

Pickering Interfaces

PXI Solutions for Hardware-in-the-Loop
Fault Insertion & Sensor Emulation



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Pickering: "Serious About Test & Validation"

Automotive & Aerospace have the toughest electronic testing requirements of any industries. Products must deliver the highest levels of technology but function in vibration and temperature ranges that challenge their designers. Add to this the requirements for the highest reliability in certain safety features of the vehicle, plus deliver the technology at competitive prices, and you have a daunting task in terms of verification.



About Pickering Interfaces

Pickering Interfaces understands these testing challenges. For over 20 years, we have been designing and manufacturing commercial and custom switching systems, as well as instrumentation for a wide range of diverse Functional Test and Hardware-In-The-Loop Simulation applications. Pickering's capabilities and expertise are the reasons why major Automotive companies including TRW, Yazaki, Delphi, Lear, BMW, Caterpillar, Magneti Marelli, Autoliv, Robert Bosch, Renault, Peugeot, VDO, Blaupunkt, Hella, Valeo, Continental Automotive, Kostal, Johnson Controls, VTI and Stoneridge specify Pickering PXI products for Automotive Functional Test. The same reasons have convinced major Aerospace companies like Lockheed Martin, Boeing, Northrop Grumman, Honeywell, TRW, Orbital Sciences, Rockwell Collins, BAe Systems, EADS, Astrium, Saab, Goodrich, GE Aviation, Ball Aerospace, Raytheon, General Dynamics, Parker Hannifin, Embraer, Airbus, Cessna, General Atomics, NASA, Hamilton Sundstrand and Rosemount Aerospace to select our products.

Pickering Interfaces offers the largest range of switching products available in PXI from a single supplier. With over 500 different switching modules in PXI alone, the chances are we have exactly what you need without any compromises. Our offerings vary from the world's highest density switching matrix (the integrated BRIC™ modules), RF, high current (to 40Amps) and optical switching products, through to switch simulators, fault insertion, strain gauge and resistor networks for hardware simulation applications.

Pickering products have gained a reputation for providing excellent reliability and value. We manufacture some of the world's smallest reed relays, providing our customers with unrivaled switching density and performance. Our Engineering Development team is always looking at new ways to make our switching modules smaller, more reliable, and electrically more capable.

Our PXI instrumentation is designed to address applications in the market that need special requirements, e.g.. our Automotive Communications module supports most major Automotive protocols and physical layer interfaces and offers the highest channel density (up to 10) in a single 3U PXI module.

Pickering also recognizes that the most capable switching and instrumentation is not readily usable if you can't easily integrate the products into your test systems. That's why Pickering has the largest selection of standard cables and connectors in the industry. We can also custom design cables for your applications and we have strong relationships with Virginia Panel and MacPanel to address your ITA requirements.

The bottom line – we make it easy for you to select the right products for your applications and integrate them into your test strategy.



Pickering & PXI

What is PXI?

PXI (PCI eXtensions for Instrumentation) defines a rugged PC platform for measurement and instrumentation. PXI modular instrumentation leverages the high-speed PCI (Peripheral Component Interconnect) Bus which is the de facto standard driving today's desktop computer software and hardware designs. As a result, PXI users can enjoy all the benefits of PCI within an architecture that supports mechanical, electrical, and software features that make sense for test and measurement, data acquisition, and industrial computing applications. PXI is very expandable: multi-function cards from a number of vendors allow special purpose systems to be constructed quickly to perform almost any control/monitoring function.

Currently, around 60 companies worldwide are members of the PXI Systems Alliance and share a common commitment to providing an open platform equipped for a variety of applications, from machine control to automated test. Growth of PXI modules has been rapid since the adoption of the PXI standard in 1997, and today more than 1500 PXI products are available.



Why use PXI?

The PXI architecture easily addresses the needs of today's Electronics Industries for fast, reliable, low cost Functional Test. The compact design allows for small footprint test systems, saving valuable manufacturing floor space. The use of the Windows software platform as a baseline makes the test engineer's job of systems integration and test program development simpler as the software tools are well recognized. The PXI Systems Alliance verifies their members' adherence to specifications so that product interoperability is assured. As a result, PXI has now been deployed in a tremendous variety of applications, from machine control to automated test. PXI has been deployed in virtually every test application in Aerospace and Automotive testing.



What do we do in PXI?

We were an early adopter of the PXI standard and have actively contributed to it through our Sponsor membership of the PXI Systems Alliance (www.pxisa.org).

Through the introduction of a series of ground breaking products we have established ourselves as the leading player in PXI switching, providing modules that offer the highest densities of switching available from any PXI vendor. Our huge range of PXI switch modules also includes the world's highest voltage, current and frequency PXI cards, as well as RF, Microwave and Optical switches.

To complement our switch modules, we have a comprehensive range of PXI chassis, instruments and accessories, enabling us to supply fully integrated PXI hardware platforms.



Whose fault is it when ECUs go wrong?

Electronic Control Units (ECUs) are ubiquitous in today's Automotive and Aerospace industries and are increasingly being used in safety-critical applications that demand the highest reliability in environments where undesirable behavior cannot be tolerated - the failure of an ECU to act in an appropriate manner under emergency conditions could pose a threat to life and/or property. Ensuring these demands are unconditionally met requires significant investment in test procedures and documentation.

An ECU relies on information from a set of sensors and controls to decide what to do with the device it is managing. These sensors are themselves often working in extremely hostile environments (e.g. car or jet engines) and predictably failures can occur in the sensors or their interconnections. The ECU has to respond appropriately to these component failures as well as to genuine system faults. A jet engine needs to shut down if it catches on fire, but should not shut down if it is clear there is a sensor fault.

Another example of an ECU operating in a hostile environment is the automotive Powertrain Control Modules (PCMs). The PCM is one of the most complex controllers in the modern vehicle and therefore requires rigorous testing of its functionality. The consequences of PCM failure have greater significance in X-by-Wire applications (a collective term for the addition of electronic systems into a vehicle to enhance and replace tasks that were previously accomplished via mechanical and hydraulic systems such as braking or steering), placing increased importance upon these test methods.

Fault Insertion Testing

Due to the high level of sophistication and complexity of today's ECU devices, special test methods are required. The idea of testing for system failures is not new – it is an important aspect of ECU validation and involves the introduction of electrical faults into a system. The test process typically duplicates various conditions which could occur because of corrosion, short/open circuits and other electrical failures inherited through age, damage or even faulty installation.

Typically, ECUs under development are exercised by a test system which simulates the device that the unit will control – this is sometimes called a Hardware-in-the-Loop (HIL) simulation. Stimulus instrumentation which simulates, for example, engine behavior is connected and controlled either by manual operation or computer, with measurement instrumentation used to capture analog and digital responses from the ECU. When it is necessary to inject faults, traditionally a patch panel such as that shown in Figure 1 has often been used

The various cables shown are used to connect any input/output (I/O) line of an ECU to stimulus or measurement instrumentation. The I/O lines may be manually disconnected to simulate an open-circuit or tied together to simulate short-circuits and the results measured. This type of solution has many inherent disadvantages, not least being size. There are also many hidden costs such as on-going maintenance issues, the need for significant knowledge on the part of the operator, potential human error and the cost of labor required to execute the test and record results.

Another major disadvantage of any manual method is the lack of repeatability. The ability to quickly reproduce a failed test condition is essential in a test system, either to aid development or to take corrective action. Being able to precisely reproduce the test procedure quickly is a major advantage in any upgrade or verification program.

The ability to gain software control of both instrument routing and the insertion of real-time electrical faults enhances both the testing process and the recording of the outcome. However, although a standard crosspoint matrix with an adequate specification is capable of handling the instrument routing to the device under test, the insertion of faults requires a specific switching architecture.



Figure 1

Using a Patch Panel to insert faults into a test system

Modular Fault Insertion Solutions

Pickering Interfaces, a global leader in modular switching, has over the last 7 years built up a comprehensive range of PXI Fault Insertion Unit (FIU) switch products. These are scalable solutions which may be used to switch signals between simulations and real-life devices in a multitude of HIL simulation and test systems. The FIUs can help to considerably simplify and accelerate the testing, diagnosis and integration work in HIL applications. The following are some of the most common fault insertion architectures. based on examples of Pickering Interfaces' FIUs:

Single Fault Bus Architecture

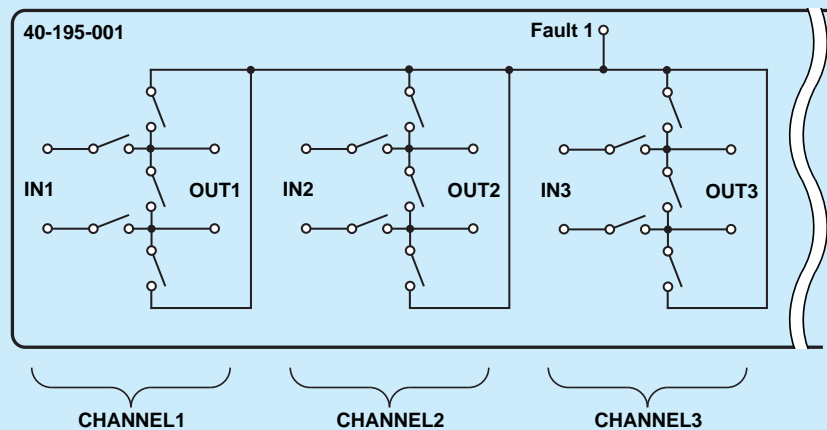


Figure 2 - Single Fault Bus Architecture

This architecture shown in Figure 2 is used on our 40-195 and 40-196 FIUs, in these two cases the input connections are grouped in pairs and then multiple pairs have a connection allowed to a single fault bus. Using this architecture a variety of faults can be simulated

- Either input connection disconnected from its output
- Input connection pair shorted together
- Either input connected to the fault bus

The fault bus could be a power supply, system ground or some other connection in the system. If more than one fault bus condition is required to be simulated then additional (external) switching has to be used to expand the possibilities, or a different architecture used.

Multiple Fault Bus Architecture

This architecture shown in Figure 3 provides greater flexibility and is used in a variety of our FIUs, including the 40-190, 40-190B, 40-191, 40-192, 40-193, 40-194 and 40-197 modules. Using this architecture a variety of faults can be simulated:

- * Any input disconnected from its output
- * Any output connected to one of two fault buses
- * Any output shorted to any other output if the fault bus is disconnected.

In the architecture used by the 40-190 series the fault bus can be disconnected or can be connected to any of four fault conditions, which allows the bus to connect ground, a power supply, or some other condition. As the connections are made with SPST switches setting them all open will allow the fault bus to be disconnected and permit a short between two signals to be created by closing two relays.

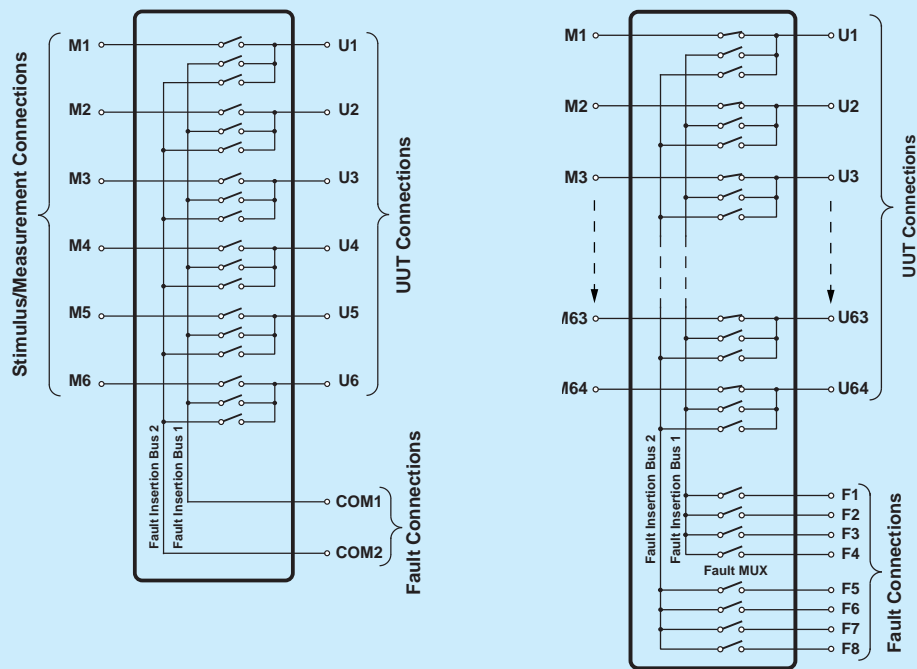


Figure 3 - Multiple Fault Bus Architecture

Fault Insertion Matrix

The 40-592 and 40-595 provides a more complex architecture that can be used in a variety of ways for complex tests.

The common way of using the fault matrix, shown in Figure 4, is for the connection between the controller and the sensor to be on the X axis. A connection from an input (for example) is made to X1.1 and its output from X1.2. In this example the default condition is for a connection to be made by the normally closed relay. Much more complex faults can be introduced:

- Open circuit between input and output
- Fault on the output to X1.2, which could be component inserted by a patch panel arrangement.
- Connection of any input to one of four fault buses (Y1 to Y4)
- Connection of any output to one of of four fault buses (Y5 to Y8)
- Short circuits between wires by using an unused X column to provide the short on an unused Y row
- Addition of other shunt components between wires using Y axis.

The variety of fault types that be simulated is large, and the third connection on each X axis adds a great deal more flexibility. This approach is much more complex and costly and is more likely to be used in, for example, Aerospace applications than Automotive for that reason.



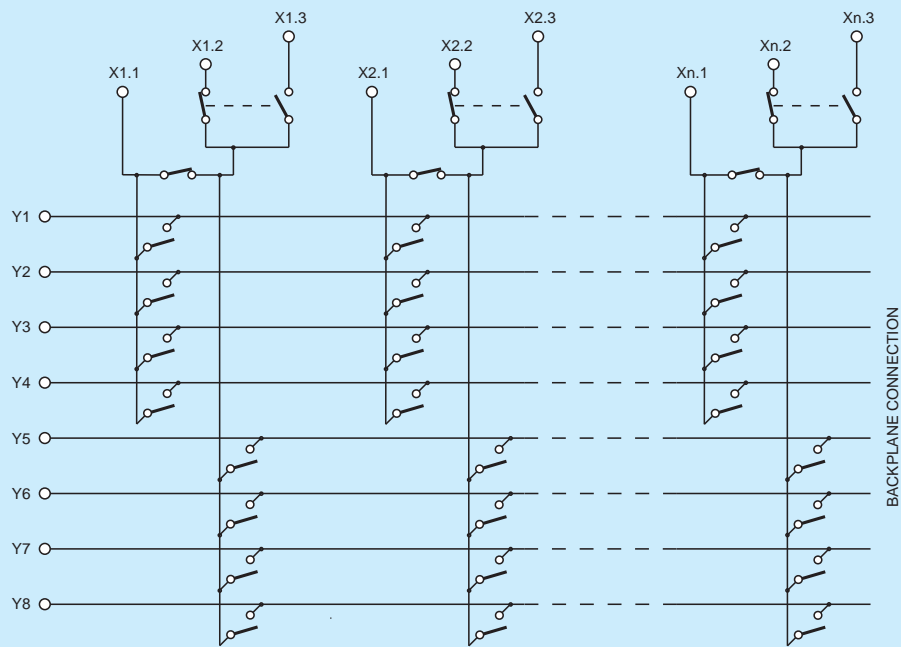


Figure 4 - Fault Insertion Matrix

The Pickering FIUs are compatible with the widely adopted PXI (PCI eXtensions for Instrumentation) standard, a multi-vendor open architecture for Test & Measurement systems. Pickering FIUs are available in a wide range of channel counts and fault bus configurations, with current handling capabilities from 1A to 30A – two example modules are shown in Figure 5.



Figure 5 - PXI Fault Insertion Modules

Figure 6 shows a high channel count automotive ECU validation system based on Pickering FIUs.

Figure 6 - PXI-based Fault Insertion System
(photo by courtesy of Clemessy)



Sensor Simulation

An ECU relies on information from a number of different sensors to monitor the equipment it is controlling – these may include measurements of temperature, strain, distance, etc. A HIL system employed to test the ECU needs to simulate the behaviour of these sensors as accurately as possible to ensure that the ECU behaves on the test bench exactly as it would when operating in the real-world. To help test system designers achieve these goals, Pickering has developed a range of PXI Programmable Resistor modules that feature multiple resistance channels with very high setting resolution (up to 2 milliohm) and excellent stability and accuracy. These modules are ideal for the simulation of resistive sensors with very fine adjustment, and they have the additional capability of being set as open and short circuit to simulate faults in the sensor connections to the ECU. Specific versions of the modules have been developed to simulate RTD's (Resistance Temperature Devices) and Strain Gauges.



High Density PXI Programmable Resistor Modules

In addition to these FIU Switch and Sensor Simulation products, Pickering has a comprehensive range of supporting products for PXI-based Test & Validation systems as follows:

Switch Simulation

An important test of Automotive ECUs is to see if the inputs respond to switches that are dirty and do not present a normal open/closed resistance. The Pickering Switch Simulation Module is designed to simulate the operation of automotive switches where dirty contacts or leaking current can be expected from switch contamination. It allows automotive I/O devices to be tested for correct operation under adverse conditions.

Digital I/O

An expanding range of digital I/O modules allows users to interface directly with high current loads such as solenoid coils. Our modules have fully protected outputs that can withstand high current and voltage surges without damage and include thermal protection that ensures that even long term connection to a faulty load will not cause instrumentation damage. Our digital inputs feature adjustable dual thresholds that allow users to easily establish if a digital input is in a low, high or indeterminate state. Their high input voltage capacity makes them an excellent choice for monitoring systems working from high voltage power supplies commonly found in aerospace applications.



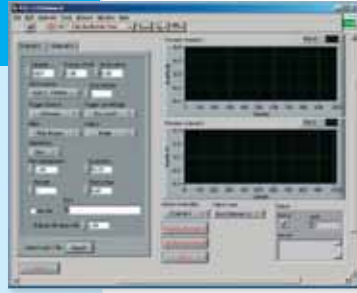
Automotive Switch Simulators,
from 8 to 32 per Module



Digital Input/Output Module

Signal Conditioning

Most PXI signal/arbitrary waveform generators lack the amplitude necessary to drive signals that simulate peripherals. Typically, additional circuitry needs to be added to the test fixture to amplify the output of the instrument. Pickering's 41-650 features multi-channel, gain selectable amplifiers that work with many instruments including the 41-620 Function Generator. The 41-660 Attenuator features selectable input ranges that accept up to 600 volt waveforms.



41-650
Soft Front Panel



5 Channel High Voltage Amplifier, 41-650 and 10 Channel High Voltage Attenuator, 41-660

Communication Protocols

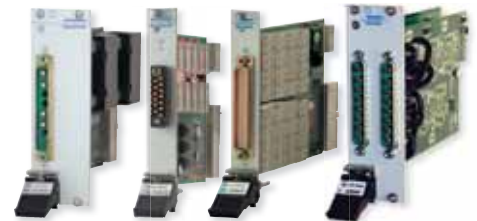
ECUs communicate with other system components for functionality, diagnostics and human interface via one or more serial bus channels. Pickering Interfaces has partnered with industry expert Ballard Technology to offer a family of products which take avionics databus interfaces to the highest level of flexibility and power. These modules support high channel counts of single or multiple protocols. In addition, our Automotive Communications module can support up to 10 CAN channels as well as other Automotive protocols and physical layer interfaces.



Avionics Databus Module

Load Management

The testing and verification of electrical and electronic systems often requires the connection of high current loads to the Unit Under Test. Pickering provides a wide range of switch Modules that can support up to 40 Amp load switching within a PXI chassis. For higher current requirements, our Relay Driver modules allow the test system to control external relays.



General Purpose Switch Modules

Environmental Testing

Testing of complex systems in an environmental chamber requires sharing the external instrumentation/ resources to stimulate and collect data from the UUT's over the cycles of the test. The Pickering BRIC™ matrix module can provide over 4,400 cross-points in 8 PXI slots with configurations up to 552 x 8 and 1104 x 4.



BRIC High-density Switch Matrix

RF and Microwave

Pickering offers an extensive range of RF switching products, with PXI solutions ranging from 300MHz high density modules through to high performance 3GHz multiplexers, solid state and microwave switches to 65GHz. We also offer a programmable attenuator from DC to 3GHz with an attenuation depth of 63dB in 1 dB steps.



PXI RF Switches

Accessories

Pickering Interfaces understands that just providing switching and instrumentation modules is not enough - users need to be provided with fast and effective ways of connecting their investment to the device under test. The modules in the Pickering Interfaces PXI and LXI families are fully supported by a comprehensive range of connector and cable accessories. The accessories are detailed in the 176 page Connection Solutions Catalog available in paper or downloadable format at www.pickeringtest.com/interconnections. The catalog is cross-referenced to all our module front-panel connectors making it easy for users to find the perfect accessories to complement their chosen products.



Fault Insertion Switch Modules

- Designed For Fault Insertion Applications
- Breakout Connections For Wiring to Sensors
- Choice of Channel Counts and Switch Configurations
- Solid State Relay Versions For Current Handling up to 30 Amps
- Kernel, VISA and IVI Support For PXI Environments
- Kernel and IVI Support For LXI Environments
- Suitable for Real Time Applications
- Complies with PXI and CompactPCI Specifications

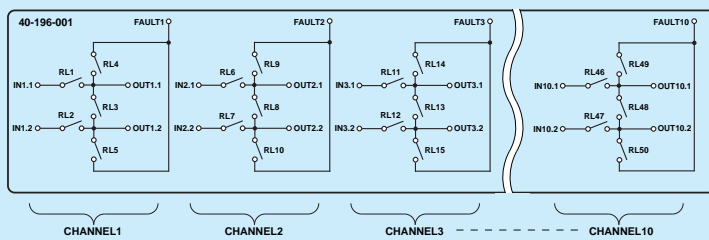
The Fault Insertion switches are designed specifically for safety critical applications where the response of a control system is required to be evaluated when sensor connections behave in unexpected ways.

These switch modules feature a breakout arrangement that allows faults to be attached to the sensor lines. This includes the breaking of a connection or the adding of a defect – all of which can simulate connectivity problems in the system. Two switching topologies are available; The first has single signal paths with series switches and switches to connect to one or more fault buses. The second has pairs of signals with series switches, shorting switches between the signal pairs and switches to connect either signal to an external fault input.

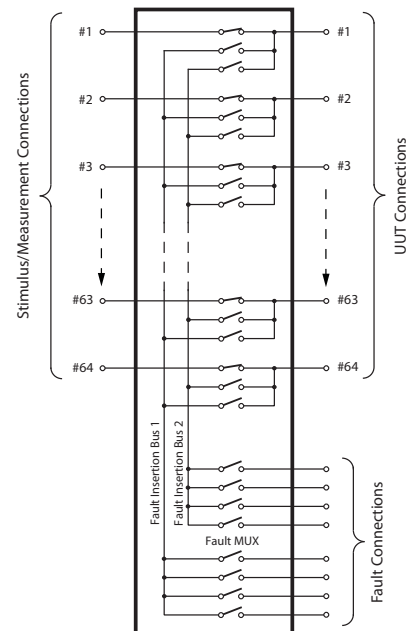
Fault insertion switches based on electro-mechanical relays are available with current handling up to 20A. Versions with solid state relays can handle up to 30A. For applications that require fault insertion switching on a larger scale, Pickering's BRIC base fault insertion matrices provide an ideal solution.

All the connectors used by these modules are supported by a comprehensive range of cable and connector accessories.

For more detailed information on each module please refer to the individual data sheets or visit our web site at: www.pickeringtest.com



40-196 Fault Insertion Switch with signal pairs and separate fault inputs



40-190 Fault Insertion Switch with two fault buses

Pickering's Range of PXI Fault Insertion Switches					
Model No.	Signal Channels	Fault Buses	Fault Inputs	Max Voltage	Max Current
40-190B	74, 64 or 32	1 or 2	4 or 8	165V	2A
40-191	6	2	2	40V	30A
40-192	6	2	2	200V	10A
40-193	7	1 or 2	1 or 2	16V	20A, 1A min
40-194	7	1 or 2	1 or 2	16V	20A, no min
40-195	22 or 11 pairs	—	8 or 4	150V	1A
40-196	10 or 5 pairs	—	10 or 5	110V	5A
40-197	34 or 16	4	8	300V	2A
40-198	20	1 or 2	3 or 6	250V	5A
40-199	10	1 or 2	2	250V	10A

Fault Insertion Matrix Modules

- **Designed For Fault Insertion Applications**
- **Breakout Connections For Wiring to Sensors**
- **Pickering BRIC™ Architecture Provides Scalable Matrix Size**
- **Wide Range of Matrix Sizes**
- **Partially Populated Configurations Available**
- **Ruthenium Reed Relay Versions For Maximum Signal Performance**
- **Electro-mechanical Relay Versions For Current Handling up to 10 Amps**
- **Occupy 4 or 8 3U PXI Slots**
- **Kernel, VISA and IVI Support For PXI Environments**
- **Kernel and IVI Support For LXI Environments**
- **Suitable for Real Time Applications**
- **Complies with PXI and CompactPCI Specifications**



40-592A BRIC8 FIBO Matrix Module

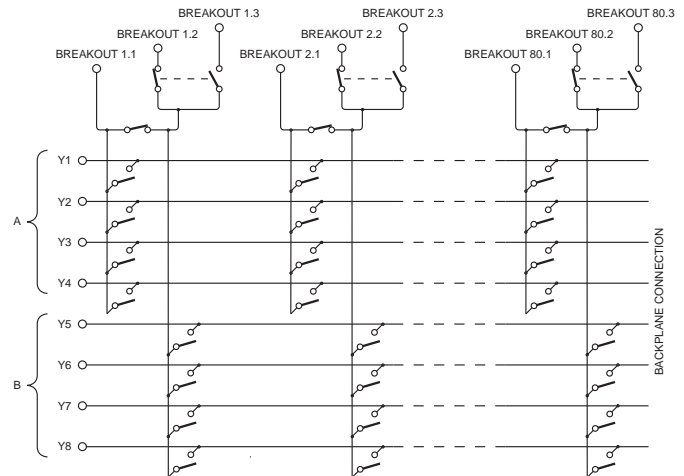
The Fault Insertion matrices are designed specifically for safety critical applications where the response of a control system is required to be evaluated when sensor connections behave in unexpected ways. This is particularly important in safety critical applications, such as automotive and aeronautical systems, where unexpected controller behavior could result in loss of life or substantial asset loss.

All these matrices feature a breakout arrangement that allows faults to be attached to the sensor lines via the Y axis. This includes the breaking of a connection or the adding of a series defect – all of which can simulate connectivity problems in the system. The three pin breakout versions allow the connection to be swapped for a “bad” sensor simulation.

The use of a programmable matrix for fault insertion ensures testing is fast to perform and can be reproduced on subsequent test cycles in the event of corrective action or a system upgrade.

All reed relay matrices use high quality sputtered ruthenium relays that exhibit excellent contact performance under low and medium level switching conditions. For applications that require fault insertion in power circuits and current handling up to 10A, Pickering’s matrices based on electromechanical relays provide an ideal solution.

The matrix design is based on Pickering’s proven BRIC architecture that allows the matrix size required for an application to be selected from the many versions available. Also, any FIBO matrix is available



in partially populated configurations giving a cost effective solution for specific applications. Please consult the sales office for details.

Connectors used are fully supported by Pickering’s accessory range of cables.

For more detailed information on each module please refer to the individual data sheets or visit our web site at: www.pickeringtest.com

Minimum Matrix Size	Maximum Matrix Size	Matrix Configuration	Relay Type	Maximum Switch Voltage	Maximum Power	Max Carry (Switch) Current	Number of Slots	Order Code
Dual 31 x 4	Dual 124 x 4	2-Pin Breakout	Sputtered Ruthenium Reed	150V DC 100V AC	20W	1.2A (1.0A)	4	40-592A-0XX
	Dual 248 x 4						8	40-592A-1XX
Dual 20 x 4	Dual 80 x 4	3-Pin Breakout					4	40-592A-00X
	Dual 160 x 4						8	40-592A-10X
Dual 6 x 4	Dual 30 x 4		Electro-mechanical	125V DC 250V AC	300W †	10A (10A) †	8	40-595A-0XX

† The power and current figures shown are for the matrix crosspoints, the breakout contacts are rated at 240W and 8A.

Programmable Resistor Modules

- Versatile Range of Resistor Modules Including Programmable Resistors and Potentiometers
- Fully Programmable Versions With Resolution of Up to 24-bit
- Resistance Range From 0 to 16MΩ
- Low Cost Fixed Value Selectable Resistor Versions With User Defined Values
- All Versions Use High Reliability Pickering Ruthenium Reed Relays
- Occupy Single 3U PXI Slot
- VISA and Kernel Support For PXI Environments
- Suitable for Real Time Applications
- Complies with PXI and CompactPCI Specifications

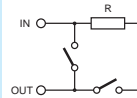
The range of programmable resistor modules includes fully programmable resistor and potentiometer modules for applications that require fine adjustment with a resolution of up to 24-bit. Also in the range are selectable resistor and potentiometer modules. These consist of fixed resistor values pre-defined by the user which can be switched in and out of circuit with reed relays.

All modules are based on high quality ruthenium reed relays that provide a very long service life and consistent contact operations at all rated switching levels.

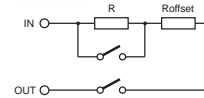
All the connectors used by these modules are supported by a comprehensive range of cable and connector accessories.

For more information on these modules please refer to the individual data sheets or visit our web site at: www.pickeringtest.com

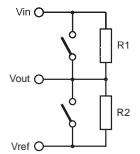
40-280
Selectable Resistor
Module



40-280 Single Resistor Card

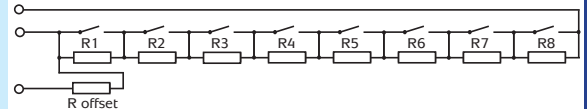


40-281 Dual Resistor Card



40-282 Potential Divider

Fixed Value Resistor Configurations as used on Selectable Resistor Modules



Example Resistor Chain as used on Programmable Resistor Modules (8-bit chain shown)

Resistor Card Configuration	Number of Channels	Resolution	Resistance Range ‡	Max Resistor Power	Front Panel Connector	Order Code †
Fixed Value Selectable Resistors	24 or 48	—	User Specified	0.5W	96-way SCSI plug	40-280
Dual Selectable Resistors	12 or 24					40-281
Fixed Value Potential Dividers	12 or 24					40-282
Programmable Resistors	Dual	16-bit	*0.5Ω to 32kΩ	1W	68-way SCSI plug	40-290
Programmable Resistors + SPDT Relays						40-291
Programmable Resistors	Quad	8-bit	*0.5Ω to 128Ω	15W	9-way D-type	40-292-011
Programmable Resistors + SPDT Relays						40-292-012
Programmable Load Resistor	1	8-bit	*40Ω to 295Ω	10W	9-way D-type	40-292-011
Programmable Load Resistor	1	8-bit	*10Ω to 2.56kΩ	10W	9-way D-type	40-292-012
Programmable Resistors	10 or 18	8-bit	*0 to 255Ω	0.5W	37-way D-type	40-295
	5 or 10	12-bit	*0 to 4kΩ			
		16-bit	*0 to 65kΩ			
	3 or 6	24-bit	*0 to 16MΩ			
Programmable Potentiometers	5 or 9	8-bit	*0 to 255Ω	0.5W	37-way D-type	40-296
	2 or 4	12-bit	*0 to 4kΩ			
		16-bit	*0 to 65kΩ			
	1 or 3	24-bit	*0 to 16MΩ			

* These values are the actual values of the fitted resistors and do not take into account the PCB path resistance

‡ Most modules can be offered with alternative resistance range, for more information contact Pickering Interfaces

† For the full order number and configuration codes for each variant, please refer to the data sheet.

Programmable Precision Resistor Modules

- Precision Variable Resistors With a Choice of Resistance Ranges and Configurations
- Very High Accuracy and Stability
- Fine Setting Resolution
- Low Thermo-Electric EMF
- Simple Calibration With an External DMM
- Occupies single or dual 3U PXI Slots
- VISA and Kernel Support For PXI Environments
- Suitable for Real Time Applications
- Complies with PXI and CompactPCI Specifications

This range of programmable resistor modules feature high setting resolution with excellent stability and accuracy through the use of innovative switching networks and software correction techniques. This also means all resistance values can be set - there are no missing values due to switch resistance or resistor tolerance.

They are ideal for simulation of sensors that require very fine adjustment and also have the capability of being set as open or short circuit to simulate faults in cabling systems. The range includes modules specifically designed for RTD and strain gauge simulation.

The modules incorporate a system for the verification of each channel using a DMM connected to the Calibration Port on the front panel. Verification can be performed with the UUT connected to the module and multiple modules can be cascaded and verified with a single DMM (this does not apply to the 40-297 which uses the same connector for the UUT and calibration).

The resistor channels and calibration port occupy separate connectors on the module's front panel. All connectors are supported by a comprehensive range of cable and connector accessories.

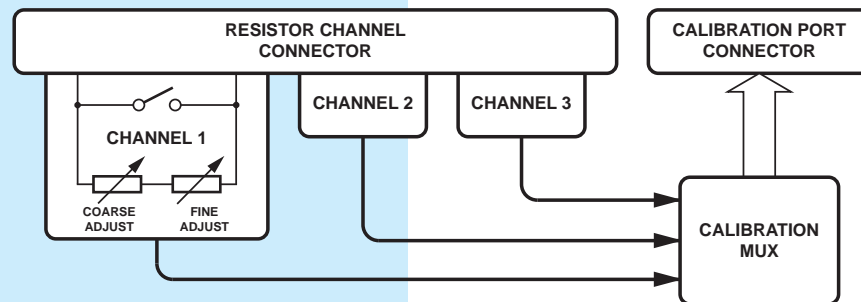


40-260 Precision Programmable Resistor Module

New versions of the precision resistor cards are being regularly introduced, please contact your local sales office for more details.

For more information on these modules please refer to the individual data sheets or visit our web site at: www.pickeringtest.com

Diagram for 40-260 Three Channel Precision Programmable Resistor Modules



Resistor Card Type	No. of Channels	Resolution/Accuracy	Resistance Range ‡	Max Resistor Power	Order Code †
Precision Programmable	3	<10mΩ / 0.1%	90Ω to 8kΩ	100mW	40-260
	2	<2mΩ or <15mΩ/0.1%	1.5Ω-2.9kΩ or 10Ω-36kΩ		40-261
RTD Simulator	6 or 18	<8mΩ or <90mΩ/0.1	90Ω-250Ω or 900Ω-2500Ω		40-262
Strain Gauge Simulator	6	<2mΩ or <25mΩ/0.03% or 0.06%	350Ω or 3kΩ Bridge		40-265
High Density Precision Programmable	18	1Ω/0.2%	1Ω to 230Ω	500mW	40-297-001
	9	0.25Ω/0.2%	2Ω to 13.5kΩ		40-297-002
	6	0.125Ω/0.2%	3Ω to 1.5MΩ		40-297-003

‡ Most modules can be offered with alternative resistance range, for more information contact Pickering Interfaces

† For the full order number and configuration codes for each variant, please refer to the data sheet.

Software

PXI Switching Software Drivers

Pickering PXI Switch Modules are supplied with Windows 98/NT/2000/XP/Vista drivers - freely available from our web site www.pickeringtest.com. Also available are code examples in LabWindows/CVI, Visual Basic, Visual C++ and Borland C++. All Modules also have comprehensive VISA and DLL (Direct I/O) support together with Soft Front Panels, source code for LabView VI's, Diagnostic utilities and HTML Help, all of which may also be downloaded directly from our web site. The VISA driver is also compatible with Real-Time operating systems such as LabVIEW RT, QNX and real-time Linux. Pickering have just one driver set that supports ALL of our PXI switch cards, thus greatly simplifying software development, especially in systems with a large number of differing switch modules. Pickering provide an IVI driver supporting most of their PXI switching modules. All Pickering PXI switch modules are compatible with NI's Measurement & Automation Explorer.

NI Switch Executive Support

All Pickering PXI switch modules that have IVI drivers are 100% compatible with Switch Executive from National Instruments. NI Switch Executive is a basic switch management and routing application that allows the interactive configuration and naming of switch modules, external connections and signal routes.

Agilent Vee Support

All Pickering PXI Switch cards and some instrument cards can be accessed from an ActiveX control and are therefore available for use within Agilent VEE. This allows a rich source of PXI switching solutions to be incorporated into systems based on non-PXI instrumentation such as IEEE-488.

Support

Support Where You Need it

Pickering switching products are covered by a 2-year warranty, the best in the business. We have direct offices in the US, several countries in Europe and China. In addition, our extensive network of authorized agents assures you that your test solutions stay operational over the life of the products being tested.



Product Life Time

They often say life is too short, well this can be true of test equipment as well. Aerospace applications require long term support through the entire life of the product – and that can be a very long time, more than twenty years is common. Pickering Interfaces understands the need for long term support of its products. We never obsolete products on commercial grounds and carefully choose our components to have a very long lifetime. We still manufacture almost all the devices we started the company with back in 1988, and where component obsolescence has forced a change we manufacture equivalent solutions that require little or no change by the user. We are able to manufacture solutions in large or small quantities, including customized products with intermittent market requirements.

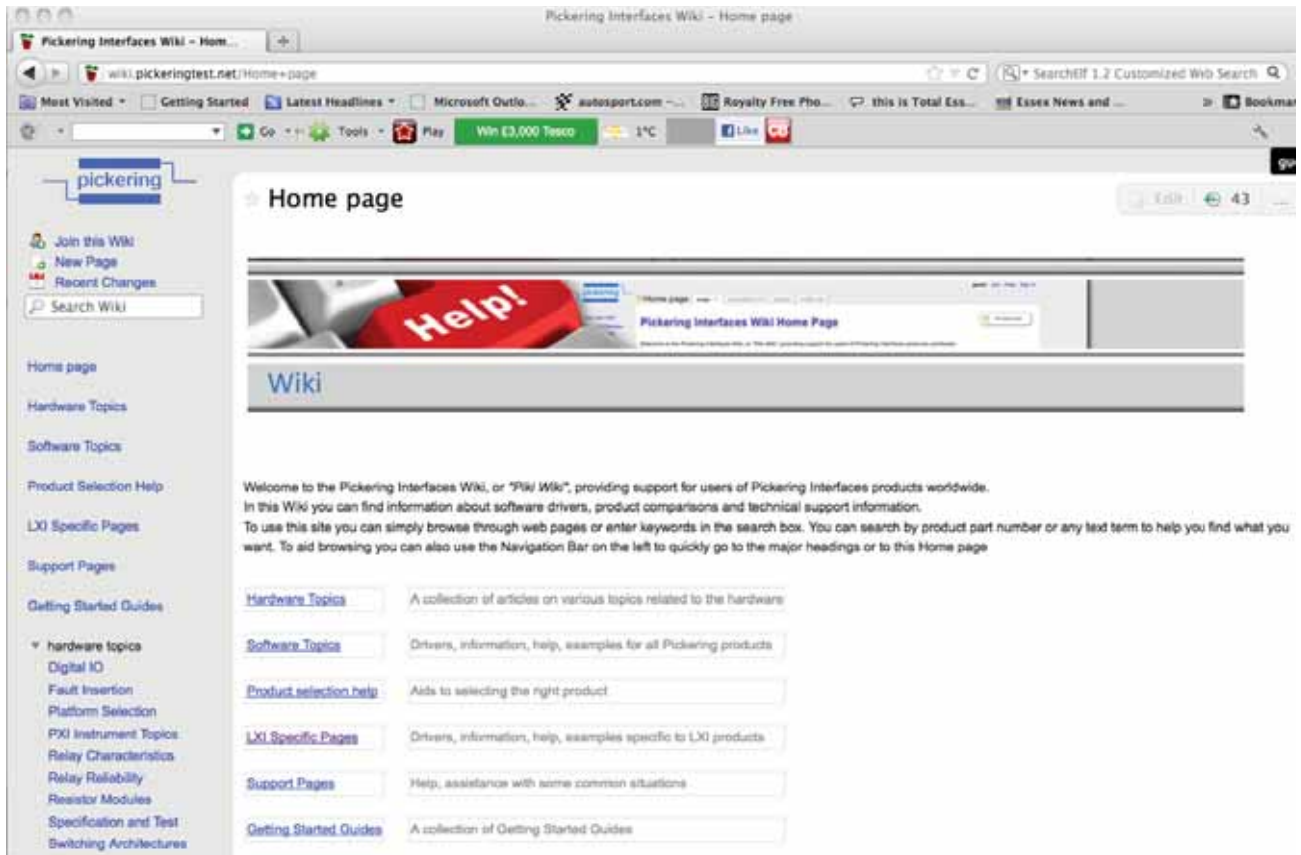
Contact Pickering Interfaces

Pickering Sales Offices phone numbers are on the back of this catalog. Also, check out our web site – go to www.pickeringtest.com and click on "Aerospace Test". Datasheets, manuals, and software drivers are available for download. Then call us and see how we can provide you with Innovative Modular Test for your Aerospace Requirements.



Pickering Wiki

The Pickering WIKI provides application and technical support for using your Pickering products in real world situations. This page is accessed via the Pickering Interfaces website at www.pickeringtest.com.



Further Information

Pickering Interfaces have a variety of comprehensive information to assist you in the selection and design of your PXI based tester. To obtain your copy please visit the Catalog section of our web site or call your local Pickering Interfaces sales office.



PXI Product Guide
Comprehensive Short Form Catalog
Listing all of over 500 Pickering PXI
Modules



**Automotive Short Form
Catalog**
A 17 page Shortform Catalog detailing
Pickering's Automotive Test Solutions



**Aerospace Short Form
Catalog**
A 20 page Shortform Catalog detailing
Pickering's Aerospace Test Solutions

Chassis and Remote Controllers

PXI Chassis

- **High Performance PXI Chassis Available with 8 or 19 Slots**
- **Remote Chassis Monitoring System**
- **Low Audible Operating Noise**
- **Ambient temp range of 0°C to +55°C**
- **Desk or Rack Mountable**

The chassis can accept any 3U PXI or cPCI modules. An intelligent chassis management system monitors the power supply voltage, internal temperature and the cooling fan speed. The current condition of the chassis is displayed on front panel status LEDs and can also be monitored remotely via an RS232 port.

Pickering can pre-configure your PXI modules and ship them pre-installed in our PXI chassis to exact customer requirements at no additional charge. Please contact your local sales office to discuss your requirements.



40-922-001 8 Slot PXI Chassis



40-923-001 19 Slot PXI Chassis



60-102-001
LXI 7-Slot Modular
Switching Chassis



60-103-001
LXI 18-Slot Modular
Switching Chassis

LXI Chassis

- **Fully Compliant LXI Interface**
- **Ethernet 100base T Interface**
- **Accepts Any Pickering Interfaces PXI 3U Switching Module**
- **More Than 500 Switching Module Configurations Available**
- **Applications From Simple Switching to RF, Microwave and Optical**
- **Support 7 or 18 User Slots**
- **Compact Half Rack Width (7-slot)/ Full Rack Width (18-Slot) 4U Form Factor**
- **350W (7-slot)/700W (18-Slot) Industrial Grade Power Supply**
- **Low Audible Operating Noise**
- **Support For Selected Instrument Modules**

Both these chassis allows the majority of the large number of 3U PXI modules from Pickering Interfaces to be installed and controlled through a standardized Ethernet interface. The chassis is supplied with a built-in generic I/O driver to control the PXI modules in accordance with the LXI specification, but can also be controlled through a kernel driver.

PCI/PCIe to PXI Interface Kit

- **High Speed Data Exchange From Desk Top Controller To PXI Chassis**
- **Save Space and Cost by Controlling Two Chassis From a Single PCI Card**
- **Available as Separate Cards or as Kits**

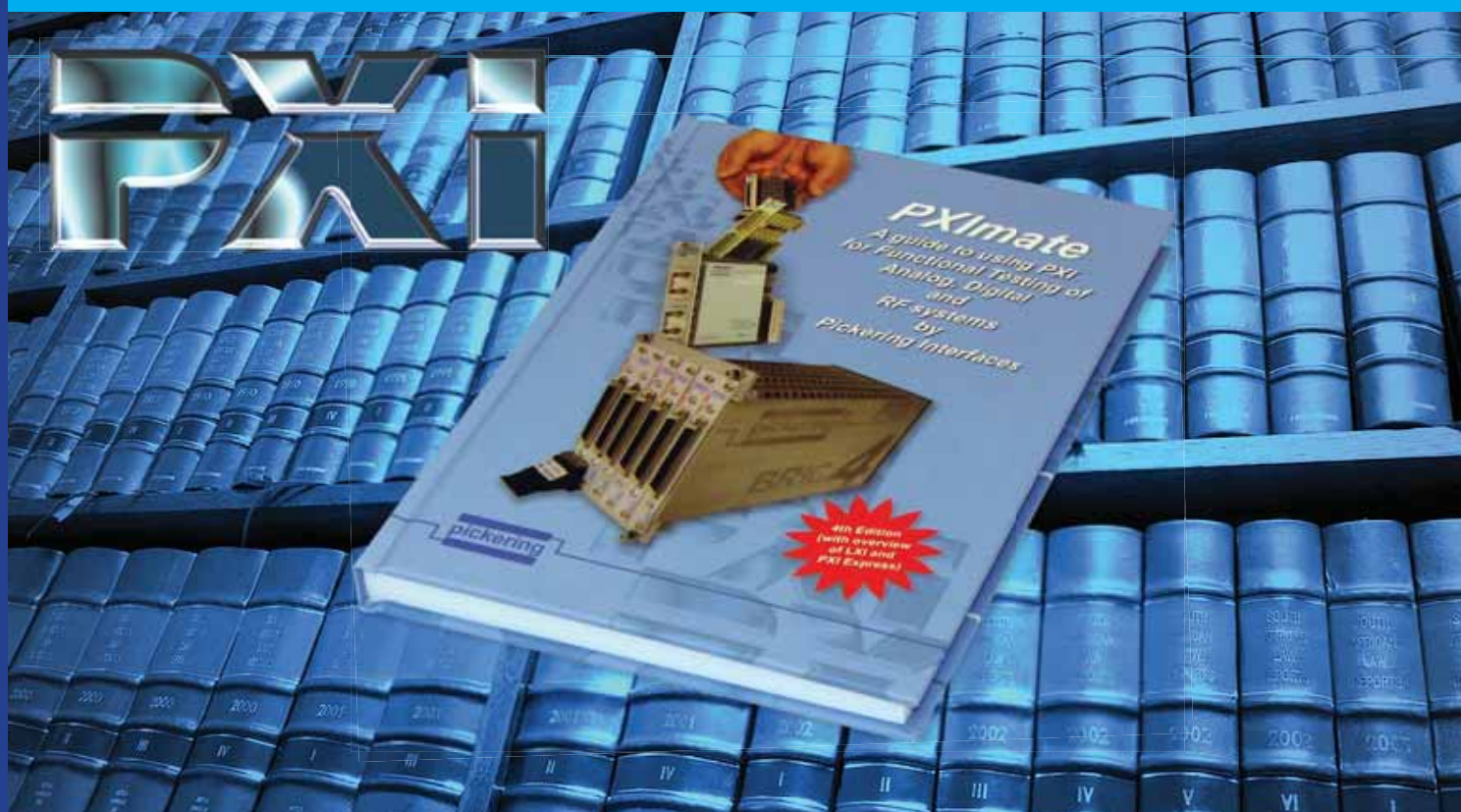
The 41-921/41-924 Control Interface Kits provide a seamless connection between a controller PC's PCI interface and a PXI chassis, so giving your PC direct control of PXI/CompactPCI via a software and hardware transparent link.



41-921 PCI to PXI Control Interface Kit

Description	Power Supplies	Input Voltage Options	Cooling Fans	Order Code
8 Slot PXI Mainframe	1 x 350W DC	100 - 240VAC	2 off 60cfm fans with filters	40-922
19 Slot PXI Mainframe	1 x 700W DC	90 - 264Vac	4 off 68cfm fans with filters	40-923
7 Slot LXI Mainframe	1 x 350 W	100 - 240VAC	2 off 60cfm fans	60-102-001
18 Slot LXI Mainframe	1 x 700 W	90-264V AC	4 off 68cfm fans	60-103-001
PCI to PXI Control Interface Kit	—	—	—	41-921A-001-KIT
Star Fabric to PXI Module	—	—	—	41-921A-001
PCI Control Interface Card	—	—	—	51-921-001
PCIe to PXI Remote Control Kit	—	—	—	41-924-001-KIT
PXI Remote Control Interface Module	—	—	—	41-924-001
PCI Control Interface Card	—	—	—	51-924-001

Your Reference Library is not complete....



...without this FREE reference book from Pickering

Are you building test systems using the PXI Standard? If the answer to the question is yes, then you need this Pickering reference books. The PXImate was written to help Test Engineers fully understand the PXI platform specifications as they relate to test system development. In addition, information on the types of products available in in PXI are highlighted.

PXImate 4th Edition

pdf download, 162 pages

bookmarked for easy navigation

If you need to learn more about PXI, go to www.pickeringtest.com/pximate and register to receive this book. Do a better job of integration – learn from Pickering’s expertise!



Other Switch And Instrument Systems From Pickering

Pickering have been manufacturing Modular Switching & Instrumentation systems since 1988. Our sister company Pickering Electronics have manufactured instrumentation quality reed relays since the late 1960's. Pickering Interfaces design & manufacture solutions for all major modular Test platforms including PXI, GPIB, PCI, VXI and now LXI, we also manufacture many customer solutions and have a wide range of connector/cabling designed for the demanding Functional Test Developer.

LXI Instruments (LAN eXtensions for Instrumentation), **LXI** - SYSTEM 60

Pickering Interfaces are Strategic members of the LXI Consortium, www.lxistandard.org. LXI is the next generation of test instrumentation combining state-of-the-art measurements in a small package at a cost-effective price using enhanced Ethernet connectivity and built in Triggering. Pickering are constantly adding to their range of LXI products, currently the range includes; High Density Matrices, High Power Matrices, Microwave Multiplexers, Microwave Matrices, Fiber Optic Multiplexers, Low Thermal EMF Matrices, High Voltage Matrices, RF & Video Matrices, a Power Management Switch, and a 7 or 18 slot Modular Switching Chassis that supports PXI switching modules in an LXI environment.



60-103 LXI 18-Slot Modular Switching Chassis



60-102 LXI 7-Slot Modular Switching Chassis



60-800/820 LXI Microwave Multiplexer



60-711 LXI Dual 24x8 Video Matrix



60-552 LXI High Density 64x64 Matrix

LXImate



Want to know more about LXI?

The LXImate is an easy to read overview of the LXI Standard and some of the products available that conform to this standard. Get your free copy of the LXImate by registering at www.pickeringtest.com/lximate



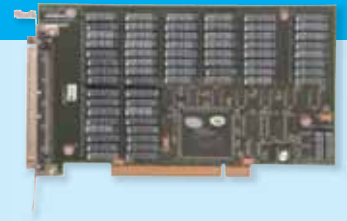
60-310 LXI High Voltage 2-Pole 300x2 Matrix

Other Switch And Instrument Systems From Pickering

PCI Switch Modules – SYSTEM 50



Pickering Interfaces have a range of competitively priced PCI switch Modules, including General Purpose Reed Relay, Matrix, Multiplexer, RF & Programmable Resistor. Pickering Interfaces PCI Modules share the same software environment as our extensive PXI range.



VXI Switching Systems – SYSTEM 30



Pickering Interfaces have a range of high density VXI switching modules, System 30, containing up to 2340 relays per module. These are C sized modules with a SCPI message based interface, VXI Plug/Play & IVI Drivers, offering up to 10 times density advantage over competing VXI switching products.



SIM Relay Cards – SYSTEM 1000

Pickering Interfaces also offer range of uncommitted relays, matrices and multiplexers based on 72-pin SIM modules. These enable the user build custom switching systems that can be located inside test fixtures and close to the unit under test. Control is via an RS232 or I2C interface.



IEEE-488.2 & RS-232 Controlled Switching Systems – SYSTEM 10/20



Pickering Interfaces' System 10 and System 20 Programmable Relay Switching Systems now offer the most comprehensive range of switching modules currently available. Our switching systems will switch from nanoVolts to 7.5 kiloVolts, DC to 26.5GHz and picoAmps to 30Amps. Models are programmable using a wide range of interfaces: IEEE 488, Ethernet, USB or RS-232.



Custom Switching Solutions

Pickering Interfaces are able to meet your exact custom switching needs. With extensive experience in PXI, PCI, VXI, IEEE-488, and Ethernet architectures, we can develop a switching solution that matches your exact needs. For further information please visit the Custom Design area of the "Sales" section of our web site or call your local Pickering Sales office.

Reed Relays

Ruthenium Sputtered Reed Relays offer maximum performance, are hermetically sealed and offer a very stable, long life relay contact (>109 operations) with fast operate time. Alternative cheaper types such as electro-mechanical armature relays or non-instrumentation grade reed relays (Rhodium plated) don't offer the consistent contact resistance, long life, fast switching speed and low level switching capability of an instrumentation reed relay. All reed relays used in our switch modules are manufactured by our sister company Pickering Electronics. www.pickeringrelay.com.



NOTES

HongKe



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