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USER MANUAL

PXI

16 CHANNEL POWER MULTIPLEXER MODULE
(MODEL No. 40-650)



Issue 3.4 December 2012

pickering

www.pickeringtest.com

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Reg No. FM38792

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Observe the Electrostatic Sensitive Device Caution detailed in Section 8.

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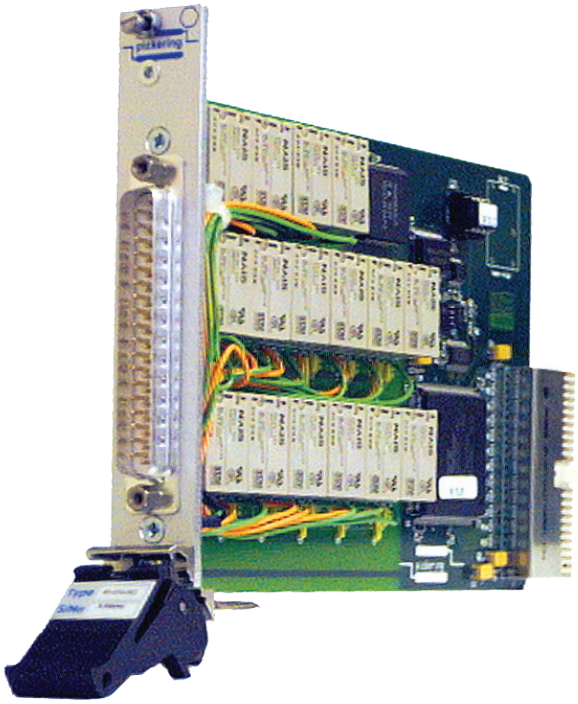
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SECTION 1 - TECHNICAL SPECIFICATION

40-650
Power Multiplexer Module



- 16-Channel Power Multiplexer
- 2-Pole Switching
- 5A Current Rating With 175W/1250VA Maximum Power
- Hot Switch to 125VDC/250VAC
- Cold Switch to 400VDC/250VAC
- VISA, IVI & Kernel Drivers Supplied for Windows XP/Vista/7
- Supported by PXI or LXI Chassis
- 2 Year Warranty

Pickering Interfaces have a range of power switching PXI modules, available in relay, matrix or multiplexer configurations. Connections are made via a front panel 37-Way D-Type male connector.

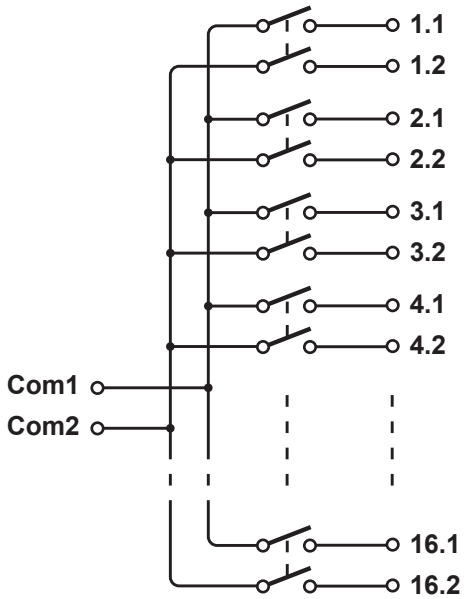
Model 40-650-002 is a 16-Channel Power Multiplexer, suitable for switching inductive/capacitive loads up to 5A at 125VDC/250VAC

Power Multiplexer Modules are intended for switching heavy AC or DC loads or for slaving up to large external relays, contactors and solenoids.

The 40-650 Power Relay Module is suitable for applications requiring switching of either AC mains or DC voltage.

Power Relay Type

The 40-650 is fitted with electro-mechanical power relays, gold-flash over silver alloy. A **Spare Relay is** built onto the circuit board to facilitate easy maintenance with minimum downtime.

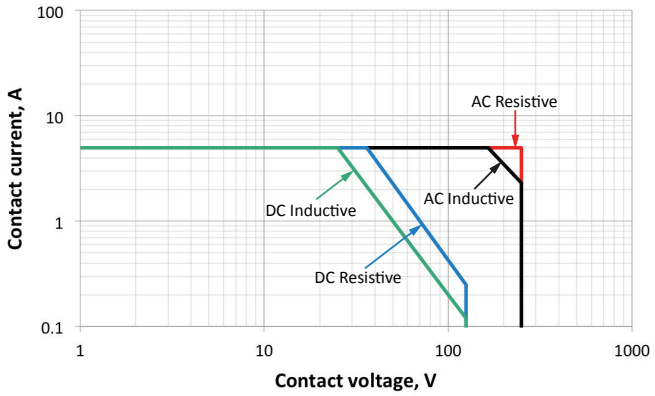


Schematic of 40-650 Power Multiplexer Module

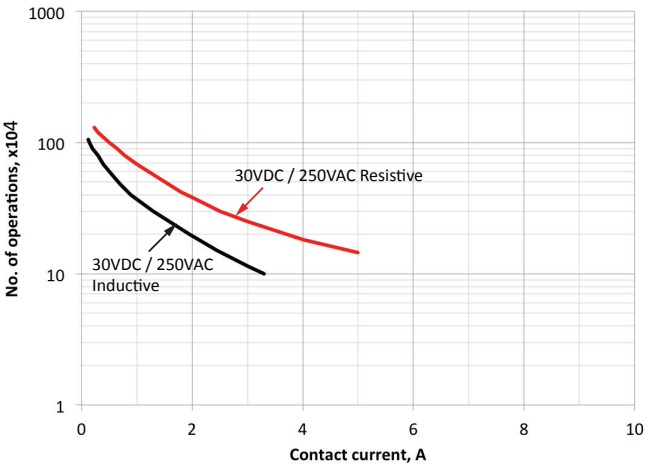
Switching Specification

Contact Type:	Gold flash over silver alloy
Cold Switching Capacity Maximum Current: Maximum Voltage:	 5A 400VDC/250VAC
Hot Switching Capacity Maximum Current: Maximum Voltage: Maximum Power:* Min. Switching Capacity:	 5A 125VDC/250VAC 175W/1250VA 10mA, 5VDC
Max Standoff Voltage: Initial Path Resistance, On: Path Resistance, Off:	400VDC <250mΩ $>10^9\Omega$
Bandwidth:	>20MHz
Operate Time:	10ms typical
Expected Life (operations) - resistive load Mechanical Life: At Max. Switch Capacity:	 $>5x10^7$ $>1x10^5$

* For variation of maximum hot switching capacity of voltage with current refer to plot.



40-650 Current/Voltage Curve



40-650 Current/Operating Life Curve

Power Requirements

+3.3V	+5V	+12V	-12V
0	360mA (280mA typ)	0	0

Mechanical Characteristics

Single slot 3U PXI (CompactPCI card).
3D models in a variety of popular file formats are available on request.

Connectors

PXI bus via 32-bit P1/J1 backplane connector.
Signals via a front panel 37-way male D-Type connector.

Product Order Codes

16-Channel Power Multiplexer, 2-Pole 40-650-002

Support Products

Spare Relay Kits

Kits of replacement relays are available for the majority of Pickering's PXI switching modules, simplifying servicing and reducing down-time. The relay kit for the 40-650 module is as follows:

91-100-052 kit for 40-650-002

For further assistance, please contact your local Pickering sales office.

Mating Connectors & Cabling

For connection accessories for the 40-650 module please refer to the **90-007D** 37-way D-type Connector Accessories data sheet where a complete list and documentation can be found for accessories, or refer to the Connection Solutions catalog.

Programming

Pickering provide kernel, IVI and VISA (NI and Agilent) drivers which are compatible with Windows XP/Vista and Windows 7 operating systems. 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:

- **National Instruments** products (LabVIEW, LabWindows/CVI, Switch Executive, MAX, TestStand, etc.)
- **Microsoft Visual Studio** products (Visual Basic, Visual C+)
- **Agilent** VEE
- **Mathworks** Matlab
- **Geotest** ATE Easy
- **MTQ Testsolutions** Tecap

Drivers for popular Linux distributions are available, other environments are also supported, please contact Pickering with specific enquiries.

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 33MHz 32-bit backplane interface.

Safety & CE Compliance

All modules are fully CE compliant and meet applicable EU directives: Low-voltage safety EN61010-1:2001, EMC Immunity EN61000-6-1:2001, Emissions EN55011:1998.

PXI & LXI Chassis Compatibility

Compatible with all chassis conforming to the 3U PXI and 3U cPCI specification. Compatible with Legacy and Hybrid peripheral slots in a 3U PXI Express chassis.

Compatible with Pickering Interfaces LXI Modular Switching chassis. For information on driving your switching solution in an LXI environment refer to the LXI Product Guide.



Latest Details

Please refer to our Web Site for Latest Product Details.

www.pickeringtest.com

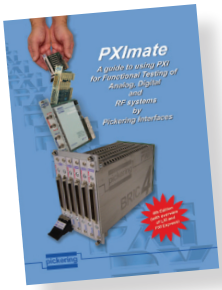


Please refer to the Pickering Interfaces "**Connection Solutions**" catalog for the full list of connector/cabling options, including drawings, photos and specifications. This is available in either print or as a download. Alternatively our web site has dynamically linked connector/cabling options, including pricing, for all Pickering PXI modules.



Refer to the "**PXI Product Guide**" for descriptions of Pickering Interfaces' comprehensive range of PXI switching and instrumentation modules, including specifications and product selection guides.

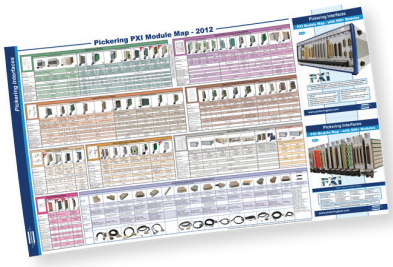
The Product Guide is available on request or can be downloaded from the Pickering website.



Ever wondered what PXI is all about?

Pickering Interfaces' "**PXImate**" Explains the basics of PXI and provides useful data for engineers working on switch based test systems.

The PXImate is available free on request from the Pickering website.



The "**PXI Module Map**" - a simple fold-out selection guide to all Pickering's 500+ PXI Modules.



"**The Big PXI Catalog**" gives full details of Pickering's entire range of PXI switch modules, instrument modules and support products.

At over 500 pages, the Big PXI Catalog is available on request or can be downloaded from the Pickering website.

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SECTION 2 - TECHNICAL DESCRIPTION

FUNCTIONAL DESCRIPTION

A functional block diagram is provided in Figure 2.1. The 16-Channel Power Multiplexer Module is powered by -12V, +5V and +12V inputs via Compact PCI connector J1. The interface to the user test equipment is via the front panel mounted 37-way D type connector, J2. The module comprises a PCB populated with 12V relays. The relays are energised via control signals from relay driver U8. The relay driver is addressed by PCI bridge U1, via the control logic, to output the required signal. Module configuration is determined by hardwired links and data stored in EEPROM U8. PCI Bridge U1 is configured by EEPROM U2.

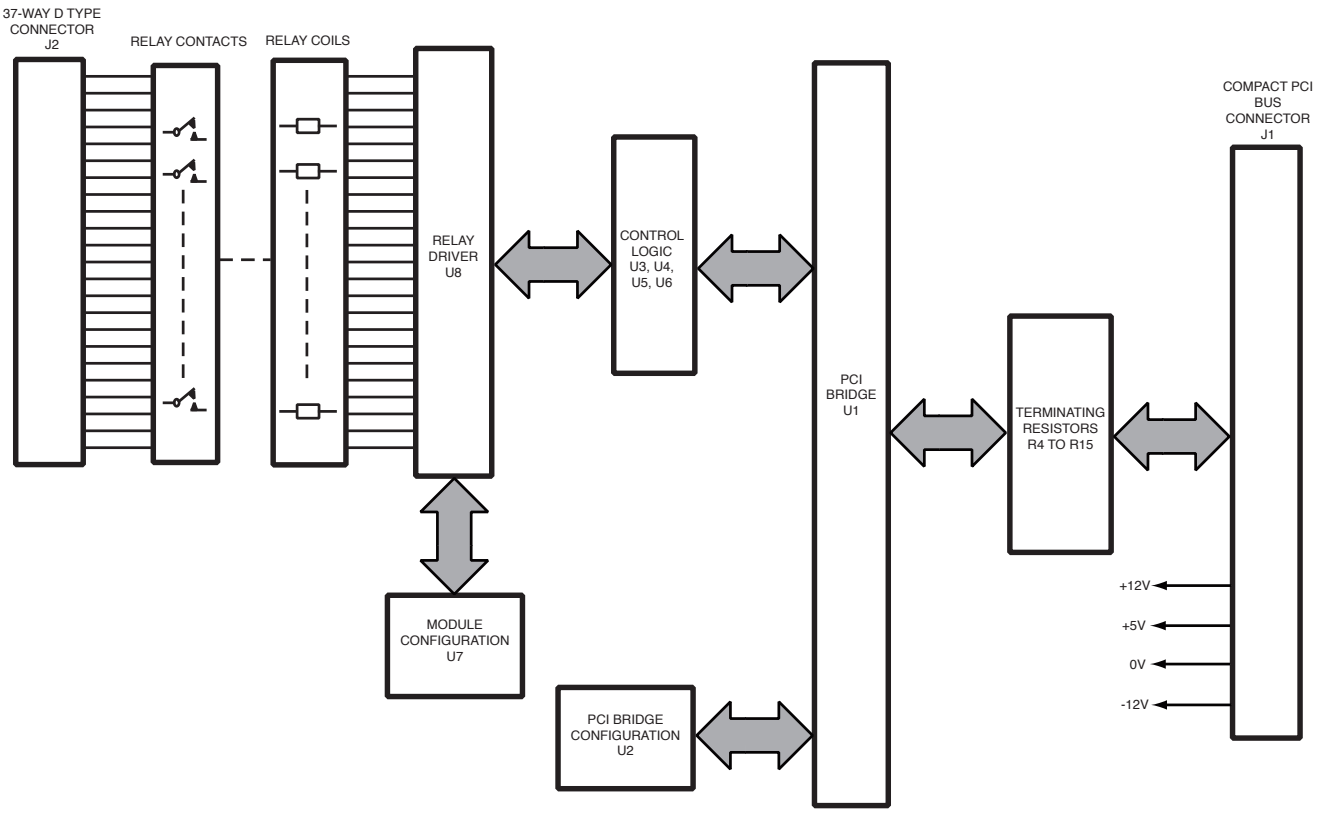


Figure 2.1 - 16-Channel Power Multiplexer Module (40-650): Functional Block Diagram

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SECTION 3 - INSTALLATION

HARDWARE INSTALLATION

CAUTION

Electrostatic discharge can damage the components on the module. To avoid such damage in handling the board, touch the anti-static bag to a metal part of the chassis before removing the board from the bag.

Ensure that there is adequate ventilation in accordance with the PXI Specification.

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.

WARNING: Do not raise the injector/ejector handle whilst inserting the module. The module will not insert properly unless the handle is in its downward position.

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. Screw the front panel of the module to the front panel mounting rail.
8. In a system employing MXI-3 to connect a desktop PC to a PXI chassis or to link multiple chassis, power-up the system as follows:
   a. For a system comprising a PC and one chassis, power up the chassis before powering up the PC.
   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 PC or chassis containing the system controller.
9. For Pickering Interfaces modular LXI installation there is no requirement to use any particular power up sequence.

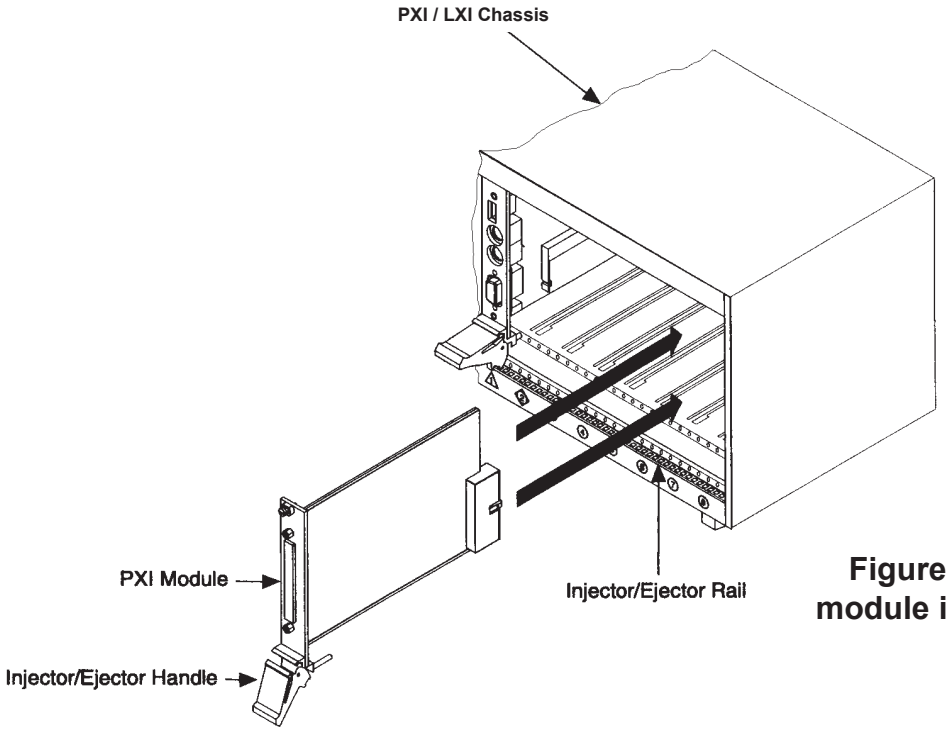


Figure 3.1 - Installing the module into a PXI / cPCI / LXI Chassis

SOFTWARE INSTALLATION

First install the appropriate Pickering PXI switch card drivers by running the installer program Setup.exe, either from the CD-ROM supplied, or by downloading the latest version from our website http://www.pickeringtest.com - the recommended method. There are different versions of the Setup program to suit different Windows versions and software environments. 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.

SECTION 4 - PROGRAMMING GUIDE

PROGRAMMING OPTIONS FOR PICKERING INTERFACES PXI CARDS

Software drivers are supplied for Microsoft Windows XP/Vista/7 operating systems, with specific support for the following development environments:

- Microsoft Visual Studio (VB, C++, C#)
- Borland C++
- National Instruments LabWindows/CVI
- National Instruments LabVIEW and LabVIEW RT

Windows drivers are supplied in the form of Dynamic Link Libraries, which should also be usable in any other development environment that supports them.

Some recent drivers developed for the LXI platform are capable of addressing both PXI and LXI domains. Such duality may be of help to users considering future migration from PXI based systems to LXI based systems, or indeed systems containing both PXI and LXI components.

Programming for PXI

A number of different Windows drivers are available to meet particular system requirements, and should none of these be suitable there is also the option of register-level programming. Drivers are generally ‘universal’, handling all models in the System 40, 45 and 50 ranges; however some models that are not compliant with the Ivi Swtch class cannot be used with the pi40iv IVI driver. The pipx40 and Pilpxi drivers are also applicable to certain models in the System 41 (PXI Instruments) range - see these drivers’ System 41 support list.

Please note that this documentation is available in its most up-to-date form as HTML help files, fully hyperlinked for easy access - both pipx40 and Pilpxi documents are included in the Pipx40vpp software installation.

IVI Driver for Windows - pi40iv

The pi40iv IVI (Interchangeable Virtual Instrument) driver supports all Pickering Interfaces PXI switch cards that are consistent with the Iviswtch class model - as are the great majority of cards in the System 40/45/50 ranges. It integrates well with LabWindows/CVI and LabVIEW, and is fully compatible with Switch Executive. It is also usable in general-purpose programming environments such as Visual C++ and Visual Basic.

Prior installation of the VISA and IviEngine from National Instruments are required for the correct installation and operation of this driver.

VISA Driver for Windows - pipx40

The pipx40 driver conforms to the VISA (Virtual Instrument Software Architecture) standard for programmable instrumentation. Instrument control environments such as LabVIEW and LabWindows/CVI are based on VISA, and pipx40 support libraries are provided for them.

Prior installation of VISA from National Instruments is required for the operation of this driver.

Where VISA is available, pipx40 can also be used in general-purpose programming environments such as Visual C++ and Visual Basic. When IVI is not a system requirement this driver will often yield faster operation than the pi40iv driver.

Direct I/ODriver for Windows - Pilpxi

The Pilpxi driver accesses cards directly, without using the VISA software layer, while offering similar overall functionality to pipx40. It is most commonly used in general-purpose programming environments such as Visual C++ and Visual Basic. Operating speed of the VISA and Direct I/O drivers is generally comparable.

Register-level Programming

Where the supplied drivers are not suitable, register-level programming can be employed - for example:

- If the functionality of the supplied drivers does not meet the application requirements
- If security considerations demand full source-code for the application
- In development environments that have alternate mechanisms for accessing PCI bus
- For operating systems other than Windows

Programming for LXI

When Pickering PXI cards are inserted into an LXI Modular Chassis a different set of drivers is available.

IVI Driver for Windows - pi40iv

The pi40iv IVI also supports LXI inserted cards simply by changing the resource string to address string to the appropriate address.

Direct I/ODriver for Windows - Piplx

The piplx driver is based on the PXI Direct IO driver pilpxi, but with added functionality to deal with the added need to address the chassis using an IP address. It integrates well with LabWindows/CVI and LabVIEW, and is fully compatible with Switch Executive. It is also usable in general-purpose programming environments such as Visual C++ and Visual Basic.

Please note that this driver may also be used in the PXI domain. If the addressed card is in the local computer PCI/PXI system, commands will be passed through to the PXI Direct IO driver. This mechanism allows the piplx driver to be used for both PXI and LXI cards.

The LXI format offers additional interface options not available in PXI :

.NET

A .NET native driver is also available. Once again this may be used for both LXI and PXI card control.

SOAP

Pickering LXI products include a SOAP interface which is usable from a wide variety of platforms and languages.

SSH

Pickering LXI products include an SSH interface which allows remote command line access to control cards, or, using a suitable package, programmatic control.

The user is advised to visit the Pickering web site for further details of all the above drivers, where documentation, example programs, and further help with driver choice are available.

LabVIEW, LabWindows/CVI and Switch Executive are trademarks of National Instruments Corporation.

General Pickering Card Architecture

With most drivers, before programming a Pickering card it is important to understand the basic architecture of Pickering cards.

The switches on a Pickering card are organized into logical sub-units, each sub-unit containing a set of objects of similar type and use. These objects may be switches, digital outputs, digital inputs, resistors, power supplies etc, depending on the nature of the specific card.

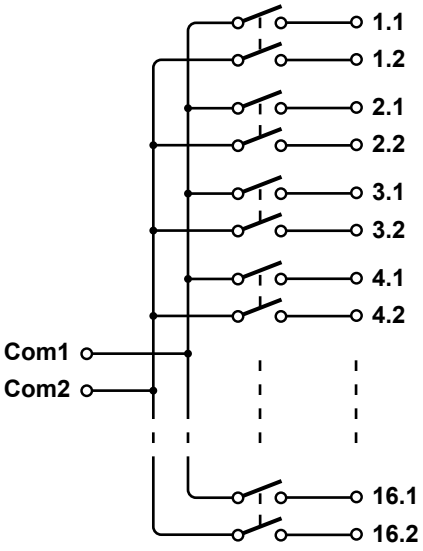
For example a simple matrix card will usually contain a single sub-unit containing the switches arranged in a 2-dimensional array. However a similar card with additional isolating relays connected to the matrix will contain additional sub-units containing those isolation relays.

Low level drivers include functions to allow the programmer to query the card to ascertain the number of sub-units, and the size and type of each sub-unit.

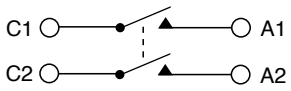
For full details of the driver functions available the programmer should refer to the documentation provided.

MODULE ARCHITECTURE 40-650: POWER MULTIPLEXER MODULE

The 40-650 Power Multiplexer Module utilises an array of 16 DPST relays. In the default state all relays are open circuit. Energising a particular relay creates a signal path between the common terminals and the corresponding channel terminals. The multiplexer module's switching architecture is shown in the diagram below:



40-650-002 16 Channel Power Multiplexer Module



DPST Relay Connections

The Sub-units used to control the module's relays are detailed in the following tables. Enabling a particular bit closes the C to A signal paths of the associated relay resulting in 2 electrical connections.

TABLE 4.1 - Multiplexer Module 40-650-002: Sub-units

Sub-unit Cross Reference			
Sub-unit	**Bit**	**Signal Path with relay energised**	**Relay**
1	1	1.1 to com1 and 1.2 to com2	RL10
	2	2.1 to com1 and 2.2 to com2	RL16
	3	3.1 to com1 and 3.2 to com2	RL9
	4	4.1 to com1 and 4.2 to com2	RL15
	5	5.1 to com1 and 5.2 to com2	RL8
	6	6.1 to com1 and 6.2 to com2	RL14
	7	7.1 to com1 and 7.2 to com2	RL7
	8	8.1 to com1 and 8.2 to com2	RL13
	9	9.1 to com1 and 9.2 to com2	RL6
	10	10.1 to com1 and 10.2 to com2	RL12
	11	11.1 to com1 and 11.2 to com2	RL5
	12	12.1 to com1 and 12.2 to com2	RL11
	13	13.1 to com1 and 13.2 to com2	RL1
	14	14.1 to com1 and 14.2 to com2	RL2
	15	15.1 to com1 and 15.2 to com2	RL3
	16	16.1 to com1 and 16.2 to com2	RL4

PROGRAMMING THE MODULE 40-650

Here are some simple examples of using the drivers with the 40-650 Power Multiplexer module.

Using PILPXI

To operate a relay the user could use the simple OpBit command or the WriteSub commands

OpBit

```
DWORD sub_unit = 1;
PIL_OpBit( card_num, sub_unit, 1, 1);   // Connects ch1.1 to com1 and ch1.2 to com2
PIL_OpBit( card_num, sub_unit, 1, 0);   // Disconnects ch1.1 from com1 and
                                                    ch1.2 from com2
PIL_OpBit( card_num, sub_unit, 3, 1);   // Connects ch3.1 to com1 and ch3.2 to com2
```

WriteSub

```
// Sub-unit is 16 bits wide, so 1 DWORD is needed to hold the pattern
DWORD data[1];
data[0] = 1;            // Sets lowest bit to 1, ch1.1 to com1 and ch1.2 to com2
PIL_WriteSub( card_num, sub_unit, data);
data[0] = 0x4;          // Sets 3rd bit, ch3.1 to com1 and ch3.2 to com2
                        // All other relays are set to off
PIL_WriteSub( card_num, sub_unit, data);
```

Using PIPX40

setChannelState

```
ViUInt32 sub_unit = 1;
pipx40_setChannelState(vi, sub_unit, 1, VI_ON);     // Connects ch1.1 to com1 etc
pipx40_setChannelState(vi, sub_unit, 1, VI_OFF);    // Disconnects ch1.1 from com1 etc
pipx40_setChannelState(vi, sub_unit, 3, VI_ON);     // Connects ch3.1 to com1 etc
```

setChannelPattern

```
// Sub-unit is 16 bits wide, so 1 ViUInt32 value is needed to hold the entire pattern
ViUInt32 data[1];
data[0] = 1;            // Sets lowest bit to 1, ch1.1 to com1 and ch1.2 to com2
pipx40_setChannelPattern( vi, sub_unit, data);
data[0] = 0x4;          // Sets 3rd bit, ch3.1 to com1 and ch3.2 to com2
                        // All other relays are set to off
pipx40_setChannelPattern( vi, sub_unit, data);
```

Using pi40iv

The IVI driver treats the multiplexer as an array of switches labelling the channels using the normal com/ch labelling tags.

```
pi40iv_Connect(vi, com, ch1);       // Connects ch1.1 to com1 and ch1.2 to com2
pi40iv_Disconnect(vi, com, ch1);    // Disconnects ch1.1 from com1 etc
pi40iv_Connect(vi, com, ch3);       // Connects ch3.1 to com1 and ch3.2 to com2
```

The IVI Switch driver specification contains no bulk setting capabilities.

SECTION 5 - CONNECTOR INFORMATION

Figure 5.1 provides Pin-Outs for the 16-Channel Power Multiplexer Module.

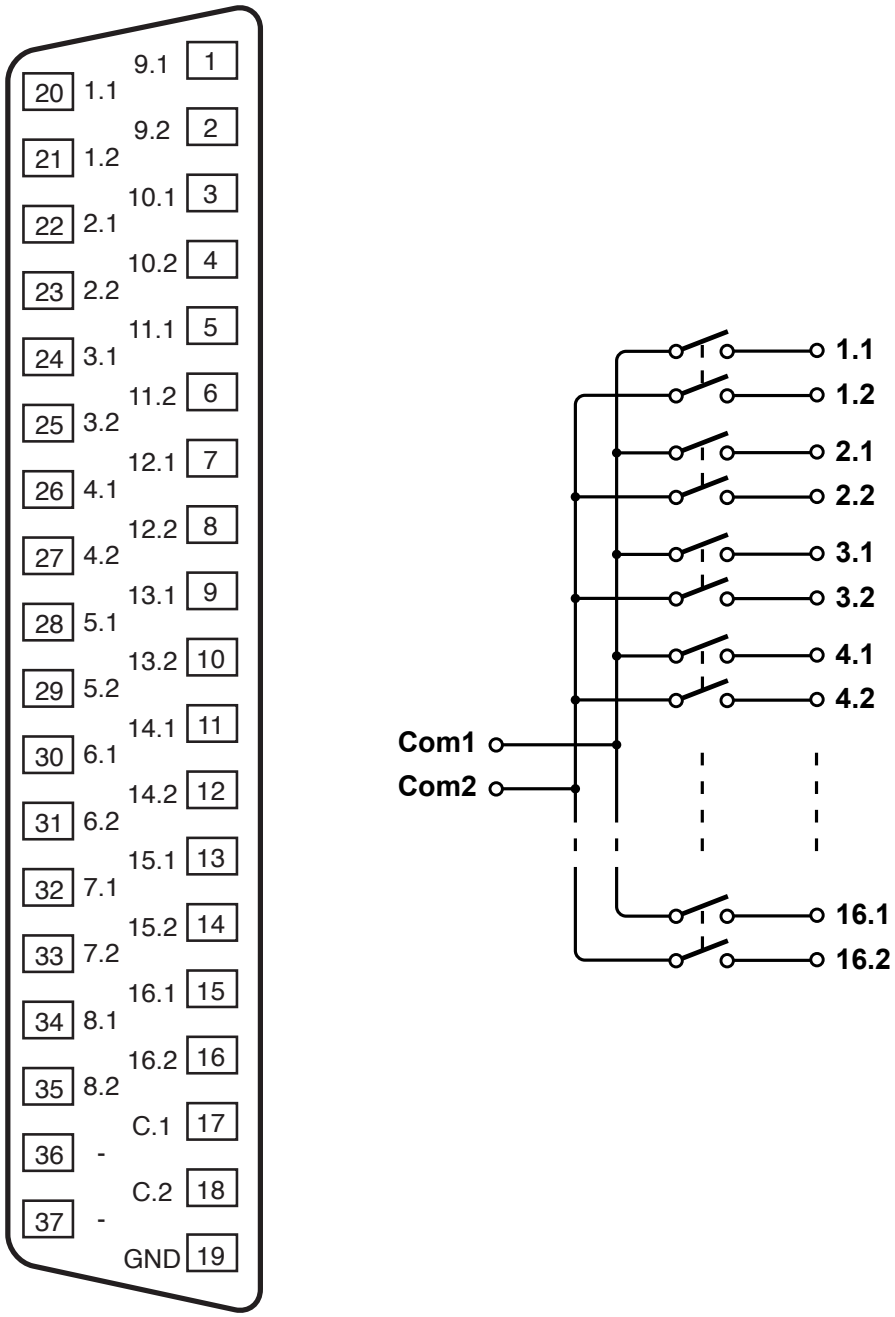


Figure 5.1 - 16-Channel Power Multiplexer Module 40-650: Pin-Outs

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SECTION 6 - TROUBLESHOOTING

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 MXI-3 you should check the integrity of all MXI-3 links. When the system is powered up, and during Windows start-up, you should expect to see periodic activity on the MXI-3 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 it's 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

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 www.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 60-102 and 60-103) 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.

RELAY LOOK-UP TABLES

The following pages provide a cross reference between the signal paths of the Power Multiplexer Module and the physical relays on the PCB. The tables can be used in the fault finding process and should be used in conjunction with the corresponding PCB layout diagram to identify the position of faulty relays.

TABLE 7.1 - Multiplexer Module 40-650-002: Relay Numbering Single 16 Channel 2 Pole

Switch Function / Relay Cross Reference (Daughterboard)		
Bank	**Channel**	**Relay**
1	13	RL1
	14	RL2
	15	RL3
	16	RL4
	11	RL5
	9	RL6
	7	RL7
	5	RL8
	3	RL9
	1	RL10
	12	RL11
	10	RL12
	8	RL13
	6	RL14
	4	RL15
	2	RL16

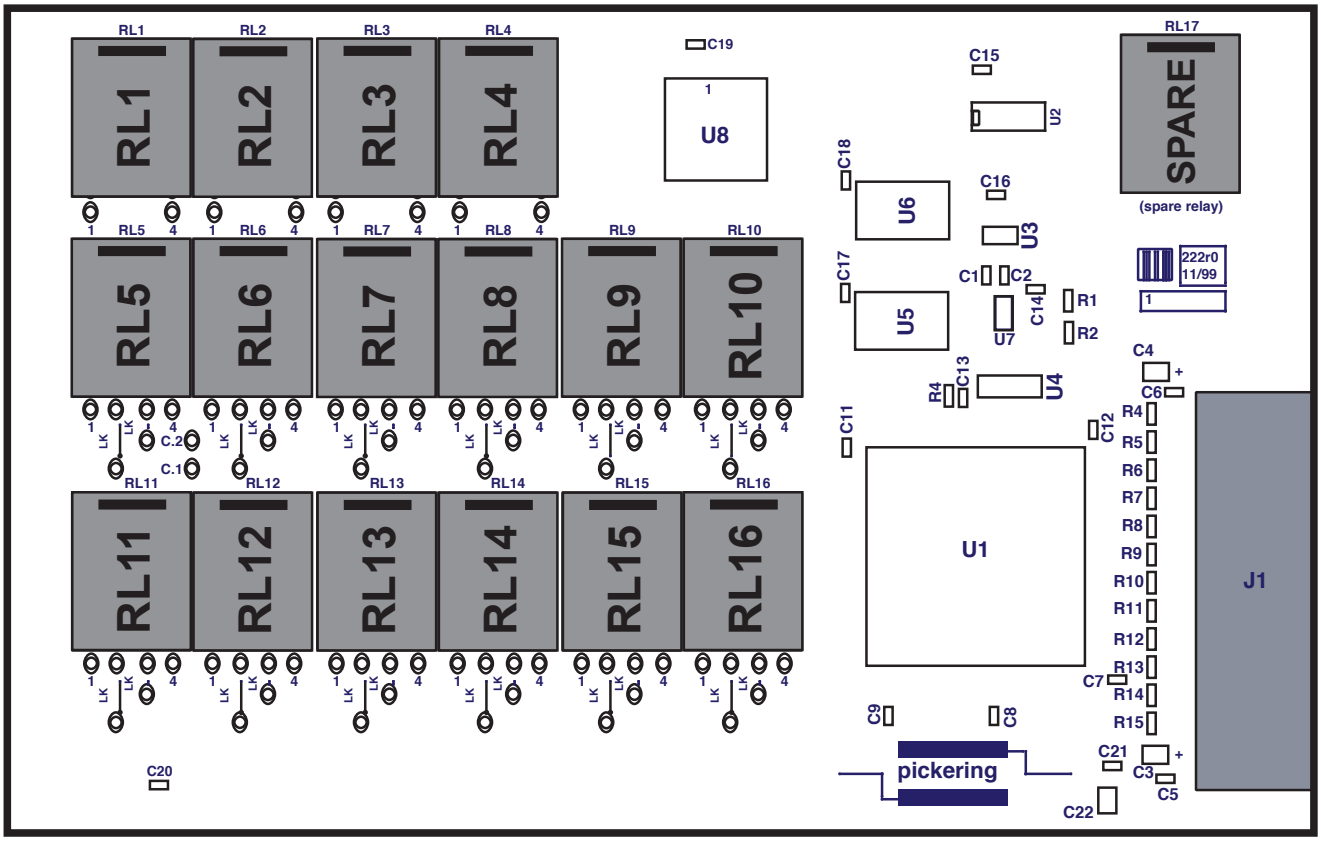


Figure 7.1 - Multiplexer Module: 40-650-002 Component Layout

SECTION 8 - 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.



WARNING - DANGER OF ELECTRIC SHOCK

THIS MODULE MAY CONTAIN HAZARDOUS VOLTAGES. BEFORE REMOVING THE MODULE FROM THE RACK REMOVE ALL SUPPLIES.



CAUTION – Handling of Electrostatic-Sensitive Semiconductor 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-units containing these devices:

1. Persons removing sub-units from an 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.

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