



pickering 4x-878 Dual 4-Channel PXI/PXIe MEMS RF Multiplexer User Manual

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4x-878 User Manual
PXI/PXIe 50 Ω 4-Channel RF MEMS Multiplexer
PXI



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Technical Support

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.

Worldwide Technical Support and Product Information

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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.	

Warnings & Cautions

WARNING – Hazardous Environments	Symbol
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.	
WARNING – Danger of Electric Shock	Symbol
<p>This module may contain hazardous voltages. Before removing the module from the rack remove all supplies and disconnect user I/O signals.</p> <p>Unused slots in the PXI/PXIe/LXI 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.</p> <p>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.</p>	
CAUTION – Handling of Electrostatic-Sensitive Devices	Symbol
<p>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:</p> <ul style="list-style-type: none"> • 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. • 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. • Outer clothing worn must be unable to generate static charges. • Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags. 	
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

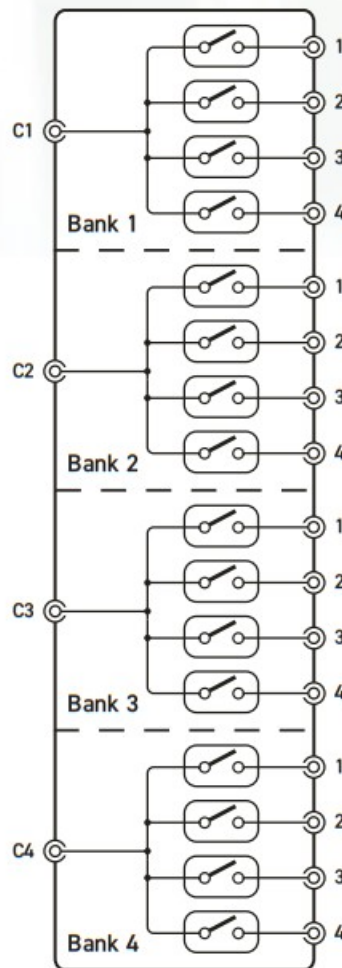
All cleaning and servicing requires the equipment to be isolated and disconnected from the power source and user I/O signals (refer to the Maintenance Section).

- 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

- Available as PXI or PXIe Modules
- 4 GHz RF Multiplexer
- Maximum RF Power to 25 W
- Single, Dual and Quad Versions

- SMB or MCX Connector Versions
- Very Low Insertion Loss
- Long Operational Life
- Fast Operating Time
- Drivers Supplied for Windows and Linux, Plus Support for Real-time Systems
- PXI Versions Supported by PXI or LXI Chassis
- Based on Menlo Micro Ideal Switch® MEMS Devices
- 3 Year Warranty



Quad 4 to 1 RF MUX (Part No. 4x-878-24x)
- Default Switch State Shown

The 40-878 (PXI) and 42-878 (PXIe) are 50 Ω 4 to 1 RF Multiplexers available with 1, 2 or 4 banks in a single PXI or PXIe slot.

The module is based on the latest micro-electromechanical system (MEMS) switching technology from Menlo Micro and has low insertion loss and VSWR. In addition, MEMS devices have a long operational life of >3 billion operations and benefit from an operating time of 50 μ s allowing greater test system throughput. The multiplexers

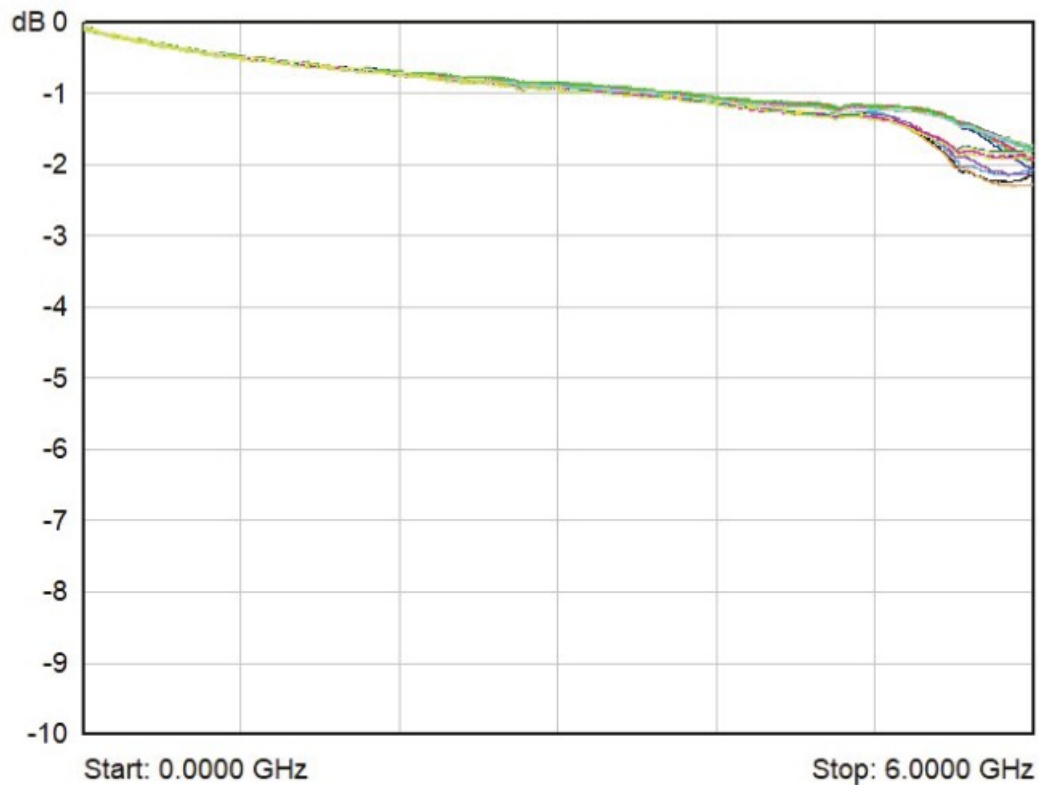
have excellent and repeatable RF characteristics beyond 4 GHz with each path having a nominally equal insertion loss. The 4x-878 minimizes the injection of noise and unwanted signals into the signal path by careful attention to the mechanical and electrical design.

Versions with MCX or SMB connectors are available, allowing users to simplify cabling issues by matching them to other connectors in their test system.

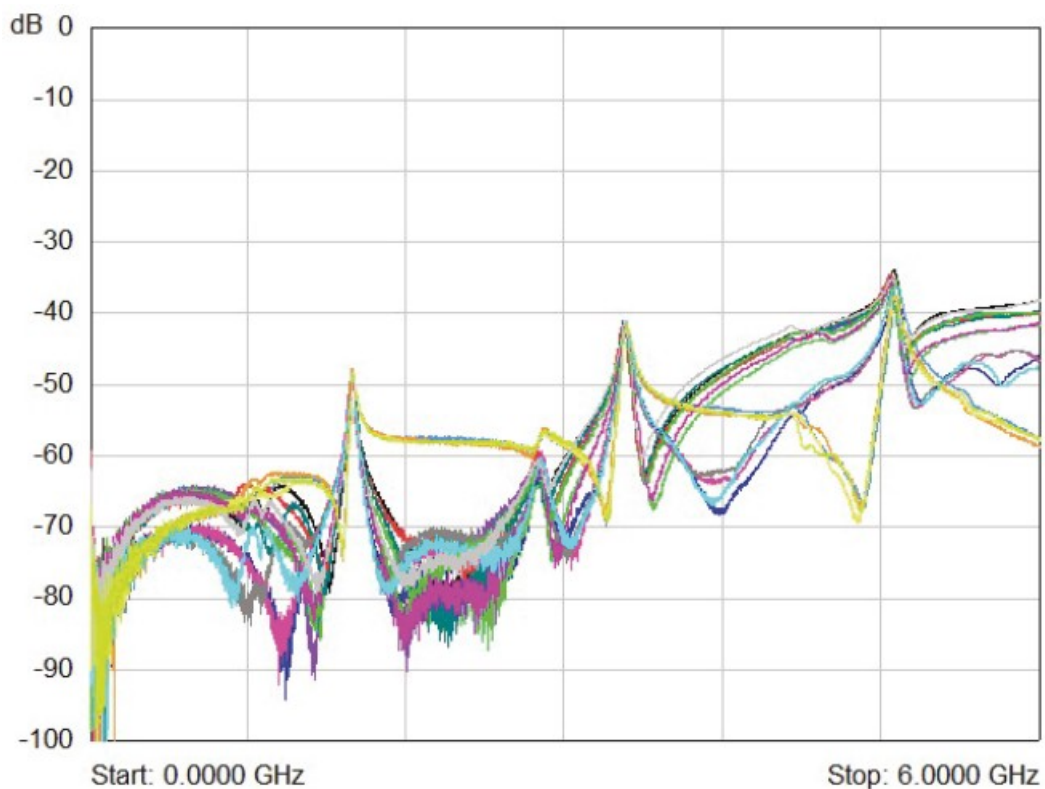
The 4x-878 is supplied with drivers that allow support in all popular software environments. It can also be supported in all Pickering's LXI Modular Switching chassis, allowing the use of a PXI or LAN controlled switching solution with the same high levels of performance.

4x-878 RF Performance Plots

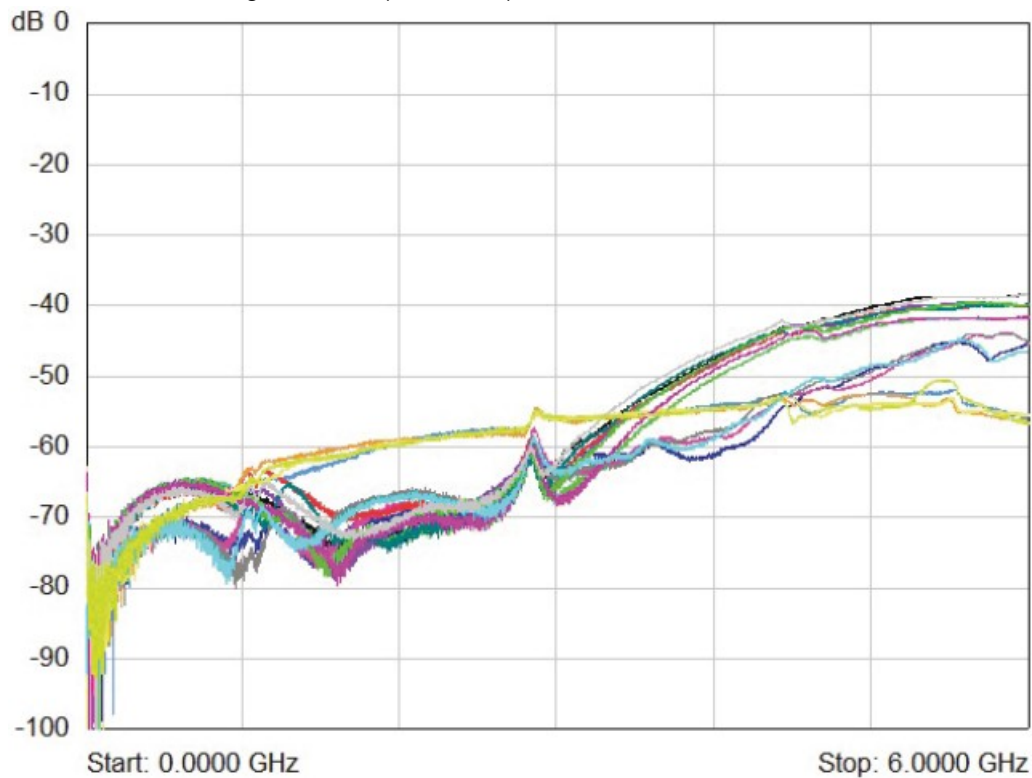
(Plots taken from typical sample showing all connecting paths for parameter)



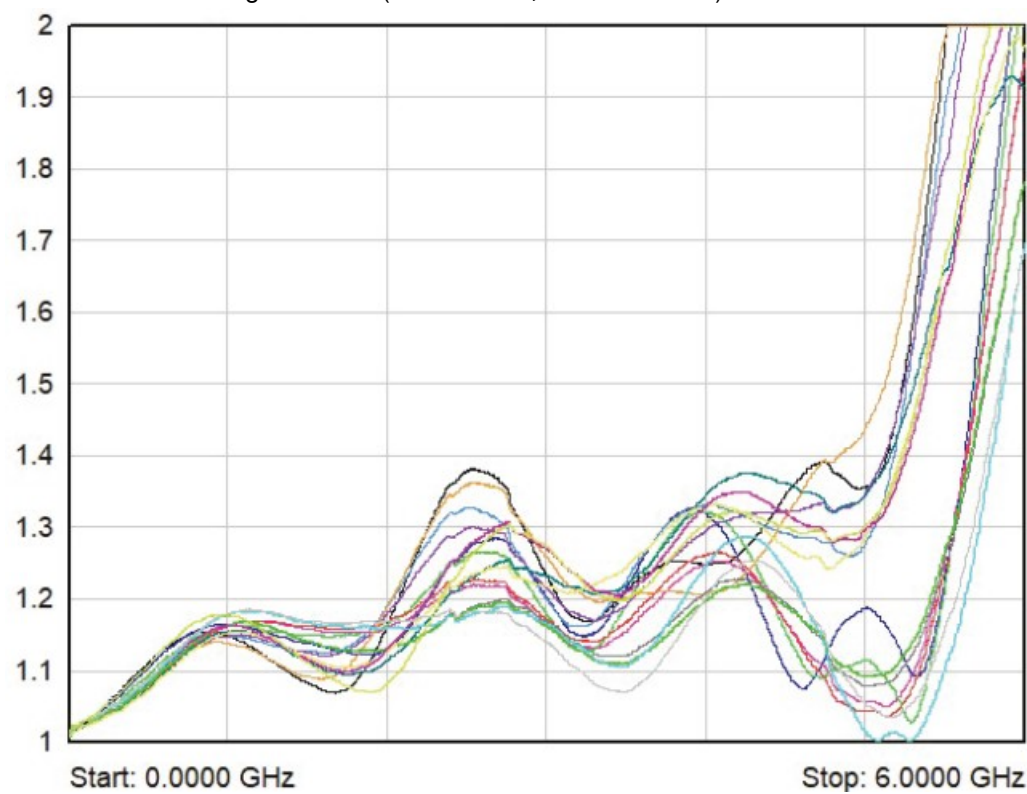
Typical Insertion Loss Plot For Each Signal Path



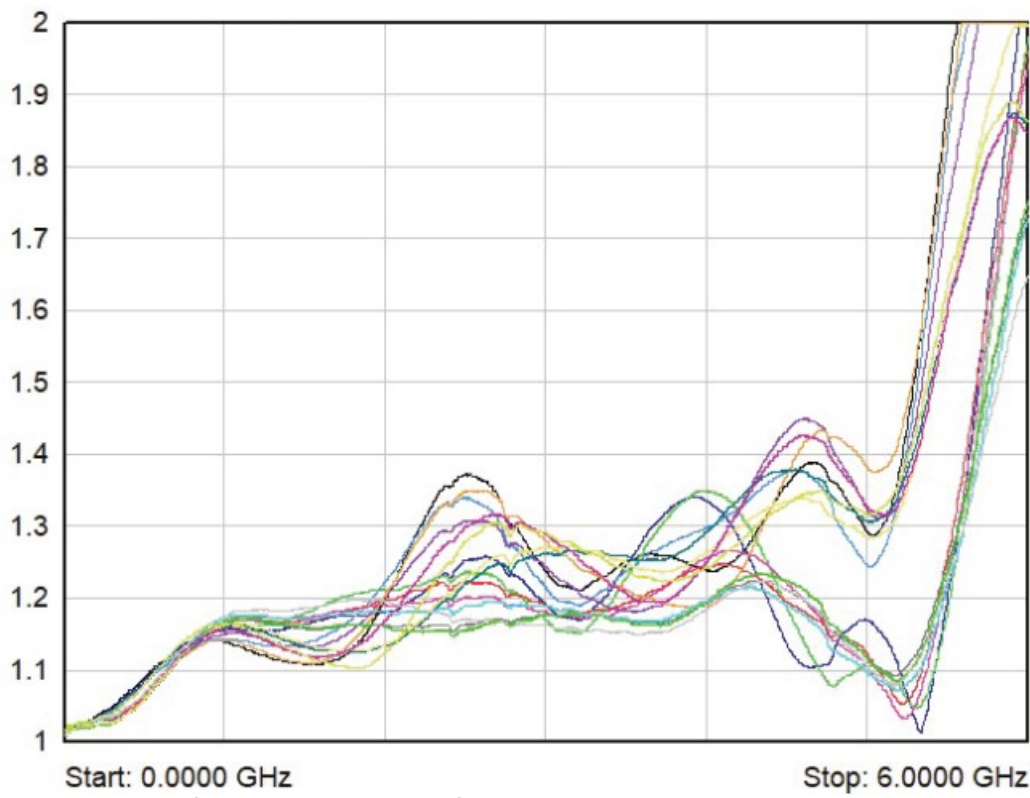
Typical Crosstalk Plot Between Signal Paths (Unloaded)



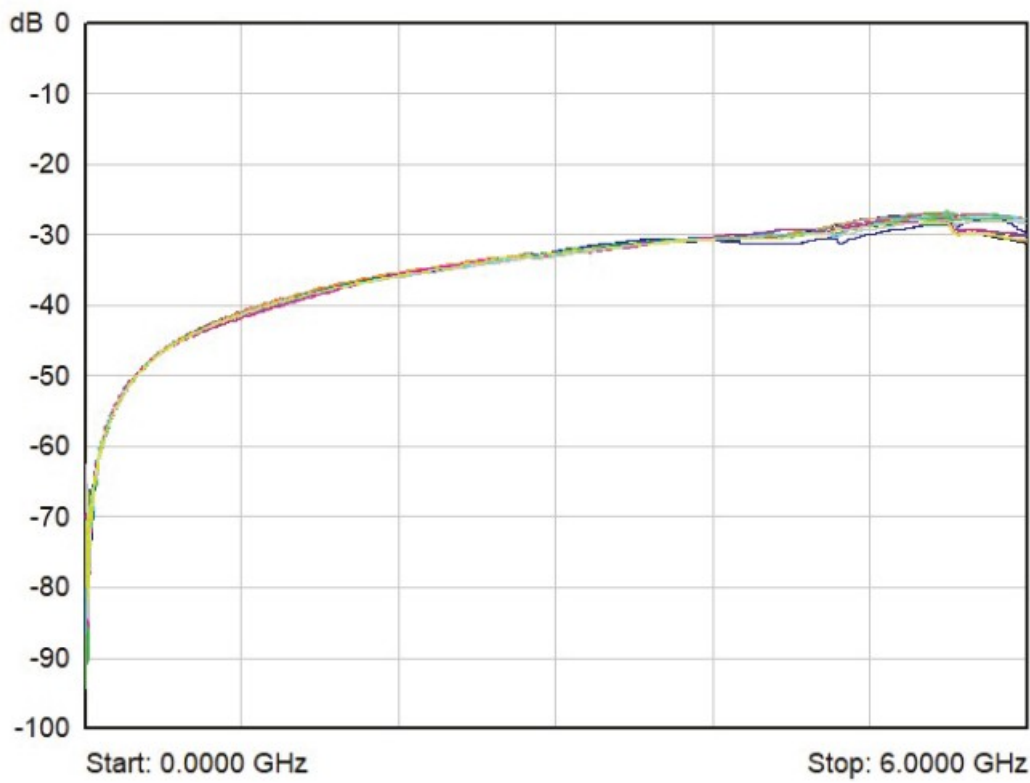
Typical Crosstalk Plot Between Signal Paths (Unswitched, Load on COM)



Typical VSWR Plot For Each Signal Path (Load on COM)



Typical VSWR Plot For Each Signal Path (Load on Channel)



Typical Isolation Plots for Each Channel

RF Specification

RF Frequency Range:	DC to 4 GHz, usable to 5 GHz
Insertion Loss:	Typically <0.7 dB to 1 GHz Typically <1.4 dB to 4 GHz
VSWR:	Typically <1.25:1 to 1 GHz Typically <1.5:1 to 4 GHz
Isolation:	Typically >40 dB to 1 GHz Typically >30 dB to 4 GHz
Crosstalk:	Typically <-60 dB to 1 GHz Typically <-40 dB to 4 GHz
Maximum RF Power (CW):	2 W to 1 MHz 10 W to 10 MHz 25 W to 4 GHz

Other Switching Specifications

Maximum DC Voltage:	35 V *
Maximum DC Current:	0.5 A
Operating Time:	50 μ s typical
Life Expectancy:	3 x 10 operations

* MEMS devices are intended for cold-switch applications only.

Power Requirements – 40-878

+3.3 V	+5 V	+12 V
200 mA	100 mA	0

Power Requirements – 42-878

+3.3 V	+12 V
200 mA	50 mA

Mechanical Characteristics

40-878 – Single slot 3U PXI (CompactPCI card).

42-878 – Single slot 3U PXIe, compatible with PXIe hybrid slot.

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

Module weight: 206 g (40-878-242)

Connectors

40-878 – PXI bus via 32-bit P1/J1 backplane connector.

42-878 – PXIe bus via XJ3 and XJ4 backplane connectors.

Signals via front panel SMB or MCX connectors.

PXI & CompactPCI Compliance – 40-878

The module is compliant with the PXI Specification 2.2.

Local Bus, Trigger Bus & Star Trigger are not implemented.

Uses a 33 MHz 32-bit backplane interface.

PXIe Compliance – 42-878

The module is compliant with the PXIe Specification 1.0.
Local Bus, Trigger Bus & Star Trigger are not implemented.

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.

Operating/Storage Conditions

Operating Temperature:	0 °C to +55 °C
Humidity:	Up to 90 % non-condensing
Altitude:	5000 m
Storage Temperature:	-20 °C to +75 °C
Humidity:	Up to 90 % non-condensing
Altitude:	15000 m

Product Order Codes

Single MEMS 50 Ω 4:1 RF MUX, SMB	4x-878-211
Dual MEMS 50 Ω 4:1 RF MUX, SMB	4x-878-221
Quad MEMS 50 Ω 4:1 RF MUX, SMB	4x-878-241
Single MEMS 50 Ω 4:1 RF MUX, MCX	4x-878-212
Dual MEMS 50 Ω 4:1 RF MUX, MCX	4x-878-222
Quad MEMS 50 Ω 4:1 RF MUX, MCX	4x-878-242

Where 4x specifies PXI or PXIe, for example:

40-878-211 Single MEMS 50 Ω 4:1 RF Multiplexer, SMB connectors in PXI format

42-878-211 Single MEMS 50 Ω 4:1 RF Multiplexer, SMB connectors in PXIe format

Product Customization

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

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.

Connection Accessories

For a complete list of connection accessories and documentation for the 4x-878 module, please refer to our RF connectors datasheet (90-011D).



42-878-241 PXIe Quad 50 Ω 4:1 RF Multiplexer

Section 2 – Technical Description

Functional Description

A functional block diagram is provided in Figure 2.1. The module is powered by +5 V and +3.3 V (PXI) or +3.3 V and +12 V (PXIe) supplies via PCI Bus connectors mounted on the mother board. The interface to the user test equipment is via the front panel mounted SMB or MCX connectors. The module comprises a mother board with the PXI/PXIe interface circuit and daughter boards populated with SPST MEMS relays. Single and dual multiplexers have one daughter board, quad multiplexers have two daughter boards. The MEMS relays are configured as 4-channel RF multiplexers and are energised via control signals from relay driver devices. The relay drivers receive control data from PCI bridge U1 mounted on the mother board via a PCB/PCB interconnection. Module configuration and setup information for the PCI bridge is stored in Serial EPROM devices.

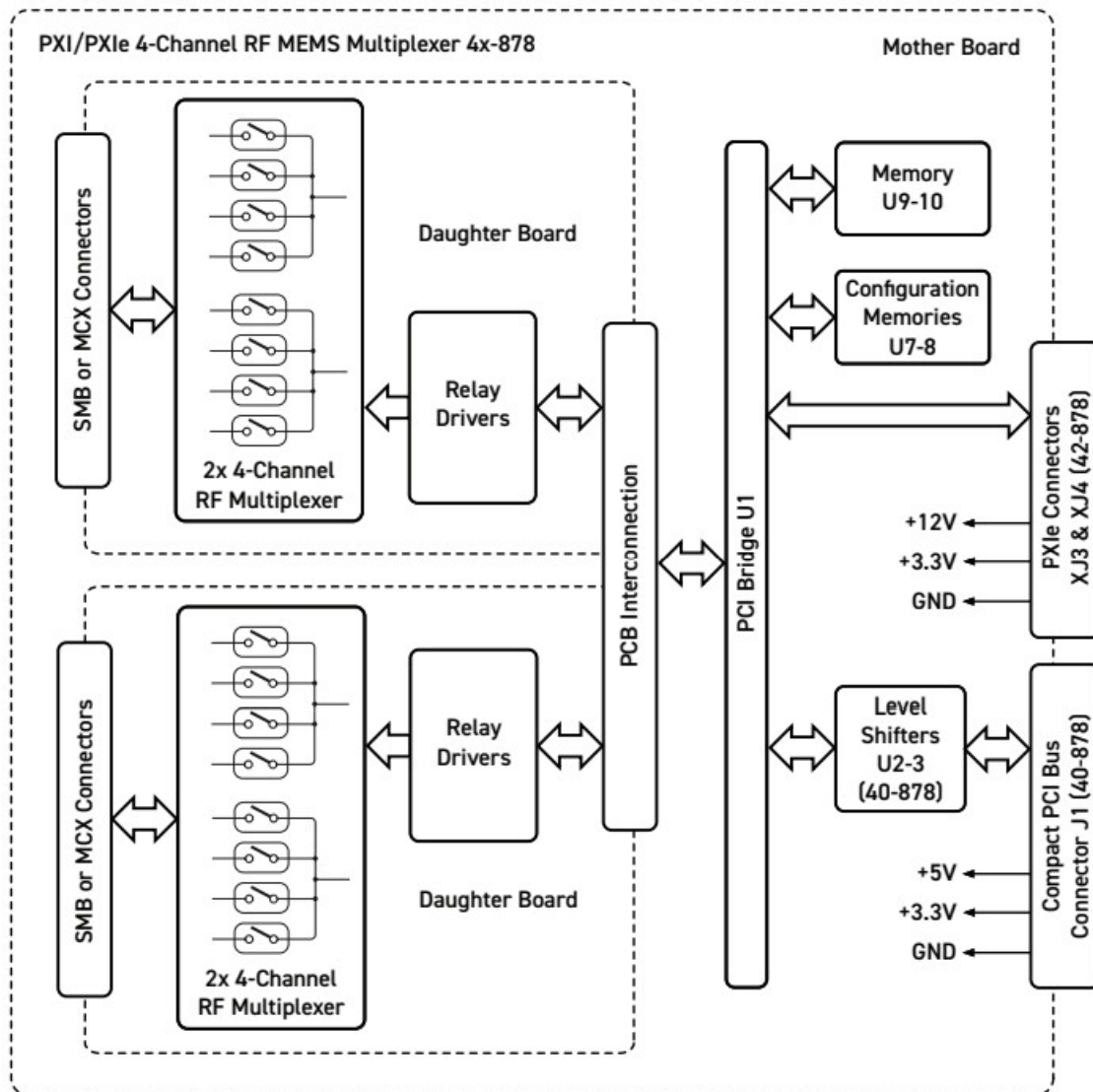


Figure 2.1 – 4-Channel RF MEMS Multiplexer Module 4x-878: Functional Block Diagram

Section 3 – Installation



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

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



Pre-operation 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.

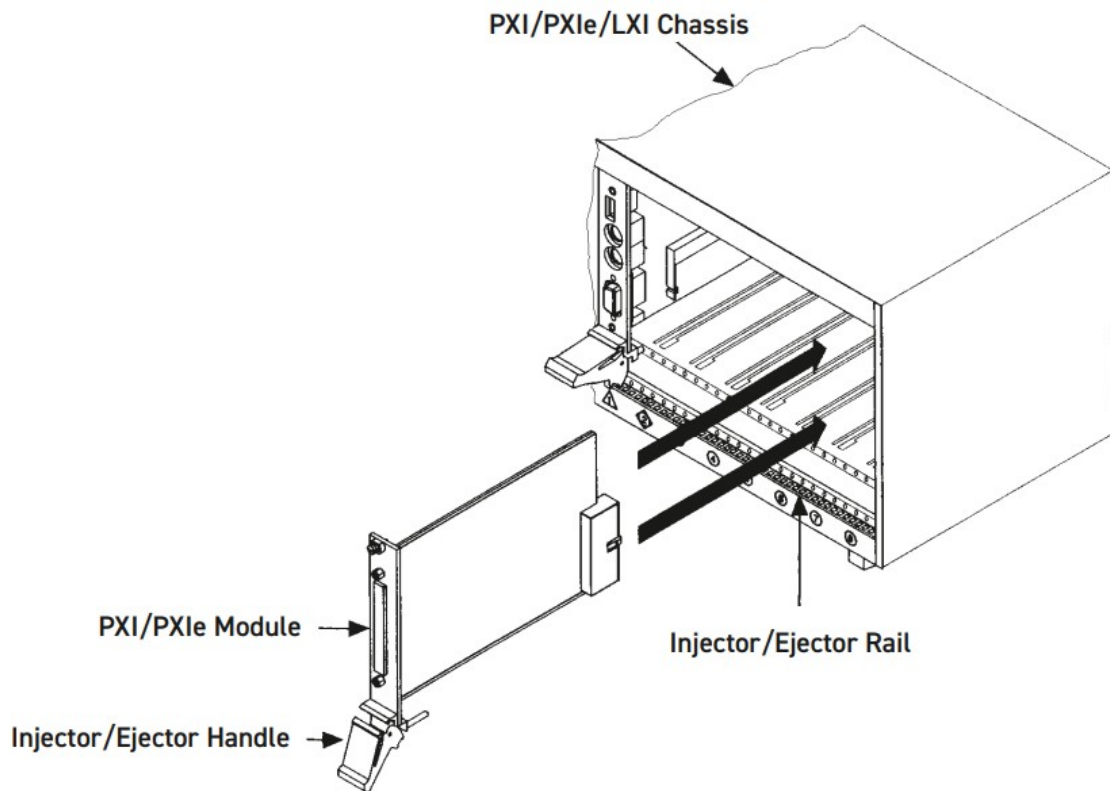


Figure 3.1 – Installing the Module into a PXI/PXIe/cPCI/LXI Chassis

Hardware Installation Electrical Connection (Chassis)



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

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 vi.

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 Pickering switching and simulation PCI, PXI and PXIe products.

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/PXIe 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.

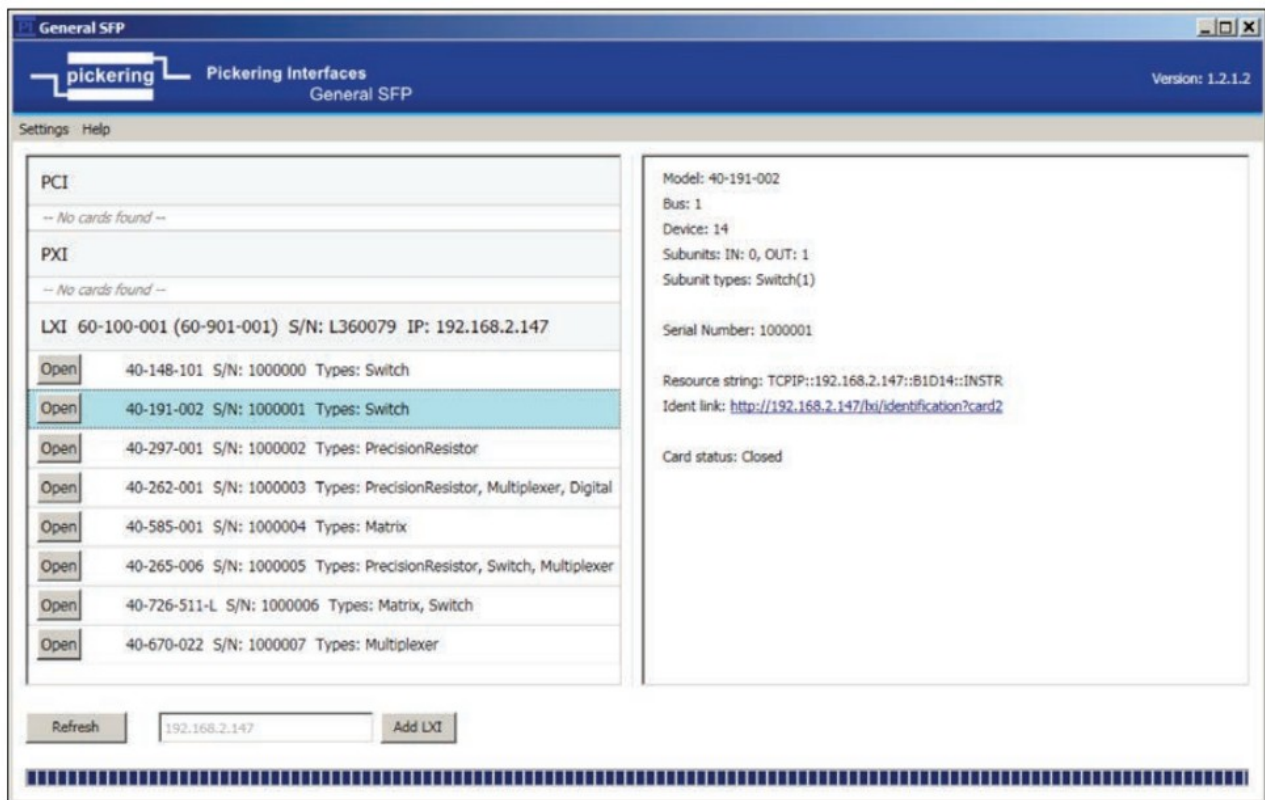


Figure 3.3 – General Soft Front Panel Selector

More details how to use the GSFP can be found in the manual, via menu Help\Manual.

Section 4 – Programming

Programming options for Pickering Interfaces PXI/PXIe 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: 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

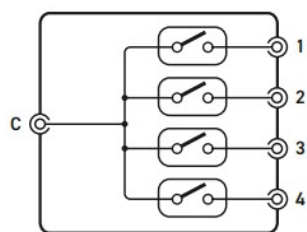
The 4x-878 module is an 4-channel RF multiplexer based on MEMS switching technology and is available with one, two or four independent banks. The multiplexers have a default state with all signal paths open. The software includes blocking that allows only one out of the four signal paths to be enabled on each bank at any one time. The module's switching architecture is shown in the diagrams below.

Signal paths are created by enabling the bits in the appropriate sub-unit as shown in Table 4.1. Page 4.4 shows some simple programming examples.

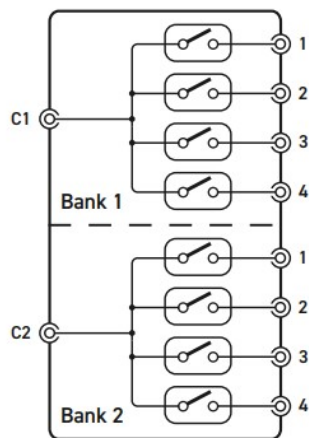
Operating & Using MEMS Switching

MEMS devices are sensitive to static and hot-switching. The module has been carefully designed to be able to withstand lower level ESD events up to 1 kV but standard ESD practice should always be used when handling the module.

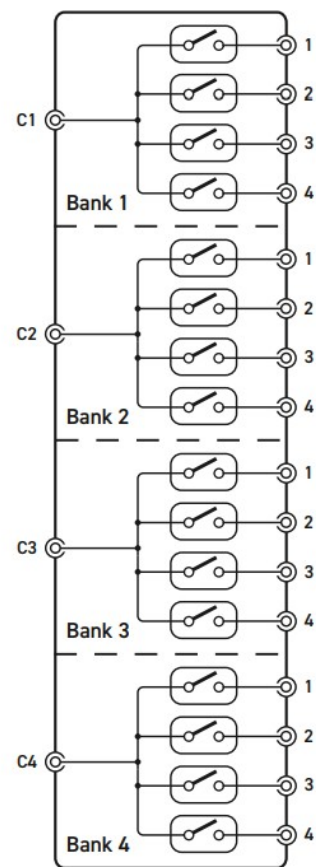
Hot-switching is not recommended when using this module to switch RF signals, the RF power to the module should be turned off before a path is switched. The devices are capable of hot-switching up to 0.5 Vp (RF 2.5 mW or 4 dBm in a 50 Ω system) but great care should be taken to ensure the limit is not exceeded.



4x-878-21x



4x-878-22x



4x-878-24x

Figure 4.1 – Switching Diagrams for 4x-878 4-Channel MEMS RF Multiplexer (default switch state shown)

Table 4.1 – Sub-unit / Bit allocations for the 4x-878 4-Channel MEMS RF Multiplexer

Programming Bit / Signal Path Table								
Applicable Modules	Multiplexer Bank	Sub-Unit	But	Signal Path	IVI Channel Names (multi-bank versions) IVI Channel Names		(single bank versions)	
4x-878-21x 4x-878-22x 4x-878-24x	1	1	1	C1 to 1	comA	chA1	corn	chl
			2	C1 to 2	comA	chA2	corn	ch2
			3	C1 to 3	comA	chA3	corn	ch3
			4	C1 to 4	comA	chA4	corn	ch4
4x-878-22x 4x-878-24x	2	2	1	C2 to 1	comB	chB1	–	–
			2	C2 to 2	comB	chB2	–	–
			3	C2 to 3	comB	chB3	–	–
			4	C2 to 4	comB	chB4	–	–
4x-878-24x	3	3	1	C3 to 1	comC	chC1	–	–
			2	C3 to 2	comC	chC2	–	–
			3	C3 to 3	comC	chC3	–	–
			4	C3 to 4	comC	chC4	–	–
4x-878-24x	4	4	1	C4 to 1	comD	chD1	–	–
			2	C4 to 2	comD	chD2	–	–
			3	C4 to 3	comD	chD3	–	–
			4	C4 to 4	comD	chD4	–	–

Programming the Module

This section provides some code fragments which show how to control the 4x-878 multiplexer using either the Direct I/O Driver or the VISA Driver.

Once the drivers are installed the manual “Sys40Prg.pdf” and driver help files which fully describes these functions can be found in the Pickering folder(s) or the Pickering entries on your Start Menu.

The card must be opened before use and closed after using the following function calls:

Direct Driver – Open with PIL_OpenCards or PIL_OpenSpecifiedCard and close with PIL_CloseCards or PIL_CloseSpecifiedCards respectively.

VISA Driver – Open with pipx40_init, and close with, pipx40_close.

Using the Pickering Direct I/O driver:

```
DWORD sub_unit = 1; // Select Bank 1
```

```
PIL_OpBit( card_num, sub_unit, 1, 1); // Enable the C1 to 1 signal path
```

```
PIL_OpBit( card_num, sub_unit, 2, 1); // Release the C1 to 1 signal path and // enable the C1 to 2 signal path
```

```
PIL_OpBit( card_num, sub_unit, 2, 0); // Release the C1 to 2 signal path and set // the multiplexer to the default position
```

Using the VISA driver:

```
ViUInt32 sub_unit = 1; // Select Bank 1
```

```
pipx40_setChannelState(vi, sub_unit, 1, VI_ON); // Enable the C1 to 1 signal path
```

```
pipx40_setChannelState(vi, sub_unit, 2, VI_ON); // Release the C1 to 1 signal path and // enable the C to 2 signal path
```

```
pipx40_setChannelState(vi, sub_unit, 2, VI_OFF); // Release the C1 to 2 signal path and // set the multiplexer to
```

default

Using the IVI driver:

The IVI driver has no special labelling for this card and treats the array of switches as a simple array, labelling the channels using the normal com./ch labelling tags (banks are labelled in sequence, 1 is A, 2 is B, 3 is C and D is 4. The following example assumes a two or four bank multiplexer, for single bank versions, the common is referred to as com, and the channels as ch1, ch2, etc.

```
pi40iv_Connect(vi, comA, chA1); // Enable the C to 1 signal path of bank 1
pi40iv_Disconnect(vi, comA, chA1); // Release the C to 1 signal path of bank 1
pi40iv_Connect(vi, comA, chA2); // Enable the C to 2 signal path of bank 1
pi40iv_Disconnect(vi, comA, chA2); // Release the C to 2 signal path and sets // multiplexer bank 1 to the default position
```

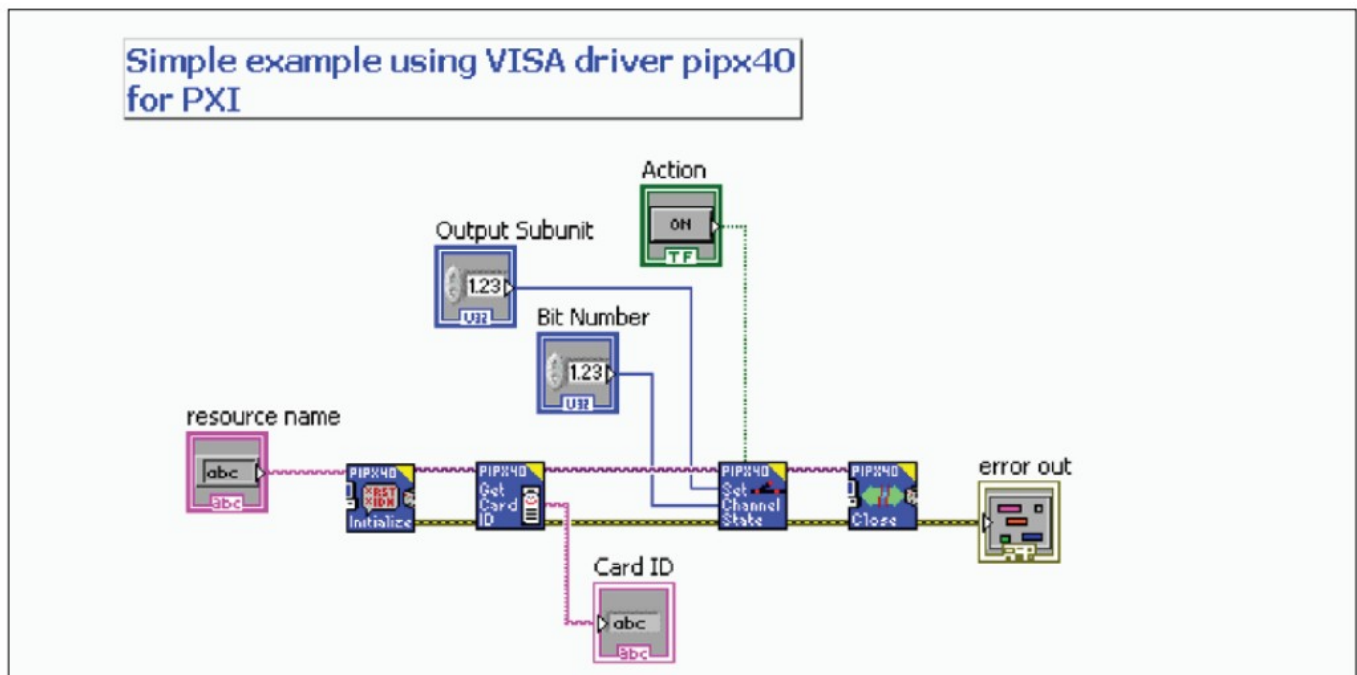
Using Pickering Drivers In LabVIEW

Most Pickering drivers include a LabVIEW wrapper to permit full operation of the Pickering product from the LabVIEW environment. These wrappers are normally installed to the current LabVIEW folder system during installation of the Pickering driver.

The process of controlling a Pickering product normally consists of the following steps:

1. Open a control session on the product.
2. Use functions in the library to operate the product.
3. Close the control session.

Following is a simple example of the use of the most common Pickering drivers:

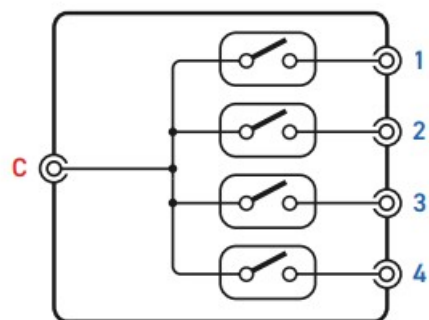
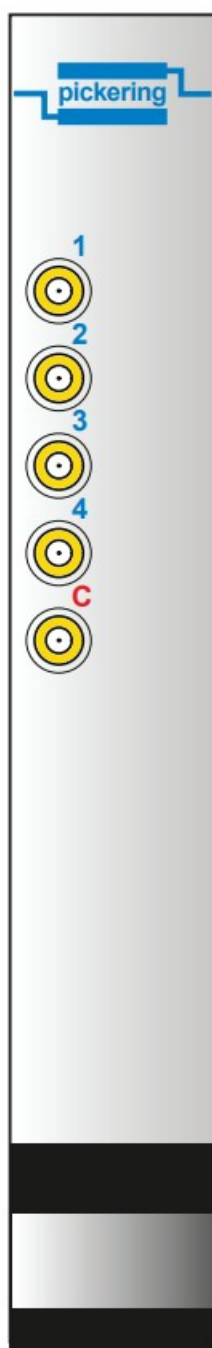


Example Use of Pickering Drivers in LabVIEW

To download LabVIEW examples, please go to:

<http://wiki.pickeringtest.net/Using+Pickering+Drivers+in+LabView>

Section 5 – Connectors



**Single 4-Channel
RF Multiplexer**

Figure 5.1 – Single 4-Channel MEMS Multiplexer Module 4x-878-21x: SMB/MCX Connector Positions

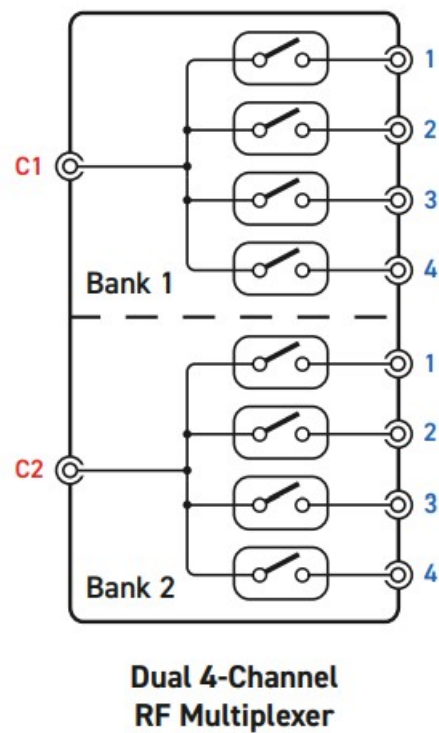
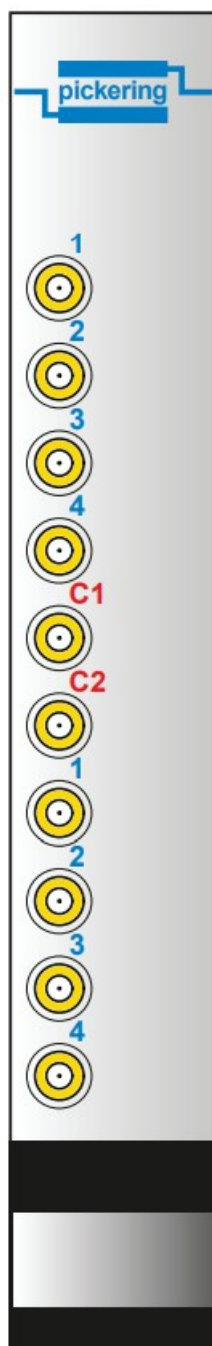


Figure 5.2 – Dual 4-Channel MEMS Multiplexer Module 4x-878-22x: SMB/MCX Connector Positions

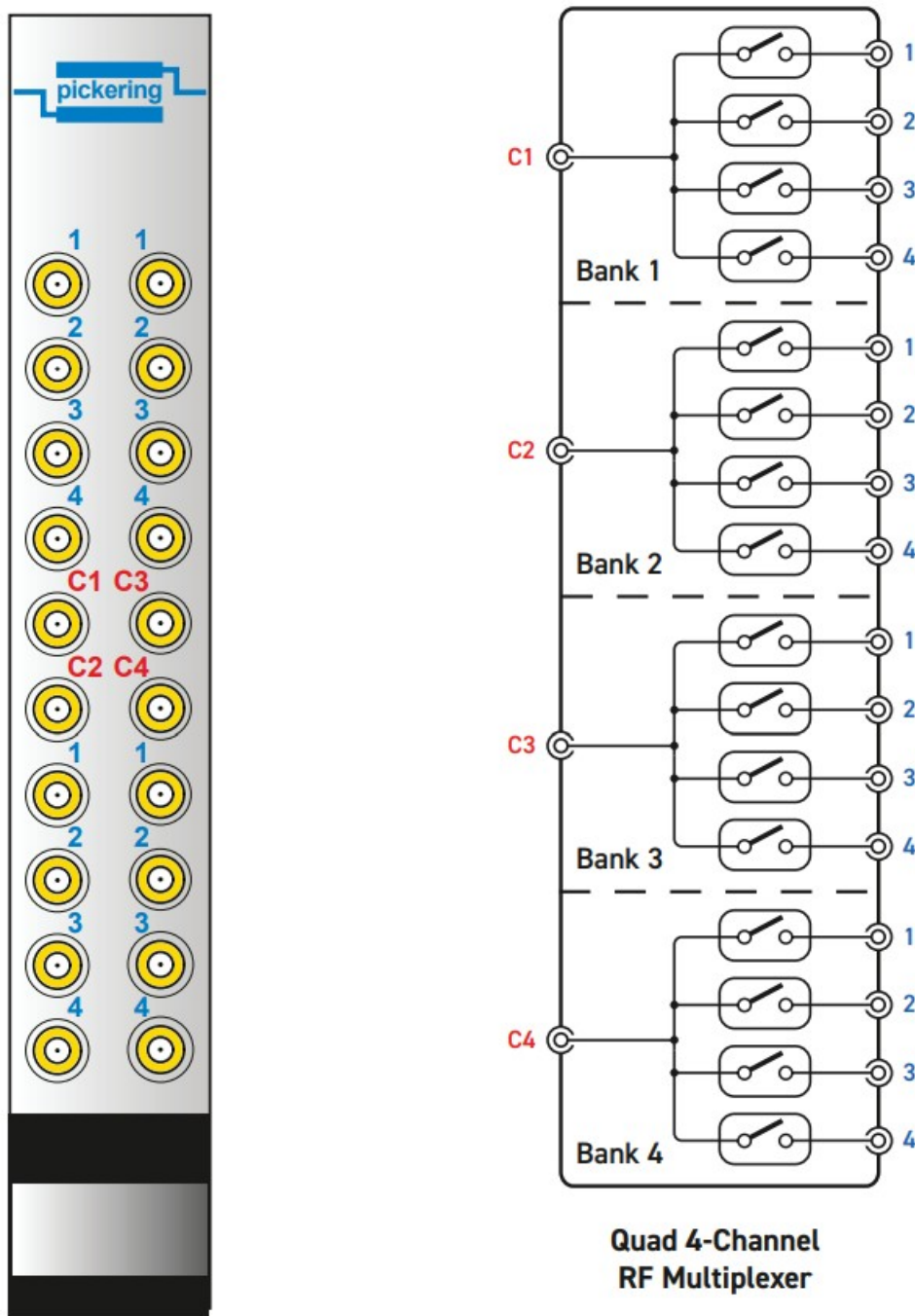


Figure 5.3 – Quad 4-Channel MEMS Multiplexer Module 4x-878-24x: SMB/MCX Connector Positions

Section 6 – Troubleshooting

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.

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/PXIe modules operating in a PXI/PXIe 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.



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Documents / Resources



[pickering 4x-878 Dual 4-Channel PXI/PXIe MEMS RF Multiplexer](#) [pdf] User Manual
4x-878 Dual 4-Channel PXI PXIe MEMS RF Multiplexer, 4x-878, Dual 4-Channel PXI PXIe MEMS RF Multiplexer, 4-Channel PXI PXIe MEMS RF Multiplexer, PXI PXIe MEMS RF Multiplexer, PXIe MEMS RF Multiplexer, MEMS RF Multiplexer, RF Multiplexer

References

- [PXI, LXI, USB & PCI switching & simulation for Test & Measurement](#)
- [Software Drivers & Downloads](#)

Manuals+