60-590 User Manual

LXI High Density EMR Matrix



pickeringtest.com

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FM38792

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All products manufactured by Pickering Interfaces are warranted against defective materials and workmanship for a period of three years, excluding programmable power supplies, from the date of delivery to the original purchaser. Any product found to be defective within this period will, at the discretion of Pickering Interfaces be repaired or replaced.

Products serviced and repaired outside of the warranty period are warranted for ninety days.

Extended warranty and service are available. Please contact Pickering Interfaces by phone, the website or via e-mail.

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Worldwide Technical Support and Product Information

Pickering Interfaces Headquarters

Stephenson Road, Clacton-on-Sea, CO15 4NL United Kingdom
Tel: +44 (0)1255-687900
e-mail: sales@pickeringtest.com

USA

Tel: +1 781 897 1710
e-mail: ussales@pickeringtest.com

France

Tel: +33 9 72 58 77 00
e-mail: frsales@pickeringtest.com

Germany

Tel: +49 89 125 953 160
e-mail: desales@pickeringtest.com

Sweden

Tel: +46 340-69 06 69
e-mail: ndsales@pickeringtest.com

Czech Republic

Tel: +420 558 987 613
e-mail: desales@pickeringtest.com

China

Tel: +86 4008 799 765
e-mail: chinasales@pickeringtest.com

Product Safety

Safety Symbols

The following safety symbols may be used on the product and throughout the product documentation.

Meaning/Description	Symbol
PROTECTIVE EARTH (GROUND) To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode.	
DANGEROUS VOLTAGE To indicate hazards arising from dangerous voltages.	
WARNING/CAUTION An appropriate safety instruction should be followed or caution to a potential hazard exists. Refer to the relevant instructions detailed within the product manual.	
HEAVY If this product is heavy reference should be made to the safety instructions for provisions of lifting and moving.	
STATIC SENSITIVE To indicate that static sensitive devices are present and handling precautions should be followed.	

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Warnings & Cautions

WARNING - Hazardous Environments	Symbol
This product is not specifically designed for use in hazardous environments, for example in explosive atmospheres. If the product is to be used in hazardous environments we recommend that the user ensures suitable protective measures are taken.	

WARNING - Danger of Electric Shock	Symbol
This unit may contain hazardous voltages. Before removing the unit from the rack remove all supplies and disconnect user I/O signals. If the unit has removable modules, unused slots in the chassis must be populated with blanking panels to prevent access to user I/O signals that may be present. Blanking panels are available to order from Pickering. If the product is not used in this manner for example by using an extender card then additional care must be taken to avoid contact with exposed signals. Not to be used in safety critical circuits, refer to the Pickering Interfaces' terms & conditions of sale. This unit must not be used for the switching of Mains Circuits. For the switching of voltages up to the unit's full specification, Secondary Circuit power supplies and the Device Under Test must be fully isolated from the Mains Circuit and the safety earth. The chassis must be correctly installed and be connected to mains or factory safety ground, please refer to the installation section of this manual.	

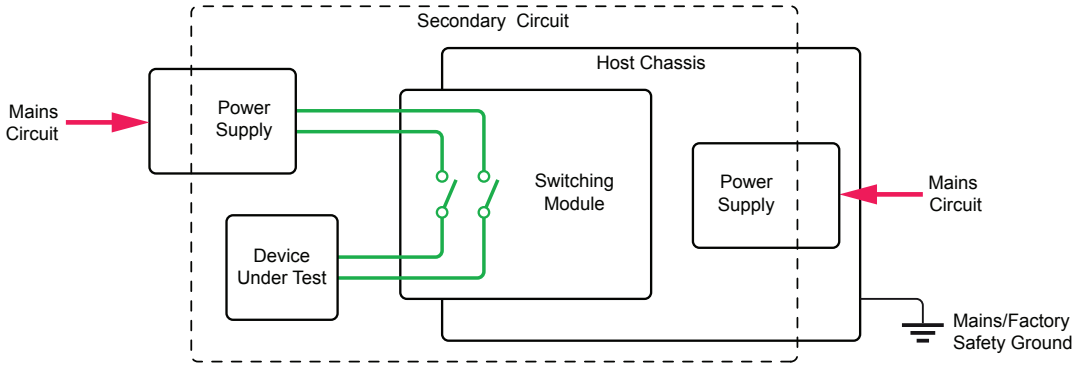


Diagram Showing Separation Between The Mains Circuit and Secondary Circuit / DUT

For the purposes of this document, a Mains Circuit is an installation classified as Overvoltage Category II up to 300 V. Separation between the Secondary Circuit and Mains Circuit is achieved by a transformer in which the primary windings are separated from the secondary windings by reinforced insulation, double insulation, or a screen connected to the protective conductor terminal.

CAUTION - Handling of Electrostatic-Sensitive Devices	Symbol
Certain semiconductor devices used in this equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their unterminated state, or sub-assemblies containing these devices: • Persons removing sub-assemblies from equipment using these devices must be earthed by a wrist strap and a resistor at the point provided on the equipment. • Soldering irons used during the repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer. • Outer clothing worn must be unable to generate static charges. • Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags.	

CAUTION - Product Documentation	Symbol
Suitably qualified & trained users should ensure that the accompanying documentation is fully read and understood before attempting to install or operate the product.	

Safety Instructions

Safety Instructions
All cleaning and servicing requires the equipment to be isolated and disconnected from the power source and user I/O signals (refer to the Maintenance Section). • Appropriate manual handling procedures should be followed as dictated by the weight of the individual module or the combined weight of the modules & chassis. • Should a fault occur with the module or chassis, immediately isolate and disconnect the incoming power to the chassis and the user I/O signals. • Ensure the equipment is installed, operated and maintained by trained and authorised personnel. • For suitably equipped products in the event of an emergency press the red "emergency stop" button situated on the front of the unit.



WARNING - RACK MOUNTING

If it is required to fit this unit into a 19 inch rack, its weight must be supported by side brackets, runners or a suitable equipment shelf.

The fixing holes in the front panel flanges are designed only for securing the device in the rack and must NOT be used to support the weight of the whole device.

Please refer to Appendix A for the procedure for fitting the supplied flanges to either side of the front panel.

Section 1 - Technical Specification



- Single Pole High Density Matrix
- 40x20 and 40x40 Versions
- Loop-Thru Connections For Easy Expansion
- Isolation Switching for Maximum Bandwidth & Contact Life
- Uses High Quality Electro-Mechanical Relays
- Switch up to 180 VDC/130 VAC and up to 60 W Max Power
- Maximum Switch Current of 2 A
- Relay Cycle Counting Included
- Built-In Scan List Sequence Stores With Triggering Capability
- 1U Rack Mountable Enclosure
- Fully Compliant To 1.4 LXI Standard
- IVI & Direct I/O Drivers
- Built-In Diagnostics
- 3 Year Warranty

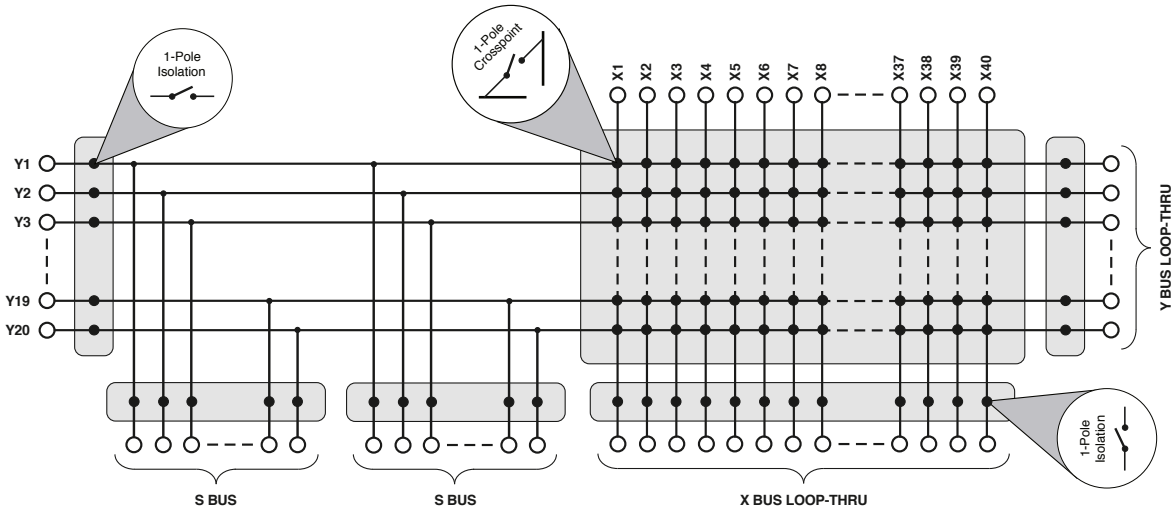
The 60-590 is a high density single pole matrix available in 40x20 or 40x40 configurations and is suitable for signal routing in large ATE systems.

Both the X bus and Y bus include loop-thru connections allowing easy expansion to produce larger matrix sizes.

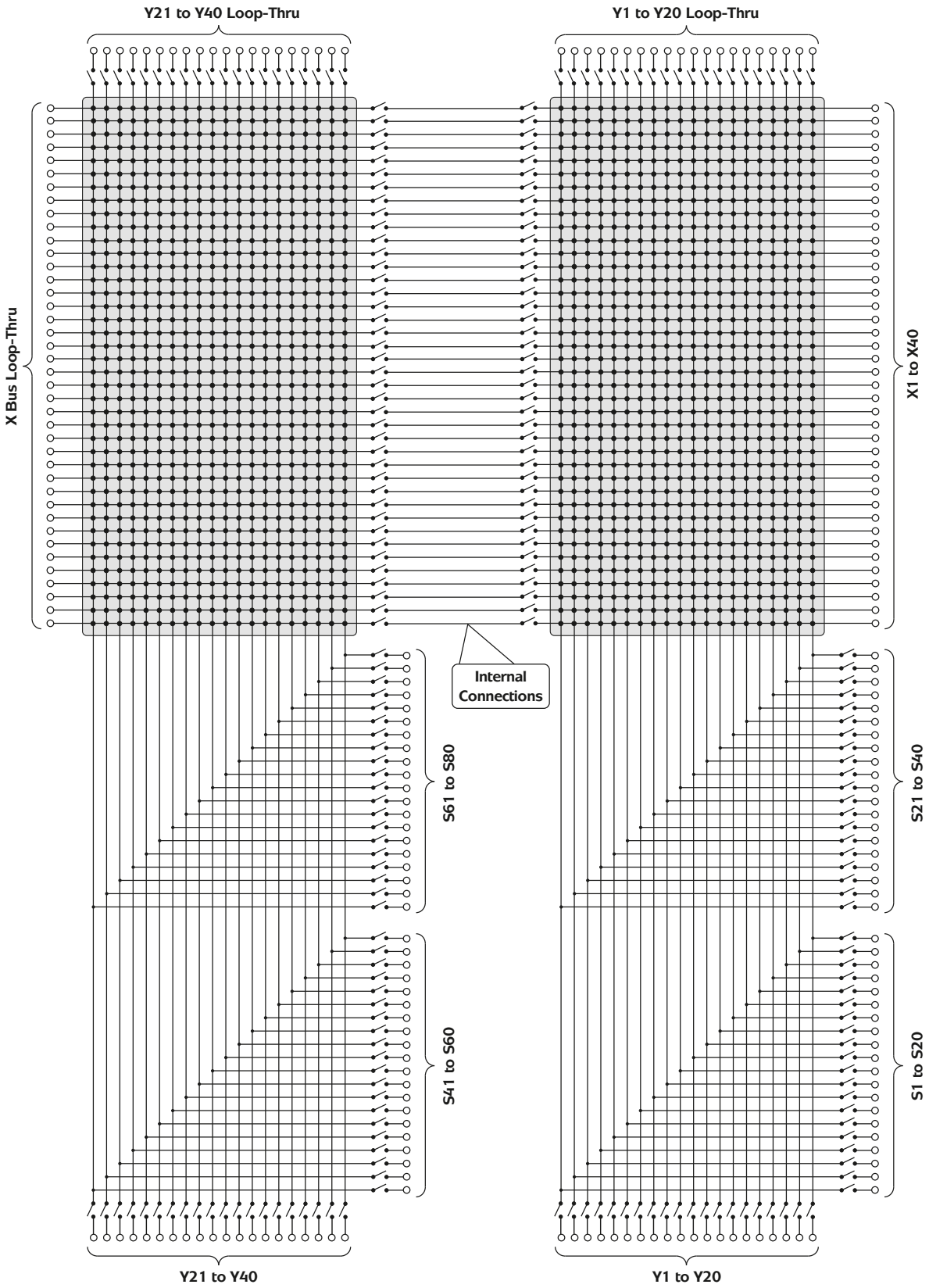
In addition to the loop-thru connections, the Y bus includes two sets of switched signal connections for the attachment of measurement equipment (see switching diagram).

The 60-590 is designed in accordance with the LXI Standard 1.4 and is supplied in a 1U high, full rack width case with 500 mm depth. It is fully programmable via the LAN interface using Pickering Interfaces' generic switch driver. Industry standard (W3C) web browsers can be used to access and change configuration information and provide access to the soft front panels.

The 60-590 is ideal for applications where a simple start-up process is required and for applications requiring control over large distances.



60-590-001 Single 40x20 Matrix Block Diagram



60-590-002 Single 40x40 Matrix Switching Diagram

Relay Cycle Counting

To aid with "health" monitoring this unit is provided with a relay cycle counting feature. The number of operations per contact are stored on the unit and can be used to determine if a relay is approaching EOL. This information could allow system connections to be revised so that signals applied to heavily used contacts are swapped with lightly used contacts to prolong the working life of the relay(s).

Sequencing Service and Triggering

The Sequencing service provides the user with the ability to set a series of pre-determined sequences on an LXI unit. These sequences can be triggered by software or one of the sixteen software configurable open collector triggers.

As the operations are grouped together, it will minimize the number of control transactions required to achieve a composite change of target switch state, condensing multiple operations in a single sub-unit into a single operation, thus reducing the overall system switch settling time.

For example, if a user wants to operate matrix crosspoints X1-Y1, X4-Y1, X2-Y2, in the first sequence, only one operation, and one delay, will be used.

Additionally, as the switch state sequences are stored within the LXI controller, the burden on the Host CPU and Ethernet traffic is greatly reduced, and so the overall system latency is also reduced.

This unit features a software reset line which provides the ability for a user supplied reset to be applied to the unit, triggering a software reset of the relays, returning all relays in the unit to their default state. There is also a software fault line available that will be triggered if there is any error detected within the unit. Please note that while these reset and fault lines use dedicated physical connections to the unit, they are software control lines and as such should not be used for safety interlocks etc.

For more information on the Pickering Sequence Manager please refer to our website.

Relay Type

The 60-590 is fitted with high quality electro-mechanical relays. These relays are leaded types (not surface mount) so field maintenance is greatly simplified. Spare relays are built onto the circuit board to allow easy maintenance with minimum downtime.

Switching Specification

Switch Type	Electro-mechanical
Contact Type:	Palladium-Ruthenium, Gold Covered Bifurcated
Max Switch Voltage:	180 VDC/130 VAC*
Max Power:	62.5 VA, 60 W
Max Switch Current:	2 A
Max Continuous Carry Current:	2 A
Max Pulsed Carry Current Example (for a single switch path):	6 A for 100 ms (up to 10% duty cycle)
Min Switch Current:	<1 nA
Initial Path Resistance - On:	<750 mΩ
Initial Path Resistance - Off:	$>10^9$ Ω
Minimum Voltage:	100 µV
Thermal Offset:	<5 µV
Operate Time:	<3 ms
Expected Life (operations)	
Very low power signal load:	$>1x10^8$
Low power load (2 W):	$>1.5x10^7$ (0.1 A 20 VDC)
Medium power load (30 W):	$>5x10^6$ (1 A 30 VDC)
Full power load (60 W):	$>1x10^5$ (2 A 30 VDC)
Bandwidth (X to Y measurement with no cables connected to loop-thru ports) typical worst case:	
60-590-001 (Single 40x20):	>5 MHz
60-590-002 (Single 40x40):	5 MHz
Crosstalk Performance:	<-40 dB to 1 MHz <-15 dB to 10 MHz
Max Number of simultaneously closed crosspoints:	100

* For full voltage rating, signal sources to be switched must be fully isolated from mains supply and safety earth.

Section 1 - Technical Specification

Power Source

Universal AC mains supply, 90-120/200-240 V 50-60 Hz	
Power Inlet:	Male IEC connector
Power Rating:	100 VA maximum
Fuse Rating:	(F) 5 A, 250 V

LAN Interface

Compliant to LXI Standard 1.4, the 60-590 has a 1000Base-T Ethernet Interface via a standard RJ-45 connector mounted on the rear panel with a display showing the unit's IP address.*

***Note:** Legacy units may not have 1000Base-T support or be fitted with an IP address display.

Mechanical Characteristics

Supplied with front panel ears to enable rack mounting on a shelf or other rear support mechanism.

Dimensions: 1U high, full rack width, 500 mm depth

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

Signal Connectors

Signals via front panel connectors.

X, X Loop-Thru and S connections are via 50-pin male D-types
Y and Y Loop-Thru connections are via 25-pin male D-types.

For pin outs please refer to the operating manual.

Scan List Sequencing

Capable of storing 5000 predefined test sequences, loaded from the host Controller to the LXI unit at process initialization, with the ability to be triggered through software or from any of the sixteen software configurable triggers. For more information on the Pickering Sequence Manager, please go to: pickering-sequence-manager

Triggering

- 16x Software Configurable Bidirectional Open Drain Triggers
- 1x Dedicated Software Reset Line
- 1x Dedicated Software Fault Line
- 1x Dedicated Interlock Line

Sequencing/Triggering port: 25-pin male micro-D connector mounted on the rear panel.

Operating/Storage Conditions

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

Safety & CE Compliance

All products are fully CE compliant and meet applicable EU directives:

Low-voltage safety EN61010-1:2010,
EMC Immunity EN61326-1:2013,
Emissions EN55011:2009+A1:2010.

Section 1 - Technical Specification

Product Order Codes

LXI High Density 40x20 Matrix	60-590-001
LXI High Density 40x40 Matrix	60-590-002

Product Customization

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

Customization can include:

- Alternative relay types
- Mixture of relay types
- Alternative number of relays
- Different performance specifications

All customized products are given a unique part number, fully documented and may be ordered at any time in the future. Please contact your local sales office to discuss.

Support Products

Mating Connectors & Cabling

For connection accessories for the 60-590 please refer to the 90-005D 50-pin D-type and 90-008D 25-pin D-type Connector Accessories data sheets where a complete list and documentation can be found for accessories, or refer to our website.



Pickering can supply mating connectors and cable assemblies to enable easy integration of the 60-590 High Density matrix

Section 2 - Technical Description

Functional Description

The 60-590-002 is a 1-pole matrix with a size of 40x40. The chassis contains an embedded processor assembly, a power supply and two matrix boards designated upper and lower. Both matrix boards are populated with a 40x20 matrix and include isolation switching for the X bus, Y bus and Y Loop-Thru connections. An S bus is included which provides the user with extra connections to the Y axis via isolation relays. The 60-590-001 has a similar architecture but has a matrix size of 40x20 and is only fitted with the lower matrix board. For a detailed illustration of the 60-590's switching architecture, refer to the diagrams in Section 1 of this document.

60-590-001:

The 40x20 matrix is fitted with a single (lower) matrix board, and has 50-pin D-type connectors for the signals X1-40, XLT1-40 and S1-40 and 25-pin D-type connectors for signals Y1-20 and YLT1-20. All these connectors are mounted in a single row on the unit's front panel. **NOTE**: For the 40x20 matrix, to make a connection between the matrix and the XLT1-40 connector, the corresponding isolation relay has to be operated.

60-590-002:

The 40x40 matrix is fitted with two 40x20 matrix boards (upper and lower). The lower row of connectors is the same as described for the 60-590-001, but the XLT1-40 connector is re-located to the upper row. So the upper connector row has 50-pin D-type connectors for XLT1-40 and S41-80 signals and 25-pin D-type connectors for the Y21-40 and YLT21-40 signals. The X bus signals are linked between the upper and lower matrix boards via two sets of isolation relays, so to make a link between the two halves of the matrix, the corresponding isolation relays have to be operated. **NOTE**: For the 40x40 matrix, there are no isolation relays between the matrix and the XLT1-40 connector.

For both versions, switch setting information for the matrix is sent from the Embedded Processor to the relay drivers on the matrix boards via the bridge. Programming information for the processor is sent to the unit via the LAN interface from a remote computer using the unit's unique Ethernet address. Programming documentation for the unit as well as data for Pickering's other LXI compatible switching products is stored in the embedded processor and can be downloaded over the LAN interface. Status LEDs on the front of the chassis indicate the condition of the unit and the LAN connection. An overall functional diagram is shown in Figure 2-1 overleaf.

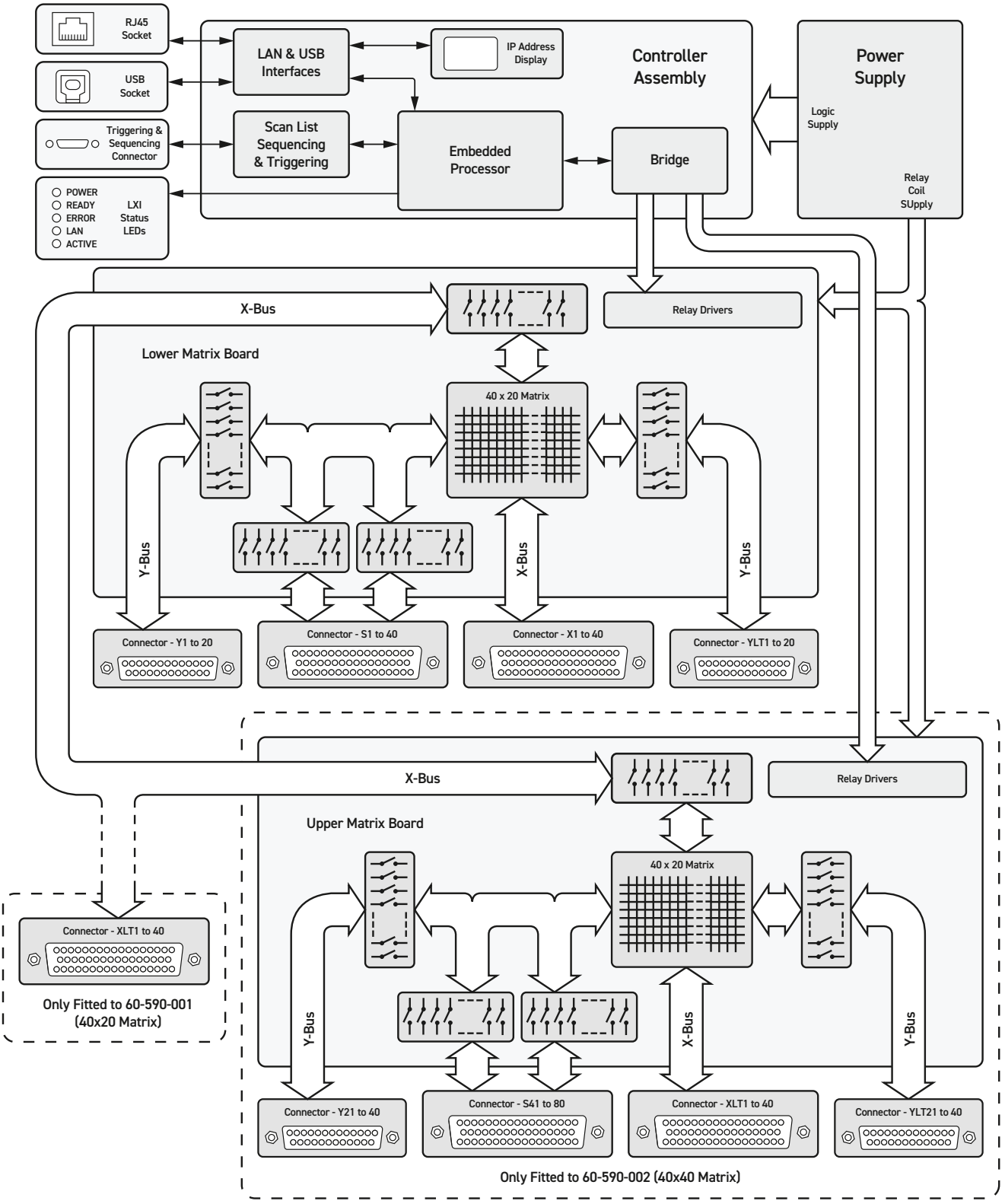


Figure 2-1. Block Diagram for the 60-590-002 LXI High Density 40x40 Matrix

Section 3 - Installation

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

The module is designed for indoor use only.

Pre-operation Checks (Unpacking)

1. Check the module for transport damage and report any damage immediately to Pickering Interfaces. Do not attempt to install the product if any damage is evident.
2. Ensure that the designated area for the product is of flat and solid construction to support its weight.

Installing the High Density EMR Matrix

The 60-590 may be mounted on a desk top or fitted into a standard 19 inch rack (rack versions are supplied with mounting flanges fitted to either side of the front panel). **When fitting into a rack it is important to provide adequate support using side brackets or runners, the mounting holes in the front panel flanges are designed only for securing the unit in the rack and must NOT be used to support the weight of the whole unit.**

The 60-590 relies upon forced air cooling for the power supply, processor and relay circuit boards. Internal fans draw air through slots milled in the front panel of the chassis and expel air through vents on the rear panel. When positioning the chassis, make sure that there is adequate clearance to allow unrestricted air flow through these vents. The locations of the air intakes and outlets are shown in Figures 3-1 and 3-2.

Power is supplied to the rear of the device using a standard IEC power lead and the power on/off switch is located next to the power inlet socket. The device is supplied with a suitable Earthed mains power lead, If a different lead is used it is important to ensure that an adequate Earth connection is present. When mounted in a rack, provision should be made to allow access to the rear of the device. This is to enable the operation of the power on/off switch and the LAN Reset button. The rear panel layout is shown below.

The High Density Matrix is controlled by the host computer via an Ethernet interface. The RJ45 socket on the rear of the unit can be connected to a hub or switch via an Ethernet cable to allow control over a local area or wide area network. Alternatively a crossover Ethernet cable can be used to connect the unit to a laptop PC and local control can be carried out isolated from a network. The IP address of the unit has to be manually or automatically configured before it can be used on a network, please refer to the following section “Setting the IP Address” and the “LXI Getting Started Guide” document to carry out this process.



Figure 3-1. Rear view of the LXI High Density Matrix showing the mains supply connection, LAN socket and cooling air outlet



Figure 3-2. Front view of the LXI High Density Matrix showing the intake slots for cooling air next to the connectors

Setting the IP Address

To use the 60-590 High Density Matrix over a LAN connection it should be set up and configured as described in the "LXI Getting Started Guide" document.

If the IP address is to be set manually and before connecting to a network, contact your IT department so they can give you the correct settings for:

- IP Address
- Subnet Mask
- Default Gateway
- DNS Server(s)

Once you have the required information, the IP configuration window is used to manually set the IP address. This is shown in Figure 3-4.

The current IP address setting of the 60-590 is indicated on a display on the rear panel of the chassis.



Figure 3-3. Display for IP Address on Rear Panel

Incorrect setting will result in a loss of communication and may also be indicated by a red LAN LED on the front panel. If this does occur press and hold the LAN Reset button on the back panel of the device for a full factory reset (see Section 6 "Troubleshooting" for details).

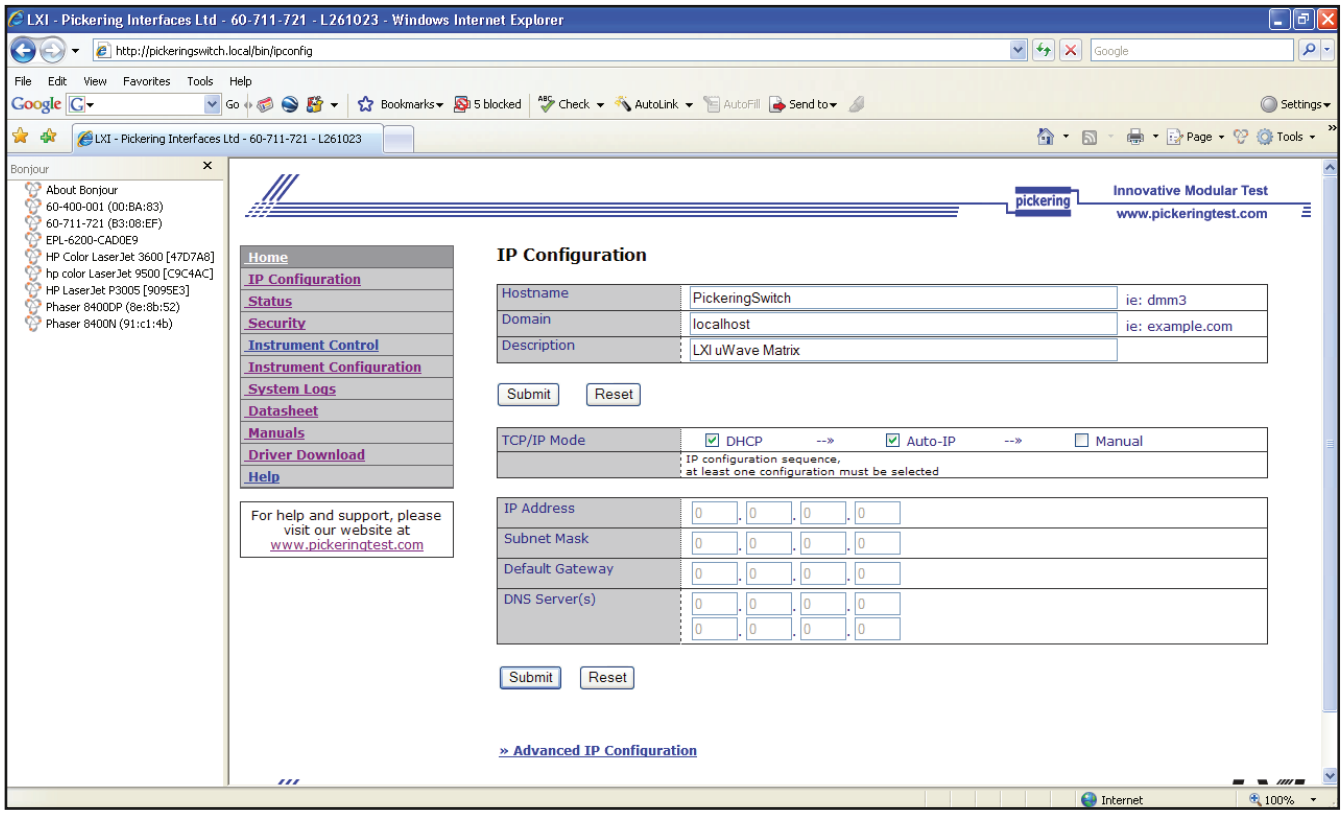


Figure 3-4. Example configuration window used to manually set the IP address of a Pickering LXI device

Installing the Software

The appropriate driver may be found on the Pickering Interfaces web-site via: pickeringtest.info/downloads/drivers/Sys60. Alternatively the driver can be downloaded from the device web page or via the DVD shipped with the product.

Soft Front Panel Operation

The 60-590 High Density Matrix can be programmed using the supplied Soft Front Panel. An example of this is shown in Figure 4-3. For a description of the controls, refer to "Using The Soft Front Panel" at the end of Section 4.

Section 4 - Programming

Programming Options for Pickering Interfaces LXI Units

For information on the installation and use of drivers and the programming of Pickering's products in various software environments, please refer to the Software User Manual.

This is available as a download from:
pickeringtest.com/support/software-drivers-and-downloads

Also, it can be accessed from the DVD supplied with the product:
<DVD_DRIVE>\downloads\Documentation\Software-Manual.pdf

Relay Cycle Counting Feature Details

For information related to the relay cycle counting feature present on this product, please refer to the Relay Cycle Counting User Guide.

This is available as a download from:
pickeringtest.com/portal/web/256/content/private/manuals/Relay-Cycle-Counting-User-Guide.pdf

Also, it can be accessed from the DVD supplied with the product:
<DVD_DRIVE>\downloads\Documentation\Relay-Cycle-Counting-User-Guide.pdf

Sequence Service and Triggering

For a description of the Sequencing Service and Triggering function as well information on the DIO/Trigger port, please refer to the Pickering Sequence Manager Getting Started Guide.

This can be downloaded via the web page:
https://www.pickeringtest.com/kb/software-topics/pickering-sequence-manager

Programming the 60-590

The 60-590-002 is a matrix which has a size of 40 connections on its X axis and 40 on its Y axis. The 60-590-001 is a smaller version with 40 connections on its X axis and 20 on its Y axis. Isolation switches are included on the X Loop-Thru, Y-bus and Y Loop-Thru connections. There are also S buses which provides the user with extra connections to the X axis of the matrix, these also have isolation switches. The model numbers and the corresponding programming sub-units used are summarized in Table 4-1 below and Figures 4-1 and 4-2 overleaf.

Table 4-1. 60-590 Programming Sub-Unit Allocation

Sub-Unit Number	60-590-001 (40x20 Matrix)		60-590-002 (40x40 Matrix)	
	Function	Sub-Unit Type	Function	Sub-Unit Type
1	40x20 Matrix	MATRIX(40x20)	40x40 Matrix	MATRIX(40x40)
2	X Loop-Thru Isolation Switches 1 to 40	SWITCH(40)	X to X Matrix Isolation Switches 1 to 40	SWITCH(40)
3	Y Axis Isolation Switches 1 to 20	SWITCH(20)	Y Axis Isolation Switches 1 to 20	SWITCH(20)
4	Y Loop-Thru Isolation Switches 1 to 20	SWITCH(20)	Y Loop-Thru Isolation Switches 1 to 20	SWITCH(20)
5	S Bus Isolation Switches 1 to 40	SWITCH(40)	S Bus Isolation Switches 1 to 40	SWITCH(40)
6	—	—	X to X Matrix Isolation Switches 1 to 40	SWITCH(40)
7	—	—	Y Axis Isolation Switches 21 to 40	SWITCH(20)
8	—	—	Y Loop-Thru Isolation Switches 21 to 40	SWITCH(20)
9	—	—	S Bus Isolation Switches 41 to 80	SWITCH(40)

Connections are made by operating the relays at the crosspoints between X and Y lines allowing single X-Y connections, or X-X connections using a Y line as a path, or Y-Y connections using an X line as a path. Whenever a crosspoint is enabled, the corresponding Y isolation switch has to be operated to route the signal to the front panel connector. Similarly, if a signal needs to be routed to the Y Loop-Thru connector, the corresponding YLT isolation switch has to be operated. It should be noted that the 40x20 version of the unit has X Loop-Thru switches that operate in the same way as the Y Loop-Thru. However, the 40x40 version of the unit has no X Loop-Thru switching between the matrix and the user connector. In this case the X Loop-Thru switches link the two halves of the matrix, therefore, to make a connection between any of the crosspoints in the range Y21 to Y40 and the front panel X connector, the two X isolation switches in the required X signal line also have to be enabled. See the diagrams in Section 1 of this document for an illustration of the switching architecture.

The following pages give very simple examples using two of the provided drivers: the Direct I/O driver piplx, and the IVI compliant driver pi40iv.

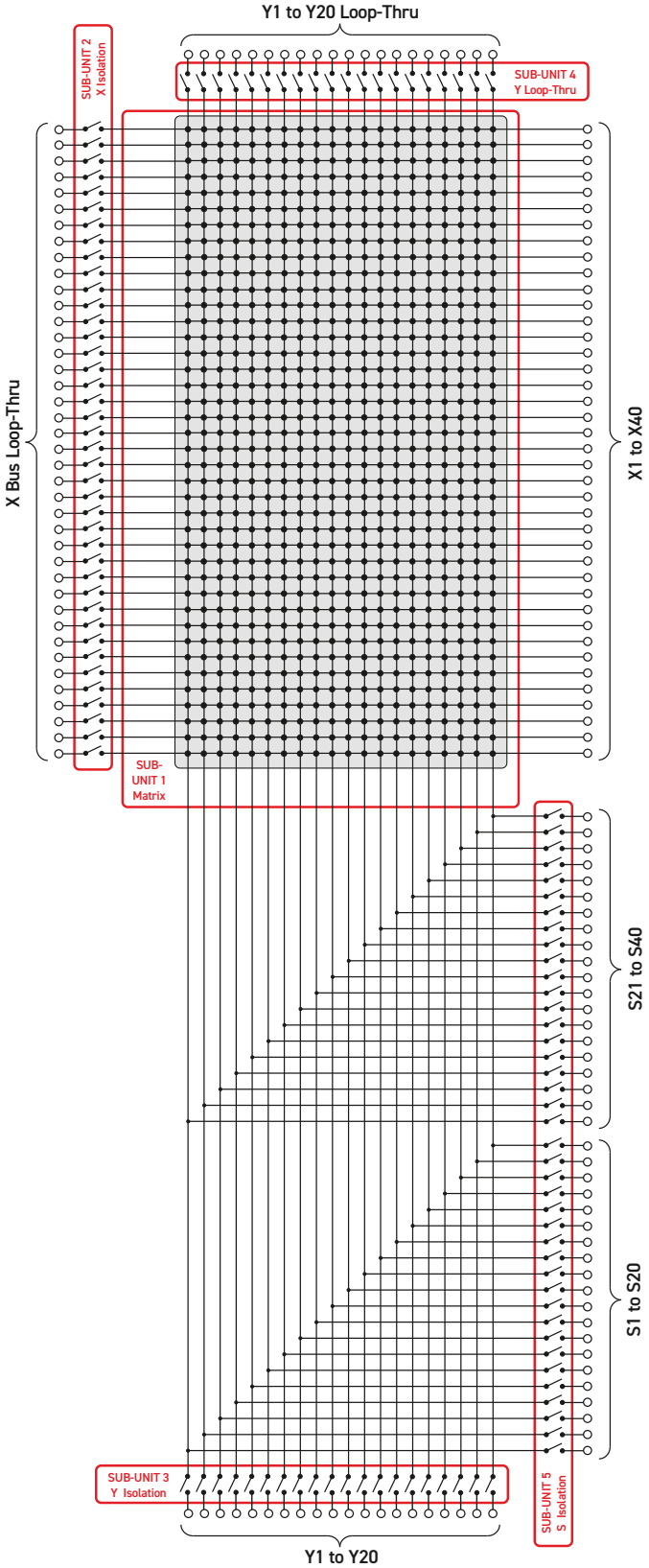


Figure 4-1. 60-590-001 High Density Matrix (40x20 Version) Sub Unit Allocation

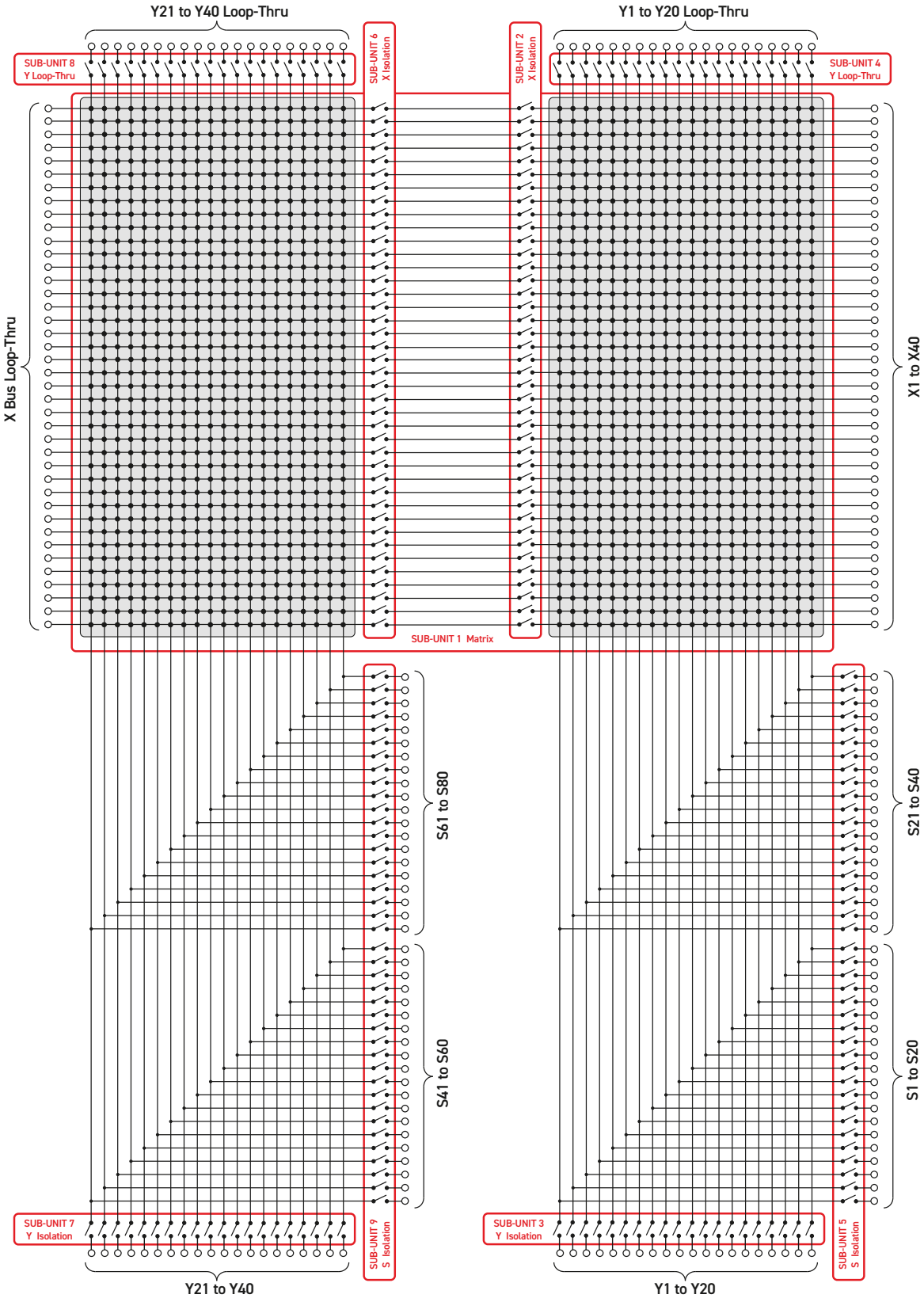


Figure 4-2. 60-590-002 High Density Matrix (40x40 Version) Sub Unit Allocation

Direct I/O Driver , piplx

The Direct I/O driver is in reality composed of a suite of separate libraries which interact to provide full control of a Pickering LXI unit. In the case of a switch card the communications library picmlx, and the switching library piplx, are needed.

Firstly a communication session to the LXI device is established. This provides a session handle to the remote LXI device which must be used in all subsequent communication with the device.

Then a specified card on the remote LXI device is opened and a handle to that card obtained, this handle must be used in all subsequent function calls to that card.

To operate a crosspoint switch, the `OpCrosspoint` function may be used specifying the session and the card handle, as well as the sub-unit to be accessed, the crosspoint location and the required state. In this case the crosspoint at (x,y) = (12,15) on the first sub-unit of the opened card is first energized, then the corresponding Y isolation switch of the third sub-unit is energized using the `OpBit` function, then both the crosspoint and isolation switch are released.

After use the card should be closed and the LXI session released to free the card and LXI device for other use.

```
DWORD err;
SESSION lxi_session;
DWORD card_handle;

err = PICMLX_Connect(0, “192.168.1.100”,  1024, 2000, &lxi_session);

if (err == 0)
{
     err = PIPLX_OpenSpecifiedCard( lxi_session, 0, 5, &card_handle);

     if (err == 0)
     {
       PIPLX_OpCrosspoint(lxi_session, card_handle, 1, 12, 15, 1);//connect crosspoint
       PIPLX_OpBit(session, card_handle, 3, 15, 1);              //connect Y isolation

       PIPLX_OpCrosspoint(lxi_session, card_handle, 1, 12, 15, 0);//release crosspoint
       PIPLX_OpBit(session, card_handle, 3, 15, 0);              //release Y isolation

       PIPLX_CloseSpecifiedCard( lxi_session, card_handle);
     }

     PICMLX_Disconnect(lxi_session);
}
```

There are other ways to control switches, including a function to set the entire matrix at a single command. The user should refer to detailed documentation for the driver to be found in the installation folder.

IVI Driver, pi40iv

Using the pi40iv driver, the `pi40iv_InitWithOptions` function should be used to establish a session on the matrix card.

Switch closures on the matrix are made using the `pi40iv_Connect` function and released using the `pi40iv_Disconnect` function.

The following code snippet demonstrates the minimum steps required to operate a switch on a Pickering LXI unit.

Firstly a device session is opened on the card located at bus 0, device 20 inside the LXI unit located at 192.168.1.100.

Then a switch closure of the matrix point at (x,y) location (12,15) is made then released.

Finally the session is closed.

SSH (Secure SHell) Interface

Refer to the section "Command Line Control of Pickering LXI Instruments" on the following pages for details of how to open this interface and general information on the command set available.

After opening an SSH session the 60-590 is controlled as follows:

To select a matrix crosspoint type **XC** followed by the required row and column separated by a comma, eg: `XC 2,4`

To clear a matrix crosspoint type **XO** followed by the required row and column separated by a comma, eg: `XO 2,4`

Or, to clear all matrix crosspoints, issue a clear sub-unit command, `CS`.

NOTE: Only one user is permitted access to device control at a time. If the device is already in use, the SSH interface may still be opened but will result in no card being accessed.

Soft Front Panel

The 60-590 High Density Matrix can be programmed using the supplied Soft Front Panel. An example of this is shown in Figure 4.3. For a description of the controls, refer to "Using The Soft Front Panel" at the end of the Programming section.

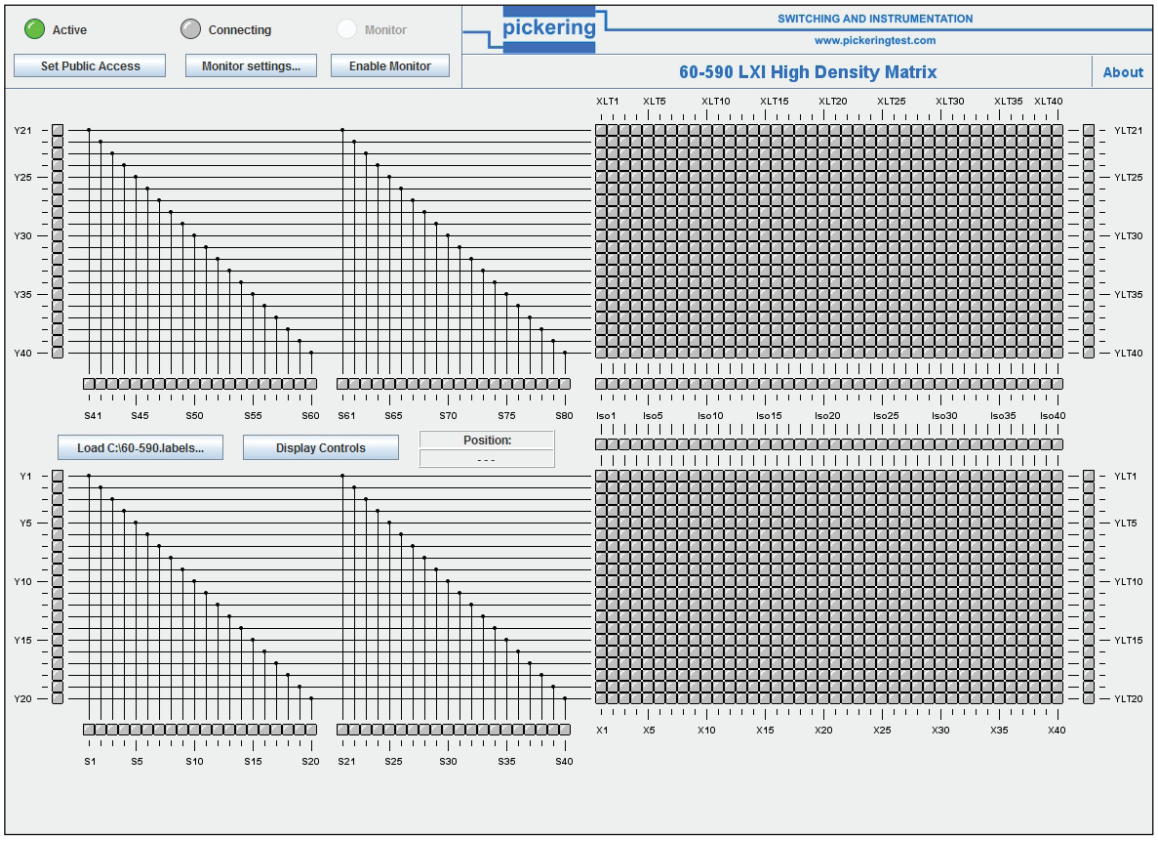


Figure 4-3. 60-590 Soft Front Panel

Command Line Control of Pickering LXI Instruments

Overview

Command line control of the Pickering LXI device range was added in firmware release 2.11. The utility provided was ported to the LXI instrument from the Windows utility PILMon and provides identical functionality.

Enabling the Command Line Control Utility

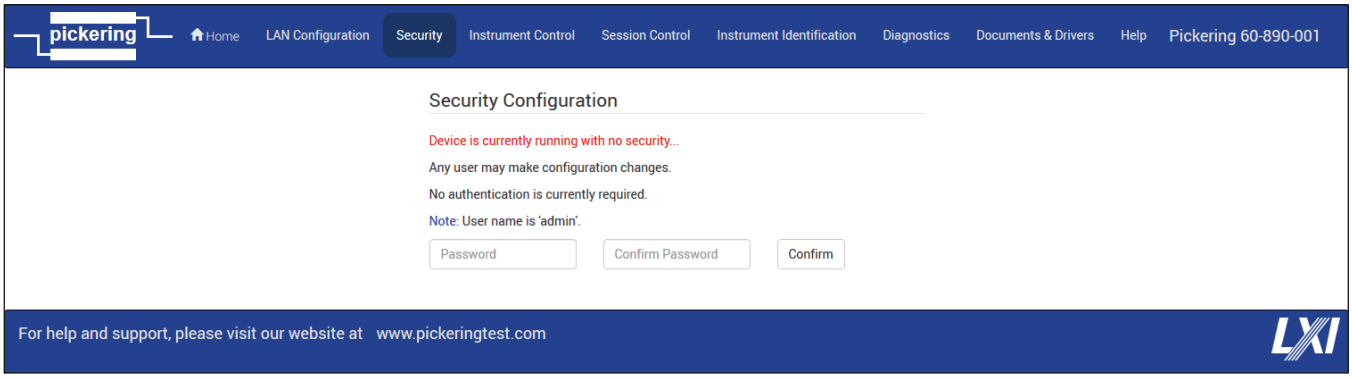
Pickering LXI devices do not provide an SSH server in the normal configuration state, the service must be explicitly enabled.

To do this the user must first enable security, this helps to prevent inadvertent access by limiting the accessibility of instrument services, principally by requiring password access to control functions. Once security is enabled, the SSH server may be started.

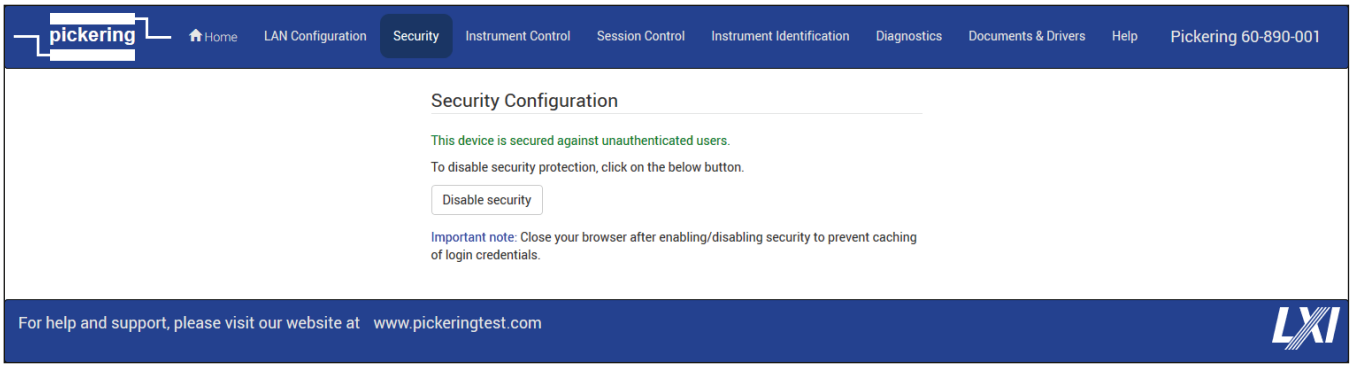
All the following assumes that the user knows the IP address of the LXI device. If this is not known, a number of tools are available, many on the Pickering distribution disk, to allow the IP address to be discovered.

Step 1 - Enable Security

Select the Security Page from the main menu list.

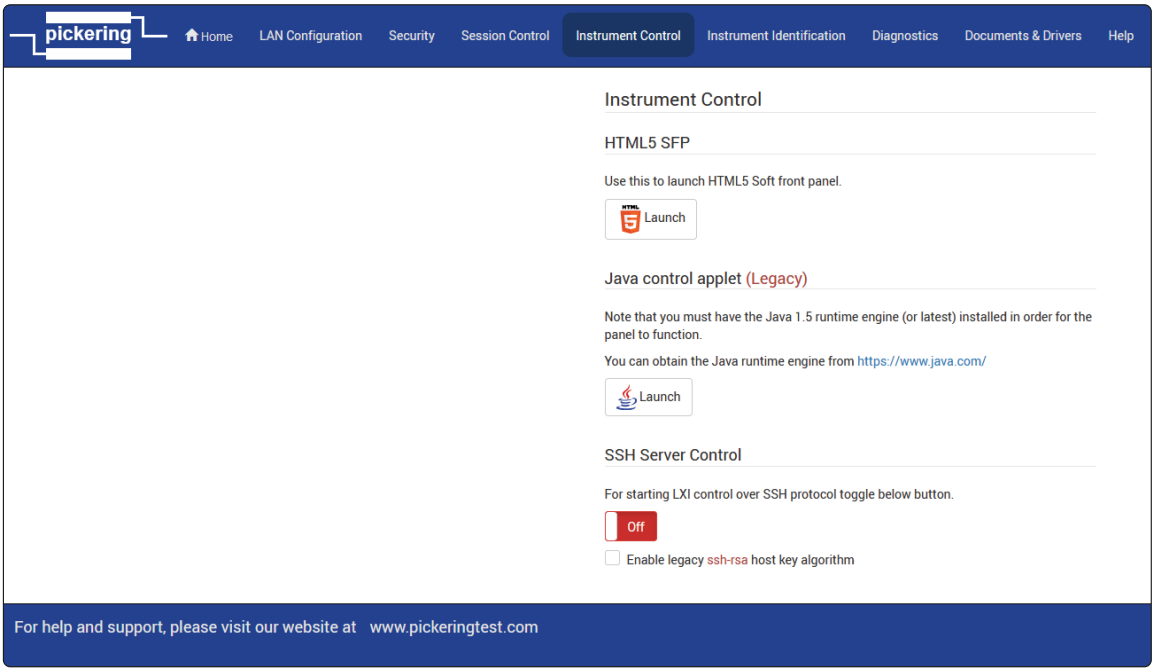


Enter a password and confirm then click on the 'Confirm' button.

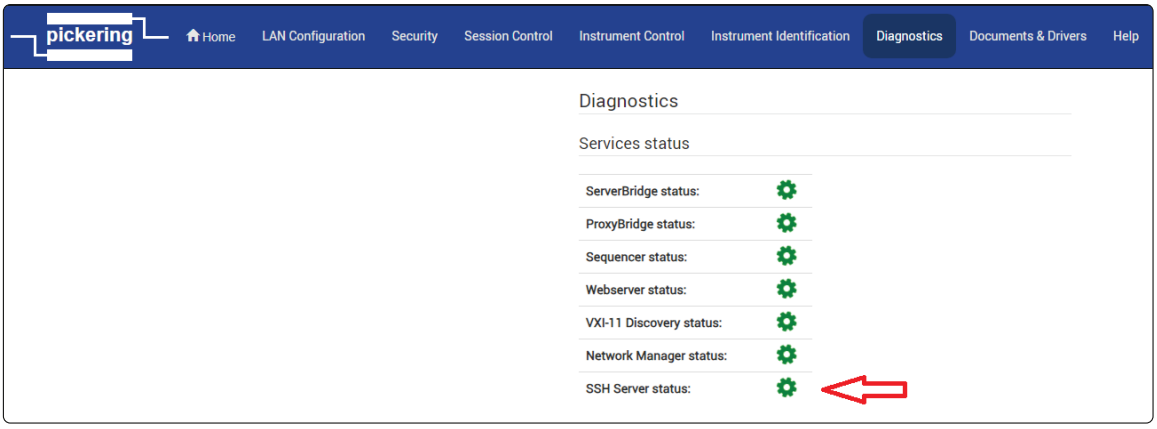


Step 2 - Enable the SSH server

Select the 'Instrument Control' page from the main menu. Navigate to section 'SSH Server Control'.
Click on toggle button to enable SSH server.



Navigate from main menu to 'Diagnostics' page and ensure that SSH server is running. See below image as reference.



The SSH server is now operative and instrument control access is available from an external SSH client application.

NOTES:

The password and state of the SSH server are stored in non-volatile memory within the device and so will remain in effect even after a power cycle. It is important to remember the password applied. Should the password be forgotten, the device may be reset to initial conditions by operating the LAN Reset button located at the rear of the device in the appropriate manner, refer to Section 7 of this manual for details of this process.

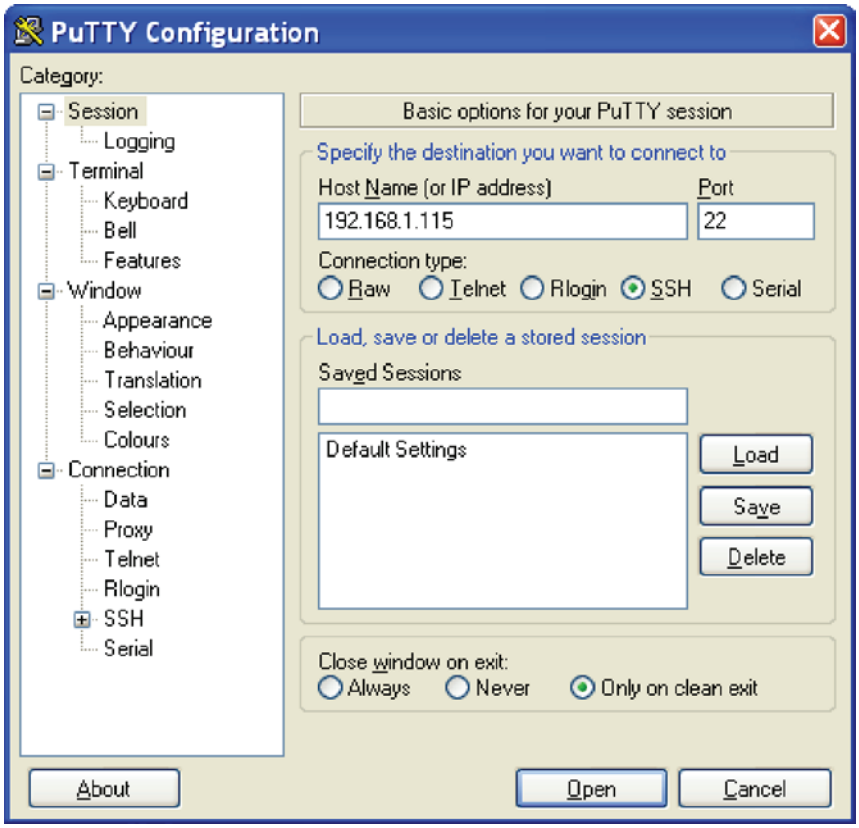
Disabling security will stop the SSH service.

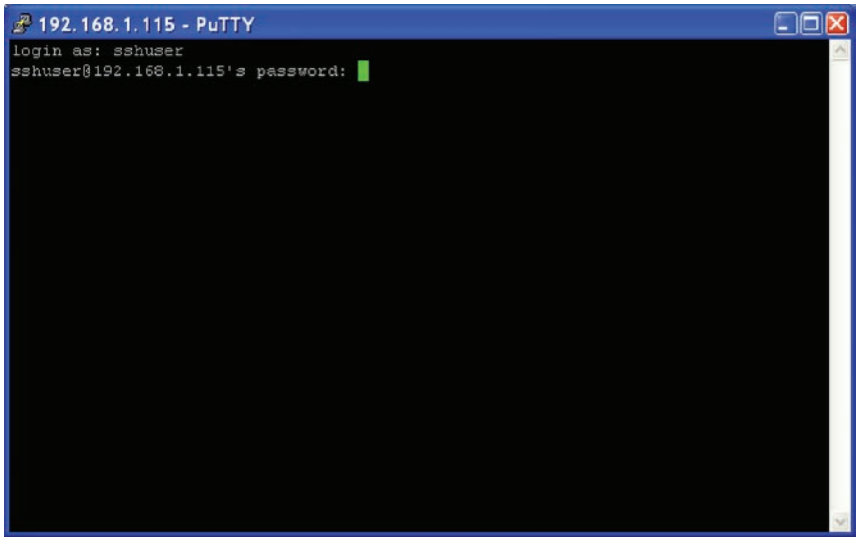
Instrument Control from an SSH Client

In the following examples the SSH client PuTTY is used, the user will have to adapt the instructions for any other client.

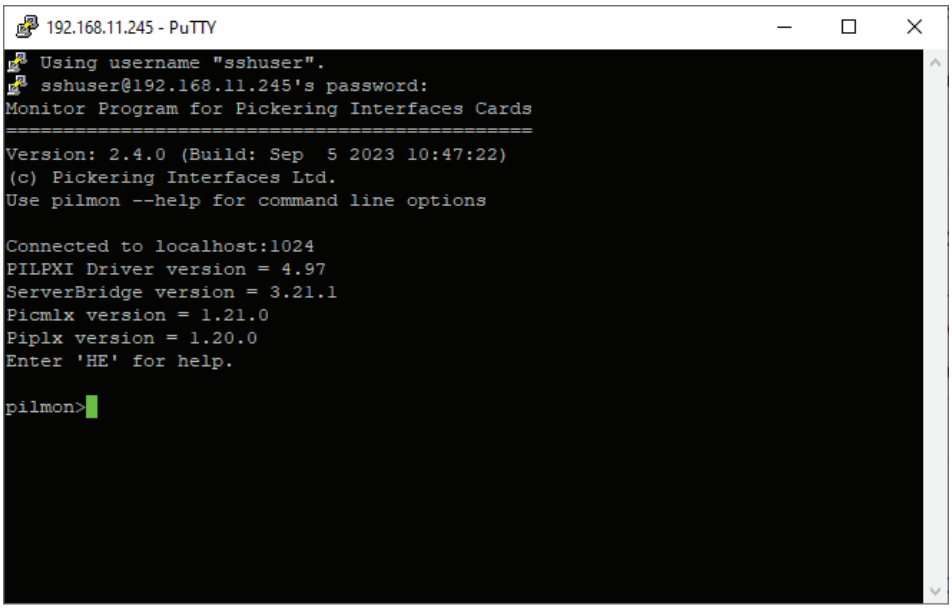
First start up the SSH client and enter the IP address of the LXI device. The user will be prompted for a login name and password.

The username for instrument control is 'sshuser', the password is that defined by the user when setting security.





Once the username and password have been supplied, the LXI device will enter an application providing a command line interface to the switch cards within the device.



When the application is expecting input, the prompt **`pilmon>`** will be displayed. Card control is achieved using a set of mnemonics plus optional data.

By default, the application opens all available switch cards contained in the LXI device. This access is exclusive and prevents other users from accessing the cards thus preventing inadvertent operation of switching functions from another location.

Typing **`HE`** in response to the prompt will list the entire command set available.

For any specific operation the appropriate command must be chosen, here a a few of the more commonly used commands:

Before attempting to control a card it is important to understand the switch architecture of that card and to know how to address the required switch. Each Pickering switch card is represented as a set of one or more sub-units, each sub-unit containing one or more switches. A sub-unit represents a collection of switches of similar type, it may represent an entire matrix, or a row of simple switches, or a power supply voltage setting.

In the case of a switch sub-unit, each switch is represented by a single bit of data and may be toggled between 0 and 1, 0 representing the off state of the switch relay and 1 representing the on state.

The precise relationship between bit positions and switch location is provided in the card manual, or by use of the LS command inside the utility program PILMon in Windows, or by the LXI SSH service application.

Commonly Used Mnemonic Commands

LS Will list all the open cards, providing the Card Number of each which is essential for further control of a card, also provided are the details of the card model number and architecture.

AD This is used to select the card and sub-unit to which commands will be addressed. For example to select the second sub-unit on the first card use `AD 1 2`

SC Closes a switch, needs additional bit position, eg `SC 1` energizes switch 1

SO Opens a switch, also needs additional bit position

SV Obtains the current state of a switch, again bit position is required

SB Sets an entire sub-unit of switches to a binary pattern, requires additional data of a pattern of hexadecimal data, eg: `SB FFFF` will energize 16 relays

CS Clears an entire sub-unit of switches

BV Used to view the current state of all the switches in a sub-unit

Many other commands are available including facilities to obtain status information, to manage masks which may be used to prevent operation of a switch or switches.

It is important to realize the difference between Read and View operations. Read is used to read back data from an input, VIEW to read back the current state of an output.

Examples

AD 1 2 Selects card1, sub-unit 2

SC 3 Closes switch 3 on current sub-unit

AD 1 3 Selects card1, sub-unit 3

BV 5 Obtains state of switch 5 on current sub-unit

In the case of matrix sub-units, the **XC** and **XO** commands are useful, obviating the need for the user to calculate the bit position for a crosspoint in the matrix by allowing a point to be addressed by row and column address.

Appendix 1

```
LXI> he
PILMon commands:
  AD [<card> <sub_unit>]      = [select and] display card/sub-unit to address
  SC <number>                 = close output (set ON)
  SO <number>                 = open output (set OFF)
  SB <bit_pattern>            = set sub-unit outputs (to hex bit-pattern)
  CS                          = clear OUTPUT sub-unit
  RS                          = clear all OUTPUT sub-units on all open cards
  ST                          = display status of currently-selected card
  BV                          = view sub-unit output states (as hex bit-pattern)
  BR                          = read INPUT sub-unit (as hex bit-pattern)
  LS [<card>]                 = list info on all open cards, or specified card
  EC <0|1>                    = turn serial echo OFF|ON (default = ON)
  WC <number> <value>         = write the calibration value for an output
  RC <number>                 = read the calibration value for an output
  LC                          = list calibration values
  DM <bit_pattern>            = set driver mode flags (to hex bit-pattern)
  AC <number>                 = matrix: close all points on single row or column
  CM                          = clear OUTPUT sub-unit mask
  SM <number> <0|1>           = UNMASK|MASK an individual output
  MB <bit_pattern>            = set OUTPUT sub-unit mask (to hex bit-pattern)
  MV                          = view sub-unit output mask (as hex bit-pattern)
  OC                          = take control of all Pickering switch cards
  CC                          = release control of all Pickering switch cards
  VO <bus> <slot>             = open card at specified location
  VC <card>                   = close specified card
  HE|HL                       = show this help information
  SV <number>                 = show state of specified output
  MS <number>                 = show mask state of specified output
  IS <number>                 = show state of specified input
  AR                          = clear all OUTPUT sub-units of the current card
  XC <row> <column>           = close matrix crosspoint
  XO <row> <column>           = open matrix crosspoint
  XV <row> <column>           = show state of a matrix crosspoint
  XM <row> <column> <0|1>     = UNMASK|MASK a matrix crosspoint
  XS <row> <column>           = show matrix crosspoint mask state
  DI                          = show diagnostic information
  SE                          = show sub-unit settling time (µs)
  CL                          = show sub-unit closure limit
  SS                          = show sub-unit status
  PT                          = show PSU type description
  PI                          = show PSU information
  PS <fp value>               = set PSU output voltage
  PV                          = show PSU output voltage setting
  PE <0|1>                    = DISABLE|ENABLE the output of a PSU
  CF                          = show number of free cards
  LF                          = list bus/slot locations of free cards
  Q                           = quit the program
```

Using the Soft Front Panel

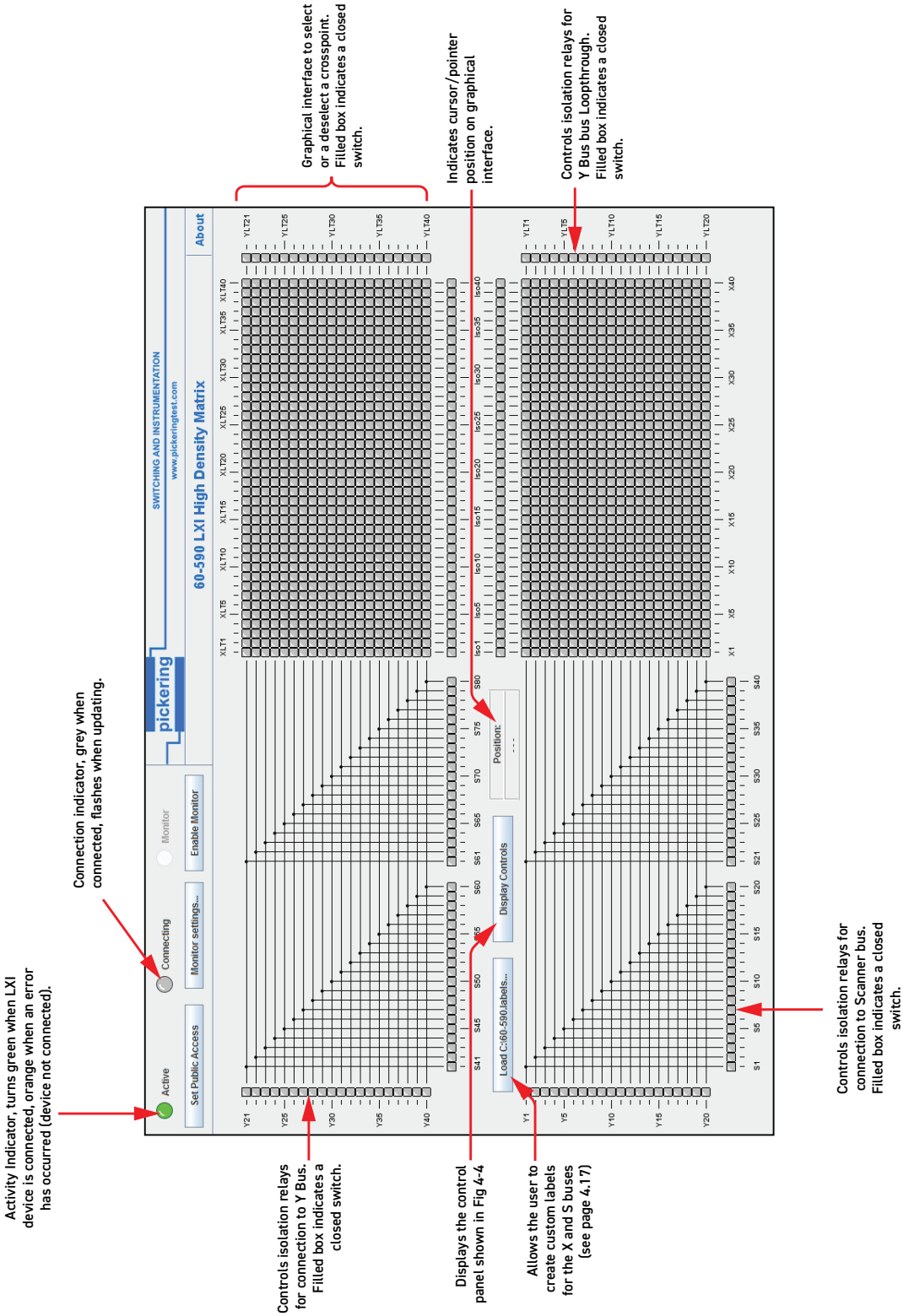


Figure 4-4. 60-590 Soft Front Panel

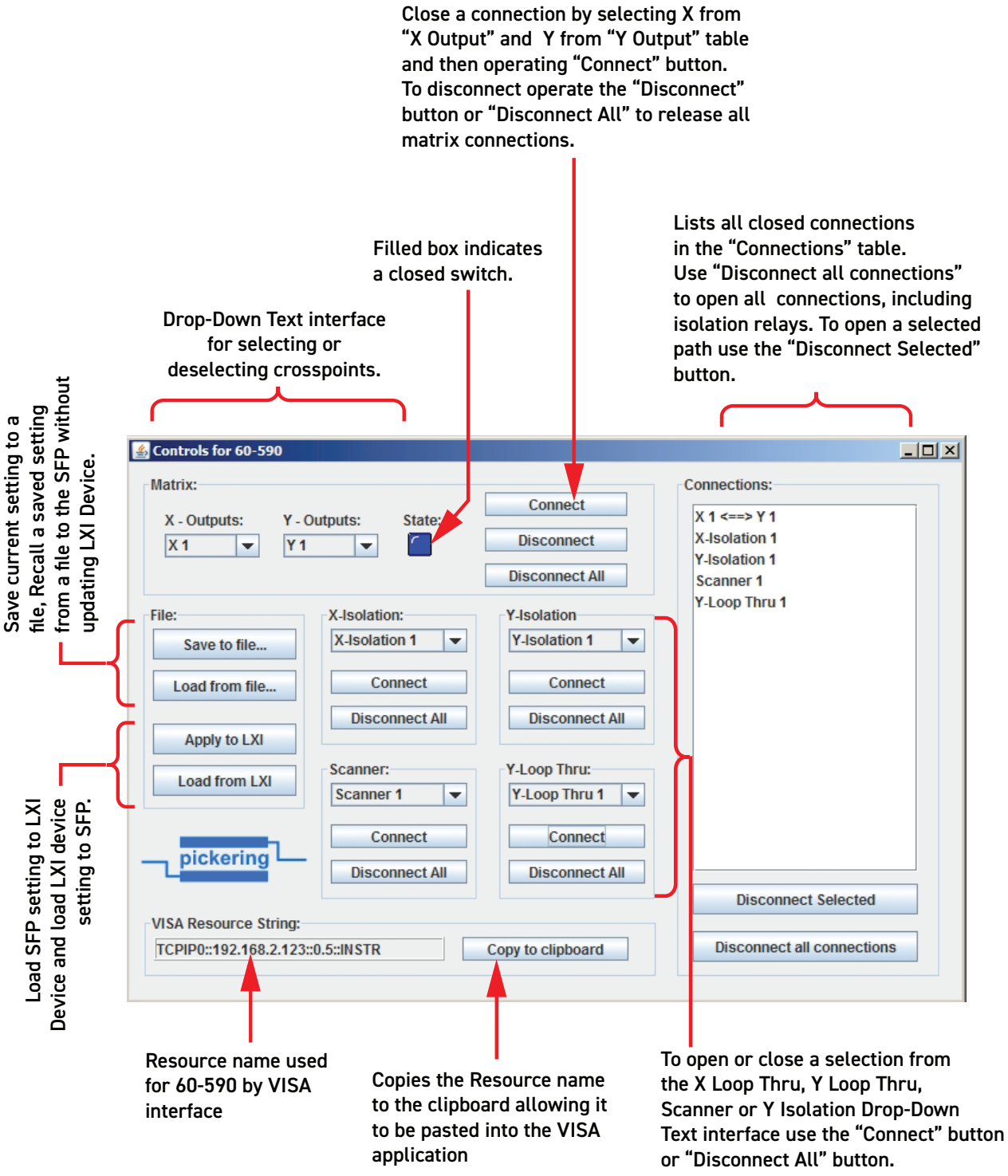


Figure 4-5. 60-590 Display Control Panel

Section 5 - Connectors

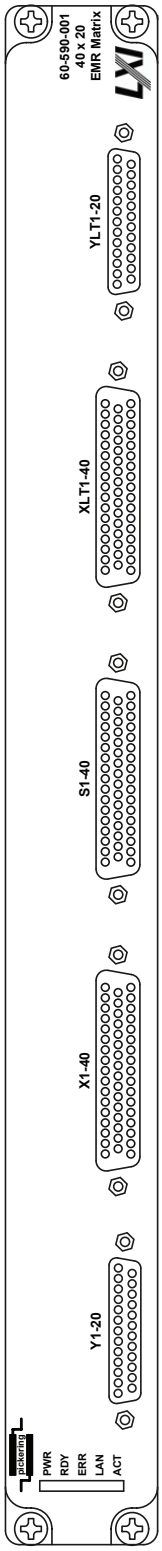


Figure 5-1. Front Panel Layout for the 40x20 High Density Matrix (60-590-001)

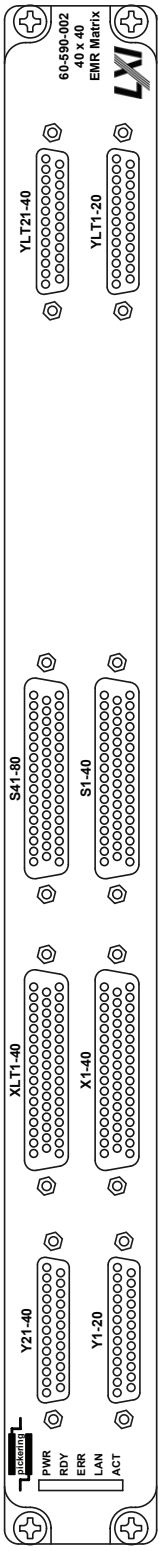


Figure 5-2. Front Panel Layout for the 40x40 High Density Matrix (60-590-002)

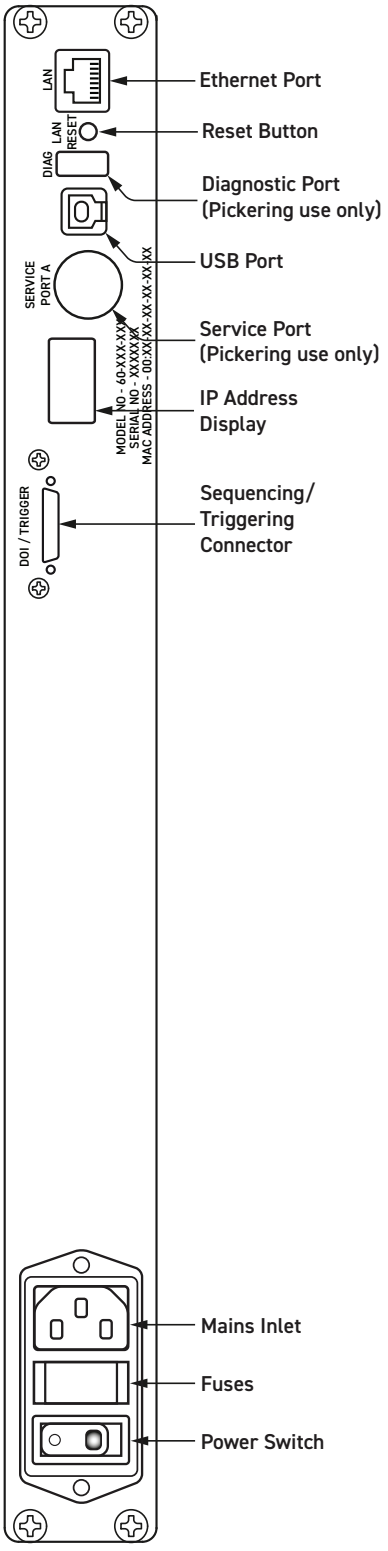
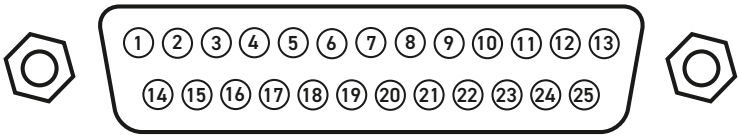


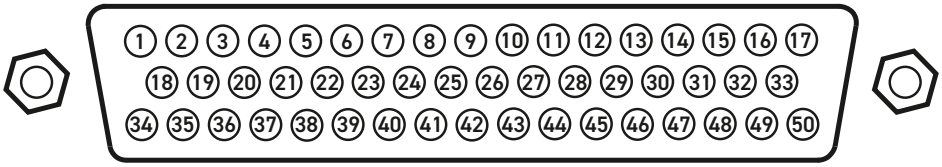
Figure 5-3. Rear Panel Layout for the High Density Matrix

Pinouts - 40x20 High Density Matrix (60-590-001)



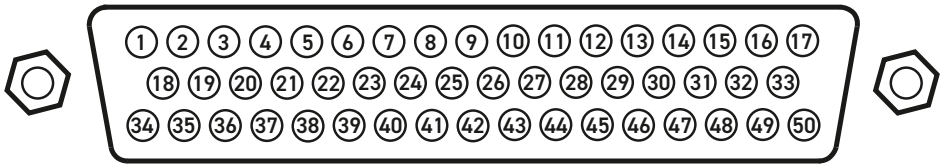
25-pin Male D-Type - "Y1-20"				
Pin No.	Signal Name		Pin No.	Signal Name
1	Y1		14	Y2
2	Y3		15	Y4
3	Y5		16	Y6
4	Y7		17	Y8
5	Y9		18	Y10
6	Y11		19	Y12
7	Y13		20	Y14
8	Y15		21	Y16
9	Y17		22	Y18
10	Y19		23	Y20
11	NC		24	NC
12	NC		25	SGND
13	NC			

Figure 5.4 - 40x20 Matrix (60-590-001) Left Hand End Connector "Y1-20"



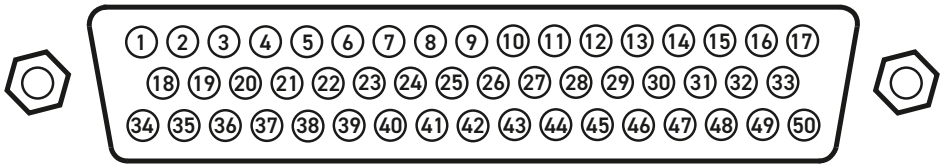
50-pin Male D-Type - "X1-40"						
Pin No.	Signal Name		Pin No.	Signal Name	Pin No.	Signal Name
1	X1		18	X2	34	X3
2	X4		19	X5	35	X6
3	X7		20	X8	36	X9
4	X10		21	X11	37	X12
5	X13		22	X14	38	X15
6	X16		23	X17	39	X18
7	X19		24	X20	40	X21
8	X22		25	X23	41	X24
9	X25		26	X26	42	X27
10	X28		27	X29	43	X30
11	X31		28	X32	44	X33
12	X34		29	X35	45	X36
13	X37		30	X38	46	X39
14	X40		31	NC	47	NC
15	NC		32	NC	48	NC
16	NC		33	NC	49	NC
17	NC				50	SGND

Figure 5.5 - 40x20 Matrix (60-590-001) Middle Left Connector "X1-40"



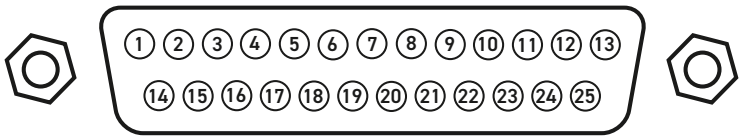
50-pin Male D-Type - "S1-40"						
Pin No.	Signal Name		Pin No.	Signal Name	Pin No.	Signal Name
1	S1		18	S2	34	S3
2	S4		19	S5	35	S6
3	S7		20	S8	36	S9
4	S10		21	S11	37	S12
5	S13		22	S14	38	S15
6	S16		23	S17	39	S18
7	S19		24	S20	40	S21
8	S22		25	S23	41	S24
9	S25		26	S26	42	S27
10	S28		27	S29	43	S30
11	S31		28	S32	44	S33
12	S34		29	S35	45	S36
13	S37		30	S38	46	S39
14	S40		31	NC	47	NC
15	NC		32	NC	48	NC
16	NC		33	NC	49	NC
17	NC				50	SGND

Figure 5.6 - 40x20 Matrix (60-590-001) Middle Connector "S1-40"



50-pin Male D-Type - "XLT1-40"						
Pin No.	Signal Name		Pin No.	Signal Name	Pin No.	Signal Name
1	XLT1		18	XLT2	34	XLT3
2	XLT4		19	XLT5	35	XLT6
3	XLT7		20	XLT8	36	XLT9
4	XLT10		21	XLT11	37	XLT12
5	XLT13		22	XLT14	38	XLT15
6	XLT16		23	XLT17	39	XLT18
7	XLT19		24	XLT20	40	XLT21
8	XLT22		25	XLT23	41	XLT24
9	XLT25		26	XLT26	42	XLT27
10	XLT28		27	XLT29	43	XLT30
11	XLT31		28	XLT32	44	XLT33
12	XLT34		29	XLT35	45	XLT36
13	XLT37		30	XLT38	46	XLT39
14	XLT40		31	NC	47	NC
15	NC		32	NC	48	NC
16	NC		33	NC	49	NC
17	NC				50	SGND

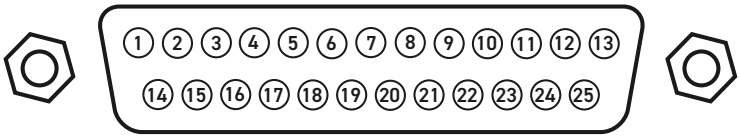
Figure 5.7 - 40x20 Matrix (60-590-001) Middle Right Connector "XLT1-40"



25-pin Male D-Type - "YLT1-20"				
Pin No.	Signal Name		Pin No.	Signal Name
1	YLT1		14	YLT2
2	YLT3		15	YLT4
3	YLT5		16	YLT6
4	YLT7		17	YLT8
5	YLT9		18	YLT10
6	YLT11		19	YLT12
7	YLT13		20	YLT14
8	YLT15		21	YLT16
9	YLT17		22	YLT18
10	YLT19		23	YLT20
11	NC		24	NC
12	NC		25	SGND
13	NC			

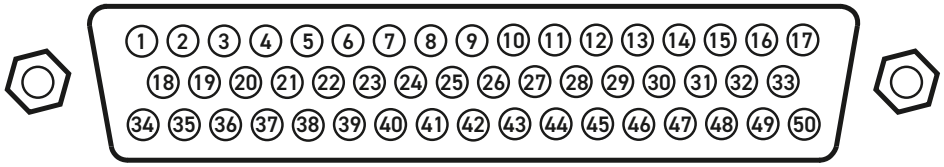
Figure 5.8 - 40x20 Matrix (60-590-001) Right Hand End Connector "YLT1-20"

Pinouts - 40x40 High Density Matrix (60-590-002)



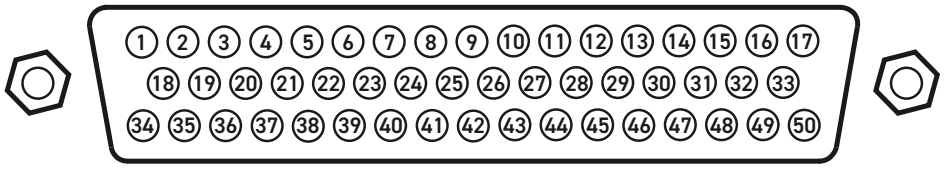
25-pin Male D-Type - "Y1-20"				
Pin No.	Signal Name		Pin No.	Signal Name
1	Y1		14	Y2
2	Y3		15	Y4
3	Y5		16	Y6
4	Y7		17	Y8
5	Y9		18	Y10
6	Y11		19	Y12
7	Y13		20	Y14
8	Y15		21	Y16
9	Y17		22	Y18
10	Y19		23	Y20
11	NC		24	NC
12	NC		25	SGND
13	NC			

Figure 5.9 - 40x40 Matrix (60-590-002) Lower Left Hand End Connector "Y1-20"



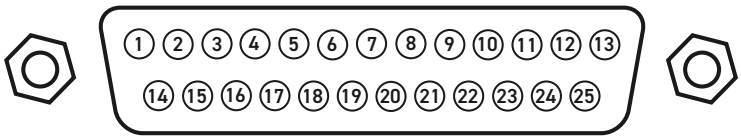
50-pin Male D-Type - "X1-40"							
Pin No.	Signal Name		Pin No.	Signal Name		Pin No.	Signal Name
1	X1		18	X2		34	X3
2	X4		19	X5		35	X6
3	X7		20	X8		36	X9
4	X10		21	X11		37	X12
5	X13		22	X14		38	X15
6	X16		23	X17		39	X18
7	X19		24	X20		40	X21
8	X22		25	X23		41	X24
9	X25		26	X26		42	X27
10	X28		27	X29		43	X30
11	X31		28	X32		44	X33
12	X34		29	X35		45	X36
13	X37		30	X38		46	X39
14	X40		31	NC		47	NC
15	NC		32	NC		48	NC
16	NC		33	NC		49	NC
17	NC					50	SGND

Figure 5.10 - 40x40 Matrix (60-590-002) Lower Middle Left Connector "X1-40"



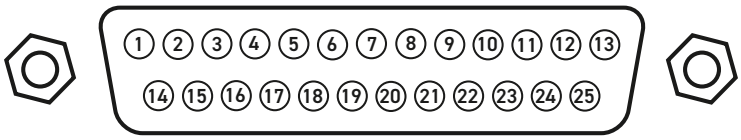
50-pin Male D-Type - "S1-40"							
Pin No.	Signal Name		Pin No.	Signal Name		Pin No.	Signal Name
1	S1		18	S2		34	S3
2	S4		19	S5		35	S6
3	S7		20	S8		36	S9
4	S10		21	S11		37	S12
5	S13		22	S14		38	S15
6	S16		23	S17		39	S18
7	S19		24	S20		40	S21
8	S22		25	S23		41	S24
9	S25		26	S26		42	S27
10	S28		27	S29		43	S30
11	S31		28	S32		44	S33
12	S34		29	S35		45	S36
13	S37		30	S38		46	S39
14	S40		31	NC		47	NC
15	NC		32	NC		48	NC
16	NC		33	NC		49	NC
17	NC					50	SGND

Figure 5.11 - 40x40 Matrix (60-590-002) Lower Middle Connector "S1-40"



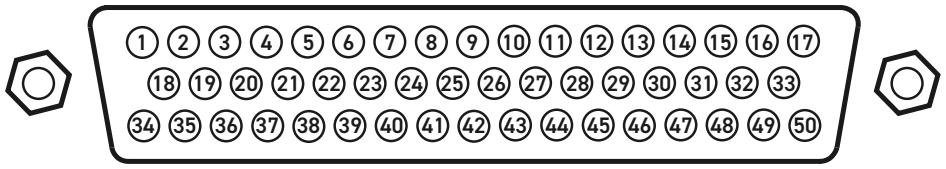
25-pin Male D-Type - "YLT1-20"				
Pin No.	Signal Name		Pin No.	Signal Name
1	YLT1		14	YLT2
2	YLT3		15	YLT4
3	YLT5		16	YLT6
4	YLT7		17	YLT8
5	YLT9		18	YLT10
6	YLT11		19	YLT12
7	YLT13		20	YLT14
8	YLT15		21	YLT16
9	YLT17		22	YLT18
10	YLT19		23	YLT20
11	NC		24	NC
12	NC		25	SGND
13	NC			

Figure 5.12 - 40x40 Matrix (60-590-002) Lower Right Hand End Connector "YLT1-20"



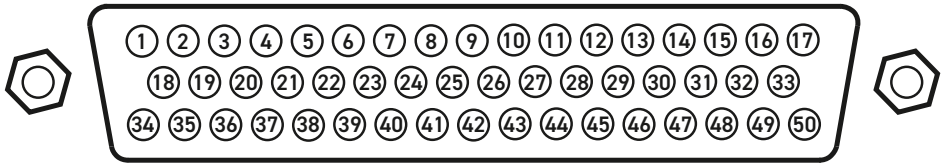
25-pin Male D-Type - "Y21-40"				
Pin No.	Signal Name		Pin No.	Signal Name
1	Y21		14	Y22
2	Y23		15	Y24
3	Y25		16	Y26
4	Y27		17	Y28
5	Y29		18	Y30
6	Y31		19	Y32
7	Y33		20	Y34
8	Y35		21	Y36
9	Y37		22	Y38
10	Y39		23	Y40
11	NC		24	NC
12	NC		25	SGND
13	NC			

Figure 5.13 - 40x40 Matrix (60-590-002) Upper Left Hand End Connector "Y21-40"



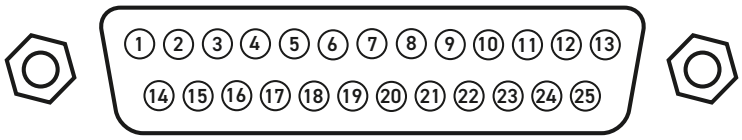
50-pin Male D-Type - "XLT1-40"						
Pin No.	Signal Name		Pin No.	Signal Name	Pin No.	Signal Name
1	XLT1		18	XLT2	34	XLT3
2	XLT4		19	XLT5	35	XLT6
3	XLT7		20	XLT8	36	XLT9
4	XLT10		21	XLT11	37	XLT12
5	XLT13		22	XLT14	38	XLT15
6	XLT16		23	XLT17	39	XLT18
7	XLT19		24	XLT20	40	XLT21
8	XLT22		25	XLT23	41	XLT24
9	XLT25		26	XLT26	42	XLT27
10	XLT28		27	XLT29	43	XLT30
11	XLT31		28	XLT32	44	XLT33
12	XLT34		29	XLT35	45	XLT36
13	XLT37		30	XLT38	46	XLT39
14	XLT40		31	NC	47	NC
15	NC		32	NC	48	NC
16	NC		33	NC	49	NC
17	NC				50	SGND

Figure 5.14 - 40x40 Matrix (60-590-002) Upper Middle Left Connector "XLT1-40"



50-pin Male D-Type - "S41-80"							
Pin No.	Signal Name		Pin No.	Signal Name		Pin No.	Signal Name
1	S41		18	S42		34	S43
2	S44		19	S45		35	S46
3	S47		20	S48		36	S49
4	S50		21	S51		37	S52
5	S53		22	S54		38	S55
6	S56		23	S57		39	S58
7	S59		24	S60		40	S61
8	S62		25	S63		41	S64
9	S65		26	S66		42	S67
10	S68		27	S69		43	S70
11	S71		28	S72		44	S73
12	S74		29	S75		45	S76
13	S77		30	S78		46	S79
14	S80		31	NC		47	NC
15	NC		32	NC		48	NC
16	NC		33	NC		49	NC
17	NC					50	SGND

Figure 5.15 - 40x40 Matrix (60-590-002) Upper Middle Connector "S41-80"



25-pin Male D-Type - "YLT21-40"				
Pin No.	Signal Name		Pin No.	Signal Name
1	YLT21		14	YLT22
2	YLT23		15	YLT24
3	YLT25		16	YLT26
4	YLT27		17	YLT28
5	YLT29		18	YLT30
6	YLT31		19	YLT32
7	YLT33		20	YLT34
8	YLT35		21	YLT36
9	YLT37		22	YLT38
10	YLT39		23	YLT40
11	NC		24	NC
12	NC		25	SGND
13	NC			

Figure 5.16 - 40x40 Matrix (60-590-002) Upper Right Hand End Connector "YLT21-40"

Section 6 - Troubleshooting

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

Installation Problems

The Plug & Play functionality of Pickering switch cards generally ensures trouble-free installation.

If you do experience any installation problems you should first ensure that all cables are properly connected.

LXI Status Indicators

Status Indicator / Colour				Status Description
PWR	RDY	ERR	LAN	
Green	Off	Off	Off	**Powering Up Status:** This state occurs when the LXI unit was turned off and the user turns it on. This state will exist for ~10-15 seconds.
Green	Orange	Orange	Orange	**PI Services Init. Status:** This state triggers after powering up status and it means that PI services are initializing (pilserv is starting and initializing). This state should last <1 second.
Green	Green	Off	Green	**Normal Operation Status:** LXI unit is turned on, Ethernet connection is established (LXI unit has assigned IP address from DHCP/AutoIP or static range), ServerBridge is running and listening for incoming connections.
Green	Green	Off	Red	**Network Failure Status:** LXI unit is turned on, but the Ethernet connection is not established (LXI unit is not connected to any network and it has not assigned an IP address). Client cannot access the unit or control any of the plugged in cards.
Green	Off	Red	Green	**ServerBridge Failure Status:** LXI unit is turned on, Ethernet connection is established (LXI unit has assigned IP address from DHCP/AutoIP or static range), ServerBridge is not running. Client can access the LXI unit thru the web interface, but cannot control any of the plugged in cards.
Green	Off/Green (toggling between off & green)	Off/Red (toggling between off & red)	Green	**ServerBridge Failure Status:** LXI unit is turned on, Ethernet connection is established (LXI unit has assigned IP address from DHCP/AutoIP or static range), ServerBridge is still restarting. Client can access the LXI unit thru the web interface, but cannot control any of the plugged in cards. The cause of the fault is usually the pilpxi driver, either of the third party drivers: pi743/pxm78xx or a bug in ServerBridge.
Green	Green	Off	Orange	**Ethernet Change Notification Status:** LXI unit is turned on, Ethernet connection is changing. This is usually caused by user action: connected ethernet cable or LAN configuration change. ServerBridge is terminated in this state and waiting to establish the Ethernet connection.

Section 6 - Troubleshooting

Q I have a power light and a ready light, but why does the LAN light flash?
A You have an IP conflict. That is another device on your network has the same TCP/IP address as your LXI device. Remove the conflict or change the IP address of your LXI unit.

Q The power is on, but why doesn't the LAN indicator light up at all?
A There is a cabling fault. Check your Ethernet lead is of the correct type and is plugged into a working hub or switch. Most hubs and switches have a link indicator to show when the connection is correct.

Q Why do I only have a red error and power light on?
A There is a hardware fault with your device, contact your local sales office.
OR, the unit has been set with an invalid IP address. Obtain the required information as outlined in Section 4 and perform a full reset as described overleaf.

Q How do I know when I can begin communicating with my device?
A The LXI devices have a Ready and an Active light that indicate its current activity. Whenever the active light is illuminated, the system is busy and may not be able to process other commands. This will normally occur when there has been a TCP/IP configuration change. Constant green illumination of Active light can indicate Gigabit Ethernet connectivity.

Q What does it mean when my LXI device's lights are all on, or flash wildly?
A The system is booting up, these sequences are used to monitor the LXI device's boot progress as an aid to fault finding. Until the Ready light is illuminated green, you should not attempt to communicate with the device.

Q All of my device's lights are on, why don't I see a green Ready light, even after a few minutes?
A Your device has a fault, contact your local sales office.

Please contact your local Pickering Interfaces sales office for any further support or email:
lxisupport@pickeringtest.com

You can also visit our website for product updates, help and downloadable materials at:
pickeringtest.com

LAN Reset

If the device's operation is inconsistent the user should try resetting using the rear panel recessed LAN Reset button to see if this effects a cure.

Momentary operation of the LAN Reset button causes a reset of the device, this is similar in effect to cycling the power.

Holding the LAN Reset button depressed for a period of about 5 seconds causes the device to be set back to factory default conditions. This will destroy any user configuration data already entered.

Alternatively, if operation over a network is still in doubt, connect the device to a laptop using the supplied grey crossover cable and set it up as described in "Configuring the LXI Device Isolated from a Network" in the "LXI Getting Started Guide" document.

Section 7 - Maintenance Information

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

Periodic Maintenance

This product and its corresponding chassis do not require any periodic maintenance.

General Cleaning

- Isolate the electrical power from the chassis and ensure that no user I/O signals are being applied.
- Wipe the product & chassis surfaces with a clean dry anti-static cloth only.

Software Update

No software updates are required for LXI products in normal operation. For the latest version of the driver please refer to our web site pickeringtest.com where links to our Software Download page will provide the latest version of the driver software for the various programming environments encountered.

Relay Look-up Tables

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

The 40x20 version of the matrix (60-590-001) has only the lower matrix board fitted, the 40x40 verson of the matrix (60-590-002) is fitted with both upper and lower matrix boards. The relay numbers of both the upper and lower matrix boards are shown in Table 7-1 as well as the number of the programming sub-unit used to control them.

Table 7-1. Relay Look-Up Table

40x40 High Density Matrix Boards																								
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB						
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit				
RL1	X1	Y1	1	X1	Y21	1	RL41	X1	Y2	1	X1	Y22	1	RL81	X1	Y3	1	X1	Y23	1				
RL2	X2	Y1	1	X2	Y21	1	RL42	X2	Y2	1	X2	Y22	1	RL82	X2	Y3	1	X2	Y23	1				
RL3	X3	Y1	1	X3	Y21	1	RL43	X3	Y2	1	X3	Y22	1	RL83	X3	Y3	1	X3	Y23	1				
RL4	X4	Y1	1	X4	Y21	1	RL44	X4	Y2	1	X4	Y22	1	RL84	X4	Y3	1	X4	Y23	1				
RL5	X5	Y1	1	X5	Y21	1	RL45	X5	Y2	1	X5	Y22	1	RL85	X5	Y3	1	X5	Y23	1				
RL6	X6	Y1	1	X6	Y21	1	RL46	X6	Y2	1	X6	Y22	1	RL86	X6	Y3	1	X6	Y23	1				
RL7	X7	Y1	1	X7	Y21	1	RL47	X7	Y2	1	X7	Y22	1	RL87	X7	Y3	1	X7	Y23	1				
RL8	X8	Y1	1	X8	Y21	1	RL48	X8	Y2	1	X8	Y22	1	RL88	X8	Y3	1	X8	Y23	1				
RL9	X9	Y1	1	X9	Y21	1	RL49	X9	Y2	1	X9	Y22	1	RL89	X9	Y3	1	X9	Y23	1				
RL10	X10	Y1	1	X10	Y21	1	RL50	X10	Y2	1	X10	Y22	1	RL90	X10	Y3	1	X10	Y23	1				
RL11	X11	Y1	1	X11	Y21	1	RL51	X11	Y2	1	X11	Y22	1	RL91	X11	Y3	1	X11	Y23	1				
RL12	X12	Y1	1	X12	Y21	1	RL52	X12	Y2	1	X12	Y22	1	RL92	X12	Y3	1	X12	Y23	1				
RL13	X13	Y1	1	X13	Y21	1	RL53	X13	Y2	1	X13	Y22	1	RL93	X13	Y3	1	X13	Y23	1				
RL14	X14	Y1	1	X14	Y21	1	RL54	X14	Y2	1	X14	Y22	1	RL94	X14	Y3	1	X14	Y23	1				
RL15	X15	Y1	1	X15	Y21	1	RL55	X15	Y2	1	X15	Y22	1	RL95	X15	Y3	1	X15	Y23	1				
RL16	X16	Y1	1	X16	Y21	1	RL56	X16	Y2	1	X16	Y22	1	RL96	X16	Y3	1	X16	Y23	1				
RL17	X17	Y1	1	X17	Y21	1	RL57	X17	Y2	1	X17	Y22	1	RL97	X17	Y3	1	X17	Y23	1				
RL18	X18	Y1	1	X18	Y21	1	RL58	X18	Y2	1	X18	Y22	1	RL98	X18	Y3	1	X18	Y23	1				
RL19	X19	Y1	1	X19	Y21	1	RL59	X19	Y2	1	X19	Y22	1	RL99	X19	Y3	1	X19	Y23	1				
RL20	X20	Y1	1	X20	Y21	1	RL60	X20	Y2	1	X20	Y22	1	RL100	X20	Y3	1	X20	Y23	1				
RL21	X21	Y1	1	X21	Y21	1	RL61	X21	Y2	1	X21	Y22	1	RL101	X21	Y3	1	X21	Y23	1				
RL22	X22	Y1	1	X22	Y21	1	RL62	X22	Y2	1	X22	Y22	1	RL102	X22	Y3	1	X22	Y23	1				
RL23	X23	Y1	1	X23	Y21	1	RL63	X23	Y2	1	X23	Y22	1	RL103	X23	Y3	1	X23	Y23	1				
RL24	X24	Y1	1	X24	Y21	1	RL64	X24	Y2	1	X24	Y22	1	RL104	X24	Y3	1	X24	Y23	1				
RL25	X25	Y1	1	X25	Y21	1	RL65	X25	Y2	1	X25	Y22	1	RL105	X25	Y3	1	X25	Y23	1				
RL26	X26	Y1	1	X26	Y21	1	RL66	X26	Y2	1	X26	Y22	1	RL106	X26	Y3	1	X26	Y23	1				
RL27	X27	Y1	1	X27	Y21	1	RL67	X27	Y2	1	X27	Y22	1	RL107	X27	Y3	1	X27	Y23	1				
RL28	X28	Y1	1	X28	Y21	1	RL68	X28	Y2	1	X28	Y22	1	RL108	X28	Y3	1	X28	Y23	1				
RL29	X29	Y1	1	X29	Y21	1	RL69	X29	Y2	1	X29	Y22	1	RL109	X29	Y3	1	X29	Y23	1				
RL30	X30	Y1	1	X30	Y21	1	RL70	X30	Y2	1	X30	Y22	1	RL110	X30	Y3	1	X30	Y23	1				
RL31	X31	Y1	1	X31	Y21	1	RL71	X31	Y2	1	X31	Y22	1	RL111	X31	Y3	1	X31	Y23	1				
RL32	X32	Y1	1	X32	Y21	1	RL72	X32	Y2	1	X32	Y22	1	RL112	X32	Y3	1	X32	Y23	1				
RL33	X33	Y1	1	X33	Y21	1	RL73	X33	Y2	1	X33	Y22	1	RL113	X33	Y3	1	X33	Y23	1				
RL34	X34	Y1	1	X34	Y21	1	RL74	X34	Y2	1	X34	Y22	1	RL114	X34	Y3	1	X34	Y23	1				
RL35	X35	Y1	1	X35	Y21	1	RL75	X35	Y2	1	X35	Y22	1	RL115	X35	Y3	1	X35	Y23	1				
RL36	X36	Y1	1	X36	Y21	1	RL76	X36	Y2	1	X36	Y22	1	RL116	X36	Y3	1	X36	Y23	1				
RL37	X37	Y1	1	X37	Y21	1	RL77	X37	Y2	1	X37	Y22	1	RL117	X37	Y3	1	X37	Y23	1				
RL38	X38	Y1	1	X38	Y21	1	RL78	X38	Y2	1	X38	Y22	1	RL118	X38	Y3	1	X38	Y23	1				
RL39	X39	Y1	1	X39	Y21	1	RL79	X39	Y2	1	X39	Y22	1	RL119	X39	Y3	1	X39	Y23	1				
RL40	X40	Y1	1	X40	Y21	1	RL80	X40	Y2	1	X40	Y22	1	RL120	X40	Y3	1	X40	Y23	1				

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards																						
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB		
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit
RL121	X1	Y4	1	X1	Y24	1	RL161	X1	Y5	1	X1	Y25	1	RL201	X1	Y6	1	X1	Y26	1
RL122	X2	Y4	1	X2	Y24	1	RL162	X2	Y5	1	X2	Y25	1	RL202	X2	Y6	1	X2	Y26	1
RL123	X3	Y4	1	X3	Y24	1	RL163	X3	Y5	1	X3	Y25	1	RL203	X3	Y6	1	X3	Y26	1
RL124	X4	Y4	1	X4	Y24	1	RL164	X4	Y5	1	X4	Y25	1	RL204	X4	Y6	1	X4	Y26	1
RL125	X5	Y4	1	X5	Y24	1	RL165	X5	Y5	1	X5	Y25	1	RL205	X5	Y6	1	X5	Y26	1
RL126	X6	Y4	1	X6	Y24	1	RL166	X6	Y5	1	X6	Y25	1	RL206	X6	Y6	1	X6	Y26	1
RL127	X7	Y4	1	X7	Y24	1	RL167	X7	Y5	1	X7	Y25	1	RL207	X7	Y6	1	X7	Y26	1
RL128	X8	Y4	1	X8	Y24	1	RL168	X8	Y5	1	X8	Y25	1	RL208	X8	Y6	1	X8	Y26	1
RL129	X9	Y4	1	X9	Y24	1	RL169	X9	Y5	1	X9	Y25	1	RL209	X9	Y6	1	X9	Y26	1
RL130	X10	Y4	1	X10	Y24	1	RL170	X10	Y5	1	X10	Y25	1	RL210	X10	Y6	1	X10	Y26	1
RL131	X11	Y4	1	X11	Y24	1	RL171	X11	Y5	1	X11	Y25	1	RL211	X11	Y6	1	X11	Y26	1
RL132	X12	Y4	1	X12	Y24	1	RL172	X12	Y5	1	X12	Y25	1	RL212	X12	Y6	1	X12	Y26	1
RL133	X13	Y4	1	X13	Y24	1	RL173	X13	Y5	1	X13	Y25	1	RL213	X13	Y6	1	X13	Y26	1
RL134	X14	Y4	1	X14	Y24	1	RL174	X14	Y5	1	X14	Y25	1	RL214	X14	Y6	1	X14	Y26	1
RL135	X15	Y4	1	X15	Y24	1	RL175	X15	Y5	1	X15	Y25	1	RL215	X15	Y6	1	X15	Y26	1
RL136	X16	Y4	1	X16	Y24	1	RL176	X16	Y5	1	X16	Y25	1	RL216	X16	Y6	1	X16	Y26	1
RL137	X17	Y4	1	X17	Y24	1	RL177	X17	Y5	1	X17	Y25	1	RL217	X17	Y6	1	X17	Y26	1
RL138	X18	Y4	1	X18	Y24	1	RL178	X18	Y5	1	X18	Y25	1	RL218	X18	Y6	1	X18	Y26	1
RL139	X19	Y4	1	X19	Y24	1	RL179	X19	Y5	1	X19	Y25	1	RL219	X19	Y6	1	X19	Y26	1
RL140	X20	Y4	1	X20	Y24	1	RL180	X20	Y5	1	X20	Y25	1	RL220	X20	Y6	1	X20	Y26	1
RL141	X21	Y4	1	X21	Y24	1	RL181	X21	Y5	1	X21	Y25	1	RL221	X21	Y6	1	X21	Y26	1
RL142	X22	Y4	1	X22	Y24	1	RL182	X22	Y5	1	X22	Y25	1	RL222	X22	Y6	1	X22	Y26	1
RL143	X23	Y4	1	X23	Y24	1	RL183	X23	Y5	1	X23	Y25	1	RL223	X23	Y6	1	X23	Y26	1
RL144	X24	Y4	1	X24	Y24	1	RL184	X24	Y5	1	X24	Y25	1	RL224	X24	Y6	1	X24	Y26	1
RL145	X25	Y4	1	X25	Y24	1	RL185	X25	Y5	1	X25	Y25	1	RL225	X25	Y6	1	X25	Y26	1
RL146	X26	Y4	1	X26	Y24	1	RL186	X26	Y5	1	X26	Y25	1	RL226	X26	Y6	1	X26	Y26	1
RL147	X27	Y4	1	X27	Y24	1	RL187	X27	Y5	1	X27	Y25	1	RL227	X27	Y6	1	X27	Y26	1
RL148	X28	Y4	1	X28	Y24	1	RL188	X28	Y5	1	X28	Y25	1	RL228	X28	Y6	1	X28	Y26	1
RL149	X29	Y4	1	X29	Y24	1	RL189	X29	Y5	1	X29	Y25	1	RL229	X29	Y6	1	X29	Y26	1
RL150	X30	Y4	1	X30	Y24	1	RL190	X30	Y5	1	X30	Y25	1	RL230	X30	Y6	1	X30	Y26	1
RL151	X31	Y4	1	X31	Y24	1	RL191	X31	Y5	1	X31	Y25	1	RL231	X31	Y6	1	X31	Y26	1
RL152	X32	Y4	1	X32	Y24	1	RL192	X32	Y5	1	X32	Y25	1	RL232	X32	Y6	1	X32	Y26	1
RL153	X33	Y4	1	X33	Y24	1	RL193	X33	Y5	1	X33	Y25	1	RL233	X33	Y6	1	X33	Y26	1
RL154	X34	Y4	1	X34	Y24	1	RL194	X34	Y5	1	X34	Y25	1	RL234	X34	Y6	1	X34	Y26	1
RL155	X35	Y4	1	X35	Y24	1	RL195	X35	Y5	1	X35	Y25	1	RL235	X35	Y6	1	X35	Y26	1
RL156	X36	Y4	1	X36	Y24	1	RL196	X36	Y5	1	X36	Y25	1	RL236	X36	Y6	1	X36	Y26	1
RL157	X37	Y4	1	X37	Y24	1	RL197	X37	Y5	1	X37	Y25	1	RL237	X37	Y6	1	X37	Y26	1
RL158	X38	Y4	1	X38	Y24	1	RL198	X38	Y5	1	X38	Y25	1	RL238	X38	Y6	1	X38	Y26	1
RL159	X39	Y4	1	X39	Y24	1	RL199	X39	Y5	1	X39	Y25	1	RL239	X39	Y6	1	X39	Y26	1
RL160	X40	Y4	1	X40	Y24	1	RL200	X40	Y5	1	X40	Y25	1	RL240	X40	Y6	1	X40	Y26	1

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards																						
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB		
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit
RL241	X1	Y7	1	X1	Y27	1	RL281	X1	Y8	1	X1	Y28	1	RL321	X1	Y9	1	X1	Y29	1
RL242	X2	Y7	1	X2	Y27	1	RL282	X2	Y8	1	X2	Y28	1	RL322	X2	Y9	1	X2	Y29	1
RL243	X3	Y7	1	X3	Y27	1	RL283	X3	Y8	1	X3	Y28	1	RL323	X3	Y9	1	X3	Y29	1
RL244	X4	Y7	1	X4	Y27	1	RL284	X4	Y8	1	X4	Y28	1	RL324	X4	Y9	1	X4	Y29	1
RL245	X5	Y7	1	X5	Y27	1	RL285	X5	Y8	1	X5	Y28	1	RL325	X5	Y9	1	X5	Y29	1
RL246	X6	Y7	1	X6	Y27	1	RL286	X6	Y8	1	X6	Y28	1	RL326	X6	Y9	1	X6	Y29	1
RL247	X7	Y7	1	X7	Y27	1	RL287	X7	Y8	1	X7	Y28	1	RL327	X7	Y9	1	X7	Y29	1
RL248	X8	Y7	1	X8	Y27	1	RL288	X8	Y8	1	X8	Y28	1	RL328	X8	Y9	1	X8	Y29	1
RL249	X9	Y7	1	X9	Y27	1	RL289	X9	Y8	1	X9	Y28	1	RL329	X9	Y9	1	X9	Y29	1
RL250	X10	Y7	1	X10	Y27	1	RL290	X10	Y8	1	X10	Y28	1	RL330	X10	Y9	1	X10	Y29	1
RL251	X11	Y7	1	X11	Y27	1	RL291	X11	Y8	1	X11	Y28	1	RL331	X11	Y9	1	X11	Y29	1
RL252	X12	Y7	1	X12	Y27	1	RL292	X12	Y8	1	X12	Y28	1	RL332	X12	Y9	1	X12	Y29	1
RL253	X13	Y7	1	X13	Y27	1	RL293	X13	Y8	1	X13	Y28	1	RL333	X13	Y9	1	X13	Y29	1
RL254	X14	Y7	1	X14	Y27	1	RL294	X14	Y8	1	X14	Y28	1	RL334	X14	Y9	1	X14	Y29	1
RL255	X15	Y7	1	X15	Y27	1	RL295	X15	Y8	1	X15	Y28	1	RL335	X15	Y9	1	X15	Y29	1
RL256	X16	Y7	1	X16	Y27	1	RL296	X16	Y8	1	X16	Y28	1	RL336	X16	Y9	1	X16	Y29	1
RL257	X17	Y7	1	X17	Y27	1	RL297	X17	Y8	1	X17	Y28	1	RL337	X17	Y9	1	X17	Y29	1
RL258	X18	Y7	1	X18	Y27	1	RL298	X18	Y8	1	X18	Y28	1	RL338	X18	Y9	1	X18	Y29	1
RL259	X19	Y7	1	X19	Y27	1	RL299	X19	Y8	1	X19	Y28	1	RL339	X19	Y9	1	X19	Y29	1
RL260	X20	Y7	1	X20	Y27	1	RL300	X20	Y8	1	X20	Y28	1	RL340	X20	Y9	1	X20	Y29	1
RL261	X21	Y7	1	X21	Y27	1	RL301	X21	Y8	1	X21	Y28	1	RL341	X21	Y9	1	X21	Y29	1
RL262	X22	Y7	1	X22	Y27	1	RL302	X22	Y8	1	X22	Y28	1	RL342	X22	Y9	1	X22	Y29	1
RL263	X23	Y7	1	X23	Y27	1	RL303	X23	Y8	1	X23	Y28	1	RL343	X23	Y9	1	X23	Y29	1
RL264	X24	Y7	1	X24	Y27	1	RL304	X24	Y8	1	X24	Y28	1	RL344	X24	Y9	1	X24	Y29	1
RL265	X25	Y7	1	X25	Y27	1	RL305	X25	Y8	1	X25	Y28	1	RL345	X25	Y9	1	X25	Y29	1
RL266	X26	Y7	1	X26	Y27	1	RL306	X26	Y8	1	X26	Y28	1	RL346	X26	Y9	1	X26	Y29	1
RL267	X27	Y7	1	X27	Y27	1	RL307	X27	Y8	1	X27	Y28	1	RL347	X27	Y9	1	X27	Y29	1
RL268	X28	Y7	1	X28	Y27	1	RL308	X28	Y8	1	X28	Y28	1	RL348	X28	Y9	1	X28	Y29	1
RL269	X29	Y7	1	X29	Y27	1	RL309	X29	Y8	1	X29	Y28	1	RL349	X29	Y9	1	X29	Y29	1
RL270	X30	Y7	1	X30	Y27	1	RL310	X30	Y8	1	X30	Y28	1	RL350	X30	Y9	1	X30	Y29	1
RL271	X31	Y7	1	X31	Y27	1	RL311	X31	Y8	1	X31	Y28	1	RL351	X31	Y9	1	X31	Y29	1
RL272	X32	Y7	1	X32	Y27	1	RL312	X32	Y8	1	X32	Y28	1	RL352	X32	Y9	1	X32	Y29	1
RL273	X33	Y7	1	X33	Y27	1	RL313	X33	Y8	1	X33	Y28	1	RL353	X33	Y9	1	X33	Y29	1
RL274	X34	Y7	1	X34	Y27	1	RL314	X34	Y8	1	X34	Y28	1	RL354	X34	Y9	1	X34	Y29	1
RL275	X35	Y7	1	X35	Y27	1	RL315	X35	Y8	1	X35	Y28	1	RL355	X35	Y9	1	X35	Y29	1
RL276	X36	Y7	1	X36	Y27	1	RL316	X36	Y8	1	X36	Y28	1	RL356	X36	Y9	1	X36	Y29	1
RL277	X37	Y7	1	X37	Y27	1	RL317	X37	Y8	1	X37	Y28	1	RL357	X37	Y9	1	X37	Y29	1
RL278	X38	Y7	1	X38	Y27	1	RL318	X38	Y8	1	X38	Y28	1	RL358	X38	Y9	1	X38	Y29	1
RL279	X39	Y7	1	X39	Y27	1	RL319	X39	Y8	1	X39	Y28	1	RL359	X39	Y9	1	X39	Y29	1
RL280	X40	Y7	1	X40	Y27	1	RL320	X40	Y8	1	X40	Y28	1	RL360	X40	Y9	1	X40	Y29	1

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards																						
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB		
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit
RL361	X1	Y10	1	X1	Y30	1	RL401	X1	Y11	1	X1	Y31	1	RL441	X1	Y12	1	X1	Y32	1
RL362	X2	Y10	1	X2	Y30	1	RL402	X2	Y11	1	X2	Y31	1	RL442	X2	Y12	1	X2	Y32	1
RL363	X3	Y10	1	X3	Y30	1	RL403	X3	Y11	1	X3	Y31	1	RL443	X3	Y12	1	X3	Y32	1
RL364	X4	Y10	1	X4	Y30	1	RL404	X4	Y11	1	X4	Y31	1	RL444	X4	Y12	1	X4	Y32	1
RL365	X5	Y10	1	X5	Y30	1	RL405	X5	Y11	1	X5	Y31	1	RL445	X5	Y12	1	X5	Y32	1
RL366	X6	Y10	1	X6	Y30	1	RL406	X6	Y11	1	X6	Y31	1	RL446	X6	Y12	1	X6	Y32	1
RL367	X7	Y10	1	X7	Y30	1	RL407	X7	Y11	1	X7	Y31	1	RL447	X7	Y12	1	X7	Y32	1
RL368	X8	Y10	1	X8	Y30	1	RL408	X8	Y11	1	X8	Y31	1	RL448	X8	Y12	1	X8	Y32	1
RL369	X9	Y10	1	X9	Y30	1	RL409	X9	Y11	1	X9	Y31	1	RL449	X9	Y12	1	X9	Y32	1
RL370	X10	Y10	1	X10	Y30	1	RL410	X10	Y11	1	X10	Y31	1	RL450	X10	Y12	1	X10	Y32	1
RL371	X11	Y10	1	X11	Y30	1	RL411	X11	Y11	1	X11	Y31	1	RL451	X11	Y12	1	X11	Y32	1
RL372	X12	Y10	1	X12	Y30	1	RL412	X12	Y11	1	X12	Y31	1	RL452	X12	Y12	1	X12	Y32	1
RL373	X13	Y10	1	X13	Y30	1	RL413	X13	Y11	1	X13	Y31	1	RL453	X13	Y12	1	X13	Y32	1
RL374	X14	Y10	1	X14	Y30	1	RL414	X14	Y11	1	X14	Y31	1	RL454	X14	Y12	1	X14	Y32	1
RL375	X15	Y10	1	X15	Y30	1	RL415	X15	Y11	1	X15	Y31	1	RL455	X15	Y12	1	X15	Y32	1
RL376	X16	Y10	1	X16	Y30	1	RL416	X16	Y11	1	X16	Y31	1	RL456	X16	Y12	1	X16	Y32	1
RL377	X17	Y10	1	X17	Y30	1	RL417	X17	Y11	1	X17	Y31	1	RL457	X17	Y12	1	X17	Y32	1
RL378	X18	Y10	1	X18	Y30	1	RL418	X18	Y11	1	X18	Y31	1	RL458	X18	Y12	1	X18	Y32	1
RL379	X19	Y10	1	X19	Y30	1	RL419	X19	Y11	1	X19	Y31	1	RL459	X19	Y12	1	X19	Y32	1
RL380	X20	Y10	1	X20	Y30	1	RL420	X20	Y11	1	X20	Y31	1	RL460	X20	Y12	1	X20	Y32	1
RL381	X21	Y10	1	X21	Y30	1	RL421	X21	Y11	1	X21	Y31	1	RL461	X21	Y12	1	X21	Y32	1
RL382	X22	Y10	1	X22	Y30	1	RL422	X22	Y11	1	X22	Y31	1	RL462	X22	Y12	1	X22	Y32	1
RL383	X23	Y10	1	X23	Y30	1	RL423	X23	Y11	1	X23	Y31	1	RL463	X23	Y12	1	X23	Y32	1
RL384	X24	Y10	1	X24	Y30	1	RL424	X24	Y11	1	X24	Y31	1	RL464	X24	Y12	1	X24	Y32	1
RL385	X25	Y10	1	X25	Y30	1	RL425	X25	Y11	1	X25	Y31	1	RL465	X25	Y12	1	X25	Y32	1
RL386	X26	Y10	1	X26	Y30	1	RL426	X26	Y11	1	X26	Y31	1	RL466	X26	Y12	1	X26	Y32	1
RL387	X27	Y10	1	X27	Y30	1	RL427	X27	Y11	1	X27	Y31	1	RL467	X27	Y12	1	X27	Y32	1
RL388	X28	Y10	1	X28	Y30	1	RL428	X28	Y11	1	X28	Y31	1	RL468	X28	Y12	1	X28	Y32	1
RL389	X29	Y10	1	X29	Y30	1	RL429	X29	Y11	1	X29	Y31	1	RL469	X29	Y12	1	X29	Y32	1
RL390	X30	Y10	1	X30	Y30	1	RL430	X30	Y11	1	X30	Y31	1	RL470	X30	Y12	1	X30	Y32	1
RL391	X31	Y10	1	X31	Y30	1	RL431	X31	Y11	1	X31	Y31	1	RL471	X31	Y12	1	X31	Y32	1
RL392	X32	Y10	1	X32	Y30	1	RL432	X32	Y11	1	X32	Y31	1	RL472	X32	Y12	1	X32	Y32	1
RL393	X33	Y10	1	X33	Y30	1	RL433	X33	Y11	1	X33	Y31	1	RL473	X33	Y12	1	X33	Y32	1
RL394	X34	Y10	1	X34	Y30	1	RL434	X34	Y11	1	X34	Y31	1	RL474	X34	Y12	1	X34	Y32	1
RL395	X35	Y10	1	X35	Y30	1	RL435	X35	Y11	1	X35	Y31	1	RL475	X35	Y12	1	X35	Y32	1
RL396	X36	Y10	1	X36	Y30	1	RL436	X36	Y11	1	X36	Y31	1	RL476	X36	Y12	1	X36	Y32	1
RL397	X37	Y10	1	X37	Y30	1	RL437	X37	Y11	1	X37	Y31	1	RL477	X37	Y12	1	X37	Y32	1
RL398	X38	Y10	1	X38	Y30	1	RL438	X38	Y11	1	X38	Y31	1	RL478	X38	Y12	1	X38	Y32	1
RL399	X39	Y10	1	X39	Y30	1	RL439	X39	Y11	1	X39	Y31	1	RL479	X39	Y12	1	X39	Y32	1
RL400	X40	Y10	1	X40	Y30	1	RL440	X40	Y11	1	X40	Y31	1	RL480	X40	Y12	1	X40	Y32	1

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards																						
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit	
RL481	X1	Y13	1	X1	Y33	1	RL521	X1	Y14	1	X1	Y34	1	RL561	X1	Y15	1	X1	Y35	1	
RL482	X2	Y13	1	X2	Y33	1	RL522	X2	Y14	1	X2	Y34	1	RL562	X2	Y15	1	X2	Y35	1	
RL483	X3	Y13	1	X3	Y33	1	RL523	X3	Y14	1	X3	Y34	1	RL563	X3	Y15	1	X3	Y35	1	
RL484	X4	Y13	1	X4	Y33	1	RL524	X4	Y14	1	X4	Y34	1	RL564	X4	Y15	1	X4	Y35	1	
RL485	X5	Y13	1	X5	Y33	1	RL525	X5	Y14	1	X5	Y34	1	RL565	X5	Y15	1	X5	Y35	1	
RL486	X6	Y13	1	X6	Y33	1	RL526	X6	Y14	1	X6	Y34	1	RL566	X6	Y15	1	X6	Y35	1	
RL487	X7	Y13	1	X7	Y33	1	RL527	X7	Y14	1	X7	Y34	1	RL567	X7	Y15	1	X7	Y35	1	
RL488	X8	Y13	1	X8	Y33	1	RL528	X8	Y14	1	X8	Y34	1	RL568	X8	Y15	1	X8	Y35	1	
RL489	X9	Y13	1	X9	Y33	1	RL529	X9	Y14	1	X9	Y34	1	RL569	X9	Y15	1	X9	Y35	1	
RL490	X10	Y13	1	X10	Y33	1	RL530	X10	Y14	1	X10	Y34	1	RL570	X10	Y15	1	X10	Y35	1	
RL491	X11	Y13	1	X11	Y33	1	RL531	X11	Y14	1	X11	Y34	1	RL571	X11	Y15	1	X11	Y35	1	
RL492	X12	Y13	1	X12	Y33	1	RL532	X12	Y14	1	X12	Y34	1	RL572	X12	Y15	1	X12	Y35	1	
RL493	X13	Y13	1	X13	Y33	1	RL533	X13	Y14	1	X13	Y34	1	RL573	X13	Y15	1	X13	Y35	1	
RL494	X14	Y13	1	X14	Y33	1	RL534	X14	Y14	1	X14	Y34	1	RL574	X14	Y15	1	X14	Y35	1	
RL495	X15	Y13	1	X15	Y33	1	RL535	X15	Y14	1	X15	Y34	1	RL575	X15	Y15	1	X15	Y35	1	
RL496	X16	Y13	1	X16	Y33	1	RL536	X16	Y14	1	X16	Y34	1	RL576	X16	Y15	1	X16	Y35	1	
RL497	X17	Y13	1	X17	Y33	1	RL537	X17	Y14	1	X17	Y34	1	RL577	X17	Y15	1	X17	Y35	1	
RL498	X18	Y13	1	X18	Y33	1	RL538	X18	Y14	1	X18	Y34	1	RL578	X18	Y15	1	X18	Y35	1	
RL499	X19	Y13	1	X19	Y33	1	RL539	X19	Y14	1	X19	Y34	1	RL579	X19	Y15	1	X19	Y35	1	
RL500	X20	Y13	1	X20	Y33	1	RL540	X20	Y14	1	X20	Y34	1	RL580	X20	Y15	1	X20	Y35	1	
RL501	X21	Y13	1	X21	Y33	1	RL541	X21	Y14	1	X21	Y34	1	RL581	X21	Y15	1	X21	Y35	1	
RL502	X22	Y13	1	X22	Y33	1	RL542	X22	Y14	1	X22	Y34	1	RL582	X22	Y15	1	X22	Y35	1	
RL503	X23	Y13	1	X23	Y33	1	RL543	X23	Y14	1	X23	Y34	1	RL583	X23	Y15	1	X23	Y35	1	
RL504	X24	Y13	1	X24	Y33	1	RL544	X24	Y14	1	X24	Y34	1	RL584	X24	Y15	1	X24	Y35	1	
RL505	X25	Y13	1	X25	Y33	1	RL545	X25	Y14	1	X25	Y34	1	RL585	X25	Y15	1	X25	Y35	1	
RL506	X26	Y13	1	X26	Y33	1	RL546	X26	Y14	1	X26	Y34	1	RL586	X26	Y15	1	X26	Y35	1	
RL507	X27	Y13	1	X27	Y33	1	RL547	X27	Y14	1	X27	Y34	1	RL587	X27	Y15	1	X27	Y35	1	
RL508	X28	Y13	1	X28	Y33	1	RL548	X28	Y14	1	X28	Y34	1	RL588	X28	Y15	1	X28	Y35	1	
RL509	X29	Y13	1	X29	Y33	1	RL549	X29	Y14	1	X29	Y34	1	RL589	X29	Y15	1	X29	Y35	1	
RL510	X30	Y13	1	X30	Y33	1	RL550	X30	Y14	1	X30	Y34	1	RL590	X30	Y15	1	X30	Y35	1	
RL511	X31	Y13	1	X31	Y33	1	RL551	X31	Y14	1	X31	Y34	1	RL591	X31	Y15	1	X31	Y35	1	
RL512	X32	Y13	1	X32	Y33	1	RL552	X32	Y14	1	X32	Y34	1	RL592	X32	Y15	1	X32	Y35	1	
RL513	X33	Y13	1	X33	Y33	1	RL553	X33	Y14	1	X33	Y34	1	RL593	X33	Y15	1	X33	Y35	1	
RL514	X34	Y13	1	X34	Y33	1	RL554	X34	Y14	1	X34	Y34	1	RL594	X34	Y15	1	X34	Y35	1	
RL515	X35	Y13	1	X35	Y33	1	RL555	X35	Y14	1	X35	Y34	1	RL595	X35	Y15	1	X35	Y35	1	
RL516	X36	Y13	1	X36	Y33	1	RL556	X36	Y14	1	X36	Y34	1	RL596	X36	Y15	1	X36	Y35	1	
RL517	X37	Y13	1	X37	Y33	1	RL557	X37	Y14	1	X37	Y34	1	RL597	X37	Y15	1	X37	Y35	1	
RL518	X38	Y13	1	X38	Y33	1	RL558	X38	Y14	1	X38	Y34	1	RL598	X38	Y15	1	X38	Y35	1	
RL519	X39	Y13	1	X39	Y33	1	RL559	X39	Y14	1	X39	Y34	1	RL599	X39	Y15	1	X39	Y35	1	
RL520	X40	Y13	1	X40	Y33	1	RL560	X40	Y14	1	X40	Y34	1	RL600	X40	Y15	1	X40	Y35	1	

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards																						
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB		
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit
RL601	X1	Y16	1	X1	Y36	1	RL641	X1	Y17	1	X1	Y37	1	RL681	X1	Y18	1	X1	Y38	1
RL602	X2	Y16	1	X2	Y36	1	RL642	X2	Y17	1	X2	Y37	1	RL682	X2	Y18	1	X2	Y38	1
RL603	X3	Y16	1	X3	Y36	1	RL643	X3	Y17	1	X3	Y37	1	RL683	X3	Y18	1	X3	Y38	1
RL604	X4	Y16	1	X4	Y36	1	RL644	X4	Y17	1	X4	Y37	1	RL684	X4	Y18	1	X4	Y38	1
RL605	X5	Y16	1	X5	Y36	1	RL645	X5	Y17	1	X5	Y37	1	RL685	X5	Y18	1	X5	Y38	1
RL606	X6	Y16	1	X6	Y36	1	RL646	X6	Y17	1	X6	Y37	1	RL686	X6	Y18	1	X6	Y38	1
RL607	X7	Y16	1	X7	Y36	1	RL647	X7	Y17	1	X7	Y37	1	RL687	X7	Y18	1	X7	Y38	1
RL608	X8	Y16	1	X8	Y36	1	RL648	X8	Y17	1	X8	Y37	1	RL688	X8	Y18	1	X8	Y38	1
RL609	X9	Y16	1	X9	Y36	1	RL649	X9	Y17	1	X9	Y37	1	RL689	X9	Y18	1	X9	Y38	1
RL610	X10	Y16	1	X10	Y36	1	RL650	X10	Y17	1	X10	Y37	1	RL690	X10	Y18	1	X10	Y38	1
RL611	X11	Y16	1	X11	Y36	1	RL651	X11	Y17	1	X11	Y37	1	RL691	X11	Y18	1	X11	Y38	1
RL612	X12	Y16	1	X12	Y36	1	RL652	X12	Y17	1	X12	Y37	1	RL692	X12	Y18	1	X12	Y38	1
RL613	X13	Y16	1	X13	Y36	1	RL653	X13	Y17	1	X13	Y37	1	RL693	X13	Y18	1	X13	Y38	1
RL614	X14	Y16	1	X14	Y36	1	RL654	X14	Y17	1	X14	Y37	1	RL694	X14	Y18	1	X14	Y38	1
RL615	X15	Y16	1	X15	Y36	1	RL655	X15	Y17	1	X15	Y37	1	RL695	X15	Y18	1	X15	Y38	1
RL616	X16	Y16	1	X16	Y36	1	RL656	X16	Y17	1	X16	Y37	1	RL696	X16	Y18	1	X16	Y38	1
RL617	X17	Y16	1	X17	Y36	1	RL657	X17	Y17	1	X17	Y37	1	RL697	X17	Y18	1	X17	Y38	1
RL618	X18	Y16	1	X18	Y36	1	RL658	X18	Y17	1	X18	Y37	1	RL698	X18	Y18	1	X18	Y38	1
RL619	X19	Y16	1	X19	Y36	1	RL659	X19	Y17	1	X19	Y37	1	RL699	X19	Y18	1	X19	Y38	1
RL620	X20	Y16	1	X20	Y36	1	RL660	X20	Y17	1	X20	Y37	1	RL700	X20	Y18	1	X20	Y38	1
RL621	X21	Y16	1	X21	Y36	1	RL661	X21	Y17	1	X21	Y37	1	RL701	X21	Y18	1	X21	Y38	1
RL622	X22	Y16	1	X22	Y36	1	RL662	X22	Y17	1	X22	Y37	1	RL702	X22	Y18	1	X22	Y38	1
RL623	X23	Y16	1	X23	Y36	1	RL663	X23	Y17	1	X23	Y37	1	RL703	X23	Y18	1	X23	Y38	1
RL624	X24	Y16	1	X24	Y36	1	RL664	X24	Y17	1	X24	Y37	1	RL704	X24	Y18	1	X24	Y38	1
RL625	X25	Y16	1	X25	Y36	1	RL665	X25	Y17	1	X25	Y37	1	RL705	X25	Y18	1	X25	Y38	1
RL626	X26	Y16	1	X26	Y36	1	RL666	X26	Y17	1	X26	Y37	1	RL706	X26	Y18	1	X26	Y38	1
RL627	X27	Y16	1	X27	Y36	1	RL667	X27	Y17	1	X27	Y37	1	RL707	X27	Y18	1	X27	Y38	1
RL628	X28	Y16	1	X28	Y36	1	RL668	X28	Y17	1	X28	Y37	1	RL708	X28	Y18	1	X28	Y38	1
RL629	X29	Y16	1	X29	Y36	1	RL669	X29	Y17	1	X29	Y37	1	RL709	X29	Y18	1	X29	Y38	1
RL630	X30	Y16	1	X30	Y36	1	RL670	X30	Y17	1	X30	Y37	1	RL710	X30	Y18	1	X30	Y38	1
RL631	X31	Y16	1	X31	Y36	1	RL671	X31	Y17	1	X31	Y37	1	RL711	X31	Y18	1	X31	Y38	1
RL632	X32	Y16	1	X32	Y36	1	RL672	X32	Y17	1	X32	Y37	1	RL712	X32	Y18	1	X32	Y38	1
RL633	X33	Y16	1	X33	Y36	1	RL673	X33	Y17	1	X33	Y37	1	RL713	X33	Y18	1	X33	Y38	1
RL634	X34	Y16	1	X34	Y36	1	RL674	X34	Y17	1	X34	Y37	1	RL714	X34	Y18	1	X34	Y38	1
RL635	X35	Y16	1	X35	Y36	1	RL675	X35	Y17	1	X35	Y37	1	RL715	X35	Y18	1	X35	Y38	1
RL636	X36	Y16	1	X36	Y36	1	RL676	X36	Y17	1	X36	Y37	1	RL716	X36	Y18	1	X36	Y38	1
RL637	X37	Y16	1	X37	Y36	1	RL677	X37	Y17	1	X37	Y37	1	RL717	X37	Y18	1	X37	Y38	1
RL638	X38	Y16	1	X38	Y36	1	RL678	X38	Y17	1	X38	Y37	1	RL718	X38	Y18	1	X38	Y38	1
RL639	X39	Y16	1	X39	Y36	1	RL679	X39	Y17	1	X39	Y37	1	RL719	X39	Y18	1	X39	Y38	1
RL640	X40	Y16	1	X40	Y36	1	RL680	X40	Y17	1	X40	Y37	1	RL720	X40	Y18	1	X40	Y38	1

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards																				
Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB			Relay No.	Lower PCB			Upper PCB	
	Relay Function		Sub unit	Relay Function		Sub unit		Relay Function		Sub unit	Relay Function		Sub unit		Relay Function	Sub unit	Relay Function	Sub unit		
RL721	X1	Y19	1	X1	Y39	1	RL761	X1	Y20	1	X1	Y40	1	RL801	Isolation S1	5	Isolation S41	9		
RL722	X2	Y19	1	X2	Y39	1	RL762	X2	Y20	1	X2	Y40	1	RL802	Isolation S2	5	Isolation S42	9		
RL723	X3	Y19	1	X3	Y39	1	RL763	X3	Y20	1	X3	Y40	1	RL803	Isolation S3	5	Isolation S43	9		
RL724	X4	Y19	1	X4	Y39	1	RL764	X4	Y20	1	X4	Y40	1	RL804	Isolation S4	5	Isolation S44	9		
RL725	X5	Y19	1	X5	Y39	1	RL765	X5	Y20	1	X5	Y40	1	RL805	Isolation S5	5	Isolation S45	9		
RL726	X6	Y19	1	X6	Y39	1	RL766	X6	Y20	1	X6	Y40	1	RL806	Isolation S6	5	Isolation S46	9		
RL727	X7	Y19	1	X7	Y39	1	RL767	X7	Y20	1	X7	Y40	1	RL807	Isolation S7	5	Isolation S47	9		
RL728	X8	Y19	1	X8	Y39	1	RL768	X8	Y20	1	X8	Y40	1	RL808	Isolation S8	5	Isolation S48	9		
RL729	X9	Y19	1	X9	Y39	1	RL769	X9	Y20	1	X9	Y40	1	RL809	Isolation S9	5	Isolation S49	9		
RL730	X10	Y19	1	X10	Y39	1	RL770	X10	Y20	1	X10	Y40	1	RL810	Isolation S10	5	Isolation S50	9		
RL731	X11	Y19	1	X11	Y39	1	RL771	X11	Y20	1	X11	Y40	1	RL811	Isolation S11	5	Isolation S51	9		
RL732	X12	Y19	1	X12	Y39	1	RL772	X12	Y20	1	X12	Y40	1	RL812	Isolation S12	5	Isolation S52	9		
RL733	X13	Y19	1	X13	Y39	1	RL773	X13	Y20	1	X13	Y40	1	RL813	Isolation S13	5	Isolation S53	9		
RL734	X14	Y19	1	X14	Y39	1	RL774	X14	Y20	1	X14	Y40	1	RL814	Isolation S14	5	Isolation S54	9		
RL735	X15	Y19	1	X15	Y39	1	RL775	X15	Y20	1	X15	Y40	1	RL815	Isolation S15	5	Isolation S55	9		
RL736	X16	Y19	1	X16	Y39	1	RL776	X16	Y20	1	X16	Y40	1	RL816	Isolation S16	5	Isolation S56	9		
RL737	X17	Y19	1	X17	Y39	1	RL777	X17	Y20	1	X17	Y40	1	RL817	Isolation S17	5	Isolation S57	9		
RL738	X18	Y19	1	X18	Y39	1	RL778	X18	Y20	1	X18	Y40	1	RL818	Isolation S18	5	Isolation S58	9		
RL739	X19	Y19	1	X19	Y39	1	RL779	X19	Y20	1	X19	Y40	1	RL819	Isolation S19	5	Isolation S59	9		
RL740	X20	Y19	1	X20	Y39	1	RL780	X20	Y20	1	X20	Y40	1	RL820	Isolation S20	5	Isolation S60	9		
RL741	X21	Y19	1	X21	Y39	1	RL781	X21	Y20	1	X21	Y40	1	RL821	Isolation S21	5	Isolation S61	9		
RL742	X22	Y19	1	X22	Y39	1	RL782	X22	Y20	1	X22	Y40	1	RL822	Isolation S22	5	Isolation S62	9		
RL743	X23	Y19	1	X23	Y39	1	RL783	X23	Y20	1	X23	Y40	1	RL823	Isolation S23	5	Isolation S63	9		
RL744	X24	Y19	1	X24	Y39	1	RL784	X24	Y20	1	X24	Y40	1	RL824	Isolation S24	5	Isolation S64	9		
RL745	X25	Y19	1	X25	Y39	1	RL785	X25	Y20	1	X25	Y40	1	RL825	Isolation S25	5	Isolation S65	9		
RL746	X26	Y19	1	X26	Y39	1	RL786	X26	Y20	1	X26	Y40	1	RL826	Isolation S26	5	Isolation S66	9		
RL747	X27	Y19	1	X27	Y39	1	RL787	X27	Y20	1	X27	Y40	1	RL827	Isolation S27	5	Isolation S67	9		
RL748	X28	Y19	1	X28	Y39	1	RL788	X28	Y20	1	X28	Y40	1	RL828	Isolation S28	5	Isolation S68	9		
RL749	X29	Y19	1	X29	Y39	1	RL789	X29	Y20	1	X29	Y40	1	RL829	Isolation S29	5	Isolation S69	9		
RL750	X30	Y19	1	X30	Y39	1	RL790	X30	Y20	1	X30	Y40	1	RL830	Isolation S30	5	Isolation S70	9		
RL751	X31	Y19	1	X31	Y39	1	RL791	X31	Y20	1	X31	Y40	1	RL831	Isolation S31	5	Isolation S71	9		
RL752	X32	Y19	1	X32	Y39	1	RL792	X32	Y20	1	X32	Y40	1	RL832	Isolation S32	5	Isolation S72	9		
RL753	X33	Y19	1	X33	Y39	1	RL793	X33	Y20	1	X33	Y40	1	RL833	Isolation S33	5	Isolation S73	9		
RL754	X34	Y19	1	X34	Y39	1	RL794	X34	Y20	1	X34	Y40	1	RL834	Isolation S34	5	Isolation S74	9		
RL755	X35	Y19	1	X35	Y39	1	RL795	X35	Y20	1	X35	Y40	1	RL835	Isolation S35	5	Isolation S75	9		
RL756	X36	Y19	1	X36	Y39	1	RL796	X36	Y20	1	X36	Y40	1	RL836	Isolation S36	5	Isolation S76	9		
RL757	X37	Y19	1	X37	Y39	1	RL797	X37	Y20	1	X37	Y40	1	RL837	Isolation S37	5	Isolation S77	9		
RL758	X38	Y19	1	X38	Y39	1	RL798	X38	Y20	1	X38	Y40	1	RL838	Isolation S38	5	Isolation S78	9		
RL759	X39	Y19	1	X39	Y39	1	RL799	X39	Y20	1	X39	Y40	1	RL839	Isolation S39	5	Isolation S79	9		
RL760	X40	Y19	1	X40	Y39	1	RL800	X40	Y20	1	X40	Y40	1	RL840	Isolation S40	5	Isolation S80	9		

Table 7-1. Relay Look-Up Table (continued)

40x40 High Density Matrix Boards									
Relay No.	Lower PCB		Upper PCB		Relay No.	Lower PCB		Upper PCB	
	Relay Function	Sub unit	Relay Function	Sub unit		Relay Function	Sub unit	Relay Function	Sub unit
RL841	Isolation X1	2	Isolation X1	6	RL881	Isolation Y1	3	Isolation Y21	7
RL842	Isolation X2	2	Isolation X2	6	RL882	Isolation Y2	3	Isolation Y22	7
RL843	Isolation X3	2	Isolation X3	6	RL883	Isolation Y3	3	Isolation Y23	7
RL844	Isolation X4	2	Isolation X4	6	RL884	Isolation Y4	3	Isolation Y24	7
RL845	Isolation X5	2	Isolation X5	6	RL885	Isolation Y5	3	Isolation Y25	7
RL846	Isolation X6	2	Isolation X6	6	RL886	Isolation Y6	3	Isolation Y26	7
RL847	Isolation X7	2	Isolation X7	6	RL887	Isolation Y7	3	Isolation Y27	7
RL848	Isolation X8	2	Isolation X8	6	RL888	Isolation Y8	3	Isolation Y28	7
RL849	Isolation X9	2	Isolation X9	6	RL889	Isolation Y9	3	Isolation Y29	7
RL850	Isolation X10	2	Isolation X10	6	RL890	Isolation Y10	3	Isolation Y30	7
RL851	Isolation X11	2	Isolation X11	6	RL891	Isolation Y11	3	Isolation Y31	7
RL852	Isolation X12	2	Isolation X12	6	RL892	Isolation Y12	3	Isolation Y32	7
RL853	Isolation X13	2	Isolation X13	6	RL893	Isolation Y13	3	Isolation Y33	7
RL854	Isolation X14	2	Isolation X14	6	RL894	Isolation Y14	3	Isolation Y34	7
RL855	Isolation X15	2	Isolation X15	6	RL895	Isolation Y15	3	Isolation Y35	7
RL856	Isolation X16	2	Isolation X16	6	RL896	Isolation Y16	3	Isolation Y36	7
RL857	Isolation X17	2	Isolation X17	6	RL897	Isolation Y17	3	Isolation Y37	7
RL858	Isolation X18	2	Isolation X18	6	RL898	Isolation Y18	3	Isolation Y38	7
RL859	Isolation X19	2	Isolation X19	6	RL899	Isolation Y19	3	Isolation Y39	7
RL860	Isolation X20	2	Isolation X20	6	RL900	Isolation Y20	3	Isolation Y40	7
RL861	Isolation X21	2	Isolation X21	6	RL901	Isolation Y1 Loop-Thru	4	Isolation Y21 Loop-Thru	8
RL862	Isolation X22	2	Isolation X22	6	RL902	Isolation Y2 Loop-Thru	4	Isolation Y22 Loop-Thru	8
RL863	Isolation X23	2	Isolation X23	6	RL903	Isolation Y3 Loop-Thru	4	Isolation Y23 Loop-Thru	8
RL864	Isolation X24	2	Isolation X24	6	RL904	Isolation Y4 Loop-Thru	4	Isolation Y24 Loop-Thru	8
RL865	Isolation X25	2	Isolation X25	6	RL905	Isolation Y5 Loop-Thru	4	Isolation Y25 Loop-Thru	8
RL866	Isolation X26	2	Isolation X26	6	RL906	Isolation Y6 Loop-Thru	4	Isolation Y26 Loop-Thru	8
RL867	Isolation X27	2	Isolation X27	6	RL907	Isolation Y7 Loop-Thru	4	Isolation Y27 Loop-Thru	8
RL868	Isolation X28	2	Isolation X28	6	RL908	Isolation Y8 Loop-Thru	4	Isolation Y28 Loop-Thru	8
RL869	Isolation X29	2	Isolation X29	6	RL909	Isolation Y9 Loop-Thru	4	Isolation Y29 Loop-Thru	8
RL870	Isolation X30	2	Isolation X30	6	RL910	Isolation Y10 Loop-Thru	4	Isolation Y30 Loop-Thru	8
RL871	Isolation X31	2	Isolation X31	6	RL911	Isolation Y11 Loop-Thru	4	Isolation Y31 Loop-Thru	8
RL872	Isolation X32	2	Isolation X32	6	RL912	Isolation Y12 Loop-Thru	4	Isolation Y32 Loop-Thru	8
RL873	Isolation X33	2	Isolation X33	6	RL913	Isolation Y13 Loop-Thru	4	Isolation Y33 Loop-Thru	8
RL874	Isolation X34	2	Isolation X34	6	RL914	Isolation Y14 Loop-Thru	4	Isolation Y34 Loop-Thru	8
RL875	Isolation X35	2	Isolation X35	6	RL915	Isolation Y15 Loop-Thru	4	Isolation Y35 Loop-Thru	8
RL876	Isolation X36	2	Isolation X36	6	RL916	Isolation Y16 Loop-Thru	4	Isolation Y36 Loop-Thru	8
RL877	Isolation X37	2	Isolation X37	6	RL917	Isolation Y17 Loop-Thru	4	Isolation Y37 Loop-Thru	8
RL878	Isolation X38	2	Isolation X38	6	RL918	Isolation Y18 Loop-Thru	4	Isolation Y38 Loop-Thru	8
RL879	Isolation X39	2	Isolation X39	6	RL919	Isolation Y19 Loop-Thru	4	Isolation Y39 Loop-Thru	8
RL880	Isolation X40	2	Isolation X40	6	RL920	Isolation Y20 Loop-Thru	4	Isolation Y40 Loop-Thru	8

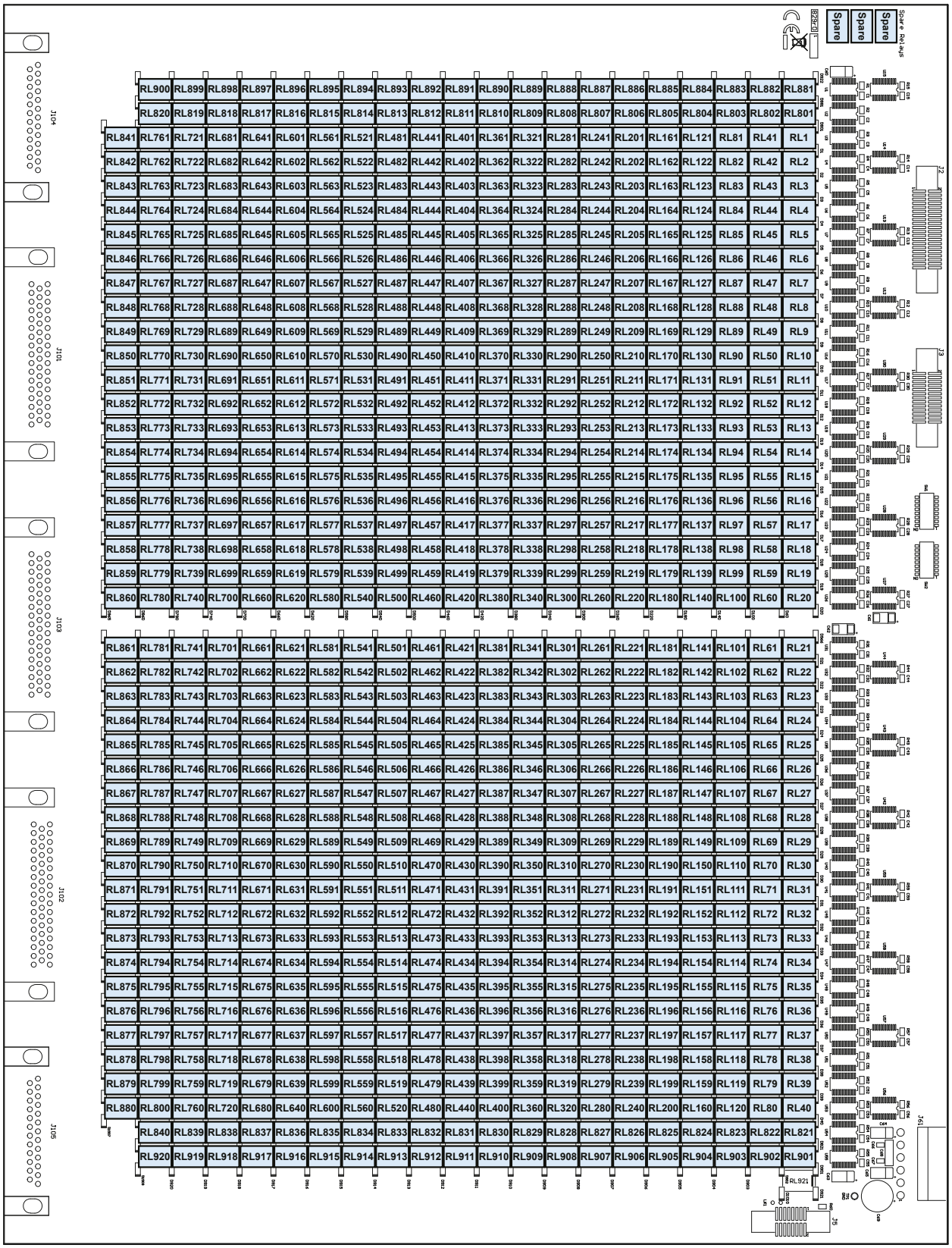


Figure 7-1. Relay Locations - LXI High Density 40x20 Matrix PCB

60-590 Chassis Parts List

The 60-590 LXI High Density Matrix chassis contains one (40x20 version) or two (40x40 version) Matrix PCBs, a Power Supply, Power Distribution Board and a Microcontroller assembly. The following pages provide a parts list for a chassis populated as a 40x40 matrix. The 40x20 version is basically the same but has only the lower Matrix PCB fitted.

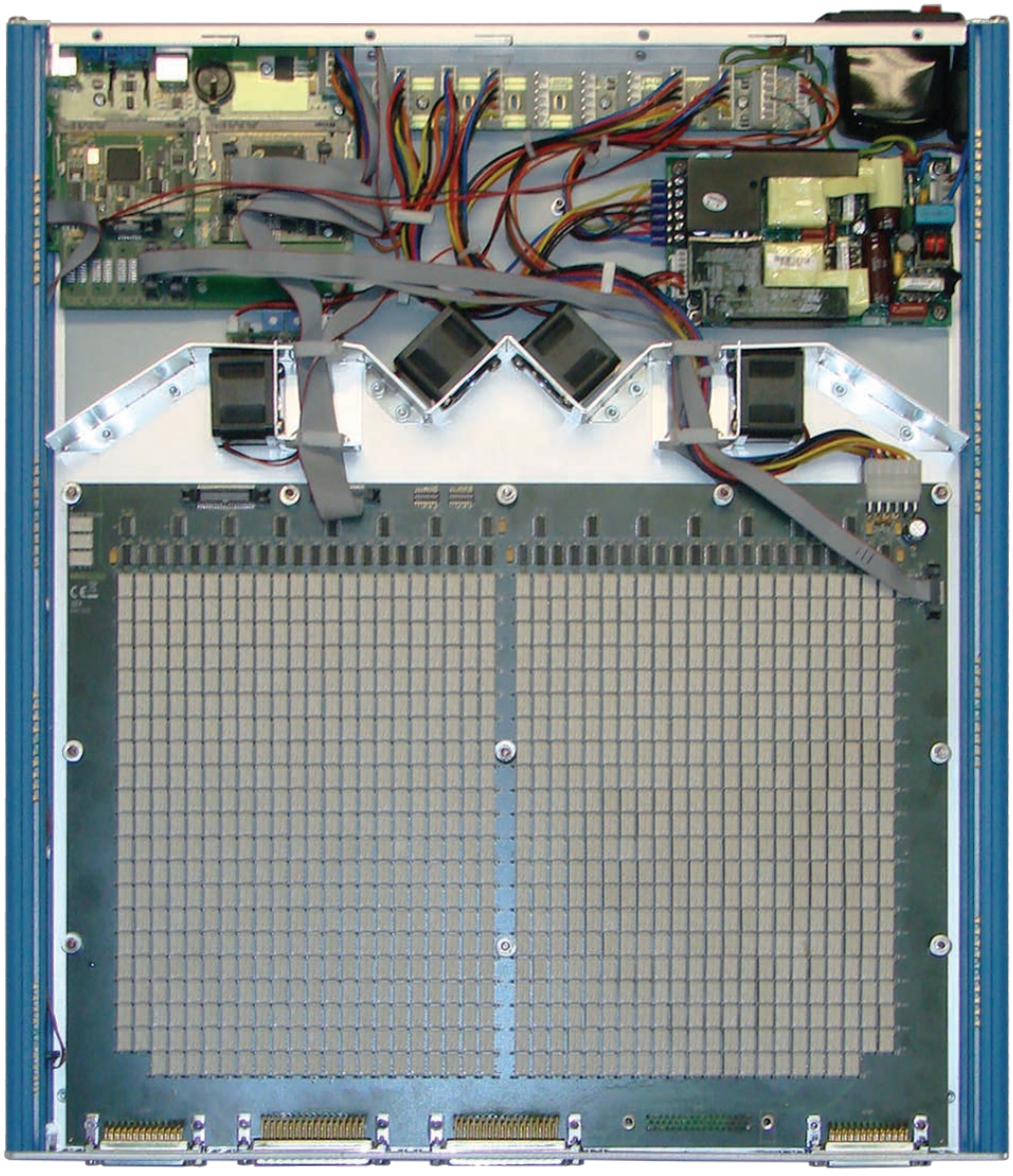


Figure 7-2. 60-590 LXI High Density Matrix Internal View

Table 7-2. 60-590 LXI High Density Matrix Chassis Parts List

Qty	Description	Value/Type	Pickering Part Number	Manufacturer Part Number
1	Multi-Rail Power Supply	±12 V, +5 V, +3.3 V	C-PS-009	VLT-130-4100
1	Mains Inlet Connector	IEC, fused with illuminated switch	C-CN-1195	
1	Fuse Drawer (for mains inlet connector)		C-CN-1196	
2	Fuse (for mains inlet connector)	2.5 A, 20x5 mm TT	C-MS-607	
1	DC Distribution Board	PCB 650	A-PC-650	
1	Fan Control Board	PCB 619	A-PC-619	
4	Fan assembly		A-MS-314	
1	Microcontroller Board	Microcontroller and Bridge	A-PC-1558	
1	Trigger Board	Daughter Card	A-PC-1173-B	
1	IP Address Display	OLED	C-MS-1051	
1	LXI Status LED Board	PCB 652	A-PC-652	
1	Matrix Board - Upper (only fitted to 60-590-002)	40x20 1-Pole Matrix	A-PC-829	
1	Matrix Board - Lower (fitted to both 60-590-001 & 60-590-002)	40x20 1-Pole Matrix	A-PC-829	
2	Ribbon Cable: Microcontroller Board to Matrix Board (only one required for 60-590-001)	40-pin	C-CN-979	
1	Ribbon Cable: LXI Status LED Board to Microcontroller Board	16-pin	C-CN-951	

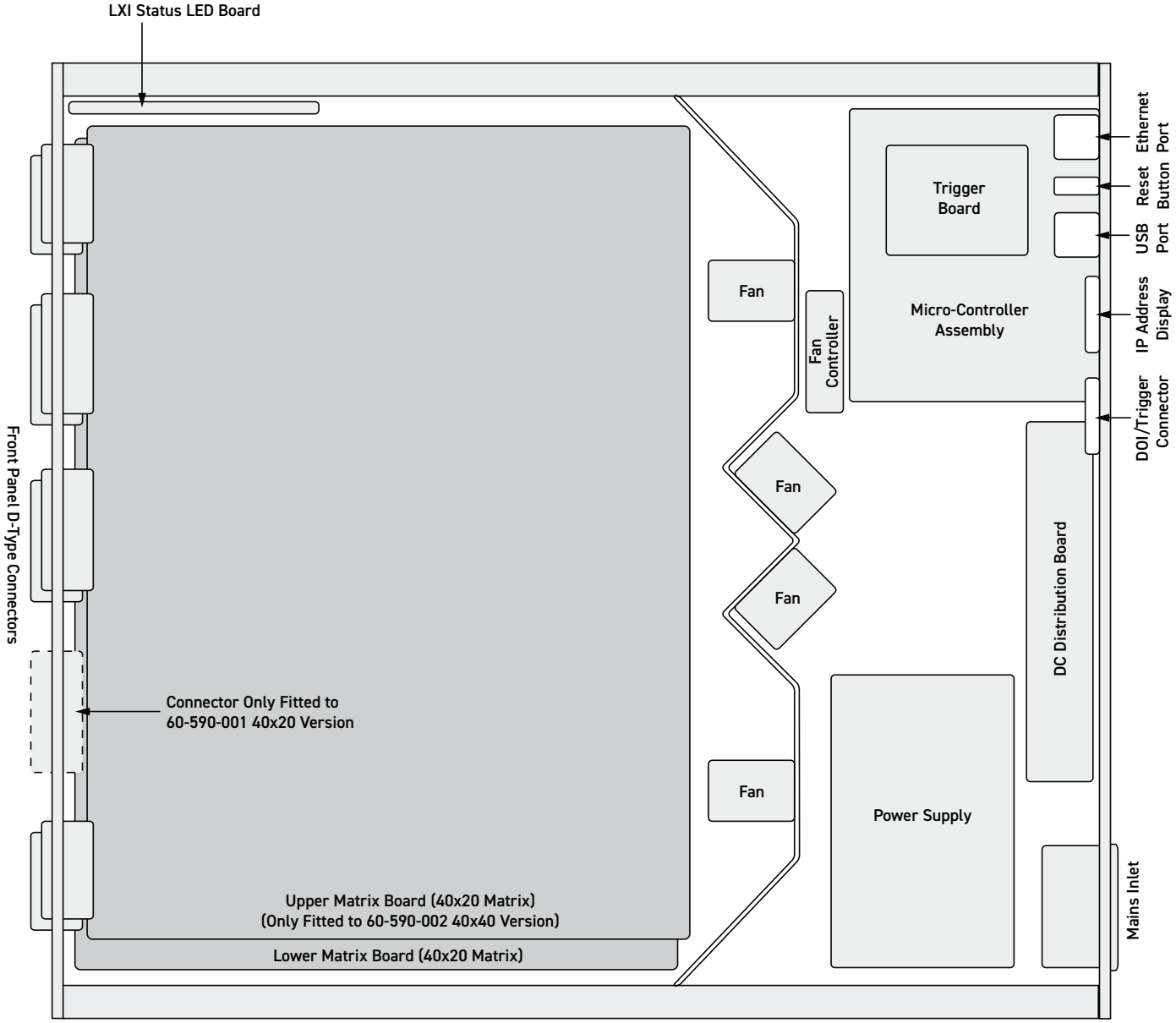


Figure 7-3. 60-590 LXI High Density Matrix: Chassis Layout

General Maintenance

The LXI High Density Expandable Matrix consists of three major functional blocks:

- Microcontroller and LAN interface
- Switch Drivers and Relay Matrix
- Power Supply and Power Distribution

This section briefly outlines these functional blocks to assist in the fault finding process. Figure 7.4 provides a diagram of how the PCBs are interconnected for a fully populated 40x40 matrix, and gives Pickering part numbers for the various assemblies. The 40x20 variant of the matrix is essentially the same but with only the lower matrix board fitted in the chassis.

Microcontroller and LAN Interface

The microcontroller assembly performs the control functions for the unit and provides interfaces to the external ethernet connection and the relay drivers on the matrix boards.

Microcontroller Assembly (A-PC-1558)

The microcontroller is a single board computer based on the ARM processor. It stores the LXI homepage and programming information for the 60-590. Part of the microcontroller assembly is the bridge circuit which provides the interface between the microcontroller and the switch drivers on the matrix boards. Switching information is sent via serial data streams to the two Matrix Base Boards via two ribbon cable.

Trigger Board (A-PC-1173-B)

This provides the interface for the sequencing and triggering functions for the unit. It is mounted on the microcontroller assembly and it connected to the DOI/Trigger connector on the rear of the chassis via a ribbon cable.

IP Address Display (C-MS-1051)

This is an OLED display mounted on the rear panel and is used for displaying the address of the unit and is controlled from the microcontroller via a ribbon cable.

LXI Status LED Board (A-PC-481 Board B)

The LED board on the unit's front panel carries the status indicators for the microcontroller and LAN connection. It is connected by a ribbon cable to a port on the Microcontroller board.

Switch Drivers and Relay Matrix

The signal switching for the 60-590 is carried out by 40x20 Matrix Boards. The 60-590-001 (40x20 matrix) has a single Matrix Board fitted, and the 60-590-002 (40x40 matrix) is fitted with two inter-linked Matrix Boards. The front panel D-type signal connectors are mounted on the Matrix Boards, 40x20 versions of the 60-590 have 5 signal connectors and 40x40 versions have 8 connectors (see Section 5 for the front panel connector positioning).

Lower Matrix Board (A-PC-829)

The Lower Matrix Board is populated with electro-mechanical relays configured as a 40x20 matrix. As well as the switching matrix there are also banks of isolation switches for the X signals, X Loop-Thru, Y Loop-Thru and the S buses. In the case of the 60-590-002, where an Upper Matrix Board is fitted, the X Loop-Thru

connections link the X bus between the two boards, and the associated isolation switches serve to connect signals between the two 40x20 matrices. For an illustration of the 60-590's switching architecture, refer to the diagrams in Section 1 of this document.

The Matrix Boards receive data for their relay drivers via ribbon cables from the Microcontroller Board, and power is supplied from the PSU via the Distribution Board. In the 40x20 version, only the Lower matrix Board is installed which is fitted with the front panel D-type connectors for the following signals: X1-40, Y1-20, XLT1-40, YLT1-20 and S1-40. In the 40x40 version of the unit, the Lower Matrix Board is a different build version and is fitted with D-type connectors for the following signals: X1-40, Y1-20, YLT1-20 and S1-40. The X bus signals are transferred between the Upper and Lower Matrix Boards via an inter-PCB connector.

Upper Matrix Board (A-PC-829)

The functionality of the Upper Matrix Board is basically the same as described previously for the Lower Matrix Board, but it houses the upper half of the 40x40 matrix (Y connections 21 to 40). The Upper Matrix Board is only fitted to the 60-590-002 (40x40 version) and X signals from the Lower Matrix Board are transferred via an inter-PCB connector. The Upper Matrix Board is fitted with the front panel D-type connectors for the following signals: Y21-40, XLT1-40, YLT21-40 and S41-80. The connectors for all other signals are fitted to the Lower Matrix Board.

Power Supply and Power Distribution

The unit has a power supply and a PCB that distributes power to the various assemblies. The power supply is fed from an AC supply via the IEC connector assembly on the unit's rear panel. This connector assembly also incorporates an illuminated power switch and two supply fuses. The earth wires from the mains connector and the power supply are attached to a grounding stud on the inside of the unit's rear panel.

PSU: Multi-Rail Power Supply (C-PS-009)

The multi-rail power supply has voltage rails of +12 V, +5 V, +3.3 V and -12 V, and supplies power for the logic, relay driver circuits and relay coils of the switching matrix.

DC Distribution board (A-PC-650)

This distribution board feeds power from the PSU to the Microcontroller assembly, the two Matrix Boards and the Fan Controller Board.

Cooling Fans and Fan Controller Board (A-PC-619)

The four cooling fans are arranged in the chassis to obtain the best air flow from the entry slots in the front panel, past the matrix boards, through the power supply and microcontroller assemblies, and out via the exhaust slots in the rear panel. The Fan Controller Board is fed with 12 volts via the DC Distribution Board and provides a regulated supply for the fans with a preset speed control.

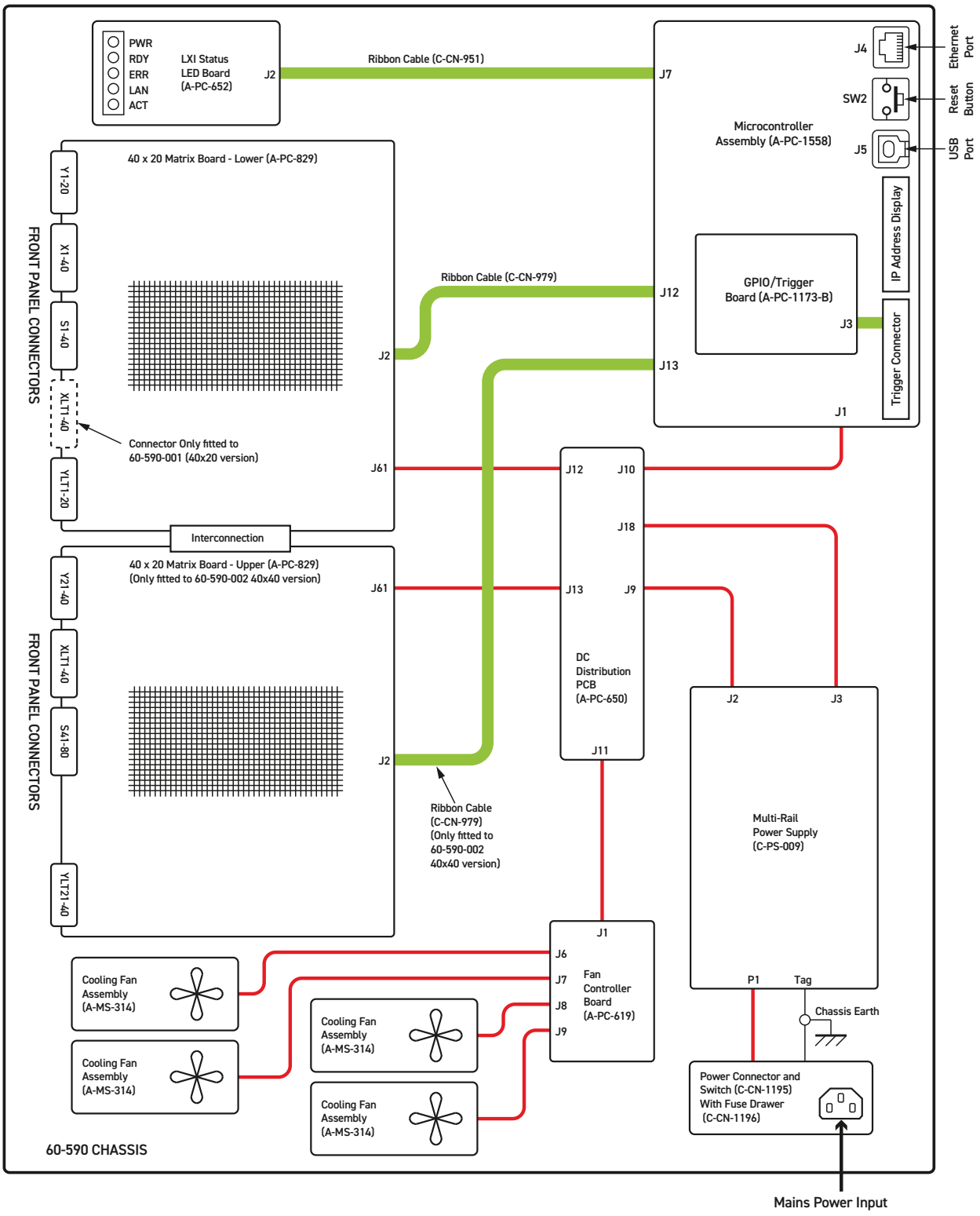


Figure 7-4. Internal Wiring For the 60-590 LXI High Density Matrix

Diagnostics

External Loop-Back Connectors

The 60-590 is fitted with the ability to perform self diagnosis of its switching matrix. This diagnostic tool requires the user to remove all front panel cabling from the unit and fit loop-back connectors to enable the routing of internally generated test signals.

To allow the diagnostic test to run, a minimum of two loop-back connectors are required - one for the 25-pin D-type connectors and one for the 50-pin D-type connectors. The unit is supplied with two loop-back connectors as outlined below:

25-pin loop-back, part number 64-590-BAT25 (initially fitted to the Y1-20 connector during testing).

50-pin loop-back, part number 64-590-BAT50 (initially fitted to the X1-40 connector during testing).

When executing the diagnostic test using two loop-back connectors the test will halt at the appropriate stage and the user will be prompted to remove a particular loop-back and re-fit to the next connector in sequence.

To simplify the test procedure, loop-backs can be fitted to all front panel connectors. To do this, extra loop-back connectors can be ordered from Pickering Interfaces or the user can construct their own using 25 and 50-pin D-type sockets and referring to the following wiring information:

25-pin Loop-Back Pin to Pin Connections
1 to 14
2 to 15
3 to 16
4 to 17
5 to 18
6 to 19
7 to 20
8 to 21
9 to 22
10 to 23

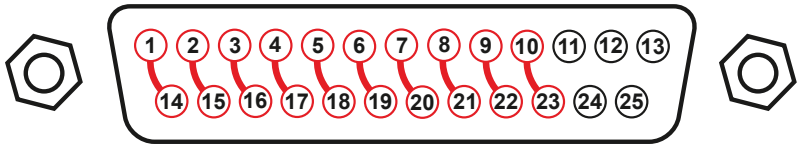


Figure 7-5. 25-pin Loop-Back Connector Wiring (female 25-pin D-type viewed from solder side) Suitable for Y1-20, YLT1-20, Y21-40 & YLT21-40 Connectors

50-pin Loop-Back Pin to Pin Connections
1 to 18
34 to 2
19 to 35
3 to 20
36 to 4
21 to 37
5 to 22
38 to 6
23 to 39
7 to 24
40 to 8
25 to 41
9 to 26
42 to 10
27 to 43
11 to 28
44 to 12
29 to 45
13 to 30
46 to 14

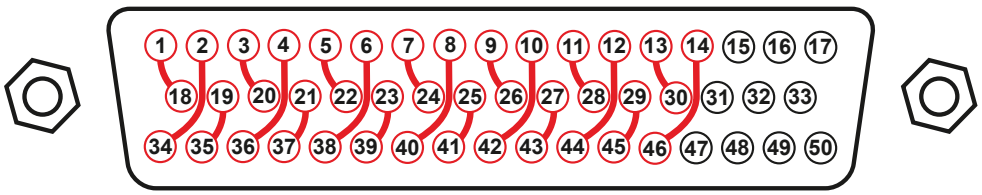


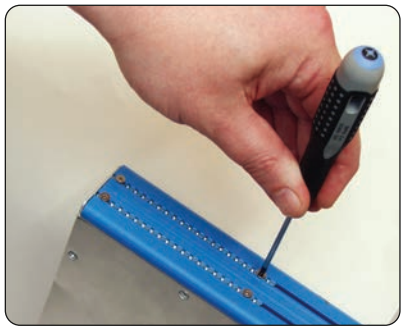
Figure 7-6. 50-pin D-type Loop-Back Connector Wiring (female 50-pin D-type viewed from solder side) Suitable for X1-40, S1-40, XLT1-40 & S41-80 Connectors

Appendix A

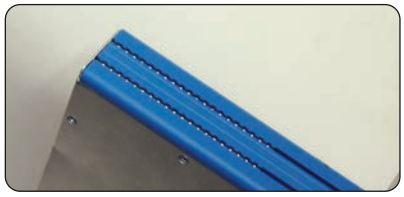
Fitting Rack Mounting Flanges

Pickering's LXI units are supplied with mounting flanges to enable fitting into a standard 19 inch rack. The following procedure describes the attachment of the flanges to the unit's side extrusions, a No.1 cross head screwdriver will be required.

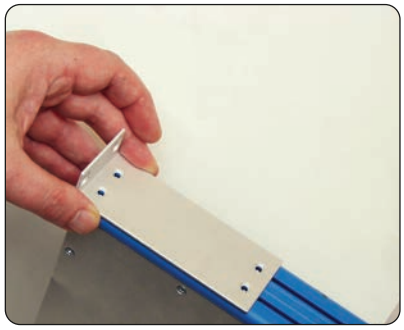
1. On the right hand side of the unit, remove the four countersunk screws that secure the two threaded strips in the upper and lower channels of the side extrusion.



2. Make sure the threaded strips are as far forward as possible and touching the back of the front panel.



3. Take one of the two supplied flanges and place against the side extrusion so that the four screw holes line up with four threaded holes in the threaded strips.



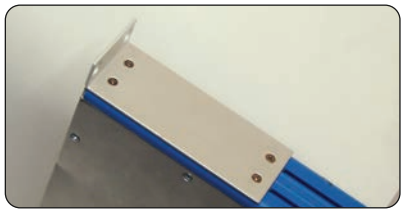
4. Loosely fit the four countersunk screws through the four holes in the flange and into the threaded strips.

5. Position the flange so that its front surface is aligned with the surface of the front panel.



6. Tighten the four countersunk screws so that the flange is secure against the side extrusion.

7. Repeat steps 1 to 6 on the left hand side of the unit using the second flange.



WARNING: The fixing holes in the front of the rack mounting flanges are designed only for securing the unit in the rack and must NOT be used to support the weight of the whole unit. The weight of the unit must be supported by side brackets, runners or a suitable equipment shelf.