Technical Manual

COUGAR COMBO
AUDIO/VIDEO ROUTING SWITCHER

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About This Manual

This manual provides detailed instructions for the installation, operation, and maintenance of the PESA Cougar Combo Audio/Video Routing Switcher.

Warnings, Cautions, and Notes

Warning statements identify conditions or practices that can result in personal injury or loss of life.

Caution statements identify conditions or practices that can result in damage to equipment.

Notes contain information important to the correct installation, operation, or maintenance of the equipment.

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Chapter 1 – Introduction

1.1 Overview

The PESA Cougar Combo Routing Switcher offers a reliable low cost answer to your video and audio routing needs. The Cougar Combo Routing Switcher is housed in a 4RU frame providing a small profile for space efficient installations. The Cougar Combo frame can be equipped with either a single System Controller or dual System Controllers. The option of dual controllers provides seamless transfer of system control in case of equipment failure. The Cougar Combo frame can also be equipped with redundant power supplies for maximum reliability and fail safe operation.

The Cougar Combo Routing Switcher is designed with small to mid-range size routing matrix applications in mind. This cost efficient router is expandable to a 64x64 size matrix. The main matrix components use plug-in circuit cards for ease of maintenance and component replacement. The Cougar Combo Routing Switcher can be serviced hot, allowing circuit card changes without powering down the matrix. Board level voltage regulation in the Cougar Frame eliminates the possibility of a central, single point power failure.

The Cougar Combo provides all the benefits of the standard Cougar products. The Cougar Combo Frame comes equipped with one RS 422 frame control port, two RS232 ports for external control via CPU Link protocol. Control Panels can be added to the RS485 interface ports. The Cougar Combo Audio and Video Matrix Cards feature easily visible LED indicators for quick view of critical voltage and circuit conditions. Alarm connectors are provided to monitor power, matrix and CPU operations.

The Cougar Combo Routing Switcher utilizes the PESA System Controller for system control. The System Controller provides a user friendly graphical interface; operating in a Windows personal computer environment. The System Controller can be installed internal to the Cougar Frame, allowing better rack space utilization. The Cougar Combo Routing Switcher working in conjunction with the System Controller utilizes PESA's low cost RCP line of control panels for remote system operation. The internal system controller can also control other frames.

The Cougar Video and audio Matrix Cards are compatible with digital composite, digital component, and compressed digital HDTV video formats. The Cougar Digital Video Matrix card provides automatic input equalization for up to 240 meters of Belden 8281 cable for data rates up to 270 Mbit/s, and up to 150 meters of cable for data rates up to 360 Mbit/s.

The standard and wideband Cougar Combo Analog Video Matrix cards work in conjunction with their respective 16x16 cross point cards and provide standard or wide bandwidth performance for conventional NTSC/PAL analog video signals. The Cougar Combo Analog Video Matrix cards can accommodate video signal amplitude levels up to 2V peak-to-peak. All of the Cougar Combo Analog Video Matrix card's inputs are terminated into 75 Ohms.

Both of the Cougar Combo's Audio Matrix cards, digital and analog, provide electronically balanced inputs and outputs for improved slew rates and lower distortion over comparable transformer coupled circuits. The Cougar Combo Audio Matrix cards feature short circuit protection, which protects the matrix cards by automatically protecting and recovering if a sustained short circuit to a signal or chassis ground occurs.

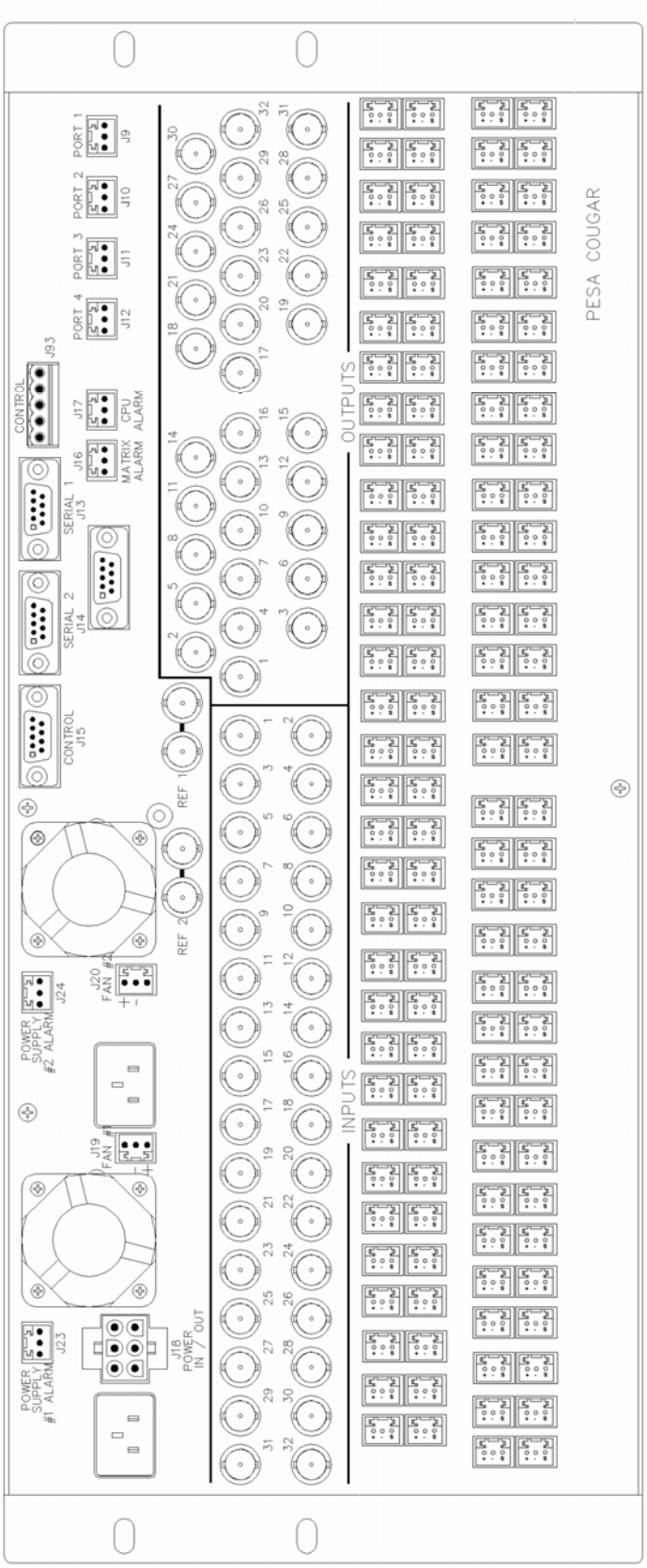


Figure 1. Cougar Combo Routing Switcher Rear View

1.2 Specifications

1.2.1 Digital Video Matrix Card

INPUTS

Impedance ..... 75 Ohms, Internally Terminated, Non-Looping, BNC
Return Loss ..... >15dB 5MHz to 270MHz
Standard ..... SMPTE 259M for 143, 177, 270, and 360 Mbit/s
Equalization ..... Automatic equalization for 0 to 240 meters of Belden 8281 or equivalent cable for data rates up to 270Mbit/s and 0 to 150 meters for data rates up to 360Mbit/s
Number 32

OUTPUTS

Impedance ..... 75 Ohm BNC
Return Loss ..... >15dB 5MHz to 270MHz
Signal Amplitude ..... 800mv ±10%, Terminated into 75 Ohms
DC Offset ..... ±0.5V, Terminated into 75 Ohms
Rise/Fall Times ..... 0.6nS ±200pS (20% to 80%), Terminated into 75 Ohms
Timing Jitter ..... 0.2UI p-p as defined in SMPTE 259M
Alignment Jitter ..... 0.2UI p-p as defined in SMPTE 259M
Standard ..... SMPTE 259M for 143, 177, 270, and 360 Mbit/s
Number 32

1.2.2 Analog Video Matrix Card

INPUT CHARACTERISTICS

Level ..... 1V P-P Nominal 2V P-P Max (without obvious distortion)
Impedance ..... Single, 75 Ohms Terminated
Return Loss ..... >40dB to 5MHz >15dB to 100MHz
Coupling ..... Direct (DC)
Connector Type ..... BNC

OUTPUT CHARACTERISTICS

Level ..... 1V P-P Nominal 2V P-P Max (without obvious distortion)
Impedance ..... 75 Ohms
Return Loss ..... >40dB to 5MHz >15dB to 100MHz
Coupling ..... Direct (DC)
DC on Outputs ..... 0V DC ±10mV DC Max
Connector Type ..... BNC
Number ..... Single
Slew Rate ..... >200V/AES

GAIN CHARACTERISTICS

Gain ..... Unity
Gain Stability ..... <±0.1dB Max
Gain Adjust Range ..... ±0.5dB

LINEAR DISTORTIONS

Frequency Response ..... <±0.1dB @ 10MHz
<±0.5dB @ 35MHz
<±1.0dB @ 75MHz
+1.5dB, -3dB @ 125 MHz
±5.0dB @ 250 MHz (Wideband)
Vertical Tilt ..... 0.25% (50Hz Square Wave)
Horizontal Tilt 0.25%
Low Frequency ..... +0.2%/ms Max With 10% Overshoot
(10% - 90% or 90% - 10% Change)

PULSE AND BAR RESPONSES

(Factor 2T)
Bar Slope 0.2%
Pulse/Bar Ratio 0.2%
Pulse Shape 0.2%

CHROMINANCE / LUMINANCE

Gain Inequality ..... ±1% Max
Delay Inequality ..... ±1nS

NON-LINEAR DISTORTIONS

(All Tests Assume 10% - 90%, 3.58MHz or 12.5% - 87.5%, 4.43MHz)
Differential Gain ..... 0.1% @ 4.43MHz
Envelop Delay ..... <2nS, 50MHz to 85 MHz
Differential Phase ..... 0.10ø @ 4.43MHz
Line Time Non-Linearity 0.2%
Transient Gain ..... 1% (Luminance, Chrominance, or Sync)

CROSSTALK

(All Inputs and Outputs Hostile)
Video to Video ..... <-60dB to 5MHz
<-35dB @ 35MHz
<-15dB @ 125MHz

SWITCHING CHARACTERISTICS

Switching Time ..... <1AES
Switching Transient ..... 22mV (30 IRE Units)
Differential Delay
Input to Input, Same Output ..... ±1ø @ 4.43MHz
Output to Output, Same Input ..... ±1.5ø @ 4.43MHz

SIGNAL TO NOISE

Video Filter ..... -73dB (Low Pass to 5MHz STD B, C, G, H, I, or 4.2MHz STD M)
Luminance Weighting Filter .....-81dB (STD A, B, D, G, H, K, and L)

1.2.3 Digital Audio Matrix Card

INPUTS

Type .....3-Pin, 2-Part, Detachable Plug
Impedance .....110 Ohms, ±20% from 0.1MHz to 6MHz, Terminated
Signal Amplitude ..... 0.2V - 7.0V P-P
Number .....32 per Level

OUTPUTS

Type .....3-Pin, 2-Part, Detachable Plug
Impedance .....110 Ohms, ±20% from 0.1MHz to 6MHz
Signal Amplitude .....0.2V - 7.0V P-P into a line terminated with 110 Ohms
Number .....32 per Level
Common Mode .....Any common mode signal present at the output terminals is >30dB below output signal from DC to 6MHz.
Rise/Fall Times ..... 5 to 30nS (Measured from 10% 90% Amplitude Points)
Jitter .....<±20nS from Ideal Jitter Free Clock (Measured at 50% Voltage Point)
Standard AES3-1998
Data Rate.....DC to 20Mbit/s

INPUT CHARACTERISTICS

Level .....+28dBm Max
Impedance .....>60K Ohms
Type .....Electrically Balanced
Coupling.....Direct (DC)
Common Mode Rejection Ratio ..... -80dB (50Hz to 60Hz)
Connector Type.....3-Pin, 2-Part, Detachable Plug

OUTPUT CHARACTERISTICS

Level ..... +28dBm into 600 Ohms
Level Variation Between Inputs ..... ±0.1dB
Impedance ..... <67 Ohms
Type .....Electrically Balanced
Number .....Single
Coupling.....Direct (DC)
DC on Outputs .....±20mV
Minimum Load @ 28dBm.....600 Ohms
Connector Type.....3-Pin, 2-Part, Detachable Plug

GAIN CHARACTERISTICS

Gain ..... Adjustable to 0.1dB
Gain Stability ..... ±0.05dB
Adjustment Range ..... Approximately ±1dB

FREQUENCY CHARACTERISTICS

Sine Wave Response ..... <±0.1dB, 20Hz to 20KHz
-3dB to 200KHz

Square Wave Response
(Overshoot and Ringing) ..... <±5%, 3KHz 10AES Rise Time (20V P-P)

DISTORTION CHARACTERISTICS

Total Harmonic Distortion (THD) ..... <0.10% @ 28dBm, 20Hz to 20KHz
Intermodulation Distortion (IMD) ..... <0.02% @ 28dBm, 20Hz to 20KHz

CROSSTALK

20Hz to 20KHz ..... <-92dB (All Inputs and Outputs Hostile)

HUM AND NOISE

(Unity Dynamic Range +28dBm)

Wideband 10Hz to 300KHz	<-80dBm	-108dBm
80KHz Low Pass Filter	<-88dBm	-116dBm
30KHz Low Pass Filter	<-92dBm	-120dBm
15KHz Low Pass Filter	<-94dBm	-122dBm
"A" Weighted		<-96dBm
		-124dBm

SWITCHING CHARACTERISTICS

DC Offset ..... <10mV, Peak
Switching Transients (30KHz Low Pass) ..... <20mV, Peak

1.2.4 Frame General Characteristics

CONNECTOR

Video ..... BNC
Audio ..... Type 3-pin, 2 part, detachable plug

POWER

Auto Range 90-260VAC, 47Hz-63Hz
Power Consumption ..... 70VA Max

ENVIRONMENTAL

Operational Temperature ..... 0-40 degrees C
Operational Humidity ..... 10-90% non-condensing

MECHANICAL

Dimension.....4RU; 19”W x 13.5”D x 7.0”H
482.6mm x 342.0mm x 178mm
Weight..... 30 lbs

Chapter 2 – Operation

2.1 General

If specified when ordered, the Cougar Combo Frame will be configured for the intended system at the factory. Before attempting to install any frame, matrix card, controller card, or power supply, read this section carefully.

The Cougar Combo Routing Switcher contains static sensitive devices. Care should be used when it is necessary to handle the internal circuit cards. It is recommended that a ground wrist strap and grounding mat be used before attempting any equipment installation.

2.2 Receipt Inspection

The Cougar Combo Routing Switcher was tested and inspected prior to leaving the factory. Upon receipt, inspect the equipment for shipping damage. If any damage is found, contact the carrier immediately and save all packing material.

2.3 Unpacking

The Cougar Combo Routing Switcher is comprised of a frame, back plane, a 32x32 Video Matrix Card, Audio Matrix Card, up to two System Controller Cards, and up to two PS130V Power Supplies. Prior to discarding packing material compare the parts received against the packing list. Carefully inspect the layers of packing material for any components, which may have been overlooked during the initial unpacking.

2.4 Location

The Cougar Combo Routing Switcher may be located anywhere power is available. However, units should be mounted as close as possible to their associated equipment to minimize cable runs. Forced air cooling is provided by a small fans located at the back of the unit. Care should be taken not to block airflow around these fans. Installation should be in an area where the ambient temperature does not exceed 40°C (104°F) inside the equipment rack.

2.5 Mounting

The Cougar Combo Routing Switcher is rack mountable in a standard 19" equipment rack. Sufficient space must be provided behind the equipment racks to allow for the control cables and power cable. All mounting holes should be utilized and mounting hardware tightened securely. As with all equipment installed in a rack, the bottom screw on each side should be installed before proceeding with the remainder of the screws. Then all screws should be securely tightened. Support the Cougar Combo Switcher's bottom while installing it in the rack. Figure 2 illustrates chassis installation in the equipment rack. NOTE: Remove the power supply retaining screws before installing the Cougar Combo Routing Switcher in an equipment rack.

To install a Cougar Combo Routing Switcher in an equipment rack follow these steps:

1. Align the frame with the slotted opening in the rack.
2. Install the bottom screws first.
3. Install the two top screws
4. Tighten all four screws securely.

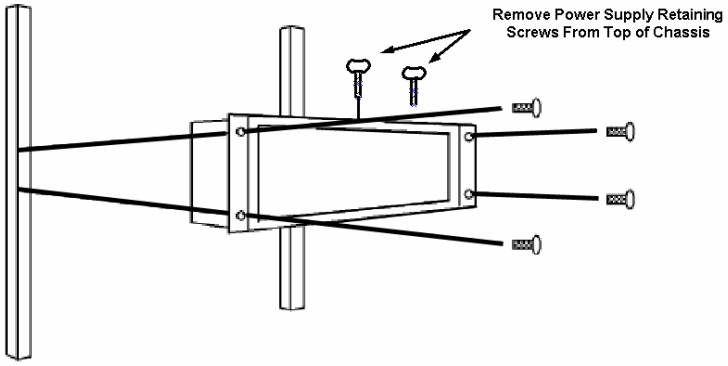


Figure 2. Chassis Mounting

2.6 Cabling

Considerable weight will be added to the rear panel of the Cougar Combo Routing Switcher by the control, signal, and power cables. Therefore, all cables should be strained relieved and secured to racks or other supporting structures. Failure to provide adequate cable support can result in cables separating from connectors. If cable runs are to be stored under an elevated floor, they should be tied to the racks as a guide. If cables are run along the floor, do not allow them to lay in the work area behind the racks. Stepping or tripping on the cables may result in connections being pulled free or wire breakage inside the insulation. The Cougar Combo Routing Switcher should be installed in the equipment rack prior to attaching cables.

Use the following rules when cabling the Cougar Combo Routing Switcher:

1. Lay all cables in their intended positions, separating control, video, and power cables wherever possible.
2. Provide proper support for each cable during the cabling process. The use of tie-wraps is recommended as shown in Figure 3.

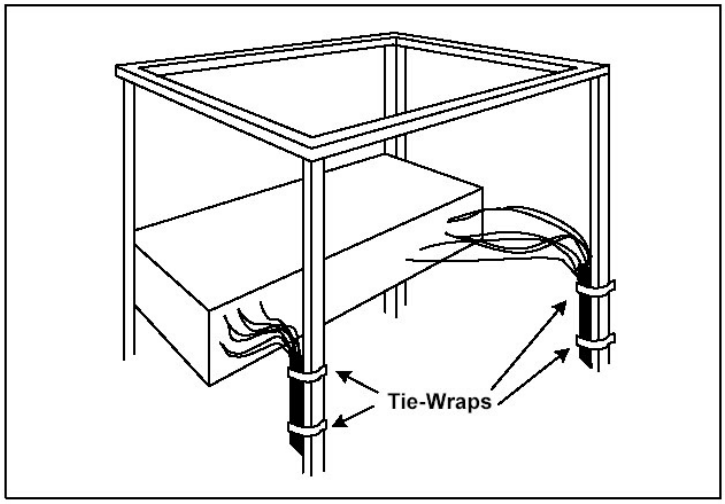
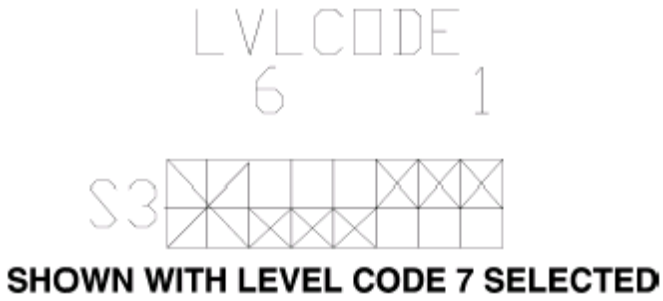


Figure 3. Cables Attached to Supports

2.7 Video Level Code (Strobe) Selection

The level (strobe) select switch, S3, (a binary coded switch) is located on the inside of the Cougar Combo Routing Switcher in the middle of the back plane. Switch numbers are 1 through 8 right to left. Switches 1-6 select level codes 0 through 62. Switches 7 and 8 are not used - their position is unimportant. Refer to Figure 4 for an example of level code selection.



Physical 0 (Logical 1) = OFF (UP)
Physical 1 (Logical 0) = ON (DOWN)

Figure 4. Video Level Code Switch Positions

NOTE **The following are logical selections. Level 0 is all switches on (down) or all switches in the physical 1 position.**

Table 1. Video Level Code Switch Positions

SWITCH POSITIONS	6	5	4	3	2	1
STROBE LEVEL 0	0	0	0	0	0	0
STROBE LEVEL 1	0	0	0	0	0	1
STROBE LEVEL 2	0	0	0	0	1	0
STROBE LEVEL 3	0	0	0	0	1	1
STROBE LEVEL 4	0	0	0	1	0	0
STROBE LEVEL 5	0	0	0	1	0	1
STROBE LEVEL 6	0	0	0	1	1	0
STROBE LEVEL 7	0	0	0	1	1	1
UP TO....						
STROBE LEVEL 62	1	1	1	1	1	0

2.8 Audio Level Code (Strobe) Selection

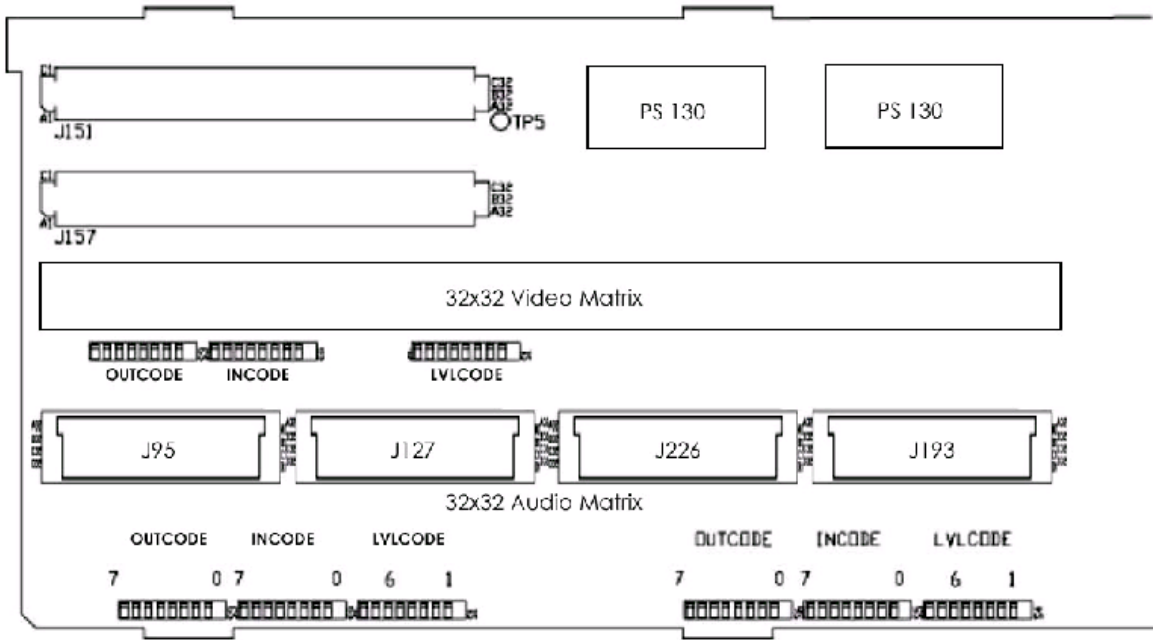


Figure 5. Cougar Combo switch locations

The audio level (strobe) select switches are located on the inside of the Cougar Combo Routing Switcher on lower middle and right of the back plane. Switch numbers are 1 through 8 right to left. Switches 1-6 select level codes 0 through 63. Switches 7 and 8 are not used - their position is unimportant. See Figure 6 for an example of setting the level code switches and Figure 7 for the switch positions.

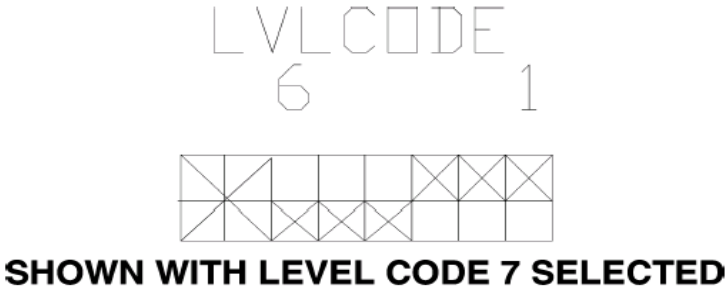


Figure 6. Audio Level Code (Strobe) Selection

Physical 0 (Logical 1) = OFF (UP)
Physical 1 (Logical 0) = ON (DOWN)

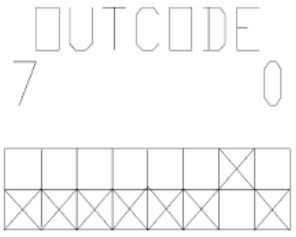
2.9 Video Output/Input Code Selection

NOTE **The following are logical selections.**

Table 2. Video Output/Input Switch Positions

SWITCH POSITIONS	6	5	4	3	2	1
STROBE LEVEL 0	0	0	0	0	0	0
STROBE LEVEL 1	0	0	0	0	0	1
STROBE LEVEL 2	0	0	0	0	1	0
STROBE LEVEL 3	0	0	0	0	1	1
STROBE LEVEL 4	0	0	0	1	0	0
STROBE LEVEL 5	0	0	0	1	0	1
STROBE LEVEL 6	0	0	0	1	1	0
STROBE LEVEL 7	0	0	0	1	1	1
UP TO....						
STROBE LEVEL 62	1	1	1	1	1	0

Video input and output coding switches are located on the inside of the Cougar Combo Routing Switcher on the back plane. The input and output switch numbers run 0 to 7, right to left. Switch S1 (outcode switch) selects output codes 0-255 and switch S2 (incode switch) selects input codes 0-255. Refer to Figure 7 for examples of output code selection and Figure 8 for an example of input code selection.



Shown with Output Code 2 selected
Physical 0 (Logical 1) = OFF (UP)

Physical 1 (Logical 0) = ON (DOWN)

Figure 7. Video Output/Input Code Selection

2.9.1 Output Code

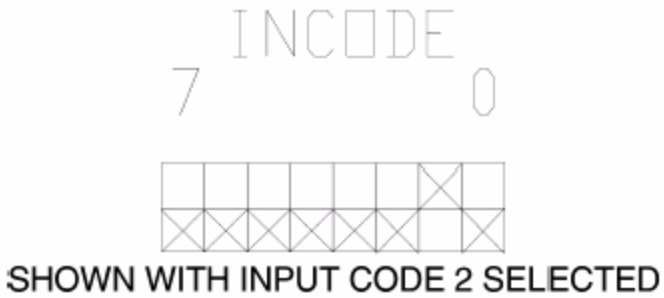
NOTE

The following are logical selections. Output code 0 is all switches on (down) or all switches in the physical 1 position.

Table 3. Video Output/Input Code Selection

SWITCH POSITION	7	6	5	4	3	2	1	0	OUTPUTS
OUTPUT CODE 0	0	0	0	0	0	0	0	0	0-32
OUTPUT CODE 1	0	0	0	0	0	0	0	1	33-64
OUTPUT CODE 2	0	0	0	0	0	0	1	0	65-96
OUTPUT CODE 3	0	0	0	0	0	0	1	1	97-128
OUTPUT CODE 4	0	0	0	0	0	1	0	0	129-160
OUTPUT CODE 5	0	0	0	0	0	1	0	1	161-192
OUTPUT CODE 6	0	0	0	0	0	0	1	1	193-224
OUTPUT CODE 7	0	0	0	0	0	1	1	1	225-256
UP TO....									
OUTPUT CODE 255	1	1	1	1	1	1	1	1	8161-8192

2.9.2 Input Code



Physical 0 (Logical 1) = OFF (UP)
Physical 1 (Logical 0) = ON (DOWN)

Figure 8. Input Code Selection

NOTE

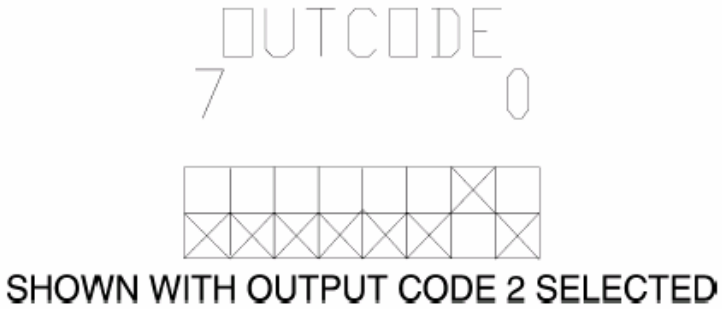
The following are logical selections. Output code 0 is all switches on (down) or all switches in the physical 1 position.

Table 4. Input Code Selection

SWITCH POSITION7	6	5	4	3	2	1	0	INPUTS
INPUT CODE 0	0	0	0	0	0	0	0	0-32
INPUT CODE 1	0	0	0	0	0	0	0	1 33-64
INPUT CODE 2	0	0	0	0	0	0	1	0 65-96
INPUT CODE 3	0	0	0	0	0	0	1	1 97-128
INPUT CODE 4	0	0	0	0	0	1	0	0 129-160
INPUT CODE 5	0	0	0	0	0	1	0	1 161-192
INPUT CODE 6	0	0	0	0	0	1	1	0 193-224
INPUT CODE 7	0	0	0	0	0	1	1	1 225-256
UP TO....								
INPUT CODE 255	1	1	1	1	1	1	1	1 8161-8192

2.10 Audio Output/Input Code Selection

Input and output coding switches are located on the inside of the Cougar Audio Routing Switcher on the lower left corner of the back plane. The input and output switch numbers run 0 to 7, right to left. Switches S2 and S3 (matrix A and matrix B outcode switches respectively) select output codes 0-255 and switches S3 and S6 (matrix A and matrix B incode switches respectively) select input codes 0-255. See Figure 9 for an example of output code selection and Figure 10 for an example of input code selection.



Physical 0 (Logical 1) = OFF (UP)
Physical 1 (Logical 0) = ON (DOWN)

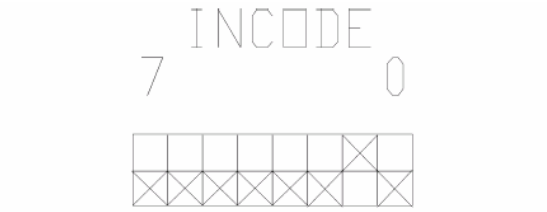
Figure 9. Audio Output/Input Code Selection

2.10.1 Output Code

NOTE **The following are logical selections.**

Table 5. Output Code Selection

SWITCH POSITION	7	6	5	4	3	2	1	0	Outputs
OUTPUT CODE 0	0	0	0	0	0	0	0	0	0-32
OUTPUT CODE 1	0	0	0	0	0	0	0	1	33-64
OUTPUT CODE 2	0	0	0	0	0	0	1	0	65-96
OUTPUT CODE 3	0	0	0	0	0	0	1	1	97-128
OUTPUT CODE 4	0	0	0	0	0	1	0	0	129-160
OUTPUT CODE 5	0	0	0	0	0	1	0	1	161-192
OUTPUT CODE 6	0	0	0	0	0	1	1	0	193-224
OUTPUT CODE 7	0	0	0	0	0	1	1	1	225-256
UP TO....									
OUTPUT CODE 255	1	1	1	1	1	1	1	1	8161-8192



SHOWN WITH INPUT CODE 2 SELECTED
Physical 0 (Logical 1) = OFF (UP)
Physical 1 (Logical 0) = ON (DOWN)

Figure 10. Output Code Selection

2.10.2 Input Code

The following are logical selections.

Table 6. Input Code Selections

SWITCH POSITION	7	6	5	4	3	2	1	0	INPUTS
INPUT CODE 0	0	0	0	0	0	0	0	0	0-32
INPUT CODE 1	0	0	0	0	0	0	0	1	33-64
INPUT CODE 2	0	0	0	0	0	0	1	0	65-96
INPUT CODE 3	0	0	0	0	0	0	1	1	97-128
INPUT CODE 4	0	0	0	0	0	1	0	0	129-160
INPUT CODE 5	0	0	0	0	0	1	0	1	161-192
INPUT CODE 6	0	0	0	0	0	1	1	0	193-224
INPUT CODE 7	0	0	0	0	0	1	1	1	225-256
UP TO....									
INPUT CODE 255	1	1	1	1	1	1	1	1	8161-8192

2.11 System Controller Card Installation

The System Controller Card(s) are installed in the upper left-hand portion of the Cougar Combo Routing Switcher. The Cougar Combo Routing Switcher is designed for the installation of up to two System Controller Cards. If only one System Controller Card is to be installed in the Cougar Combo Routing Switcher, install it in the upper card slot.

To install the System Controller Card(s) in the Cougar Combo Routing Switcher take the following steps.

1. Align the first (primary) System Controller Card with the upper set of circuit card guides in the upper left-hand portion of the Cougar Combo Routing Switcher.
2. Carefully push the System Controller Card into the Cougar Combo Routing Switcher until the circuit card connectors make initial contact with back plane connectors. At this point, firmly but carefully continue pushing the controller card into the frame while making sure the connectors are properly aligned and that no connector pins are being bent. Continue pushing the controller card until it is in place and the connectors are firmly mated.
3. Align the second (redundant) System Controller Card with the lower set of circuit card guides in the upper left-hand portion of the Cougar Combo Routing Switcher and repeat step 2.

4. Once the System Controller Card(s) are installed in the Cougar Combo Routing Switcher, install the controller card locking brace and secure it with a twist nut to hold the controller card(s) in place.

The controller locking brace may be removed after shipment to ease the replacement of System Controller Card(s) when necessary.

2.12 PS130 Power Supply Installation

The PS130 Power Supplies are installed in the upper, right-hand portion of the front of the Cougar Combo Routing Switcher. The Cougar Combo Routing Switcher is designed for the installation of up to two PS130 Power Supplies.

The Cougar Combo chassis and PS130 power supplies contain electrical shock hazards. The Cougar Combo Routing Switcher and the PS130 power supplies should only be serviced by qualified service personnel and/or qualified technicians.

The minimum number of power supplies must be installed in the Cougar Combo frame before attempting to power up the frame.

To install the PS130 Power Supplies in the Cougar Combo Routing Switcher take the following steps while referring to the Cougar Combo Mainframe configuration drawing:

1. Align the shield plate on the first PS130 Power Supply with the left-hand set of circuit card guides in the upper, right-hand portion of the front of the Cougar Combo Routing Switcher (circuit side to the left).
2. Carefully push the PS130 Power Supply into the Cougar Combo Routing Switcher until the power supply connectors make initial contact with the Power Mid-Plane connectors. At this point, firmly but carefully continue pushing the PS130 Power Supply into the frame while making sure the connectors are properly aligned. Continue pushing the power supply until the slide lock snaps into place and the connectors are firmly mated.
3. Align the shield plate on the next PS130 Power Supply with the next set of circuit card guides in the upper, right-hand portion of the front of the Cougar Combo Routing Switcher and repeat step 2.

2.13 32x32 Video and Audio Matrix Card Installation

2.13.1 Video

The 32x32 Video Matrix Card, analog or digital, is installed in the upper portion of the Cougar Combo Routing Switcher. To install the matrix board in the Cougar Combo Routing Switcher take the following steps:

1. Align the shield plate of the matrix card with the set of circuit card guides in the upper portion of the Cougar Combo Routing Switcher.
2. Carefully push the matrix board into the switcher until the circuit card connectors make initial contact with back plane connectors. At this point, firmly but carefully continue pushing the matrix card into the switcher while making sure the connectors are properly aligned and that no connector pins are being bent. Continue pushing the card until it is in place and the connectors are firmly mated.

2.13.2 Audio

The 32x32 Audio Matrix Card, analog or digital, is installed in the lower portion of the Cougar Combo Routing Switcher. To install the matrix board in the Cougar Combo Routing Switcher take the following steps:

1. Align the matrix card shield plate with the set of circuit card guides in the lower portion of the Cougar Combo Routing Switcher.
2. Carefully push the matrix board into the switcher until the circuit card connectors make initial contact with back plane connectors. At this point, firmly but carefully continue pushing the matrix card into the switcher while making sure the connectors are properly aligned and that no connector pins are being bent. Continue pushing the card until it is in place and the connectors are firmly mated.

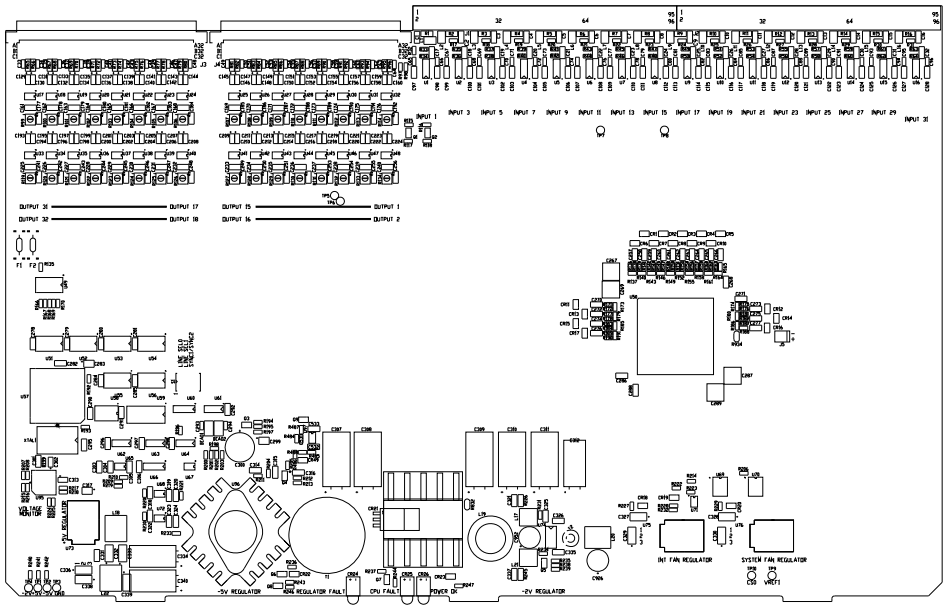


Figure 11. 32x32 Digital Video

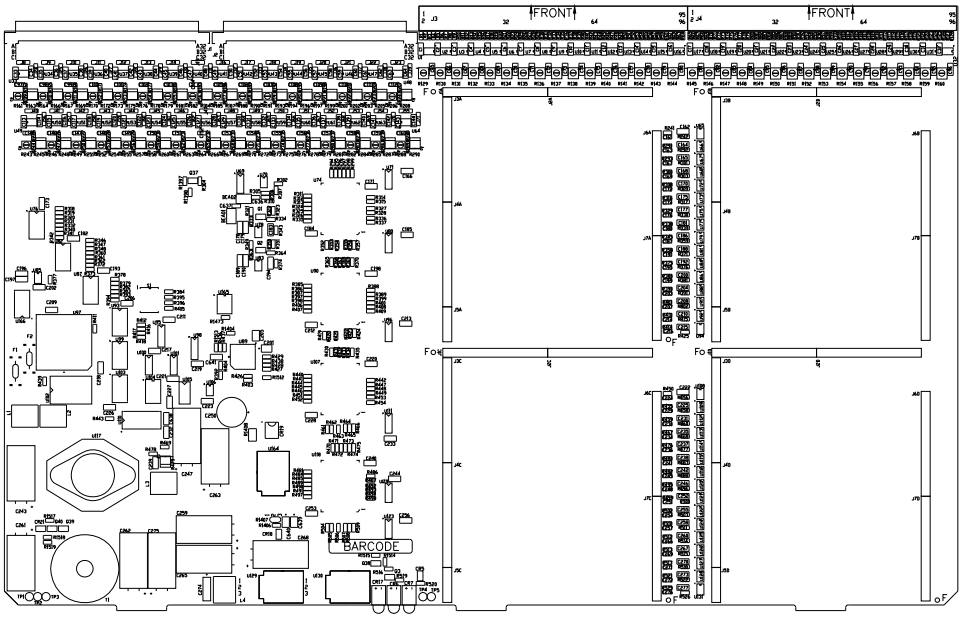


Figure 12. 32x32 Analog Video

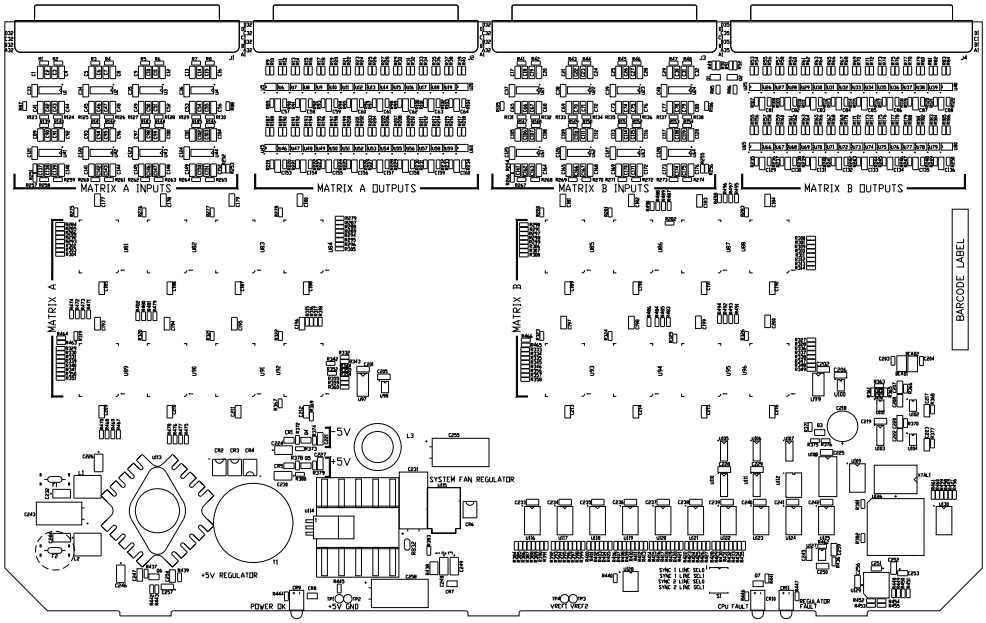


Figure 13. 32x32 Digital Audio

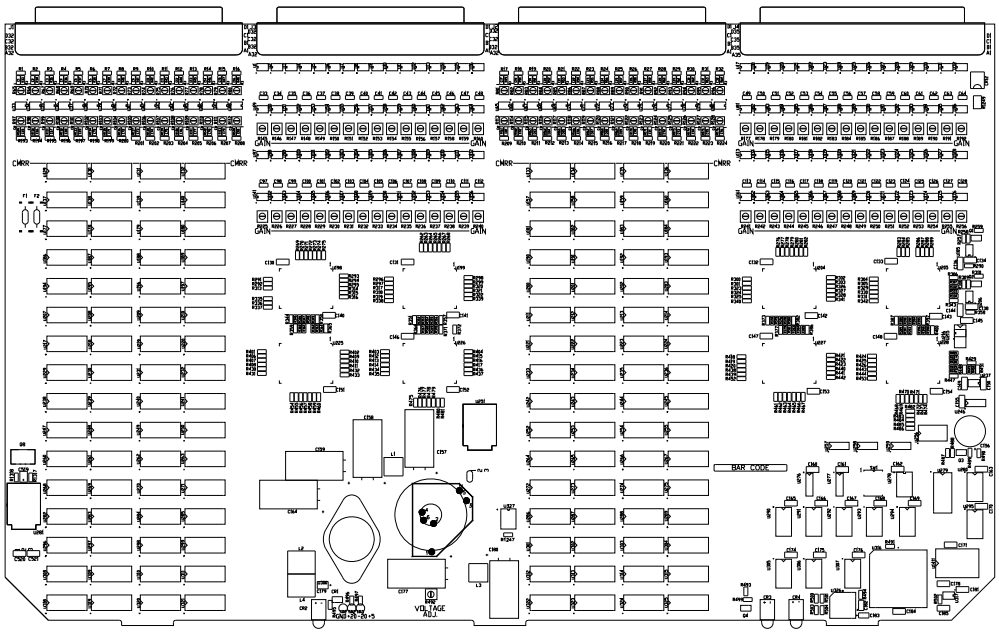


Figure 14. 32x32 Analog Audio

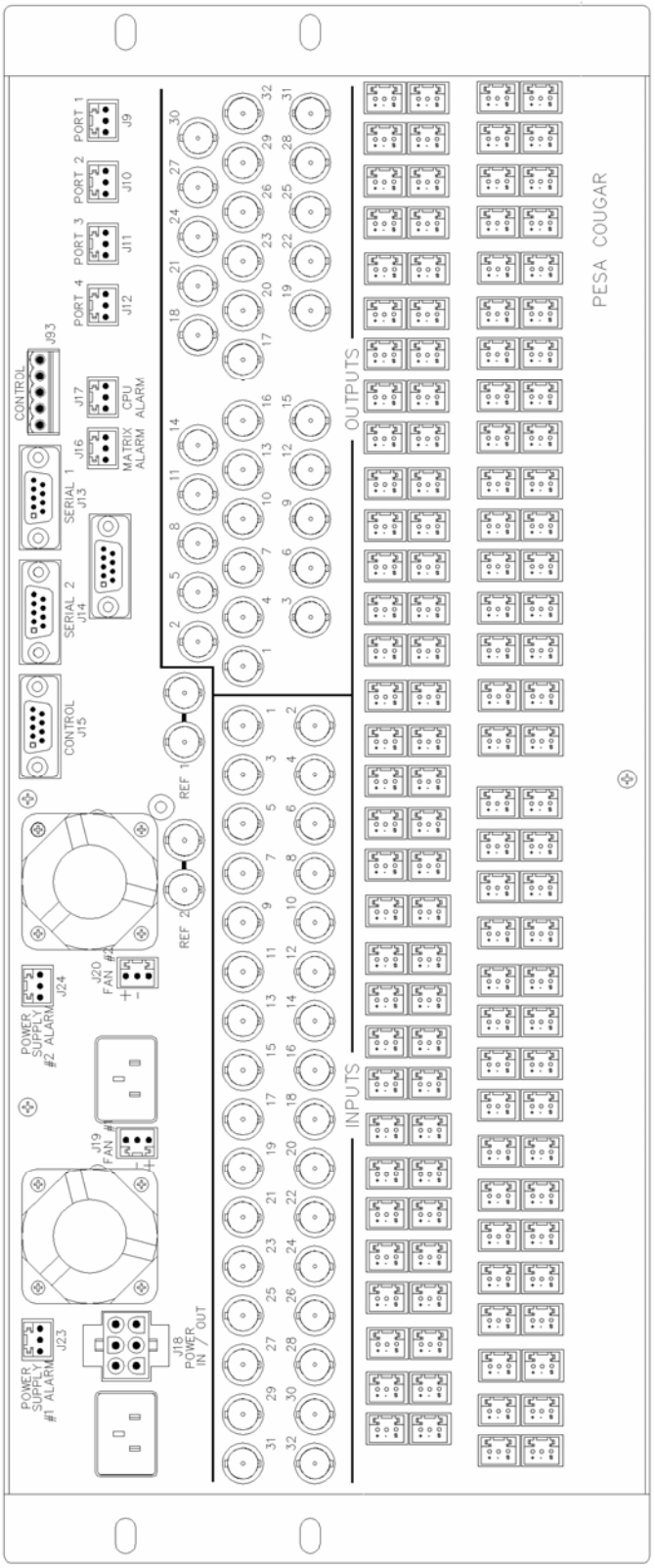


Figure 15. Cougar Combo Routing Switcher Back Plane

2.14 Rear Panel Connectors

The manual subsections discuss the various system connectors found on the rear back plane (rear panel) of the Cougar Combo Routing Switcher.

2.14.1 RCP Panel Connectors (J9-J12)

The RS485 panel port connectors allow the daisy-chained connection of up 64 remote control panels to the Cougar Digital Video Routing Switcher. Bi-directional communications between the internally installed System Controller(s) and the various models of PESA's low cost RCP control panels are sent and received over RS232 and RS 422 busses.

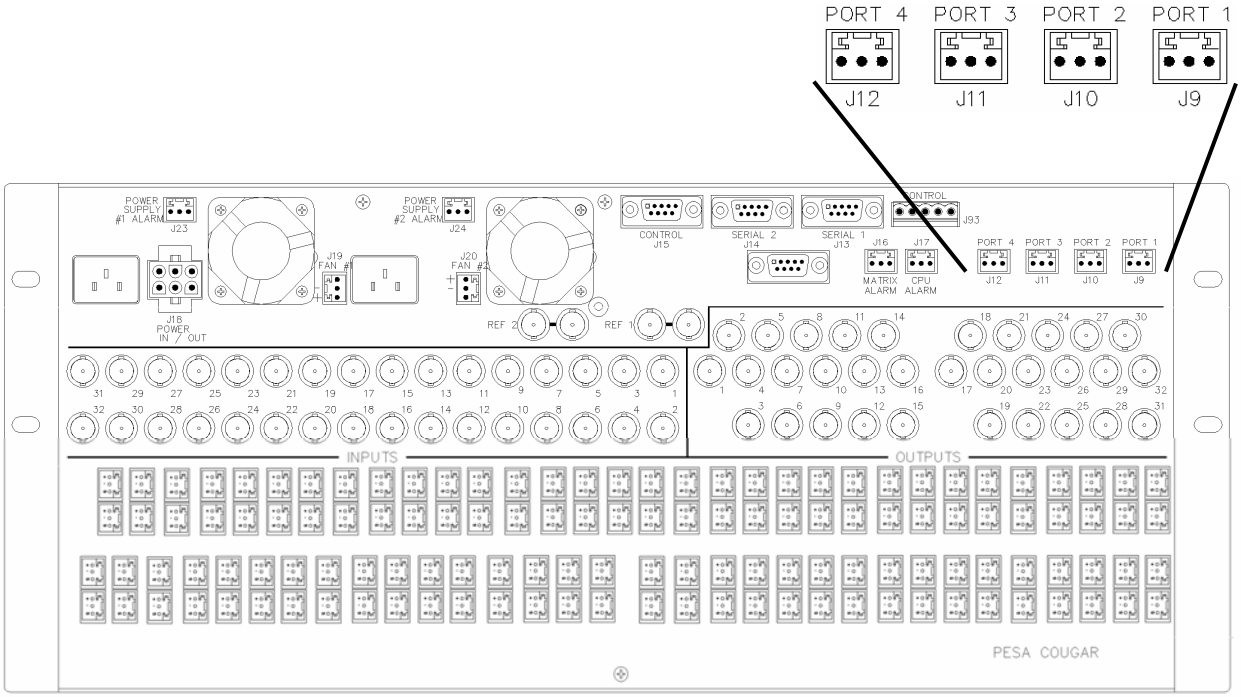


Figure 16. RCP Panel Connectors (J9-J12)

2.14.2 Serial (CPU Link) Connectors (J13 and J14)

The CPU Link connectors allow serial communications between the internally installed System Controller(s) and up to two external computers. The System Controller supports asynchronous, bi-directional communications, at 9600 baud. The protocol used in communication via these ports is a proprietary protocol developed by PESA for switcher control.

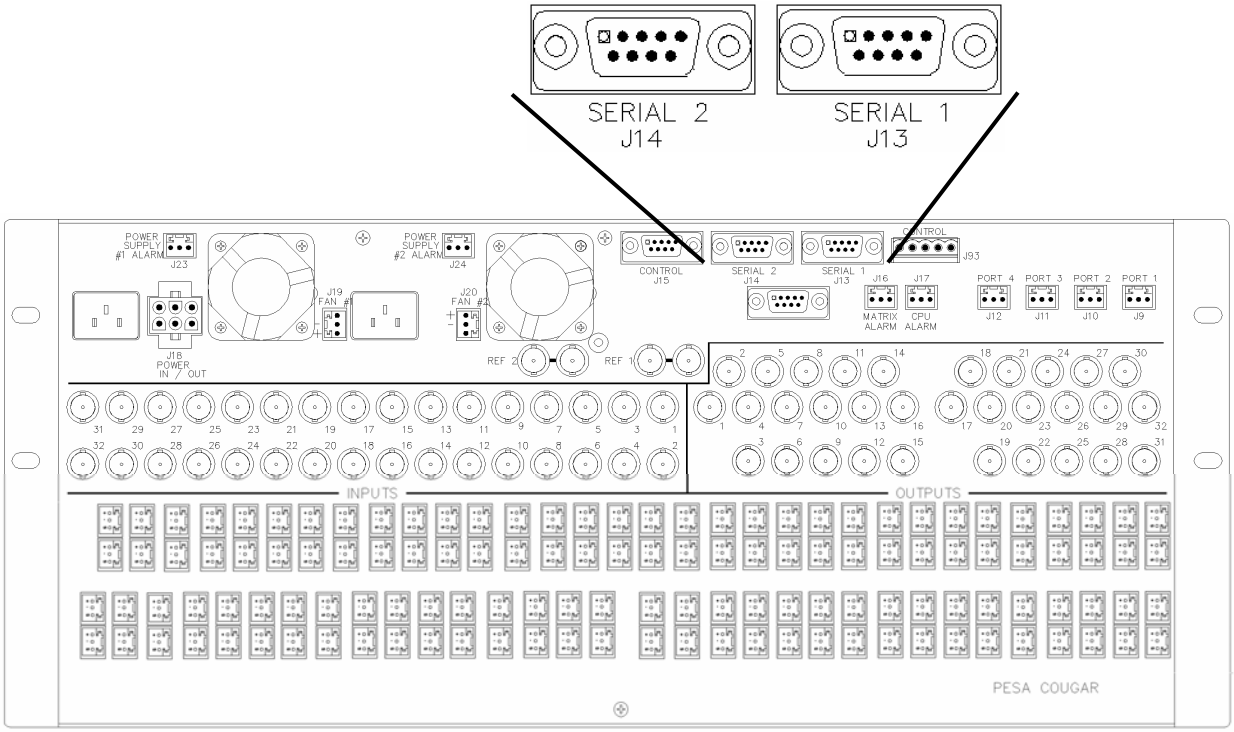


Figure 17. Serial (CPU Link) Connectors (J13 and J14)

The pinout for CPU link connector is as follows:

Table 7. Serial Connectors J13 and J14 Pinouts

PIN NO.	DESCRIPTION
1	CD
2	RX DATA
3	TX DATA
4	DTR
5	GROUND
6	DSR
7	RTS
8	CTS
9	N/C

2.14.3 Control (PRC) Connectors (J15 and J93)

J15 provides for the connection of an optional external controller to the Cougar Combo Routing Switcher. J93 provides for the connection of additional Cougar Combo Routing Switchers to form up to a 64x64 switching matrix. Both of the control connectors allow for the bi-directional transmission of data.

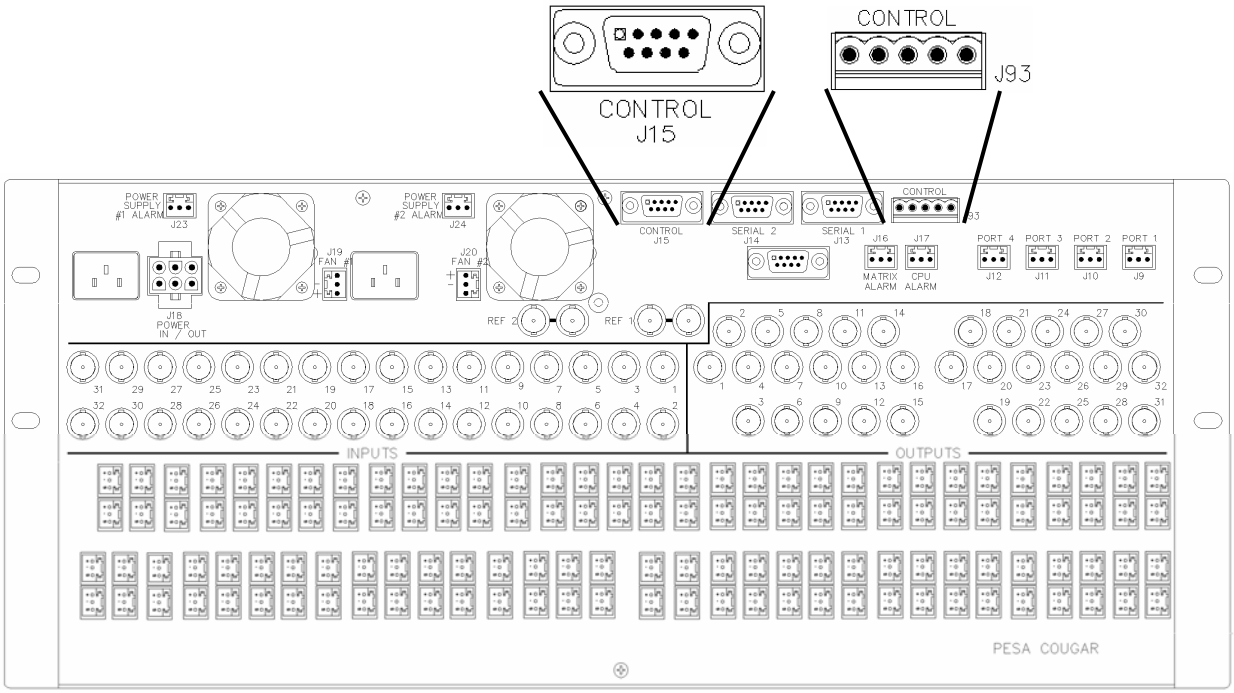


Figure 18. Control (PRC) Connectors (J15 and J93)

The pinout of control connector J15 is as follows:

Table 8. Control (PRC) Connector J15 Pinout

PIN NO.	DESCRIPTION
1	GROUND
2	RX+ DATA
3	TX- DATA
4	GROUND
5	SPARE
6	GROUND
7	RX- DATA
8	TX+ DATA
9	GROUND

The pinout of control connector J93 is as follows:

Table 9. Control (PRC) Connector J93 Pinout

PIN NO.	DESCRIPTION
1	TX+ DATA
2	TX- DATA
3	GROUND
4	RX+ DATA
5	RX- DATA

For PRC communications, the user should use a direct pin-for-pin cable for interfacing between the System Controller and the peripheral equipment.

Do NOT use a "NULL MODEM" cable.

2.14.4 Matrix Card Alarm Connector (J16)

An alarm circuit has been provided in the 32x32 matrix card's circuitry. This circuit acts as a switch to trigger an optional external alarm in the event of a controller fault or failure. The controller alarm circuit supplies a contact closure but does not provide a voltage to the external alarm. The Matrix Card Alarm Connector, located on the back plane, allows connection of the Matrix Card Alarm.

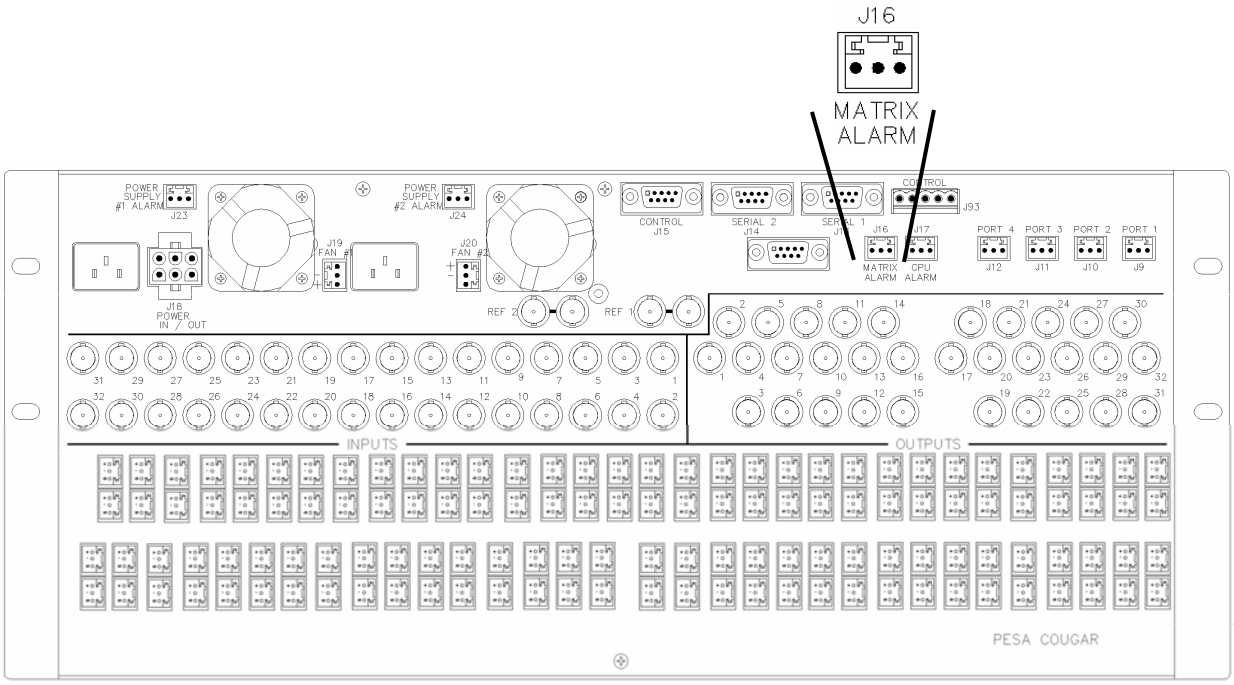


Figure 19. Matrix Card Alarm Connector (J16)

2.14.5 CPU Alarm Connector (J17)

Not used.

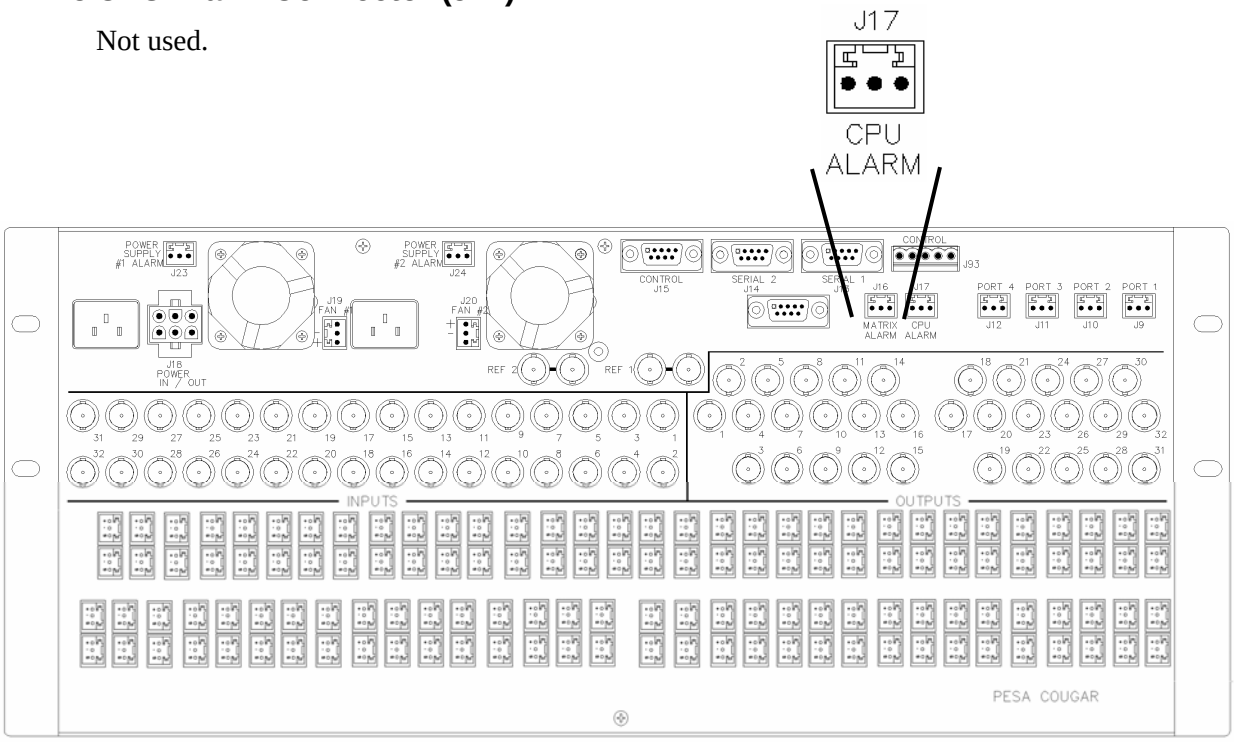


Figure 20. CPU Alarm Connector (J17)

2.14.6 Power In/Out Connector (J18)

Power can be supplied to the Cougar Combo Routing Switcher by the use of an externally mounted power supply, by the use of an internal PS130V Power Supply, or by the use dual internal PS130V Power Supplies. The use of at least one PS130V Power Supply per Cougar Combo frame is required to prevent overload conditions. The DC Power Connector can be used as DC power input (external power supply) or as DC power output (internal power supply or power supplies) to allow the Cougar Combo Routing Switcher to power additional video equipment items. External power supplies must be diode isolated from the internal power supply. A 1N5821 or equivalent type diode may be used for this purpose.

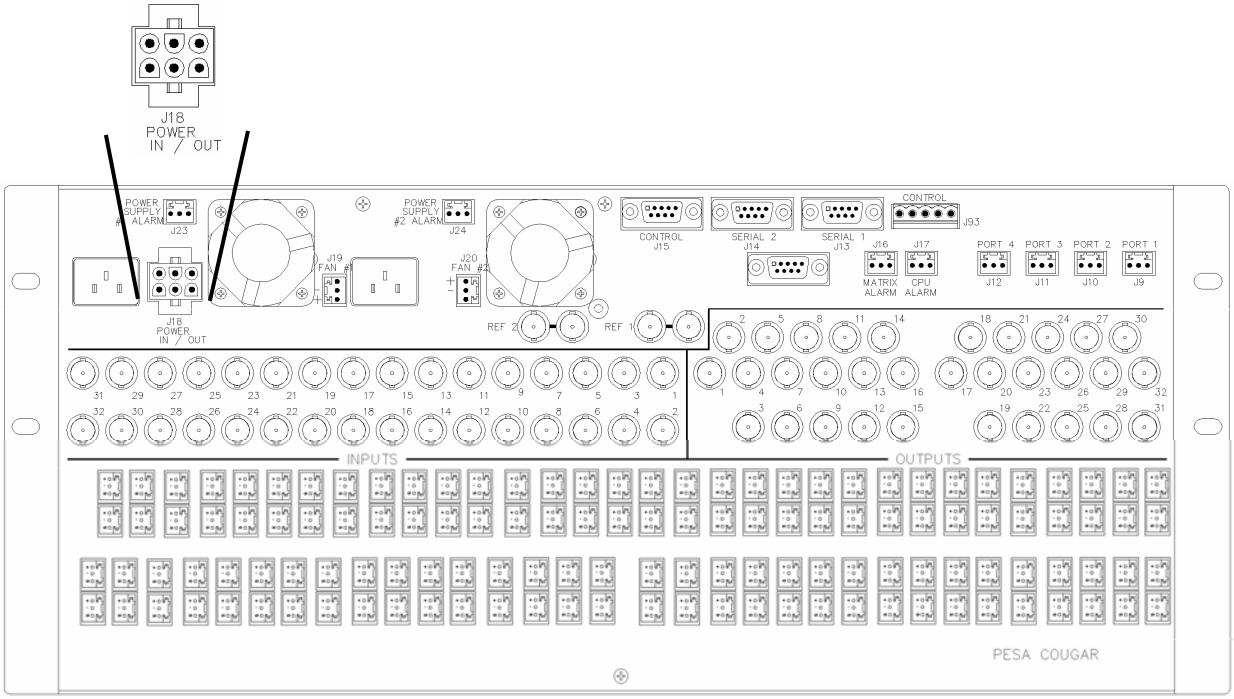


Figure 21. Power In/Out Connector (J18)

2.14.7 Power Supply Alarm Connectors (J23 and J24)

An alarm circuit has been provided in the PS130V Power Supply's circuitry. This circuit acts as a switch to trigger an optional external alarm in the event of a failure in the power supply or of the external 110VAC (220VAC for the international version) source. The alarm circuit supplies a contact closure but does not provide a voltage to the external alarm. The alarm connectors, located on the back plane, allow connection of external power supply alarms.

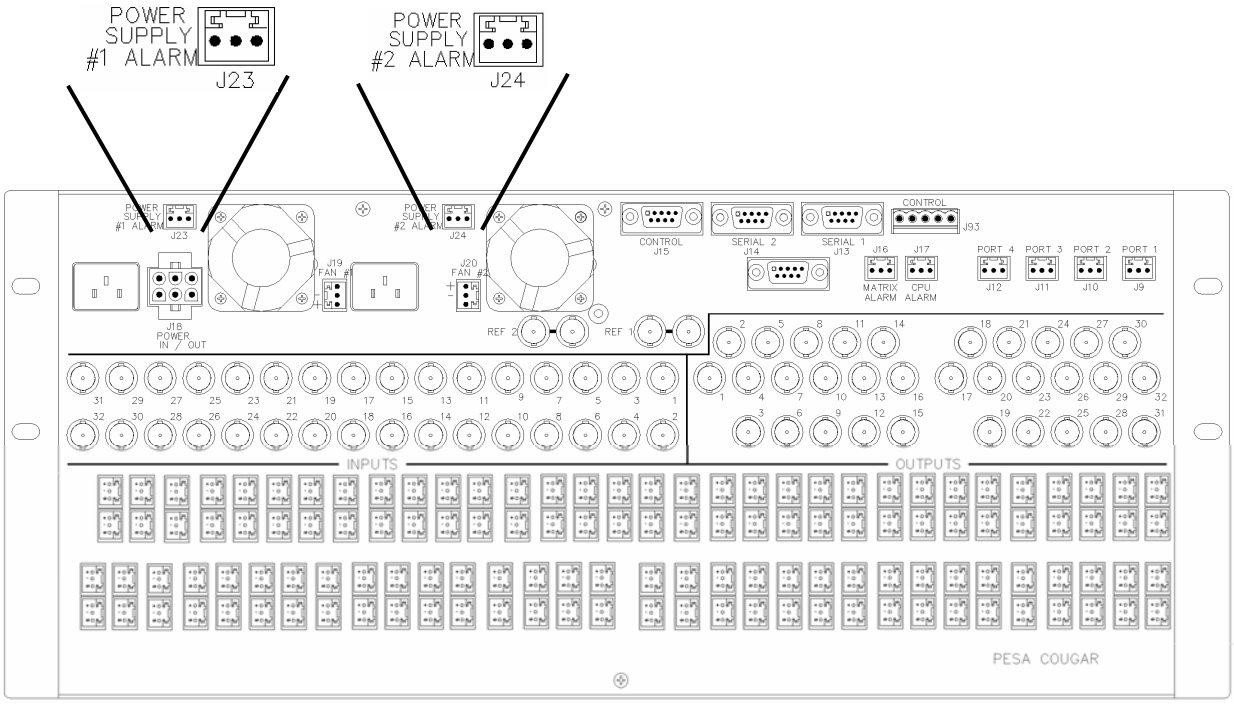


Figure 22. Power In/Out Connector (J18)

2.14.8 Reference (Sync) Connectors (1 and 2)

The sync connectors are used to connect an external sync signal to the Cougar Combo Routing Switcher. The sync signal may be either a color black or composite video signal. The use of an external sync signal allows switch changes to be accurately timed in the vertical interval. The sync connectors are loop-thru connectors and must be terminated with 75 Ohms if looping is not used.

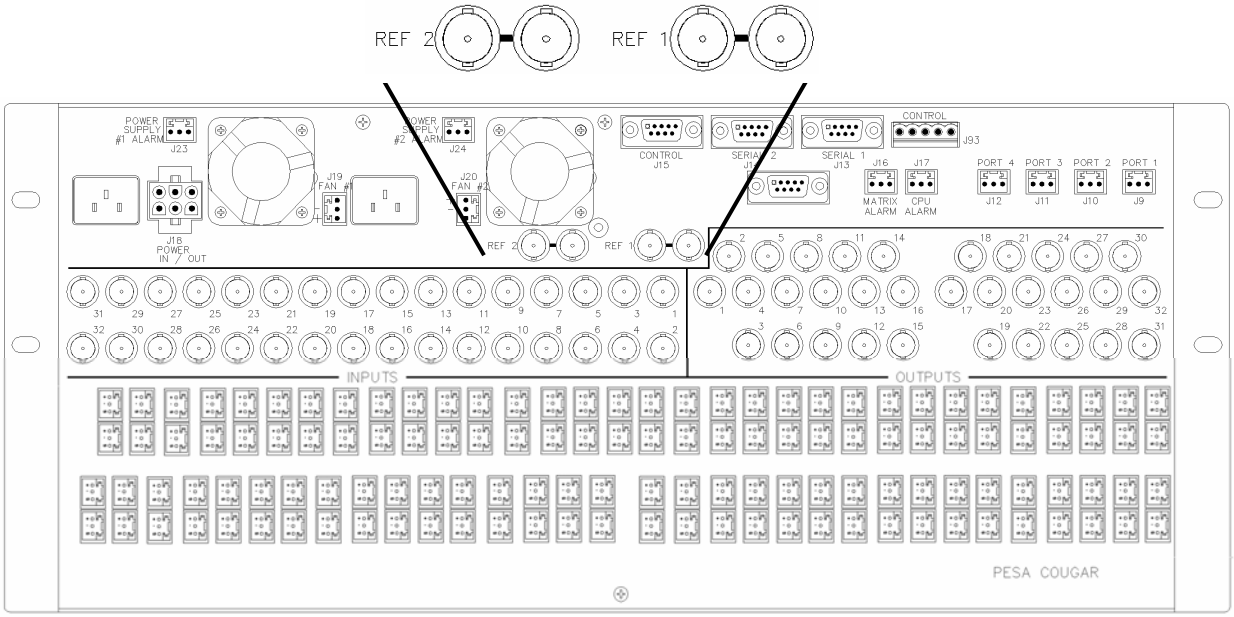


Figure 23. Reference (Sync) Connectors (1 and 2)

2.14.9 Video Input and Output Connectors

There are 32 BNC video input connectors and 32 BNC video output connectors located on the Cougar Combo Routing Switcher's rear panel. These connectors allow the connection of the video sources (input connectors) and video destinations (output connectors) to the Cougar Combo Routing Switcher. The video input connectors are internally terminated into 75 Ohms.

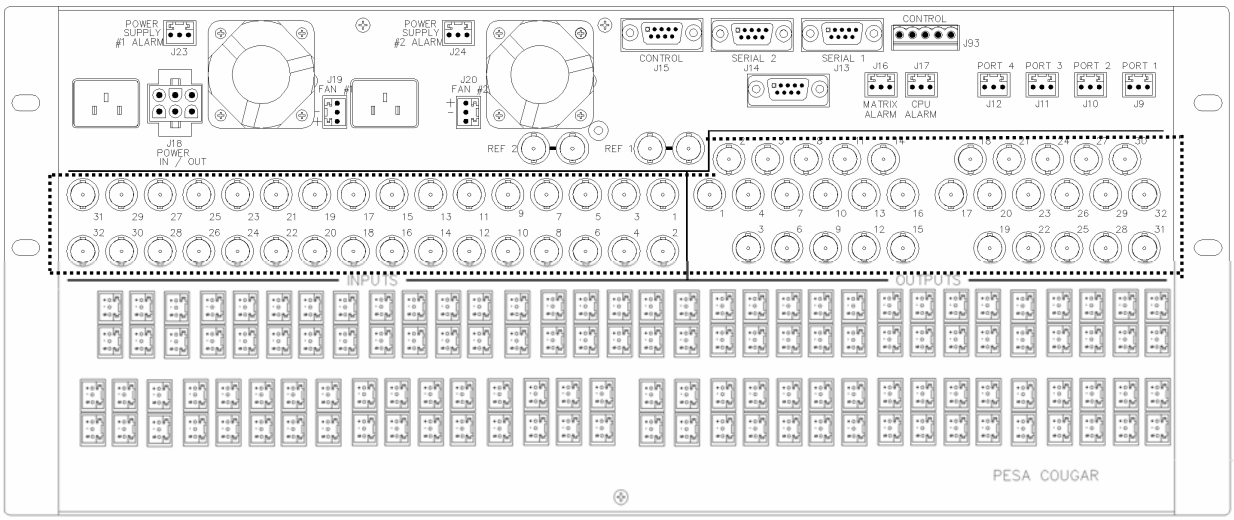


Figure 24. Video Input and Output Connectors

2.14.10 Audio Input/Output Connectors

There are 32 matrix A and B twisted pair audio input connectors and 32 matrix A and B twisted pair audio output connectors located on the Cougar Combo Routing Switcher's rear panel. These connectors allow the connection of the audio sources (input connectors) and audio destinations (output connectors) to the Cougar Combo Routing Switcher.

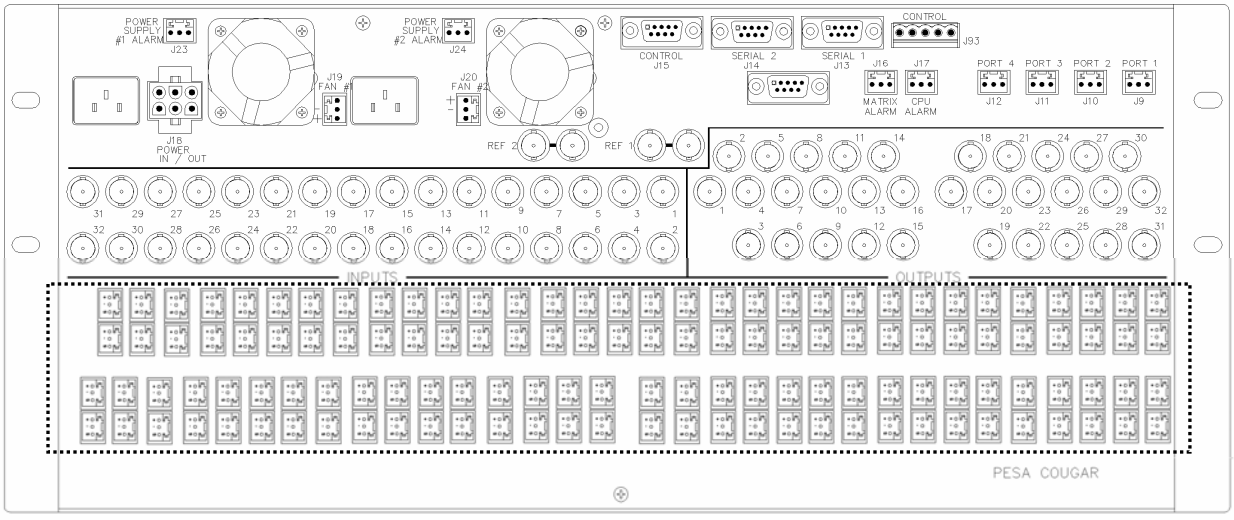


Figure 25. Audio Input/Output Connectors

2.14.10.1 Input Signal Connectors (A INPUTS, B INPUTS)

These 3-contact connectors provide the input signal interface. See Figure 26 for an orientation view showing contact locations.

The INPUT connectors are connected to the audio signal sources with cables constructed with 3-contact connectors (Part No. 81-9029-0811-0) and shielded, twisted-pair cable (Part No. 81-9028-0043-2, Belden 8451, or equivalent) as shown in Figure 28. The connector body has an integral strain relief which requires the use of a nylon cable tie (Part No. 81-9021-0028-8).

The following figure shows the contact locations when viewed from the rear of the chassis.

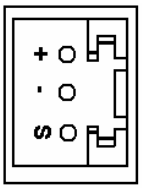


Figure 26. Input Signal Connector

The following figure shows a WECO connector. If the connector is not hot-stamped, refer to this figure for the contact locations.

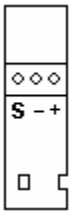


Figure 27. WECO Connector

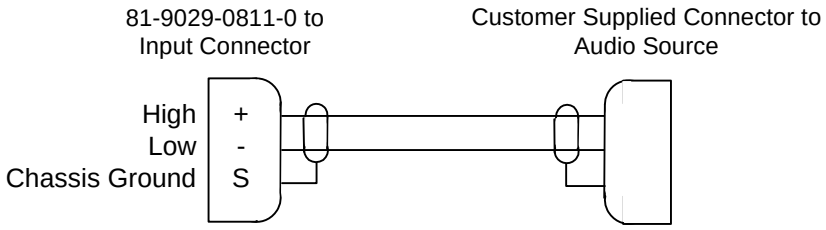


Figure 28. Input Signal Cable

2.14.10.2 Output Signal Connectors (A Outputs, B Outputs)

These 3-contact connectors provide the output signal interface. See Figure 29 for an orientation view showing contact locations.

The Output connectors re connected to the audio signal sources with cables constructed with 3-contact connectors (Part No. 81-9029-0811-0) and shielded, twisted-pair audio cable (Part No. 81-9028-0043-2, Belden 8451 or equivalent) as shown in Figure 31.

The connector body has an integral strain relief which requires the use of a nylon cable tie (Part No. 81-9021-0028-8).

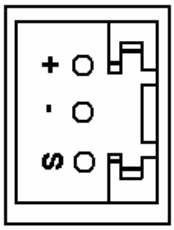


Figure 29. Output Signal Connector

The following figure shows a WECO connector. If the connector is not hot-stamped, refer to this figure for the contact locations.

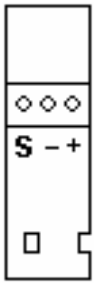


Figure 30. WECO Connector

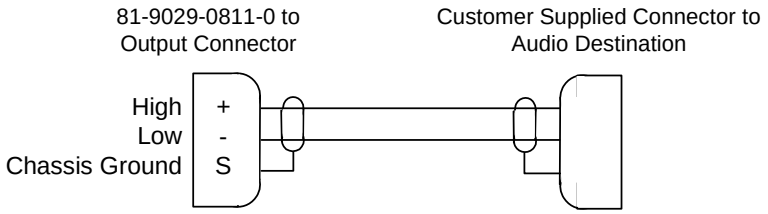


Figure 31. Output Signal Cable

2.15 System Connections

Once the Cougar Combo Routing Switcher is installed in the equipment rack, system connections can be made. Use the following guide to insure that the Cougar Combo Routing Switcher system interconnections are properly connected and that the control, power, sync, and digital video cables are correctly installed.

2.16 Connection Guide

See Figure 32 on the next page for an illustration of system connections.

1. Connect the external sync sources to the reference inputs using Belden 8281 coaxial cable or equivalent. Be sure to properly terminate the external sync sources into 75 Ohms.
2. Connect the primary external computer to the Serial 1 Connector using a 9-pin RS232 cable. Please note that this connection has to be made in order to configure the internal System Controller using the Control System software package. If a secondary external computer is to be used, connect it to the Serial 2 connector.
3. If additional Cougar Combo Routing Switchers are to be utilized as part of the switching matrix, connect J93 on the primary Cougar Combo Routing Switcher to J93 on the other Cougar Combo Routing Switchers using 5-pin ribbon cables.
4. If an external controller is to be utilized to control the Cougar Combo Routing Switcher, connect the external controller to J15 using 9-pin RS232 cable.
5. Connect the RCP control panels to the RS485 ports (J9-J12) using twisted pair cables. The connection to the control panel may be daisy chained.
6. If desired, connect an external alarm to the Matrix Board Alarm Connector (J17).
7. If desired, connect an external backup power supply to the power in/out connector (J18) or use the Cougar Combo Routing Switcher to power other video equipment by looping a power cable between J18 and the additional video equipment.
8. If desired, connect an external alarm to the power supply #1 alarm connector (primary power supply). If a secondary (redundant) power supply is installed in the Cougar Combo Routing Switcher, connect an external alarm to the power supply #2 alarm connector, if desired.
9. Connect the digital video sources to the video inputs using Belden 8281 coaxial cable or equivalent 75 Ohms coaxial cable.
10. Connect the video outputs to the digital video destinations using Belden 8281 coaxial cable or equivalent.

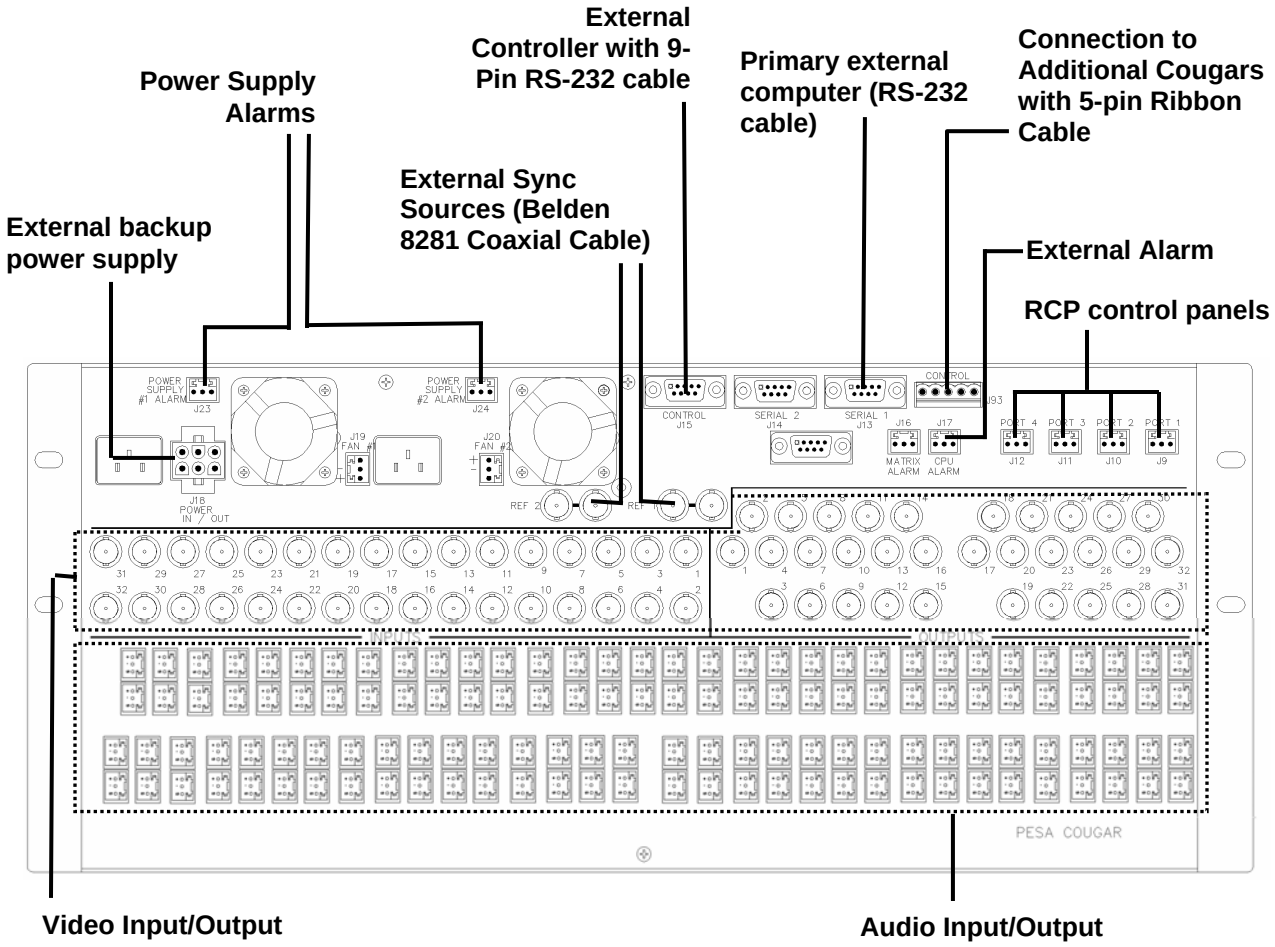


Figure 32. Connection Guide

Chapter 3 – Operation

3.1 General

The operation of the Cougar Combo Routing Switcher consists of periodically monitoring the 32x32 Video Matrix Card LEDs. The matrix card LEDs and their proper indications are discussed below.

3.2 Regulator Fault LED (Red) (CR24)

The Regulator Fault LED (CR24) is utilized to visually indicate a regulator problem on the video matrix card. A problem with the power supply or regulator circuits will cause this LED to light. However, in the event of a total power outage this LED will be rendered inoperable.

3.3 CPU Fault LED (Red) (CR25)

The CPU Fault LED (CR25) is utilized to visually indicate a microprocessor problem on the matrix card. A problem with the CPU or controller circuits will cause this LED to light.

3.4 Power OK LED (Green) (CR26)

The Power OK LED (CR26) on the front edge of the matrix card is utilized to visually indicate that the proper power supply voltage is being supplied to the card. A decrease in the brightness of this LED indicates an approximate 12% drop in voltage and should be checked. A 25% drop in voltage will cause the LED to extinguish.

3.5 32x32 Digital Video Matrix Card Adjustments

There are no user adjustments on the 32x32 Video Matrix Card.

3.6 32x32 Analog Video Matrix Card Adjustments

The 32x32 Analog Video Matrix Card is adjusted at the PESA factory prior to shipment and should only have to be readjusted if equipment repairs are made or if the equipment configuration changes. The adjustment of the 32x32 Analog Video Matrix Card consists of adjusting the common mode rejection ratio for each input and adjusting the DC offset and gain for each output. The following calibrated test equipment items or their equivalent is needed to accurately adjust the 32x32 Analog Video Matrix Card:

- Audio Generator
- Distortion Analyzer
- High Frequency Generator
- Spectrum Analyzer

- Oscilloscope
- Digital Voltmeter
- 75 Ohms Termination

3.6.1 Voltage Adjustment

The voltage adjustment provides the means to adjust the output of the 32x32 Analog Video Matrix Card's power regulator circuits. To adjust the voltage adjustment on the 32x32 Analog Video Matrix Card, take the following steps:

1. Set the digital voltmeter to a range of approximately 10V DC.
2. Connect the digital voltmeter's high input to TP1 (+5.6V DC) and low input to TP3 (ground).
3. Adjust the voltage adjustment for a +5.6V DC $\pm$0.1 reading on the digital voltmeter.
4. Move the digital voltmeter's high input to TP2 (-5.6V DC). The reading on the digital voltmeter should be -5.6V DC $\pm$5%.
5. Disconnect the digital voltmeter from the test points.

3.6.2 Common Mode Rejection Ratio (CMRR)

The input common mode rejection ratio adjustments provide the means to eliminate unwanted common mode noise and hum on the 32x32 Analog Video Matrix Card's outputs. To set the common mode rejection ratio adjustments on the 32x32 Analog Video Matrix Card, take the following steps:

1. Short the high side (center pin) of the selected video input to the low side (shield) of the same input.
2. Connect the audio generator to the distortion analyzer.
3. Adjust the audio generator for a 60Hz at +8.0dB output as displayed on the distortion analyzer.
4. Disconnect the audio generator from the distortion analyzer.
5. Connect the high side of the audio generator's output to the short between the high side and low side of the selected video input. Connect the low side of the audio generator's output to ground.
6. Connect the distortion analyzer to the one of the video outputs.
7. Switch the selected video input to the selected video output.
8. Adjust the CMRR adjustment for the selected video input for a null (lowest) reading on the distortion analyzer. The null reading should be at least -80dB below the input of +8.0dB.
9. Repeat steps 1-8 for each video input. Once all of the CMRR adjustments have been completed, disconnect all test equipment.

3.6.3 DC Offset

The output DC offset adjustments provide the means to eliminate the unwanted DC voltage level on the 32x32 Analog Video Matrix Card's outputs. To adjust the DC offset adjustments on the 32x32 Analog Video Matrix Card, take the following steps:

1. Do not apply any input signals to the 32x32 Analog Video Matrix Card while adjusting the matrix card's DC offset adjustments.
2. Connect the digital voltmeter to a video output.
3. Set the digital voltmeter to low DC range (approximately 100mV).
4. Adjust the DC offset correlating to the selected video output the lowest reading on the digital voltmeter. The lowest reading should be 0 $\pm$ 10mV DC.

Repeat steps 2-4 for each video output. Once all of the DC offset adjustments have been completed, disconnect all test equipment.

3.6.4 Gain

The output gain adjustments provide the means to adjust the 32x32 Analog Video Matrix Card's outputs for unity gain (outputs equal to inputs). To adjust the gain adjustments on the 32x32 Analog Video Matrix Card, take the following steps:

1. Connect the high frequency sweep generator to the spectrum analyzer. Be sure to terminate the high frequency generator's output into 75 Ohms.
2. Adjust the sweep generator for a 1KHz to 10MHz at 0dB display on the spectrum analyzer.
3. Disconnect the sweep generator from the spectrum analyzer. Be sure to leave the spectrum analyzer's input terminated with 75 Ohms.
4. Connect the sweep generator to one of the analog video matrix card's inputs.
5. Connect the spectrum analyzer to one of the analog video matrix card's outputs.
6. Switch the selected input to the selected output.
7. Adjust the gain correlating to the selected output for a 0dB $\pm$0.1dB display on the spectrum analyzer at 100KHz. A vertical display of $\pm$0.1dB per division is recommended.
8. Repeat steps 5-7 until all of the analog video matrix card's gain adjustments have been completed. Once all of the gain adjustments have been completed, disconnect all test equipment.

3.7 Operation of the Analog and Digital Audio Matrix Card

The operation of the Cougar Combo Routing Switcher consists of periodically monitoring the 32x32 Audio Matrix Card LEDs. The matrix card LEDs and their proper indications are discussed below.

3.8 Regulator Fault LED (Red) (CR3)

The Regulator Fault LED (CR3) is utilized to visually indicate a regulator problem on the matrix card. A problem with the power supply or regulator circuits will cause this LED to light. However, in the event of a total power outage this LED will be rendered inoperable.

3.9 CPU Fault LED (Red) (CR4)

The CPU Fault LED (CR4) is utilized to visually indicate a microprocessor problem on the matrix card. A problem with the matrix card CPU or controller circuits will cause this LED to light.

3.10 Power OK LED (Green) (CR2)

The Power OK LED (CR2) on the front edge of the matrix card is utilized to visually indicate that the proper power supply voltage is being supplied to the card. A decrease in the brightness of this LED indicates an approximate 12% drop in voltage and should be checked. A 25% drop in voltage will cause the LED to extinguish.

3.11 32x32 Digital Audio Matrix Card Adjustments

There are no user adjustments on the 32x32 Digital Audio Matrix Card.

3.12 32x32 Analog Audio Matrix Card Adjustments

The 32x32 Audio Matrix Card is adjusted at the PESA factory prior to shipment and should only have to be readjusted if equipment repairs are made or if the equipment configuration changes. The adjustment of the 32x32 Audio Matrix Card consists of adjusting the voltage adjustment, adjusting the common mode rejection ratio for each input, and adjusting the gain for each output. The following calibrated test equipment items or their equivalent is needed to accurately adjust the 32x32 Analog Audio Matrix Card:

Audio Generator

- Distortion Analyzer
- Digital Voltmeter
- Oscilloscope
- 600 Ohms Termination

3.12.1 Voltage Adjustment

The voltage adjustment provides the means to adjust the output of the 32x32 Audio Matrix Card's power regulator circuits. To adjust the voltage adjustment on the 32x32 Audio Matrix Card, take the following steps:

1. Set the digital voltmeter to the 100V DC range.
2. Connect the digital voltmeter's high input to TP1 (+20V DC) and low input to TP3 (ground).
3. Set the voltage adjustment for a +20V DC ±0.5 reading on the digital voltmeter.
4. Disconnect the digital voltmeter's high input from TP1 and connect it to TP2 (-20V DC). Check the digital voltmeter for -20V DC ±0.5 reading.
5. Disconnect the digital voltmeter from the test points.

3.12.2 Common Mode Rejection Ratio (CMRR)

The input common mode rejection ratio adjustments provide the means to eliminate unwanted noise and hum on the 32x32 Audio Matrix Card's outputs. The CMRR adjustments are set at the PESA factory and should only need to be readjusted after port changes. To adjust the common mode rejection ratio adjustments on the 32x32 Audio Matrix Card, take the following steps:

1. Short the high side (+ pin) of the selected audio input to the low side

(- pin) of the same input (i.e. short the plus and minus pins together).

2. Connect the audio generator to the distortion analyzer.
3. Adjust the audio generator for a 60Hz at +28dB output as displayed on the distortion analyzer.
4. Disconnect the audio generator from the distortion analyzer.
5. Connect the high side of the audio generator's output to the short between the high side and low side of the selected audio input. Connect the low side of the audio generator's output to ground.
6. Connect the distortion analyzer to the one of the audio outputs.
7. Switch the selected audio input to the selected audio output.
8. Adjust the CMRR for the selected audio input for a null (lowest) reading on the distortion analyzer. The null reading should be at least -80dB below the input level.
9. Repeat steps 1-8 for each audio input. Once all of the CMRR adjustments have been completed, disconnect all test equipment.

3.12.3 Gain

The output gain adjustments provide the means to adjust the 32x32 Analog Audio Matrix Card's outputs for unity gain (outputs equal to inputs). To adjust the gain adjustments on the 32x32 Analog Audio Matrix Card take the following steps:

1. Connect the audio generator to the distortion analyzer.
2. Adjust the high frequency generator for a 10KHz at +28dB display on the distortion analyzer.
3. Disconnect the audio generator from the distortion analyzer.
4. Connect the audio generator to one of the audio matrix card's inputs.
5. Connect the distortion analyzer to one of the matrix cards.
6. Switch the selected input to the selected output.
7. Adjust the gain adjustment correlating to the selected output for a +28dB $\pm$0.1dB display on the distortion analyzer.
8. Repeat steps 5-7 until all of the audio matrix card's gain adjustments have been completed. Once all of the gain adjustments have been completed, disconnect all test equipment.

The gain will change a little less than 1dB when a 600 Ohms termination is used on an output. The gain adjustment is intended (only) to make up for the 1dB change. PESA recommends leaving the outputs not terminated. The Cougar Combo Routing Switcher is shipped with its outputs set for unity gain with no termination.

Chapter 4 – Maintenance

This section will cover the maintenance, troubleshooting, and repair of the Cougar Combo Routing Switcher.

This equipment contains static sensitive devices. It is recommended that a grounded wrist strap and mat be used while making repairs or adjustments.

4.1 General

The Cougar Combo Routing Switcher is designed to produce the proper signal levels throughout the frame. There are no adjustments on the 32x32 Digital Audio Matrix Card and the need for regular maintenance is minimal.

4.2 Test Equipment

The test equipment recommended for servicing the Cougar Combo Routing Switcher and its associated circuit cards is listed below. Equivalent test equipment may be used.

- Audio Generator
- Digital Voltmeter
- High Frequency Generator
- Spectrum Analyzer
- Digitizing Oscilloscope
- Pattern Generator
- Oscilloscope
- Distortion Analyzer
- 75 Ohms Termination
- 600 Ohms Termination

4.3 Preventive Maintenance

To avoid possible electric shock, remove all power supply cords before servicing.

Use the following guidelines for general preventive maintenance:

1. Keep the inside of the equipment items clean, especially if your facility is subject to dust or dirt in the atmosphere. Use compressed air, an antistatic cloth, or a gentle vacuum to clean the frame and internal components.

2. Observe proper procedures for preventing electrostatic discharge when cleaning the units, and when inserting and removing cards.

3. Ensure that all tools and personnel handling individual components are properly grounded.

4. Avoid covering the front grille for any extended period. Blocking the front grille will block the air flow through the fan and may overheat the internal circuit cards.

4.4 Maintenance

The Cougar Combo Routing Switcher and its associated circuit cards are designed and manufactured to give long, trouble free service with minimum maintenance requirements. If problems do occur, follow the troubleshooting procedure provided in this section

4.5 Corrective Maintenance

The following paragraphs provide information to assist the servicing technician in maintenance of the Cougar Combo Routing Switcher and its associated circuit cards.

4.6 Factory Repair Service

If desired, equipment or boards may be returned to the factory (transportation prepaid) for repair. Refer to the General Assistance and Service information sheet in the front of this manual. Call the PESA Service Department for a RMA number before shipping an equipment item.

Pack the equipment securely and label with the correct address. Proper packaging saves money. The small amount of extra care and time it takes to cushion a part or unit correctly may prevent costly damage while in transit. Make certain that the address is both legible and complete. Failure to do so often results in delay or even loss.

4.7 Troubleshooting

The best troubleshooting tool is a familiarity with the equipment and a through understanding of its operation. Before troubleshooting the Cougar Combo Routing Switcher or its associated circuit cards review Sections 3 of this manual. Use the functional descriptions and adjustment procedures to quickly locate problems.

If a problem is suspected with an individual circuit card, first swap out the card and recheck the system for the problem. If the problem can be isolated to the card, and your facility is equipped for component level repair, proceed with repairs.

Before proceeding with component level repair, make sure the equipment is out of warranty. Repairing equipment covered by a warranty will void the warranty.

4.8 System Checks

Prior to troubleshooting the Cougar Combo Routing Switcher the following basic system checks should be performed.

1. Verify the AC circuit condition. Ensure the unit is receiving the correct voltage from the main AC power source.
2. Check all line fuses and power cords.
3. Ensure that all circuit cards are firmly seated
4. Ensure all interconnecting cables and connectors are plugged in or firmly seated.
5. If applicable, ensure main power switch is turned on.

4.9 Replacement Parts

Only parts of the highest quality have been used in the design and manufacture of the Cougar Combo Routing Switcher and its associated circuit cards. If the inherent stability and reliability are to be maintained, replacement parts must be of the same quality. A replacement parts list is provided in Section 7 of this manual. When replacing parts, avoid using excessive solder on the printed circuit board. Always make sure that the solder does not short two circuits together. Be sure the replacement part is identical to the original, and is placed in exactly the same position with the lead lengths (if applicable).

4.10 Filter Cleaning

The front door of the Cougar Combo Routing Switcher contains an air filter. The air filter should be cleaned on a periodic basis. Remove the filter from the door and clean it with soapy water or low pressure air. After drying reinstall the filter in the door.

4.11 PS130V Power Supply

Replacement of the two power supply fuses is accomplished by disconnecting power to the unit, removing the power supply and disassembling the fuse holder on the rear of the supply. The replacement value of the power supply fuses is 3.15 Amp for line voltages from 90-250 VAC.