TECHNICAL MANUAL

CHEETAH DRS SERIES AUDIO ROUTERS

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April, 2007

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April, 2007

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Chapter 1 About This Manual

1.1 DOCUMENTATION AND SAFETY OVERVIEW

This manual provides instructions for the installation, operation, and maintenance as well as a top-level functional description of the Cheetah DRS Series Audio Routing Switchers built by QuStream.

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 necessary information pertaining to the text or topic they address. It is imperative that audiences read and understand the statements to avoid possible loss of life, personal injury, and/or destruction/damage to the equipment. These additional statements may also provide added information that could enhance the operating characteristics of the equipment (i.e., Notes). Examples of the graphic symbol used to identify each type of statement and the nature of the statement content are shown in the following paragraphs:

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 DESCRIPTION

QuStream's Cheetah DRS Series Audio Router is a compact, flexible and fully expandable Distributed Routing System for audio signals, offering the user a high degree of versatility and features. In the greatest sense of the word, the Cheetah DRS is a true distributed routing system, using high-speed time slice digital data manipulation and multiplexing technologies for signal distribution, rather than a crosspoint matrix array. This cutting edge technology allows audio input and output frames to be distributed remotely from one another as needed for a particular installation. For the DRS Audio Router application, the time slice data bus is referred to as the Packet Audio Stream (PAS) bus. Audio signals are sampled and "packetized" into a serial data stream for routing between DRS frames. On the output side, the PAS bus data is reconstructed into the original audio signals; and these signals are made available for distribution at the desired output channel of the router. All input/output frame connections are made using common CAT5E cable and standard RJ-45 connectors. In most DRS configurations, full redundancy of every link in the router system is possible, including the PAS bus. Figure 2-1 is a front and rear view of a typical DRS rack unit with the front cover in place.

Figure 2-1 Cheetah DRS Router – Typical Rack Unit (Front & Rear View)

PAS bus system architecture allows input and output frames to be conveniently located anywhere within the facility. Any input signal on any input frame is available on any output channel on any output frame. Input frames may be placed in various locations physically close to audio signal sources such as network or telephone feeds, satellite receivers or audio mixing consoles. System output frames may be located close to destination points such as control rooms, production suites or operator consoles. This architecture allows for greatly simplified facility wiring schemes and higher quality signal integrity due to shorter cable run requirements. Frame-to-frame cable lengths may be up to 100 meters using CAT5E cable.

Every DRS router installation is configured using combinations of three different types of system frames: Input, Output and Data Exchange Engine. Each chassis frame occupies a single rack unit (RU) in a standard equipment rack and is configured with the appropriate backplane for the desired signal and connector type, a mid-plane for internal connections, the appropriate logic circuit card assembly (CCA) for the frame function and signal type and a single power supply/controller module (two if power supply/controller redundancy is desired). The function of each system CCA or module assembly is introduced later in this chapter and discussed further in Chapter 5 of this manual.

Cheetah DRS Routing Systems may be structured in a myriad of different input and output (I/O) size, signal type and I/O connector type configurations. Each Input Frame supports up to 128 input channels and each Output Frame provides up to 128 output channels. DRS routers are easily expandable from the basic 128X128 system configured in three, single RU frames (one Input Frame, one Output Frame and one Data Exchange Engine), to a maximum configuration of 2048X2048 in 36 single RU frames. Any DRS System installation may be expanded in the field simply by adding the required number and type of system frames for the desired level of expansion.

System control of the Cheetah DRS Router is just as flexible as the I/O installation. Every router configuration requires a System Controller that acts as the master overseer of the entire system. The System Controller communicates commands to and from one or more Frame Controller Module(s). In a DRS system the Frame Controller circuitry is co-resident with the power supply on a specialized module called the Power Supply/PERC1000 Controller Module. PERC1000 (P1K) is the name given to the Frame Controller circuitry and communication protocol. The System Controller in a DRS router application is given the name PERC2000. PERC2000 (P2K) identifies a QuStream designed and built circuit card assembly (mounted in either a stand-alone rack frame with power supply or a Cheetah Video Matrix Switcher) and the associated software application installed on a Windows based computer. The P2K CCA contains the circuitry and firmware necessary to communicate bi-directionally with the P1K Frame Controller as well as with the PC based P2K software application over an Ethernet link. The P2K CCA also interfaces and communicates with and configures a wide variety of control panels used to operate the DRS Router System. The P2K System is covered in detail in other documentation and manuals. Throughout this manual the name PERC 2000 System Controller, or simply P2K, is used to refer collectively to the P2K CCA, its stand-alone rack frame (if used), all associated operating software and the various hardware control panels used in a given system.

System synchronization and clock timing for the DRS router is derived from a source of in-house sync reference from the facility sync generator and must be supplied to every DXE frame in the system via the loop-thru BNC connectors on the rear panel of each DXE. The DRS may be added to in-house sync distribution in a daisy-chain fashion along with other facility equipment.

For the user/installer who may not be familiar with time-slice signal processing technology or the concept of multiplexing numerous slices of data over a serial bus architecture, a brief, top-level tutorial of how this digital signal manipulation and transfer method is applicable to signal routing is provided in Chapter 5 of this manual. QuStream recommends that you take the time to read this tutorial and familiarize yourself with your new routing system before proceeding with the installation.

2.2 FEATURES

Features of the DRS Audio Router include:

- Highly Versatile and Flexible Distributed Routing System
- High Speed PAS Bus System Architecture
- Supports Sources of AES/EBU and Analog Audio (Dedicated Input Frame Type Required)
- Supports Dolby-E Audio
- I/O Configurations Available From 128X128 Up To 2048X2048
- Full Redundancy (Power, Control and PAS Bus) Available as an Option for Most Configurations
- In-Field Expandability: As Your Needs Grow – Your DRS Router Can Grow With You
- Multiple I/O Connector Types Supported: BNC, ELCO, DB-50 and Weidmuller (6-Pin Detachable)
- Power Supply/Controller Modules are Hot-Swappable (Frames Equipped With Redundant Modules)
- Will Sync To Any Of The Following Sync Source Types: NTSC, PAL, Tri-Level, AES Silent
- Ethernet Based Control System Protocol Using the P2K Controller System

2.3 OVERVIEW OF SYSTEM ARCHITECTURE

There are three different types of frames used in the DRS System: Input, Output and Data Exchange Engine (DXE). Input and output frames are configured with the appropriate connector backplanes and logic card for different signal types supported by the system. Figure 2-2 illustrates typical component layout and locations for a DRS frame. A brief overview of each frame type and its components is provided in the following paragraphs, a more detailed discussion of the circuit cards and modules used in each frame is contained in Chapter 5 of this manual.

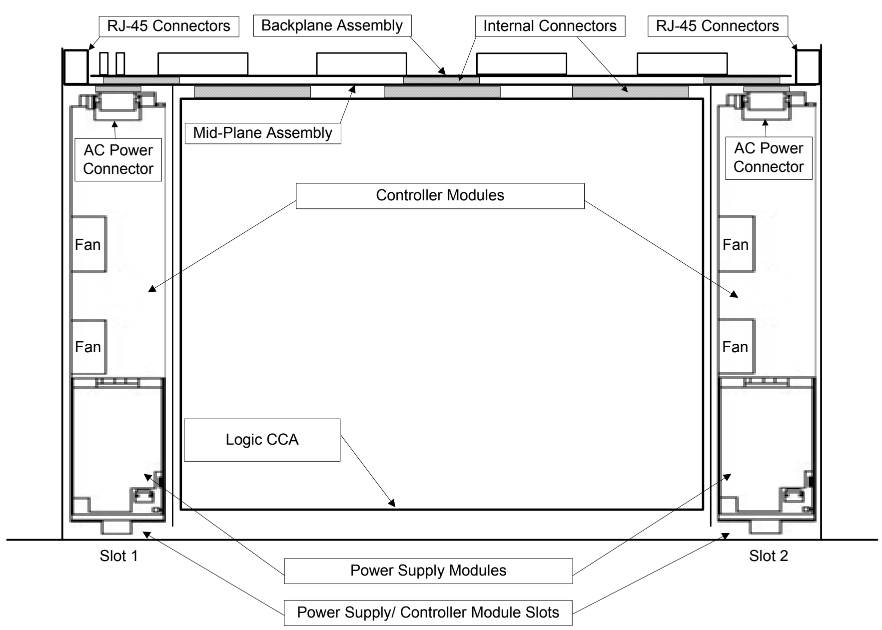


Figure 2-2 Frame Component Layout (Typical)

2.3.1 INPUT FRAME

An Input Frame is the DRS system component that accepts audio signals from external sources. Every input frame is composed of a Backplane Assembly, Logic Card, Mid-Plane Assembly and up to two Power Supply/Controller Modules.

Each input frame is configured with one of the following backplane types, depending on the input signal type and the type of connector used in the installation. An illustration of each backplane is shown in Figure 2-3.

Connector Type	Signal Type
BNC Connectors	AES Unbalanced Audio, 75 Ohm
ELCO/EDAC Connector	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
50 Pin "D" Connectors	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
6-Pin Connector (Detachable – Weidmuller)	AES Balanced Audio, 110 Ohm or Analog Balanced Audio

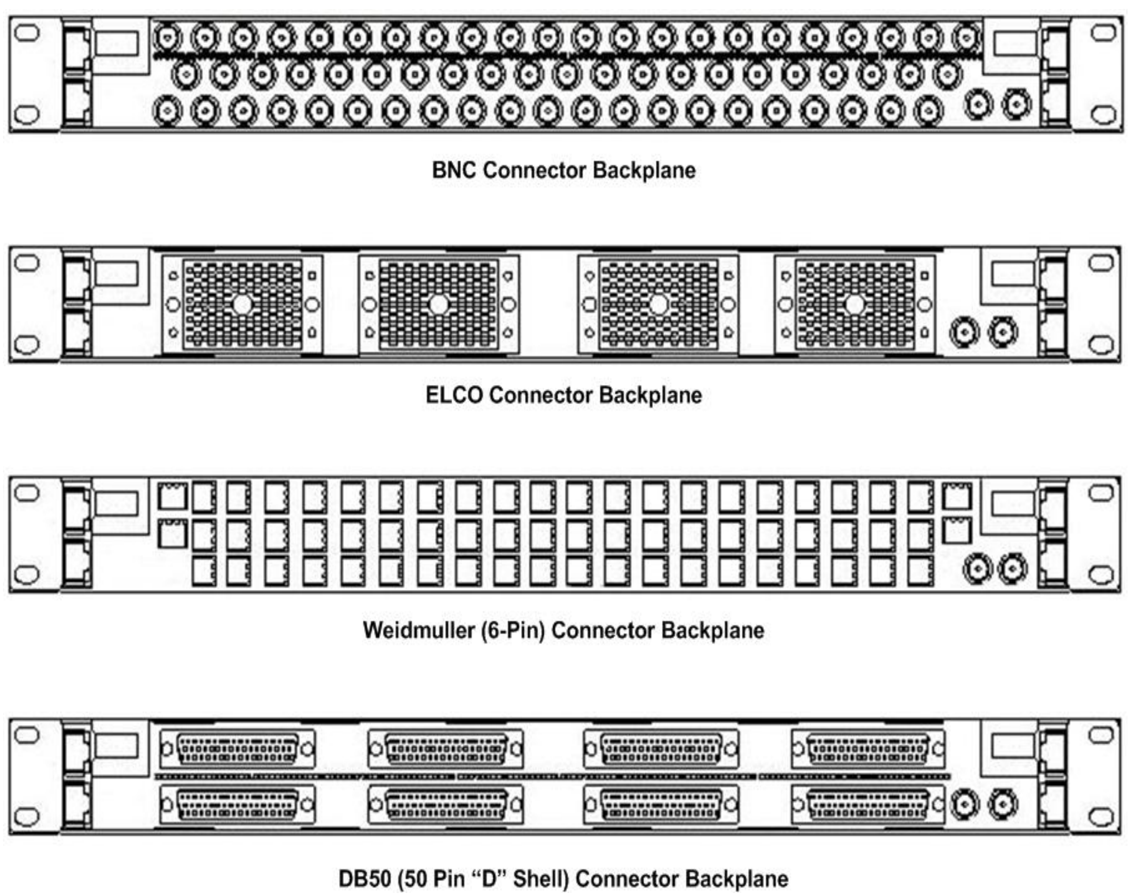


Figure 2-3 Input/Output (I/O) Backplanes

NOTE	**If the BNC Connector Backplane is used, you will note there are 64 BNC Connectors on the backplane. However, there are still 128 data channels used in the configuration. Since the BNC backplane is used for connection of AES Audio sources, each input actually carries a pair of audio signals.**

There are two distinct logic cards that may be used in an input frame: Analog Input, for analog signal sources, or AES Digital Input, for AES/EBU compliant digital audio signal sources. Only one logic card may be used in a frame, and the type of card used determines the frame as accepting either analog or digital input signals. The frame type is dedicated, and dependent on the logic card. Analog and digital audio sources may not be input to the same frame at this time. Future product offerings may include the capability of mixed analog and digital audio sources.

There are two distinct mid-plane assemblies, one of which will be present in the frame, dependent on the type of backplane used. Basically, the mid-plane routes signals between the backplane assembly and the logic card and also routes voltage sources from the power supply/controller module to the logic card. There are no active components on the mid-plane board, and the only component of interest to the user is a sixteen position rotary switch mounted to the logic card side of the assembly. This switch is for possible future product implementations and is not used in the DRS applications covered by this manual. Setting position of this switch on an input frame has no effect on DRS system operation.

2.3.2 OUTPUT FRAME

An Output Frame is the DRS system component that provides audio output connections for the various destination points in the facility. Every output frame is composed of a Backplane Assembly, Logic Card, Mid-Plane Assembly and up to two Power Supply/Controller Modules.

Each output frame is configured with one of the following backplane types, depending on the type of signal output and the type of connector used in the installation. The backplanes are identical to those used on an Input Frame and are shown in Figure 2-3.

Connector Type	Signal Type
BNC Connectors	AES Unbalanced Audio, 75 Ohm
ELCO/EDAC Connector	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
50 Pin “D” Connectors	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
6-Pin Connector (Detachable - Weidmuller)	AES Balanced Audio, 110 Ohm or Analog Balanced Audio

NOTE	**If the BNC Connector Backplane is used, you will note there are 64 BNC Connectors on the backplane. However, there are still 128 data channels used in the configuration. Since the BNC backplane is used for connection of AES Audio sources, each input actually carries a pair of audio signals.**

Just as with an input frame, there are two distinct logic cards which may be used in an output frame: Analog Output, for driving analog signal sources, or AES Digital Output, for supplying AES/EBU compliant digital audio signal sources. Only one logic card may be used in a frame, and the type of card used determines the frame as providing either analog or digital output signals. The frame type is dedicated, and dependent on the logic card.

Also as with an input frame, there are two distinct mid-plane assemblies, one of which will be present in the frame, dependent on the type of backplane used. The mid-plane routes signals between the backplane assembly and the logic card and also routes power rails/control signals from the power supply/controller module to the logic card. There are no active components on the mid-plane board, and the only component of interest to the user is a sixteen position rotary switch mounted to the logic card side of the assembly. This switch is for possible future product implementations and is not used in the DRS applications covered by this manual. Setting position of this switch on an output frame has no effect on DRS system operation..

2.3.3 DATA EXCHANGE ENGINE

Data Exchange Engine (DXE) Frames, transfer data on the PAS bus between input and output frames. Each DXE Frame interfaces up to four input frames with up to four output frames. Systems up to 512X512 can be configured using a single DXE frame. The Packet Audio Stream Bus signal from each input or output frame interfaces with the DXE using a single run of CAT5E cable, up to 100 meters in length. Every DXE frame is composed of a Backplane Assembly, up to two Power Supply/PERC1000 Controller Modules, a Logic Card and a Mid-Plane Assembly. There are no variations of the components comprising a DXE. The Backplane Assembly provides all connectors needed for intra-system connection, and a pair of loop-thru sync reference input BNC connectors. The mid-plane routes signals between the backplane and the logic card as well as power rails and control signals between the power supply/controller module and the logic card. There are no active components on the mid-plane, and the only function of interest to the user is a rotary switch used to select configuration parameters for the system. System configuration and switch settings are discussed in Chapter 3 of this manual. In any DRS installation the frame controller circuitry for the entire system is resident on the power supply/controller module(s) in the DXE frame(s). Control data is passed between the DXE and the I/O frames over the PAS bus.

2.3.4 POWER SUPPLY/CONTROLLER MODULES

Two Power Supply/Controller Modules are available in the DRS system architecture. Both supplies are constructed as a modular unit that can slide into either of the two available slots in the frame chassis. In redundant power supply applications, a power supply/controller module is used in both slots of an input frame to provide power redundancy.

A typical power supply/controller module is shown in Figure 2-4. The two modules are distinctly different in controller function, even though for both modules the power supply portion of the module is identical in function and circuitry. For purposes of this brief introduction the basic functional difference is discussed in the following paragraphs. A more detailed discussion of the two modules is presented in Chapter 5 of this manual. The two modules are identified as follows:

Power Supply/Fan Controller Module - This module contains the power supply circuitry, a pair of fans used to circulate cooling air through the chassis frame, and a controller circuit which controls operation of the on-board cooling fans, depending on operational parameters of the chassis.

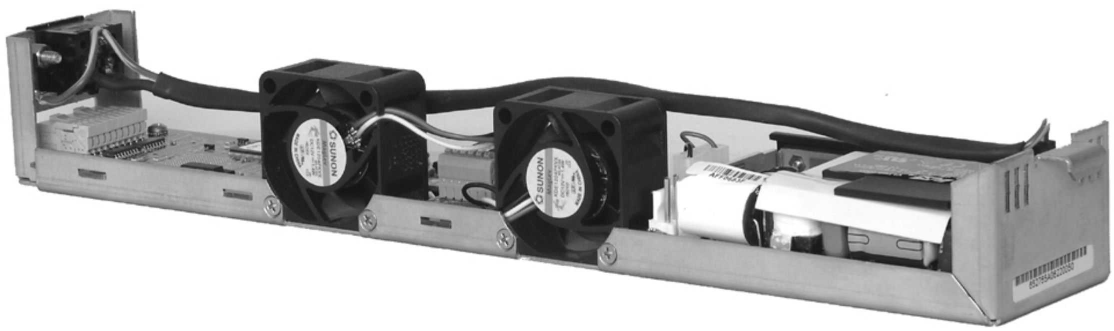


Figure 2-4 Power Supply/Controller Module (Typical)

Power Supply/PERC1000 Controller Module - This module also contains the power supply circuitry, a pair of fans used to circulate cooling air through the chassis frame and fan controller functions. In addition it contains the Frame Controller circuitry, referred to as the P1K Controller. This circuitry interfaces a Data Exchange Engine to external control devices using an Ethernet link and the P2K System Controller.

2.4 SYSTEM CONFIGURATION AND EXPANSION

2.4.1 REAR PANEL CONNECTIONS – I/O FRAMES

Regardless of the backplane, mid-plane or logic card used, the intra-system connectors are the same for each input or output frame variation. These connections are shown and identified in Figure 2-5 using the ELCO/EDAC Connector Backplane for example only. Connectors identified by Figure 2-5 are identical for all I/O backplanes, and their function is discussed in the following paragraphs.

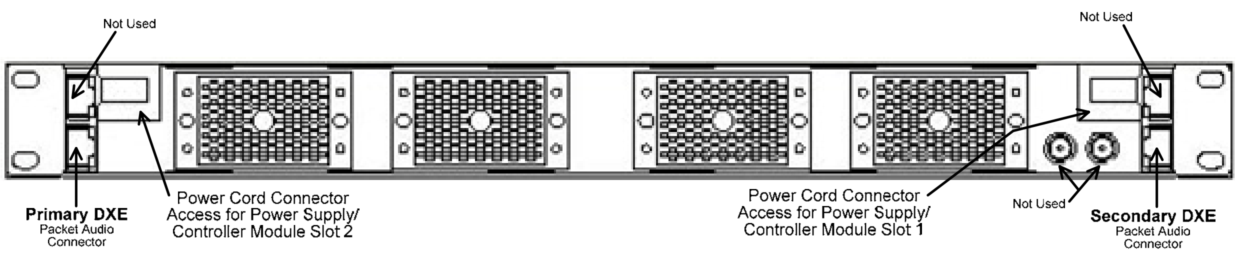


Figure 2-5 I/O Frame Rear Panel Connections (Typical)

Packet Audio Connector (PAS Bus) There are two Packet Audio (PAS Bus) Connectors (RJ-45) located on the rear panel of each input and output frame. These are the LOWER connectors located on each side of the frame rear panel. When viewed from the rear of the frame the left-hand connector is the **Primary DXE Connector** and the right-hand connector is the **Secondary DXE Connector**. These are interface point(s) for the packet audio stream to the DXE Frame. When only one DXE frame is used, connect a cable between the Primary DXE connector and the DXE. In a redundant system, connect the Secondary DXE connector to the second (redundant) DXE frame.

Power Cord Connector Access Each power supply/controller module used in a DRS frame is fitted into a chassis slot (either slot 1 or slot 2). When a power supply is installed, its 3-prong input power receptacle is accessible through this opening on the frame rear panel. Each power supply carries its own dedicated power receptacle. Input power is not bussed between modules. When two power supplies are used (for redundancy) a separate power cord must be attached to each receptacle through its access port. Each access port is equipped with a harness device for the input power cord. The harness secures the cord to help prevent accidentally disconnecting the frame from its power source.

There is a second RJ-45 connector located above the PAS bus connector on each side of the frame rear panel and also a pair of BNC connectors located on the lower right-hand side of the rear panel. These connectors are intended for future product implementations and are not used in DRS applications covered by this manual.

2.4.2 REAR PANEL CONNECTIONS – DXE FRAME

Rear panel connections for the DXE are shown and identified in Figure 2-6 and discussed in the following paragraphs.

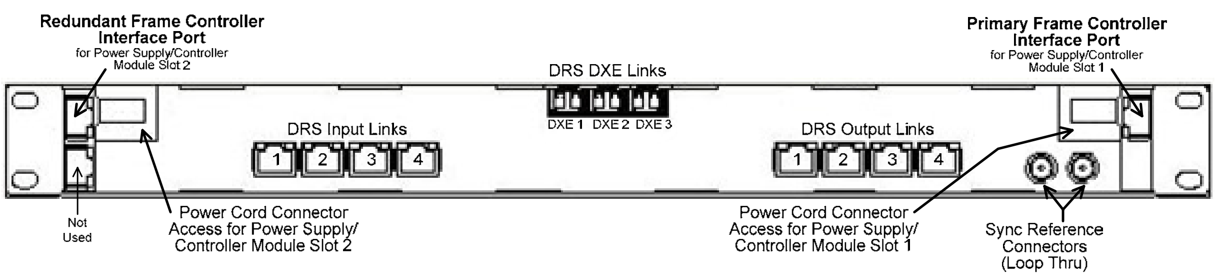


Figure 2-6 DXE Frame Rear Panel Connections

Frame Controller Interface Port There are two Frame Controller Interface Port Connectors (RJ-45) located on the rear panel of each DXE frame. These are the UPPER connectors located on each side of the frame rear panel. When viewed from the rear of the frame the right-hand connector is the **Primary Frame Controller Interface Port** and the left-hand connector is the **Redundant Frame Controller Interface Port**. These are interface points between the frame controller circuitry on the Power Supply/PERC1000 Module(s) and the P2K System Controller circuitry. Each frame controller interface port connector is dedicated to a particular power supply/controller module slot: the Primary Port connector associates to module slot 1 (Refer to Figure 2-2 for module slot identification) and the Redundant Port connector associates to module slot 2.

In a system with a non-redundant frame controller, install the Power Supply/PERC1000 module in slot 1 and use the Primary Frame Controller Interface Port connector to connect the DXE to the P2K System Controller. If a second (redundant) frame controller is installed, use the Redundant Frame Controller Interface Port connector to connect it to the P2K. In a redundant control system installation, two separate cables will be used for interface with the P2K Controller System. These connectors are not configured in a bus and do not communicate with one another. Each frame controller must have a dedicated connection to the system controller or the facility local area network (LAN).

DRS Input Links There are four DRS Input Link Connectors (RJ-45) located on the rear panel of every DXE frame. These connectors are labeled IN 1 thru IN 4 and are used to interface the DXE frame with up to four input frames via the Packet Audio Stream (PAS) Bus. Input frames MUST be attached to the DXE frame DRS input link connectors in numerical sequence. When connecting a single input frame to the DXE, always use DRS Input Link 1. If two input frames are used in an expanded system with a single DXE, the PAS Bus connection from the input frame assignrd audio inputs 1 – 128 MUST be attached to DRS Input Link connector IN 1 on the DXE frame. Likewise, the PAS connection from the input frame supporting audio inputs 129 – 256 MUST be attached to DRS Input Link connector IN 2 on the DXE frame, etc.

DRS Output Links There are four DRS Output Link Connectors (RJ-45) located on the rear panel of every DXE frame. These connectors are labeled OUT 1 thru OUT 4 and are used to interface the DXE frame with up to four output frames via the PAS Bus. Just as with input frames, output frames MUST be attached to the DXE frame output link connectors in numerical sequence. When connecting a single output frame to the DXE, always use DRS Input Link 1. If two output frames are used in an expanded system with a single DXE, the PAS Bus interconnection from the output frame providing audio outputs 1 – 128 MUST be attached to Output Link Connector OUT 1 on the DXE frame. The packet audio stream interconnection from the output frame providing audio outputs 129 – 256 MUST be attached to Output Link Connector OUT 2 on the DXE frame, etc.

DRS DXE Links Located along the top edge of the rear panel are three fiber optic cable connectors denoted as DRS DXE Links. These connectors are labeled DXE 1 thru DXE 3 and are used to interconnect DXE frames in expanded DRS systems requiring more than one DXE frame. The subject of expanded systems using multiple DXE frames is discussed later in this chapter. However, it should be noted here that multiple DXE interconnections are made using a "star" networking topology where every DXE frame in the system is connected directly with all other frames via the Fiber Expansion Ports. All DXE to DXE connections are made using LC to LC duplex fiber optic cable.

Sync Reference Connectors The two Sync Reference Connectors (BNC) located on the rear panel of every DXE frame are the interface point(s) for a source of sync reference from the in-house sync generator. It is imperative that EVERY DXE frame in a DRS system be connected to house sync. All system timing and clocking functions are synchronized between frames using the sync pulse as a reference. The pair of connectors are a loop-thru arrangement and either may be used for input or output.

Power Cord Connector Access Each power supply/controller module used in a DRS frame is fitted into a chassis slot (either slot 1 or slot 2). When a power supply is installed, its 3-prong input power receptacle is accessible through this opening on the frame rear panel. Each power supply carries its own dedicated power receptacle. Input power is not bussed between modules. When two power supplies are used (for redundancy) a separate power cord must be attached to each receptacle through its access port. Each access port is equipped with a harness device for the input power cord. The harness secures the cord to help prevent accidentally disconnecting the frame from its power source.

2.4.3 BASIC SYSTEM CONFIGURATION (128 INPUT X 128 OUTPUT)

A complete DRS Router is composed of a minimum of three single RU “boxes” or frames. The most basic installation, a 128 input X 128 output, non-redundant system consists of an input frame, an output frame, a DXE frame and an external P2K control system. A block diagram of a basic 128X128 Router is shown in Figure 2-7. The input frame, output frame and DXE each occupy one rack unit of space in a standard equipment rack. The input frame supports 128 audio signals and the output frame provides 128 output signals. The DXE performs the data exchange between the input frame and the output frame. A single run of common CAT5E cable (up to 100 Meters), fitted with standard RJ-45 connectors on each end, between the input frame and the DXE and a single run of CAT5E cable between the output frame and the DXE completes the PAS bus interface and provides all interconnections between the frames. It is important for proper operation that the input frame Primary PAS bus connector is attached to DRS Input Link Connector 1 (IN 1) and the output frame Primary PAS bus connector is attached to DRS Output Link Connector 1 (OUT 1).

In this application, both the Input Frame and the Output Frame must have at least one Power Supply/Fan Controller Module installed (either slot 1 or slot 2), and the DXE Frame must have at least one Power Supply/PERC1000 Controller Module (Primary Controller) installed in module slot 1. System control communication between the P1K Frame Controller module (located in the DXE frame) and the P2K System Controller is accomplished by an Ethernet connection either directly to the P2K system or over the facility local area network (LAN) using CAT5E cable fitted with an RJ-45 connector. Refer to the PERC2000 documentation for further information on the control system.

Each DXE frame in the DRS Routing System must be connected to an in-house timing synchronization reference signal from the facility sync generator. This reference pulse is used to synchronize system timing.

Loop-thru BNC connectors for sync reference input and output are provided on the backplane of every DXE. Sync may be routed in a daisy-chain configuration through the DXE to another piece of equipment, or the chain terminated at the second BNC with a 75 Ohm terminator load. Remember, if the DXE frame is the only, or the last, piece of equipment on the chain the open connector on the rear panel pair must be fitted with a 75 Ohm terminator load.

Even in the most basic configuration, it is possible to have full power supply and frame controller (P1K) redundancy simply by installing a second power supply/controller module in the open slot of all system frames. The input and output frames should have a second Power Supply/Fan Controller Module installed; and the DXE frame should have a second Power Supply/PERC1000 Module installed in module slot 2. A block diagram of a 128X128 installation with power and frame controller redundancy is shown in Figure 2-8.

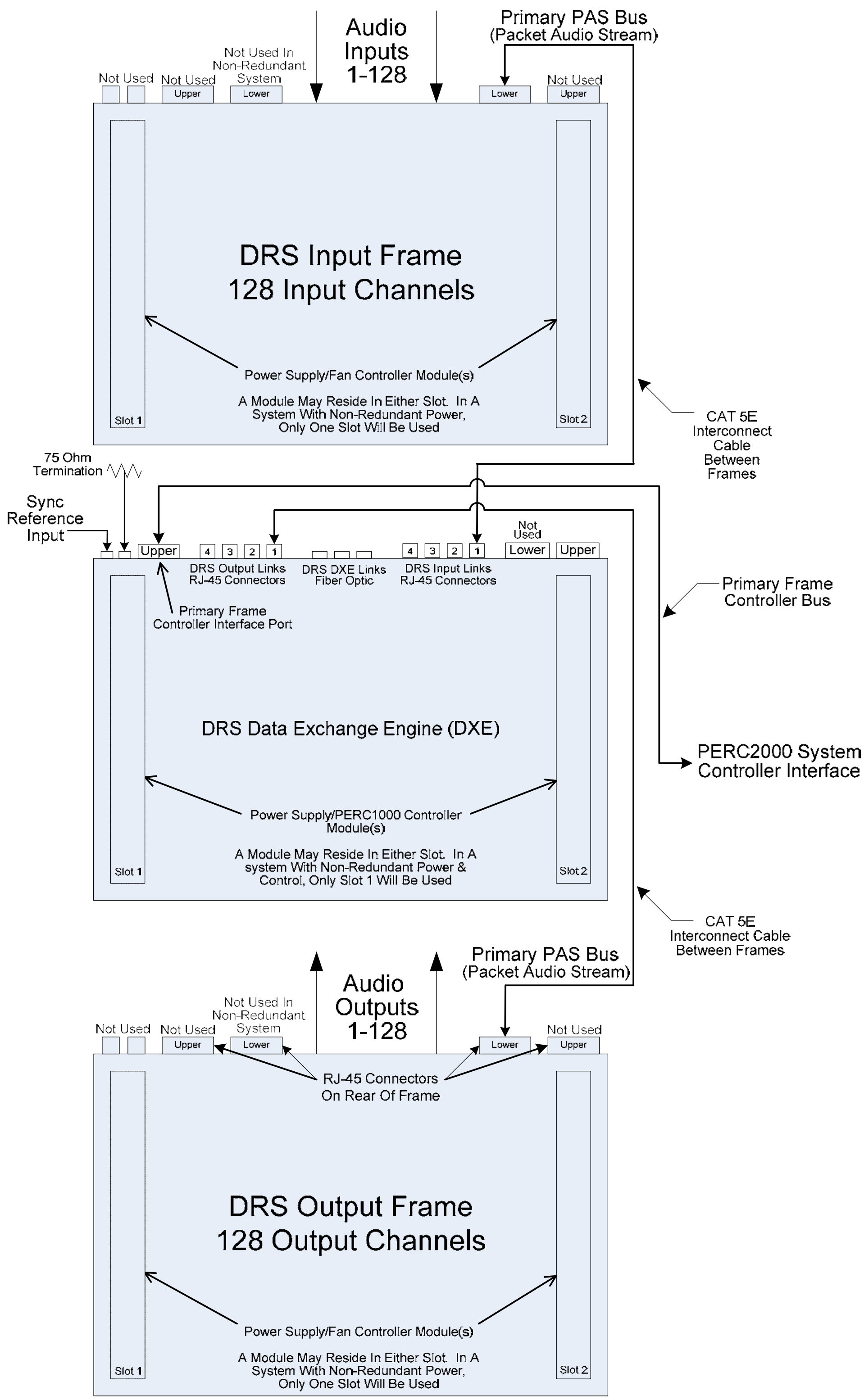


Figure 2-7 128 X 128 Non-Redundant Router System

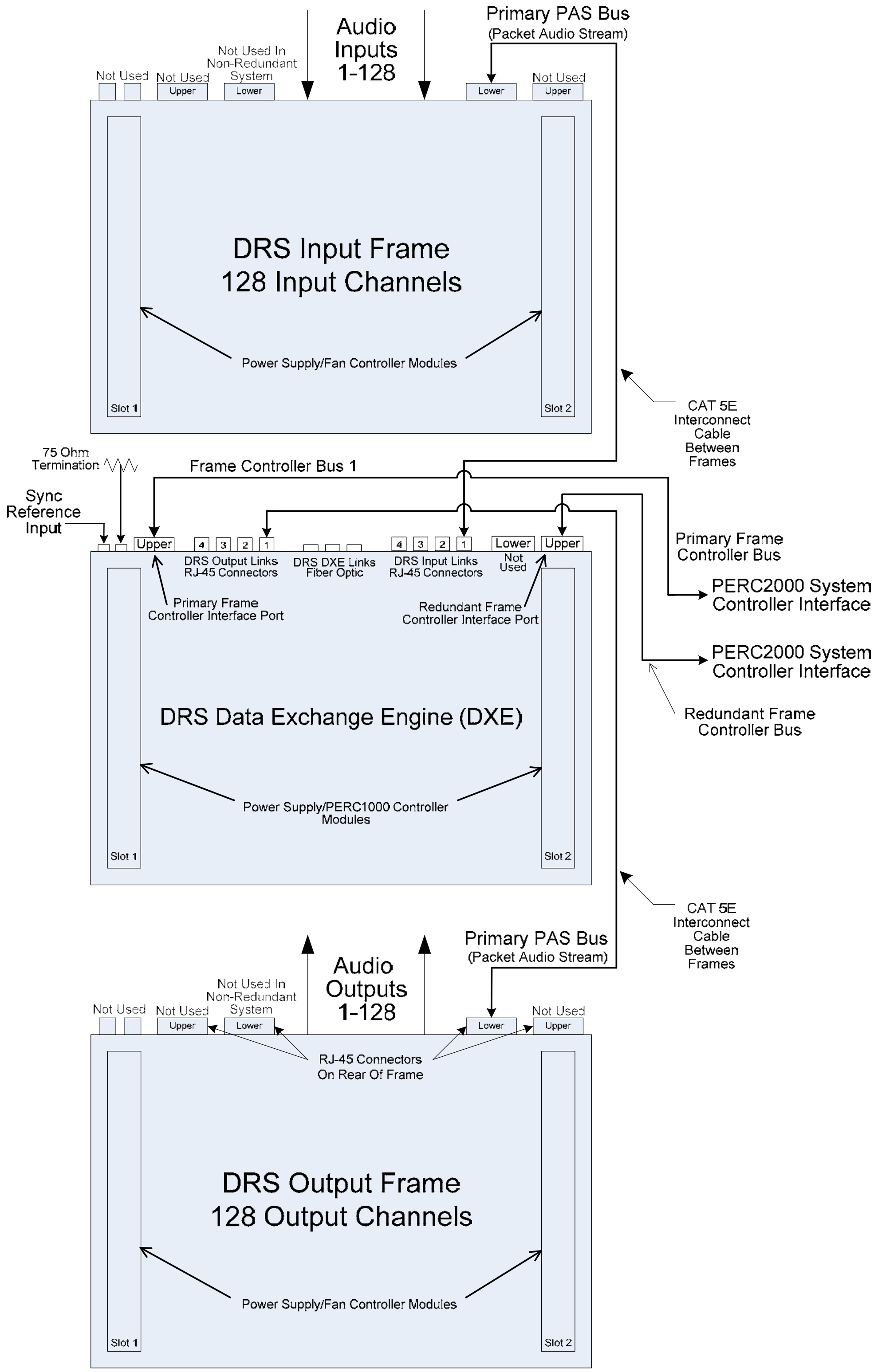


Figure 2-8 128 X 128 Router System With Redundant Power & Controller

Several operating parameters of each power supply module are constantly monitored for status. Should a failure of the primary power supply ever occur, the back-up supply automatically and seamlessly becomes the primary supply for the frame.

In addition to power redundancy, each Power Supply/PERC 1000 module in the DXE frame has redundant frame controller capability as well. Notice that each controller module (Frame Controller Bus 1 and 2) has its own Ethernet port for interface with the P2K system controller. These are denoted as PERC 2000 System Controller Interface A and B in Figure 2-8. In order for frame controller redundancy to be functional each module must be independently connected to the system controller. There are various schemes on how to configure this, and each is discussed in detail in Chapter 3 of this manual. For our purposes in this chapter suffice it to say that if properly interfaced to the system controller, each frame controller module is capable of serving as primary controller for the frame. Both modules are constantly monitored and should the acting primary module fail, the redundant controller will automatically become primary.

By installing a second PAS bus interconnection using the second PAS bus port on each frame and an additional DXE frame to perform exchange of the redundant bus data, a second packet audio stream is established. Should either PAS bus connection between frames be broken or data become corrupted, the second (redundant) bus will keep the system fully functional without any interruption of audio signals. A block diagram of a fully redundant 128X128 installation with PAS bus, power and frame controller redundancy is shown in Figure 2-9.

Single DXE Frame System An example of a 512 input X 512 output expanded system using four input frames, four output frames and a single DXE frame is shown in Figure 2-10. Input frames are identified as frames 1 thru 4, and each accepts up to 128 audio input channels. Input channels are assigned to input frames in the following numerical sequence:

Input Frame 1 Accepts Audio Input Channels 1 thru 128

Input Frame 2 Accepts Audio Input Channels 129 thru 256

Input Frame 3 Accepts Audio Input Channels 257 thru 384

Input Frame 4 Accepts Audio Input Channels 385 thru 512

Analog audio and AES digital audio sources may be mixed within an expanded system, but may NOT be mixed within frames. In our 512 X 512 example, input frame 1 may be configured to accept analog sources, while frames 2 thru 4 may be configured to accept AES digital sources. Any combination of analog and digital input frames is allowed in an expanded system. Remember, however, that all analog sources must be attached to analog input frames and all digital audio sources must be attached to digital input frames.

In a manner identical to input frames, for this 512 X 512 example, output frames are identified as frames 1 thru 4, and each provides up to 128 audio output channels. Output channels are assigned to output frames in the following numerical sequence:

Output Frame 1 Provides Audio Output Channels 1 thru 128

Output Frame 2 Provides Audio Output Channels 129 thru 256

Output Frame 3 Provides Audio Output Channels 257 thru 384

Output Frame 4 Provides Audio Output Channels 385 thru 512

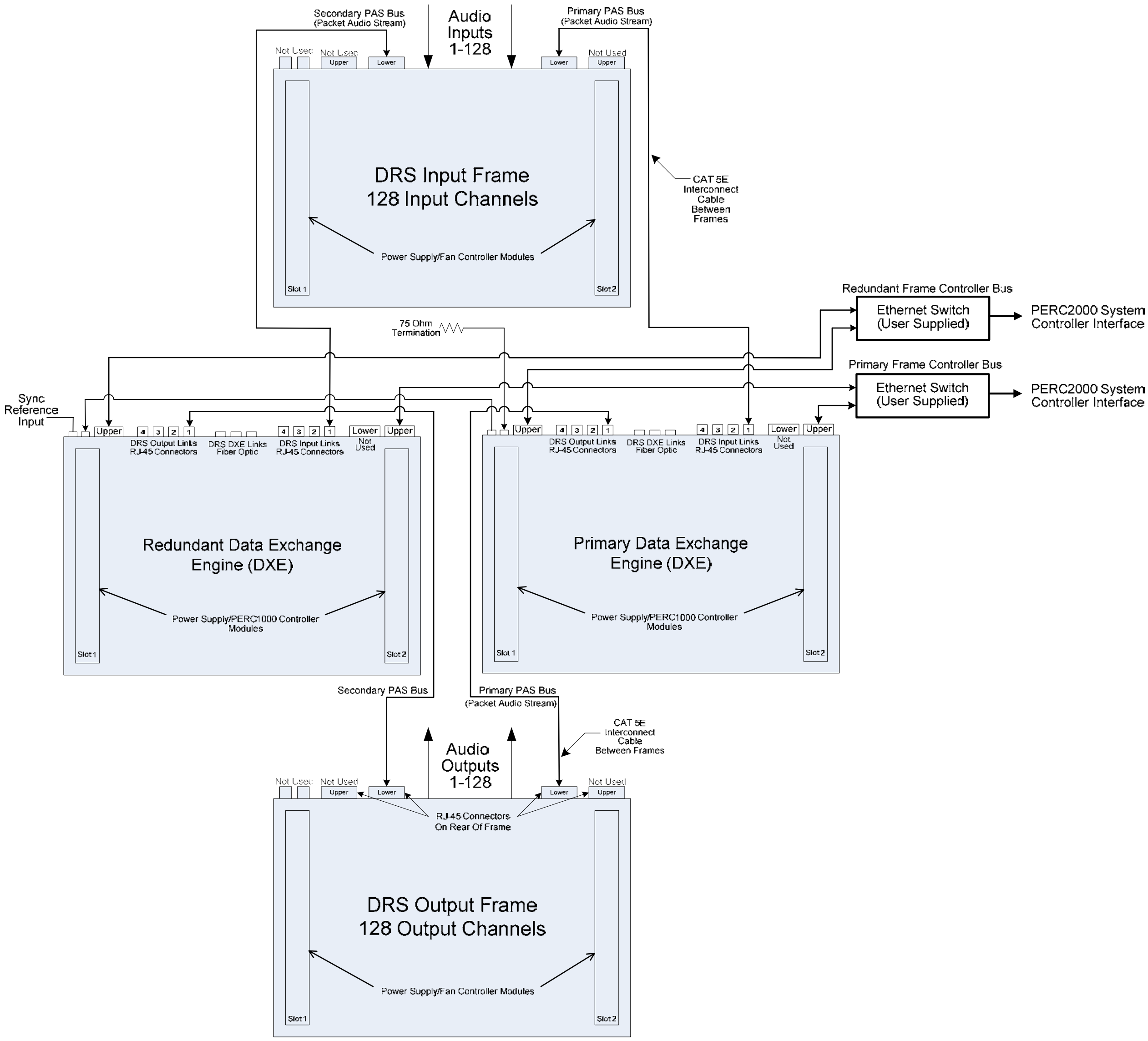


Figure 2-9 128 X 128 Router System With Fully Redundant PAS Bus, Power & Controller

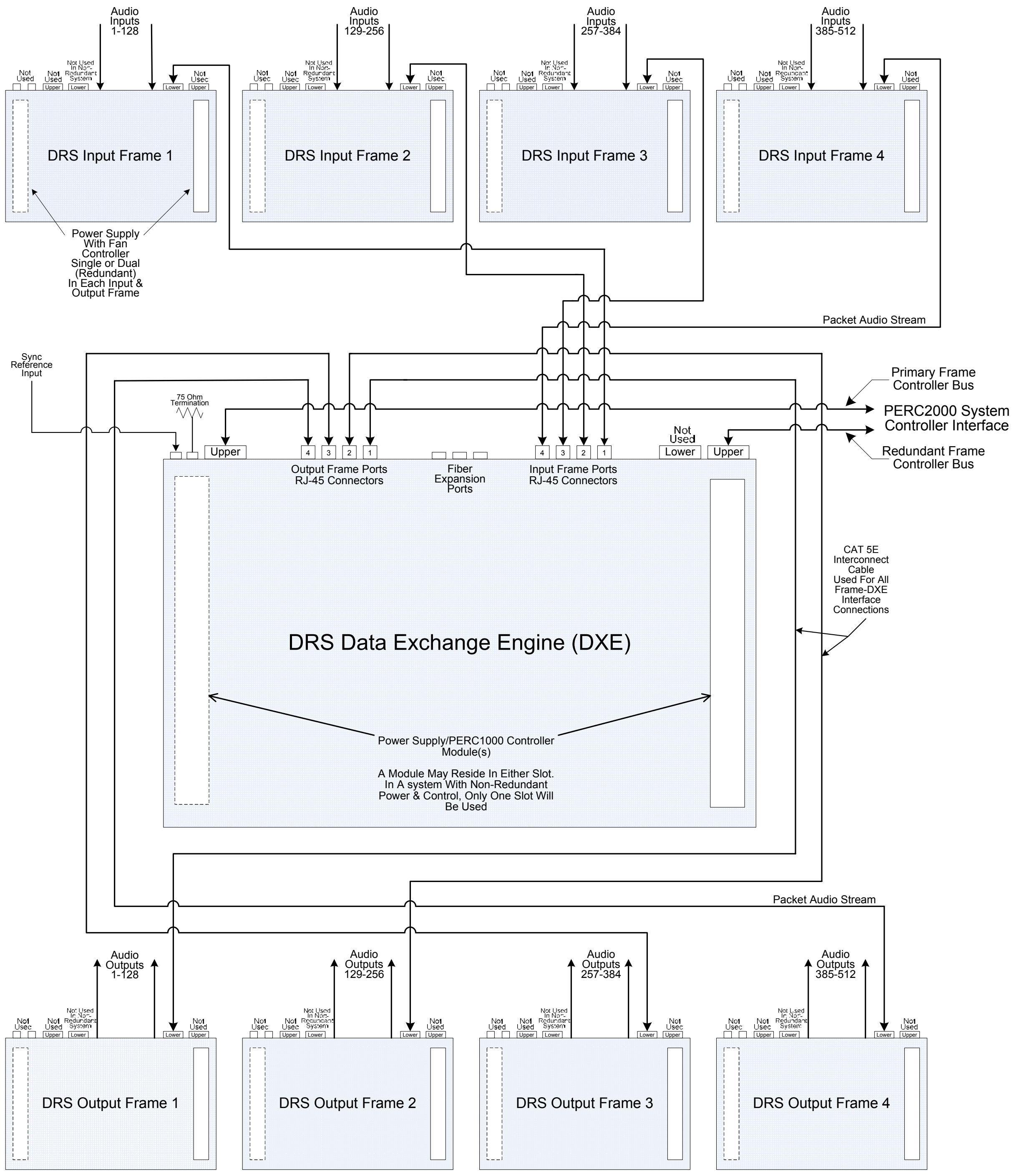


Figure 2-10 512 Input X 512 Output Expanded DRS System

2.4.4 SYSTEM EXPANSION

It is possible to expand either the input or output capacity, or both, of the DRS system, up to a maximum configuration of 2048X2048. Expanded systems use multiple input and/or output frames and one or more data exchange engine (DXE) frames. Each DXE frame can interface with up to four input frames and up to four output frames. All interconnections between input or output frames and a DXE are made using CAT5E cable, up to a 100 meter run.

Just as with input frames, analog audio and AES digital audio output channels may be mixed within the expanded system, but not mixed within frames. Any combination of analog and digital output frames is allowed in an expanded system. Remembering, however, that analog frames provide analog outputs and digital frames provide AES digital outputs.

The PAS bus from each input and output frame attaches to the DXE via the **DRS Input Links** and **DRS Output Links** connectors, respectively. There are four DRS Input Links and four DRS Output Links connectors (RJ-45) on the DXE rear panel. Each input and output link connector is identified by a number: IN 1 thru IN 4 and OUT 1 thru OUT 4. For proper system operation, it is imperative that the input frame and output frames be interconnected with the DXE in numerical sequence as follows:

Input Frame 1 (Audio Input Channels 1 – 128) to Input Link IN 1

Input Frame 2 (Audio Input Channels 129 – 256) to Input Link IN 2

Input Frame 3 (Audio Input Channels 257 – 384) to Input Link IN 3

Input Frame 4 (Audio Input Channels 385 – 512) to Input Link IN 4

Output Frame 1 (Audio Output Channels 1 – 128) to Output Link OUT 1

Output Frame 2 (Audio Output Channels 129 – 256) to Output Link OUT 2

Output Frame 3 (Audio Output Channels 257 – 384) to Output Link OUT 3

Output Frame 4 (Audio Output Channels 385 – 512) to Output Link OUT 4

If an expanded system has less than four input frames or less than four output frames, the numerical channel I/O and interconnect sequence must still be followed. For example, if a system has two input frames and three output frames, the frames must be interconnected to the DXE as follows:

Input Frame 1 (Audio Input Channels 1 – 128) to Input Link IN 1

Input Frame 2 (Audio Input Channels 129 – 256) to Input Link IN 2

Output Frame 1 (Audio Output Channels 1 – 128) to Output Link OUT 1

Output Frame 2 (Audio Output Channels 129 – 256) to Output Link OUT 2

Output Frame 3 (Audio Output Channels 257 – 384) to Output Link OUT 3

Every DXE frame in the system must be connected to a source of in-house sync reference. Figure 2-9 shows a loop-thru method between DXE frames using coaxial cable (75 Ohm) fitted with BNC connectors on each end. At the output connector on the last DRS frame in the path, the chain may be continued to another piece of equipment, or terminated with a 75 Ohm terminator load. If the DXE frame is the only, or the last, piece of equipment on the chain the open connector must be fitted with a 75 Ohm terminator load.

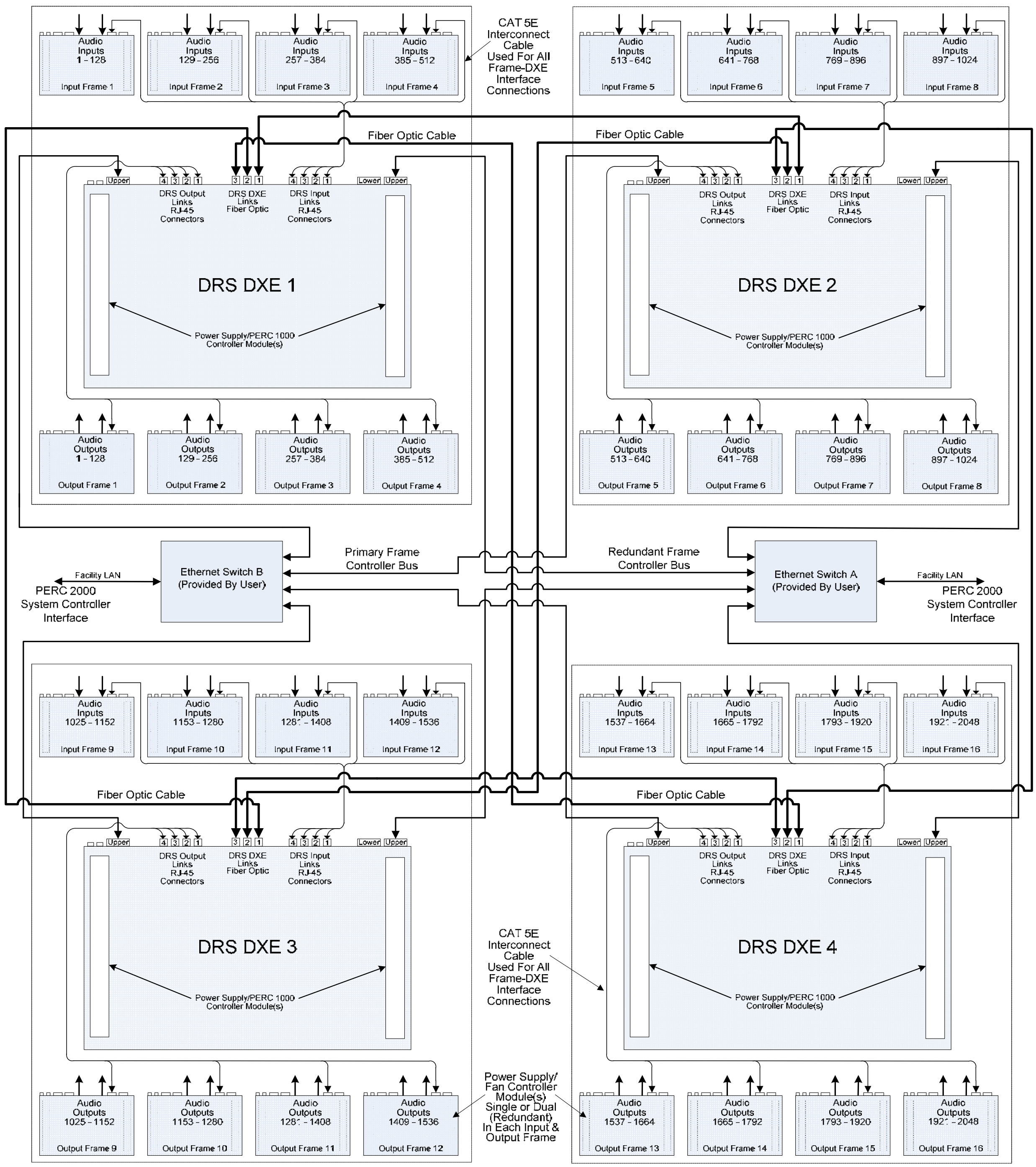
The DXE must have at least one Power Supply/PERC1000 Controller Module installed. If only one module is used, it serves as the Primary Controller and must be installed in module slot 1. System control communication between the P1K frame controller module and the P2K system controller is accomplished by an Ethernet connection either directly to the P2K system or over the facility local area network (LAN) using common CAT5E cable fitted with an RJ-45 connector. Refer to the PERC2000 documentation for further information on the control system.

Multiple DXE System Systems requiring greater than 512 inputs or 512 outputs are configured using two or more DXE frames and the required number of input and output frames to provide the desired I/O capacity. Any number of input and output frames may be used, up to the system maximum of 16 input and 16 output frames, providing up to 2048 input and 2048 output channels. Since each DXE supports up to four input and four output frames, up to four DXE frames may be used in a system to link the input and output frames.

In the previous section we introduced and discussed system expansion for a 512 X 512 router using four input frames, four output frames and a single DXE; and interconnecting the I/O frames to the DXE in an ascending numerical sequence. Building a system greater that 512 X 512 expands the same principle and is accomplished by interconnecting the DXE frames to one another in an ascending numerical sequence, using fiber optic cable.

Consider each DXE frame and its associated I/O frames as a 512 input by 512 output "building block" of the overall expanded system. Input and output frames are interconnected to each DXE in the system in exactly the same way as for a single DXE configuration. Each DXE, along with its respective "building block" of input channels and output channels, is then interconnected with all the other DXE frames in the system by fiber optic links. Connections between DXE frames are made using "star" topology, whereby every frame has a direct connection to every other frame. Daisy-chaining is not acceptable for DXE to DXE interconnection.

Figure 2-11 illustrates a full capacity 2048 input and 2048 output router configured using 16 input frames, 16 output frames and 4 DXE frames. In order to eliminate clutter and make the illustration as clear as possible, sync reference connections are not shown. However, as with any DRS installation, every DXE in the system MUST be connected to a source of in-house synchronization. Multiple DXE systems may be configured using two, three or four DXE frames, depending on the required I/O channel capacity, number of I/O frames, and physical layout of the router system for a particular installation.



NOTE: For Clarity Of Illustration, Sync Reference Connections Are Not Shown. Each DXE MUST Be Connected To A Source Of In-House Sync.

Figure 2-11 2048 Input X 2048 Output Expanded DRS System

When multiple input or output frames are used, the packet audio stream bus from each input and output frame must be attached to the DXE rear panel DRS Input and Output Link connectors in an ascending numerical sequence: Input Frame 1 to DRS Input Link IN 1, Input Frame 2 to DRS Input Link IN 2, Output Frame 2 to DRS Output Link OUT 2, etc. In a similar manner multiple DXE frames must be interconnected to one another in ascending numerical sequence. DXE frames are interconnected via the DRS DXE Links connectors (fiber optic) labeled DXE 1 thru DXE 3. These connectors are located along the top edge of each DXE rear panel.

While similar to the numerical hook-up sequence of I/O frames, the procedure is not identical. Each DXE frame is interconnected with other DXE frames in the system using a “star” hook-up arrangement whereby each frame has a direct connection with every other frame. Proper intra-frame cabling for a four DXE system is shown in Figure 2-11. More information on proper cabling of a multiple DXE system, and a hook-up table, is presented in Section 3 (Installation) of this manual.

Each frame in the system must contain at least one power supply/controller module. In an expanded system at least one Power Supply/PERC 1000 Module must be installed in every DXE frame. Input and output frames must have at least one power supply/controller module installed. Typically Power Supply/Fan Controller Modules are used in the I/O frames.

The Frame Controller in each DXE in an expanded system must be connected to the P2K System Controller using an external Ethernet switch device. Each DXE must have a direct connection from its active frame controller port to the Ethernet Switch. Daisy-chaining control cables between DXE frames is not acceptable.

Chapter 3 Installation

3.1 MOUNT EACH DRS FRAME IN AN EQUIPMENT RACK

STOP	**Make sure the frame power cords are disconnected from the power source before installing the frame into an equipment rack.**
CAUTION	**Fans that are mounted inside of this equipment provide forced-air cooling. Do not block airflow around these fans.**

All frames comprising a Cheetah DRS router system are designed for installation in a standard 19" equipment rack. Provide sufficient space behind the equipment racks to allow for control, signal, interconnect and power cables. Use all chassis mounting holes, and tighten mounting hardware securely by using the rack equipment manufacturer's suggested torque settings.

Install equipment into racks as follows:

1. Carefully, remove equipment from packing container and place each frame near the rack where it will be installed.
2. Loosen two thumbscrews on each end of the chassis front cover and move cover away from chassis. The front cover must be removed from the frame in order to gain access to mounting ears and screw holes.
3. Insert chassis frame into equipment rack and support the bottom of the chassis while mounting hardware is installed.
4. Install the bottom two chassis mounting screws.
5. Install the top two chassis mounting screws.
6. Install Rear Support Rails (Paragraph 3.2)
7. Tighten all chassis mounting screws until they are secure.

3.2 INSTALL REAR SUPPORT RAILS

Every DRS frame is shipped with a Rear Rack Rail Kit. It is essential that this kit be installed as part of the mounting procedure for the frame. Major components included with the kit are shown in Figure 3-1. Each kit consists of two rear rack rails, two rail mounting ears and four screws (not shown) to attach rails to the frame.

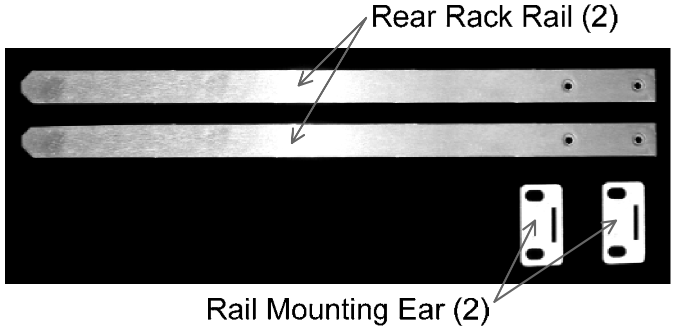


Figure 3-1 Rear Rack Rail Kit

Install the Rear Rack Rails as follows:

1. Mount DRS Chassis in equipment rack at the desired location and secure chassis into rack with four rack mounting screws (not supplied).

2. Install one Rear Rack Rail to DRS Chassis at the two Rack Rail Attachment Points using two Mounting Screws as shown in Figure 3-2.

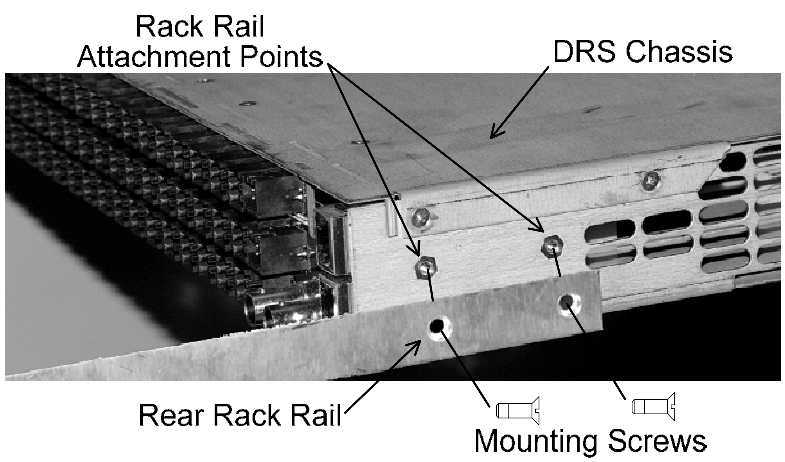


Figure 3-2 Rear Rack Rail Mounting

3. Repeat Step 2 on opposite side of Chassis using second rack rail and remaining two mounting screws.

4. Figure 3-3 shows the rear of the chassis with both rack rails installed.

Figure 3-3 Rear Rack Rails - Installed

5. Install one of the Rack Rail Mounting Ears by aligning the rectangular cutout in the mounting ear with one of the rack support rails previously installed and sliding the mounting ear onto the rail. Ensure that the two screw holes in mounting ear face to outer edge as shown in Figure 3-4

6. Secure mounting ear to rear rail of equipment rack using two rack mounting screws (not supplied) as shown in Figure 3-4. Be sure that the screw holes in the mounting ear align with screw threads in the equipment rack in such a way that the DRS chassis is level in the equipment rack from front to rear as shown in Figure 3-5.

7. Repeat Steps 5 and 6 for the remaining mounting ear and rack rail.

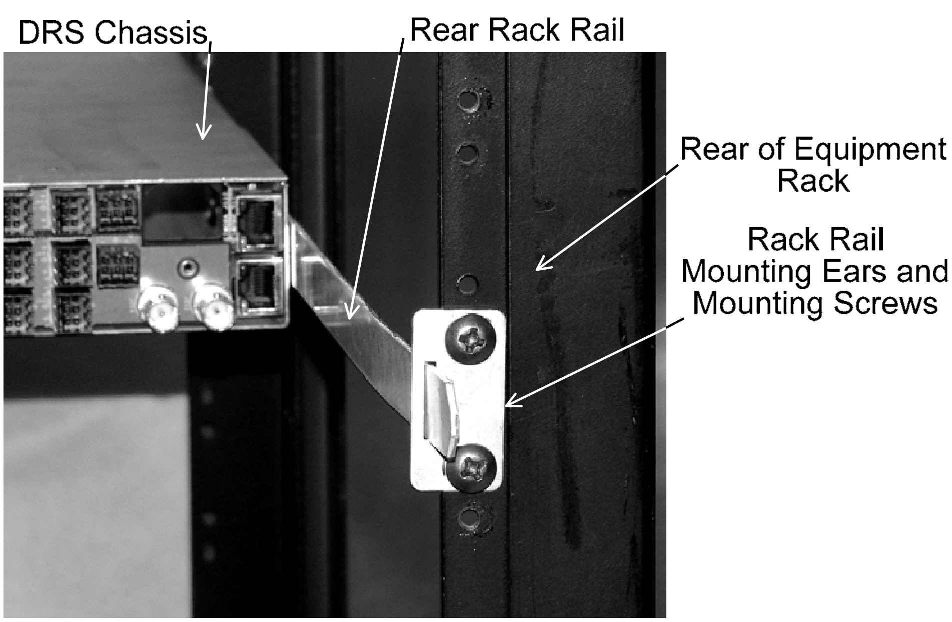


Figure 3-4 Rack Rail Mounting Ear Installation

Figure 3-5 Installed Rear Rack Support System

3.3 CONNECT EQUIPMENT CABLES

Use the following guidelines when connecting equipment cables:

Install equipment in rack before connecting cables.

Relieve strain on all cables to prevent connector separation.

To the greatest extent possible, separate control, signal, and power cables to minimize crosstalk and interference.

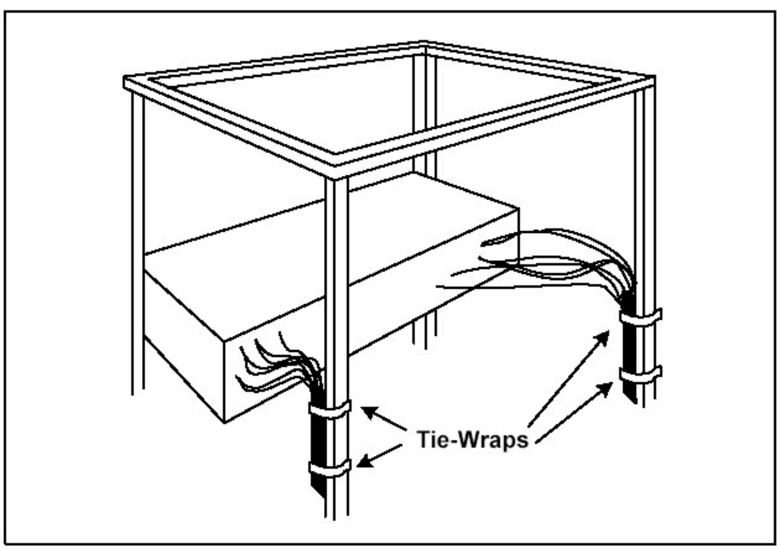


Figure 3-6 Cables Attached To Supports

Use as many cable ties as necessary to secure audio cables and CAT 5E cables to the rack, as shown in Figure 3-6. This will provide cable strain relief and help route cables away from hazardous areas. Do not use cable ties on fiber optic cable.

Route cables away from physical traffic areas to avoid creating a safety hazard (trip or shock).

3.4 CONNECTION CHECKLIST

Once each DRS system frame is installed in an equipment rack, associated system connections can be completed. Order of completion of installation steps is not critical, however, DO NOT apply power to a frame until all audio signal, sync, packet audio stream, fiber optic and control cables have been installed and their connections verified for proper placement and accuracy. Use the following guide to insure that all connections are made properly and that power, system interconnect and audio signal cables are correctly installed.

1. Connect an external sync source to the Sync Reference Input (REF) of each DXE Frame using 75 Ohm coaxial cable such as Belden 8281, or equivalent. Be sure to properly terminate external sync sources into a 75Ω load terminator.
2. If using shell connectors such as the ELCO/EDAC, Weidmuller or DB50, prepare each connector with its associated input or output audio signals using connector pin-out data provided in Paragraph 3.5, below. Installation will be much smoother if all connectors intended to mate with rear panel connectors on DRS I/O frames are pre-wired and tested. If possible, use an Ohmmeter or audible signal tracing device to verify continuity of each connection prior to attaching the external connector to the DRS system.
3. When installing cabling between various frames of the DRS system, use high quality CAT5E cable for interconnecting the packet audio stream between frames. Use high quality LC to LC duplex fiber optic cable for interconnecting DXE frames in an expanded system. Refer to Paragraph 3-6, below, for further information on interconnecting various frames of a complete DRS routing system.

3.5 CONNECTOR PIN-OUT DATA

Each input and output frame in a DRS system is configured with a backplane equipped with one of the connector types listed below. The type of backplane used is dependent on the type of signal connected and type of connector used in the installation. In the following paragraphs, each type of connector is illustrated and pin-out data is provided as a guide when wiring mating connectors to interconnect with the DRS frame.

Connector Type	Signal Type
BNC Connectors	AES Unbalanced Audio, 75 Ohm
ELCO/EDAC Connector	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
50 Pin “D” Connector	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
6-Pin Connector (Detachable - Weidmuller)	AES Balanced Audio, 110 Ohm or Analog Balanced Audio

Each AES digital input and output source actually contains a pair of audio signals, therefore the full 128 channel capacity of the DRS frame is realized with 64 AES input sources or output signals. All input and output frame backplanes, with the exception of the BNC backplane, provide 128 physical input connections. When connecting AES digital audio sources to the router, this equates to two physical connection points for each audio input signal. One input allows sources to be AC coupled to router inputs and the other allows sources to be DC coupled. In similar manner when connecting interface cabling to AES digital output connectors, there are two physical connection points for each audio output signal. One output allows audio signals to be AC coupled to equipment external to the router and the other output allows the signal to be DC coupled to external equipment. Pin-out charts contained in the following paragraphs identify how to connect an input source or an output signal for AC or DC coupling. In the case of the BNC backplane, all inputs and outputs are AC coupled to router circuitry.

NOTE	**DRS systems contain both input frames and output frames. For simplicity the following text addressing the various types of connectors found on the input and output backplanes use the inclusive acronym *I/O* to refer to both input and output signals and input and output connections. The reader must keep in mind that in a DRS system each frame is dedicated either as an input or an output frame. Input signals, connections and backplanes are located only on an input frame. Output signals, connections and backplanes are located only on an output frame.**

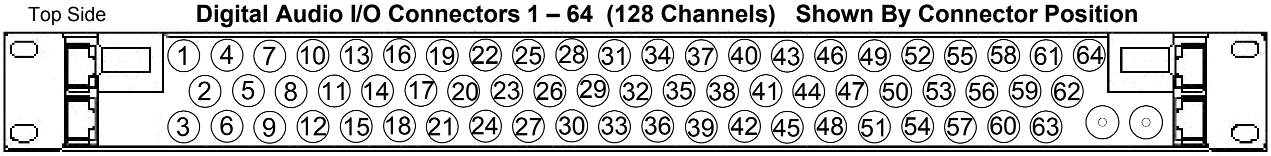
3.5.1 BNC CONNECTOR BACKPLANE

There are 64 BNC I/O connectors on a BNC backplane, each connects to a source of unbalanced AES-compliant digital audio. Figure 3-7 illustrates a BNC backplane and identifies I/O channel layout. QuStream recommends that you create a chart or list of signals attached to router connectors identifying the source (destination) of the signal, cable number (or other identification designation) and router channel number assigned to the signal. It's also a good idea to make a sketch of the rear panel of the router frame and note cable numbers (or other identifier) attached to each I/O BNC connector. Retain this documentation for future reference. Carefully follow the connector layout and channel identification chart shown in Figure 3-7 when completing connections to the DRS router to prevent inadvertent signal swapping.

NOTE	**There are 64 BNC connectors on the backplane, however, there are 128 data channels used in the configuration. Since the BNC backplane is used for connection of AES Audio sources, each input actually carries a pair of audio signals.**

Top Side

Digital Audio I/O Connectors 1 – 64 (128 Channels) Shown By Connector Position



Rear View Of
I/O Frame

BNC Connector Number	**AES Digital** Audio Channels	**BNC Connector Number**	**AES Digital** Audio Channels	**BNC Connector Number**	**AES Digital** Audio Channels	**BNC Connector Number**	**AES Digital** Audio Channels
1	1, 2	17	33, 34	33	65, 66	49	97, 98
2	3, 4	18	35, 36	34	67, 68	50	99, 100
3	5, 6	19	37, 38	35	69, 70	51	101, 102
4	7, 8	20	39, 40	36	71, 72	52	103, 104
5	9, 10	21	41, 42	37	73, 74	53	105, 106
6	11, 12	22	43, 44	38	75, 76	54	107, 108
7	13, 14	23	45, 46	39	77, 78	55	109, 110
8	15, 16	24	47, 48	40	79, 80	56	111, 112
9	17, 18	25	49, 50	41	81, 82	57	113, 114
10	19, 20	26	51, 52	42	83, 84	58	115, 116
11	21, 22	27	53, 54	43	85, 86	59	117, 118
12	23, 24	28	55, 56	44	87, 88	60	119, 120
13	25, 26	29	57, 58	45	89, 90	61	121, 122
14	27, 28	30	59, 60	46	91, 92	62	123, 124
15	29, 30	31	61, 62	47	93, 94	63	125, 126
16	31, 32	32	63, 64	48	95, 96	64	127, 128

Figure 3-7 BNC Backplane – Connector and I/O Channel Identification
(Viewed From Chassis Rear)

3.5.2 ELCO/EDAC CONNECTOR BACKPLANE

There are four ELCO/EDAC 120 pin connectors used on a backplane, each providing 32 input or output connections, for a total of 128 connections. Figure 3-8 illustrates the ELCO/EDAC backplane and identifies I/O connection layout. Notice that I/O connections are numbered consecutively from the left side of frame (looking from rear) to the right side. This same numbering convention holds for each individual connector, with I/O connections provided by each also beginning on the left side of the connector (viewed from the rear) and moving to the right side. Also note that the set of pins associated with the first numerical input of each connector (1, 33, 65 and 97) is located on lower left side of connector.

NOTE	**ELCO/EDAC backplanes are manufactured using EDAC Part Number 516-120-520-202 connectors from the 516 Rack and Panel Connector Series. Choose mating connectors from this series (or equivalent) that best fit your installation. Mating connectors are available in many styles from the manufacturer and may be viewed at their website: www.edac.net**

When connecting AES digital audio inputs and outputs to the router, the 128 input connections equate to two physical connection points for each digital audio signal. One input allows input sources or output signals to be AC coupled to the router and the other allows signals to be DC coupled. When connecting analog input or output signals each of the 128 input connections is used for a separate single-channel audio input or output. Detailed pin-out diagrams are provided by Figure 3-9 and Figure 3-10; and a pin identification chart is provided by Table 3-1.

QuStream recommends that you create a chart or list of signals attached to router connectors identifying the source (destination) of signal, cable number (or other identification designation) and router channel number assigned to the signal. It's also a good idea to make a sketch or a table of pin layout for each connector identifying connector number, signal source (destination) and cable numbers (or other identifier) attached to each set of I/O pins and the router channel number associated with each cable. Prepare this sketch or table BEFORE attaching wires to connector blocks and use it as a reference guide when performing connector block assembly. Retain this documentation for future reference. **Carefully** follow connector pin-out data provided in this text when assembling connector blocks to prevent inadvertent signal swapping. If at all possible, use a continuity measurement device to verify cable connections before attaching mating connectors to DRS rear panel connectors.

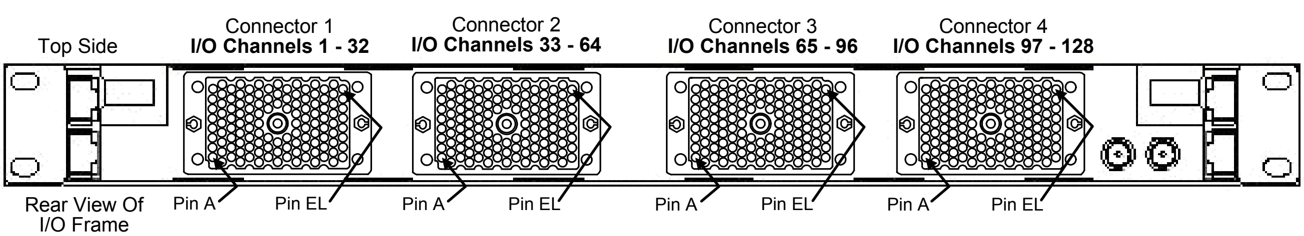


Figure 3-8 ELCO/EDAC Backplane - Connector and I/O Channel Identification
(Viewed From Chassis Rear)

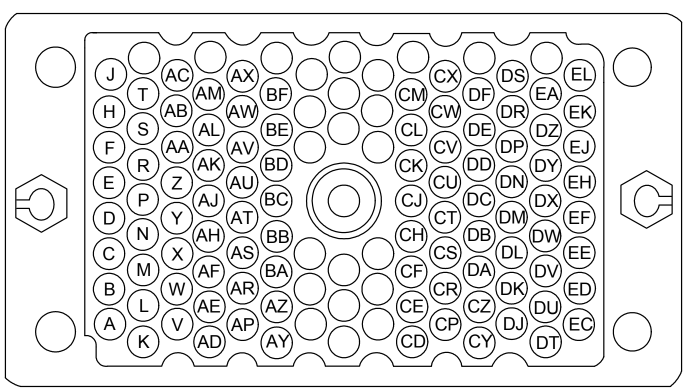


Figure 3-9 ELCO/EDAC Audio Connector Pin-Out Diagram (Refer To Table 3-1)
(Connector As Mounted On I/O Backplane, Viewed From Chassis Rear)

Table 3-1 ELCO/EDAC Audio Connector Pin-Outs

Connection Pin-Outs By Input/Output Number
for ELCO/EDAC Audio Connectors
Refer To Figures 3-3, 3-4 and 3-5 for Proper Connector Orientation
and Channel Assignments

I/O Connections 1 – 32, Rear Panel Connector 1

I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)		I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)
1	1 AC CPLD	1	A	K	V		17	9 AC CPLD	17	CD	CP	CY
2	1 DC CPLD	2	B	L	W		18	9 DC CPLD	18	CE	CR	CZ
3	2 AC CPLD	3	C	M	X		19	10 AC CPLD	19	CF	CS	DA
4	2 DC CPLD	4	D	N	Y		20	10 DC CPLD	20	CH	CT	DB
5	3 AC CPLD	5	E	P	Z		21	11 AC CPLD	21	CJ	CU	DC
6	3 DC CPLD	6	F	R	AA		22	11 DC CPLD	22	CK	CV	DD
7	4 AC CPLD	7	H	S	AB		23	12 AC CPLD	23	CL	CW	DE
8	4 DC CPLD	8	J	T	AC		24	12 DC CPLD	24	CM	CX	DF
9	5 AC CPLD	9	AD	AP	AY		25	13 AC CPLD	25	DJ	DT	EC
10	5 DC CPLD	10	AE	AR	AZ		26	13 DC CPLD	26	DK	DU	ED
11	6 AC CPLD	11	AF	AS	BA		27	14 AC CPLD	27	DL	DV	EE
12	6 DC CPLD	12	AH	AT	BB		28	14 DC CPLD	28	DM	DW	EF
13	7 AC CPLD	13	AJ	AU	BC		29	15 AC CPLD	29	DN	DX	EH
14	7 DC CPLD	14	AK	AV	BD		30	15 DC CPLD	30	DP	DY	EJ
15	8 AC CPLD	15	AL	AW	BE		31	16 AC CPLD	31	DR	DZ	EK
16	8 DC CPLD	16	AM	AX	BF		32	16 DC CPLD	32	DS	EA	EL

I/O Connections 33 – 64, Rear Panel Connector 2

I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)		I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)
33	17 AC CPLD	33	A	K	V		49	25 AC CPLD	49	CD	CP	CY
34	17 DC CPLD	34	B	L	W		50	25 DC CPLD	50	CE	CR	CZ

35	18 AC CPLD	35	C	M	X		51	26 AC CPLD	51	CF	CS	DA
36	18 DC CPLD	36	D	N	Y		52	26 DC CPLD	52	CH	CT	DB
37	19 AC CPLD	37	E	P	Z		53	27 AC CPLD	53	CJ	CU	DC
38	19 DC CPLD	38	F	R	AA		54	27 DC CPLD	54	CK	CV	DD
39	20 AC CPLD	39	H	S	AB		55	28 AC CPLD	55	CL	CW	DE
40	20 DC CPLD	40	J	T	AC		56	28 DC CPLD	56	CM	CX	DF
41	21 AC CPLD	41	AD	AP	AY		57	29 AC CPLD	57	DJ	DT	EC
42	21 DC CPLD	42	AE	AR	AZ		58	29 DC CPLD	58	DK	DU	ED
43	22 AC CPLD	43	AF	AS	BA		59	30 AC CPLD	59	DL	DV	EE
44	22 DC CPLD	44	AH	AT	BB		60	30 DC CPLD	60	DM	DW	EF
45	23 AC CPLD	45	AJ	AU	BC		61	31 AC CPLD	61	DN	DX	EH
46	23 DC CPLD	46	AK	AV	BD		62	31 DC CPLD	62	DP	DY	EJ
47	24 AC CPLD	47	AL	AW	BE		63	32 AC CPLD	63	DR	DZ	EK
48	24 DC CPLD	48	AM	AX	BF		64	32 DC CPLD	64	DS	EA	EL

I/O Connections 65 – 96, Rear Panel Connector 3

I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)		I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)
65	33 AC CPLD	65	A	K	V		81	41 AC CPLD	81	CD	CP	CY
66	33 DC CPLD	66	B	L	W		82	41 DC CPLD	82	CE	CR	CZ
67	34 AC CPLD	67	C	M	X		83	42 AC CPLD	83	CF	CS	DA
68	34 DC CPLD	68	D	N	Y		84	42 DC CPLD	84	CH	CT	DB
69	35 AC CPLD	69	E	P	Z		85	43 AC CPLD	85	CJ	CU	DC
70	35 DC CPLD	70	F	R	AA		86	43 DC CPLD	86	CK	CV	DD
71	36 AC CPLD	71	H	S	AB		87	44 AC CPLD	87	CL	CW	DE
72	36 DC CPLD	72	J	T	AC		88	44 DC CPLD	88	CM	CX	DF
73	37 AC CPLD	73	AD	AP	AY		89	45 AC CPLD	89	DJ	DT	EC
74	37 DC CPLD	74	AE	AR	AZ		90	45 DC CPLD	90	DK	DU	ED
75	38 AC CPLD	75	AF	AS	BA		91	46 AC CPLD	91	DL	DV	EE
76	38 DC CPLD	76	AH	AT	BB		92	46 DC CPLD	92	DM	DW	EF

77	39 AC CPLD	77	AJ	AU	BC		93	47 AC CPLD	93	DN	DX	EH
78	39 DC CPLD	78	AK	AV	BD		94	47 DC CPLD	94	DP	DY	EJ
79	40 AC CPLD	79	AL	AW	BE		95	48 AC CPLD	95	DR	DZ	EK
80	40 DC CPLD	80	AM	AX	BF		96	48 DC CPLD	96	DS	EA	EL
I/O Connections 97 – 128, Rear Panel Connector 4												
I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)		I/O Connection	AES Digital Audio Channel	Analog Audio Channel	Pos. (+)	Neg. (-)	Ground (Shield)
97	49 AC CPLD	97	A	K	V		113	57 AC CPLD	113	CD	CP	CY
98	49 DC CPLD	98	B	L	W		114	57 DC CPLD	114	CE	CR	CZ
99	50 AC CPLD	99	C	M	X		115	58 AC CPLD	115	CF	CS	DA
100	50 DC CPLD	100	D	N	Y		116	58 DC CPLD	116	CH	CT	DB
101	51 AC CPLD	101	E	P	Z		117	59 AC CPLD	117	CJ	CU	DC
102	51 DC CPLD	102	F	R	AA		118	59 DC CPLD	118	CK	CV	DD
103	52 AC CPLD	103	H	S	AB		119	60 AC CPLD	119	CL	CW	DE
104	52 DC CPLD	104	J	T	AC		120	60 DC CPLD	120	CM	CX	DF
105	53 AC CPLD	105	AD	AP	AY		121	61 AC CPLD	121	DJ	DT	EC
106	53 DC CPLD	106	AE	AR	AZ		122	61 DC CPLD	122	DK	DU	ED
107	54 AC CPLD	107	AF	AS	BA		123	62 AC CPLD	123	DL	DV	EE
108	54 DC CPLD	108	AH	AT	BB		124	62 DC CPLD	124	DM	DW	EF
109	55 AC CPLD	109	AJ	AU	BC		125	63 AC CPLD	125	DN	DX	EH
110	55 DC CPLD	110	AK	AV	BD		126	63 DC CPLD	126	DP	DY	EJ
111	56 AC CPLD	111	AL	AW	BE		127	64 AC CPLD	127	DR	DZ	EK
112	56 DC CPLD	112	AM	AX	BF		128	64 DC CPLD	128	DS	EA	EL

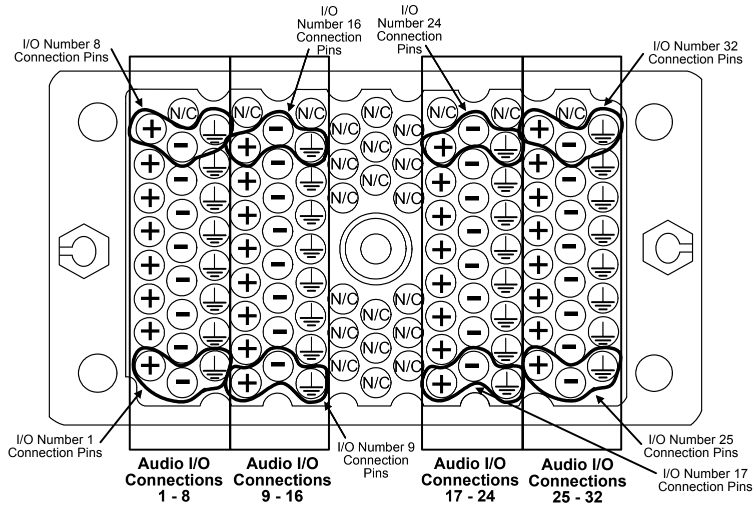


Figure 3-10 ELCO/EDAC Audio Connector I/O Channel Grouping

Wiring errors within connectors can be both frustrating and time consuming. Carefully check pin-out and I/O channel data provided here and verify proper cabling and connector hook-up BEFORE completing connection to the DRS frame.

3.5.3 6-PIN (WEIDMULLER) CONNECTOR BACKPLANE

There are 64 6-Pin I/O connectors on a 6-pin connector backplane, each connector provides 2 physical input or output connections for a total of 128 I/O connections on a backplane. Figure 3-11 illustrates the 6-pin connector backplane and identifies connector layout by “J” number. You will note from the illustration that I/O connectors are arranged in rows and columns and numbered from the left side of frame (looking from the rear) to the right side. Also note the connector column on the left hand side of the backplane (first column) and the connector column on the right hand side (last column) contain only two connectors, while all other columns contain three connectors. These connectors are labeled J1 and J2 (left side) and J63 and J64 (right side) in Figure 3-11. The installer MUST be aware that these four connectors are oriented 90 degrees counter-clockwise from the remaining 60 connectors on backplane. This orientation difference does not affect pin-outs or signal connections in any way, other than to note that respective mating plugs for these connectors must be rotated to proper orientation in order for connector keying pins to line up properly. Figure 3-11 shows in detail the orientation of backplane connectors and pin-out connections of mating plugs.

The mating plug used with the on-board connectors is a solder-less type and uses a spring clamp to securely hold input or output cable wires. Connections are made by inserting the wire end into the round receptacle on the plug. The small square hole beside each wire receptacle contains a spring release that loosens the clamp and allows the wire to be removed from its associated receptacle. To remove a wire, simply insert the blade of a small flat tip screwdriver into the release hole adjacent to the receptacle containing the wire you wish to remove, and gently pull the wire from the receptacle.

When connecting AES digital audio inputs and outputs to router, the 128 input connections equate to two physical connection points for each digital audio signal. One input allows input sources or output signals to be AC coupled to the router and the other allows signals to be DC coupled. When connecting analog input or output signals each of the 128 input connections is used for a separate single-channel audio input or output. Refer to diagrams provided by Figures 3-11 thru 3-13; and pin identification chart provided by Table 3-2.

As with any connection and cabling operation, QuStream recommends that you create a chart or list of signals attached to 6-pin connectors identifying source (destination) of signal, cable number (or other identification designation) and router channel number assigned to signal. It's also a good idea to make a sketch or a table of pin layout for each connector identifying connector number, signal source (destination) and cable numbers (or other identifier) attached to each set of I/O pins and the router channel number associated with each cable. Prepare this sketch or table BEFORE attaching wires to male mating plugs for each backplane connector and use it as a reference guide when performing connector assembly. Retain this documentation for future reference. **Carefully** follow connector pin-out data provided in this text when assembling male mating plug connectors to prevent inadvertent signal swapping. If at all possible, use a continuity measurement device to verify cable connections before attaching mating connectors to DRS rear panel connectors.

Connector orientation and pin identification diagrams are provided by Figure 3-11. Figure 3-12 provides a detailed view of I/O connector numbering layout and Figure 3-13 illustrates channel I/O pin arrangement for a typical 6-pin connector. Table 3-2 is a detailed I/O channel pin-out chart.

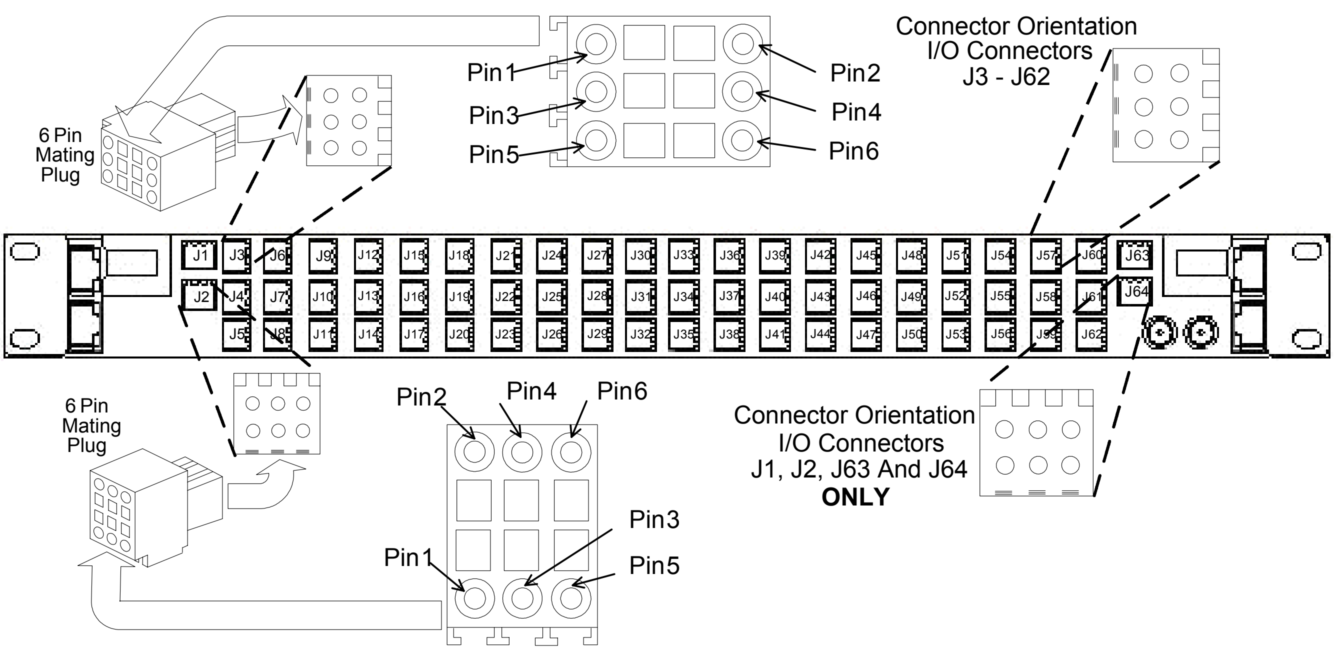


Figure 3-11 6-Pin Connector Backplane Orientation and Pin-Out Diagram

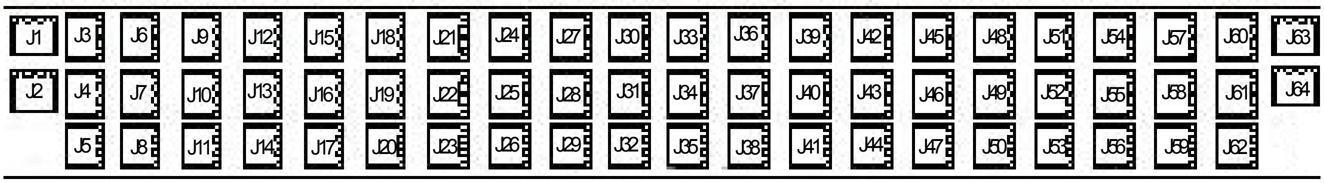


Figure 3-12 6-Pin Connector Backplane – Connector Numbering Layout

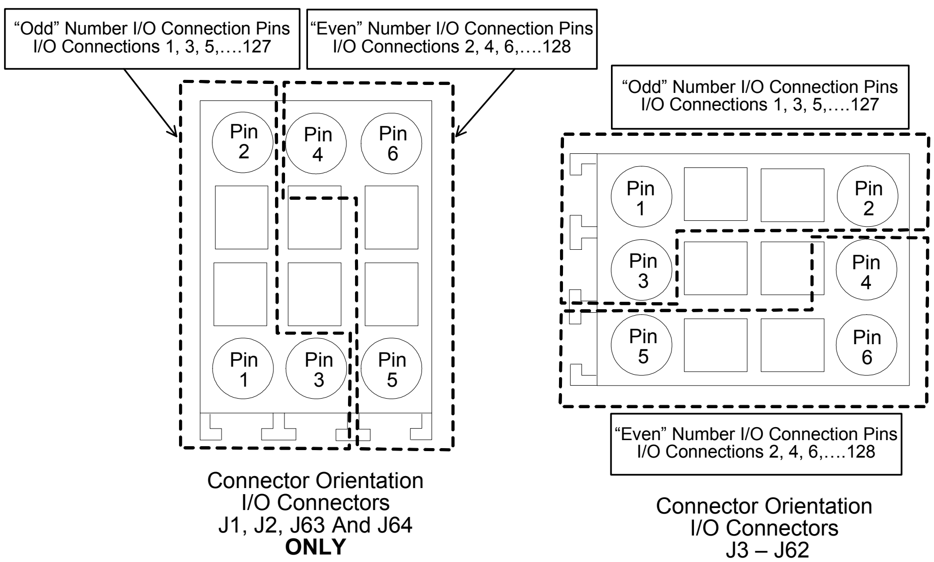


Figure 3-13 6-Pin Detachable Connector – I/O Channel Pin Grouping

Table 3-2 6-Pin Audio Connector Backplane – Channel Pin-Out Chart

Connection Pin-Outs By Input/Output Channel
for 6-Pin Detachable Audio Connectors
Refer To Figures 3-11, 3-12 and 3-13 for Proper Connector Orientation and Channel Assignments

Backplane Connector Number	AES Digital Audio Channel	Analog Audio Channel	Pos. (+) Pin	Neg. (-) Pin	Ground (Shield) Pin		Backplane Connector Number	AES Digital Audio Channel	Analog Audio Channel	Pos. (+) Pin	Neg. (-) Pin	Ground (Shield) Pin
J1	1 DC CPLD	1	1	2	3		J17	17 DC CPLD	33	1	2	3
J1	1 AC CPLD	2	5	6	4		J17	17 AC CPLD	34	5	6	4
J2	2 DC CPLD	3	1	2	3		J18	18 DC CPLD	35	1	2	3
J2	2 AC CPLD	4	5	6	4		J18	18 AC CPLD	36	5	6	4
J3	3 DC CPLD	5	1	2	3		J19	19 DC CPLD	37	1	2	3
J3	3 AC CPLD	6	5	6	4		J19	19 AC CPLD	38	5	6	4
J4	4 DC CPLD	7	1	2	3		J20	20 DC CPLD	39	1	2	3
J4	4 AC CPLD	8	5	6	4		J20	20 AC CPLD	40	5	6	4
J5	5 DC CPLD	9	1	2	3		J21	21 DC CPLD	41	1	2	3
J5	5 AC CPLD	10	5	6	4		J21	21 AC CPLD	42	5	6	4
J6	6 DC CPLD	11	1	2	3		J22	22 DC CPLD	43	1	2	3
J6	6 AC CPLD	12	5	6	4		J22	22 AC CPLD	44	5	6	4
J7	7 DC CPLD	13	1	2	3		J23	23 DC CPLD	45	1	2	3
J7	7 AC CPLD	14	5	6	4		J23	23 AC CPLD	46	5	6	4
J8	8 DC CPLD	15	1	2	3		J24	24 DC CPLD	47	1	2	3
J8	8 AC CPLD	16	5	6	4		J24	24 AC CPLD	48	5	6	4
J9	9 DC CPLD	17	1	2	3		J25	25 DC CPLD	49	1	2	3
J9	9 AC CPLD	18	5	6	4		J25	25 AC CPLD	50	5	6	4
J10	10 DC CPLD	19	1	2	3		J26	26 DC CPLD	51	1	2	3
J10	10 AC CPLD	20	5	6	4		J26	26 AC CPLD	52	5	6	4
J11	11 DC CPLD	21	1	2	3		J27	27 DC CPLD	53	1	2	3
J11	11 AC CPLD	22	5	6	4		J27	27 AC CPLD	54	5	6	4
J12	12 DC CPLD	23	1	2	3		J28	28 DC CPLD	55	1	2	3

J12	12 AC CPLD	24	5	6	4		J28	28 AC CPLD	56	5	6	4
J13	13 DC CPLD	25	1	2	3		J29	29 DC CPLD	57	1	2	3
J13	13 AC CPLD	26	5	6	4		J29	29 AC CPLD	58	5	6	4
J14	14 DC CPLD	27	1	2	3		J30	30 DC CPLD	59	1	2	3
J14	14 AC CPLD	28	5	6	4		J30	30 AC CPLD	60	5	6	4
J15	15 DC CPLD	29	1	2	3		J31	31 DC CPLD	61	1	2	3
J15	15 AC CPLD	30	5	6	4		J31	31 AC CPLD	62	5	6	4
J16	16 DC CPLD	31	1	2	3		J32	32 DC CPLD	63	1	2	3
J16	16 AC CPLD	32	5	6	4		J32	32 AC CPLD	64	5	6	4

Backplane Connector Number	AES Digital Audio Channel	Audio I/O Channel	Pos. (+) Pin	Neg. (-) Pin	Ground (Shield) Pin		Backplane Connector Number	AES Digital Audio Channel	Audio I/O Channel	Pos. (+) Pin	Neg. (-) Pin	Ground (Shield) Pin
J33	33 DC CPLD	65	1	2	3		J49	49 DC CPLD	97	1	2	3
J33	33 AC CPLD	66	5	6	4		J49	49 AC CPLD	98	5	6	4
J34	34 DC CPLD	67	1	2	3		J50	50 DC CPLD	99	1	2	3
J34	34 AC CPLD	68	5	6	4		J50	50 AC CPLD	100	5	6	4
J35	35 DC CPLD	69	1	2	3		J51	51 DC CPLD	101	1	2	3
J35	35 AC CPLD	70	5	6	4		J51	51 AC CPLD	102	5	6	4
J36	36 DC CPLD	71	1	2	3		J52	52 DC CPLD	103	1	2	3
J36	36 AC CPLD	72	5	6	4		J52	52 AC CPLD	104	5	6	4
J37	37 DC CPLD	73	1	2	3		J53	53 DC CPLD	105	1	2	3
J37	37 AC CPLD	74	5	6	4		J53	53 AC CPLD	106	5	6	4
J38	38 DC CPLD	75	1	2	3		J54	54 DC CPLD	107	1	2	3
J38	38 AC CPLD	76	5	6	4		J54	54 AC CPLD	108	5	6	4
J39	39 DC CPLD	77	1	2	3		J55	55 DC CPLD	109	1	2	3
J39	39 AC CPLD	78	5	6	4		J55	55 AC CPLD	110	5	6	4
J40	40 DC CPLD	79	1	2	3		J56	56 DC CPLD	111	1	2	3
J40	40 AC CPLD	80	5	6	4		J56	56 AC CPLD	112	5	6	4
J41	41 DC CPLD	81	1	2	3		J57	57 DC CPLD	113	1	2	3

J41	41 AC CPLD	82	5	6	4		J57	57 AC CPLD	114	5	6	4
J42	42 DC CPLD	83	1	2	3		J58	58 DC CPLD	115	1	2	3
J42	42 AC CPLD	84	5	6	4		J58	58 AC CPLD	116	5	6	4
J43	43 DC CPLD	85	1	2	3		J59	59 DC CPLD	117	1	2	3
J43	43 AC CPLD	86	5	6	4		J59	59 AC CPLD	118	5	6	4
J44	44 DC CPLD	87	1	2	3		J60	60 DC CPLD	119	1	2	3
J44	44 AC CPLD	88	5	6	4		J60	60 AC CPLD	120	5	6	4
J45	45 DC CPLD	89	1	2	3		J61	61 DC CPLD	121	1	2	3
J45	45 AC CPLD	90	5	6	4		J61	61 AC CPLD	122	5	6	4
J46	46 DC CPLD	91	1	2	3		J62	62 DC CPLD	123	1	2	3
J46	46 AC CPLD	92	5	6	4		J62	62 AC CPLD	124	5	6	4
J47	47 DC CPLD	93	1	2	3		J63	63 DC CPLD	125	1	2	3
J47	47 AC CPLD	94	5	6	4		J63	63 AC CPLD	126	5	6	4
J48	48 DC CPLD	95	1	2	3		J64	64 DC CPLD	127	1	2	3
J48	48 AC CPLD	96	5	6	4		J64	64 AC CPLD	128	5	6	4

3.5.4 DRS INTERCONNECT CABLES

System interconnects for Packet Audio Stream (PAS) Bus connections between frames and Ethernet connection(s) for system control are made using common CAT5E cable and RJ-45 connectors. Two types of Ethernet cables are commonly available: those that are "straight-thru" pin-for-pin and "crossover" cables that have transmit leads (TX+ and TX-) and receive leads (RX+ and RX-) exchanged between the two connector ends according to a specified pin-out standard. All DRS connections, both PAS and Ethernet, can use either type of cable. Auto-detect circuitry determines the type of cable used and makes proper internal connections accordingly. This operation is totally transparent and requires no operator input or action.

Pre-assembled Ethernet cables, in various lengths, with connectors attached are readily available from a number of sources. In some installations it may be necessary, due to routing requirements or other constraints, to run bulk cable and attach connectors once the cable is in place. Installing connectors on the ends of CAT5E cable or splicing two cable ends together requires some degree of specialized training, skill and equipment. QuStream highly recommends that, unless you have training in proper crimping techniques and the necessary equipment, you should purchase pre-assembled cables if at all possible for your installation. If using pre-assembled cabling is not feasible for your installation, consider procuring the services of a trained technician to install connectors and verify cable continuity before proceeding with system interconnection.

If you do choose to make your own interconnect cables, always use the very best quality cable and connectors available, use a good crimping tool and follow proper technique when installing connector ends to the cable run. AN IMPROPERLY INSTALLED CONNECTOR END CAN SERIOUSLY DEGRADE PERFORMANCE OF THE DRS SYSTEM. The installer should be aware that there is no "rock solid" color-coding convention for wiring an Ethernet cable; in fact as of this writing, several coding schemes exist. For all practical purposes the color-coding has no effect on system operation as long as the wire pairs on each end of the connector are properly mated. For the sake of consistency, QuStream recommends that you wire all cables as pin-for-pin "straight-thru" (no TX/RX crossover) using the EIA/TIA 568B "standard" color code scheme shown in Figure 3-14. Pin numbering for a standard RJ-45 connector is also provided in Figure 3-14 for reference.

RJ-45 Connector Pin Number	Wire Color
1	White/Orange
2	Orange
3	White/Green
4	Blue
5	White/Blue
6	Green
7	White/Brown
8	Brown

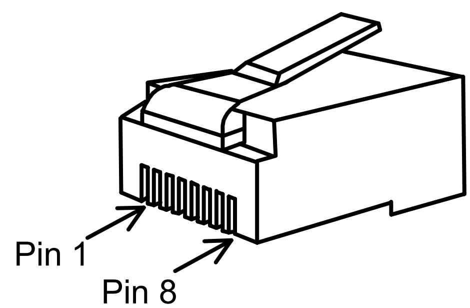


Figure 3-14 EIA 568B Color Code for Ethernet Cable and RJ-45 Pin-Out Diagram

3.6 INTRA-SYSTEM CABLING AND CONNECTIONS

Chapter 2 of this manual took a rather in-depth look at various DRS system installations; from a simple three box 128X128 system using one input frame, one output frame and one DXE frame to a fully expanded 2048X2048 system using four DXE frames and their associated I/O frames. From the simplest to the most complex system, each installation requires some degree of intra-system cabling between the various frames comprising the DRS router. The number and type of intra-system cables will vary by system and depends on the number of I/O frames, number of DXE frames and whether or not system redundancy is incorporated. Regardless of the number and length of cables ultimately used for configuration, there are three types of intra-system connections possible for a DRS installation: Packet Audio Stream, DXE Fiber Optic Links (if used) and P2K System Controller Interface. Each connection type is identified and discussed in the following paragraphs.

3.6.1 PACKET AUDIO STREAM

Audio signal "packets" are routed between frames over the Packet Audio Stream connections. When installing packet audio stream cable, there are really very few constraints on routing and placement. You will obtain best performance and highest signal integrity by using a high quality CAT5E cable for interconnection. Plan your installation by determining the location of I/O frames and use the shortest, most direct path possible for running cables between frames. Be sure that the RJ-45 connector on each cable end is properly wired per pin-out or wire color code and that the connector is securely attached to the cable wires. If possible use an Ohmmeter or other signal tracing device to verify continuity of interconnecting cables before installing them to DRS frames.

NOTE	**DO NOT CONNECT THE PACKET AUDIO STREAM CONNECTORS TO AN ETHERNET NETWORK!!** **Even though the Packet Audio Stream connections are made using RJ-45 connectors and CAT5E cable, they SHOULD NOT be made through the facility LAN. The packet audio bus operating parameters require dedicated, point-to-point connections, and WILL NOT function over a network!!**

128X128 Systems To configure a basic 128X128 router, install the Packet Audio Stream cable between input and output frames and the DXE as shown in Figure 3-15. Packet Audio Stream connectors are located on the left and right side of the I/O frame chassis rear panel, and are the lower of the pair of RJ-45 connectors. Notice that there are two packet audio stream connectors, identified as Primary DXE Connector and Secondary DXE Connector. When connecting a single DXE (non-redundant) system, connector the Primary DXE Connector on both the input and output frames to the DXE.

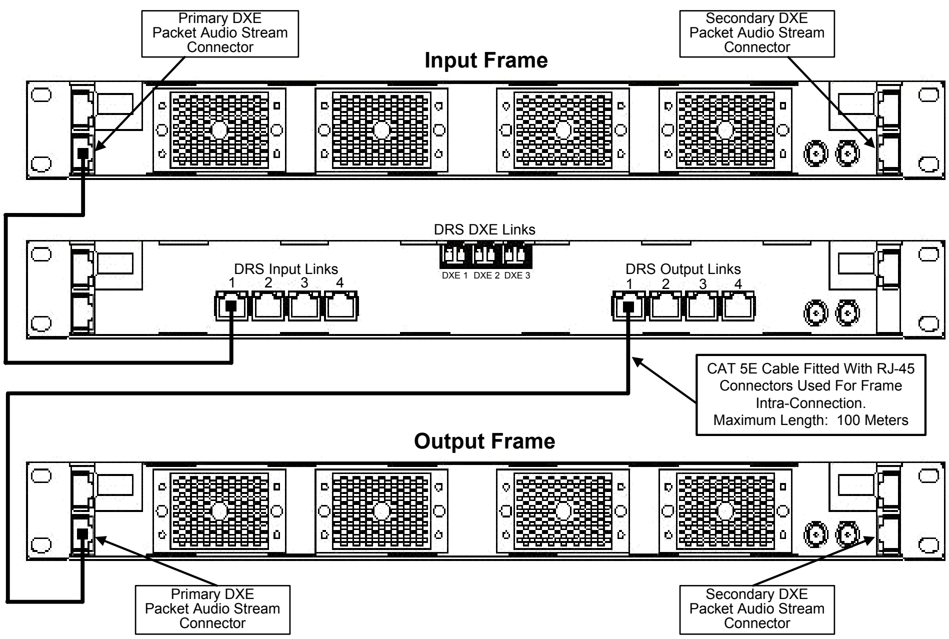


Figure 3-15 Packet Audio Stream Connection (Non-Redundant PAS Bus)

If PAS bus redundancy is desired, the installation requires a second DXE frame. In this installation use the PAS Bus connectors identified as Primary DXE to interconnect packet audio stream cables from input and output frames to the Primary DXE frame (designated as DXE 1 in Figure 3-16), and the Secondary DXE connectors to form the second PAS bus with the Secondary DXE frame (DXE 2). This installation provides full packet audio bus redundancy. Should cables from either the input or output frame to the primary DXE become disconnected or data become unavailable or unusable for whatever reason, the second DXE, and the redundant bus, will immediately become the primary bus and keep the packet audio stream intact between the input and output frame, with no signal interruption. Figure 3-16 illustrates a redundant PAS bus system. Use this figure as a guide for installation of cables.

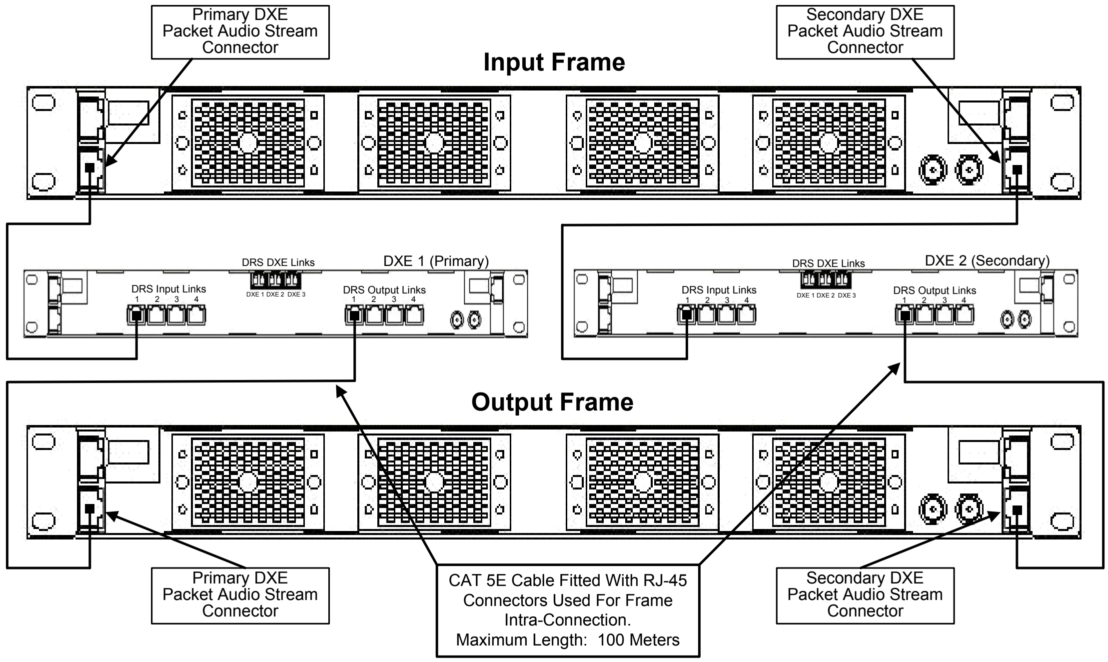


Figure 3-16 Packet Audio Stream Connection (Redundant PAS Bus)

Expanded Systems To configure an expanded system using one or more DXE frames, each input and output frame must be connected to a DXE. Figure 3-17 illustrates cabling for an expanded system using four input frames, four output frames and a single DXE. Just as in a 128X128 installation, the packet audio stream from each input frame in the system attaches to a DXE via the DRS Input Links connectors and each output frame attaches to the DXE via the DRS Output Links connectors. Input link connectors are numbered IN 1 thru IN 4 and output link connectors are numbered OUT 1 thru OUT 4. For proper system operation, it is imperative that input frames and output frames be interconnected with the DXE in numerical sequence shown in Table 3-3.

Table 3-3 I/O Frame To DXE Frame Interconnect Chart

Frame Number	Audio Channels	DXE Connector
Input Frame 1	Input Channels 1 – 128	Input Link IN 1
Input Frame 2	Input Channels 129 – 256	Input Link IN 2
Input Frame 3	Input Channels 257 – 384	Input Link IN 3
Input Frame 4	Input Channels 385 – 512	Input Link IN 4
Output Frame 1	Output Channels 1 – 128	Output Link OUT 1
Output Frame 2	Output Channels 129 – 256	Output Link OUT 2
Output Frame 3	Output Channels 257 – 384	Output Link OUT 3
Output Frame 4	Output Channels 385 - 512	Output Link OUT 4

If an expanded system has less than four input frames or less than four output frames, the numerical channel I/O and interconnect sequence must still be followed. For example, if a system has two input frames and three output frames, they must be connected to the DXE as follows:

Input Frame 1 (Audio Input Channels 1 – 128) to Input Link IN 1

Input Frame 2 (Audio Input Channels 129 – 256) to Input Link IN 2

Output Frame 1 (Audio Output Channels 1 – 128) to Output Link OUT 1

Output Frame 2 (Audio Output Channels 129 – 256) to Output Link OUT 2

Output Frame 3 (Audio Output Channels 257 – 384) to Output Link OUT 3

Install the packet audio stream cables between the input, output and DXE frames using Table 3-3 and Figure 3-17 as a guide.

3.6.2 DXE FIBER OPTIC LINKS

When multiple DXE frames are used in an expanded system, all of the frames must be interconnected using an optical cabling method analogous to the “star” networking topology. There are a few constraints on connecting and routing the optical cables. You will obtain best performance and highest signal integrity by using high quality fiber optic cable for interconnection. Plan your installation by determining the location of the DXE frames and use the shortest, most direct path possible for running optical cables between frames.

You will find it very helpful in installing and working with any fiber optic system to take time to familiarize yourself with some basic knowledge of optical data transmission principles and fiber optic cable characteristics. It is not the intent of this manual to provide a tutorial on optical data systems; however, to insure the best DRS router installation possible there are a few points in dealing with optical cable that should be discussed.

Duplex fiber optic cable with a type LC connector on each end is required for connection of DXE frames. Duplex cable actually consists of two separate optical conductors, think of them as “pipelines” for light, in each run of cable. Since light is not bi-directional, two conductors are required for a two-way communication system: one conductor is the transmit cable, the other is the receive cable. The two conductors attach to DXE rear panel receptacle connectors.

NOTE	**The Transmit Port from one DXE MUST connect to the receive Port of another DXE. In order to accomplish this, each duplex cable MUST be configured as “Cross-Over.”**

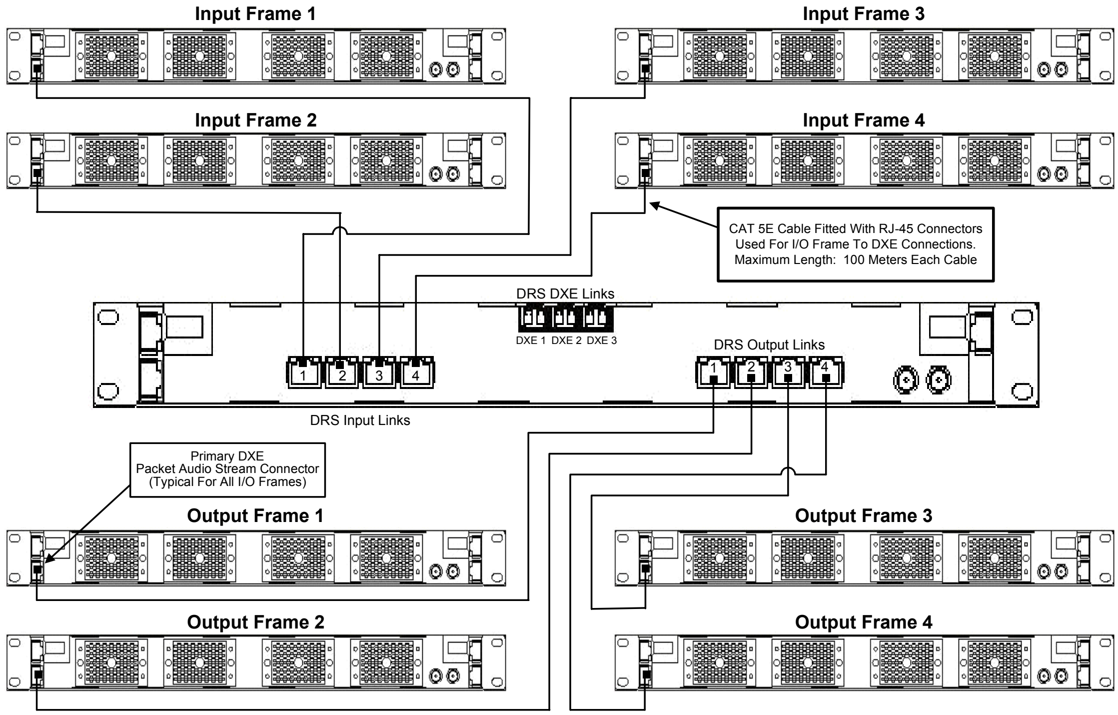


Figure 3-17 Packet Audio Stream Connections - Input and Output Frames To DXE Frame

Fiber optic cable, like any other cable, is available is bulk spools of varying lengths without connectors attached. Be aware that some degree of specialized training, skill and equipment is required when installing connectors on the ends of fiber optic cable or splicing two cable ends together. In some installations it may be necessary, due to routing requirements or other constraints, to run bulk cable and attach connectors once the cable is in place. For easier and quicker installation, pre-assembled fiber optic cables, in various lengths, with connectors attached are readily available from a number of sources. QuStream highly recommends that, unless you have training in working with optical cable and the necessary equipment, you should purchase pre-assembled cables if at all possible for your installation. If using pre-assembled cabling is not feasible for your installation, consider procuring the services of a trained fiber technician, certified for fiber terminations, to install connectors and verify cable continuity before proceeding with DXE interconnection.

One final point on dealing with optical cable: be sure that the optical connectors are clean and dust free. Each end of a fiber cable connection is fitted with a small lens to direct the light source. Dust, even small amounts, can greatly degrade performance of an optical data transmission system. Always keep dust caps on cable connector ends and optical receptacle connectors when cables are not attached. NEVER touch the end of the optical connector or receptacle with your bare skin. Grease and dirt, even minute amounts, can seriously degrade performance of the optics.

The dual conductors of fiber optic cable are usually attached to a connector equipped with two fiber-end lenses, one for each conductor. This assembly mates to rear panel DXE Link receptacles on the DXE simply by inserting the connector end into its mating receptacle with very slight pressure. A snap latch secures the end into the receptacle. To remove cable-end connector from a rear panel receptacle, gently press the latch tab and pull cable from receptacle. Immediately replace dust caps on the end of each conductor of the fiber cable and the DXE connector receptacle.

Multiple DXE frames must be interconnected to one another in a numerical sequence via the DRS DXE Links connectors, labeled DXE 1 thru DXE 3, located along the top edge of each DXE rear panel. DXE frames are interconnected with one another in a manner whereby each frame has a direct connection with every other frame. Interconnection of a full capacity system can be accomplished with three connectors on each DXE.

- The easiest way to remember how each frame should be cabled is to think of the number sequence 1 thru 4, leaving out the number of the frame you are connecting. This will give you the frame numbers sequentially that each rear panel connector should be cabled to, also in numeric sequence.
- An illustration of a properly cabled four DXE system is shown in Figure 3-18. Refer to the figure as we consider an example of this sequencing.
- Assume that you are cabling up a four DXE system, beginning with DXE frame 1. Think of the number sequence 1 thru 4, leaving out the number 1 (for frame 1) we have 2, 3 and 4. This says that rear panel DXE Link Connectors DXE 1 thru DXE 3 on frame 1 attach to connector DXE 1 on frames 2,3 and 4, respectively.
- For frame 2 our number sequence is 1, 3 and 4 (1 thru 4, leaving the digit 2 out for frame 2). Frame 2 rear panel DXE Link Connectors DXE 1 thru DXE 3 interconnect with connector DXE 2 on frames 1, 3 and 4, respectively.
- This method will also work with systems containing fewer than four DXE frames. Simply use a number sequence containing the number of DXE frames in the system. In such a configuration, not all of the DXE Link connectors will be used. This numeric method works regardless of the number of DXE frames in the system.
- One final example: consider a three DXE system. The number sequence is 1, 2 and 3 (3 total frames in the system). When connecting DXE frame 1 the number sequence consists of the digits 2 and 3 (1, 2 and 3 leaving digit 1 out for frame 1). This says that frame 1 DXE Link connectors DXE 1 and DXE 2 attach to connector DXE 1 on frames 2 and 3, respectively.
- Continue this algorithm until all frames in the system are interconnected.

Table 3-4 is a hook-up chart providing quick reference for determining proper DXE to DXE frame connection.

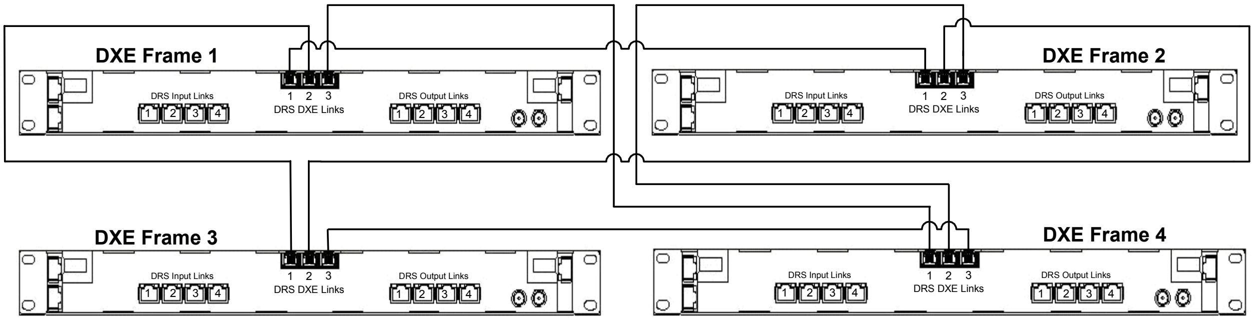


Figure 3-18 Multiple DXE Fiber Optic Links - Cable Interconnect Diagram

Table 3-4 DXE Frame Interconnection Chart

System Frame	Rear Panel "DRS DXE Link" Connectors and Corresponding System DXE Frame Interconnections (Fiber Optic Cable Destination DXE Frame and Destination Rear Panel "DRS DXE Link" Connector)		
	DRS DXE Link 1	**DRS DXE Link 2**	**DRS DXE Link 3**
DXE Frame 1	DXE Frame 2 – DXE Link 1	DXE Frame 3 – DXE Link 1	DXE Frame 4 – DXE Link 1
DXE Frame 2	DXE Frame 1 – DXE Link 1	DXE Frame 3 – DXE Link 2	DXE Frame 4 – DXE Link 2
DXE Frame 3	DXE Frame 1 – DXE Link 2	DXE Frame 2 – DXE Link 2	DXE Frame 4 – DXE Link 3
DXE Frame 4	DXE Frame 1 – DXE Link 3	DXE Frame 2 – DXE Link 3	DXE Frame 3 – DXE Link 3

Interconnecting between the proper DXE Link Connectors on each frame is critical for proper system operation. Use the references discussed above when installing fiber interconnect cables to insure that all cables are attached to the proper connectors. The system will not function properly and troubleshooting could be a tedious task if these connections are not made correctly.

In planning your installation, consider carefully the placement of DXE frames and how to route and dress optical cabling between all frames. As with any wiring effort, use of a chart or sketch greatly simplifies final hook-up once all optical cables are in place. Make notes of cable numbers (or other identifiers) and the name and number of the rear panel connector to which each cable is attached. Always retain any installation data for future use should system troubleshooting ever be necessary.

NOTE	**Dust, even small amounts, can greatly degrade performance of an optical data transmission system. Always keep the dust caps on the cable connector ends and the optical receptacle connectors when the cables are not attached. NEVER touch the end of the optical connector or receptacle with your bare skin. Grease and dirt, even minute amounts, can seriously degrade performance of the optics.**

3.6.3 PERC2000 SYSTEM CONTROLLER INTERFACE

As discussed in previous chapters and sections of this manual, the control system for a DRS router consists of the P1K Controller circuitry co-resident on a Power Supply/PERC1000 Controller Module, and the P2K System Controller located external to the DRS router. It is not the intent of this manual to provide a detailed tutorial of the P2K CCA or software. The P2K has its own technical manual and other documentation, and the user of this equipment is referred to that documentation for additional information. However, for purposes of installing the DRS router the user needs to have a good basic understanding of the controller system components, their function and possible physical locations. There are also some cabling considerations to the controller interface that must be addressed. These topics are briefly introduced and discussed in the following paragraphs.

P2K is the name given collectively to a System Controller circuit card assembly (CCA), its associated board-resident firmware and a graphical user interface (GUI) application that resides and runs on a Microsoft Windows™ based PC platform. Consider the System Controller to be the master overseer of the entire router system. This master overseer can not only control the DRS system but can also simultaneously control other QuStream routers or switchers, such as a Cheetah Video Matrix Switcher, which may be attached to it. The System Controller CCA circuitry communicates bi-directionally with the Frame Controller circuitry over a standard 10/100 Ethernet link. Think of the Frame Controller as a slave that is subservient to its master – the System Controller. The Frame Controller circuitry orchestrates system commands for the router under its control. In terms of a router/switcher installation, where, for example, audio is routed by a Cheetah DRS System and video is routed by a Cheetah Video Matrix Switcher, the Frame Controller for the DRS system (P1K) receives commands from the System Controller (P2K) and is responsible for executing these commands on the system it is controlling – in this example the audio router. Likewise, a separate frame controller is contained in the Video Matrix Switcher. It receives commands from the same P2K System Controller, but it is responsible for executing the commands of the system controller on the video matrix and has nothing whatsoever to do with controlling the audio router. 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 which may be used by facility operators to control operation of the entire switching system.

From the previous discussion, we see that any system must have the components of the P2K System Controller interfacing with the components of the P1K Frame Controller to effectively control the operation of the router. There are two very distinct ways that the P2K circuitry can be accessed for the DRS router:

- In some installations, the P2K CCA(s) will be mounted in a stand-alone rack frame with a power supply and the necessary external connectors. Only one P2K CCA is required for any system, however, a second CCA may be installed in the rack frame to provide full system redundancy in the event one of the CCAs should have a failure.

- Cheetah Video Matrix Switcher frames are designed to house the P2K System Controller CCA(s) internal to the switcher. Slots are provided in the matrix frame for up to two P2K CCAs. Only one is required for system operation, but two may be used for system redundancy, if desired.

For true redundant system operation, not only are two System Controller CCAs required, but two Frame Controllers (P1K) are also required. If two P2K CCAs are used for system redundancy, there are actually two totally separate 10/100 Ethernet Links for system control. One link interfaces to each of the Frame Controllers. One of the links becomes the “primary” data link and the second becomes the “secondary” data link. Should either one have a failure – the remaining functional link becomes the “primary” regardless of its previous status.

As previously mentioned, the P1K circuitry for the DRS system interfaces to the P2K circuitry using CAT5E cable and RJ-45 connectors over a protocol standard 10/100 Ethernet link. If the stand-alone rack frame P2K is used, the Ethernet cable from the DRS Frame Controller Module connects to one of the RJ-45 connectors on the rear of the P2K rack unit. If the facility is also using a Cheetah Video Matrix Switcher and chooses to mount the System Controller CCA(s) in the matrix frame, then the Ethernet cable from the DRS Frame Controller Module connects to one of the “System Controller” RJ-45 connectors on the rear panel of the matrix switcher. If two P2K CCAs are used for redundancy, at least two P1K Frame Controller modules will be used in the DRS system. One will function as the “primary” controller and the other as the “secondary.” Should either one fail, the remaining functional bus continues to control the system.

Control Cabling for 128X128 Systems Recall from discussions in Chapter 2 of various configurations possible for a DRS system, that in a basic 128X128 router the P1K frame controller circuitry is contained in the DXE frame of the system. One module or two may be used in the chassis frame. If one module is used, the router contains only a “primary” control bus and the Ethernet cable from the frame controller connects to the Ethernet connector for the system controller, either on the stand-alone rack frame or the rear panel of a video matrix switcher. This configuration is illustrated in Figure 3-19.

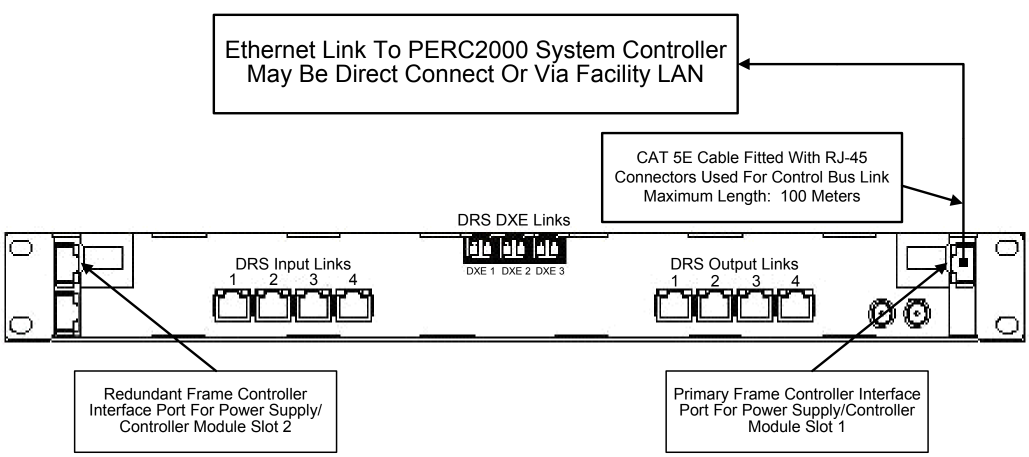


Figure 3-19 Control Cabling for Single Controller Module Installation

If two Power Supply/PERC1000 Controller modules are used in the DXE, two hook-up configurations are possible, one of which will be used depending on the System Controller configuration. First, if there are two P2K System Controller CCAs then each one will have its own control bus. In this application, Ethernet cables from the DRS frame connect to system controller Ethernet ports through an external Ethernet Switch. This arrangement now contains a "primary" bus and a "secondary" bus for full redundancy, and is illustrated in Figure 3-20.

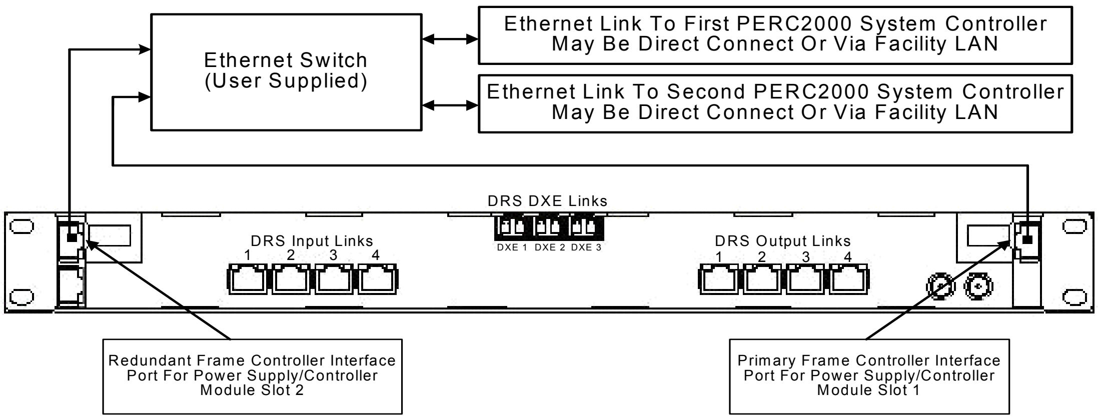


Figure 3-20 Control Cabling for Fully Redundant Dual Controller Module Installation

If there is only one P2K system controller CCA and two P1K modules, the installer must use an Ethernet switch to connect the two buses to the single port of the P2K. While this option does not provide full redundancy, it still offers a redundant frame controller should one of the modules ever fail. This configuration is illustrated in Figure 3-21.

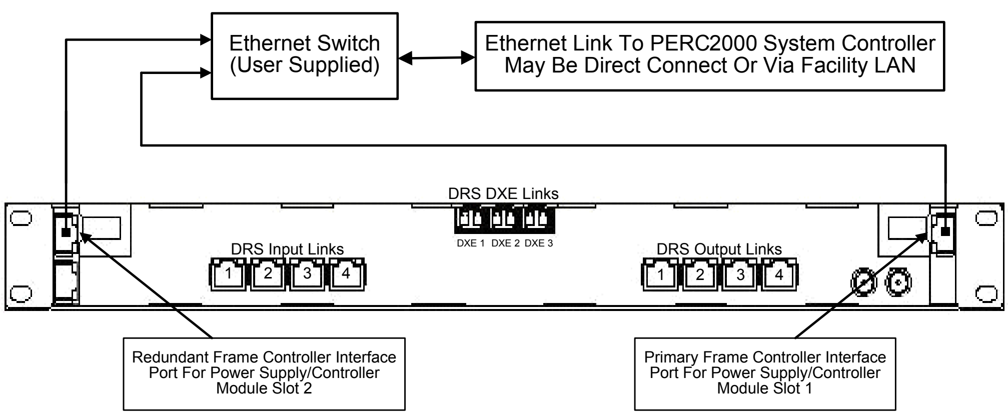


Figure 3-21 Control Cabling for Redundant Frame Controller Module Installation

Installations providing PAS bus redundancy require two DXE frames with each requiring an Ethernet connection with the P2K System Controller. Any of the control cabling schemes discussed above may be used with a dual DXE system. The difference being that like frame controller interface ports of each DXE must be connected to the system controller through a high-speed Ethernet switch. Figures 3-22 through 3-24 illustrate the cabling schemes shown in Figures 3-19 through 3-21 using dual DXE frames. When configuring a PAS bus redundant installation use these figures as a guide for installing control cabling.

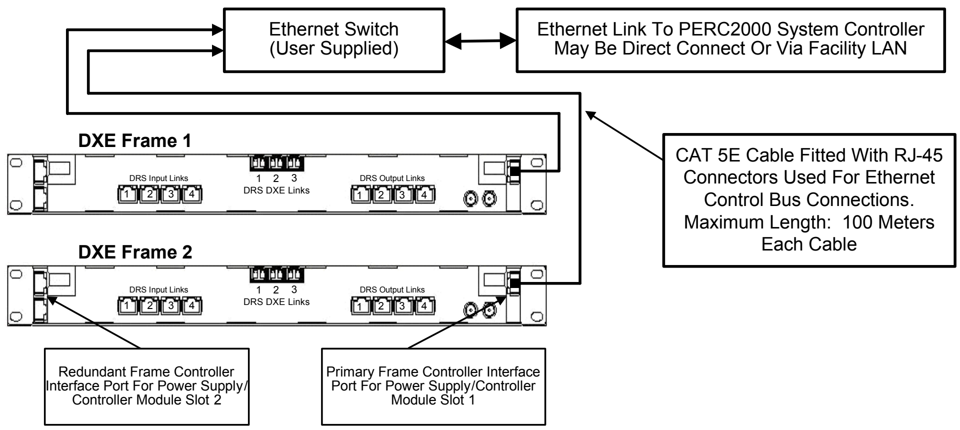


Figure 3-22 Control Cabling for Dual DXE, Single Controller Module Installation

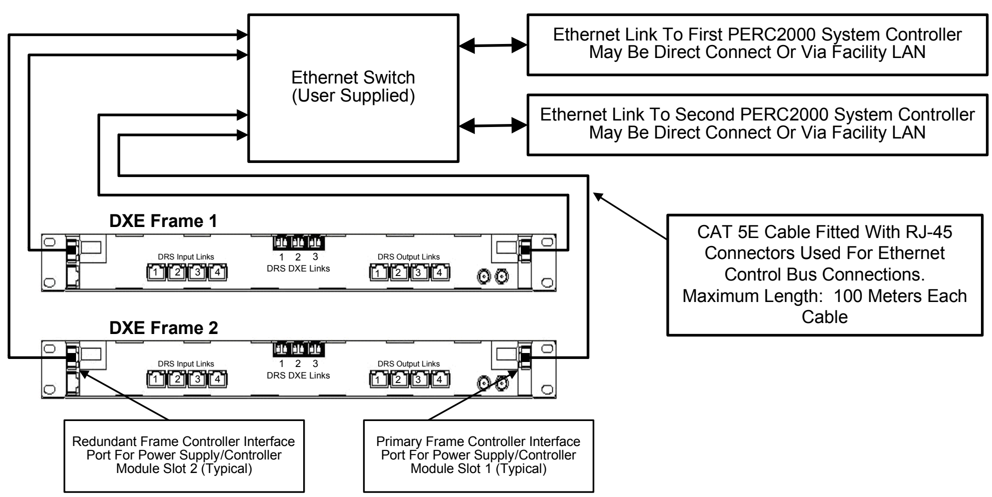


Figure 3-23 Control Cabling for Dual DXE, Fully Redundant Dual Controller Module Installation

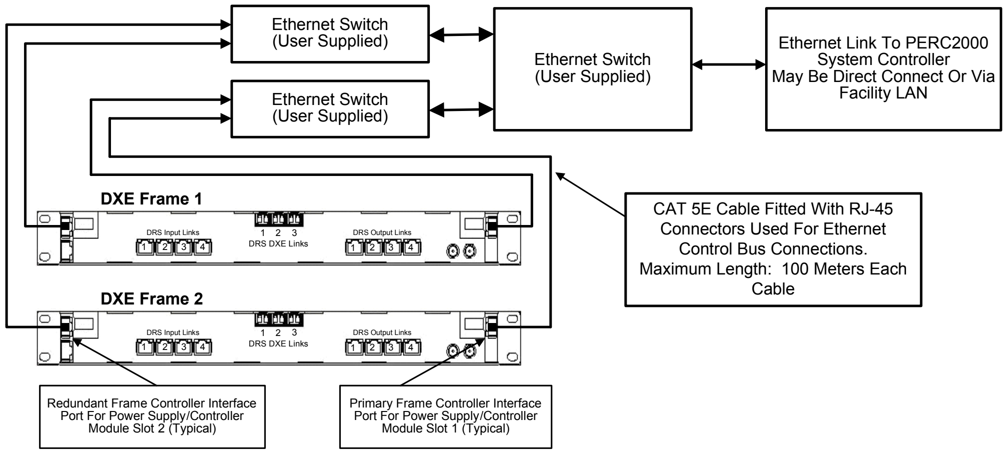


Figure 3-24 Control Cabling for Dual DXE, Redundant Frame Controller Module Installation

__Control Cabling for Expanded System Installations__ Control bus cables for installations using a single DXE frame connect exactly as described in previous paragraphs for a single DXE (non-redundant PAS bus) 128X128 system. Refer to Figure 3-19, 3-20 and 3-21.

When multiple DXE frames are used, the installation principle is still the same as for a single DXE. Either one frame controller module or two may be used in each DXE chassis frame. If one module is used the router contains only a "primary" control bus. Control cables from every DXE frame in the system connect to the system controller through an Ethernet switch. Just as with a single frame installation, the system controller connection is either on the stand-alone rack frame or the rear panel of a video matrix switcher. This configuration is illustrated in Figure 3-25.

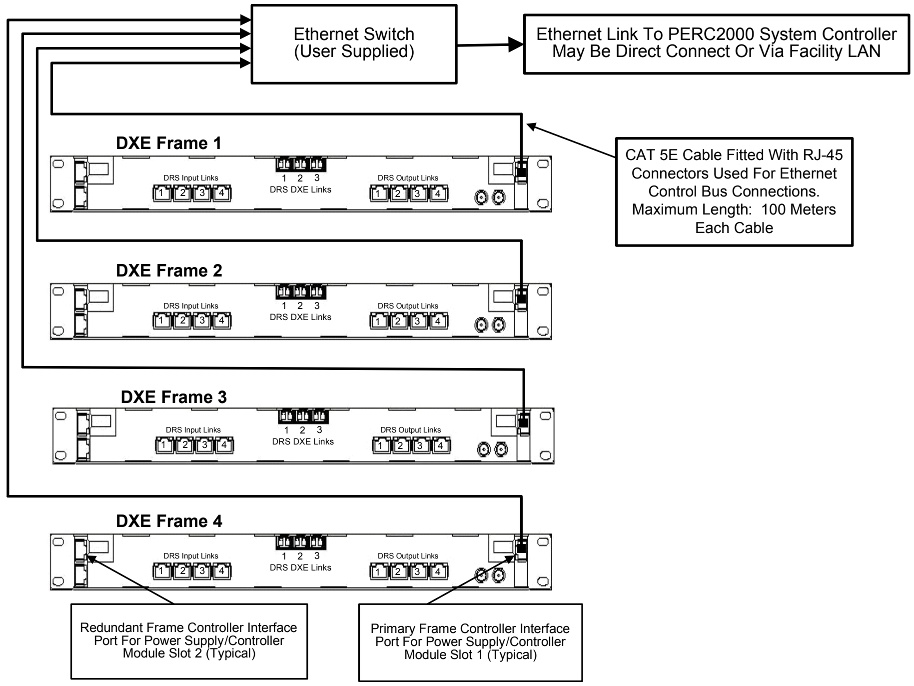


Figure 3-25 Control Cabling for Multiple DXE, Single Controller Module Installation

If two Power Supply/PERC1000 Controller modules are used in each DXE frame, the same two hook-up configurations as with a single frame installation are possible, one of which will be used depending on the System Controller configuration used. If there are two P2K System Controller CCAs in the system then each one will have its own control bus. In this application, Ethernet cables from both module slot connectors on every DXE frame connect through an Ethernet switch to the system controller Ethernet ports. This arrangement now contains a “primary” bus and a “secondary” bus for each DXE frame, providing full control system redundancy. This configuration is illustrated in Figure 3-26.

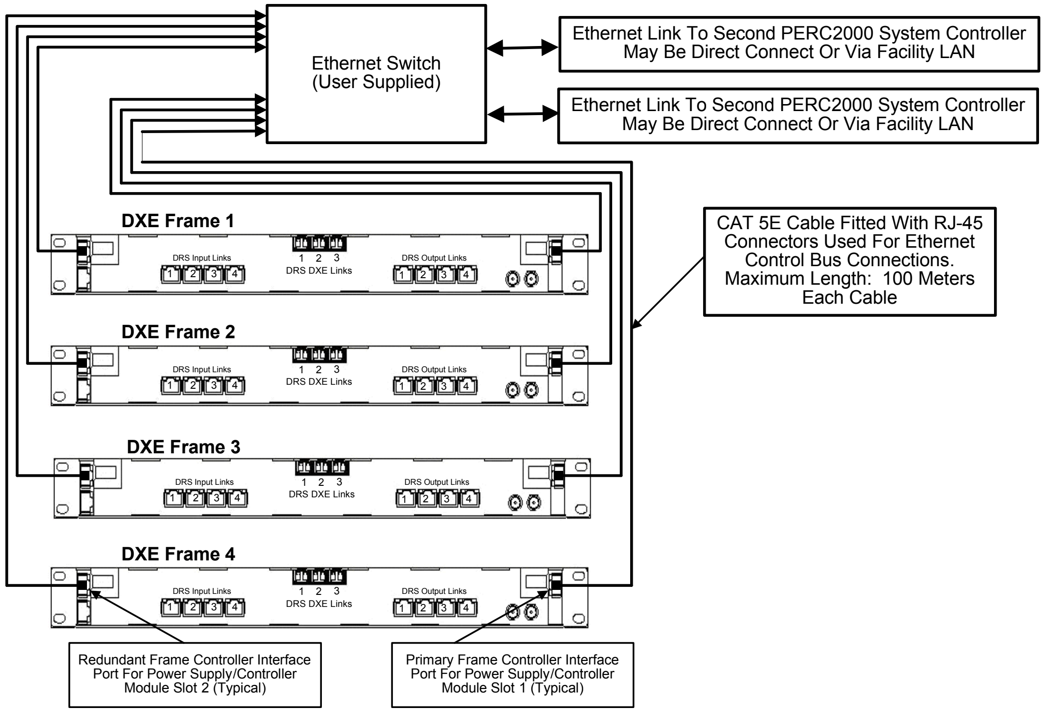


Figure 3-26 Control Cabling for Multiple DXE Fully Redundant, Dual Controller Module Installation

If there is only one P2K system controller CCA and two P1K modules in each DXE, the Ethernet cable from the Primary module slot connector on every DXE frame connects through an Ethernet switch to one link of another Ethernet switch. The cable from each Redundant module slot connector also attaches through an Ethernet switch to a second link on this additional Ethernet switch. This additional switch connects the two DRS control system buses to the single port of the P2K. While this option does not provide full redundancy, it still offers a redundant frame controller should one of the modules ever fail. This configuration is illustrated in Figure 3-27.

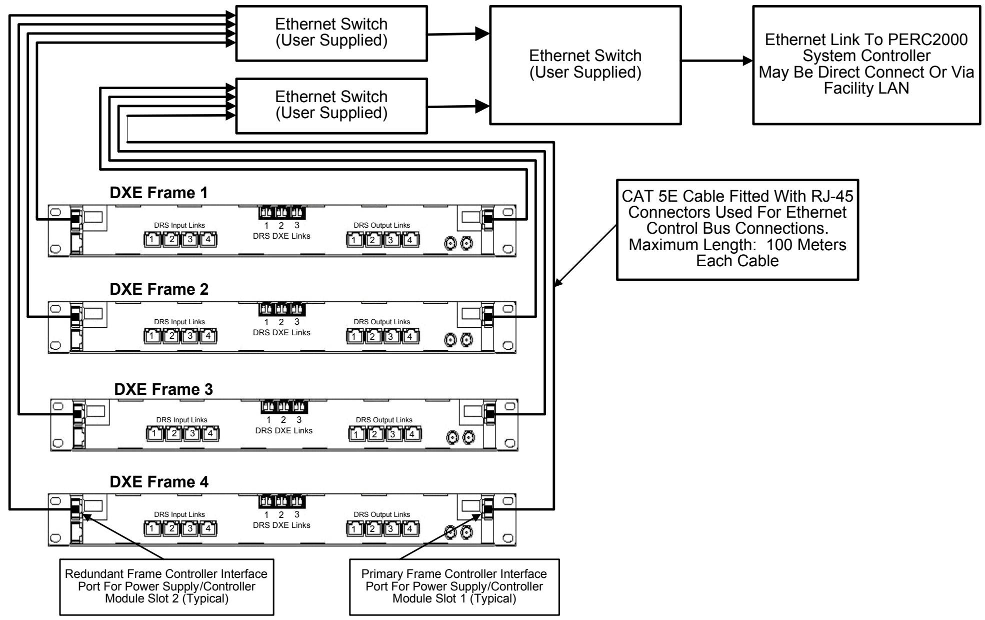


Figure 3-27 Control Cabling for Multiple DXE Redundant Frame Controller Module Installation

3.7 POWER CONNECTIONS

Power for all DRS system frames is derived from wall receptacles. No special direct wiring or heavy gauge wire is required for this equipment. There are two power connector access ports, one located on the upper left-hand side and the other on the upper right-hand side of the rear panel of each DRS frame, regardless of frame type. These ports allow access to the power receptacle on the power supply/controller module located in the slot associated with each. In a non-redundant power or control system, only one of the slots will have a power supply module installed. Attach the power cord through the proper access port to the receptacle on the power supply module. Each power supply carries its own dedicated power receptacle. Input power is not bussed between modules. When two power supplies are used (for redundancy) a separate power cord must be attached to each receptacle through its access port.

Each access port is equipped with a harness device for the input power cord that secures the cord to prevent accidentally disconnecting the frame from its power source. To use the harness, slip the groove on the power cord connector end horizontally into the opening of the harness. In planning your installation, consider the location of each DRS system frame and how to route and dress power cords from the power source to each frame.

Connecting the power cord to a source of power immediately applies power to the DRS frame. Do not apply power for the first time until all signal, intra-system, sync and control connections have been made and verified.

3.8 INITIAL POWER-UP

Before applying power to the DRS system for the first time, please take time to go back over your installation:

- Check for electrically sound connections, proper connector placement and possible wiring errors.
- Ensure that each DXE frame has a connection with a source of in-house sync reference and that each loop-through connector is either daisy-chained to the next unit in the chain, or is properly terminated into a 75Ohm load.
- Check that all logic cards and power supply/controller modules are securely installed in each system frame.
- Ensure that all RJ-45 connectors between frames and system controllers are in the proper mating receptacle and are securely snapped in place.
- Verify settings of the rotary configuration switches on each DXE mid-plane, refer to Paragraph 4-2 of this manual.

There are no power switches on the DRS frames and each frame is powered-up simply by connecting the main power cord to a source of primary power. Systems with redundant power supply/controller modules have two main power cords per frame, each of which must be connected to source of primary power.

- Apply power to all frames in the system.
- Wait a few seconds for each frame to perform processor boot-up, and observe status of the ERROR LED located on front edge of each logic card as shown by Figure 3-28.
- This LED will initially light upon application of power, but should extinguish after the on-board processor has completed start-up.
- Verify that the LED is off on all DRS frames.

Figure 3-28 ERROR LED Location

- Once the initial power-up procedure is completed on all frames, replace front panels on each frame by aligning front panel and tightening two thumbscrews, Figure 3-29.

Figure 3-29 Front Panel Replacement

Chapter 4 Operation

4.1 AN INTRODUCTION TO THE PERC CONTROL SYSTEM

All control and panel set-up operations for a DRS system are done through the Ethernet Routing Control (PERC) system which consists of the P1K Frame Controller circuitry co-resident on a Power Supply/PERC1000 Controller Module, and the P2K System Controller located external to the DRS router.

PERC2000 (P2K) is the name given collectively to a System Controller circuit card assembly (CCA), its associated board-resident firmware and a graphical user interface (GUI) application that resides and runs on a Microsoft Windows™ based PC platform. The System Controller CCA circuitry communicates bi-directionally with the P1K Frame Controller over a standard 10/100 Ethernet link. The Frame Controller portion of the system executes commands within the DRS frames, while the System Controller provides programming and interface functions to various types of control panels that may be used by facility operators to control the DRS router. Any DRS system must have the components of the P2K System Controller interfacing with the components of the P1K Frame Controller to effectively control the operation of the router.

Configuration, operation and monitoring functions of the DRS are all accomplished using tools of the P2K system controller. Refer to the system controller documentation for all aspects of system operation.

4.2 SETTING FRAME CONTROLLER IP ADDRESS AND DXE FRAME CONFIGURATION

Each DXE frame in a DRS system must be configured for the control system to identify its frame controller(s) and properly access its input and output channel assignments. In the PERC system, this is done by assigning the proper Internet Protocol (IP) Address to the each frame controller module using the rotary switch located on the frame mid-plane. Figure 4-1 illustrates the location of the rotary switch on the DXE mid-plane.

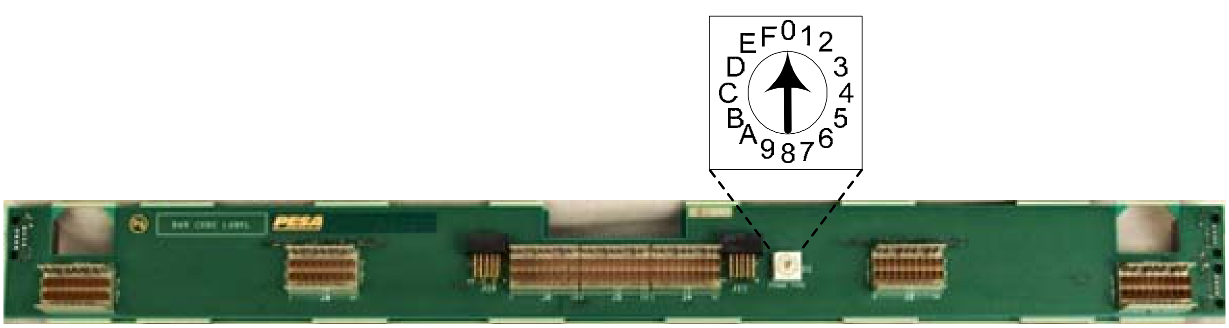


Figure 4-1 Rotary Switch Location – DXE Mid-Plane (Internal to Frame)

Three operational parameters for an individual DXE frame are determined by the setting of this switch:

DXE I/O Range - Assigns the input and output channels processed by an individual DXE.

Primary/Redundant DXE - Assigns Primary or Redundant status to an individual DXE.

IP Address - Assigns the IP Address to the Frame Controller Module(s) installed in each DXE. Notice from Table 4-1 the IP address assigned by each switch position to the various frame controller(s) is the Base IP Address incremented sequentially by a value of one in the fourth octet of the address.

Each P1K Module is factory configured to a Base IP Address of 192.168.1.200 and a Subnet Mask of 255.255.0.0. The actual IP Address used by an individual P1K module is determined by the Base IP Address, the position of the rotary switch in the DXE frame and the module slot within the DXE frame the P1K module occupies.

Table 4-1 identifies switch settings and the associated parameters.

Table 4-1 DXE Frame Configuration Settings

DXE Rotary Switch Setting	Primary/Redundant DXE	DXE I/O Range	IP Address Controller in Slot 1	IP Address Controller in Slot 2
0	Primary	1 – 512	192.168.1.201 (Base IP Address + 1)	192.168.1.202 (Base IP Address + 2)
1	Primary	513 – 1024	192.168.1.203 (Base IP Address + 3)	192.168.1.204 (Base IP Address + 4)
2	Primary	1025 – 1536	192.168.1.205 (Base IP Address + 5)	192.168.1.206 (Base IP Address + 6)
3	Primary	1537 - 2048	192.168.1.207 (Base IP Address + 7)	192.168.1.208 (Base IP Address + 8)
4	Redundant	1 – 512	192.168.1.209 (Base IP Address + 9)	192.168.1.210 (Base IP Address + 10)
5	Redundant	513 – 1024	192.168.1.211 (Base IP Address + 11)	192.168.1.212 (Base IP Address + 12)
6	Redundant	1025 – 1536	192.168.1.213 (Base IP Address + 13)	192.168.1.214 (Base IP Address + 14)
7	Redundant	1537 - 2048	192.168.1.215 (Base IP Address + 15)	192.168.1.216 (Base IP Address + 16)

- If you are configuring a 128X128, non-redundant system, the switch setting on the single DXE required for the configuration is Zero (0). This setting identifies the DXE as Primary with I/O channels 1-512. A single Power Supply/Frame Controller Module is installed in Slot 1 (Primary Controller). Assuming a base IP Address of 192.168.1.200, the IP Address for the frame controller is 192.168.1.201.

- If we add a second Frame Controller to slot 2 (Redundant Controller) to this frame, the IP Address assigned to this controller is 192.168.1.202.
- As a final example if add a second DXE frame to this configuration for system redundancy, the rotary switch setting for this second frame is Four (4) – Redundant DXE for I/O Channels 1 – 512. The IP Address of the primary controller is 192.168.1.209 and if a second controller (redundant slot) is added to this frame its IP Address is 192.168.1.210.

Follow these examples and Table 4-1 to determine the proper setting of all DXE frames in the system.

Before applying power to the system for the first time, QuStream recommends that you verify the setting of the rotary switch on every DXE frame used in the configuration.

4.3 CHANGING THE DEFAULT IP ADDRESS OF A FRAME CONTROLLER MODULE

In some applications it may be necessary to configure system Frame Controllers to an IP Address other than the factory assigned address. In order to change the base address used by the P1K Controller(s) you must first configure a PC to use an IP address and Subnet Mask that allows the PC to communicate with the controllers using their factory default IP Address. For Windows based computers this is accomplished using the “Network Connections” dialog box. Please contact your Network Administrator or other IT support personnel for detailed instructions on configuring the network interface on your PC. Since the default IP Addresses used by the P1K Controllers may already be used by other equipment on your network it may be necessary to setup a small isolated network segment separate from the facility network in order to change the initial P1K address settings.

The following steps outline the procedure for changing the Base IP Address of the P1K Modules:

1. Determine the Base IP Address and Subnet Mask that will be used for the P1K modules on your network. The IP assignments must come from the support personnel responsible for configuring and maintaining your network. Fully expanded systems require a Base IP Address plus a range of 16 additional IP Addresses beyond the base address.
2. Configure a PC to use an IP Address and Subnet Mask that is compatible with the default address used by the P1K Controllers.
3. If necessary, isolate the P1K Controllers and the PC from your main network and power-up the equipment.
4. Using the PC, establish a TelNet session with the first P1K Controller (Typical command line: telnet 192.168.1.201)
5. At the TelNet prompt, enter the command “pesa-ip”.
6. Each IP Address consists of four “octets” of digits separated by a period (dot). For example the factory default IP Address for the P1K is 192.168.1.200. The first octet is 192, the second is 168, the third is 1 and the fourth is 200. At the prompts enter the appropriate octet data of the IP Address you wish to assign to the P1K Module.
7. When the new address data is entered, close the TelNet window and re-boot the P1K Module.
8. Repeat Steps 4 thru 7 for each P1K a change of Default IP Address.

Chapter 5 Functional Description

5.1 AN INTRODUCTION TO MULTIPLEX DATA SYSTEMS

QuStream's Cheetah DRS Series Audio Router uses a time slice/multiplex serial data bus signal processing scheme. Very simplistically stated, in this processing method multiple signals from various sources are sampled and the data obtained from each is stored as a packet and formatted into a serial output stream (multiplex data bus). At the receiving end this "packetized" stream of data is read at the same clock rate as it was packaged, using a synchronized clock strobe, and the individual digital signals are reconstructed as they were at the source. For purposes of this text the data bus generation circuitry is referred to as the Bus Transmitter (XMTR), and the receiving circuitry is referred to as the Bus Receiver (RCVR). Multiplexed data bus systems are used in many applications requiring efficient transfer of large amounts of data.

Let's take a closer look at how multiplexing technology is applied to the Cheetah DRS Router. For a simplified explanation consider the most basic configuration as it would apply to a distributed routing system: a multiplex data system with two input channels and two output channels, 2x2, with the Bus XMTR circuitry located remotely from the Bus RCVR circuitry. For this example assume that both input signals are analog audio and that we wish to have the input point and output point separated by a distance of 30 meters. A top-level, simplified block diagram of this system is shown in Figure 5-1.

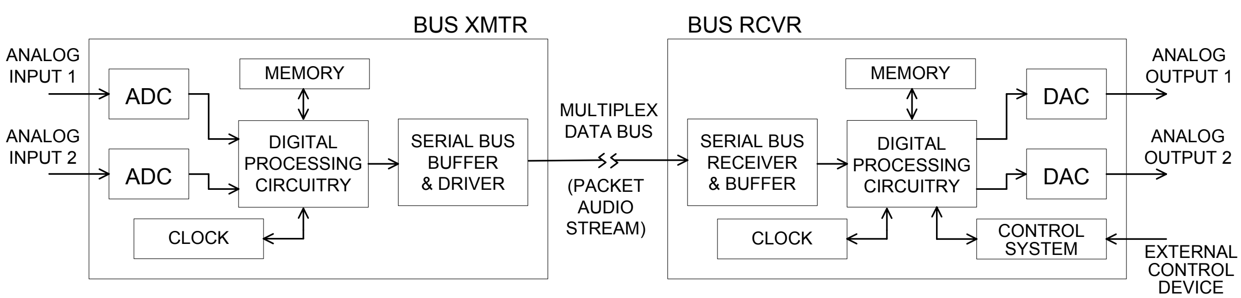


Figure 5-1 Simplified Block Diagram – 2x2 Multiplex Bus Router

Analog Inputs 1 and 2 are connected to the Bus XMTR circuitry, where the multiplex data bus is generated, and each is routed to an Analog-to-Digital Converter (ADC) device. The output of each ADC is a digital translation of the analog input that is routed to the Digital Processing Circuitry. This circuitry sequentially "reads" or samples the data of each input at a rate determined by the system Clock. Real-time instances of the data sample words are stored in Memory. Additional processing circuitry takes the data words stored in memory and sequentially writes these words, as data packets, into a serial data stream containing all the samples of inputs 1 and 2, plus necessary control data for clock synchronization and other housekeeping operations. This data stream (Multiplex Data Bus) is routed to the Serial Bus Buffer and Driver circuitry where it is level shifted and fed through a driver to the outside world.

A low-loss cable (In our example a 30 meter cable) routes the multiplex data bus from the Bus XMTR to the Bus RCVR. At the receiver, bus data enters the Serial Bus Receiver and Buffer circuitry where it is level shifted, buffered and conditioned for use by the Digital Processing Circuitry. Using control data packets embedded in the multiplex data stream for clock synchronization and other functions, the processing circuitry "disassembles" the data stream, extracts the data words (samples) for inputs 1 and 2, and stores each sample in Memory. For purposes of this simple example consider that data for each input is stored in a memory location dedicated to that input, in this example, of course, input 1 and 2.

In order for our simple 2X2 router to be of any use, we have to be able to access either input signal (1 or 2) at either output connector (1 or 2) and be able to specify which input signal we want on each output connection by some External Control Device. To do this it is necessary to "build," as directed by commands from the control system, a data stream for each output channel containing only the data words, in the exact order, as the original input signal selected as the channel output. This is done by a portion of the processing circuitry that "reads" the memory location corresponding to a particular input channel and processes the data bits into a serial stream containing only the sampled data for that input channel.

In our example, suppose we want to route input 1 to output 1. The external control device allows us to assign input signals to specific output paths, in this case input 1 to output 1, and it in turn issues the command to Control System circuitry within the Bus RCVR. On receipt of our command, processing circuitry for output 1 reads the sample data in the memory location associated with input 1 at the proper refresh rate and reconstructs the digital data translation of analog input 1. The digital data stream is routed through a Digital-to-Analog Converter (DAC) device and an exact reproduction of analog input 1 is available at output channel 1. If we want input 1 available simultaneously at outputs 1 and 2, processing circuitry for both output channels (1 and 2) read sample data from the memory location associated with input channel 1. Both data streams are converted to analog outputs by the DAC device for the respective output channel, and analog input 1 is available at both router output channels. By this same method, in order to route input 2 to output 1, the processing circuitry associated with output 1 would read the data for input 2 from its memory location. This data would be converted by the output channel 1 DAC and be available for use at the channel 1output connector.

This is a greatly simplified tutorial to the basic idea behind a multiplex data transfer system. In reality, the multiplex data stream is usually bidirectional and there are many other communication and control activities occurring between the processing devices per the transmission protocol. However, this explanation provides the user who may not be familiar with a multiplex system a basic understanding of how a multiplex router gets signals from one place to another. You can easily see how this system can be expanded beyond two inputs and two outputs. Since the "packetized" multiplex data bus from the input circuitry (Bus XMTR) contains data samples for all input channels, any output channel on the Bus RCVR may provide a reconstruction of any input signal by reading the appropriate memory location and processing the data back to a usable audio signal. Expanding the number of input channels and output channels allows a very efficient and flexible signal routing system to be implemented.

5.2 THE CHEETAH DRS ROUTER

Relating this routing concept to the Cheetah DRS Router, think of the Bus XMTR as an Input Frame, the Bus RCVR as an Output Frame, the System Control function as the P1K Frame Controller located in the DXE Frame and the External Control Device as the P2K System Controller. Instead of two input channels and two output channels, each frame can process up to 128 channels. In the DRS application, the multiplex data bus is referred to as the Packet Audio Stream Bus, or simply PAS Bus. A simplified, top-level block diagram of a 128 X 128 router is shown in Figure 5-2.

Think of a DXE simplistically as a data router. In the configuration of a basic 128X128 system the DXE receives the "packetized" audio stream from the input frame through a Serial Bus Receiver and Buffer which level shifts and conditions incoming data for use by the processing circuitry. Data from the input frame is read by the Digital Processing Circuitry where it is "disassembled" and the data packets (samples) for all 128 inputs are extracted and stored in Memory.

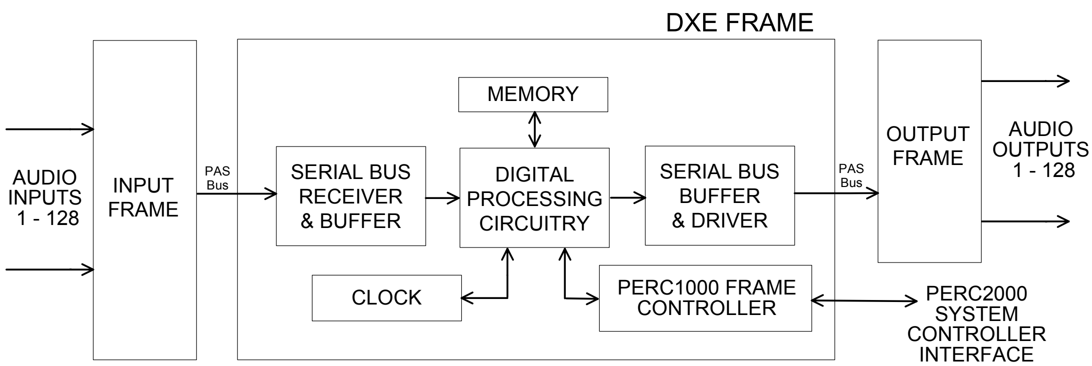


Figure 5-2 Simplified Block Diagram – 128X128 DRS System

For a useable router, we have to be able to access any input signal (1 thru 128) at any output frame connector (1 thru 128) and be able to specify which input signal we want on each output connection by some control scheme. In the case of the DRS, this is the P1K Frame Controller and the P2K System Controller. Under software control, the DXE processing circuitry generates the packet audio stream received by the Output Frame. This data stream contains the data packets necessary to reconstruct the input signals which are assigned to be available at the output connectors of the output frame. PAS bus data to the output frame is "built" as directed by commands from the Control System. Prior to leaving the DXE the data stream (Packet Audio Stream) is routed to the Serial Bus Buffer and Driver circuitry where it is level shifted and fed through a driver to the system output frame.

When PAS data is received by the output frame the signal is buffered and processed in a manner similar to our simple 2 X 2 example. Under software control, the data packets received from the DXE are disassembled and the data stored in memory. Processing circuitry within the output frame retrieves the data specified for a given output channel and reconstructs the original input signal.

A simplified block diagram of a 512 X 512 single DXE expanded system is shown in Figure 5-3. Each of the four Input Frames generates a "packetized" audio stream of the inputs connected to it. In other words, the data stream from frame 1 contains data for inputs 1 – 128, the stream from frame 2 contains data for input 129 – 256, etc. All of the input streams are received by the DXE. In a manner similar to a 128 X 128 system, incoming data from all four input frames is read by DXE processing circuitry where the data is "disassembled" and data packets (samples) for all 512 input signals are extracted and stored in Memory.

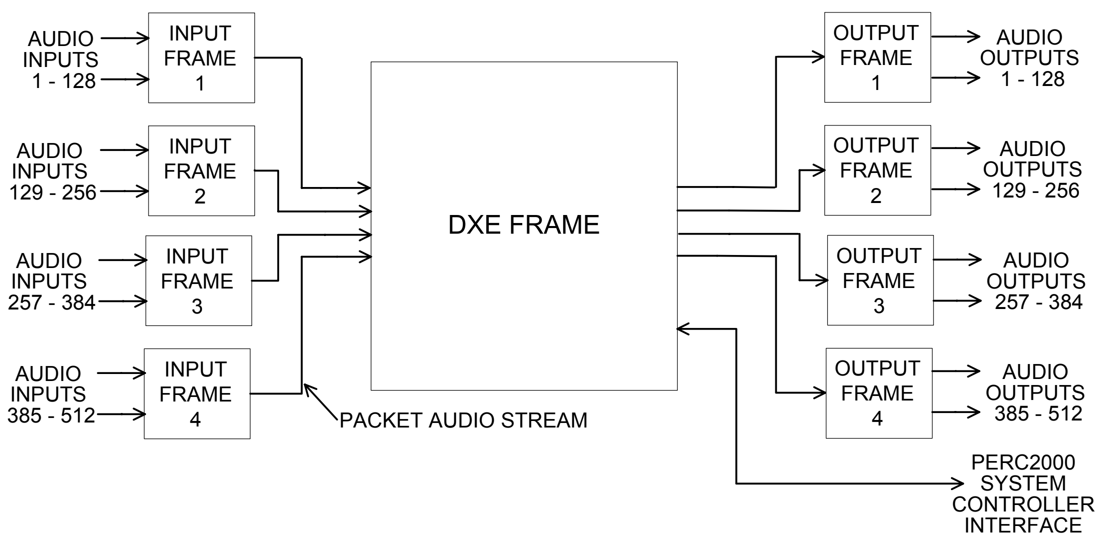


Figure 5-3 Simplified Block Diagram – Expanded DRS System

In an expanded system, we have to be able to access any input signal (1 thru 512) at any output connector (1 thru 512) and be able to specify which input signal we want on each output connection. Under software control, the DXE processing circuitry generates four packet audio stream outputs – one dedicated for each Output Frame in the system. Each data stream contains the data packets necessary to reconstruct the input signals which are assigned to be available at the output connectors of the respective output frame. Each output PAS is "built" as directed by commands from the System Controller, in the same manner as discussed for a single output frame – only on a much larger scale. Each data stream (Packet Audio Stream) is routed to its respective output frame where the data stream is reconstructed into individual output signals.

When multiple DXE frames are used (up to four), the operational theory is the same as just presented for a single DXE system, again – just on a larger scale. In operation, each DXE makes its 512 input signals available to all other DXE frames in the system by fiber optic links. Under software control, data streams are constructed by each DXE with the data packets required by the other DXE frames to service the output channels supported by each.

Again, the DRS user should be aware that the text just presented is a simplified, basic level tutorial of what occurs in a DRS installation, and is presented only as an overview of the system to acquaint the user with the concepts of multiplex routing and how it is implemented by the Cheetah DRS Router.

5.3 DRS SYSTEM COMPONENTS

A brief discussion of the function of each circuit card assembly (CCA) and module available in the DRS system architecture is presented in the following paragraphs.

5.3.1 INPUT AND OUTPUT BACKPLANES

Audio signals enter the DRS Router through any of four distinct backplane assemblies fitted to Input Frames, and exit the router through backplane assemblies fitted to Output Frames. Backplanes used for both input and output frames are identical, and the type used is determined by the input signal characteristics and, possibly, existing cabling which may be present in the facility. Nomenclature of each backplane is determined by the type of signal connector it supports. Backplane types may be mixed within systems, but only one type is possible for each input or output frame. Note also that the loop-thru BNC connectors for connecting the frame to a synchronization reference source are located on the backplane. Table 5-1 identifies the connector types available, and the mating signal characteristics of each. Figure 5-4 illustrates each of the backplane types. There are no active components on any of the backplane assemblies.

Table 5-1 I/O Backplane Types

Backplane Nomenclature	Connector Type	Signal Characteristics
BNC Connector Backplane	BNC Connectors	AES Unbalanced Audio, 75 Ohm
ELCO Connector Backplane	ELCO/EDAC 120 Pin Block Connector	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
DB50 Connector Backplane	50 Pin “D” Connectors	AES Balanced Audio, 110 Ohm or Analog Balanced Audio
6-Pin Connector Backplane	Weidmuller 6-Pin Detachable	AES Balanced Audio, 110 Ohm or Analog Balanced Audio

5.3.2 INPUT AND OUTPUT MID-PLANES

Each input and output frame is fitted with a mid-plane assembly, which is one of two possible types. Each mid-plane is fitted with connectors on both sides of a printed circuit (PC) assembly. There are no active components on either mid-plane, and the purpose of the assembly is to route signals between the backplane, logic card and controller card(s) (fan controller or frame controller); and power from the power supply module(s) to the logic card. In addition, the RJ-45 PAS Bus and Ethernet connectors are located on the mid-plane. The type of mid-plane used in a particular input or output frame is determined by the type of backplane used and has no relevance on the operation of the frame. The difference between the two mid-planes is solely internal connector placement. There are no user serviceable components on the mid-plane assembly. A sixteen position rotary switch is mounted to the logic card side of each mid-plane assembly. This switch is for possible future product implementations and is not used in the DRS application. Setting position of this switch has no effect on DRS system operation.

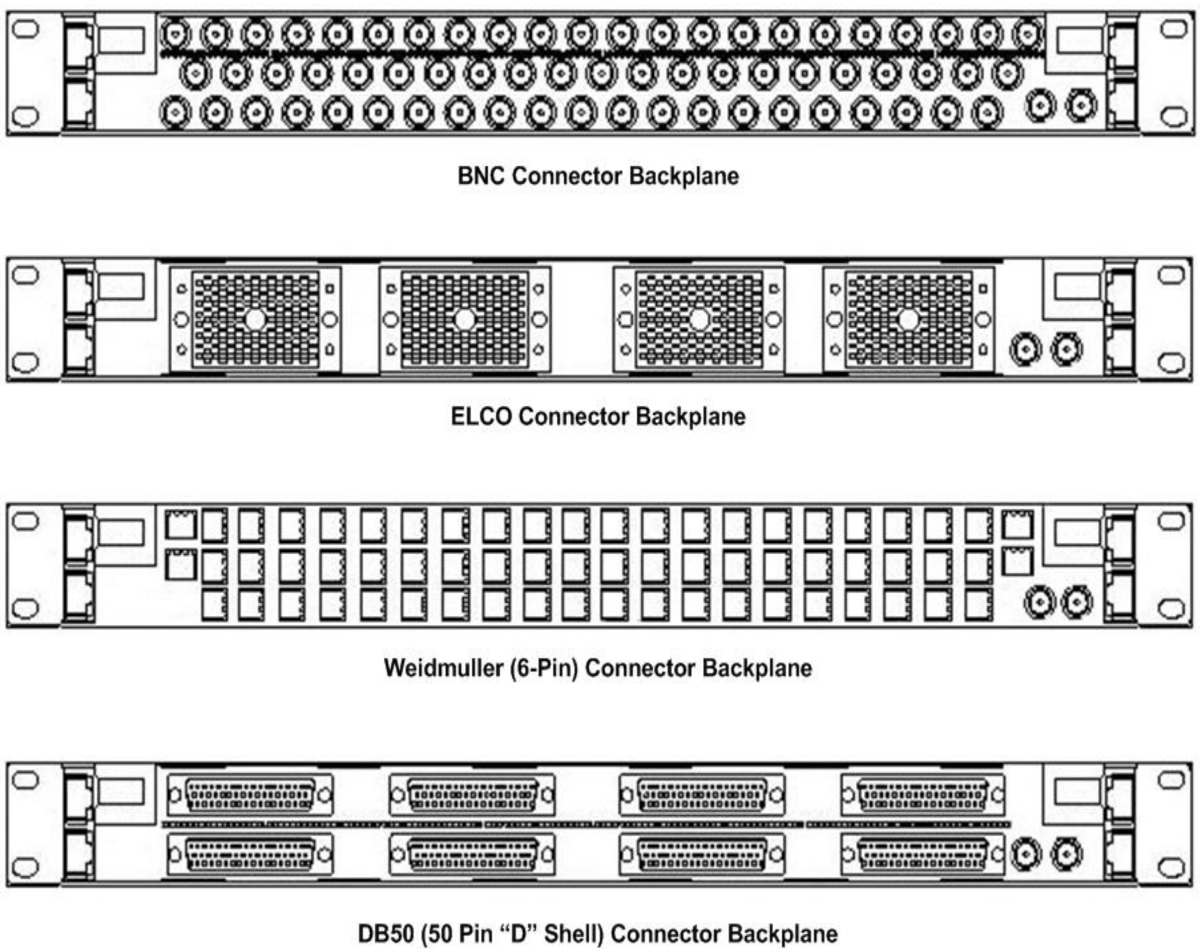


Figure 5-4 I/O Backplane Assemblies

5.3.3 INPUT AND OUTPUT LOGIC CIRCUIT CARD ASSEMBLIES

With the exception of the power supply and the frame or fan controller, all remaining active circuitry for the frame is contained on the logic CCA. There are two types of cards, Analog and AES (digital), for both input frames and output frames, for a total of four different logic cards. The logic card used in a particular frame is totally dependent on the type of input or output signal the frame is processing. All data processing circuitry, signal buffers and bus interface components are contained on the logic card. Analog Logic cards contain all the circuitry mentioned above, plus the Analog-to-Digital Converters (input card) or Digital-to-Analog Converters (output card) for implementing the analog to digital (or digital to analog) signal conversion.

AES Digital Input Logic CCA

Remember that each AES digital input source actually contains a pair of audio signals, therefore the full 128 signal channel capacity of the DRS frame is realized with 64 AES input sources. All input frame backplanes, with the exception of the BNC backplane, provide 128 physical input connections. When connecting AES digital audio sources to the router, this equates to two physical connection points for each audio input source, only one of which is used. One input allows sources to be AC coupled to the router inputs and the other allows sources to be DC coupled. In the case of the BNC backplane, all inputs are AC coupled to the router circuitry.

Figure 5-5 presents a block diagram of the input logic card for AES digital audio sources. You will notice that the input channel circuitry is shown as four blocks of 16 inputs – for a total of 64 digital audio input channels or 128 digital audio signals. Each block functions identically, but is shown in the diagram as a separate circuit element because there are actually four individual FPGA devices which process 16 input channels each. Each of the 16 paths in each block also functions identically. For simplicity consider input channel 1.

AES compliant digital audio from an external source enters the CCA through one of two possible rear panel input connections providing either AC signal coupling or DC signal coupling. If AC coupling is desired, incoming audio is coupled through a pair of isolation capacitors to the Input Buffer amplifier. If the incoming audio signal is attached to the DC coupling connection, it is applied directly to the buffer input. From the buffer the audio signal sampling data rate is detected by logic circuitry within the FPGA and the audio signal is routed to the input of a Sample Rate Converter device. Clocking and control signals are generated by the logic circuitry and passed to the sample rate converter. The clocking signals allow the converter devices to adjust audio samples to a common clock rate prior to entering the Processing Circuitry. Processing logic within the FPGA device accepts 16 input sources and generates a single data stream containing samples of all input signals. All 64 input channel paths and four processing logic devices operate in this same manner.

Data from each of the four processors is received by the inputs of an Audio Multiplexer device. This device, under control of the Digital Processing Circuitry sequentially routes the four serial data streams to the processing logic circuitry. Here the audio data, along with other control and synchronization words are “packetized” into a single serial output data stream, the Packet Audio Stream. This serial data stream is routed to a pair of Ethernet Transceiver devices. These devices convert the serial data into protocol standard gigabit Ethernet signals. Two bus connections are provided for redundant system operation, if desired.

A Data Transceiver device on-board the input logic card provides the electrical interface with the controller circuitry located on the Power Supply/Controller Module(s) in the frame. This bi-directional data link allows power supply health and status data to be passed between the logic CCA and the controller module. On-board Visual Status LEDs provide the user a quick status check of CCA functionality.

On-board voltage regulation and monitoring circuitry provides power for all circuit elements and reports power faults or errors to the digital processing circuitry. The Hot Swap Controller allows the logic card to be removed and replaced with the frame in a power-up condition without damage.

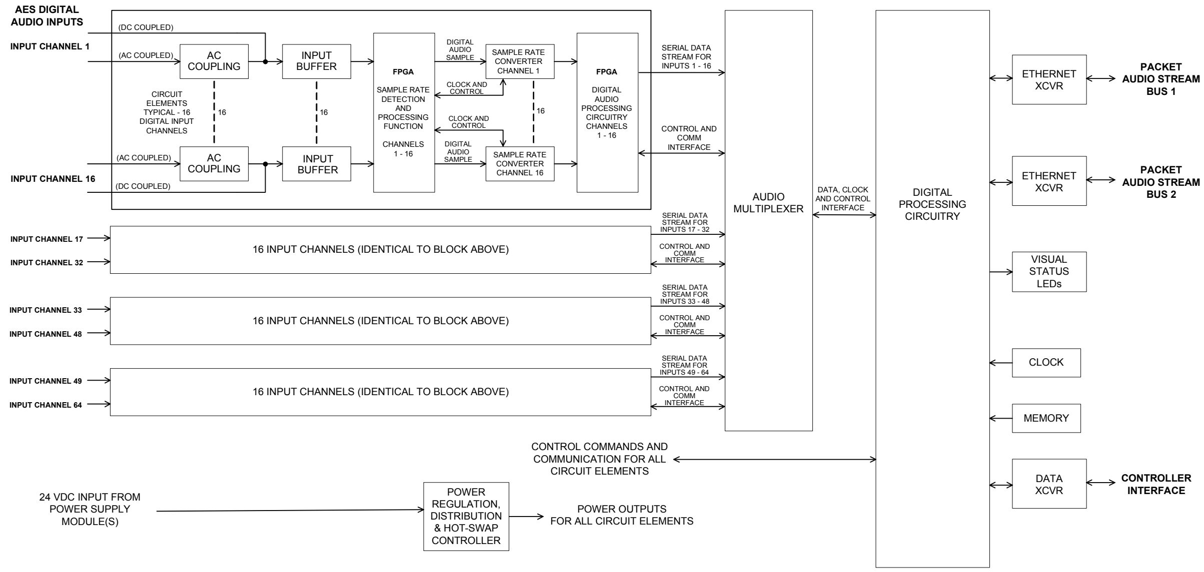


Figure 5-5 Block Diagram - AES Digital Input Logic CCA

AES Digital Output Logic CCA

Figure 5-6 presents a block diagram of the output logic card for AES digital audio signals. Multiplex data (Packet Audio Stream) enters the CCA through a pair of gigabit Ethernet Transceiver devices. Two devices are provided for redundancy – both are identical and, in the case of a non-redundant installation, either may be used for system interconnection with an input frame or a DXE frame. The packet audio stream (PAS) is a high-speed serial data bus containing audio data and control data "packetized" into a single serial output data stream. The serial data output stream from the Ethernet transceiver(s) is routed to the Digital Processing circuitry where the data packets are "disassembled" into the original audio and control words. These are stored in memory for retrieval by the Audio De-Multiplexer device.

Just as with the input logic card, the audio processing circuitry is divided into four blocks of 16 data paths for a total of 64 audio paths. Four FPGA devices process 16 output channels each. Each FPGA block and path within each block is identical. For simplicity we will discuss output channel 1.

Serial data containing the words for output channel 1 are received by the proper FPGA processing device by way of the audio de-multiplexer. Additional control and communication signals are also received by the FPGA. Audio data and control signals allow the FPGA processing circuitry to reconstruct the audio signal data for output channel 1. This signal is routed through an Output Driver to one of two possible output paths allowing either AC coupling or DC coupling of the output signal to equipment external to the DRS router.

Remember that each AES digital output actually contains a pair of audio signals, therefore the full 128 signal capacity of the DRS frame is realized with 64 AES output channels. All output frame backplanes, with the exception of the BNC backplane, provide 128 physical input connections. When connecting interfacing cabling to AES digital audio output channels from the router, this equates to two physical connection points for each output source. If AC coupling is desired, output audio is coupled through a pair of isolation capacitors to the proper connector pins for Output 1 – AC Coupled on the rear panel of the output frame. The DC coupled output signal bypasses the coupling capacitors and is attached directly to the pins for Output 1 – DC Coupled on the rear panel output connector. In the case of the BNC backplane, all output sources are AC coupled to external circuitry.

A Data Transceiver device on-board the output logic card provides the electrical interface with the controller circuitry located on the Power Supply/Controller Module(s) in the frame. This bi-directional data link allows power supply health and status data to be passed between the logic CCA and the controller module. On-board Visual Status LEDs provide the user a quick status check of CCA functionality.

On-board voltage regulation and monitoring circuitry provides power for all circuit elements and reports any power faults or errors to the digital processing circuitry. The Hot Swap Controller allows the logic card to be removed and replaced with the frame in a power-up condition without damage.

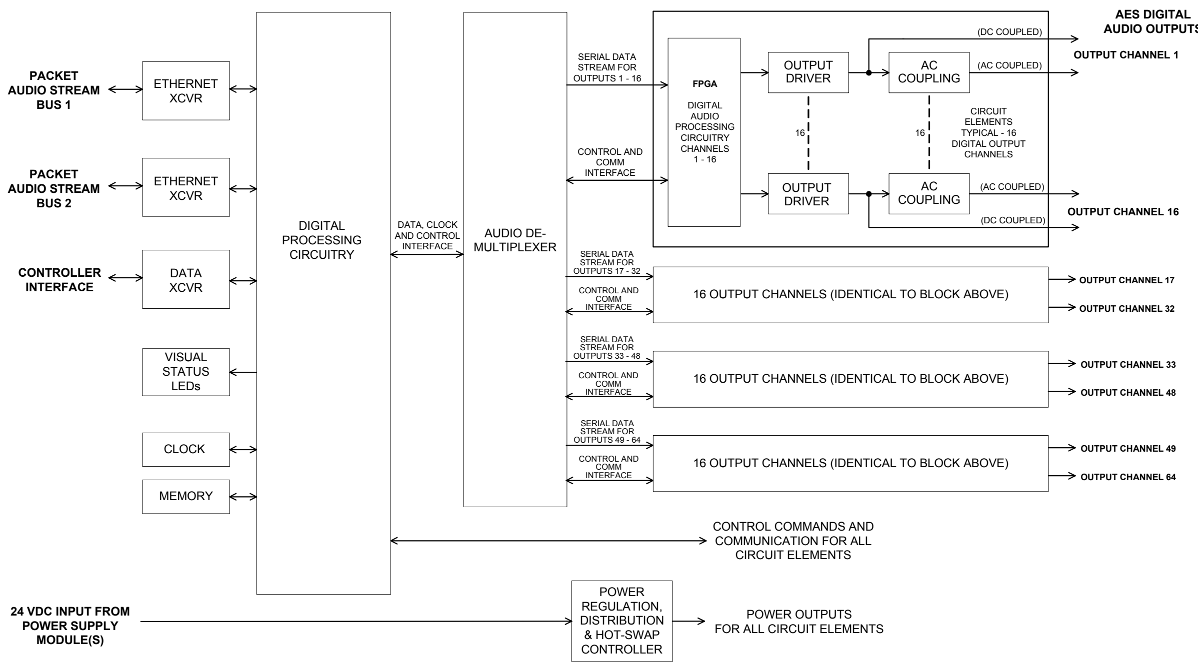


Figure 5-6 Block Diagram - AES Digital Output Logic CCA

Analog Input Logic CCA

All input frame backplanes for analog sources provide 128 physical input connections – one for each source. Figure 5-7 presents a block diagram of the input logic card for analog audio sources. Notice that the input channel circuitry is shown as four blocks of 32 inputs – for a total of 128 analog audio input signals. Each 32 input block functions identically, but is shown in the diagram as a separate circuit element because each block contains a dedicated FPGA device for processing its 32 input channels. Each 32 input block is further broken down into four sub-blocks. Each sub-block provides eight analog input paths and contains an eight-input analog-to-digital converter (ADC) device to process its eight input signals. Each eight-input sub-block functions identically and each signal path within a sub-block functions identically. For simplicity we will consider input channel 1.

Analog audio from an external source enters the CCA by way of the backplane connectors and is applied directly to an Input Buffer stage. From the buffer the signal passes to a Signal Attenuator Selector. This circuit selects the amount of attenuation applied to the signal based on control data received from processing logic. The audio signal is once again passed through a Buffer stage prior to entering an eight-input ADC device. The ADC sequentially converts the analog data present at its inputs into a serial digital data stream. Clocking and control data for the ADC is received from the FPGA processing circuitry. The ADC device also generates a control signal which adjusts the DC offset applied to the analog audio by the buffer. Serial data from the ADC device is routed to one of four signal processing paths of the Digital Audio Processing Circuitry for Channels 1 – 32. In our example, the digital interpretation of analog input 1 is contained in the data stream produced by the ADC device processing input signals 1 thru 8. This serial data stream, along with the data stream of the other three ADC devices (channels 9 thru 16, 17 thru 24 and 25 thru 32), is received by the FPGA for channels 1 thru 32. Processing logic within the FPGA device accepts the four data streams and generates a single data stream containing samples of all the input channels for the 32 input block – for our example channels 1 thru 32. All 128 input channel paths and four processing logic devices operate in this same manner.

Data from each of the four processors is received by the inputs of an Audio Multiplexer device. This device, under control of the Digital Processing Circuitry sequentially routes the four data streams to the processing logic circuitry. Here the audio data, along with other control and synchronization words are "packetized" into a single serial output data stream, the Packet Audio Stream, and routed to a pair of Ethernet Transceiver devices. These devices convert the serial data into protocol standard gigabit Ethernet signals. Two bus connections are provided for redundant system operation, if desired.

A Data Transceiver device on-board the input logic card provides the electrical interface with the controller circuitry located on the Power Supply/Controller Module(s) in the frame. This bi-directional data link allows power supply health and status data to be passed between the logic CCA and the controller module. On-board Visual Status LEDs provide the user a quick status check of CCA functionality.

On-board voltage regulation and monitoring circuitry provides power for all circuit elements and reports any power faults or errors to the digital processing circuitry. The Hot Swap Controller allows the logic card to be removed and replaced with the frame in a power-up condition without damage.

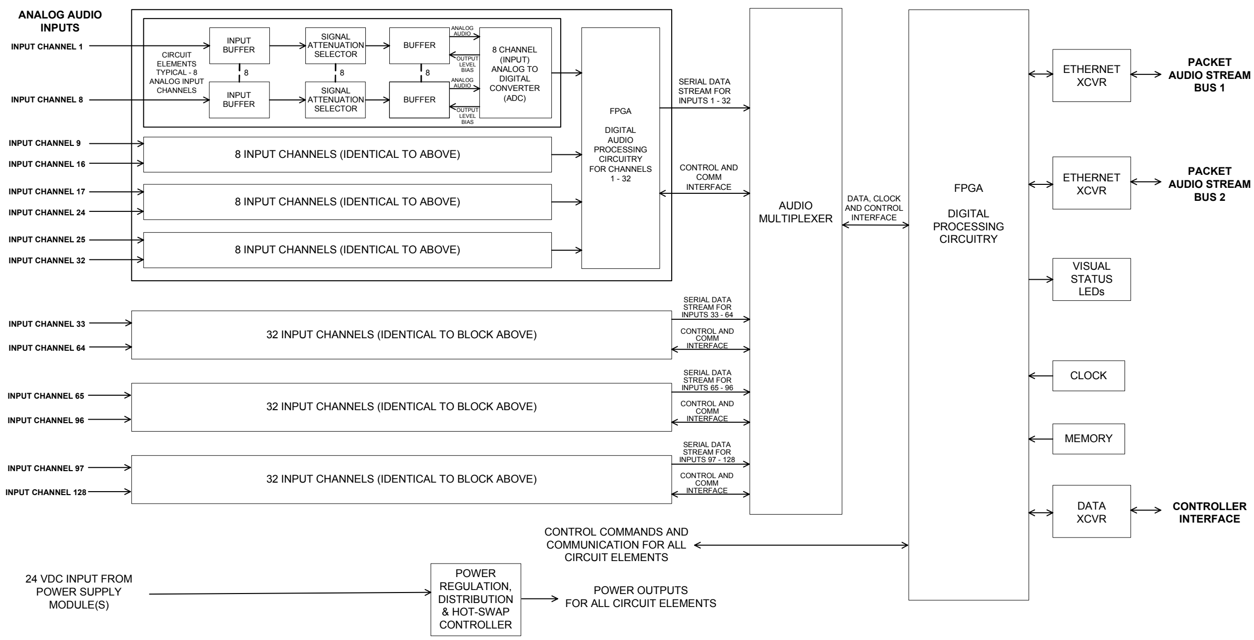


Figure 5-7 Block Diagram - Analog Input Logic CCA

Analog Output Logic CCA

Figure 5-8 presents a block diagram of the output logic card for analog audio signals. Multiplex data (Packet Audio Stream) enters the CCA through a pair of gigabit Ethernet Transceiver devices. Two devices are provided for redundancy – both are identical and, in the case of a non-redundant installation, either may be used for system interconnection with an input frame or a DXE frame. The packet audio stream (PAS) is a high-speed serial data bus containing audio data and control data “packetized” into a single serial output data stream. The serial data output stream from the Ethernet transceiver(s) is routed to the Digital Processing Circuitry where the data data packets are “disassembled” into the original audio data and control words. These are stored in Memory for retrieval by the Audio De-Multiplexer device.

Just as with the input logic card, the audio processing circuitry is divided into four blocks of 32 signal paths for a total of 128 audio paths. Each 32 output signal block functions identically, but is shown as a separate circuit element because each block contains a dedicated FPGA device for processing its 32 output channels. Notice also that each 32 output block is further broken down into four sub-blocks. Each sub-block provides eight analog output paths and contains an eight-output digital-to-analog converter (DAC) device to generate its eight analog output signals. Each eight-output sub-block functions identically and each signal path within a sub-block functions identically. For simplicity we will trace and discuss output channel 1.

Data containing the digital words for output signals 1 thru 32 is received by the proper FPGA processing device by way of the audio de-multiplexer. The audio de-multiplexer receives the data stream from the processing circuitry containing data for all 128 audio output signals and, under control of the processing logic circuitry, produces four data output streams, each containing data for 32 sequential audio output signals. Data containing the proper audio and control data for each 32 output signal block is received by the FPGA device associated with that block.

For our example of output channel 1, the data stream from the de-multiplexer containing data for analog signals 1 thru 32 is received by the FPGA device associated with the 32 signal block for output channels 1 thru 32. Four serial data streams, each containing data for eight audio signals, are concurrently generated by the FPGA associated with the signal block and routed to the four sub-blocks. Again using our example of output channel 1, the FPGA device for output channels 1 thru 32 would generate four data streams, one of which would contain data for audio signals 1 thru 8. This serial data is received by the eight-output digital-to-analog converter (DAC) device associated with analog output channels 1 thru 8. The remaining three data streams from the FPGA device contain, respectively, data for output channels 9 thru 16, 17 thru 24 and 25 thru 32 and are routed to the DAC device associated with the analog output circuitry for these output channels.

Each DAC device receives serial digital data from the FPGA and by processing the data produces eight analog audio signals that feed eight identical audio processing paths. Analog audio from the DAC device is passed through a Buffer amplifier to a Signal Attenuator. This circuit selects the amount of attenuation applied to the signal based on control data received from processing logic. From the attenuator, the analog audio signal enters an Output Driver stage where the gain is set for distribution to external sources.

A Data Transceiver device on-board the output logic CCA provides electrical interface with the controller circuitry located on the Power Supply/Controller Module(s) in the frame. This bi-directional data link allows power supply health and status data to be passed between the logic CCA and the controller module. On-board Visual Status LEDs provide the user a quick status check of CCA functionality.

On-board voltage regulation and monitoring circuitry provides power for all circuit elements and reports any power faults or errors to the digital processing circuitry. The Hot Swap Controller allows the logic card to be removed and replaced with the frame in a power-up condition without damage.

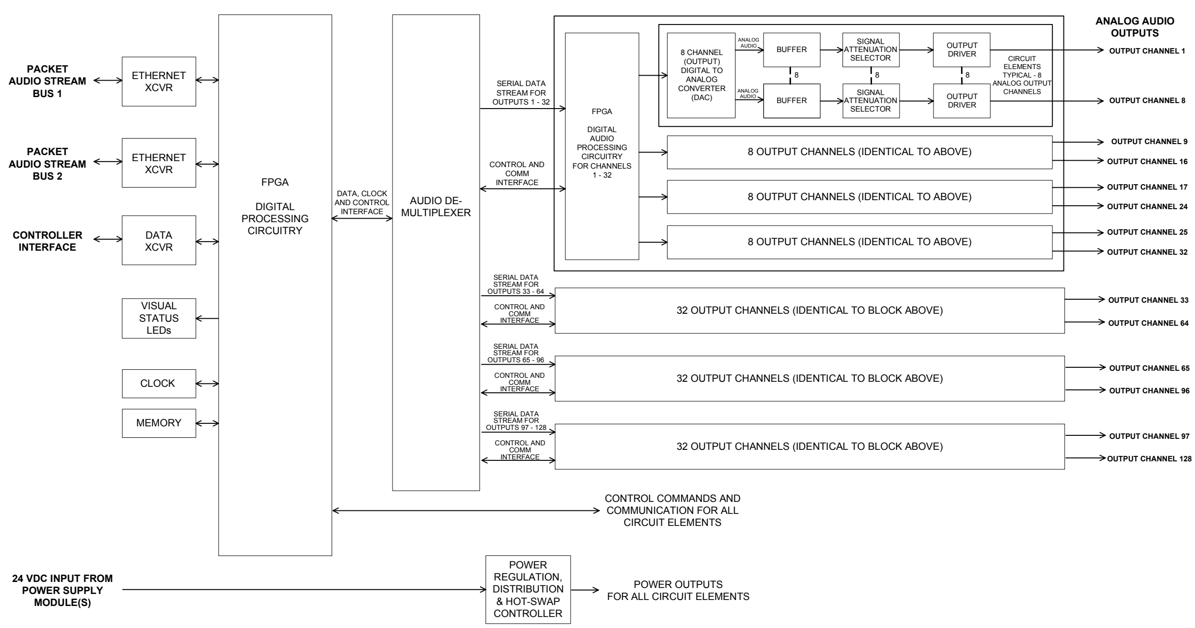


Figure 5-8 Block Diagram - Analog Output Logic CCA

5.3.4 DATA EXCHANGE ENGINE (DXE) BACKPLANE AND MID-PLANE

Expanded system interconnects between input frames, output frames and other DXE frames are made through connectors on the DXE Backplane and Mid-plane. The Backplane Assembly provides all connectors needed for interconnects between input frames (J1 thru J4), output frames (J5 thru J8) and a pair of loop-thru sync reference input BNC connectors (J113 and J114). A second set of BNC connectors (J115 and J116) are also mounted on the DXE backplane. These connectors are for possible future product implementations and are not used in the DRS application covered by this documentation.

The mid-plane routes signals between the backplane and the logic card as well as power rails and control signals between the power supply/controller module and the logic card. There are no active components on the mid-plane, and the only function of interest to the user is a rotary switch used to select configuration parameters for the system. Switch location is shown in Figure 5-9. System configuration and switch settings are discussed in Chapter 3 of this manual. In any application using a DXE the frame controller circuitry for the entire system is resident on the power supply/controller module(s) in the DXE Frame(s). Control data is passed between the DXE and the I/O frames over the PAS bus.

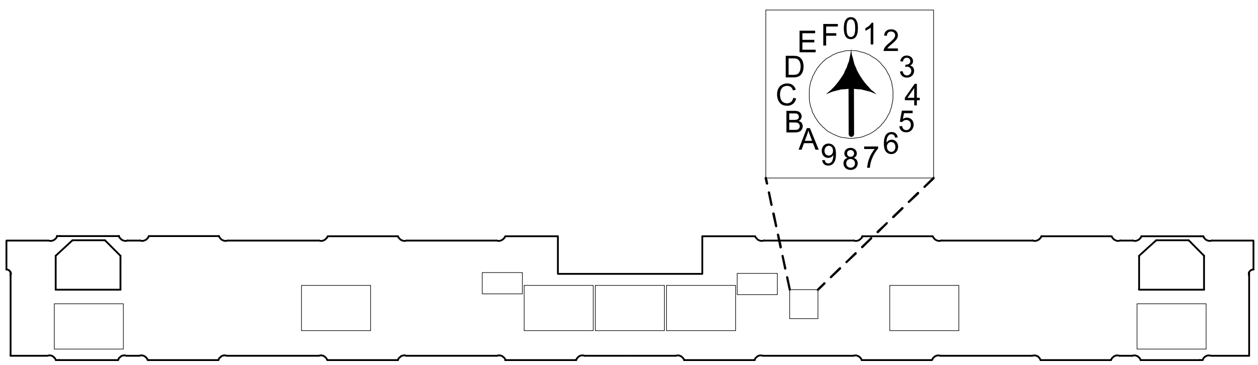


Figure 5-9 Rotary Switch Location – DXE Mid-Plane (Internal to Frame)

5.3.5 DATA EXCHANGE ENGINE (DXE) LOGIC CIRCUIT CARD ASSEMBLY

Figure 5-10 presents a block diagram of the DXE logic card. Basically, this card contains high-speed circuitry to process and distribute large amounts of digital data.

Multiplex data (Packet Audio Stream) from each Input Frame in the system (4 maximum) enters the DXE circuitry through one of four Ethernet Transceiver devices. Input frames must be connected to the DXE in numerical sequence such that the PAS containing audio channels 1 – 128 connects through Ethernet transceiver 1 (rear panel J1), the PAS containing audio channels 129 – 256 connects through Ethernet transceiver 2 (rear panel J2), etc. Each transceiver accepts the gigabit Ethernet protocol data bus and provides an output of data to the FPGA logic circuitry. Under command of the digital processing circuitry, the FPGA concurrently reads the four data buses, processes and stores data for the 512 audio input signals.

Audio signals extracted from the input frame packet audio streams are processed and "packetized" to derive up to 4 packet audio streams for the system Output Frames. Logic circuitry "builds" the data streams to contain the input audio signals and control data to be routed to the proper output frame(s). Each data stream is passed from the FPGA logic circuitry to an Ethernet Transceiver device. Each transceiver converts data present at its input into protocol standard gigabit Ethernet signals which interconnect the system output frames to the DXE. Output frames must be connected to the DXE in numerical sequence such that the PAS containing audio channels 1 – 128 connects through Ethernet transceiver 5 (rear panel J5), the PAS containing audio channels 129 – 256 connects through Ethernet transceiver 6 (rear panel J6), etc.

Two Data Transceiver devices on-board the DXE logic card provide electrical interface with Frame Controller circuitry located on the Power Supply/Controller Module(s) in the frame. This bi-directional data link allows control and timing data to pass between the on-board circuitry and the frame controller(s). If only one frame controller is present in the DXE frame, only the data transceiver associated with the active frame controller slot is active. A push-button switch, denoted on the diagram as the Controller Selector Switch, is located on the front edge of the DXE logic card and is accessible with the front cover of the DRS removed. If two frame controllers are used in the frame for redundancy, pressing this switch will toggle the active controller between the two. A pair of LEDs located near the switch, provide a visual indication of the active controller module. There are some additional Visual Status LEDs that provide the user a quick status check of the health of both the FPGA logic circuitry and on-board operating voltages.

In a manner very similar to the logic circuitry in an individual DXE frame processing serial data streams from and to the input and output frames attached directly to it, logic circuitry in every frame must also process a very high-speed bidirectional data bus, referred to as a DXE Link, from every other DXE frame in an expanded system. Each DXE Link carries all local inputs from one DXE to all other DXE frames. This allows every DXE frame to share inputs with all other DXE frames.

Consider two DXE frames communicating with one another over a DXE link. The first DXE is identified as frame 1 - it receives inputs 1 – 512 from the input frames connected to it and generates output channels 1 – 512 using the output frames connected to it. The second DXE is identified as frame 2 and it receives input audio signals 513 – 1024 and generates output signals 513 - 1024. Suppose we would like to route input channel 1 to output 514 and input 1024 to output channel 2. We must transfer data between frames to do this, and this is done over the DXE link between the two frames. Frame 1 logic circuitry "builds" a data stream for frame 2 containing all of its 512 input signals. Frame 2 logic circuitry "builds" a data stream for frame 1 containing all of its input signals. The DXE link bi-directionally transfers this data between frame 1 and 2. Expanding this concept with three DXE links connected between frames in such a way that every DXE frame has a direct link connection with every other DXE frame allows all input channels to be accessible to all output channels regardless to which frame they are physically connected.

Obviously, the data link between DXE frames must be very high speed and carry tremendous amounts of data. For this reason, DXE frames are interconnected using optical transmission methods and fiber-optic interconnect cable. FPGA logic circuitry on the DXE logic CCA generates up to three DXE link data streams and receives up to three data streams from other system frames. Each of the three DXE link data streams is routed from the logic circuitry to one of three Fiber Optic Transceiver devices. These devices are accessible through rear panel connectors and are connected between other system frames in a "star" networking topology.

A source of sync reference from an in-house sync generator enters the logic card by way of loop-through rear panel BNC connectors, is routed through a buffer and then enters the Sync Processor circuitry. Here, the sync signals required for proper timing and synchronization of the on-board processing functions are generated and routed to the FPGA Logic circuitry. On-board voltage regulation and monitoring circuitry provides power for all circuit elements and reports any power faults or errors to the processing circuitry. The Hot Swap Controller allows the logic card to be removed and replaced with the frame in a power-up condition without damage.

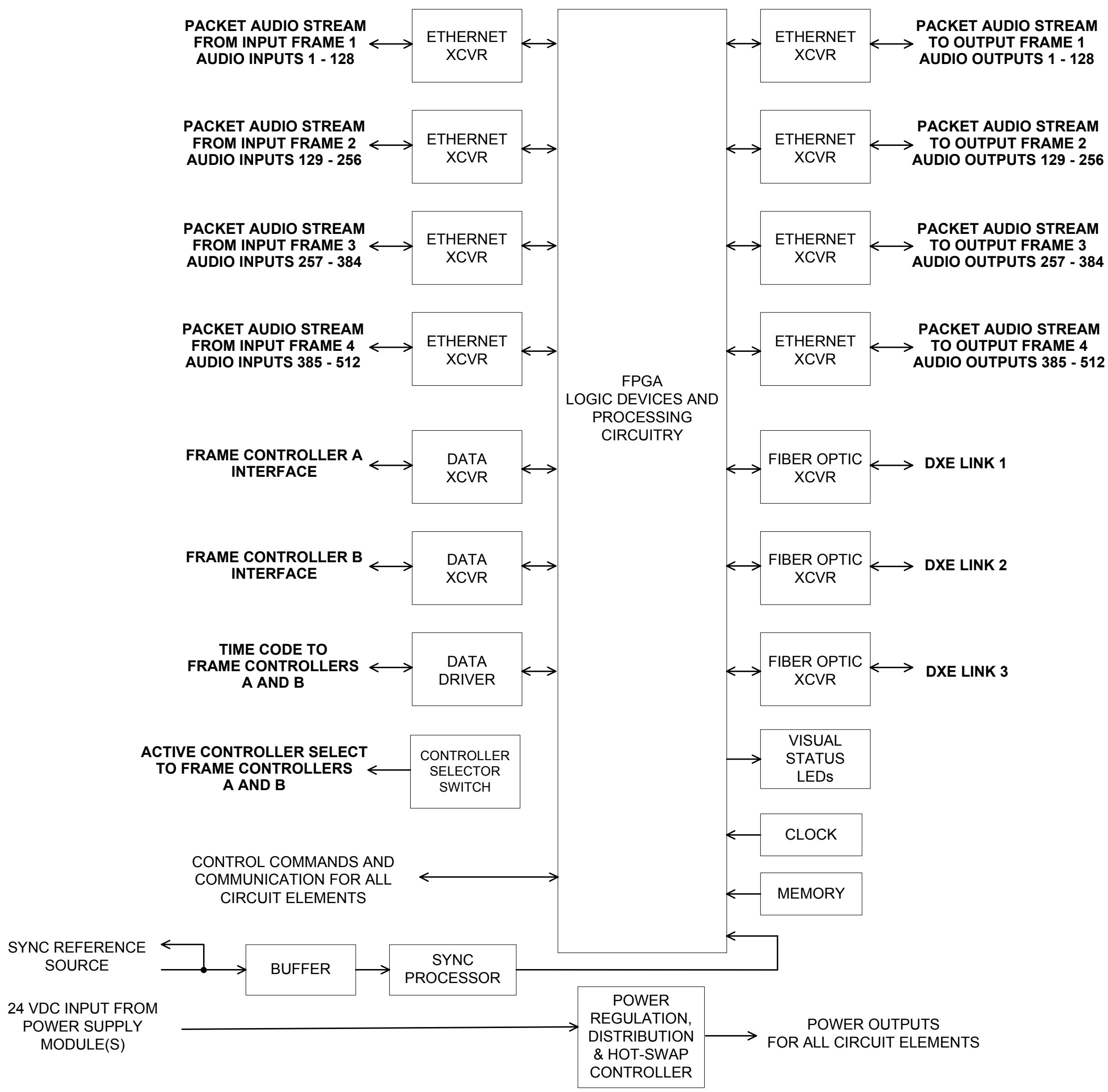


Figure 5-10 Block Diagram - DXE Logic CCA

5.3.6 PERC 1000 FRAME CONTROLLER/POWER SUPPLY MODULE

Figure 5-11 is a block diagram of the P1K Frame Controller/Power Supply Module, which is the DRS system component that communicates with the PERC 2000 System Controller. Bidirectional data bus interface with the P2k controller is made through an Ethernet Transceiver device that accepts the Ethernet protocol bus, processes incoming data and provides an output of serial data to the Microcontroller and Processing Circuitry. The Ethernet Transceiver also receives data from the microcontroller, processes this data to Ethernet protocol and transmits it to the P2K controller via the bidirectional link.

Processing Logic under microprocessor control communicates commands and system functional data with the DXE logic CCA. A Data Driver device receives a serial data stream from the processing logic, isolates and level shifts the data for transmission and sends the data stream, via the mid-plane, to logic circuitry on-board the DXE CCA. In similar fashion, the DXE logic card contains a data driver device that transmits a data stream to the Data Receiver device. Here, the incoming data is isolated and processed for retrieval by the on-board processing logic.

Sync Processor circuitry receives a sync pulse input from the DXE logic CCA. Here, the sync signals required for proper timing and synchronization of the on-board processing functions are generated and routed to the microcontroller circuitry.

Processing logic on the frame controller also communicates Status Commands with a redundant frame controller (if the frame is so equipped) and the DXE logic card. This bidirectional message bus between system components allows each component to monitor the status and health of the other components. Should status faults or component failures be detected, logic circuitry performs automatic swapping of primary and secondary controllers, power supplies and generation of visual (LED) warning alerts to the user,

Primary power (Main AC Power Input) enters the frame and is routed to the input of a 24 Volt Power Supply Module. DC power from the module routes to a Voltage Monitor device, Fan Speed Control circuitry, on-board Power Regulation devices and is also routed via the mid-plane to voltage regulators on-board the DXE logic CCA.

Output voltage from the supply module is constantly monitored by the voltage monitor device; should the voltage output swing higher than a fixed upper-limit or lower than a fixed lower-limit, this variance is detected and a warning message issued to the processing logic circuitry. On-board voltage regulation and distribution circuitry provides power for all on-board circuit elements.

Power from the supply module is also received by the Fan Voltage Regulator/Speed Control circuitry. This card function provides power to the Chassis Cooling Fans contained on the power supply/controller module assembly. Each fan provides a monitor voltage output which is read by the processing logic and allows the processor to monitor the speed of the fan. Using chassis temperature parameters received through component status data the processor determines the proper operating speed necessary for the cooling fans and sets the voltage level received by each fan, which varies fan speed, by commands to the fan regulation and speed control circuitry.

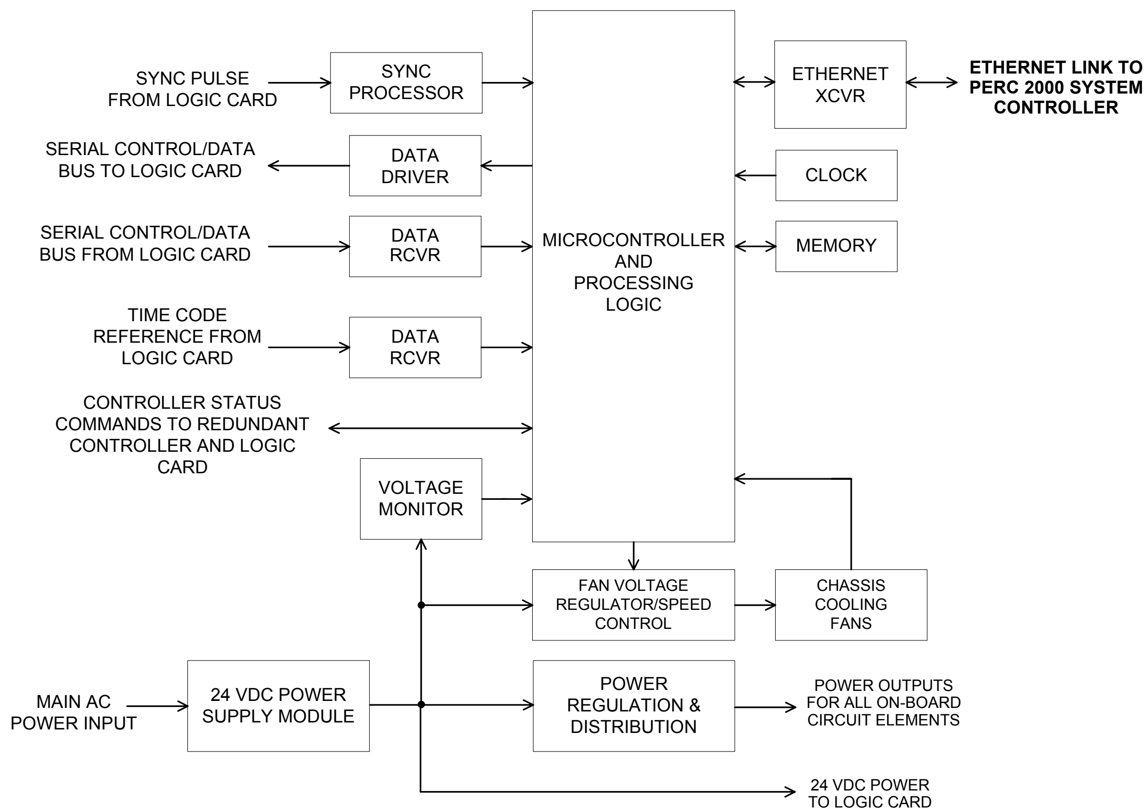


Figure 5-11 Block Diagram - PERC 1000 Frame Controller/Power Supply Module

5.3.7 FAN CONTROLLER/POWER SUPPLY MODULE

Figure 5-12 is a block diagram of the Fan Controller/Power Supply Module. While functionally similar in many ways to the P1K controller/power supply module, the fan controller provides an abbreviated sub-set of the processing commands performed by the frame controller. Programming for the processing logic is completely different between the two assemblies.

Processing logic on the fan controller communicates Status Commands with a redundant fan controller (if the frame is so equipped) and the frame logic card. This bidirectional message bus between system components allows each component to monitor the status and health of the other components. Should status faults or component failures be detected, logic circuitry performs automatic swapping of primary and secondary power supplies and generation of visual (LED) warning alerts to the user, Primary power (Main AC Power Input) enters the frame and is routed to the input of a 24 Volt Power Supply Module. DC power from the module routes to a Voltage Monitor device, Fan Speed Control circuitry, on-board Power Regulation devices and is also routed via the mid-plane to voltage regulators on-board the logic CCA mounted in the frame.

Output voltage from the supply module is constantly monitored by the voltage monitor device; should the voltage output swing higher than a fixed upper-limit or lower than a fixed lower-limit, this variance is detected and a warning message issued to the processing logic circuitry. On-board voltage regulation and distribution circuitry provides power for all on-board circuit elements.

Power from the supply module is also received by the Fan Voltage Regulator/Speed Control circuitry. This card function provides power to the Chassis Cooling Fans contained on the power supply/controller module assembly. Each fan provides a monitor voltage output which is read by the processing logic and allows the processor to monitor the speed of the fan. Using chassis temperature parameters received through component status data the processor determines the proper operating speed necessary for the cooling fans and sets the voltage level received by each fan, which varies fan speed, by commands to the fan regulation and speed control circuitry.

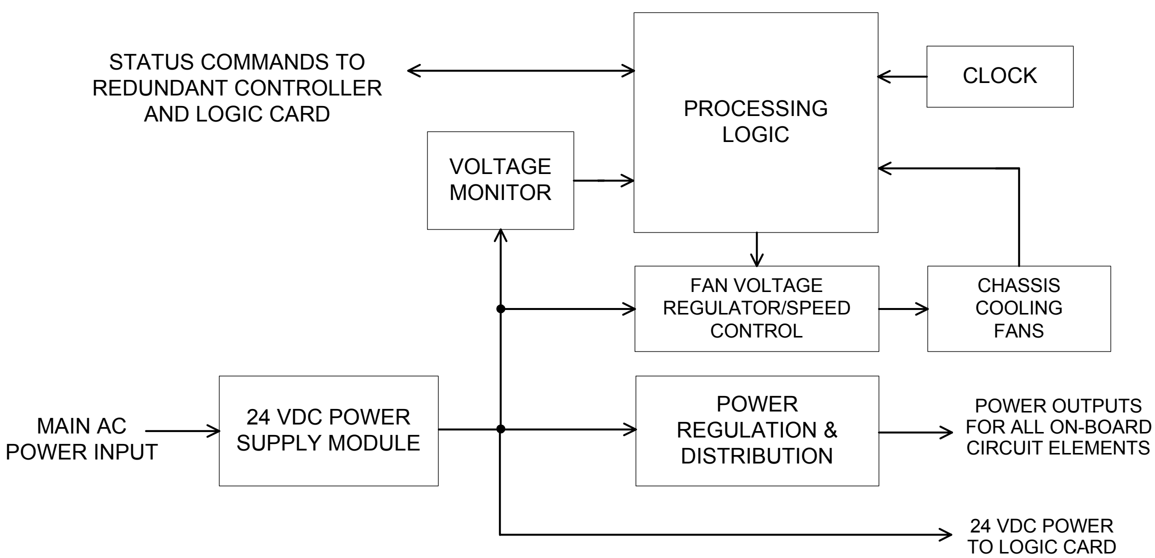


Figure 5-12 Block Diagram - Fan Controller/Power Supply Module