PESA
Switching
Systems

CHEETAH SERIES 256X256R FULLY REDUNDANT VIDEO MATRIX SWITCHER

Cheetah 256CX Frame
Using 144x144 Matrix CCA

Technical Addendum

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Table Of Contents

List Of Figures

List Of Tables

Chapter 1   INTRODUCTION

1.1   PURPOSE OF TECHNICAL ADDENDUM

This Technical Addendum (TA) addresses the 256 Input by 256 Output Fully Redundant (256X256R) Routing Switcher built by PESA Switching Systems, Inc., and how it differs from a "standard" Cheetah Generation I (CH Series) product. It is assumed that the user has access to PESA Technical Manual 81-9059-0570-0, Rev. A, entitled *Cheetah Series Video Matrix Switchers*. It is also assumed that the user has a good understanding of the structure of a routing switcher and the top-level function of the various Circuit Card Assemblies (CCAs) and other modules used in the frame. With the exception of the 144X144 Matrix CCA, the hardware and components introduced and discussed in the Technical Manual apply to the 256CX switcher. The 256X256R switcher is built using a Cheetah Generation I 256X, 18 RU frame, but incorporates the latest generation 144X144 Matrix Circuit Card Assembly (CCA). Note however, in the 256X256R switcher, 128 input and 128 output channels of the 144X144 Matrix are used. For the user who may be unfamiliar with the previous generation Cheetah Series, a brief background of the Generation I product and the differences this router introduces are presented in the following paragraphs.

Cheetah CH Series Routing Switcher Frames, currently referred to as Generation I Frames, offer a great deal of versatility and flexibility due to the modular concept of the component backplanes used to configure a system. When a Generation 1 Routing Switcher is built, a chassis frame of the proper size to accommodate the required number of CCAs, Modules and other system components is fitted with backplane assemblies that interface the Input and Output CCAs (mounted through the rear of the switcher frame) with the Matrix CCAs, Power and Control components located internal to the switcher frame. Likewise, the Matrix CCAs and other internal components attach to dedicated backplanes for power and signal distribution. The various types of backplanes (I/O and Matrix) used to configure a system are interconnected. Each backplane, and its associated CCA(s) or module(s), may be loosely thought of as a "building block" for a particular switcher configuration. A series of DIP switches and rotary switches on the various backplanes are factory set to assign the "personality" to each of the system components. This scheme of assigning identification to the backplane and interface ports allows full interchangeability between like CCAs in the system.

Of particular interest to this TA is the Matrix CCA and its associated backplane. Cheetah Generation I Series switchers are built around a 64X64 Matrix CCA that provides an array of 64 inputs and 64 outputs available on each card. With the exception of the Generation I 64X (64X64) Switcher, all other Generation I frames in the CH Series use a 128 input by 128 output Matrix Backplane that supports and provides interface functions to four 64X64 Matrix CCAs. This backplane is referred to as the 128 Backplane. For purposes of this discussion, think of the backplane and its associated matrix CCAs as a modular unit providing 128 input channels and 128 output channels.

A single Generation I 256X Frame provides physical space and interface functions for up to two backplane "modules." Fitting this frame with two 128 Backplane modules does indeed provide a 256 input by 256 output matrix array. However, configuring a fully redundant matrix switcher requires two independent instances of the entire matrix configuration. Two 128 backplanes can not fulfill both the array size and the redundancy requirement for the switcher configuration addressed by this TA. Using the Generation I 128 Backplane and 64X64 Matrix CCAs, the largest fully redundant array size that can be configured in a single 18 RU Frame is 128X128.

As product technology evolved, PESA Engineers developed a 144 Input by 144 Output (144X144) Matrix CCA. This latest, larger array card allows for a 256 input by 256 output matrix backplane, occupying the same frame space as the previous 128 Backplane. This backplane is referred to as the 288 Backplane. The backplane can support up to 288 inputs by 288 outputs, however in the 256X256R application, the backplane is used as a 256X256 configuration. It consists of 4 144X144 Matrix CCAs, and is the same physical size and footprint as the 128 Backplane. While technically not a Cheetah Generation I Series CCA, the 144 Matrix card is perfectly adaptable to the Generation I frames (128X and larger). Thus, denser array matrices are possible using the same rack space as the Generation I Series frames.

Incorporating the 144X144 Matrix CCA(s) and the 288 Backplane into the Generation I 256X Frame easily accommodates the requirement for the fully redundant 256X256 Routing Switcher addressed by this TA. In this application, two 256 Backplane "modules" are installed in the 256X frame. Each 256 Backplane assembly functions as a totally independent 256X256 matrix array, thus providing two instances of the matrix array required for redundancy. Two 256 Backplane assemblies, populated with eight 128X128 Matrix CCAs provide the required fully redundant I/O capacity. Cheetah Power Supply Modules, the System Controller CCA(s) and Frame Controller CCA(s) are also used in configuring the 256X256R routing switcher.

Contained in this TA, as a supplement to the Cheetah Generation I Technical Manual, is an introduction to the 144 Matrix CCA (used and identified as 128X128 in this application); plus specifications, layout drawings, DIP and rotary switch settings, and card slot identification peculiar to the 256X256R system configuration.

1.2 144x144 VIDEO (CROSSPOINT) MATRIX CARD

In the 256X256R application the 144x144 Video Matrix Card selects one of 128 inputs to each of 128 outputs. Input signals from the input buffer cards are buffered to the input of a high-speed matrix. The output of the matrix is again buffered and sent to the output combiner cards. Since the 144X144 matrix card is used as a 128 input X 128 output in this application, for simplicity the remainder of this text will refer to the 144X144 matrix as 128X128.

1.2.1 128 Input X 128 Output Digital Video Matrix Card

As the name implies, the 128 X 128 digital matrix card accepts up to 128 SDI or HD video sources from the input buffer cards and provides up to 128 output channels to the output combiner cards. All switching is done by a special purpose device, controlled by commands from the matrix frame controller. Any input signal may be routed to any or multiple output channels of the card. When the I/O capacity of the switcher is greater than can be satisfied by a single 128 X 128 matrix card, as is the case with the 256X256R frame addressed by this TA, multiple matrix cards are used to meet the required capacity.

There are six LEDs located on the front edge of each matrix card that provide a visual indication of the operational status of the card, these are identified by Figure 1-1 Table 1-1 lists the possible states and interpretation data for the LEDs.

Figure 1-2 is a block diagram of the 128 X 128 digital matrix card. Paragraph 1.2.2 presents a narrative description of the circuit functions shown on the block diagram.
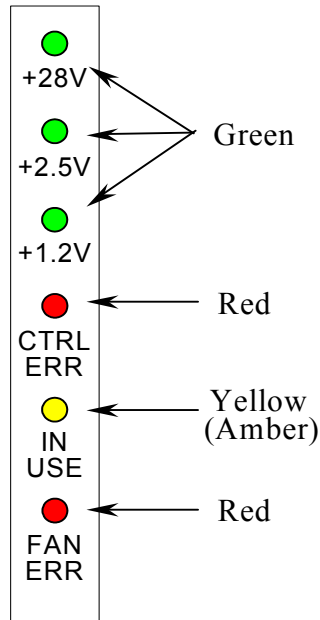
FIGURE 1-1   128x128 VIDEO CROSSPOINT MATRIX CARD LED INDICATORS

1.2.2   Functional Description – 128 X 128 Digital Video Matrix Card

Refer to Figure 1-2 as we discuss the various circuit functions of this card. There are 128 identical input channel paths provided. Video signals are derived from the output channels of the input buffer cards and routed to the inputs of the matrix card. As a signal enters the card it is routed to an Input Buffer stage, internal to the crosspoint device. This device contains the switching circuitry to deliver a signal on any of its 128 input channels to any of its 128 output channels. Switching data for the crosspoint device is received from the on-board microcontroller circuitry. The crosspoint also contains 128 output buffer stages, internal to the device, for isolation. Video from each device channel is available at the card edge connector where it is routed to the output combiner cards.

The On-Board Microcontroller is the interface between the matrix card and the frame control system. The microcontroller constantly monitors the status and health of the card and reports this data to the system frame controller. Commands from the frame controller are interpreted by the microcontroller circuitry and select the active inputs and outputs of the crosspoint device. Data indicating the status of the operating voltage rails is sent to the microcontroller by circuitry contained in the Voltage Regulator stage. The microcontroller also provides a visual indication of certain board functions by controlling the operating state of the status LEDs. Operating voltages necessary to power the matrix card circuitry are derived from on-board voltage regulator devices.

TABLE 1-1   128X128 VIDEO CROSSPOINT MATRIX CARD LED DESCRIPTIONS

LED	COLOR	STATUS	DESCRIPTION
+28V	Green	ON	Indicates that the +28Vpower is stable and within normal operating parameters.
		OFF	Indicates that +28V is not stable; power supplies are not working.
+2.5V	Green	ON	Indicates that the +2.5Vpower is stable and within normal operating parameters.
		OFF	Indicates that +2.5V is not stable; power supplies are not working.
+1.2V	Green	ON	Indicates that the +1.2Vpower is stable and within normal operating parameters.
		OFF	Indicates that +1.2V is not stable; power supplies are not working.
Ctrl Err	Red	ON	Indicates that a control error has occurred, or that a loss of receive clock from frame controller has been detected. A control error includes a bad CRC of the received data, incorrect number of words in the message being received, or corrupted data in the message being received. The LED will remain on until a message with a good CRC has been received.
		Blinking	Indicates a missing receive clock error.
		OFF	No alert conditions are present.
In Use	Yellow	ON	Indicates that a crosspoint on the matrix card is activated.
Fan ERR	Red	ON	Indicates a failure of the cooling fan on-board the crosspoint device. .
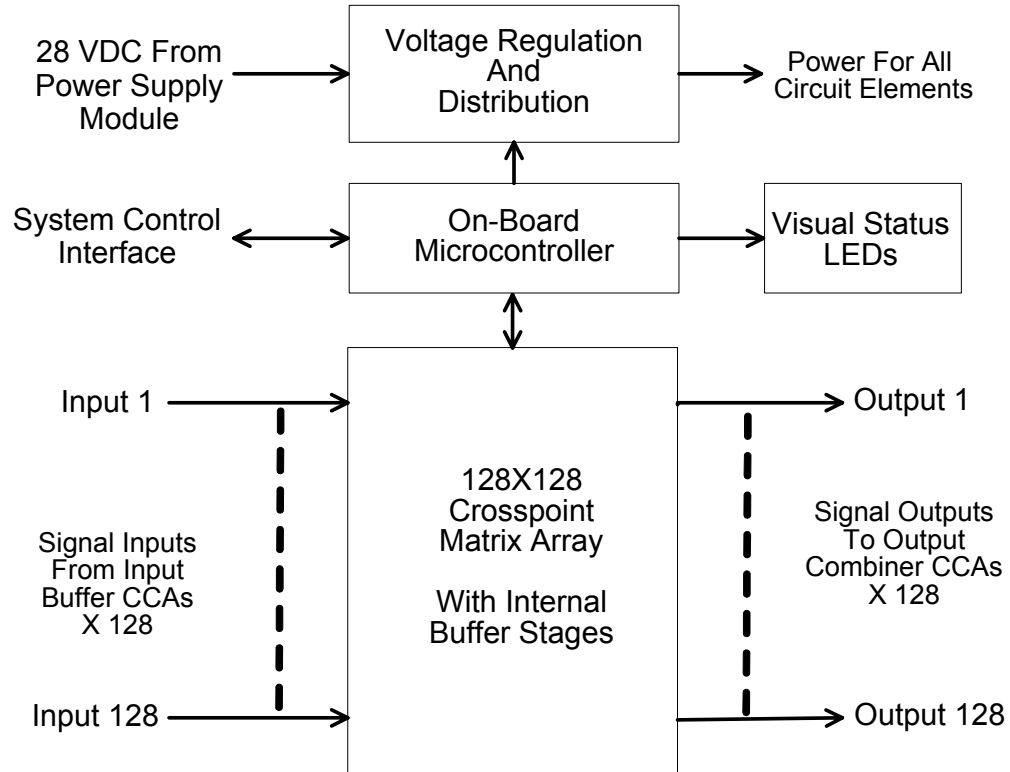
FIGURE 1-2   BLOCK DIAGRAM – 128 X 128 DIGITAL VIDEO MATRIX CARD

With the exception of the 128X128 Matrix CCA and the expanded Backplane, all other components used in the 256X256R switcher configuration are the same as the Generation I components discussed in the Cheetah Technical Manual referenced in the first paragraph of this addendum. Please refer to that manual for information on the Generation I components.

There are eight 128X128 Matrix CCAs used in the 256X256R configuration. A very basic sketch of the chassis layout is shown in Figure 1-3. This diagram identifies the location of the System Controller CCA(s), Frame Controller CCA(s), Power Supply Modules and the Matrix CCAs. Figure 1-4 provides a rear view of the rack frame with input and output connection points located.

FIGURE 1-3: 256X256R ROUTER CHASSIS (FRONT VIEW – DOOR OPEN)

Quick Reference Chart
Input/Output Connector Channels By I/O Card Slot Number

OUTPUT CHANNELS

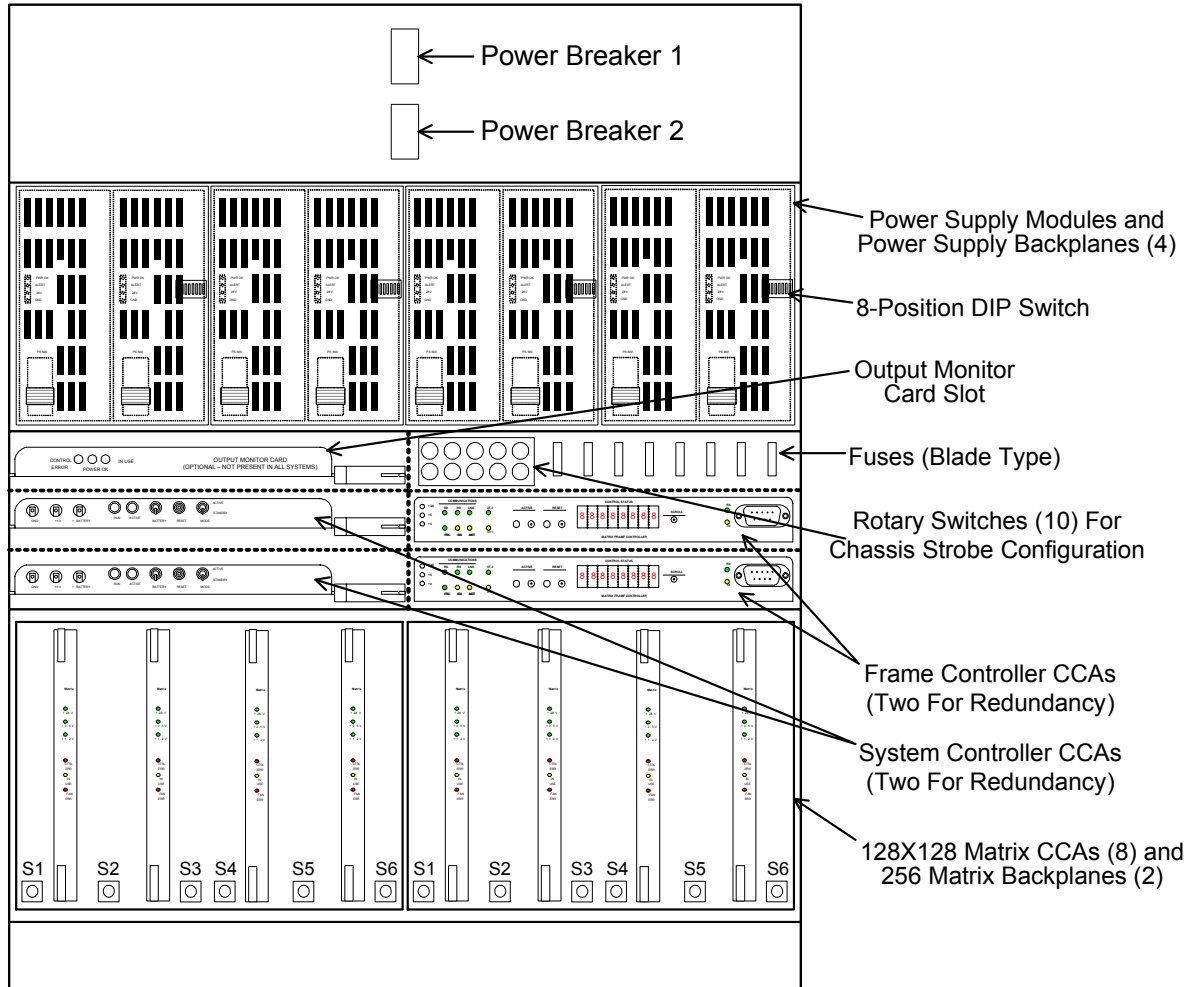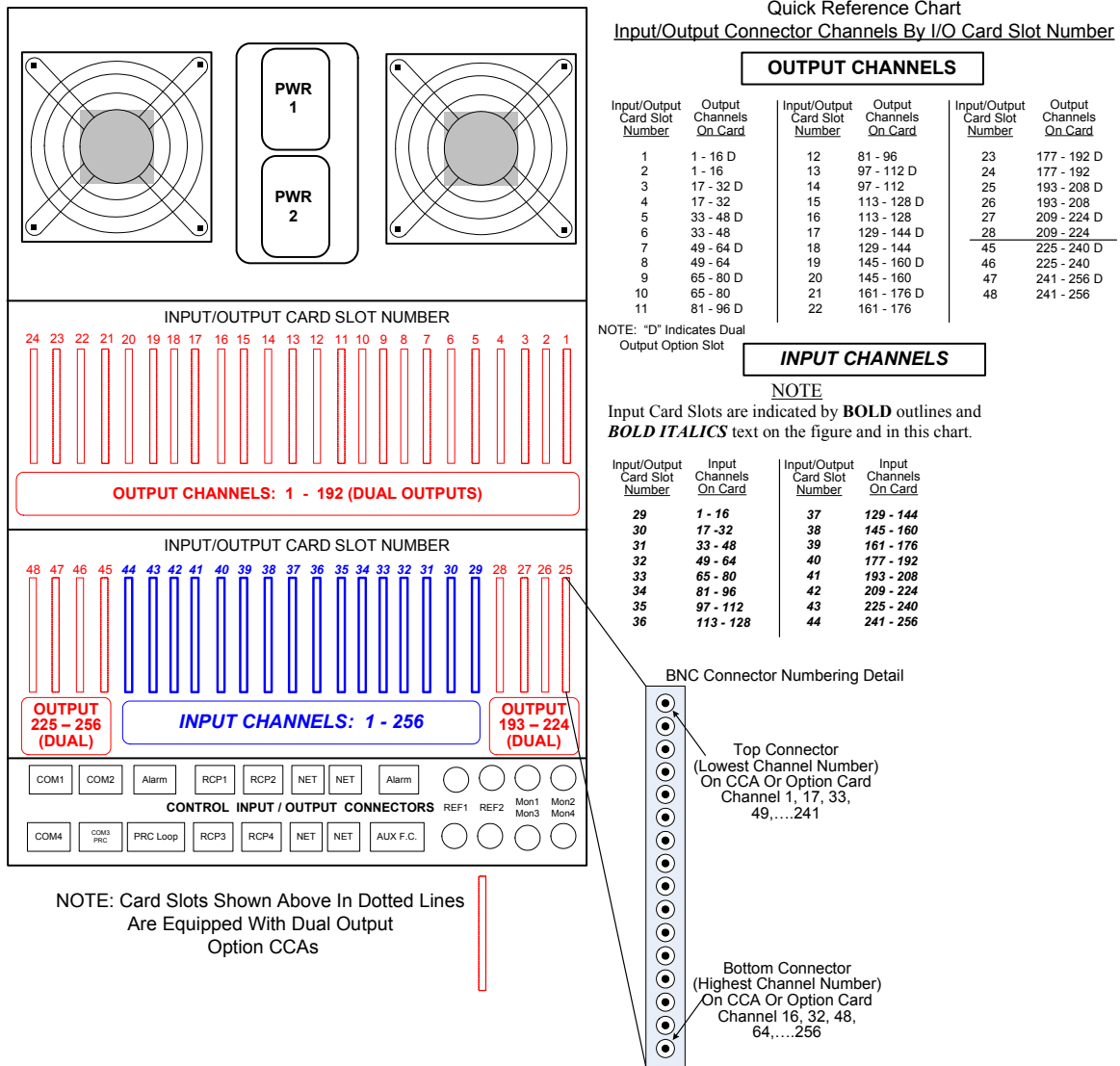| Input/Output Card Slot Number	Output Channels On Card	Input/Output Card Slot Number	Output Channels On Card	Input/Output Card Slot Number	Output Channels On Card
1	1 - 16 D	12	81 - 96	23	177 - 192 D
2	1 - 16	13	97 - 112 D	24	177 - 192
3	17 - 32 D	14	97 - 112	25	193 - 208 D
4	17 - 32	15	113 - 128 D	26	193 - 208
5	33 - 48 D	16	113 - 128	27	209 - 224 D
6	33 - 48	17	129 - 144 D	28	209 - 224
7	49 - 64 D	18	129 - 144	45	225 - 240 D
8	49 - 64	19	145 - 160 D	46	225 - 240
9	65 - 80 D	20	145 - 160	47	241 - 256 D
10	65 - 80	21	161 - 176 D	48	241 - 256
11	81 - 96 D	22	161 - 176		

NOTE: "D" Indicates Dual Output Option Slot

INPUT CHANNELS

NOTE

Input Card Slots are indicated by **BOLD** outlines and ***BOLD ITALICS*** text on the figure and in this chart.

Input/Output Card Slot Number	Input Channels On Card	Input/Output Card Slot Number	Input Channels On Card
29	*1 - 16*	*37*	*129 - 144*
30	*17 -32*	*38*	*145 - 160*
31	*33 - 48*	*39*	*161 - 176*
32	*49 - 64*	*40*	*177 - 192*
33	*65 - 80*	*41*	*193 - 208*
34	*81 - 96*	*42*	*209 - 224*
35	*97 - 112*	*43*	*225 - 240*
36	*113 - 128*	*44*	*241 - 256*

BNC Connector Numbering Detail

Top Connector (Lowest Channel Number) On CCA Or Option Card Channel 1, 17, 33, 49,….241

Bottom Connector (Highest Channel Number) On CCA Or Option Card Channel 16, 32, 48, 64,….256

PWR 1
PWR 2

INPUT/OUTPUT CARD SLOT NUMBER
24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

OUTPUT CHANNELS: 1 - 192 (DUAL OUTPUTS)

INPUT/OUTPUT CARD SLOT NUMBER
48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25

OUTPUT 225 – 256 (DUAL)   *INPUT CHANNELS: 1 - 256*   **OUTPUT 193 – 224 (DUAL)**

COM1 COM2 Alarm RCP1 RCP2 NET NET Alarm
CONTROL INPUT / OUTPUT CONNECTORS REF1 REF2 Mon1 Mon3 Mon2 Mon4
COM4 COM3 PRC PRC Loop RCP3 RCP4 NET NET AUX F.C.

NOTE: Card Slots Shown Above In Dotted Lines Are Equipped With Dual Output Option CCAs

FIGURE 1-4: 256X256R ROUTER CHASSIS (REAR VIEW)

Chapter 2   INSTALLATION

2.1   INITIAL INSTALLATION STEPS

With the exception of the rear panel connector arrangement, all installation steps for the 256X256R Switcher are the same as for the Generation I product. Refer to the Cheetah Technical Manual referenced in the first paragraph of this addendum for initial unpacking, site preparation and installation steps.

Once the rack frame is mounted and all preliminary steps have been performed, connecting the video input and output signals and the sync reference pulse source is the next step. The rear panel arrangement of the 256X256R Switcher is different than that called out in any configuration shown in the Technical Manual. Refer to Paragraph 2.2 of this addendum when completing the video I/O connections for proper identification of the I/O connector locations and channel numbering scheme.

2.2   VIDEO I/O CONNECTION

All connections to the 256X256R router (other than video I/O) will be the same as outlined in the Cheetah Technical Manual. Follow the installation procedure identified in the technical manual when connecting power, sync reference and control cabling. When connecting video input and output signals follow the diagrams provided in this Technical Addendum. Figure 1-4 illustrates the entire rear panel of the router and features a quick reference guide to the input and output connector configuration. Figure 2-1 in this chapter provides a closer and more detailed view of the rear panel input and output connectors. Use these references when making video I/O connections to the 256X256R router.
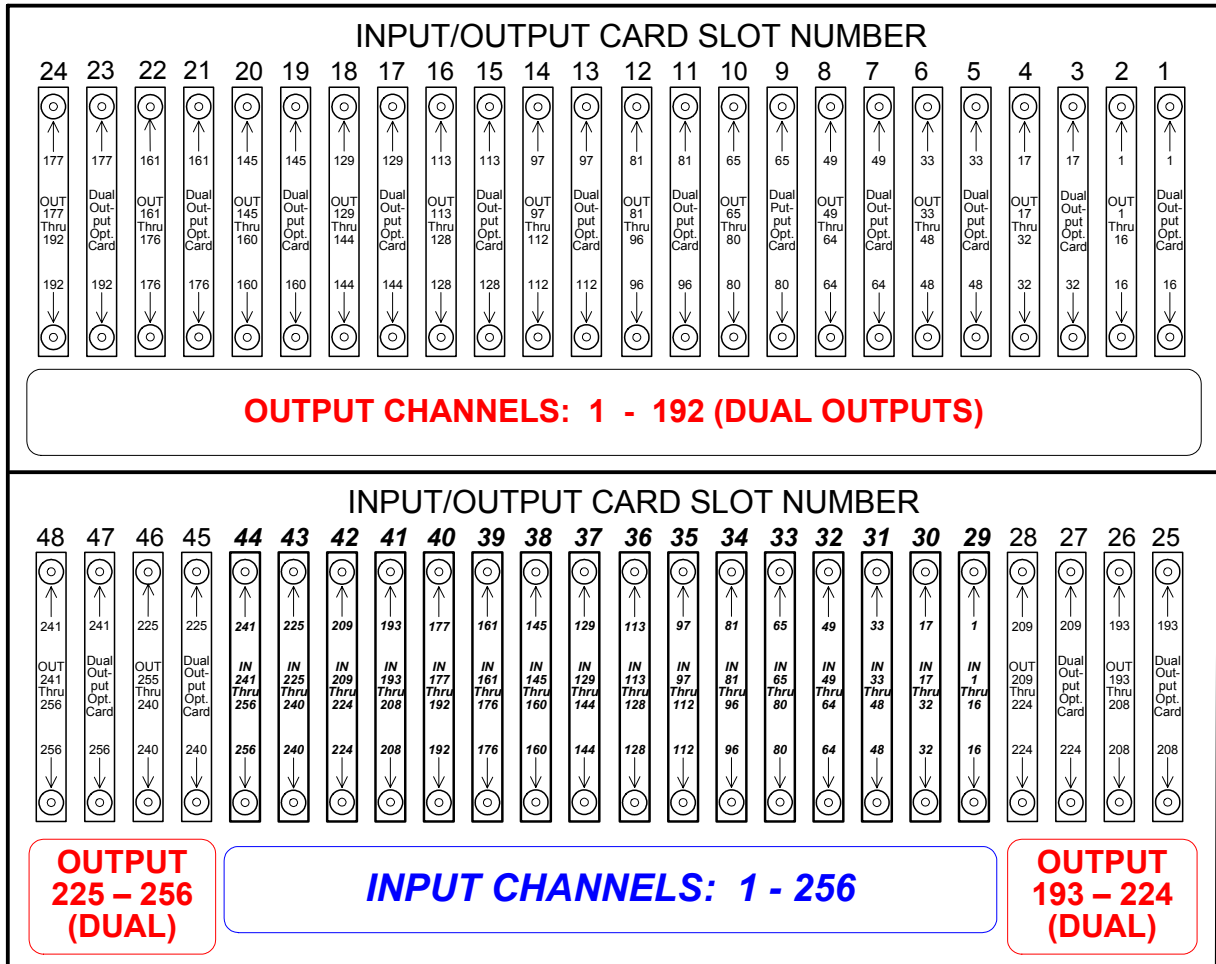
FIGURE 2-1: 256X256R ROUTER INPUT/OUTPUT CONNECTOR ARRANGEMENT

Chapter 3   REFERENCE DATA

3.1   REFERENCE DATA INTRODUCTION

This section of the TA provides the user with reference data peculiar to the 256X256R configuration of the Cheetah Gen I Matrix Switcher. In the following paragraphs you will find information that will prove useful in the event that system maintenance or repair should ever be required. Included are a diagram (Figure 3-1) showing the input and output channel assignments of the eight matrix crosspoint CCAs, plus setting information for all DIP and rotary switches used to configure the switcher.

3.2   DIP SWITCH/ROTARY SWITCH SETTINGS FOR THE 256X256R SYSTEM

There are numerous switches used in configuring the Cheetah Matrix Switcher for any particular input/output matrix combination. Switch settings define the operational parameters for the various CCAs and modules used in the switcher and assign the "personality" to each group of backplanes and their associated CCAs. Using the switch configuration scheme prevents any "card specific" functions, settings or jumpers and allows any input, output, or matrix CCA or power supply module to be "hot swapped" on the fly with any other card or module, of the same type. These switches are all preset at the factory and should never need any maintenance or adjustment. This information is provided as a reference so that in the event any switch setting should inadvertently be changed, it can be restored to its correct setting.

Switches are of two type: rotary or DIP. A small screwdriver can be used to make adjustments to the rotary switches. The tip of a small screwdriver or other small pointed object may be used to select the ON or OFF position of the DIP switches. Please note that the DIP switches are very small and each switch section is very delicate and can easily be damaged. Use extreme care if it is ever necessary to change the position of any section of the DIP switches.

The following paragraphs discuss the configuration switch settings listed below:

- Chassis Level Codes (Strobes) Rotary Switch Settings (Paragraph 3.2.1)
- Chassis Power Supply Backplane DIP Switch Settings (Paragraph 3.2.2)
- Chassis Input/Output Backplane DIP Switch Settings (Paragraph 3.2.3)
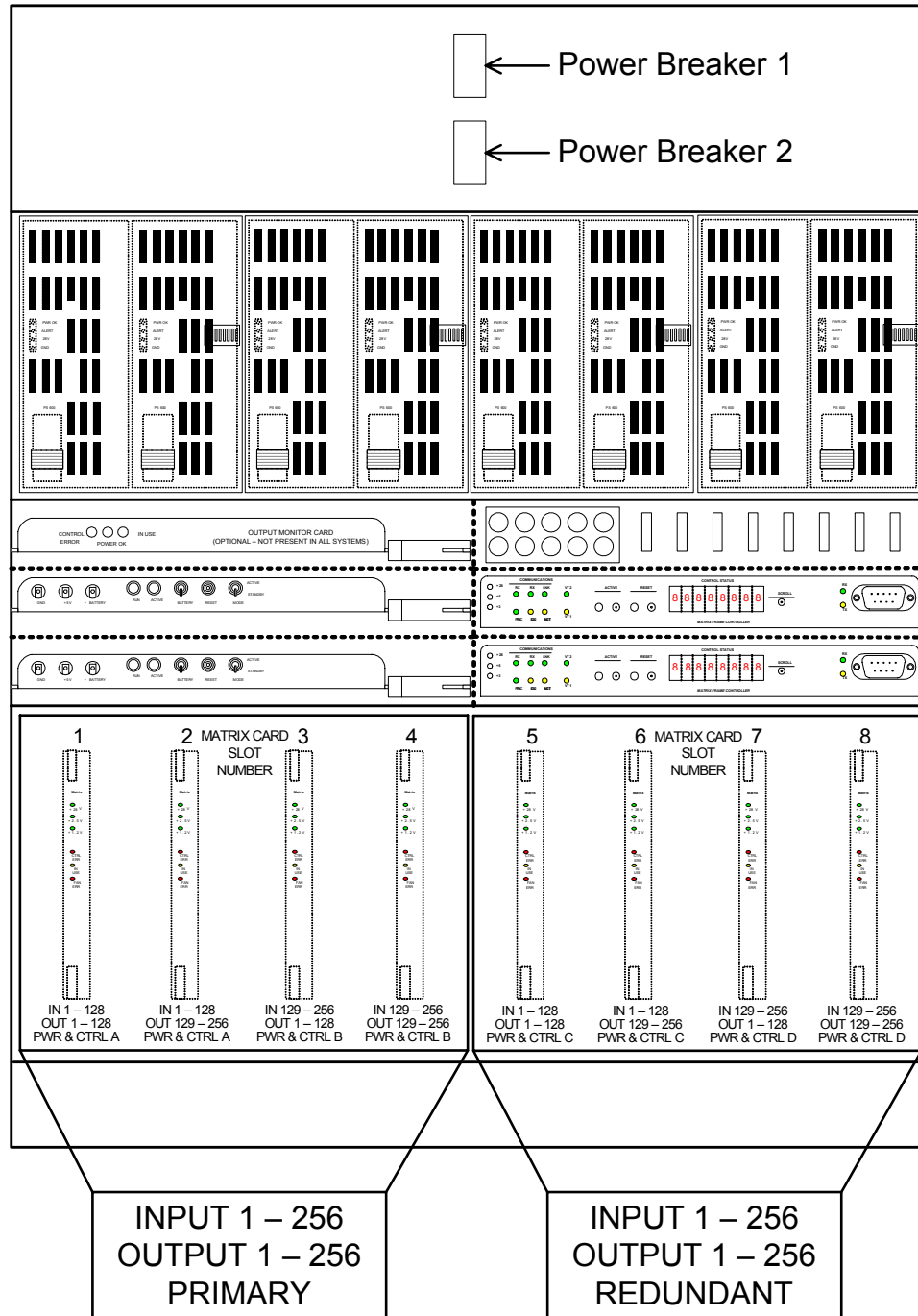- Chassis Matrix Backplane Rotary Switch Settings (Paragraph 3.2.4)

Power Breaker 1

Power Breaker 2

INPUT 1 – 256
OUTPUT 1 – 256
PRIMARY

INPUT 1 – 256
OUTPUT 1 – 256
REDUNDANT

FIGURE 3-1: 128x128 MATRIX CROSSPOINT CCA I/O CHANNEL ASSIGNMENTS

3.2.1   Chassis Level Codes (Strobes) Rotary Switch Settings

Chassis Level Codes (Strobes) assign operational parameters to the switcher frame. There are ten rotary switches, located just above the frame controller card(s), used to set the chassis level code and other frame operational characteristics. Proper setting positions for these ten switches are shown in Figure 3-2.

### 3.2.2   Chassis Power Supply Backplane DIP Switch Settings

Each Power Supply Backplane provides slots for up to two power supply modules. Located on the right side of each backplane is an eight position DIP switch used to assign identity data to the power supply module(s) installed on the backplane. Removing the power supply module installed on the right-hand side of the backplane allows access to this DIP switch. Proper setting positions for each switch section in the DIP package are shown in Figure 3-3. In this figure, the power supply modules are shown in dotted lines in order for the switch locations to be visible.

3.2.3   Chassis Input/Output CCA Backplane DIP Switch Settings

Each Input/Output CCA Backplane provides slots for up to four input or output CCAs. An eight-position DIP switch, located on the lower right-hand side of each backplane, assigns a unique identity to each backplane card. Among other functions, this switch setting allows the controller circuitry to assign the input or output channel number range to each I/O CCA – thus allowing any I/O card on the rear panel to be "hot swapped" with a card of like type. Proper setting positions for each switch section in the DIP package are shown in Figure 3-4. I/O CCAs must be removed from the backplane to gain access to the DIP switch. Figure 3-4 illustrates switch location and card slots on the backplanes with no I/O CCAs installed.

3.2.4   Chassis Matrix Backplane Rotary Switch Settings

Each Matrix CCA Backplane provides slots for up to four 128X128 matrix crosspoint CCAs. There are six rotary switches located along the bottom edge of each backplane. Settings of these switches assign a unique identity to each matrix backplane and the set of matrix CCAs installed in it. These settings allow the controller circuitry to assign the input and output channel number range to each matrix backplane and each matrix CCA. Figure 3-5 shows the location of each of the six switches on each backplane board. The matrix card image used in this figure is smaller than actual size to allow the backplane components to be shown. Setting positions for each switch are provided in Table 3-1 and listed by individual backplane boards.
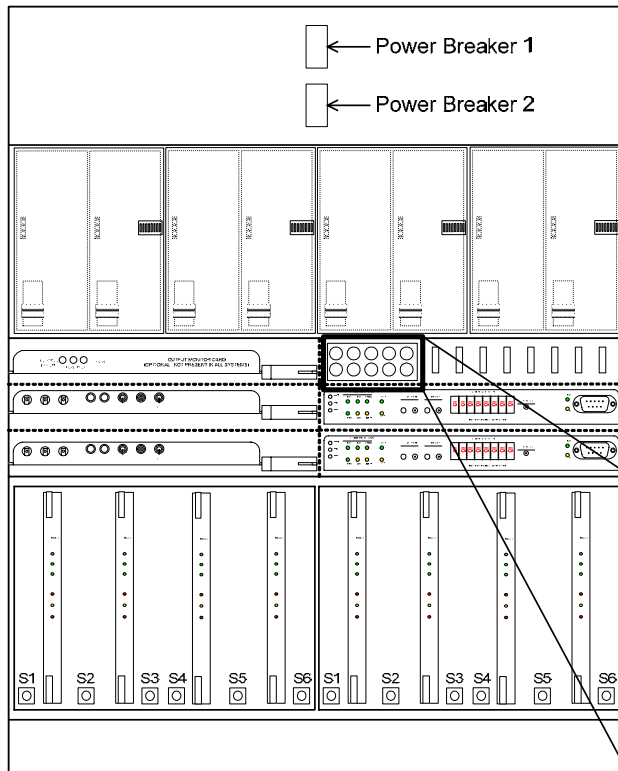
Switch	Description	Setting
S1	Level (MSB – Most Significant Bit)	
S2	Level (LSB – Least Significant Bit)	
S3	Output (MSB)	According to Customer Configuration
S4	Output (LSB)	
S5	Input (MSB)	
S6	Input (LSB)	
S7*	Frame (MSB)	1
S8*	Frame (LSB)	8
S9	Network (Fan Setting)	0
S10	Output Monitor	Customer Configuration

*NOTE: The setting of Switches S7 and S8 assign the "frame type" parameter to the switcher. In this configuration, the frame is a "Type 24."
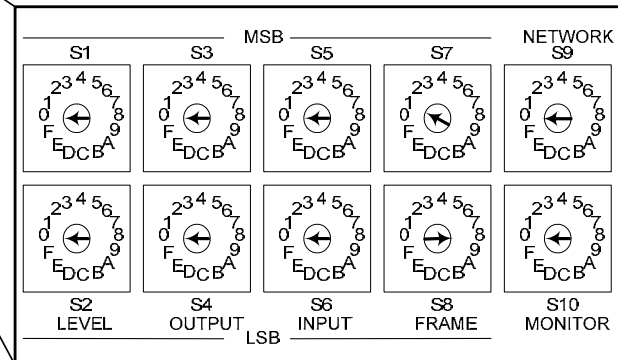

FIGURE 3-2: CHASSIS AND LEVEL CODE SWITCH SETTINGS

ON
OFF

ON
OFF

Power Breaker 1

Power Breaker 2

ON
OFF

ON
OFF

CONTROL
ERROR

IN USE

POWER OK

OUTPUT MONITOR CARD
(OPTIONAL – NOT PRESENT IN ALL SYSTEMS)
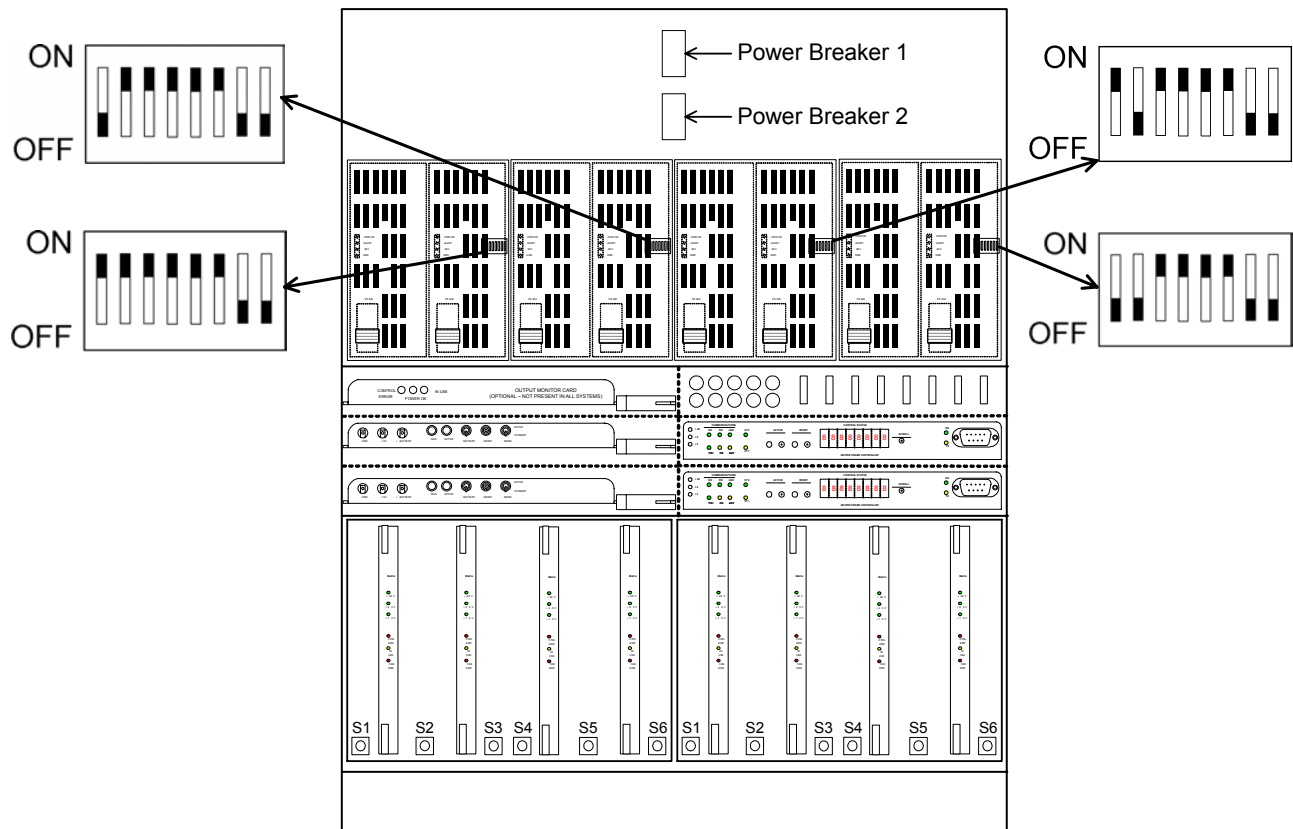
S1 S2   S3 S4   S5   S6   S1   S2   S3 S4   S5   S6

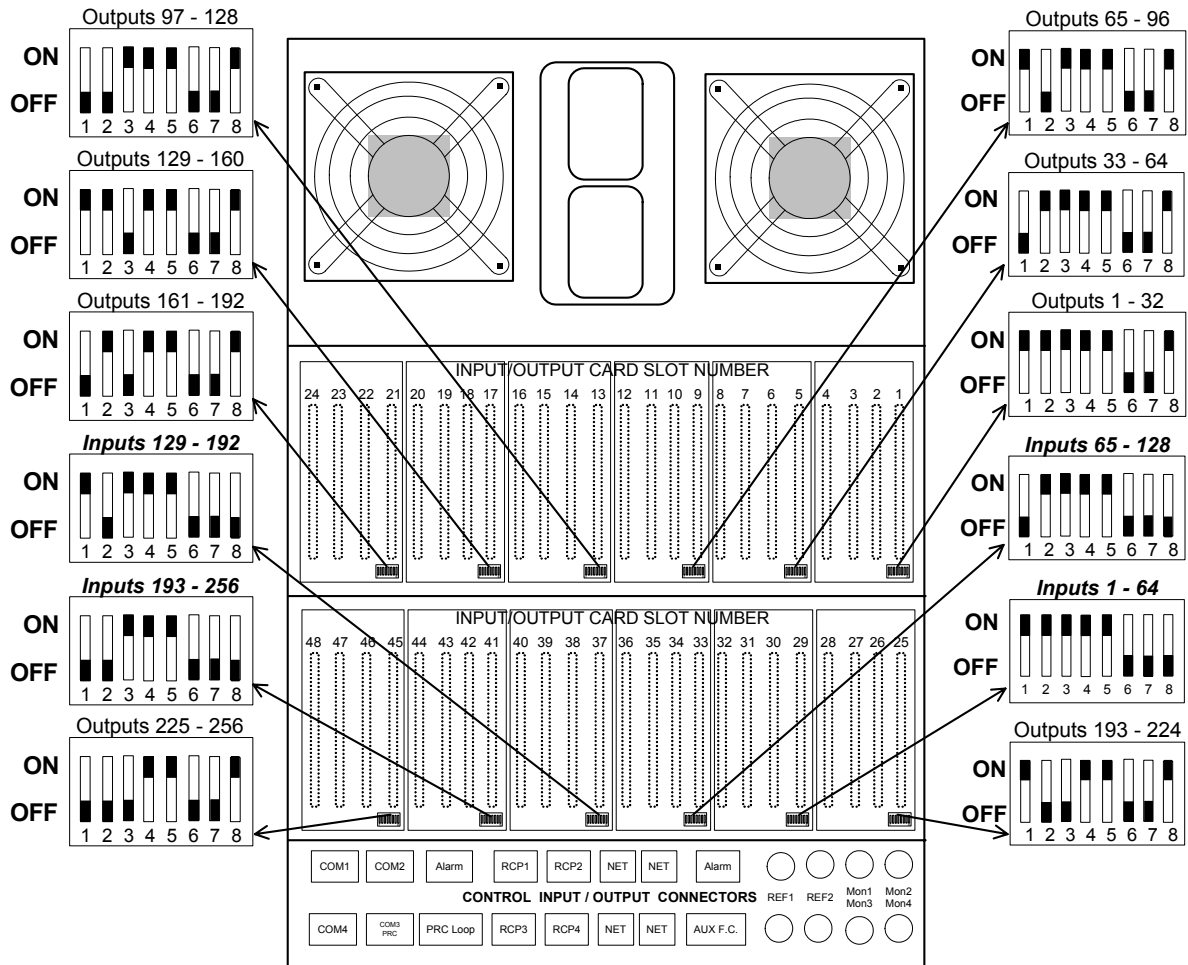**FIGURE 3-3: 256X256R POWER SUPPLY BACKPLANE DIP SWITCH LOCATIONS AND SETTINGS (FRONT VIEW)**
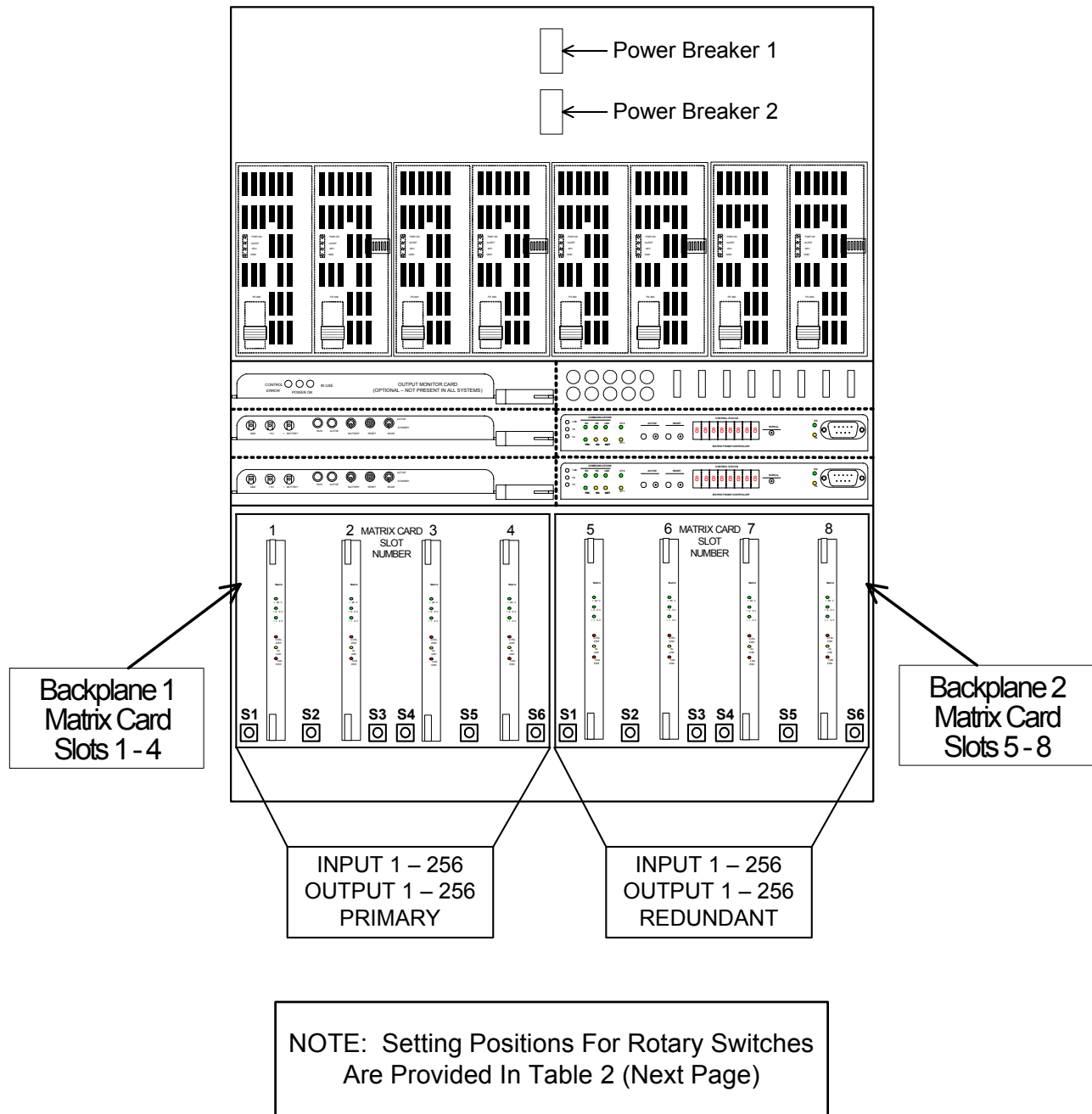
FIGURE 3-4: Input/Output Backplane DIP Switch Settings

FIGURE 3-5: Matrix Backplane Rotary Switch Locations

TABLE 3-1: MATRIX BACKPLANE ROTARY SWITCH SETTINGS.

SWITCH	SETTING	I/O
MATRIX BACKPLANE 1 CARD SLOTS 1-4		
S1	0	Outputs: 1-128
S2	0	Inputs: 1-128
S3	1	Outputs: 129-256
S4	0	Outputs: 1-128
S5	1	Inputs: 129-256
S6	1	Outputs: 129-256

SWITCH	SETTING*	I/O
MATRIX BACKPLANE 2 CARD SLOTS 5-8		
S1	2	Outputs: 1-128
S2	0	Inputs: 1- 128
S3	3	Outputs: 129-256
S4	2	Outputs: 1-128
S5	1	Inputs: 129-256
S6	3	Outputs: 129-256

*NOTE: Switch Settings For Redundant Matrix Backplane, Card Slots 5-8, Reflect Physical Outputs 257- - 512 Of The Matrix Cards