

A Division of I.F. Engineering Corp

MS-500x Matrix Switch

Operating Manual

CPT-102-1410

Rev D

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Revision History
CPT-102-1410

Revision	Date	Summary of Changes
-	10/24/12	Original Issue
A	1/25/13	Added MS-5000-16X16-VHF-UHF-077 Switch information. Added MS-5000-16X32-VHF-UHF-S Switch Preliminary Information.
B	5/6/13	Updated MS-5000-16X16-VHF-UHF-S Switch Information. Updated MS-5000-16X32-VHF-UHF-S Switch Information. Refer to ECN 1319001
C	9/3/14	Added MS-5000-4X8-VHF-UHF-S Switch information.
D	11/10/16	Added MS-5000-32X4-LB-FO Switch information

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WARNING Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

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CAUTION Always use the three-prong AC power cords supplied with this product. Failure to ensure adequate grounding may cause product damage. When adapting to foreign AC mains connectors, a grounded line cord must be selected.

WARNING The mains plug shall be inserted only in a socket outlet provided with a protected earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

WARNING There are no operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

WARNING Before this instrument is switched on, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.

WARNING There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel

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Table of Contents

1	Introduction.....	1
1.1	Applicability.....	1
1.2	Terminology.....	1
2	Controls and Indicators.....	2
2.1	Front Panel.....	2
2.2	Rear Panel	3
3	Installation	3
3.1	Connections	3
3.1.1	AC Power	3
3.1.2	Serial Port	3
3.2	RS-422 Remote Control Operation	4
4	Front Panel Operation	6
4.1	Remote and Local Modes	6
4.2	Setting Switches.....	6
4.3	Using the Menus	7
4.4	LCD screens and Menus.....	7
4.4.1	Menu Tree.....	7
4.4.2	Startup Splash.....	8
4.4.3	Connection Screen.....	8
4.4.4	Remote/Local Control	9
4.4.5	Status	9
4.4.6	Set Defaults.....	14
5	Remote Control	15
5.1	Interfaces.....	15
5.2	Protocol	15
5.2.1	Summary.....	16
5.2.2	Detailed Command and Status Formats.....	16
	Appendix.....	19
A.	MS-5000-32x8-LB-FO.....	20
B.	MS-5000-16x16-VHF-UHF-077	23
C.	MS-5000-16x32-VHF-UHF-S.....	26
D.	MS-5000-4x8-VHF-UHF-S.....	29
E.	MS-5000-32x4-LB-FO.....	33

1 Introduction

CrossPoint Technologies Model MS-500x Matrix Switches are available in a variety of input/output configurations. The operation and remote control interfaces are identical for all devices. The MS-5000 series are solid state switches. The chassis size varies with the complement of switches installed. Frequency range is customer specified.

1.1 Applicability

This manual covers a family of Matrix Switches. The following models are included in this manual:

MS-5000-32x8-LB-FO
MS-5000-16X16-VHF-UHF-077
MS-5000-16X32-VHF-UHF-S
MS-5000-4X8-VHF-UHF-S
MS-5000-32X4-LB-FO

Detailed specifications and additional information specific to each model are found in the Appendix.

Other models are available for different frequency ranges or for different numbers of channels. The MS-500x can be optimized to your application.

1.2 Terminology

Matrix switches are specified in one of two ways. If the matrix is designed as “full fan out”, each input can be routed to all its outputs simultaneously. Each output has only one input at a time. If the matrix is “full fan in”, each output can sum all inputs simultaneously. Each input can only be assigned to a single output at a time.

These matrix configurations exhibit a “one to many” (fan out) or “many to one” (fan in) characteristic. The internal configurations of these two architectures are often a mirror image of one another.

2 Controls and Indicators

2.1 Front Panel

There may be different front panel heights, but the layout of the controls is always the same. The 1RU Matrix Controller front panel is shown here. All the indicators and controls are identified and explained below. More details on how to use these controls may be found in Section 4.

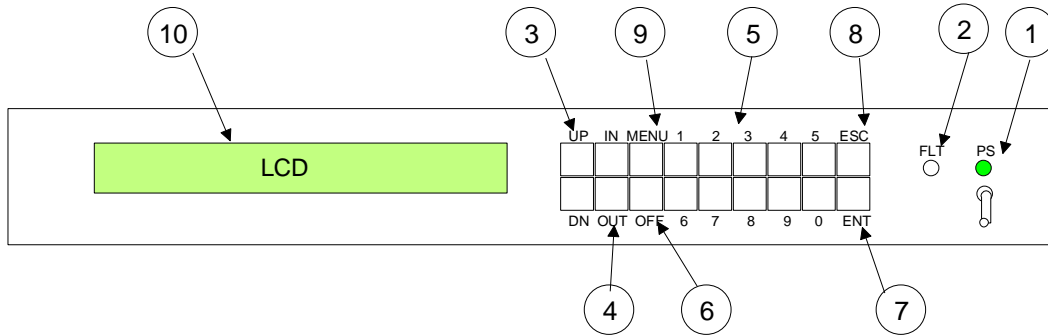


Figure 1 : Front Panel Controls and Indicators

Front Panel Controls and Indicators

Callout	Name	Description
1	POWER Indicator & Power switch	Illuminated green when power is on. Turns Red if a power supply problem is detected. Two LED's are present when there are redundant power supplies.
2	FAULT Indicator	Illuminated Red when any fault is detected in any chassis. This is a summary alarm indication
3	UP and DOWN	Used to cycle through the list of available inputs or outputs when in an Edit mode. Scrolls through Menu items when in MENU mode Incrementing/Decrementing rolls over/under at the extremes
4	IN and OUT	Press IN or OUT to enter the Edit mode, and change a switch connection.
5	Numeric keys	Enter matrix port numbers directly using these keys.
6	OFF key	Used to disconnect an output. This key can be used in Edit mode. Press Enter to accept the OFF (disconnect) condition.
7	ENTER key	Accept the current input or output, exit the Edit mode and return to the next higher menu level.
8	ESCAPE key	Cancel the current Edit session and return to the next higher menu level. No changes occur to matrix state.
9	MENU key	Move from the normal display to the various configuration and status menus.
10	LCD Display	For local status and control.

2.2 Rear Panel

Rear panels are customized to the different matrix configurations. Specific drawings found in the Appendix for each model that identify the connector reference numbers (“J numbers”).

3 Installation

The Matrix Switch mounts in a standard EIA rack. Some units use internal fans provide cooling from side to side. Standard rack mounting will allow adequate clearance for the air vents on the sides. The unit does not require empty rack space above or below.

3.1 Connections

3.1.1 AC Power

The Matrix is provided with a standard detachable US AC line cord. However, the internal power supplies have universal voltage capability (220/110 VAC). Plug the equipment into an AC source of either 110 or 220 VAC.

3.1.2 Serial Port

The serial port is a dual purpose connector located on the rear of the Matrix. The connector is labeled CTRL. It provides RS-232 format signals as well as RS-422 signals. The chassis connector is a common 9 pin male D connector.

3.1.2.1 RS-232 Operation

RS-232 is recommended for cable lengths up to 50 feet between the computer and the matrix. Longer links can be accommodated reliably, but may require experimenting with slower baud rates, lower loss cable and better shielding.

The link can operate at four baud rates between 2400 and 19200 bits per second. The baud rate is selected by the front panel menus. The other communication parameters are fixed at 8 bit words, no parity and 1 stop bit. Set your remote computer interface to the same settings. Factory default is 19200 baud.

The serial interface does not support hardware or software flow control. Commands and responses are relatively short and flow control is not normally required. The command/response method assures that the host computer can sense if the Matrix is unable to accept more characters.

The RS-232 interface is pin compatible with standard PC serial ports, which use RS-574 pin assignments. To control the system from a PC, a “null Modem” cable is required. A Null Modem adapter can be used with a “straight through” cable, or a custom cable can be wired, following the diagram below.

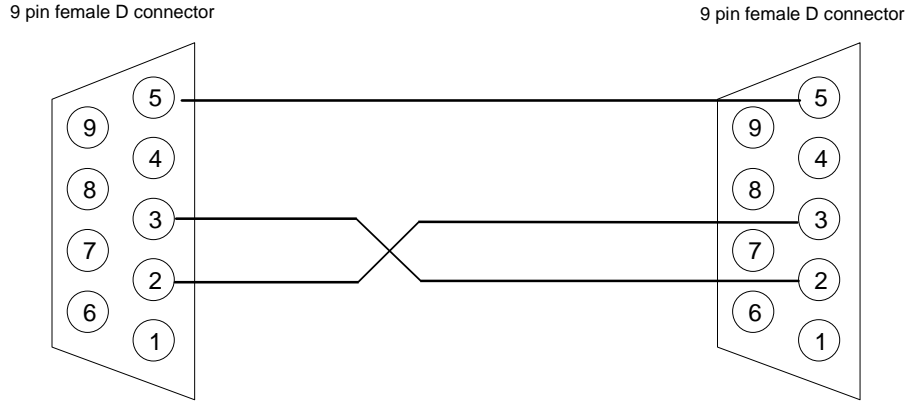


Figure 2 : PC to Matrix Chassis – RS-232

The Serial port connector (CTRL) pin assignments are:

Pin	RS-232 Applicability	RS-485 Applicability	Circuit Function	Direction
1		X	TxDataB	Output
2	X		Receive Data	Input
3	X		Transmit Data	Output
4		X	RxDataB	Input
5	X	(Shield)	Gnd	
6		X	TxDataA	Output
7			unused	
8			unused	
9		X	RxDataA	Input

3.2 RS-422 Remote Control Operation

RS-422 operation allows data communication over cables of up to 4,000 feet. Use RS-422 when the remote computer must be located far from the matrix chassis, or when ambient electronic noise levels are very high. The RS-422 standard uses balanced differential signaling, for significantly more reliable communication than RS-232. The drivers and receivers are RS-485 compliant, which makes them suitable for direct interface to full duplex RS-485 systems as well.

The link can operate at four baud rates between 2400 and 19200 bits per second. The other communication parameters are fixed at 8 bit words, no parity and 1 stop bit. Set your remote computer interface to the same settings. For long runs, a termination might be required to assure reliable communication at high baud rates. If you experience data integrity problems (parity errors, garbled data) try slower baud rates. If slower baud rates help, then try the faster rates with a 120 ohm terminating resistor across the receive data pins (RXA and RXB). Terminate each pair at its receiver. The terminations can be installed inside the back shells of the cable connectors. The actual resistance value may be adjusted to match the cable’s characteristic impedance. A value of 120 ohms is typical for twisted shielded pairs.

The serial interface does not support hardware or software flow control. Commands and responses are relatively short and flow control is not normally required. The command/response method assures that the host computer can sense if the Matrix is unable to accept more characters.

The interface requires 2 twisted pairs of wires between the communicating devices. Shielding is recommended over the two pairs. For best performance and safety, do not ground the shield at both ends. Leave one end of the shield unconnected. If each pair is individually shielded, ground the shield at its source end (driven end) and leave it floating at its receiving end.

The suggested drawing below is for the RS-422 interface using 2 twisted shielded pairs. The computer side does not show pin numbers, as there are many forms of RS-422 connectors available. Notice the individual shields are grounded at opposite ends, and there is no ground continuity between the two devices (the two shields are assumed isolated from each other). In long runs, this serves to protect both devices from carrying ground currents, especially in the event of a power line fault in either device. If your cable has individual shields that are in intimate contact with each other, it may not be possible to avoid ground current flow down the cable shield.

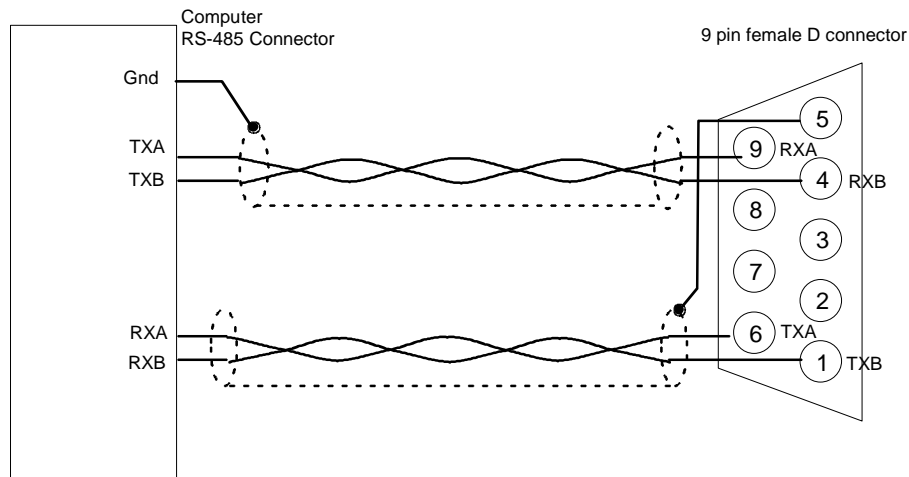


Figure 3 : Computer to Matrix RS-422 Wiring

A standard PC RS-232 port can be transformed to balanced operation using an “RS-232 to RS-422” or “RS-232 to RS-485” adapter device. These devices are available from a variety of sources. Some can be powered directly from the RS-232 handshake signals available at the PC connector. This type is recommended, as it does not require a separate power supply or transformer for operation.

Suggested sources for these adapters are B&B Electronics (www.bb-elec.com or 815-433-5100) and Black Box Network Services (www.blackbox.com or 877-877-2269).

4 Front Panel Operation

After all connections have been made, power up the Matrix. The matrix will power on in Local mode, so the front panel is enabled. After displaying the model number, and initializing itself, the matrix will set itself to the connection paths that existed when it was powered down.

The following sections discuss general operations. Detailed operating sequences appear after the general discussion

4.1 Remote and Local Modes

Manual operation is permitted whenever the matrix is in Local mode. The front panel can always be used to view the state of the matrix. But to make changes, the matrix must be placed into Local mode.

The remote computer can place the matrix in Remote mode, thereby disabling changes from the front panel. However, the matrix can be returned to Local mode using its front panel menus. The remote computer can also place the matrix into Local Lockout state. In Local Lockout state, the front panel is disabled and cannot be used. The remote computer must release the matrix from Local Lockout state before front panel control can occur. To allow recovery if the remote computer fails, the matrix can be power cycled. It will always release the Local Lockout and revert to Local state at power up. The matrix paths will be interrupted during this power cycle operation.

4.2 Setting Switches

To change the matrix connection in a fan in switch, first select the Input that is to be sent to a different output, by pressing the IN key. To change the matrix connection in a fan out switch, first select the Output that will have a new input assigned to it, by pressing the OUT key.

Pressing IN/OUT will change the LCD display to an edit mode. A blinking cursor will appear to indicate the Matrix is waiting for data. Use the numeric keys to specify the desired port, or use the UP and DOWN keys to increment/decrement through the available port numbers. When the display shows the desired port, press ENTER to confirm the choice. Pressing ESC will cancel the edit. At this point, no change has yet occurred to any connections.

Now press OUT for a fan in switch, or press IN for a fan out switch. The appropriate field will change to edit mode, with the blinking cursor. The text message for this field includes the notation SEL to indicate that this field is the one that actually makes RF changes. Changes made here are going to affect the actual paths through the switches. Use the OFF key to break the RF connection, or enter 0 as the selection. When the display shows the desired port, press ENTER to confirm the choice. Pressing ESC will cancel the edit. The new RF connections are established at this time.

As digits are entered, they scroll left, to the maximum number of digits allowed for the matrix. If an incorrect digit is typed, follow it by correct digits, allowing the erroneous digit to “fall out” of the left of the display area. Leading zeroes may be entered to flush erroneous digits. The ENT key accepts only the digits actually displayed. An entry of “0” is the same as pressing the OFF key

When the ENT key is pressed, the Matrix verifies that the number entered by the operator is within the valid range of the matrix. If the operator enters a number that is out of range for the matrix (e.g. typing in “9” for a 8x8 matrix), the operation is aborted, and the LCD displays the previous selection. No change occurs in the RF path. If the number is accepted, the change is made to the RF path, and the display is updated. Any leading zeroes are removed and the cursor disappears

4.3 Using the Menus

The menu system provides screens for configuring certain internal parameters, such as serial interface baud rates. It also provides status information regarding internal fault monitoring. There are screens to restore the matrix to its default settings. Menus are multi-level hierarchies. The operator chooses a level and moves to the next lower level until the specific items are reached

The normal display is the Connection screen, showing the state of the RF matrix. Press the MENU key to change to the first menu heading. Use the UP/DOWN keys to scroll through the headings. Press ENT to move down into the multi-level menus. Press ESC to return to the next higher menu level.

Once a specific parameter is reached, the parameter can be changed by using the UP/DN keys to see the various options. When the desired value is displayed, press ENT to make that the current value of the parameter. Press ESC to abort, and return to the next higher level.

Certain parameters require that the matrix be reset. The reset operation occurs automatically, without powering off the matrix. The LCD will show "Resetting" followed by the normal initialization screen. The RF connection will be restored, typically without actually being broken. The reset operation occurs whenever a communication parameter is changed (RS-232, RS-422 or Ethernet)

4.4 LCD screens and Menus

4.4.1 Menu Tree

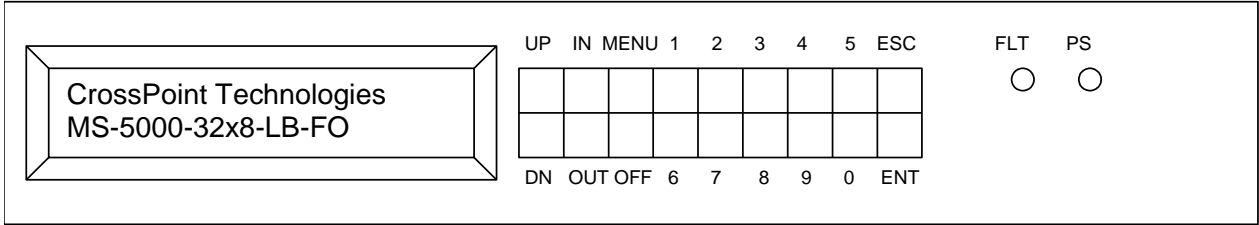
```

Startup Splash
Connection Screen
  Remote/Local Mode
  BITE Status
    Power Supply status
    Internal communication status
  Maintenance & Setup
    Serial Options
      RS232/RS422 Interface Selection
      Baud Rate
    Ethernet
      DHCP enable
      Static IP address set or DHCP address readback
      Port
      Static Net Mask
      MAC (Hardware) address readback
      System Network ID readback
    Software Version
  Set Defaults

```

4.4.2 Startup Splash

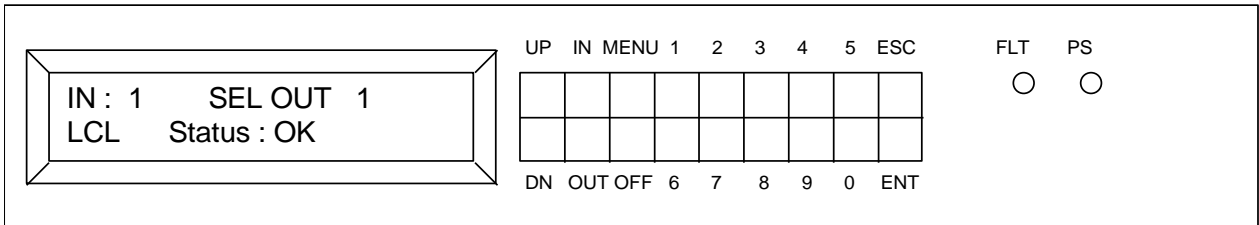
The splash screen is visible for 3 seconds after power on or reset. It gives the model number of the controller...



4.4.3 Connection Screen

Screen then goes to the Connection screen. This screen is visible whenever the user has not entered the Menu system. Connections can be changed from this screen if the Matrix is in Local (LCL) mode. Connections are restored to the state they were in at power down.

This screen can be accessed by pressing the ESC key several times in any other menus. The system will back out of menus until it reaches this display.



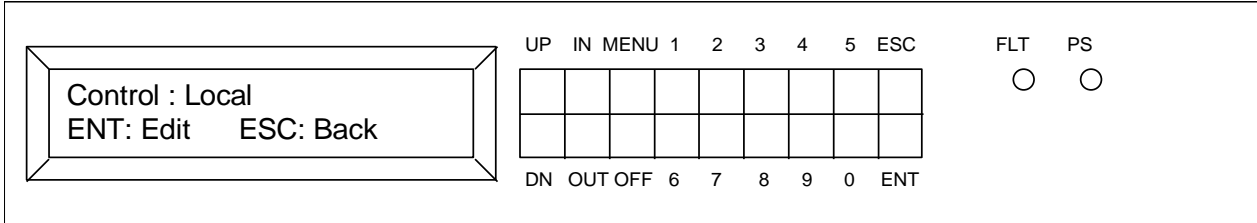
The sequence of keystrokes to make a connection will differ for Fan In vs. Fan Out switches. Fan Out switches allow each output to be connected to only a single input at a time, while allowing any input to be connected to multiple outputs simultaneously. Conversely, a Fan In matrix allows an input to be connected to a single output at a time, while an output can receive signals from many inputs simultaneously. The LCD display cannot easily show the multiple connections. Therefore, Fan Out switches are controlled by first specifying an output, and then selecting an input to route to that output. Fan In switches operate by first selecting an input and then selecting its single destination at an output.

The display above is from the 32x8-FO. The Output is noted as “SEL OUT” to reinforce the idea that the Output is being changed when a new selection is entered.

Begin by pressing the OUT key. The channel number can be entered using the numeric keys or by the UP/DN keys to scroll. Press ENT when complete. Pressing OFF will turn the RF path off completely. Entering an Input value of 0 will also turn the output OFF. After ENT is pressed, the blinking cursor will disappear, indicating that the connection has been made. If a number is entered that is out of range, the screen will revert to the previous Input, and no change in connection will occur. Pressing ESC will exit the Edit mode without making any changes.

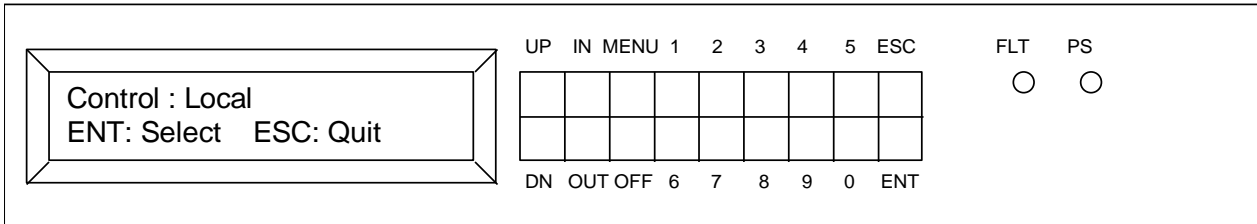
4.4.4 Remote/Local Control

From the connection screen, pressing MENU will bring up the first Menu heading. Scroll through the top level items using the UP/DN keys. Press ENT to step into a selection and view the current setting. Press ENT again to step into the list of choices. Choices are viewed by scrolling UP/DN. Press ENT to select a new parameter value. Press ESC to back up one level in the menu and abandon any changes. The first MENU screen will look like this:



The Matrix is in Local mode unless the remote computer has taken over the matrix. If the screen shows "Remote", front panel control is disabled. (Matrix settings can be viewed but not changed). When the system is in Remote mode, control can be acquired by pressing ENT to step into this menu item. Press UP or DN until the screen shows Local, as in the picture below. The bottom line instructs the operator to press ENT to confirm this change to Local mode. Pressing ESC will abandon the change, and back up one level to the top menu list.

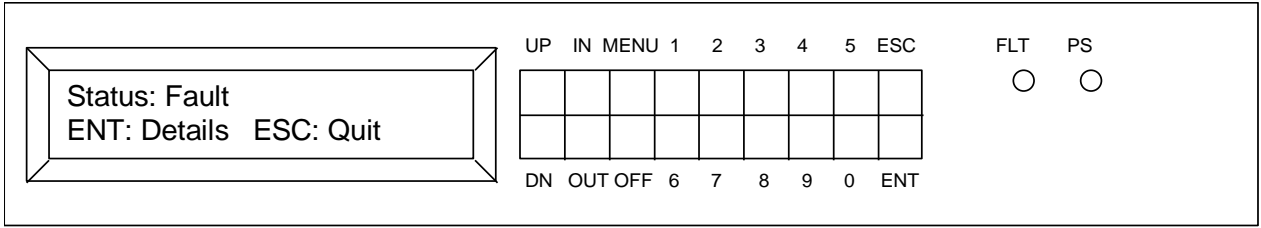
The system may also be in Local Lockout mode. In this mode, the remote computer has absolute control. This menu item cannot be used to regain control from a Local Lockout condition. The remote computer must place the Matrix into either Remote or Local modes or power must be cycled to release a Local Lockout.



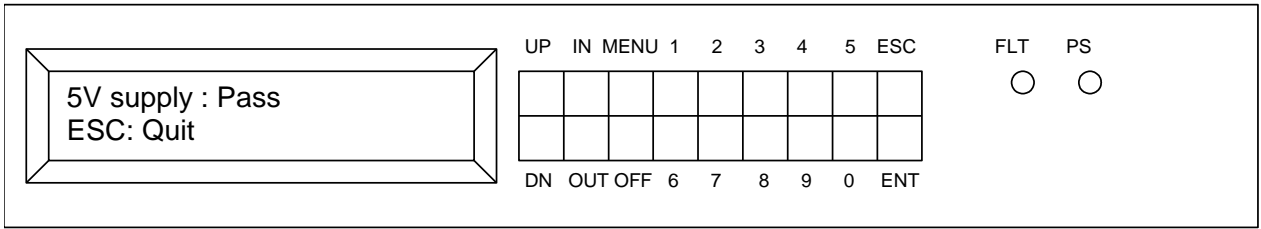
4.4.5 Status

The next top level Menu item, "Status", displays details from the built in test circuits. This example shows a Fault reported. The Red FLT lamp will be lit at all times when any fault is detected. If the problem is a power supply, the PS LED will be lit. Switches with redundant power supplies will have two LED's for this purpose. Press ENT to drop down and view details.

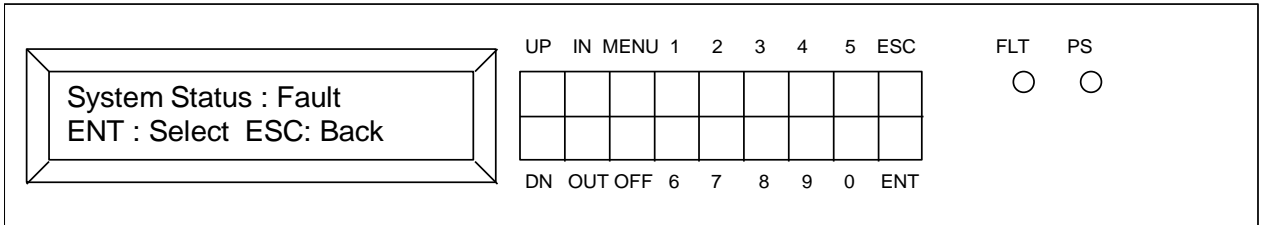
While in these menus, the screen is not updated dynamically. Changes to any fault status information are displayed once for that screen. To see the effect of changes, you must navigate out of that screen and re-enter to refresh the screen data.



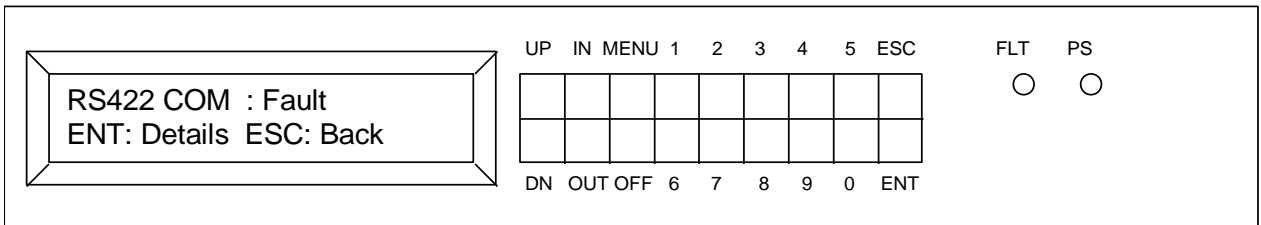
Use the UP/DN buttons to scroll through the various power supply voltages. A sample display is shown below:



After scrolling through all the power supplies, the screen will show the internal communication status. This screen is as shown below. The message is "OK" if there are no faults.



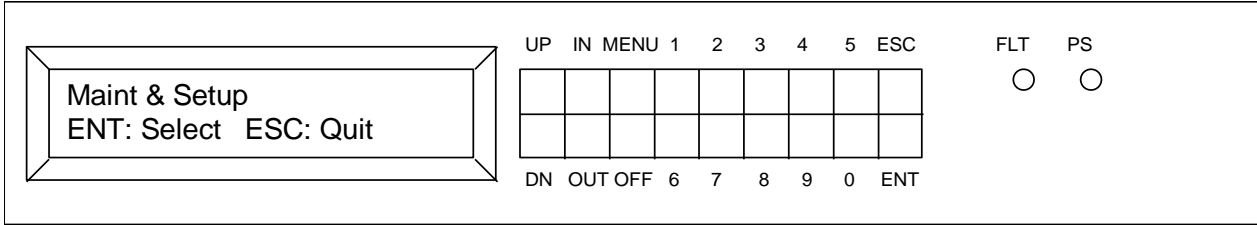
Press Enter to see more details. The first screen is the internal RS422/485 communication state.



If a fault is present, there is an option to see details. Press Enter to get the next screen

Maintenance & Setup

This top level menu item allows the setup of the serial port, and allows reading the software version identifier.



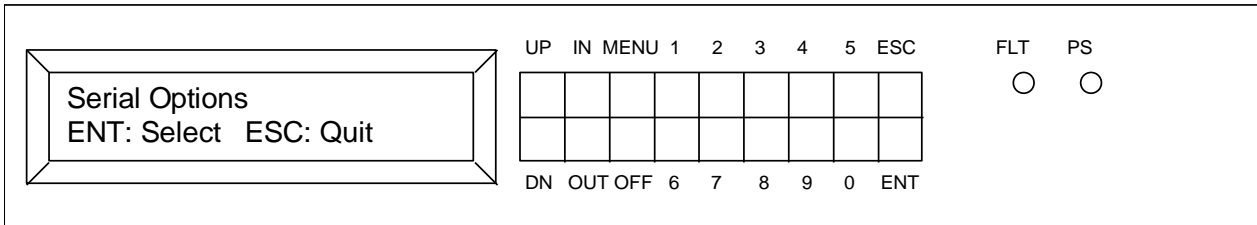
Press ENT to drop into the menu and scroll through the choices.

CAUTION

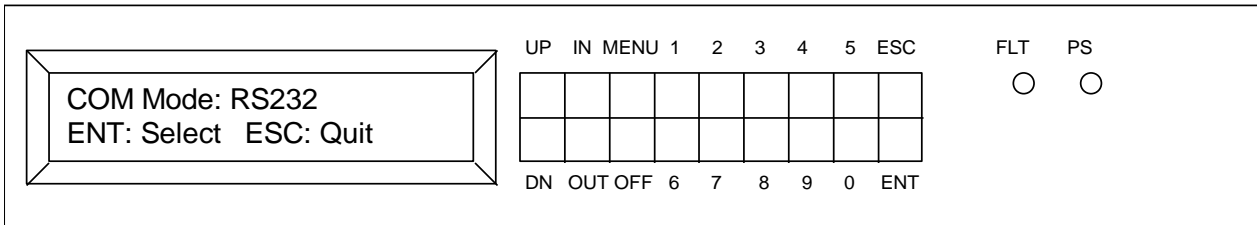
If any of the serial or Ethernet settings are changed, when the user navigates back to this top level menu item, the switch matrix will reset itself and begin using the new parameters. Switch matrix connections **will be interrupted** while this reset takes place, and will then be automatically restored. Reset typically takes less than 10 seconds, depending on network response times.

Serial Options

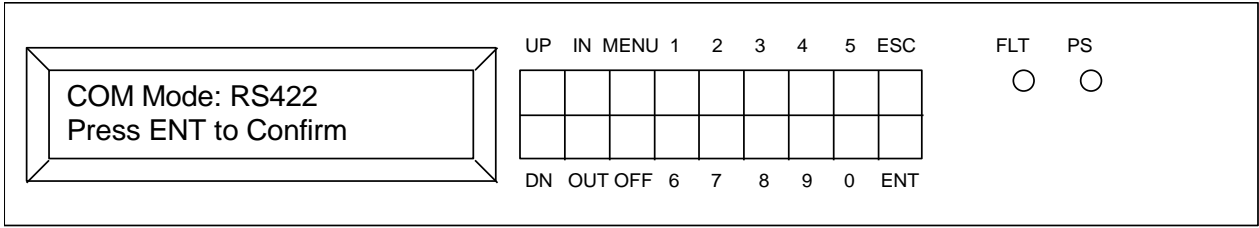
All serial communication settings are made from these menu items. Press ENT to drop into these items



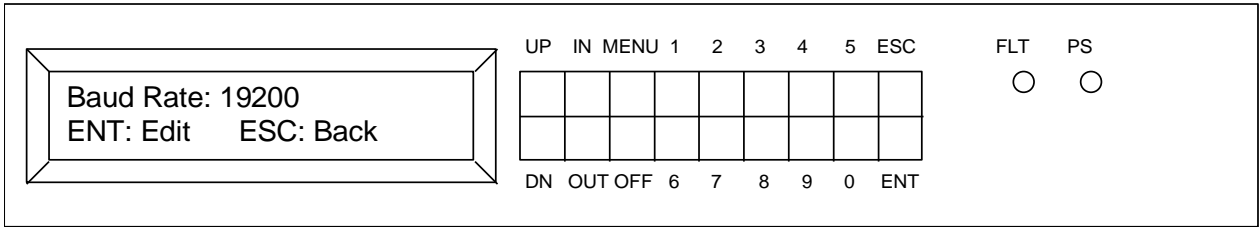
The default RS232 mode is shown here.



Pressing ENT will allow scrolling through the other choices. RS422 and (future) Ethernet are selected from this menu. To select RS422, use UP/DN until the screen shows RS422. Press ENT to change the interface. Changing Serial mode parameters will cause the Matrix to reset itself automatically when the action is confirmed, and will be operational again in about 6 seconds.



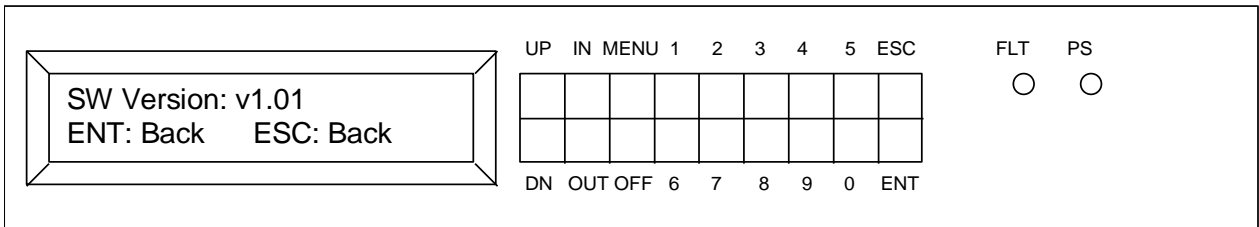
Similar menu choice selects baud rate. Factory default is 19200 baud.



Press ENT to drop into the menu item and scroll through available choices. Press ENT to change the baud rate. Changing Serial mode parameters will cause the Matrix to reset itself automatically when the action is confirmed, and will be operational again in about 6 seconds

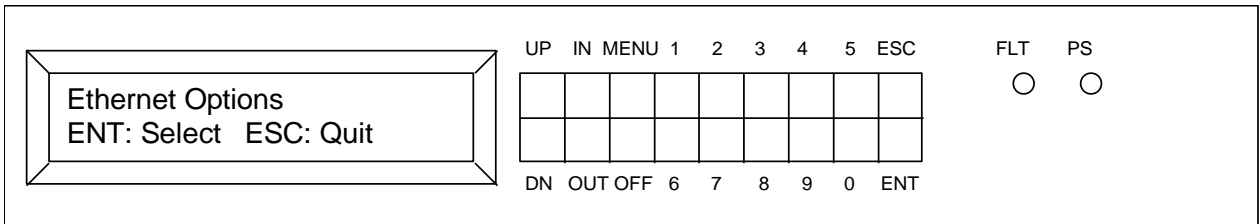
4.4.5.1 Software Version

This read only display shows the current installed version of firmware in the system controller.

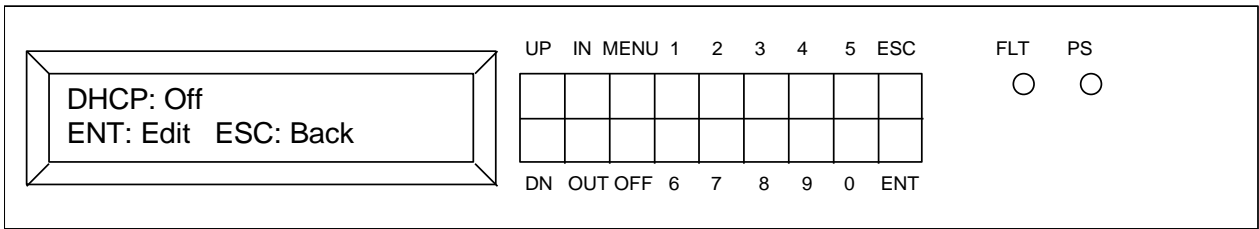


4.4.5.2 Ethernet Options

All Ethernet communication settings are made from these menu items. Press ENT to drop into these items

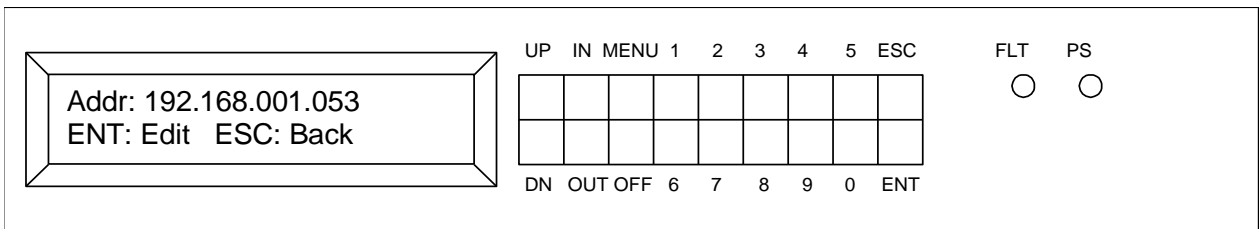


The default condition is for static IP addressing. Therefore, DHCP is off by default. The DHCP selection menu appears first because its state will have an effect on data items presented in later menus.



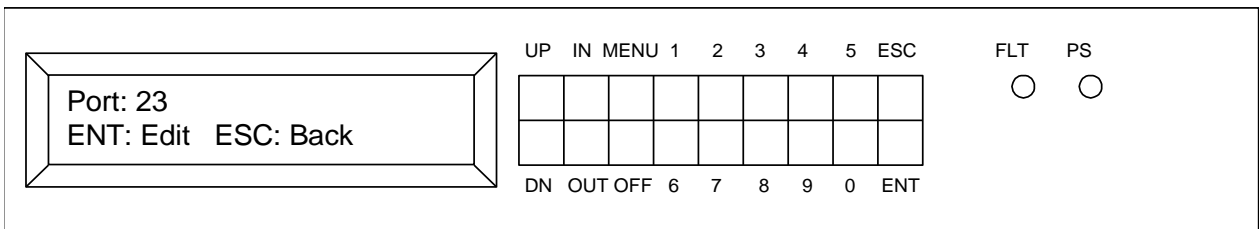
Pressing ENT will enter the DHCP edit mode. Then use the UP/DN keys to set DHCP ON or OFF as desired. Press ENT to accept the setting and return to this level of the menu. Press ESC to abort any change and leave the current value in place

The next menu item is the IP address screen. This screen shows either the static IP address assigned during setup (when DHCP is off) or it shows the address received from the DHCP initialization process if DHCP is enabled. If DHCP is enabled, but no address has been assigned, the screen will show an address of 000.000.000.000. In this case, communication with the matrix is not possible.

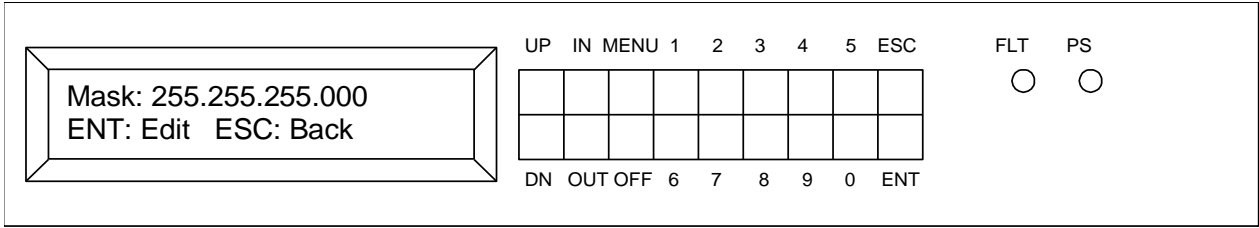


If DHCP is off, press ENT to manually set the IP address. Your network administrator will be able to help determine this address. The address must be manually typed using the numeric keys. Leading zeroes must be entered, as each field is a fixed 3 characters. Press ENT when done to accept the new address and return to the upper level menu. If DHCP is enabled, this screen is read-only.

The next menu item is the IP Port value. The default is Port 23, the standard port for Telnet services. If another port is desired, it may be set here. Ports in the full range 1..65535 are accepted. Leading zeroes are not required for this item.

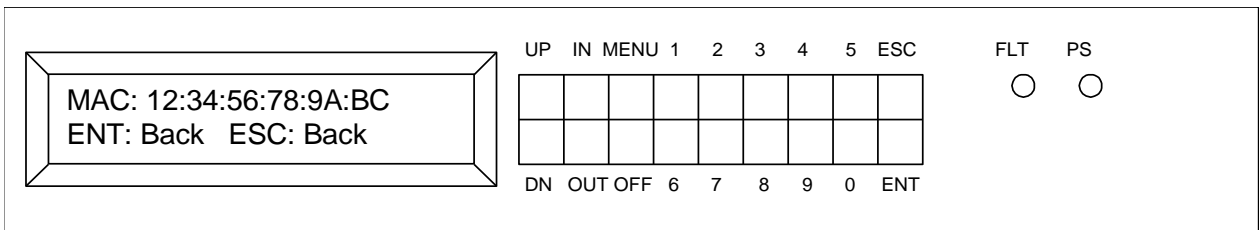


When using static addressing (DHCP Off), a network mask must be supplied. The next menu item allows this mask value to be entered. Like the IP address, leading zeroes are required because the number is broken into 4 fields, and a decimal point key is not available. Set the netmask according to the addressing system used in your network. Your Network Administrator will know what this value should be.

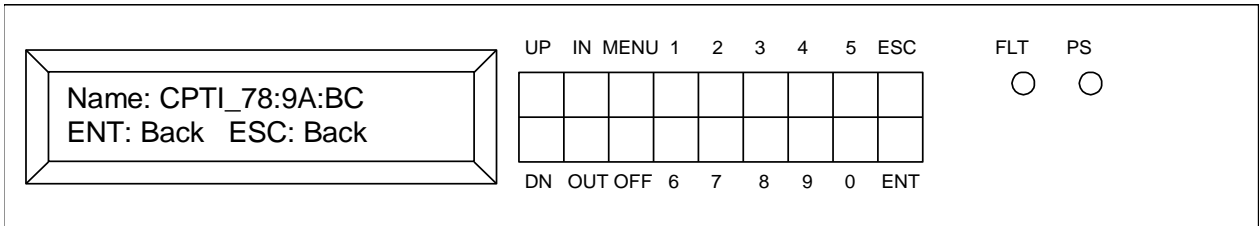


If DHCP is On, this field is read only, and shows the last value entered manually, not the value in use on the network.

For system administration, it is often important to know the hardware MAC (Media Access Control) address. This address is assigned in silicon at the factory, and is globally unique among all Ethernet devices. The next menu item displays the MAC address of the matrix switch, and is read-only.

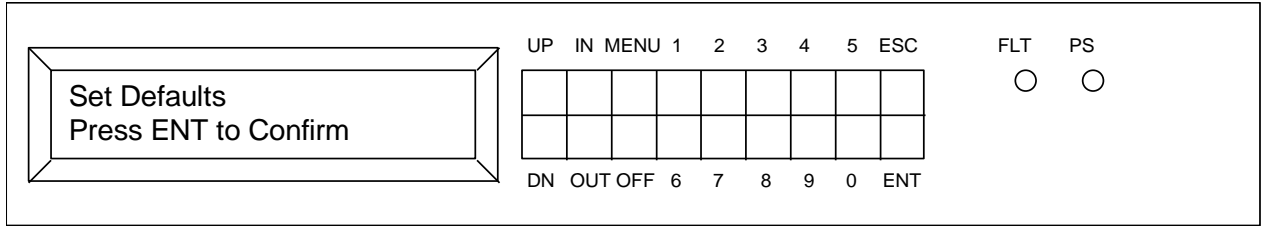


In some networks the System Administrator will want to put a name for the switch into the IP routing tables. If DHCP is being used, the IP address can change dynamically, so it becomes difficult to find the matrix by its IP address. A name can be assigned, so that the matrix can be found by name-server techniques. To simplify this setup, the switch matrix creates a unique name for itself and registers this name with the local router during DHCP initialization. The name is always of the format "CPTI_" followed by the last 6 characters of its MAC address. (The first 6 characters of the MAC will always be the same for all CrossPoint products, so they add no uniqueness to the name). The CPTI_ header allows the matrix to be easily identified in a router table by the System Administrator, and matched to a specific switch matrix.



4.4.6 Set Defaults

This menu item erases all communication parameters, and sets the matrix to RS232, 19200 baud. All switches are set to their OFF condition (Failsafe models revert to failsafe condition). The Matrix resets itself and will be operational again in about 6 seconds.



5 Remote Control

5.1 Interfaces

The matrix system may be controlled by serial port or by Ethernet (if installed). For serial control, a dumb terminal or terminal emulator program, such as HyperTerm (found on most PC's) provides a manual interface for simple command entry and status message readback. For Ethernet control, a Telnet program (or Hyperterm) provides similar capability across the network.

The matrix system does not echo characters as they are typed, so use the Local Echo feature of your program to see what you type. Every completed command returns either a copy of what was received, or an error code. This reply returns after the command has executed, signaling that the command was acted upon.

5.2 Protocol

All messages and responses over the User IO interface are ASCII strings. No binary data is transmitted over this interface. Commands consist of 2 ASCII characters and may require an optional parameter string. Commands are terminated by carriage return (hex 0D). Execution does not begin until the carriage return is received.

Multiple commands may be sent on the same line if separated by a semicolon (;). Incoming command strings are limited to 63 characters, including the carriage return. Outgoing responses are truncated if they would exceed 255 characters.

In most cases, a command mnemonic can be followed by an ASCII question mark ("?"). This form of the command will be interpreted as a status request and the current value associated with that command will be returned. The state of the device will not be altered by a status request.

Parameters are typically separated by commas. Certain commands can have multiple parameter sets which are separated by parentheses.

The 2 character mnemonics are case insensitive on receipt, but will be upper case in the response.

Transmit and receive operations are synchronous to one another. Incoming commands and status requests are executed in the order received. Responses are returned when the command is complete. All commands are echoed after completion as a verification to the remote computer. If the host computer does not wait for the response string, it should allow 250 msec between commands to ensure that it does not overrun internal buffers.

When input numbers or output numbers are required as parameters, they may omit leading zeroes. Up to 3 characters are accepted. The maximum matrix size is 999 x 999.

When parameters are out of range (e.g. an input number is higher than the number of installed inputs), those specific portions of the command are ignored. In commands which include lists of items, all items are processed unless an error is encountered. All items after an error are discarded, as well as the error itself. An error response is returned.

Command Set

5.2.1 Summary

Mnemonic	Description
ID	Identify Matrix
SC	Switch Close
DS	Report All switch positions
ER	Error Response
AO	All Switches Open
SO	Switch Open
SZ	Switch Size
TR	Test Report
VR	Firmware Version
TR	Test Report

5.2.2 Detailed Command and Status Formats**ID Device ID**

FORMAT: (1) ID
 (2) ID?

RESPONSE: (1) same as (2)
 (2) IDCrossPoint Technologies MS-5000-32x8-LB-FO example)

DESCRIPTION: Returns ASCII string identifying the Switch Matrix model. This query may be used as a confirmation that the device is communicating.

SC Switch Close

FORMAT: (1) SC(xxx,yyy)(zzz,aaa)...
 (2) SCxxx? (fan in)
 (3) Scyyy? (fan out)
 Where xxx and zzz = input channel number in ASCII format
 Yyy and aaa = output channel number in ASCII format
 Notice that the parameters pairs are in (input,output) order regardless of the type of matrix (fan in or fan out). For a fan out switch, specifying an output connected to input 0 (0,yyy) is equivalent to issuing the SO command for that channel (SOyyy). The output will be disconnected from all inputs. Similarly, for a fan in switch, specifying an input connected to output 0 (xxx,0) is equivalent to issuing the SO command for that channel (SOxxx).

RESPONSE: (1) SC(xxx,yyy)(zzz,aaa)...
 (2) SC(xxx,yyy) A value of 0 indicates the input or output is unconnected (equivalent to SOxxx)

DESCRIPTION: This command connects a list of specified outputs to specified inputs.

DS Dump Switch States

FORMAT: (1) DS
(2) DS?

RESPONSE: (1) same as format (2)
(2) DS(xxx,yyy)(zzz,www)...
The responses are organized as (input, output). Pairs are enclosed in parentheses. A selection value of "0" signifies an no connection

DESCRIPTION: Dumps a list of all connections. This is a status request only. No changes to switches will occur.

EXAMPLES: DS(000,001) (005,002) (006,003) (005,004): from MS-4000-6x4-IF-FO . In the example, Output 1 is set to off (000), output 2 is set to input 005, output 3 is set to input 006, output 4 is set to input 005. Note that input 5 is sent to outputs 2 and 4.

ER Error Reply

DESCRIPTION: If the system detects an error in an incoming command, it will reply with ERxxx where the xxx is a numeric code indicating the error type. The offending command string may be appended after a colon.

EXAMPLE: sending a command "FG3" which is an unknown command will cause the system to reply with "ER001:FG". The list of possible error codes are:

Error Code	Description	Comments
ER001	Unrecognized command	
ER002	one or more parameters are incorrect	not used for numeric range errors
ER003	Command not applicable to this particular device	
ER004	one or more numeric parameters are out of range	
ER005	something wrong in how info is grouped (parens, semicolons, etc)	

AO All Switches Open

FORMAT: (1) AO

RESPONSE: (1) AO - if the matrix is not Failsafe type
(2) FS - if the matrix is a Failsafe type.

DESCRIPTION: Opens all switches in the matrix or sets them to their failsafe positions.

SO Switch Open

FORMAT: (1) SOxxx,yyy
 Where xxx,yyy = comma separated list of output channel numbers in ASCII format (fan out) or a comma separated list of input channel numbers in ASCII format (fan in)

RESPONSE: (1) SOxxx,yyy

DESCRIPTION: This command disconnects specified outputs from all inputs. Equivalent to SC(xxx,0)(yyy,0) for fan out matrix or SC(0,xxx)(0,yyy) for fan in matrix

SZ Switch Size

FORMAT: (1) SZ
 (2) SZ?

RESPONSE: (1) same as (2)
 (2) SZxxx,yyy
 Where xxx = number of inputs and yyy = number of outputs.

DESCRIPTION: Returns the size of the matrix switch.

TR Report Test Results

FORMAT: (1) TR
 (2) TR?

RESPONSE: (1) same as (2)
 (2) TR"string"
 where
 "string" is an ASCII string composed of internal values and parameters, and is dependent upon the configuration of the matrix

DESCRIPTION: Returns test data (BITE) results. Return string will contain pass/fail indications for internal tests such as power supply voltages and switch cards.

EXAMPLE: Normal response might look like TR5V:P,BAT:P. This response shows the 5V and Batteries both Pass internal monitoring

VR Firmware Version

Returns firmware version number and date.

FORMAT: VR or VR?

RESPONSE: VRV1.25 Sep 06 2014 10:12:13 (typical response)

Appendix

Includes

- Specifications**
- Panel Drawings**
- Connectors**
- Spares**

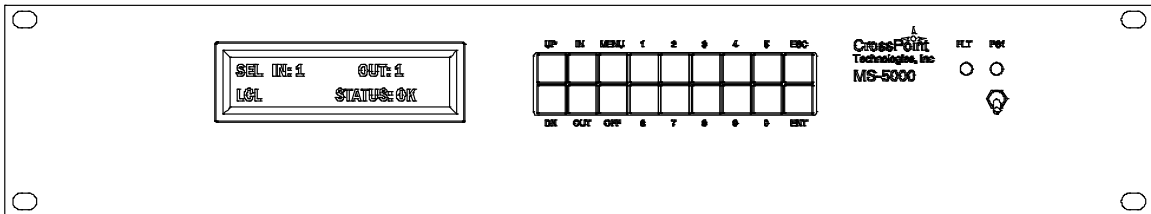
These configurations are covered in this Appendix.

- MS-5000-32x8-LB-FO
- MS-5000-16X16-VHF-UHF-077
- MS-5000-16X32-VHF-UHF-S
- MS-5000-4X8-VHF-UHF-S
- MS-5000-32X4-LB-FO

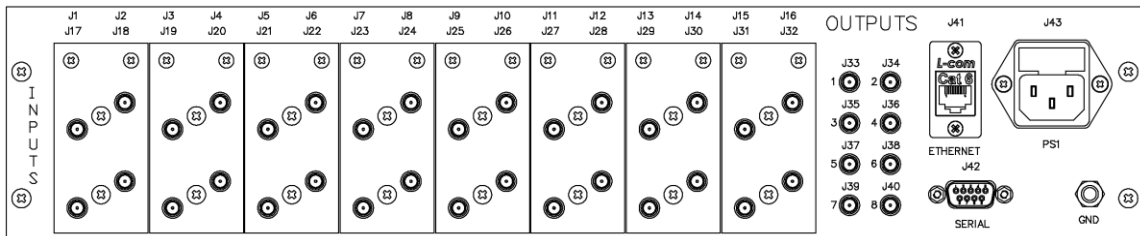
A. MS-5000-32x8-LB-FO

Specification	Conditions	Min	Typ	Max	Units
Frequency Range		950		2150	MHz
Gain		-2	0	+2	dB
Off-Isolation		60			dB
In-In Isolation		60			dB
Out-Out Isolation		60			dB
Impedance			50		Ω
VSWR				1.8	
1dB Output Compression		-5			dBm
NF				10	dB
IP3(input)		+8			dBm
Temperature (Op)		0		50	$^{\circ}\text{C}$
AC Voltage		88		260	VAC
Power Consumption			50		W

Dimensions: 17 x 20 deep x 3.5 high (nominal) : 2 RU
 Switch Type: Solid State
 Control: RS232 or RS422 selectable, and Ethernet
 Connectors: SMA-F in and out



Front Panel



Rear Panel

Connector List

Ref	Connector Type	Name
J1	SMA-F	Input 1
J2	SMA-F	Input 2
J3	SMA-F	Input 3
J4	SMA-F	Input 4
J5	SMA-F	Input 5
J6	SMA-F	Input 6
J7	SMA-F	Input 7
J8	SMA-F	Input 8
J9	SMA-F	Input 9
J10	SMA-F	Input 10
J11	SMA-F	Input 11
J12	SMA-F	Input 12
J13	SMA-F	Input 13
J14	SMA-F	Input 14
J15	SMA-F	Input 15
J16	SMA-F	Input 16
J17	SMA-F	Input 17
J18	SMA-F	Input 18
J19	SMA-F	Input 19
J20	SMA-F	Input 20
J21	SMA-F	Input 21
J22	SMA-F	Input 22
J23	SMA-F	Input 23
J24	SMA-F	Input 24
J25	SMA-F	Input 25
J26	SMA-F	Input 26
J27	SMA-F	Input 27
J28	SMA-F	Input 28
J29	SMA-F	Input 29
J30	SMA-F	Input 30
J31	SMA-F	Input 31
J32	SMA-F	Input 32
J33	SMA-F	Output 1
J34	SMA-F	Output 2
J35	SMA-F	Output 3
J36	SMA-F	Output 4
J37	SMA-F	Output 5
J38	SMA-F	Output 6
J39	SMA-F	Output 7
J40	SMA-F	Output 8
J41	RJ45	Ethernet Control
J42	D9	Serial Control In/Out
J43	IEC	AC Input
	Stud	Ground

Spares List

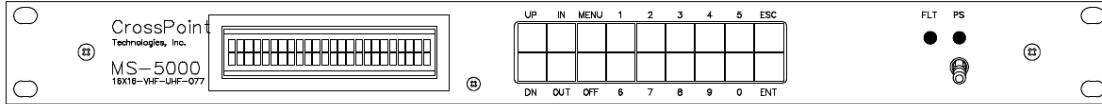
The following are parts used in the MS-5000-32X8-LB-FO switch that should be considered for a spares kit.

Qty per	Part Number	Description
1	CPT-099-1231	Assembly, Combiner Module
1	CPT-076-1228	Assembly, SPI Interface
1	CPT-099-1230	Assembly, Carrier Board w/ Firmware
1	CPT-006-1222	Assembly, Keypad
1	CPT-099-1221	Module 16X4 VHF/UHF Switch
1	CPT-099-1229	Assembly Amplifier Module L-BAND
2	0217004.HXP	Fuse 4A 250V 5X20MM IEC Fast Acting

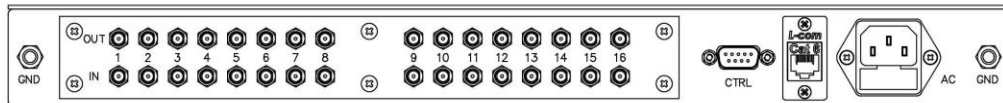
B. MS-5000-16x16-VHF-UHF-077

Specification	Conditions	Min	Typ	Max	Units
Frequency Range		20		3000	MHz
Gain		-2.5	0	+2.5	dB
Isolation In/In	20-1500MHz	80			dB
	1500-3000MHz	60			dB
Isolation Out-Out	20-3000MHz	80			dB
Isolation In-Out (Adj)	20-1500MHz	70			dB
	1500-3000MHz	65			dB
Rev Isolation Out/In	20-1500MHz	75			dB
	1500-3000MHz	65			dB
1dB Output Compression	20MHz	+1			dBm
	1500MHz	-2			dBm
	3000MHz	-9			dBm
OPIP2	Test Tones Pout -15dBm	+24			dBm
OPIP3	Test Tones Pout -15dBm	+12			dBm
Impedance			50		Ω
VSWR	Input			2.0:1	
	Output			1.7:1	
Noise Figure				8	dB
Temperature (Op)		0		50	°C
AC Voltage		90		240	VAC
Power Consumption			25		W

Dimensions: 17 x 20 deep x 1.75 high (nominal) : 1 RU
 Switch Type: Solid State
 Control: RS232 or RS422 selectable, and Ethernet
 Connectors: SMA-F in and out



Front Panel



Rear Panel

Connector List

Ref	Connector Type	Name
IN1	SMA-F	Input 1
IN2	SMA-F	Input 2
IN3	SMA-F	Input 3
IN4	SMA-F	Input 4
IN5	SMA-F	Input 5
IN6	SMA-F	Input 6
IN7	SMA-F	Input 7
IN8	SMA-F	Input 8
IN9	SMA-F	Input 9
IN10	SMA-F	Input 10
IN11	SMA-F	Input 11
IN12	SMA-F	Input 12
IN13	SMA-F	Input 13
IN14	SMA-F	Input 14
IN15	SMA-F	Input 15
IN16	SMA-F	Input 16
OUT1	SMA-F	Output 1
OUT2	SMA-F	Output 2
OUT3	SMA-F	Output 3
OUT4	SMA-F	Output 4
OUT5	SMA-F	Output 5
OUT6	SMA-F	Output 6
OUT7	SMA-F	Output 7
OUT8	SMA-F	Output 8
OUT9	SMA-F	Output 9
OUT10	SMA-F	Output 10
OUT11	SMA-F	Output 11
OUT12	SMA-F	Output 12
OUT13	SMA-F	Output 13
OUT14	SMA-F	Output 14
OUT15	SMA-F	Output 15
OUT16	SMA-F	Output 16
CTRL	D9	Serial Control In/Out
	RJ45	Ethernet Control
AC	IEC	AC Input
	Stud	Ground

Spares List

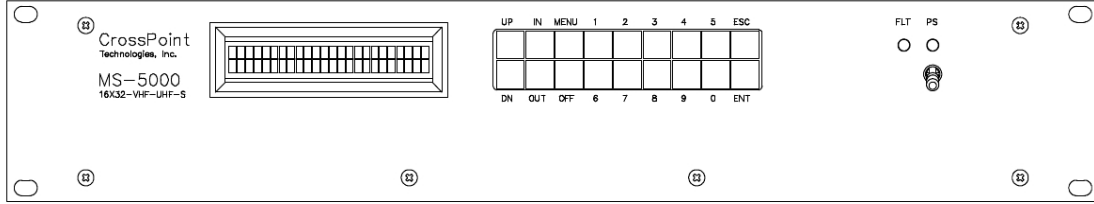
The following are parts used in the MS-5000-16X16-VHF-UHF-077 switch that should be considered for a spares kit.

Qty per	Part Number	Description
1	ECM60US05 w/Cover	Power Supply 60W 5VDC 90-264VAC
1	CPT-076-1228	Assembly, SPI Interface
1	CPT-076-1230	Assembly, Carrier Board w/ Firmware
1	CPT-006-1222	Assembly, Keypad
1	CPT-076-1221	Module 16X16 VHF/UHF Switch
1	CPT-077-1229	Assembly Amplifier Module VHF/UHF BAND
2	0217004.HXP	Fuse 4A 250V 5X20MM IEC Fast Acting

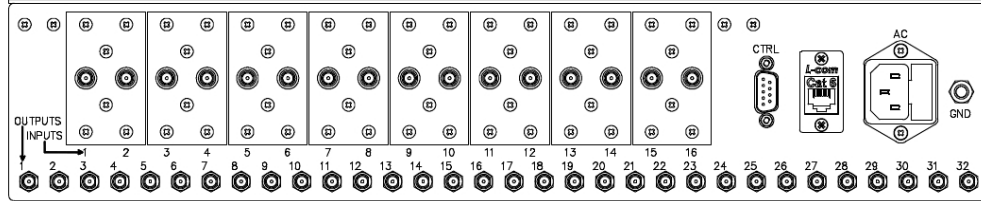
C. MS-5000-16x32-VHF-UHF-S

Specification	Conditions	Min	Typ	Max	Units
Frequency Range		20		3000	MHz
Gain		-3	0	+3	dB
	Typical	-2	0	+2	dB
Isolation In/In	20-1500MHz	80			dB
	1500-3000MHz	60			dB
Isolation Out-Out	20-3000MHz	80			dB
Isolation In-Out (Adj)	20-1500MHz	70			dB
	1500-3000MHz	65			dB
Rev Isolation Out/In	20-1500MHz	75			dB
	1500-3000MHz	65			dB
1dB Output Compression	20MHz	-2			dBm
	1500MHz	-5			dBm
	3000MHz	-12			dBm
OPIP2	Test Tones Pout -18dBm	+17			dBm
OPIP3	Test Tones Pout -18dBm	+7			dBm
Impedance			50		Ω
VSWR	Input			2.0:1	
	Output			1.7:1	
Noise Figure				8	dB
Temperature (Op)		0		50	$^{\circ}\text{C}$
AC Voltage		90		240	VAC
Power Consumption			30		W

Dimensions: 17 x 20 deep x 3.50 high (nominal) 2 RU
 Switch Type: Solid State
 Control: Front Panel Keypad, RS232 or RS422 selectable, and Ethernet
 Connectors: SMA-F in and out



Front Panel



Rear Panel

Connector List

Ref	Connector Type	Name
IN1	SMA-F	Input 1
IN2	SMA-F	Input 2
IN3	SMA-F	Input 3
IN4	SMA-F	Input 4
IN5	SMA-F	Input 5
IN6	SMA-F	Input 6
IN7	SMA-F	Input 7
IN8	SMA-F	Input 8
IN9	SMA-F	Input 9
IN10	SMA-F	Input 10
IN11	SMA-F	Input 11
IN12	SMA-F	Input 12
IN13	SMA-F	Input 13
IN14	SMA-F	Input 14
IN15	SMA-F	Input 15
IN16	SMA-F	Input 16
OUT1	SMA-F	Output 1
OUT2	SMA-F	Output 2
OUT3	SMA-F	Output 3
OUT4	SMA-F	Output 4
OUT5	SMA-F	Output 5
OUT6	SMA-F	Output 6
OUT7	SMA-F	Output 7
OUT8	SMA-F	Output 8
OUT9	SMA-F	Output 9
OUT10	SMA-F	Output 10
OUT11	SMA-F	Output 11
OUT12	SMA-F	Output 12

Ref	Connector Type	Name
OUT13	SMA-F	Output 13
OUT14	SMA-F	Output 14
OUT15	SMA-F	Output 15
OUT16	SMA-F	Output 16
OUT17	SMA-F	Output 17
OUT18	SMA-F	Output 18
OUT19	SMA-F	Output 19
OUT20	SMA-F	Output 20
OUT21	SMA-F	Output 21
OUT22	SMA-F	Output 22
OUT23	SMA-F	Output 23
OUT24	SMA-F	Output 24
OUT25	SMA-F	Output 25
OUT26	SMA-F	Output 26
OUT27	SMA-F	Output 27
OUT28	SMA-F	Output 28
OUT29	SMA-F	Output 29
OUT30	SMA-F	Output 30
OUT31	SMA-F	Output 31
OUT32	SMA-F	Output 32
CTRL	D9	Serial Control In/Out
	RJ45	Ethernet Control
AC	IEC	AC Input
	Stud	Ground

Spares List

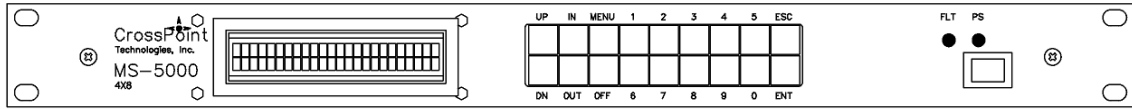
The following are parts used in the MS-5000-16X32-VHF-UHF-S switch that should be considered for a spares kit.

Qty per	Part Number	Description
1	T.B.D.	Power Supply
1	CPT-076-1228	Assembly, SPI Interface
1	CPT-124-1230	Assembly, Carrier Board w/ Firmware
1	CPT-006-1222	Assembly, Keypad
1	CPT-076-1221	Module 16X16 VHF/UHF Switch
1	CPT-124-1229	Assembly Amplifier Module VHF/UHF BAND
2	0217008.HXP	Fuse 8A 250V 5X20MM IEC Fast Acting

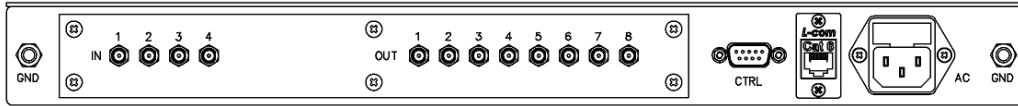
D. MS-5000-4x8-VHF-UHF-S

Specification	Conditions	Min	Typ	Max	Units
Frequency Range		20		3000	MHz
Gain		-2.5	0	+2.5	dB
Isolation In/In	20-1500MHz	80			dB
	1500-3000MHz	60			dB
Isolation Out-Out	20-3000MHz	80			dB
Isolation In-Out (Adj)	20-1500MHz	70			dB
	1500-3000MHz	65			dB
Rev Isolation Out/In	20-1500MHz	75			dB
	1500-3000MHz	65			dB
1dB Output Compression	20MHz	+1			dBm
	1500MHz	-1			dBm
	3000MHz	-5			dBm
OPIP2	Test Tones Pout -15dBm	+24			dBm
OPIP3	Test Tones Pout -15dBm	+12			dBm
Impedance			50		Ω
VSWR	Input			2.0:1	
	Output			1.7:1	
Noise Figure				8	dB
Temperature (Op)		0		50	$^{\circ}\text{C}$
AC Voltage		90		240	VAC
Power Consumption			25		W

Dimensions: 17 x 20 deep x 1.75 high (nominal) : 1 RU
 Switch Type: Solid State
 Control: RS232 or RS422 selectable, and Ethernet
 Connectors: SMA-F in and out



Front Panel



Rear Panel

Connector List

Ref	Connector Type	Name
IN1	SMA-F	Input 1
IN2	SMA-F	Input 2
IN3	SMA-F	Input 3
IN4	SMA-F	Input 4
OUT1	SMA-F	Output 1
OUT2	SMA-F	Output 2
OUT3	SMA-F	Output 3
OUT4	SMA-F	Output 4
OUT5	SMA-F	Output 5
OUT6	SMA-F	Output 6
OUT7	SMA-F	Output 7
OUT8	SMA-F	Output 8
CTRL	D9	Serial Control In/Out
	RJ45	Ethernet Control
AC	IEC	AC Input
	Stud	Ground

Spares List

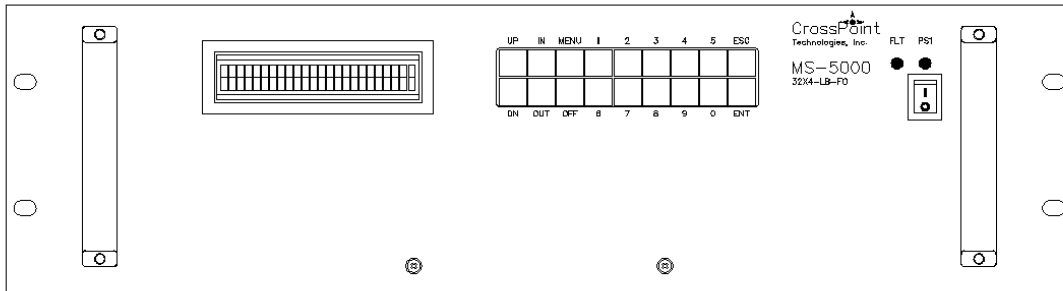
The following are parts used in the MS-5000-4X8-VHF-UHF-S switch that should be considered for a spares kit.

Qty per	Part Number	Description
1	ECM60US05 w/Cover	Power Supply 60W 5VDC 90-264VAC
1	CPT-076-1228	Assembly, SPI Interface
1	CPT-169-1230	Assembly, Carrier Board w/ Firmware
1	CPT-100-1222	Assembly, Keypad
1	CPT-169-1221	Module 16X16 VHF/UHF Switch
1	CPT-169-1229	Assembly Amplifier Module VHF/UHF BAND
2	0217004.HXP	Fuse 4A 250V 5X20MM IEC Fast Acting

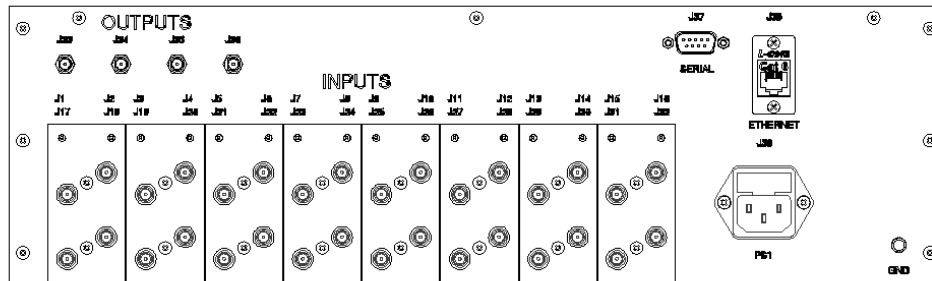
E. MS-5000-32x4-LB-FO

Specification	Conditions	Min	Typ	Max	Units
Frequency Range		950		2150	MHz
Gain		-2	0	+2	dB
Off-Isolation		55			dB
In-In Isolation		55			dB
Out-Out Isolation		55			dB
Impedance			50		Ω
VSWR				1.8	
1dB Output Compression		-5			dBm
NF				12	dB
IP3(input)		+8			dBm
Temperature (Op)		0		50	$^{\circ}\text{C}$
AC Voltage		88		260	VAC
Power Consumption			60		W

Dimensions: 17 x 20 deep x 3.5 high (nominal) : 2 RU
 Switch Type: Solid State
 Control: RS232 or RS422 selectable, and Ethernet
 Connectors: SMA-F in and out



FRONT PANEL VIEW



REAR PANEL VIEW

Connector List

Ref	Connector Type	Name
J1	SMA-F	Input 1
J2	SMA-F	Input 2
J3	SMA-F	Input 3
J4	SMA-F	Input 4
J5	SMA-F	Input 5
J6	SMA-F	Input 6
J7	SMA-F	Input 7
J8	SMA-F	Input 8
J9	SMA-F	Input 9
J10	SMA-F	Input 10
J11	SMA-F	Input 11
J12	SMA-F	Input 12
J13	SMA-F	Input 13
J14	SMA-F	Input 14
J15	SMA-F	Input 15
J16	SMA-F	Input 16
J17	SMA-F	Input 17
J18	SMA-F	Input 18
J19	SMA-F	Input 19
J20	SMA-F	Input 20
J21	SMA-F	Input 21
J22	SMA-F	Input 22
J23	SMA-F	Input 23
J24	SMA-F	Input 24
J25	SMA-F	Input 25
J26	SMA-F	Input 26
J27	SMA-F	Input 27
J28	SMA-F	Input 28
J29	SMA-F	Input 29
J30	SMA-F	Input 30
J31	SMA-F	Input 31
J32	SMA-F	Input 32
J33	SMA-F	Output 1
J34	SMA-F	Output 2
J35	SMA-F	Output 3
J36	SMA-F	Output 4
J37	RJ45	Ethernet Control
J38	D9	Serial Control In/Out
J39	IEC	AC Input
	Stud	Ground

Spares List

The following are parts used in the MS-5000-32X4-LB-FO switch that should be considered for a spares kit.

Qty per	Part Number	Description
1	CPT-099-1231	Assembly, Combiner Module
1	CPT-076-1228	Assembly, SPI Interface
1	CPT-099-1230	Assembly, Carrier Board w/ Firmware
1	CPT-012-1220	Assembly, Keypad
1	CPT-099-1221	Module 16X4 VHF/UHF Switch
1	CPT-099-1229	Assembly Amplifier Module L-BAND
2	0217004.HXP	Fuse 4A 250V 5X20MM IEC Fast Acting