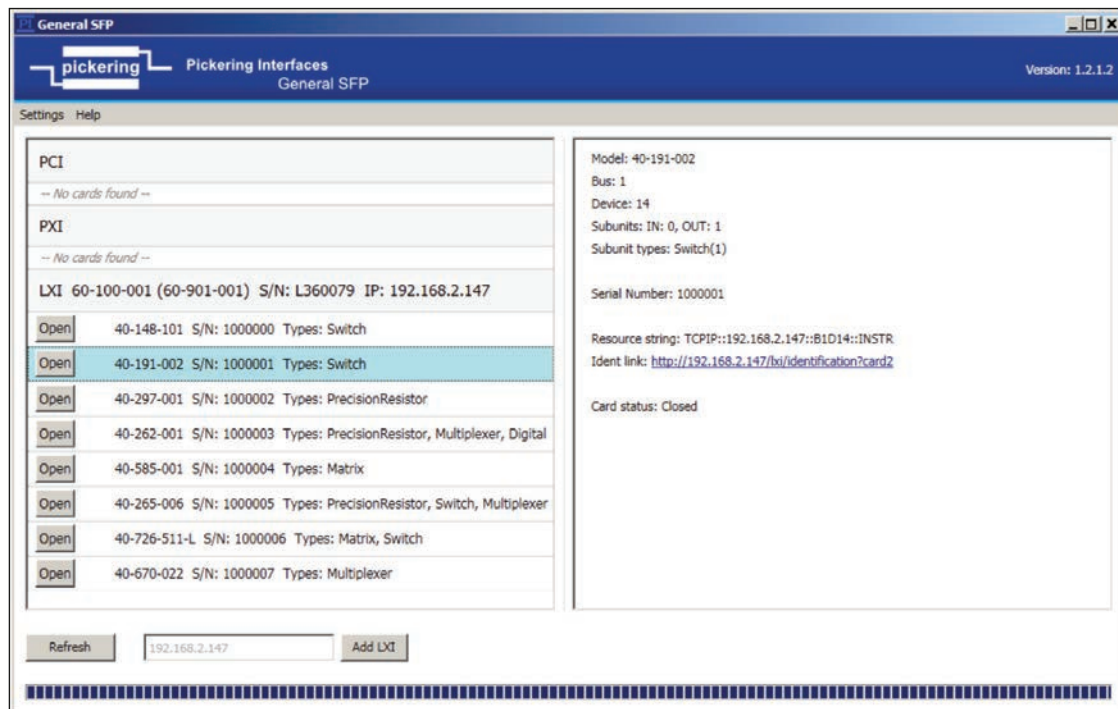


Figure 3.3 - General Soft Front Panel Selector

More details how to use the GSFP can be found in the manual, via menu **HelpManual**

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SECTION 4 - PROGRAMMING GUIDE

PROGRAMMING OPTIONS FOR PICKERING INTERFACES PXI MODULES

For information on the installation and use of drivers and the programming of Pickering's products in various software environments, please refer to the Software User Manual.

This is available as a download from:

<https://www.pickeringtest.com/support/software-drivers-and-downloads>

Also, it can be accessed from the DVD supplied with the product:

`<DVD_DRIVE>\downloads\Documentation\Software-Manual.pdf`

MODULE ARCHITECTURE

These 2 channel resistor modules expose a total of 3 sub-units as detailed below:

Sub-Unit	Type	Size	Use
1	Resistor	38	Resistor 1
2	Resistor	38	Resistor 2
3	MUX	6	DMM MUX

PROGRAMMING THE MODULE

Resistance Control

In practice the control of resistance is not performed by controlling of the sub-units directly but rather using the SetResistance() functions provided in the driver.

In pilpxi:

```
DWORD PIL_ResSetResistance(DWORD card, DWORD channel, DWORD Mode, double
resistance)
```

Or, in pipx40:

```
ViStatus pipx40_resSetResistance(ViSession vi, ViUInt32 subUnit, ViUInt32 mode,
ViReal64 resistance)
```

These functions accept a floating point value of resistance and calculate the appropriate settings of the sub-units required to achieve that resistance.

Notes:

The resistor sub-units should NOT be controlled using driver functions intended for switch control if accurate resistance is required. Only the resistance setting functions should only be used for setting resistance.

The monitor port should not be left connected to external equipment during normal use and the DMM MUX should be reset if it has been used.

DMM MUX

The DMM MUX sub-unit is present for calibration purposes and is not required for normal use. It should be left in the default state or reset prior during normal use.

The DMM multiplexer sub-unit contains 3 bit positions for each resistor channel. These are organised as 3 bits per channel:

- Bit 1 – monitor across entire resistor
- Bit 2 – monitor coarse section
- Bit 3 – monitor fine section

So, to monitor a resistor, the user should set the following bits:

Resistor	Entire Resistor	Coarse Section	Fine Section
1	1	2	3
2	4	5	6

The DMM multiplex sub-unit is controlled using the normal driver functions:

In pilpxi:

```
DWORD PIL_OpBit(DWORD card, DWORD sub-unit, DWORD bit_num, BOOL Action)
```

Or in pipx40:

```
ViStatus pipx40_setChannelState(ViSession vi, ViUInt32 subUnit, ViUInt32 channel, ViBoolean state);
```

The sub-unit is cleared using clear sub-unit functions in the library:

```
pipxi:          DWORD PIL_ClearSub(DWORD CardNum, DWORD OutSub);
```

```
pipx40:        ViStatus pipx40_clearSub(ViSession vi, ViUInt32 subUnit);
```

LabVIEW

LabVIEW VIs are provided for the control of the resistance channels.

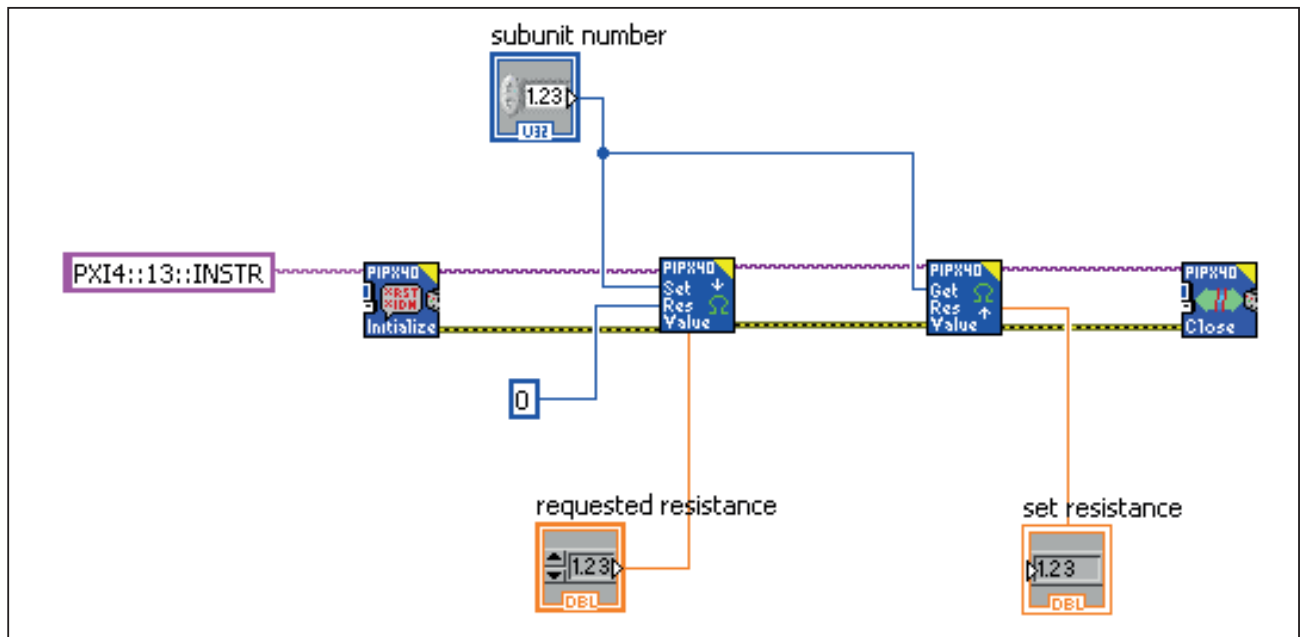


Figure 4.1 - Example LabVIEW VI Supplied With The Precision Resistor Module

USING THE SOFT FRONT PANEL

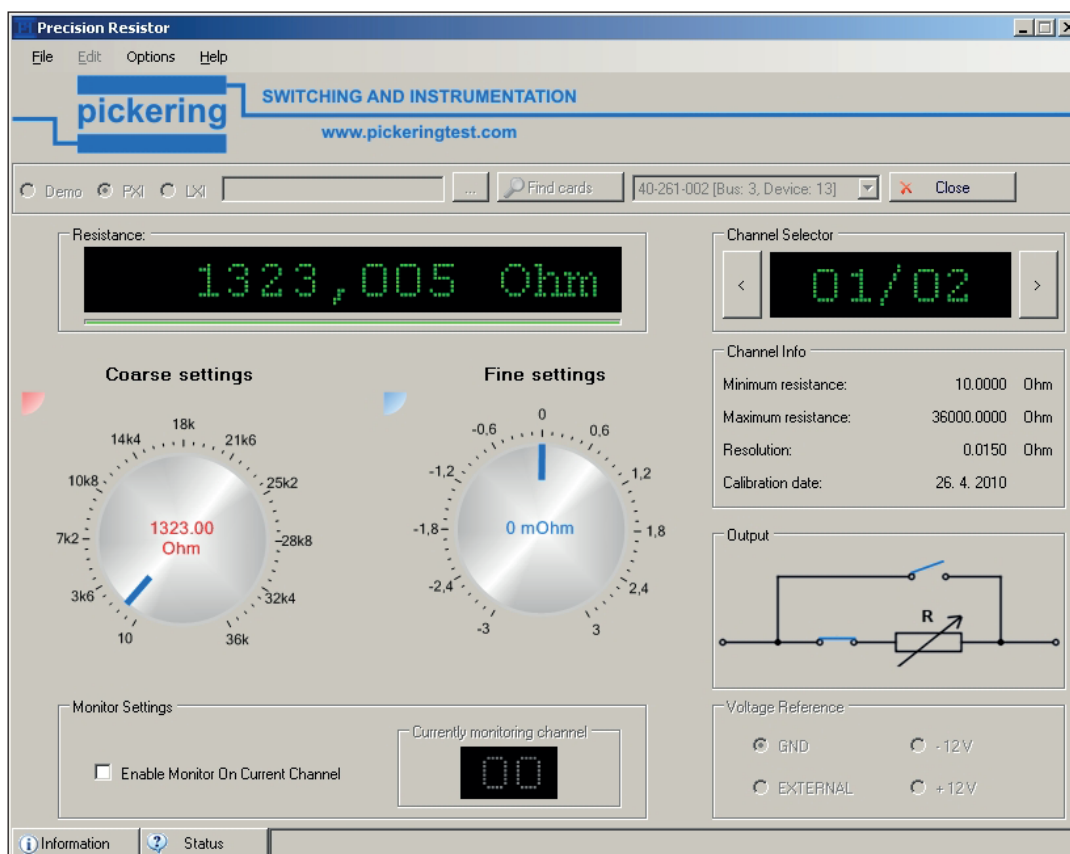


Figure 4.2 - Soft Front Panel Supplied With Precision Resistor Modules

Starting The SFP

To start the Soft Front Panel, double-click the icon in the applications folder.

Next, select Demo, PXI or LXI from the buttons in the top left of the window depending on which mode is required.

Demo Mode

The combo box displaying the available cards for simulation is now enabled as well as the “Open” button. Select a card from the list and click the “Open” button to start simulating the specified card. The application will enable the controls needed according to the simulated card’s specification.

PXI Mode

The “Find cards” button is now enabled. Click this button to find all the available Precision Resistor cards in the connected PXI device. If there are suitable cards, they will be listed in the combo box. Here you can select the one you want to control (similar to Demo mode) and click the “Open” button. The application will open the card and enable the appropriate controls.

LXI Mode

The empty text field and the button with three dots are now enabled. You can type the IP address of the LXI device directly into text field, or you can use the discovery mechanism by clicking the button with three dots to find the devices. When you click the button with three dots it opens a new window and automatically tries to discover all available LXI devices. Depending on your operating system, you may see the Windows Security Alert window; click the “Unblock” button to allow the Soft Front Panel access to the network (Windows XP), or select the networks you want the Soft Front Panel to access and click the “Allow access” button (Windows 7). All located devices are then listed in the table. You can select the appropriate device from the table and click the “OK” button, or simply double-click on the device you want to use. You can also refresh the table by clicking the “Discover” button at the bottom of the window.

After selection of the device, the “Find cards” button is enabled. Click this button to find available Precision Resistor cards in the connected LXI device. If there are suitable cards, they will be listed in the combo box. There you can select the one you want to control (similar to Demo mode) and click the “Open” button. The application will open the card and enable the appropriate controls.

Controlling a Resistor Channel

The “Channel Selector” on the Soft Front Panel can be used to select a resistance channel to control by clicking on the left and right buttons either side of the channel number display.

The knob controls can be used to control the channel. The knob marked “Coarse” has a small resolution but covers the full resistance range of the channel, the knob marked “Fine” has high resolution and has a small resistance range within the setting of the Coarse knob.

You can also use the arrow keys and Page Up / Page Down keys to control the enabled knob.

- Arrow keys will increase/decrease enabled knob by 10 x smallest step
- Page Up / Page Down keys increase/decrease enabled knob by 100 x smallest step

Note: The coloured mark in the upper left corner of the knob control indicates that it is enabled. By clicking on the mark, it changes colour (red means enabled, blue means disabled) the same as the label inside the knob.

Important note: There’s a progress bar just under the resistance display which indicates the time between a resistance command being sent and the resistance value being physically set on the channel.

You can also use a keyboard to manually set the resistance. Double-clicking on the resistance display enables keyboard input.

There are different ways to manually set resistance:

- Type the resistance in Ohms, for example 123,5 (You must use your system’s default decimal separator).
- Type a resistance in milli, kilo, mega, giga or tera Ohms. For example 10m, 11k, 12M, 13G, 14T. You can also type decimal numbers like 11,5k.
- Type a combined value, like 1k2 (corresponding to 1200 Ohm).
- Type a lower value than minimum to make a “short” connection or type a value higher than maximum to make an “open” connection.

Clicking “Enter” will submit the value and the Soft Front Panel will set it on the resistance channel. You can also use “Backspace” to delete typed text or “Escape” key to cancel typing.

To control the Precision Resistor channel’s output you can also use the Output diagram control at the bottom right of the Soft Front Panel. Simply click on the switches in the diagram to select short circuit or open circuit for the resistance channel.

Setting the Common Mode Voltage

You can change the common mode voltage for all the resistor channels by clicking on one of the radio buttons inside the Voltage Reference group box. The default is GND.

Monitor Function

The Precision Resistor card has a calibration port providing a convenient way of measuring the resistance of a channel without having to use an external switching network to connect a DMM to each channel in turn. Click on the “Enable Monitor On Current Channel” check box to route the current resistor channel to the Calibration Port connector on the front of the card. Unchecking the Enable Monitor On Current Channel disables the Calibration Port connector. The digital display to the right of the control group shows the currently monitored channel.

Information & Status

At the bottom of the control window, there are two addition buttons: Information and Status. Click on “Information” to obtain information about the card currently being controlled. Next to the Status button is a display of the current status of the card, click on “Status” to update this display.

Load & Save

You can save the current state of the Soft Front Panel by selecting “Save” or “Save as...” from the “File” menu. You can also load the previously saved state of the Soft Front Panel by selecting “Load” from the “File” menu.

Settings

You can change settings of the Soft Front Panel by clicking on “Settings” from the menu “Options”. Here you can change the Broadcast Echo port, Broadcast Echo time out, Direct Echo port, etc.

Important note: The standard broadcast address is 255.255.255.255, but in some cases it can cause problems. For example, if you have more than one network interface (physical or virtual), you must specify the broadcast address of the specified sub net where you want to discover LXI devices.

Example: We want to discover LXI devices connected to a class C network where there is a computer with the IP address 192.168.10.13 and the network’s sub mask is 255.255.255.0, then the correct broadcast address is 192.168.10.255.

Help

From this menu you can open the Help document by clicking on “Contents” or you can obtain the information about the application by clicking on “About”. The About window displays the cards supported by the Soft Front Panel and also the required assemblies. You can also get System information by clicking on the “System Info” button. Alternately, F1 displays the help file, for more help please contact support@pickeringtest.com.

SECTION 5 - CONNECTOR INFORMATION

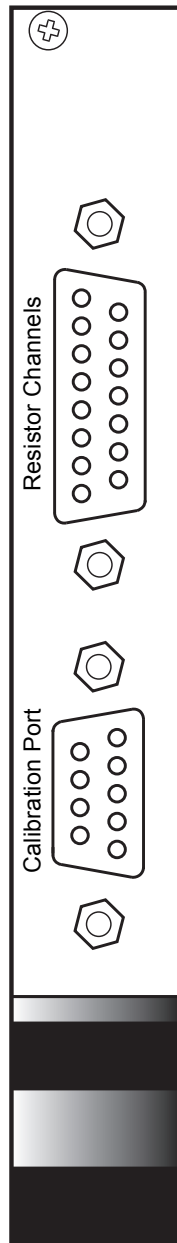


Figure 5.1 - Precision Programmable Resistor Module 40-261: Connector Positions

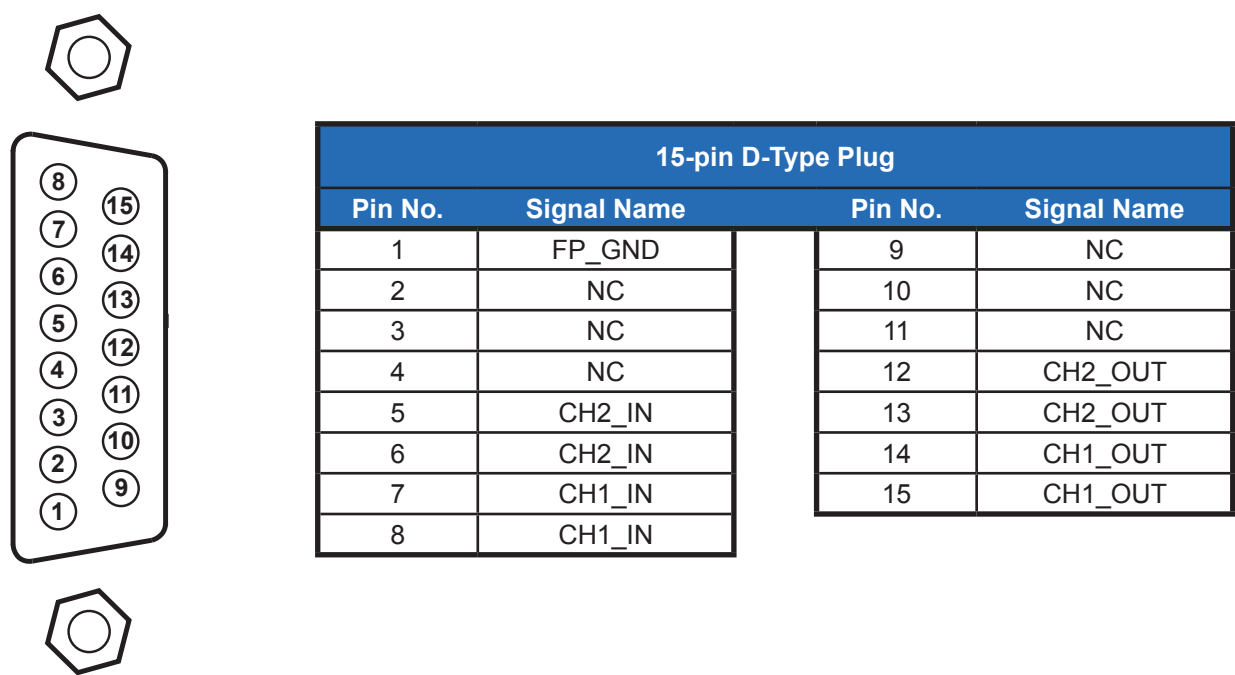


Figure 5.2 - Resistor Channel Connector Pinouts
(15-pin male D-type viewed from front of module)

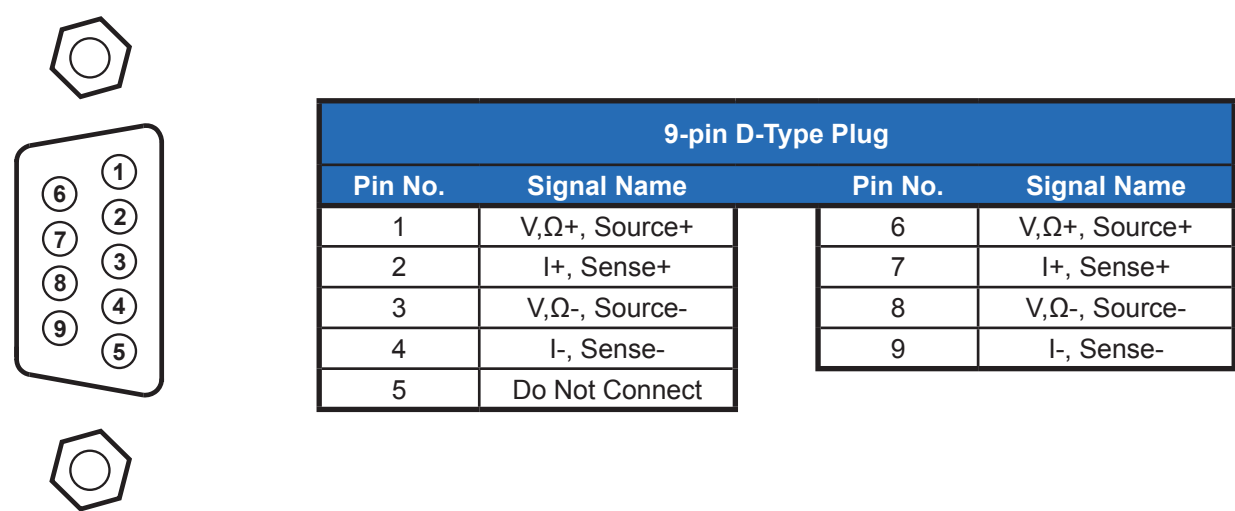


Figure 5.3 - Calibration Port Connector Pinouts
(9-pin male D-type viewed from front of module)

SECTION 6 - TROUBLE SHOOTING

Refer to the Warnings and Cautions at the front of this manual



INSTALLATION PROBLEMS

The Plug & Play functionality of Pickering switch cards generally ensures trouble-free installation.

If you do experience any installation problems you should first ensure that all cards are properly seated in their slots. Improperly mated cards may go undetected by the operating system, or may be detected as a card of an unknown type. They can also cause the computer to freeze at various stages in the boot sequence.

If your system employs a remote control interface you should check the integrity of all remote control interface links. When the system is powered up, and during Windows start-up, you should expect to see periodic activity on the remote control interface RX/TX (yellow) indicators, clearing to leave only the PWR/LNK (green) LEDs illuminated. The RX/TX indicators should show activity when you attempt to access a card.

DIAGNOSTIC UTILITY

The Pickering Diagnostic Utility (accessible through the Programs>>Pickering>>PXI Utilities menu) generates a diagnostic report of the system's PCI configuration, highlighting any potential configuration problems. Specific details of all installed Pickering switch cards are included. All the installed Pickering switch cards should be listed in the "Pilpxi information" section - if one or more cards is missing it may be possible to determine the reason by referring to the PCI configuration dump contained in the report, but interpretation of this information is far from straightforward, and the best course is to contact Pickering support: support@pickeringtest.com, if possible including a copy of the diagnostic report.

In the "VISA information" section, if VISA is not installed its absence will be reported. This does not affect operation using the Direct I/O driver, and is not a problem unless you wish to use VISA. VISA is a component of National Instruments LabWindows/CVI and LabVIEW, or is available as a standalone environment.

If VISA is present and is of a sufficiently recent version, the section "Pipx40 information" should present a listing similar to "Pilpxi information".

Please note that the Diagnostic Utility cannot access cards if they are currently opened by some other application, such as the Test Panels or Terminal Monitor.

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SECTION 7 - MAINTENANCE INFORMATION

Refer to the Warnings and Cautions at the front of this manual



PERIODIC MAINTENANCE

This product and its corresponding chassis do not require any periodic maintenance.

GENERAL CLEANING

- Isolate the electrical power from the chassis and ensure that no user I/O signals are being applied.
- Wipe the product & chassis surfaces with a clean dry anti-static cloth only.

SOFTWARE UPDATE

For PXI modules operating in a PXI chassis, no module software updates are required. For the latest version of the driver please refer to our web site pickeringtest.com where links to our Software Download page will provide the latest version of the driver software for the various programming environments encountered.

For PXI modules which are supported in one of Pickering Interfaces' Modular LXI Chassis (such as the 60-102B and 60-103B) no module software update is required. If the module was introduced after the LXI chassis was manufactured the module may not be recognized, in this case the chassis firmware may need upgrading. This is a simple process which is described in the manual for the Modular LXI Chassis.

VERIFICATION & ADJUSTMENT PROCEDURE

This section provides a procedure for verifying that the 40-261 is performing to its specification and guidance on adjustment.

In normal use the 40-261 does not require regular adjustment. Where procedures require regular verification checks of instrumentation in a system Pickering Interfaces recommend a 1 year interval between tests.

If the module is used in a system which uses a DMM connected to the Calibration Port to periodically verify the resistor channels are within specification, then we recommend that no other verification tests are performed since traceability is provided by the DMM calibration.

Verification

Depending on the customer's requirements a verification check can be made periodically by connecting to the standard "Resistor Channels" port to check the module is within specification. The module has an internal date counter that shows a message in the diagnostics after this time but will not effect the cards operation. The customer has the option to read and reset the verification/calibration date as required via the following programming functions:

PIL_ReadCalDate

PIL_WriteCalDate

The module also has two internal calibration stores User_Store & Factory_Store which contain the same calibration information when leaving the factory. Resistance calls are made using the calibration values in the User_Store, in nearly all cases no changes to either store will be required, if the User_Store is accidentally modified the Factory_Store can be copied to the User_Store to recover the factory calibration.

Verification Procedure

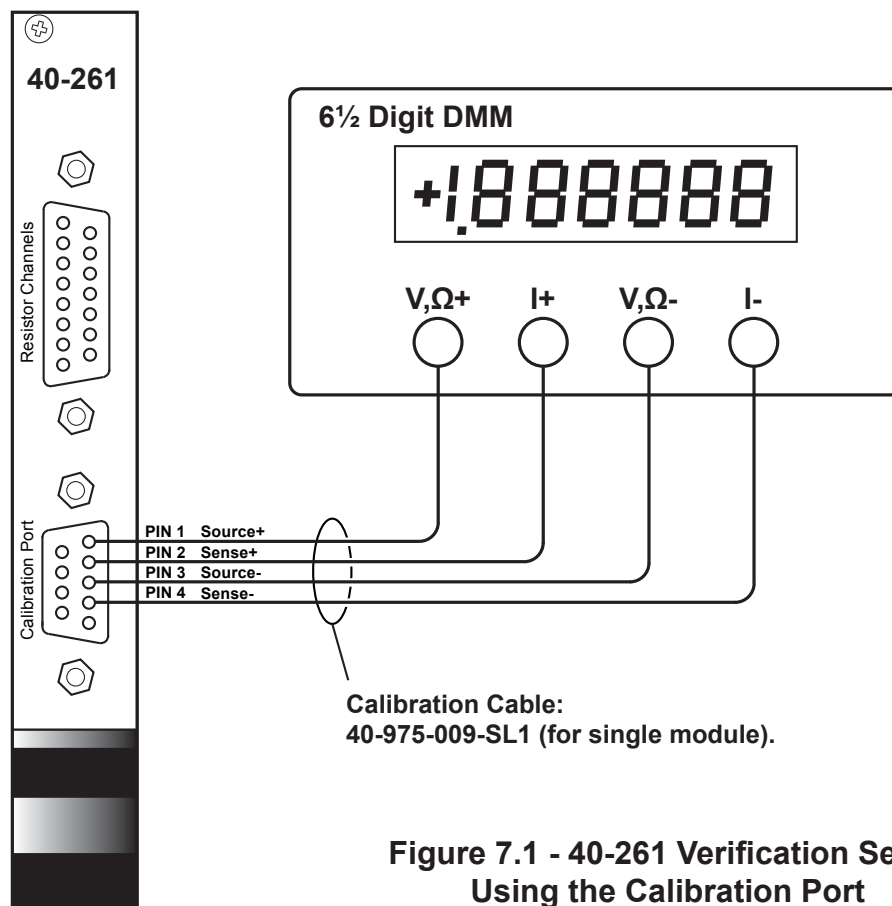
The verification procedure describes a set of measurements that is adequate to check that the module is performing to specification.

The following equipment is required to perform the test

- A DMM with 4 terminal resistance capability and a performance at least equivalent to a 6.5 digit model. Example: Agilent 34410A or 34411A
- A cable assembly to connect the DMM to the 40-261. This can be constructed by the user or the user can purchase a ready made cable from Pickering Interfaces suitable for connecting to the Calibration Port connector.

There are two ways of connecting to the module to conduct the test.

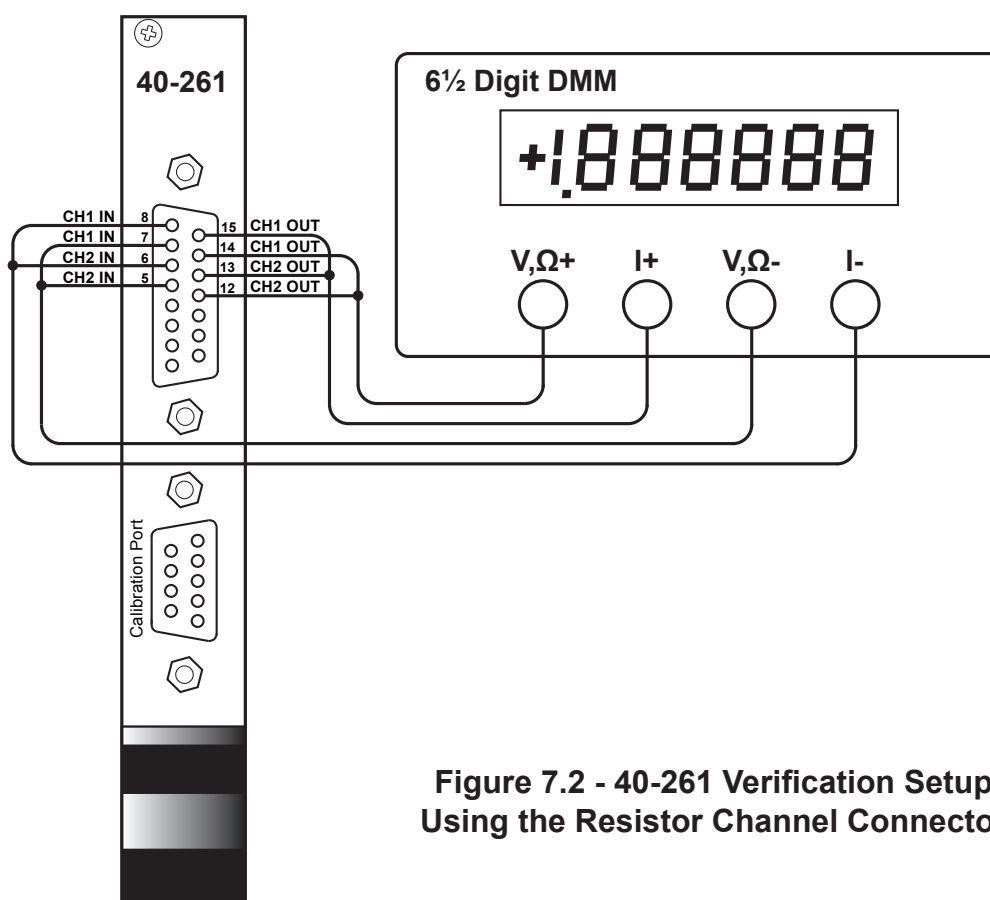
- Calibration Port method (recommended)



**Figure 7.1 - 40-261 Verification Setup
Using the Calibration Port**

In this case the DMM is connected to the Calibration Port. A Pickering Interfaces cable assembly can be used for this purpose. Using this method the user can measure each channel in turn without changing the connection to the 40-261. The calibration MUX in the 40-261 will provide the switching function. The calibration MUX can be controlled through the SFP Monitor Port tab.

- Connecting to the Resistor Channel connector



**Figure 7.2 - 40-261 Verification Setup
Using the Resistor Channel Connector**

In this case the DMM is connected to the resistor through the normally used connector. Both channels are wired in parallel as a complete 4 terminal system.

When testing the channels not being used are set to the open circuit condition so that each channel can be tested in turn without having to change the connection.

Whichever method of connection is used the procedure is the same. A set of 4 terminal resistance measurements is made using the DMM which can be recorded as part of the calibration procedure.

The following pages tabulate the measurements that need to be performed. The Soft Front Panel is used to set the required resistance, the DMM is used to measure the result and it is recorded in a results table.

Table 7.1 - Calibration Resistance Settings For Each Model

40-261-001		40-261-002	
Short (0Ω)	30Ω	Short (0Ω)	250Ω
1.5Ω	50Ω	10Ω	300Ω
1.52Ω	70Ω	15Ω	500Ω
1.54Ω	90Ω	15.2Ω	700Ω
1.56Ω	110Ω	15.4Ω	900Ω
1.58Ω	130Ω	15.6Ω	1100.00Ω
1.6Ω	150Ω	15.8Ω	1300.00Ω
1.62Ω	200Ω	16Ω	1500.00Ω
1.64Ω	250Ω	16.2Ω	2000.00Ω
1.66Ω	300Ω	16.4Ω	2500.00Ω
1.68Ω	400Ω	16.6Ω	3000.00Ω
1.7Ω	500Ω	16.8Ω	4000.00Ω
1.8Ω	700Ω	17Ω	5000.00Ω
1.9Ω	800Ω	18Ω	6000.00Ω
2Ω	1000Ω	19Ω	8000.00Ω
2.5Ω	1300Ω	20Ω	10000.00Ω
3Ω	1800Ω	25Ω	12000Ω
4Ω	2300Ω	30Ω	15000Ω
6Ω	2900Ω	40Ω	18000Ω
8Ω		60Ω	22000Ω
10Ω		80Ω	26000Ω
15Ω		100Ω	30000Ω
20Ω		150Ω	36000Ω
25Ω		200Ω	

For convenience, Tables 7.2 and 7.3 on the following pages are provided for a means of recording calibration results for one channel of each model.

Adjustment Procedure

In the unlikely event that adjustment of the 40-261 is required we recommend returning it to Pickering Interfaces. Adjustment of the 40-261 requires the use of a high performance DMM and an automated program in order to maintain its accuracy in the event of an adjustment being required to improve performance.

VERIFICATION TEST RESULTS

Table 7.2 - Calibration Test Results For 40-261-001

Serial Number:	
Channel Number:	
Date of Test:	
Operator's Name:	
Test Equipment Used:	

Resistance Setting	Measured Value	Maximum	Minimum	Result (delete as appropriate)
Short (0Ω)		0.1Ω	0Ω	Pass / Fail
1.5Ω		1.571	1.429Ω	Pass / Fail
1.52Ω		1.591	1.449Ω	Pass / Fail
1.54Ω		1.611	1.469Ω	Pass / Fail
1.56Ω		1.631	1.489Ω	Pass / Fail
1.58Ω		1.651	1.509Ω	Pass / Fail
1.6Ω		1.671	1.529Ω	Pass / Fail
1.62Ω		1.691	1.549Ω	Pass / Fail
1.64Ω		1.711	1.569Ω	Pass / Fail
1.66Ω		1.731	1.589Ω	Pass / Fail
1.68Ω		1.751	1.609Ω	Pass / Fail
1.7Ω		1.771	1.629Ω	Pass / Fail
1.8Ω		1.871	1.729Ω	Pass / Fail
1.9Ω		1.972	1.828Ω	Pass / Fail
2Ω		2.072	1.928Ω	Pass / Fail
2.5Ω		2.572	2.428Ω	Pass / Fail
3Ω		3.072	2.928Ω	Pass / Fail
4Ω		4.073	3.927Ω	Pass / Fail
6Ω		6.075	5.925Ω	Pass / Fail
8Ω		8.076	7.924Ω	Pass / Fail
10Ω		10.078	9.922Ω	Pass / Fail
15Ω		15.082	14.918Ω	Pass / Fail
20Ω		20.086	19.914Ω	Pass / Fail
25Ω		25.090	24.910Ω	Pass / Fail
30Ω		30.094	29.906Ω	Pass / Fail
50Ω		50.110	49.890Ω	Pass / Fail
70Ω		70.126	69.874Ω	Pass / Fail
90Ω		90.142	89.858Ω	Pass / Fail
110Ω		110.158	109.842Ω	Pass / Fail
130Ω		130.174	129.826Ω	Pass / Fail
150Ω		150.190	149.810Ω	Pass / Fail
200Ω		200.230	199.770Ω	Pass / Fail
250Ω		250.270	249.730Ω	Pass / Fail
300Ω		300.310	299.690Ω	Pass / Fail
400Ω		400.390	399.610Ω	Pass / Fail
500Ω		500.470	499.530Ω	Pass / Fail
700Ω		700.630	699.370Ω	Pass / Fail
800Ω		800.710	799.290Ω	Pass / Fail
1000Ω		1000.870	999.130Ω	Pass / Fail
1300Ω		1301.110	1298.890Ω	Pass / Fail
1800Ω		1801.510	1798.490Ω	Pass / Fail
2300Ω		2301.910	2298.090Ω	Pass / Fail
2900Ω		2902.390	2897.610Ω	Pass / Fail

Note: The maximum and minimum values listed do not take into account test equipment uncertainty, values are provided for convenience only. Only a high performance measuring device should be used to minimize the additional uncertainty.

Table 7.3 - Calibration Test Results For 40-261-002

Serial Number:	
Channel Number:	
Date of Test:	
Operator's Name:	
Test Equipment Used:	

Resistance Setting	Measured Value	Maximum	Minimum	Result (delete as appropriate)
Short (0Ω)		0.1Ω	0Ω	Pass / Fail
10Ω		10.078Ω	9.922Ω	Pass / Fail
15Ω		15.082Ω	14.918Ω	Pass / Fail
15.2Ω		15.282Ω	15.118Ω	Pass / Fail
15.4Ω		15.482Ω	15.318Ω	Pass / Fail
15.6Ω		15.682Ω	15.518Ω	Pass / Fail
15.8Ω		15.883Ω	15.717Ω	Pass / Fail
16Ω		16.083Ω	15.917Ω	Pass / Fail
16.2Ω		16.283Ω	16.117Ω	Pass / Fail
16.4Ω		16.483Ω	16.317Ω	Pass / Fail
16.6Ω		16.683Ω	16.517Ω	Pass / Fail
16.8Ω		16.883Ω	16.717Ω	Pass / Fail
17Ω		17.084Ω	16.916Ω	Pass / Fail
18Ω		18.084Ω	17.916Ω	Pass / Fail
19Ω		19.085Ω	18.915Ω	Pass / Fail
20Ω		20.086Ω	19.914Ω	Pass / Fail
25Ω		25.090Ω	24.910Ω	Pass / Fail
30Ω		30.094Ω	29.906Ω	Pass / Fail
40Ω		40.102Ω	39.898Ω	Pass / Fail
60Ω		60.118Ω	59.882Ω	Pass / Fail
80Ω		80.134Ω	79.866Ω	Pass / Fail
100Ω		100.150Ω	99.850Ω	Pass / Fail
150Ω		150.190Ω	149.810Ω	Pass / Fail
200Ω		200.230Ω	199.770Ω	Pass / Fail
250Ω		250.270Ω	249.730Ω	Pass / Fail
300Ω		300.310Ω	299.690Ω	Pass / Fail
500Ω		500.470Ω	499.530Ω	Pass / Fail
700Ω		700.630Ω	699.370Ω	Pass / Fail
900Ω		900.790Ω	899.210Ω	Pass / Fail
1100Ω		1100.950Ω	1099.050Ω	Pass / Fail
1300Ω		1301.110Ω	1298.890Ω	Pass / Fail
1500Ω		1501.270Ω	1498.730Ω	Pass / Fail
2000Ω		2001.670Ω	1998.330Ω	Pass / Fail
2500Ω		2502.070Ω	2497.930Ω	Pass / Fail
3000Ω		3002.470Ω	2997.530Ω	Pass / Fail
4000Ω		4003.270Ω	3996.730Ω	Pass / Fail
5000Ω		5004.070Ω	4995.930Ω	Pass / Fail
6000Ω		6004.870Ω	5995.130Ω	Pass / Fail
8000Ω		8006.470Ω	7993.530Ω	Pass / Fail
10000Ω		10008.070Ω	9991.930Ω	Pass / Fail
12000Ω		12009.670Ω	11990.330Ω	Pass / Fail
15000Ω		15012.070Ω	14987.930Ω	Pass / Fail
18000Ω		18014.470Ω	17985.530Ω	Pass / Fail
22000Ω		22017.670Ω	21982.330Ω	Pass / Fail
26000Ω		26020.870Ω	25979.130Ω	Pass / Fail
30000Ω		30024.070Ω	29975.930Ω	Pass / Fail
36000Ω		36028.870Ω	35971.130Ω	Pass / Fail

Note: The maximum and minimum values listed do not take into account test equipment uncertainty, values are provided for convenience only. Only a high performance measuring device should be used to minimize the additional uncertainty.

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