60-807 User Manual

LXI 50 Ω Microwave Matrix



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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.

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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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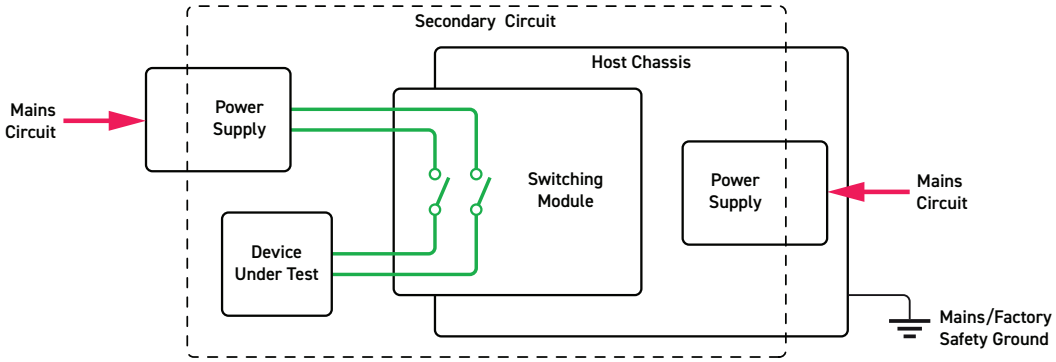
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Appendix A

Fitting Rack Mounting Flanges A.1

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.



WARNING

Only the correct connector series should be mated with this unit. For versions with SMA connectors, the user should only mate the correct type to the unit, failure to do so may result in damage to the connector.

Also, it is important that the SMA connector's nut is properly tightened to the correct torque with a 5/16 inch wrench. This should be 3-5 in·lbs (0.3 to 0.6 N·m) for brass, and 7-10 in·lbs (0.8–1.1 N·m) for stainless steel connectors.

Section 1 - Technical Specification

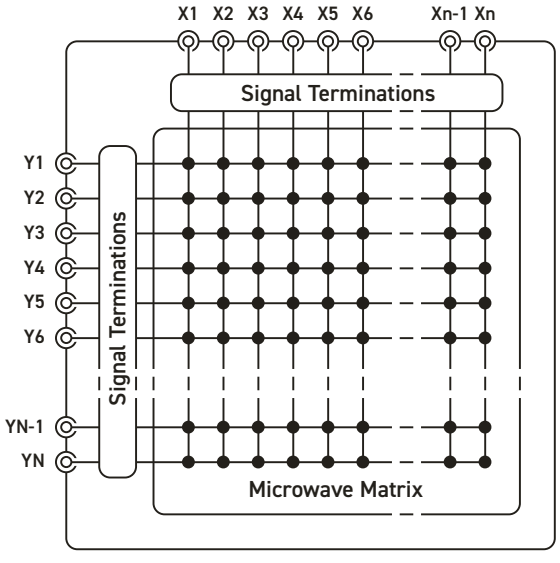


- High Performance RF Matrix
- 6 GHz, 12.4 GHz, 18 GHz, 26.5 GHz, 40 GHz, 50 GHz or 67 GHz Bandwidths
- Matrix Sizes Up to 12x12 (Other Sizes Available on Request)
- Unterminated or Terminated Versions Available
- Failsafe & Latching Relay Options
- 6U Format (for 12x12 Matrix)
- Excellent RF & Repeatability Characteristics
- LED Indication of Active Signal Paths (Failsafe Versions Only)
- Relay Cycle Counting Included
- Built-In Scan List Sequence Stores With Triggering Capability
- LXI Standard 1.5 Compliant
- IVI & Direct I/O Drivers
- 3 Year Warranty

The 60-807 Microwave Matrix is suitable for routing 50 Ω signals up to 67 GHz. With sizes up to 12x12 it is ideal for constructing complex microwave switching systems for many applications (other sizes are available on request). Connection is by front panel mounted SMA. SMA 2.9, SMA 2.4, SMA 1.85 or N-type connectors.

The 60-807 matrix is constructed from interconnected microwave tree multiplexers which allows the routing of any single input port to any single output port. Also, the matrix is available with automatic termination of unused signals.

The matrix has an extremely high level of performance with low VSWR, very high isolation, low loss and high power handling. It provides a compact switching solution ideal for 50 Ω systems with frequencies from HF up to microwave.



Schematic Diagram for the 60-807 Microwave Matrix - available with or without signal terminations

Controlling the Matrix

The 60-807 is controlled through an LXI interface based on 1000Base-T Ethernet. This provides a quick and easy method of installing the unit and a simple way of controlling it at a remote location through its API or built in soft front panel. The ability to control the unit at a distance aids the testing of systems without the need for a physical presence.

Relay Type

To provide maximum flexibility this range is available with either failsafe or latching relays. For definition, the contacts of failsafe relays return to the default state when the system power is removed whereas latching relay contacts retain their last set state when the power is removed.

LED Indication

Each X and Y signal path of the 60-807 has an associated front panel LED to show when a path is active (LEDs are only fitted to versions with failsafe relays).

Easy Repair

The construction of the 60-807 permits ease of assembly and maintenance. All the cabling required to create the switching configuration is contained within the unit for a neat solution in a small form-factor.

Other Microwave Switching Configurations

We are able to offer other microwave switching solutions, if you have a custom requirement for switching please contact your local Pickering Interfaces sales representative.

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, in the case of a matrix, if a user wants to operate 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.

Section 1 - Technical Specification

Typical Specification for 18 GHz 12x12 Matrix

Configuration:	12x12 Microwave blocking matrix
Operate Time:	15 ms (typical)
Impedance:	50 Ω
Bandwidth	DC to 18 GHz
Isolation:	>120 dB
Insertion Loss:	7 dB (port X+Y) (typical) 3 dB (Y = 1) (typical) 4.5 dB (2 <= Y <=5) (typical) 9.5 dB (6 <= Y <= 11) (typical)
VSWR (typical unless stated):	2.0:1 (typical) / 2.3:1 (max) (port X+Y) 2.0:1 (Y = 1) 2.5:1 (2 <= Y <=5) 2.8:1 (6 <= Y <= 11)

Note: These are representative figures, the actual specification will depend upon the matrix size and frequency range selected.

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:	5 A, 250 V

LAN Interface

Compliant to LXI Standard 1.5, the 60-807 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.

LXI Status Indicators

Front panel mounted LEDs:

- Power
- Ready
- Error
- LAN
- Active

Mechanical Characteristics

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

Dimensions: Full 19" rack width, 500 mm depth
6U high - 12x12 matrix (for the rack size of other versions, please contact Pickering).

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

Cooling

Fan assisted cooling, side air intakes and rear exhaust.

Signal Connectors

Signals via front panel mounted coaxial connectors:

- 6 GHz versions - 50 Ω SMA connectors
- 12.4 GHz versions - 50 Ω N-type connectors
- 18 GHz & 26.5 GHz versions - 50 Ω SMA connectors
- 40 GHz versions - 50 Ω SMA 2.92 connectors
- 50 GHz versions - 50 Ω SMA 2.4 connectors
- 67 GHz versions - 50 Ω SMA 1.85 connectors

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.

Product Order Codes

LXI Microwave Matrix, 50 Ω, Failsafe Relays	
6 GHz, SMA	60-807-010-xyz
6 GHz, SMA, Terminated	60-807-020-xyz
12.4 GHz, N-type	60-807-111-xyz
12.4 GHz, N-type, Terminated	60-807-121-xyz
18 GHz, SMA	60-807-210-xyz
18 GHz, SMA, Terminated	60-807-220-xyz
26.5 GHz, SMA	60-807-310-xyz
26.5 GHz, SMA, Terminated	60-807-320-xyz
40 GHz, SMA 2.92	60-807-410-xyz
40 GHz, SMA 2.92, Terminated	60-807-420-xyz
50 GHz, SMA 2.4	60-807-510-xyz
50 GHz, SMA 2.4, Terminated	60-807-520-xyz
67 GHz, SMA 1.85	60-807-610-xyz
67 GHz, SMA 1.85, Terminated	60-807-620-xyz
LXI Microwave Matrix, 50 Ω, Latching Relays	
6 GHz, SMA	60-807-015-xyz
6 GHz, SMA, Terminated	60-807-025-xyz
12.4 GHz, N-type	60-807-116-xyz
12.4 GHz, N-type, Terminated	60-807-126-xyz
18 GHz, SMA	60-807-215-xyz
18 GHz, SMA, Terminated	60-807-225-xyz
26.5 GHz, SMA	60-807-315-xyz
26.5 GHz, SMA, Terminated	60-807-325-xyz
40 GHz, SMA 2.92	60-807-415-xyz
40 GHz, SMA 2.92, Terminated	60-807-425-xyz
50 GHz, SMA 2.4	60-807-515-xyz
50 GHz, SMA 2.4, Terminated	60-807-525-xyz
67 GHz, SMA 1.85	60-807-615-xyz
67 GHz, SMA 1.85, Terminated	60-807-625-xyz

Where:

x = the X size:	y = the Y size:	z = the number of banks:
0 = 2	0 = 2	1 = single
1 = 4	1 = 4	2 = dual
2 = 6	2 = 6	3 = triple
3 = 8	3 = 8	4 = quad
4 = 10	4 = 10	
5 = 12	5 = 12	

Versions with other matrix sizes and different frequency ranges can be made to order, please contact sales office.

Mating Connectors & Cabling

For connection accessories for the 60-807 please refer to the 90-011D RF Cable Assemblies data sheet where a complete list and documentation can be found for accessories, or refer to our website.

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.

Section 2 - Technical Description

Functional Description

The 60-807 is a microwave matrix with up to 12 X connections and 12 Y connections with up to 4 banks under control of an LXI interface designed for the routing of signals with frequencies up to 6, 12.4, 18, 26.5, 40, 50 or 67 GHz (depending upon the variant). Versions are also available whereby unused signals are terminated into 50 Ω. User connections are via SMA, or N-type connectors on the front panel. A block diagram for the unit is shown in Figure 2-1 and detailed switching diagrams are shown in Figures 2-2 and 2-3.

Switch setting information for the unit is sent from the Embedded Processor to the Relay Driver PCBs via a Bridge circuit. The Relay Driver board's data ports are interconnected in a daisy chain and are controlled with a serial data stream from the Bridge board. 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. LXI Status LEDs on the front of the chassis indicate the condition of the unit and the LAN connection.

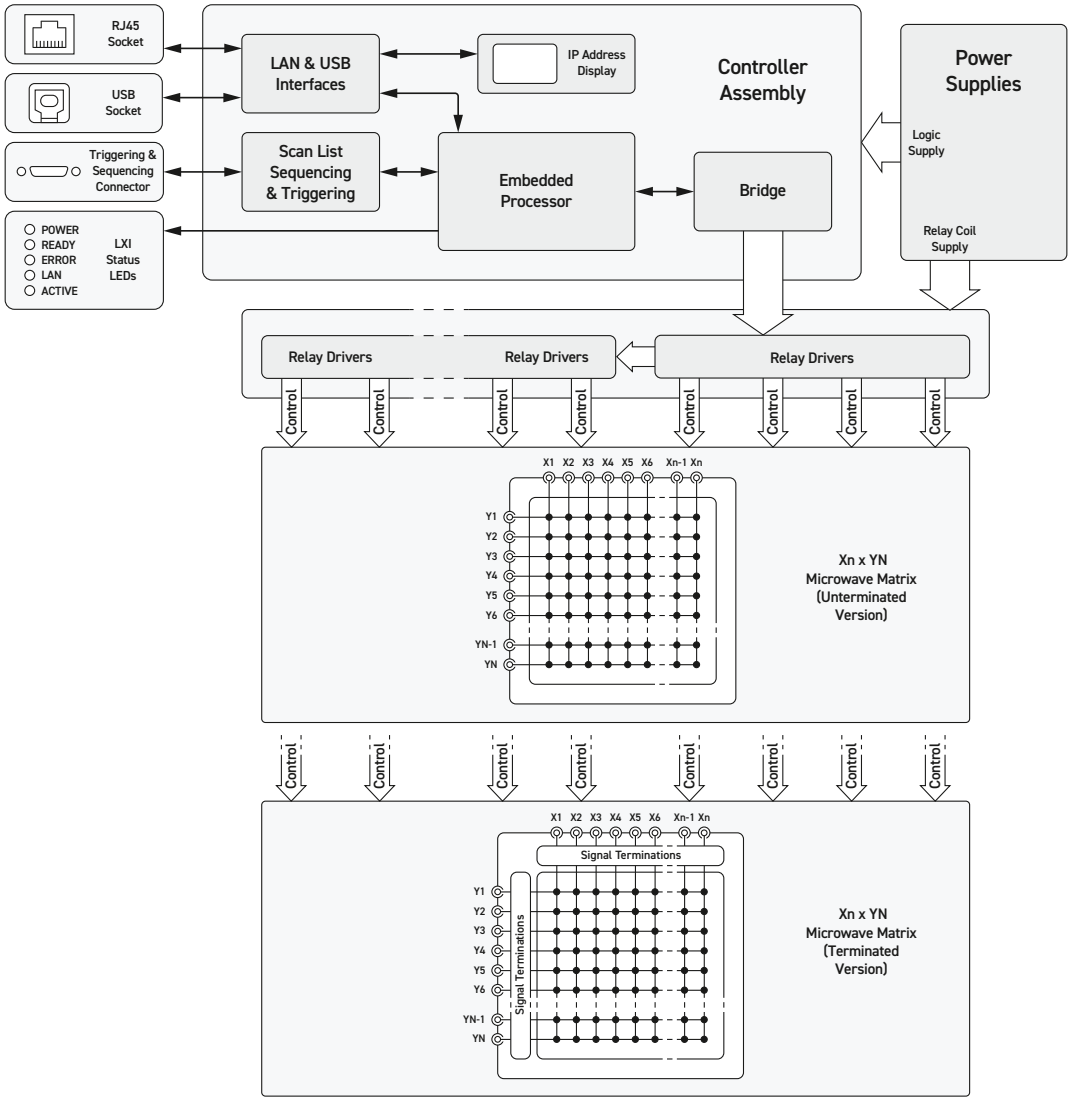


Figure 2-1. Block Diagram for the 60-807 Microwave Matrix

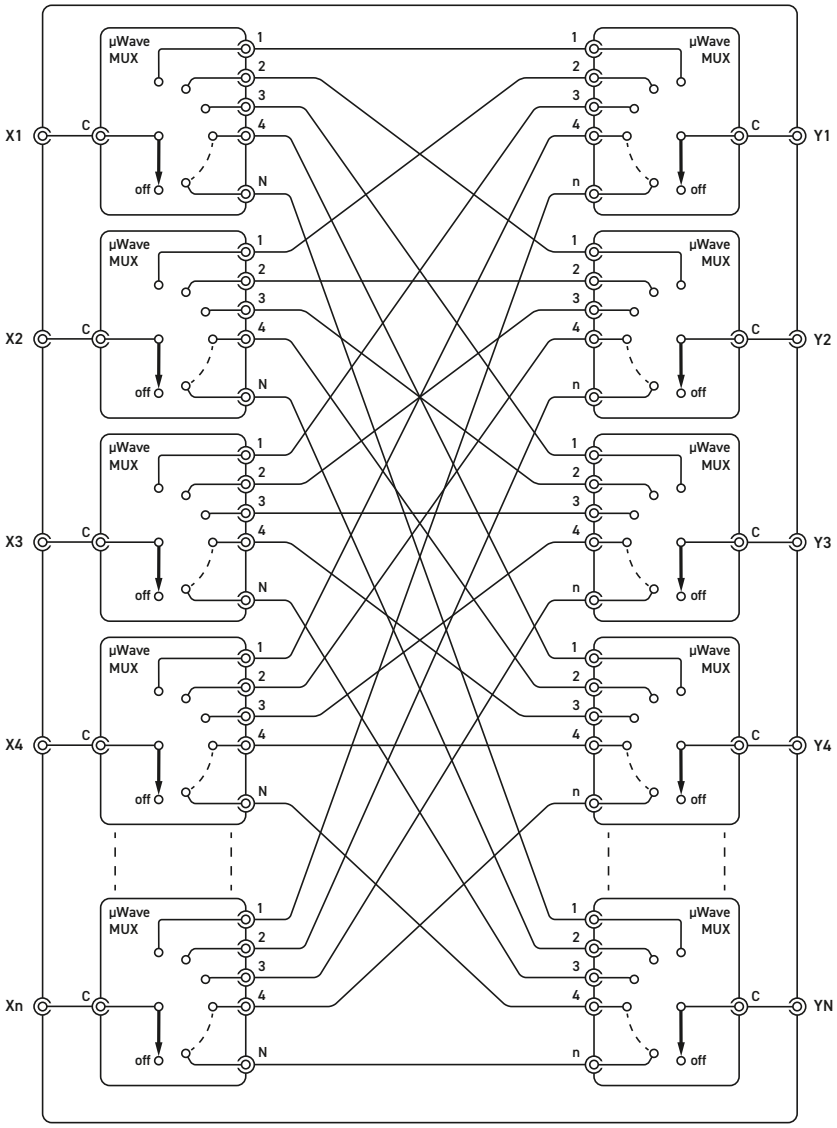


Figure 2-2. Detailed Schematic Diagram for the 60-807 Microwave Matrix - Unterminated Version

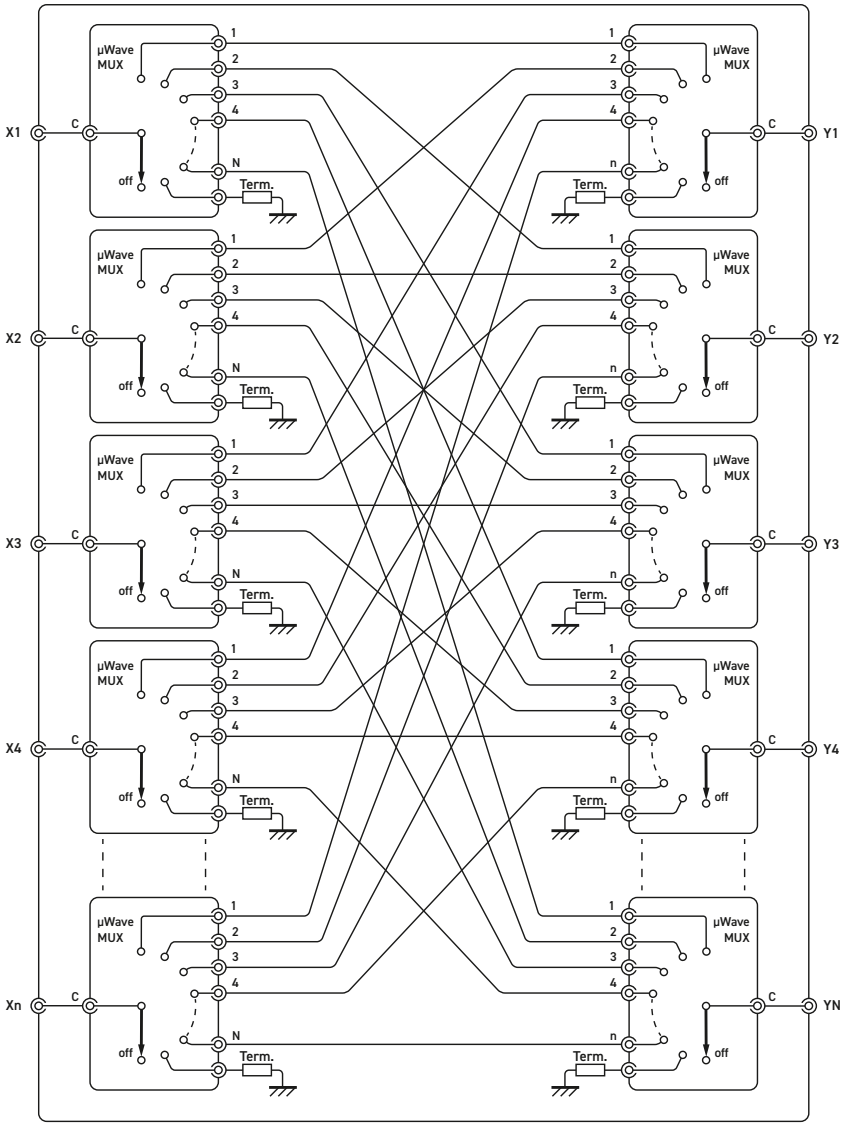


Figure 2-3. Detailed Schematic Diagram for the 60-807 Microwave Matrix - Terminated Version

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 Microwave Matrix

The 60-807 may be mounted on a desk top or fitted into a standard 19 inch rack (rack mounting flanges are supplied with the unit that can be fitted to the sides 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 unit relies upon forced air cooling. Internal fans draw air through slots in the front panel and expel air through vents in 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 unit using a standard IEC power lead and the power on/off switch is located next to the power inlet socket. The unit 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 unit. This is to enable the operation of the power on/off switch. The rear panel layout is shown in Figure 3-2.

The Microwave 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. Example front view of the Microwave Matrix showing status indicators, IP address display & intake slots for cooling air (shown as an illustration - actual unit will vary)

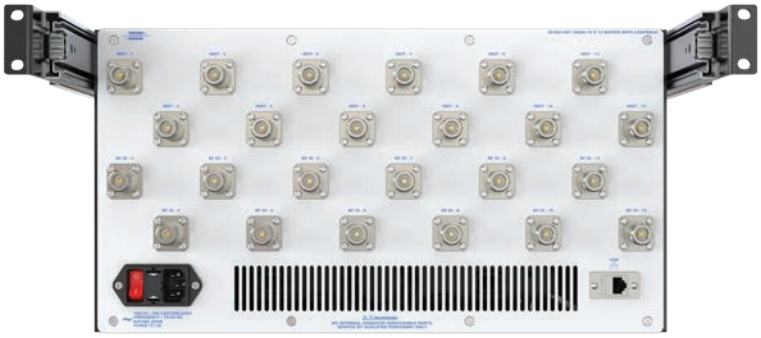


Figure 3-2. Example rear view of the Microwave Matrix showing the RF connectors, mains supply connection, LAN socket and cooling air outlets (shown as an illustration - actual unit will vary)

Setting the IP Address

To use the 60-807 Microwave 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 60-807 is indicated on an LCD display on the front panel of the chassis.

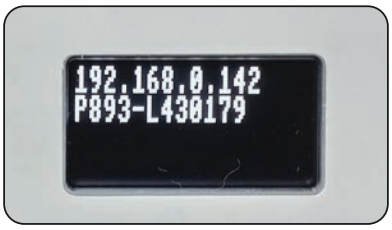


Figure 3-3. Display for IP Address on Front Panel

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 front panel of the device for a full factory reset (see Section 6 "Troubleshooting" for details).

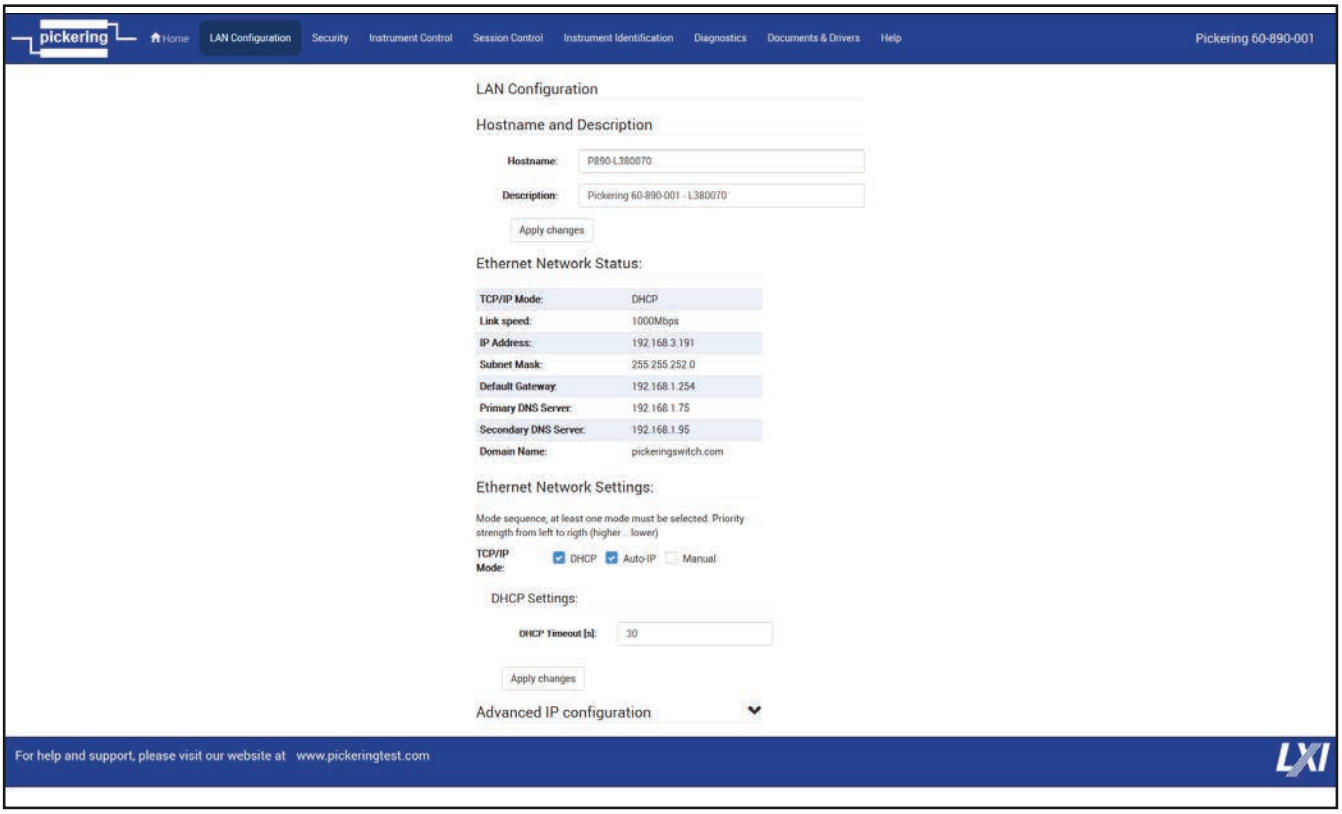


Figure 3-4. Example configuration window used to manually set the IP address of a Pickering LXI device

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 Microwave 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 Microwave Matrix

The 60-807 is a microwave matrix that consists of up to 12 connections on the X axis and 12 connections on the Y axis and can have up to 4 separate banks. The matrix is constructed from interconnected multiplexers and allows paths to be set between an X port and one Y port with a total of twelve X to Y connections for a 12x12 matrix. Connections from an X port to multiple Y ports, or a Y port to multiple X ports is not possible, also X to X or Y to Y connections are not possible. Versions are available where switches include termination where unused channels are routed into 50 Ω.

For failsafe versions, the initial state of the switches is with the all X and Y ports open circuit. This is also the default (power off) state. Latching versions retain last state.

The matrix is controlled using a single sub-unit and versions with multiple matrices have a sub-unit for each bank as shown in Table 4-1.

Table 4-1. 60-807 LXI Microwave Matrix - Sub-unit and IVI Channel Names

Switch	Bank	Sub-unit	Signal Path (when energized)	IVI Channel Names (N is the maximum X count & n is the maximum Y count)	
nxN Matrix	1	1	connection between any X1 - Xn port to any Y1 - YN port	Versions with a single matrix:	
				x1 - xN	*y1 - y1n*
				Versions with multiple matrices:	
				xA1 - xAN	*yA1 - yAn*
nxN Matrix	2	2	connection between any X1 - Xn port to any Y1 - YN port	*xB1 - xBN*	*yB1 - yBn*
nxN Matrix	3	3	connection between any X1 - Xn port to any Y1 - YN port	*xC1 - xCN*	*yC1 - yCn*
nxN Matrix	4	4	connection between any X1 - Xn port to any Y1 - YN port	*xD1 - xDN*	*yD1 - yDn*

Direct I/O Driver, piplx

The Direct I/O driver is 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 unit is established. This provides a session handle to the remote LXI unit which must be used in all subsequent communication with the unit.

Then a specified card on the remote LXI unit 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 LXI handle, the card handle then the sub-unit to access and the crosspoint location and its state. In this case the crosspoint at (x,y) = (3,1) on the first sub-unit of the opened card is first energized then released.

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

```
DWORD err;
SESSION lxi_session;
DWORD card_handle;
DWORD sub_unit, bit;

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

if (err == 0)
{
	err = PIPLX_OpenSpecifiedCard( lxi_session, 0, 20, &card_handle);

	if (err == 0)
	{
		PIPLX_OpCrosspoint(lxi_session, card_handle, 1, 3, 1, 1);
			//Connect crosspoint X3 - Y1 in sub-unit 1
	.
	.
	.
		PIPLX_OpCrosspoint(lxi_session, card_handle, 1, 3, 1, 0);
			//Disonnect crosspoint X3 - Y1 in sub-unit 1

		PIPLX_CloseSpecifiedCard( lxi_session, card_handle);
	}

	PICMLX_Disconnect(lxi_session);
}
```

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 switches 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.

A switch closure of the X3-Y1 crosspoint is enabled, then disconnected.

Finally the session is closed.

```
ViSession vi;
ViStatus err;

ViRsrc rsrc_name = "TCPIP::192.168.1.100::0.20::INSTR";
ViString options = "Simulate=1,RangeCheck=1,QueryInstrStatus=0, \
                                Cache=1,DriverSetup=Model:60-891-007;";

err = pi40iv_InitWithOptions(rscr_name, VI_TRUE, VI_TRUE, options, &vi);


if (err == VI_SUCCESS)
{
       pi40iv_Connect(vi, "x3", "y1");         //Connect X3 to Y1 signal path
       .
       .
       .
       pi40iv_Disconnect(vi, "x3", "y1");             //Disconnect X3 to Y1 signal path
}

pi40iv_Close(vi);
```

Notes:

The channel names for the matrix switches will be as follows (where 'N' is the maximum X count and 'n' is the maximum Y count):

For a single bank matrix:

```
x1, x2, x3, x4 – xN
y1, y2, y3, y4 – yn
```

For a multi-bank matrix:

```
xA1, xA2, xA3, xA4 – xAN
yA1, yA2, yA3, yA4 – yAn

xB1, xB2, xB3, xB4 – xBN
yB1, yB2, yB3, yB4 – yBn

xC1, xC2, xC3, xC4 – xCN
yC1, yC2, yC3, yC4 – yCn

xD1, xD2, xD3, xD4 – xDN
yD1, yD2, yD3, yD4 – yDn
```

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 60-807 is controlled as follows:

To select a matrix sub-unit on the LXI unit (card 1), type AD followed by the card number and sub-unit number eg: `AD 1 2` (this will select matrix bank 2).

To select a matrix crosspoint type XC followed by the required output, eg: `XC 1 2` (this will select crosspoint x1 - y2)

To clear a matrix crosspoint type XO followed by the required output, eg: `XO 1 2` (this will clear crosspoint x1 - y2)

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 60-807 Microwave 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 this section.

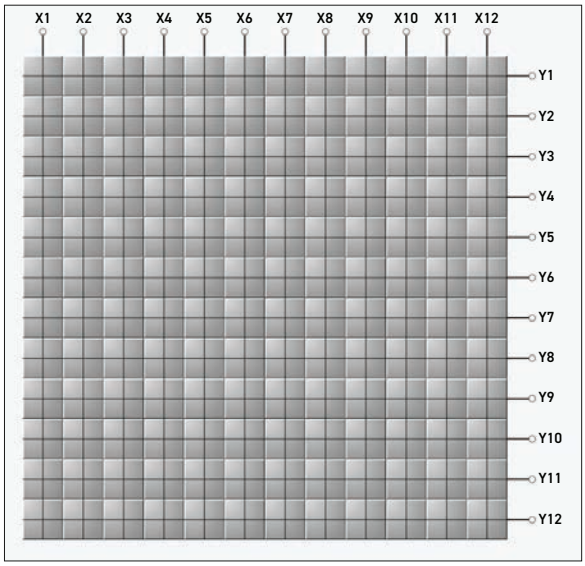


Figure 4-2. Example Soft Front Panel for a 60-807 Microwave Matrix

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

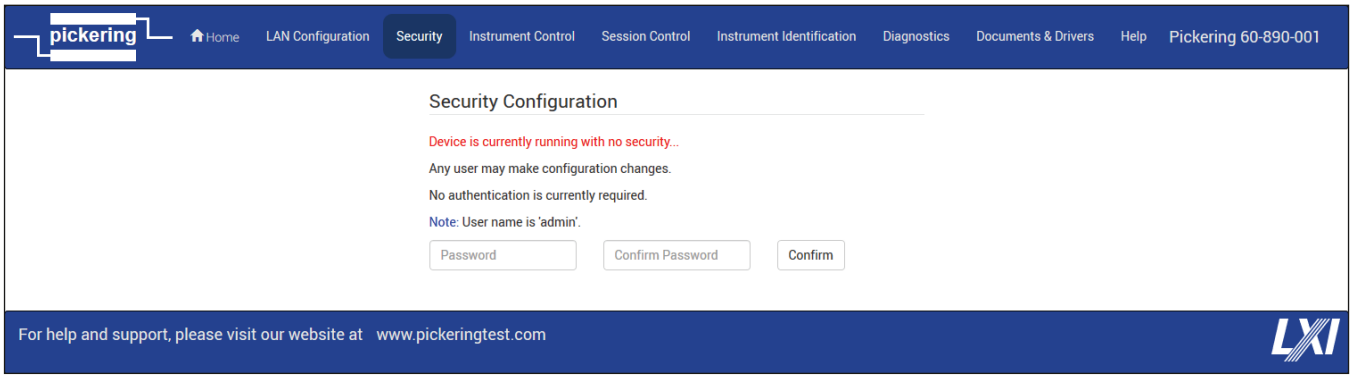
Pickering LXI devices do not provide an SSH server in the normal configuration state, the service must be explicitly enabled.

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.

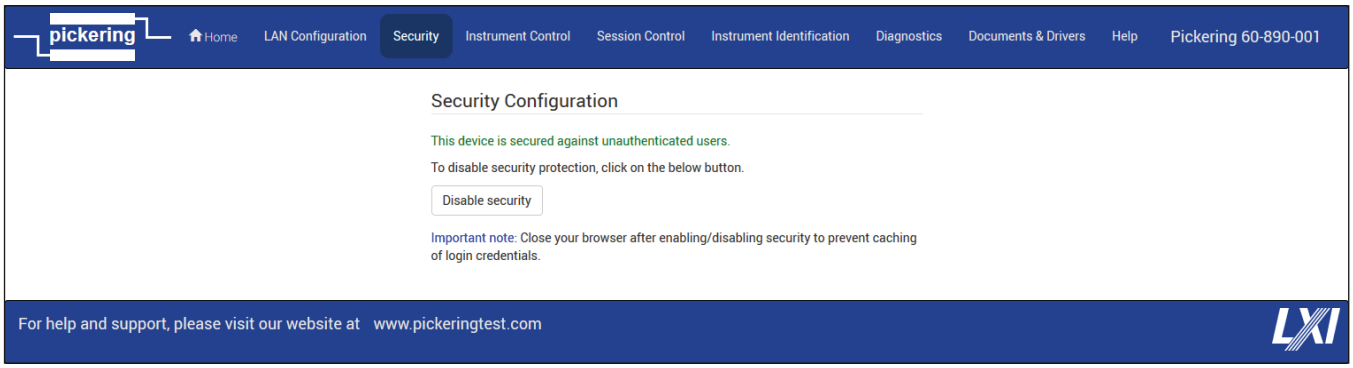
All the following assumes that the user knows the IP address of the LXI device. If this is not known, a number of tools are available, many on the Pickering distribution disk, to allow the IP address to be discovered.

Step 1 - Enable Security

Select the Security Page from the main menu list

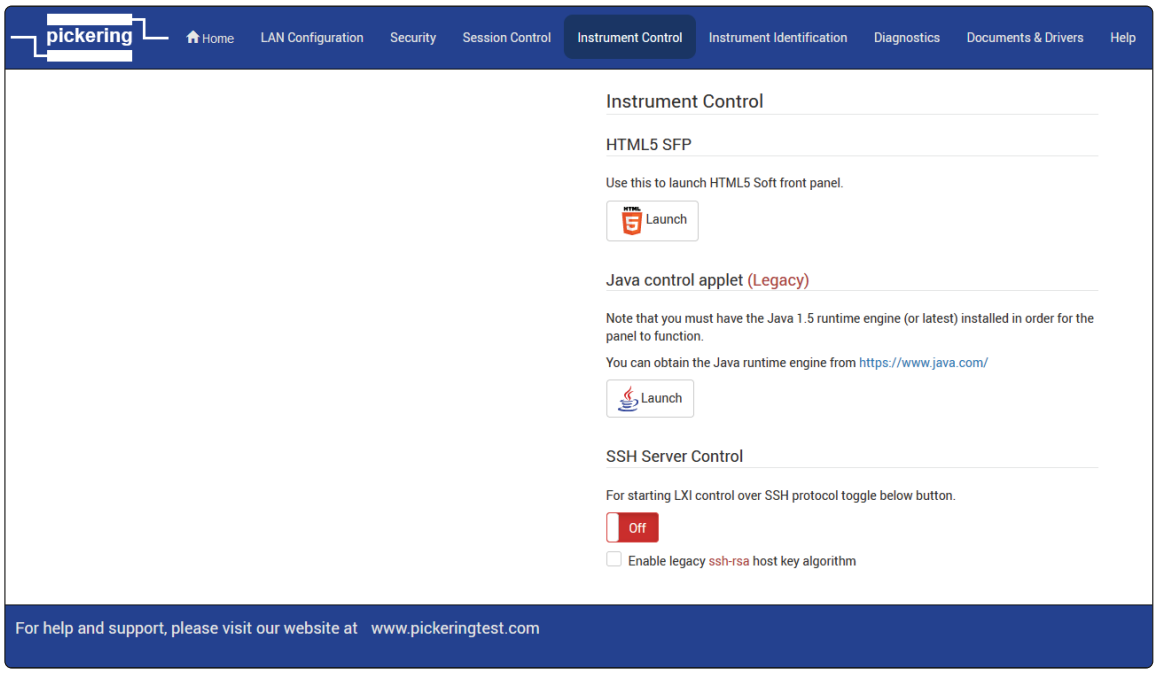


Enter a password and confirm then click on the Confirm button.

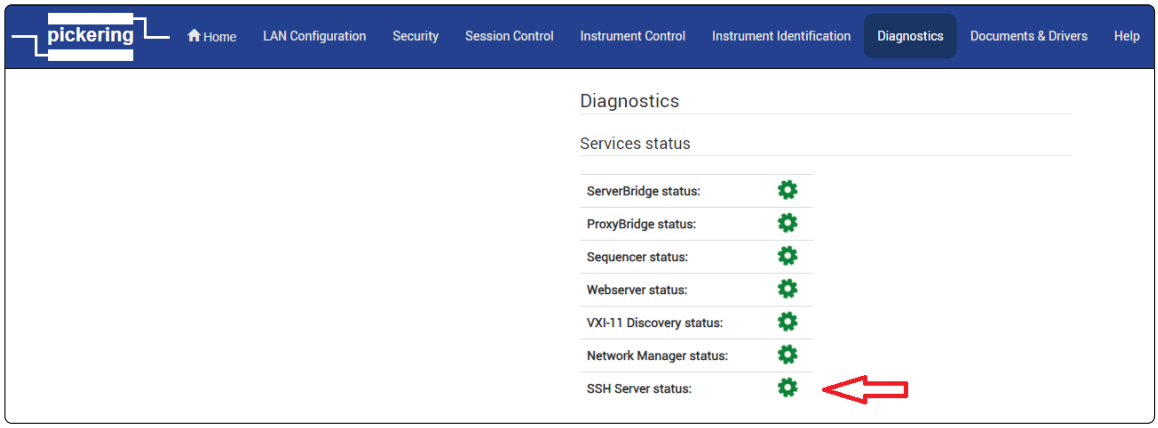


Step 2 - Enable the SSH server

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

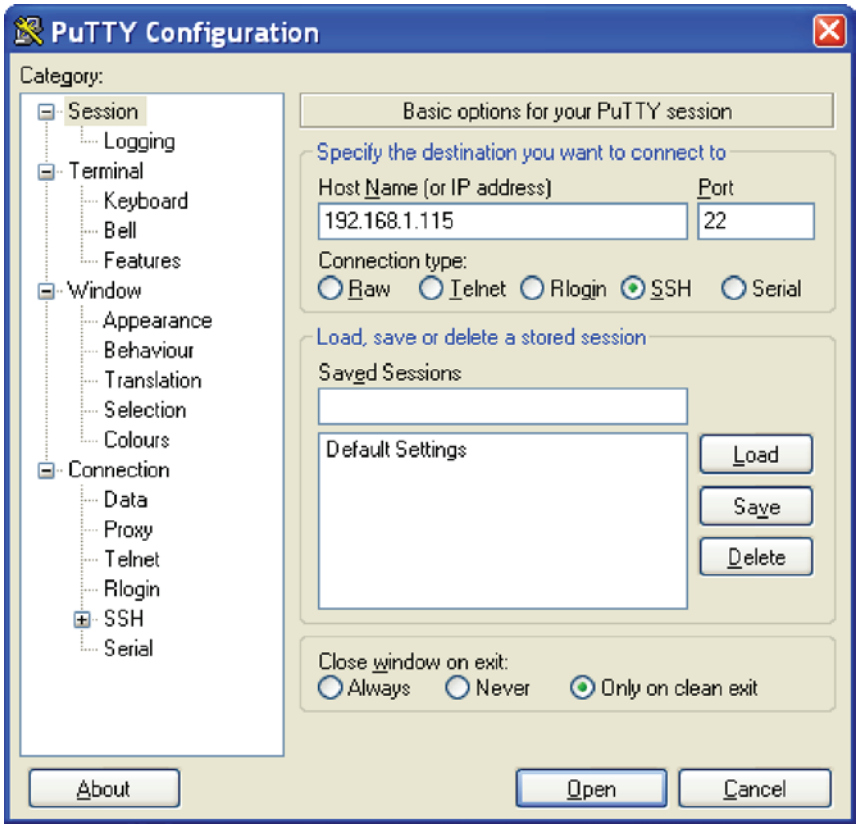
Disabling security will stop the SSH service.

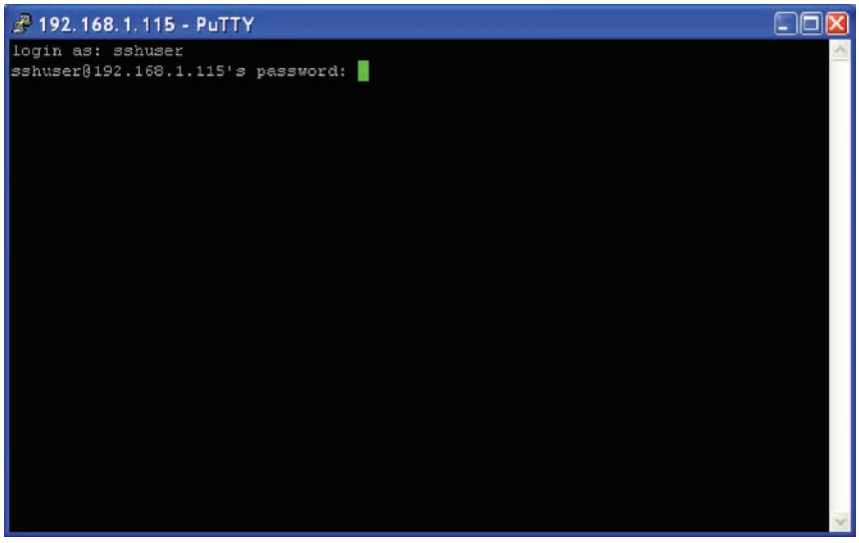
Instrument Control from an SSH Client

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

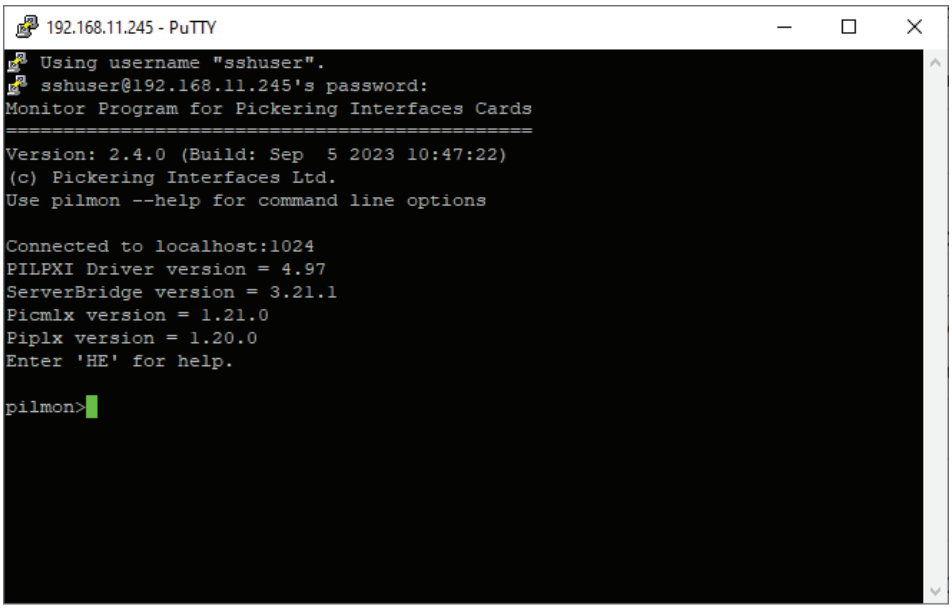
First start up the SSH client and enter the IP address of the LXI device. The user will be prompted for a login name and password.

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 energises 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 energise 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 realise 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

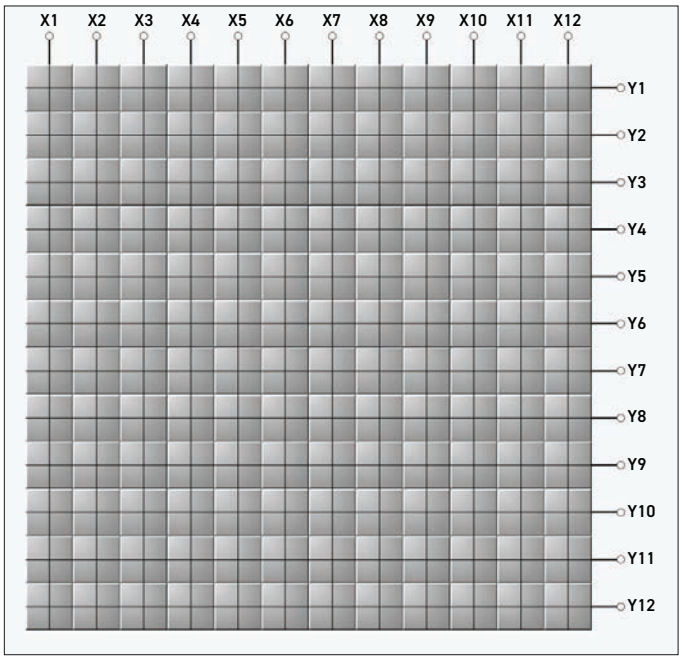


Figure 4-3. Example Soft Front Panel for the 60-807 Microwave Matrix

Clicking on a grey box closes the corresponding matrix crosspoint.

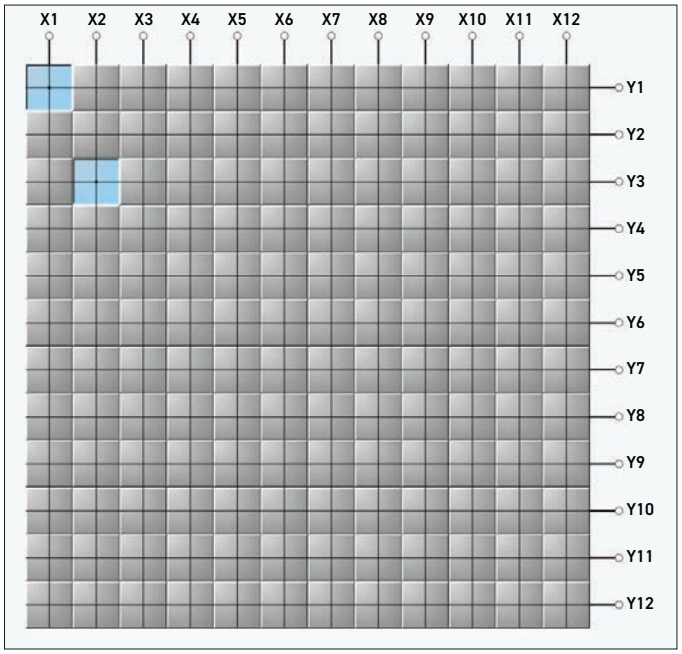


Figure 4-4. Example Soft Front Panel With Paths Set

In this example, crosspoints X1-Y1 and X2-Y3 are enabled.

Section 5 - Connectors

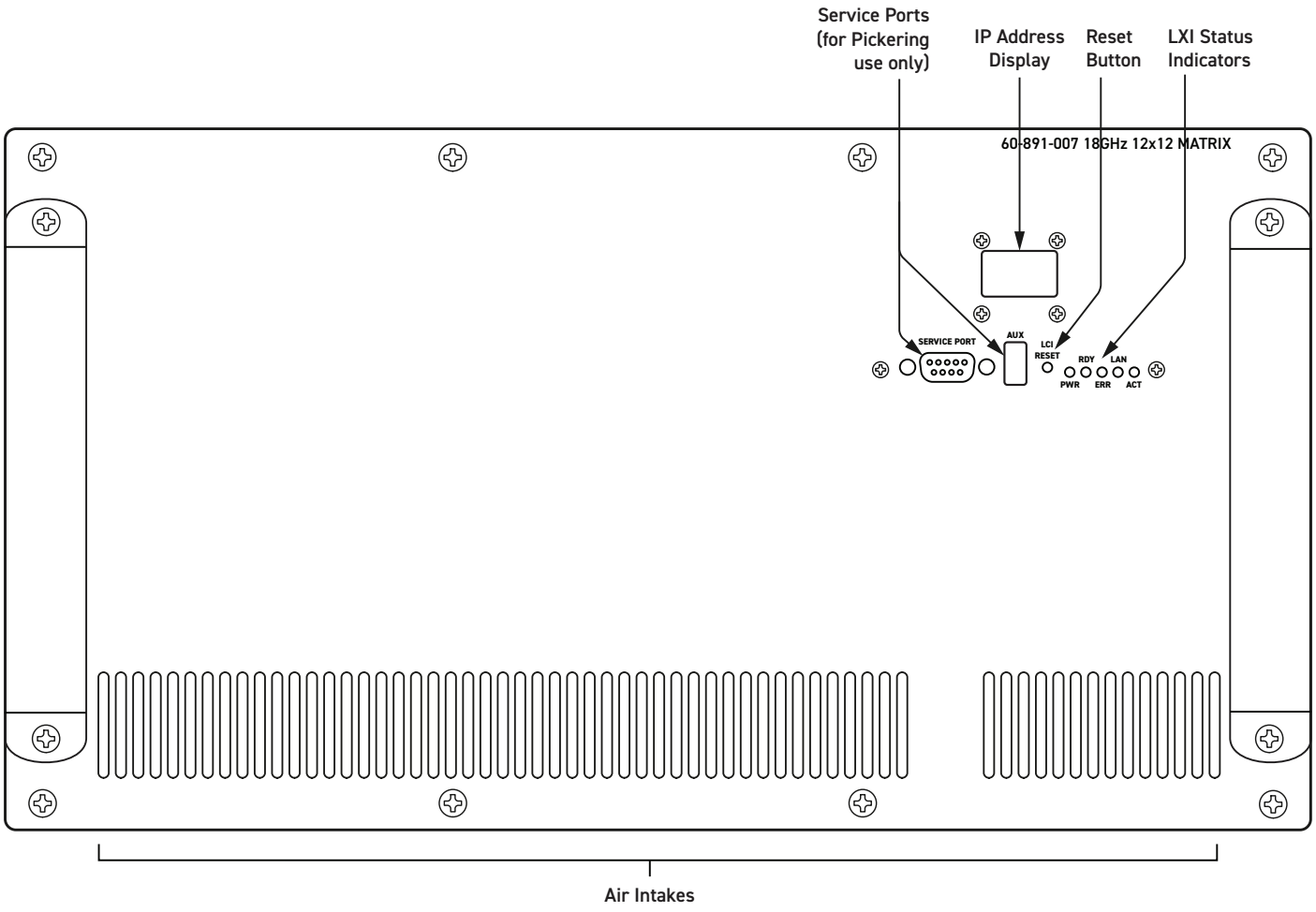


Figure 5-1. Example Front Panel Layout for the 60-807 LXI Microwave Matrix (shown as an illustration - actual unit will vary)

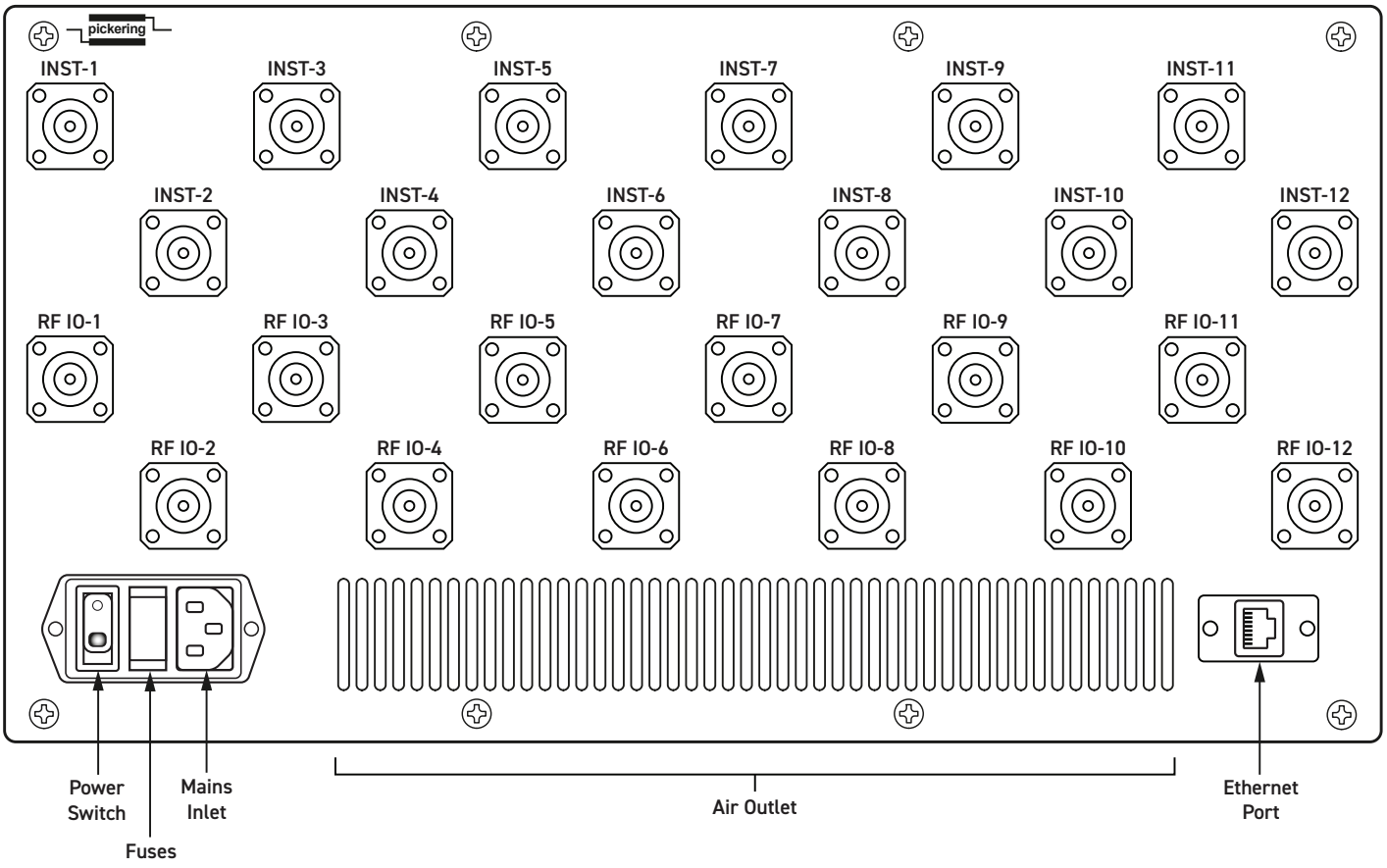


Figure 5-2. Example Rear Panel Layout for the 60-807 LXI Microwave Matrix (shown as an illustration - actual unit will vary)

Note 1:
Only the correct connector series should be mated with this unit. For SMA connectors the user should only mate the correct type to the unit, failure to do so may result in damage to the connector.

Note 2:
It is important that the SMA connector's nut is properly tightened to the correct torque with a 5/16 inch wrench. This should be 3-5 in·lbs (0.3 to 0.6 N·m) for brass, and 7-10 in·lbs (0.8–1.1 N·m) for stainless steel connectors.

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 initialising (pilserv is starting and initialising). 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:
http://www.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.

Microwave Matrix Parts Overview

The 60-807 Microwave Matrix chassis contains a number microwave switches interconnected as matrix of the required size. Included are a Power Supplies and a Microcontroller assembly. The following pages provide a brief description and internal architecture diagrams for the PCBs and sub-assemblies that make up the unit.

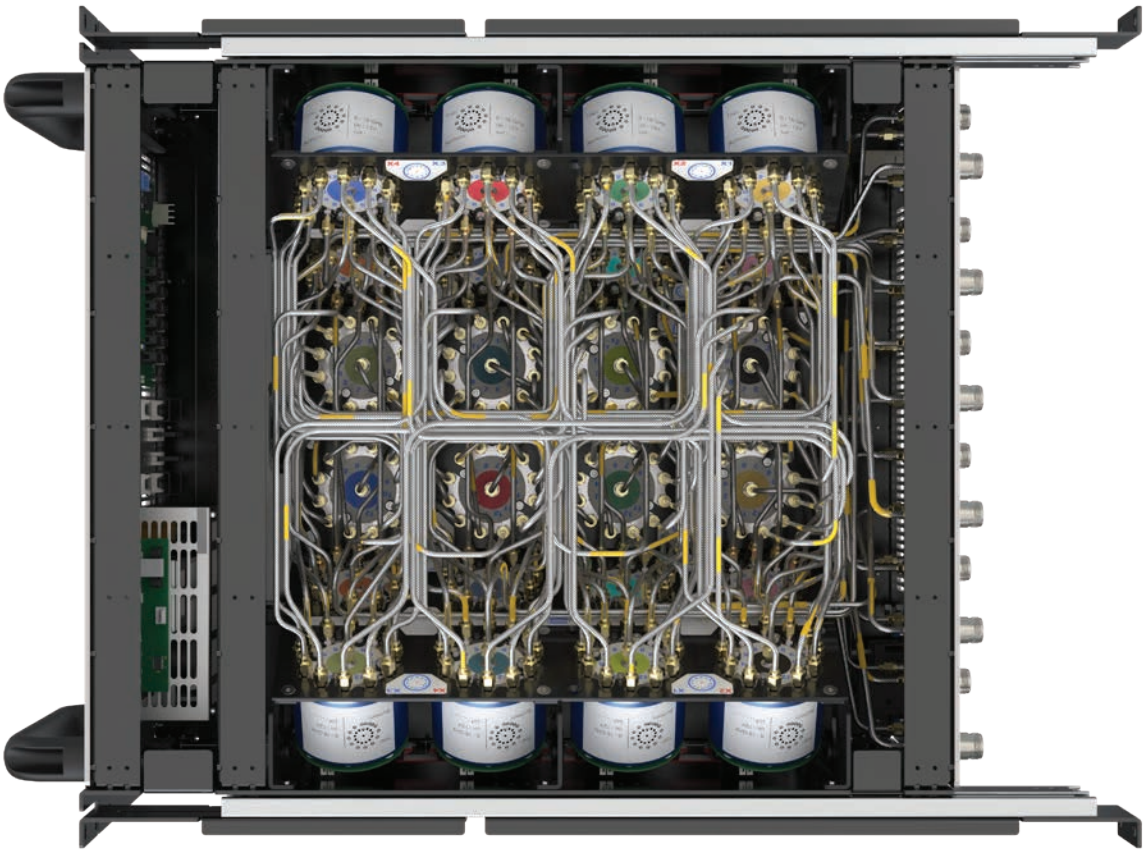


Figure 7-1. Example of the 60-807 LXI Microwave Matrix With Top Cover Removed (shown as an illustration - actual unit will vary)

Section 7 - Maintenance Information

General Maintenance

The 60-807 does not require any regular maintenance procedures. With the exception of the Microwave Relays, the unit has no user serviceable parts, and in the event of a failure, repair must be carried out by a suitably qualified person. This section briefly outlines the functional blocks that make up the unit to assist in the fault finding process.
The LXI Microwave Matrix consists of three major functional blocks:

- Microcontroller and LAN interface.
- Relay Drivers and Microwave Relays.
- Power Supplies and Power Distribution.

Figure 7.2 provides a diagram of how the assemblies are interconnected, Figures 7.3 and 7.4 show example configurations of the RF switches.

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 driver boards.

Microcontroller Board

The microcontroller is a single board computer based on the ARM processor. It stores the LXI homepage and programming information for the unit.
This board also provides the interface between the microcontroller and the relay drivers on the driver boards. Serial data streams carrying switching information are sent to the driver PCBs mounted on the rear of each microwave relay via ribbon cables with multiple relays per serial data stream connected in a daisy-chain configuration.

LXI Status LED Board

The LED board on the unit's front panel carries the status indicators for the microcontroller and LAN connection.

Relay Drivers and Microwave Relays

Each microwave relay is fitted with a driver PCB that contains a driver IC that converts the serial data stream into relay coil drive lines.

Microwave Relay Assembly

The microwave relay assemblies consist of an RF multiplexer soldered to an interface PCB. Ribbon cable headers are provided that allow the serial data stream to be daisy-chained between relays. The coaxial connections of the relays are interconnected to create the matrix of the required size.
If a relay assembly is replaced care must be taken to ensure that it is **refitted in the same orientation** to ensure the correct positioning of the RF ports plus the control signals.

Power Supplies and Power Distribution

The unit has a single power supply 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.

Single-Rail Power Supply (C-PS-025)

The single-rail power supply has a voltage rail of +12 V and supplies power for the whole system.

Cooling Fan Assemblies

The unit is cooled by a number of cooling fans. Air is drawn into the chassis from intakes in the front panel, passes over the microwave relays, through the power supply and microcontroller area, and out via exhaust vents in the rear panel.

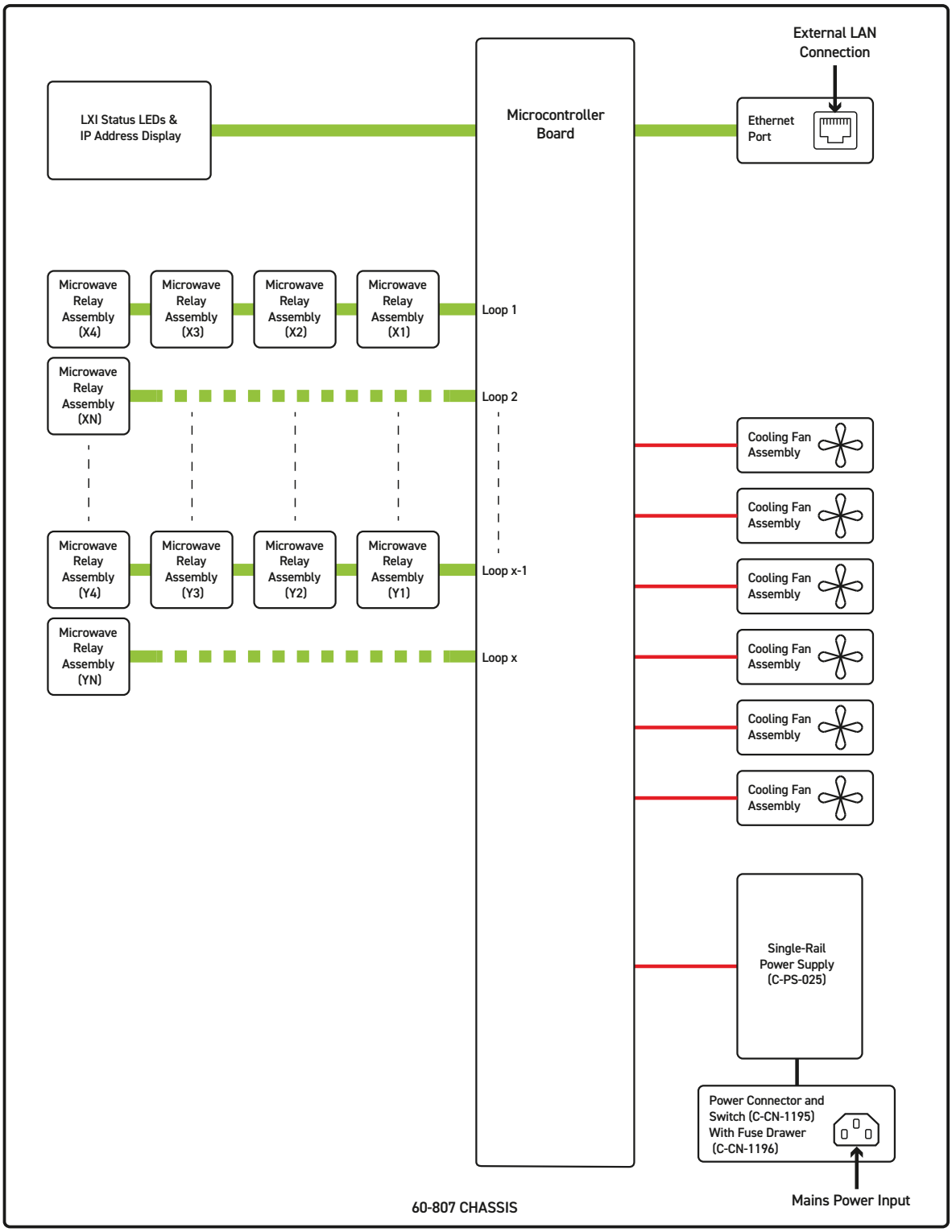


Figure 7-2. 60-807 LXI Microwave Matrix - Internal Wiring

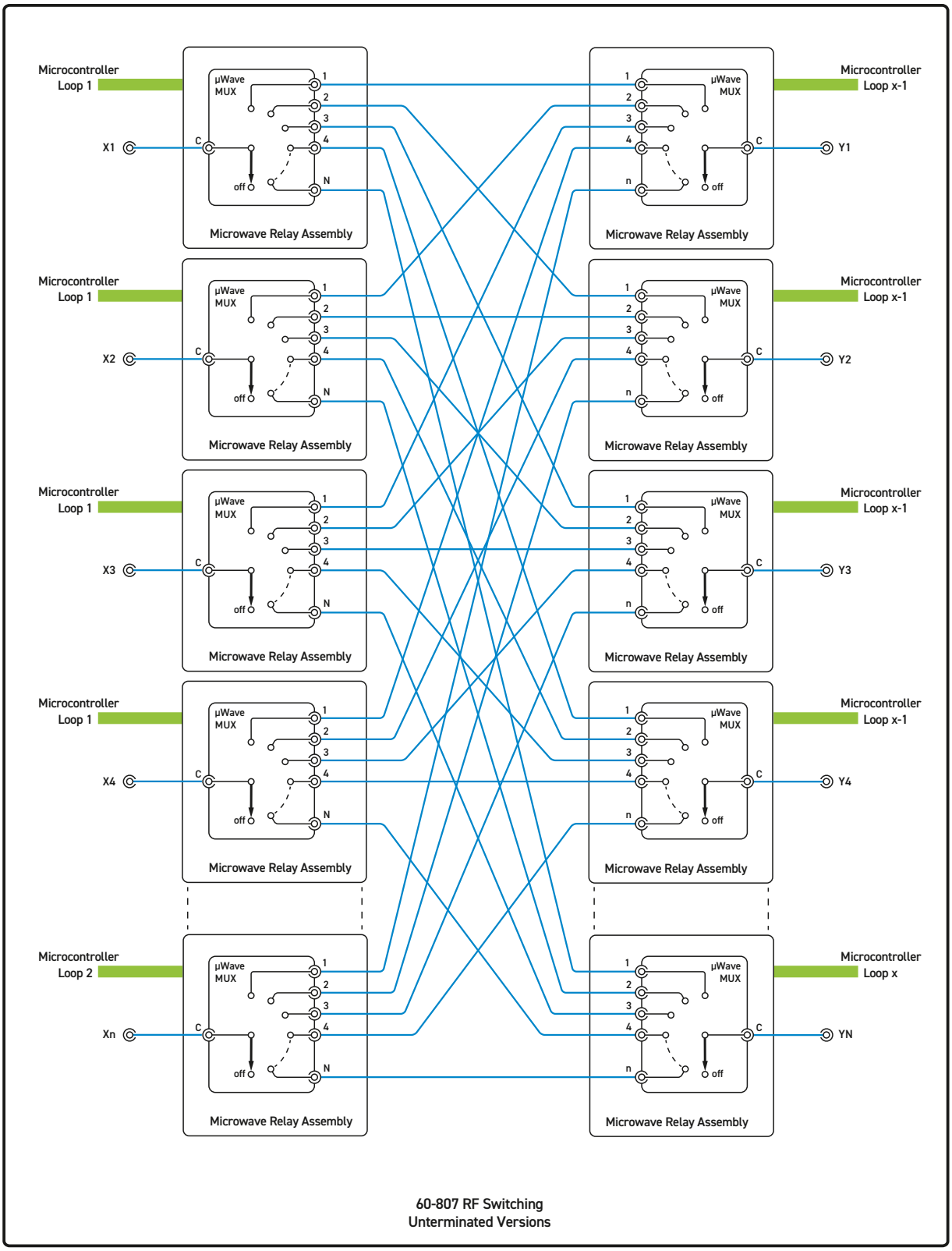


Figure 7-3. 60-807 LXI Microwave Matrix - RF Components (single bank unterminated version)

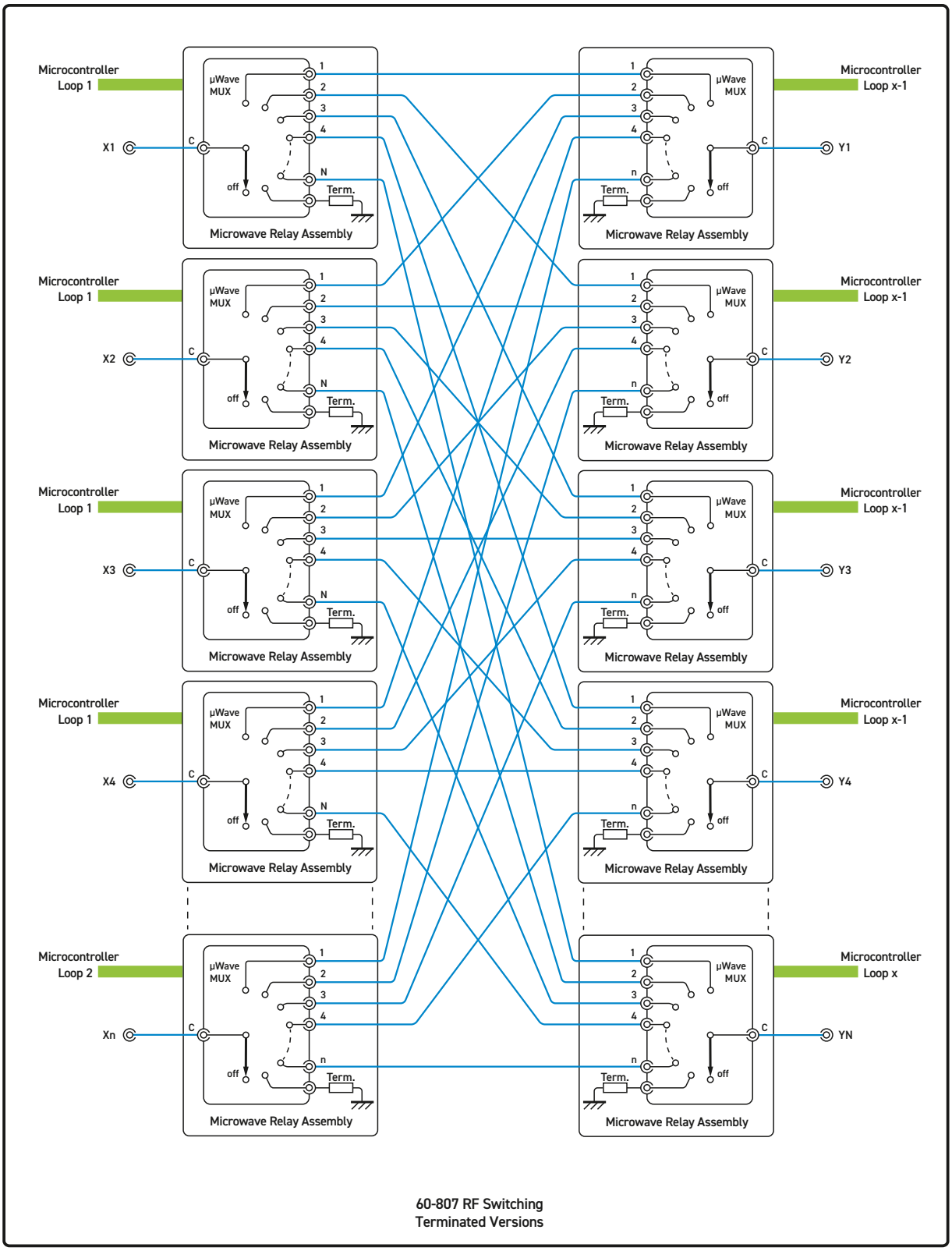


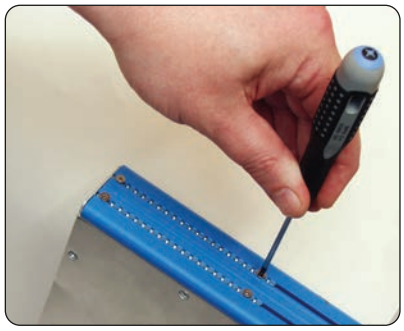
Figure 7-4. 60-807 LXI Microwave Matrix - RF Components (single bank terminated version)

Appendix A

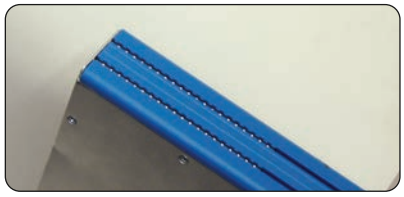
Fitting Rack Mounting Flanges

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.

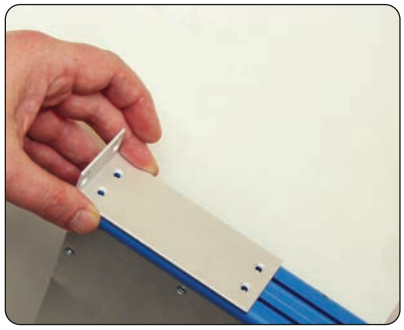
1. On the right hand side of the unit, remove the four countersunk screws that secure the two threaded strips in the upper and lower channels of the side extrusion.



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



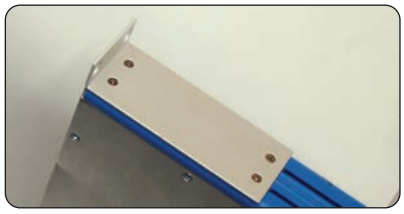
3. Take one of the two supplied flanges and place against the side extrusion so that the four screw holes line up with four threaded holes in the threaded strips.



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.