

LUMILOOP



User's Manual

RF Mux 1.0

DC - 12 GHz
12:2 RF Switch Matrix

Distributed by: Reliant EMC LLC, 3311 Lewis Ave, Signal Hill CA 90755, 408-916-5750, www.reliantemc.com

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1 RFMux Hardware

The RF switch matrix RF Mux supports switching of up to twelve independent signal sources to up to two receivers. The block schematic is shown in Figure 1. Figure 2 and 3 show the device from the outside.

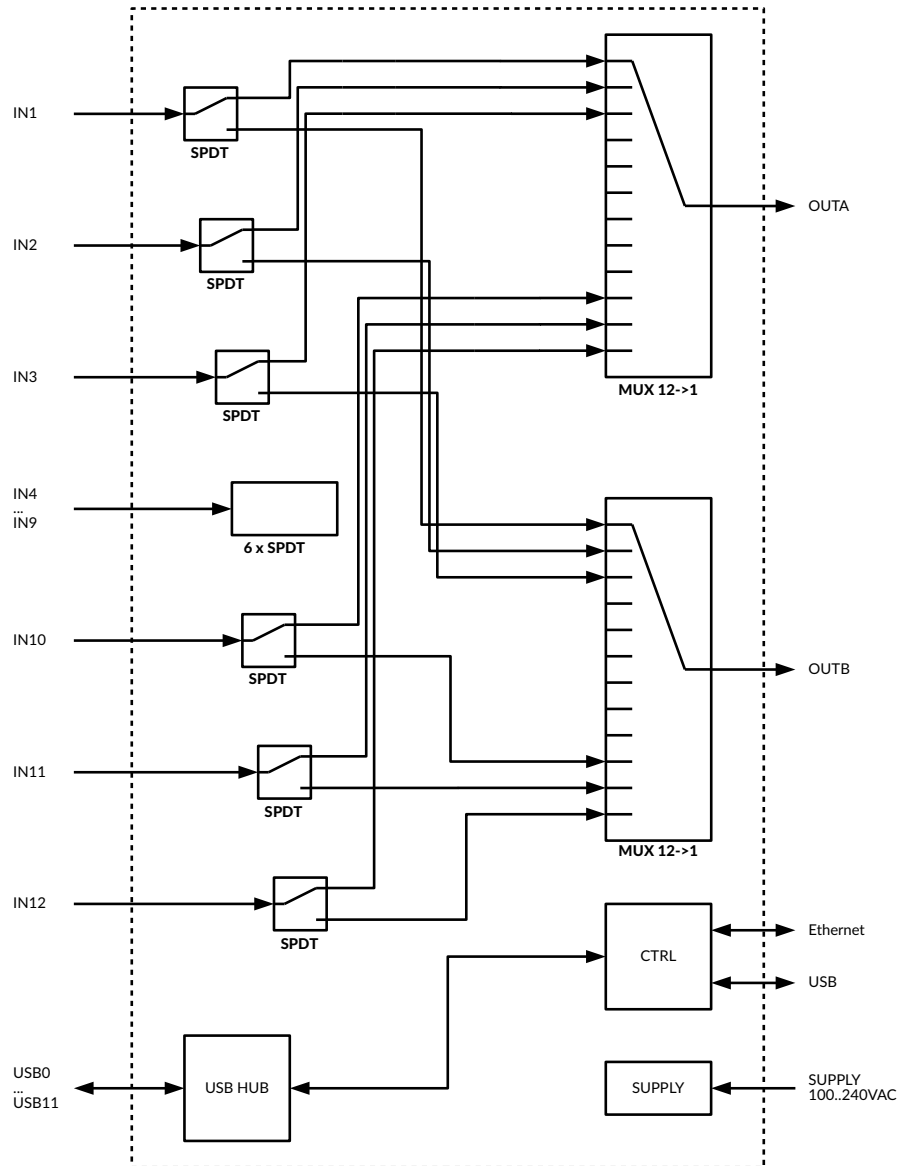


Figure 1: Block schematic of RF Mux

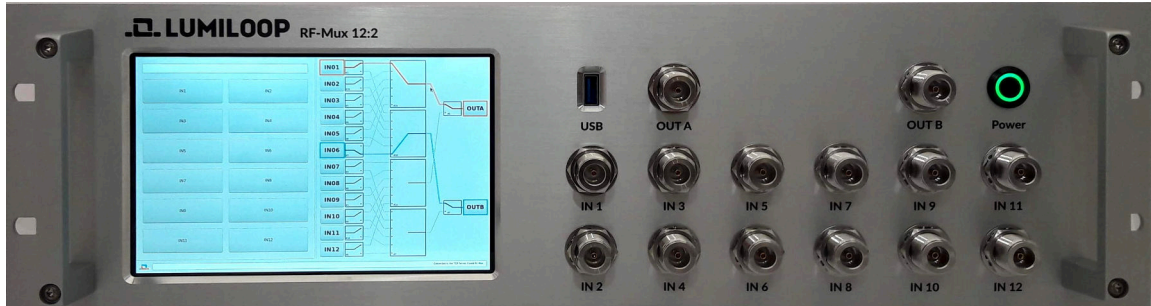


Figure 2: Front-side view of RF Mux

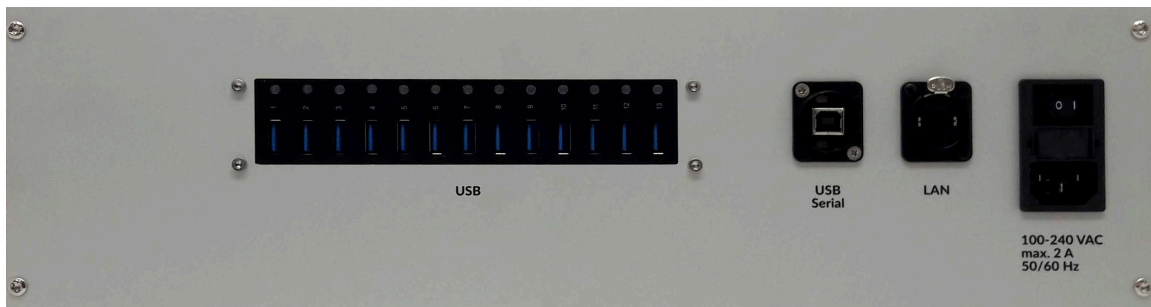


Figure 3: Back-side view of RF Mux

2 RFMux Software

Switch settings are controlled using SCPI commands that can be issued via the RF Mux USB or Ethernet (TCP/IP) interface. Additionally, a touch sensitive display can be used for manual switch control.

2.1 Operation using the GUI

Switch channels can be selected by pressing any input or output button. As shown in Figures 4 and 5, selecting an input allows choosing either output or "OFF", selecting an input allows choosing any of the twelve inputs or "OFF".

The active switch path are highlighted by the GUI, the number of switching cycles is shown in the representations of each RF relay. The GUI will update in case of remote operation.

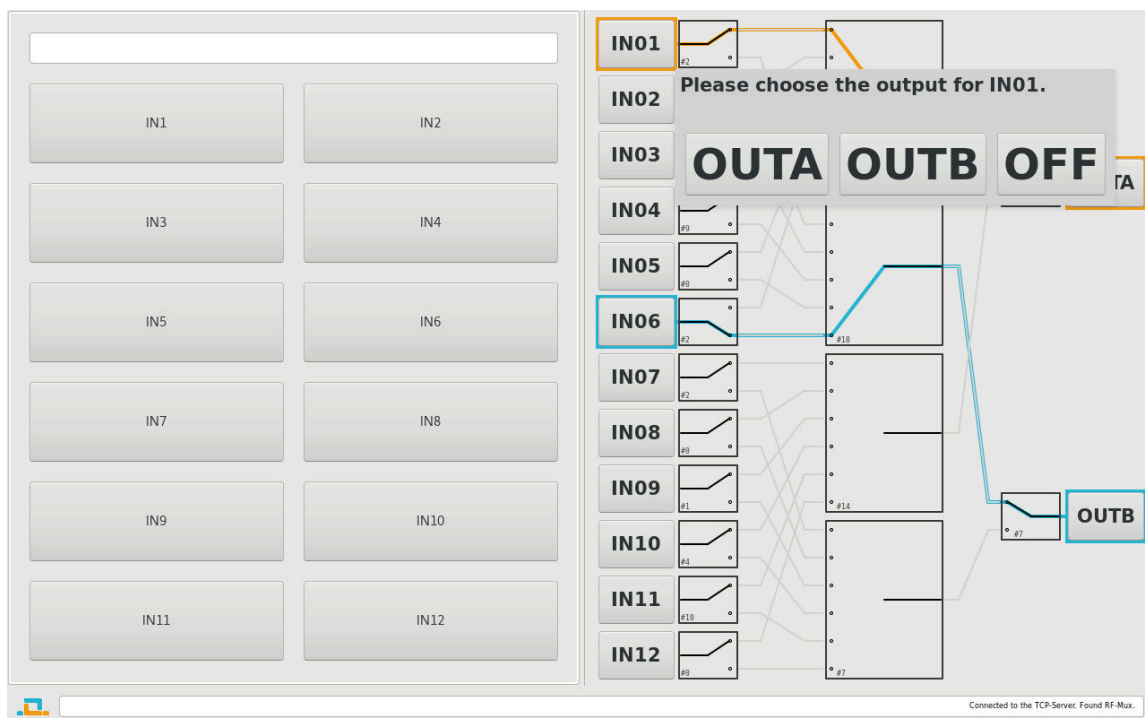


Figure 4: Manual channel selection via input button

2.2 Operation using SCPI commands

Section 4 details all SCPI commands. The commands »:OUT«, »:OUTA« and »:OUTB« are used to connect both or a single output to any of the twelve inputs. The commands expect the input number, between one and twelve as parameters. Specifying zero will turn the respective output off.

The »:CNT?« command can be used to check the number of switching cycles for each RF relay.

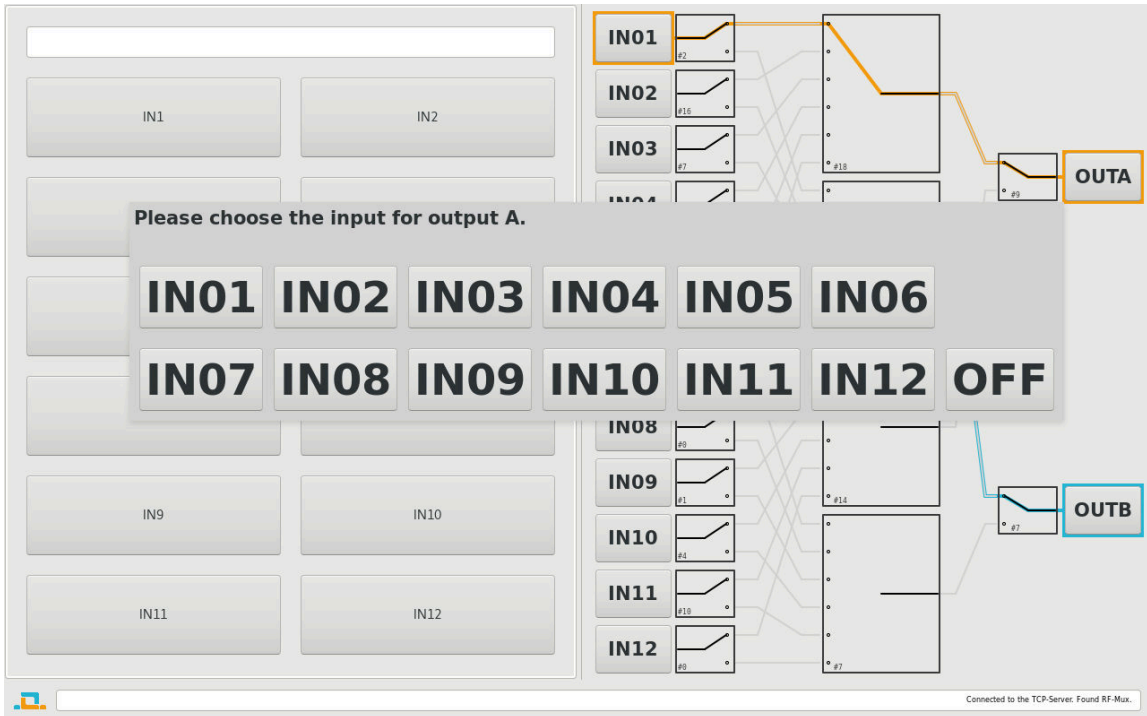


Figure 5: Manual channel selection via output button

2.3 Built-in RF Mux PC

RF Mux can operate as a regular PC incorporating a USB hub which is available for connecting additional USB devices. A USB keyboard and mouse can be attached to any USB port. Pressing moving the mouse pointer into the upper left corner of the screen will give access to the Gnome desktop environment.

The RF Mux PC runs a 64 bit Debian GNU/Linux 9.5 as its operating system. Note that both the root password and the user password of the default user are "qwer1234".

3 SCPI Communication Basics

The RF Mux TCP Server provides a convenient text command-based interface, it supports up to 32 concurrent TCP/IP client connections on port 10002. Alternatively, RF Mux may be connected via the USB port labeled "USB Serial". The USB port uses an FTDI USB to Serial converter and needs to be configured to 9600 Baud, 8 data bits, no parity, 1 stop bit, i.e. 9k6 8N1, employing no flow control.

All commands sent to the TCP Server are ASCII text commands terminated by a newline (\n), carriage return (\r) or semicolon (;) character or any combination thereof. Replies sent by the TCP Server in reply to queries are single lines of text terminated by a carriage return character followed by a newline character (\r\n).

This section gives examples of communication with the TCP Server using standard libraries and utilities.

3.1 National Instruments VISA

NI VISA is a cross-platform library for unified communication with measurements connected via GPIB, serial port, Network socket, etc. NI VISA handles all low-level configuration and provides buffered bidirectional IO streams. This section explains how to configure a socket connection to the RF Mux TCP Server using the debug tool provided with the NI VISA library and how to test it. NI VISA needs to be downloaded from the "National Instruments" homepage and installed first.

Open the NI VISA Measurement and Automation Explorer (NI MAX). Add a new network device by selecting the subsection "Network devices" of "Devices and Interfaces" next click on "Add Network Device". As shown in Figure 6(a), select "Manual Entry of Raw Socket" and click "Next". As shown in Figure 6(b) enter the correct "Hostname or IP" the TCP "Port Number", click "Validate" to connect to the LSProbe TCP Server. Both NI MAX and the TCP Server's output will indicate a successful connection. Click "OK" and "Finish" to return to the NI MAX main window.

Right-click on the newly created network device and select "OPEN VISA Test Panel" as shown in Figure 7. No changes are required in the "TCP/IP Settings" tab. Set "Enable Termination Character" in the "IO Settings" tab, click "Apply Changes" and observe the return data output as shown in Figure 8(a). This step needs to be repeated for every NI VISA Input/Output debug session. The "View Attributes" tab in Figure 8(b) shows the VISA parameters "VI_ATTR_TERMCHAR_EN" set to "VI_TRUE" and the "VI_ATTR_TERMCHAR" attribute set to "0xA". When using the NI VISA library for connecting to the LSProbe TCP Server make sure to set all VISA parameters identically.

Click on "Input/Output" to start testing NI VISA communication. Clicking "Query" will retrieve the identification string using the "*idn?" command.

3.2 Raw TCP socket communication using PuTTY

Run PuTTY and enter the host name or IP address and the TCP port number. Set "Connection type" to "Raw" as shown in Figure 9. Optionally, save the session configuration for later use. Click "Open"

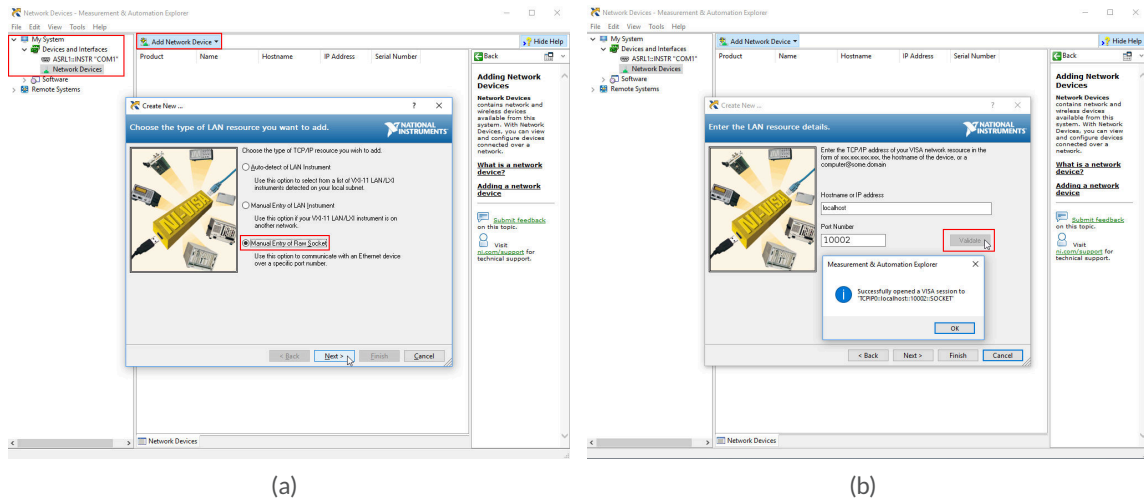


Figure 6: Connection to RF Mux TCP Server through NI MAX

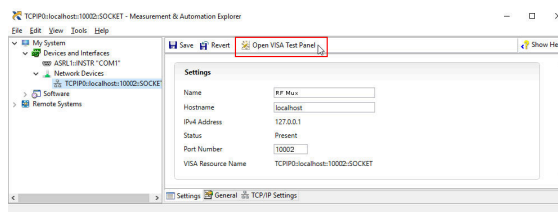


Figure 7: Starting NI VISA Test Panel

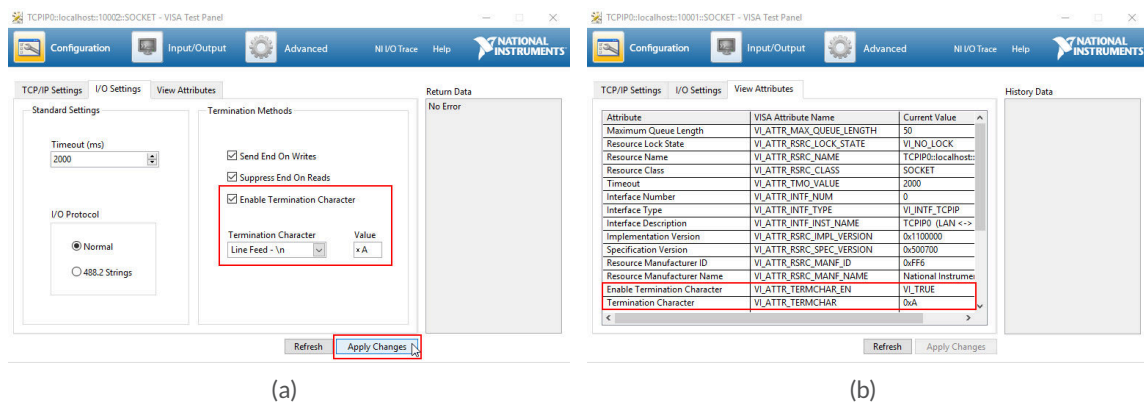


Figure 8: Configuring VISA TCP/IP socket parameters

to start the terminal session. Figure 9(b) shows the terminal window. Enter commands and press Return when done. Query commands will generate one reply line each. Multiple commands may be sent in rapid succession by separating them by semicolons.

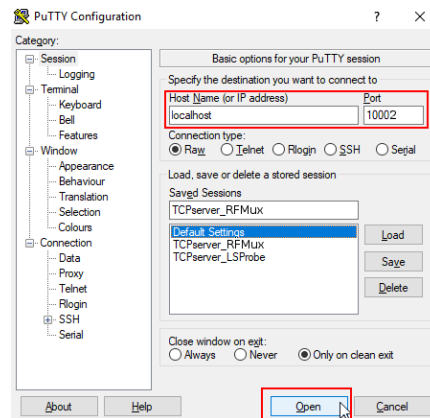


Figure 9: Configuring PuTTY

4 SCPI Command Reference

4.1 Generic Commands

4.1.1 *CLS

Clear all status registers and structures, e.g. error queue.

4.1.2 *ESE <ESR>

Set event status enable register. This feature is currently not implemented.

PARAMETERS:

Integer value for event status register.

4.1.3 *ESE?

Query event status enable register. This feature is currently not implemented.

RETURN VALUE:

Returns the integer value of the event status register.

4.1.4 *ESR?

Query the most recent error status register value. The error will be removed from error queue.

RETURN VALUE:

Value of most recent errors in error queue.

4.1.5 *IDN?

Query TCP Server identification string.

RETURN VALUE:

Comma-separated string, consisting of maker, product name, product version, TCP server build date and TCP server build time, e.g. »LUMILOOP,RFMux,1.0,Sep 2018,08:07:06«.

4.1.6 *OPC

Set operation complete flag after the completion of the previously sent command. This feature is currently not implemented.

4.1.7 *OPC?

Query operation complete flag. This feature is currently not implemented.

RETURN VALUE:

Always 1.

4.1.8 *RST

Reset TCP server. This will close all previously opened Computer Interfaces, rescan the USB bus and open all detected Computer Interfaces. This will perform a power-on reset of all Computer Interfaces.

The TCP server will print enumeration status information to its standard error output.

4.1.9 *SRE <int>

Set service request enable register. This feature is currently not implemented.

PARAMETER:

Integer value of service request enable register.

4.1.10 *SRE?

Query service request enable register. This feature is currently not implemented.

RETURN VALUE:

Always 0.

4.1.11 *STB?

Query status byte. Note that only bit 4 is currently implemented.

RETURN VALUE:

The returned integer value contains the following status flags:

BIT 0

Unused bit.

BIT 1

Protection event flag, currently not implemented.

BIT 2

Error/Event queue message available.

BIT 3

Questionable status, currently not implemented.

BIT 4

Message available, currently not implemented.

BIT 5

Standard event status register, currently not implemented.

BIT 6

Service request, currently not implemented.

BIT 7

Operation status flag, currently not implemented.

4.1.12 *TST?

Initiate self test and return test result. This feature is currently not implemented.

RETURN VALUE:

0 on success and 1 on passing the self test.

4.1.13 *WAI

Wait for the completion of the previously issued command. This feature is currently not implemented.

4.2 :SYSTem Commands

4.2.1 :SYSTem:ERRor[:NEXT]?

Query most recent entry in system error queue and remove entry from error queue.

RETURN VALUE:

Returns comma-separated error and error message string enclosed in quotes, e.g. »0,"No error".«

4.2.2 :SYSTem:ERRor:COUNT?

Query number of entries in system error queue.

RETURN VALUE:

Number of values in error queue.

4.2.3 :SYSTem:MAKer?

Query maker identification string.

RETURN VALUE:

Name string of the device maker, e.g. »LUMILOOP«.

4.2.4 :SYSTem:DEVice?

Query device identification string.

RETURN VALUE:

Name string of the device, e.g. »LSProbe«.

4.2.5 :SYSTem:VERSion?

Query device version string.

RETURN VALUE:

Version string of the device, e.g. »1.0«.

4.2.6 :SYSTem:DEBUg <Value>

Set value of debug flags in debug register. Doing so makes the TCP output debug information to standard error.

PARAMETER:

Unsigned integer value containing flags for debugging purposes. Setting a bit to 1 enables debug output, setting a bit to 0 disables debug output. The bit positions of the debug flags are defined as follows:

BIT 0

unused

BIT 1

unused

BIT 2

Enable echoing of all incoming TCP server messages.

BIT 3

Enable echoing of all outgoing TCP server messages.

BIT 4

Debug relay switch communications.

E.g. enable SCPI command input and output debugging by issuing »:syst:debug 12«.

4.2.7 :SYSTem:DEBUG?

Query value of debug flags in debug register.

RETURN VALUE:

Unsigned integer value containing the debug flags. See :SYSTem:DEBUG <Value> for the description of the individual debug flags.

4.2.8 :SYSTem:CONnected?

Query type of connected relay.

RETURN VALUES:

A string indicating the type of the connected relay PCB, one of LSGeneric, RFMUX, LSPM or UNKNOWN. NAN returned if no relay control PCB is connected.

4.2.9 :SYSTem:TYPE?

Query circuit types of all connected circuit boards.

RETURN VALUES:

Comma separated list of strings indicating the types of all connected circuit boards, one of LSGeneric, RFMuxA, RFMuxB, LSPM or UNKNOWN. NAN returned if no circuit board is connected.

4.2.10 :OUT

Set INPUT number Na to OUTA and INPUT number Nb to OUTB.

PARAMETERS:

The first unsigned integer-valued parameter sets the number of the INPUT for OUTA. If the value exceeds the number of available input relays or is to be set to the same number as configured for OUTB the command will not be processed. The second unsigned integer-valued parameter sets the number of the INPUT for OUTB. If the value exceeds the number of available input relays or is to be set to the same number as configured for OUTA the command will not be processed.

4.2.11 :OUT?

Query OUTA and OUTB relay configuration.

Returns two strings indicating the INPUT for OUTA and OUTB. If an output is disabled then OFF is returned. NAN will be returned if no RF-Mux PCB is connected to the TCP-Server.

4.2.12 :OUTA

Set INPUT number Na to OUTA.

PARAMETER:

The unsigned integer-valued parameter sets the number of the INPUT for OUTA. If the value exceeds the number of available input relays or is to be set to the same number as configured for OUTB the command will not be processed.

4.2.13 :OUTB

Set INPUT number Nb to OUTB.

PARAMETER:

The unsigned integer-valued parameter sets the number of the INPUT for OUTB. If the value exceeds the number of available input relays or is to be set to the same number as configured for OUTA the command will not be processed.

4.2.14 :CNT?

Return number of switching cycles for all eighteen relay switches.

RETURN VALUES:

A list of eighteen comma separated, 64bit integer values indicating the number of switching cycles for each switch relay since first usage. NAN will be returned if no RF-Mux is connected to the TCP-Server.

5 Specifications

Table 1: RF Mux Switch matrix properties

Property	Condition	min	typ	max	Unit
Frequency range		9 k		6 G	Hz
Insertion loss			2		dB
Flatness		-2		+1	dB
Isolation		60			dB
RF input power			20	dBm	
Impedance			50		Ohm
Return loss		10			dB

Table 2: Further RF Mux properties

Property	Condition	min	typ	max	Unit
Betriebstemperaturbereich		0		40	°C
Operating Voltage	50..60 Hz	100		240	VAC
Power Consumption				150	W
Outside Dimensions	Width			19	Inch
	Depth			550	mm
	Height			3	19 InchHE
Switching Cycles	max. 0,1 W	10 ⁶			Cycles

Table 3: RF Mux inputs and outputs

Connector	Type	Notes
IN1 ... IN12	N Socket	12 pcs.
OUTA, OUTB	N Socket	2 pcs.
USB Host	USB A Socket	> 12 pcs.
Ethernet	RJ45 Socket	
USB Device	USB B Socket	
SUPPLY	IEC 60320-1 C13	

6 Warranty Conditions

1. The period of warranty shall start from the date of delivery of the product to the customer and shall cover a period of 24 months.
2. These warranty conditions apply to devices purchased in Germany. These conditions of warranty also apply if these devices are exported abroad and meet the technical requirements (e.g. voltage, frequency) for the respective country and which are suitable for the respective climatic and environmental conditions.
3. Every and all parts of the product are under LUMILOOP's warranty coverage against any defect that may occur during production, assembly and/or defective parts.
4. In case of repair within warranty period, the time spent on the repair work is added to the warranty period. Repair time of the product is maximum 20 (twenty) working days. A warranty event does not lead to a new warranty period. The warranty period for built-in spare parts ends with the warranty period for the entire device.
5. In case of failure of the product during warranty period, the producer or reseller company has to assign another product to the customer with similar features until completion of repair of the product.
6. Within the warranty period, if the product fails because of general material and workmanship, or mounting faults, it will be repaired without demanding any charge.
7. In case of any failure in the product, occurring at least four times in one year or six times within the warranty period, product replacement or refund is mandatory depending on the choice of the customer.
8. Free repair and product exchange obligations will be annulled under the following conditions:
 - a) If the product becomes faulty due to use contrary to the terms or conditions stated in the user's manual,
 - b) If the product has been opened, used, or previously repaired by unauthorized persons,
 - c) Use of the product by plugging into inappropriate voltages or with faulty electric installation,
 - d) If the product serial number has been altered or removed,
 - e) If the fault or damage to the product occurred during the transportation outside of the responsibility of LUMILOOP GmbH,
 - f) A break or scratch to the product's exterior while in the customer's possession,
 - g) Damage from chemical and electrochemical effects of water
 - h) When our product is damaged due to use with spare parts, accessories or devices purchased from other companies which are not original parts.
 - i) Those damages caused by natural disasters such as fire, lightning, flood, earthquake, etc.
9. A short report prepared by the LUMILOOP GmbH will determine whether the damage was caused by improper use.
10. Customers are required to initially report any conflicts between themselves and an authorized reseller to the address below:

7 Revision History

2018/09/05

- Initial release.

2018/09/07

- Fix spelling
- Add information about operating system and USB to serial converter

EC DECLARATION OF CONFORMITY

We,

declare under sole responsibility that the:

Model / Part Number: RFMux 1.0
Model / Part Name: RF Switch Matrix
Date of Declaration: September 5, 2018

to which this declaration relates, meets the requirements and is in conformity with the relevant EC Directives listed below using the relevant section(s) of the following EC harmonized standards and other normative documents:

Applicable Directives:

2014/35/EU (Low Voltage Directive)
2014/30/EU (EMC Directive)
2011/65/EU (RoHS)

Applicable harmonized standards and/or other normative documents:

EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use
Part 1: General requirements

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements
Part 1: General requirements

Authorized Signatories:

LUMILOOP GmbH

This declaration attests the compliance with the stated directives. It does not imply any assurance of characteristics.