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USER MANUAL

PXI RF MATRIX MODULE
(MODEL No. 40-725-511 / 711 / 721 / 731 / 751)



Issue 3.0 October 2007

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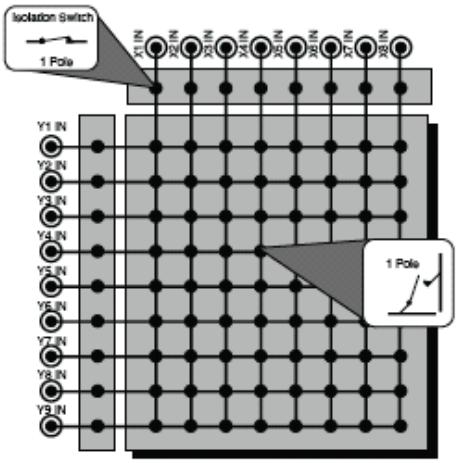
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SECTION 1 - INTRODUCTION

GENERAL

The 40-725-511/711/721/731/751 RF Matrix Module forms part of the System 40 PXI Programmable Switching system. The 40-725 is an 8 x 9 RF Matrix Module suitable for switching frequencies to beyond 500MHz. The 40-725 is provided in either 50Ω or 75Ω versions with a choice of coaxial connectors. It is intended for the easy construction of high performance bidirectional matrix switching systems.

Automatic Isolation Switches are located on all coaxial connectors (refer to drawing), these disconnect the matrix from the external test fixture. This maximises isolation and RF performance.



Matrix Operation

The 40-725 is a true 8 x 9 high density matrix, any combination of crosspoints may be selected. Only the signal is switched, all grounds are common.

Special Version With Loopthrough on Y9

A version is available which is compatible with the VXI 30-728-721 and MAX 20 (Mobus card). This is a 75Ω matrix, but uses 50Ω SMB coaxial connectors. Also a loop thru is retained on Y9 (used for external self test).

VERSIONS

The RF Matrix Module is provided in the following configurations:

- 8 x 9 RF Coaxial Matrix, 500MHz Bandwidth, 50 Ω SMB Coaxial Connector (40-725-511)
- 8 x 9 RF Coaxial Matrix, 400MHz Bandwidth, 2 Slot Width, 75 Ω SMZ/Type 43 Coaxial Connector (40-725-711)
- 8 x 9 RF Coaxial Matrix, 400MHz Bandwidth, 75 Ω SMB (50 Ohm Type) Coaxial Connector (40-725-721)
- 8 x 9 RF Coaxial Matrix, 400MHz Bandwidth, 75 Ω 1.0/2.3 Coaxial Connector (40-725-731)
- 8 x 9 RF Coaxial Matrix, 400MHz Bandwidth, 75 Ω Mini SMB Coaxial Connector (40-725-751)

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SECTION 2 - SPECIFICATION

General Switching Specification

Maximum Voltage:	100V DC
Maximum Power:	10W
Maximum Switch Current:	0.5A
Maximum Carry Current:	0.5A
Characteristic Impedance:	50Ω or 75Ω
On Path Resistance:	<500mΩ
Off Path Resistance:	>10^8Ω
Thermal Offset:	<30µV
Expected Life (Low Power):	1x10^9 operations
Expected Life (Max Power):	>5x10^6 operations
Operate Time:	<1.0ms, 0.5ms typ
Release Time:	<1.0ms, 0.5ms typ

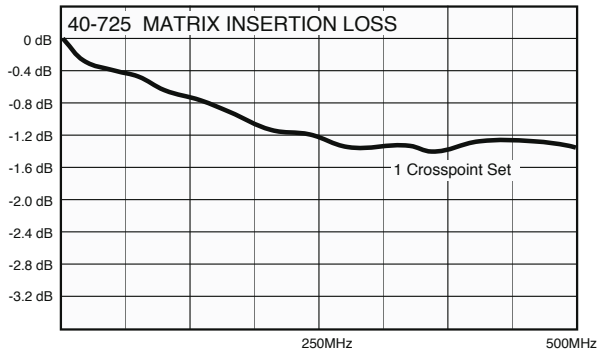
RF Specification

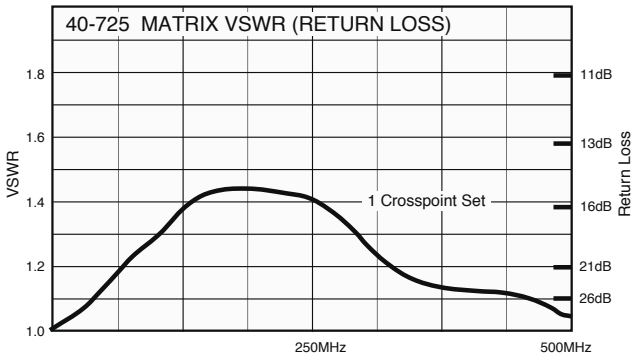
Maximum Frequency:	500MHz
Typical Rise Time:	800ps †
Insertion Loss (<500MHz):	<3dB †
V.S.W.R. (<500MHz):	<1:1.8 †
Isolation (<500MHz):	>70dB
Crosstalk (<500MHz):	>60dB

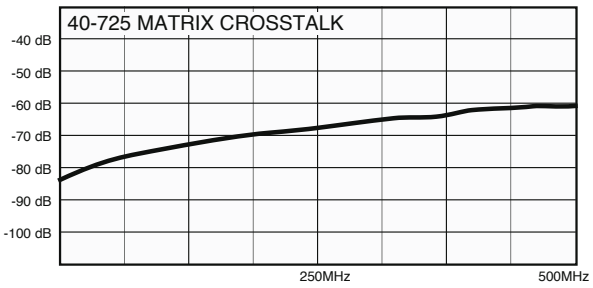
Loop Thru RF Specification (1 Pole)

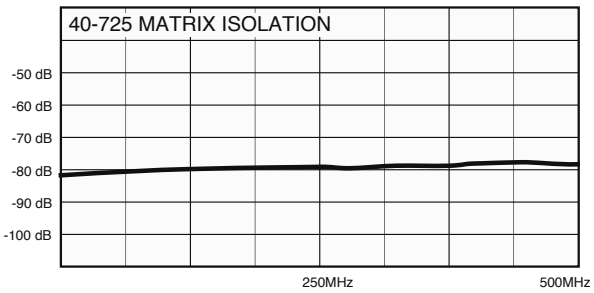
Insertion Loss (<100MHz):	<1dB
V.S.W.R. (<100MHz):	<1:1.05

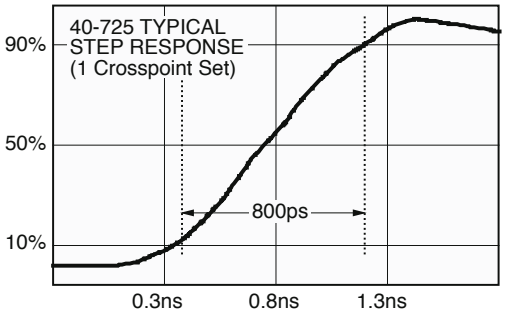
† Matrix RF Performance is entirely dependant upon the combination of crosspoints currently selected, these figures are for **one** selected crosspoint on any X or Y channel only, refer to graphs.











RF Performance Plots for 40-725 75Ω 500MHz RF Matrix Module

Typical curves are shown for matrix rows/columns with 1 crosspoint set. For optimum insertion loss and VSWR (reflection) performance ensure only one crosspoint is set in any one row/column. Multiple crosspoints can be set on any one row or column but this will seriously degrade RF performance.

Programming

Pickering provide kernel, VISA and IVI drivers which are compatible with Windows 2000/NT/XP operating systems, the VISA driver is also compatible with the LabVIEW RT operating system.

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

Other environments are also supported, please contact Pickering with specific enquiries.

Power Requirements

+3.3V	+5V	+12V	-12V
0	320mA (typ 240mA)	0	0

Width and Dimensions

Single slot 3U PXI (CompactPCI card). Except the SMZ/BT Type 43 option which is 2 slot (40-725-711).

PXI & CompactPCI Compliance

All Pickering Interfaces PXI modules comply with the PXI Specification 2.1. Local Bus, Interrupts, Trigger Bus and Star Trigger are not implemented.

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.

Connectors

PXI bus via 32 bit P1/J1 backplane connector. Signals via 17 front panel mounted coaxial connectors.

Product Order Codes

PXI 8 x 9 500MHz Coaxial Matrix	
SMB Version, 50Ω	**40-725-511**
BT Type 43/SMZ Version, 75Ω (2 slot module)	**40-725-711**
1.0/2.3 Version, 75Ω	**40-725-731**
Mini SMB Version, 75Ω	**40-725-751**
Special version of the 75Ω Coaxial Matrix, 400MHz Bandwidth with Loop Thru on Y9 position. 75Ω Impedance (but using 50Ω SMB connectors)	**40-725-721**

Operating/Storage Conditions

Operating Conditions

Operating Temperature:	0°C to 55°C
Humidity:	Up to 95% non-condensing
Altitude:	5000m

Storage and Transport Conditions

Storage Temperature:	-20°C to +75°C
Humidity:	Up to 95% non-condensing
Altitude:	15000m

Mating Connectors & Cabling

Examples of connectors and cabling for the 40-725 are:

40-977-511-1M	Cable, 50Ω SMB, Plug to Plug, 1 Meter Length.
40-977-711-1M	Cable, 75Ω SMZ/Type 43, Plug to Plug, 1 Meter Length.
40-977-731-1M	Cable, 75Ω 1.0/2.3, Plug to Plug, 1 Meter Length.
40-977-751-1M	Cable, 75Ω Mini SMB, Plug to Plug, 1 Meter Length.

Please refer to the Pickering Interfaces "**Interconnection 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.



Latest Details

Please refer to our Web Site for Latest Product Details.

www.pickeringtest.com

SECTION 3 - INSTALLATION

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.

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.

CAUTION

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.

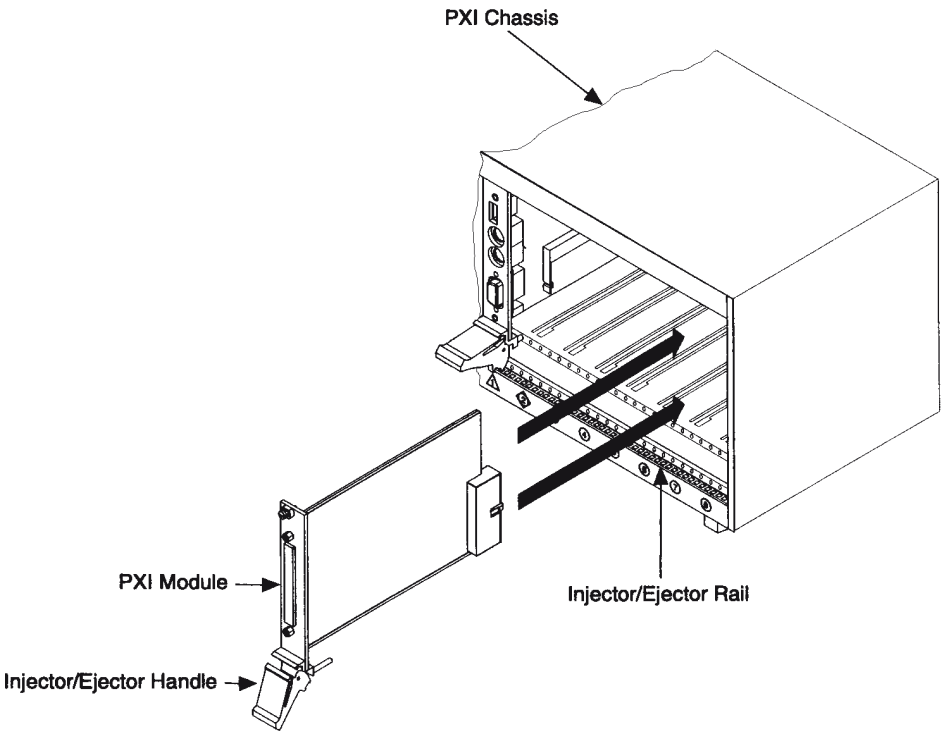


Figure 3.1 - Installing the module into a PXI/Compact PCI Chassis

TESTING OPERATION

Start the Test Panels application from the Programs>>Pickering>>PXI Utilities menu. If you are a LabVIEW user, run “Test Panels (LabVIEW VI)”; if not, run “Test Panels (EXE)”. A selector panel will appear, listing all installed Pickering PXI switch 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.

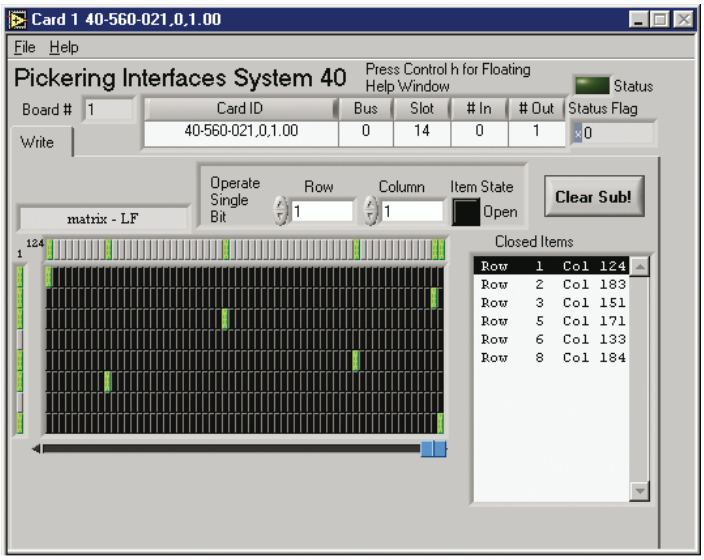


Figure 3.2 - Typical Test Panel Display

As an alternative to the Test Panels, the simple Terminal Monitor program PILMon (again on the Programs>>Pickering>>PXI Utilities menu) allows access to all functions of Pickering switch cards through a command-line interface. In PILMon, enter “HE” for help on it’s commands.

Please note that both the Test Panels and Terminal Monitor gain exclusive access to the cards, and so only one of them can be operational at any time.

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SECTION 4 - PROGRAMMING

Programming options for Pickering Interfaces PXI Cards

Software drivers are supplied for Microsoft Windows 2000/XP operating systems, with specific support for the following development environments:

- Microsoft Visual Basic
- Microsoft Visual 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.

Three 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 Iviswtch 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 lists.

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 is 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/O Driver 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 PCIbus.
- For operating systems other than Windows LabVIEW, LabWindows/CVI and Switch Executive are trademarks of National Instruments Corporation.

Details of the above drivers is available in separate documentation.

Card Architecture

Sub-units

Pickering PXI cards contain one or more independently addressable functional blocks, or sub-units. Sub-unit numbers begin at 1, and separate sequences are used for input and output functions. This number is used in function calls to access the appropriate block. Generally, sub-unit numbers correspond directly to the bank numbers specified in hardware documentation.

Sub-unit examples:

Model	Configuration	INPUT sub-unit #1	OUTPUT sub-unit #1	OUTPUT sub-unit #2	OUTPUT sub-unit #3
40-110-021	16 SPDT switches	None	16 SPDT switches	None	None
40-290-121	Dual Programmable resistors + 16 SPDT switches	None	Resistor #1	Resistor #2	16 SPDT switches
40-490-001	Digital I/O	16-channel inputs	32-channel outputs	None	None
40-511-021	Dual 12 x 4 matrix	None	12 x 4 matrix #1	12 x 4 matrix #2	None

Sub-unit characteristics

The numbers of input and output sub-units in a card can be obtained using functions from the libraries:

pipx40 `pipx40_getSubCounts`

pilpxi `PIL_EnumerateSubs`

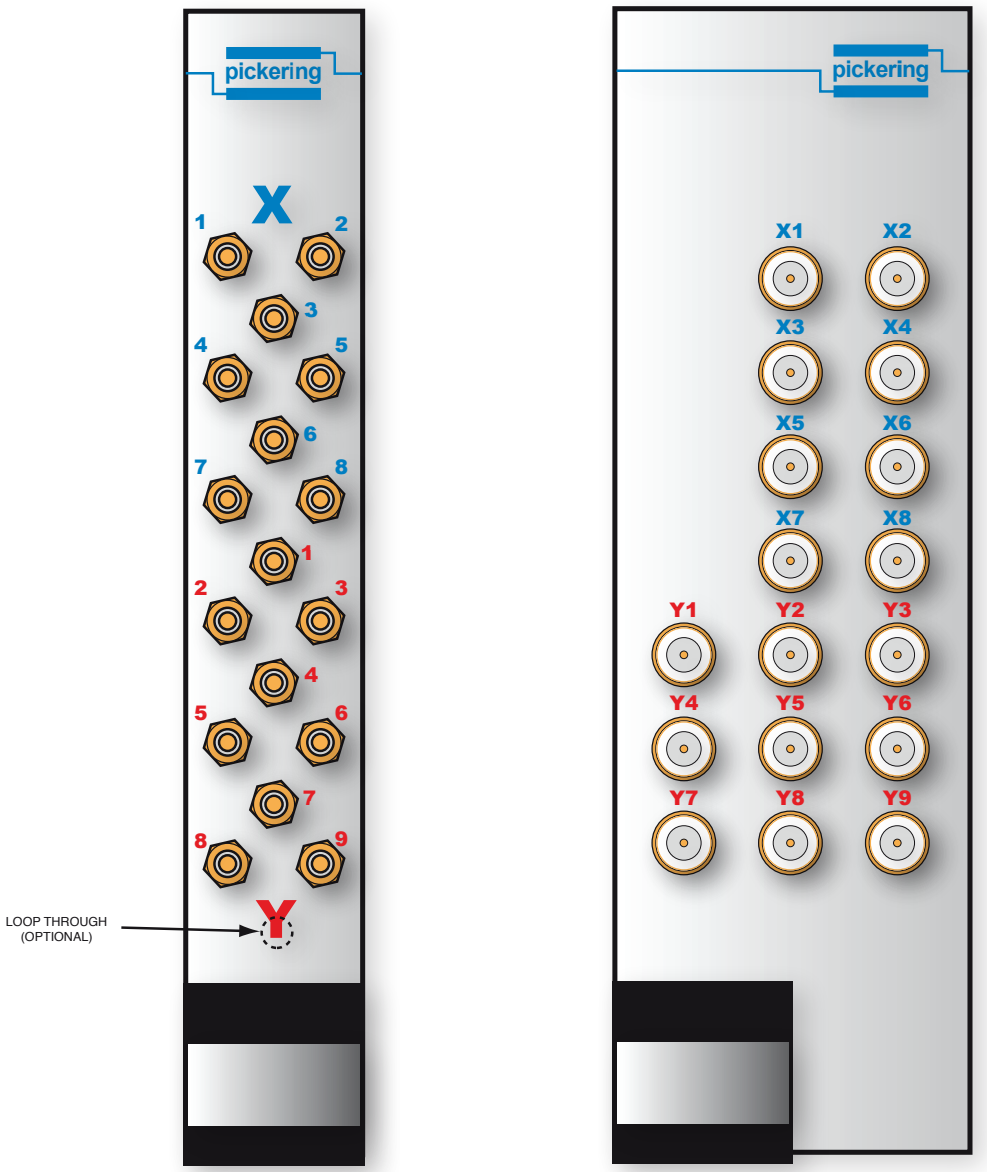
pipx40 `pipx40_getSubType, pipx40_getSubInfo`

pilpxi `PIL_SubType, PIL_SubInfo`

For further detail of how to access and use Pickering drivers the user is advised to refer to the documentation provided with the installed drivers.

SECTION 5 - CONNECTOR PIN OUTS

Figure 5.1 provides pin outs for the RF Matrix Modules in the 40-725-511/711/721/731/751 model range.



40-725-511/721/731/751 **40-725-711**

Figure 5.1 - RF Matrix Module 40-725-511/711/721/731/751: 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.

Table 6.1 provides a relay look-up table.

TABLE 6.1 - 8 x 9 RF Matrix Relay Layout

LOGICAL RELAY NUMBER	CROSSPOINT	PHYSICAL RELAY	ISOLATION Y, X
1	Y1, X1	RL107	RL103, RL67
2	Y1, X2	RL106	RL103, RL66
3	Y1, X3	RL105	RL103, RL65
4	Y1, X4	RL104	RL103, RL64
5	Y1, X5	RL101	RL102, RL63
6	Y1, X6	RL100	RL102, RL62
7	Y1, X7	RL99	RL102, RL61
8	Y1, X8	RL98	RL102, RL60
9	Y2, X1	RL97	RL93, RL67
10	Y2, X2	RL96	RL93, RL66
11	Y2, X3	RL95	RL93, RL65
12	Y2, X4	RL94	RL93, RL64
13	Y2, X5	RL91	RL92, RL63
14	Y2, X6	RL90	RL92, RL62
15	Y2, X7	RL89	RL92, RL61
16	Y2, X8	RL88	RL92, RL60
17	Y3, X1	RL87	RL83, RL67
18	Y3, X2	RL86	RL83, RL66
19	Y3, X3	RL85	RL83, RL65
20	Y3, X4	RL84	RL83, RL64
21	Y3, X5	RL81	RL82, RL63
22	Y3, X6	RL80	RL82, RL62
23	Y3, X7	RL79	RL82, RL61
24	Y3, X8	RL78	RL82, RL60
25	Y4, X1	RL77	RL73, RL67
26	Y4, X2	RL76	RL73, RL66
27	Y4, X3	RL75	RL73, RL65
28	Y4, X4	RL74	RL73, RL64
29	Y4, X5	RL71	RL72, RL63
30	Y4, X6	RL70	RL72, RL62
31	Y4, X7	RL69	RL72, RL61
32	Y4, X8	RL68	RL72, RL60

LOGICAL RELAY NUMBER	CROSSPOINT	PHYSICAL RELAY	ISOLATION Y, X
33	Y5, X1	RL51	RL47, RL59
34	Y5, X2	RL50	RL47, RL58
35	Y5, X3	RL49	RL47, RL57
36	Y5, X4	RL48	RL47, RL56
37	Y5, X5	RL45	RL46, RL55
38	Y5, X6	RL44	RL46, RL54
39	Y5, X7	RL43	RL46, RL53
40	Y5, X8	RL42	RL46, RL52
41	Y6, X1	RL41	RL37, RL59
42	Y6, X2	RL40	RL37, RL58
43	Y6, X3	RL39	RL37, RL57
44	Y6, X4	RL38	RL37, RL56
45	Y6, X5	RL35	RL36, RL55
46	Y6, X6	RL34	RL36, RL54
47	Y6, X7	RL33	RL36, RL53
48	Y6, X8	RL32	RL36, RL52
49	Y7, X1	RL31	RL27, RL59
50	Y7, X2	RL30	RL27, RL58
51	Y7, X3	RL29	RL27, RL57
52	Y7, X4	RL28	RL27, RL56
53	Y7, X5	RL25	RL26, RL55
54	Y7, X6	RL24	RL26, RL54
55	Y7, X7	RL23	RL26, RL53
56	Y7, X8	RL22	RL26, RL52
57	Y8, X1	RL21	RL17, RL59
58	Y8, X2	RL20	RL17, RL58
59	Y8, X3	RL19	RL17, RL57
60	Y8, X4	RL18	RL17, RL56
61	Y8, X5	RL15	RL16, RL55
62	Y8, X6	RL14	RL16, RL54
63	Y8, X7	RL13	RL16, RL53
64	Y8, X8	RL12	RL16, RL52
65	Y9, X1	RL11	RL7, RL59
66	Y9, X2	RL10	RL7, RL58
67	Y9, X3	RL9	RL7, RL57
68	Y9, X4	RL8	RL7, RL56
69	Y9, X5	RL5	RL6, RL55
70	Y9, X6	RL4	RL6, RL54
71	Y9, X7	RL3	RL6, RL53
72	Y9, X8	RL2	RL6, RL52

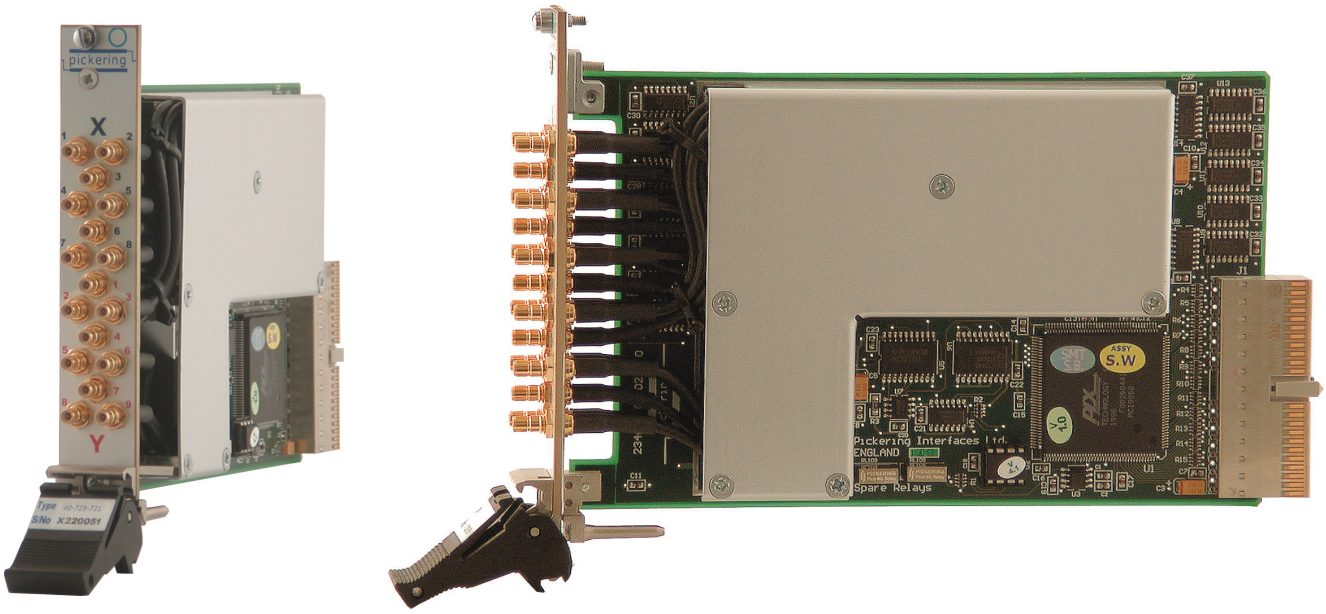
SECTION 7 - FUNCTIONAL DESCRIPTION

MECHANICAL DESCRIPTION

The RF Matrix Module conforms to the 3U height (128mm) Eurocard standard. The module comprises the following:

- CPCI Ejector Handle
- Front Panel mounted 50Ω SMB, or 75Ω SMZ/Type 43, SMB, 1.0/2.3 or Mini SMB connectors
- 107 single pole RF Ruthenium Reed Switches
- Two spare Reed Switches
- Compact PCI backplane connector
- PCI Bridge (U1)
- Control Logic

The front panel is secured to the PCB by two M2.5 x 6mm pan-head posi-drive screws.



FUNCTIONAL DESCRIPTION

A functional block diagram is provided in Figure 7.1. The RF Matrix Module is powered by a +5V input via Compact PCI connector J1. The interface to the user test equipment is via the front panel mounted connectors. The module comprises a PCB populated with single pole RF relays. The relays are energised via control signals from relay drivers U8 to U21. The relay drivers are addressed by PCI bridge U1 to output the required signal. PCI Bridge U1 is configured by EEPROM U2.

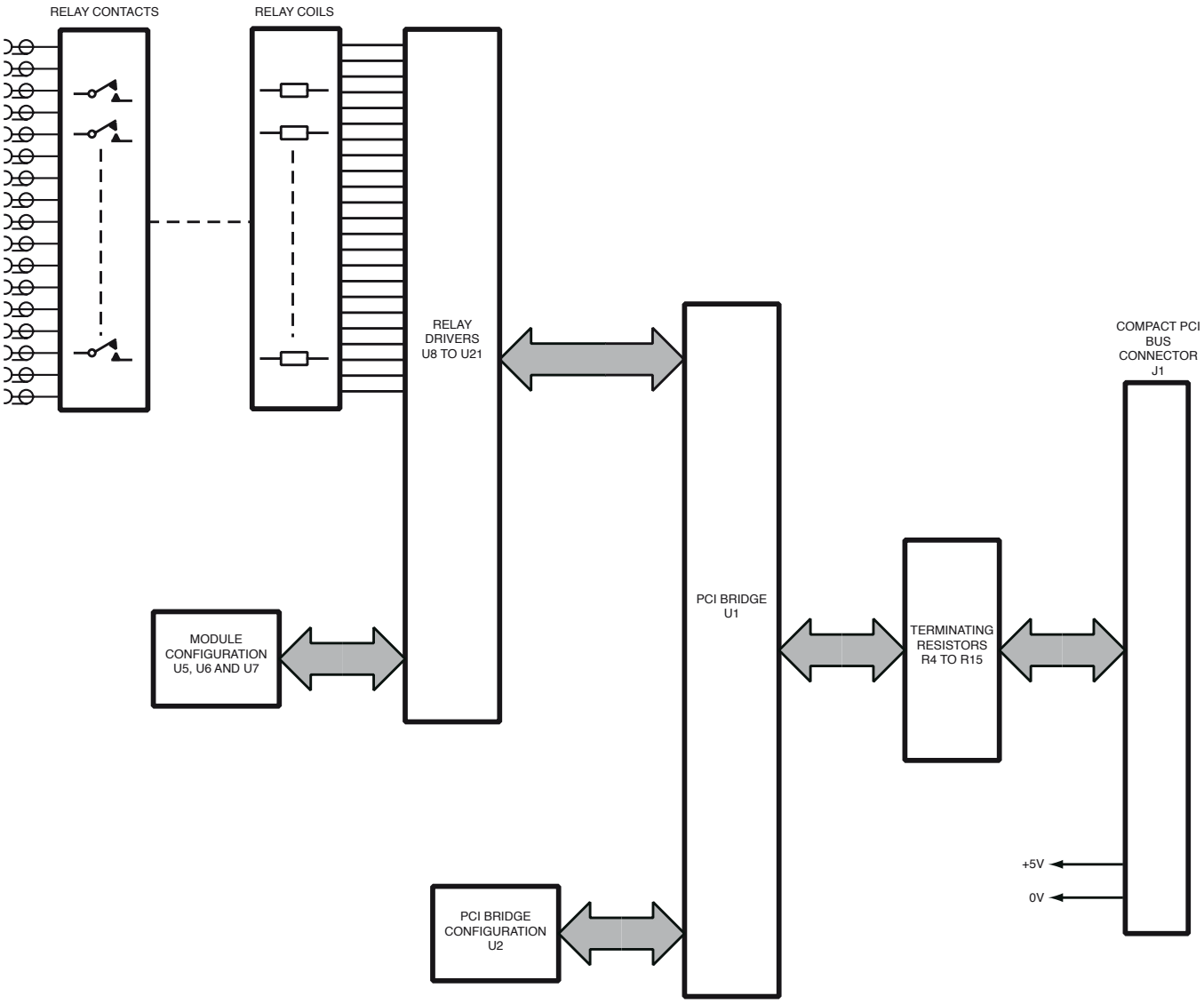


Figure 7.1 - RF Matrix Module: Functional Block Diagram

SECTION 8 - PARTS LIST

The following pages provide parts lists and a component layout diagram for RF Matrix Modules.

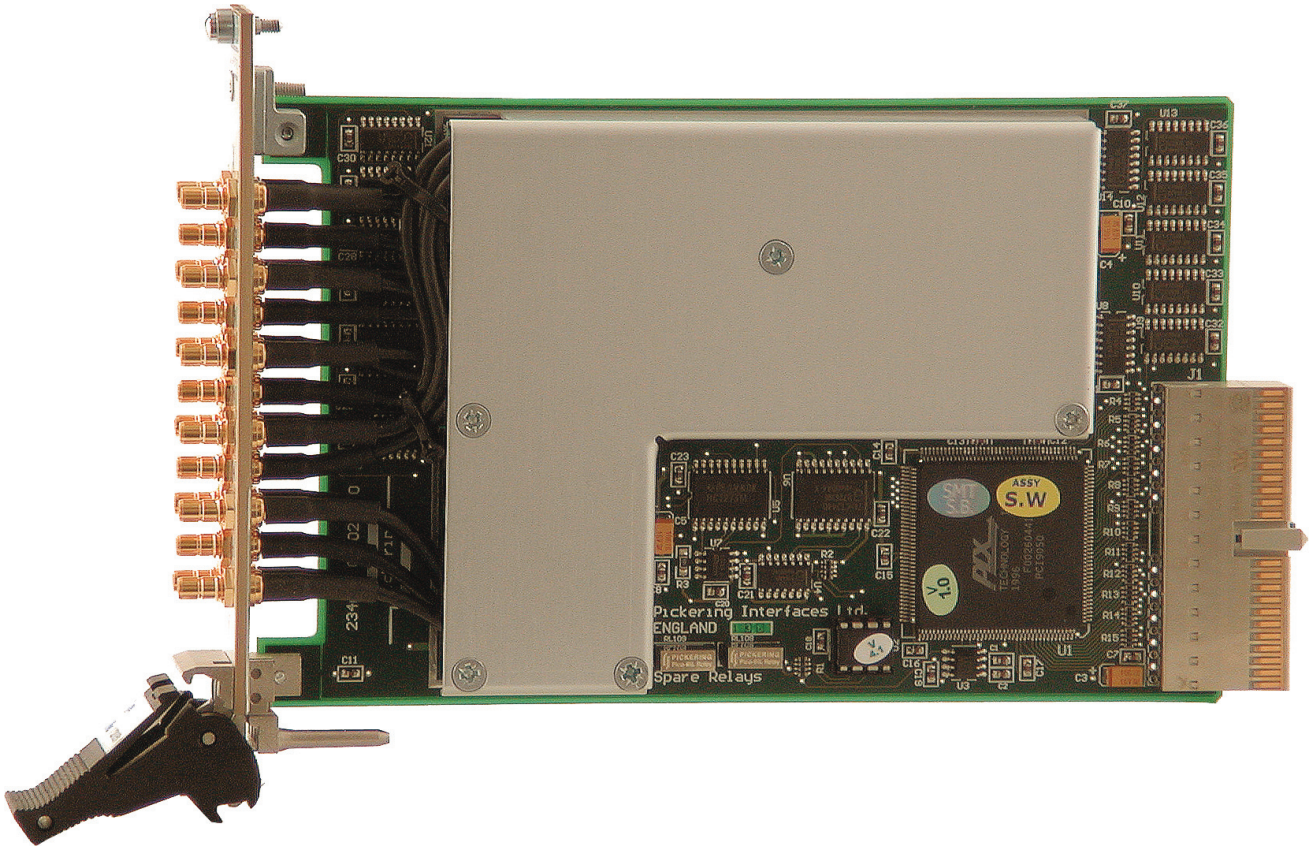


Table 8.1 provides a parts list and Figure 5.1 a component layout diagram for the 40-725-511/711/721/731/751 Multiplexer Module.

TABLE 8.1 - RF Matrix Module 40-725-511/711/721/731/751 Parts List

PCB Location	Pickering Interfaces Part Number	Part Description	Quantity
R1, R2	C/RS/079	RESISTOR N/W 4 x 10k 1206	2
R3	C/RS/085	RESISTOR 10k 0805	1
R4 to R15	C/RS/102	RESISTOR N/W 4 x 10R 1206	12
RL1 to RL109	C/RL/115	111RF-1-A-5/2D	109
C1, C2, C7 to C37	C/CP/034	CAPACITOR 100nF 0603	33
C3 to C6	C/CP/024	CAPACITOR 10uF TANT SMD	4
J1	C/CN/355	cPCI J1 CONNECTOR	1
	C/MS/071	FEMALE CODING KEY, BRILLIANT BLUE, V	1
U1	C/IC/098	PCI9050 PQFP	1
U2	C/IC/099	93CS46 DIP	1
	C/IC/035	8 PIN DIP SKT	1
U3	C/IC/056	7705 SOP	1
U4	C/IC/087	74HCT32 SOP	1
U5	C/IC/100	74HCT273 SOP	1
U6	C/IC/101	74HCT244 SOP	1
U7	C/IC/090	93C56 SOP	1
U8 to U21	C/IC/108	HEF4794B SOP	14

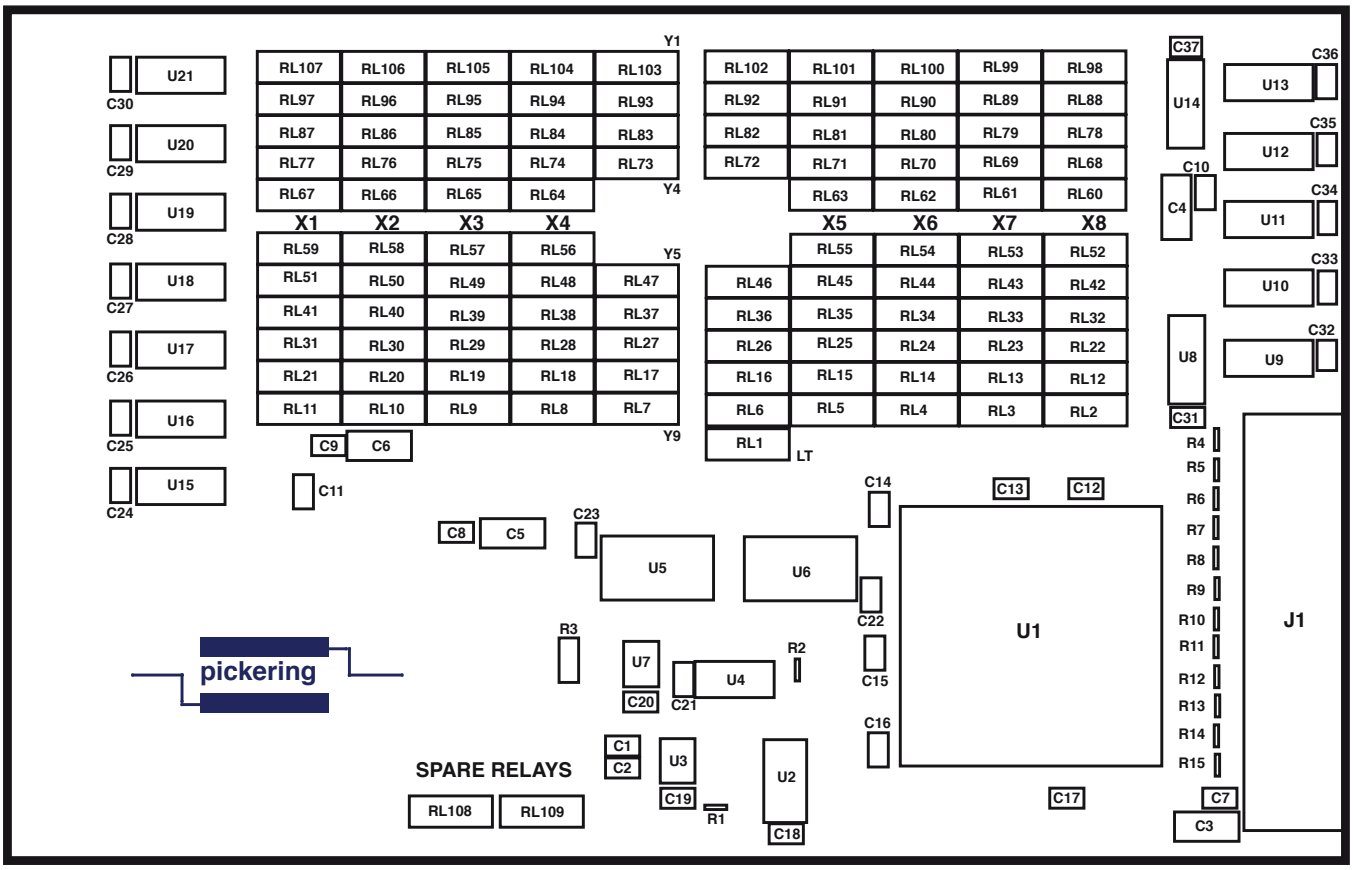
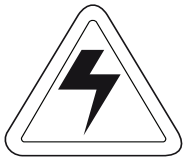


Figure 8.1 - RF Matrix Module: Component Layout

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SECTION 9 - WARNINGS AND CAUTIONS



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 the 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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