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Find the *Pickering 40-513-021* at our website: ***Click HERE***

USER MANUAL

MATRIX MODULE
(MODEL No. 40-510/511/512/513)



Issue 3, Aug 2006

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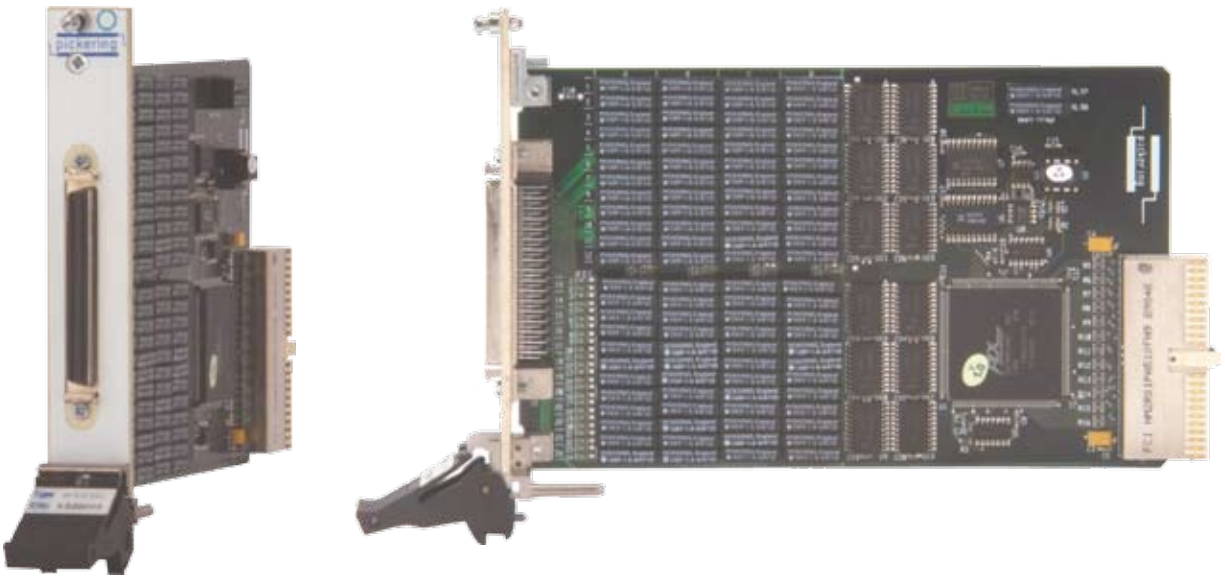
SECTION 1 - INTRODUCTION

GENERAL

The 40-51* range of Matrix Modules form part of the System 40 PXI Programmable Switching system. Each matrix module is fully implemented, i.e. a relay is provided at each potential crosspoint. The functionality of each module in the range is the same, the part number being derived from the number of relays, the type of relay (e.g. single or two pole, screened, etc) and whether single or dual bank operation.

The Matrix Module is provided in the following configurations:

- Single 12 x 4 Matrix, Single Pole Switching (Part Number 40-510-021)
- Single 12 x 4 Matrix, Screened Single Pole Switching (Part Number 40-510-021-S)
- Single 12 x 4 Matrix, Two Pole Switching (Part Number 40-510-022)
- Dual 12 x 4 Matrix, Single Pole Switching (Part Number 40-511-021)
- Dual 12 x 4 Matrix, Screened Single Pole Switching (Part Number 40-511-021-S)
- Dual 12 x 4 Matrix, Two Pole Switching (Part Number 40-511-022)
- Single 12 x 8 Matrix, Single Pole Switching (Part Number 40-512-021)
- Single 12 x 8 Matrix, Screened Single Pole Switching (Part Number 40-512-021-S)
- Single 12 x 8 Matrix, Two Pole Switching (Part Number 40-512-022)
- Single 24 x 4 Matrix, Single Pole Switching (Part Number 40-513-021)
- Single 24 x 4 Matrix, Screened Single Pole Switching (Part Number 40-513-021-S)
- Single 24 x 4 Matrix, Two Pole Switching (Part Number 40-513-022)



NOTE

The high density of relays on this module means that the replacement of faulty relays should only be carried out by qualified personnel using the correct equipment. If qualified personnel or the correct equipment are unavailable please return the module to Pickering Interfaces for repair.

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SECTION 2 - SPECIFICATION

Relay Type

All 40-510 series modules are fitted with Reed Relays (Ruthenium sputtered type), these offer very long life with good low level switching performance and excellent contact resistance stability.

Spare Reed Relays are built onto the circuit board to facilitate easy maintenance with minimum downtime.

All reed relays are manufactured by our sister company Pickering Electronics, www.pickeringrelay.com.

Programming

All PXI cards are supplied with complete Windows 98/2000/NT/XP drivers, these perform the following functions:-

- Write word/s to card (to set relay pattern)
- Write bit to card (to operate an individual relay)
- Full relay status reporting
- Card identification and location information

Up to date driver software is available from our web site at www.pickeringtest.com

Power Requirements

+3.3V	+5V	+12V	-12V
0	400mA (typ 280mA)	0	0

Width and Dimensions

Single slot 3U PXI (CompactPCI card).

PXI & CompactPCI Compliance

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

Supplied soft front panels and driver software are fully Windows 98/2000/NT/XP compatible.

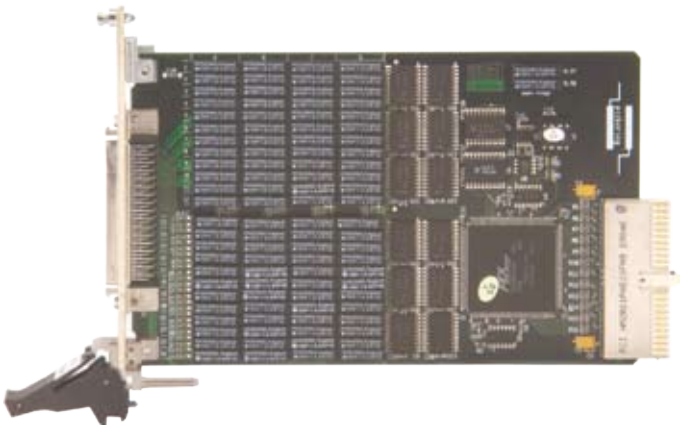
Safety & CE Compliance

All modules meet applicable EU directives. Low-voltage safety EN 61010-1:1993. EMC Immunity EN 50082-1:1992, Emissions EN 55011:1991. For full safety, compliance and environmental specifications refer to Operating Manual.

Connectors

PXI bus via 32 bit P1/J1 backplane connector.

Signals via front panel 68 Way female connector, pin outs are in the operating manual.



Switching Specification

Switch Type:	**Ruthenium Reed**
Max Standoff Voltage:	150Vd.c./100Va.c.
Max Power: Max Switch Current: Max Carry Current:	20W 1A 1.2A
Path Resistance On (single module): Off (single module): Differential Thermal Offset:	 <300mΩ $>10^9$Ω <5μV
Operate Time: Release Time:	<0.5ms, 0.25ms typ. <0.5ms, 0.25ms typ.
Expected Life Low power load: Full power load:	 $1x10^9$ operations $>5x10^6$ operations

Isolation and Crosstalk (screened reed versions)

Crosstalk	@1MHz:	62dB (typical)
	@10MHz:	42dB (typical)
	@25MHz:	40dB (typical)
Isolation	@1MHz:	65dB (typical)
	@10MHz:	49dB (typical)
	@25MHz:	45dB (typical)

Product Order Codes

Single 12 x 4 Matrix, 1 Pole	**40-510-021**
Single 12 x 4 Matrix, 2 Pole	**40-510-022**
Dual 12 x 4 Matrix, 1 Pole	**40-511-021**
Dual 12 x 4 Matrix, 2 Pole	**40-511-022**
Single 12 x 8 Matrix, 1 Pole	**40-512-021**
Single 12 x 8 Matrix, 2 Pole	**40-512-022**
Single 24 x 4 Matrix, 1 Pole	**40-513-021**
Single 24 x 4 Matrix, 2 Pole	**40-513-022**

Options

–S All 1 pole versions are available with screened reed relays (e.g. 40-512-021-S)

Mating Connectors & Cabling

Please refer to the Pickering Interfaces "**Interconnection Solutions**" catalog for a 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

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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.

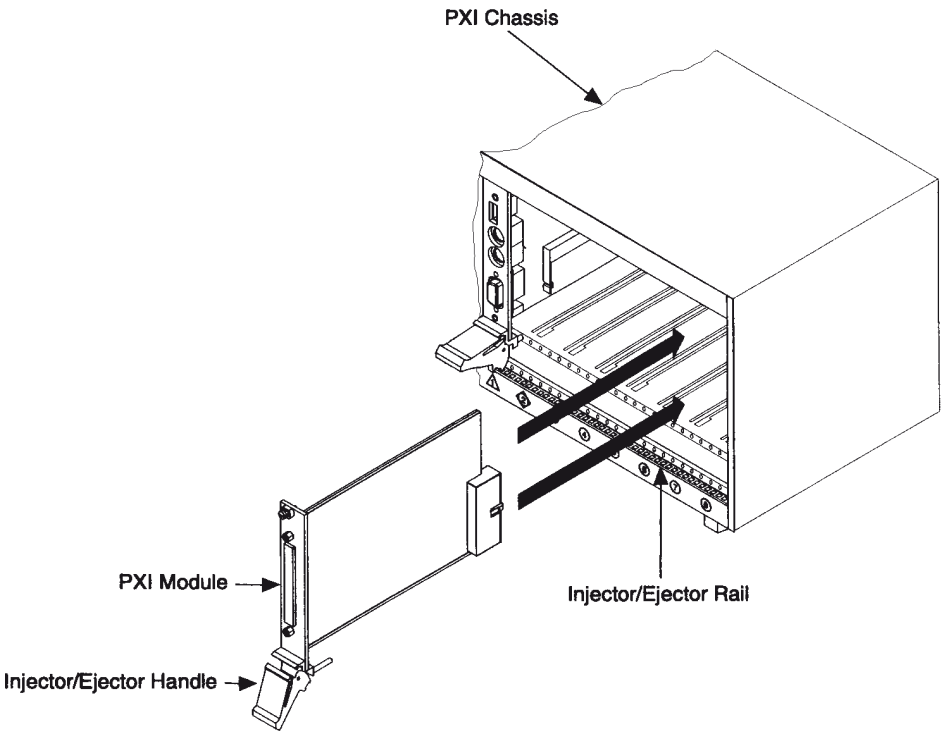


Figure 3.1 - Installing the module into a PXI/Compact PCI Chassis

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.

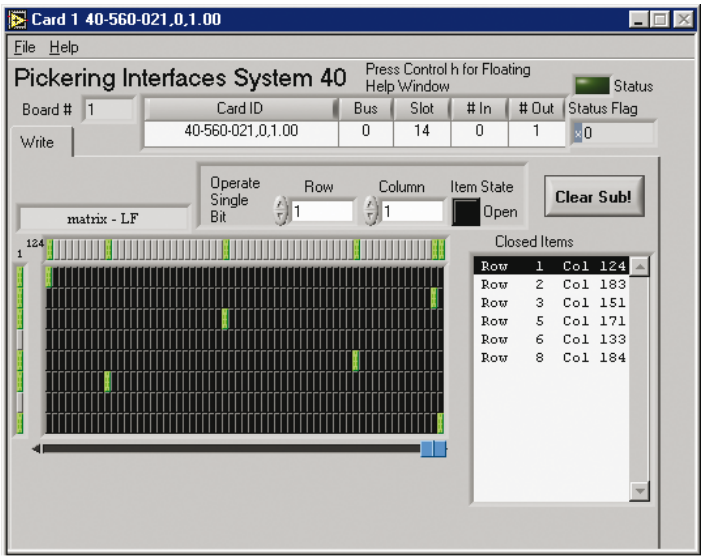


Figure 3.2 - Typical Test Panel Display

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

System 40, System 45 and System 50 cards are supported by comprehensive Windows software drivers and can also be programmed at register-level.

There are two separate Windows drivers, one accessing cards by Direct I/O and the other through VISA (Virtual Instrument Software Architecture). Both are fully documented by ReadMe and HTML help files, accessible through shortcuts on the Programs>>Pickering menu.

The following programming environments are supported for both drivers:

- Microsoft Visual Basic
- Microsoft Visual C++
- Borland C++
- National Instruments LabWindows/CVI
- National Instruments LabVIEW

Support for all these environments is included in the standard installation.

Please refer to the PXI Switching Programming Manual for complete programming information. This manual is available on the Pickering Interfaces website at http://www.pickeringtest.com.

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SECTION 5 - CONNECTOR PIN OUTS

Figures 5.1 to 5.4 provide pin outs for the Matrix Modules in the 40-51* model range.

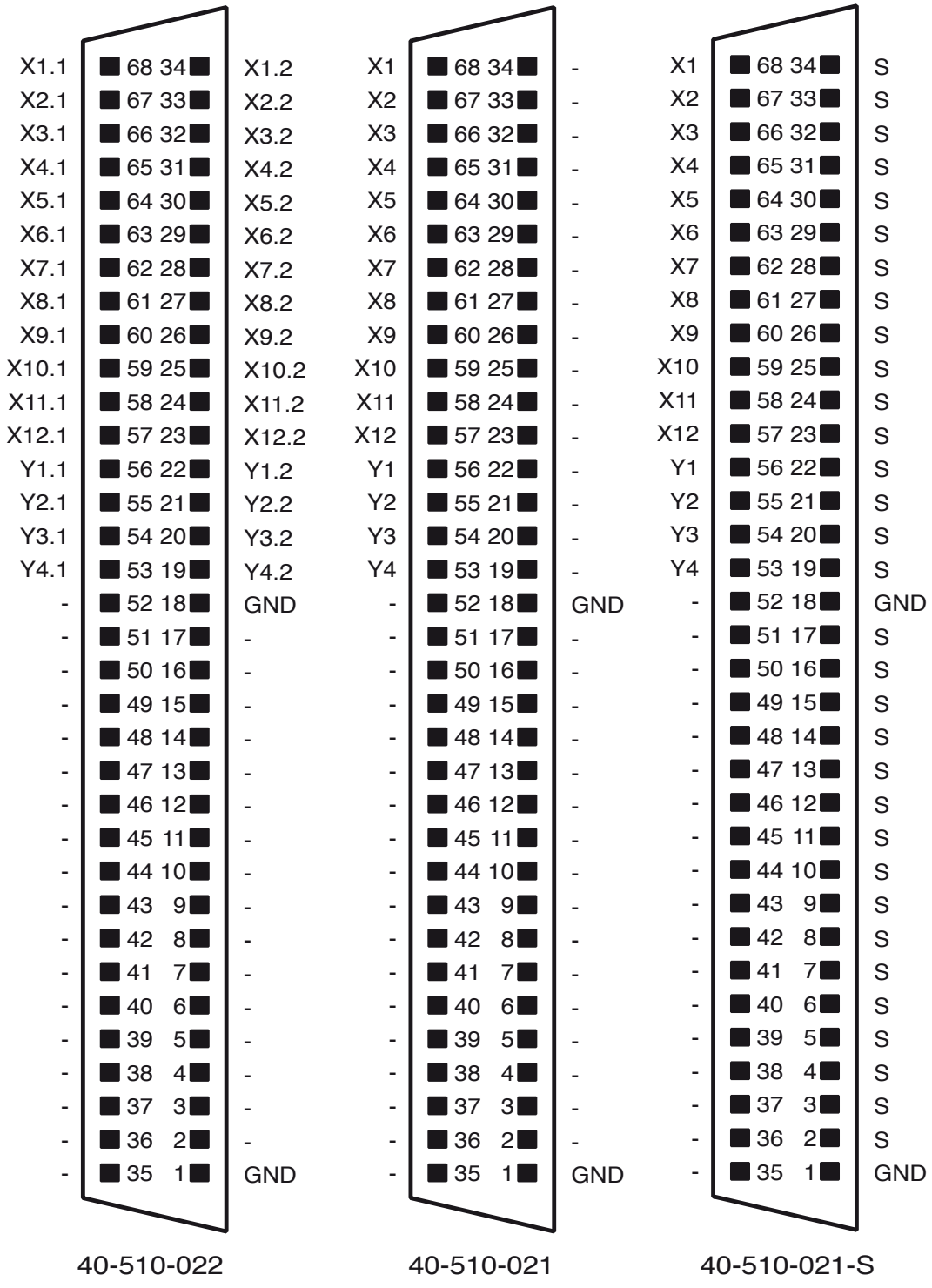


Figure 5.1 - Matrix Module 40-510: Pin Outs

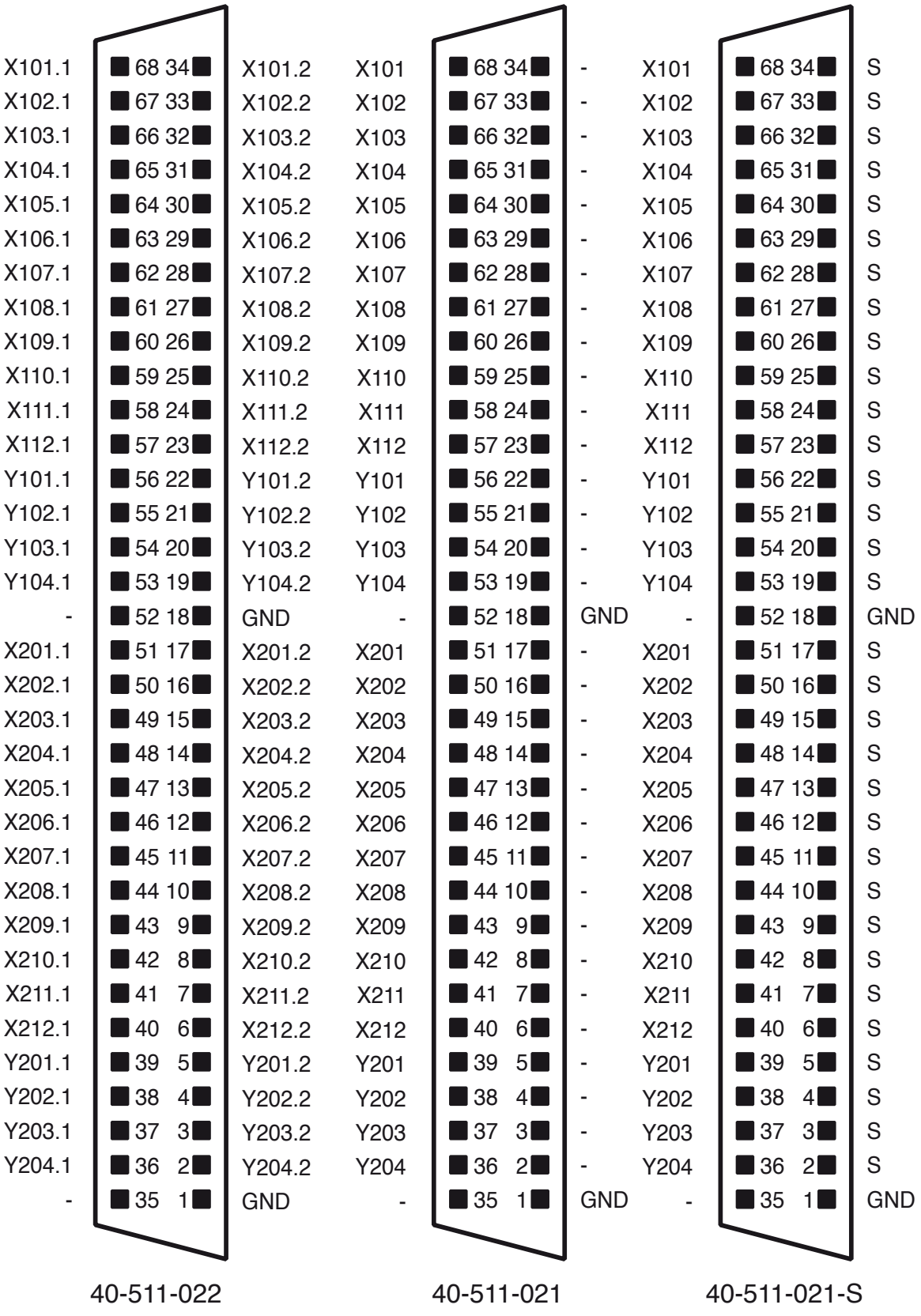


Figure 5.2 - Matrix Module 40-511: Pin Outs

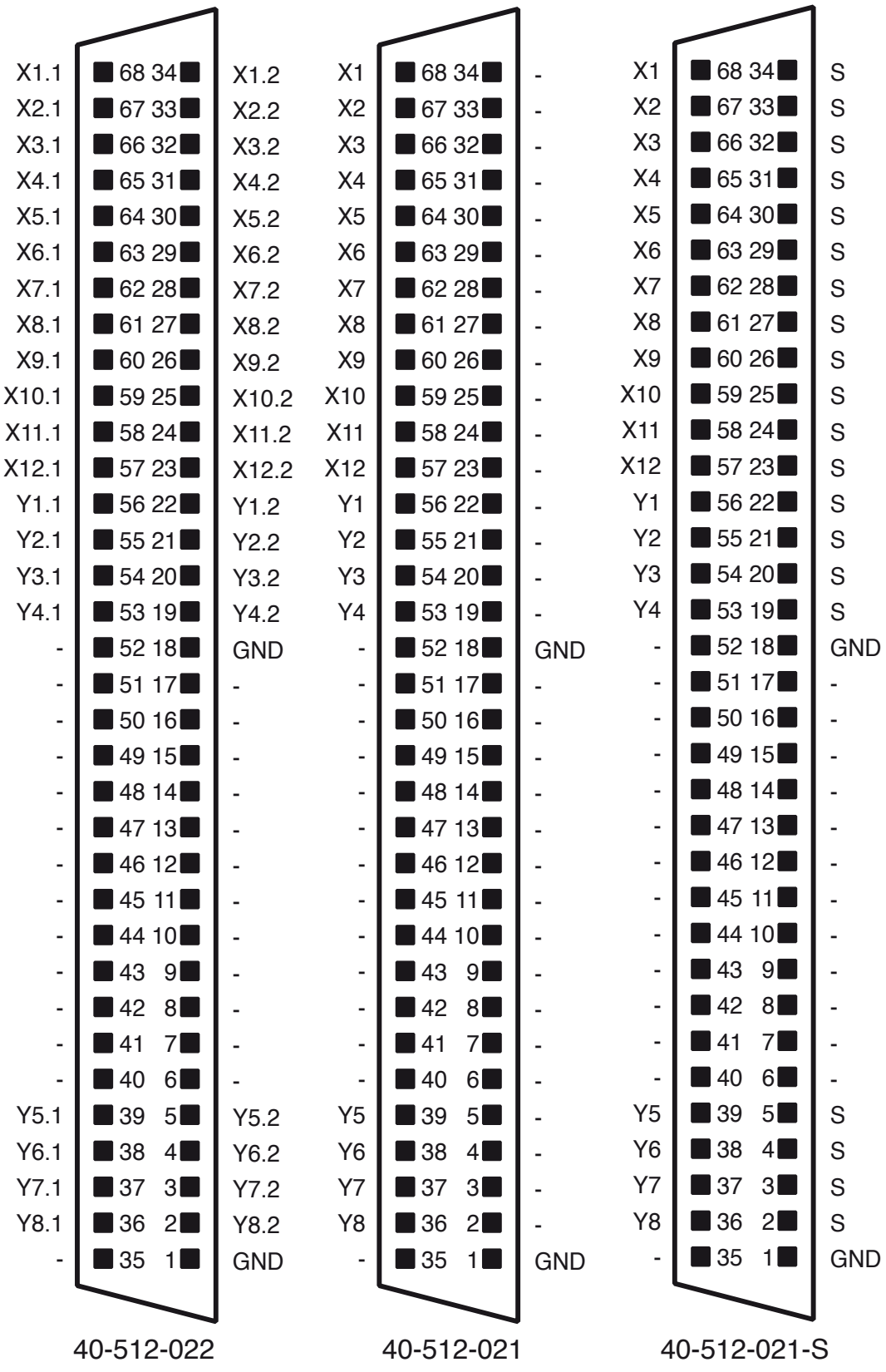


Figure 5.3 - Matrix Module 40-512: Pin Outs

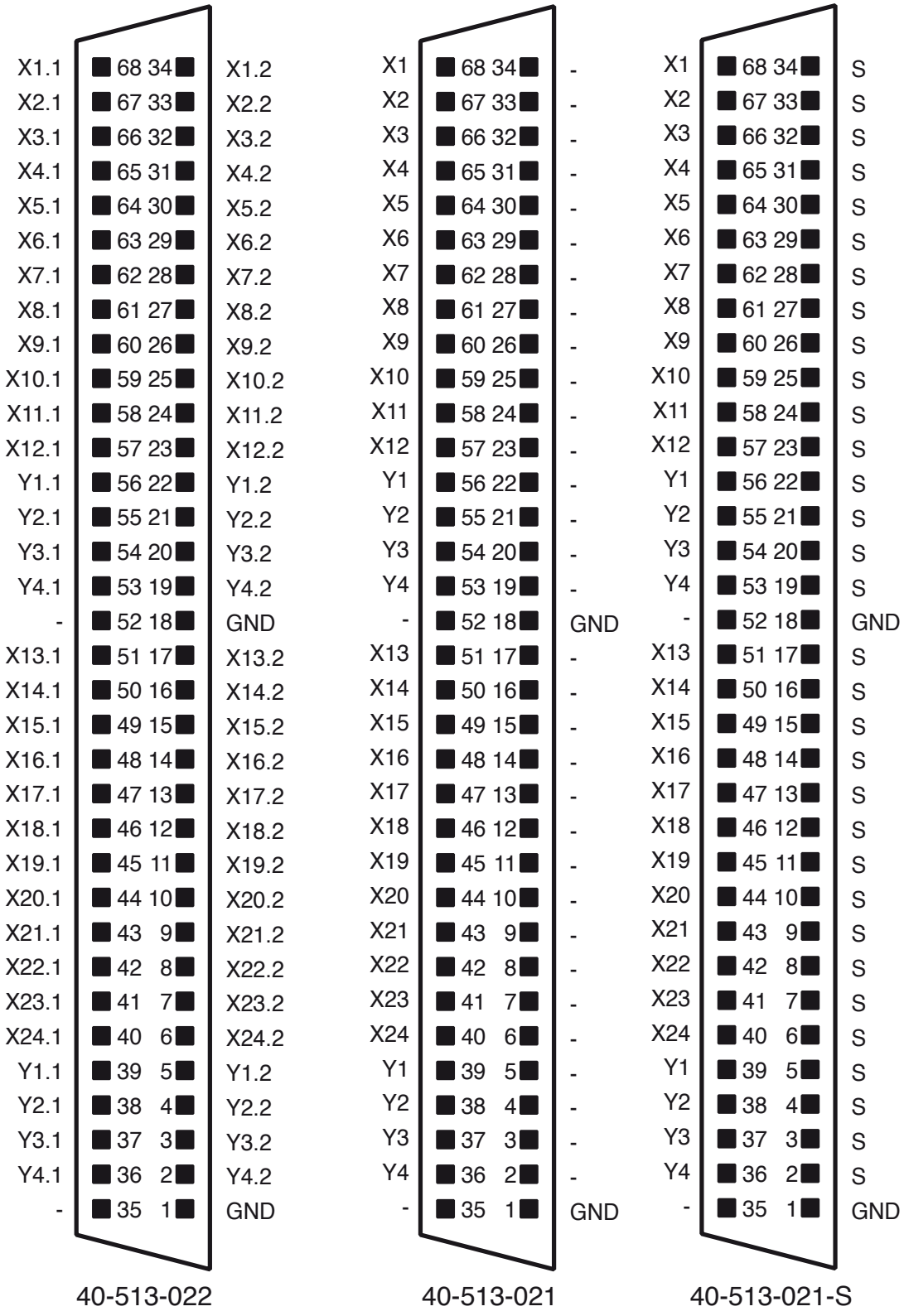


Figure 3.4 - Matrix Module 40-513: Pin Outs

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.

Tables 5.1 to 5.4 provide relay locations and their associated crosspoints.

NOTE

The high density of relays on this module means that the replacement of faulty relays should only be carried out by qualified personnel using the correct equipment. If qualified personnel or the correct equipment are unavailable please return the module to Pickering Interfaces for repair.

TABLE 5.1 - Single 12 x 4 Matrix 40-510-021/022 Relay Layout

	ROW A		ROW B		ROW C		ROW D	
COLUMN	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT
1	1	X1, Y1	13	X1, Y2	25	X1, Y3	37	X1, Y4
2	2	X2, Y1	14	X2, Y2	26	X2, Y3	38	X2, Y4
3	3	X3, Y1	15	X3, Y2	27	X3, Y3	39	X3, Y4
4	4	X4, Y1	16	X4, Y2	28	X4, Y3	40	X4, Y4
5	5	X5, Y1	17	X5, Y2	29	X5, Y3	41	X5, Y4
6	6	X6, Y1	18	X6, Y2	30	X6, Y3	42	X6, Y4
7	7	X7, Y1	19	X7, Y2	31	X7, Y3	43	X7, Y4
8	8	X8, Y1	20	X8, Y2	32	X8, Y3	44	X8, Y4
9	9	X9, Y1	21	X9, Y2	33	X9, Y3	45	X9, Y4
10	10	X10, Y1	22	X10, Y2	34	X10, Y3	46	X10, Y4
11	11	X11, Y1	23	X11, Y2	35	X11, Y3	47	X11, Y4
12	12	X12, Y1	24	X12, Y2	36	X12, Y3	48	X12, Y4

TABLE 5.2 - Dual 12 x 4 Matrix 40-511-021/022 Relay Layout

		ROW A		ROW B		ROW C		ROW D	
COLUMN	SUB-UNIT NUMBER	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT
1	1	1	X1, Y1	13	X1, Y2	25	X1, Y3	37	X1, Y4
2	1	2	X2, Y1	14	X2, Y2	26	X2, Y3	38	X2, Y4
3	1	3	X3, Y1	15	X3, Y2	27	X3, Y3	39	X3, Y4
4	1	4	X4, Y1	16	X4, Y2	28	X4, Y3	40	X4, Y4
5	1	5	X5, Y1	17	X5, Y2	29	X5, Y3	41	X5, Y4
6	1	6	X6, Y1	18	X6, Y2	30	X6, Y3	42	X6, Y4
7	1	7	X7, Y1	19	X7, Y2	31	X7, Y3	43	X7, Y4
8	1	8	X8, Y1	20	X8, Y2	32	X8, Y3	44	X8, Y4
9	1	9	X9, Y1	21	X9, Y2	33	X9, Y3	45	X9, Y4
10	1	10	X10, Y1	22	X10, Y2	34	X10, Y3	46	X10, Y4
11	1	11	X11, Y1	23	X11, Y2	35	X11, Y3	47	X11, Y4
12	1	12	X12, Y1	24	X12, Y2	36	X12, Y3	48	X12, Y4
13	2	1	X1, Y1	13	X1, Y2	25	X1, Y3	37	X1, Y4
14	2	2	X2, Y1	14	X2, Y2	26	X2, Y3	38	X2, Y4
15	2	3	X3, Y1	15	X3, Y2	27	X3, Y3	39	X3, Y4
16	2	4	X4, Y1	16	X4, Y2	28	X4, Y3	40	X4, Y4
17	2	5	X5, Y1	17	X5, Y2	29	X5, Y3	41	X5, Y4
18	2	6	X6, Y1	18	X6, Y2	30	X6, Y3	42	X6, Y4
19	2	7	X7, Y1	19	X7, Y2	31	X7, Y3	43	X7, Y4
20	2	8	X8, Y1	20	X8, Y2	32	X8, Y3	44	X8, Y4
21	2	9	X9, Y1	21	X9, Y2	33	X9, Y3	45	X9, Y4
22	2	10	X10, Y1	22	X10, Y2	34	X10, Y3	46	X10, Y4
23	2	11	X11, Y1	23	X11, Y2	35	X11, Y3	47	X11, Y4
24	2	12	X12, Y1	24	X12, Y2	36	X12, Y3	48	X12, Y4

TABLE 5.3 - Single 12 x 8 Matrix 40-512-021/022 Relay Layout

	ROW A		ROW B		ROW C		ROW D	
COLUMN	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT
1	1	X1, Y1	13	X1, Y2	25	X1, Y3	37	X1, Y4
2	2	X2, Y1	14	X2, Y2	26	X2, Y3	38	X2, Y4
3	3	X3, Y1	15	X3, Y2	27	X3, Y3	39	X3, Y4
4	4	X4, Y1	16	X4, Y2	28	X4, Y3	40	X4, Y4
5	5	X5, Y1	17	X5, Y2	29	X5, Y3	41	X5, Y4
6	6	X6, Y1	18	X6, Y2	30	X6, Y3	42	X6, Y4
7	7	X7, Y1	19	X7, Y2	31	X7, Y3	43	X7, Y4
8	8	X8, Y1	20	X8, Y2	32	X8, Y3	44	X8, Y4
9	9	X9, Y1	21	X9, Y2	33	X9, Y3	45	X9, Y4
10	10	X10, Y1	22	X10, Y2	34	X10, Y3	46	X10, Y4
11	11	X11, Y1	23	X11, Y2	35	X11, Y3	47	X11, Y4
12	12	X12, Y1	24	X12, Y2	36	X12, Y3	48	X12, Y4
13	49	X1, Y15	61	X1, Y6	73	X1, Y7	85	X1, Y8
14	50	X2, Y5	62	X2, Y6	74	X2, Y7	86	X2, Y8
15	51	X3, Y5	63	X3, Y6	75	X3, Y7	87	X3, Y8
16	52	X4, Y5	64	X4, Y6	76	X4, Y7	88	X4, Y8
17	53	X5, Y5	65	X5, Y6	77	X5, Y7	89	X5, Y8
18	54	X6, Y5	66	X6, Y6	78	X6, Y7	90	X6, Y8
19	55	X7, Y5	67	X7, Y6	79	X7, Y7	91	X7, Y8
20	56	X8, Y5	68	X8, Y6	80	X8, Y7	92	X8, Y8
21	57	X9, Y5	69	X9, Y6	81	X9, Y7	93	X9, Y8
22	58	X10, Y5	70	X10, Y6	82	X10, Y7	94	X10, Y48
23	59	X11, Y5	71	X11, Y6	83	X11, Y7	95	X11, Y8
24	60	X12, Y5	72	X12, Y6	84	X12, Y7	96	X12, Y8

TABLE 5.4 - Dual 24 x 4 Matrix 40-513-021/022 Relay Layout

	ROW A		ROW B		ROW C		ROW D	
COLUMN	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT	LOGICAL RELAY NUMBER	CROSSPOINT
1	1	X1, Y1	25	X1, Y2	49	X1, Y3	73	X1, Y4
2	2	X2, Y1	26	X2, Y2	50	X2, Y3	74	X2, Y4
3	3	X3, Y1	27	X3, Y2	51	X3, Y3	75	X3, Y4
4	4	X4, Y1	28	X4, Y2	52	X4, Y3	76	X4, Y4
5	5	X5, Y1	29	X5, Y2	53	X5, Y3	77	X5, Y4
6	6	X6, Y1	30	X6, Y2	54	X6, Y3	78	X6, Y4
7	7	X7, Y1	31	X7, Y2	55	X7, Y3	79	X7, Y4
8	8	X8, Y1	32	X8, Y2	56	X8, Y3	80	X8, Y4
9	9	X9, Y1	33	X9, Y2	57	X9, Y3	81	X9, Y4
10	10	X10, Y1	34	X10, Y2	58	X10, Y3	82	X10, Y4
11	11	X11, Y1	35	X11, Y2	59	X11, Y3	83	X11, Y4
12	12	X12, Y1	36	X12, Y2	60	X12, Y3	84	X12, Y4
13	13	X13, Y1	37	X13, Y2	61	X13, Y3	85	X13, Y4
14	14	X14, Y1	38	X14, Y2	62	X14, Y3	86	X14, Y4
15	15	X15, Y1	39	X15, Y2	63	X15, Y3	87	X15, Y4
16	16	X16, Y1	40	X16, Y2	64	X16, Y3	88	X16, Y4
17	17	X17, Y1	41	X17, Y2	65	X17, Y3	89	X17, Y4
18	18	X18, Y1	42	X18, Y2	66	X18, Y3	90	X18, Y4
19	19	X19, Y1	43	X19, Y2	67	X19, Y3	91	X19, Y4
20	20	X20, Y1	44	X20, Y2	68	X20, Y3	92	X20, Y4
21	21	X21, Y1	45	X21, Y2	69	X21, Y3	93	X21, Y4
22	22	X22, Y1	46	X22, Y2	70	X22, Y3	94	X22, Y4
23	23	X23, Y1	47	X23, Y2	71	X23, Y3	95	X23, Y4
24	24	X24, Y1	48	X24, Y2	72	X24, Y3	96	X24, Y4

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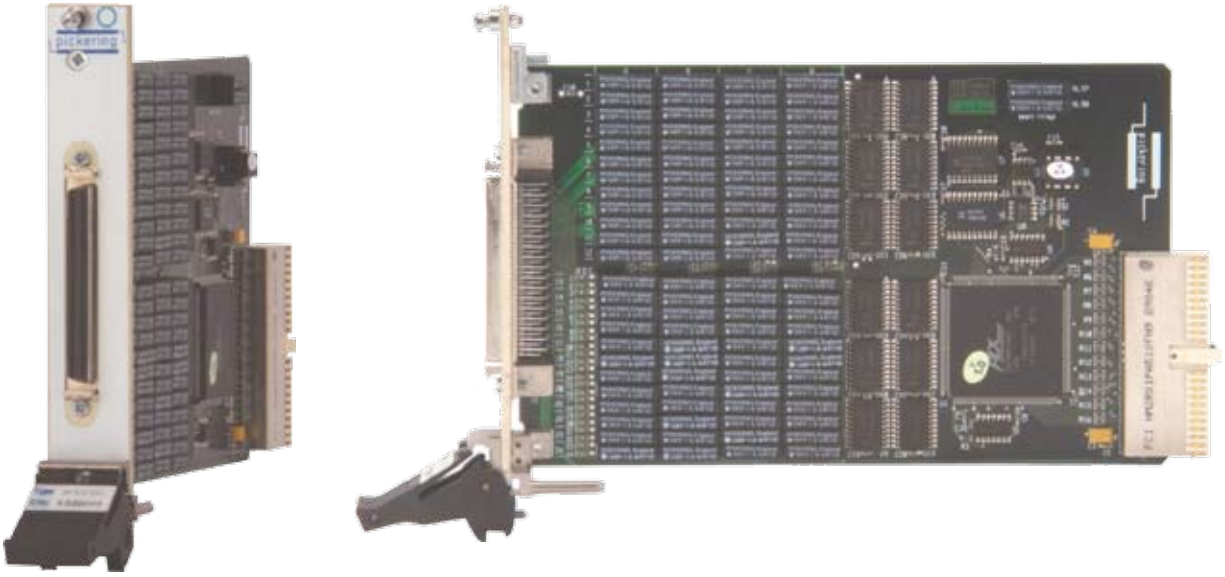
SECTION 7 - FUNCTIONAL DESCRIPTION

MECHANICAL DESCRIPTION

The 40-51* range of Matrix Modules conform to the 3U height (128mm) Eurocard standard. Each module comprises the following:

- CPCI Ejector Handle
- Front Panel mounted 68-way SCSI 2 Type connector
- 48 or 96 Ruthenium Reed Switches, or
- 48 or 96 Screened Ruthenium Reed Switches (-S) versions only
- Two spare Reed Switches (Relays RL97 and 98) (See note)
- 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 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 68-way SCSI type connector, J2. A bank of relays, which are either single pole, screened single pole or two pole depending on the module type are energised via control signals from storage registers U9 to U20. The storage registers are addressed by PCI bridge U1 to output the required signal. Module configuration, i.e. 12 x 4, 12 x 8, 24 x 4, etc, is determined by hardwired links and data stored in EEPROM U8. PCI Bridge U1 is configured by EEPROM U2.

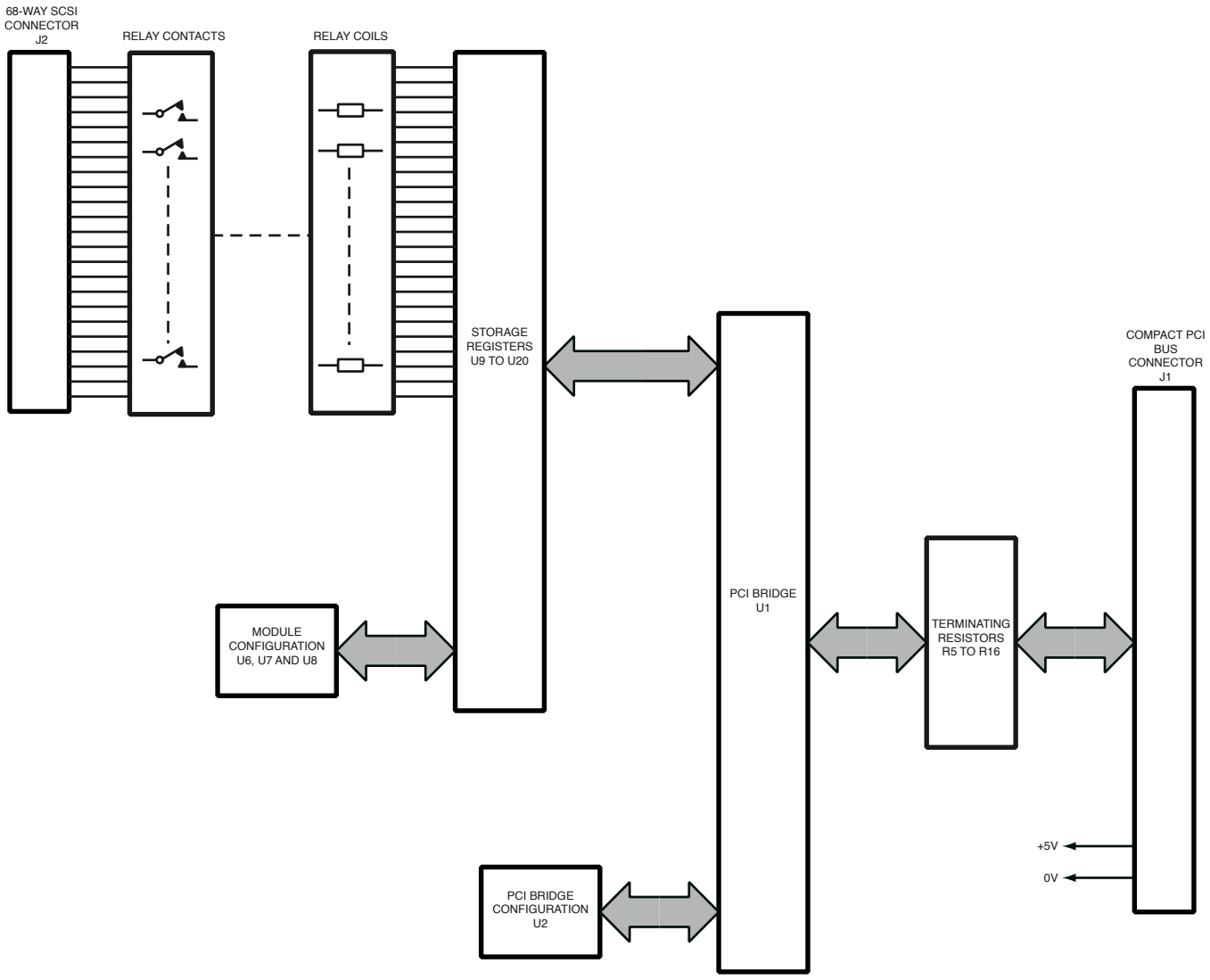


Figure 7.1 - Matrix Module (40-510/511/512/513): Functional Block Diagram

SECTION 8 - PARTS LIST

Table 8.1 provides a parts list and Figure 8.1 a component layout diagram for the 40-51* series Matrix Modules.

TABLE 8.1 - Matrix Module 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, R4	C/RS/085	RESISTOR 10k 0805	2
R5 to R16	C/RS/102	RESISTOR N/W 4 x 10R 1206	12
RLA1 to D24, RL97, RL98	C/RL/086	109-2-A-5/2D	98
C1, C2, C5 to C30	C/CP/034	CAPACITOR 100nF 0603	28
C3, C4	C/CP/024	CAPACITOR 10uF TANT SMD	2
J1	C/CN/355	cPCI J1 CONNECTOR	1
	C/MS/071	FEMALE CODING KEY, BRILLIANT BLUE, V	1
J2	C/CN/363	SCSI3 68 PIN	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, U5	C/IC/087	74HCT32 SOP	2
U6	C/IC/100	74HCT273 SOP	1
U7	C/IC/101	74HCT244 SOP	1
U8	C/IC/090	93C56 SOP	1
U9 to U20	C/IC/102	74ACT273 SOP	12

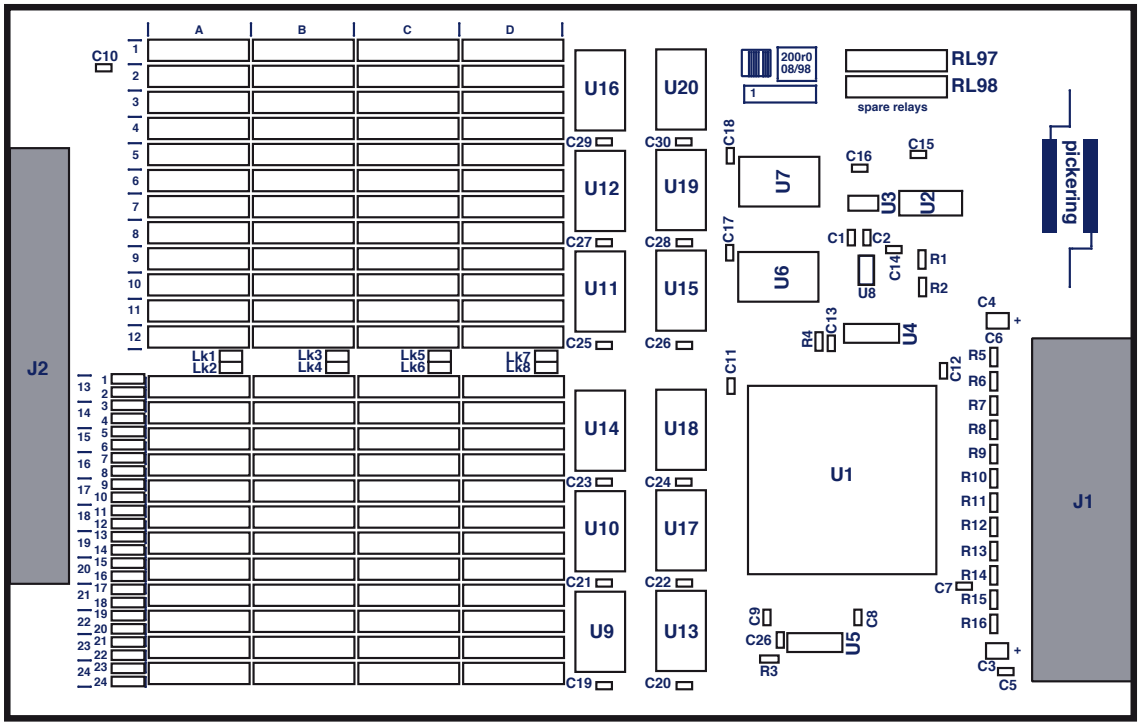
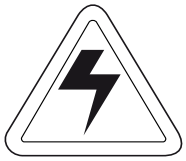


Figure 8.1 - Matrix Module: Component Layout

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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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