Cheetah

VIDEO MATRIX SWITCHERS

TECHNICAL DOCUMENTATION PACKAGE

CHEETAH SERIES CORE COMPONENTS TECHNICAL MANUAL

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PRELIMINARY

Cheetah Advanced Technology Systems

QuStream Group of Companies

PESA Switching Systems

FORTELDTV

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Chapter 1: About This Manual

1.1 DOCUMENTATION AND SAFETY OVERVIEW

This manual provides detailed instructions for the installation, operation, and maintenance of the PESA Cheetah Series Switchers.

It is the responsibility of all personnel involved in the installation, operation, and maintenance of the equipment to know all the applicable safety regulations for the areas they will be working in. ***Under no circumstances should any person perform any procedure or sequence in this manual if the procedural sequence will directly conflict with local Safe Practices. Local Safe Practices shall remain as the sole determining factor for performing any procedure or sequence outlined in this document.***

1.2 WARNINGS, CAUTIONS, AND NOTES

Throughout this document, you should notice various Warnings, Cautions, and Notes. These addendum statements supply invaluable information pertaining to the text that they address. It is imperative that audiences read and understand the statements to avoid possible loss of life, personal injury, destruction/damage to the equipment, and/or added information that could enhance the operating characteristics of the equipment (i.e., Notes). The following subsections represent a description of the Warnings, Cautions, and Notes statements contained in this manual:

1.2.1 WARNING

Warning statements identify conditions or practices that can result in loss of life or permanent personal injury if the instructions contained in the statement are not complied with.

1.2.2 CAUTION

Caution statements identify conditions or practices that can result in personal injury and/or damage to equipment if the instructions contained in the statement are not complied with.

1.2.3 NOTE

Notes are for information purposes only. However, they may contain invaluable information important to the correct installation, operation, and/or maintenance of the equipment.

Chapter 2: Introduction

2.1 CHEETAH PRODUCT OVERVIEW

PESA's Cheetah Series Video Matrix Switcher products offer a full line of high reliability, field-proven routing switchers that can stand up to your facility's toughest demands. Whether it be a fast paced production facility with high capacity, high performance demands or a broadcast installation running a twenty-four hour schedule, the Cheetah Series is up to the challenge and designed to deliver the performance and reliability you expect and deserve.

All Cheetah Series switchers are manufactured using a "building block" architecture of ***core components*** to allow a myriad of input and output (I/O) capacity combinations in a variety of signal types. The entire Cheetah Series product line consists of chassis frames in a variety of rack space and I/O capacity combinations; Input, Output and Option modules for various signal types; Matrix Array circuit cards and modular Power Supplies. A wide variety of control system options are available from simple X-Y panels to a Microsoft Windows based application, running on a standard PC. Other options allow the user to control a Cheetah Switcher located in a remote location over an Internet connection. Cheetah matrix switchers also come supplied with ViewPort, a PESA proprietary Windows based PC diagnostics application that allows the operator to monitor the performance and health of the entire switcher in real time.

Cheetah Series products offer full-featured video matrix switchers capable of handling Serial Digital Interface (SDI) and High-Definition Television (HDTV) digital video sources, as well as other non-standard digital signals, in the same frame. Signal connection options include standard BNC connectors for using copper wire coaxial cable and optional fiber input and output modules to take advantage of high speed, low-loss optical transmission methods. BNC and fiber optic connectors may be mixed within a frame to provide maximum input and output flexibility.

Cheetah product offerings are also available for routing analog video sources (NTSC and PAL). Routers equipped for analog I/O capability use the same rack frames and control system components as our digital switchers. This allows an analog frame to be in-field upgraded to digital video by replacing the analog circuit cards with the proper digital circuit cards for the signal type used.

An input of system synchronization, derived from a source of in-house sync reference from the facility sync generator, must be supplied to each Cheetah frame. This signal is used for internal system timing and to allow true vertical-interval switching of video sources. Loop-thru BNC connectors for sync reference connection are provided on the backplane of every chassis frame. The router may be added to in-house sync distribution in a daisy-chain fashion along with other facility equipment.

All system components, including power supplies, are "hot-swappable," meaning they can be removed and replaced on the fly with no interruption of signal outputs. Full system redundancy is possible in many configurations.

Using the various core components of the Cheetah Series, routing switchers can be scaled from a capacity of 64 inputs and 64 outputs (64X64) in 4 rack units (RU) up to a 1024X1024 system occupying 2 rack frames.

2.2 HOW TO USE THIS MANUAL

There are a large number of variations in the core components (modules and circuit cards) within the Cheetah Series, and several different chassis frames used to house and interconnect these system components. A single Technical Manual for the entire Cheetah Product Line would contain a vast amount of data with only a few pieces of it typically pertinent to a particular installation.

In order to allow you to quickly get the information for your system without wading through a sea of non-applicable data, and to present the information in the most straight-forward manner possible, we have divided the Cheetah documentation into this volume for the core components, a separate volume for each of the Cheetah Series chassis frames, and a Cheetah Quick Start Guide.

To assemble a full set of documentation for a particular system, you will need the Cheetah Core Components Manual (which is the volume you're reading now), the manual for the specific chassis frame used in your system, and the Cheetah Series Quick-Start Guide (PESA Part Number XXXX). You will also need the documentation for the control system used by your switcher. In most all cases this will either be the PERC1000/2000 controller or the 3500 Series controller.

Installation instructions tailored to each frame in the series are presented in the Technical Manual for the specific frame model and type. PESA Part Numbers (publication number) for the frame manuals are presented in the following table. Find the part number of the manual for your frame and refer to it during all steps of system installation. All of the referenced publications in the Cheetah product line are available on the CD shipped with your system.

Table 2-1 Chassis Frame Technical Manuals

Cheetah Chassis Frame Model/Type	PESA Part Number For Technical Manual
256 CH and 256 CX	TBD
448 CH "Flexi-Frame"	TBD
512 XR	TBD
512 CH, 512 CX and 1024 XR	TBD
64 NE	TBD
64 XE and 64 WE	TBD
128 NE	TBD
128 XE and 128 WE	TBD

The remainder of Chapter 2 presents a brief introduction to the principles of a crosspoint matrix type routing switcher system, and an introductory look at the building blocks and basic architecture of a typical Cheetah Video Matrix Switcher.

Chapter 3 contains discussions of all the various modules and circuit card assemblies in the Cheetah product line. Reference the sections of this chapter pertaining to the modules and circuit card types used in your switcher.

Chapter 4 presents a much more in-depth discussion of the Cheetah Video Matrix Routing Switcher, identifying the commonalities between all system variations. PESA highly recommends that if you are not already familiar with the architecture and functional theory of the Cheetah system that you take time to thoroughly read Chapter 4 BEFORE proceeding with your installation.

PESA also recommends before continuing with your installation that you get acquainted with your system. Be familiar with the type of input, output and matrix circuit cards your particular frame contains; as well as any option cards or mezzanine cards that your system may include. Also, know what type of frame you have. There are several variations of the Cheetah chassis frame. Component and connector locations can vary considerably by frame, even though the core components are the same regardless to which frame type they are installed. If you are not already familiar with the basic building blocks used to assemble a Cheetah Video Matrix Switcher, we encourage you to read the portions of this manual pertinent to the components used in your system. If you do not already have a familiarity with the principles of a matrix type routing switcher, you should take the time to read the brief introduction provided in the following section.

2.3 A BASIC ROUTING SWITCHER TUTORIAL

The function of any routing switcher is, simply stated, to route input signals from multiple sources to output channels so that the signals can be selected and distributed as needed to various locations. Consider a basic electro-mechanical A-B switch. This simple device accepts a single input from an external source and, depending on the position of the switch, routes the input to one of two possible outputs: Output A or Output B. While far too elementary to be considered a routing switcher, the A-B Switch analogy does give an idea of the most basic function of a routing switcher.

State-of-the-art routing switchers take this simple switching principle and allow any of numerous input signals to be routed to multiple output channels in many different input/output (I/O) combinations, using very simple to quite sophisticated and automated control systems.

The most common method of implementing a large multi-input, multi-output switcher is to construct a matrix array consisting of a defined number of input and output paths. Input signals enter the matrix and output signals leave the matrix in such a way that every input path forms an intersection with every output path. As an example consider a matrix with two input paths and two output paths, or a 2X2 array, as shown in Figure 2-1.

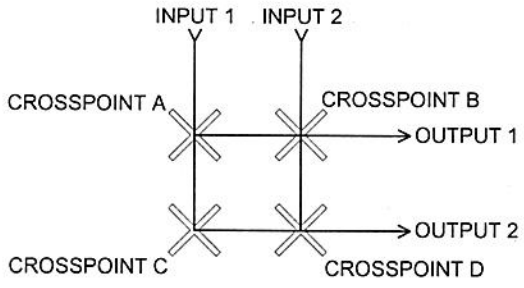

Figure 2-1 2X2 Crosspoint Matrix Array

We can use this array to easily route specific inputs to specific outputs by controlling whether or not a viable electrical connection of input to output is made at each intersection. This is done by placing a crosspoint switching device, which may be thought of as an electronic implementation of an on-off switch, at each potential path intersection. In normal convention each crosspoint switching device is referred to simply as a ***crosspoint***.

You can see from this illustration that the crosspoint at each I/O path intersection determines whether the signal path connection is "made" (switch closed) or "broken" (switch open). In our 2X2 example, to have input 1 routed to output 1, crosspoint A must "make" (close) a connection, and the connection at crosspoint B must be "broken" (open). In order to route Input 1 to Outputs 1 and 2, crosspoints A and C must both make a connection, and crosspoint switches B and D must be open (connection broken). To route Input 2 to Output 1, crosspoint switch A must be open and crosspoint B must be closed. By controlling which crosspoint switches are open and closed, it is obvious that any input of the matrix can be routed to any one, or multiple, outputs.

By increasing the number of input channels and output channels in the matrix array, and thereby the number of crosspoints, the concept of a matrix type routing switcher is realized.

Adapting this theoretically simple matrix array concept to an actual video switching application requires a great deal of electronic circuitry. Figure 2-2 illustrates the basic building blocks required to configure a routing switcher. In this illustration, signals enter buffer amplifiers contained on the Input Buffer CCA. Buffered and isolated input signals enter the Crosspoint Matrix CCA. Output signals from the Crosspoint Matrix CCA are routed to the Output Driver CCA where they are buffered, delivered through the output connectors of the switcher and are available for use as needed in the facility. Of course we must have some way of controlling the crosspoints and other system functions, and this is done by some form of System Control circuitry.

While this tutorial does introduce the bare-bone basics of a matrix type routing switcher, it by no means covers all the supporting functions and other circuitry required to implement an actual switcher.

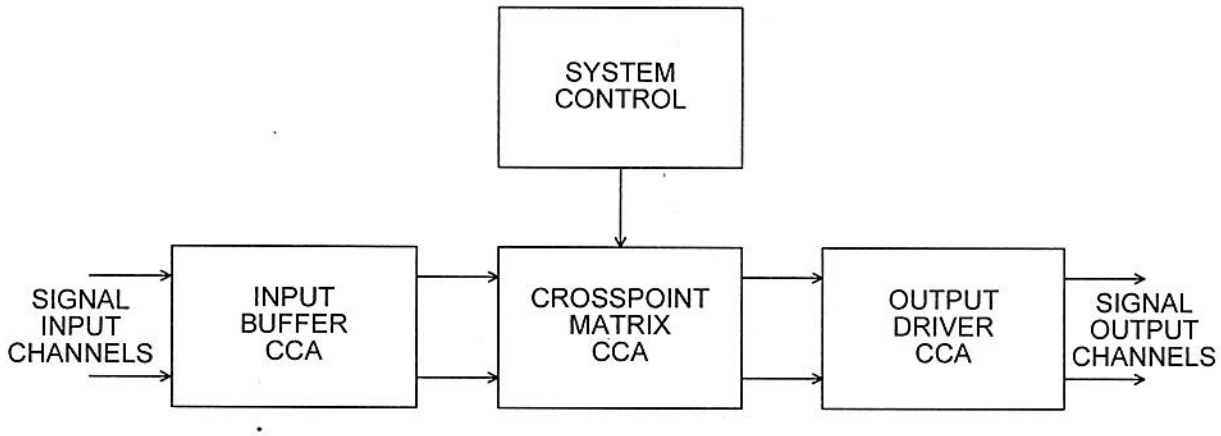

Figure 2-2 Basic Generic Switcher Building Blocks

In a practical switching system, due to physical size, on-board circuitry requirements and other constraints, there is a limitation as to the number of input channels that can be contained on an Input Buffer CCA, the array size that can be handled by an individual Crosspoint Matrix CCA, and the

number of output channels supported by an individual Output Driver CCA. It is, of course, possible to configure a routing switcher with more input and/or output channels than can be accommodated by single Input, Matrix or Output CCAs by adding and interconnecting additional circuit cards as needed to attain the desired system capacity.

Adding more capacity and functionality also means that the infrastructure of the routing switcher such as circuit card capacity, physical size, frame cooling, power and control requirements and interface access must be considered. And, since a video router must be capable of manipulating various types of signal sources: analog, standard definition, high definition, etc., Input, Output and Matrix CCAs must be available to process the various signal types.

2.4 INTRODUCTION TO THE CHEETAH ROUTING SWITCHER SERIES

As you can see from the preceding discussion, there are many potential system variables. The frame size and layout and the number and type of circuit cards and modules used to configure a specific routing switcher can differ greatly depending on the required I/O capacity and other characteristics of the system. In order to meet a wide range of customer needs, PESA's Cheetah Series product line consists of many sizes and styles of chassis frames, and system core components.

2.4.1 CORE SYSTEM COMPONENTS

Every Cheetah Series Routing Switcher system is configured using combinations of the Core System Components mounted in a chassis frame. Regardless of system size and other variables the components common in all Cheetah systems are:

Input Circuit Card Assembly

Matrix Circuit Card Assembly

Output Circuit Card Assembly

Power Supply Module

Control System (System Controller CCA and Frame Controller CCA)

Option Cards

Output Monitor Circuit Card Assembly

Each core component is identified and a very brief look at the function of each is provided in the following paragraphs.

2.4.2 INPUT CIRCUIT CARD ASSEMBLY

As the name implies, the Input Circuit Card Assembly (CCA), often referred to simply as the Input Card, is the entry point for video signals into the routing switcher matrix. Each input card accepts up to 16 video input signals from various sources. There are six input card variations in the Cheetah Series product line, to accommodate different input signal types. Each individual card in the series is discussed in Chapter 3 of this manual.

Each input card, regardless of signal type, contains the cable equalization circuitry, buffer amplifiers and signal drivers used to condition the incoming signal prior to entering the switching matrix. Each input card also contains circuitry to monitor the status of the input channels, power rails and other operational functions.

Input cards are physically attached to the rear panel of the chassis frame and provide the input connectors for attaching signals to the switcher. Each card is equipped with two status LEDs on the edge of the assembly close to the bottom input connectors. The user can very quickly perform a visual assessment of the status of the input cards by observing the state of the LEDs.

2.4.3 MATRIX CIRCUIT CARD ASSEMBLY

Each Matrix Card is where the actual crosspoint switching function takes place. Each card supports a finite number of input channels, provides a finite number of output channels and contains the crosspoint matrix array circuitry to perform the switching tasks. In the Cheetah Series product line there are four matrix card variations available to accommodate different array size and signal type requirements. These cards include a 64 input by 64 output, a 128 input by 128 output, and a 144 input by 144 output Matrix CCA for digital signals and a 64 input by 64 output array for analog signals. Each card variation is discussed in Chapter 3 of this manual.

Additional circuitry on each matrix card keeps a running check of the operational status of the crosspoint device, power rails and other operational functions.

In all Cheetah variations, the matrix cards are installed inside the chassis frame and are accessible by opening the front access door. Each card is equipped with LEDs on the assembly edge so that the user can quickly assess the status of each matrix card in the system with a visual inspection.

2.4.4 OUTPUT CIRCUIT CARD ASSEMBLY

The Output Card is the exit point for video signals leaving the routing switcher and each card provides up to 16 video output channels. There are seven output card variations to accommodate different signal output types; each variation is discussed in Chapter 3 of this manual.

Each output card contains the necessary channel combiner circuitry, buffer amplifiers, re-clocking circuitry and driver amplifiers used to generate the signal output for each channel. Voltage comparators monitor the status of the power rails. On-board programmed logic circuitry interpret data from the comparators along with data relevant to the status of the output channels and other card operational functions to provide a real-time status monitor as to the health of each output card.

Additional circuitry on the output card selects and generates a monitor output signal that asserts any output channel of the card onto the output monitor bus. This bus is internal to the switcher frame and is only used if the optional output monitor CCA is installed in the switcher system.

Control data received from the Frame Controller CCA is processed by on-board logic circuitry and interpreted into channel select commands for the channel combiner crosspoints and the monitor source selection crosspoints.

Output cards are physically attached to the rear panel of the chassis frame and provide the connectors for accessing the signal outputs from the switcher. Each card is equipped with two status LEDs on the edge of the assembly close to the bottom connectors. The user can very quickly perform a visual assessment of the status of the output cards by observing the state of the LEDs.

2.4.5 POWER SUPPLY MODULE

Cheetah video routing switchers all use various quantities of a common 600 Watt power supply module that provides a fully regulated source of ±28 VDC @ 22A. The number of power supply modules used in a frame is dependent on several factors including the number of input, matrix and output cards required for system capacity, the number and types of option cards used in a particular switcher application and whether or not power redundancy is desired.

When more than one power supply module is used in a system, all of the modules are physically and electrically identical. Each module is "hot-swappable" for easy removal and replacement without any disruption of switcher outputs. Circuitry internal to the power supply continuously monitors the operational parameters, output voltage and current level and the module operating temperature. Three LED display devices on the front panel of each module allow the user to quickly perform a visual assessment of the status of each supply module by observing the state of the LEDs.

2.4.6 CONTROL SYSTEM

Every switcher configuration requires a Control System. In the Cheetah family there are two core components of the control system that reside within the chassis frame: the System Controller Card and the Frame Controller Card.

The System Controller Card resides in the matrix switcher frame, however the term System Controller refers collectively to the System Controller CCA and its associated board-resident firmware and a software application that runs on a Microsoft Windows based PC platform. In the Cheetah product line there are two variations of System Controllers: the 3500PRO and the PERC2000. Each of these variations will be discussed in Chapter 3, but for our purposes here, think of the system controller as the mediator between the outside world and the frame controller. Regardless of which control system is used (3500 or PERC), at least one system controller card must be installed in the chassis frame. Each chassis frame can support up to two system controller cards although only one controller card is required. A second system controller card may be installed for redundancy capability.

The Frame Controller Card also resides in the matrix switcher frame. Just as with the system controller card, each chassis frame can support up to two frame controller cards, although only one is required. A second frame controller card may be installed for redundancy capability.

Consider the System Controller to be the master overseer of the entire system. The system controller card communicates bi-directionally with the frame controller circuitry. Think of the Frame Controller as a slave that is subservient to its master – the System Controller. The Frame Controller circuitry orchestrates all system switching commands and all other control functions for the entire switcher frame. It is the job of the System Controller to keep the entire system running as it is programmed to do. The System Controller provides programming functions and interface functions to various types of control panels that may be used by the facility operator to control the operation of the entire switching system. Also, the system may be operated from a Windows based PC interfaced to the system controller and running the controller software application.

2.4.7 OPTION CARDS

There are four option cards available in the Cheetah Series that enhance the function of standard output cards:

HD to SDI Down-Conversion Option Card

SDI to Analog Conversion Option Card

Dual Output Option Card

Fiber Output Option Card

Each standard output card, regardless of signal type, is equipped with a row of on-board connectors that allow an option card to be "piggy-backed" to it in a mezzanine card fashion. Each option card is fitted with connectors appropriate to its output signal that are mounted on a panel that rides parallel to the output connector panel of the standard card. Whenever an option card is used, each output card, with its option card in place, will occupy two I/O slots on the rear of the chassis frame. Since some of the

option cards are specific for certain output signal types, it should be obvious that not all option cards are suitable for all output cards. Due to physical space limitations and backplane wiring configurations, not all Cheetah chassis frames allow option cards to be installed on the output cards used in the system.

You will find a more thorough discussion of each option card in Chapter 3. A very brief introduction to each and where it can be used is contained in the following paragraphs.

The HD to SDI Down-Conversion Option Card installs to the HD Multi-Rate Output Card and converts the High Definition video signal from each active output to a Standard Definition SDI digital video output. The HD and SDI outputs are both available from BNC connectors located on the frame rear panel.

In similar fashion, the SDI to Analog Option Card installs to the SDI Output Card and converts the SDI digital video signal from each active output to an NTSC/PAL composite analog video signal. Both the SDI digital and analog outputs are available from BNC connectors located on the rear panel of the chassis frame.

The Dual Output Option Card installs to a standard output card and provides a second set of output connectors for each output channel. Both output signals are available from BNC connectors located on the rear panel of the switcher frame. Although identical in appearance and installation, the HD/SDI dual output option cards and the analog or high level analog dual output option cards are not interchangeable.

The Fiber Output Option Card installs to a standard (HD, SDI or Fiber) output card and provides a set of fiber optic output connectors co-resident with the BNC output connectors. Both connectors for each output channel are located on the rear panel of the chassis frame. Note that this option card is not compatible with analog or high-level analog output cards.

2.4.8 OUTPUT MONITOR CIRCUIT CARD ASSEMBLY

Certain Cheetah chassis frames provide for a source of monitor video (SD and HD Only). When so equipped, this option allows the user to select up to two outputs of the switch matrix and have the selected signals available at the monitor output connectors on the frame rear panel. The monitoring option is not available for analog signals. There is a constraint on which output channels can be viewed simultaneously and that is that each requested channel must be associated with different output cards. It is not possible to monitor two output channels from the same output card.

The Output Monitor CCA, when installed, resides in the switcher chassis frame and contains a crosspoint device that receives the monitor output signal from each of the output cards in the frame. This device, under software control via the on-board control logic circuitry, selects up to two input signals as monitor output signals. The selected monitor sources are re-clocked to correct any jitter or other signal aberration, buffered and available at the monitor connectors on the frame rear panel.

Logic circuitry on the monitor output card monitors the status and health of the video output, power rails, on-board control circuitry and other operational parameters of the card. LEDs along the edge of the assembly allow the user to perform a visual assessment of the status of the monitor output card.

2.5 A WORD ABOUT BACKPLANES

With the exception of option cards that "piggy-back" on an output card, all circuit cards and power supply modules install into the switcher chassis frame through some type of backplane arrangement. Each backplane also contains switches (rotary or DIP style) used to assign it operational parameters and system configuration "personality." Backplane types and structure will vary between frames and Chapter 4 will present an in-depth discussion of the various backplanes used in Cheetah chassis frames. For this basic introduction, the important thing to remember is that in some frames the component

backplanes are "modular" and can be used as "building blocks" when configuring a system. In this application, the number and type of backplanes can vary from system to system. In other frames, the backplane arrangement is "fixed" and the number, location and type of card slots on the backplane cannot be altered for different configurations. The importance of this will become evident in our discussion of frames in the next paragraph.

2.6 CHEETAH CHASSIS FRAMES

There are several different types of chassis frames in the Cheetah family, each designed for a specific purpose – but most are built with a degree of flexibility to accommodate as wide a range of customer needs as possible. Previous sections of this chapter briefly identified the core components used in all Cheetah video switchers, regardless of which frame is used. Now we will take a closer look at what frames are available and identify some key differences, and commonalities, between each type.

It should be somewhat obvious that as switcher I/O capacity increases, the physical size of the frame must grow to meet the additional circuit card and infrastructure requirements. However, what may not be quite as obvious is the additional power demand as more cards are added. Not only must the physical size increase with capacity, but a more robust power supply and distribution system must also be available. More circuitry also brings more heat, therefore the cooling capacity of the frame must increase with matrix size as well.

While all frames do indeed serve the same basic purpose – and that is to house the switcher "building block" components and provide the system infrastructure - the layout of where the components are installed, the internal signal routing through backplanes and mid-planes and the frame-specific power supply components vary greatly between the different series of frames. For this reason each frame type in the Cheetah family has its own Technical Manual Volume. All frame-specific data such as the items just mentioned plus connector locations and other pertinent information is contained in the individual volume.

To meet various system requirements there are actually two very different styles of Cheetah chassis frames, these are referred to as Generation I (Gen I) frames and Generation II (Gen II) frames. While the Gen I or Gen II moniker in no way affects the function of the frame, it does identify the frame architecture and interconnection structure. Differences between Gen I frames and Gen II frames are discussed in the following paragraphs. Table 2-2 identifies by model nomenclature which frames fall into which category.

Table 2-2 Cheetah Series Chassis Frames By Type

CHEETAH GENERATION I FRAMES		CHEETAH GENERATION II FRAMES	
Model Nomenclature	Rack Unit Size	Model Nomenclature	Rack Unit Size
64 CH	6 RU	64 NE	4 RU
128 CH and 128 CX	10 RU	64 XE	6 RU
256 CH and 256 CX	18 RU	64 WE	6 RU
448 CH "Flexi-Frame"	27 RU	128 NE	7 RU
512 XR	27 RU	128 XE	11 RU
512 CH and 512 CX	41 RU	128 WE	11 RU
864 XR	41 RU		
1024 XR	41 RU		

The number used in the model nomenclature is a rough indication of the maximum number of channels this frame can support. As we told you a few paragraphs back, most frames are designed to allow some flexibility in configuration, so the numerical identifiers are not always an absolute indicator of frame I/O capacity – this can vary depending on the number and type of circuit cards used. However, the digit in the model nomenclature does relate to certain characteristics of the frame such as physical size, circuit card capacity and frame layout.

Gen I frames are constructed using a "modular" backplane concept. With the exception of the 64 CH frame, there are basically three types of backplanes used in the Gen I Series: Input/Output, or simply I/O Backplanes; Matrix Backplanes and Power Supply Backplanes. In most cases four circuit cards can be installed to a specific backplane type; so we can actually view a fully populated I/O backplane assembly as a "block" of input or output channels and a fully populated matrix backplane as a "square" matrix array of a specific size. Each Power Supply Backplane can support up to two Power Supply Modules. In every case the backplane provides the mating connectors for the circuit cards (or modules) installed to it and also modular connectors that provide the interface points for getting power and signals into and out of the circuit card assemblies in a convenient manner. Type-specific backplanes are very key to the building block concept of Gen I frames.

In configuring a typical Gen I frame, with the exception of the 64 CH frame, various numbers of backplane modules of the needed types are mounted into the chassis frame and then internally interconnected to one another. All operating voltages, control signals and I/O channel signals are routed between the system circuit cards via these interconnected backplanes.

Gen II frames use what are essentially two fixed backplanes that directly attach to one another through on-board connectors. The two backplanes are arranged such that one of the backplanes serves to support and interconnect all of the cards and modules mounted inside the chassis frame (components visible from the front of the frame with the door open). The second backplane serves to support and interconnect all the input and output cards installed to the rear panel of the chassis.

In configuring a Gen II frame there are no modular backplanes and the number and type of cards that can be used in the frame is more rigid than with the Gen I frames. Gen II frames tend to be more of an "off the shelf" configuration.

The 64 CH frame is configured using modular style I/O Backplanes, but the cards and modules mounted inside the chassis frame are all connected to a single "fixed" backplane. The unique characteristics of the 64 CH frame are thoroughly discussed in the manual volume specifically for that frame. For our purposes in this discussion, we just want you to be aware that although technically, by its interconnect methodology within the frame, the 64 CH is a Gen I frame, it is unique in that it does not incorporate Matrix Backplanes or Power Supply Backplanes in its configuration.

Every frame, in both Gen I and Gen II genres, has certain maximum numbers of circuit cards of each type that can be installed in it, as shown in Table 2-3. Note that the card populations shown in the table are absolute maximums, by type, that a particular frame can accommodate. These numbers DO NOT necessarily represent the actual number of cards of each type that will be present in a specific frame configuration. Actual card population can vary and is very system specific.

Table 2-3 Cheetah Series Active Components Matrix

CHEETAH SERIES FRAMES	CORE COMPONENT MAXIMUM QUANTITIES INDICATED BY FRAME TYPE										
	Input Buffer CCA [1]	Matrix CCA [1]	Output Combiner CCA [1]	Matrix Frame Controller CCA	System Controller CCA	Power Supply Module	Dual BNC Output Option [2]	HD to SDI Output Option [2]	SDI to Analog Output Option [2]	Fiber Optic Output Option [2]	Output Monitor [3]
64x64	4	1	4	2	2	2	4	4	4	4	1
128x128	8	4	8	2	2	4	8	8	8	8	1
256x256	16	16	16	2	2	8	16	16	16	16	1
256x448	16	28	28	2	2	16	28	28	28	28	1
512x512	32	64	32	2	2	16	32	32	32	32	1
1024x256	64	64	64	2	2	16	16	16	16	16	1

[1] Indicated quantities are maximum number of cards each frame can support. Quantities of each CCA type will vary by matrix configuration.

[2] Only one option card may be attached to an output card. Maximums indicated above are total number of option cards of any type that may be used in the frame.

[3] Output Monitor option is not available for analog signal outputs and is not available in all frame configurations.

Before leaving the subject of chassis frames let's look at an illustration of a populated Gen I 256 CH frame. Figure 2-3 is an illustration looking into the front of the chassis frame with the hinged access door not shown. Figure 2-4 is an illustration looking at the rear panel of the chassis frame. Major system components are identified, but remember, that the purpose of this section is to provide a basic introduction to all frames. Your frame can vary greatly from the illustrations shown here.

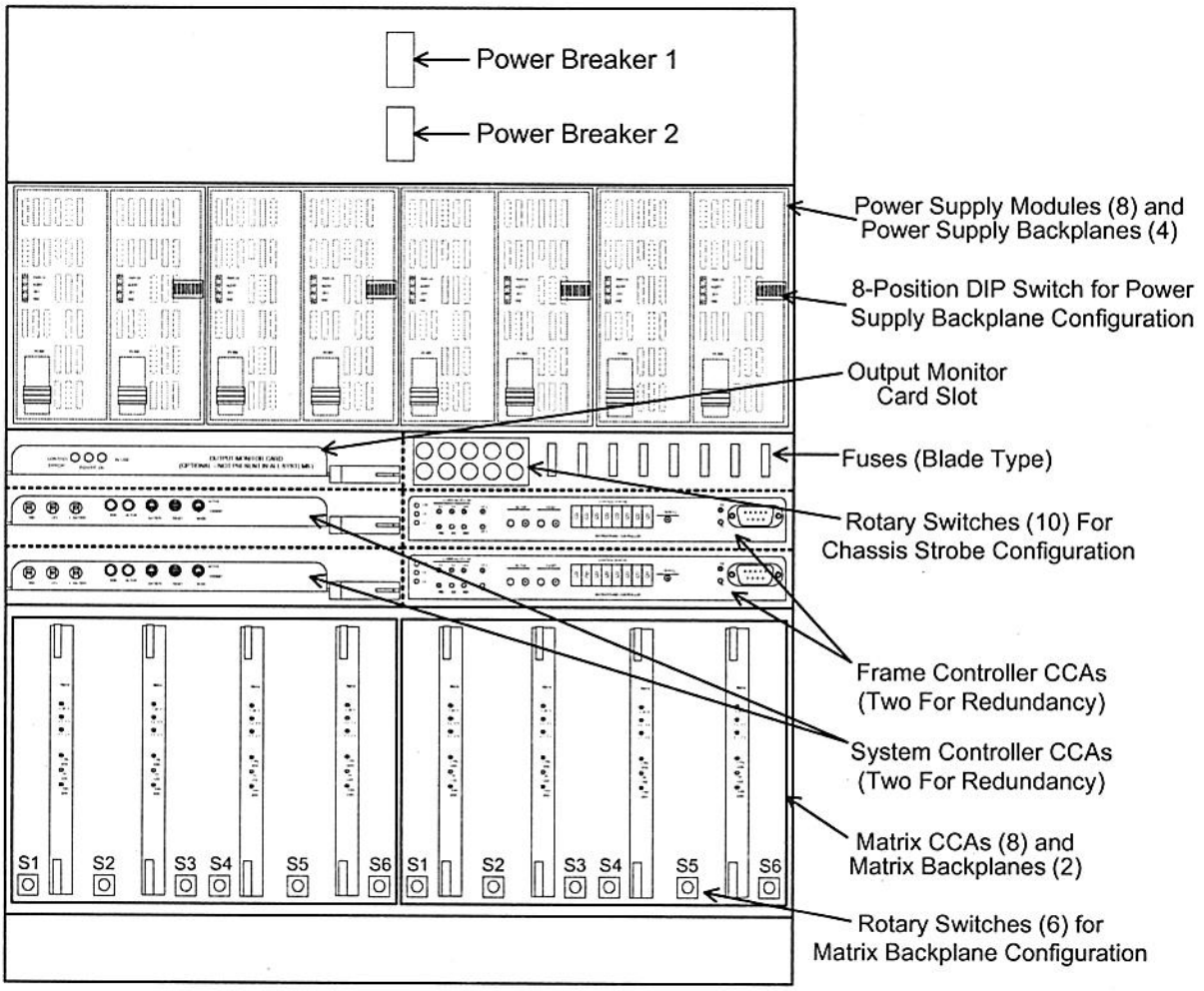

Figure 2-3 Example Chassis Frame Layout (Front View)

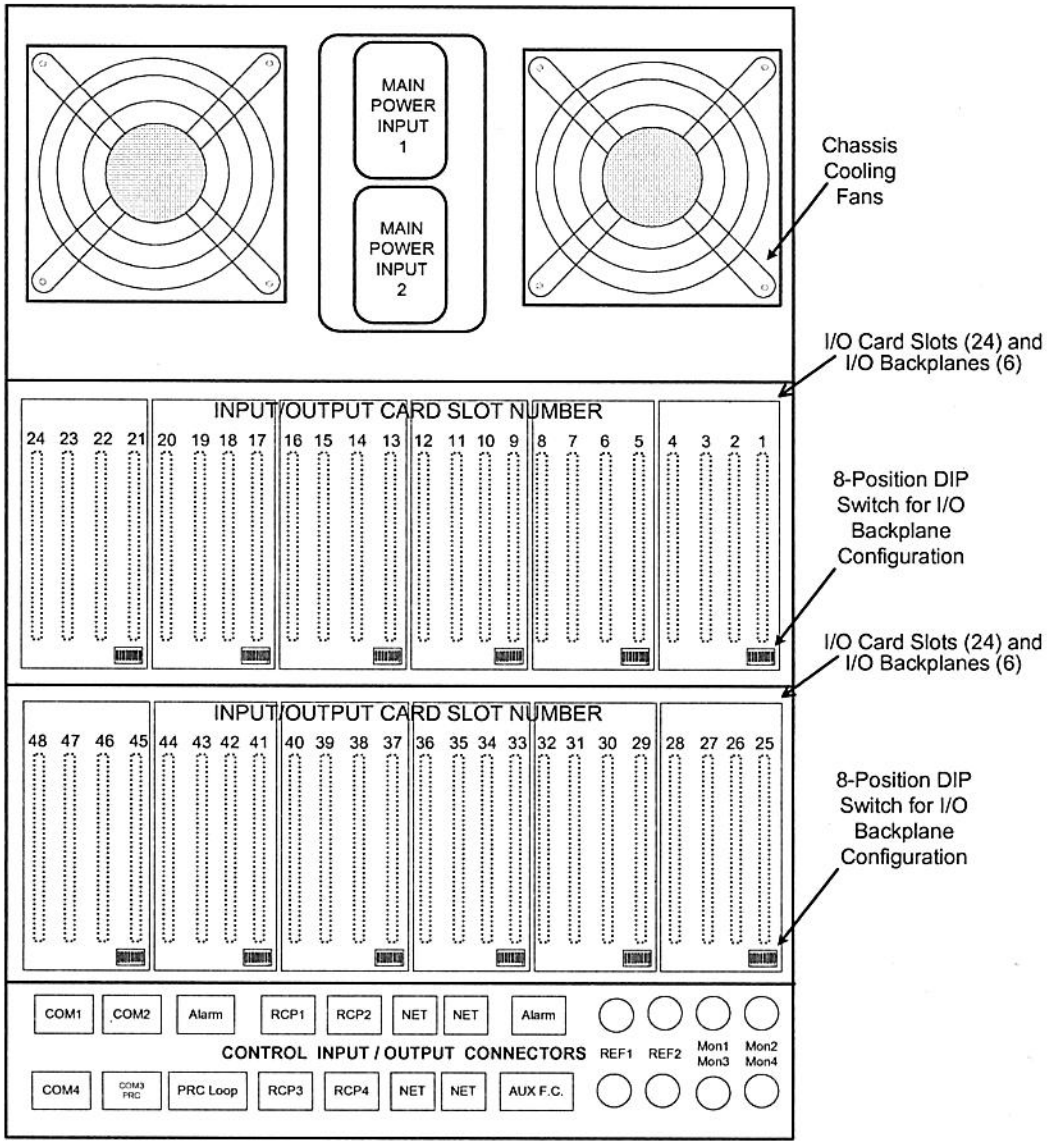

Figure 2-4 Example Chassis Frame Layout (Rear View)

We've already briefly introduced the nomenclature and function of the circuit card assemblies and power supply modules shown in Figures 2-3 and 2-4. When we introduced the concept of modular backplanes in Paragraph 2-5 we also mentioned that there were configuration switches contained on each backplane assembly – regardless of type. Note in Figure 2-3 that there are two power supply modules residing on each power supply backplane along with an 8-position DIP switch; and four matrix cards residing on each matrix backplane along with six rotary switches (S1 thru S6). In addition to the switches on the backplanes, also note the ten rotary switches used for chassis strobe configuration.

Figure 2-4 illustrates the rear panel of the chassis frame where the input and output cards are installed. Note in this figure that up to four input or output cards may reside on each I/O Backplane and that each backplane contains an 8-position DIP switch.

The DIP switches and rotary switches on the various backplanes and in the chassis frame are factory set to assign operational parameters to the system components. The switch settings assign such things as what channel numbers a bank of input or output cards will service, frame type, number of cooling fans, etc. Although the switches are set at the factory for every system, a guide to the proper settings for each switch is included in the tech volume for a particular frame. This scheme of assigning identification to the backplane and interface ports allows full interchangeability between like CCAs in the system.

In every frame variation the input cards and the output cards are loaded through the rear panel card chassis into mating connectors located on an I/O backplane. Note in Figure 2-4 that there are 24 slots for I/O cards in each card chassis, configured as six I/O backplanes with four cards installed to each. All slots may or may not be used in a particular system dependent on the number of input and output channels and whether or not the output cards are fitted with option cards. When option cards are used, each output card will occupy two slots in the card chassis. In a typical Cheetah system, the input cards and output cards will be co-resident in the card chassis. Be aware that although input cards and output cards can be co-resident in the card chassis, they CAN NOT be co-resident on the same backplane. Each I/O backplane in the chassis is designated as either an input or an output backplane. Since every frame type is different as to I/O connector location, layout and labeling, refer to the tech volume for your frame for a rear panel I/O connection guide.

In the next chapter we are going to discuss each core component and its possible variations in greater detail. It is really only necessary that you locate and read the sections of Chapter 3 pertinent to the components comprising your system. However, if you do read the entire section, you might very well find some ideas to increase the versatility of your switcher or perhaps some optional capability that you might not have known was available and could be of use in your installation.

2.7 FEATURES

All Cheetah video matrix switchers offer alarm support, switch confirmation, block checking, and power-out-of-range indicators. Features include:

- Full feature control system using either standard PESA PRC Control or PESA Network Control
- Video and data signal from 3Mb/s to 1.5 GB/s
- Conforms to SMPTE 259M and 292M
- Input EQ to 300M SD, 100M HD
- Bypass mode for non-standard data signals
- Output option slots support dual output, fiber output, DAC module for SDI conversion to National Television Standards Committee / Phase-alternating line (NTSC/PAL) outputs, SD Converter, and HD to SD converter
- Full redundant controllers available
- N+1 redundant internal DC power; full redundant AC power
- All modules are hot-swappable for on-air maintenance
- Dual Output Monitor (Optional and Not Available On All Frames)

Chapter 3: Core Components

3.1 REVIEW OF CORE COMPONENTS

Previous sections of this manual provided a very basic introduction to the various system components considered the core of any Cheetah Video Matrix Routing Switcher. As a review, here once again is the list of cards and modules considered to be the ***core components*** common to all Cheetah systems:

Input Buffer Circuit Card Assembly

Matrix Circuit Card Assembly

Output Combiner Circuit Card Assembly

Power Supply Module

Control System (System Controller CCA and Frame Controller CCA)

Option Cards

Output Monitor Circuit Card Assembly

Remember, not all of these components will be used in every system. Within each category of core component there are several variations of product available for use in different applications. In this chapter we will take a more in-depth look at each card or module, and its different variations.

3.2 INPUT BUFFER CIRCUIT CARD ASSEMBLIES

The input buffer card is the component that interfaces with video signals from external sources. Regardless of variation, each input card contains the rear panel connectors and the signal processing circuitry for up to 16 input channels. Figure 3-1 shows a typical input card with BNC connectors.

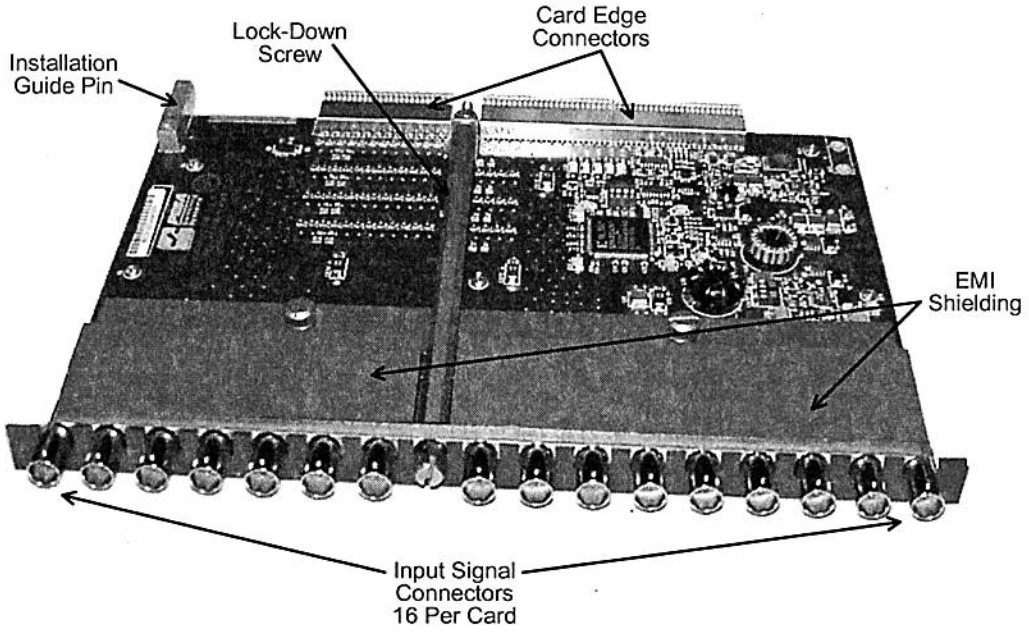

Figure 3-1 Typical Input Buffer CCA

3.2.1 SDI INPUT BUFFER CCA WITH BNC CONNECTORS

Each SDI Input Buffer CCA accepts up to 16 inputs of Standard Definition Interface (SDI) video from external sources through BNC connectors located along the rear panel of the card. Signals with data rates of 144, 270 or 360 Mbs may be applied to the input connectors of this card. Each input channel provides equalization for cable lengths up to 300 meters. This card is fully compliant with SMPTE 259M-A, B, C and D.

There are two LEDs located on the lower rear edge of each input card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry.

Figure 3-2 is a block diagram of the digital input cards with BNC connectors. Paragraph 3.2.4 presents a narrative description of the circuit functions shown on the block diagram. Table 3-1 lists the possible states and interpretation data for the rear panel LEDs.

3.2.2 HD-MULTI-RATE INPUT BUFFER CCA WITH BNC CONNECTORS

Each HD Multi-Rate Input Buffer CCA accepts up to 16 inputs of High Definition (HD) video from external sources through BNC connectors located along the rear panel of the card. Signals with data rates from 3 Mbs to 1.5 Gbs may be applied to the input connectors of this card. Each input channel provides equalization for cable lengths up to 100 meters. This card is fully compliant with SMPTE 292M or SMPTE 259M standards.

There are two LEDs located on the lower rear edge of each input card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry.

Figure 3-2 is a block diagram of the digital input cards with BNC connectors. Paragraph 3.2.4 presents a narrative description of the circuit functions shown on the block diagram. Table 3-1 lists the possible states and interpretation data for the rear panel LEDs.

3.2.3 HD-MULTI-RATE INPUT BUFFER CCA FOR OUTPUT EXPANSION WITH BNC CONNECTORS

Function and Specifications for the HD Multi-Rate Input Buffer CCA for Output Expansion are identical to that of the HD M-R card described in Paragraph 3.2.2. The difference between the two cards is the addition of 16 BNC connectors located on the top surface of the circuit card. In the instance of a Cheetah router expanded beyond a single chassis frame small cables are connected between these on-board connectors and the input card(s) of the second frame. Doing this allows the two frames to share input signals so that the number of output channels provided by the system can be increased.

Just as with the other two digital input cards, this card with expansion capability also has the same two LEDs on the rear edge. Table 3-1 lists the possible states and interpretation data for the rear panel LEDs.

Figure 3-2 is a block diagram of the digital input cards with BNC connectors. Notice on the diagram a circuit block labeled Expansion Buffer and shown in dotted lines. The output from this signal buffer is the signal available at the expansion BNC connector on the board. Paragraph 3.2.4 presents a narrative description of the circuit functions shown on the block diagram.

3.2.4 FUNCTIONAL DESCRIPTION – DIGITAL INPUT CARDS WITH BNC CONNECTORS

Input cards described in Paragraphs 3.2.1 thru 3.2.3 above are all designed for routing digital video with input signals derived from external sources through rear panel BNC connectors and copper wire cable. Refer to Figure 3-2 as we discuss the various circuit functions of these cards. There are 16 identical input channel paths provided by each card. Once a signal enters the card through a rear panel connector it is routed to the Input Signal Equalization circuitry. Here any signal jitter or other signal degradations are corrected. Each circuit device also generates a digital control signal, the Input Signal Present Flag, to alert the On-Board Microcontroller that an active video source is connected to the channel path. From the equalization stage the video passes through a buffer stage to the input of a 1 X 5 Driver device. This device accepts a single input of video and produces 5 isolated outputs of the signal. Four of these outputs are available at the card edge connectors for routing to the Matrix Backplanes or Matrix Card(s) – the ultimate destination of each output is dependent on the frame size and type. The fifth output from the driver stage is routed internally to an Expansion Buffer. This stage is shown in dotted lines because the device is only used, and will only be present, on the HD-Multi-Rate Input Buffer CCA For Output Expansion, discussed in Paragraph 3.2.3.

The On-Board Microcontroller is the interface between the input card and the frame control system. The microcontroller is constantly monitoring the status and health of the card and reporting this data to the system frame controller. Flag signals from each equalizer stage report the presence of a video input signal. 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 input card circuitry are derived from on-board voltage regulator devices.

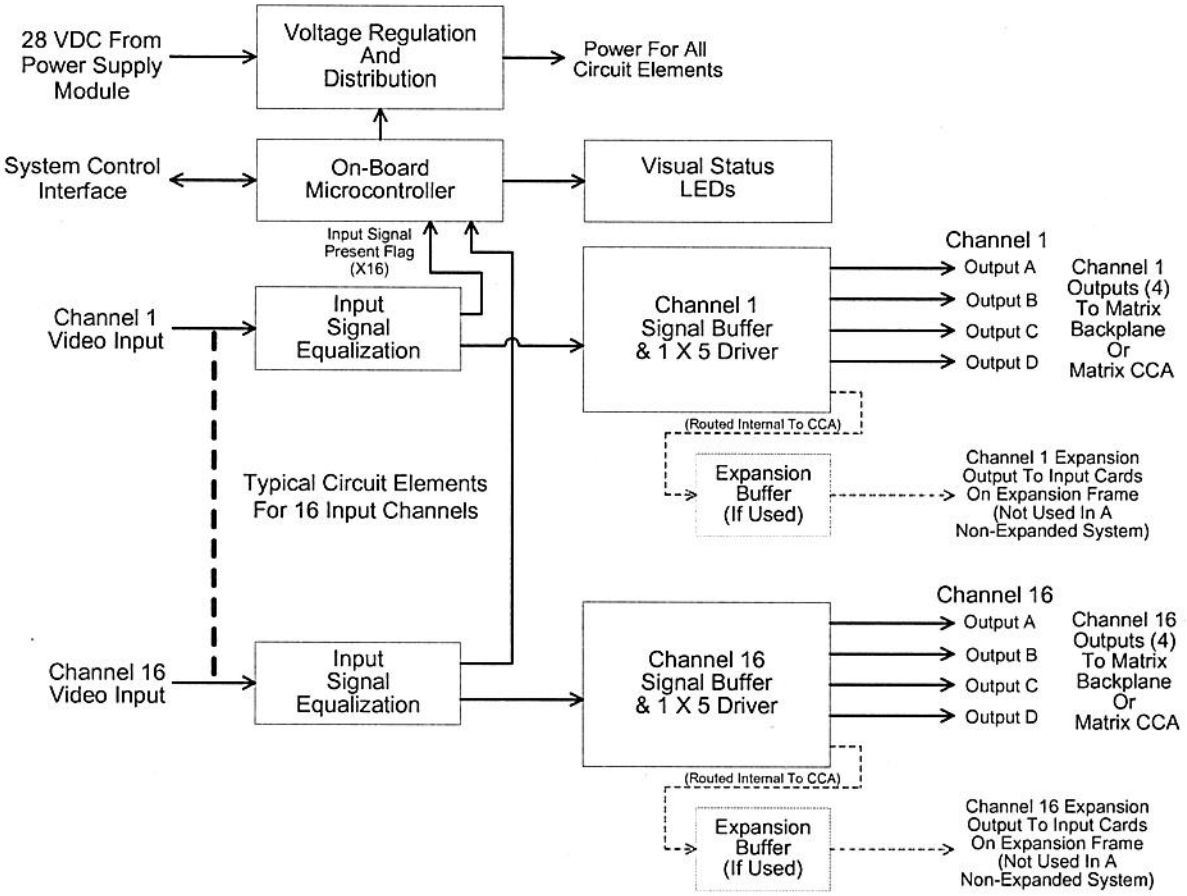

FIGURE 3-2 Block Diagram – Typical Digital Input Buffer CCA For Copper Wire Connection

Table 3-1 Input Buffer Card LED Indicators

LED	COLOR	STATUS	DESCRIPTION
COM Error	Red	**ON**	Indicates that an invalid CRC has been detected.
		Blinking	Indicates a loss of communication from the frame controller. This LED can only be reset when a valid CRC is received.
PWR Good	Green	**ON**	Indicates that the +28V, +4.8V, +4.3V, and +3.5V power is stable and within normal operating parameters.
		OFF	Indicates that +28V is not stable or the +4.8V, +4.3V, or +3.5V power supplies are not working.

3.2.5 HD-MULTI-RATE INPUT BUFFER CCA WITH SFP, LC FIBER CONNECTORS

HD Multi-Rate Input Buffer cards accept up to 16 inputs of High Definition (HD) video from external sources through Small Form Factor Pluggable (SFP) fiber modules using Small Form Factor LC style fiber optic connectors located along the rear panel of the card. Each input channel supports either single-mode or multi-mode cabling at an optical wavelength of 1310 nM. Signals with data rates from 3 Mbs to 1.5 Gbs may be applied to the input connectors of this card. This card is fully compliant with SMPTE 292M or SMPTE 259M standards. There are two LEDs located on the lower rear edge of each input card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry. Figure 3-3 shows the input card with fiber optic connectors (shown with dust caps in place over connectors). Figure 3-4 is a block diagram of the digital input cards with fiber optic connectors. Table 3-1 lists the possible states and interpretation data for the rear panel LEDs.

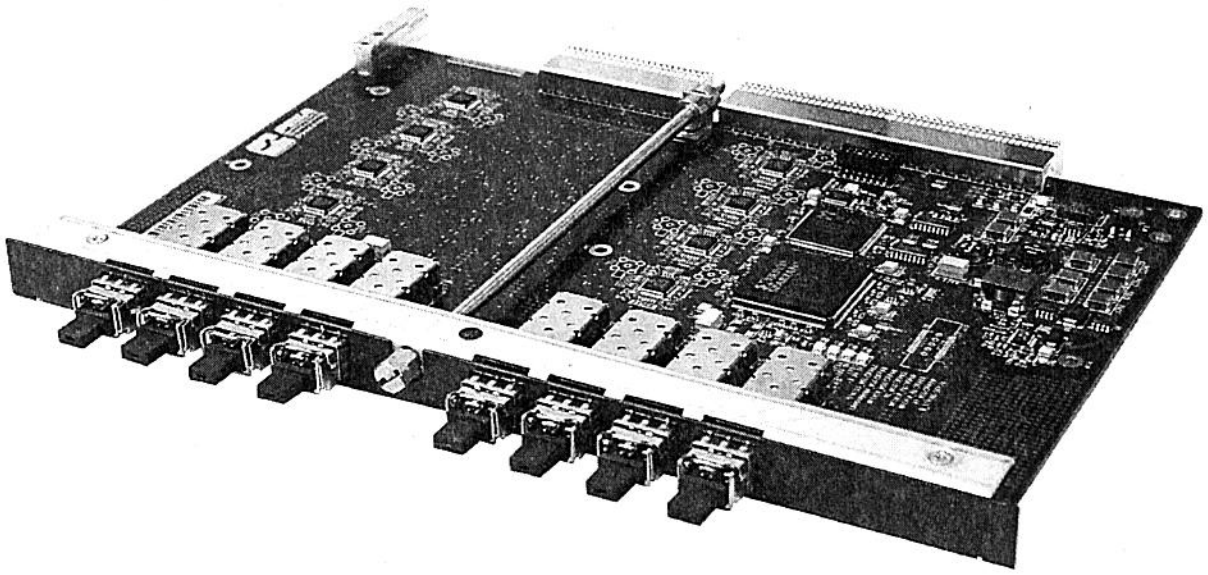

Figure 3-3 Input Buffer CCA With Dual Channel Fiber Optic Receivers

3.2.6 FUNCTIONAL DESCRIPTION – DIGITAL INPUT CARD WITH FIBER OPTIC CONNECTORS

Functionally, the Digital Input Card With Fiber Optic Connectors is virtually identical to the BNC connector variation discussed above. The difference, obviously, being the use of fiber optic cabling rather than coaxial cable and BNC connectors. Refer to Figure 3-4 as we discuss the various circuit functions of this card. There are 16 identical input channel paths provided by each card. You will note on the block diagram that there are 8 fiber optic receiver modules used on the card and that each receiver module is a dual channel device. Once a signal enters the card through an optical connector, circuitry within the receiver module converts the optical signal to an electrical signal that can be processed by the buffer and driver stages. Each receiver module also generates a digital control signal, the Input Signal Present Flag, to alert the On-Board Microcontroller that an active video source is connected to one or both of its channel paths. From the optical receiver stage the video passes through a buffer stage to the input of a 1 X 5 Driver device. This device accepts a single input of video and

produces 5 isolated outputs of the signal. In the current product four of these outputs are available at the card edge connectors for routing to the Matrix Backplanes or Matrix Card(s) – the ultimate destination of each output is dependent on the frame size and type. Future product offerings could use the fifth output from the driver stage for system output expansion just as the HD-Multi-Rate Input Buffer CCA For Output Expansion, discussed in Paragraph 3.2.3.

The On-Board Microcontroller is the interface between the input card and the frame control system. The microcontroller is constantly monitoring the status and health of the card and reporting this data to the system frame controller. Flag signals from each equalizer stage report the presence of a video input signal. 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 input card circuitry are derived from on-board voltage regulator devices.

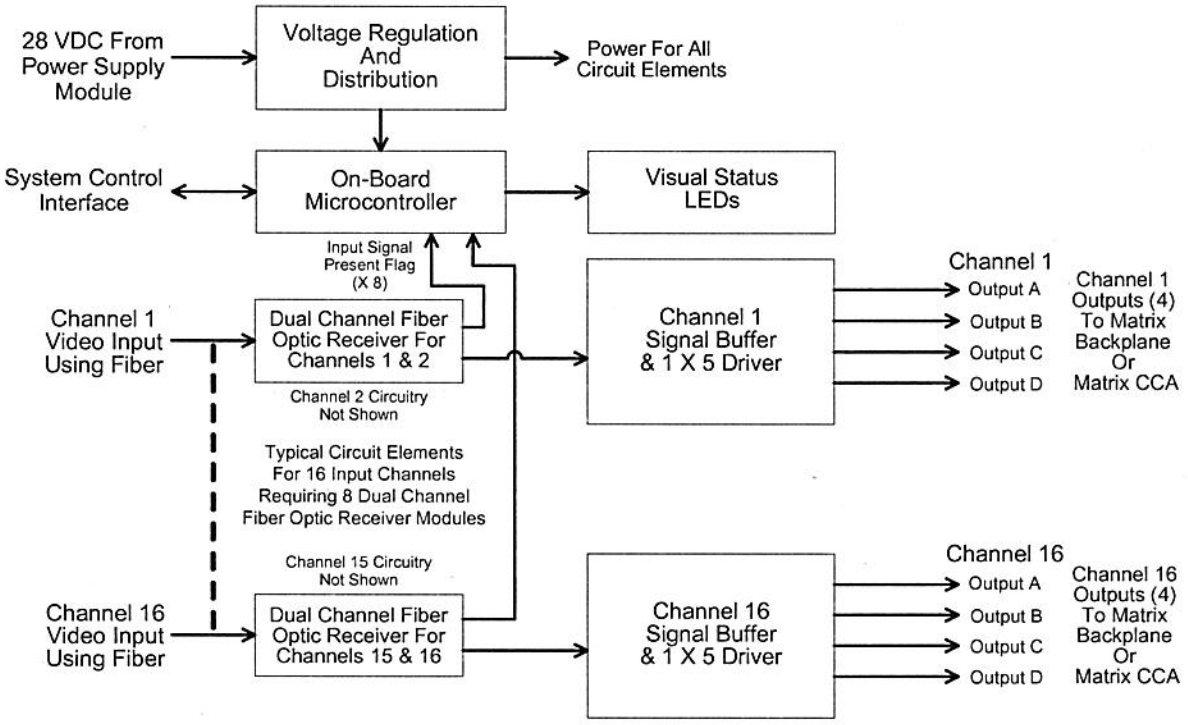

Figure 3-4 Block Diagram – Typical Digital Input Buffer CCA For Fiber Optic Connection

3.2.7 ANALOG VIDEO INPUT BUFFER CCA WITH BNC CONNECTORS

Each Analog Video Input Buffer CCA accepts up to 16 inputs of analog video in either NTSC or PAL formats from external sources through BNC connectors located along the rear panel of the card. Signals with bandwidths up to 50 MHz may be applied to the input connectors of this card. There are two LEDs located on the lower rear edge of each input card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry. Figure 3-5 is a block diagram of the analog input cards with BNC connectors. Table 3-1 lists the possible states and interpretation data for the rear panel LEDs.

3.2.8 ANALOG HIGH-LEVEL VIDEO INPUT BUFFER CCA WITH BNC CONNECTORS

Functionally similar to the standard analog input buffer card, the Analog High Level Video Input Buffer CCA also accepts up to 16 inputs of analog video in either NTSC or PAL formats from external sources through BNC connectors located along the rear panel of the card. Signals with sync voltage levels of ± 5V at bandwidths up to 50 MHz may be applied to the input connectors of the high level card. These operating parameters make the high level buffer ideal for use in telemetry or other applications where critical high level video paths must be distributed. There are two LEDs located on the lower rear edge of each input card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry. Figure 3-5 is a block diagram of the analog input cards with BNC connectors. Table 3-1 lists the possible states and interpretation data for the rear panel LEDs.

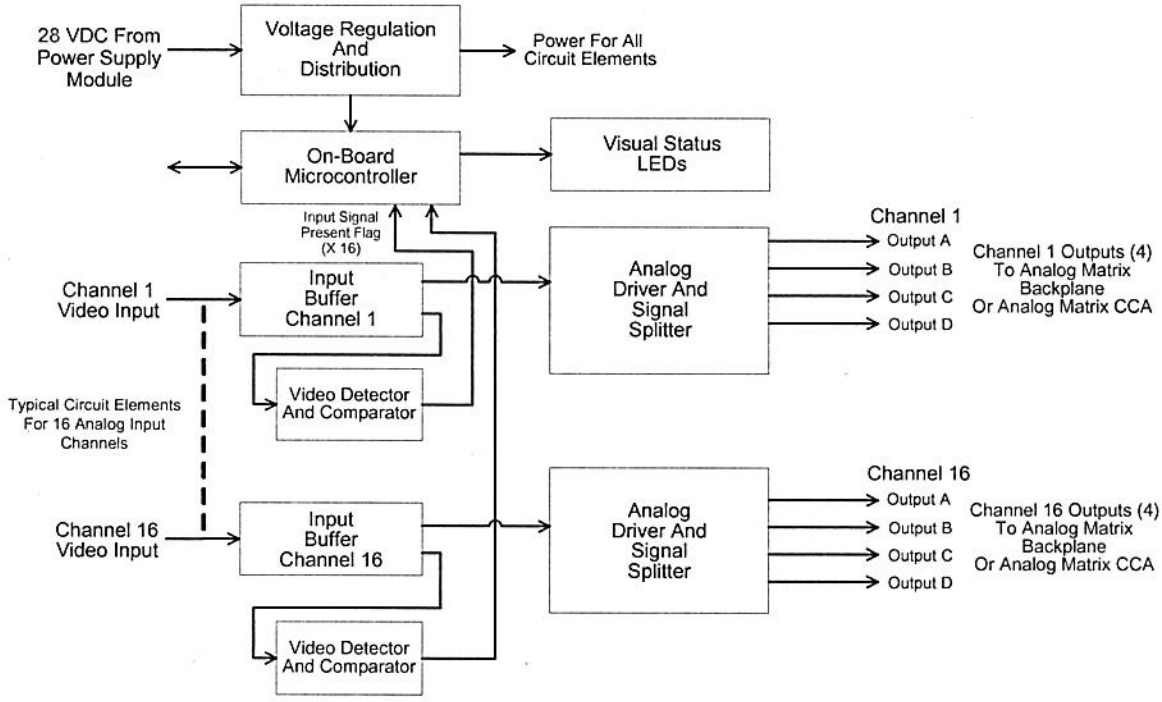

FIGURE 3-5 Block Diagram – Typical Analog Input Buffer CCA For Copper Wire Connection

3.2.9 FUNCTIONAL DESCRIPTION – ANALOG INPUT CARDS WITH BNC CONNECTORS

Both variations of the analog signal buffer cards described above are designed for routing analog video with input signals derived from external sources through rear panel BNC connectors and copper wire cable. . Refer to Figure 3-5 as we discuss the various circuit functions of this card. There are 16 identical input channel paths provided by each card. As a signal enters the card through a rear panel connector it is routed to an Input Buffer stage, the output of which is split to two paths. One output of each buffer enters a video sensing circuit consisting of a Video Detector and a Comparator. Video at the output of the buffer is rectified and compared against a fixed reference voltage. The output of the comparator changes state when a video signal is present thus becoming a digital control signal, the Input Signal Present Flag, to alert the On-Board Microcontroller that an active video source is connected to the channel path. The second output from each buffer stage is routed to an Analog Driver. Video on the output of the driver amplifier is split by a discrete component divider into four output sources. These four outputs are available at the card edge connectors for routing to the Matrix Backplanes or Matrix Card(s) – the ultimate destination of each output is dependent on the frame size and type.

The On-Board Microcontroller is the interface between the input card and the frame control system. The microcontroller is constantly monitoring the status and health of the card and reporting this data to the system frame controller. Flag signals from each video detector report the presence of a video signal on its input. 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 input card circuitry are derived from on-board voltage regulator devices.

3.3 MATRIX CIRCUIT CARD ASSEMBLIES

The matrix card is where the actual signal routing and switching function takes place. In the Cheetah Product family there are three matrix array size cards for digital video signals (64 inputs X 64 outputs, 128 inputs X 128 outputs and 144 inputs X 144 outputs) and a 64 input X 64 output card for analog video signals. Figure 3-6 shows a typical digital video matrix card.

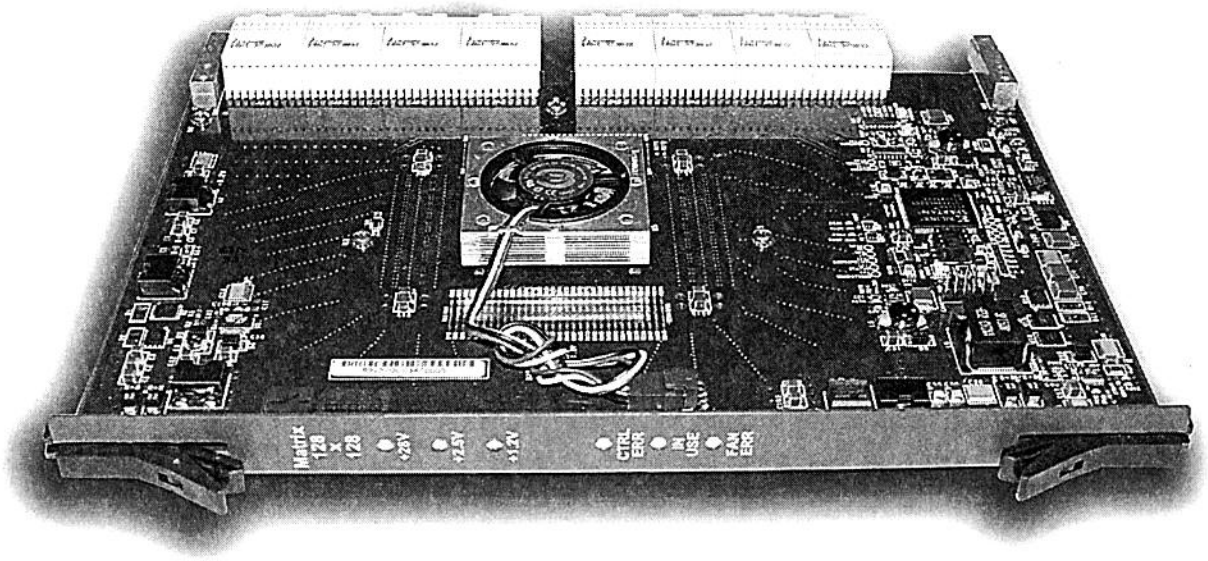

FIGURE 3-6 Typical Digital Video Matrix CCA (128 X 128 Card Shown)

3.3.1 64 INPUT X 64 OUTPUT DIGITAL VIDEO MATRIX CARD

As the name implies, the 64 X 64 digital matrix card accepts up to 64 SDI or HD video sources from the input buffer cards and provides up to 64 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 64 X 64 matrix card, multiple matrix cards may be used in most Cheetah chassis frames. System expansion and multiple matrix card systems are discussed in the next chapter of this manual.

There are five LEDs located on the front edge of each 64 x 64 matrix card that provide a visual indication of the operational status of the card, these are identified by Figure 3-7. Table 3-2 lists the possible states and interpretation data for the LEDs.

Figure 3-8 is a block diagram of the 64 X 64 digital matrix card. Paragraph 3.3.2 presents a narrative description of the circuit functions shown on the block diagram.

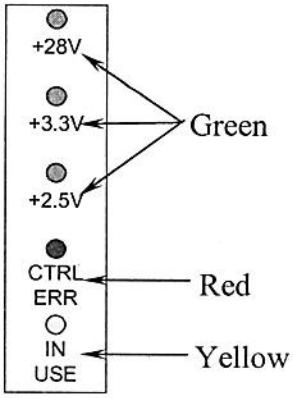

FIGURE 3-7 64x64 Video Crosspoint Matrix Card LED Indicators

Table 3-2 64x64 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.
+3.3V	Green	**ON**	Indicates that the +3.3Vpower is stable and within normal operating parameters.
		OFF	Indicates that +3.3V 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.
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.
Port A/B	Yellow (On the PCB only)	**ON**	These surface-mount LEDs indicate whether the card is communicating with the frame controller via communications port A or B. They are not user-accessible.

3.3.2 FUNCTIONAL DESCRIPTION – 64 X 64 DIGITAL VIDEO MATRIX CARD

Refer to Figure 3-8 as we discuss the various circuit functions of this card. There are 64 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, the output of which feeds directly into the special purpose crosspoint device. This device contains the switching circuitry to deliver a signal on any of its 64 input channels to any of its 64 output channels. Switching data for the crosspoint device is received from the on-board microcontroller circuitry. Each output channel from the crosspoint device is routed to one of 64 identical output buffer stages for isolation. From the buffer output each 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 is constantly monitoring the status and health of the card and reporting 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.

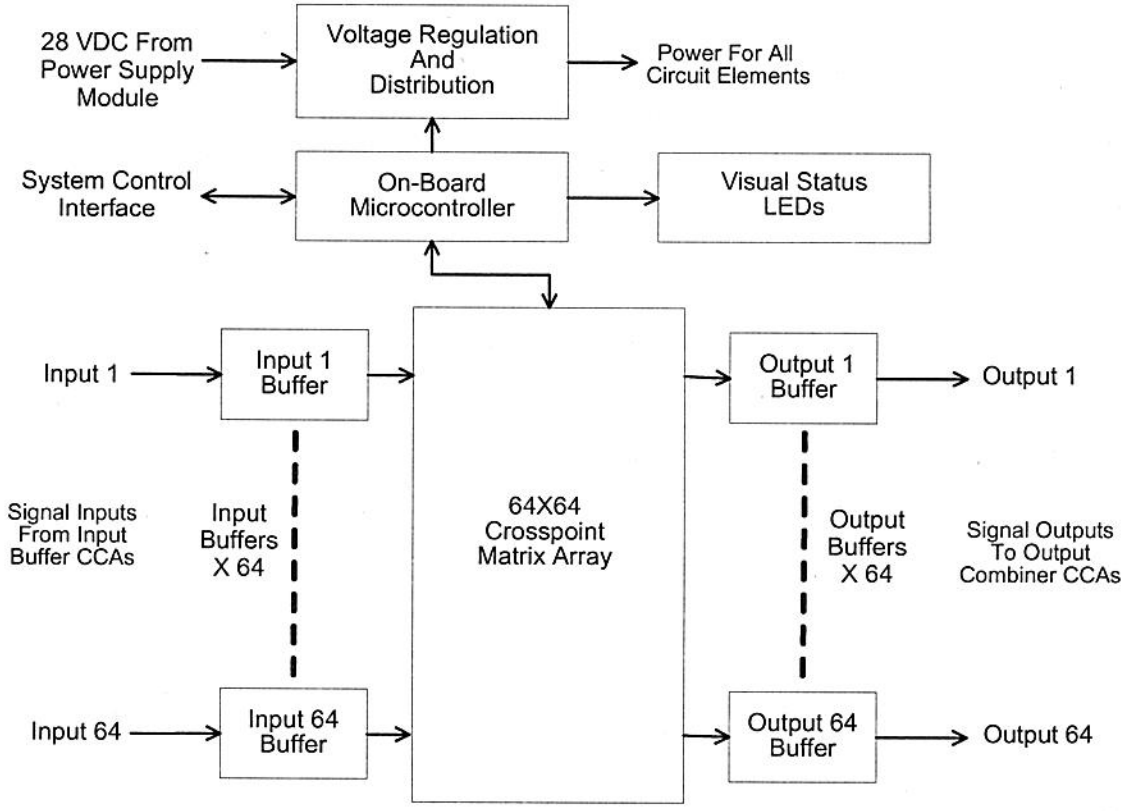

Figure 3-8 Block Diagram – 64 X 64 Digital Video Matrix Card

3.3.3 128 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, multiple matrix cards may be used in most Cheetah chassis frames. System expansion and multiple matrix card systems are discussed in the next chapter of this manual.

There are six LEDs located on the front edge of each 128 x 128 matrix card that provide a visual indication of the operational status of the card, these are identified by Figure 3-9. Table 3-3 lists the possible states and interpretation data for the LEDs.

Figure 3-10 is a block diagram of the 128 X 128 digital matrix card. Paragraph 3.3.4 presents a narrative description of the circuit functions shown on the block diagram.

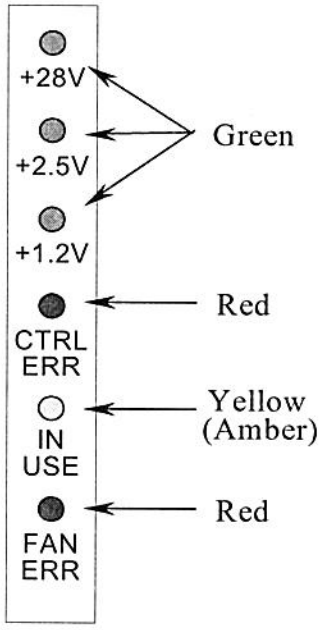

Figure 3-9 128x128 Video Crosspoint Matrix Card LED Indicators

Table 3-3 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. .

3.3.4 FUNCTIONAL DESCRIPTION – 128 X 128 DIGITAL VIDEO MATRIX CARD

Refer to Figure 3-10 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 is constantly monitoring the status and health of the card and reporting 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.

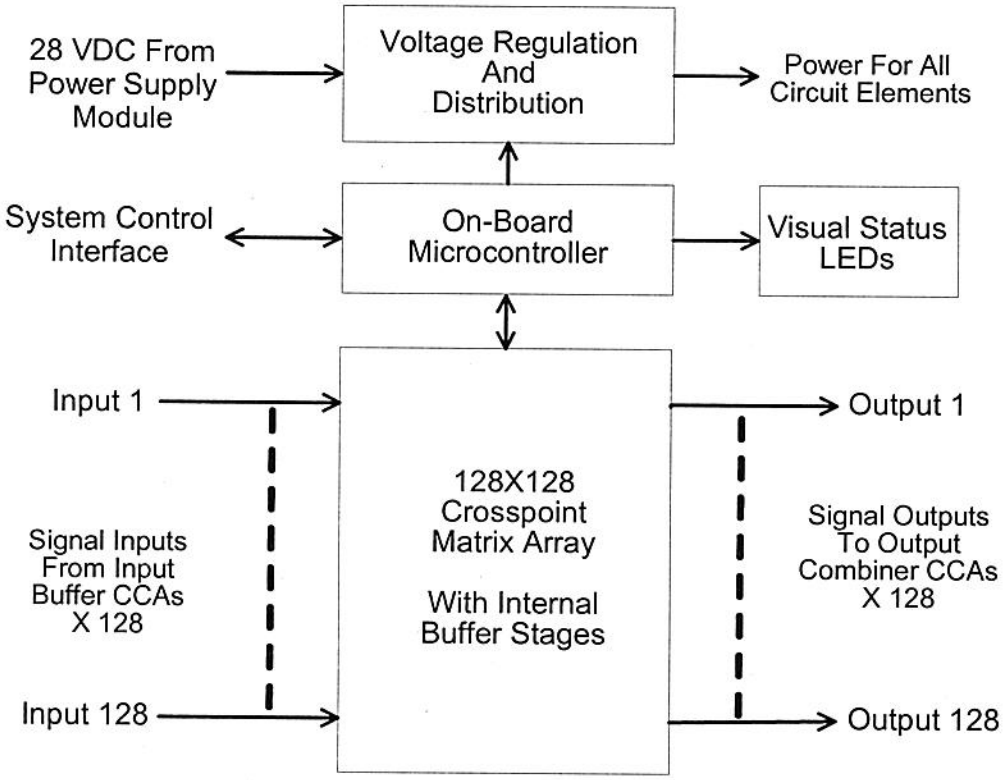

Figure 3-10 Block Diagram – 128 X 128 Digital Video Matrix Card

3.3.5 144 INPUT X 144 OUTPUT DIGITAL VIDEO MATRIX CARD

As the name implies, the 144 X 144 digital matrix card accepts up to 144 SDI or HD video sources from the input buffer cards and provides up to 144 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 144 X 144 matrix card, multiple matrix cards may be used in most Cheetah chassis frames. System expansion and multiple matrix card systems are discussed in the next chapter of this manual.

There are six LEDs located on the front edge of each 144 x 144 matrix card that provide a visual indication of the operational status of the card, these are identified by Figure 3-11. Table 3-4 lists the possible states and interpretation data for the LEDs.

Figure 3-12 is a block diagram of the 144 X 144 digital matrix card. Paragraph 3.3.6 presents a narrative description of the circuit functions shown on the block diagram.

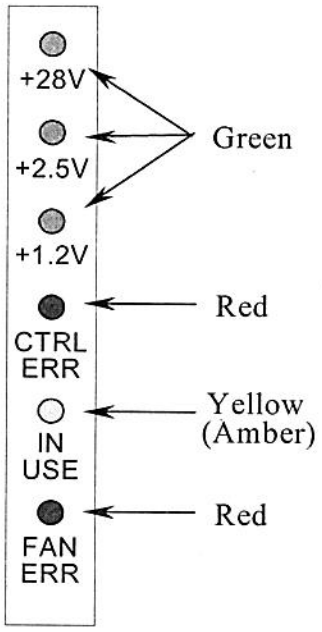

Figure 3-11 144x144 Video Crosspoint Matrix Card LED Indicators

Table 3-4 144x144 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.

LED	COLOR	STATUS	DESCRIPTION
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. .

3.3.6 FUNCTIONAL DESCRIPTION – 144 X 144 DIGITAL VIDEO MATRIX CARD

Refer to Figure 3-12 as we discuss the various circuit functions of this card. There are 144 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 144 input channels to any of its 144 output channels. Switching data for the crosspoint device is received from the on-board microcontroller circuitry. The crosspoint also contains 144 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 is constantly monitoring the status and health of the card and reporting 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.

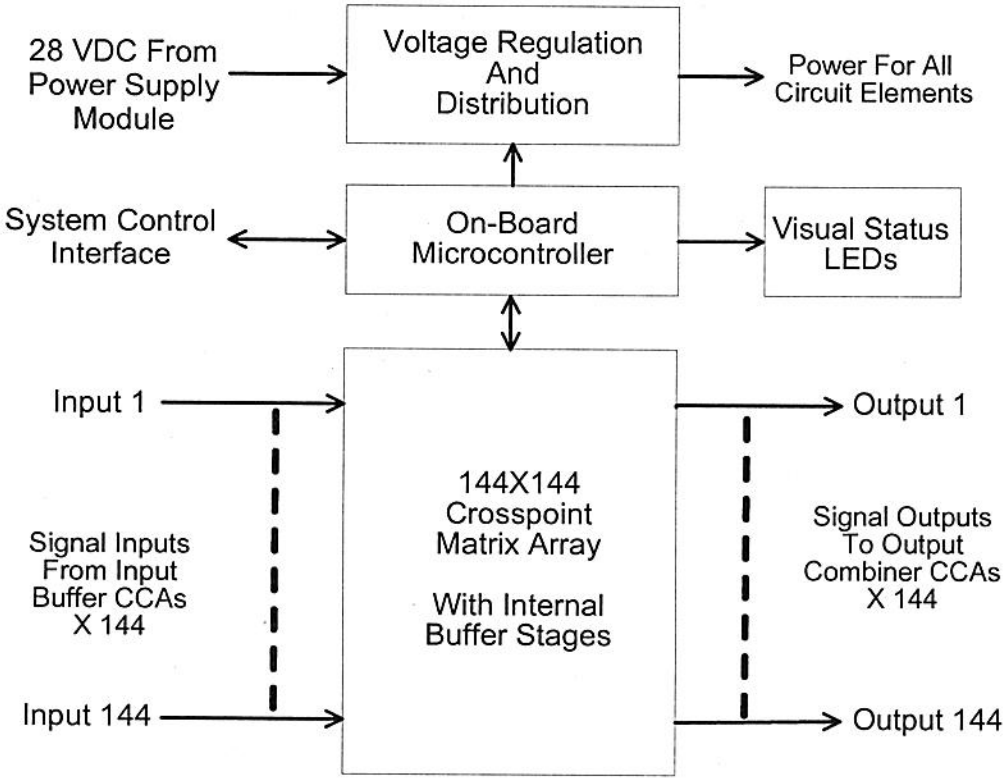

Figure 3-12 Block Diagram – 128 X 128 Digital Video Matrix Card

3.3.7 64 INPUT X 64 OUTPUT ANALOG VIDEO MATRIX CARD

The 64 X 64 analog matrix card accepts up to 64 analog video sources from the input buffer cards and provides up to 64 output channels to the output combiner cards. 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 64 X 64 matrix card, multiple matrix cards may be used in most Cheetah chassis frames. System expansion and multiple matrix card systems are discussed in the next chapter of this manual.

There are five LEDs located on the front edge of each 64 x 64 analog matrix card that provide a visual indication of the operational status of the card, these are identified by Figure 3-13. Table 3-5 lists the possible states and interpretation data for the LEDs.

Figure 3-14 is a block diagram of the 64 X 64 analog matrix card. Paragraph 3.3.8 presents a narrative description of the circuit functions shown on the block diagram.

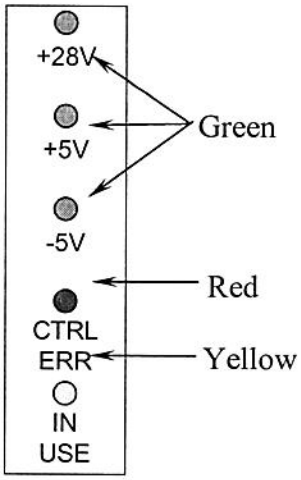

Figure 3-13 64x64 Analog Video Crosspoint Matrix Card LED Indicators

Table 3-5 64x64 Analog 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.
+5V	Green	**ON**	Indicates that the +5Vpower is stable and within normal operating parameters.
		OFF	Indicates that +5V is not stable power supplies are not working.
-5V	Green	**ON**	Indicates that the -5Vpower is stable and within normal operating parameters.
		OFF	Indicates that -5V 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.
Port A/B	Yellow (On the PCB only)	**ON**	These surface-mount LEDs indicate whether the card is communicating with the frame controller via communications port A or B. They are not user-accessible.

3.3.8 FUNCTIONAL DESCRIPTION – 64 X 64 ANALOG VIDEO MATRIX CARD

Refer to Figure 3-12 as we discuss the various circuit functions of this card. You will notice that the analog matrix card is implemented using 16 input X 16 output crosspoint devices. Consider the array configuration as consisting of four 64 input X 16 output matrices, each composed of four 16 X 16 crosspoint devices and sixteen 4 X 1 crosspoint devices.

In each instance of a 64 X 16 matrix all of the 64 input signals must be available to each group of 16 output channels. Four 16 X 16 crosspoint devices satisfy this requirement. Each device receives one group of 16 of the 64 input channels: 1 thru 16, 17 thru 32, 33 thru 48 and 49 thru 64. Each device can matrix any of its 16 input signals to any of its 16 output channels.

Taking a closer look at the 64 X 16 array handling output channels 1 thru 16, we see that each of the four crosspoint devices must provide an output signal for each of the output channels of the group. Like-channel outputs, 1 thru 16 in our example, from each 16 X 16 crosspoint are routed to the inputs of a 4 X 1 crosspoint device. This device can matrix any of its four inputs to its single output. Thus video for a specific output channel from one of the four 16 X 16 devices may be selected as the output of the 4X1 crosspoint. In this manner any of the 64 video input signals may be selected as the source for any of the output paths.

Four of the 64 X 16 arrays provide the 64 output channel capacity of the card, with each output channel having access to any of the 64 input channels. Each of the four 64 X 16 array groups provide 16 of the 64 output channels: 1 thru 16, 17 thru 32, 33 thru 48 and 49 thru 64.

Each input signal from an input buffer card is received by the analog matrix card through card edge connectors and passed to the input of a buffer stage. There are 64 identical input buffer stages on the card. These are shown on the block diagram as four groups of sixteen inputs each. From each buffer stage the video is routed to the four 16 X 16 crosspoint devices associated with its input channel number. The video signal at the output of each of the 64 4 X 1 crosspoint devices is passed through an output buffer stage and is available at the card edge connectors for the output combiner cards. Channel select and switching control data for all crosspoint devices is derived from the microcontroller circuitry.

The On-Board Microcontroller is the interface between the analog matrix card and the frame control system. The microcontroller is constantly monitoring the status and health of the card and reporting 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 devices. 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.

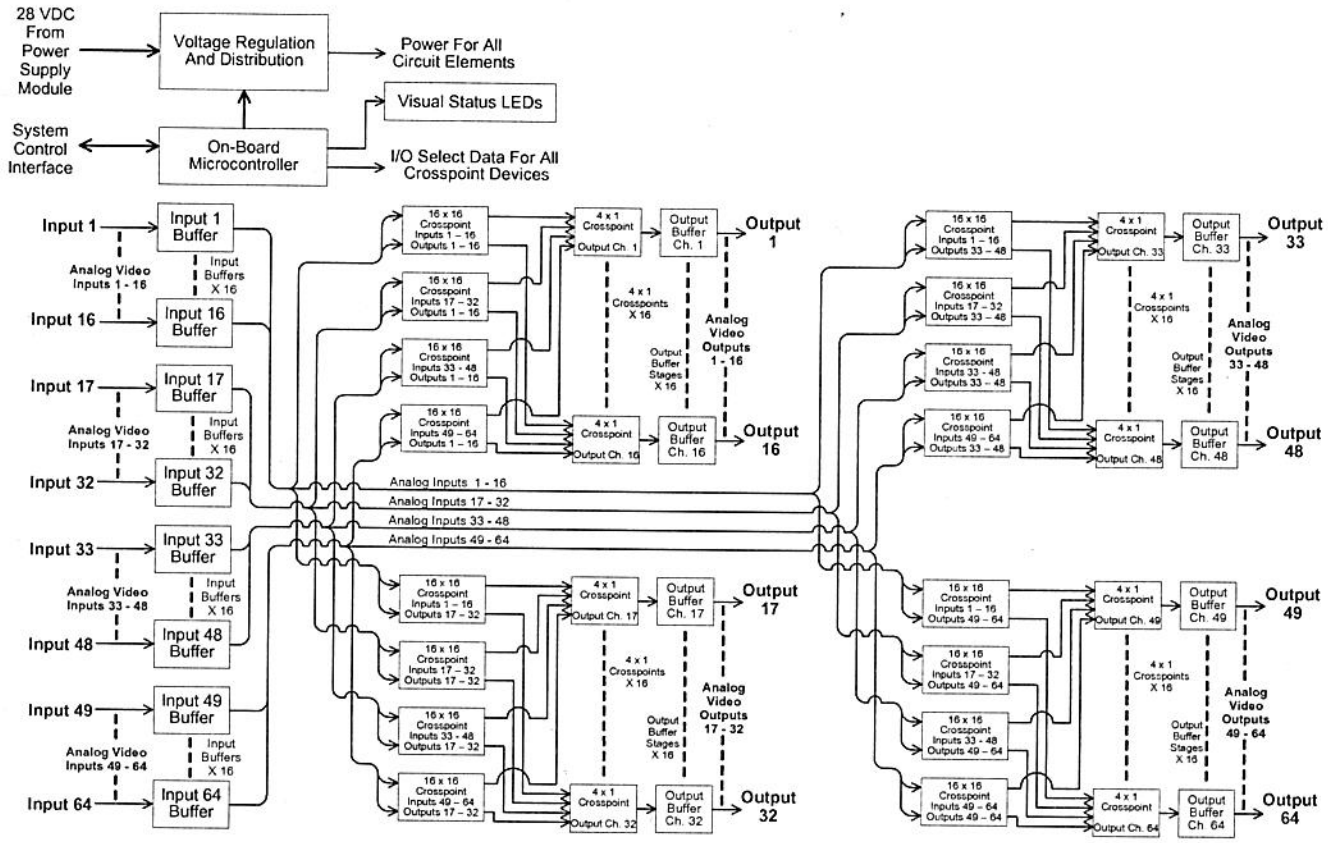

Figure 3-14 Block Diagram – 64 X 64 Analog Video Matrix Card

3.4 OUTPUT COMBINER CIRCUIT CARD ASSEMBLIES

The Output Combiner card is the component that provides video signals from the routing switcher for use by external sources. Regardless of variation, each output combiner card contains the rear panel connectors and the signal processing circuitry for up to 16 output channels. Figure 3-15 shows a typical digital video output combiner card with BNC connectors.

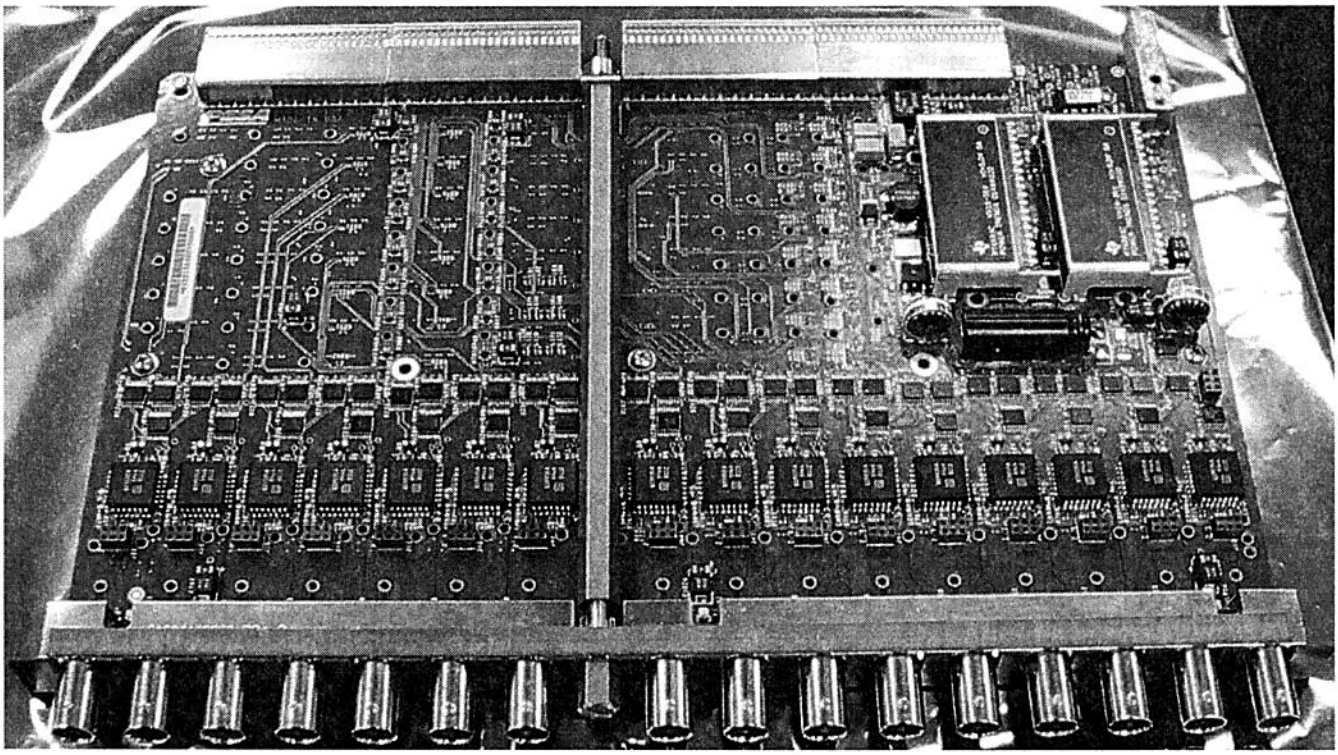

Figure 3-15 Typical Output Combiner CCA (Digital Video BNC Card Shown)

3.4.1 SDI OUTPUT COMBINER CCA WITH BNC CONNECTORS

Each SDI Output Combiner CCA provides up to 16 outputs of Standard Definition Interface (SDI) video through BNC connectors located along the rear panel of the card. Signals with data rates of 143 to 540 Mbs may be processed and buffered by any output channel. This card is fully compliant with SMPTE 259M-A, B, C and D.

There are two LEDs located on the lower rear edge of each output combiner card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry.

Figure 3-16 is a block diagram of the digital input cards with BNC connectors. Paragraph 3.4.3 presents a narrative description of the circuit functions shown on the block diagram. Table 3-6 lists the possible states and interpretation data for the rear panel LEDs.

3.4.2 HD-MULTI-RATE OUTPUT COMBINER CCA WITH BNC CONNECTORS

Each HD Multi-Rate Output Combiner CCA provides up to 16 outputs of High Definition (HD) video through BNC connectors located along the rear panel of the card. Signals with data rates from 3 Mbs to 1.5 Gbs may be processed and buffered by any output channel. This card is fully compliant with both SMPTE 292M and SMPTE 259M re-clocking standards of 143, 177, 270, 360 and 540 Mbs as well as 1.485 Gbs. In addition non-standard signals from 3 Mbs to 1.5 Gbs are supported.

There are two LEDs located on the lower rear edge of each input card. The top one is red in color and its state indicates the status of the communications circuitry on-board the card. The second LED is green in color and its state indicates the status of the operating voltages for the on-board circuitry.

Figure 3-2 is a block diagram of the digital input cards with BNC connectors. Paragraph 3.4.3 presents a narrative description of the circuit functions shown on the block diagram. Table 3-6 lists the possible states and interpretation data for the rear panel LEDs.

3.4.3 FUNCTIONAL DESCRIPTION – DIGITAL OUTPUT COMBINER CARDS WITH BNC CONNECTORS

Output cards described in Paragraphs 3.4.1 thru 3.4.2 above contain circuitry to receive video signals from the matrix CCAs, combine (select) and process the incoming signals and drive up to 16 digital video output signals through rear panel BNC connectors and copper wire cable. Refer to Figure 3-6 as we discuss the various circuit functions of these cards.

There are 16 identical output channel paths provided by each card. Each output channel selects its input signals from one of up to 8 matrix CCAs in the frame. An 8X1 Signal Source Selector is associated with each of the 16 input channel paths. This selector, under software control, determines the active video signal for the output path. The selected signal enters a Dual Output Buffer stage where two separate output signals are produced. One of these signals enters the Digital Video Reclocker stage where it is processed and synchronized for output from the switcher. The second output from the dual buffer is again buffered by a Monitor Buffer and then routed into the monitor video source selector.

Video from the re-clocker stage enters a second Dual Output Buffer stage with two output signals. One of these output signals enters the Output Driver stage where the video signal is amplified to a level capable of driving an external device. The output signal from the driver stage is available at the rear panel BNC connector associated with the output channel path. The second output signal from the dual buffer is routed to the pins of an on-board connector for output option cards, if used.

Video signals from each of the 16 output channel paths on the card are received by Monitor Video 16X1 Signal Source Selector circuitry. This device, under software control, selects one of the 16 input signals as the monitor video output source from the output card.

The On-Board Microcontroller is the interface between the input card and the frame control system. The microcontroller is constantly monitoring the status and health of the card and reporting this data to the system frame controller. Flag signals from each equalizer stage report the presence of a video input signal. 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 input card circuitry are derived from on-board voltage regulator devices.

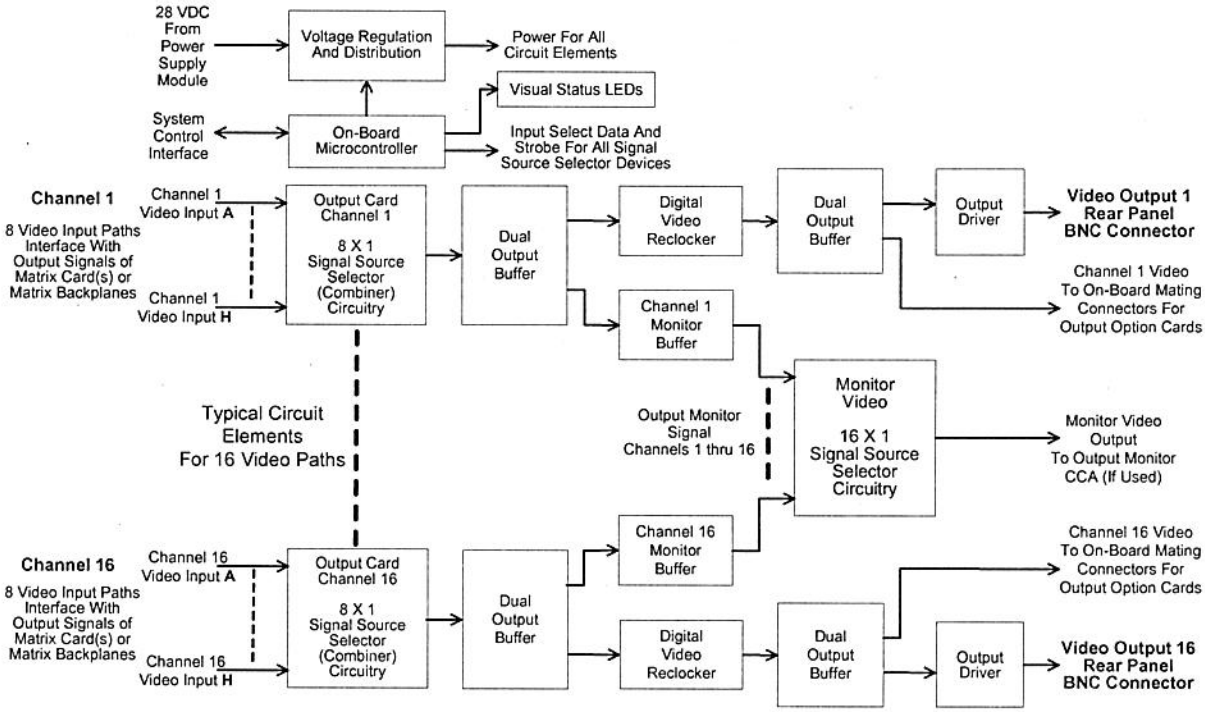

Figure 3-16 Block Diagram – Typical Digital Output Combiner CCA For Copper Wire Connections

Table 3-6: Output Combiner Card LED Indicators

LED	COLOR	STATUS	DESCRIPTION
COM Error	Red	**ON**	Indicates that a control error has occurred or a loss of receive clock from the 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. If a control error occurs, the LED will remain on until a message with a good CRC has been received
		Blinking	Indicates a missing receive clock error.
PWR Good	Green	**ON**	Indicates that the +28V, +5.0V, +3.7V, and +4.5V power is stable and within normal operating parameters.
		OFF	Indicates that +28V is not stable or the +5.0V, +3.7V, or +4.5V power supplies are not working.

Chapter 4: System Architecture

4.1 INTRODUCTION

Cheetah Video Matrix Routing Switchers can be configured to accommodate various digital signal formats, such as multi-rate HD and SDI, within the same frame. Analog (NTSC/PAL) signals may not be routed through the same matrix array as digital signals. It is possible, however, to configure essentially two separate switchers (matrix arrays), one for digital the other for analog, contained in the same chassis frame – sharing control system components. This application will be discussed in detail later in this section. Initially, let's look at the components required to configure a basic digital signal routing switcher.

As previously mentioned, the architecture of the Cheetah Series allows systems of various capacity to be configured using the core component building blocks and a chassis frame. For our first look at the Cheetah architecture we'll consider a fairly basic 64 input by 64 output (64X64) configuration. Figure 2-3 is a block diagram showing the various system components and functions required to "build" this system. In this illustration we are using four input CCAs (16 channels each), a single 64X64 Matrix CCA, four output CCAs (16 channels each) and other system components required for an operational system. Refer to this figure as we discuss each block of the diagram in the following paragraphs.

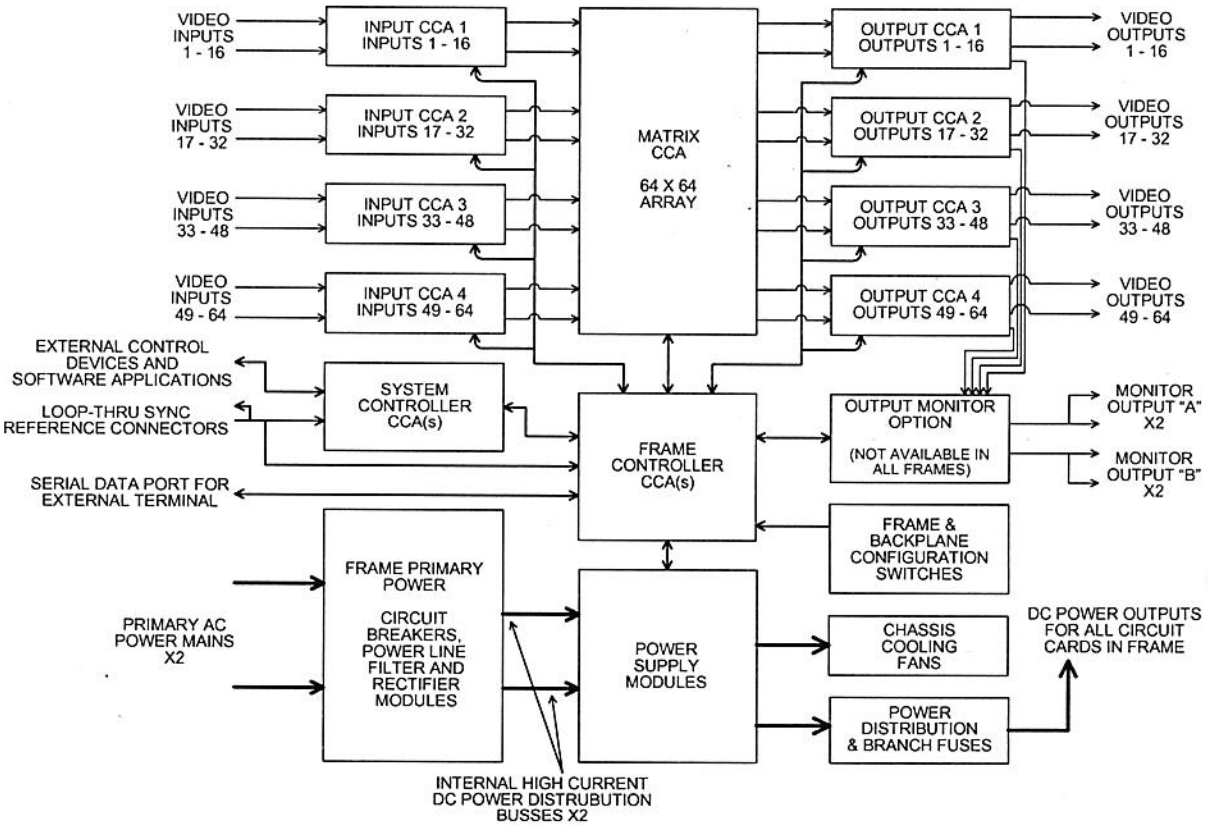

Figure 4-1 Block Diagram – 64x64 Switcher Components

Video signals enter the router from external sources through one of the four Input CCA cards. Each input card provides 16 input channels, for a total of 64 video inputs. Incoming video signals are buffered and conditioned by the input CCA circuitry and then routed to the inputs of the Matrix CCA.

As you recall, there are several variations of the Cheetah Series Matrix CCA, in this application a single 64X64 matrix card provides the required switching capacity. The 64 video output signals from the matrix CCA are routed in groups of 16 to the inputs four Output CCA cards.

Each Output CCA provides 16 output channels, for a total of 64 video outputs. Incoming video from the matrix is buffered and conditioned by the output CCA before leaving the routing switcher. Video signals at the output connectors are available for distribution as required within the facility. Also notice that each Output CCA provides an output of monitor video that is routed to the Output Monitor Option CCA. A 16 input X 1 output selector device on-board each output card selects which video channel is routed to the output monitor card.

Monitor video from each Output CCA is received by the Output Monitor Option CCA. A source selector within the monitor card selects, via commands from the Frame Controller, which incoming monitor video signal is routed to the monitor output circuitry. There are actually two independent video paths within the monitor card, allowing two monitor channels from a single monitor CCA. Each monitor output signal is available on two rear-panel BNC connectors.

The System Controller CCA is the interface between the Cheetah switcher and an external control system. Actual control of the switching matrix and all frame functions is performed by the Frame Controller CCA. The System Controller and the Frame Controller communicate bi-directionally over a serial communication protocol. Commands from the external control system are issued by the System Controller to the Frame Controller where they are implemented within the frame. Status and other operational data from the various frame components is read by the Frame Controller and passed by way of the System Controller to the external control system.

The Frame Primary Power components interface with the facility Primary Power source, and consist of circuit breakers for overload protection, power line filter and rectifier modules. A high current DC voltage output is available from the rectifiers and distributed in a power bus arrangement to the Power Supply Modules within the frame.

Each frame is equipped with the number of Power Supply Modules necessary to provide operating power to the system components. Modules may also be installed to provide power supply redundancy should a power supply module fail. Each module communicates its operational status to the Frame Controller CCA. Should any module fail, visual and (if connected) audible warnings are given to indicate the failure. Also, a redundant module, if so equipped, can be transparently switched by control circuitry to functionally replace the failed module. Voltage output from the power supply modules powers the Chassis Cooling Fans and is routed to the Power Distribution and Branch Fuses circuitry. Each Input, Output and Matrix CCA receives power by way of a fused distribution bus.

As previously discussed, there are no function-specific settings on any individual CCA, therefore like components within each Cheetah router may be interchanged without affecting matrix configuration. Instead of coding channel assignments to each card, the Cheetah frames use connector-specific (or backplane-specific) coding by using a series of Frame and Backplane Configuration Switches. These switches are either of the rotary or DIP type, and the settings of each assign the "personality" to each card or backplane in the system.

(TEXT TO BE CONTINUED)