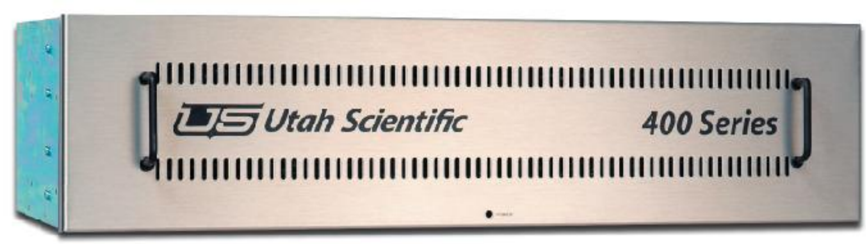
Utah Scientific

The UTAH-400 **Data Router**



Setup and Operations Guide

The UTAH-400 Data Router

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This equipment has been tested and found to comply with the limits for a Class A, digital device, pursuant to Part 15, Subpart B of the FCC Rules and the Canadian EMC Requirement (ICES-003). These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user will be required to correct the interference at their own expense. Shielded cables must be used to ensure compliance with the FCC Class A limits.

Declaration of Conformity

Utah Scientific, Inc.

4750 Wiley Post Way, Suite 150
Salt Lake City, Utah 84116-2878 U.S.A.

We declare our sole responsibility that the Utah-400 Digital Routing Switcher is in conformance with the following standards:

- EN50081-1 Generic Emission Standard
- EN50082-1 Generic Immunity Standard
- IEC-950 Product Safety
- C-UL 1950 Product Safety
- UL 1950 Product Safety

Following the provisions of the Directive(s) of the Council of the European Union:

- EMC Directive 89/336/EED
- Low Voltage Electrical Directive 72/23/EEC

Utah Scientific, Inc. hereby declares that the product specified above conforms to the above Directive(s) and Standard(s).

Important Safeguards and Notices

This section provides important safety guidelines for the Operator and Service Personnel. Specific warnings and cautions are found throughout the guide where they apply, but may not appear here. Please read and follow the important safety information, specifically those instructions related to risk of fire, electric shock, or injury to persons.

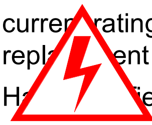
Safety Symbols

- Hazardous Voltage symbol
- Caution symbol. The product is marked with this symbol when it is necessary to refer to the manual to prevent damage to the product.

Warnings

Please observe the following important warnings:

- Any instructions in this guide that require opening the chassis, changing a power supply, or removing a board, should be performed by qualified personnel only. To reduce the risk of electric shock, do not perform any service unless you are qualified to do so.
- Heed all warnings on the unit and in the operating instructions.
- Do not use this product in or near water. Disconnect AC power before installing any options or servicing the unit unless instructed to do so by this manual.
- This product is grounded through the power cord ground conductor. To avoid electric shock, plug the power cord into a properly wired receptacle before connecting the product inputs or outputs.
- Route power cords and other cables so they won't be damaged.
- The AC receptacle (socket) should be located near the equipment and be easily accessible.
- Disconnect power before cleaning. Do not use any liquid or aerosol cleaner - use only a damp cloth.
- Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed conductors and components while power is on. Do not insert anything into either of the systems two-power supply cavities with power connected.
- Do not wear hand jewelry or watches when troubleshooting high current circuits, such as power supplies. During installation, do not use the door handles or front panels to lift the equipment as they may open abruptly and injure you.



- To avoid fire hazard when replacing fuses, use only the specified correct type, voltage and current rating as referenced in the appropriate parts list for this product. Always refer fuse replacement to qualified service personnel.
- Have qualified personnel perform safety checks after any service.

Cautions

Please observe the following important cautions:

- When installing this equipment do not install power cords to building surfaces. To prevent damage when replacing fuses, locate and correct the problem that caused the fuse to blow, before connecting power.
- Use only specified replacement parts

Notices

Please observe the following important notes:

- [illegible] adjacent symbol is indicated on the chassis, please refer to the manual for additional information.
- For the HD-2020 Chassis and Master Control Panel, refer to “Connecting and Disconnecting Power” - Chapter 2 (Hardware Installation).

Company Information

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- Return of the price paid, or
- Repair or replacement of the software or hardware that does not meet the above warranties and is returned to Utah Scientific under the returned materials authorization (RMA) process with freight and forwarding charges paid.

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Table of Contents

CHAPTER 1 *Introduction*

Introduction

In This Guide

This guide provides instructions on installing, configuring and operating the Utah Scientific, Utah-400 Data Routing Switcher. The following chapters and appendices are included:

- Chapter 1, “Introduction” summarizes the guide, describes basic router operation and describes the hardware and software components of the Utah-400 Data Routing Switcher.
- Chapter 2, “Hardware Installation” provides instructions for installing the Utah-400 Data Routing Switcher in your facility.
- Chapter 3, “System Operations” provides specific information on operating the Utah-400 Data Routing Switcher.
- Chapter 4, “Troubleshooting” looks at some of the common hardware and software problems, diagnostics and solutions available to the user on site. Included in this section is information on the various avenues to contact Utah Scientific Technical Services and tips on discussing equipment problems.

How to use this Guide

The chapters in this guide follow a logical sequence from the Introduction to Specifications.

- Read this chapter (Chapter 1 “Introduction”) to familiarize your self with the Data Router product.
- Follow the instructions in Chapter 2, “Hardware Installation” to install your Data Router system hardware.
- The information in Chapter 3, “System Operations” explains the specifics of operating the Data Router at a broadcast facility.
- Chapter 4, the “Troubleshooting” section, will help you to isolate problem areas and how to contact Customer Service.

Conventions

The following conventions are used throughout this guide:

- Connectors and terminators will be indicated by bold, upper case text in Arial Black font. For example:
  - Connect the MX-Bus to J-1
- ·Operator Actions will be indicated in Helvetica Bold where a board is inserted, removed and/or an action is required in the Troubleshooting or configuration sections of this manual. There will usually be a graphic to accompany the instruction(s). For example:
  - Insert the expansion Input board in slot 6.
  - Switch the suspected bad input to a known good input to verify output “X”.
- The use of bullets indicates a random order of operation or to draw the readers’ attention to specific items.
- The use of numbers in specific operations or lists indicates a “recommended order of operation” to perform specific tasks. Bulleted items may be below numbered items to highlight tasks or indicate the operation(s) may be performed at random.

Abbreviations

The following abbreviations may be used in this guide:

TABLE 1-1. **Common Abbreviations and Mnemonics**

Abbreviation	Description
ATR	Audio Tape Recorder
AES	Audio Engineering Society
CPU	Central Processing Unit
DTR	Digital Tape Recorder
EBU	European Broadcast Union
ENET	Ethernet
HDTV	High Definition Television
I/O	Input / Output
IP	Internet Protocol
JPEG	Joint Photographic Experts Group
M-JPEG	Motion – JPEG
MPEG	Motion Picture Experts Group
MX-Bus	Utah Router Control Comm. Bus
RMS	Router Management System
RU	Rack Unit
SDI	Serial Digital Interface
U-Net	Utah Control Panel Comm. Network
UTP	Unshielded Twisted Pair
VTR	Video Tape Recorder

Terms

The following terms are used throughout the documentation in this guide:

- “Operator” and “User” refer to the person using or operating the Utah-400 Digital Router System.

- “System” refers to the entire interconnected Utah-400 System including control panels, routers, software, and chassis.
- “Mainframe” refers to the Utah-400 chassis plus redundancy.
- “Input” refers to an audio, video, or data signal source that is connected to the Utah-400 main frame.
    - One video input represents one High Definition or Serial Digital Interface video output signal.
    - One audio input represents a single monophonic track from an analog audio source.
    - One digital audio input represents two tracks (left and right channel) from a digital audio source.
- “Source” refers to an audio or video device whose output signals are connected to the Utah-400 mainframe inputs. Examples of audio / video sources are ATR’s, VTR’s, DTR’s, cameras, video / audio routers, audio mixers, graphics systems, and satellite feeds.
- “Output” refers to the Utah-400 audio, video, or data signals from the Utah-400 “Outputs”, which are connected to the ‘destination device’. This term also includes the physical output connectors on the frame.
- “Port” refers one physical connector that carries one input and one output
- “Destination” refers to the device, which is receiving the Utah-400 output signal. This could include VTRs, monitors, satellite feeds, or video / audio routers.
- ·“Signal Level” refers to the logical level of the audio / video routers in relation to the entire connected system(s). Typically, the Utah-400 occupies levels above 1, with master control occupying the lowest logical level.
- ·“Hot Swappable” refers to a printed circuit board, which can be removed or replaced with system power “on”.
- “Control Panel” refers to the physical human interface used to control the various systems in use.
- “Display” is the ‘LCD Display’ on the panels in use.
- “Monitor” refers to the monitor attached to the monitor matrix port of a video or audio router system.

- “High Definition" refers to all 780p and 1080i formats – as per CEMA definition. The typical high definition data rate is 1.85 Giga Byte and a 16:9 Aspect Ratio Picture characterizes this technology.
- “Serial Digital Interface (SDI)” refers to the serial digital video signal operating at 125 to 270 MB. Utah Scientific data rates for the serial digital router are 143, 177, 270,360 and 540 MB.

Routing Switcher Basics

A routing switcher is a specialized form of broadcast equipment that allows the user to connect large numbers of source and destination devices together electronically – without patching or running cables across floors and without significant signal loss.

The routing switcher solves connectivity problems and increases signal qualities in a wide variety of applications. The technologies of routing switchers now include the standard analogue, digital video, digital audio, and increasingly the high definition formats.

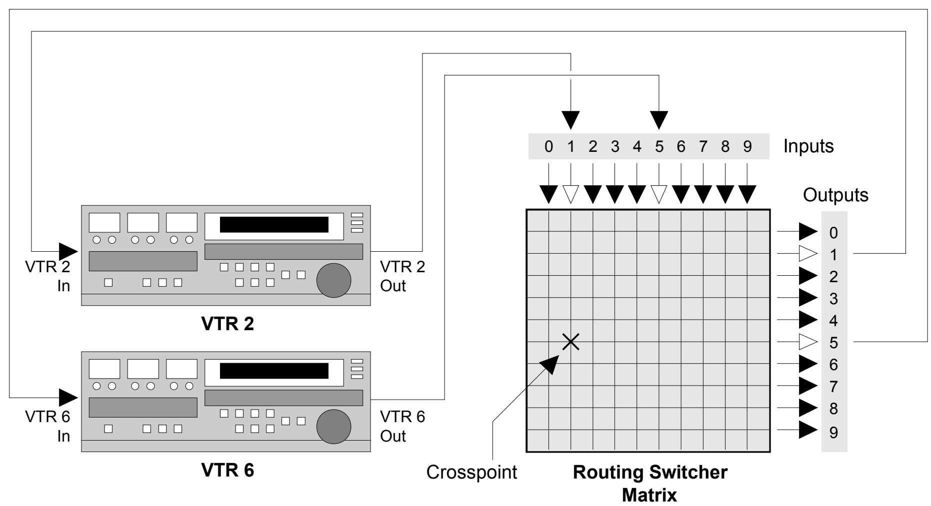
The routing switcher provides the user with the following advantages:

- Many signal levels (determined by the matrix size) may be switched simultaneously.
  - A simple route connects (switches) one signal level from one source (for example a VTR) to one destination (a monitor).
    - A complex route would connect multiple signal levels from one source to multiple destinations, including tie lines. For example, a satellite feed to a group of VTRs and monitors.
  - Audio and video signal levels can be switched in groups (all follow takes) or individually (breakaway takes). Any input can be switched to any output, limited only by the matrix size.
  - The Routing Switcher may be controlled manually via control panels, or with computer controlled automation.

Switching Matrix

A switching matrix is the internal array of inputs, crosspoints and outputs that allow a routing switcher to perform the task of routing signals from sources to destinations. The figure below illustrates a simple 10 X 10 switching matrix – with 10 Inputs and 10 Outputs.

Note the following points regarding the illustration:



- Each VTR is fully connected to the matrix – all audio/video inputs and outputs.
- A cross-point (represented by an X) is the internal electronic connection of the input to the output – either audio or video.
- When the cross-point is turned “ON” the connection is made between the source and destination. The action of turning the cross-point on is known as making a “Take”.
- When an entire audio/video array is connected in this manner, from all of the devices in your facility, you have full routing flexibility.
- Without re-cabling or re-patching, a device can play back one moment (as a source) and record the next moment (as a destination).

Signal Levels

A “signal level” represents one of many specific types of audio or video elements that a routing switcher is capable of handling. The typical signals capable of being switched are:

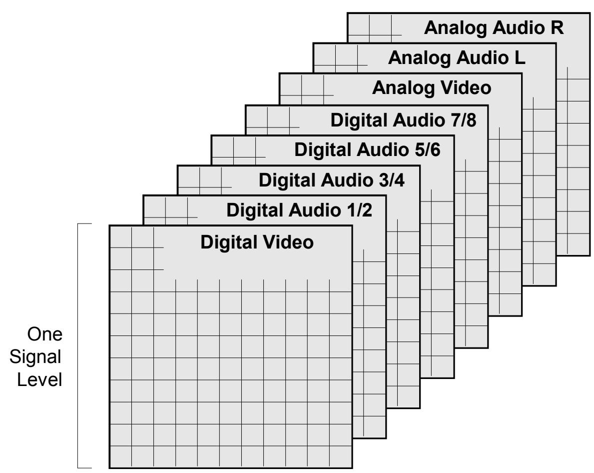
• Analog Video

• Analog Audio (stereo with left and right channels).
• Digital Video
• Digital Audio (dual channel – stereo pair)
• High Definition Video.

Some systems may be configured with one signal level, while others may be configured with multiple signal levels.

While the diagram in the previous section shows only one signal level, a multi-signal level system is capable of routing any combination up to 32 levels – each with its own matrix and crosspoints.

The figure below illustrates ***eight signal levels*** in a 10 X 10 matrix system.



Signal routers are typically much larger than a 10 X 10 matrix, depending on user needs. Each signal level may also have different sizes of matrices and do not all need to be the same size.

The Utah-400 Data Routing Matrix

The Utah-400's unique data matrix technology allows for flexibility of matrix size available to the user. Each chassis contains 64 bidirectional matrix ports. Up to four chassis can be interconnected so the user can expand in groups of 64 ports up to a maximum matrix size of 256 ports.

The crosspoint board and its flexible design characterize the Utah-400 system. Including expansion inputs, this board supports a 256 x 64 switching matrix.

Features of this technology include signal presence indicators for both input and outputs. The status of the router input and output activity can be continuously monitored via the crosspoint status port or router control system.

Refer to the Utah-400 Data Matrix Block Diagram for the following signal routing description.

Each matrix interface port supports bidirectional data traffic with port signals A and B. Either signal can be assigned as receive; while the other is assigned as transmit. The port interface logic determines this assignment according to control signals received from the matrix controller and MX bus.

At system start-up, each port defaults to SMPTE “tributary” mode, where port signal A is assigned as receive and port signal B is assigned as transmit. These assignments can be reversed at any time via the router control system, to support SMPTE “controller” mode.

Further, at system start-up, each port has its transmit-output disabled until commanded to turn it on. This prevents potential signal contention with external equipment.

Three LED indicators are associated with each matrix interface port. The controller indicator, labeled “CT” illuminates green when the port is placed in “controller” mode. When the port is in “tributary” mode, this indicator is unlit.

Active signal transitions at the receive line will cause the receive indicator, “RX” to illuminate yellow.

The port’s transmit indicator, “TX”, illuminates red when the port output drives a logic-zero, and green when it drives a logic-one. Live data traffic will cause both colors to be emitted. When a matrix interface port is disabled, its TX indicator output is suppressed.

The receive signal selected by the port interface logic is connected to a crosspoint input, where it is available for the operator to make a “Take”, enabling the routing path of this input to its desired output(s).

The output from the crosspoint is directed to its proper path to the port interface logic. From this point the output signal is sent to the output driver in the selected port transceiver, and its destination.

Up to four chassis can be linked to create larger switching matrices. The crosspoint board houses three expansion transceiver devices to implement this feature.

Each expansion transceiver communicates over a bidirectional high-speed serial link to an alternate chassis. In the transmit direction, the local port input signals, 64 total, are sampled, combined with synchronization signals, and formatted into a serial signal for application to the alternate chassis. In the receive direction, the alternate chassis conveys its 64 inputs to the local chassis.

The local chassis assigns the serially received block of 64 input signals to a specific range of inputs to its switching matrix, where they are available as additional sources for output. When a chassis receives and locks to an expansion signal, it lights a “frame lock” LED which indicates that its block of inputs are available for matrix connection.

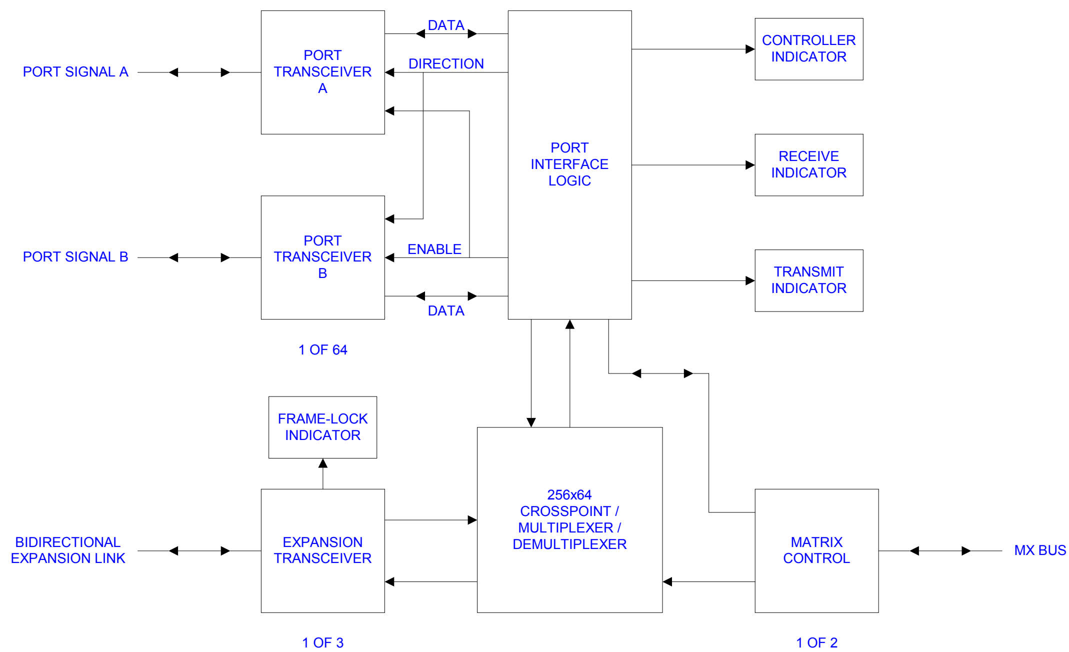


FIGURE 1-1. The Utah-400 Data Matrix Block Diagram

Introducing the Utah-400 Data Routing Switcher

Utah Scientifics' Utah-400 Data Routing System incorporates the latest technology and is designed to meet the most demanding user needs in the switching router market.

The Utah-400 Data Routing System offers the following features:

- Bidirectional switching matrices from 64 ports up to 256 X 256
  - All routers utilize the same chassis as building blocks for all configurations.
  - Very compact – 64 port = 3 RU; 128 x 128 = 6 RU; 256 x 256 = 12 RU
  - Frames are 3 Rack Units (RU) High (5.25 inches / 13.34 cm)
  - Fully redundant power supplies and AC sources (separate receptacles for each chassis supply)
  - Low power consumption – 64 port = < 75 Watts
  - Two cooling fans with side exhaust. Chassis will cool itself with one fan running
  - Fans replaceable without powering-down router.
  - Input, output, and expansion signal presence indicators
  - Router expansions are field upgradeable.
  - All active circuit boards insert and extract from the front of the router, less downtime when troubleshooting problems.
- Compatible with existing control systems.
  - Uses the existing Utah Scientific MX-Bus Router Interface.
  - UNET
  - Internet
  - RS-232 / RS-422
  - Personal Computer
- Error Indicators include voltage, fan, and temperature.
- Redundancy used to avoid a single point failure where possible.
- Non-Intrusive diagnostics and status reports when interfacing with a personal computer.

System Configurations

There is one chassis configuration for the Utah-400 Data Router.

Larger matrices are built by interconnecting identical chassis. The largest supported configuration consists of four chassis that are interconnected to create a 256 x 256 matrix.

Standard Configuration

A front view of the 64-port chassis is shown below.

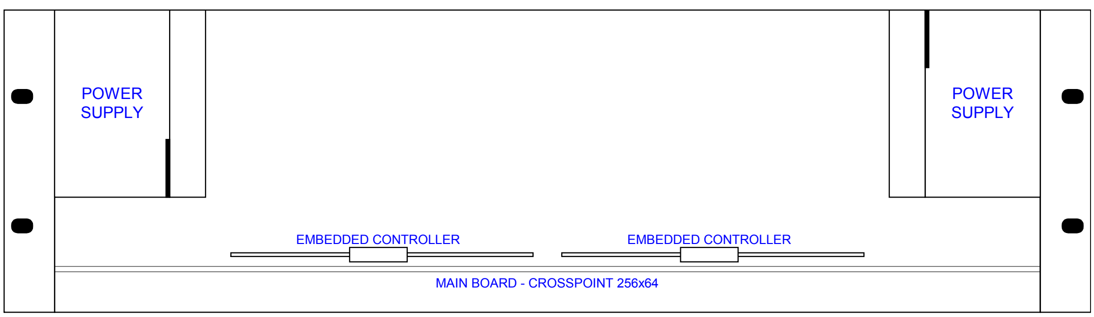


FIGURE 1-2. The Utah-400 64-Port Data Router

- The 64-Port Data Router Includes:
  - 1) Main Board (includes 256 x 64 crosspoint)
  - 2) Embedded Controllers
  - 2) Power Supplies
  - 1) I/O Backplane

UT-400 Data Router Functional Description

When controlling a remote VTR from a local VTR, an RS-422 serial connection is often used. This interface allows for control data to be transmitted from one device and received by the other (and vice-a-versa). For this to work properly, the TRANSMIT pins (TX) of one device must be connected to the RECEIVE pins (RX) of the other device. Since the RS-422 serial cable used for connection between the two VTRs is usually a straight-thru cable (which would obviously connect the same physical RS-422 pins on each machine together), it may leave you wondering how the VTRs accomplish this TX to RX connection. The answer is fairly simple. The function of the pins must change. This change is accomplished by the Local/Remote switch. When the switch is moved to Remote, the RS-422 pins change their function as seen in the following image.

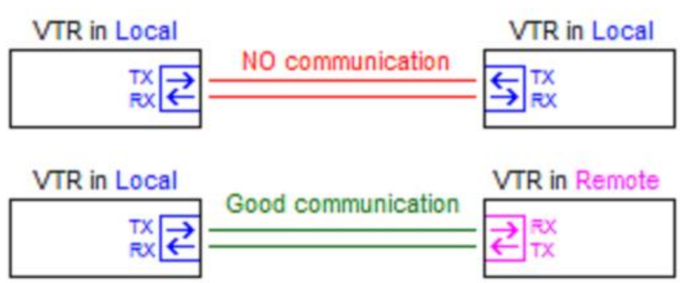


FIGURE 1-3.

When discussing RS-422 control, you will often hear the terms Tributary (TRIB) and Controller (CNTL) used to describe the different devices. When a VTR is in the Local mode, it is considered to be the Controlling Device (CNTL). When it is in Remote, it is considered to be the Tributary Device (TRIB). Therefore, successful communication is having a Controlling device properly control a Tributary device. A Controller cannot control another Controller (or a TRIB control a TRIB) device.

When an operator has multiple devices to control, it is convenient to use a Data Router to connect the devices together. This allows the operator to control many different TRIB devices from his single CNTL device. With a data router between the CNTL and TRIB devices, it is now important to properly manage and configure the ports of the data router to maintain communication. Remember that a CNTL must connect to a TRIB to enable communication. This holds true for the device to data router port also.

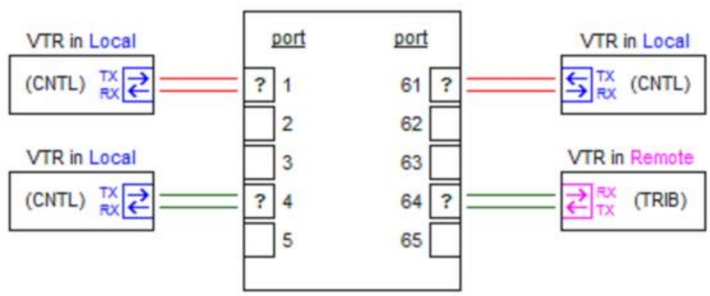


FIGURE 1-4.

For each of the devices shown in the previous figure, the ports with question marks must be set to the opposite mode. In other words, if the device is a CNTL, then the port must be TRIB to communicate. To satisfy the colors shown for the valid/non-valid communications (as dictated by the colors in the first figure), the ports would be set as shown below. Notice how the top two devices and their associated router ports are all configured for the same mode (CNTL's), thus causing a loss of communication between those devices and their router ports. The bottom two devices are communicating with their respective router ports.

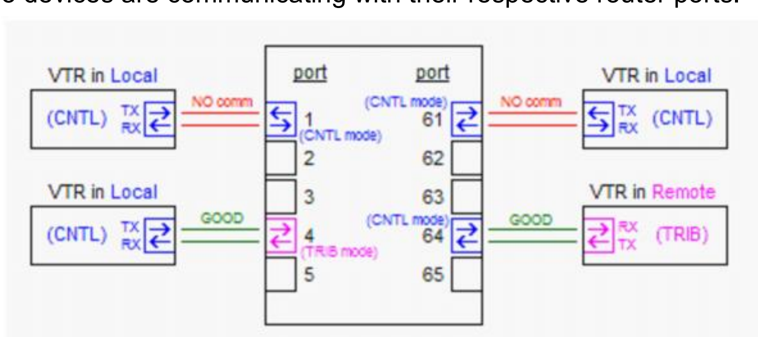


FIGURE 1-5.

This current scenario allows for the bottom left VTR to control the bottom right VTR – assuming you route port6 4 to port 4 on the data router. If you toggle the mode for port 61 and then route port 64 to port 61, then the top right VTR would be able to control the bottom right VTR. This route would automatically disconnect port 4 from port 64 so it would no longer have control.

Looking at the figure below, you can see which mode the ports are now in after performing the route of port 64 to port 61. Port 4 can still communicate with its VTR, but it is not connected (routed) to any other ports within the router. Also, port 1 still cannot communicate with its VTR because its mode is wrong. To initiate communication between this VTR and its port, either the port mode needs to toggle or the VTR needs to be switched to Remote.

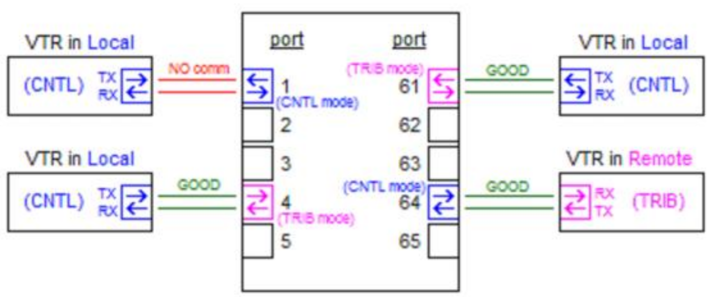


FIGURE 1-6.

Now that you understand how a specific device communicates to a router port, it is time to discuss how the proper port mode is selected for each device. Not only does this include dedicated CNLT and TRIB devices, it also must include devices like VTRs that change their mode with a flip of a switch.

Since there is no way for the hardware to automatically know and set the proper port mode, it must be defined (and controlled) in software. Within the configuration software, there are mode assignments that can be applied to the various devices. The simplest of these modes are ‘Controller’ and ‘Tributary’. Logically, these are used to define devices that are always CNTL’s or always TRIB’s. When you define a particular device as a Controller, the associated port will default to TRIB mode so that communication can always happen between that device and its router port. Likewise, a device defined as a Tributary will default its port to CNTL mode.

If your data router consisted of devices that were only Controllers and Tributaries, it would be quite simple to configure and use. The router ports would always be in their proper mode to allow communication with their devices. Therefore, whenever you route one port to another, the two associated devices would always be able to communicate with each other. There would never be a need to change the port mode.

With most systems, this is not the case. VTRs are almost always used and in both modes (local & remote). If they were defined as a dedicated controller or tributary device, then every time you toggled its mode switch, you would also have to make an attribute switch on the router to maintain communication. When connecting two VTRs, this could mean a total of three router switches to get it to communicate properly - not very efficient.

To alleviate this, there are two other mode assignments available for VTRs. They are ‘Auto Dest’ and Auto Src’. The ‘Dest’ and ‘Src’ designations are used to define whether you typically use the destination device as the controller or the source device as the controller. When you route an ‘Auto’ device, the system will automatically set the port mode based on whether this “AUTO device” is routed in the destination window or in the source window of the control panel. This allows for a single route on the panel to establish communications between devices.

The more common option is to use the destination device as the controller. Regardless, whichever method you choose (source controllers or destination controllers) it would be applied to the entire router as a basic “mode of operation” for the operators to follow. You can imagine the confusion if there was one VTR set to Auto-Dest and another to Auto-Src. You wouldn’t be able to make the two VTRs communicate when routing one to the other. They would both want to be controllers or both tributary devices no matter how you routed them. Hence, the importance of the “mode of operation” when using the data router.

There is one situation that needs to be handled a little differently. This is when you route an AUTO device to a dedicated device (or vice-a-versa). You will find that if you route in one direction it will establish communications, but routing in the other direction it will not. Take a look at the following two examples. They both show the same dedicated CNTL device and AUTO device (VTR) configured as 'Auto-Dest' (which means the destination device will be the controller in our examples). The VTR has its switch is in the proper Remote position to be controlled by the CNTL.

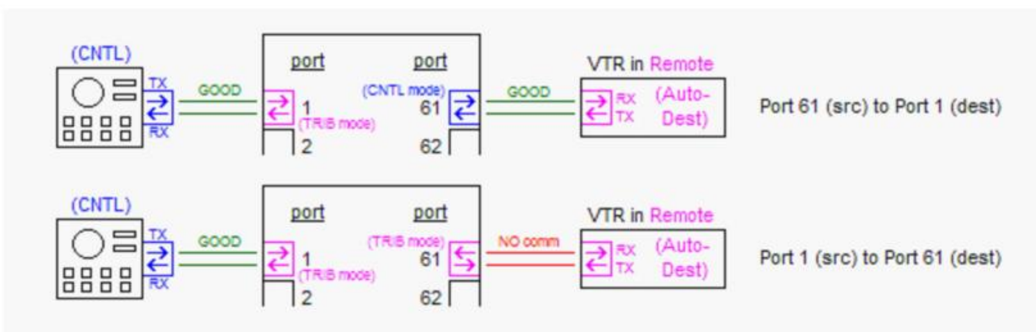


FIGURE 1-7.

The top example shows the route being made with the VTR in the source window of the panel and the CNTL device in the destination window (which follows our 'mode of operation'). Therefore, when you route the source port 61 to the destination port 1, the system will automatically toggle the "auto" port 61 to the correct mode. In this case, that would be CNTL mode to communication with the TRIB device.

If you route in the opposite direction (source port 1 to destination port 61), you end up with the bottom example. This is not in compliance with the chosen mode of operation. Since the VTR was switched as the destination, the system is expecting the VTR to be the controller. Therefore, it will automatically toggle port 61 to the TRIB mode and you will lose communications between the VTR and its port.

Because of this, you may wonder why anyone would route against the "mode of operation". The most common place for this to happen is when dealing with a device like a Final Cut Pro or Avid Studio etc. (a PC based device as the controller). The reason for switching against the mode of operation has to do with the video, not the control. The PC device will be used to both ingest video and play out video. When you ingest video, The PC is the destination for the video and the route follows the first example above. When you play out from the PC, the VTR becomes the destination. You only want this to be the destination for the video though. You don't want it to be the destination for the data control because you will end up with the second example above and you will lose control of the VTR.

There are two common scenarios when using a PC device. One is simple, but the other is the tricky one that needs to be handled differently (as mentioned above). The simple scenario is when the PC has its own dedicated VTR. In this case, you would simply define this VTR as a TRIB device. It would never be used to control another device. Both route directions (for ingesting and play out) are acceptable and will always work for both the control and video.

The second scenario is when the VTR is also used to control other VTRs. In this case, the VTR must be defined as AUTO. Therefore, the routing becomes important. As mentioned earlier, if the PC is ingesting video, then it is the destination, the VTR is the source, and the data control follows the video. You will not have any problems with this type of route.

The "tricky" route is when you need to play out from the PC (for recording to the VTR). You would be selecting the VTR as the destination even though you don't want it to be the controller. Therefore, you must route only the video level and not the data level. This is known as a "break-away" route. You can perform this by either selecting only the video level for the route or by deselecting the data level prior to pressing the TAKE button.

If the operators do not want to perform break-away routes, then there are some configuration methods you can employ that may be preferable. The easiest method may be to simply not define the data level for the PC devices in the source table. You must still define them in the destination table though (and set their attribute). When using this method, the first route between the VTR and PC must be made with the PC as the destination device. This will establish the data communication for controlling the VTR. A route in the other direction will NOT change the data level. This means that if you have control of the VTR, you will maintain control of the VTR when routing for play-out. Likewise, if you don't already have control of the VTR, routing it for play-out first will NOT give you control.

There are other creative methods for configuration that have been used so feel free to experiment and come up with your own. As long as you understand the data router and how (and if) its ports are toggled when making routes, then you should feel confident in experimenting with your configuration.

There is one last thing to mention regarding the mode selection for the devices. We discussed the Controller, Tributary, and two AUTO modes, but you also may have noticed that these four modes are duplicated in two groups. The first group is categorized as the standard (Std) set whereas the second group is the non-standard (NonStd) set. The standard and non-standard sets are specific to the physical pin-out used when wiring the devices to the router. In the data router manual, we specify what the pin-out should be for the wiring of the RJ45 port on the data router to the 9-pin port of the device. This is considered the "standard" wiring as depicted in the mode selections. The non-standard set was simply included to support some of the earlier data routers where the devices were physically wired up exactly opposite to this standard. This set is typically not used with new installations.

CHAPTER 2

Hardware Installation

In This Chapter

This chapter provides instructions for installing your Utah-400 Data Router in your facility. The following topics are covered:

Caution: To avoid damage to the system, do not connect AC power until the hardware is fully installed.

Unpacking and Inspection

When you receive your Utah-400 system, inspect each shipping carton for signs of damage. Contact your dealer and shipper immediately if you suspect any damage has occurred during shipping. Check the contents of each carton against your Utah Scientific order and verify them against the shipping manifest. If any items are missing, contact your dealer or Utah Scientific immediately.

Save the shipping box and material for future use, in case the unit may have to be shipped back to Utah Scientific.

> ***Caution: The Utah-400 data router weighs approximately twenty-five pounds; with shipping materials and accessories the box weight may equal more than thirty pounds.***

Each router is wrapped in anti-static plastic prior to boxing up. Figure 2-1 shows the typical packaging of a single Utah-400 router.

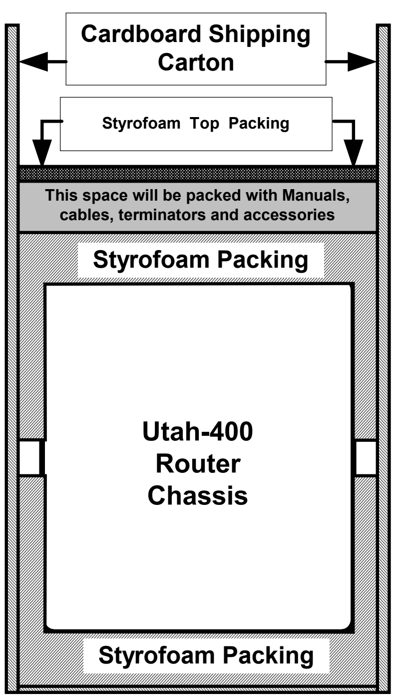


FIGURE 2-1. **Utah-400 Packaging**

Recommended unpacking method:

1. With carton setting upright, open the top.
2. Remove the Styrofoam packing material in the top of the box.
3. Remove the accessories.
4. Remove the Styrofoam Packing from the top of the Utah-400.
5. Grasp the sides of the Utah-400 and gently pull it up and out of the bottom Styrofoam packing material and box.
6. Place the Utah-400 on a stable bench or cart.
7. With the Utah-400 sitting on a bench or cart, remove the anti-static wrap covering the router and save for future use.
8. Move the router to the installation site.

Installing Physical Equipment

Installation of your Utah-400 data router may require some or all of the following steps:

1. Mounting equipment in rack frames
2. Installing MX-Bus cables
3. Determining and Setting the Router Signal Level
4. Installing data port signal cables
5. Installing expansion I/O signal cables
6. Connecting power
7. Hardware checkout

Mounting Equipment in Rack Frames

Installing the Utah-400 Digital Routing Switcher

Use the following steps to install the Utah-400 Systems into the rack frames:

1. Determine the vertical layout of your frames before you begin the installation. Please note:
   - You may wish to place blank panels between the systems to increase ventilation and make cabling easier.

- You may wish to install the systems in a way to reflect the priority of audio, video, and data signal levels.

  For example: If digital video is signal level 1, digital audio is signal level 2 and 3, the digital video may occupy a lower position in the rack frame.

  Note: See Figure 2-2 for an example rack frame layout.

2. Once your layout is determined, remove the front cover from the Utah-400 and set it aside.

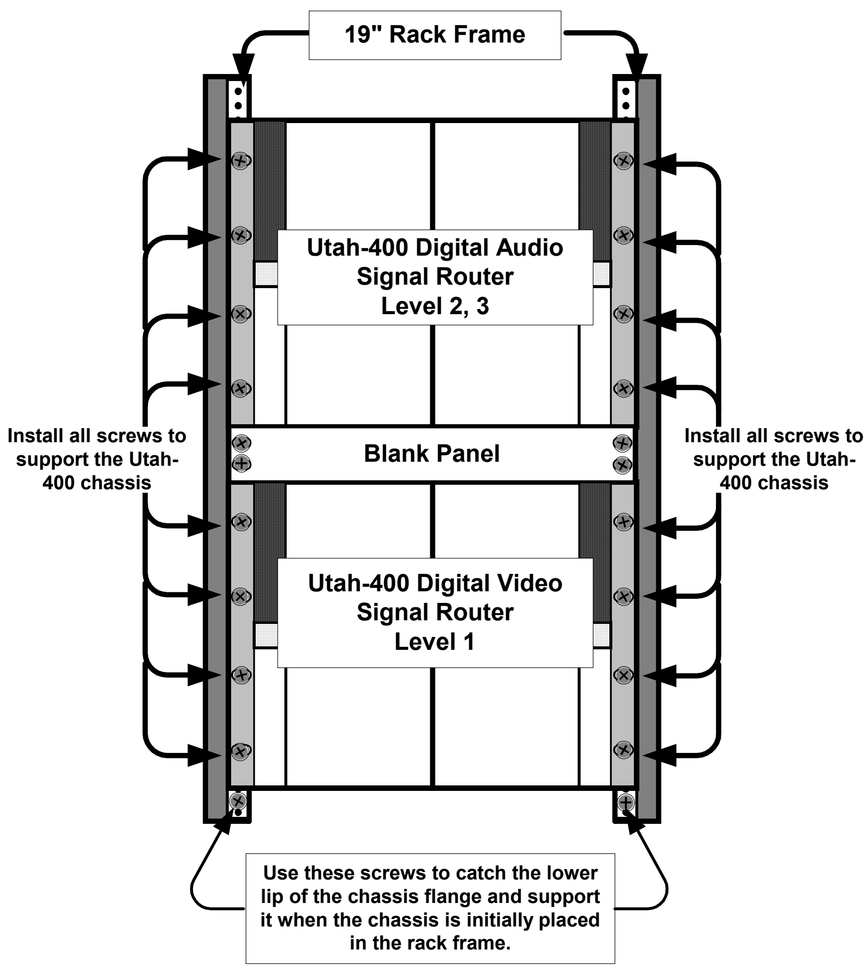


FIGURE 2-2. **Utah-400 Chassis Mounted in 19” Rack Frame**

3. Install the Utah-400 chassis' in the 19" rack frame.

   Note: The 64-port chassis (with power supplies and PCB's) weighs close to 25 pounds; Utah Scientific recommends a minimum of two persons, preferably three, to install the chassis in the rack frame. Install all mounting screws in the front of the chassis; the entire weight of the router and cables are supported by the chassis side-frames.

   a. Determine the height to mount the Utah-400 in the rack frame.

   b. Install two rack screws into the empty rack frame below the height determined in step a, above. These screws will be used to support the weight of the chassis when it is moved into the rack frame. See Figure 2-3, Section A.

   c. With two persons, pick the chassis up from the shipping carton at the left and right side frames.

   d. Move the chassis to the 19" rack frame and carefully slide it into the rack frame, hooking the flange of the chassis above the rack screws installed in step b., above. See Figure 2-3, Section B.

      Note: An alternative method is to support the Utah-400 Chassis with a shelf or similar support and align the mounting holes accordingly.

   e. With the chassis resting on the lower rack screws, carefully lift the left side frame, align the lowest chassis frame mounting hole with a rack frame threaded hole and start rack screw. Repeat for the right hand side frame.

   f. Once the lower chassis rack screws are in place, snug both sides up, but do not tighten.

   g. Align remaining two mounting holes, install remaining two rack screws through mounting holes and then snug them down.

   h. Finally, tighten all four rack screws installed in the chassis mounting holes.

4. Replace all front covers when the installation is complete.

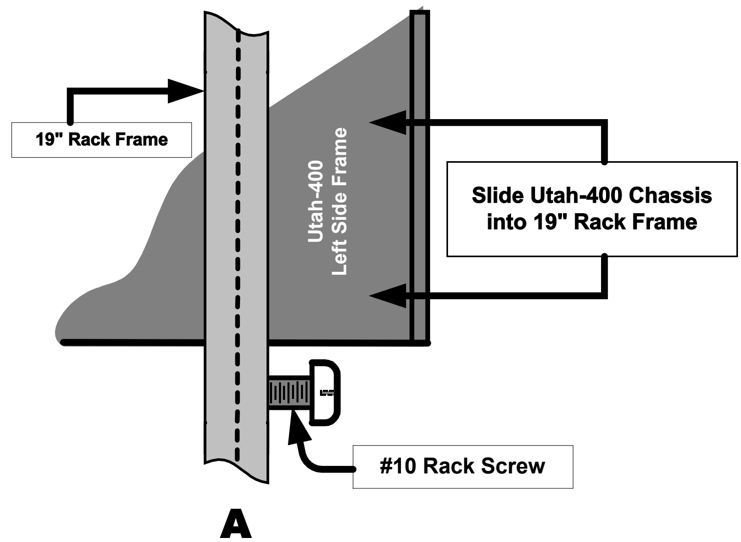


FIGURE 2-3. **Sliding the Utah-400 Chassis into Rack Frame**

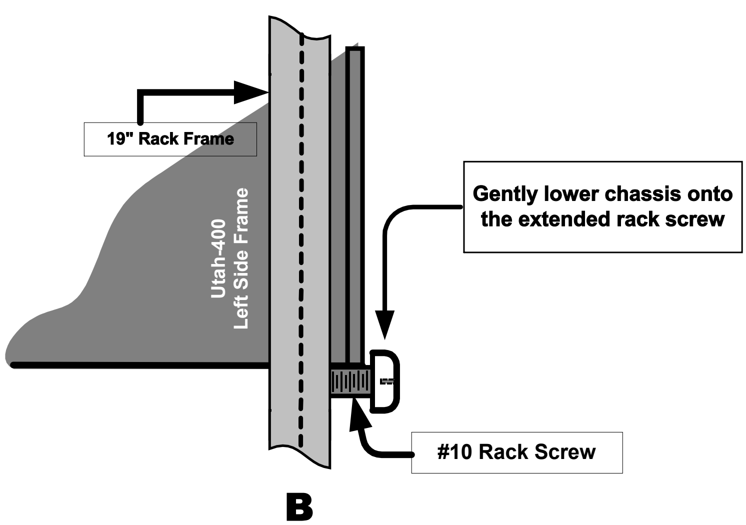


FIGURE 2-4. **Lowering the Utah-400 Chassis on the Rack Screw.**

Installing the MX-Bus Cables

The Utah-400 Data routing system utilizes the MX-Bus control system. It must be connected to the SC-4 control system to switch its inputs and outputs. In addition, the proper levels and offsets must be set on the Utah-400 routing system(s) so they will operate on the proper signal levels.

The MX-Bus is a daisy chain configuration, must not exceed 300 feet (91.4 meters) in length; and must be terminated at both ends of the daisy chain.

Your Utah-400 router is shipped standard with:

- One MX-Bus Cable – 10 ft. (USI Part Number: 80229-10). Other lengths are available and may be ordered through Utah Scientific sales at 1–800–453–8782.

Interconnecting the SC-4 and Utah-400 Frames

The MX-Bus interconnection to the Utah-400 typically starts at the SC-4 control system and is terminated at the last physical Utah-400 chassis. The actual physical arrangement depends on the site placement of the various physical components.

Figure 2-5 shows a typical MX-Bus installation.

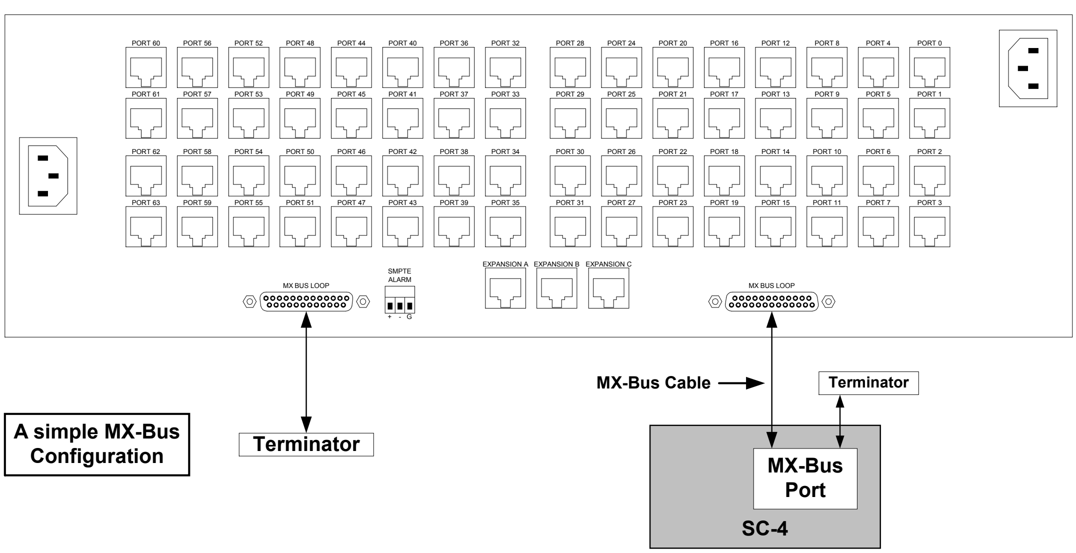


FIGURE 2-5. The MX-Bus Connection to an SC-4 Controller

Note: The Data Router Rear Panel is shown here.

Figure 2-6 is a block diagram showing the Utah-400 Data Router in an MX-Bus daisy chain with other Utah Scientific equipment.

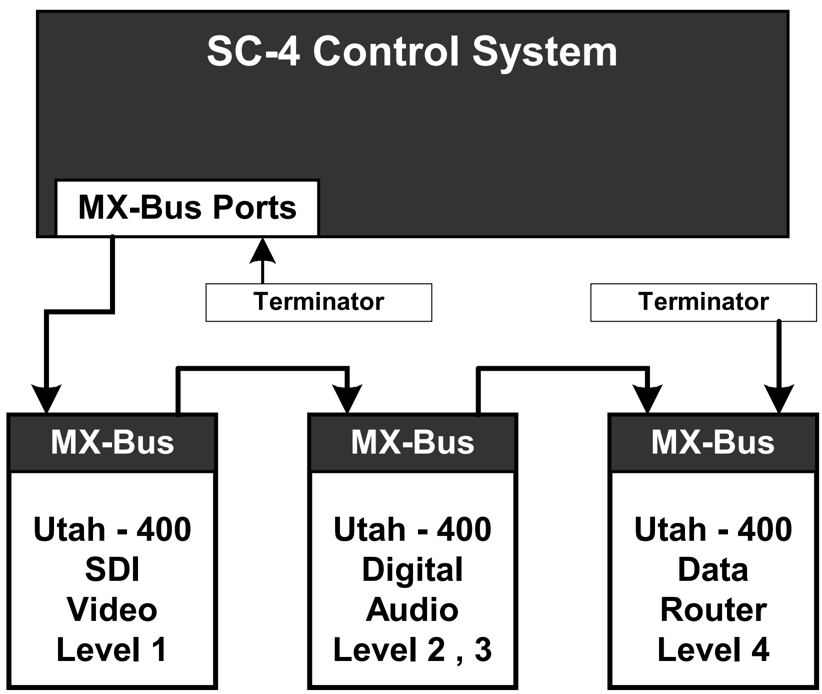


FIGURE 2-6. **Block Diagram of an MX-Bus Daisy Chain**

Determining and Setting Router Signal Levels

Signal levels are preset at the factory and tested during manufacturing, determined by customer input and requirements. The installation of your new Utah-400 Router should not require any signal level changes to operate after the new installation.

By definition, a signal level represents distinct elements of the broadcast system. These individual elements include, but are not limited to, High Definition Video, SDI Video, Digital Audio, Analog Video, Analog Audio and Data Routers. For additional information relating to signal levels, refer to the Introduction, Page 1-6.

Should you ever need to change the signal level of your router it is useful to determine:

- What new signal level is required
- If other signal levels will have to be modified to accommodate the new signal level
- Additional encoding requirements necessitated by the change

To change the Utah-400 Data Router Signal Level:

> **Note**: The Utah-400 main board must be powered down or reset for it to recognize any configuration changes made to the dipswitches. If the router has on-air signals present do not attempt a reconfiguration until it can be completed during the off-air time slots.

1. If the Utah-400 is not powered down, disconnect it from the power source.
2. Remove the front cover from the Utah-400.
3. Pull the Main Board Assembly slightly out of the router using the board ejectors located on the left and right hand sides of the board. See Figure 2-7. (The main board assembly does not have to be completely removed from the chassis to change configuration.)
4. On the Main Board Assembly, locate the Configuration Dipswitches. See Figure 2-9.

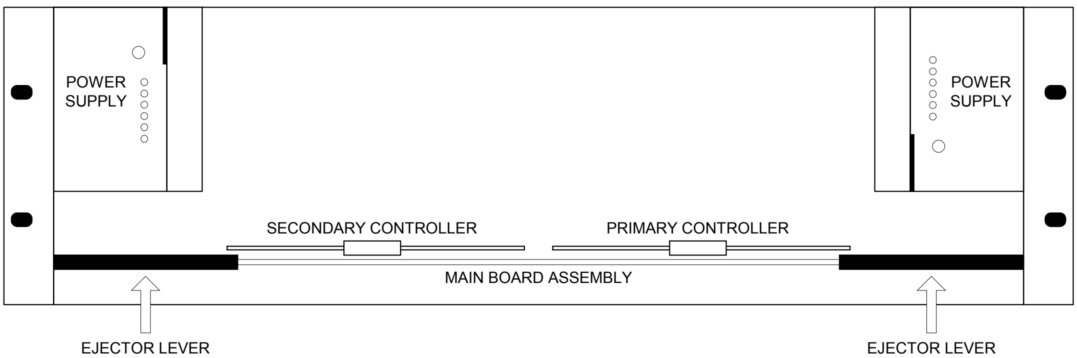


FIGURE 2-7. Chassis Assembly with Front Cover Removed

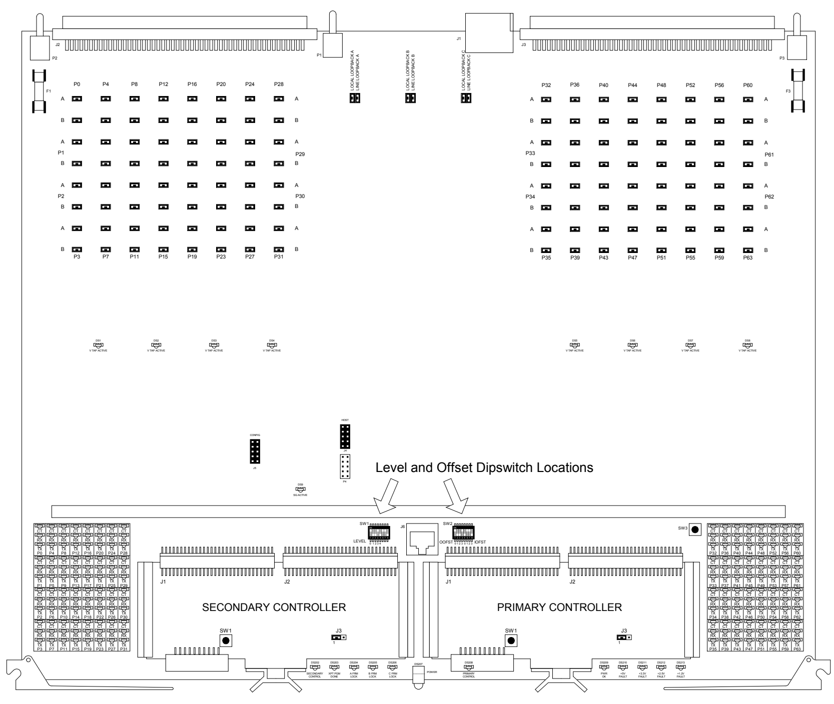
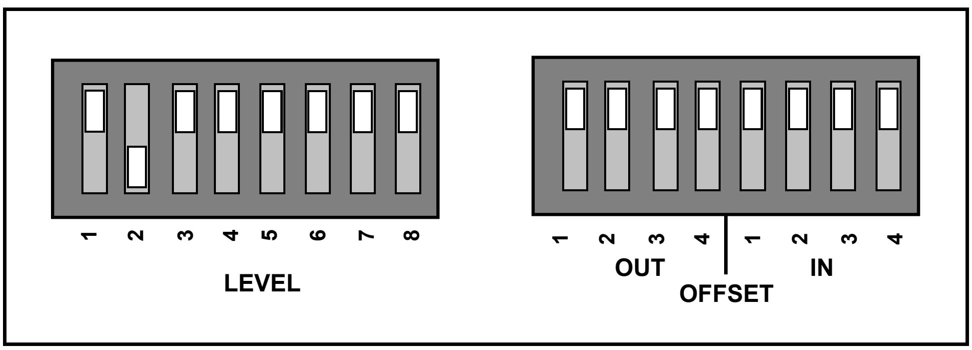


FIGURE 2-8. Main Board Assembly Dipswitch Locations

5. There are two eight-position dipswitches on the Main Board Assembly. The Level dipswitch is located toward the front of the board, behind the Secondary Controller sub-assembly; the Offset dipswitch is located behind the Primary Controller sub-assembly. See Figure 2-9.
6. Reference Table 2-1 to set the Level dipswitches and Table 2-2 to determine which switches must be changed for the Level desired.
7. Reference Table 2-3 to set the Offset dipswitches per your requirements.
8. Re-insert the Main Board Assembly into the router chassis, reinstall the front cover, and re-apply power.



Main Board Dipswitches as shown:
Input Offset = 0; Output Offset = 0; Level = 3 (SC-4 Control)

FIGURE 2-9. **Utah-400 Configuration Dipswitches as they appear on the Data Router Main Board Assembly**

TABLE 2-1. **Utah-400 Level Dipswitch Settings**

Switch	Level Assignment
1	Off = Level 1 On = Level 2
2	Off = Level 1 On = Level 3
3	Off = Level 1 On = Level 5
4	Off = Level 1 On = Level 9

TABLE 2-1. Utah-400 Level Dipswitch Settings

Switch	Level Assignment
5	Off = Level 1 On = Level 17
6	Not Used
7	Not Used
8	Not Used

TABLE 2-2. Level Assignment Per Dipswitch Selection

Level	SC-4 Dipswitch Assignments				
	Switch Number				
	1	2	3	4	5
1	On	On	On	On	On
2	Off	On	On	On	On
3	On	Off	On	On	On
4	Off	Off	On	On	On
5	On	On	Off	On	On
6	Off	On	Off	On	On
7	On	Off	Off	On	On
8	Off	Off	Off	On	On
16	Off	Off	Off	Off	On

Note: Not all Signal Levels are shown.

TABLE 2-3. Utah-400 Offset Dipswitch Settings

Input/Output Switch	Function	Description
1	Input / Output Offset 64	Offsets base Input / Output by 64 from 0
2	Input / Output Offset 128	Offsets base Input / Output by 128 from 0
3	Input / Output Offset 256	Offsets base Input / Output by 256 from 0
4	Input / Output Offset 512	Offsets base Input / Output by 512 from 0

Installing the Data Matrix Port Cables

This section provides guidelines for installing the Utah-400 Data Matrix Port Cables at the matrix I/O rear panel connectors.

The data matrix is fitted with industry-standard “Modular” RJ-45 connectors that are intended to be used with common Category-5 computer network cables. Plug/cable assemblies wired at all eight signal contacts (four twisted-pairs) must be used to allow conveyance of two differential signal-pairs, signal commons, and frame ground between equipment communications ports.

Electrical characteristics specified in SMPTE-207M require communication links to function at cable lengths up to 1220 meters (approximately 4000 feet), at 38.4 kBaud. Standard Category-5 UTP (unshielded twisted pair) cable can be used for short and intermediate-length connections (up to 100 meters or 330 feet is suggested as a guideline). Utah Scientific recommends that shielded Category-5 cable, or equivalent, be used for longer runs, or in any environment where high radio-frequency field strengths exist, such as in proximity to broadcast transmitters.

The following recommendations are made regarding cable connections:

- Ensure that the router frames are installed securely in equipment racks.
- Ensure that equipment racks are connected to a properly designed facility ground system.
- Due to the compactness of the Utah-400 Data Router Backplane RJ-45 connector array, it may be useful to have a connector chart convenient to the rear panel for reference.
- Label the port cables connecting to the rear panel – for example: VTR1 – Control.
- Avoid mechanical stress on the rear panel RJ-45 connections by providing proper strain relief of all cables.
- All matrix connections are intended as point-to-point. Do not wire “Tee” connections to loop a port signal. This will result in serious signal degradation and/or port signal contention.

Figure 2-10 shows the entire Utah-400 64 Port Data Router Matrix Backplane.

Figure 2-11 shows the port assignments at the rear panel; use this matrix as a reference to connect the port cables to the chassis.

Figure 2-12 shows the Utah-400 Data Router pin assignments for the data-matrix modular RJ-45 receptacles.

Figure 2-13 shows an optional adaptor assembly used to convert an RJ-45 cable to interface to a D-subminiature mating connector.

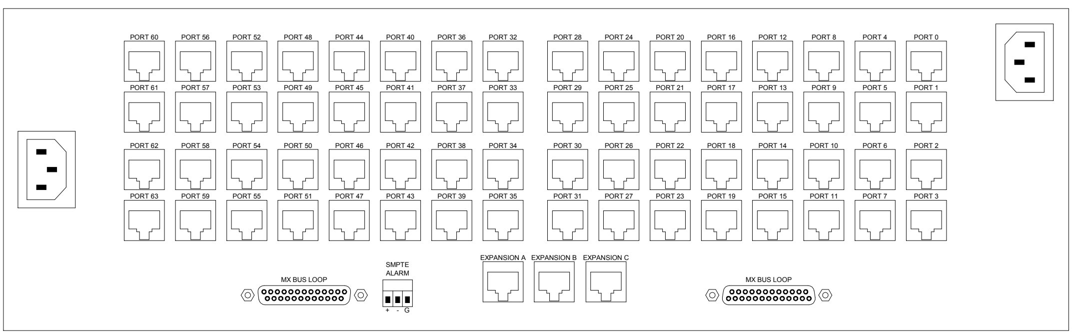


FIGURE 2-10. Complete Utah-400 Data Router Rear Panel

60	56	52	48	44	40	36	32	28	24	20	16	12	08	04	00
61	57	53	49	45	41	37	33	29	25	21	17	13	09	05	01
62	58	54	50	46	42	38	34	30	26	22	18	14	10	06	02
63	59	55	51	47	43	39	35	31	27	23	19	15	11	07	03

Utah-400 Data Port Assignments

FIGURE 2-11. Data Router Port Connector Matrix

Modular RJ-45 Serial Port Pin Assignments

As described above, the Utah-400 Data Router provides 64 bi-directional serial ports using Modular RJ-45 connectors located on the rear panel of the chassis. Pin numbers are assigned to the RJ-45 receptacles as follows:

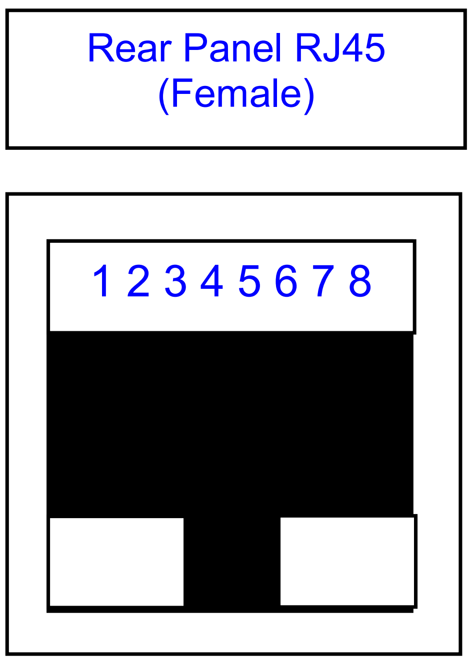


FIGURE 2-12. RJ-45 Receptacle Pin Assignments

SMPTE-207M Serial Port Information

All ports on the Utah-400 data router are electronically reversible between SMPTE-207M Bus Controller mode and Tributary mode. Power-on default at each port is Tributary mode with TX disabled. The port sense can be reversed, as required, and TX is enabled as soon as a port connection is established. Reference to SMPTE-207M is in terms of electrical characteristics only.

The default pin assignment is shown in the table:

TABLE 2-4. Utah-400 Data Router Pin Assignment – Tributary Mode

SMPTE-207M Tributary Pin Assignment 8-Pin RJ-45 Connector		
Pin	Description	Direction
1	Frame Ground	
2	Frame Ground	
3	TX Common	
4	TX-	Out
5	TX+	Out
6	RX Common	
7	RX+	In
8	RX-	In

If the sense of a port is electronically reversed, the pin assignment becomes:

TABLE 2-5. **Utah-400 Data Router Pin Assignment - Controller Mode**

SMPTE-207M Bus Controller Pin Assignment 8-Pin RJ-45 Connector		
Pin	Description	Direction
1	Frame Ground	
2	Frame Ground	
3	RX Common	
4	RX-	In
5	RX+	In
6	TX Common	
7	TX+	Out
8	TX-	Out

D-subminiature Adaptors

The interface connector specified in the SMPTE-207M standard is a 9-pin D-subminiature type, as used on many types of third-party equipment. To readily accommodate this type of interface, Utah Scientific offers adaptor assemblies with Modular RJ-45 receptacles at one end and DE-9 male or female connectors at the other. A typical adaptor, which mates directly with a D-subminiature connector, is pictured in Figure 2-13:

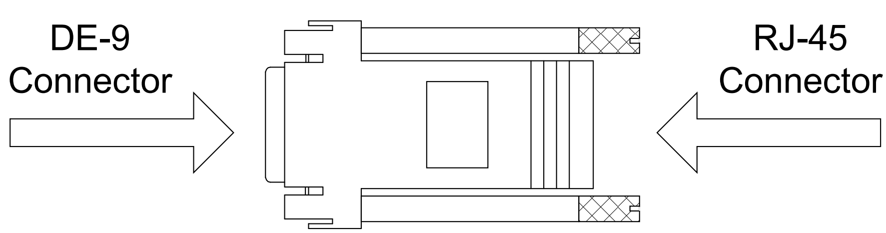


FIGURE 2-13. **D-subminiature to RJ-45 Adaptor**

Pre-wired adaptors can be purchased with the following Utah Scientific part numbers:

TABLE 2-6. Utah-400 Data Router Adaptor Part Numbers

D-subminiature to Modular Adaptors	
Utah Scientific Part Number	Description
140064-04	Adaptor – RJ-45 Female to DE-9 Male
140064-05	Adaptor – RJ-45 Female to DE-9 Female

Both adaptor assemblies use the same pin assignment convention. When the connecting router port is in its default SMPTE Tributary mode, the adaptor pin assignment corresponds to table 2-7:

TABLE 2-7. Utah-400 Data Router Port Adaptor in Tributary Mode

D-subminiature Adaptor Pin Assignment Tributary Mode		
RJ-45 Pin	Description	DE-9Pin
1	Frame Ground	1
2	Frame Ground	9
3	TX Common	6
4	TX-	2
5	TX+	7
6	RX Common	4
7	RX+	3
8	RX-	8

When the connecting router port is in SMPTE Controller mode, the adaptor pin assignment corresponds to table 2-8:

TABLE 2-8. Utah-400 Data Router Port Adaptor in Controller Mode

D-subminiature Adaptor Pin Assignment Controller Mode		
RJ-45 Pin	Description	DE-9Pin
1	Frame Ground	1
2	Frame Ground	9
3	RX Common	6
4	RX-	2
5	RX+	7
6	TX Common	4
7	TX+	3
8	TX-	8

Pin assignments at the DE-9 connectors are consistent with SMPTE-207M specifications.

Data Matrix Signal-Line Terminations

All differential transmit and receive signal-pairs in the data port matrix have provision for line-to-line termination resistors. As the Utah-400 Data Router is shipped from the factory, all signal-pairs have their termination resistors, nominally 100 ohms, enabled. This configuration will cover the bulk of applications, but there are some special circumstances that may require disabling certain termination resistors.

In general, the requirement for far-end termination of data transmission cables is governed by the relation

$$t_r > 4t_{delay}$$

where tr is the rise (or fall) time of the driver and tdelay is the propagation delay time of the cable. If the inequality is satisfied, the transmission line is considered “short” and a far-end termination is not strictly required. The minimum driver signal rise/fall-time specified by SMPTE-207M is 140 nanoseconds, which requires far-end termination for cables longer than approximately 7 meters (23 feet). Termination resistors present on short lines are almost always benign and may be disregarded.

Since SMPTE-207M requires communication links to function at cable lengths up to 1220 meters (approximately 4000 feet), RX differential pairs require termination resistors. Because either differential signal-pair in the port, pair-A or pair-B, may be assigned as the RX pair, a termination resistor is provided for each signal-pair. However, the extra load that a termination resistor imparts to a local TX driver reduces its nominal output signal swing to 1.50 Vpk-pk; whereas SMPTE-207M requires a minimum drive level of 2.00 Vpk-pk.

Generally, in interfacing modern equipment, which uses common RS-422/RS-485 line receivers, this is not an issue due to increased RX input sensitivity of these receivers that exceeds SMPTE requirements. With problematic equipment, however, removable shunts to open the termination resistors at the TX drivers are provided.

To change the Utah-400 Data Router Port Terminations:

Note: The Utah-400 Main Board Assembly must be partially removed from the chassis to make port termination configuration changes. If the router has on-air signals present, do not attempt reconfiguration until it can be completed during off-air time periods.

1. If the Utah-400 is not powered down, disconnect it from the power source.
2. Remove the front cover from the Utah-400.
3. Pull the Main Board Assembly out of the router using the board ejectors located on the left and right hand sides of the board.
4. On the Main Board Assembly, locate the port termination shunts. See Figure 2-14.

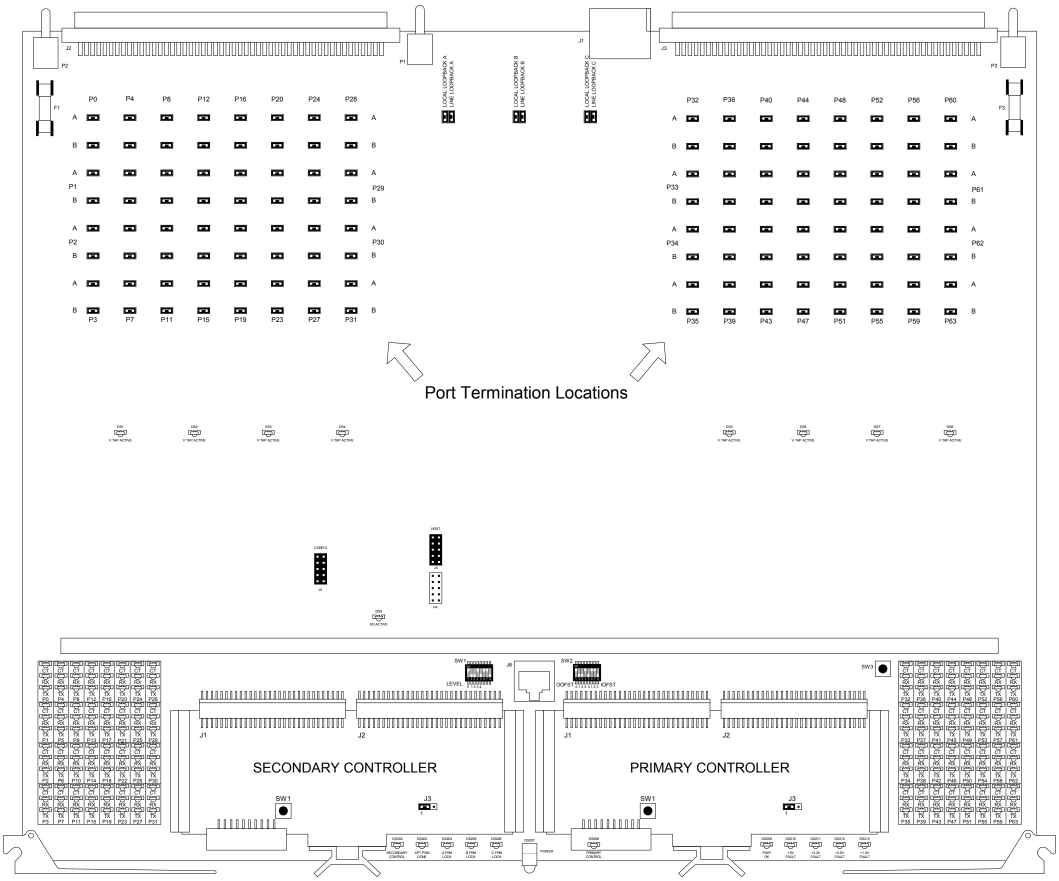


FIGURE 2-14. **Main Board Assembly Port Termination Shunt Locations**

5. The left array of shunts supports matrix data ports 0-31 and is shown in greater detail in Figure 2-15. Note that the shunts are arranged in a rectangular array of eight columns of four ports each, and eight rows accommodating the A and B pairs for the four ports per column.

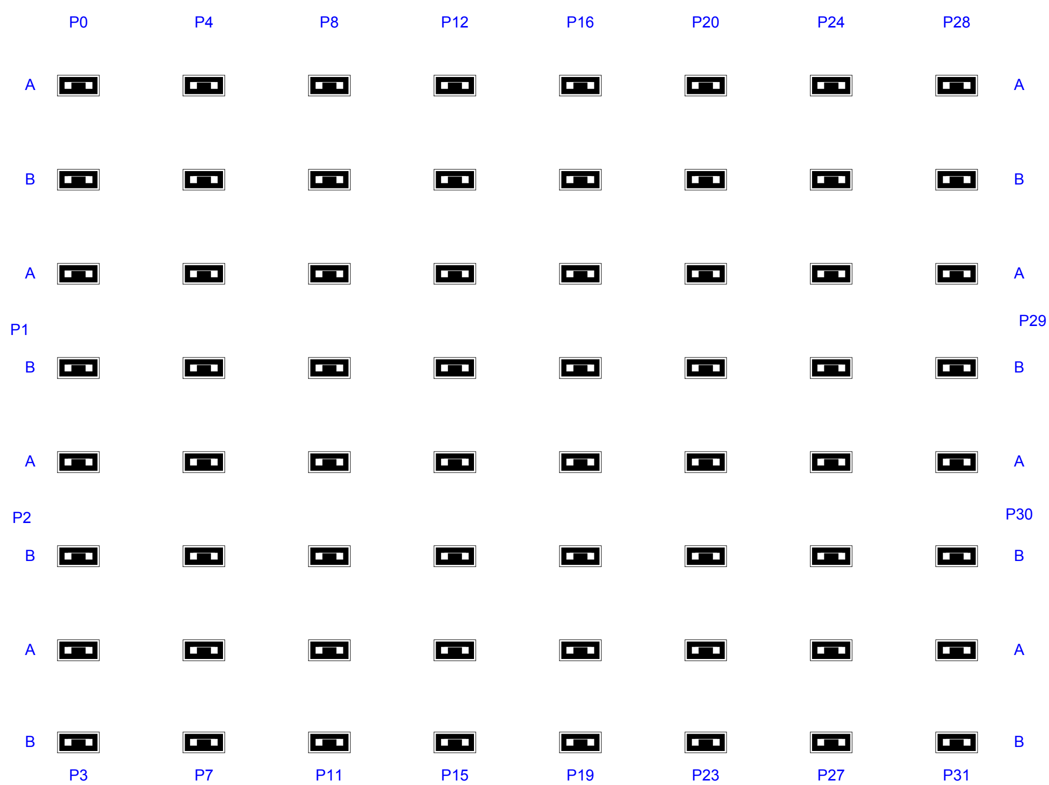


FIGURE 2-15. Main Board Assembly – Port 0-31 Termination Shunt Arrangement

6. The right array supports data ports 32-63 and is shown in greater detail in Figure 2-16. These shunts are arranged in the same format as the left array.

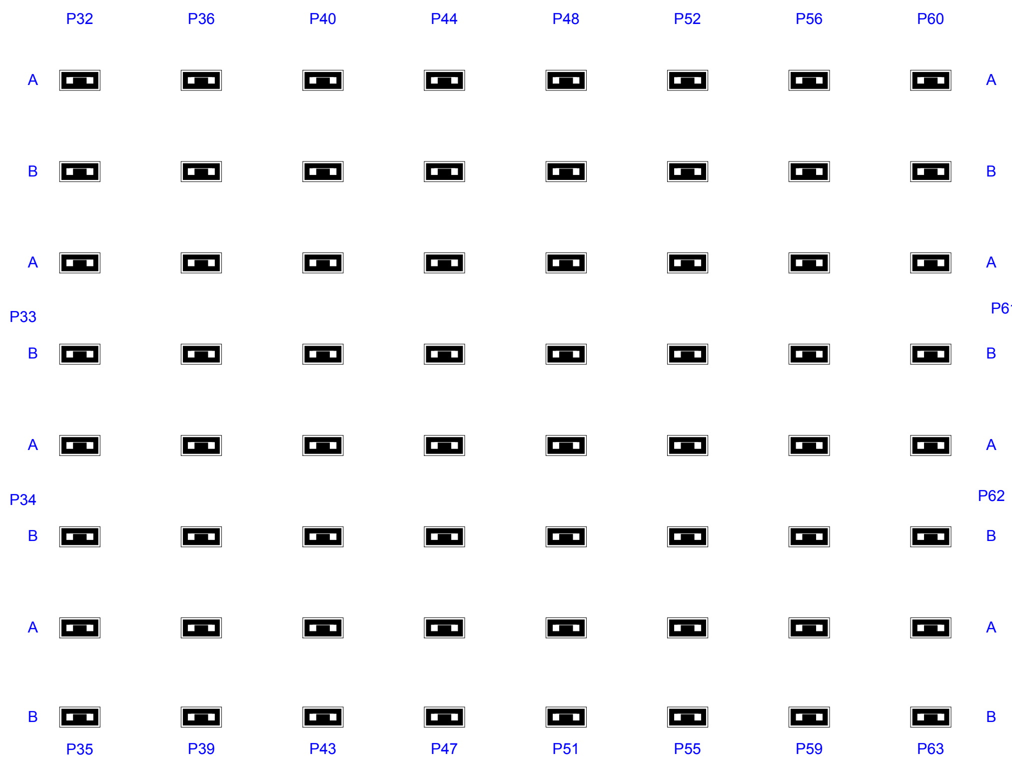


FIGURE 2-16. Main Board Assembly – Port 32-63 Termination Shunt Arrangement

7. Using the figures above, identify the ports and the signal-pair within each port where it is desired to remove the terminations (these are normally limited to TX ports where it is necessary to increase drive signal amplitude).
8. Open the terminations, as required, by removing the shunt from its header pins. (The shunt may be “stored” for future use by re-inserting it over one of the two header pins.)
9. It may be useful to make a written record of the termination (shunt) configuration for future reference without having to disrupt the router.
10. Re-insert the Main Board Assembly into the router chassis, reinstall the front cover, and re-apply power.

Matrix Expansion Facilities

Each Utah-400 Data Router chassis is provided with three high-speed bi-directional serial links to effect switching matrix expansion to a maximum of 256 bi-directional ports.

Each high-speed transceiver transmits a TDM (time-division multiplex) signal that encodes the 64 local matrix inputs. The receive-channel of the transceiver conveys the 64 inputs from the alternate chassis with which it is linked. This cross-connection allows the inputs present at either chassis to be available to the switching matrices of both chassis. The TDM scheme processes the asynchronous data streams present at the matrix ports by using very high factors of over-sampling. Each matrix input serial data stream, which is limited to 115 kBaud, is sampled at 7.5 MHz. Since the sampling process is asynchronous, the high over-sampling ratio ensures that the jitter imparted to the sampled matrix input signals is kept very small. The multiplexed expansion link, including the over-sampled local matrix inputs and synchronization "overhead", operates at 900 MBaud.

I/O for each bi-directional link is interfaced with a Modular RJ-45 connector on the rear panel of the router chassis. The external connection is made with shielded Category-5E cable with its RJ-45 plugs wired as a "crossover" cable, as used in Ethernet applications. Two chassis are interconnected with a single cable to implement a 128-port switching matrix; three chassis with three cables to implement a 192-port matrix; and four chassis with a total of six cables to implement a 256-port matrix. The receive-port signals in the three high-speed serial links on a given chassis are assigned to specific matrix input ranges. Those assignments are affected by the setting of the local MX-bus address-offset DIP switches, so that the matrix space is always contiguous, starting at address zero.

Figure 2-17 shows the rear panel of a Utah-400 Data Router and the location of the expansion ports.

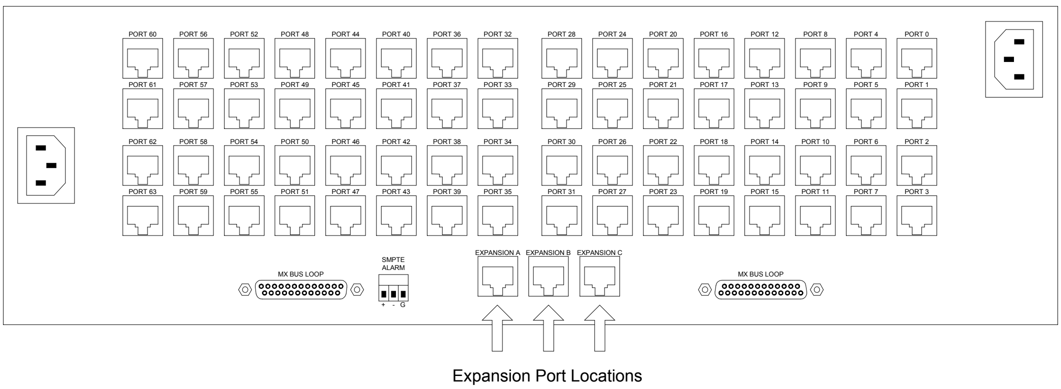


FIGURE 2-17. Utah-400 Data Router Rear Panel Expansion Ports

Utah-400 Data Router chassis must be linked using specific expansion ports to implement larger switching matrices. Figures 2-18, 2-19, and 2-20 show standard connections for 128, 192, and 256 port systems, respectively.

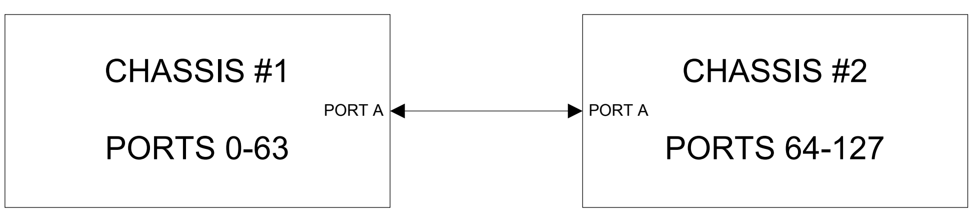


FIGURE 2-18. Utah-400 Data Router – 2-Chassis System

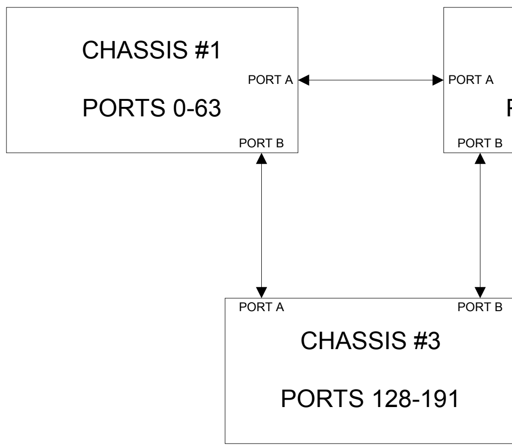


FIGURE 2-19. Utah-400 Data Router – 3-Chassis System

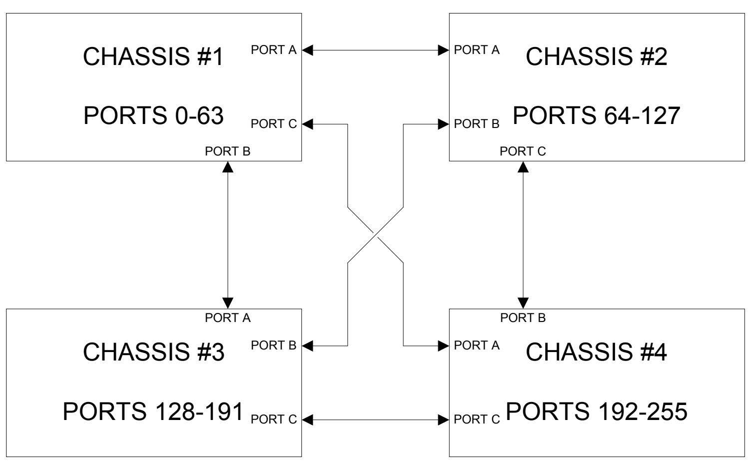


FIGURE 2-20. Utah-400 Data Router – 4-Chassis System

In support of these interconnects, the input and output offset dipswitches at the Main Board Assemblies of the (up to) four chassis must be set specifically to map the expansion-port input signals to specific address ranges. Table 2-9 lists those settings:

TABLE 2-9. Utah-400 Data Router Expansion Systems Offset Dipswitch Programming

Utah-400 Data Router Expansion Systems Offset Dipswitch Programming										
Chassis	Input Offset Dipswitch Assignment				Output Offset Dipswitch Assignment				Input Range	Output Range
	1	2	3	4	1	2	3	4		
1	On	On	On	On	On	On	On	On	0-63	0-63
2	Off	On	On	On	Off	On	On	On	64-127	64-127
3	On	Off	On	On	On	Off	On	On	128-191	128-191
4	Off	Off	On	On	Off	Off	On	On	192-255	192-255

Utah-400 Data Router system expansion facilities are designed to be used with short external interconnect cables. Each chassis is furnished with one shielded crossover cable 3 feet in length, Utah Scientific part number 94005-2003.

The following guidelines are offered for expanded systems:

1. All interconnected Utah-400 Data Router chassis should be co-located in the same equipment mounting rack, or in immediately adjacent racks
2. If the Data Router chassis are deployed in adjacent racks, proper system grounding between/among the racks is essential
3. Expansion port interconnect cables must never be greater than 6 meters (20 feet) in length.

SMPTE Alarm Facility

The SMPTE Alarm terminal block on the rear of the chassis provides a means to connect external alarm signaling equipment to the Utah-400 Data Router. Alarm indications include the following:

1. Internal power supply failure
2. Internal cooling fan failure
3. Internal over-temperature

4. External power source failure

The alarm terminal block is positioned on the rear panel of the chassis. Figure 2-21 shows its location:

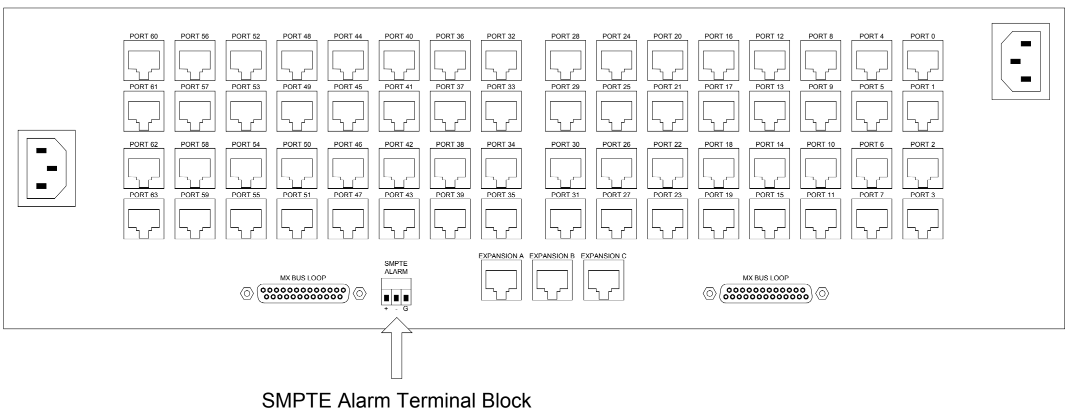


FIGURE 2-21. Utah-400 Data Router – External Alarm Connection

The alarm circuit provides a “dry” circuit relay contact closure across terminals (+) and (-) during an alarm condition. Terminal (G) is a chassis ground connection to provide a ready means to connect an external cable shield conductor.

The router system’s internal relay contacts are intended for a low-voltage, low-current external circuit. Contact ratings are 30 VDC at 1 Ampere, resistive, maximum. Although the alarm circuit is isolated from other circuits in the Utah-400 Data Router, alarm circuit potentials should be maintained to within 30 VDC of system ground.

Note that removing power from the router chassis will result in an alarm condition, closing the alarm contacts. As a convenience during system maintenance, the alarm terminal block is a “docking” type and may be unplugged to open the alarm circuit to silence an external alarm, if necessary.

Connecting and Disconnecting Power

The Utah-400 Data Routing System is designed for continuous power; there is no AC Power Switch on the router.

> **Important**: The AC power cord is the only facility with which chassis power can be connected or disconnected. **In case of an emergency, the user should have quick access to the AC plug(s) or an external electrical disconnect.**

Power redundancy is built into Utah-400 Data Routing Systems. The power cords plug into the right and left hand sides of the chassis rear panel. Either AC source can power the routing system independently.

This provides the flexibility to connect one AC Source to the standard utility source; with the second AC Source being connected to an uninterruptible system, such as a backup generator system.

Reference Figure 2-22, AC Power Connections, for the following instructions.

- On the back of the chassis locate the left and right AC IEC connectors
- Plug the IEC end of the power cord into the chassis IEC socket
- Plug the 3-pronged NEMA AC Plug into the desired AC source(s)

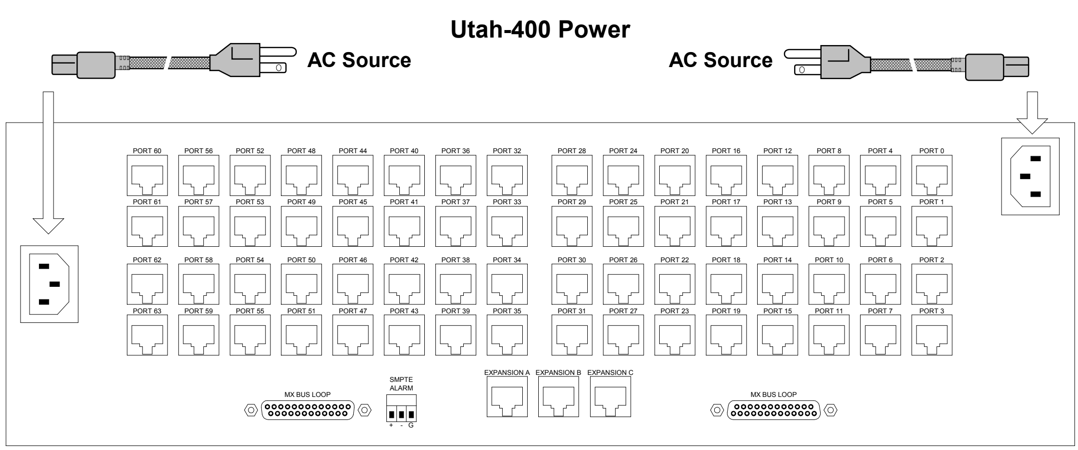
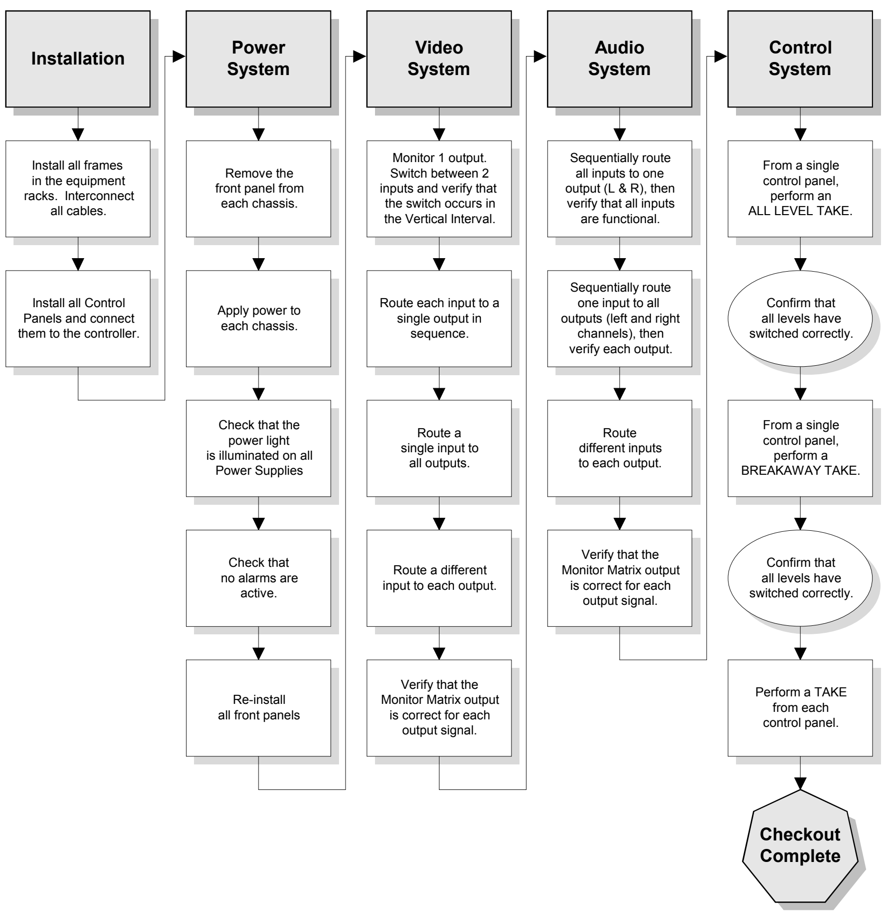


FIGURE 2-22. Utah-400 Data Router Power Connections

Hardware Checkout

Use the following flow chart to check out your Utah-400 System. Note the following important points:

- For the Video and Audio System columns may be switched numerically if encoding is not required.
- For the System Control column, the SC-4 Control system may require some configuration in order to perform all functions.



CHAPTER 3

System Operations

This section contains detail pertinent to your UT-400 Data Router operation. The following topics are included:

Data Port Indicators

Signal activity and configuration at the matrix data ports is reported by two arrays of LED status indicators. One LED array supports chassis I/O ports 0-31 and the second supports chassis I/O ports 32-63. See Figure 3-1 for the locations of the LED indicators on the main board assembly.

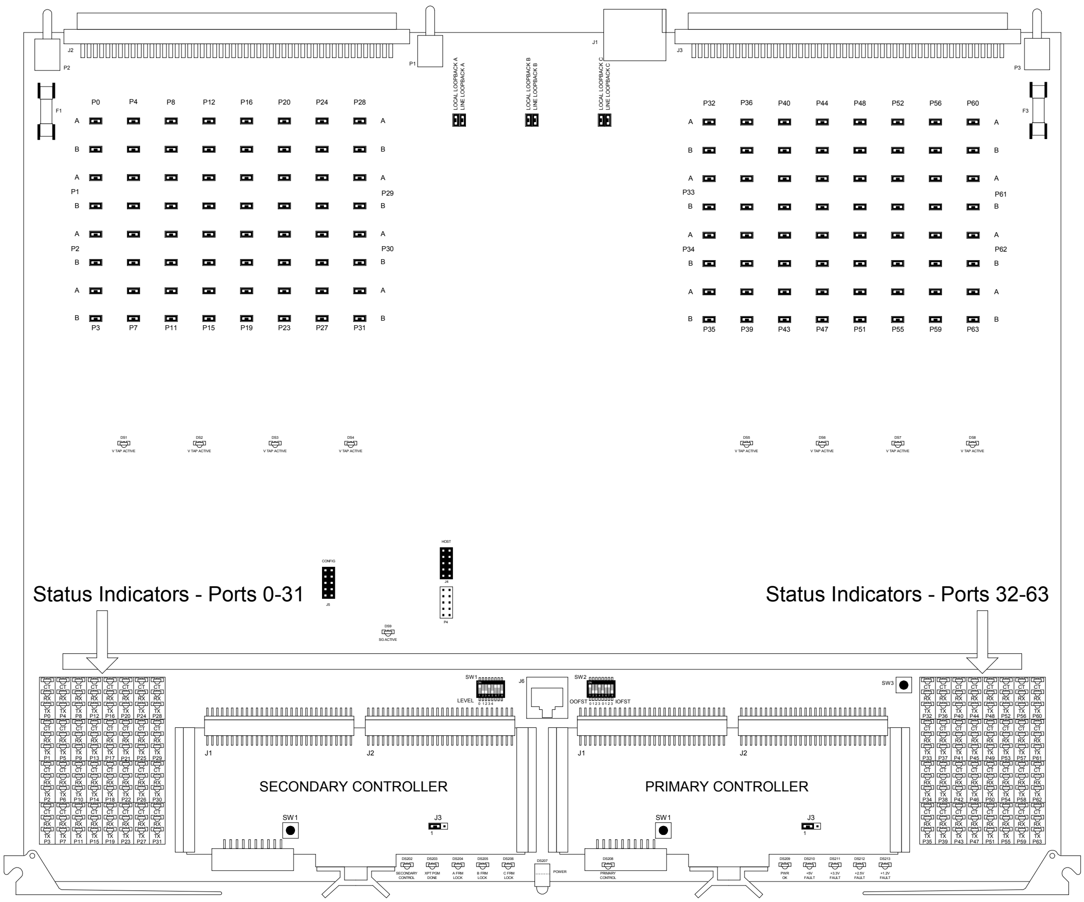


FIGURE 3-1. Port Status Indicator Locations

Figure 3-2 shows a closer view of the left hand status indicator array. Other than the port assignments, the right hand status indicator array is identical.

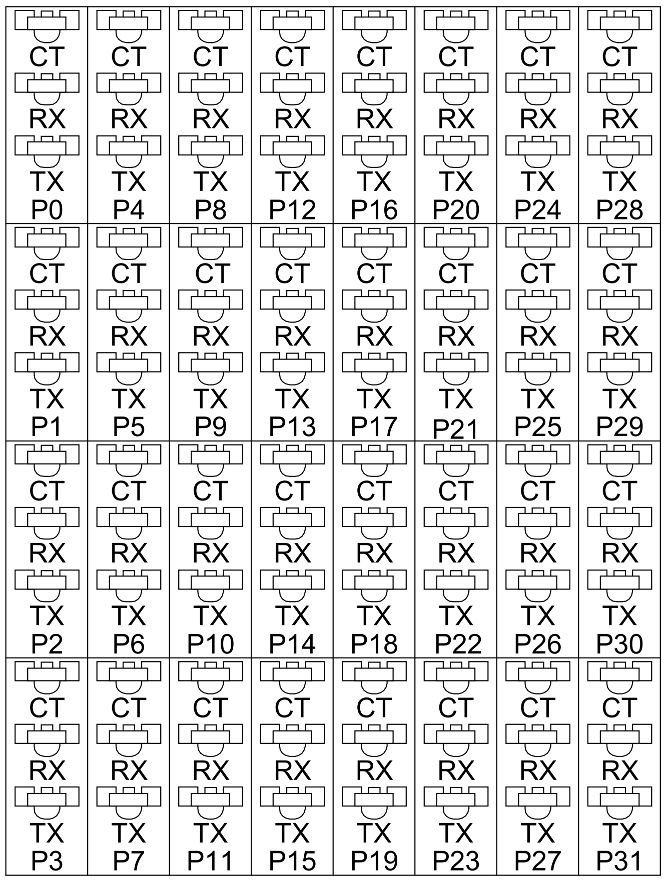


FIGURE 3-2. Port Status Indicator Array – Ports 0-31

Each port has three LED indicators associated with it. The indicators for each port are grouped within a white silk-screened box on the PCB and identified with a port number. For example, at the upper left corner of Figure 3-2 data port 0 is identified as “P0”. Within the group of three indicators associated with a port, the following functions are assigned:

A green LED marked “CT” illuminates when the associated port is placed in SMPTE “controller” mode. This LED is dark when the port is in SMPTE “tributary” mode.

A yellow LED marked “RX” is associated with the port’s receive function. Low-to-high transitions of a received signal trigger this LED. When triggered, this LED stays illuminated for a minimum of 133 milliseconds to make very low duty-cycle data traffic visible at the indicator.

A red-green bicolor LED reports activity at the port’s transmit-driver. When the port is enabled and a logic-zero state is transmitted, the “TX” LED is illuminated red. When the port is enabled and a logic-one state is transmitted, the “TX” LED is illuminated green. A pulse-conditioning arrangement is implemented such that with very low duty-cycle data traffic, the non-dominant logic state illuminates its corresponding LED color for a minimum of 133 milliseconds for visibility. When a port’s transmit section is disabled, the “TX” LED output is suppressed.

Main Board Status Indicators

Twelve status indicators populate the forward edge of the main board assembly. Refer to Figure 3-3 for the location of these indicators.

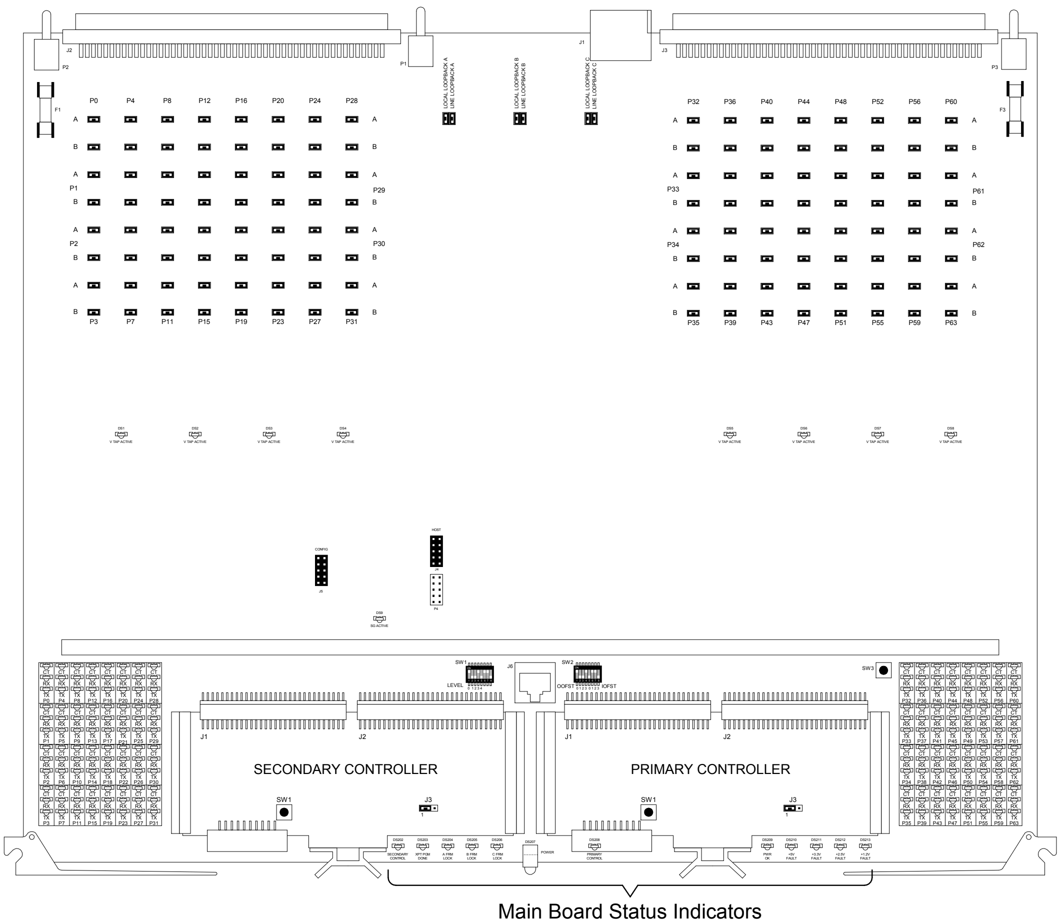


FIGURE 3-3. Main Board Status Indicators

The following table contains the functions of these indicators (left to right):

TABLE 1.

Indicator Legend	**Function**
Secondary Control (Green)	Illuminates when the secondary controller subassembly has control of main board functions and is reporting system status via the MX bus.
XPT Program Done (Green)	Illuminates when the main crosspoint/multiplexer/demultiplexer circuit on the main board has been successfully configured and is ready for operation.
A FRM Lock (Green)	Illuminates when the expansion transceiver device associated with expansion port A locks to the framing of an expansion signal from an alternate chassis. This indicates that a valid signal has been found and synchronization has been achieved.
B FRM Lock (Green)	Illuminates when the expansion transceiver device associated with expansion port B locks to the framing of an expansion signal from an alternate chassis. This indicates that a valid signal has been found and synchronization has been achieved.
C FRM Lock (Green)	Illuminates when the expansion transceiver device associated with expansion port C locks to the framing of an expansion signal from an alternate chassis. This indicates that a valid signal has been found and synchronization has been achieved.
Power (Red/Green)	Illuminates green when voltage monitor indications from the main board assembly, and voltage, temperature, and fan monitor indications from both power supply assemblies are satisfactory. Illuminates red when a fault condition is detected. This indicator is visible with the chassis front cover installed.
Primary Control (Green)	Illuminates when the primary controller subassembly has control of main board functions and is reporting system status via the MX bus.
PWR OK (Green)	lluminates when all voltage monitor indications at the main board assembly are satisfactory.
+5V Fault (Red)	Illuminates when a fault condition is detected in the +5.0 volt power supply at the main board assembly.
+3.3V Fault (Red)	Illuminates when a fault condition is detected in the +3.3 volt power supply at the main board assembly.
+2.5V Fault (Red)	Illuminates when a fault condition is detected in the +2.5 volt power supply at the main board assembly.
+1.2V Fault (Red)	Illuminates when a fault condition is detected in the +1.2 volt power supply at the main board assembly.

Main Board ScanGate Indicators

Nine additional status indicators on the main board assembly indicate functionality of an internal serial communication bus called the ScanGate bus. Refer to Figure 3-4 for the location of these indicators.

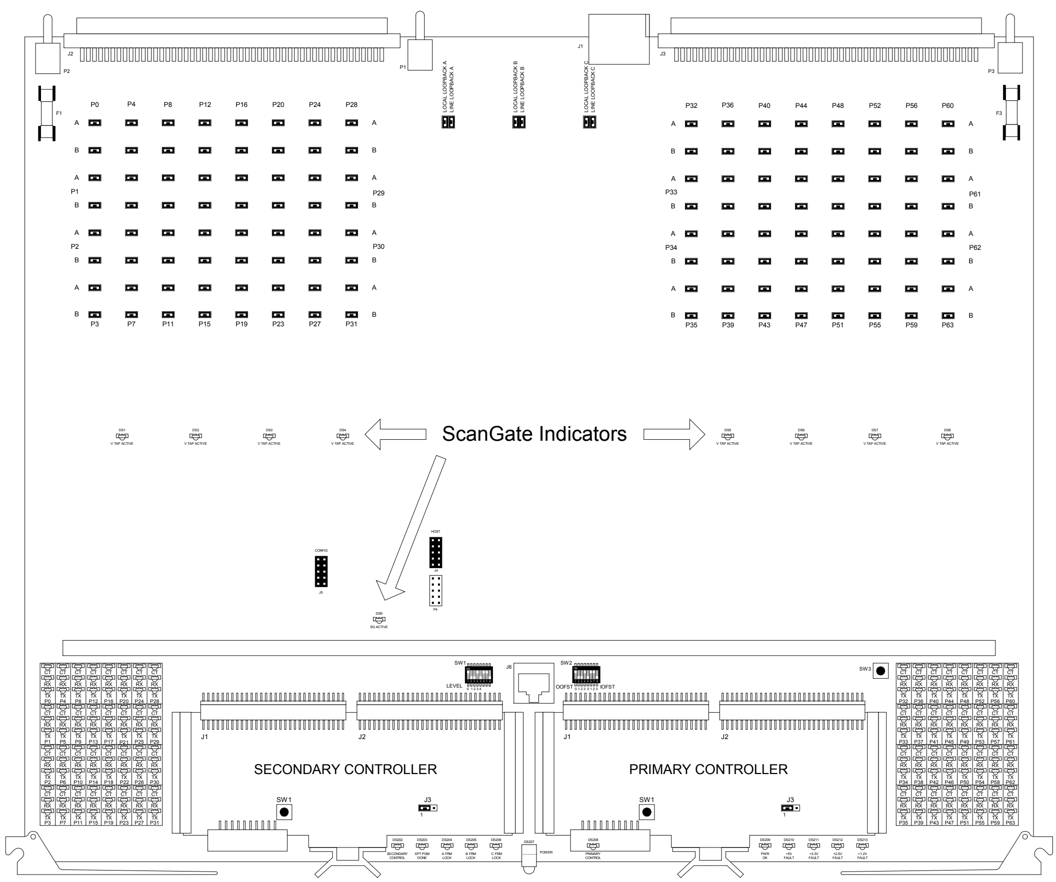


FIGURE 3-4. Main Board ScanGate Indicators

During normal system operation, all nine of these indicators are illuminated, indicating that either the primary or secondary controller subassembly is actively communicating with port interface devices on the main board assembly. If the main board has power and these indicators are not illuminated, it indicates that there is a failure with the enabled controller or main board assembly.

Power Supply Status Indicators

The power supply subassemblies in the Utah-400 data router chassis provide individual status indications. Refer to figure 3-5 for a graphic of the left power supply assembly. The right power supply assembly is identical except that it is physically inverted.

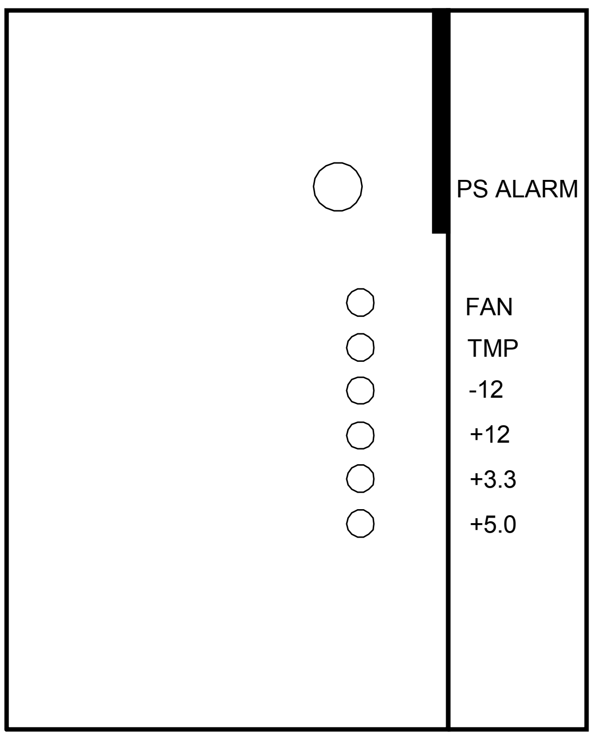


FIGURE 3-5. Power Supply Status Indicators

The following table describes the functions of these indicators (top to bottom):

Indicator Legend	Function
PS Alarm (Red/Green)	Illuminates green when voltage, temperature, and fan monitor indications from the power supply assembly are satisfactory. Illuminates red when a fault condition is detected.
Fan (Red)	Illuminates when the assembly's fan is rotating slower than a predetermined detection threshold.
TMP (Red)	Illuminates when the assembly's temperature sensor reports a temperature in excess of a predetermined detection threshold.
-12 (Red)	Illuminates when the magnitude of the voltage of the -12 volt output of the power supply is below threshold. Note: This power supply output is not used in the Utah-400 Data Router application.
+12 (Red)	Illuminates when the voltage of the +12 volt output of the power supply assembly is below threshold. This power supply output is used to energize the cooling fan in the power supply subassembly.
+3.3 (Red)	Illuminates when the voltage of the +3.3 volt output of the power supply assembly is below threshold.
+5.0 (Red)	Illuminates when the voltage of the +5.0 volt output of the power supply assembly is below threshold.

Reset Switch

The location of the reset switch on the main board assembly is illustrated in figure 3-6.

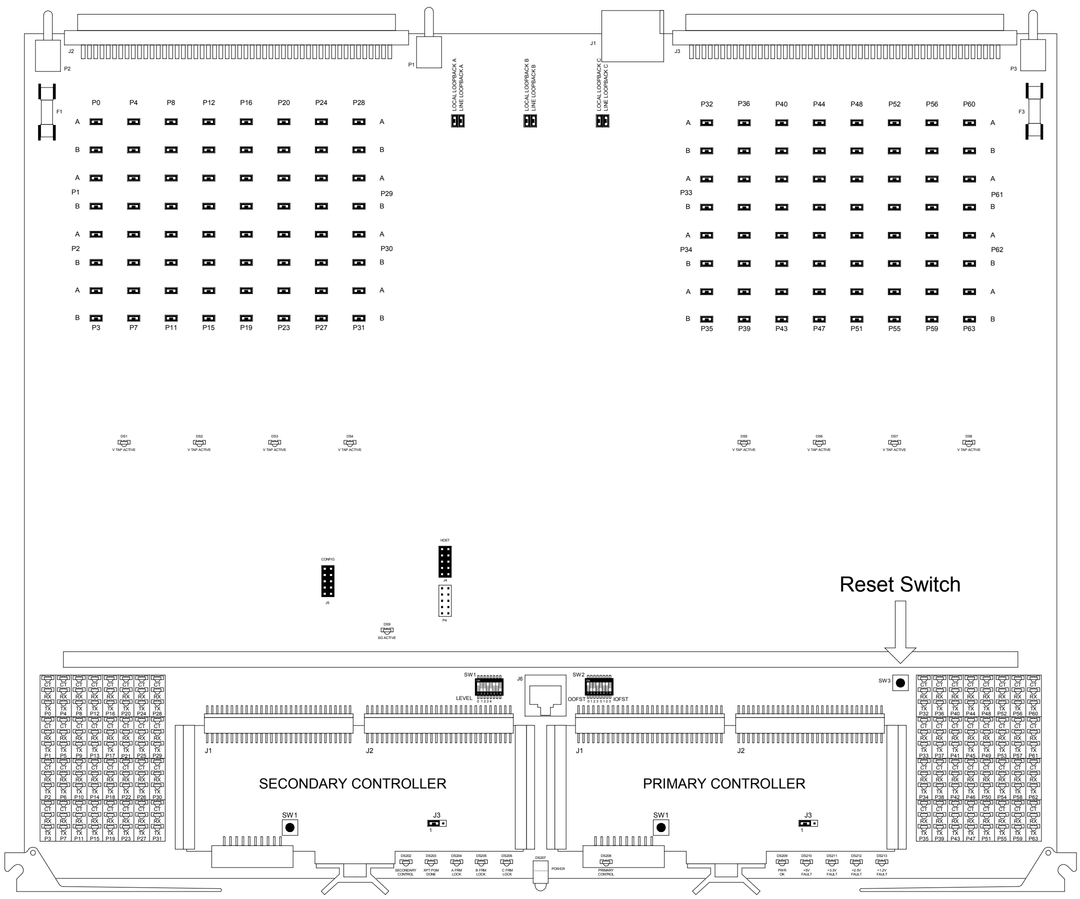


FIGURE 3-6. Reset Switch

The reset switch, when pressed and released, will reinitialize the main board assembly's cros-spoint/multiplexer/demultiplexer device, expansion transceivers, and port interfaces, clearing all matrix connections in the process. If the Utah-400 Data Router is being actively controlled by a system controller such as the SC-4, the matrix connections and port configurations will be refreshed in several seconds. If the Data Router is not under active control, the connections and configuration will not be refreshed. This function would normally be invoked only during system troubleshooting.

> ***Caution: The reset switch should never be pressed unless it is safe to do so, i.e. when there is no critical router traffic to disrupt.***

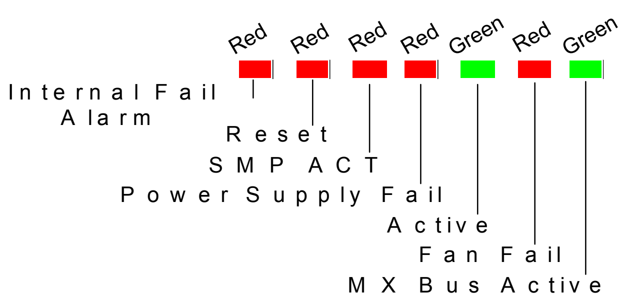
FPGA Control Board

The Crosspoint board module decodes the incoming information delivered through the MX bus cable. The MX connection itself is located at the center rear of the crosspoint card. The module queries the power supplies for status determination, and controls the tachometer for the chassis' 4 cooling fans. The crosspoint board module also contains a contact closure that is used to identify error conditions associated with crosspoint card's SMPTE alarm.

This module is part of a redundant pair, with the right hand (front) module acting as the default active.

FIGURE 3-7. Video Crosspoint Board Module

Module LED Indications



Internal Fail Alarm (Red)
Lit when the card is experiencing a problem with its internal power supplies.

Reset (Red)
Indicated when the card is in a stand-by mode.

Power Supply Fail (Red)
Indicates a problem with one of the UT-400's power supplies.

Active (Green)
Indicates the current card is 'active' when lit.

Fan Fail (Red)
Indicates a problem with one if the four cooling fans.

MX Bus Active (Green)
Data is being received correctly.

CHAPTER 4

Troubleshooting

Note: Parts of this section were derived from the Utah-200 Manual; some areas may not apply directly to the Utah-400 but will be corrected in the next version of this manual.

In This Chapter

This chapter is designed to help the user diagnose problems on the Utah-400 Routers to the subsystem level. There are no repairable boards in the Utah-400 system, contact Utah Scientific Technical Services at 800-447-7204 regarding any problems you may be having. Should any printed circuit boards need repair, Technical Services can advise you on shipping and on the repair process.

Subsystem Level Troubleshooting

A routing system is typically comprised of several subsystems:

- Video System
- Audio System
- Control System
- Power System

Fault finding is simplified by first isolating the problem to one of these subsystems. For example, if the audio-system is functioning normally, but there are problems with video, the problem is probably confined to the video system.

Note: With the exception of a system using Digital Video with embedded audio, audio signals are switched through a different matrix than the video signals.

Main Troubleshooting Chart

The following table provides an indication of what subsystems should be reviewed for common problems.

Please note:

- The numbers shown in the four Subsystem Table Reference columns indicate specific troubleshooting problems that are found in the four individual Subsystem Tables.
- For example: a 1 listed under the Video column refers to problem number 1 in the "Video Subsystem Table" on the following page. Here you will find a list of specific checks that will assist in troubleshooting the problem.

TABLE 4-1. Main Troubleshooting Table

Problem	Subsystem Table Reference			
	Video	Audio	Power	Control
No Video or Audio outputs	1	1	1,2	1
Video and Audio outputs are present but neither can be switches	2,3	2,3		1,2,6
No Video output, Audio functions normally	1,2,3		1	2
No Audio output, Video functions normally		1,2,3	2	2
Video switches normally but audio does not switch		2,3		2
Audio switches normally but the video does not switch	2,3			2
Flash on video when switching	4			
Cannot access expansion inputs or outputs of video level	5			
Audio signal level incorrect		4		
Video signal level incorrect	7			
Video signal anomaly	5,6,8			
Video monitor matrix not functional	9			
Audio monitor matrix not functional		5		
Control panel does not function				1,2,3
Control via serial port not functional				4
Ethernet control port not functional				5
Alarm port active			3	6
SC-4 Ports not "Active"			3,4	4,5
Undefined level types in SC-4 Controller				1,2,4

Video Subsystem Troubleshooting Table

Use the following table to troubleshoot specific video subsystem problems. The numbers in the left-hand column indicate specific references from the Video column in the **Main Troubleshooting Table**.

TABLE 4-2. **Video Subsystem Troubleshooting Table**

Problem		Check
1	No video output	• Control cable connected, or internal controller functional? • Different input works on output bus? • Other outputs functional?
2	Unable to select a specific input	• Control panel programming correct? • Output signal level locked or protected?
3	Unable to select any input	• Control cable connected? • Control panel defective? • Controller failure?
4	Video flash when switching between inputs	• Input sources timed correctly? • Input reference signal present and timed? • Input reference correct standard? • Correct video standard jumper set on controller board?
5	Inputs / Outputs inaccessible	• Expansion matrix crosspoint cards present?
6	Sync missing on video output (analog)	• Sync present on selected input? • Normal DC level on input?
7	Video output level incorrect	• Input level correct • Output terminated at destination (analog)? • Input/output compensation jumpers correctly set?
8	Sparkles on video output (digital)	• Input signal amplitude too low? • Cable length > 300 meters on input?
9	Monitor Matrix not functional	• Selected correctly on control panel?

Audio Subsystem Troubleshooting Table

Use the following table to troubleshoot specific audio subsystem problems. The numbers in the left-hand column indicate specific references from the Audio column in the Main Troubleshooting Table.

TABLE 4-3. Audio Subsystem Troubleshooting Table

Problem		Check
1	No audio output	• Control cable connected, or internal controller functional? • Different input works on output bus? • Other outputs functional?
2	Unable to select a specific input	• Control panel programming correct? • Output signal level locked or protected?
3	Unable to select any input	• Control cable connected? • Control panel defective? • Controller failure?
4	Output level incorrect (analog)	• Input level correct? • Input termination in correct position? • Output termination in correct position?
5	Monitor Matrix not functional	• Selected correctly on control panel?

Power Subsystem Troubleshooting Table

Use the following table to troubleshoot specific power subsystem problems. The numbers in the left-hand column indicate specific references from the Power column in the **Main Trouble-shooting Table**.

TABLE 4-4. **Power Subsystem Troubleshooting Table**

Problem		Check
1	No video output	• Power applied to video frame? • Warning indicators on the front of each power supply? • Control cable between chassis connected?
2	No audio output	• Power applied to audio frame? • Warning indicators on the front of each power supply? • Control cable between chassis connected?
3	Alarm active	• Voltage alarm active (LED on)? • Fan alarm active (LED on)? • Temperature alarm active (LED on)?
4	Controller power	• Power applied to controller frame?

Power Supply Alarms

Power supply alarms are indicated by red LEDs on the front of each power supply module. They consist of voltage, fan, and temperature alarms.

- The voltage alarm indicates that one of the supply voltages is either too high or too low.
- The fan alarm indicates that the fan has stalled.
- The temperature alarm indicates that the temperature is elevated in the power supply. This may be caused by dirt or dust blocking the airway, a defective cooling fan, or by operation in extreme temperatures.

Note: Optional redundant power supplies may be fitted to most UTAH-400 systems. In this configuration, the failure of a power supply should not affect normal system operations, but users would be unaware of the power supply failure. Thus, it is highly advisable to utilize the SMPTE alarm output provided at the rear of the chassis.

Control Subsystem Troubleshooting Table

Use the following table to troubleshoot specific control subsystem problems. The numbers in the left-hand column indicate specific references from the Control column in the **Main Troubleshooting Table**.

TABLE 4-5. **Control Subsystem Troubleshooting Table**

Problem		Check
1	No control of any level	• Internal controller operating? (see below) • External controller connected? • Control panels connected? (see below) • MX bus terminated? (see below) • U-Net terminated? (see below) • Completed controller software upgrade?
2	No control of individual signal level or levels	• MX bus cable connected ? (see below) • MX bus correctly terminated ? (see below) • Is non functional signal level address set correctly ? (see • below). • Control panel programmed correctly ? (see "Operations") • Output locked or protected on that level ? (see "Operations")
3	Control panel not functional	• Panel address set to unique number? • Completed panel software upgrade?
4	Serial control port not functional	• Communications baud rate incorrect? • Serial control Protocol incorrect? • Serial control cable wired correctly?
5	Ethernet port not functional	• Ethernet option fitted? • Connected to PC directly by null cable? • Connected to network via gateway?
6	Alarm active	• Active CPU indicator extinguished? (SC-4) • Heartbeat indicator extinguished? (SC-4) • MX activity light does not flash? (SC-4)

System Controller Alarms

System controller alarms are indicated by LEDs on the front of each controller card.

- Either an active LED (DS4) or standby LED (DS5) should be lit on each controller card. If only one controller is present (non redundant system), the active LED (DS4) should be illuminated.
- The heartbeat LED (DS6) indicates that the processor is communicating with the vital parts of the system and is running the application software.
- The MX LEDs indicates communication with the crosspoint matrix. The transmit LED (DS8) will flash whenever communication is being made from the controller to the matrix. The receive LED (DS7) will flash whenever communication is being received by the controller from the matrix.
- U-Net is used for communication between the controller and the control panels. The U-Net data and U-Net transmit enable LEDs (DS9 and DS10) indicate when information is exchanged between the system controller and a control panel.
- If the active LED (DS4) is on and the U-Net transmit enable LED (DS10) is off, this indicates that a controller software upgrade has failed and the controller is waiting for a valid controller software upgrade to be uploaded.

Please note the following additional points regarding the controller:

- If used with an SC-3 or SC-4 system controller consult the appropriate controller manual for details about the controller card.
- The total MX bus cable length must be less than 300 feet and must be terminated at the last chassis.

Control Panel Troubleshooting

If your control panel does not control any of the matrix, check that power is applied to the panel.

- Panels communicate to the controller by a special network known as U-Net. Panels are connected together daisy chain style to the controller. Removing a panel physically from the network will break the chain and disconnect panels downstream from the controller.
- U-Net uses unshielded twisted pair cable. It requires two twisted pairs terminated in an RJ 45 connector. The maximum length of any segment is 1000 feet and must be terminated at the last control panel in each segment. Refer to the Appendix C "U-Net Cabling" for details.
- The panel may be communicating to the controller correctly, but the required signal level matrix may not be responding. Check the Dipswitch setting on the rear panel of the non-functional router level.

Confirm that the control panel address is a unique number. Each panel address is set by a rear panel Dipswitch and must be a unique address. This control panel address is read when the control panel is powered up.

Diagnostic Loopback Functions

Each of three expansion transceiver devices resident on the Utah-400 Data Router main board assembly has the capability to communicate with an alternate chassis when multiple Utah-400 Data Router chassis are linked to form larger switching matrices.

To facilitate troubleshooting of these larger systems, each expansion transceiver supports "local-loopback" and "line-loopback" diagnostic modes. Local-loopback, when selected, replicates the 64 inputs present at the local chassis matrix port inputs to the alternate range of matrix inputs that the expansion transceiver device supports.

For example, in a 128-port two-chassis configuration, expansion transceiver-A at chassis 1 is linked with expansion transceiver-A at chassis 2. Chassis 1's local inputs represent matrix ports 0-63 while those at chassis 2 represent matrix ports 64-127. If expansion transceiver-A at chassis 1 is placed in local-loopback mode, its matrix inputs 0-63 are replicated at its matrix inputs 64-127, respectively. Similarly, if expansion transceiver-A at chassis 2 is placed in local loopback mode, its local matrix inputs, 64-127, are replicated at its matrix inputs 0-63, respectively.

Line-loopback mode performs a similar function, but at the opposite end of a communication link. For example, in a 128-port two-chassis configuration, placing expansion transceiver-A at chassis 2 in line-loopback mode returns the matrix inputs originating at chassis 1 (0-63) back to chassis 1. This can be used to accomplish verification of the physical link (cable) between the chassis, as well as additional functionality of the expansion transceivers themselves.

Figure 4-1 shows the locations of the expansion transceiver controls on the main board assembly. The local-loopback and line-loopback functions are invoked by removing the appropriate shunts from their header pins.

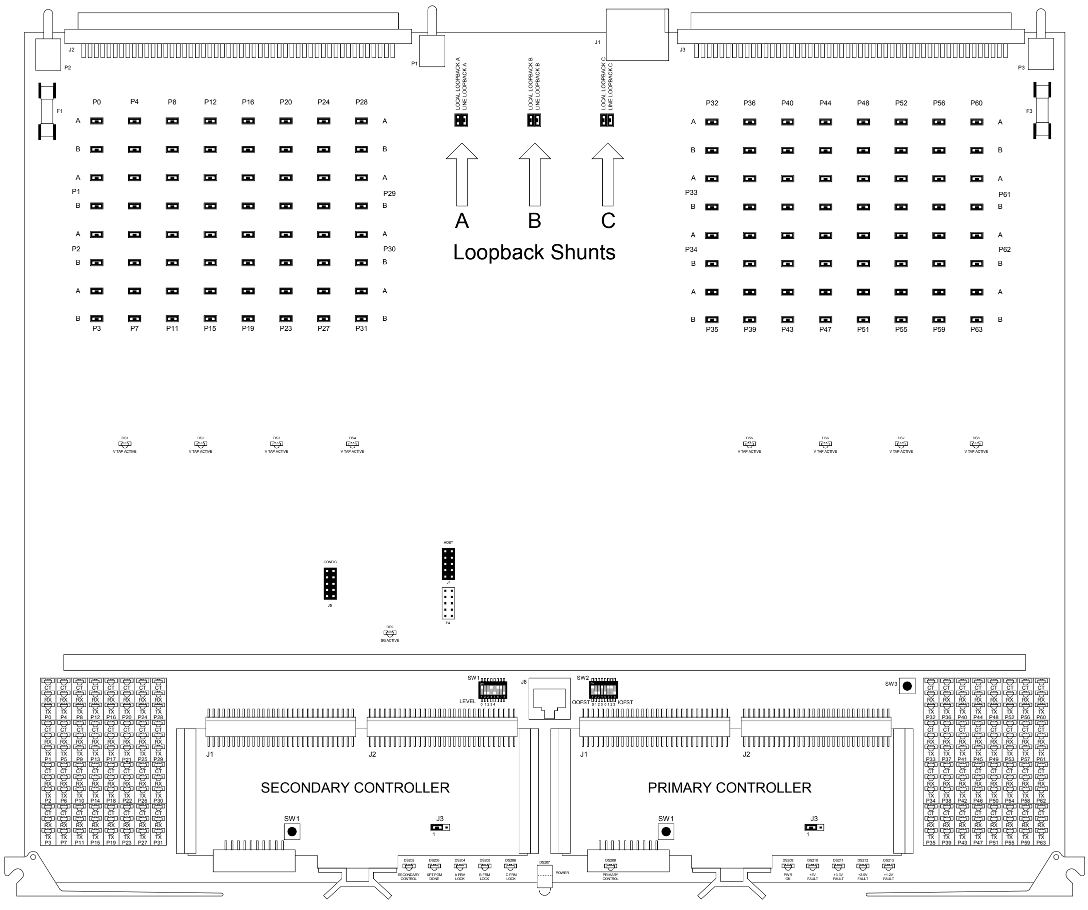


FIGURE 4-1. Loopback Shunts

The PCB is marked to indicate the functionality of a particular header and shunt.

One possible testing scenario using these facilities and building on the previous examples is as follows:

1. Connect test equipment such as a data terminal to port 0 of chassis 1. The equipment should be capable of transmitting a suitable data signal to the receive terminals of the port and monitoring a data signal received from the transmit terminals of the port.
2. First, use the router control system to loop back port 0 on itself (port 0 RX to port 0 TX), verifying functionality of the test equipment and chassis 1 local I/O.
3. Next, place expansion transceiver-A at chassis 1 in local-loopback mode and use the router control system to connect port 64 RX to port 0 TX. Since the port 0 RX is replicated as port 64 RX, the test equipment will see the loopback as before. This verifies a large portion of the expansion transceiver-A hardware at chassis 1.
4. Next, return expansion transceiver-A at chassis 1 to normal operating mode and place expansion transceiver-A at chassis 2 in line-loopback mode. Reestablish, if necessary, the connection from port 64 RX to port 0 TX at chassis 1. As in the previous step, port 0 RX is replicated as port 64 RX, the test equipment will see the loopback as before. This completely verifies expansion transceiver-A hardware at chassis 1, the external interconnect, and a section of the expansion transceiver-A hardware at chassis 2.
5. Return expansion transceiver-A at chassis 2 to normal operating mode.

Caution: When testing/verification procedures are complete, all shunts must be replaced at their header locations to restore normal router functionality.

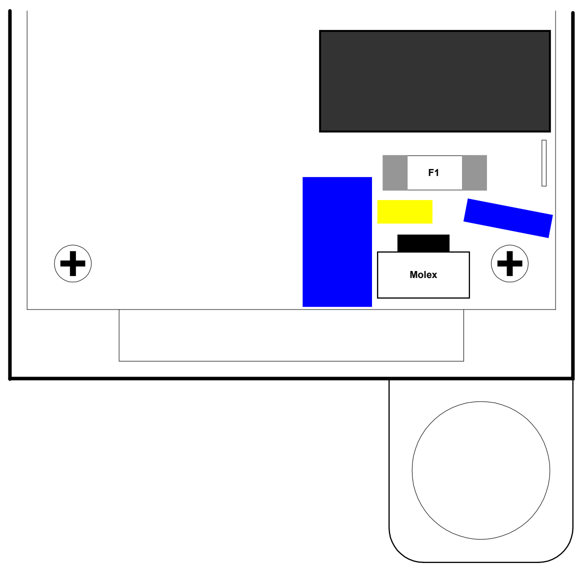
Checking and Replacing Fuses

If your Utah-400 Router is plugged-in and no fans are operating and/or no LED's are lit, this may indicate that a fuse is blown in the Utah-400 Data Router System or an external AC power source problem.

If the AC source(s) are good, check the following items in the Utah-400:

- Reference Figures 4-2: Power Supply Main Fuse and 4-3: Main Board Assembly Fuse Locations for the following explanation.
- Remove the front cover from the Utah-400.
- Observe whether the Alarm LED(s) are illuminated green on the Power Supplies and if the large Power-Good LED is illuminated green on the Main Board Assembly.
- Recheck the AC connections to make sure they are securely plugged-in.
- If no LED's are illuminated:
  - Disconnect AC Power from the router.
  - Use the finger-pull to remove one of the power supply assemblies
  - Check the Main Fuse (F1) located just behind the front vent of the power supply. If it is blown, it is indicative of a serious problem with the power supply. Contact Utah Scientific Customer Service at 800-447-7204 for instructions.
  - Repeat with redundant power supply if necessary.
  - Reconnect AC Power and observe whether the Utah-400 power is normal.
- If the large Power-Good LED is not illuminated green on the Main Board Assembly, remove the Main Board and check fuses F1 and F3.
  - Replace Fuse F1 or F3 if necessary. These fuses are both 5x20mm, 5 ampere, slow blow

- Replacement fuses are available as USI p/n 41907-0005, Bussman GDC-5, or Littelfuse 218.005



Front of Power Supply

FIGURE 4-2. Power Supply Main Fuse

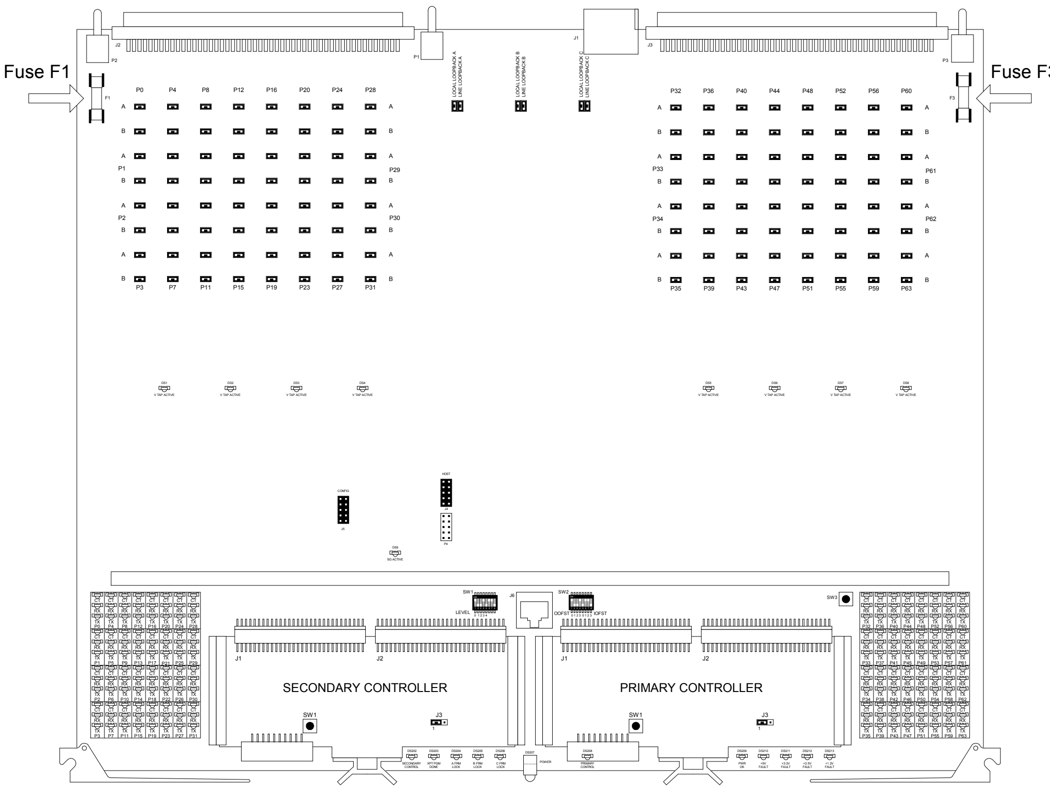


FIGURE 4-3. Main Board Fuse Locations