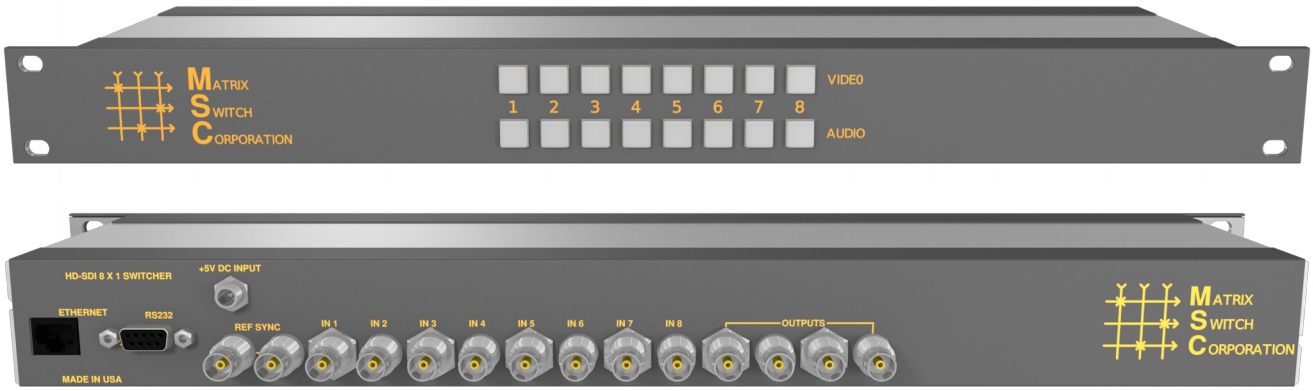
Matrix Switch Corporation
MSC-HD81L
Product Manual

Compact 8 input 1 output 3G-SDI Video Router with Button Control Panel

Revision 1.2



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1 Getting Started

Congratulations on your purchase of a quality Matrix Switch Corporation product. This section contains a general overview of device functionality and provides information to get you up and running quickly. Additional sections in this manual can be consulted for more detailed information on the subsystems and features of this product.

1.1 Device Connections

The **MSC-HD81L** comes with a power supply adapter, a redundant power supply (if ordered) and a documentation CD. Additional cables and hardware are not usually provided.

- **Power supply adapter** – A 5 Volt 2 Amp power supply adapter is provided which is connected to the 5.5mm OD 2.5mm ID coaxial connector on the device and plugged into a 100-240V 50/60Hz AC power source.
- **Redundant power supply (Optional)** – The additional redundant power supply can be connected via the second power supply connector (if applicable), to provide an additional power source in the event that one of the supplies fails or is disconnected from the power source.
- **Ethernet connector (Optional)** – Connect to a network switch with an Ethernet cable. Required for accessing the web page interface, TCP/IP Mascot interface or for interfacing with remote control panels. A crossover cable can also be utilized for connecting directly to a computer or remote panel.
- **SDI Video Inputs** – Connect SDI sources to input connectors using 75 Ohm Coax cable with BNC connectors designed for high speed SDI video applications. Unused inputs can be left unconnected. Inputs with supported standard rate (3G, HD or SD) SDI signals will be auto re-clocked for reduced jitter. Other non standard rates between 125 Mbit/s and 2.97 Gbit/s will be passed through without re-clocking or jitter reduction. Adaptive cable equalization on each input can equalize input signals from Belden type 1694A cables up to lengths of 120m (@3G), 140m (@HD) and 400m (@SD).
- **SDI Video Outputs** – Connect SDI destinations to output connectors using 75 Ohm Coax cable with BNC connectors designed for high speed SDI video applications. Unused outputs can be left unconnected. Outputs utilize standard SMPTE levels of 800mV peak-to-peak. This model features quad redundant SDI outputs.
- **Sync Reference (Optional)** – If switching on vertical sync pulse is desired, connect one of the Sync Reference connectors to a sync pulse signal (NTSC, PAL or tri-level) using 75 Ohm Coax with BNC connectors and the other Sync Reference connector can be used as a pass-through to additional properly 75 Ohm terminated equipment or a 75 Ohm terminator should be installed. If the sync reference functionality is not used, both connectors can be left unconnected.
- **RS-232 Serial (Optional)** – If serial control is desired, using the Mascot Protocol, connect a D9 female to male straight through cable to a control system, such as a computer. Use 9600 bps 8N1 as the serial configuration and enable local echo to see typed characters.

1.2 Powering Up The Device

This device is not equipped with a power switch and is simply connected to the power supply adapter which is plugged into a suitable AC power source, to power it up.

Once the device is powered it goes through the following startup sequence:

- 5 second startup delay to allow for Power On Software Updates.

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- Routing matrix is initialized to Preset 0 state (defaults to source 1 connected to all destinations).
- The button control panel is initialized and buttons are illuminated to show the initial routing status.

1.3 Front Panel Button Interface

The MSC-HD81L is equipped with a 8x1 button panel which provides one of several options for controlling and viewing the status of the routing matrix.

This panel interface provides separate Video and Audio input buttons. The current active input for the single available output is indicated by the given numbered input button being lit. Pressing a button in the Video row will cause that input to be connected to the output.

1.4 Web Page Interface

All Matrix Switch Corporation router and panel devices come with a built-in web page interface.

This is the recommended interface for configuration and is also a convenient way to control the matrix routing of the device.

Devices come factory configured with default settings, unless a pre-configuration request is made during purchase, an example being a multi device application.

1.4.1 Accessing The Web Page Interface

The default network IP address for this device is 192.168.2.60. Refer to the table below for the default IP addresses for other types of Matrix Switch Corporation devices.

Device Type	**Default IP Address**
Video/Audio Routers	192.168.2.60
Remote Button Panels	192.168.2.64
Remote LCD Screen Panels	192.168.2.80

To access the web page interface of the device:

1. Connect the Ethernet port of a computer either directly to the device using a crossover cable or to the same Ethernet network through a network switch or other LAN infrastructure.
2. Manually configure the computer's IP address to be a **unique** address on the same IP subnet as the device. For example 192.168.2.10. The Netmask should be 255.255.255.0. The Gateway doesn't matter for this purpose, but could be set to 192.168.2.1.
3. Make sure the device is powered on.
4. Using a web browser on the computer, enter the device's IP address into the Location bar and press ENTER. The web page interface should load. If the web page interface fails to load, double check the computer's network settings and physical Ethernet connections. In the event that the IP address of the device is unknown, refer to the Unknown IP Address troubleshooting section.

1.4.2 Network Settings

Network settings can be changed on the Config tab of the Web Page Interface. This includes DHCP enable, IP

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address, Netmask and Gateway settings. DHCP should only be used for assigning specific network settings from a central DHCP server or when assigned IP addresses can be determined, otherwise configuring the device via its IP address would be prevented if the IP address is unknown. After changing network settings, click the Save button and then click the Reboot button to restart the device. Refer to the Config Tab - Network Settings section for more details.

In the event that the device's IP address is unknown, refer to the Unknown IP Address troubleshooting section.

Refer to the Network Planning section for assistance with developing a network plan for multi-device applications.

1.4.3 Matrix Routing

The Routing tab of the Web Page Interface provides a convenient way to view and change the matrix routing state and is the default page shown.

A preset can also be recalled from this interface, by selecting one from the Load Preset drop down control.

Refer to the Routing Tab section for more details.

1.4.4 Labels

Labels can be assigned to video (and audio if applicable) sources and destinations. Labels can also be assigned to presets. Labels can be up to 8 characters in length. The default source labels use “Src” as a prefix, and the destination labels use “Dest” as a prefix (example: Src1). The presets are labeled “Startup” for Preset 0 and “PresetN”, where N is a number from 1 to 9, for the remaining presets.

The Labels Tab on the Web Page Interface can be used for modifying labels. Click the Save button to store any changes that are made. Refer the Labels Tab section for more details.

1.4.5 Presets

There are 10 stored matrix routing presets. Preset 0 is recalled on power up and by default routes source 1 to all destinations. All other presets default to “No Change” for all destinations, which when recalled will have no effect. Presets can assign a partial subset of destinations or all destinations as desired.

Presets can be modified on the Presets Tab of the Web Page Interface. Refer to the Presets Tab section for more details.

1.4.6 Panel Remote Router IP Address

Remote panels control Matrix Switch Corporation video/audio routers with the TCP/IP protocol via the Ethernet port.

NOTE: The button panel interface of a router device may also be used to remotely control a different router. In that case the Control Mode selection setting is used to determine the mode of the panel interface.

The **Remote Router IP** setting on the Config Tab of the Web Page Interface defines the IP address of the remote router which the panel interface will control. This defaults to 192.168.2.60 on remote panels, which is the default IP address of Matrix Switch Corporation routers.

After changing the **Remote Router IP** setting click the **Save** button to store the changes, which take effect immediately (a reboot is not required).

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Refer to the Config Tab - Button Panel Settings section for more details on configuring the Remote Router IP Address.

Refer to the Network Planning section for more details on configuring devices in multi-device applications.

1.5 Network Planning

The default device settings can be used without change in applications with a single router and optionally one remote panel on the same Ethernet network. Larger installations or integration with existing IP LAN networks require some network planning.

NOTE: Matrix Switch Corporation can assist in planning and pre-configuring devices for specific application requirements at purchase time. Just ask a sales or customer service representative.

Manual IP address management is recommended, although a DHCP server can be a convenient option for centrally managing IP addresses by device MAC address, the net effect still being a fixed IP for each device. Consult your DHCP server documentation for information on assigning IP addresses by MAC address, if this option is chosen.

All devices which need to communicate with one another (routers, remote panels and computers) need to be physically connected to the same LAN or allow IP packet routing between networks if on separate LANs.

SECURITY WARNING: Matrix Switch Corporation devices are meant for installation in trusted LAN environments. In the event that remote device configuration or control is desired over public networks or the Internet, it is strongly recommended that some form of inter-network security is utilized, such as firewalls and encrypted VLAN or secure data tunnels. This is necessary to prevent undesired access to devices.

Devices on the same LAN need to be assigned unique IP addresses in the same IP subnet. Matrix Switch Corporation devices are configured by default to use IP addresses in the class C IP subnet 192.168.2.x. When integrating devices into an existing LAN network, unique IP addresses should be assigned from the applicable network and the Netmask setting of the devices should be set to reflect the class (size) of the IP network (the default of 255.255.255.0 is for class C, which accommodates up to 254 addresses).

The Gateway setting is required to be set to the IP address of the network gateway on remote panels which will be accessing routers across network subnets, but this setting is otherwise not needed.

After assigning device network settings, including unique IP addresses, remote panels need to be assigned the correct IP addresses to their **Remote Router IP** setting of the router they will control.

Additional configuration changes may be required, depending on the application and are described in subsequent sections.

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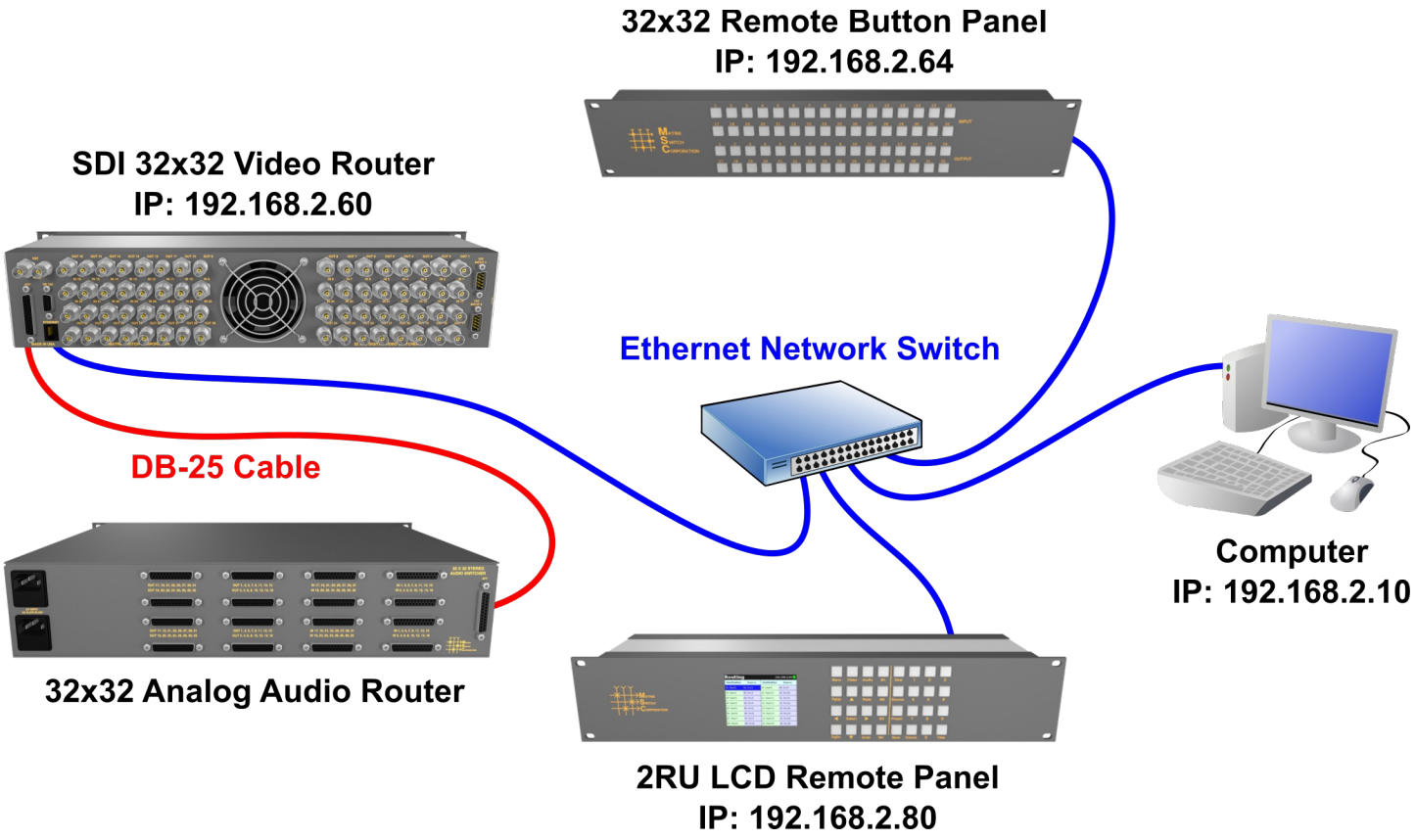
1.5.1 Installation Example

The following diagram is of a simple installation example consisting of a 32x32 SDI Video Router, with a secondary level 32x32 Analog Audio router connected via the AFV DB-25 interface, a 32x32 Remote Button Panel, a 2RU LCD Remote Panel and a Computer system.



1.6 Advanced Panel Configuration

Button panel interfaces (on local and remote panels) can be configured to control a subset of destinations, sources and/or levels.

Example use scenarios

- Utilize an 8x1 remote panel to control a single destination of an 8x8 video router.
- Use the local panel of a 16x16 two level Video and Audio router to control Video only and an additional 16x16 remote panel to control Audio independently.
- Use a 4x4 panel to independently control 4 destinations of an 8x8 router and limit selectable sources to 4 sources.

The applicable settings for advanced panel control scenarios can be found on the Config Tab of the Web Page Interface. Refer to that section for additional details.

1.7 3D Video Configuration

Matrix Switch Corporation video routers offer two software based solutions for dual channel 3D support. This

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is usually only used with SDI video, but is not limited to that video type.

3D support options

1. Paired I/O using a single router device. Resulting 3D matrix size is half of the devices original size, for example an 8x8 router would yield a 4x4 3D router. Not available with devices with less than 2 destinations or sources. I/O pairs are consecutive, for example output 1 and 2 would be for the first 3D channel, 3 and 4 would be for the 2nd, etc.
2. Dual linked router devices. Uses 2 devices connected via TCP/IP over their Ethernet ports, one acting as a master, to provide 3D support. Devices must have the same matrix size. Resulting 3D matrix is equal to the matrix size of a single device, for example two 8x8 routers would result in one 8x8 3D router. One router controls one half of the 3D channels (right eye) and the other controls the other half (left eye).

Option 1 is enabled through the **3D I/O Pairing** setting and Option 2 is enabled by setting the **Control Mode** to **Remote Sync (3D)** and assigning the secondary router's IP address to the **Remote Router IP** setting. All of these settings can be found on the Config Tab of the Web Page Interface. Refer to the Config Tab - System Settings and Config Tab - Button Panel Settings sections for additional details.

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2 Web page interface

2.1 Overview

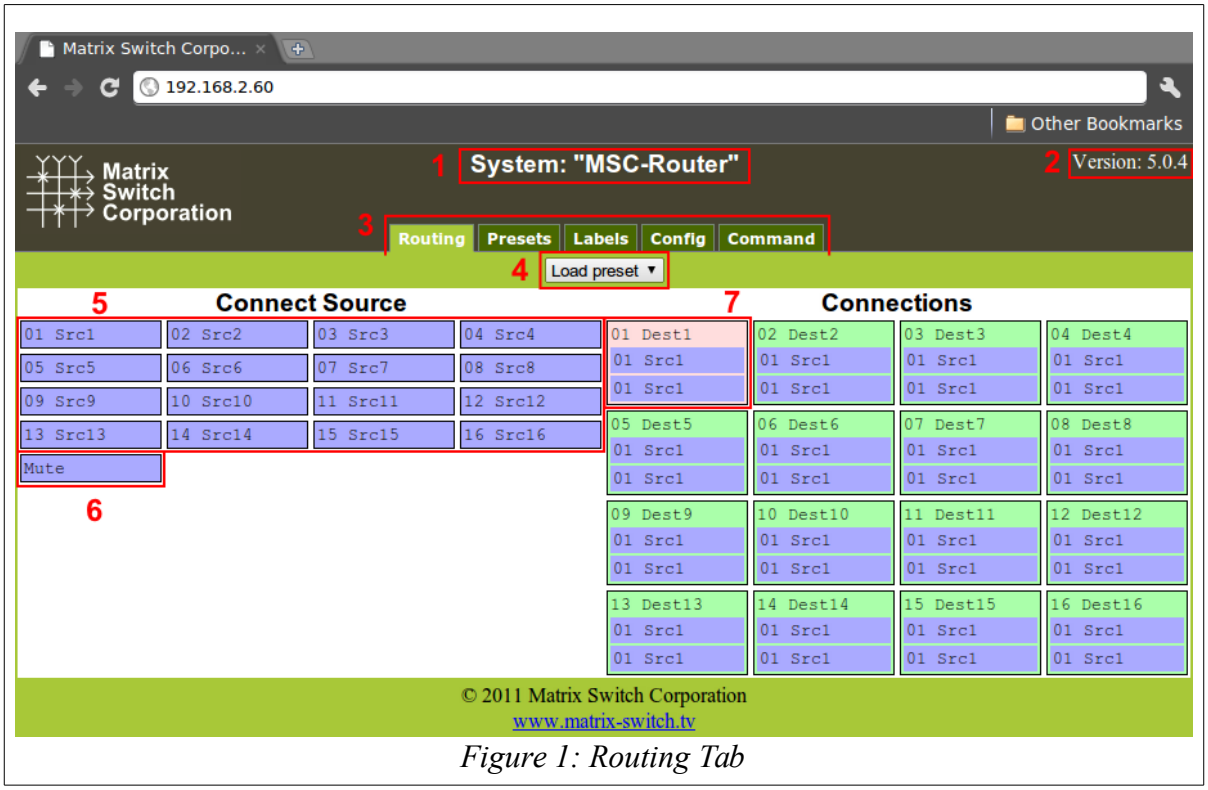

Figure 1: Routing Tab

All Matrix Switch Corporation Router and Remote Panel systems include a built in web page that can be used with standards compliant Javascript enabled web browsers, including but not limited to Firefox, Chrome, Safari and recent versions of Internet Explorer.

Figure 1 shows the Routing tab of a 16x16 switcher with 2 levels with numbered outlines to aid in further description below. The web page interface for other router systems is sized appropriately. Remote Panels show only the Config and Command tabs.

Numbered sections in Figure 1

1. System name (can be assigned on the Config tab)
2. System firmware series and version
3. Tab navigation
4. Preset load drop down selection
5. Source connect buttons
6. Mute button (may not be available on all switchers and levels)
7. Currently selected destination (destination name followed by currently connected source names for both levels).

2.2 Routing Tab

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The right side of the Routing tab interface under the title "Connections" displays the current state of the routing matrix. Each destination is depicted as a box containing the destination number/label followed by one or more source numbers/labels of the currently connected sources for each level of the destination. The currently selected destination is highlighted in red (**#7** in Figure 1). For multi-level systems either the destination or one of the levels can be individually selected for changing all levels or a single level.

The left side of the Routing tab under the title "Connect Source" (**#5** in Figure 1) displays all the available sources and Mute (if available) to connect from.

2.2.1 Changing a connection

To change a routing connection, select the desired destination by clicking on the Destination label or an individual level source label (multi-level systems only). Then click on a Source button or Mute (if available) from the "Connect Source" section. The clicked source will be connected to the selected Destination for one or more levels (depending on if the Destination or a single level is selected).

2.2.2 Loading a preset

Presets store connection states for one or more Destinations. Loading a Preset on the Routing tab consists of simply clicking on the "Load preset" drop down selector (**#4** in Figure 1) and selecting the desired preset, which is then loaded and applied to the current routing matrix. More information on Presets is contained in the following Presets tab section.

2.3 Presets Tab

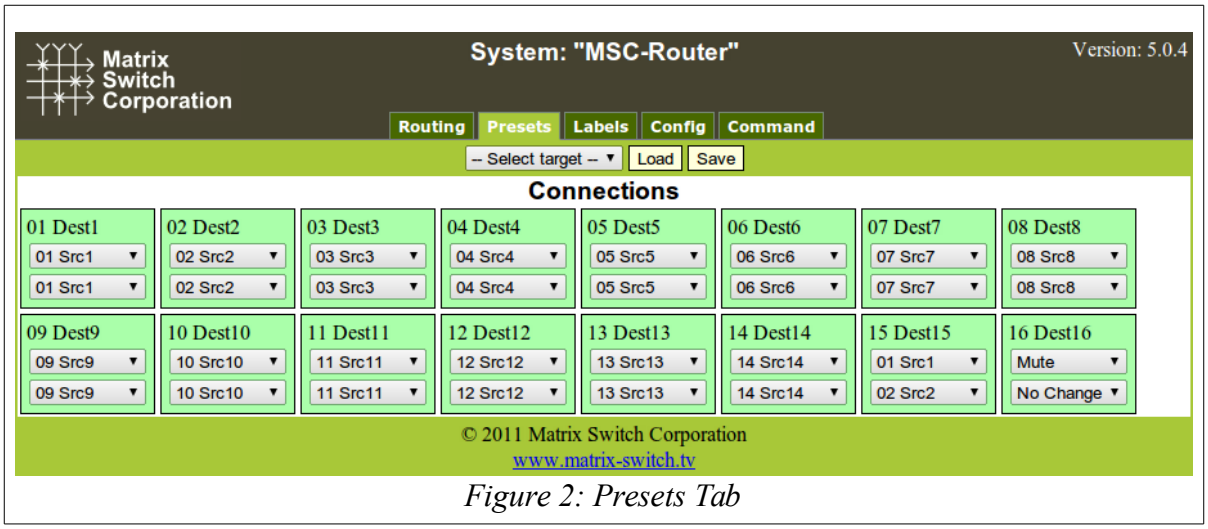

Figure 2: Presets Tab

Figure 2 depicts the Presets Tab which can be used to edit presets or perform batch matrix connection operations. Under the "Connections" title is shown the **Work Matrix**, which is a temporary area for working with matrix routing and loading to/saving from stored **Presets** and the current **Active Routing** state. For each Destination the Destination number and label is displayed followed by one or more drop down selection lists for each source level. The selection lists contain all available sources (listed by source number and label) and the special values **No Change** and **Mute** (the latter only if available for the given level). The **No Change** option indicates that the Destination for the given Level should not be changed from its current value, when the preset

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is recalled, which allows for a subset of the routing matrix to be changed. **Mute** will output blank Video or silent Audio for the given Destination level and is not supported on all routers/levels.

2.3.1 Loading Work Matrix from a source target

The **Work Matrix** can be loaded from the current **Active Routing** matrix or a Preset. Simply select the desired source target from the "Select target" drop down list and click the **Load** button.

2.3.2 Saving Work Matrix to a target

The **Work Matrix** can be saved to one or more targets including the **Active Routing** matrix or a **Preset**. Simply select the desired destination target from the "Select target" drop down list and click the **Save** button. When saving to the **Active Routing** matrix, the connections defined in the **Work Matrix** will become immediately active for the current routing state, allowing for batch routing operations to be performed and executed simultaneously. Saving to a **Preset** will store the Work Matrix state to non volatile memory, which persists through device power cycles and can be recalled at a later time.

2.3.3 Usage scenarios

The flexibility of the Presets Tab interface allows for several useful scenarios, some of which are described below:

- **Batch connection operations** – To perform several connection operations all at the same time: make the desired connection changes to the **Work Matrix**, leaving all others as "No Change", and then apply the changes to the **Active Routing** target by selecting it from the "Select target" drop down and clicking the **Save** button.
- **Store Active Routing matrix state to a Preset** – The entire **Active Routing** matrix state can be stored to a Preset by first loading it to the **Work Matrix**, followed by selecting the desired target Preset and clicking the **Save** button.
- **Editing an existing Preset** – Editing a Preset is done by loading it to the **Work Matrix**, making the desired changes and saving it back to the same Preset. All this is accomplished without changing the **Active Routing** matrix state.

2.4 Labels Tab

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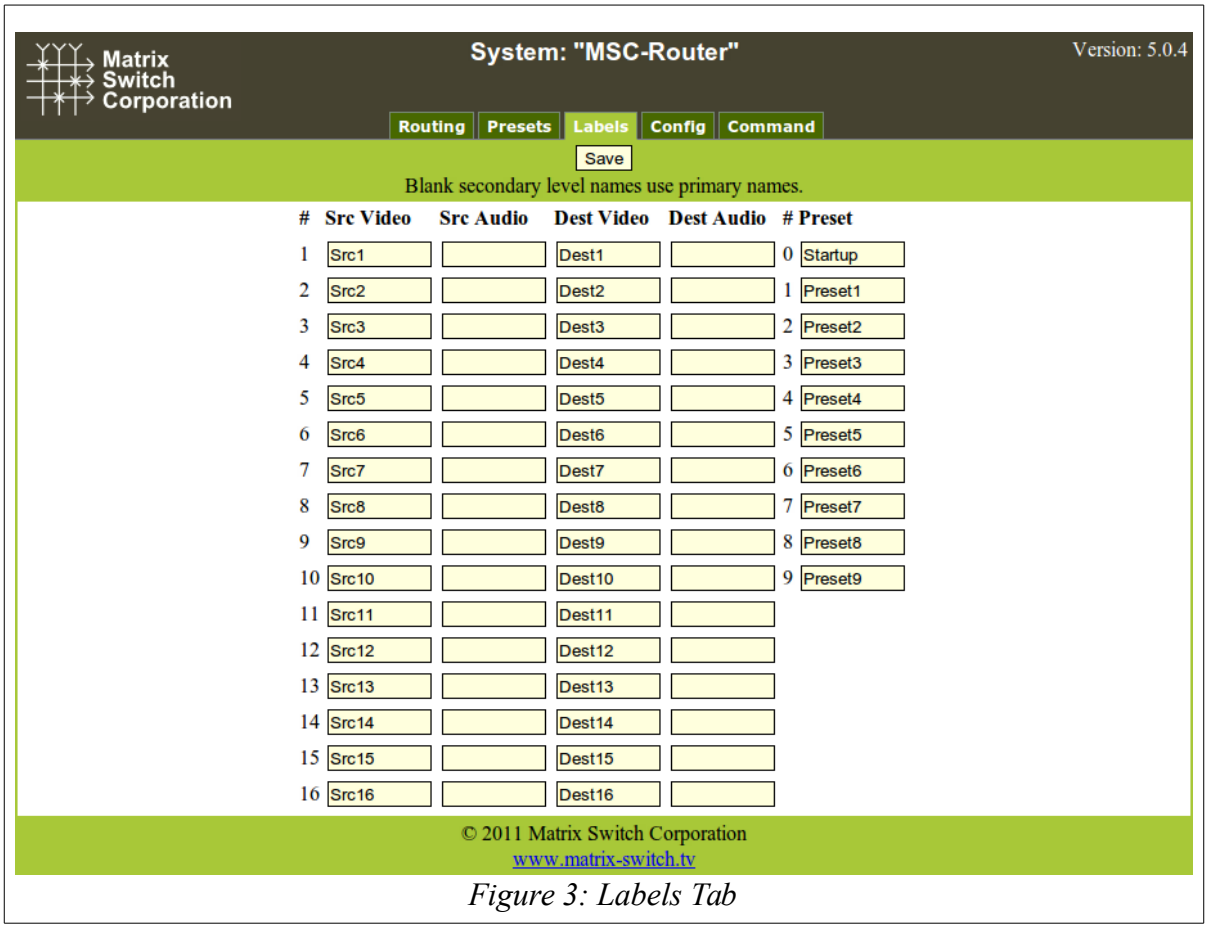

Figure 3: Labels Tab

Figure 3 shows the Labels Tab. Click on a field or use the tab key to step between fields. Label names are limited to 8 characters including spaces. Multi-level routers will have columns for Video and Audio Sources and Destinations. Single level routers will have a column for Source labels and one for Destination labels. On multi-level routers, secondary levels can be left blank to use the same label as the first level. Presets can also be assigned label names. Click the **Save** button to save changes that have been made.

2.5 Config Tab

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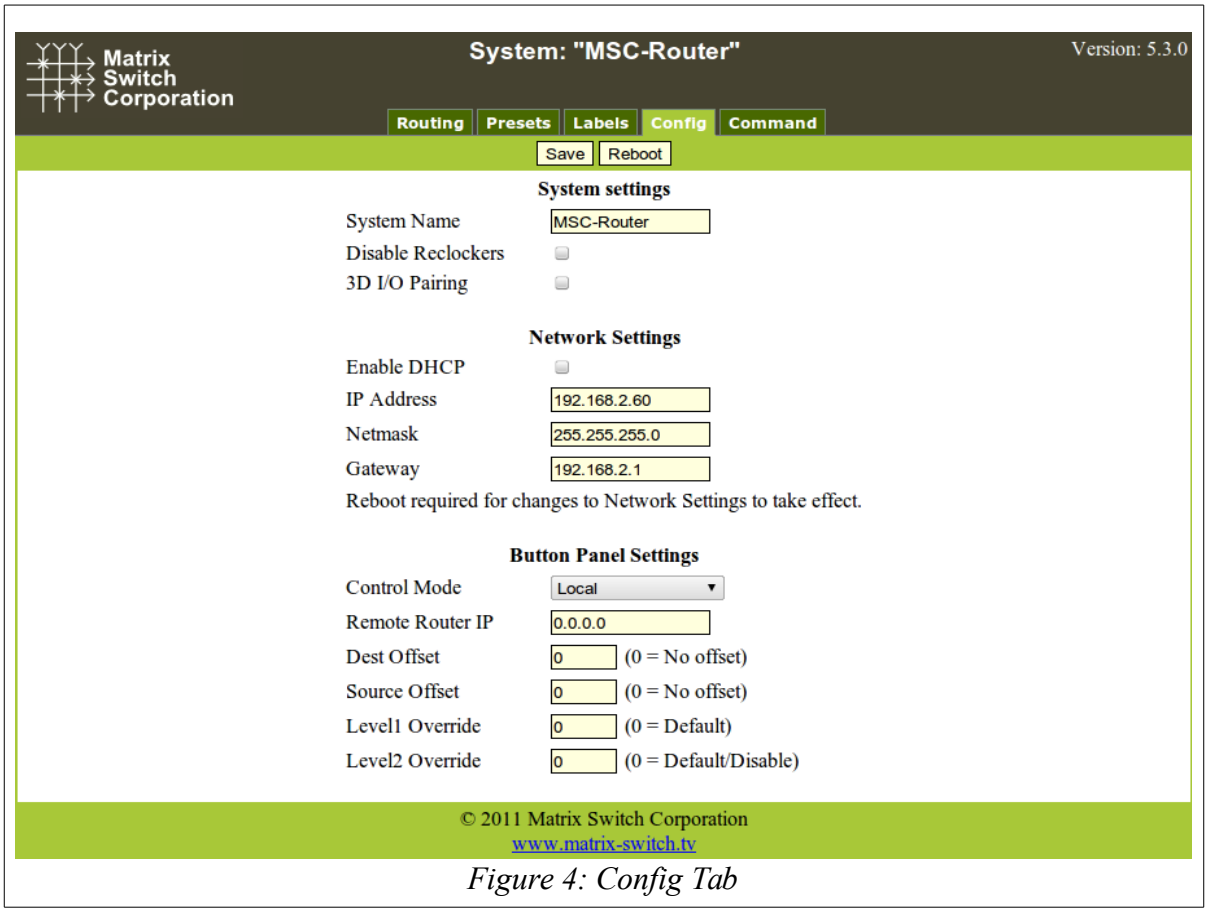

Figure 4: Config Tab

Figure 4 depicts the Config Tab as seen on a Router system beginning with Carina Series Firmware 5.3.0. Configuration fields vary depending on router features, firmware version and if the device is a Remote Panel.

NOTE: After changing any configuration settings click the **Save** button. All **Network Settings** changes require a Reboot of the device in order to take effect. After clicking **Save**, click the **Reboot** button to restart the device. Remember to enter a new IP address into your Web browser's Location bar, if the device's IP address has changed.

2.5.1 System Settings

- **System Name** – A descriptive name of the system (up to 15 characters), displayed at the top of the Web Page interface which is helpful when managing multiple systems.
- **Disable Reclockers** – Disable SDI reclockers (not supported by all Routers, added with Carina Series Firmware 5.3.0).
- **3D I/O Pairing** – Enable pairing of destinations/sources for two channel 3D support (only supported by Routers with 2 or more destinations, added with Carina Series Firmware 5.3.0).

2.5.2 Network Settings

WARNING: DHCP should only be enabled or the **IP Address** or **Netmask** changed if one has an understanding of TCP/IP network configuration. Once the save button is pressed and the system is rebooted any changes to DHCP enable, the IP Address or the Netmask shall result in having to access the web page with the

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new settings. If there are Matrix Switch Corporation remote control panels which access the system which has been changed, they must also be reconfigured to use the new router IP address as well. See the Network Planning section for more helpful information on planning your network.

- **Enable DHCP** – Check this box to enable DHCP. Disables IP Address, Netmask and Gateway fields as these settings are obtained from the DHCP server.
  - **WARNING:** A DHCP server must be present on your network for this to function properly. Using DHCP allows for dynamic IP or fixed IP assignment from a central location (the DHCP server). Using this option is only recommended if using fixed IP assignment based on the device's MAC address or if there is a way to determine what IPs the devices get assigned. Otherwise it may become difficult to determine what IP address to use when accessing the Web Page or utilizing other Ethernet control interfaces.
- **IP Address** – The IP address of the system.
- **Netmask** – The system network mask.
- **Gateway** – The IP address of your network's Gateway, if applicable. Only necessary on systems which access other systems outside of your network (a remote panel which accesses a router on a different network for example).

2.5.3 Button Panel Settings

These settings control the operation of the device's button control panel interface (if applicable).

Four fields are provided for specifying what portion of a router is controlled by the button panel interface. This provides added flexibility in defining what destinations and sources a panel controls. Some examples of use include, using multiple 16x1 Remote Panels (16 source, 1 destination) to control individual destinations of a 16x4 Router (16 source, 4 destination). Another usage scenario would be to have 2 separate panels control different levels of a Video/Audio Router.

- **Control Mode** – Set the matrix control mode (only present on Routers, added with Carina Series Firmware 5.3.0). Available options include:
  - **Local** - Button panel controls the router itself.
  - **Remote** - Button panel controls a remote router at the IP address set by the Remote Router IP field.
  - **Remote Sync** - Synchronize matrix crosspoint changes to another router at the IP address specified by the Remote Router IP field. Used for dual system 3D support.
- **Remote Router IP** – The IP address of the remote Router to control.
- **Dest Offset** – This setting determines what destination the button panel starts on. Defaults to 0 which means the control panel starts on destination 1. Setting this value to 8 for example would cause the first destination of the button panel to control destination 9.
- **Source Offset** – This setting determines what source the button panel starts on. Defaults to 0 which means the control panel starts on source 1. Setting this value to 8 for example would cause the first source of the button panel to control source 9. NOTE: If the currently active source cannot be represented on the control panel, no source button LED will light.
- **Level1 Override** – This setting determines the primary control level of the button interface. It defaults to 0 which is equivalent to level 1, usually a Video level. Setting this value to 2 for example would set the primary level to be level 2 (usually Audio).
- **Level2 Override** – This setting determines the secondary control level of the button interface. It defaults to 0, which if the Level1 Override is also 0 is equivalent to level 2, but if the Level1 Override is

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a value other than 0, the secondary level control is disabled. Can only be assigned a non-zero value if Level1 Override is also non-zero. If set to 3 for example, the secondary level would be level 3.

2.6 Command Tab

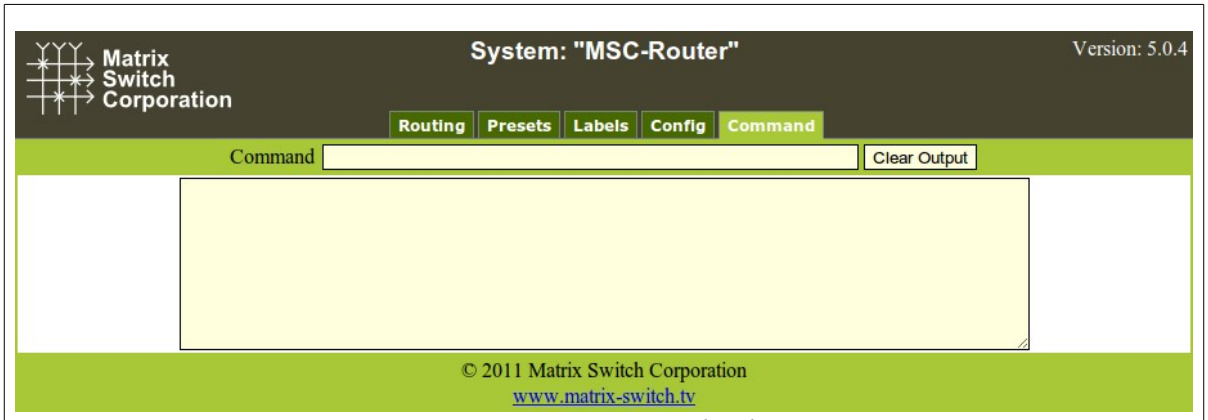

Figure 5: Command Tab

The Command Tab (Figure 5) provides access to the Mascot protocol interface. Commands are typed on the Command text entry line followed by pressing the Enter key to execute them. The results will be displayed in the text area below the command line. Clicking the **Clear Output** button will clear all command output in the lower area.

See the section Mascot Control Protocol for more information.

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3 Mascot Control Protocol

MASCOT (**MA**trix **S**witch **CO**rporation Pro**T**ocol) provides an ASCII text based command interface via several different transports to control and get status from Matrix Switch Corporation devices. This command protocol can be utilized for manual control or for integration with automation control systems.

Mascot command interface options

- Web Page Command Tab – The most convenient user command interface, which can be accessed using a Web Browser on a Computer by the device's IP address.
- TCP/IP port 40 – A TCP/IP command interface is provided on port 40 which uses the device's Ethernet connector as a physical transport and can be accessed via a telnet application.
- RS-232 Serial Port – Serial can also be used with the configuration parameters: 9600 bps 8N1.

3rd Party support

The MASCOT protocol contains a subset of the basic ISIS Protocol command set and therefore some 3rd party equipment may work without modification using this protocol. For information about other third party control system manufacturers who support MASCOT, contact Matrix Switch Corporation.

3.1 Protocol changes

As new commands are added or other changes occur, the MASCOT protocol version is incremented. The protocol revision can be obtained using the MascotVer command.

Protocol revision history

Mascot version 2.4 (Carina Series Firmware 5.6.3)

- Added .MtxGroup, PanelDis, PanelExtEn, and Sierra commands.

Mascot version 2.3 (Carina Series Firmware 5.5.1)

- Added Quit Command, SysType Command and Vars Command which have previously been supported on the MSC-GCP2U32 only.

Mascot version 2.2 (Carina Series Firmware 5.5.0)

- The X Command now accepts a 0 valued wild card destination to switch all destinations to a given source.

Mascot version 2.1 (Carina Series Firmware 5.3.0)

- New commands: PairIO – for paired I/O 3D support, PanelOfs – for defining remote panel I/O regions to control, PanelRate – to set remote panel refresh rate, ReclkDis – for disabling SDI reclockers and RemoteSync – for synchronizing two video router systems for 3D use.
- Added E12 “Unsupported command” error which is returned when a command is not supported by the current system or settings.
- Added support for Line Feed character as a command terminator (to be compatible with older firmware). Carriage Return should normally be used.
- Added “lock” (0x02) and “reclk” (0x04) to MtxCfg Command “flags” field.

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3.2 Telnet access

A telnet client can be used to access the command interface on TCP/IP port 40. Many operating systems come with a Telnet client or one can be easily obtained. To control a device using Telnet the IP address and TCP/IP port number will need to be supplied. This is typically added as arguments when executing the "telnet" command via your operating system's command prompt or run dialog. Here is an example for a device on the IP address 192.168.2.60:

```
telnet 192.168.2.60 40
```

Press the Enter key which should display the command ">" prompt character, confirming that the device is connected.

3.3 Serial access

Matrix Switch router systems and LCD remote panels come equipped with a serial port which can be used as another means of sending Mascot commands. Connect a Computer system to the device using a 9 pin RS-232 serial cable. Using this interface requires a serial terminal program, such as HyperTerminal on Windows. Configure the terminal software for 9600 bps 8N1. In addition Local Echo should be on in order to see what is typed. Pressing the Enter key once connected should yield the ">" prompt character.

3.4 Command format

Commands consist of a command name, zero or more arguments separated by commas and a carriage return (CR, ASCII 13 - the Enter key on a keyboard). Optionally multiple commands can be combined by separating them with a '#' character and the command chain is terminated with a CR character. Spaces are not required between arguments, but can be optionally supplied for readability. A space is also not required between command names and their first argument, if the argument is numeric.

Special command characters

#	Multiple command separator, for chaining commands.
<CR>	Carriage Return (ASCII 13), indicates the end of a command or chain of commands, Enter key.
<BS>	Backspace character (ASCII 11), can be used to backspace characters in interactive command shells.
"	Used for double quoting string arguments.
'	Used for single quoting string arguments.

Command example

```
X1,1#X2,2#S<CR>
```

Connects Source 1 to Destination1 and Source 2 to Destination 2, followed by displaying the Active Routing matrix status. The <CR> is the Carriage Return character.

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3.4.1 Command names

Command names consist of one or more alphabetical characters and are case **insensitive**. For convenience with manual command entry they can also be matched using partial names. The first matching alphabetically sorted command is used (for example: 'H', 'He', 'hEL' or 'Help' can be used to execute the Help command). However, this feature should not be relied on with 3rd party integration, since a given partial command may execute a different command as new ones are added to the protocol.

3.4.2 Command arguments

Command arguments are separated into two categories: numeric and string arguments. These are further explained in the table below:

Command argument types			
Numeric		**String**	
Decimal (123)	1 to 3 decimal digits	Unquoted	Commands with string arguments automatically interpret argument as string (spaces and commas not allowed).
Hex (0x3D)	0xNN where NN are 2 hex digits from 0-9, A-F or a-f	Double quoted	One or more characters surrounded by double quotes (“An Argument”).
		Single quoted	One or more characters surrounded by single quotes ('An Argument').

3.5 Response format

Most command responses consist of one or more values separated by newlines and ending with the ‘>’ prompt character. **Newlines** consist of a Carriage Return/New Line (CR LF) pair of characters (ASCII 13 followed by ASCII 10).

The Prompt ‘>’
A prompt character ‘>’ is displayed each time a command or chain of commands is entered, to indicate readiness to receive additional commands. If an error occurs in response to a command, an error will be displayed prior to the prompt with the following format:

```
E00: Error message
>
```

00 will contain a 2 digit decimal error code.

3.6 Command argument values

Command arguments are shown in the Help command output surrounded by square brackets '[ARG]' or parenthesis '(ARG)'. Square brackets indicate an optional argument and parenthesis indicate a required

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argument. Any optional argument specified requires that all prior optional arguments are also specified.

Argument	Valid Range	Meaning
DEST	1-N	Destination number (N = Count of destinations)
SRC	1-N or 0	Source number (N = Count of sources), 0 acts as mute (if supported).
LEVEL	1-N	Level number (N = Count of system levels)
PRESET	0-9	Preset number (preset 0 is special Startup preset)
IP	D.D.D.D	IP address string argument, specified as 4 decimal digits from 0 to 255 separated by periods.
NETMASK	D.D.D.D	Network mask string argument, specified as 4 decimal digits from 0 to 255. Must be a valid IPv4 netmask.
JSON	string	JSON formatted string, the structure of which depends on the command. The JSON string should be quoted in single quote characters when specifying a JSON value in a command.
LABEL	string	A string label argument, max of 8 characters.
STR	string	A generic string argument (max length depends on the command).

3.7 Error codes

This following table shows possible error codes which may be returned in response to commands.

Error #	Message	Description
E01	Token too long	A command name or string argument was too long.
E02	Invalid command	Invalid command name.
E03	Invalid argument	One or more invalid argument values.
E04	Invalid destination	Invalid matrix destination number.
E05	Invalid source	Invalid matrix source number.
E06	Invalid level	Invalid matrix level number.
E07	Invalid preset	Invalid preset number.
E08	Unterminated string	Double or single quoted string not terminated.
E09	Backspace limit reached	Devices have a limited backspace buffer size, if too many characters are backspaced and then more characters are appended, this error will occur.
E10	HTTP buffer overflow	Only applicable to the web page command interface. Unlimited command input or output can be handled, but not both.
E11	Serial receive overrun	One or more characters were lost on the serial interface.
E12	Unsupported command	Command is not supported by the system or current configuration. Firmware 5.3.0 and newer.

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3.8 Basic command reference

Basic commands consist of those commands which are used for modifying routing and other simple commands.

Mascot version where a command was added is indicated in parenthesis, (2.3) for example.

Command	Arguments	Description
Help		Display command help reference.
P *	[PRESET]	Recall a preset.
PAdd *	(PRESET)(DEST)(SRC) [LEVEL]	Add a connection to a preset.
PClr *	(PRESET)	Clear a preset to "No Change" values.
PSub *	(PRESET)(DEST) [LEVEL]	Subtract a connection from a preset.
PView *	[PRESET]	View preset contents.
Quit (2.3)		Quit TCP/IP telnet session.
S *	[1]	Matrix routing status (supplying 1 will display labels).
SysType (2.3)		Query system hardware series.
Vars (2.3)		Query all system configuration variables.
W *	[PRESET]	Store current matrix routing to a preset.
X *	[DEST][SRC][LEVEL]	Perform a matrix connect operation.

*** Router systems and MSC-GCP2U32 LCD panel only**

3.9 Advanced command reference

These additional commands consist of those which are not as commonly used as the basic commands, such as system configuration commands.

Mascot protocol versions where a command was added is indicated in parenthesis, (2.3) for example.

Command	Arguments	Description
B	(0 | 1)	Reboot system into Bootloader, typically used for software update. A 0 or 1 value is required and selects the Bootloader IP address. A value of 0 uses 192.168.2.59 and 1 uses configured system IP.
C *		Query system matrix info, which is displayed in the format DESTS,SRCS,LEVELS,FLAGS1,FLAGS2. **MtxCfg command supersedes this command.**
DestNames *	[DEST][LEVEL] [LABEL]	Query or assign destination names.
DHCP	[0 | 1]	Query or assign DHCP enable.
E *	[0 | 1]	Query or assign matrix connection echo enable.

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Firmware		Query system firmware version.
FrameIP	[IP]	Remote router IP address the panel will control.
Gateway	[IP]	Query or assign network gateway IP address.
IP	[IP]	Query or assign device system IP address.
LockStatus +		Get video lock status and rate detection information (not all HD router systems are supported).
MAC		Query system MAC address
MascotVer		Query Mascot protocol version.
MtxCfg * (2.0)	[0-7]	Query current matrix config.
MtxGroup + (2.4)	[LVL1][LVL2]	Query or assign I/O grouping.
NetMask	[NETMASK]	Query or assign network mask.
PairIO + (2.1)	[0 | 1]	Query or assign I/O pairing enable (3D support). **MtxGroup supersedes this command.**
PanelDis (2.4)	[0 | 1]	Query or assign internal panel button interface disable.
PanelExtEn (2.4)	[0 | 1]	Query or assign external panel interface enable (if available).
PanelOfs (2.1)	[DEST][SRC] [LVL1][LVL2]	Query or assign button panel destination/source offsets and levels to control. Useful for configuring multiple panels to control different I/O regions of a router.
PanelRate (2.1)	[RATE]	Set remote panel refresh rate in seconds.
PsetNames *	[PRESET][LABEL]	Query or assign preset names.
Reboot		Reboot the system.
ReclkDis + (2.1)	[0 | 1]	Disable SDI reclockers (not all SDI router systems are supported).
RemoteSync + (2.1)	[0 | 1]	Query or assign remote router syncing. Useful for creating a 3D system out of 2 routers.
Sierra + (2.4)	[0 | 1]	Query or assign Sierra Video Systems protocol enable on serial port interface.
SrcNames *	[SRC][LEVEL] [LABEL]	Query or assign source names.
SysName	[STR]	Query or assign system name.
WebPass	(STR)	Assign web password.

*** Router systems and MSC-GCP2U32 LCD panel only.**
+ Router systems only.

3.10 B Command

The B command is used for rebooting the system into Bootloader for software updates. See the Software Update section for details.

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3.11 C Command

Routers and MSC-GCP2U32 only

NOTE: Superseded by the MtxCfg Command.

The C command queries the matrix size. The response is in the format “Dests,Srcs,Levels,Flags1,Flags2”. Where “Dests” is the count of system destinations, “Srcs” is the count of sources and “Levels” is the number of system levels. The Flags1 and Flags2 fields are currently unused and will be 0.

Example for a 16x16 system with 2 levels

```
>C
16,16,2,0,0
>
```

3.12 DestNames Command

Routers and MSC-GCP2U32 only

Query or assign destination names. This command has 4 variations, described by the following table. Destination names are saved and recalled on power up.

Command	Description
DestNames	Query all destination names.
DestNames DEST	Query destination names for all levels of a given destination.
DestNames DEST, LEVEL	Query the name of a specific destination and level.
DestNames DEST, LEVEL, LABEL	Assign a label to a destination.

When querying names, labels are surrounded by double quotes and each level is separated by commas ',' (multi-level systems only) and each destination is separated by newlines. Secondary levels use empty strings to indicate that the label of the first level should be used.

Examples

```
>DestNames
“Dest1”,”AudDest1”
“Dest2”,””
“Dest3”,””
“Dest4”,””
>DestNames 1
“Dest1”,”AudDest1”
>DestNames 1,2
“AudDest1”
>DestNames 1,2,””
>
```

The first 3 example commands are query commands. The last assigns an empty string to the second level of the first destination (thereby indicating that the first level label should be used).

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3.13 DHCP Command

Query or assign DHCP enable. A value of 0 disables DHCP client support and will therefore use the manual values assigned via the IP, Netmask and Gateway commands. A value of 1 enables DHCP and will obtain the values for the IP address, Netmask and Gateway from your DHCP server. This value is saved and recalled on power up.

WARNING: A DHCP server must be present on your network for this to function properly. Using DHCP allows for dynamic IP or fixed IP assignment from a central location (the DHCP server). Using this option is only recommended if using fixed IP assignment by MAC address or if there is a way to determine what IPs the Matrix Switch Corporation systems get assigned. Otherwise it may become difficult to determine what IP address to use when accessing the Web Page or other control interfaces. In the event that the IP address or Netmask of a system is unknown, consult the Unknown IP Address section for this device.

Command	Description
DHCP	Query DHCP enable.
DHCP 0 | 1	Set DHCP enable (0 to disable, 1 to enable)

Examples to query and then enable DHCP

```
>DHCP
0
>DHCP 1
>
```

3.14 E Command

Routers and MSC-GCP2U32 only

Query or assign matrix routing changes echo. A value of 0 disables this feature. A value of 1 will cause all matrix routing changes to be echoed in the form of an X command: “Xd,s[,l]”. Where 'd' is the destination number, 's' is the source number and 'l' is the optional level number. This is useful for diagnostic purposes or automation software which would like to receive synchronous matrix routing state updates.

NOTE: Enabling this feature may slow down the system significantly during excessive matrix routing changes (especially when enabled on the serial port). Also of note is that this option takes effect only while the system remains powered (serial port) or for the duration of the connection (TCP/IP telnet sessions). This command is not supported by the HTTP web command interface.

Command	Description
E	Query matrix echo enable.
E 0 | 1	Set matrix echo enable (0 to disable, 1 to enable).

Examples to query and then enable matrix echo

```
>E
0
```

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```
>E 1
>
```

3.15 Firmware Command

Query the system firmware version.

Example

```
>Firmware
5.0.6
>
```

3.16 FrameIP Command

Query or assign the remote router IP address. Usually only used on Remote Panel devices or in conjunction with the RemoteSync Command to create a dual router 3D system. Sets the IP address of the Router system which the button panel will connect to and control (or which the router will synchronize to when using the RemoteSync command). This can also be enabled on Router systems with a local button panel to configure the Router's panel to control a different Router (set to 0.0.0.0 by default to disable remote control and control the Router device itself). This setting is saved and recalled on power up.

Command	Description
FrameIP	Query IP address of remote Router system to control.
FrameIP IP	Set IP address of remote Router system to control (use 0.0.0.0 on Router systems to disable remote control).

Example to query and assign the remote Router IP

```
>FrameIP
192.168.2.60
>FrameIP 192.168.2.61
>
```

3.17 Gateway Command

Query or assign the network Gateway IP address. This is usually only needed on Remote Panel systems which control a Router device on a different network. This setting is saved and recalled on power up.

Command	Description
Gateway	Query IP address of network Gateway.
Gateway IP	Set IP address of network Gateway.

3.18 Help Command

Display command reference information.

3.19 IP Command

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Query or assign the system IP address. This setting is saved and recalled on power up.

WARNING: The system IP address should only be changed if one has an understanding of TCP/IP network configuration. Maintaining the ability to access a device's web page and for Remote Panel devices to be able to communicate with Routers requires that the IP address is known, valid and systems are configured to be on the same IP network. In the event that the IP address of a system is unknown refer to the Unknown IP Address section for this device.

Command	Description
Ip	Query IP address of the system.
Ip IP	Set IP address of the system.

Example querying and assigning the IP address

```
>IP
192.168.2.60
>IP 192.168.2.61
>
```

3.20 LockStatus Command

Routers only

Query the video lock status and video rate of a Video Router's outputs. This command is only supported on some Router systems. Unsupported systems will return an "Unsupported command" error on version 2.1 and newer protocol versions and blank output on older versions.

Command	Description
LockStatus	Displays Video lock status and rate detection for outputs. Format is one decimal number per output (0: Unlocked, 1: SD, 2: HD).

Example for a 16x4 system (SD, HD, Unlocked, Unlocked)

```
>LockStatus
1,2,0,0
>
```

3.21 MAC Command

Query system Ethernet MAC address.

Command	Description
MAC	System Ethernet MAC address in hh:hh:hh:hh:hh:hh where each hh is a pair of hex digits.

Example

```
>MAC
00:50:C2:8B:DF:FE
```

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```
>
```

3.22 MascotVer Command

Query Mascot protocol version. This is useful for software which interacts with a device using the Mascot protocol and wants to discover what protocol version is in use. The returned value is either an integer such as "2" or major and minor version numbers separated by a period, such as "2.3".

Example

```
>MascotVer
2.3
>
```

3.23 MtxCfg Command

Routers and MSC-GCP2U32 only - Protocol Version: 2.0

Query matrix configuration. This command replaces the C command and provides the ability to query the matrix dimensions, labels, current matrix state and preset data. The information to return is specified by the sum of the flags values listed in the following table:

Flag	Information	Fields in JSON data
1	Return names (Destination, Source and Preset).	destNames, srcNames and psetNames
2	Return matrix routing state.	state
4	Return preset routing data.	psetData

The returned data is JSON formatted data (see www.json.org for details).

If no arguments are specified then a simple format is returned consisting of an array of arrays (one per level) with 3 integer numbers specifying the destination count, source count and flags of the level. The flags value is the sum of one or more values from the Flags table below.

Flags

Name	Value	Description
mute	1	Mute support.
lock	2	Video lock status query support
reclk	4	Reclocker disable support.

Example

```
>MtxCfg
[[8,8,3][4,8,0]]
```

The example above is simple output (no arguments) for a matrix with 2 levels, the first has 8 destinations, 8

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sources and supports mute and lock status query (1 + 2 = 3). The second level has 4 destinations, 8 sources and does not support mute, lock status query or reclocker disable.

If an argument is specified (0-7), then a more descriptive JSON structure is returned, of the following form (newlines and spaces added as a visual aid, but are not necessarily part of the response):

```
{
  “version” : 1,
  “status” : “STATUS”,
  “levels” :
  [
    {
      “name” : “NAME”,
      “type” : “TYPE”,
      “destCount” : DEST_COUNT,
      “srcCount” : SRC_COUNT,
      “flags” : “FLAGS”,
      “destNames” : [ “NAME”, ”NAME”, ... ],
      “srcNames” : [ “NAME”, ”NAME”, ... ],
      “state” : [ SRC, SRC, ... ],
      “psetData” : [ [ SRC, ... ], [ SRC, ... ], ... ]
    },
    ...
  ],
  “psetNames” : [ “NAME”, ”NAME”, ... ]
}
```

Table of information on values in capital letters above:

Label	Description
STATUS	Matrix status: OK, UPDATING, DISCONNECT or ERROR. Returned if the matrix is OK, updating (from a remote router for example), one or more remote routers disconnected or a general error (remote router in error status for example) respectively.
NAME	Descriptive name of a level, destination, source or preset (8 chars or less).
TYPE	Level type: VIDEO, AUDIO, HD, VGA, 3G, ANALOG or AES. Used for general video, general audio, HD video, VGA video, 3G HD video, analog audio or AES digital audio respectively.
DEST_COUNT	Count of destinations for the level.
SRC_COUNT	Count of sources for the level.
FLAGS	A space separated list of flag keywords indicating support for various features, as defined by the Name column in the Flags table above.
SRC	Source values for matrix state and preset data. Values start from 1, 0 represents mute and -1 represents “No Change” (for preset data only).

Example - Newlines and spaces added to response as a visual aid.

```
>MtxCfg7
```

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```
{
  “version” : 1,
  “status” : “OK”,
  “levels” :
  [
    {
      “name” : “Level1”,
      “type” : “VIDEO”,
      “destCount” : 4,
      “srcCount” : 4,
      “flags” : “mute”,
      “destNames” : [ “Dest1”, ”Dest2”, “Dest3”, “Dest4” ],
      “srcNames” : [ “Src1”, ”Src2”, “Src3”, “Src4” ],
      “state” : [ 1, 2, 3, 4 ],
      “psetData” :
      [
        [1,2,3,4], [1,1,1,1], [-1,-1,-1,-1], [-1,-1,-1,-1],
        [-1,-1,-1,-1], [-1,-1,-1,-1], [-1,-1,-1,-1], [-1,-1,-1,-1],
        [-1,-1,-1,-1], [-1,-1,-1,-1]
      ]
    },
  ],
  “psetNames” :
  [
    “Startup”,”Preset1”,”Preset2”,”Preset3”,”Preset4”,
    ”Preset5”,“Preset6”,”Preset7”,”Preset8”,”Preset9”
  ]
}
```

The example output above is a typical response for a 4x4 Video router. Current matrix routing is “straight through”, 10 presets are defined (1st is straight through, 2nd is mapped all to source 1, and all other presets have not been assigned (No Change). Note that future protocol versions may support more than 10 presets and therefore may return information for more or less than 10 presets for the psetData and psetNames arrays.

3.24 MtxGroup Command

Carina Series routers only - Protocol Version: 2.4

Query or assign I/O grouping. This setting is saved and recalled on power up.

The I/O grouping feature is used to combine multiple inputs and outputs. Combined grouped inputs and outputs then behave as if they were a single I/O, which changes the size of the router matrix accordingly (matrix size divided by group count), and matrix routing changes update the grouped I/Os simultanously. Group counts are assigned on a per level basis, allowing for different I/O grouping for separate levels (for example separate video and audio levels). Real world examples of I/O grouping include: dual channel 3D video and combining multiple audio channels (4 AES digital audio streams for example).

Command	Description
MtxGroup	Query current I/O grouping.
MtxGroup LEVEL1	Set level 1 I/O grouping (0 or 1 disables grouping).
MtxGroup LEVEL1, LEVEL2	Set level 1 and level 2 I/O grouping (0 or 1 disables grouping).

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Example querying and assigning I/O grouping

```
>MtxGroup
1,1
>MtxGroup 2,4
>MtxGroup
2,4
>
```

The first example MtxGroup command shows that I/O grouping is disabled on both levels of a 2 level system. The second command configures the system for dual I/O grouping on level 1 and quad I/O grouping on level 2. On an example 16x16 two level router this would result in an 8x8 matrix on level 1 and a 4x4 matrix on level 2.

3.25 NetMask Command

Query or assign the system network mask value. This value is related to the IP address of the system and is used for IP communications over the Ethernet network. This setting is saved and recalled on power up.

WARNING: The system netmask should only be changed if one has an understanding of TCP/IP network configuration. Maintaining the ability to access a device's web page and for Remote Panel devices to be able to communicate with Routers requires that the IP address is known, valid and systems are configured to be on the same IP network. In the event that the IP address or Netmask of a system is unknown, consult the Unknown IP Address section for this device.

Command	Description
NetMask	Query network mask value.
NetMask NETMASK	Set network mask value.

Example querying and assigning netmask

```
>NetMask
255.255.255.0
>NetMask 255.255.255.192
>
```

3.26 P Command

Routers and MSC-GCP2U32 only

Recalls a preset. Each Router system contains 10 presets numbered 0 through 9 which can store the entire matrix routing state or one or more single destination connections. Preset 0 is recalled on system power up.

Command	Description
P PRESET	Recall a preset.

Example to recall preset 1

```
>P 1
>
```

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3.27 PAdd Command

Routers and MSC-GCP2U32 only

Preset add command. Adds a connection to a preset. This can be used to incrementally create a preset without changing the active matrix routing. 0 can be used for SRC for Mute (if supported). This command stores preset information which is retained and available through system power cycles.

Command	Description
PAdd PRESET, DEST, SRC	Add a connection of SRC to DEST on PRESET for all levels.
PAdd PRESET, DEST, SRC, LEVEL	Add a connection of SRC to DEST/LEVEL on PRESET.

Example

```
>PAdd 1,2,3
>PAdd 1,3,0,2
>
```

The first command adds a connection from Source 3 to Destination 2 on Preset 1. The second command Mutes Destination 3/Level 2 on Preset 1.

3.28 PairIO Command

Routers only - Protocol Version: 2.1

NOTE: Superseded by MtxGroup command.

I/O pairing is used for pairing destinations/sources for 3D support. When activated a router will appear to have half the number of physical destinations and sources. A given matrix crosspoint change will cause 2 destinations to be changed. Each odd destination/source is paired with the next highest even number destination/source. This option is stored and recalled on power on. When enabling this feature on a 4x4 video router for example, it would appear as a 2x2 3D router where destination 1 & 2 are paired and 3 & 4 are paired, likewise for sources. This setting is stored and recalled on power up.

Command	Description
PairIO	Query current value of I/O pairing configuration.
PairIO 0 | 1	Enable or disable I/O pairing (0: disable, 1: enable)

Example

```
>PairIO
0
>PairIO 1
>
```

The first command queries the current state of I/O pairing, the second enables it.

3.29 PanelOfs Command

Carina series only - Protocol Version: 2.1

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Define destination/source regions or assign media levels which a remote panel controls. This is typically used to configure multiple remote panels to control portions of a video/audio router. For example, two 8x8 remote panels could be used to control separate halves of an 8x16 router, the first would control the default destination 1-8 and the second would be configured using this command to control destination 9-16 (a destination offset of 9). Another useful configuration would be to configure one remote panel to control video only and another to control audio only of a video/audio router by assigning primary level values of 1 and 2 respectively using this command. This setting is stored and recalled on power up.

Command	Description
PanelOfs	Query current panel offset settings, 4 values are returned separated by commas, corresponding to the same values which are assigned.
PanelOfs DESTOFS, SRCOFS, LVL1, LVL2	Assign panel destination/source offsets and level control values.

The DESTOFS parameter assigns a destination offset that determines which destination the button panel starts on, 0 is used for no offset (default). The SRCOFS parameter is used likewise to assign a source offset. The LVL1 and LVL2 parameters are used for modifying what levels the panel will control. The default is 0 for both values which uses the default levels of 1 and 2 for the primary and secondary levels respectively. If LVL1 is assigned a value other than 0 and LVL2 is 0 then the secondary level control will be disabled.

Examples

```
>PanelOfs
0,0,0,0
>PanelOfs 1,0,0,0
>PanelOfs 0,0,2,0
>
```

The first command just queries the current panel offset values, which returns all 0s (the default). The second command assigns 1,0,0,0 which sets a destination offset of 1, which will set the first destination of the button panel to destination 2. The third command sets up a button panel to control the 2nd level of a router.

3.30 PanelDis Command

Carina series only - Protocol Version: 2.4

Query or assign internal button interface panel disable setting. This setting is stored and recalled on power up.

Command	Description
PanelDis	Query internal panel disable setting.
PanelDis 0 | 1	Assign internal panel disable setting (0: enable, 1: disable)

Examples

```
>PanelDis
0
```

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```
>PanelDis 1
>
```

The first command queries the current panel disable setting (0: enabled). The second command disables the internal panel interface.

3.31 PanelExtEn Command

Carina series only - Protocol Version: 2.4

Query or assign external button interface panel enable setting (if applicable – not all router devices have an external panel interface). This setting is stored and recalled on power up.

Command	Description
PanelExtEn	Query external panel interface enable setting.
PanelExtEn 0 | 1	Assign external panel interface enable setting (0: disable, 0: enable)

Examples

```
>PanelExtEn
0
>PanelExtEn 1
>
```

The first command queries the current external panel interface setting (0: disabled). The second command enables the external panel interface.

3.32 PanelRate Command

Protocol Version: 2.1

For changing remote button panel refresh rate. When a button panel is configured to control a remote router the current connection status is refreshed at regular intervals. This command can be used to increase or decrease the rate, which is saved and recalled on system power up. The default refresh rate is 5 seconds. This value is stored and recalled on power up.

Command	Description
PanelRate	Query current panel refresh rate (in seconds).
PanelRate RATE	Set remote panel refresh rate in seconds.

Examples

```
>PanelRate
5
>PanelRate 1
>
```

The first command queries the current panel refresh rate, which returns 5 (default). The second command sets

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the refresh rate to be 1 second.

3.33 PClr Command

Routers and MSC-GCP2U32 only

Clear a preset. For Preset 0 this sets all Destinations to Source 0. Other Presets are assigned "No Change" to all Destinations. This command stores preset information which is available through system power cycles.

Command	Description
PClr PRESET	Clear a preset.

Example to clear preset 1

```
>PClr 1
>
```

3.34 PsetNames Command

Routers and MSC-GCP2U32 only

Query or assign preset names. Preset names are stored and recalled on power up.

Command	Description
PsetNames	Query all preset names.
PsetNames PRESET	Query a single preset name.
PsetNames PRESET, LABEL	Assign a preset label.

When querying names, labels are surrounded by double quotes and separated by newlines.

Examples

```
>PsetNames
"Startup"
"Preset1"
"Preset2"
"Preset3"
"Preset4"
"Preset5"
"Preset6"
"Preset7"
"Preset8"
"Preset9"
>PsetNames 1
"Preset1"
>PsetNames 1,"MyPreset"
>
```

The first 2 example commands are query commands. The last assigns "MyPreset" to Preset 1.

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3.35 PSub Command

Routers and MSC-GCP2U32 only

Preset subtract command. Removes a connection in a preset by setting a Destination or Destination/Level to "No Change". This can be used to incrementally create a preset without changing the active matrix routing. This command changes preset data which is stored and persists through power cycles.

Command	Description
PSub PRESET, DEST	Remove any existing connection to DEST in PRESET for any level.
PSub PRESET, DEST, LEVEL	Remove any existing connection to DEST/LEVEL in PRESET.

Example

```
>PSub 1,2
>PSub 1,3,2
>
```

The first command removes any connection to Destination 2 in Preset 1. The second command removes any connection to Destination 3/Level 2 on Preset 1.

3.36 PView Command

Routers and MSC-GCP2U32 only

View presets. Displays the content of one or all presets.
The format of the returned output is "1:S1[,S2] 2:S1[,S2] ..." where the 1: and 2: are incrementing destination values, followed by one or more source values (depending on the number of system levels).

Special source values

- '-' indicates "No Change", which causes no changes to the given Destination/Level.
- 0 indicates "Mute"

Command	Description
PView	Display all presets.
PView PRESET	Display a single PRESET.

Example on a 16x4 system with 2 levels

```
>PView 1
1:1,1 2:2,2 3:6,7 4:0,-
>
```

The above example shows that Preset 1 would cause Destination 1 to be connected to Source 1 for both levels, Destination 2 to be connected to Source 2 for both levels, Destination 3 to be connected to Source 6 for Level 1 and Source 7 for Level 2 (break away) and Destination 4 to be Muted for Level 1 and "No Change" would be made for Level 2.

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3.37 Reboot Command

Instructs the system to reboot, which is done after a brief delay.

3.38 ReclkDis Command

Routers only - Protocol Version: 2.1

Command for disabling or enabling SDI reclockers. Not all router systems support this option. Value is saved and recalled on power up.

Command	Description
ReclkDis	Query current value of reclocker disable.
ReclkDis 0 | 1	Enable or disable reclockers (0 or 1 respectively).

Examples

```
>ReclkDis
0
>ReclkDis 1
>
```

The first command above queries the current reclocker disable value which returns 0 (the default, reclockers enabled). The second command disables the reclockers.

3.39 RemoteSync Command

Routers only - Protocol Version: 2.1

Command to enable syncing matrices of two router systems. Usually used for creating a 3D matrix from two router systems, which will result in one router controlling the left 3D channels and the other router controlling the right channels. When enabled, this option synchronizes matrix crosspoint changes to the router IP address assigned with the FrameIP Command. This command should only be enabled with one of the two routers (the primary router). This value is stored and recalled on power up.

Command	Description
RemoteSync	Query current value of remote router syncing.
RemoteSync 0 | 1	Enable or disable remote router syncing (1 or 0 respectively).

Examples

```
>RemoteSync
0
>RemoteSync 1
>FrameIP 192.168.2.61
>
```

The first command in the above examples queries the current value of the remote sync option, which returns 0 (disabled, the default). The second command enables remote syncing and the final command sets the IP address

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of the router to sync (secondary router).

3.40 S Command

Routers and MSC-GCP2U32 only

Query the current matrix routing state. Source values for all levels of every destination are shown. This command without an argument is equivalent to the X Command with no arguments. If an argument value of '1' is supplied, then the matrix state is displayed with labels. The state of each destination is displayed, one per line, in the format:
“DestNLvl1”:”SrcLvl1”,”DestNLvl2”:”SrcLvl2”,...

Example

```
>S1
“Dest1”:”Src4”,”Dest1”:”Src4”
“Dest2”:”Src3”,”Dest2”:”Src3”
“Dest3”:”Src2”,”Dest3”:”Src2”
“Dest4”:”Src1”,”Dest4”:”Src4”
```

The example above is output from a two level (Video and Audio for example) 4x4 matrix with sources routed in reverse order, except destination 4, which has a 2nd level break away which is routed from source 4.

3.41 Sierra Command

Carina Series routers only - Protocol Version: 2.4

Queries or assigns Sierra Video Systems protocol on serial port. This setting is stored and recalled on power up.

Command	Description
Sierra	Query Sierra Video Systems protocol enable on serial port.
Sierra 0 | 1	Assign Sierra Video Systems protocol enable (0: Disable – use MASCOT protocol, 1: Enable)

Examples

```
>Sierra
0
>Sierra 1
>
```

The first command above queries the current value of the Sierra Video Systems protocol enable (0 = disabled, using MASCOT protocol). The second command enables the Sierra Video Systems protocol on the serial port.

3.42 SrcNames Command

Routers and MSC-GCP2U32 only

Query or assign source names. This command has 4 variations, described by the following table. Source names are stored and recalled on power up.

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Command	Description
SrcNames	Query all source names.
SrcNames SRC	Query source names for all levels of a given source.
SrcNames SRC, LEVEL	Query the name of a specific source and level.
SrcNames SRC, LEVEL, LABEL	Assign a label to a source.

When querying names, labels are surrounded by double quotes and each level is separated by commas ',' (multi-level systems only) and each source is separated by newlines. Secondary levels use empty strings to indicate that the label of the first level should be used.

Examples

```
>SrcNames
“Src1”,”AudSrc1”
“Src2”,””
“Src3”,””
“Src4”,””
>SrcNames 1
“Src1”,”AudSrc1”
>SrcNames 1,2
“AudSrc1”
>SrcNames 1,2,””
>
```

The first 3 example commands are query commands. The last assigns an empty string to the second level of the first source (thereby indicating that the first level label should be used).

3.43 SysName Command

Query or assign system name. The system name is provided for convenience when managing multiple Matrix Switch Corporation systems. This value is stored and recalled on power up.

Command	Description
SysName	Query system name.
SysName STR	Set system name (up to 15 characters).

Example for querying and assigning system name

```
>SysName
MSC-Router
>SysName “MyRouter”
>
```

3.44 SysType Command

Protocol Version: 2.3

Query the system series type, which is currently defined as one of the following values:

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Value	Series name
0	Carina
1	Lupus
2	Lynx
3	Hydra

NOTE: This command was not added until version 2.3 of the Mascot protocol. On previous versions, this command is available on the MSC-GCP2U32 LCD panel but not other Matrix Switch Corporation systems. When determining the system type, if executing the command returns an Invalid Command error, the system series can be assumed to be Carina.

Command	Description
SysType	Query the system hardware series.

Examples

```
>SysType
E01: Invalid command
>SysType
2
>
```

The first example command shows the response that would be received on a Carina series system with older firmware not supporting the SysType command, the second example is what might be returned by an MSC-GCP2U32 LCD panel.

3.45 Vars Command

Protocol Version: 2.3

Display all system configuration variables. Useful in serial terminal or telnet sessions to view all configuration values.

Command	Description
Vars	Display all system configuration parameters. Note that variables consisting of JSON data simply show the string JSON, to keep the output concise. The output consists of one line per variable, with the variable name followed by an equals '=' and then the value (not quoted).

Examples

```
>Vars
DefaultProfile=1
DHCP=1
DNSPri=0.0.0.0
DNSSec=0.0.0.0
```

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```
Firmware=1.5.1
Gateway=192.168.2.1
IP=192.168.2.80
Mac=00:00:00:00:00:00
MascotVer=2
MtxProfiles=JSON
Netmask=255.255.255.0
Profile=1
SerBaud=115200
SerProto=Mascot
SysName=MSC-Panel
SysType=2
>
```

The example above shows a typical output of the Vars command for an MSC-GCP2U32 LCD panel.

3.46 W Command

Routers and MSC-GCP2U32 only

Write current matrix routing state to a preset. Recalling the preset later will restore the routing matrix to the same state. This command modifies preset data which persists through power cycles.

Command	Description
W PRESET	Write current matrix routing state to PRESET.

Example to save state to preset 1

```
>W 1
>
```

3.47 WebPass Command

Assign a web password to password protect the web page interface. The serial and TCP/IP port Mascot protocol control is not protected by this password. This value is stored and recalled on power up.

Command	Description
WebPass STR	Set web page password (blank to disable)

Examples of setting and clearing web page password

```
>WebPass SeCr3t
>WebPass “”
>
```

3.48 X Command

Routers and MSC-GCP2U32 only

Query or make changes to the matrix routing state. This command comes in several variations described by the following table.

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Command	Description
X	Query complete routing state (equivalent to S Command).
X DEST	Query connected sources for DEST for all levels.
X DEST, SRC	Connect SRC to DEST for all levels.
X DEST, SRC, LEVEL	Connect SRC to DEST/LEVEL.

When querying connection state, sources for each level are separated by commas (multi-level systems only) and are displayed for each destination and separated by newlines.

The value 0 can be used for DEST to switch all destinations to a given source. A level may also be specified to isolate switching a single level of all destinations. **(Protocol Version 2.2)**

The value 0 can be used for SRC to Mute a destination (if supported for a given level).

Examples

```
>X
1,1
2,2
3,8
0,4
>X 3
3,8
>X 3,4
>X 4,0,2
>
```

In the above examples the first command queries the matrix routing state (typical of a 16x4 system for example), the second command queries destination 3 only, the third command connects source 4 to destination 3 on all levels and the fourth command mutes destination 4 level 2.

Command stacking

Command stacking is especially useful for the X command, since it allows for several connections to be performed at the same time.

Example

```
>X1,4#X2,3#X3,2#X4,1
>
```

The above would connect source 4 to destination 1, source 3 to destination 2, source 2 to destination 3 and source 1 to destination 4 for all levels.

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4 Software Updates

The procedure for updating software (also called firmware) on Matrix Switch Corporation devices is determined by the hardware series. It is recommended that software updates are only performed in order to resolve an issue or gain a desired feature. While the software update procedures have been designed to be resistant to failure, there is still a risk of a device becoming inoperable in the event that an update is interrupted.

4.1 Software Update on Carina Series Devices

There are two basic methods of performing a software update: Power On Software Update (**POSU**) and Command Software Update (**CSU**). Both methods use the TFTP protocol over the device's Ethernet port.

CSU is recommended if the device is on a different IP network than the default 192.168.2.x and the update computer's IP is already configured on that network. POSU is needed if the device's software gets corrupted (due to a failed update attempt) or if sending a Mascot command to the device is problematic.

Software update method comparison

- POSU uses a fixed update IP address of 192.168.2.59 whereas CSU uses the device's configured IP address.
- POSU should be available even if a device's firmware gets corrupted from a previous update attempt, whereas CSU will likely no longer be possible.
- POSU has a shorter TFTP "update time window" of 5 seconds and the TFTP transfer has to occur within this period after power cycling the device. This means the PC needs to be in close proximity of the device, remote power control be possible or coordination with someone to power cycle the device when initiating the TFTP transfer. Because of the shorter update window, a cross over Ethernet cable is not recommended, due to potential delay in the physical Ethernet link becoming active.
- CSU requires an extra step of a Mascot command being sent to the device.

4.1.1 Software Update Requirements

To perform a software update, the following is required:

1. A computer connected to the same Ethernet network as the device being updated.
2. A TFTP client program installed on the computer. See TFTP Software section for details.
3. The device to update with its Ethernet port connected to the same network as the PC.
4. A firmware file image for the device from Matrix Switch Corporation. The file name is of the form MatrixFirmware-x.x.x.hex, where x.x.x is the version number.
5. See errata sections Upgrading from version 4.x.x or older firmware or Downgrading from version 5.4.0 to a previous version if applicable.

4.1.2 Power on Software Update

This method requires that a TFTP transfer is initiated immediately after powering up the device.

NOTE: A cross over cable is not recommended for this update method, due to the probability that the delay of the physical Ethernet link becoming active exceeds the TFTP update time window. Please use a network switch

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and connect the PC and device to it.

Steps for executing a Power On Software Update:

1. Ensure that the Software Update Requirements are met.
2. Configure the PC for the IP address 192.168.2.58 or another unique IP on the same 192.168.2.x IP network (except 192.168.2.59). Make sure that no other system on the network is using 192.168.2.59 or the IP assigned to the PC.
3. Prepare the TFTP program to transfer the firmware file to the device, but do not initiate the transfer yet. See the section TFTP Software for details.
4. Power on the device (power cycle it if it is already on).
5. Immediately after powering on the device, initiate the TFTP transfer (hit ENTER on the tftp command, etc), there is only a 5 second time window to initiate the transfer.
6. If the transfer does not complete successfully within 30 seconds, retry from step 3.

4.1.3 Command Software Update

This method uses the device's already assigned IP address and the execution of a Mascot command to initiate the software update. If the IP is unknown, use the Power On Software Update method or refer to the Unknown IP Address section.

NOTE: The software update time window is 30 seconds for this method, so a cross over cable should be OK, but if in doubt, make sure there is an Ethernet switch between the device and update PC.

Steps for executing a Command Software Update:

1. Ensure that the Software Update Requirements are met.
2. Configure the PC for a unique IP address on the same IP network as the device (if not already). Make sure that there are no IP conflicts with the PC or device.
3. Prepare the TFTP program to transfer the firmware file to the device, but do not initiate the transfer yet. See the section TFTP Software for details.
4. Power up the device being updated, if not already operating.
5. Use one of the following methods to send a Mascot command to the device:
    - If the device already contains version 5 firmware (mid year 2011), connect to the device's web page interface by using a web browser, entering it's IP address into the browser's Location bar and pressing ENTER. Navigate to the command tab, where the command will be typed into the text entry field at the top.
    - Use a telnet client to connect to port 40 on the device. For many command line telnet clients (Windows XP, Mac OSX, Linux, etc) this can be accomplished by opening up a command terminal and typing the following command (replace 192.168.2.60 with the actual IP of the device): “telnet 192.168.2.60 40”. Once connected press ENTER and make sure a “>” prompt character is displayed (indicating that a valid connection has been established). The software update command can then be typed in the telnet session.
    - If the device is a Matrix Switch Corporation router, then you can connect a serial cable between it and the PC. Use a terminal program, such as Hyperterm, and configure the serial settings for 9600 Baud 8N1 (8 data bits, No parity, 1 stop bit). Press ENTER to confirm the connection (a '>' prompt character should be displayed). The software update command can then by typed in the serial connection window.

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- If you are unable to establish a Mascot command connection, use the Power On Software Update method.

6. Type the Mascot command "B1" followed by ENTER, utilizing one of the above Mascot connection methods.
7. A few seconds after entering the above command, initiate the TFTP transfer (hit ENTER on the tftp command, etc), there is a 30 second time window to initiate the transfer.
8. If the transfer does not complete successfully within 30 seconds, retry from step 3.

4.2 TFTP Software

There are many different options for TFTP client programs, the choice of which depends on what operating system you are using on the update computer. The following sections list some options for various operating systems.

4.2.1 Windows XP

Windows XP has a TFTP client installed and enabled by default.

To use the tftp utility on Windows XP:

1. Copy the MatrixFirmware-x.x.x.hex file to somewhere easily accessible from the command prompt.
2. Open a windows command prompt (Start Menu->Run and type "cmd" and ENTER).
3. Execute "cd" commands to navigate to the folder where the firmware file is located.
4. Type the following command to prepare the TFTP transfer (but don't hit ENTER yet):

```
tftp 192.168.2.59 put MatrixFirmware-x.x.x.hex
```

5. Make sure to replace 192.168.2.59 with the device's IP address if using the Command Software Update method and replace MatrixFirmware-x.x.x.hex with the correct version number of the file.
6. To initiate the transfer hit ENTER after typing the above command.
7. The tftp program will indicate if the transfer was successful or not.

4.2.2 Windows Vista and Windows 7

Both Windows Vista and Windows 7 have a command line tftp client, but it must first be enabled.

To enable the tftp utility on Windows Vista or Windows 7:

1. Go to Control Panel -> Programs and Features -> Windows Features and make sure the "TFTP Client" is checked.
2. Follow the directions for Windows XP

4.2.3 Mac OSX

Mac OSX comes with a tftp client. It is accessed from the Terminal application.

To use the tftp application on Mac OSX:

1. Copy the MatrixFirmware-x.x.x.hex file to somewhere easily accessible from the command prompt, for example your home directory at /Users/your_user_name/

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2. Open a terminal: Applications -> Utility -> Terminal
3. Use 'cd' commands to change to the location of the firmware file, for example: **cd /Users/your_user_name/**
4. Type: tftp [ENTER]
5. Once in the tftp application type the following lines and press ENTER at the end of each line, except the last line to prepare the TFTP transfer:

```
connect 192.168.2.59
binary
rexmt 1
timeout 30
put MatrixFirmware-x.x.x.hex
```

6. Make sure to replace 192.168.2.59 with the device's IP address if using the Command Software Update method and replace MatrixFirmware-x.x.x.hex with the correct version number of the file.
7. To initiate the transfer hit ENTER after the **put** command above.
8. The tftp program will indicate if the transfer was successful or not.
9. If the transfer failed (timed out, etc), retry the **put** command or quit the application (type 'quit' and ENTER) and start over from step 3.

4.2.4 Linux

The tftp application can easily be installed with your distributions package manager from a terminal, below are some example commands for various distributions.

Commands for installing tftp on different Linux distributions:

- Ubuntu: sudo apt-get install tftp
- Fedora: yum install tftp
- Suse: smart install tftp

Using the tftp application on Linux:

1. Open a terminal command line application.
2. Use 'cd' commands to change to the directory where the firmware file is located, for example (if the firmware file is on your desktop): **cd ~/Desktop**
3. Execute the tftp command with the IP address of the device (make sure to use the device's configured IP if using the Command Software Update method):

```
tftp 192.168.2.59
```

4. Execute the following commands from within the tftp program, pressing ENTER after each line, except the last one to prepare the TFTP transfer:

```
binary
rexmt 1
timeout 30
put MatrixFirmware-x.x.x.hex
```

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5. Make sure to replace MatrixFirmware-x.x.x.hex with the correct version number of the file.
6. To initiate the transfer press ENTER after the last command above.
7. The tftp program will indicate if the transfer was successful or not.
8. If the transfer failed (timed out, etc), retry the **put** command or quit the application (type 'quit' and ENTER) and start over from step 2.

4.3 Software Update Errata

This section contains information on various errata and issues that may be encountered with certain hardware or versions of the firmware.

4.3.1 Upgrading from version 4.x.x or older firmware

If updating from 4.x.x or older firmware (systems sold pre mid year 2011), there are some additional requirements and steps.

Additional requirements and steps with 4.x.x or older firmware:

1. Some Matrix Switch Corporation routers are not supported by newer firmware and therefore a software update to version 5 should not be attempted on those devices. This includes 4x4 and 8x8 HD-SDI routers pre serial number 9000 (systems sold before mid year 2011). If in doubt, please contact MSC.
2. The system's settings will not be retained after the software update. This means that all input/output labels, networking configuration and the Ethernet MAC address will be lost and will need to be re-entered. See below for details on obtaining the current settings.
3. If using the Command Software Update method, some methods of entering the software update Mascot command will not be available (such as the command tab on the web interface). Use telnet or the serial method in such cases or Power On Software Update.

Steps to retrieving system settings prior to software update:

1. Utilizing one of the Mascot command methods (telnet or serial, see step 5 in the Command Software Update section), type the following commands with ENTER after each one and copy and paste the output to a text document:

```
M
I
G
O
01
```

2. Save the text document for future reference, when re-entering the system settings.

Re-entering settings after software update:

1. Connect to the device's web page interface (see step 5 in the Command Software Update section).
2. Navigate to the command tab and enter the following command to enter manufacturing mode:

```
manuf 1
```

3. Go to the web page Config tab and enter the MAC address and networking information previously

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saved. Please contact Matrix Switch Corporation if the MAC address has been misplaced for the system.

4. Go to the Labels tab on the web page interface and re-enter the destination and source labels.

4.3.2 Downgrading from version 5.4.0 to a previous version

If downgrading from Carina firmware version 5.4.0 or newer to a version prior to 5.4.0, the system configuration will not be retained. Please contact Matrix Switch Corporation in the event that this is required and we can assist you in the process of backing up and restoring your device's configuration.

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5 Troubleshooting

This section contains information on frequent issues and ways to troubleshoot them.

5.1 Unknown IP address

In the event that the IP address of a device is unknown, the following procedure can be used to retrieve it:

A computer with an RS-232 serial port is required. If you don't have access to a computer with an RS-232 serial port, a USB to RS-232 adapter is an easy way to add one. Connect the RS-232 serial port to the DE-9 pin female connector on the router device. Start up a serial terminal application (such as Hyperterminal on Windows), configure it for the correct system serial port with the following settings: 9600 bps, 8 data bits, no parity and 1 stop bit (8N1). Make sure the router device is powered on and allow for adequate time for it to boot up. Press the ENTER key in the serial terminal application once connected and a '>' prompt character should be displayed. Type the following commands (pressing ENTER after each one) to get the IP address and netmask:

```
ip
netmask
```

5.2 No Ethernet link when connected to network switch

This device utilizes a 10 BaseT Ethernet interface. In the event that the device is connected to a network switch and no physical link is established, please try the following:

1. Ensure that the Ethernet cable is good (try it with another known good Ethernet device or swap the cable for a known good cable).
2. Ensure proper power supply is being used for the system (5 Volt 2 Amp)
3. If the switch is a managed switch, try forcing 10 BaseT for the Ethernet port the device is connected to, instead of rate auto detection.

5.3 Unexpected reboots

If the device is rebooting unexpectedly (detectable on routers when the routing state gets reset to preset 0), make sure the correct power supply is being used with the device (5 Volt 2 Amp).

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6 Reference

6.1 Specifications

Physical	
Size	19"W x 1.75"H x 5"D
Rack Size	1RU
Weight	5 lbs
Power	5 VDC
Power Connector	5.5mm OD 2.5mm ID coaxial
Storage Temp	-10 Through +50 Deg C
Operating Temp	0 Through +40 Deg C
Humidity	0 Through 90% Non-Condensing
Warranty	2 Years Parts & Labor

SDI Video	
Connector type	BNC
Data Types	SMPTE 259/292/424
Data Rates	19 Mbit/s through 3.0 Gbit/s
Re-clocking Data Rates	270 Mbit/s, 1.485 Gbit/s, 2.97 Gbit/s
Input/Output Return Loss	> 15dB @ HD, > 12dB @ 3G
Input Level	800 mV P-P +/- 20%
Input Impedance	75 Ohms +/- 1%
Cable equalization (1694A coax)	400m @ SD, 140m @ HD, 120m @ 3G
Output Level	800 mV P-P +/- 5%
Output Impedance	75 Ohms +/- 1%
Output Jitter	< 0.2 UI

Reference Signal	
Connector Type	Analog BNC with pass-through
Format	NTSC, PAL and Tri-level sync

Control Specifications	
Serial RS232	9600 bps 8N1
Ethernet	10 BaseT TCP/IP
Local Panel Interface	Elastomeric Buttons
Remote Panel Support	Yes

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6.2 Glossary

- **Active Routing** – The current routing state of a Router's Matrix.
- **Destination** – A Video or Audio destination (output from a Router device). Numbered starting from 1.
- **Input** – Synonymous with Source.
- **IP** – Stands for Internet Protocol. Base protocol of the Internet which can also be used on LANs. This protocol uses 4 byte addresses (IPv4) written in "quad dot" format, which is four decimal numbers separated by periods (192.168.2.60 for example).
- **LAN** – Stands for Local Area Network. Refers to a single local Ethernet network, usually consisting of a single IP subnet.
- **Level** – Router devices may contain multiple Video and Audio levels. Level numbers start from 1.
- **Mascot Protocol –** An abbreviation of **MA**trix **S**witch **CO**rporation pro**T**ocol. An ASCII text based protocol for interfacing to Matrix Switch Corporation devices.
- **Matrix** – Used when referring to a Router's entire routing state.
- **Mute** – When supported, a destination can be muted, which for video means the output is turned off and for audio means it is silenced.
- **Output** – Synonymous with Destination.
- **Preset** – Matrix Switch Corporation Router devices provide 10 presets which store matrix Routing connections. When a preset is “recalled” zero or more matrix connections are changed based on the content of the Preset. Numbered starting from 0. Preset 0 is special in that it is recalled on system startup.
- **Remote Panel** – Matrix Switch Corporation Remote Panels connect to Router devices for remote control with touch buttons.
- **Router** – A Video/Audio Routing device routes one or more sources to one or more destinations (not to be confused with a Network router, which is referred to as a Network Switch in this manual).
- **Simple Panel** – A Matrix Switch Corporation Remote Panel which has buttons only.
- **Smart Panel** – A Matrix Switch Corporation Remote Panel which comes equipped with an LCD screen interface.
- **Source** – A Video or Audio source (input to a Router device). Numbered starting from 1.
- **TCP** – Stands for Transport Control Protocol. This protocol is used by Matrix Switch Corporation devices for remote panel control, the MASCOT network interface and the web page interface.

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7 Matrix Switch Corporation Warranty

MSC provides the following limited warranty with its products:

1. MSC warrants that the equipment it manufactures is free from defects in material and workmanship.

2. This warranty begins on the day the product is shipped from MSC and shall be in effect for two years.

3. If the product is found to be defective, MSC shall at its option:
   a) Provide free replacement parts.
   b) Repair the unit at MSC's facilities.
   c) Repair the unit at the customer's location.
   d) Exchange the product for a product of the same type.

MSC shall make every reasonable effort to support critical emergencies by supplying no-cost loan equipment while the defective unit is being repaired.

4. Customer bears the cost of shipping products returned to MSC under this warranty; however, MSC shall bear the cost of shipping repaired products or replacement parts to the customer.

5. Any customer returning a product for repair shall first obtain from MSC a Return Material Authorization (RMA) number which shall be placed on the outside of the shipping package.

6. This warranty does not apply if the product has been damaged by accident, abuse, misuse, misapplication or modification.

EXCEPT AS SET FORTH ABOVE, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. MSC EXPRESSLY DISCLAIMS ALL EXPRESS OR IMPLIED WARRANTIES NOT STATED HEREIN. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, THE PURCHASER'S SOLE REMEDY SHALL BE REPLACEMENT OR REPAIR AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES WILL MSC BE LIABLE TO THE PURCHASER OR ANY USER FOR ANY DAMAGES INCLUDING INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSE, LOST PROFITS, LOST SAVINGS OR OTHER DAMAGES ARISING OUT OF THE USE OF, OR INABILITY TO USE THE PRODUCT, EVEN IF MSC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

To the extent this warranty conflicts with local law, local law shall only apply to such conflict.

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