Model 9430
Flexible Matrix Router
3G/HD/SD/ASI/310M

Installation, Configuration and Operations Guide

Source: **Video Server 1**

Destination: **Satellite Link**

Revision 1.2   SW v1.1.2

ENSEMBLE
D E S I G N S

Purveyors of Fine Video Gear—Loved by Engineers Worldwide

Clearly, Ensemble wants to be in the broadcast equipment business. It's so rare anymore to find a company of this caliber that has not been gobbled up by a large corporation. They are privately held so they don't have to please the money people. They really put their efforts into building products and working with customers.

I'm really happy with the Avenue products and Ensemble's service, and even more important my engineers are happy. We've continued to upgrade the product and add more cards. We will be rebuilding our production control room and we will use Avenue again.

~ Don McKay, Vice President Engineering, Oregon Public Broadcasting

## Who is Ensemble Designs?

By Engineers, For Engineers

In 1989, a former television station engineer who loved designing and building video equipment, decided to start a new company. He relished the idea of taking an existing group of equipment and adding a few special pieces in order to create an even more elegant ensemble. So, he designed and built his first product and the company was born.
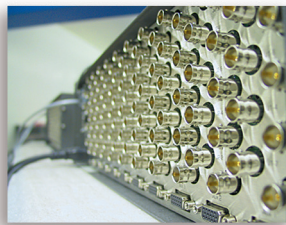
Avenue frames handle 270 Mb/s, 1.5 Gb/s and 3 Gb/s signals, audio and MPEG signals. Used worldwide in broadcast, mobile, production, and post.

Focused On What You Need

As the company has grown, more former TV station engineers have joined Ensemble Designs and this wealth of practical experience fuels the company's innovation. Everyone at the company is focused on providing the very equipment you need to complete your ensemble of video and audio gear. We offer those special pieces that tie everything together so that when combined, the whole ensemble is exactly what you need.
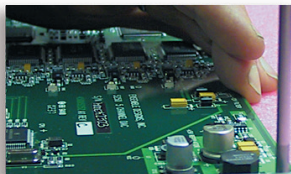
We're focused on processing gear– 3G/HD/SD/ASI video, audio and optical modules.

Notably Great Service for You

We listen to you – just tell us what you need and we'll do our best to build it. We are completely focused on you and the equipment you need. Being privately held means we don't have to worry about a big board of directors or anything else that might take attention away from real business. And, you can be sure that when you call a real person will answer the phone. We love this business and we're here to stay.

Come on by and visit us. Drop in for lunch and a tour!

Bricks and Mortar of Your Facility

The bricks and mortar of a facility include pieces like up/downconverters, audio embedders, video converters, routers, protection switches and SPGs for SD, HD and 3Gb/s. That's what we're focused on, that's all we do – we make proven and reliable signal processing and infrastructure gear for broadcasters worldwide, for you.

Shipped with care to television broadcasters and video facilities all over the world.

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Preface

Document Organization at a Glance

This manual addresses all of the essential topics for understanding how to install, configure and use the Router Module (9430) and its optional components—the Dual Clean Switch Submodule Option (9435), the I/O Expansion Module Option (9440), and the Router Control Panel (5830). See the following table for a quick glance at what each chapter addresses. Note also that all of the items in the main table of contents, as well as the chapter titles below, are links.

Chapter Title	Topics Covered
Chapter 1: Introduction	A brief introduction to this document and to the Router. Includes a link to a short video by David Wood, Chief Design Engineer.
Chapter 2: System Overview	Describes the overall Router system—its hardware and software components, example applications, and diagrams of example configurations.
Chapter 3: Installation	This chapter consists of two parts: Part One describes how components are assembled in the event that you need to add components in the future. Original orders are delivered preassembled. Part Two describes required cable connections that all customers must perform, as well as Router Control Panel (5830) installation.
Chapter 4: Configuration	Covers initially connecting to the Router, port configuration, creating and editing profiles, control points and access authentication, timing and genlock, internal test signal generators, switch point identification, and working with the clean switch option.
Chapter 5: Operations and Step-by-Step Procedures	After the Router has been installed and configured, it is ready to use. This chapter addresses all of the standard operational tasks of the Router that you can perform using the Router Control Panel (5830) and web browser interface. Operational tasks include performing takes, direct takes, gang takes, direct gang takes, and accessing ancillary data.
Chapter 6: External Control	Provides an overview of how the Router handles external control integration; the Router Control Panel GPI Inputs; supported control protocols, including Ensemble Designs' unique Avenue FMR protocol that supports multiple simultaneous protocols and control profiles for external interfaces.
Chapter 7: Maintenance and Troubleshooting	This chapter addresses certain known issues and possible issues that new users may encounter while becoming familiar with using the Flexible Matrix Router.
Specifications	Presents standard specifications for the 9430 regarding inputs, max cable length, outputs and reference. Specifications for the inputs and outputs are also covered for the 9440.

Chapter Title	Topics Covered
Appendix A: Automation Protocols	This appendix describes the various communication protocols available in the 9430 Flexible Matrix Router to support external control by an automation system. It also discusses the various means for connecting an external controller to the router. The intended audience is the developer tasked with connecting an external control device to the router.
Glossary	Includes definitions of commonly-used terms relevant to the video broadcast industry.

Chapter 1: Introduction

In this Chapter

This chapter addresses the following topics:

- Purpose of Document
- Intended Audience
- Introductory Video from David Wood, Chief Design Engineer
- Additional Resources

Purpose of Document

This Installation, Configuration and Operations Guide supports the process of planning for, installing, configuring and operating the Ensemble Designs Avenue 9430 Flexible Matrix Router. This manual describes the elements of the system, how they work together, and the practical aspects of working with the Router to meet your facility's needs.

Because the Avenue 9430 Flexible Matrix Router can accomodate such a broad range of applications, this document does not address every possible use of the Router. Rather, this document provides ample information for understanding the components of the system and the processes required to use it, ranging from initially connecting with the Router, assigning it an IP address compatible with your network environment, setting up customized Access Points and Profiles, configuring Ports, and many other critical aspects of configuring and operating the Router.

Use the Contents and the Preface to quickly link to a specific chapter or topic.

Intended Audience

In addition to the target audience listed below, this document is meant for anyone who needs to target a specific area of functionality in order to meet an immediate need, as well as for those who need to have a comprehensive understanding of the Router from a systems planning point of view.

The intended audience for this manual includes people with the following roles:

- studio designers
- broadcast engineers
- installation and configuration personnel
- router operators

Introductory Video from David Wood, Chief Design Engineer

This product can be configured with various options and in different sizes to address a wide variety of applications. Please view the two-minute video below for a brief overview presentation of the Avenue Flexible Matrix Router by Chief Design Engineer, David Wood.
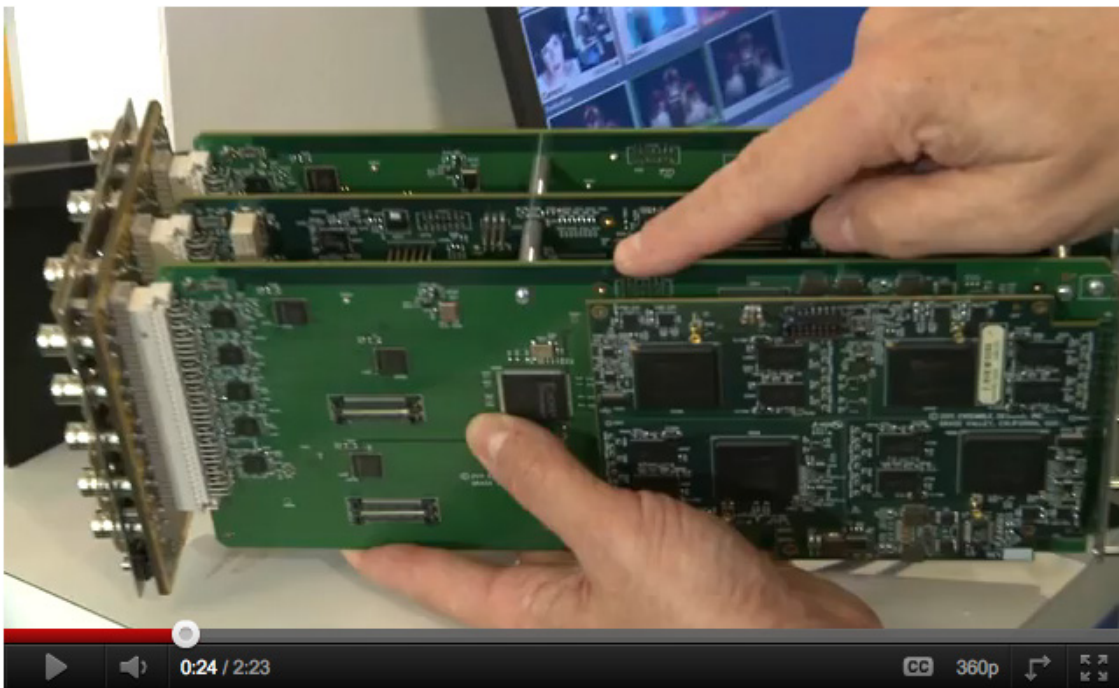
David Wood, Chief Design Engineer, talking about the new Flexible Matrix Router. Note that the photograph is a link to a video on YouTube.

Additional Resources

In addition to this document, please refer to these resources:

- Introductory video by Cindy Zuelsdorf, Marketing, about the Avenue Flexible Matrix Router
- Avenue Flexible Matrix Router Brochure
- Avenue Flexible Matrix Router Quick Start Guide
- Product page from the Ensemble Designs website

Chapter 2: System Overview

In this Chapter

This chapter addresses the following topics:

- Hardware Elements
- Applications
- Example Diagram of Complete Router System with All Options Installed
- Router Expansion Example for a 21 In x 9 Out Router Configuration
- Example Diagram of Router System Using One 9430, One 9440 and One 9435

The Avenue Flexible Matrix Router is a digital Router that can be configured in a variety of matrix sizes and with a variety of options. Highlights of its functionality include ease of expansion, configurable input/output ports, exclusive video thumbnails, configurable control panels, built-in test signal generator and sync pulse generator, and assignable resources such as optional clean and quiet switching on multiple outputs.

The exclusive live thumbnail display in the Router Control Panel and web user interface lets you look at your source before you perform a take.

Highly flexible matrix sizing lets you decide on your own configuration. The basic size is 8 inputs by 2 outputs. You can add user configurable input/output ports up to 28x2 (or 8x22) and any size in between.

The assignable clean switch option gives you full frame synchronization that locks to your house reference so it can switch cleanly between asynchronous sources. VITC captured from the reference input can drive time-scheduled switching.

The Avenue modular digital video router is a flexible, technologically advanced small router. Its flexibility makes it possible to tailor the input/output dimensions to a wide range of applications, including mobile and portable systems, ENG trucks, QC monitoring stations, graphics and post-production islands, edit suites, ingest, production switcher pre-select, master control bypass switching, driving on-set monitors, general utility switching, and numerous other applications.

Hardware Elements

The hardware elements that make up the Router are as follows:

- 9430 Router Module
- 9440 I/O Expansion Module
- 9435 Dual Clean Switch Submodule
- 5830 Router Control Panel

9430 Router Module

The control system for the Router resides on this module. The control system, discussed at length in Chapter 4: Configuration, is accessed through a web browser interface.

The 9430 Router Module provides eight dedicated Input Ports and two dedicated Output Ports. In addition to these Inputs and Outputs, the 9430 provides video thumbnail capture, Test Signal Generation, and Genlock/Timing. The smallest possible version of the Flexible Matrix Router consists only of a 9430 module.

Built-in Signal Diagnostics

Circuitry on the 9430 module detects and measures key parameters associated with each video source and makes these parameters available for display on both the hardware and software panels. Parameters include synchronicity and timing, line and frame rate, embedded audio presence/absence, closed caption information, and timecode data.

Fail-Safe Relay Bypass Mechanism

Input 1 and Output 1 are linked together by a fail-safe relay bypass mechanism. In the event of a power or system failure, the signal presented to Input 1 is directly connected to Output 1.

9440 I/O Expansion Module Option

One or two 9440 I/O Expansion modules can be added to a 9430 to provide additional digital I/O Ports. Each 9440 adds ten bi-directional ports, each of which can be independently configured as an input or an output. These expansion modules attach to either side of the 9430 core module to form a maximum set of three boards. A Router with two 9440 modules has a total of 30 ports.

9435 Dual Clean Switch Submodule Option

Each of the 9435 submodules provide two independent frame-synchronized SDI clean switches, resulting in the ability to switch cleanly between asynchronous sources. Audio sample rate conversion makes the audio output clean and silent. You can use the control system to assign a clean switch to any SDI input or output. Each clean switch can be assigned to one or more outputs by using the Follow port configuration. For more information about port configuration choices, please see Configuring the Router's Ports on page 54.

A total of two 9435 submodules, providing a total of four independent clean switches, can be installed. The first 9435 mounts on the 9430 Router Module. The second 9435 installs on the 9440 Input Expansion Module in expansion position 1.

5830 Router Control Panel

The Router Control Panel communicates with the 9430 Core module by Ethernet to control the Router and display thumbnail previews of content. An essentially unlimited number of 5830 Router Control Panels can be used in a Router system. You can also access signal diagnostic information from the LCD display on the Router Control Panel. The Router Control Panel is only 1.8" (45mm) deep, so it can be installed in very shallow positions.

Long Distance Capability

Because each Router Control Panel connects to the Router over Ethernet, and because Ethernet reaches much farther than coaxial cable, Router Control Panels can be physically located very far away from the Router if desired.

For example, if you need the capability to select sources at the transmitter remotely, such as in the event of either a master control switcher failure or a microwave link failure between the studio and the transmitter, you can use the Router as part of a backup switcher at the transmitter. Sources such as a network feed, a small server or a weather camera could be switched to air in an emergency. You can do the selecting remotely, such as at the studio (or even from home if need be), or from any location with Ethernet access.

Applications

The flexibility of the Avenue Flexible Matrix Router system makes it possible to tailor the input and output dimensions to a diverse range of requirements. Therefore, it can accommodate many environments and applications, including the following:

- Mobile and portable systems
- QC stations
- Graphics and post-production islands
- ENG trucks
- Edit suites
- Ingest
- Production switcher pre-select
- Master control bypass switching
- Driving on-set monitors
- General utility switching

Cuts-Only Master Control

When used in conjunction with the Clean Switch option, and because it performs cuts rather than fades and wipes, the Flexible Matrix Router can function as a Cuts-Only Master Control Switcher.

Master Control Bypass

Facilities such as TV stations can use the Flexible Matrix Router as a Master Control Bypass switcher. With the same sets of feeds going to both the Master Control Switcher and the Flexible Matrix Router, program sources can be switched over to the Flexible Matrix Router during maintenance, for emergencies, or during upgrades.

The Master Control Switcher and the Flexible Matrix Router can both go through a protection switch, such as the Avenue 7455 HD/SD/ASI/310M protection switch, before going on to an MPEG encoder for transmission.

Quality Control and Signal Monitoring

The Flexible Matrix Router can be used for quality control and signal monitoring. In a smaller TV station, for example, personnel in engineering can monitor a variety of channels internally. For a larger facility, someone would be performing dedicated quality control monitoring.

For just a quick check, the small LCD display on the Router Control Panel may provide enough of an image preview. Or the LCD can be used as a preview before bringing up the signal on a monitor. The LCD display can also be used to show signal metadata while a monitor can be used to view the picture in a larger format or perhaps as a quad split.

Monitors and Projectors for Venues

The Flexible Matrix Router brings many sophisticated options to non-broadcast environments, such as corporate meeting rooms, event venues and churches. Because of the simple and accessible Router user interface that runs on a web browser, iPad or Router Control Panel, all video professionals can easily make use of the Router.

For example, a guest speaker who wants to access an assortment of media could have numerous inputs available to them and a number of destinations, such as projector screens or monitors. Using an iPad as a router controller, for instance, the guest speaker would only have to tap the iPad a couple of times to change the source going to a monitor or screen projector. Sources could include still pictures with background music, lyrics, and live feeds.

Another possible source for such environments is content from the Internet. When a computer with Internet access is connected to a BrightEye Mitto™ scan converter, for example, you can upconvert video from YouTube, Skype or any website to SD, HD or 3G SDI video and route that signal to any Router destination. Mac and PC computers, iPhone and iPad can all be used as sources with BrightEye Mitto. All Mitto units accept VGA, DVI and HDMI input signals from PC and Mac computers.

Example Diagram of Complete Router System with All Options Installed
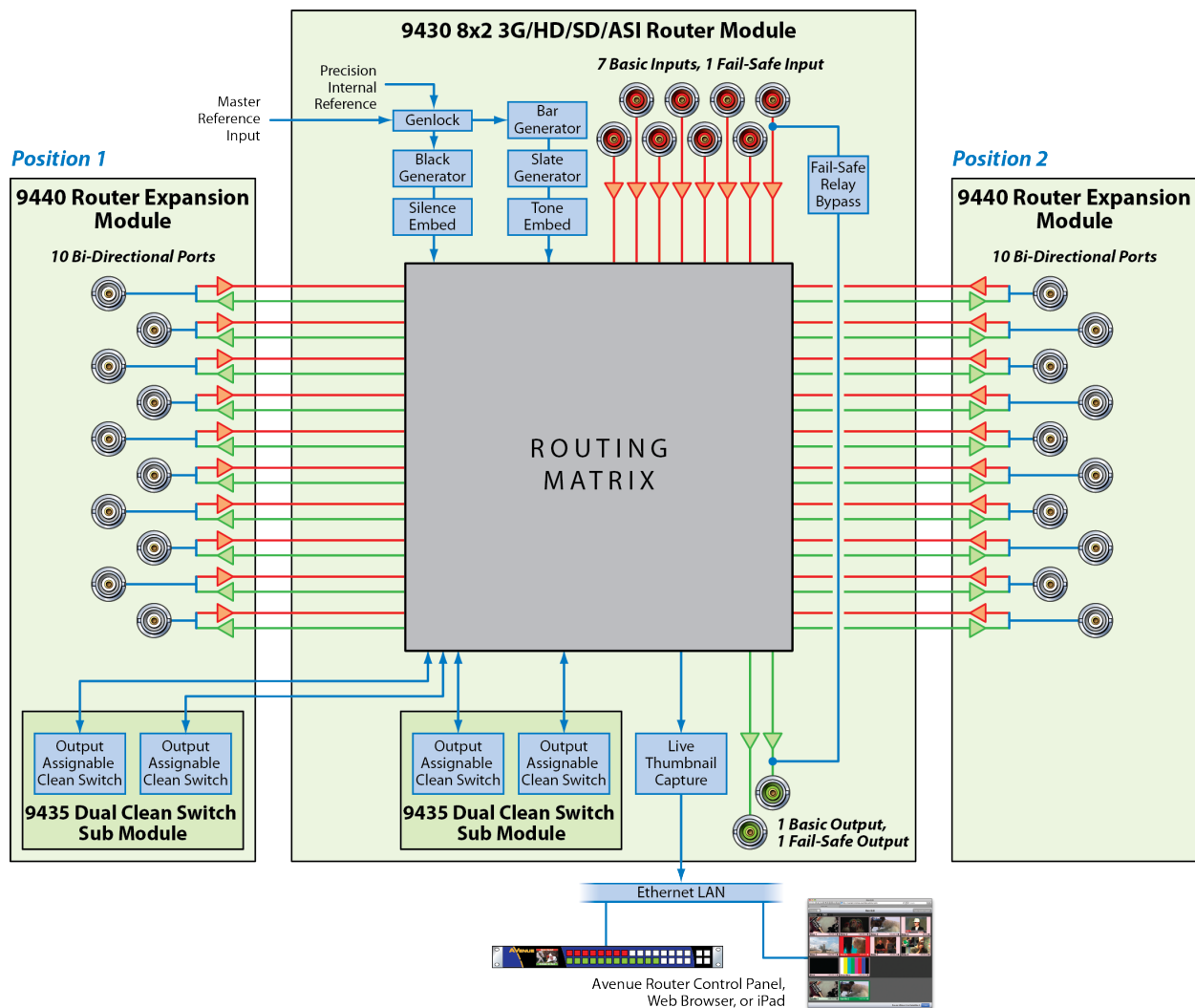
The above diagram illustrates one 9430 Router Module with two 9440 I/O Expansion Modules, two 9435 Dual Clean Switch Submodules, and a Router Control Panel (5830). Such an implementation would have 30 Ports and four independent assignable Clean Switches. Each 9440 has 10 bi-directional Ports. This combination of hardware components would be installed in an Avenue 3RU Frame.

Router Expansion Example for a 21 In x 9 Out Router Configuration

The 9430 and 9440 modules combine to form a Router with 20 or 30 Ports. They are joined together by three signal routing backplanes which provide the interconnection between the I/O ports on the 9440 and the 9430 core module.

The Router board sets with 20 and 30 Ports install in an Avenue 3RU Frame. The 10 Port Router, consisting of a single 9430 module (and optionally including a 9435 Dual Clean Switch), can be installed in either the Avenue 1RU or 3RU Frames.
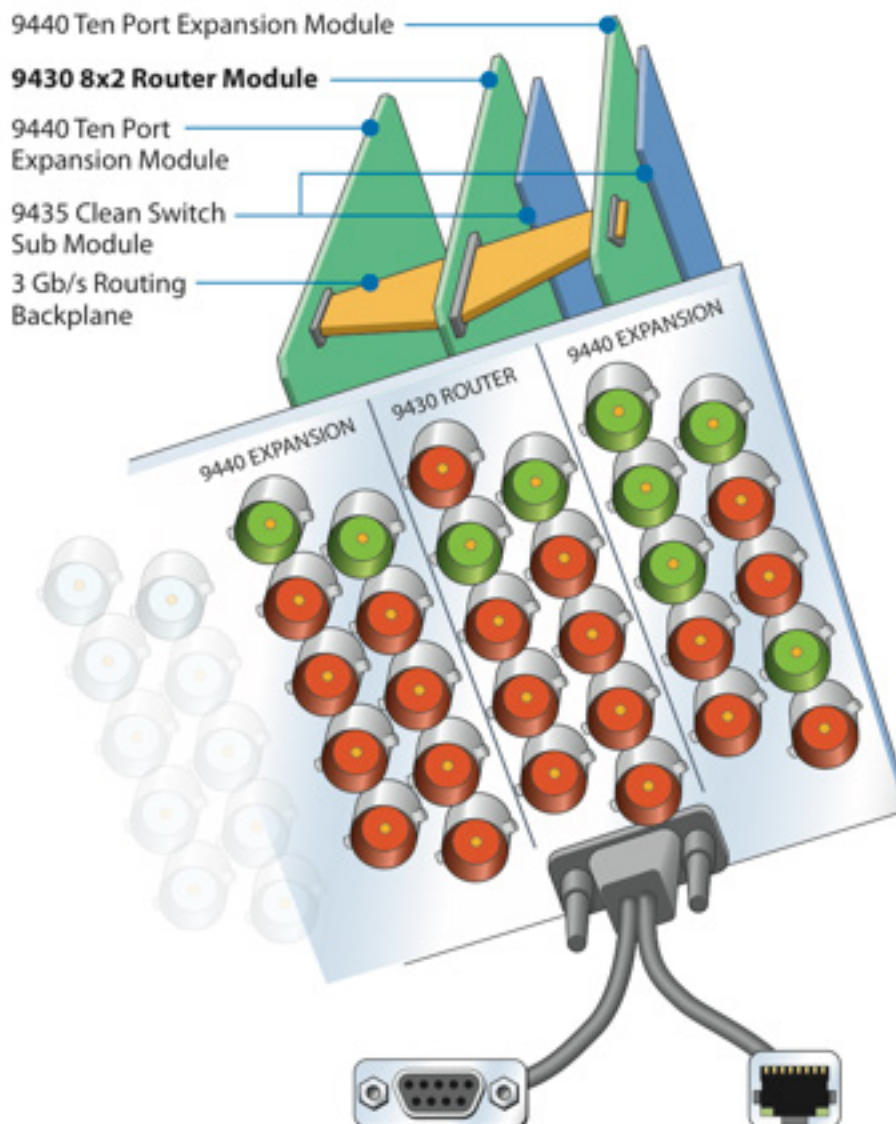
30 Port Router: one 9430 Router Module, two 9440 Expansion Modules, two 9435 Clean Switch Submodules, and Routing Backplanes, viewed from the rear. Use the RS-232 or Ethernet to connect with Avenue Control Panel, Master Control, or Automation System.

Example Diagram of Router System Using One 9430, One 9440 and One 9435

The Flexible Matrix Router is very versatile. Using the Router's built-in configuration tools, you can create highly customized and sophisticated systems. This produces very efficient, compact solutions to a wide variety of system design challenges. And because the customization is "soft," the solution can evolve as needs change—in some cases without moving a single cable.
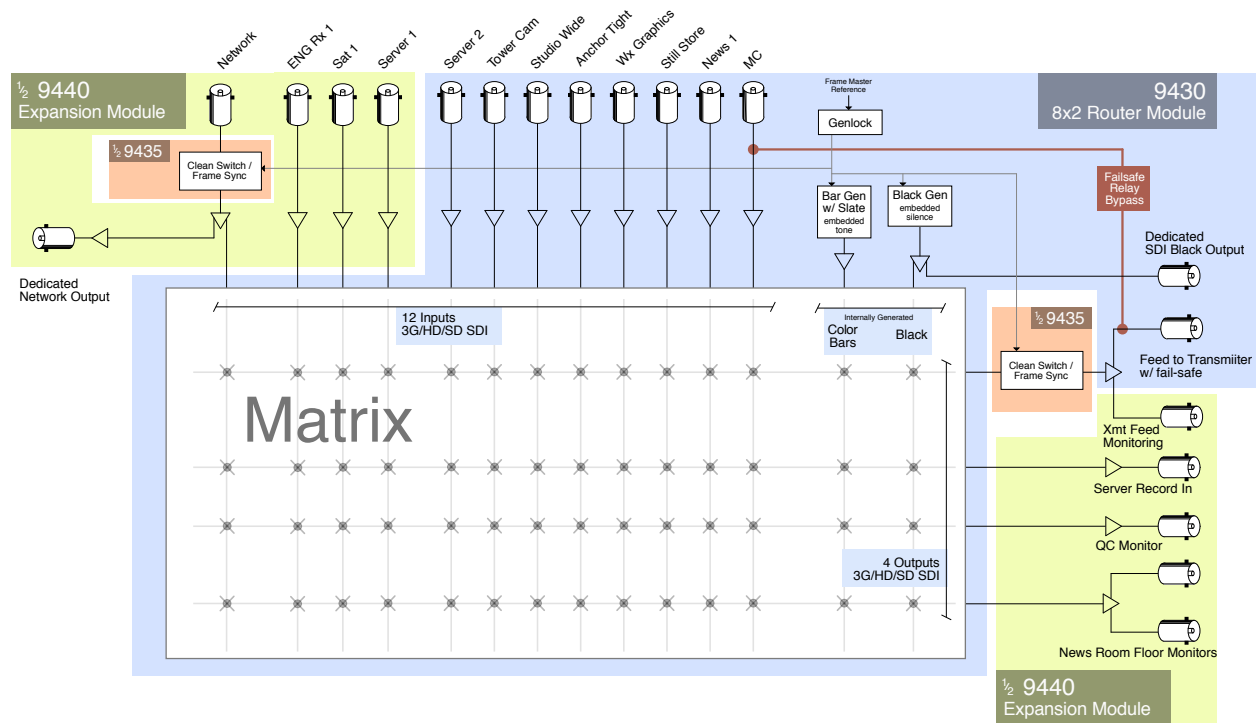
In this example, a bypass and backup switcher for Master Control uses just one 9430, one 9440, and one 9435.

Clean Switches are used to make the Network input synchronous to all outputs and to provide clean and quiet switching (between all inputs) on the output feeding the transmitter. In the example shown above, the switching matrix is configured as 12 Sources and 4 Destinations. Output ports using the Follow feature provide duplicate outputs of selected Destinations, and a loop-through of the Network input.

A large format version of this diagram is available as a PDF here.

Chapter 3: Installation

In this Chapter

This chapter consists of two parts:

Part One: Module Assembly, describes how modules are assembled in the event that you need to add modules or submodules in the future. Original orders are delivered preassembled. Topics addressed include:

- Original Orders Preassembled
- 9430 Router Module
- 9435 Dual Clean Switch Option
- 9440 I/O Expansion Option

Part Two: Required Cable Connections, describes cable connections that all customers must perform, as well as Router Control Panel (5830) installation. Topics addressed include:

- Seating the Board Set Firmly in the Frame
- Installing the BNC Plastic Overlays
- Digital Signal Connections
- Router Control Connections
- Connecting a Timing Reference to the Avenue Frame
- Connecting a Timing Reference to the 9430 Router
- Router Control Panel Installation

Detailed instructions for installing the Avenue frame itself are provided in the Avenue System Overview Manual.

PART ONE: MODULE ASSEMBLY

Original Orders Preassembled

For original orders, Ensemble Designs will assemble all modules (the 9430, 9435, and 9440 modules as applicable) before shipping them to your facility. You can then install the assembly into the Avenue frame as a single unit. However, if you add modules at a later time, these instructions will show you how to assemble and install them.

9430 Router Module

Every Router will include a 9430 Router Module—a 10 Port Router with 8 dedicated Inputs and 2 dedicated Outputs. Shown below is a 9430 Router Module with no additional modules installed.
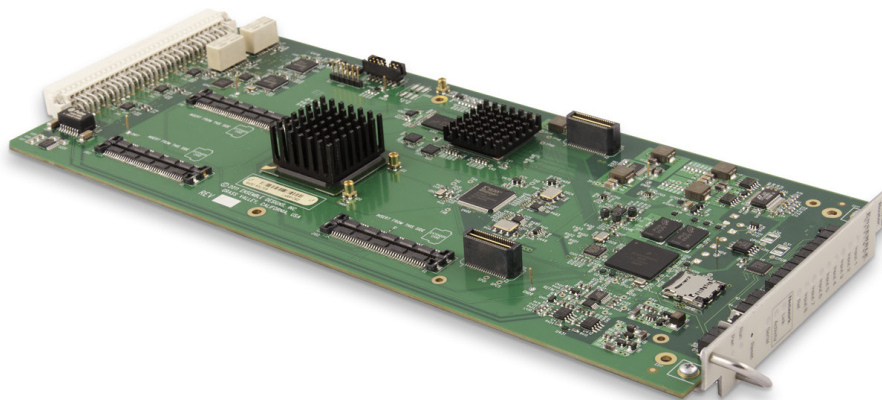
The 9430 Router Module with no additional modules installed

9435 Dual Clean Switch Option

An optional 9435 Dual Clean Switch submodule can be mounted to one or both of the following:

- the 9430 Router Module
- the 9440 Expansion Module in the Expansion 1 position (the left hand position as viewed from the front of the frame)

The 9435 Dual Clean Swith submodule is secured to the 9430 and/or 9440 by screws and threaded stand-offs in four positions.

> **Note:** Only a 9440 in the Expansion 1 position supports the 9435 Dual Clean Switch. Although it is mechanically possible to install a 9435 on a 9440 in Expansion 2, that 9435 will not appear as a resource in the configuration menus.
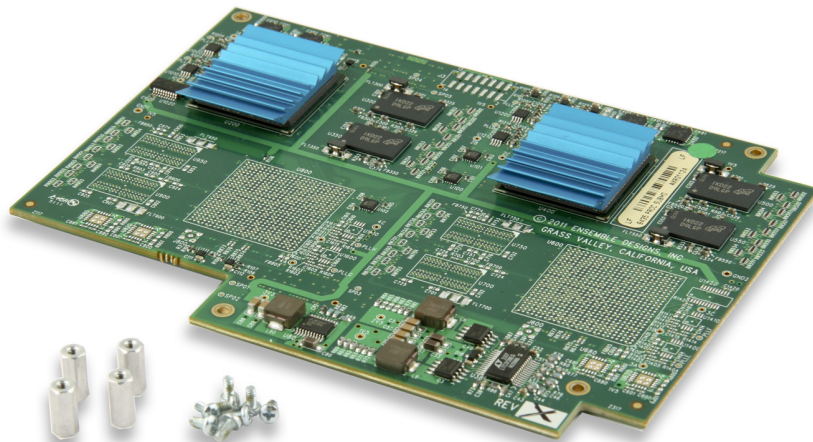
A 9435 Dual Clean Switch submodule with 4 screws and threaded stand-offs
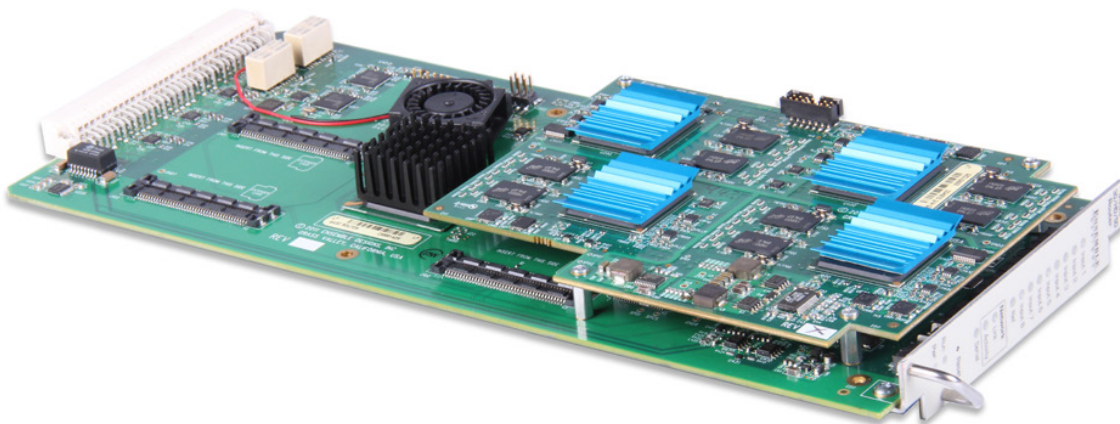
A 9430 Router Module with a 9435 Dual Clean Switch submodule installed

9430 and 9435 Fit in a Single Frame Slot

Note that the 9435 fits within the slot profile of the 9430, so the combination of the two still occupies a single frame slot in either a 1RU or 3RU Avenue Frame.
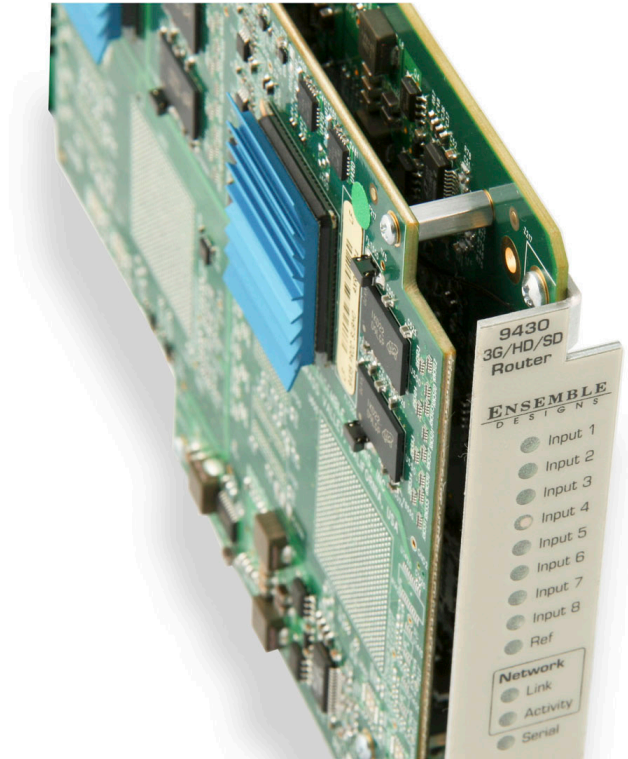
Detail of a 9435 Clean Switch installed on a 9430 Router Module

9440 I/O Expansion Option

A maximum of two 9440 I/O Expansion Modules can be attached to the 9430 Router Module, one per side.
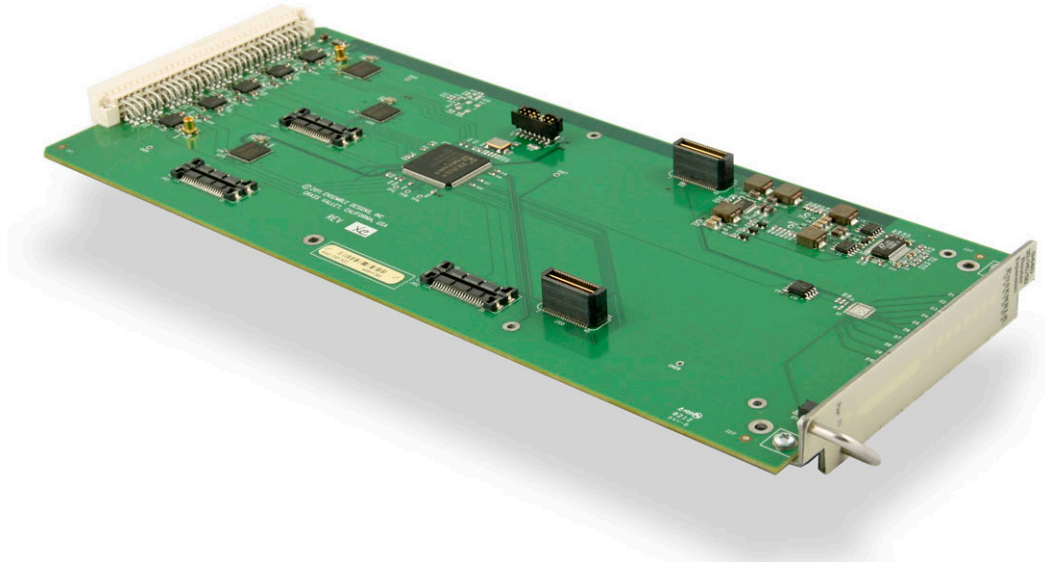
A 9440 I/O Expansion Module

The 9440 I/O Expansion Modules are mechanically attached to a 9430 with screws and stand-offs. The signal electrical connection is made by three high-speed routing backplanes with precision transmission lines designed to support signals up to 3 Gb/s.

Two Types of Routing Backplane Kits

There are two types of routing backplanes, one for 20 Port Routers, and one for 30 Port Routers. Pictured below is the attachment kit for a 30 Port Router.
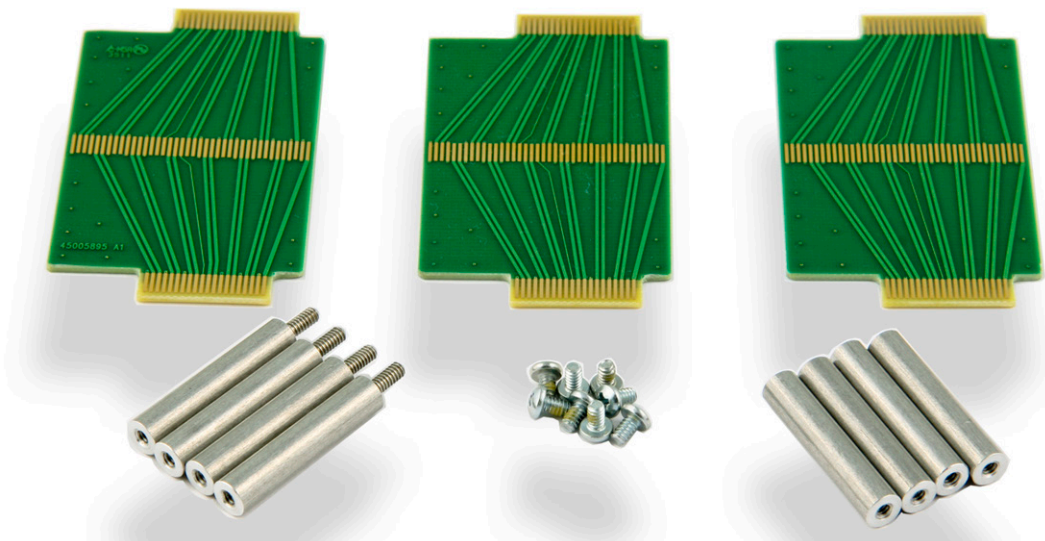
An attachment kit for a 30 Port Router

Sliding Routing Backplanes through Slots in the 9430

The routing backplanes slide through slots in the 9430 module, picking up electrical connections on each side from these slot connectors.
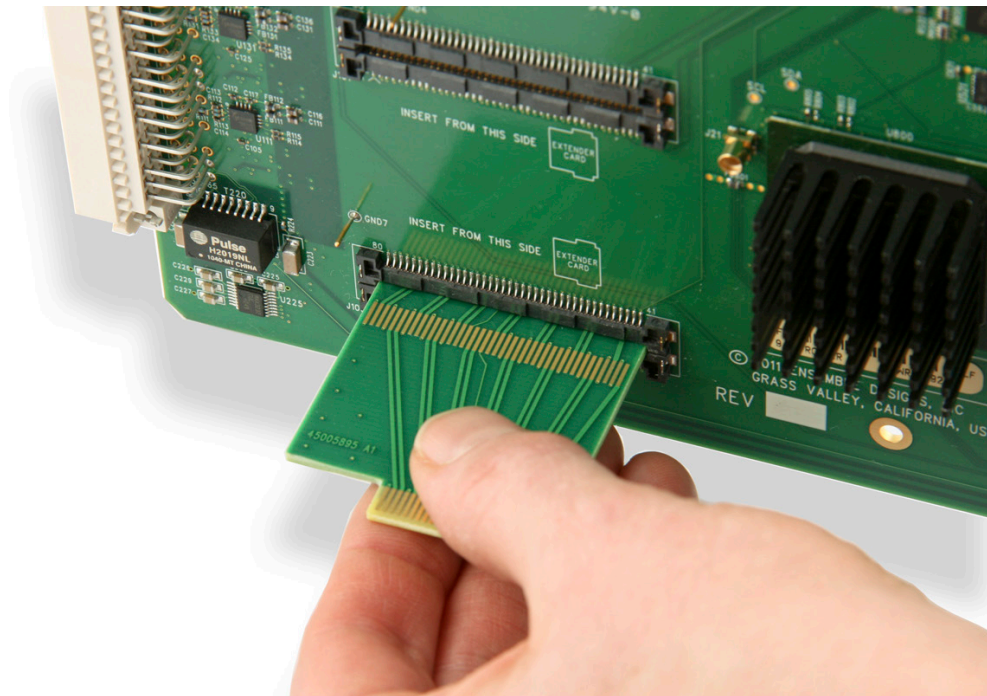
From the top side of the 9430, gently insert the the routing backplanes through the slot connectors.

The slot connectors on the 9440s are set back farther from the module edge connector than on the 9430. Therefore, the routing backplanes must be oriented with the small ends offset away from the edge connector. Beyond that, the backplanes do not have polarity.
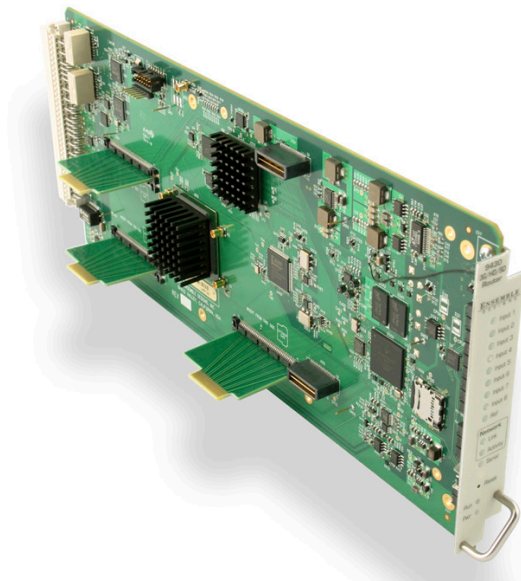
The 9430 ready to accept a 9440 I/O Expansion Module.

Installing Stand-Offs on the 9440

Install the four stand-offs on each 9440 using one screw per stand-off, as shown below.
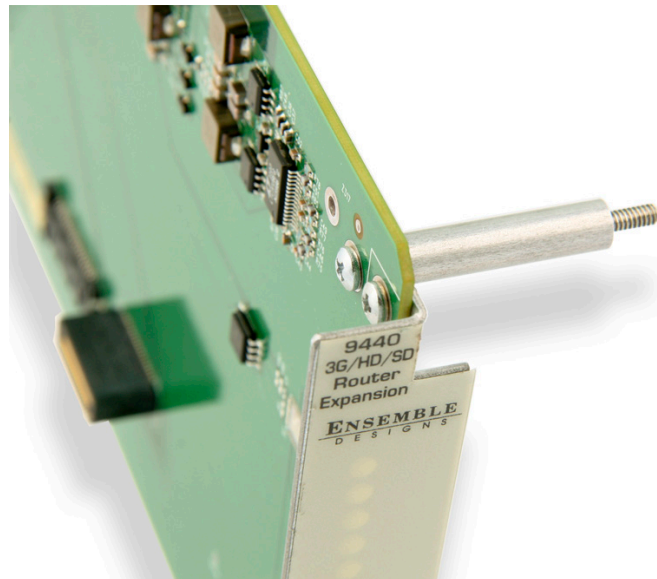
Stand-offs on the 9440 Expansion Module

Aligning the 9440 with Routing Backplanes

Align the 9440 with the routing backplanes. Gently guide the backplanes into the smaller slot connectors on the 9440. The narrow end of the backplane will be flush with the connector on the 9440.

Complete the mechanical attachment with screws in the stand-offs.
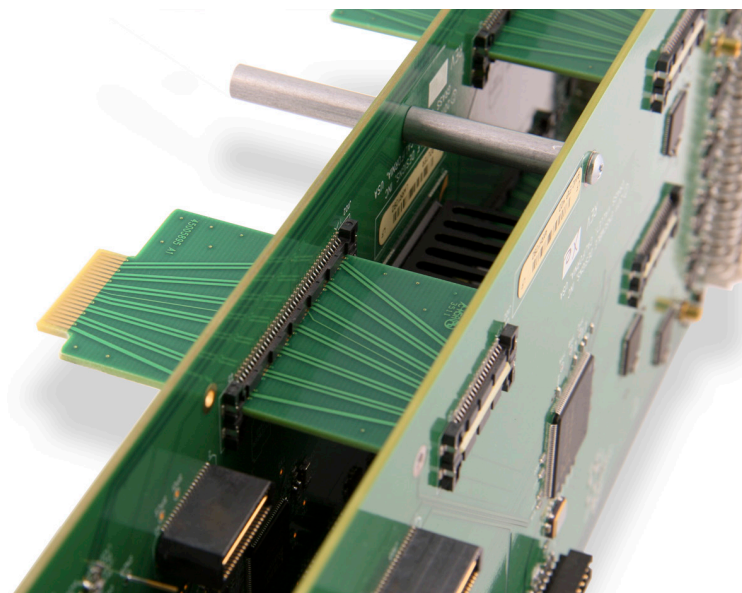
A completed stand-off with screw in place and backplanes connected to 9430 and 9440

Example of Completed Assembly

The example shown below consists of one 9430 and two 9440s, with backplanes and stand-offs in place, providing 30 ports. This assembly is ready to install in an Avenue 3RU Frame.
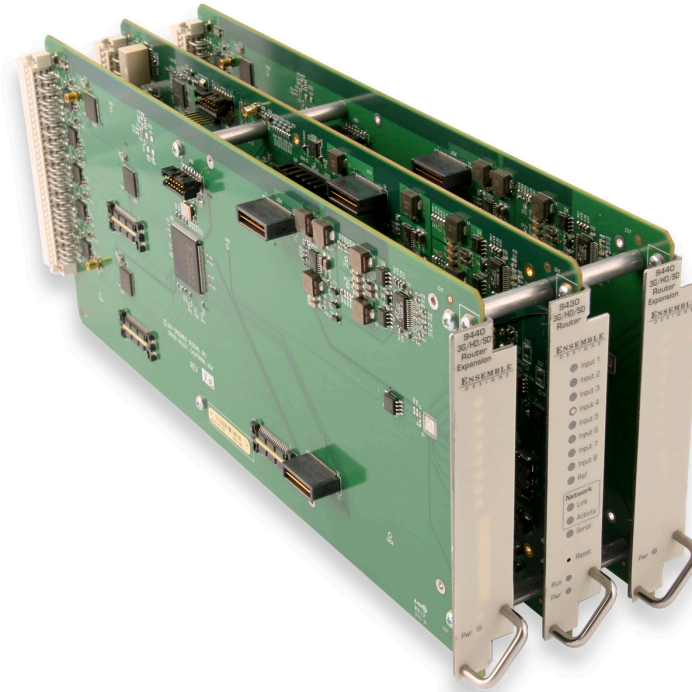
An Assembled 30 Port Router ready to install in an Avenue 3RU Frame

PART TWO: REQUIRED CABLE CONNECTIONS

Seating the Board Set Firmly in the Frame

Install the board set in the frame, taking care to insure that the modules are fully seated into the frame backplane connector. This requires more force than with a single module.

Avenue 3RU Frame Partition Divider Consideration

Because a multi-board assembly cannot span the divider in the Avenue 3RU Frame between slots 4 and 5, the three modules making up a 30 Port Router **cannot** be installed in either of these two ranges:

- Slots 3, 4, 5

- Slots 4, 5, 6

It is strongly recommended to take this into account during frame and slot planning. Otherwise, you may have to make a last-minute change to an otherwise carefully planned installation design. Despite this restriction, it is still possible to install as many as three 30 Port Routers in a single 3RU frame.

Installing the BNC Plastic Overlays

On the rear of the Avenue frame, install the BNC plastic overlays provided onto the corresponding group of rear BNC connectors associated with the Router location.

The 9440 modules have two plastic overlays, one for the Expansion 1 position and one for the Expansion 2 position. As an orientation aid, the bottom of each 9440 plastic overlay is marked with an arrow that should be pointing toward the 9430 that sits between the 9440s.

Note that the plastic overlays have optional adhesive backings for securing them to the frame. Use of the adhesive backing is only necessary if you would like the location to be permanent and is not recommended if you need to change module locations.
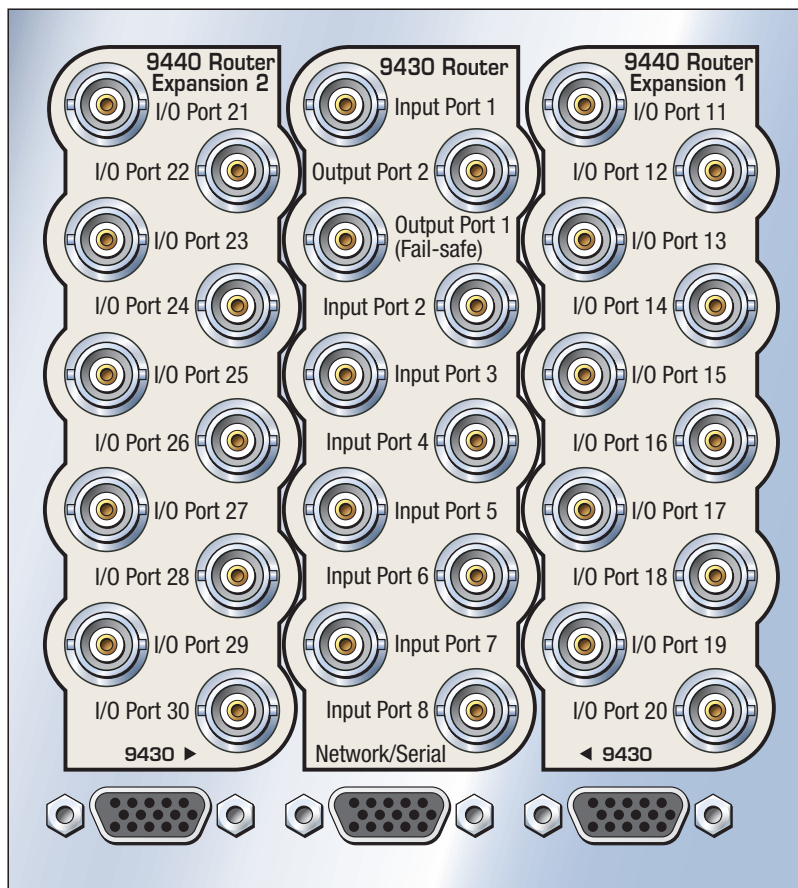
BNC plastic overlays on the rear of the frame

Digital Signal Connections

The digital inputs and outputs of the Router are all equally capable of supporting 3G SDI, HD SDI, SD SDI, DVB-ASI, SMPTE 310M and AES audio signals. Connections to sources and destinations are made with 75 ohm coaxial cable.

Cable Length Considerations

An important technical consideration in system wiring is the length of the cables that run between different pieces of equipment. The high frequency content of the serial digital signal, which is attenuated in proportion to the length of the cable, sets an upper limit to the distance over which the interface will work reliably. Beyond that distance, data bit errors will corrupt the signal and render the content unusable. The maximum length for digital grade, RG-6 type cable (such as Belden 1694A) varies according to the data bit-rate of the interface as follows:

Type	Bit-Rate	Maximum Cable Length
3G HD SDI	3 Gb/s	70 meters (229 feet)
HD SDI	1.5 Gb/s	100 meters (328 feet)
SD SDI	270 Mb/s	300 meters (984 feet)
DVB-ASI	270 Mb/s	300 meters (984 feet)
SMPTE 310M	19.3 Mb/s	100 meters (328 feet), but 30 meters (98 feet) is recommended due to the inherent weakness of the 310M signal
AES	3 Mb/s	100 meters

These numbers are conservative in order to provide a margin of safety that accommodates variations in the output amplitude and jitter content of sources, and the input sensitivity of destinations. Do not exceed these values because when a system is pushed beyond its design limitations, what works one day may not work the next day.

Furthermore, these numbers assume a direct, single cable connection between devices. If the signals are passing through patch panels or cable couplers, the maximum total cable length must be reduced.

Fail-Safe Bypass from Input 1 to Output 1

The fail-safe bypass feature of the Avenue Flexible Matrix Router supports a connection from Input 1 to Output 1 in the event of a system or power failure. This is accomplished in a simple manner: Bypass connects the two ports (BNC connectors) together through a passive, mechanical relay. This means that the signal will be carried through the Router even when there is a total loss of power and control. But it also means that the length of the cable between the source and destination is now the total of the input and output cabling. That total must be less than the bit-rate appropriate maximum listed in the above table. And since the Router in bypass mode is effectively a cable coupler, that maximum needs to be further reduced. If other elements or requirements in a system design render the bypass behavior irrelevant, this combined cable length consideration can be disregarded.

It is possible to extend performance beyond these maximums by the use of lower loss RG-11 cable such as Belden 7732LL. The low-loss performance comes from a larger dielectric cross section, so these alternatives are less flexible and more challenging to install and terminate.

Conversely, smaller diameter cable (Belden 1855A) is often favored for its lower weight and higher installation density. These choices must take into account their greater high frequency attenuation.

Router Control Connections

Although the Avenue Frame system is equipped with both RS-232 and Ethernet interfaces, the 9430 has its own dedicated control connections. The communication bandwidth needed to support the live video thumbnails and the expectation on the part of third-party control systems (automation, event control) for a dedicated control port require this.

RS-232 and 100Mb Ethernet Interface Adaptor Cable

The connection to both the RS-232 and 100Mb Ethernet interfaces on the 9430 are accomplished through an adaptor cable (part number 23700040) which connects to the HD-15 connector specific to the slot where the 9430 is installed. This adaptor is included with the 9430 module. It is configured as a "Y" cable with a separate leg for the 9-pin D-Sub RS-232 and RJ-45 Ethernet connectors. If only one of these interfaces is required, it is acceptable (though irreversible) to cut off the unwanted leg.

The Ethernet port should be connected with CAT5 or CAT6 cabling to a network Ethernet router or switch to make it accessible to computers on the network. This port can also be directly connected to a computer or to a Router Control Panel (5830). The Ethernet port will auto-sense cable direction, so a cross-over cable is not needed.

The RS-232 port will operate from 1,200 to 115,200 baud.

The configuration of these interfaces and the selection of serial protocol are described in Chapter 6: External Control on page 96.

Rear BNC connectors and the HD-15 connector on the 9430

Adaptor "Y" cable (part number 23700040) for connecting the 9430 to RS-232 and 100Mb Ethernet interfaces

Connecting a Timing Reference to the Avenue Frame

In order to genlock the video resources in the Router (TSGs and Clean Switches) to a larger video system, connect a timing reference to the Master Reference Input on the Avenue Frame. This is a loop-through connection on the 3RU Frame which requires a termination. On the 1RU Frame it is an internally terminated input.

The Router will also use this reference input to determine the vertical interval switching point.

Connecting a Timing Reference to the Master Reference Input on the rear of the Avenue Frame. The loop through is terminated with a 75 ohm terminator.

Connecting a Timing Reference to the 9430 Router

The reference input of the 9430 will accept these reference types:

- NTSC or PAL analog video
- HD Tri-Level Sync
- 10 MHz precision reference

When VITC (Vertical Interval Timecode) is present on NTSC or PAL analog composite reference sources, it will be available to the Router for event scheduling.

The Router can operate without a timing reference by utilizing its own internal SPG (Sync Pulse Generator).

See Setting Up Timing and Genlock on page 70 for more details about configuring the Router's Timing and Genlock systems.

Router Control Panel Installation

Connecting Ethernet Cable to RJ-45 Port

Make an Ethernet connection to the RJ-45 port on the rear of the Router Control Panel. The Ethernet cable should be connected to a network Ethernet router or switch to make it accessible to the Router. The Ethernet port will auto-sense cable direction, so a cross-over cable is not needed.

A modular power supply is provided to power the Router Control Panel. Alternately, power can be supplied by the Ethernet connection using PoE (Power over Ethernet), provided that you have a PoE-enabled Ethernet switch to insert power into the Ethernet cables.

The rear of the Router Control Panel. Note the three connectors: the RJ-45 Port, the Power Input, and the 9-Pin GPI Connector.

Long Distance Capability

Because the Router Control Panels connect to the Router over Ethernet, and because Ethernet reaches much farther than coaxial cable, Router Control Panels can be physically located very far away from the Router if desired. Therefore, you can install the Router Control Panels wherever you need them to be located as long as you have Ethernet connectivity.

The Router Control Panel is only 1.8" (45mm) deep, so it can be installed in very shallow positions.

The front of the Router Control Panel. Both rows of buttons are capable of illuminating either red or green.

Labeling Buttons

The Router Control Panel comes with two button labeling options:

1. Pre-printed key cap inserts, described on this page, and

2. A customizable label template that generates a PDF, described on the next page.

First Method: Key Cap Inserts

The provided key cap inserts give a broad range of terms and numbers printed on clear plastic sheets. Each individual button legend pops out from its sheet and can be inserted into the Router Control Panel buttons between the clear overcap and the white diffuser, if desired.

The button legends are designed to be used individually—one per button, or as a combined set—two on a button. When combining them, one appears higher on the button and the other appears lower.

To Place a Button Legend Inside a Control Panel Button

1. Pull a button off of the Control Panel by simply squeezing and pulling. Each button is held to the Panel with a pressure fit. A bit of pressure is required.

2. Remove the inner white diffuser part of the button from the clear overcap with a fingernail or a sharp edged tool. Note the orientation of each button: there are slightly indented slits located on the top and bottom of both the clear overcap and white diffuser.

3. Place a button legend between the clear overcap and the white diffuser, keeping both parts aligned top to bottom and noting orientation. Snap the two button pieces back together.

4. Snap the button back in place on the Control Panel with some slight pressure. The button must be level to the plane of the Panel before it will snap correctly back into place.

Button legends can be inserted between the clear overcap and the white diffuser of the key cap.

Second Method: Customizable Label Template

You can create your own customized button labels directly from one of your Profiles. (For more information about Profiles, see Creating and Editing Profiles on page 59.) The template draws from the Port names associated with the Profile you choose. This automatically generates a PDF document of precisely scaled and aligned labels that you can print on paper or acetate.

To Print Labels from a Selected Profile:

1. From a web browser that has access to the Router, click **Settings** in the upper left corner. The Settings > General page displays.

2. Select **Profiles** in the left navigation panel. The Profiles page displays.

3. For the Profile that you want to use as a basis for printing labels, click **Edit**. The Edit Profile page displays.
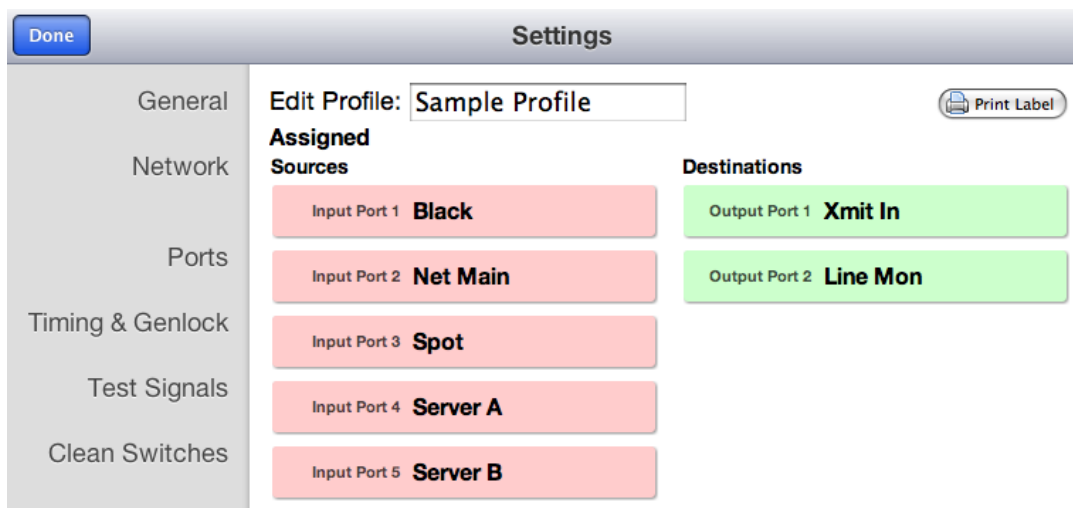
4. In the upper right area of the Edit Profile page, click **Print Label**. A Labels.cgi page is created and displays in a new browser tab or window.
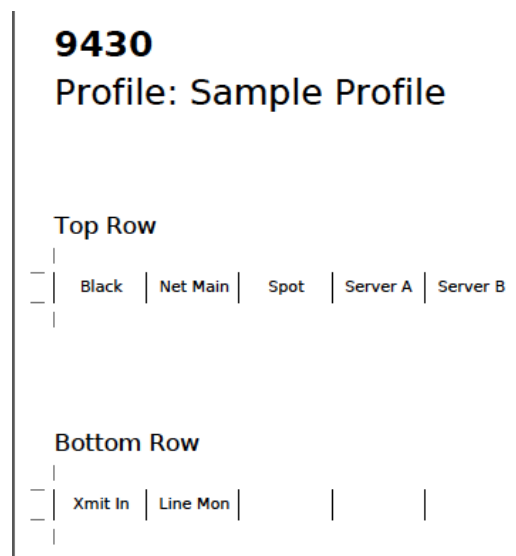
5. Toward the bottom of the generated label page, click the **Print** icon. If you do not see this toolbar, move your mouse cursor across the screen. It may not constantly display itself.

6. Cut the printed labels into two strips as shown below. Align and place the labels onto the Router Control Panel.
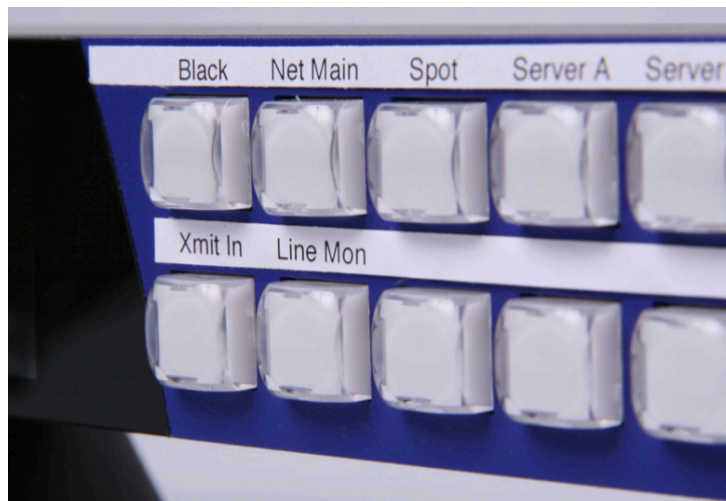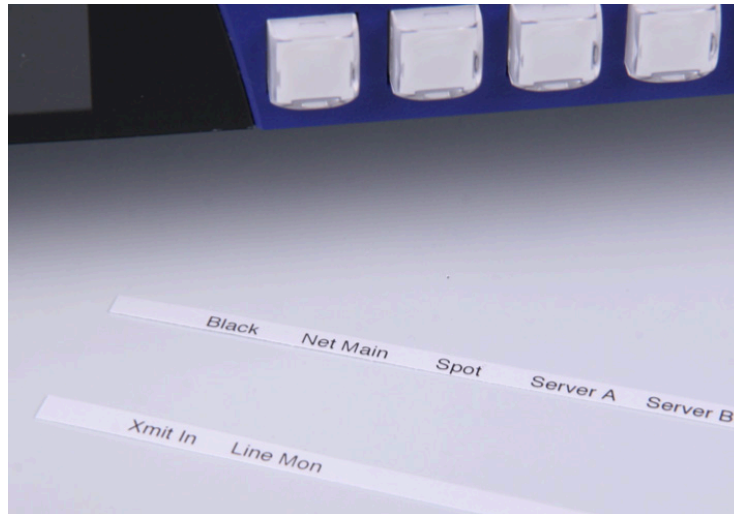
GPI Control

The Router Control Panel is equipped with 8 GPI (General Purpose Interface) inputs. These provide a simple, wire-per-function interface for applications such as:

- Master Control Fault "Panic" Button

- Monitor Follow in Camera Shading

- Crosspoint selection from relay contact closure

Connection to the GPI Inputs is made through the female 9-pin D-Sub connector on the rear of the Router Control Panel.

The pinout of this connector is organized as follows:

Pin #	Function
1 - 8	GPI Inputs 1 through 8
9	Ground

A GPI function is activated by making a momentary connection between the GPI pin and ground. This can be done with a switch, a relay, or an open-collector driver. The GPI input is internally pulled high, the external control must sink 1 mA.

Functions are assigned to the GPIs through the Control Profile that has been assigned to the panel.

For more information about Profiles, see Creating and Editing Profiles on page 59.

Chapter 4: Configuration

In this Chapter

This chapter covers the following topics:

- The Router's Network Environment
- Avenue Touch Screen and Avenue PC Controls
- Initially Connecting to the Router
- Assigning the Router a New IP Address and Subnet Mask
- Establishing Initial Control Point and Profile for Administrator Functions
- Configuring the Router's Ports
- Creating and Editing Profiles
- Establishing Control Points and Access Authentication
- Setting Up Timing and Genlock
- Configuring Internal Test Signal Generators
- Switch Point Identification
- Working with the Clean Switch Option

The Router's Network Environment

The 9430 Router Module and the Router Control Panels (5830) communicate over a 100 Mb Ethernet LAN (Local Area Network). In this section, we cover the essential factors for configuring the Router in a typical networking environment. Your own networking environment may differ. While we recommend certain practices, you must nevertheless configure the network parameters in each of these devices in accordance with your network.

Avenue Touch Screen and Avenue PC Controls

While the primary method for controlling the Router is through the web browser interface discussed in Chapter 5: Operations and Step-by-Step Procedures on page 87, the Avenue Touch Screen or Avenue PC Controls are used for initially assigning the Router and optional Control Panel new IP Addresses and Subnet Masks as needed.

If you do not use Avenue Touch Screen or Avenue PC Controls, see Method Two: For Customers Not Using Avenue Touch Screen or Avenue PC on page 42.

Initially Connecting to the Router

Establishing Network Connectivity between Controlling Computer and 9430

Please review the section <u>Router Control Connections</u> on page 32 if necessary to make sure you have network connectivity between your controlling computer and the 9430. It is critical that the controlling computer be networked to the "Y" adaptor cable which connects to the HD-15 connector specific to the slot in the frame where the 9430 is installed.

Assigning the Router a New IP Address and Subnet Mask

When you initially power up the 9430 as received from the factory, it will take the self-assigned static IP address of 192.168.1.100. The 9430 needs to be configured for a manually assigned static IP address and subnet mask that are compatible with your network environment. The next section of this chapter describes two methods for assigning a new static IP address and subnet mask to the 9430.

1.　The first method is for customers who are using either Avenue Touch Screen or Avenue PC to control the Avenue Frame.

2.　The second method is for customers who have neither Avenue Touch Screen nor Avene PC.

These are general instructions. We recommend that you consult your IT staff if you are uncertain about any of these network configuration settings.

Method One: For Customers Using Avenue Touch Screen or Avenue PC

To Set the IP Address

1.　From the Avenue Frame, select the 9430 module from the Touch Screen. The 9430 menus display.
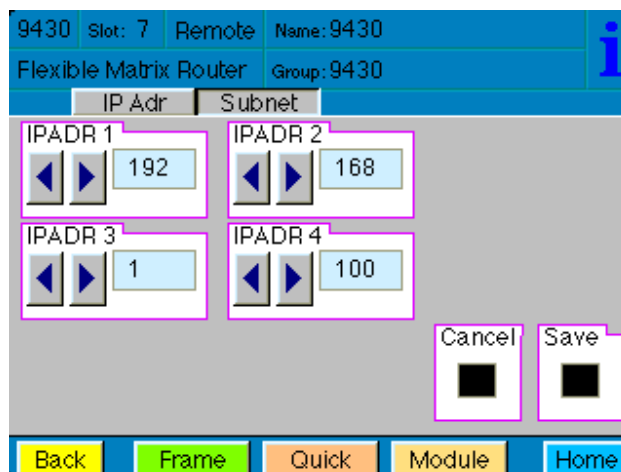
The Touch Screen interface showing the IP address of the Router as received from the factory.

2.　From the **IP Adr** menu, enter the IP address you want to use that is compatible with your own network. The simplest method is to touch each number field, using the keypad to enter the new numbers. For example, you may want to change the IP address to something like the following:

　　　•　10.123.222.100

Note that when using Avenue PC instead of the Touch Screen interface, after entering numbers into the number fields, you will need to hit the "enter" or "return" key for the change to register.
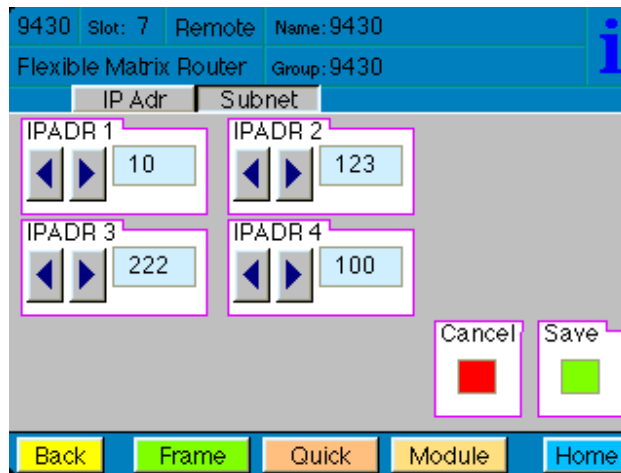
A new IP address has been entered, but not yet saved.

To Set the Subnet Mask

The subnet mask must be set in accordance with the size and topology of your network. The default setting as received from the factory is 255.255.255.0. This is a typical setting for a smaller network. For a larger network, a typical setting is 255.255.0.0. If in doubt, use the setting for a larger network.

1. From the **Subnet** menu, modify the settings as needed. Use the arrow buttons to change the settings, or touch each number field to use the keypad.

2. When finished, press **Save**. Both the **Cancel** and **Save** buttons turn black to indicate that your new settings have been saved.

It should now be possible to browse to the 9430 from a computer on your network.
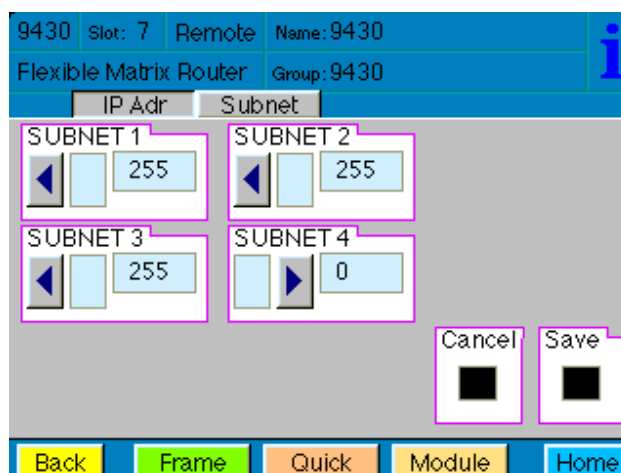
The Subnet Touch Screen menu. The black Cancel and Save buttons indicate that the settings have been saved.

Method Two: For Customers Not Using Avenue Touch Screen or Avenue PC

Temporarily Changing IP Address on Controlling Computer

When you initially power up the 9430 as received from the factory, it will take the self-assigned static IP address of 192.168.1.100.

In order to connect initially with the Router to assign it an IP address that suits your own network, you must first temporarily change the controlling computer's IP address so that it is in the same range as the 9430's default IP address.

For example, you could use the following settings temporarily on the controlling computer:

- IP address: 192.168.1.10

- Subnet mask: 255.255.255.0.

Consideration

Depending on how your computer network is configured, it may be simpler to use a computer, such as a laptop, that is outside of the network solely for the purpose of assigning the Router its new IP address. This may be simpler than temporarily changing the IP address of the controlling computer that is within your network.

Instructions for Temporarily Changing the IP Address for Mac and Windows XP

For the Mac

1. From the dock, click the System Preferences icon. The System Preferences window displays.

2. Click the Network icon. The Network window displays.

3. From the Configure drop-down control, select Manually.
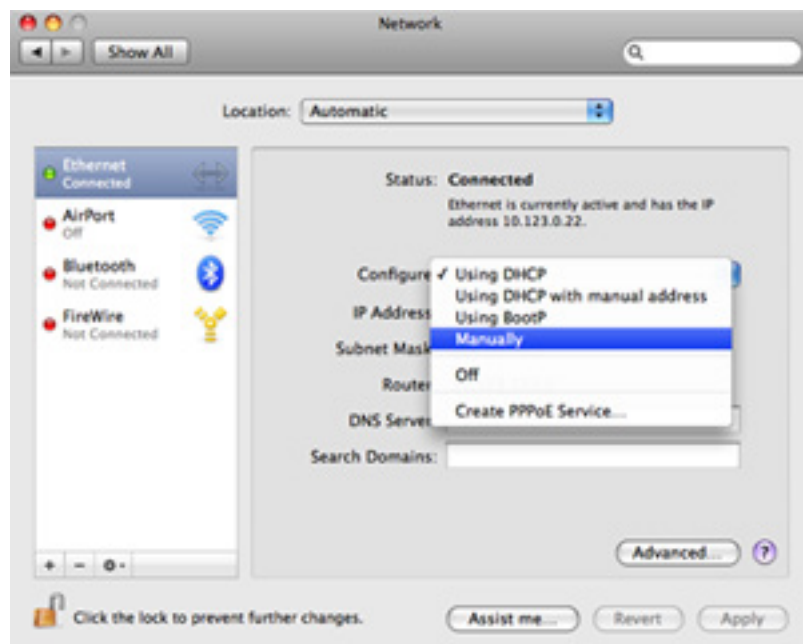
4. Enter the IP address and
    subnet mask settings
    as applicable, then click
    Apply.
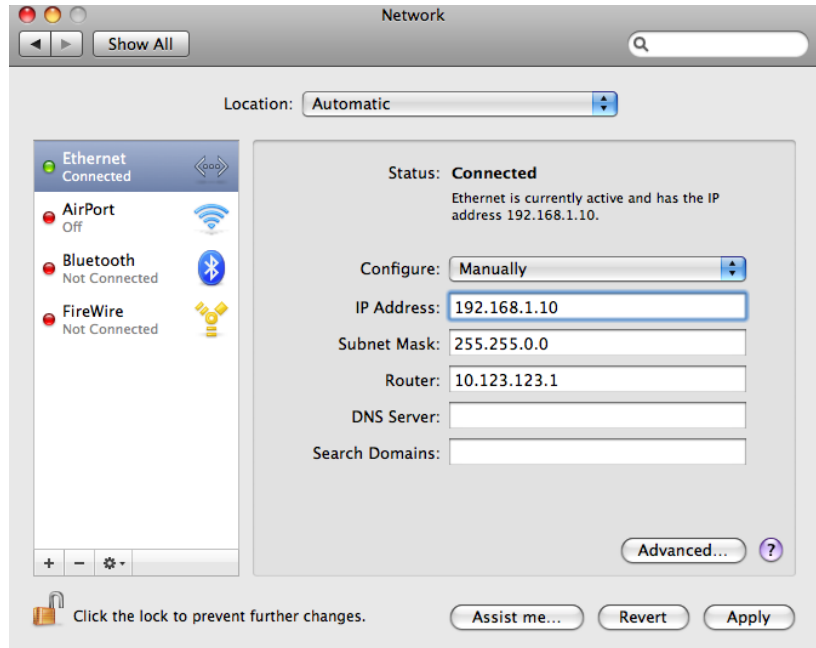
Example of network configuration settings for temporarily changing the IP address of a Mac to make the initial connection to the 9430 Router

For Windows XP

1. Select Start > Control Panel.
    The Control Panel displays.

2. Double-click the Network Connections icon.
    The Network Connections window displays.
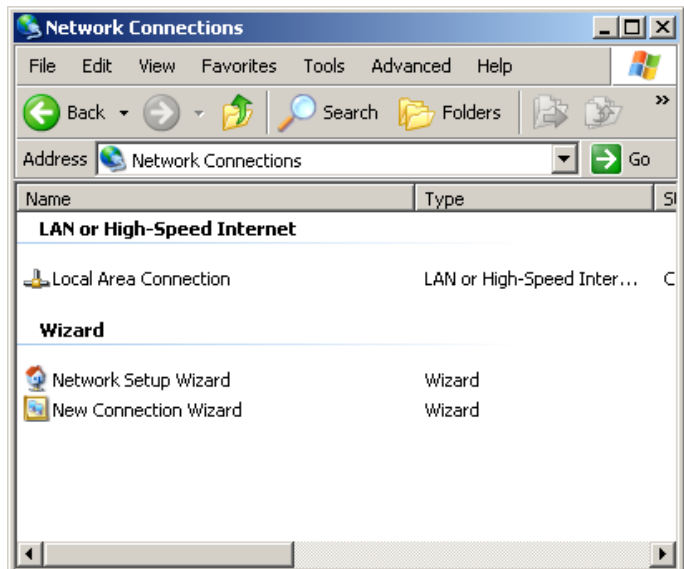
3. Double-click the Local Area
    Connection icon. The Local Area
    Connection Status window displays.
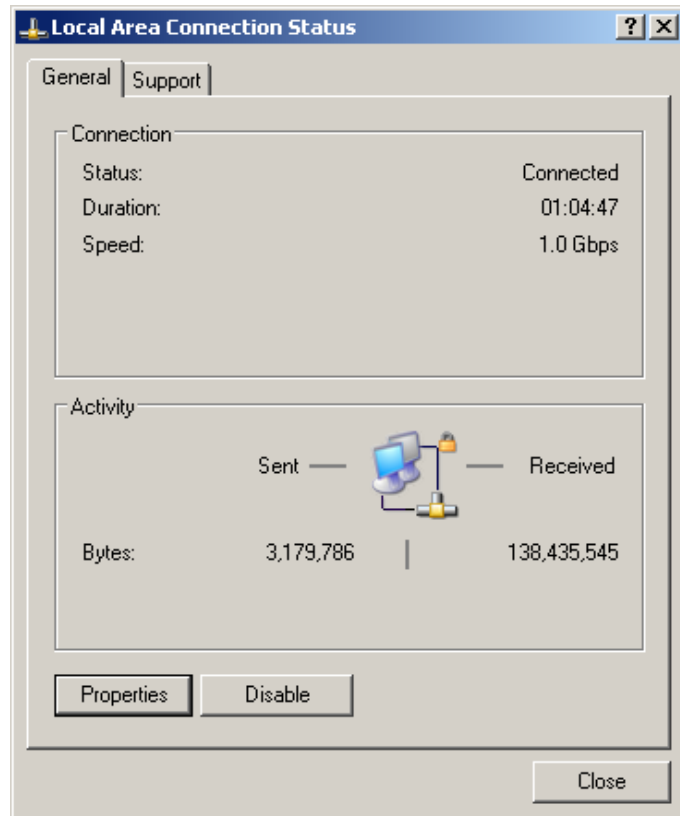
4. Click the Properties button. The Local
    Area Connection Properties window
    displays.
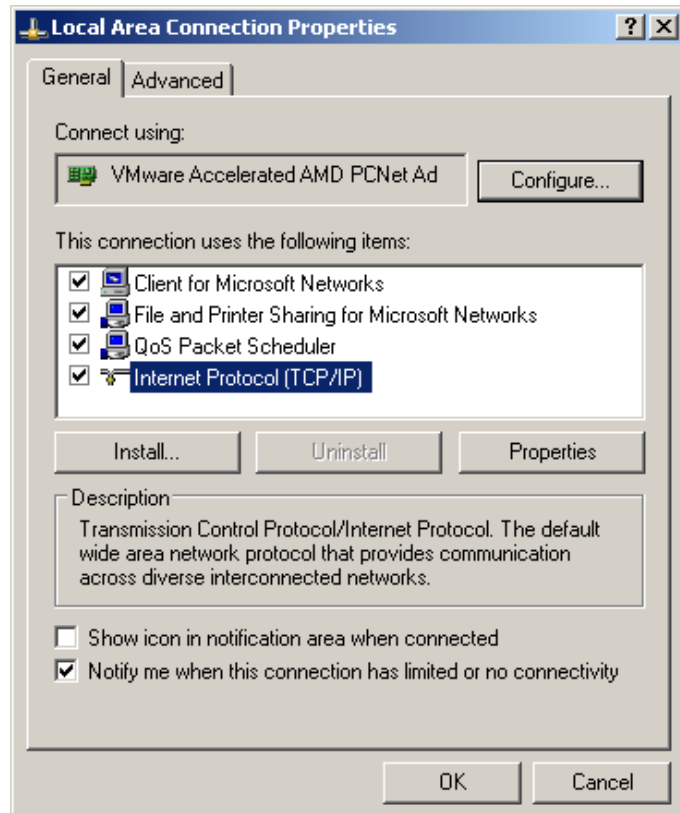
5.   Select Internet Protocol (TCP/IP), then click the Properties button. The Internet Protocol (TCP/IP) Properties window displays.

6.   Select the radio button for "Use the following IP address."
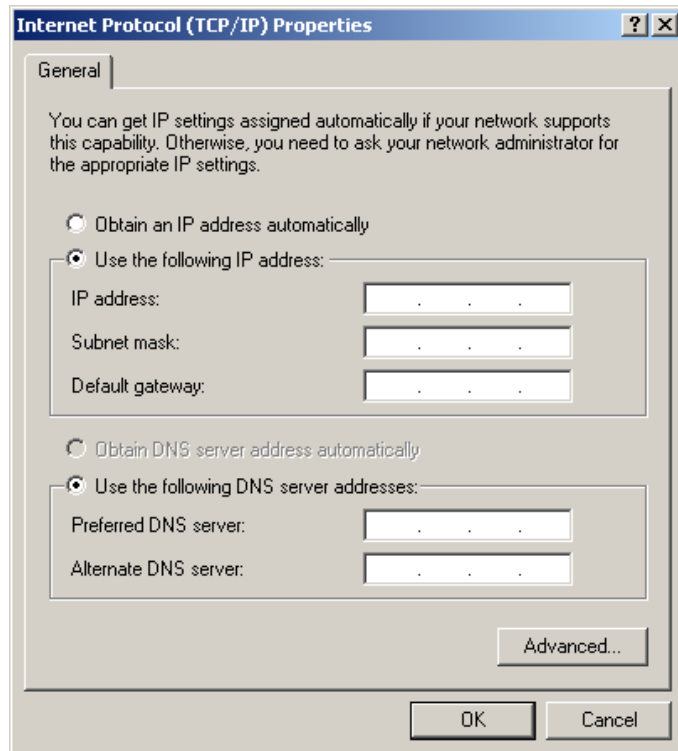
7.   Enter the IP address and Subnet mask information as applicable, then click OK.
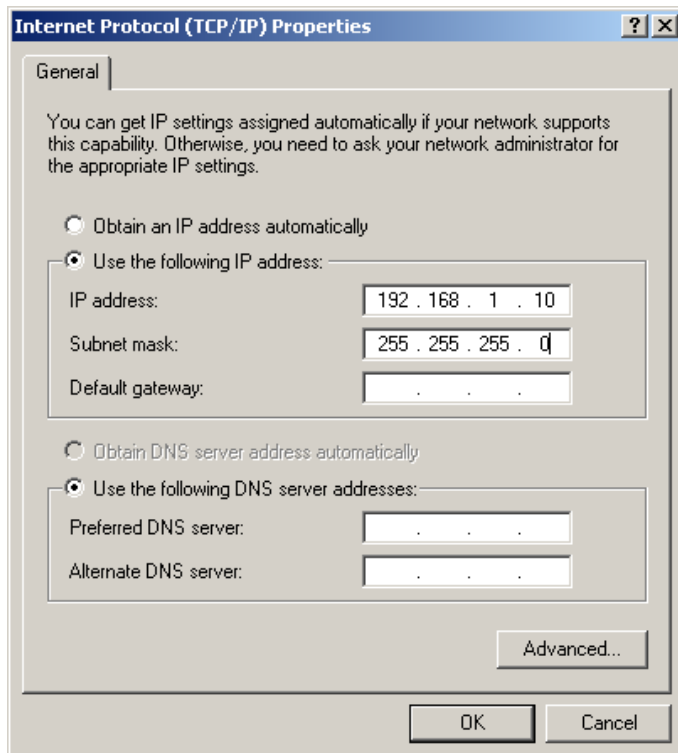
To Set the IP Address on the 9430 Router

1. At this point, you are ready to connect to the Router from your web browser. Navigate to the URL http://192.168.1.100. The first time that you browse to the Router's IP address, a web page displays with the message "Control Point Needed."
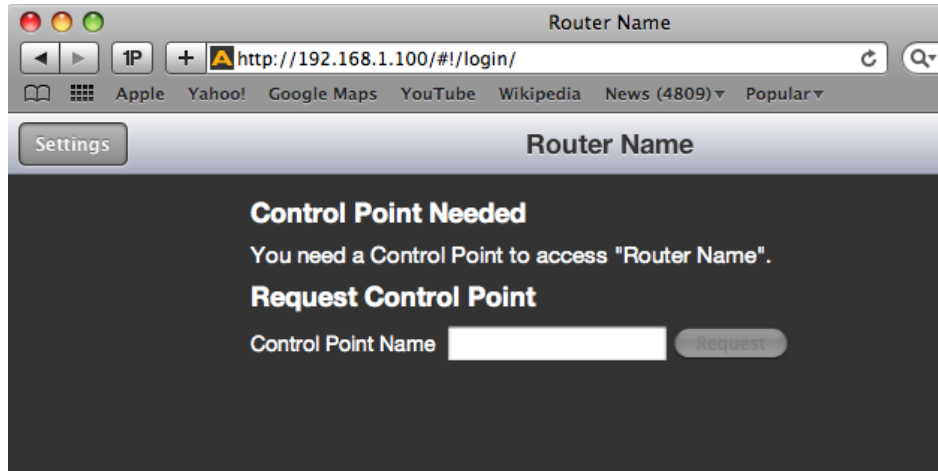
The message "Control Point Needed" appears only the first time you browse to the Router's assigned IP address.

2. Click **Settings** in the upper left part of the browser window. The Settings > General window displays.
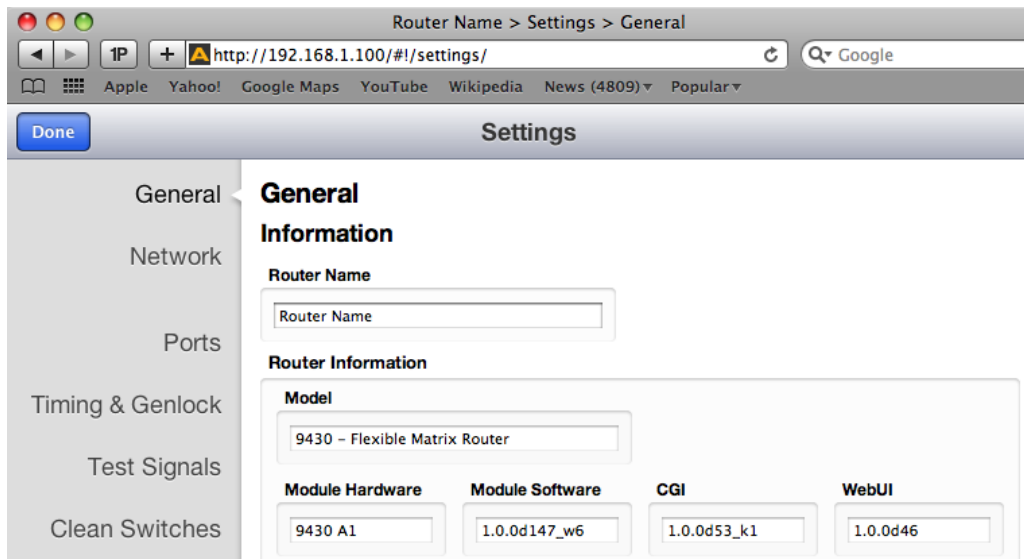
The Settings > General window

3. From the left navigation panel, click **Network**. The Network window displays.

4. In the Address field, enter the IP address you want to use for the Router; for example, 10.123.222.100. If you know the Gateway and DNS Server information, enter that information.
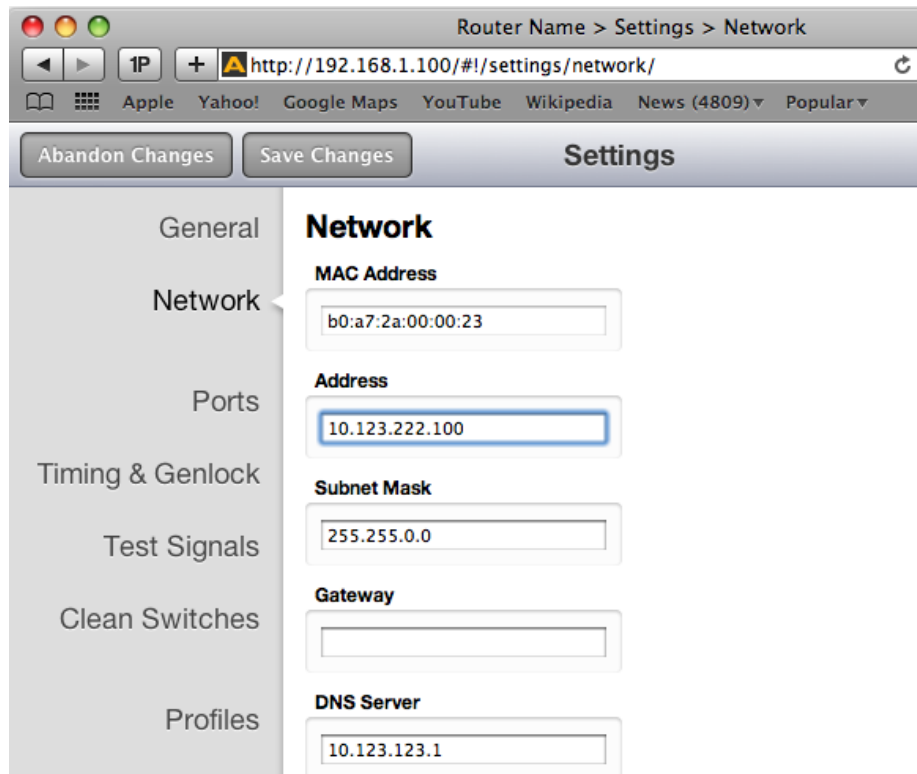
Entering the IP address you want to use for the Router that suits your own network environment

5. Click **Save Changes**, then click **Done**. You will temporarily lose connection to the Router at this point because it is now using an IP address that is outside of the range of your computer.
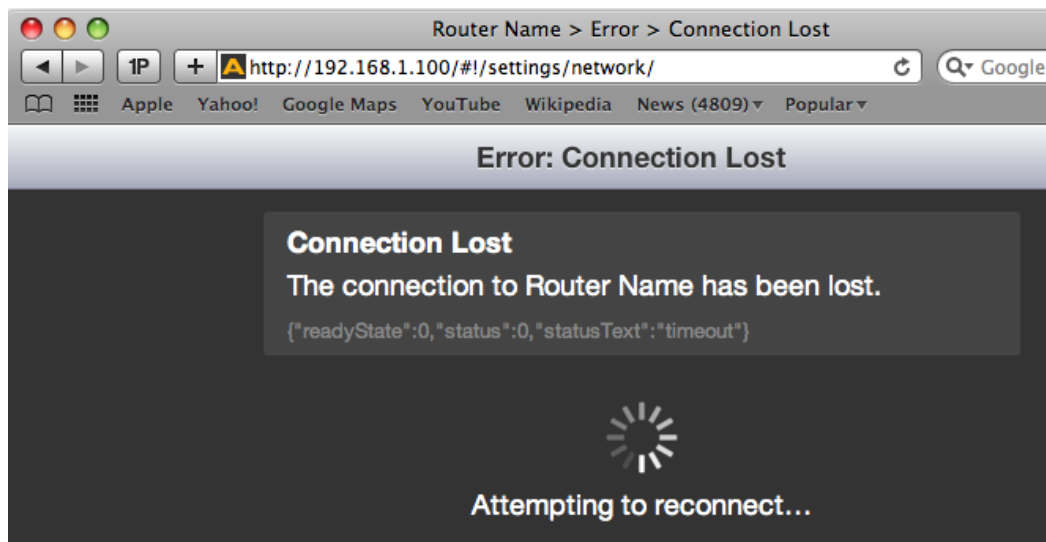
An expected temporary loss of connection as part of the initial configuration process

Readjusting Controlling Computer's IP Address to be in Range of Router's Newly Assigned IP Address

Now that you have set the Router's IP address away from its factory default in favor of an IP address suitable for your own network environment, you must change the IP address of the controlling computer once again so that it is in a compatible range with the Router's new IP address.

This may be as simple as reverting to a dynamically assigned IP address if the controlling computer is on a network with a DHCP server compatible with the Router's new IP address. Or you may want to assign a static IP address, provided that it is one that allows you to access the 9430 with its newly assigned IP address.
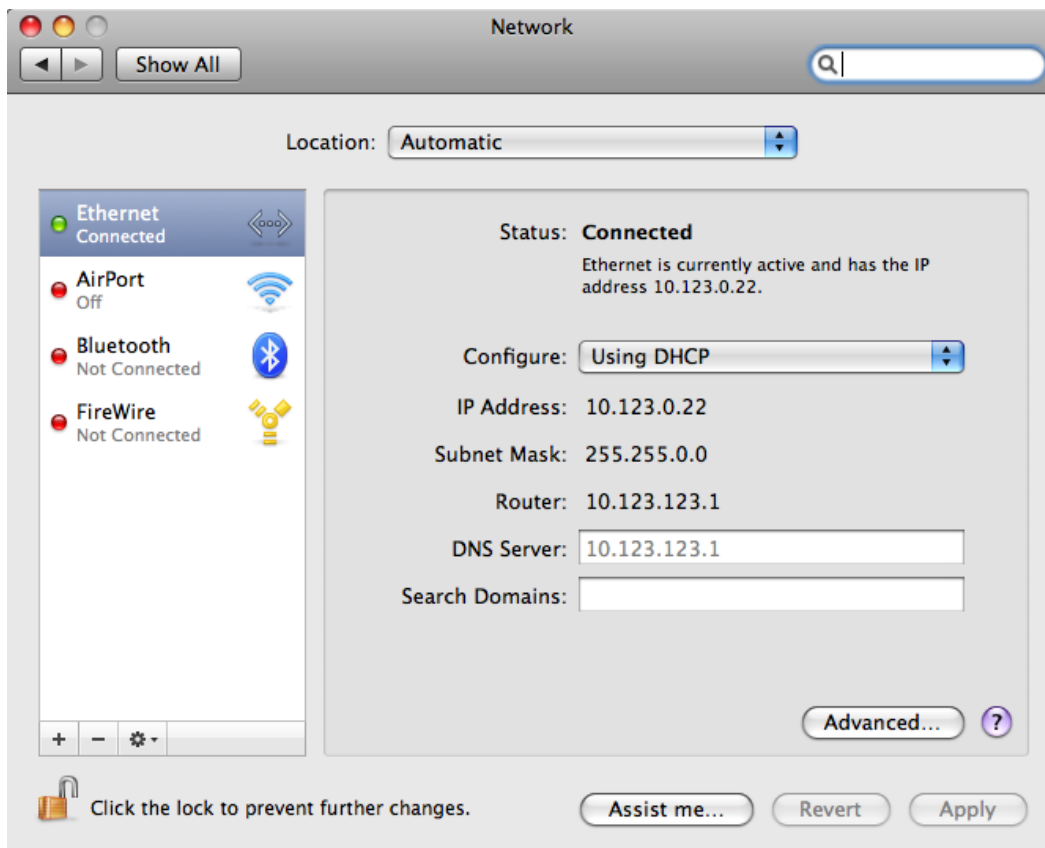
Example of readjusting the controlling computer's IP address to be within range of the Router's newly assigned IP address.

Establishing Initial Control Point and Profile for Administrator Functions

Now that you have set the Router's IP address and subnet mask in a manner that suits your network environment, you can start the configuration process. From the controlling computer, connect to the 9430 to establish an initial Control Point for administrator functions.

To Create an Initial Control Point

1.   Navigate to the 9430's new IP address with your browser. The Control Point Needed window displays.

2.   From the Control Point Needed window, enter the name you want to use to refer to the initial Control Point (for example, "Router Admin").
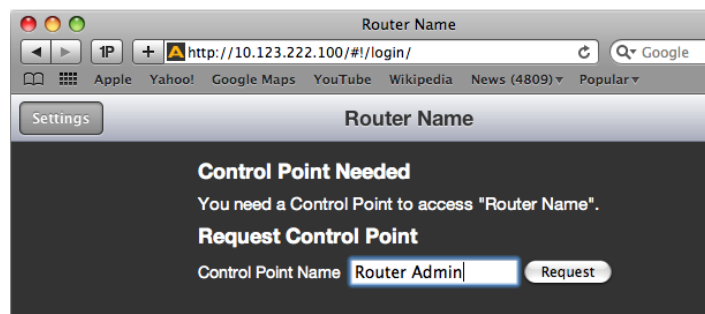
3.   Click Request. The message "Control Point Disabled" displays.
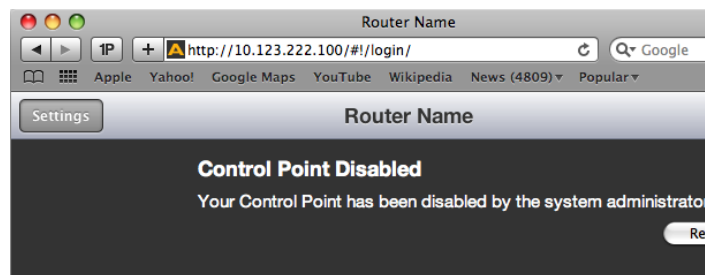
4.   Click **System Settings** in the upper left part of the browser window. The Settings > General window displays.
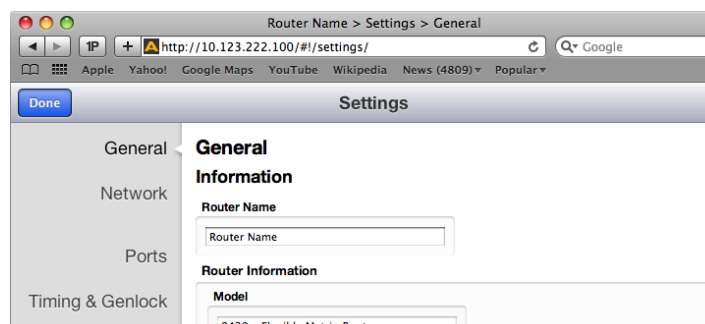
5.   From the left navigation panel, click **Network**. The Network page displays.
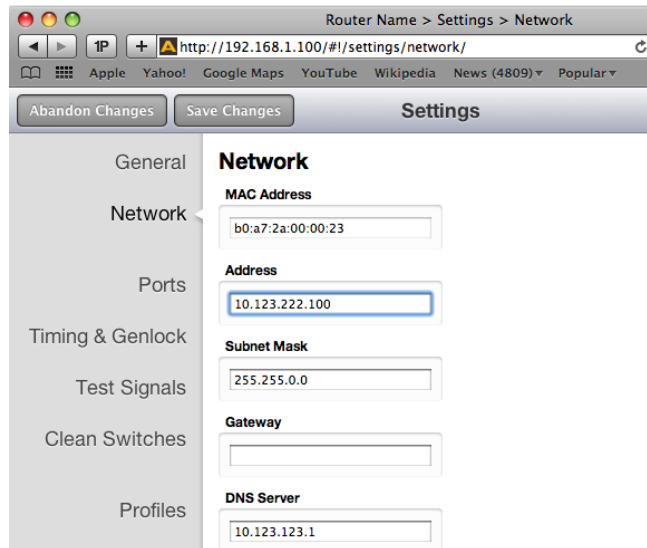
6.   Set the Gateway and DNS Server parameters according to your network configuration. In general, these settings will be required only in installations with extended networking requirements, such as a remote site connected by VPN.

7.   From the left navigation panel, click **Control Points**. The Control Points window displays. The Control Point you just requested is listed under Pending Authorization.
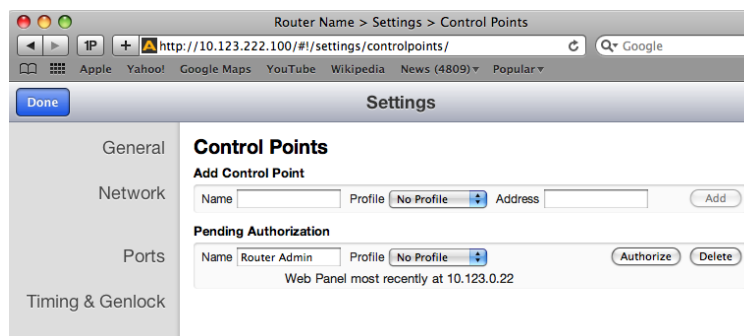
The Settings > Control Points window

To Assign the Factory Default Profile to the Router Admin Control Point

You must assign a Profile that defines which sources and destinations this Control Point can access. To begin with, choose the Factory Default Profile. It provides access to the eight Inputs, two Test Signal Generators, and two Outputs of the basic 9430 module.

1. Under Pending Authorization, select **FactoryDefault** from the Profile drop-down control.
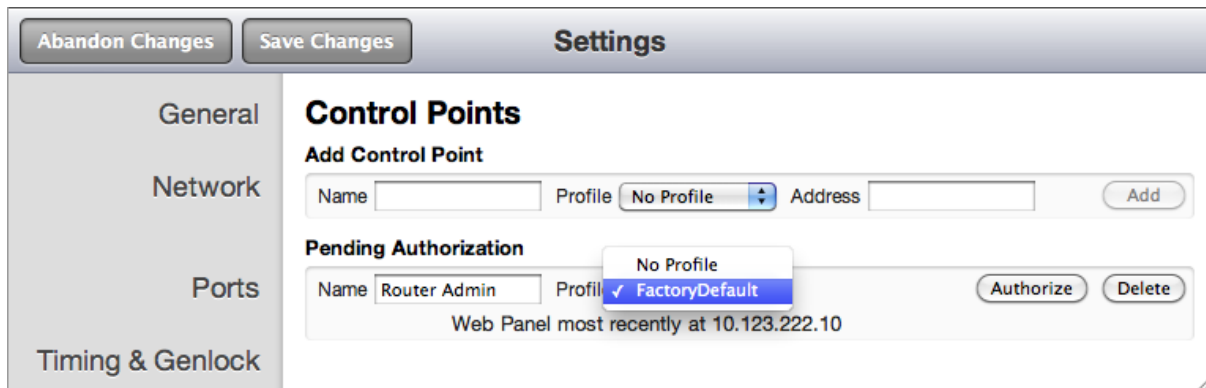
2. Click **Authorize**. The Router Admin Control Point now displays in the list of authorized Control Points.

3. Click **Save Changes** in the upper left area of the window.

4. Click **Done**.

You should now be presented with a Router Control view with thumbnail icons, as shown below.

Now that you have set the Router's IP address, assigned a Profile and authorized an initial Control Point, you have access to all of the Router's configuration settings.

In the example just discussed, the Router Admin Control Point is specific to the controlling computer. Later sections of this chapter discuss how to create additional Control Points for other computers, laptops, iPads, and Router Control Panels (5830). You can also use external control panels using serial protocols.

For more details, see:

- Creating and Editing Profiles on page 59
- Establishing Control Points and Access Authentication on page 63
- Chapter 6: External Control on page 96

Security and Administrative Access to Settings

All of the Router's configuration parameters can be accessed through the **Settings** button in the upper left corner of the web interface. Without enabling a password, anyone with access to the Router (meaning anyone who has an authorized Control Point with an assigned Profile) can make changes to its Settings.

Depending on the security needs of your facility, you may wish to limit access to the Router's Settings to only certain people. From the General > Settings page, you can limit administrative access to the Router by creating a password.

To Limit Access to the Router's Settings

1. From the Router's web interface, click **Settings**. The Settings > General page displays.

2. In the Security section, click the Required checkbox to enable the password functionality.

Security

Admin Password	New Admin Password	Repeat New Password
☑ Required	••••••••••	••••••••••

3. Select a password and enter it into the New Admin Password field. Enter it a second time in the Repeat New Password field.

4. Click **Save Changes**, then click **Done**. The main Router web interface displays.

Password Required

The administrator password is required to access settings.

Administrator Password [   ]

[Cancel] [Login]

When a password is required for administrative access, users who try
to access Settings will get a message that says "Password Required."

Next, we will go over the background information necessary to understand how to configure the Router's Ports according to your facility's intended use.

Configuring the Router's Ports

Planning Router Port Configuration

Typically, during the planning stage of your Router implementation, you would determine in advance how you want to initially use the router in terms of inputs, outputs, test signals and clean switches.

Cabling Router to Match Plan

Based on your plan, connect cables to the ports to match your intended use. After you have completed cabling the router, you will then configure the ports to match how you have wired the router for your facility.

Before going step-by-step through the process of configuring the Router's ports, it is necessary to go over some background information in order to understand what the configuration options mean.

Components Chosen Determines Quantity and Types of Ports Available

The number and types of ports available in the Router is determined by the components chosen. Without taking the 9435 Clean Switch option into account yet, there are three underlying hardware module configuration options, creating a total of 33 possible Router sizes:

One 9430 Module	One 9430 Module and One 9440 Module	One 9430 Module and Two 9440 Modules
One 9430 module has 8 fixed inputs and 2 fixed outputs for a total of 10 ports.	One 9430 module plus one 9440 module has 8 fixed inputs, 2 fixed outputs, and 10 bi-directional ports for a total of 20 ports.	One 9430 module plus two 9440 modules has 8 fixed inputs, 2 fixed outputs, and 20 bi-directional ports for a total of 30 ports.
8 x 2	18 x 2 17 x 3 16 x 4 15 x 5 14 x 6 13 x 7 12 x 8 11 x 9 10 x 10 9 x 11 8 x 12	28 x 2 27 x 3 26 x 4 25 x 5 24 x 6 23 x 7 22 x 8 21 x 9 20 x 10 19 x 11 18 x 12 17 x 13 16 x 14 15 x 15 14 x 16 13 x 17 12 x 18 11 x 19 10 x 20 9 x 21 8 x 22

Definitions of Port Configuration Choices

Port configuration choices are described below, followed by detailed examples.

Unassigned

For all Port Types

A port can be set to Unassigned when it is not in use. This will remove it from the list of Sources and Destinations that can be assigned to a Control Profile.

Source

For Fixed Input and Bi-directional Ports

When configured as a Source, a port is an input to the switching matrix. The Source can be given a name, and under that name it will be available for assignment in a Control Profile. Making this selection on bi-directional ports will cause them to operate as inputs.

Destination

For Fixed Output and Bi-directional Ports

Configuring a port as a Destination makes it available for use in Control Profiles under its assigned name as a Router output. A bi-directional port configured as a Destination will cause it to operate as an output.

Follow

For Fixed Output and Bi-directional Ports

Output capable ports can be configured to Follow, or duplicate, the signal on any Source or Destination. The Follow configuration essentially makes a port into a DA. Ports that are configured to Follow will not appear on the list of Sources and Destinations that can be assigned to a Control Profile.

Paired

For all Port Types

This is used to create pairs of Inputs or Outputs to support signals such as Key & Fill, RGB444 Link A & B, or 3D Left & Right. Pairing associates the port to an existing Source or Destination assignment.

> **Note:** While the Paired configuration is valid on all port types, only input capable ports can be paired to a Source, and only output capable ports can be paired to a Destination.

Primary TSG

For Fixed Output and Bi-directional Ports

This Primary TSG configuration delivers the test signal being generated in the Primary TSG to an output port, independently of any user control of the switching matrix.

Secondary TSG

For Fixed Output and Bi-directional Ports

The Secondary TSG configuration delivers the test signal being generated in the Secondary TSG to an output port, independently of any user control of the switching matrix.

> **Note:**   As described above, only ports that are configured as Sources or Destinations are available to assign to the Source and Destination buttons on a control panel.

Port Configuration Choices Available According to Port Type

These three port types (fixed input, fixed output, bi-directional) can accept 3G, HD, SD, ASI, 310M, and AES, and can be configured in the following ways:

For Fixed Input

Fixed Input ports can be configured in one of three ways:

1. Unassigned
2. Source (the default on a new installation)
3. Paired

For Fixed Output

Fixed Output ports can be configured in one of six ways:

1. Unassigned
2. Destination (the default on a new installation)
3. Follow
4. Paired
5. Primary TSG
6. Secondary TSG

For Bi-Directional

Bi-directional ports can be configured in one of seven ways:

1. Unassigned (default on new installation)
2. Source
3. Destination
4. Follow
5. Paired
6. Primary TSG
7. Secondary TSG

Implementing Router Port Configuration Plan

Now that we have covered the background context for numbers and types of Router ports available and what the various configuration selections mean, you are ready to configure the Router's ports.

To Configure the Router's Ports

From the left navigation panel, select **Ports**. The Ports page displays. Initially, all the ports show "Unassigned" for the Type drop-down control.
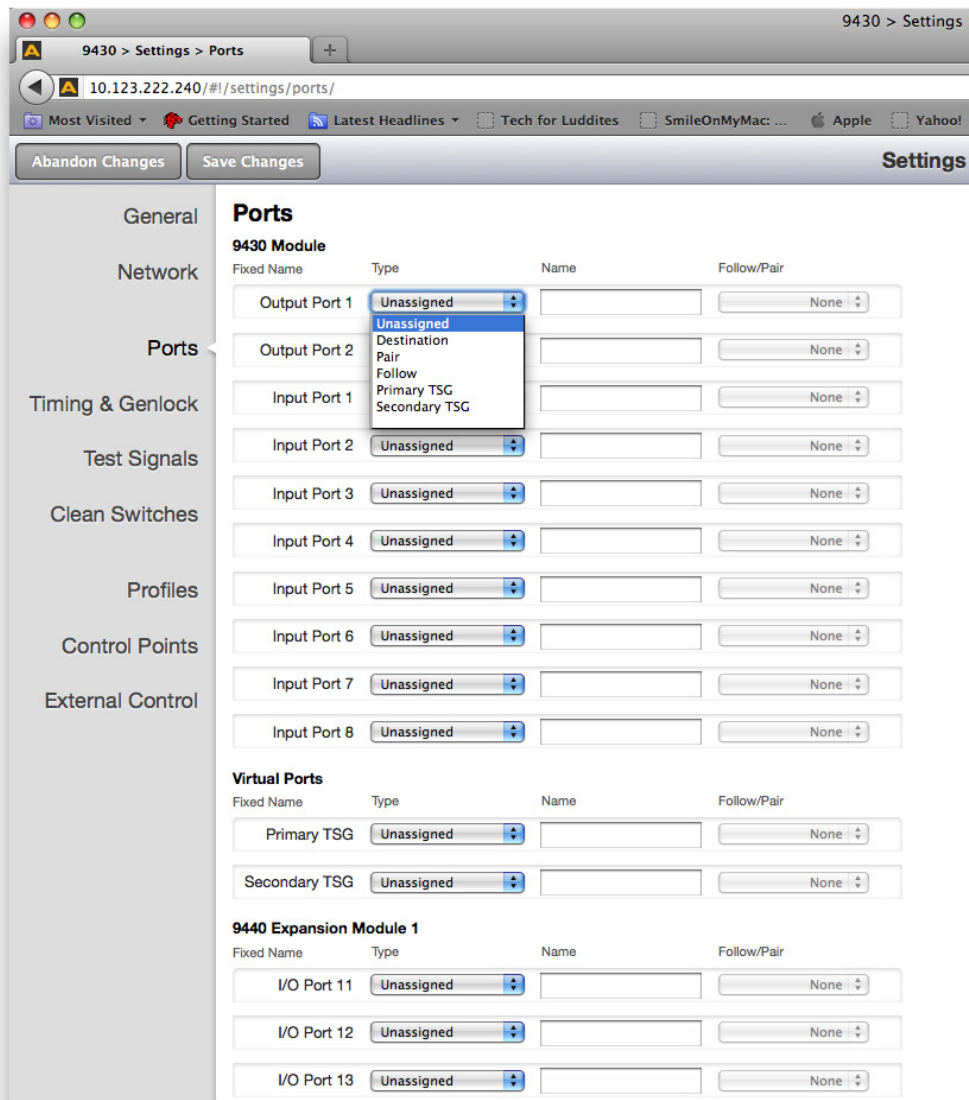
Configuring Ports: Making a selection from the Type drop-down control for Output Port 1

On the Ports page, take the following steps for each port that you plan to use:

1. Select its Type from the Type drop-down control.

2. Indicate a Name (this is the Port's name that is visible when creating Profiles).

3. If applicable, make a selection from the Follow/Pair drop-down control.

4. Click **Save Changes** near the upper left area of the browser window to save your changes, or click **Abandon Changes** if you want to cancel your changes.

Now that you have configured the Router's Ports, the next stage of Router configuration is to create Profiles and Control Points to accommodate as many users as you need in your facility.
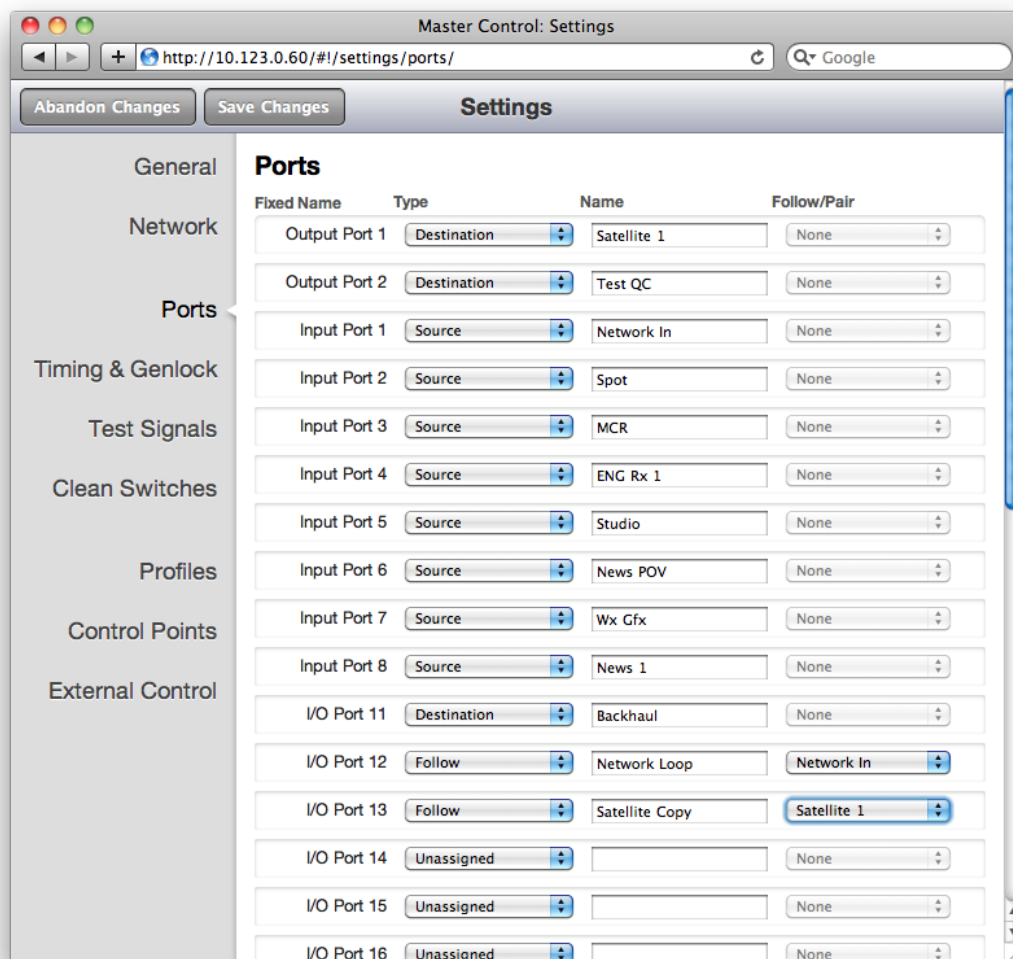
An Example Port Configuration

Creating and Editing Profiles

A Profile provides each Control Point with a configured view of the Sources and Destinations on the Router. A Profile defines which Sources and Destinations can be accessed from any given Control Point.

A Profile also defines the order in which Sources and Destinations display for a Control Point. This ordering feature is of particular interest in the case of RS-232 and TCP/IP control for automation because it provides a simple means to map Sources and Destinations to suit the automation protocol.

Every Control Point, such as a Router Control Panel (5830), a web browser, an iPad, or a serial interface for external control, must have a Profile assigned to it in order for that Control Point to be able to use the Router. Multiple Control Points can share the same Profile.

Each Profile can be customized to have access to unique combinations of not only Destinations, but also Sources.

Characteristics of Profiles

- Required for every Control Point
- Show only Sources and Destinations
- Define which Sources and Destinations can be accessed
- Define the order in which Sources and Destinations are displayed
- Can be assigned to multiple Control Points

Creating an Initial Set of Profiles

Complete the process of creating as many profiles as your Router users will require. While you can always create additional Profiles or edit existing ones, you may want to systematically think through your users' needs to determine what the initial set of Profiles will be. This will simplify the overall configuration process as you begin assigning Profiles to Control Points.

To Create a Profile

1. From the left navigation panel, click **Profiles**. The Profiles page displays.

2. Enter a profile name in the New Profile field.

3. Click **Create**. The new Profile is listed on the Profiles page.

4. Next to the newly created Profile, click **Edit**. The Edit Profile page displays. At the outset of creating a new profile, all the available Sources and Destinations are presented.

5. Click and drag unassigned Sources and Destinations up to the assigned area as needed for this specific profile. Note that you can rearrange the order as desired. Additionally, you can include empty spaces to create groupings of Sources and Destinations by clicking and dragging a Space icon up to be a source or destination.

6. When finished, click **Save Changes** in the upper left part of the screen, then click **Done**.

This newly created Profile is now available to assign to one or more Control Points.

Repeat steps 1 through 6 until you have as many Profiles as you need.

Examples of Profiles

After the functions of the Ports have been defined, the available Sources and Destinations are selectively assigned to Profiles.

Ports that are configured as Follow, Paired, or Unassigned are not available to a Profile since they cannot be "controlled."

Master Control Room (MCR) 10 x 3

In the example below, there are ten Sources and three Destinations for a Master Control Room Profile named "MCR." In this example, all available Sources and Destinations have been assigned.
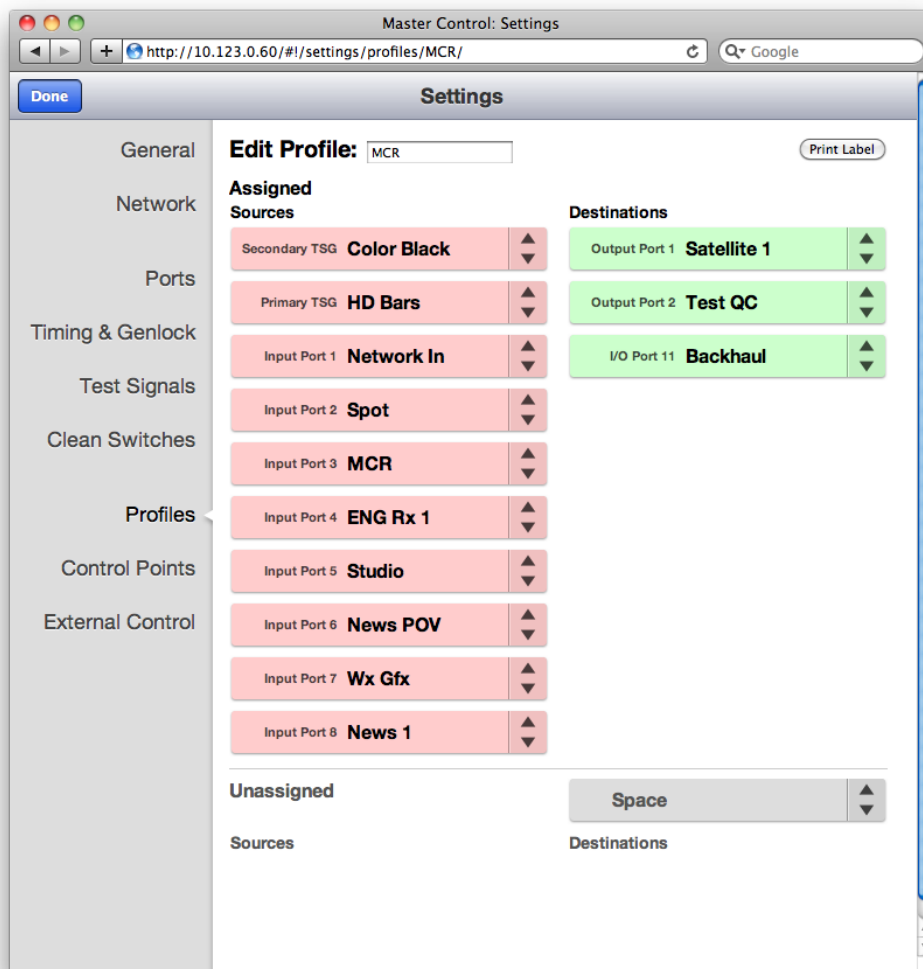
An example of a Master Control Room (MCR) Profile with 10 Sources and 3 Destinations

MCR Profile Edited and Reordered to 8 x 3

This Profile has been edited to remove access to two of the Sources (ENG Rx 1 and News 1). In addition, blank spaces have been inserted to organize the selections as they are presented on a control panel. Those "blanks" will produce unused buttons on the panel.

This profile also has the Sources and Destinations in a different order and will be reflected in the button assignment on a control panel. If this profile were assigned to the serial interface for automation control, the order and spacing of Sources and Destinations would "map" the external control to the Router.
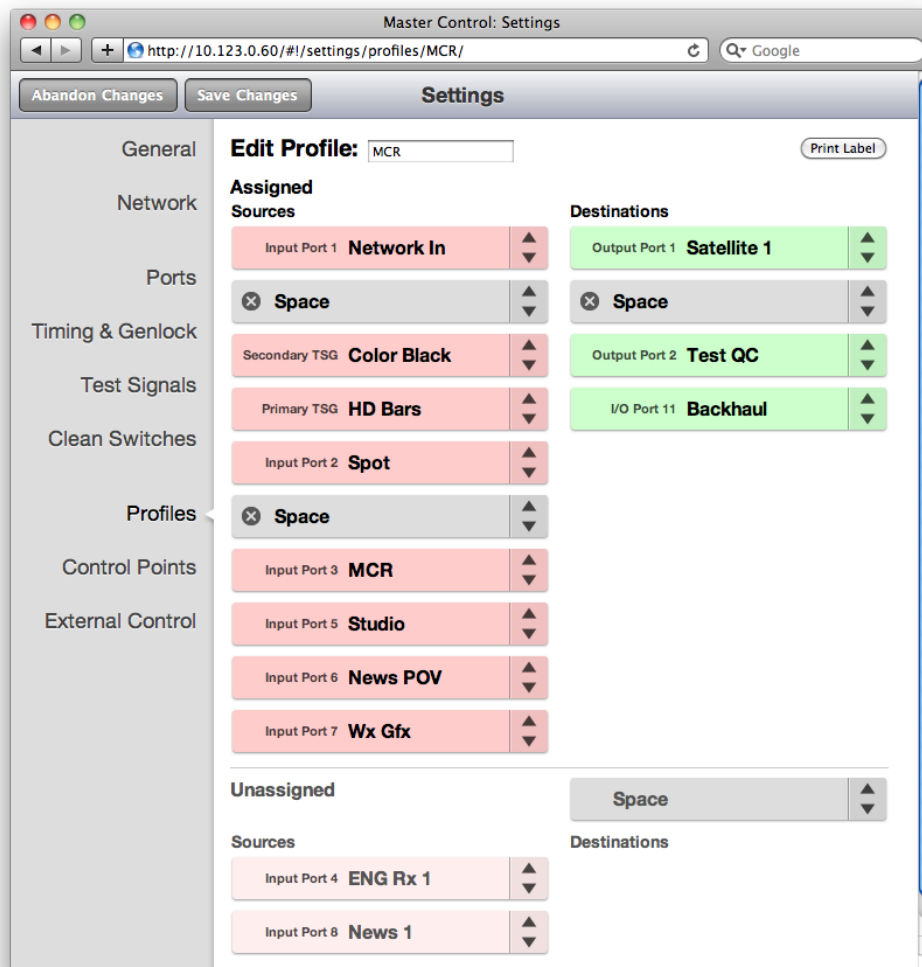
An edited and reordered Master Control Room (MCR) Profile with 8 Sources and 3 Destinations

MCR Profile Edited to 8 x 1

This Profile has been further edited by removing two Destinations. The result is a Profile that allows control over only a single output. If assigned to a Router Control Panel (5830), this would effectively create a single destination panel.
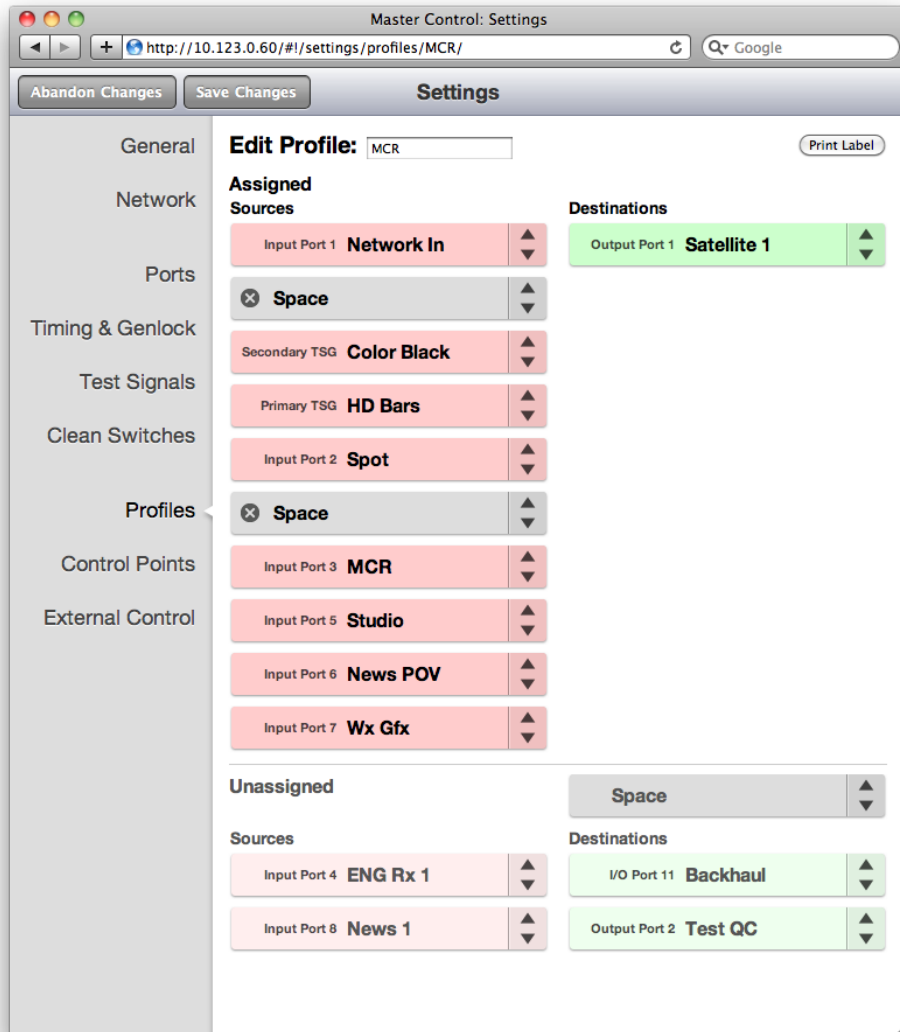
An edited Master Control Room (MCR) Profile with 8 Sources and 1 Destination

Establishing Control Points and Access Authentication

There are many ways to control the Router and many possible Control Points. In order to manage these and selectively limit access, each possible Control Point must be authenticated.

An administrator grants access to Control Points through configuring the Control Points page. Access the Control Points page by selecting **Control Points** from the left navigation panel of the web interface. The administrator assigns a previously created Profile to each of the various Control Points. Control Points can be either assigned or requested. These methods are discussed in more detail shortly.

Characteristics of Control Points

For each Control Point, only the Sources and Destinations that have been defined by its assigned Profile will be available.

For a Control Point to work, it must meet these conditions:

- It must be authenticated, meaning that the Enabled check box is selected in the Control Points window.
- It must have a Profile assigned to it.

If these conditions are not met, the browser window displays the message, "Control Point Disabled."
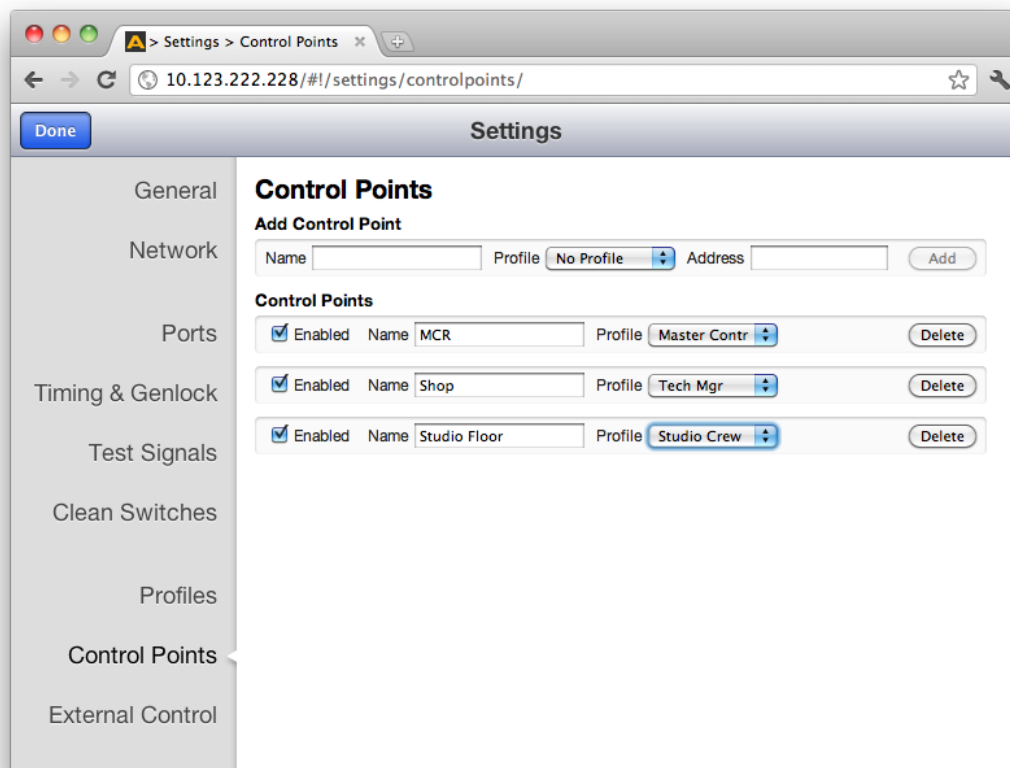
The Control Points window showing three Control Points. Note that these Control Points are enabled (the Enabled check box is selected) and have Profiles assigned to them.

Examples of Control Points

- 5830 Router Control Panel

- Laptops, iPads and other computers using a web browser

- External control using serial protocols

Configuring the 5830 Router Control Panel

Configuring the Router Control Panel involves:

- Connecting it to the network with an Ethernet cable,

- Turning on the power, (unless it is being powered using Power over Ethernet, or PoE),

- Determining whether to use a static (the default) or dynamic IP address,

- Granting it access to the Router, and

- Assigning it a Profile.

Note: Please connect the Router Control Panel to the network before turning on its power. The Router Control Panel can be powered using PoE (if you have a PoE switch upstream from the Panel), or it can be powered by the power supply included with each Panel.

Assigning an IP Address to the 1RU Control Panel

The 5830 1RU Control Panel comes from the factory with the following defaults:

- Static IP Address: 192.168.1.101

- Subnet: 255.255.255.0

You can change this configuration by accessing the 5830 from a web browser. To do this, you will need a computer whose network configuration is compatible with the 5830 defaults. In general, this will require that the computer be connected to the same Ethernet switch as the 5830. A WiFi connection will work only if it provides access to the 5830 subnet. The computer will need an address in the range of 192.168.1.0 to 192.168.1.254 in order to connect to the 5830.

Once you can browse to the 5830, you will see the following Settings > General window:
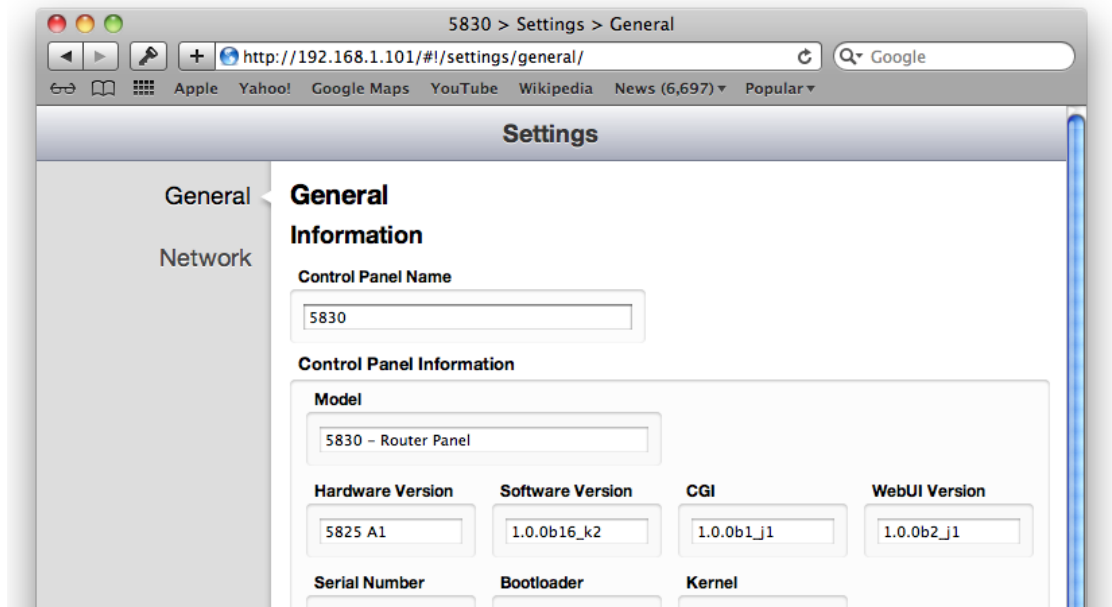
The 5830 Settings > General window

1. From the left navigation panel, select Network. The Settings > Network window displays.
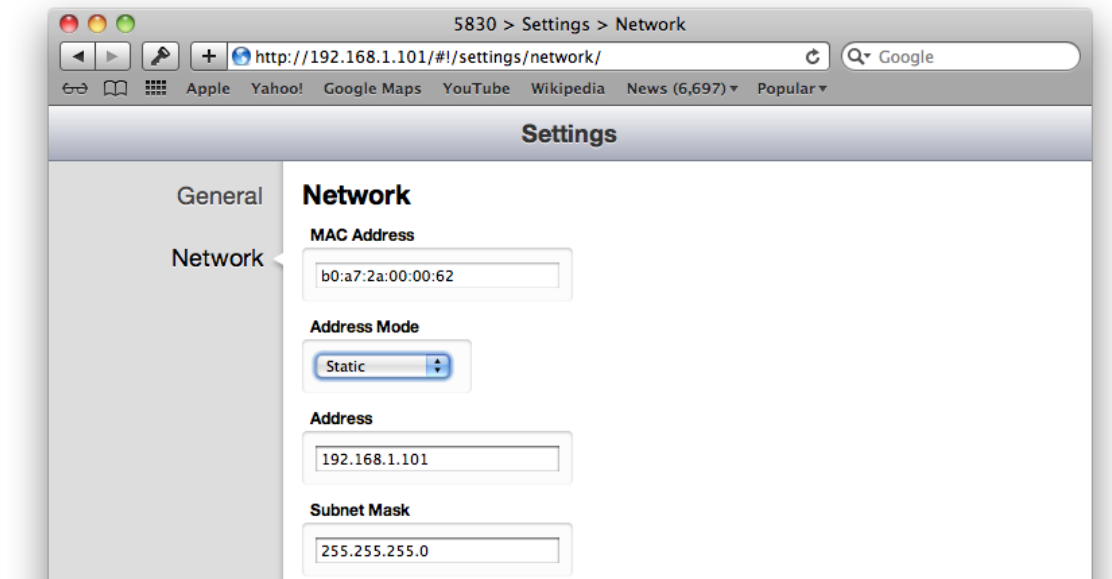
The 5830 Settings > Network window showing the factory default settings

Although the 9430 Router Module must use a fixed (static) IP Address, it is possible to operate the 5830 with either a static address or one that is automatically assigned by your network under DHCP. If DHCP is selected from the Address Mode pull-down control, the 5830 will obtain an address from the DHCP server on your network.

Our recommendation is to use a fixed (static) IP Address for the 5830 Control Panel.

2. Configure the fields in the Network settings window appropriately to your network. Gateway and DNS Server fields are optional.

3. Be sure to double-check the IP Address and Subnet Mask before clicking **Save Changes**. At this point, the browser connection will be lost. If you are using DHCP, you can determine what address was generated by looking at the display on the 5830 itself.

4. Restore the controlling computer's IP address to its previous settings in order to restore its network connectivity. You will now be able to reconnect to the 5830 Control Panel's Settings as needed by navigating to its new IP Address.
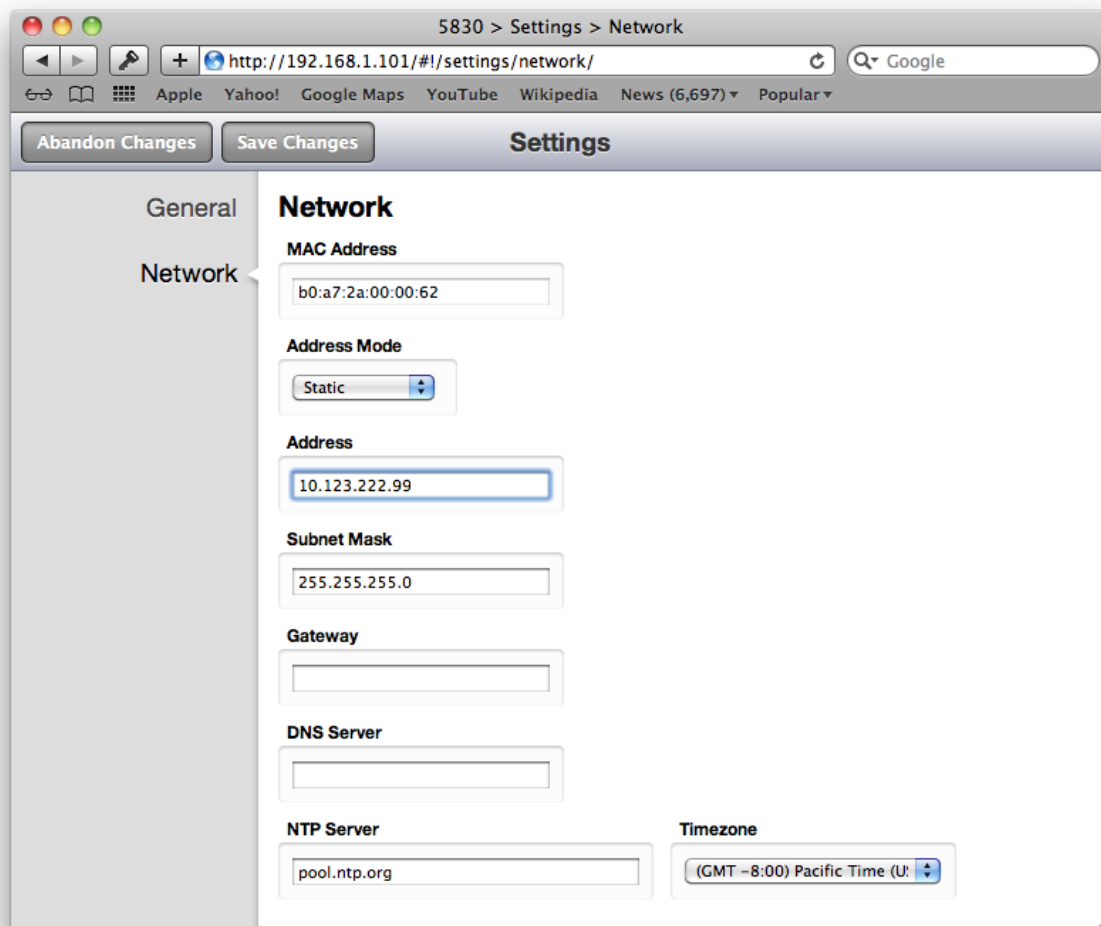
The 5830 Settings > Network window showing modified settings

Creating a Control Point for the 5830 Panel

1. Browse to the 9430 Settings > Control Points page.

2. Under the heading Add Control Point, enter a name for the 5830 Panel in the Name field.

3. Select **FactoryDefault** from the Profile drop-down control.

4. Enter the IP address of the 5830 into the Address field.

5. Click **Add**.

6. Click **Done**.

At this point, now that you have assigned a compatible IP address to the Control Panel and you have added it as a Control Point, it will be able to connect to the Router.
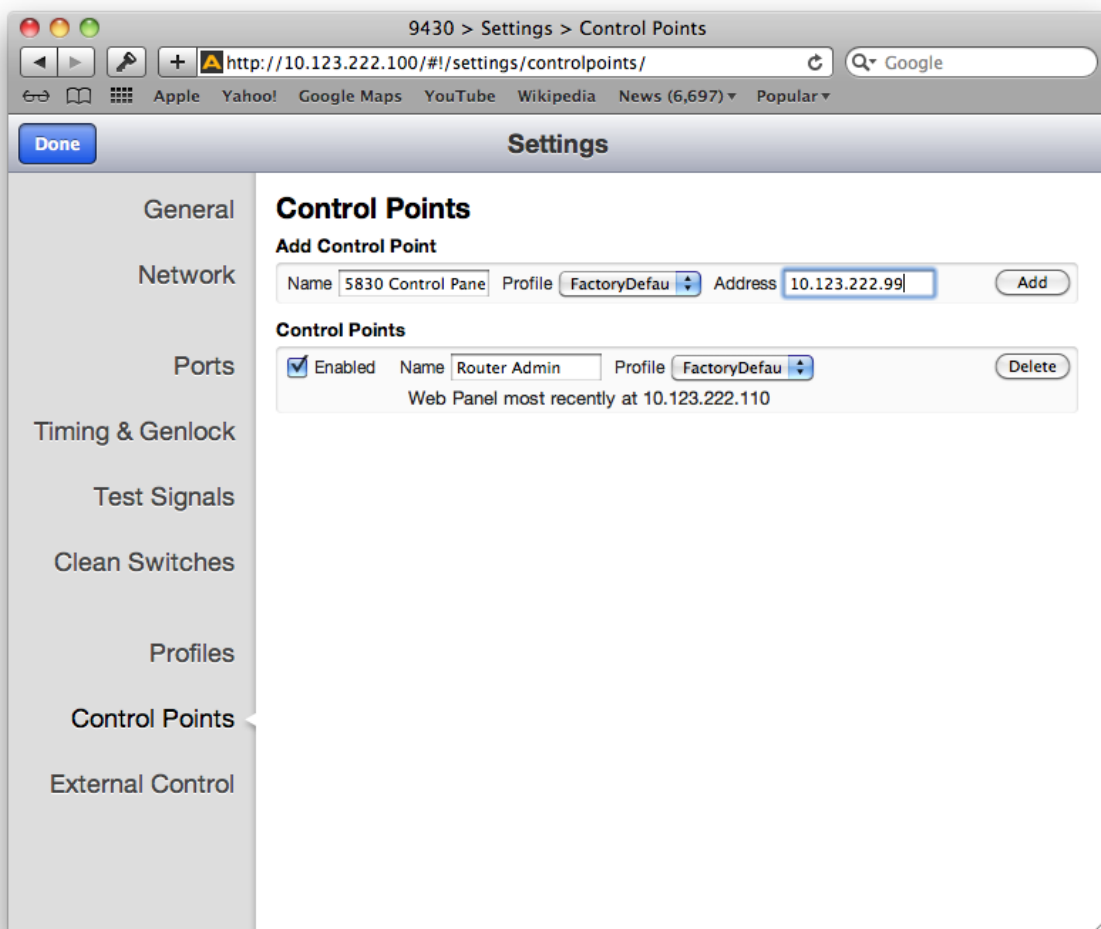
The 9430 Settings > Control Points window showing the process of adding the 5830 Control Panel as a Control Point

Configuring Other Control Points

For control points other than Router Control Panels, such as iPads and web browsers, there are two methods for adding them. One method is to request access from a Control Point. The other method is to assign an IP address to a Control Point. These two methods are described as follows:

First Method: Requesting Access from a Control Point

1. From the desired control point, whether from an iPad or from a computer web browser, enter the Router's IP address (for example, http://10.123.222.240) into the browser's address field. A browser window displays indicating that a Control Point is Needed.

2. Enter your desired Control Point name in the Control Point Name field, then click **Request**. The browser window indicates that your Control Point has been disabled. Your request has become a Pending Authorization item for the administrator.

Second Method: Assigning an IP Address as a Control Point

To assign the IP address of a device to create a Control Point:

1. Navigate to the IP address of the Router.

2. In the upper left area, click **Settings**. The Settings page displays.

3. From the left navigation panel, click **Control Points**. The Control Points page displays.

4. Under the heading Add Control Points, indicate a name in the Name field.

5. Select a profile from the Profile drop-down control.

6. Enter the IP address for the device into the Address field.

7. Click **Add**. The Control Points page refreshes to show that the newly assigned Control Point is enabled.

Approving Pending Authorizations

To approve an authorization request:

1. Click **Settings** in the upper left area of the browser.

2. Click **Control Points** in the left navigation panel. The Control Points page displays.

3. Under Pending Authorizations, you will see the request that was just submitted.

4. For this new request, select a Profile from the drop-down control.

5. Click **Authorize**. The Control Points page refreshes and now includes the newly requested Control Point.

> **Note:** In order to access **Settings**, you must have administrator access. See Security and Administrative Access to Settings on page 53 for more details.

Number of Control Points That Can Operate Simultaneously

The Router performs best with a maximum of four control points operating simultaneously. The Router's data bandwidth is shared across all of the control points. Each additional control point adds an incremental load on the system. When more than four control points are being used, the Router's video thumbnail display performance may begin to degrade.

Asymmetrical Bandwidth Requirements

The continuous delivery of video thumbnails to each control point requires more bandwidth than is required for performing takes. The video thumbnails, comprising the vast bulk of the data, flow outward from the 9430 to each control point. The return data, in contrast, consists primarily of crosspoint commands, or takes. Because the Router has greater bandwidth for takes, the execution of takes will still be quite responsive even in a large system with markedly degraded thumbnail refresh performance.

Best Practice: Closing Web Browser Control Points When Not In Use

To minimize the load on the Router, it is recommended to close any Web Browser Control Points that are not being used.

Setting Up Timing and Genlock

The 9430 can be locked to a Frame Reference (through the Avenue Frame Master Reference input), or operated from an internal precision reference. The Reference Source control selects between those two choices.

The Reference Status indicator displays the status of the currently selected reference.
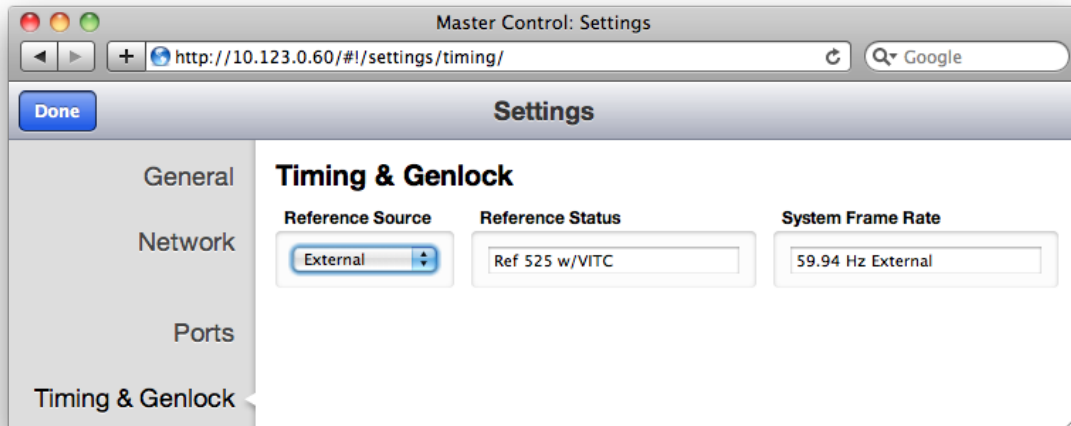
The Router uses the video format selection of the Primary Test Signal Generator to determine two system-wide parameters—System Frame Rate, and Vertical Interval Switch Point.

System Frame Rate

Distributed within the Router is a System Frame Rate Reference. It is used to vertically lock the outputs of the internal Test Signal Generators and the Clean Switch frame syncs. The System Frame Rate is selected by the Primary Test Signal Generator. If the selected genlock reference is in the same frame rate family (see the Note on Frame Rates on the next page), the System Frame Rate Reference will also be locked to the external reference. If the external reference is in a conflicting frame rate family (for example, SD 525 reference vs. 1080p/50 in the Primary Test Signal Generator), the System Frame Rate Reference will be internally generated.

Vertical Interval Switch Point

The precise point in the vertical interval where the crosspoint switch will occur is taken from the timing of the Primary Test Signal Generator. This provides flexibility in the system by allowing, for example, the use of an SD reference with a matrix that changes at HD switch points.

Note on Frame Rates

Despite the large number of video formats supported by the Router, there are only three possible frame rate families.

50 Hz	The 50 Hz frame rate family includes 25 Hz and 50 Hz frame and field rates. This family includes all of the "PAL" related standards in both standard and high definition.
59.94 Hz	All of the NTSC-derived standards, including 23.98, 29.97, and 59.94 Hz field and frame rates. There is a 4 Frame to 5 Frame relationship between 23.98 and 59.94 which allows these to peacefully co-exist.
60 Hz	The "not quite 60 Hz" challenges of the 59.94 world are addressed with this family which includes 24 Hz, 30 Hz, and 60 Hz field and frame rates. Though not used for broadcast, this family is useful for film rate and scientific/industrial applications.

The vast majority of applications, even those including both SD and HD formats, will all fall within a single frame rate family. For example, as members of the 59.94 family, both SD 525 and 1080i/59.94 can be simultaneously vertically locked to a single reference.

Configuring Internal Test Signal Generators

The 9430 is equipped with two independent internal Test Signal Generators (TSG). These generators are driven from the genlock source chosen by the Reference Source control on the Timing and Genlock page.

Each TSG can be independently configured for format, frame rate, and test pattern. The TSG outputs will always be clock-locked to the reference source. Further, they will be vertically locked and timed if the video standard the TSG is configured for is compatible with the provided reference.
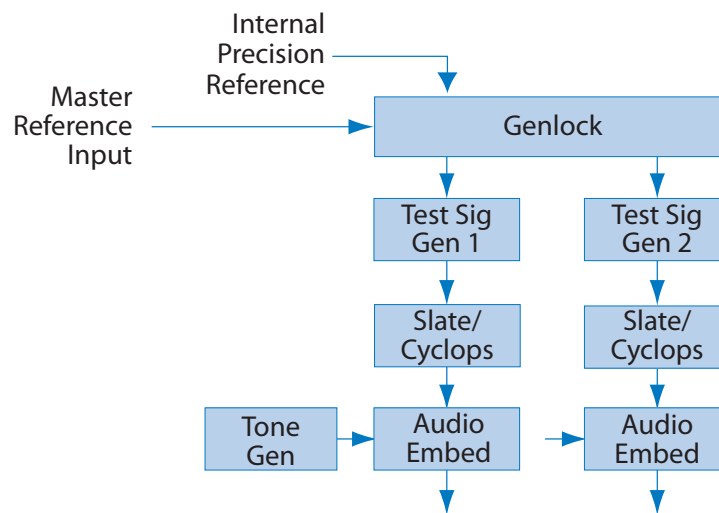
Because the Router generates the test signals internally, the TSGs are available as sources in the Router (without consuming a physical input BNC) and can be selected to any output destination. Source names can be assigned to them in the Port Configuration menu, and their position on control panels is assigned in the **Profiles** menu.

Test Signal Generator Configuration

There are two sets of configuration controls, one for each TSG. These configurations are independent, allowing the two generators to operate in different formats – and even at different frame rates. To configure them to the same standard, and to set them to matching timing (relative to the genlock reference), make the same settings for Standard, Vertical Timing, and Horizontal Timing.
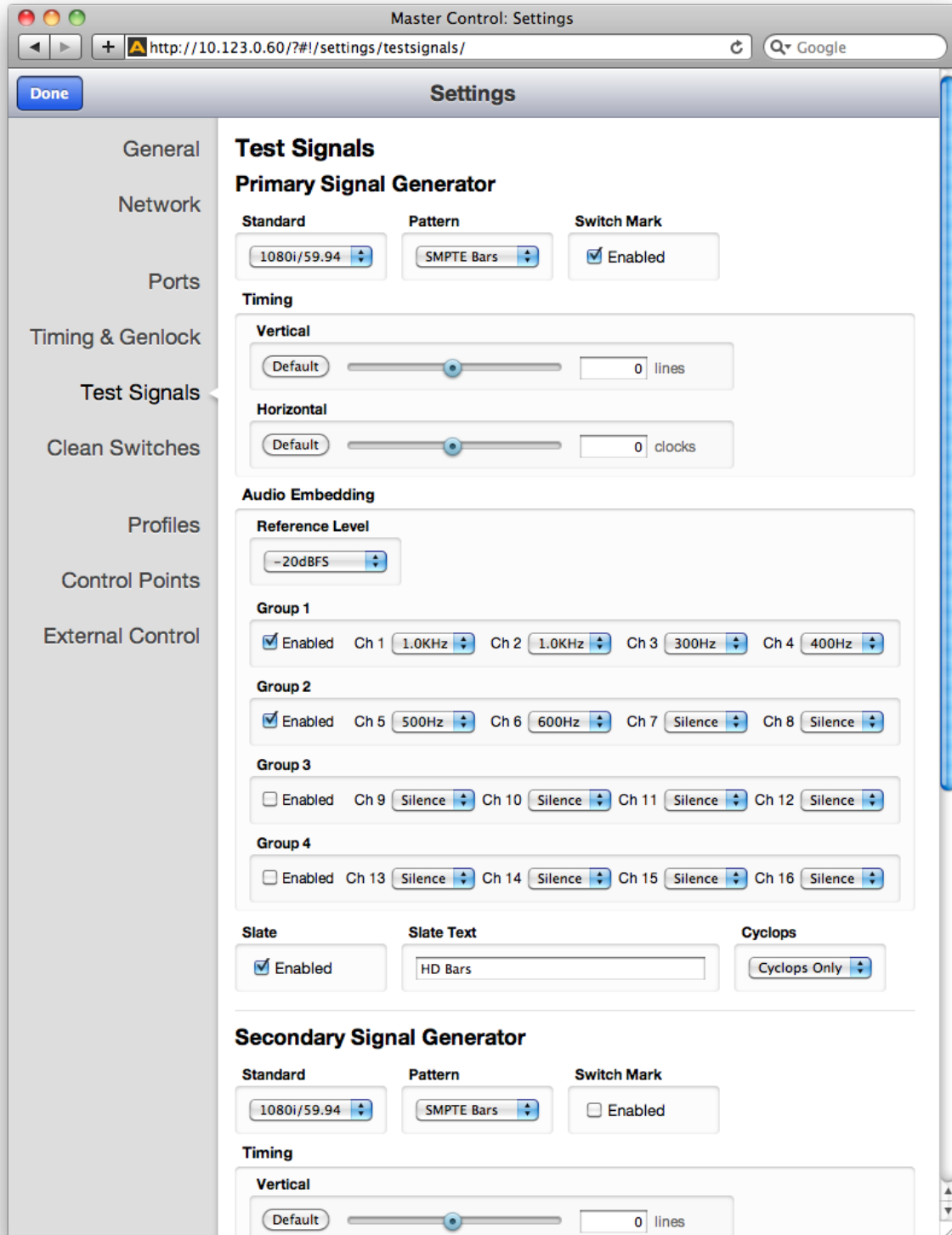
The Test Signals configuration page

The configuration controls for the TSGs as are follows:

Standard

Select the desired operating format and frame rate.

> **Note:** The choice of Standard for the Primary Test Signal Generator sets the System Frame Rate for the entire Router. This is detailed earlier in the section Setting Up Timing and Genlock on page 70.

If the Secondary TSG is set to a Standard which is incompatible with the System Frame Rate (determined by the Primary TSG), then it will have a free-running H and V. This makes it possible, for example, to produce both HD1080i/59.94 in the Primary TSG, and 1080i/50 in the Secondary TSG. Both will have the same frequency accuracy (from the genlock reference), but only one will be vertically and horizontally timeable.

Standard

`1080i/59.94 ⬍`

```
    720p/50
    720p/59.94
    720p/60
    1080i/50
✓   1080i/59.94
    1080i/60
    1080p/25
    1080p/23.98
    1080p/24
    1080p/50
    1080p/59.94
    1080p/60
    1080sF/25
    1080sF/23.98
    1080sF/24
    525i/59.94
    625i/50
```

Pattern

Choose the desired test pattern to be presented by the TSG.

In addition to Black and Bars, the Pathological test pattern is provided. Also known as Digital Checkfield, it is a "worst-case" signal that stresses SDI cable drivers and equalizers. It is extremely useful in proving the integrity of a system.

Pattern

`SMPTE Bars ⬍`

```
    Black
✓   SMPTE Bars
    Pathological
    Off
```

Switch Mark
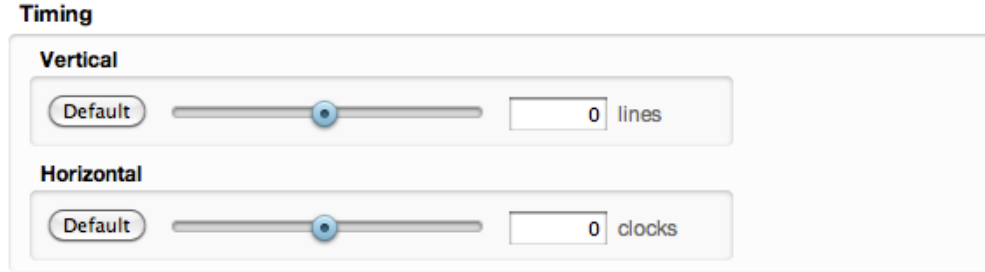
This control enables the Switch Mark feature to identify the point in the vertical interval where the matrix crosspoint switch will occur. See "Switch Point Identification" on page 78 for more details.

Switch Mark

☑ Enabled

> **Note:** The Switch Mark is always valid on the Primary Test Signal Generator because its format and timing configuration drives the entire Router. It is only valid on the Secondary TSG when it is configured to match the Primary.

Vertical and Horizontal Timing

Timing

Vertical

[Default] ———————●——————— [0] lines

Horizontal

[Default] ———————●——————— [0] clocks

The Vertical and Horizontal Timing controls adjust the timing of the TSG relative to the genlock reference. Setting the H and V parameters to 0 will "zero" time the TSG to the reference. Negative values will cause the TSG to be early with respect to the reference; positive values will make the TSG later in time.

When the Router is being operated from an external 10 MHz reference, or when it is configured to use its internal precision frequency reference, there is no external video reference against which H and V timing can be adjusted. In that case, all of the resources in the router (the TSGs and the Clean Switch/Synchronizers) will be adjusted against a common, internally generated video timing reference. This means that they can be adjusted relative to each other. If all of their H and V Timing parameters are set to identical values (like 0), they will all be locked (synchronous) to each other and they will all be in vertical and horizontal alignment with each other.

> **Note:** The timing adjustments for the Primary Test Signal Generator are also used to position the vertical interval switching point in the Router's matrix. The timing of the Primary TSG can be compared to other sources on a Waveform Monitor to ensure that the switch point will be properly aligned to the sources feeding the Router.

Audio Embedding

Each TSG has an Audio Embedder (Multiplexer) that can embed 16 channels of audio into the TSG SDI output. Audio is embedded in groups, each of which contains 4 channels. There are 9 audio sources for each channel – 8 tone generators, plus silence.

> **Note:** In the world of digital audio, there is a big difference between "Silence" and "no signal present." In the same way that Black is a legitimate video signal, digital silence must be sent to destinations rather than just sending "nothing." Thus, TSGs should generally be configured to embed ALL of the groups that may be in use in a facility, with Silence chosen as the audio signal for channels where no content is needed or desired. Otherwise, switching between a TSG with only one group enabled, and a source with two groups of embedded audio present, will produce undesirable effects in downstream equipment.

Audio Reference Level

This control selects the Digital Reference Level for the audio tone generators. This sets the nominal reference level (or 0 VU for you old-school folks) relative to Digital Full Scale (DFS). This relationship is expressed on a logarithmic (decibel) scale. Since DFS is the 'loudest' signal that can be represented, a setting of -18 dBFS will be 18 dB below Full Scale which is 2dB greater than a setting of -20 dBFS. This control should be set in accordance with the audio practice in use in your facility. Frequently, -20 dBFS is the common practice in NTSC countries, while -18 dBFS is used in PAL countries.
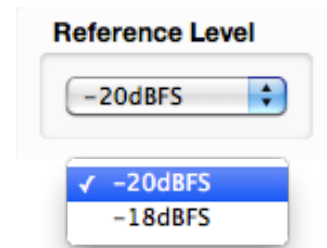
Audio Group Enable

Each of the four possible audio groups can be Enabled independently.
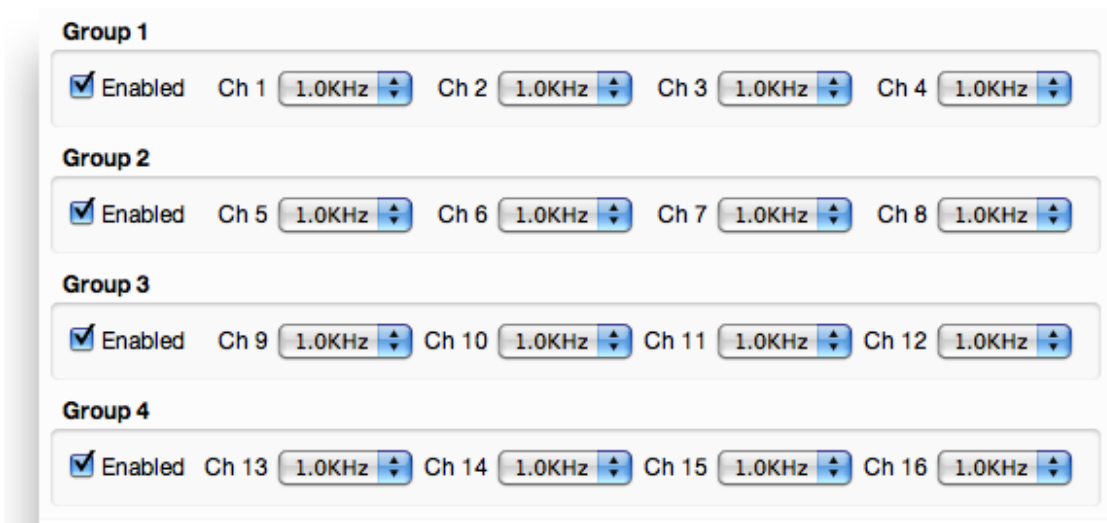
Audio Source Selection

Choose between Silence, or one of eight tone frequencies. The tone generators produce sine waves with precision at 24 bits of quantization. This can be verified with a digital audio distortion analyzer with a noise floor at -144 dBFS.

Any tones that are selected will be dynamically modified if the Cyclops control is configured for Audio Pop or Beep. (The Cyclops control adds motion, audio pop or beep, and closed caption elements to the video test signal which proves that the signal reaching a given destination is a true live signal and not a freeze frame from a frame synchronizer that has lost its input.)
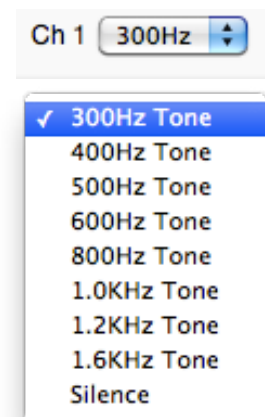
Slate Enable

When enabled, the text which has been entered in the Slate Text field will appear over top of the test pattern.

Slate Text

Enter the desired Slate text in this field, then hit the Tab key or click outside of the Slate Text field. As with all of the configuration settings in the Router, this will be saved in non-volatile memory so that it persists when the Router is powered down. The text entered in this field is not lost when the **Slate Enable** is turned off.

Cyclops

In order to produce a dynamic, constantly changing Test Pattern, enable one of the **Cyclops** modes to affect the picture, sound or both. The Cyclops feature adds a motion element which is overlaid over the test pattern video. It is located below the Slate field. The white cyclops pulse continuously sweeps horizontally back and forth in its black window. At the left and right extremes of its excursion the pulse makes a one frame bright flash.

Meanwhile, the Beep/Pop feature will add variety to the tones carried by the embedded audio. Selecting **Beep** will produce a short beep (and is otherwise silent), while **Pop** momentarily takes the selected tone to silence. Industry practice identifies odd numbered channels as carrying Left content, and even numbered channels as the Right half of a stereo program. The Pop and Beep timing in the audio follows this convention, with the odd channels being marked when the Cyclops makes its left flash, and the even channels marked when the right edge flash occurs.

Further, the 'left' channel is a single Beep/Pop, while the 'right' channel is a double Beep/Pop. This allows left/right identification even after the audio has been disembedded (demultiplexed) and has lost the implied channel association.
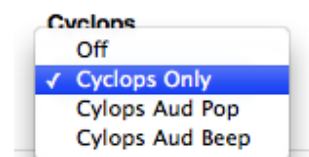
These aural and visual markers provide proof at downstream points in a transmission chain that it is producing live, uninterrupted delivery of content – even when not in active service. The precise synchronization between the visual Cyclops and the aural Beep/Pop are also useful to verify sound/picture lip-sync.

Switch Point Identification

As described in the section <u>Setting Up Timing and Genlock on page 70</u>, the video format and horizontal and vertical timing for the Primary TSG determines timing and location of the switch point in the vertical interval. Under SMPTE RP 168, the switch point varies from one format to another. In general, it should occur during the middle portion of a specific line in the vertical interval. These locations, which are as far away as possible from the SAV and EAV digital sync words, offer the best opportunity to minimize the disturbance that is inevitably produced by switching between two digital bit streams – even streams that are very closely timed to each other.

> **Note:** This discussion of vertical interval switching applies ONLY to the switching that takes place in the SDI matrix. Router outputs which are delivered through a 9435 Clean Switch do not suffer from any disturbance when a switch takes place. This holds true even when switching between un-timed or asynchronous sources. The 9435 Clean Switch is operating on deserialized (parallel) data where absolutely precise alignment is possible. The switch takes place between these perfectly aligned signals before being reserialized and sent to the output.

In order to help identify when and where the switch is taking place, the TSGs have a marking feature. When the Switch Mark is enabled, a white pulse will be inserted on the switching line. The beginning and ending of the pulse corresponds to the RP 168 specified switching area. This line can be viewed on a digital waveform monitor, or on a picture monitor which offers V Delay.
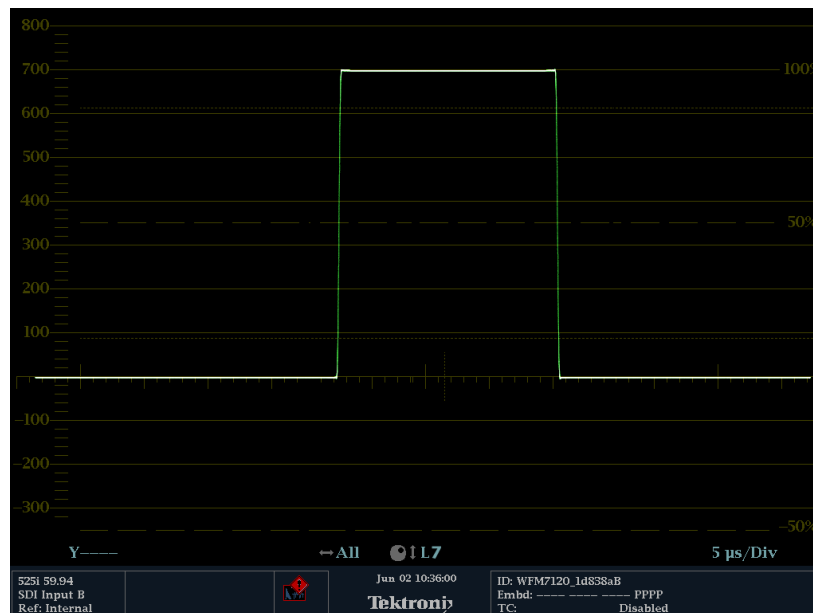
Display of Y Channel for 1080i/59.94 with Switch Mark Enabled.

When switching away from the TSG output with Switch Mark to a source without, there will be a momentary frame where the switching discontinuity will be visible.
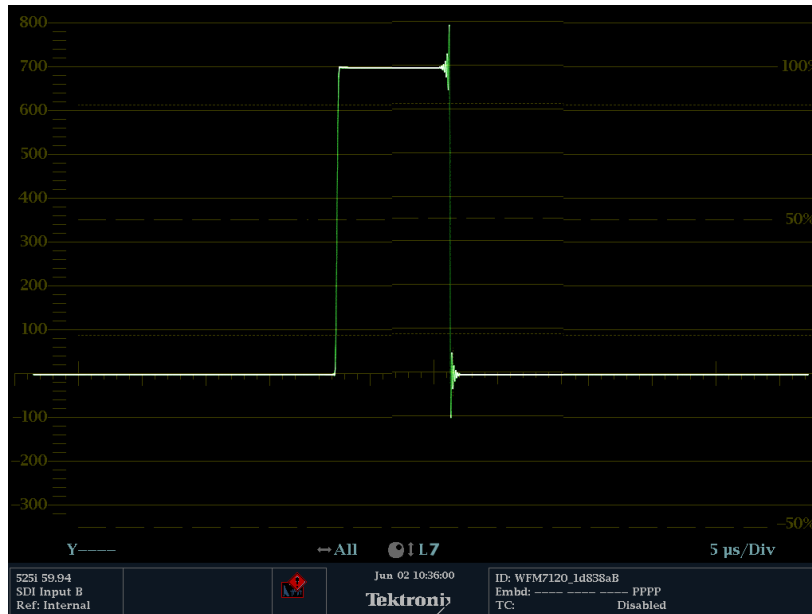
Working with the Clean Switch Option

Each 9435 Dual Clean Switch Option provides two, independent Frame sync/Clean Switches. These resources can be deployed within the Router in a variety of ways. The physical location of the submodule, whether installed on the 9430 core module, or on the 9440 in Expansion 1 position (the left hand position as viewed from the front of the frame) does not affect where or how each of these resources are assigned or used.

> **Note:**   Only a 9440 in the Expansion 1 position supports the 9435 Dual Clean Switch. Although it is mechanically possible to install a 9435 on a 9440 in Expansion 2, that 9435 will not appear as a resource in the configuration menus.
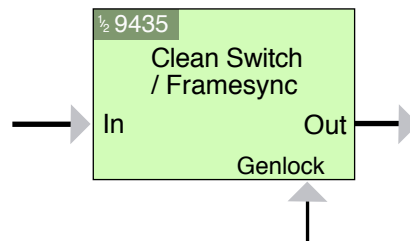
A Clean Switch is a Frame sync whose input and output can be connected to different points within the Router. The flexibility this provides allows the Clean Switch to be associated with either inputs or outputs.

The output side of the Clean Switch is genlocked to the reference being used within the Router. This ensures that the output is stable regardless of the input signal. Not only does this ensure clean switching between un-timed and even asynchronous sources, it also guarantees a stable, Black output upon loss of input.

In parallel with the video processing, 16 channels of embedded audio are silently switched as well. Incoming audio is disembedded, sample rate converted, switched, and then embedded into the output. The audio processing includes a delay mechanism to compensate for the delay imposed on the video by the frame sync. This compensation ensures that the time relationship (lip-sync) between audio and video is maintained.

The configuration of the Clean Switch includes its video format, timing, and embedded audio group enables.

When a Clean Switch is assigned to an output port, its input is fed from the routing matrix and it drives the output BNC connector. Any SDI source in the Router switched to this output will be presented synchronously and timed.
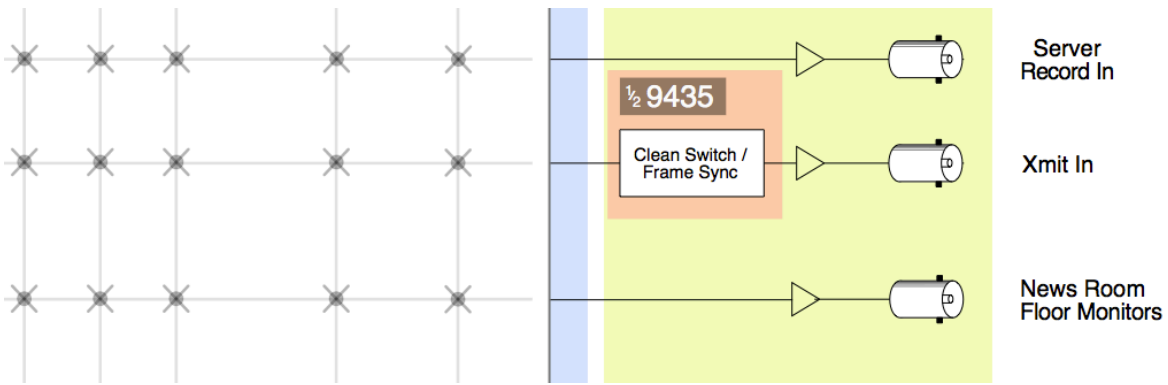
If an output port has been configured to Follow a Destination which has a Clean Switch assignment, that port will also deliver the Clean Switch output. That port set to Follow will not be seen as a destination on a control panel because there is still only one Destination.
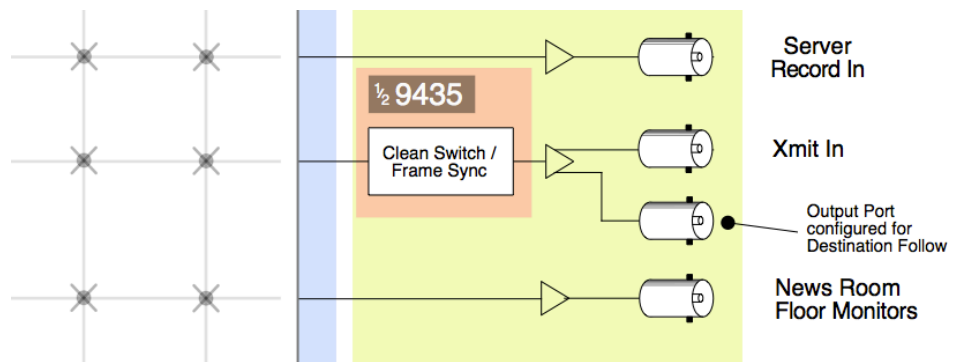
The conceptual effect of this is to have incorporated an output DA (Distribution Amp) into the Router.

By assigning a Clean Switch to a Source (input port), it is fed from that port and its output drives the routing matrix.

This configuration is particularly useful with an asynchronous source. The frame sync feature of the Clean Switch means that this source will now be synchronous and timed on any output it is switched to.

This is essentially the same as placing an external frame sync upstream of that router input.

This technique can be further enhanced by the use of the Follow feature on an output port. When a port is assigned to follow a Source which has a Clean Switch assigned, the follow output will pick up the frame sync output, making the synchronized version of the signal available for external use independently of any signal switching within the routing matrix.
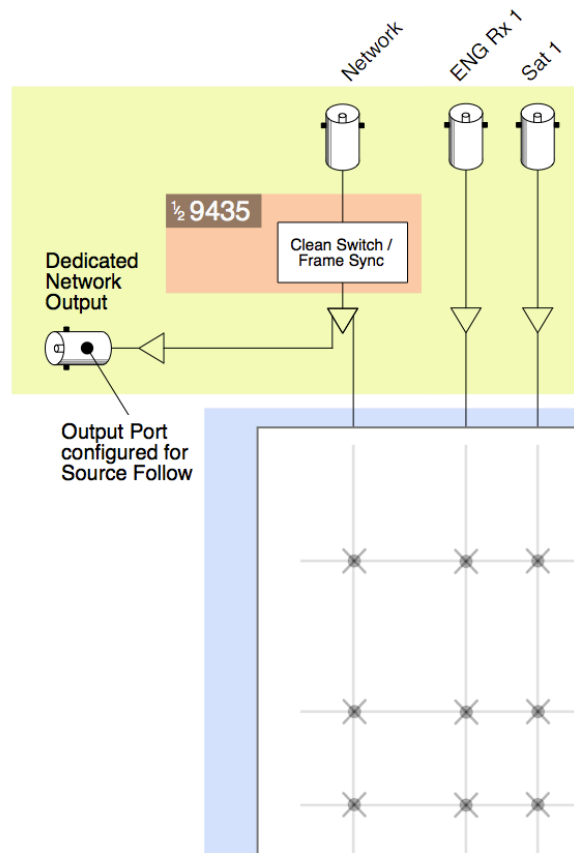
Clean Switch Configuration

There are four sets of configuration controls, one for each of the possible Clean Switches. Each Clean Switch is configured independently.
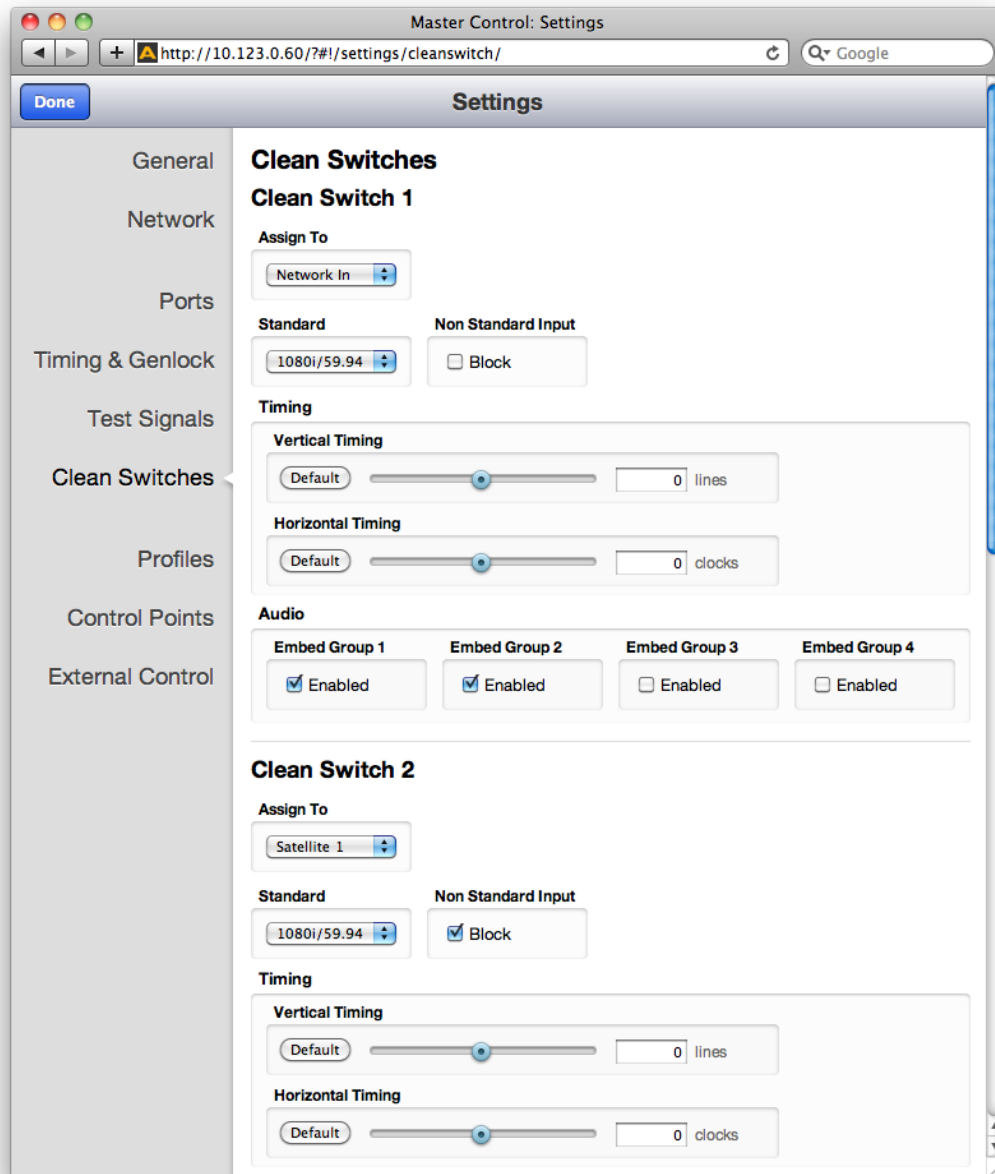
The Clean Switch configuration page

The configuration controls for the Clean Switches are as follows:

Assign To

Assign the Clean Switch to any of the Sources (Input Ports) or Destinations (Output Ports) that have been configured in the Port Configuration menu. Only the currently available Sources and Destinations will be presented as choices in this menu. Because only one CS can be assigned to any given Source or Destination, the list presented will not include any ports that are already assigned to other Clean Switches. In order to change assignments to move a port from one CS to another CS, you must first release the original assignment by selecting "None."
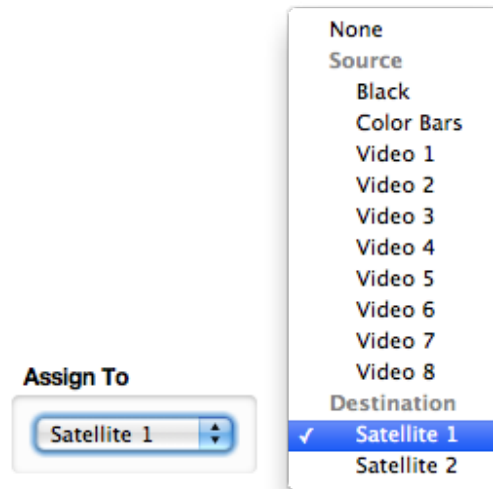
Standard

Select the desired operating format and frame rate. Only input signals matching that Standard will be processed by the Clean Switch.

If a source in a different format is selected, the CS will be bypassed and the source will be switched to the output without any processing. This applies for both Input and Output configurations.
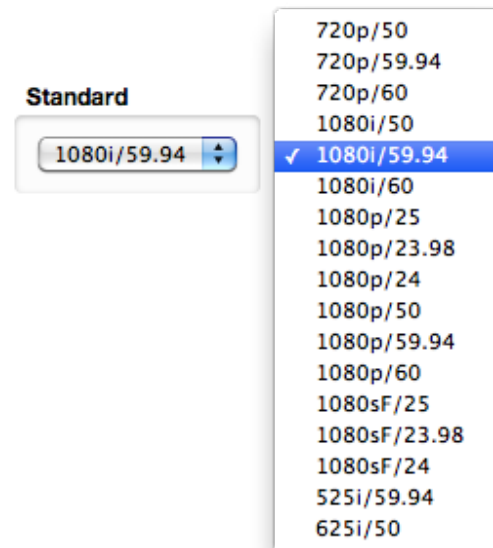
Non Standard Blocking

When Non Standard Inputs are blocked, the output of the Clean Switch will go to Black when a differing input is presented.

Vertical and Horizontal Timing

This control adjusts the timing of the Clean Switch relative to the genlock reference. Setting the H and V parameters to 0 will "zero" time the CS, matching it to the reference. Negative values will cause the CS to be early with respect to the reference; positive values will make the Clean Switch output later in time.

Timing

Vertical Timing

Default   0   lines

Horizontal Timing

Default   0   clocks
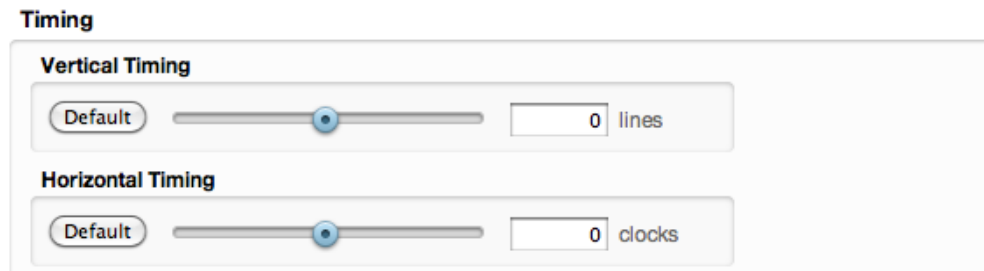
The best or most appropriate setting for the timing controls will depend upon the way in which the CS is to be used and the nature of the video inputs.

Note: A video frame sync imposes delay on a video signal passing through it in order to align that input to the user adjusted output timing. The amount of delay is a function of the difference in timing between the incoming video and the output of the frame sync. The frame sync can only add delay to the video in order to make up that difference, and the amount will change automatically in accordance with the timing of the input signal. If the input signal is one line early compared to the output, the frame sync will add only one line of delay. But if the incoming video is just one line late, the frame sync will add nearly an entire frame (less one line) to bring the signal into time. If the input is asynchronous, its timing will be changing (drifting) continuously. And in that case, the delay imposed by the frame sync will vary continuously between (near) zero and one frame.

When a Clean Switch is being used as a pre-selector to a production switcher, the CS output timing must fall within the input auto-time window of the switcher. In general, this will be accomplished by setting the Clean Switch H and V parameters to zero.

If the Clean Switch is feeding on-set monitors in a live environment from sources also used on the production switcher, it is generally desirable to minimize the delay on those monitors. This is accomplished by setting the Vertical timing of the Clean Switch to a small positive value. Setting this parameter to +4 lines will typically guarantee that the sources (which have near zero timing) will only experience 2 or 3 lines of delay. Since most production switchers have a forward delay of 1, 2, or 3 lines, a setting of +4 lines on the Clean Switch will also allow the switcher output to be used with minimum delay.

Audio Embed

The Clean Switch supports 16 channels (four groups) of embedded audio. In order for the Clean Switch output to have a consistent configuration of audio, regardless of what is present on the input, individual enables are provided for each group.

The Clean Switch output will always contain the enabled groups, but channels that are not present in the input will simply be silent. In this way, switching between sources with differing audio configurations will produce smooth, silent transitions.

Chapter 5: Operations and Step-by-Step Procedures

In this Chapter

This chapter provides complete step-by-step procedures for each task that you can perform with the Router using the following control choices:

- Router Control Panel (5830) Operation
- Router Operation with the Web Browser Interface

You can use the web browser interface on a computer or on an iPad.

For serial protocols through TCP/IP, RS-232 and SNMP, please see Chapter 6: External Control on page 96.

Router Control Panel (5830) Operation

Orientation of Front Panel

The Router Control Panel has an LCD Display on the left. The two small round buttons to the left of the LCD Display are used for accessing ancillary data.

By default, the top row of buttons is used for Sources and illuminates red, while the bottom row of buttons is used for Destinations and lluminates green. However, if more than 16 Sources are being used, the buttons in the lower row can be used for Sources and will illuminate red as needed. Similarly, if more than 16 Destinations are being used, the buttons in the upper row can be used for Destinations and will illuminate green as needed.

The **Direct** and **Take** buttons are on the far right side of the front panel. The **Direct** button is on top; the **Take** button is on the bottom.

Performing Takes with the Router Control Panel

While performing a take is a straight forward task, it can be done using more than one method.

To Perform a Take by Selecting a Source and a Destination

1. Select a Source by pressing one of the red Source buttons. The button illuminates more brightly to indicate that it is selected. The LCD display shows the realtime video thumbnail image of the Source you selected so that you can visually verify the content.

2. Select a Destination by pressing one of the green Destination buttons. The button illuminates more brightly to indicate that it is selected. As soon as you have selected both a Source and a Destination, the blue **Take** button, located in the lower right part of the router control panel, illuminates, indicating that the Router is ready for a Take.

3. Press the **Take** button. Your chosen Source is routed to the Destination that you selected. The LCD display continues to show the realtime video thumbnail image that is currently being routed to your chosen Destination. The **Take** button is no longer illuminated.

To Perform a Take by Selecting Only a New Source

As long as the Destination that you want is already selected, you can perform a Take by selecting a new Source, then pressing the **Take** button.

1. Leaving the Destination selection unchanged, select a new Source. The Source button illuminates to indicate that it is selected. The LCD display shows the real time video thumbnail image of the Source you selected so that you can visually verify the content.

2. Press the **Take** button. Your newly selected Source is now routed to the Destination. The LCD display continues to show the real time video thumbnail image that is currently being routed to your chosen Destination. The **Take** button is no longer illuminated.

Performing Direct Takes with the Router Control Panel

In Direct Take mode, you leave the same Destination selected while choosing a series of different Sources. There is no need to press the **Take** button when in Direct Take mode.

To Perform a Direct Take

1. Press the **Direct** button in the upper far right area of the router control panel. The **Direct** button illuminates to indicate that it is active.

2. Press a Destination button.

3. Press a Source button. The Destination immediately reflects your newly selected Source.

As long as you remain in Direct Take mode, you can continue to change Sources for the same Destination by pressing one Source button at a time in sequence.

To Exit Direct Take Mode

Press the **Direct** button in the upper far right area of the router control panel. The **Direct** button is no longer illuminated.

Accessing Ancillary Data with the Router Control Panel

For each video source, the Router detects and measures key parameters such as synchronicity, timing, line and frame rate, embedded audio presence/absence, closed caption information, and timecode data.

To Access Ancillary Data

For the Source currently showing in the LCD display, use the two small buttons located to the left of the LCD to navigate among the screens that show ancillary data. There are three ancillary data screens. Use either button to navigate among these screens.

Router Operation with the Web Browser Interface

You can control the Router through its web browser user interface. You can perform takes, direct takes, gang, and gang combined with direct takes.

Prerequisites

Before you can access the Router through a web browser, you need to have access to an authenticated Control Point and the Router's IP address. For further details about these requirements, please see the following sections:

- Assigning the Router a New IP Address on page 45

- Establishing Control Points and Access Authentication on page 63

- First Method: Requesting Access from a Control Point on page 68

Accessing the Web Browser Control Interface

To access the web browser control interface, enter the Router's IP address into the browser's address bar. The Router's interface displays, showing Sources in the upper area and Destinations in the lower area.
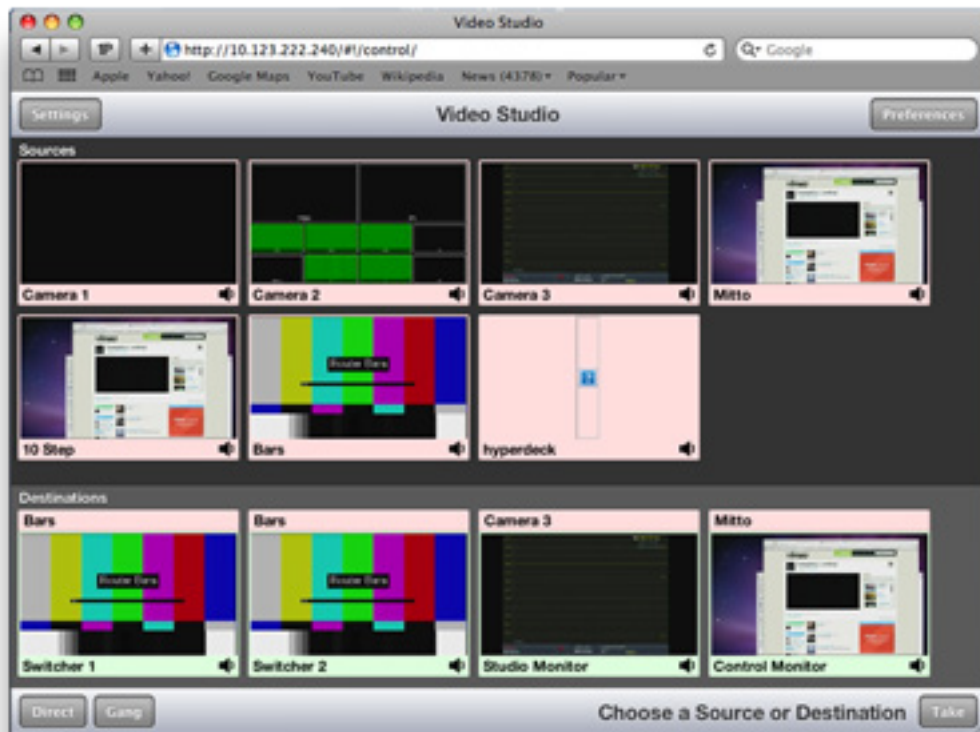
The Web Browser Interface

About the Web Browser Interface

The web browser interface is organized into an upper area for Sources, and a lower area for Destinations. The relative size of the upper and lower areas can be resized by clicking and dragging along the location where the background color changes to differentiate the upper and lower areas of the window.

The thumbnail images for Sources display their names on the lower part of each Source image frame. The thumbnail images for Destinations display their names on the lower part of each Destination image frame. Additionally, Destination thumbnails display the currently mapped Source name along the top of the frame.

See the following examples:
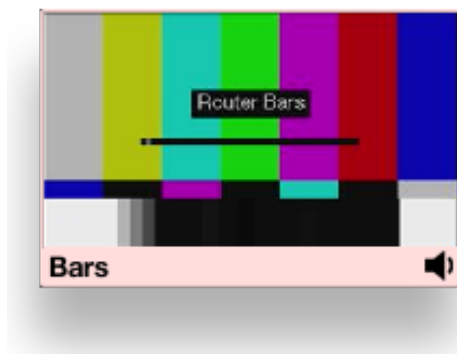
Source Example: *The name of the Source displays on the bottom of the frame.*
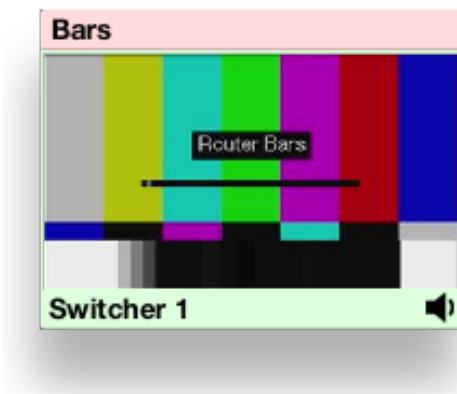
Destination Example: *The name of the Source mapped to this Destination displays on the top of the frame; the name of the Destination displays on the bottom of the frame.*

The name of each Source and each Destination is determined during Router configuration. For further details on Source and Destination naming, see <u>To Configure the Router's Ports</u> on page 57.

Preferences

Use the **Preferences** button, located in the upper right area of the browser window, to customize how the thumbnail images display. Sources and Destinations can be sized independently. Choose from small, medium and large.

For Sources, you can also choose to display ancillary data next to each thumbnail or instead of each thumbnail. It is the same ancillary data that is available through the LCD display of the Router Control Panel (5830).

Message Bar

A Message Bar located in the lower right area of the browser window reflects your actions with respect to Sources and Destinations. For example, before you have taken any action, the Message Bar displays the message "Choose a Source or Destination."
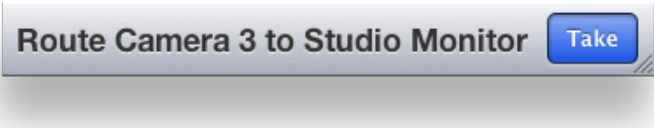
Choose a Source or Destination   Take

After selecting a Source named "Camera 3," the Message Bar now says: "Choose Destination for Camera 3."

Choose Destination for Camera 3   Take

If you then select a Destination named "Studio Monitor," the Message Bar now says: "Route Camera 3 to Studio Monitor." Note that the **Take** button is now blue, indicating that the Router is ready for a Take.

Route Camera 3 to Studio Monitor   Take

On the other hand, if you have selected the Destination named "Studio Monitor," and haven't yet selected a Source, the Message Bar will say: "Choose Source for Studio Monitor."

Choose Source for Studio Monitor   Take

Performing Takes with a Web Browser

While performing a take is a straight forward task, it can be done using more than one method.

To Perform a Take by Selecting a Source and a Destination

1. Select a Source by clicking one of the Source thumbnail images. The thumbnail frame turns red to indicate that it is selected.

2. Select a Destination by clicking one of the Destination thumbnail images. The thumbnail frame turns green to indicate that it is selected. As soon as you have selected both a Source and a Destination, the **Take** button turns blue, indicating that the Router is ready for a Take.

3. Click **Take** in the lower right area of the web browser. Your chosen Source is routed to the Destination you selected. The Destination thumbnail image updates to reflect your currently selected Source. The **Take** button is now greyed out.

To Perform a Take by Selecting Only a New Source

As long as the Destination that you want is already selected, you can do a Take by selecting a new Source, then clicking **Take**.

1. Leaving the Destination selection unchanged, select a new Source.

2. Click **Take**. Your chosen Source is routed to the Destination. The Destination thumbnail image updates to reflect your new Source selection.

Performing Direct Takes with a Web Browser

In Direct Take mode, you leave the same Destination selected while selecting different Sources with only one click. There is no need to click the **Take** button when in Direct Take mode.

To Perform a Direct Take

1. Click **Direct** in the lower left area of the browser window. The **Direct** button turns orange.

2. Select a Destination.

3. Select a Source. The Source is immediately routed to the Destination. The Destination thumbnail image reflects your newly selected Source.

As long as you remain in Direct Take mode, you can continue to change Sources for the same Destination with only one click.
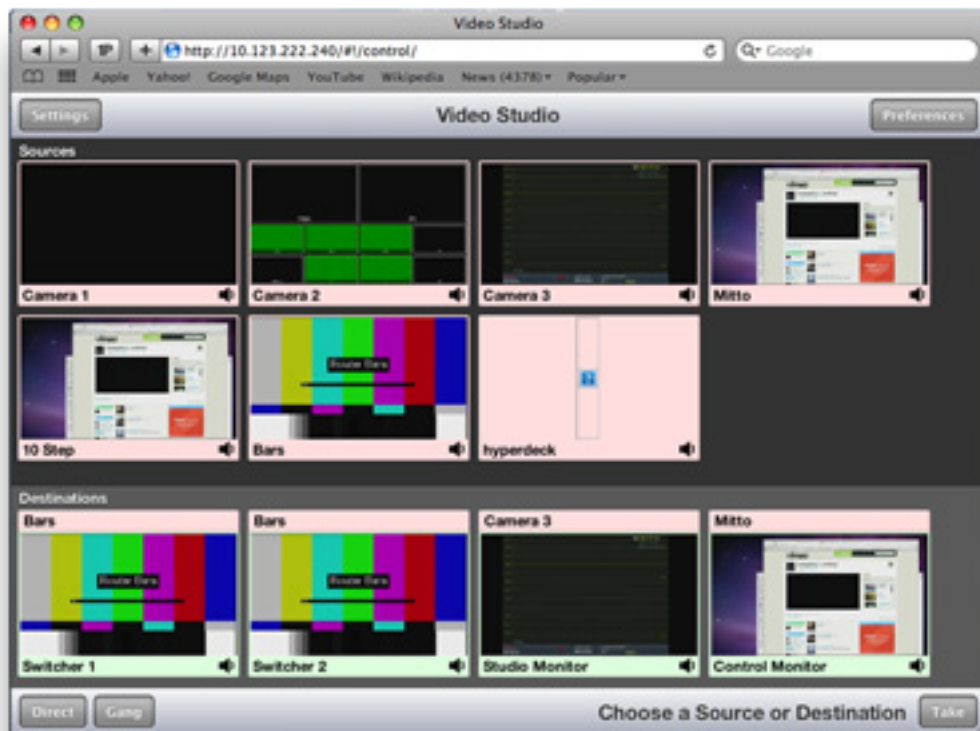
To Exit Direct Take Mode

Click **Direct** in the lower left area of the browser window. The **Direct** button is now greyed out, indicating that you are no longer in Direct Take mode.

Performing Gang Takes with a Web Browser

Gang Takes involve routing one Source at a time to a set of Destinations.

To Perform a Gang Take

1. Click **Gang** in the lower left area of the browser window. The **Gang** button turns orange.

2. Select a Source by clicking one of the Source thumbnail images. The thumbnail frame turns red to indicate that it is selected.

3. Select a set of Destinations by clicking multiple Destination thumbnail images sequentially. The first thumbnail frame you select turns green; the remaining thumbnails you select turn yellow.

4. Click **Take** in the lower right area of the web browser. The Source is routed to the set of Destinations. The set of selected Destination thumbnail images updates to reflect your selected Source. The **Take** button is now greyed out.

You can continue to perform gang takes in this manner as long as you are in Gang mode.

To Exit Gang Mode

Click **Gang** in the lower left area of the browser window. The **Gang** button is now greyed out, indicating that you are no longer in Gang Mode.

Performing Direct Gang Takes with a Web Browser

Direct Gang Takes involve routing one Source at a time to a set of Destinations instantaneously, without having to use the **Take** button.

To Perform a Direct Gang Take

1. Click **Direct** in the lower left area of the browser window. The **Direct** button turns orange.

2. Click **Gang** in the lower left area of the browser window. The **Gang** button turns orange.

3. Select a set of Destinations by clicking multiple Destination thumbnail images sequentially. The first thumbnail frame you select turns green; the remaining thumbnails you select turn yellow.

4. Select a Source by clicking one of the Source thumbnail images. The Source is routed to the set of Destinations. The set of selected Destination thumbnail images updates to reflect your selected Source.

To Exit Direct Gang Mode

Click **Direct** and **Gang** in the lower left area of the browser window. The **Direct** and **Gang** buttons are now greyed out, indicating that you are no longer in Direct Gang Mode.

Chapter 6: External Control

The Router's Approach to Control Integration

The Router provides control from external systems like automation and event controllers. As there is a significant legacy of protocols and usage models in current practice, the Router supports a variety of external control protocols, offering a range of commands and control capabilities in order to make control integration as easy as possible. These protocols can be used with both the RS-232 and Ethernet physical interfaces. This approach generally allows the Router to be used without adaption in current systems.

RS-232 Interface and 9-Pin D Connector Pin Out

One leg of the RS-232 and 100Mb Ethernet Interface Adaptor Cable, or "Y" cable, provides a 9-pin female D connector for the RS-232 interface. The pin-out for that connector is as follows:

9 pin female D connector
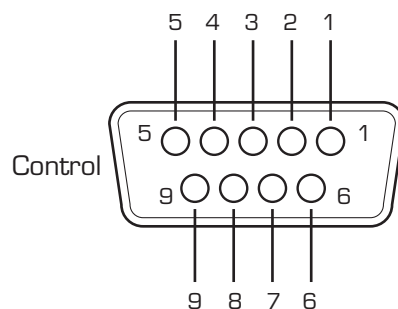
PIN	FUNCTION
1	
2	TX - Data output
3	RX - Data input
4	
5	Gnd
6	
7	
8	
9	

Router Control Panel (5830) GPI Inputs

The Router Control Panel provides 8 GPI contact closure inputs. These can be configured on a specific Router Control Panel to integrate it with other equipment. When used in a camera shading installation as the reference monitor input selector, GPI connections from the joystick button on the camera control head can make camera selections. In a master control bypass application, a GPI "panic button" can be used to force the system into bypass.

Overview of Supported Control Protocols

The Router supports the following control protocols:

- Avenue FMR

- Grass Valley TenXL

- Grass Valley 100

- Generic ASCII

- RS-232
- Telnet
- TCP/IP

These control protocols are briefly described below. For detailed documentation of the automation protocols, please see "<u>Appendix A: Automation Protocols</u>" on page 105.

Avenue FMR

Unique to the Avenue 9430/9440 Flexible Matrix Router, this is an ASCII (human readable) control protocol with an extensive command set, offering very useful and powerful external control functionality. These interfaces are enabled, disabled and configured through the **External Control** tab on the web configuration tool.

Simultaneous Support for Multiple Protocols

These protocols are accessible over three different interfaces. Each interface is independent, allowing simultaneous support for different protocols on different interfaces.

Control Profiles for External Interfaces

An interface is "connected" to the Router through a **Control Profile** – similar to a physical control panel. This allows for the choice of available **Sources** and **Destinations**, and the order in which they are mapped to the interface protocol to be customized on the Router rather than on the controlling device.

Grass Valley TenXL

The Router supports both the ASCII (human readable) and SMPTE ESbus (binary) variants of this protocol. Supports only source to destination control.

Grass Valley 100

The Router supports SMPTE ESbus with and without the "break" character requirement. Though widely implemented, this protocol is limited in usefulness with a router because it supports only 4 output busses. Supports only source to destination control.

Generic ASCII

The Router supports this simple human readable protocol with both space and comma variable separators. Supports source to destination routing and salvos.

RS-232

The conventional RS-232 serial interface is provided from the 9430 module through the control breakout cable. This interface can operate from 1200 to 115,200 baud (bits per second).

Telnet

Using the Ethernet port on the control breakout cable, you can open a Unix-style Telnet session with the 9430 module. As a text-oriented communications facility, Telnet is only suited to ASCII protocols. It provides easy access from a distance (even a great distance) and can be of particular utility for system

debugging. If the Telnet interface is disabled in the External Control configuration, the 9430 will refuse the connection.

TCP/IP

You can open a TCP/IP session at a private port number (to be specified) to enable network control. As with Telnet, this interface must be enabled in the External Control configuration in order for the 9430 to accept the connection. This is the preferred network equivalent to RS-232 and it works with both ASCII and binary protocols and command sets.

Additional GPI and Serial Connections through JL Cooper eBOX

Additional GPI and Serial connections for the Router can be made through the JLCooper eBOX, a third-party device. It provides 24 GPI inputs, 24 GPI outputs and 4 serial connectors. Please see Using the JL Cooper eBOX with Ensemble Designs Avenue Equipment for a detailed description of the process of configuring the Router for GPIO (general purpose input/output) functionality using the eBOX.

SNMP Interface

A Simple Network Management Protocol (SNMP) agent in the 9430 supports Control and Status queries from an SNMP manager.

Programming Reference Document

The Management Information Base (MIB) document, specific to the Router, is a required programming reference while customizing the SNMP manager. You can either download the MIB document directly from the Router's web interface or request it from Ensemble Designs.

The SNMP interface will be active only if enabled through External Control configuration. SNMP support will not be available on initial product shipments, but will be provided by a subsequent system software upgrade.

Software Development Kit (SDK)

When control requirements go beyond straight forward functions, such as source to destination routing and salvo execution, you may need to develop an interface more specific to your needs. To that end, Ensemble Designs will be releasing an interface design guide, or software development kit (SDK), to support such efforts.

Accessing Features Unique to the 9430 Flexible Matrix Router

That more extensive interface will be necessary when you need to access features unique to the Flexible Matrix Router, such as:

- reading the input signal metadata;
- controlling the internal TSGs; and
- capturing video thumbnails remotely

Configuring External Control
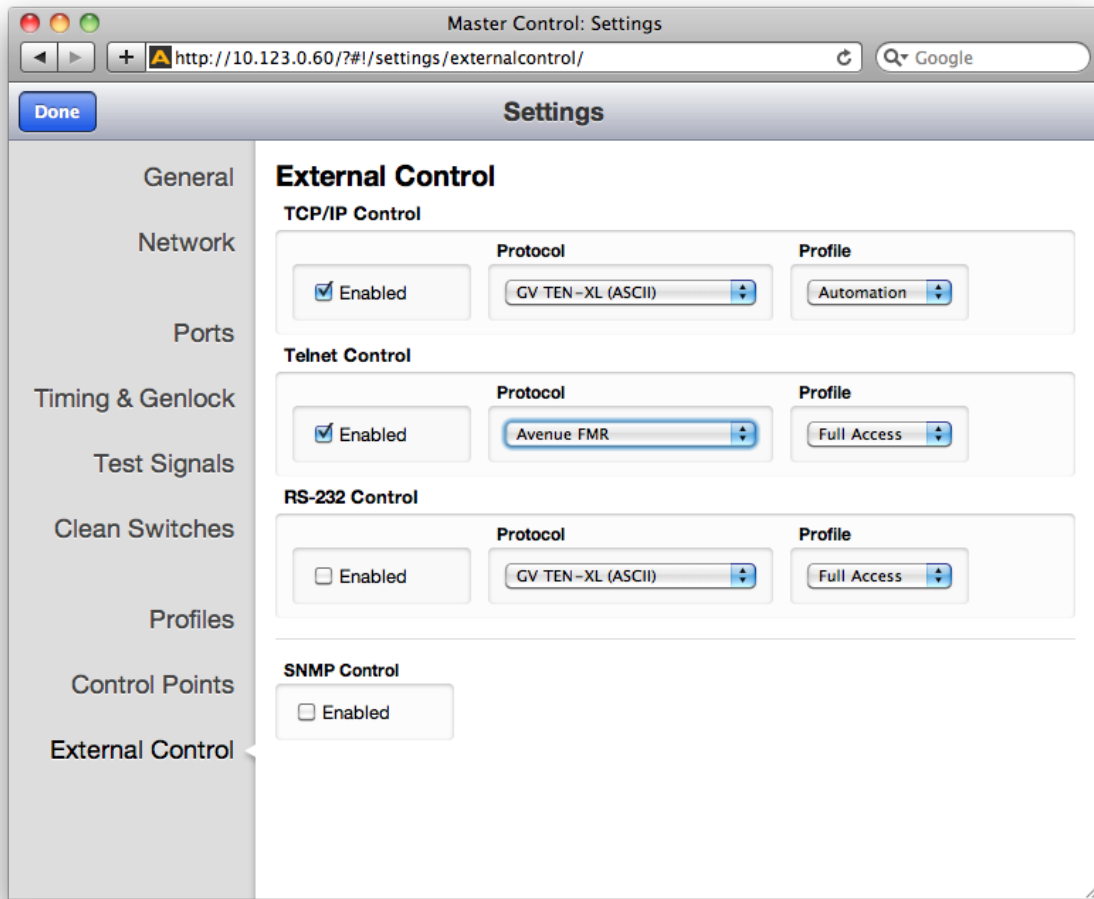
For each of the enabled interfaces, select the desired protocol. The mapping of that protocol to Sources and Destinations will be controlled by the Profile that is assigned to the interface. Any Profile can be edited to modify the Sources and Destinations that are available to it and the order in which they are listed. For more information, see <u>Creating and Editing Profiles</u> on page 59.
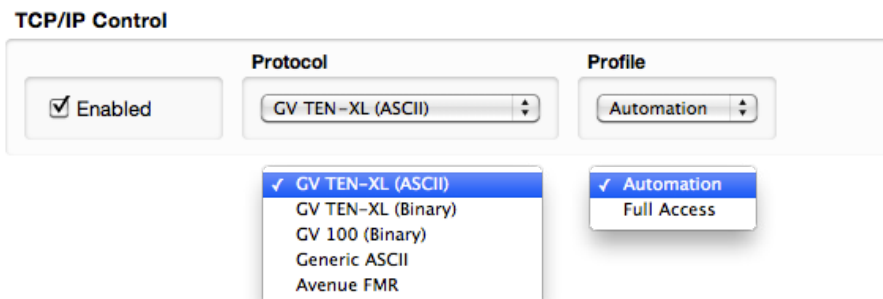
Chapter 7: Maintenance and Troubleshooting

This chapter addresses certain known issues and possible issues that new users may encounter while becoming familiar with using the Flexible Matrix Router.

Troubleshooting the Router Module (9430)

Cannot Connect to the Router

If you are having difficulty connecting to the Router, check that the IP addresses of the Router and the computer or device are not in conflict. Check also that the cabling is correct.

- Review the instructions in <u>Initially Connecting to the Router</u> on page 40 to make sure you have configured the IP addresses correctly.

- See also <u>Router Control Connections</u> on page 32 to make sure you have correctly cabled the control connections between the Router and the controlling computer.

Router Not Running

To Determine if the Router is Running

Open the front door of the Avenue frame and check the Run light on the front panel of the 9430. When the Router is running properly, the Run light will be blinking on and off. Note that the rate of blinking will not match the rate of blinking of the Run lights of other modules running in the Avenue frame. However, if the Run light stops blinking, whether it remains on or off, it means that the Router has stopped.

Resetting the Router

There are two types of resets for the 9430. One is a reboot. The other is a reset to the factory default settings.

Rebooting

To reboot the 9430, use something with a fine point, such as a paperclip, to press into the small "Reset" hole on the lower part of the front panel. Press once briefly and release. The module will reboot. A reboot typically takes a few minutes. After the reboot is complete, the Run light will resume blinking.

Resetting to Factory Default Settings

If you want to reset your module to factory default settings, use something with a fine point, such as a paperclip, to press and hold into the small "Reset" hole on the lower part of the front panel. Continue holding the Reset button in its pressed in position until you see all of the Input lights on the front panel illuminate several times (approximately 15 seconds), then release. The 9430 will reboot with factory default settings. Note that the IP address and all other settings will have to be reconfigured.

Authorized Control Point Unable to Connect to Router

If you are using an authorized Control Point but you are seeing the message "Control Point Disabled," check to make sure that the Control Point has been assigned a Profile. Without an assigned Profile, it is

expected behavior that you would see the message "Control Point Disabled."

Please see Creating and Editing Profiles on page 59 and Establishing Control Points and Access Authentication on page 63 for more details on this issue.

Troubleshooting the Router Control Panel (5830)

Router Control Panel has Lost its Connection to the Router

If the Router Control Panel becomes unresponsive or loses its communication with the Router, there are two methods for resetting it.

Rebooting the Router Control Panel

To reboot the 5830, use something with a fine point, such as a paperclip, to press into the small "Reset" hole on the back of the Router Control Panel. Press once briefly and release. The unit will reboot. A reboot typically takes a few minutes. After the reboot is complete, the Router Control Panel should re-establish its connection to the Router.

Resetting the Router Control Panel to Factory Default Settings

If you want to reset your 5830 to factory default settings, use something with a fine point, such as a paperclip, to press and hold into the small "Reset" hole on the back of the Router Control Panel. Continue holding the Reset button in its pressed in position for approximately 15 seconds, then release. The 5830 will reboot with factory default settings. Note that the IP address and all other settings will have to be reconfigured.

Configuration Changes are not Taking Effect

After making changes to configuration settings, make sure you are doing two things:

- Click the **Save Changes** button
- Click the **Done** button

If you save changes without also clicking **Done**, the changes may not be implemented.

Troubleshooting the Web Browser Control UI

If the Take Button is Grayed Out

If the **Take** button is blue, it means that a Take is possible. If the **Take** button is grayed out, then no Take can be done without first selecting both a Source and a Destination. If a Source and a Destination you want are already selected, you do not need to select one again.

Supported Browsers

The Router supports current versions of the following browsers for Mac and PC:

- Safari (version 5 or later)
- Firefox (version12 or later)
- Chrome (version 17 or later)

- Internet Explorer (version 9 or later)

Enabling cookies is required for all browsers.

Software Updating

Download Current Software

Download the current software for the 9430 to your PC or Mac from the following URL:

http://www.ensembledesigns.com/support/avenue-support/avenue-software

Navigate to your 9430 Module through a Web Browser

From the controlling computer, navigate to the IP address of your 9430 from a web browser. The Router view displays.

From the upper left area of the web page, select **Settings**. The Settings > General window displays.

Update the Module Software

From the Settings > General window, under the Software Update heading, click the **Choose File** button. From the navigation dialog window, navigate to the updated software file that you downloaded to your computer. Select the downloaded software, then click the **Start Update** button. The Updating Firmware window displays. The updating process can take several minutes.

Warranty and Factory Service

This module is covered by a five year limited warranty. If you require service (under warranty or not), please contact Ensemble Designs and ask for customer service before you return the unit. This will allow the service technician to provide any other suggestions for identifying the problem and recommending possible solutions.

If you return equipment for repair, please get a Return Material Authorization Number (RMA) from the factory first.

tel +1 530.478.1830
fax +1 530.478.1832

service@ensembledesigns.com

www.ensembledesigns.com

Ship the product and a written description of the problem to:

Ensemble Designs, Inc.
Attention: Customer Service RMA #####
870 Gold Flat Rd.
Nevada City, CA 95959 USA

Be sure to put your RMA number on the outside of the box.

Specifications

9430

Inputs

Number	Eight
Signal Type	HD Serial Digital 1.485 Gb/s, SMPTE 274M, 292M or 296M
	HD Serial Digital 2.97 Gb/s, SMPTE 424M, 425M
	SD Serial Digital 270 Mb/s, SMPTE 259M
	DVB-ASI at 270 Mb/s, SMPTE 310M
	AES3id
Impedance	75Ω
Return Loss	>15dB to 1.485 GHz

Max Cable Length

270 Mb/s	300 meters Belden 1694A
1.485 Gb/s	100 meters Belden 1694A
2.97 Gb/s	70 meters Belden 1694A
Automatic Cable EQ	

Outputs

Number	Two
Signal Type	Follows input
Impedance	75Ω
Return Loss	>15dB to 1.485 GHz
Output DC	None (AC coupled)

Reference

Number	One via frame master ref input
Signal Type	Composite black, Tri-Level Sync, 10 MHz

Standards Supported

1080i 50, 59.94 or 60 Hz, SMPTE 274M -4,5,6
720p 50, 59.94 or 60 Hz, SMPTE 296M -1,2,3
1080p 23.98, 24 or 25 Hz, SMPTE 274M -9,10,11
1080p 50, 59.94, 60 Hz, SMPTE 424M, 425M
Level A, Level B (9435 Level A only)
1080sF 23.98, 24 or 25 Hz, RP211 -14,15,16
625i 50
525i 59.94

9440

Inputs

Number	**Up to ten, user configurable**
Signal Type	**Same as 9430**
Impedance	**75Ω**
Return Loss	**>15dB to 1.485 GHz**

Outputs

Number	**Up to ten, user configurable**
Signal Type	**Follows input**
Impedance	**75Ω**
Return Loss	**>15dB to 1.485 GHz**
Output DC	**None (AC coupled)**

Appendix A: Automation Protocols

Revision 1.1

1 Introduction

This appendix describes the various communication protocols available in the 9430 Flexible Matrix Router to support external control by an automation system. It also discusses the various means for connecting an external controller to the router.

The intended audience is the developer tasked with connecting an external control device to the router.

Some discussion of configuration of the 9430 router is covered in this document, but only as it pertains to attaching an external control device. It is recommended that the reader be familiar with general router configuration procedures as described earlier in this manual.

2 Conventions

This section describes the conventions used in this appendix.

- A number followed by the letter "H" is a hexadecimal number. E.g., 12H is the hexadecimal equivalent of decimal 18.

- Command syntax in this appendix is described using a notation similar to BNF (Backus-Naur Form).

<symbol>	A symbol is represented by the symbol name inside of arrow brackets '<' and '>'.
[optional]	Optional parts are shown inside of square brackets.
…	Items that can be repeated are indicated by an ellipse.
literals	Characters, numbers, and strings of text that are not part of a symbol are to be interpreted literally. They would be typed exactly as they are shown.
'>'	Single quotes may be used in certain cases to avoid ambiguity when a character needs to be typed literally. For example, since the arrow bracket is normally used to indicate a symbol, enclosing it in single quotes means it should be interpreted literally as the arrow bracket character. In this case it should be typed as a single character (without the quotes).

Syntax Example:

@<Space>X:<Lvls>/<Dest>,<Src>[/<Dest>,<Src>…]<CR>

The symbols in the above example are <Space>, <Lvls>, <Dest>, <Src>, and <CR>. The meaning of symbols like these will be defined as they occur throughout this document.

The optional portion in the example (enclosed in square brackets), shows that an additional "/<Dest,<Src>" element may be present. It also indicates (with the ellipse character) that this optional element may occur repeatedly.

The following characters in the example are literals and should be typed as they appear (no quotes):

'@', 'X', ':', '/', and ','

3 Overview

The 9430 Flexible Matrix Router is a highly configurable router. The basic size is 8 inputs by 2 outputs (8x2). You can add up to two I/O Expansion Modules, each with 10 bi-directional ports. Each of these additional ports can be independently configured as an input or output. This permits easy configuration of the matrix into various symmetrical and asymmetrical geometries (28x2, 8x22, 15x15, and many sizes in between).

In addition to the configurability of the ports within the matrix, the presentation of these inputs and outputs to a control point (e.g., control panel, web browser, automation system, etc.) is also configurable. This presentation is managed through a Profile—a map of the sources (inputs) and destinations (outputs) that are available to a control point. The Profile also determines the order in which the sources and destinations appear. These Profiles thereby provide the flexibility for every control point to have its own view (or a shared view) of the organization of inputs and outputs. The use of Profiles to order the inputs and destinations is of particular interest for installations using automation systems. (For details, refer to "Understanding Profiles" on page 107 in this appendix.)

4 Before You Begin

Some configuration of the 9430 Router will be required in order to control it from an external device such as an automation system.

In order to configure the router, you will need to establish an IP Address for the 9430 Router and browse to the 9430's web page from a computer. The details for doing this are not covered in this appendix. Please refer to "Chapter 4: Configuration" earlier in this manual for instructions.

5 Understanding Profiles

Any device used to control the 9430 Router must be assigned a Profile.

A Profile provides a configured view of the sources and destinations in the router. It determines which sources and destinations are accessible by the device. It also defines the order of the sources and destinations as seen by the controlling device. This ordering feature is of particular interest for automation control because it provides a simple means to map sources and destinations to suit the automation system's requirements.

An example will help illustrate how a Profile is used to connect an automation system to the router.

> **Note:**   It is assumed the reader is familiar with the methods for configuring input and output ports in the 9430 Router. For help with these topics, please refer to "Configuring the Router's Ports" on page 54.

Assume that we have cabled up the router so that it has 4 inputs and 2 outputs. Table 1 lists the inputs and outputs connected to the router in this example.

Table 1

Router port number	Src/Dest Name
Input Port 1	Network Feed
Input Port 2	Studio 3
Input Port 3	Server 6
Input Port 4	Server 4
Output Port 1	Microwave
Output Port 2	Transmitter

Suppose we want to access these inputs and outputs from an automation system and that we want to renumber the sources and destinations to fit the automation system's numbering scheme. In Table 2 we have added a column to list the desired automation number associated with each input/output.

Table 2

Router port number	Src/Dest Name	Desired automation number
Input Port 1	Network Feed	source # 7
Input Port 2	Studio 3	source # 5
Input Port 3	Server 6	source # 2
Input Port 4	Server 4	source # 3
Output Port 1	Microwave	destination # 8
Output Port 2	Transmitter	destination # 3

By rearranging the information in Table 2, we have produced a sorted list of sources and a sorted list of destinations for the automation system. The results are in Table 3 and Table 4.

Table 3

Desired automation Src number	Src Name	Router port number
1	-	-
2	Server 6	Input Port 3
3	Server 4	Input Port 4
4	-	-
5	Studio 3	Input Port 2
6	-	-
7	Network Feed	Input Port 1

Table 4

Desired automation Dest number	Dest name	Router port number
1	-	-
2	-	-
3	Transmitter	Output Port 2
4	-	-
5	-	-
6	-	-
7	-	-
8	Microwave	Output Port 1

Note: In this example, we are assuming a protocol that numbers sources and destinations beginning with the number 1. Some protocols begin numbering at zero (e.g., the Grass Valley TEN-XL ASCII Protocol and the Generic ASCII protocol).

We can now use these lists to create a Profile in the 9430 Router that numbers the sources and destinations to match the desired automation numbering scheme.

Using the 9430's Profile Editor to arrange the order of the sources and destinations in their respective columns, and inserting spaces at the appropriate places, we can create a Profile with the numbering order that the automation system requires. The Profile to accomplish this is illustrated in Figure 1.
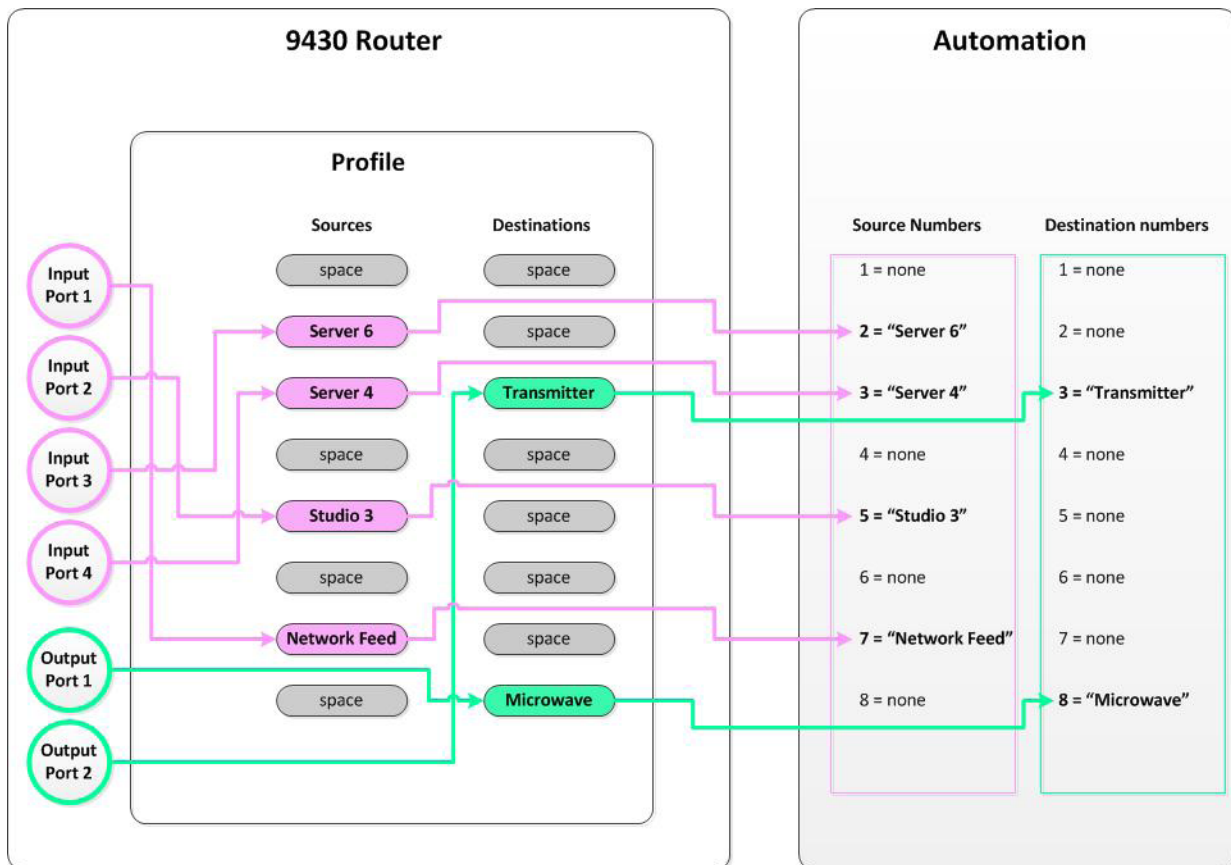
Figure 1

To change the number for a particular source or destination, simply edit the Profile and move the source or destination to its new position until the order produces the numbering scheme required by the automation system. For example, if Transmitter needs to be changed to destination 1, simply drag it to the top of the destination list in the Profile Editor and save the Profile.

For detailed instructions on how to create and edit Profiles, refer to "Creating and Editing Profiles" on page 59.

6 Configuration

To control the router from an external device such as an automation system, the router requires some configuration. To do this you will need to browse to the 9430's web page from a computer. (Details for doing this are covered in "Initially Connecting to the Router" on page 40.)

After browsing to the 9430's web page, click the gray button in the upper left part of the browser window to select **System Settings**. The **General** page will appear on the right side of the screen.

On the left side of the screen is the Navigation Panel. It is currently set to the **General** page. Use the Navigation Panel to select different areas of configuration.

6.1 Profile Configuration

To access the Profile Editor, select **Profiles** in the Navigation Panel.

Create or edit a Profile so the sources and destinations are in the order the automation system requires. Refer to the example discussed in Section 5, "Understanding Profiles," in this appendix.

> **Note:** The only sources and destinations that show up in the Profile Editor are those that have been previously defined in the **Ports** page. To view this page, select **Ports** in the Navigation Panel. Refer to "Configuring the Router's Ports" on page 54 for information on defining ports.

6.2 External Control Configuration

In order to control the 9430 Router from an automation system or other external controller, specific configuration choices need to be made in the External Control Editor.

To access the External Control Editor, select **External Control** in the Navigation Panel.

6.2.1 Connection Mode

Choose the means of connecting the automation system to the router. The choices are TCP/IP, Telnet, or RS-232.

TCP/IP

To use TCP/IP with your automation system, check the **Enable** box in the **TCP/IP Control** section of the External Control page.

When using TCP/IP, the automation system will need to connect to Port 5200 at the 9430 Router's IP address.

Telnet

To use Telnet with your automation system, check the **Enable** box in the **Telnet Control** section of the External Control page.

Telnet is by its nature a text-based communication method. As a result, this connection choice is only appropriate for ASCII-based protocols.

When using Telnet, the automation system will need to connect to Port 5100 at the 9430 Router's IP address.

For security reasons the default Telnet port number has been disabled in the 9430 Router. Only Port 5100 is activated for Telnet use in the router and is strictly limited to use by automation systems using the protocols described in this document.

RS-232

The 9430 Router provides an RS-232 port for serial communications. The pin-out of the DB 9 serial connector used for this purpose is described in "Chapter 6: External Control" on page 96.

To connect to the router via the RS-232 port of your automation system, check the **Enable** box in the **RS-232 Control** section of the External Control page.

To use RS-232, you will need to set the following additional configuration items in the router:

Baud Rate

From the **Baud Rate** drop-down control, select the baud rate the automation system will use to communicate with the router. The 9430 Router supports the following baud rates for serial communication:

> 9600
> 19200
> 38400
> 115200

Data Bits

From the **Data Bits** drop-down control, select the number of data bits that will be transmitted per byte. The 9430 Router supports 7 or 8 data bits per byte for serial communication.

Stop Bits

From the **Stop Bits** drop-down control, select the number of stop bits that will be sent per byte. The 9430 Router supports 1 or 2 stop bits per byte for serial communication.

Parity

From the **Parity** drop-down control, select the desired parity setting. The 9430 Router supports odd, even, or no parity for serial communication.

6.2.2 Protocol Selection

From the **Protocol** drop-down control, select which protocol the router and automation system will use to communicate. The details of the various protocols are discussed in Section 7, "Protocols," in this appendix.

6.2.3 Profile Selection

From the **Profile** drop-down control, select the Profile that will determine the automation numbering scheme. (If you have not set up a Profile, refer to Section 5, "Understanding Profiles," in this appendix.)

7 Protocols

The 9430 Router supports multiple protocols to allow crosspoint switching from external controllers.

The supported protocols are these:

- GV TEN-XL ASCII Protocol
- GV Performer ASCII Protocol
- Generic ASCII Protocol

For installations that already support one of these protocols, choosing the same protocol can minimize programming changes to the automation system when installing the 9430 Router.

These protocols are presented in the subsections below.

7.1 GV TEN-XL ASCII Protocol

The Grass Valley TEN-XL ASCII Protocol is a serial protocol used by TEN-XL Routing Switchers. For installations that already support this protocol, this is a good choice to minimize programming changes to the automation system.

The implementation of this protocol has been adapted as appropriate to reflect the features in the 9430 Router.

7.1.1 Protocol Requirements

- Sources and destinations are numbered starting at 0.

- All commands begin with the ASCII STX character (02H).

- Receipt of STX in the middle of a command discards all collected bytes and begins a new command.

- Errors of any kind (e.g., missing parameters, unexpected characters, out of range values, etc.) result in discarding the current command.

- Parsing will not tolerate any additional characters within a command. For example, spaces embedded within a command will cause the command to be discarded.

- Audio crosspoints are ignored on switching requests. In the Command Response message, the audio source is always reported as '0' (30H).

- The Power Supply status returned in the Command Response message is always reported as '3' (33H), which means okay.

- The protocol requires 2 digits to specify a destination. This 2-digit number represents a decimal number. For example, a destination that is specified with a high digit of '1' and a low digit of '2' represents the decimal number 12.

7.1.2 Commands

This section lists the commands supported in the TEN-XL ASCII protocol.

Status Request Command

Description: This command requests the current source selected on the specified destination.

Syntax: <STX><Dest High><Dest Low><ENQ>

<STX>	Start character (02H)
<Dest High>	High byte of destination number. Valid range is '0' to '9' (30H to 39H)
<Dest Low>	Low byte of destination number. Valid range is '0' to '9' (30H to 39H)
<ENQ>	Enquiry character (05H)

Example: Request the status for destination number 13. Assume that the video source assigned to this destination is 7.

Request: In Hex   02 31 33 05
            In ASCII   <STX>13<ENQ>

Response: In Hex   37 30 33
            In ASCII   703

Crosspoint Select Command

Description: This command requests switching the specified video source to the specified
                destination. Note that the audio crosspoint specified will have no effect; however, it
                must be a legal ASCII decimal digit from 0 to 9.

Syntax: <STX><Dest High><Dest Low><Video Src><Audio Src>

<STX>	Start character (02H)
<Dest High>	High byte of destination number. Valid range is '0' to '9' (30H to 39H)
<Dest Low>	Low byte of destination number. Valid range is '0' to '9' (30H to 39H)
<Video Src>	Video source number. Valid range is '0' to '9' (30H to 39H)
<Audio Src>	Audio source number. Valid range is '0' to '9' (30H to 39H)

Example: Request switching video source 4 to destination 0. In this example, we specify an
                arbitrary audio source number of 9 which will be ignored.

Request: In Hex   02 30 30 34 39
                In ASCII   <STX>0049

Response: In Hex   34 30 33
                In ASCII   403

Notes: If the video source requested is not valid for the specified destination, the response
                will return the current video source that is assigned to that destination.

                If the destination number specified is invalid, the command is invalid and there is no
                response.

Command Response Message

Description: This is the response to all valid GV TEN-XL commands sent to the router.

Syntax: <Video Src><Audio Src><PS OK>

<Video Src>	Video source number assigned to requested destination. Valid range is '0' to '9' (30H to 39H).
<Audio Src>	Audio source number. Not used. Always reported as '0' (30H).
<PS OK>	Power supply okay. Not used. Always reported as okay: '3' (33H).

Example: Router receives a Status Request command for destination number 1. Assume that video source 6 is assigned to this destination.

Request: In Hex   02 30 31 05
                       In ASCII   <STX>01<ENQ>

Response: In Hex   36 30 33
                       In ASCII   603

Notes: The Audio Source number and the Power Supply portions of the response are required by the protocol, but the values returned are to be ignored.

7.2 GV Performer ASCII Protocol

The Grass Valley Performer ASCII protocol is a serial protocol used by the Performer™ 10 x 1 Routing Switcher. For installations that already support this protocol, this is a good choice to minimize programming changes to the automation system.

The implementation of this protocol has been adapted as appropriate to reflect the features in the 9430 Router.

7.2.1 Protocol Requirements

- Sources and destinations are numbered starting at 1.

- The 9430 Router supports source and destination numbers beyond the limit specified in the original protocol. However, any valid source or destination in the 9430 Router can be specified in this implementation of the protocol.

- The maximum byte count for Cmd Data is 251 bytes (FBH).

- Multiple commands may be sent within a single message.

- All digits in messages are ASCII hex digits. For example, a message length specified with a high digit of '1' and a low digit of '2' represents the hexadecimal number 12H, or decimal 18.

- ASCII hex digits are not case specific. The 9430 Router will accept upper or lower case ASCII hex digits.

- All messages begin with a carriage return character (0DH).

- All line feeds (0AH), spaces (20H), and nulls (00H) are ignored within messages, and are not included in the message length calculation.

- The Performer Switch 1 Address bytes in messages are ignored; however, they must be legal ASCII hex digits from '0' to 'F'.

- Errors of any kind (e.g., missing parameters, unexpected characters, out of range values, etc.) result in discarding the remaining portion of the message at the point of the error.

- The P, C, R, and Q commands are not supported and will be ignored.

- No response is sent from the 9430 Router because none of the supported commands require a response.

7.2.2 Message Structure

This section describes the message structure supported in the GV Performer ASCII Protocol.

A message consists of a Message Header followed by Command Data (Cmd Data). The Message Header consists of 5 bytes of information (described below). The Command Data portion can vary in size depending on which commands and how many commands are included within it.

The general message structure is as follows:

Syntax: <CR><Adr High><Adr Low><Len High><Len Low><Cmd Data>

<CR>	Carriage return (0DH). Part of the Message Header.
<Adr High>	High byte of Performer Switch 1 Address. Part of the Message Header. This is ignored, but must be valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Adr Low>	Low byte of Performer Switch 1 Address. Part of the Message Header. This is ignored, but must be valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Len High>	High byte of byte count for Cmd Data. Part of the Message Header. Must be valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Len Low>	Low byte of byte count for Cmd Data. Part of the Message Header. Must be valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Cmd Data>	Zero or more commands consisting of valid ASCII characters.

7.2.3 Commands

This section describes the commands in the GV Performer ASCII Protocol that are supported by the 9430 Router. Commands in the original protocol that are not supported by the 9430 Router will simply be ignored.

The commands described here fit into the <Cmd Data> field of the message described in "Message Structure" above on this page.

Note that multiple commands may be sent in a single message up to a maximum of 251 bytes.

Data Preset Command

Description: This command presets a crosspoint for later execution. The source is not actually switched to the destination until a subsequent **Take** command or **All Take** command is received by the router.

Syntax:

Message Header:
<CR><Adr High><Adr Low><Len High><Len Low>

Cmd Data:
D<Lvl High><Lvl Low><Src High><Src Low><Dest High><Dest Low>

D	ASCII character 'D' identifies this as Data Preset command.
<Lvl High>	High byte of Level. See note below.
<Lvl Low>	Low byte of Level. See note below.
<Src High>	High byte of Source number. Any valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Src Low>	Low byte of Source number. Any valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Dest High>	High byte of Destination number. Any valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Dest Low>	Low byte of Destination number. Any valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').

Note: The only Levels supported by the 9430 Router are "All Levels" ("00" or 3030H) and "Video Level" ("01" or 3031H). These 2 Level values are treated by the router as equivalent to one another. Any other Level value will cause the command to be ignored.

Example: Request a preset of Source 14 (0EH) on Destination 2.
The Address bytes are ignored, so the example specifies an arbitrary value of "00" (3030H). For the Level bytes, the example specifies "01" (3031H). There are 7 bytes of Cmd Data in this example (specified as "07" or 3037H).

Request: In Hex   0D 30 30 30 37 44 30 31 30 45 30 32
             In ASCII   <CR> 00 07 D 01 0E 02 (spaces for readability only)

Response: No serial response. The router remembers the preset source for the specified destination.

Take Command

Description: This command requests a Take of a previously set preset source to the specified destination.

Syntax:

Message Header:
<CR><Adr High><Adr Low><Len High><Len Low>

Cmd Data:
T<Dest High><Dest Low>

T	ASCII character 'T' identifies this as Take cmd.
<Dest High>	High byte of Destination number. Any valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
<Dest Low>	Low byte of Destination number. Any valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').

Example: Request a Take of the previous set preset source to Destination 4.

Request: In Hex   0D 30 30 30 33 54 30 34
            In ASCII   <CR> 00 03 T 04   (spaces for readability only)

Response: No serial response. If a preset source had previously been set for Destination 4, the router now switches that source to Destination 4.

All Take Command

Description: This command requests a Take of all previously set preset sources to their respective destinations.

Syntax:

    Message Header:
    <CR><Adr High><Adr Low><Len High><Len Low>

    Cmd Data:
    A

A	ASCII character 'A' identifies this as All Take command.

Example: Request a Take of all the previously set preset sources to their respective destinations.

Request: In Hex   0D 30 30 30 31 41
       In ASCII   <CR> 00 01 A (spaces for readability only)

Response: No serial response. All preset sources are switched to their respective destinations.

7.3 Generic ASCII Protocol

The Generic ASCII protocol is based on the Leitch Pass-Through Protocol described in Chapter 4 of the Leitch serial protocol reference manual "SPR-MAN", edition 4.

The Generic ASCII protocol supports a subset of the commands described in the Leitch protocol. Commands described in the Leitch protocol that are unsupported by the 9430 Router are simply ignored.

The implementation of this protocol has been adapted as appropriate to reflect the features in the 9430 Router.

7.3.1 Protocol Requirements

- Sources and destinations are numbered starting at 0.

- Commands must be sent one at a time. Before sending the next command, wait for the router to send the prompt ('>').

- Errors of any kind (e.g., missing parameter, unexpected characters, out of range values, etc.) result in discarding the current command. There is no error reporting.

- Parsing will not tolerate any additional characters within a command. For example, spaces embedded within a command will cause the command to be discarded.

- All digits in messages are ASCII hex digits. For example, a source specified with a high digit of '1' and a low digit of '2' represents the hexadecimal number 12H, or decimal 18.

- ASCII hex digits are not case specific. The 9430 Router will accept upper or lower case ASCII hex digits. Responses from the 9430 Router will always use lower case for ASCII hex digits.

- Sources and destinations can be specified using up to 4 ASCII digit characters. E.g., Source 2 can be specified as "2", "02", "002", or "0002".

- The 9430 Router does not support multiple levels as described in the Pass-Through Protocol. In commands that specify a level number, the 9430 Router will only respond to level 0. All other level designations are ignored. Levels are specified in a single hex digit from '0' to 'F'.

7.3.2 Router Responses

All commands sent to the 9430 Router must be terminated with a carriage return character (0DH). Upon receiving a carriage return, the 9430 Router will send a response to the automation system.

The possible responses are a simple **Prompt Response** or a **Status Response** followed by a **Prompt Response**. These are discussed below.

Prompt Response
This response consists of the single ASCII character '>' (3EH).

The 9430 Router will send this response anytime it receives a carriage return. This is an indication to the automation system that the router is ready for the next command.

If a command is sent to the 9430 Router that requires a more extensive response, the **Prompt Response** will be sent immediately following the more extensive response.

Status Response

Certain commands sent to the 9430 Router require that a **Status Response** be returned by the router. This response identifies the source that is currently switched to the destination specified. The response takes this form:

Syntax: S:<Lvl><Dest>,<Src><CR><LF>

S:	ASCII character 'S' (53H) followed by ASCII character ':' (3AH). Identifies this as a Status Response.
<Lvl>	This is the level. The 9430 Router will always report this to 0.
<Dest>	Destination number. No leading zeros will be used. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
,	Comma character (2CH). Separates destination numbers from source numbers.
<Src>	Source number. No leading zeros will be used. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
<CR>	ASCII carriage return character (0DH).
<LF>	ASCII line feed character (0AH).

Example: In response to a **Direct Crosspoint Take** command, suppose that the 9430 Router reports that Source 11 (0BH) is selected on Destination 4. The response would look as follows. (Note that the router will always report the Level as 0):

Response: In Hex   53 3A 30 34 2C 62 0D 0A
               In ASCII   S:04,b<CR><LF>

Note: After the **Status Response** is sent, a **Prompt Response** is sent.

7.3.3 Commands

This section lists the commands supported in the Generic ASCII protocol.

Commands from the original Leitch Pass-Through Protocol that are not listed in this section are not supported by the 9430 router and will be ignored.

Direct Crosspoint Take Command

Description: This command requests a Take operation on the specified destination-source pair(s).

Syntax: @<Space>X:<Lvls>/<Dest>,<Src>[/<Dest>,<Src>…]<CR>

@<Space>	ASCII '@' (40H) followed by ASCII space character ' ' (20H). Identifies the start of a command.
X:	ASCII 'X' followed by ASCII ':'. Identifies this as a Direct Crosspoint Take command.
<Lvls>	The level(s) to be affected. Multiple levels may be specified by listing several digits in a row. The 9430 Router only supports level 0 and ignores other levels. A level is specified by a single valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
/	ASCII forward slash character '/' (2FH). Separates Levels from destination-source pairs. Forward slash is also used to separate multiple destination-source pairs when more than one pair is specified.
<Dest>	Destination number. Up to 4 characters (including leading zeros) may be used to specify the destination. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
,	Comma character (2CH). Separates destination numbers from source numbers in each destination-source pair.
<Src>	Source number. Up to 4 characters (including leading zeros) may be used to specify the source. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
<CR>	ASCII carriage return character (0DH).

Example 1:   Perform a Take of Source 10 (0AH) on Destination 4. Level 0 must be specified.

Request: In Hex   40 20 58 3A 30 2F 34 2C 41 0D
                In ASCII   @ X:0/4,A<CR>

Response: In Hex   53 3A 30 34 2C 61 0D 0A
                In ASCII   S:04,a<CR><LF>

Example 2:   Perform a Take of sources on multiple destinations: Source 9 on Destination 3, Source 7 on Destination 1, and Source 5 on Destination 2.

Request: In Hex   40 20 58 3A 30 2F 33 2C 39 2F 31 2C 37 2F 32 2C 35 0D
                In ASCII   @ X:0/3,9/1,7/2,5<CR>

Response: In Hex   53 3A 30 33 2C 39 0D 0A
                              53 3A 30 31 2C 37 0D 0A
                              53 3A 30 32 2C 35 0D 0A

               In ASCII   S:03,9<CR><LF>
                              S:01,7<CR><LF>
                              S:02,5<CR><LF>

Crosspoint Status Command

Description: This command requests the crosspoint status of the specified destination.

Syntax: @<Space>X?<Lvl><Dest><CR>

@<Space>	ASCII '@' (40H) followed by ASCII space character ' ' (20H). Identifies the start of a command.
X?	ASCII 'X' followed by ASCII '?'. Identifies this as a Crosspoint Status command.
<Lvl>	The 9430 Router only supports level 0. Must be ASCII digit '0'.
<Dest>	Destination number. Up to 4 characters (including leading zeros) may be used to specify the destination. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
<CR>	ASCII carriage return character (0DH).

Example: Get the status of Destination 7. Level 0 must be specified. Assume that the router reports Source 6 is selected on Destination 7.

Request: In Hex   40 20 58 3F 30 37 0D
               In ASCII   @ X?07<CR>

Response: In Hex   53 3A 30 37 2C 36 0D 0A
               In ASCII   S:07,6<CR><LF>

Preset Crosspoint Command

Description: This command stores crosspoints in the preset buffer for later execution. The preset destination-source pairs are not actually switched until a subsequent Execute Preset Buffer command is issued.

Syntax: @<Space>P:<Lvls>/<Dest>,<Src>[/<Dest>,<Src>…]<CR>

@<Space>	ASCII '@' (40H) followed by ASCII space character ' ' (20H). Identifies the start of a command.
P:	ASCII 'P' followed by ASCII ':' (3AH). Identifies this as a Preset Crosspoint command.
<Lvls>	The level(s) to be affected. Multiple levels may be specified by listing several digits in a row. The 9430 Router only supports level 0 and ignores other levels. A level is specified by a single valid ASCII hex digit. (E.g. '0' to '9' or 'A' to 'F').
/	ASCII forward slash character '/' (2FH). Separates Levels from destination-source pairs. Forward slash is also used to separate multiple destination-source pairs when more than one pair is specified.
<Dest>	Destination number. Up to 4 characters (including leading zeros) may be used to specify the destination. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
,	Comma character (2CH). Separates destination numbers from source numbers in each destination-source pair.
<Src>	Source number. Up to 4 characters (including leading zeros) may be used to specify the source. Any valid ASCII hex digits. (E.g. '0' to '9' or 'A' to 'F').
<CR>	ASCII carriage return character (0DH).

Example 1:   Perform a preset of Source 10 (0AH) on Destination 4. Level 0 must be specified.

Request: In Hex   40 20 50 3A 30 2F 34 2C 41 0D
               In ASCII   @ P:0/4,A<CR>

Response: In Hex   3E
               In ASCII   '>'

Example 2:   Perform presets of the following source-destination pairs: Source 9 on Destination 3, Source 7 on Destination 1, and Source 5 on Destination 2.

Request: In Hex   40 20 50 3A 30 2F 33 2C 39 2F 31 2C 37 2F 32 2C 35 0D
               In ASCII   @ P:0/3,9/1,7/2,5<CR>

Response: In Hex   3E
               In ASCII   '>'

Execute Preset Buffer Command

Description: This command executes a Take operation on all crosspoints previously stored in the preset buffer.

Syntax: @<Space>B:E<CR>

@<Space>	ASCII '@' (40H) followed by ASCII space character ' ' (20H). Identifies the start of a command.
B:	ASCII 'B' followed by ASCII ':' (3AH). Identifies this as one of the "buffer" commands.
E	ASCII 'E'. Identifies this as the Execute Preset Buffer command.
<CR>	ASCII carriage return character (0DH).

Example: Execute the crosspoints previously stored in the preset buffer. Assume the presets are as follows: Source 9 on Destination 3, Source 7 on Destination 1, and Source 5 on Destination 2.

Request: In Hex   40 20 42 3A 45 0D
                In ASCII   @ B:E<CR>

Response: In Hex   53 3A 30 33 2C 39 0D 0A
                                 53 3A 30 31 2C 37 0D 0A
                                 53 3A 30 32 2C 35 0D 0A

                In ASCII   S:03,9<CR><LF>
                                 S:01,7<CR><LF>
                                 S:02,5<CR><LF>

Clear Preset Buffer Command

Description:　　This command clears all crosspoints in the preset buffer.

Syntax:　　　　@<Space>B:C<CR>

@<Space>	ASCII '@' (40H) followed by ASCII space character ' ' (20H). Identifies the start of a command.
B:	ASCII 'B' followed by ASCII ':' (3AH). Identifies this as one of the "buffer" commands.
C	ASCII 'C' Identifies this as the Clear Preset Buffer command.
<CR>	ASCII carriage return character (0DH).

Example:　　Clear the crosspoints previously stored in the preset buffer.

Request:　　In Hex　　　　40 20 42 3A 43 0D
　　　　　　In ASCII　　　@ B:C<CR>

Response:　　In Hex　　　　3E
　　　　　　In ASCII　　　'>'

Glossary

AES/EBU

The digital audio standard defined as a joint effort of the Audio Engineering Society and the European Broadcast Union. AES/EBU or AES3 describes a serial bitstream that carries two audio channels, thus an AES stream is a stereo pair. The AES/EBU standard covers a wide range of sample rates and quantizations (bit depths). In television systems, these will generally be 48 KHz and either 20 or 24 bits.

AFD

Active Format Description is a method to carry information regarding the aspect ratio of the video content. The specification of AFD was standardized by SMPTE in 2007 and is now beginning to appear in the marketplace. AFD can be included in both SD and HD SDI transport systems. There is no legacy analog implementation. (See WSS).

ASI

A commonly used transport method for MPEG video streams, ASI or Asynchronous Serial Interface, operates at the same 270 Mb/s data rate as SD SDI. This makes it easy to carry an ASI stream through existing digital television infrastructure. Known more formally as DVB-ASI, this transport mechanism can be used to carry multiple program channels.

Aspect Ratio

The ratio of the vertical and horizontal measurements of an image. 4:3 is the aspect ratio for standard definition video formats and television and 16:9 for high definition. Converting formats of unequal ratios is done by letterboxing (horizontal bars) or pillar boxing (vertical pillars) in order to keep the original format's aspect ratio.

Bandwidth

Strictly speaking, this refers to the range of frequencies (i.e. the width of the band of frequency) used by a signal, or carried by a transmission channel. Generally, wider bandwidth will carry and reproduce a signal with greater fidelity and accuracy.

Beta

Sony Beta SP video tape machines use an analog component format that is similar to SMPTE, but differs in the amplitude of the color difference signals. It may also carry setup on the luminance channel.

Bit

A binary digit, or bit, is the smallest amount of information that can be stored or transmitted digitally by electrical, optical, magnetic, or other means. A single bit can take on one of two states: On/Off, Low/High, Asserted/ Deasserted, etc. It is represented numerically by the numerals 1 (one) and 0 (zero). A byte, containing 8 bits, can represent 256 different states. The binary number 11010111, for example, has the value of 215 in our base 10 numbering system. When a value is carried digitally, each

additional bit of resolution will double the number of different states that can be represented. Systems that operate with a greater number of bits of resolution, or quantization, will be able to capture a signal with more detail or fidelity. Thus, a video digitizer with 12 bits of resolution will capture 4 times as much detail as one with 10 bits.

Blanking

The Horizontal and Vertical blanking intervals of a television signal refer to the time periods between lines and between fields. No picture information is transmitted during these times, which are required in CRT displays to allow the electron beam to be repositioned for the start of the next line or field. They are also used to carry synchronizing pulses which are used in transmission and recovery of the image. Although some of these needs are disappearing, the intervals themselves are retained for compatibility purposes. They have turned out to be very useful for the transmission of additional content, such as teletext and embedded audio.

CAV

Component Analog Video. This is a convenient shorthand form, but it is subject to confusion. It is sometimes used to mean ONLY color difference component formats (SMPTE or Beta), and other times to include RGB format. In any case, a CAV signal will always require 3 connectors – either Y/R-Y/B-Y, or R/G/B.

Checkfield

A Checkfield signal is a special test signal that stresses particular aspects of serial digital transmission. The performance of the Phase Locked-Loops (PLLs) in an SDI receiver must be able to tolerate long runs of 0's and 1's. Under normal conditions, only very short runs of these are produced due to a scrambling algorithm that is used. The Checkfield, also referred to as the Pathological test signal, will "undo" the scrambling and cause extremely long runs to occur. This test signal is very useful for testing transmission paths.

Chroma

The color or chroma content of a signal, consisting of the hue and saturation of the image. See also Color Difference.

Component

In a component video system, the totality of the image is carried by three separate but related components. This method provides the best image fidelity with the fewest artifacts, but it requires three independent transmission paths (cables). The commonly used component formats are Luminance and Color Difference (Y/Pr/Pb), and RGB. It was far too unwieldy in the early days of color television to even consider component transmission.

Composite

Composite television dates back to the early days of color transmission. This scheme encodes the color difference information onto a color subcarrier. The instantaneous phase of the subcarrier is the color's hue, and the amplitude is the color's saturation or intensity. This subcarrier is then added onto the existing luminance video signal. This trick works because the subcarrier is set at a high enough frequency to leave spectrum for the luminance information. But it is not a seamless matter to pull

the signal apart again at the destination in order to display it or process it. The resultant artifacts of dot crawl (also referred to as chroma crawl) are only the most obvious result. Composite television is the most commonly used format throughout the world, either as PAL or NTSC. It is also referred to as Encoded video.

Color Difference

Color Difference systems take advantage of the details of human vision. We have more acuity in our black and white vision than we do in color. This means that we need only the luminance information to be carried at full bandwidth, we can scrimp on the color channels. In order to do this, RGB information is converted to carry all of the luminance (Y is the black and white of the scene) in a single channel. The other two channels are used to carry the "color difference". Noted as B-Y and R-Y, these two signals describe how a particular pixel "differs" from being purely black and white. These channels typically have only half the bandwidth of the luminance.

Decibel (dB)

The decibel is a unit of measure used to express the ratio in the amplitude or power of two signals. A difference of 20 dB corresponds to a 10:1 ratio between two signals, 6 dB is approximately a 2:1 ratio. Decibels add while the ratios multiply, so 26 dB is a 20:1 ratio, and 14 dB is a 5:1 ratio. There are several special cases of the dB scale, where the reference is implied. Thus, dBm refers to power relative to 1 milliwatt, and dBu refers to voltage relative to .775V RMS. The original unit of measure was the Bel (10 times bigger), named after Alexander Graham Bell.

dBFS

In Digital Audio systems, the largest numerical value that can be represented is referred to as Full Scale. No values or audio levels greater than FS can be reproduced because they would be clipped. The nominal operating point (roughly corresponding to 0 VU) must be set below FS in order to have headroom for audio peaks. This operating point is described relative to FS, so a digital reference level of -20 dBFS has 20 dB of headroom before hitting the FS clipping point.

DVI

Digital Visual Interface. DVI-I (integrated) provides both digital and analog connectivity. The larger group of pins on the connector are digital while the four pins on the right are analog.

EDH

Error Detection and Handling is a method to verify proper reception of an SDI or HD-SDI signal at the destination. The originating device inserts a data packet in the vertical interval of the SDI signal and every line of the HD signal which contains a checksum of the entire video frame. This checksum is formed by adding up the numerical values of all of the samples in the frame, using a complex formula. At the destination this same formula is applied to the incoming video and the resulting value is compared to the one included in the transmission. If they match, then the content has all arrived with no errors. If they don't, then an error has occurred.

Embedded Audio

Digital Audio can be carried along in the same bitstream as an SDI or HD-SDI signal by taking advantage of the gaps in the transmission which correspond to the horizontal and vertical intervals

of the television waveform. This technique can be very cost effective in transmission and routing, but can also add complexity to signal handling issues because the audio content can no longer be treated independently of the video.

Eye Pattern

To analyze a digital bitstream, the signal can be displayed visually on an oscilloscope by triggering the horizontal timebase with a clock extracted from the stream. Since the bit positions in the stream form a very regular cadence, the resulting display will look like an eye – an oval with slightly pointed left and right ends. It is easy to see from this display if the eye is "open", with a large central area that is free of negative or positive transitions, or "closed" where those transitions are encroaching toward the center. In the first case, the open eye indicates that recovery of data from the stream can be made reliably and with few errors. But in the closed case data will be difficult to extract and bit errors will occur. Generally it is jitter in the signal that is the enemy of the eye.

Frame Sync

A Frame Synchronizer is used to synchronize the timing of a video signal to coincide with a timing reference (usually a color black signal that is distributed throughout a facility). The synchronizer accomplishes this by writing the incoming video into a frame buffer memory under the timing direction of the sync information contained in that video. Simultaneously the memory is being read back by a timing system that is genlocked to a house reference. As a result, the timing or alignment of the video frame can be adjusted so that the scan of the upper left corner of the image is happening simultaneously on all sources. This is a requirement for both analog and digital systems in order to perform video effects or switch glitch-free in a router. Frame synchronization can only be performed within a single television line standard. A synchronizer will not convert an NTSC signal to a PAL signal, it takes a standards converter to do that.

Frequency Response

A measurement of the accuracy of a system to carry or reproduce a range of signal frequencies. Similar to Bandwidth.

H.264

The latest salvo in the compression wars is H.264 which is also known as MPEG-4 Part 10. MPEG-4 promises good results at just half the bit rate required by MPEG-2.

HD

High Definition. This two letter acronym has certainly become very popular. Here we thought it was all about the pictures – and the radio industry stole it.

HDMI

The High Definition Multimedia Interface comes to us from the consumer marketplace where it is becoming the de facto standard for the digital interconnect of display devices to audio and video sources. It is an uncompressed, all-digital interface that transmits digital video and eight channels of digital audio. HDMI is a bit serial interface that carries the video content in digital component form over multiple twisted-pairs. HDMI is closely related to the DVI interface for desktop computers and their displays.

IEC

The International Electrotechnical Commission provides a wide range of worldwide standards. They have provided standardization of the AC power connection to products by means of an IEC line cord. The connection point uses three flat contact blades in a triangular arrangement, set in a rectangular connector. The IEC specification does not dictate line voltage or frequency. Therefore, the user must take care to verify that a device either has a universal input (capable of 90 to 230 volts, either 50 or 60 Hz), or that a line voltage switch, if present, is set correctly.

Interlace

Human vision can be fooled to see motion by presenting a series of images, each with a small change relative to the previous image. In order to eliminate the flicker, our eyes need to see more than 30 images per second. This is accomplished in television systems by dividing the lines that make up each video frame (which run at 25 or 30 frames per second) into two fields. All of the odd-numbered lines are transmitted in the first field, the even-numbered lines are in the second field. In this way, the repetition rate is 50 or 60 Hz, without using more bandwidth. This trick has worked well for years, but it introduces other temporal artifacts. Motion pictures use a slightly different technique to raise the repetition rate from the original 24 frames that make up each second of film—they just project each one twice.

IRE

Video level is measured on the IRE scale, where 0 IRE is black, and 100 IRE is full white. The actual voltages that these levels correspond to can vary between formats.

ITU-R 601

This is the principal standard for standard definition component digital video. It defines the luminance and color difference coding system that is also referred to as 4:2:2. The standard applies to both PAL and NTSC derived signals. They both will result in an image that contains 720 pixels horizontally, with 486 vertical pixels in NTSC, and 576 vertically in PAL. Both systems use a sample clock rate of 27 MHz, and are serialized at 270 Mb/s.

Jitter

Serial digital signals (either video or audio) are subject to the effects of jitter. This refers to the instantaneous error that can occur from one bit to the next in the exact position of each digital transition. Although the signal may be at the correct frequency on average, in the interim it varies. Some bits come slightly early, others come slightly late. The measurement of this jitter is given either as the amount of time uncertainty or as the fraction of a bit width. For 270 Mb/s SD video, the allowable jitter is 740 picoseconds, or 0.2 UI (Unit Interval – one bit width). For 1.485 Gb/s HD, the same 0.2UI spec corresponds to just 135 pico seconds.

Luminance

The "black & white" content of the image. Human vision had more acuity in luminance, so television systems generally devote more bandwidth to the luminance content. In component systems, the luminance is referred to as Y.

MPEG

The Moving Picture Experts Group is an industry group that develops standards for the compression of moving pictures for television. Their work is an on-going effort. The understanding of image processing and information theory is constantly expanding. And the raw bandwidth of both the hardware and software used for this work is ever increasing. Accordingly, the compression methods available today are far superior to the algorithms that originally made the real-time compression and decompression of television possible. Today, there are many variations of these techniques, and the term MPEG has to some extent become a broad generic label.

Metadata

This word comes from the Greek, meta means 'beyond' or 'after'. When used as a prefix to 'data', it can be thought of as 'data about the data'. In other words, the metadata in a data stream tells you about that data – but it is not the data itself. In the television industry, this word is sometimes used correctly when, for example, we label as metadata the timecode which accompanies a video signal. That timecode tells you something about the video, i.e. when it was shot, but the timecode in and of itself is of no interest. But in our industry's usual slovenly way in matters linguistic, the term metadata has also come to be used to describe data that is associated with the primary video in a datastream. So embedded audio will (incorrectly) be called metadata when it tells us nothing at all about the pictures. Oh well.

Multi-mode

Multi-mode fibers have a larger diameter core than single mode fibers (either 50 or 62.5 microns compared to 9 microns), and a correspondingly larger aperture. It is much easier to couple light energy into a multi-mode fiber, but internal reflections will cause multiple "modes" of the signal to propagate down the fiber. This will degrade the ability of the fiber to be used over long distances.
See also Single Mode.

NTSC

The color television encoding system used in North America was originally defined by the National Television Standards Committee. This American standard has also been adopted by Canada, Mexico, Japan, Korea, and Taiwan. (This standard is referred to disparagingly as Never Twice Same Color.)

Optical

An optical interface between two devices carries data by modulating a light source. This light source is typically a laser or laser diode (similar to an LED) which is turned on and off at the bitrate of the datastream. The light is carried from one device to another through a glass fiber. The fiber's core acts as a waveguide or lightpipe to carry the light energy from one end to another. Optical transmission has two very significant advantages over metallic copper cables. Firstly, it does not require that the two endpoint devices have any electrical connection to each other. This can be very advantageous in large facilities where problems with ground loops appear. And secondly, and most importantly, an optical interface can carry a signal for many kilometers or miles without any degradation or loss in the recovered signal. Copper is barely useful at distances of just 1000 feet.

Oversampling

A technique to perform digital sampling at a multiple of the required sample rate. This has the advantage of raising the Nyquist Rate (the maximum frequency which can be reproduced by a given sample rate) much higher than the desired passband. This allows more easily realized anti-aliasing filters.

PAL

During the early days of color television in North America, European broadcasters developed a competing system called Phase Alternation by Line. This slightly more complex system is better able to withstand the differential gain and phase errors that appear in amplifiers and transmission systems. Engineers at the BBC claim that it stands for Perfection At Last.

Pathological Test Pattern – see Checkfield

Progressive

An image scanning technique which progresses through all of the lines in a frame in a single pass. Computer monitors all use progressive displays. This contrasts to the interlace technique common to television systems.

Return Loss

An idealized input or output circuit will exactly match its desired impedance (generally 75 ohms) as a purely resistive element, with no reactive (capacitive or inductive) elements. In the real world, we can only approach the ideal. So, our real inputs and outputs will have some capacitance and inductance. This will create impedance matching errors, especially at higher frequencies. The Return Loss of an input or output measures how much energy is returned (reflected back due to the impedance mismatch). For digital circuits, a return loss of 15 dB is typical. This means that the energy returned is 15 dB less than the original signal. In analog circuits, a 40 dB figure is expected.

RGB

RGB systems carry the totality of the picture information as independent Red, Green, and Blue signals. Television is an additive color system, where all three components add to produce white. Because the luminance (or detail) information is carried partially in each of the RGB channels, all three must be carried at full bandwidth in order to faithfully reproduce an image.

ScH Phase

Used in composite systems, ScH Phase measures the relative phase between the leading edge of sync on line 1 of field 1 and a continuous subcarrier sinewave. Due to the arithmetic details of both PAL and NTSC, this relationship is not the same at the beginning of each frame. In PAL, the pattern repeats ever 4 frames (8 fields) which is also known as the Bruch Blanking sequence. In NTSC, the repeat is every 2 frames (4 fields). This creates enormous headaches in editing systems and the system timing of analog composite facilities.

Setup

In the NTSC Analog Composite standard, the term Setup refers to the addition of an artificial offset or pedestal to the luminance content. This places the Black Level of the analog signal 54 mV (7.5 IRE) positive with respect to ground. The use of Setup is a legacy from the early development of television receivers in the vacuum tube era. This positive offset helped to prevent the horizontal retrace of the electron beam from being visible on the CRT, even if Brightness and Contrast were mis-adjusted. While the use of Setup did help to prevent retrace artifacts, it did so at the expense of dynamic range (contrast) in the signal because the White Level of the signal was not changed.

Setup is optional in NTSC systems, but is never used in PAL systems (see 'Perfection' characteristic of PAL). This legacy of Setup continues to persist in North American NTSC systems, while it has been abandoned in Japan.

In the digital component world (SD and HD SDI) there is obviously no need for, and certainly every reason to avoid, Setup. In order for the interfaces between analog and digital systems to operate as transparently as possible, Setup must be carefully accounted for in conversion products. When performing analog to digital conversion, Setup (if present) must be removed and the signal range gained up to account for the 7.5% reduction in dynamic range. And when a digital signal is converted back to analog form, Setup (if desired on the output) must be created by reducing the dynamic range by 7.5% and adding the 54 mV positive offset. Unfortunately, there is no truly foolproof algorithm to detect the presence of Setup automatically, so it's definitely a case of installer beware.

SDI

Serial Digital Interface. This term refers to inputs and outputs of devices that support serial digital component video. This could refer to standard definition at 270 Mb/s, HD SDI or High Definition Serial Digital video at 1.485 Gb/s, or to the newer 3G standard of High Definition video at 2.97 Gb/s.

SMPTE

The Society of Motion Picture and Television Engineers is a professional organization which has done tremendous work in setting standards for both the film and television industries. The term "SMPTE"' is also shorthand for one particular component video format - luminance and color difference.

Single Mode

A Single mode (or mono mode) optical fiber carries an optical signal on a very small diameter (9 micron) core surrounded with cladding. The small diameter means that no internally reflected lightwaves will be propagated. Thus only the original "mode" of the signal passes down the fiber. A single mode fiber used in an optical SDI system can carry a signal for up to 20 kilometers. Single mode fibers require particular care in their installation due to the extremely small optical aperture that they present at splice and connection points. See also Multi-mode.

TBC

A Time Base Corrector is a system to reduce the Time Base Error in a signal to acceptable levels. It accomplishes this by using a FIFO (First In, First Out) memory. The incoming video is written into the memory using its own jittery timing. This operation is closely associated with the actual digitization of the analog signal because the varying position of the sync timing must be mimicked by the sampling function of the analog to digital converter. A second timing system, genlocked to a stable reference,

is used to read the video back out of the memory. The memory acts as a dynamically adjusting delay to smooth out the imperfections in the original signal's timing. Very often a TBC will also function as a Frame Synchronizer. See also Frame Sync.

Time Base Error

Time base error is present when there is excessive jitter or uncertainty in the line to line output timing of a video signal. This is commonly associated with playback from video tape recorders, and is particularly severe with consumer type heterodyne systems like VHS. Time base error will render a signal unusable for broadcast or editing purposes.

Timecode

Timecode, a method to uniquely identify and label every frame in a video stream, has become one of the most recognized standards ever developed by SMPTE. It uses a 24 hour clock, consisting of hours, minutes, seconds, and television frames. Originally recorded on a spare audio track, this 2400 baud signal was a significant contributor to the development of video tape editing. We now refer to this as LTC or Longitudinal Time Code because it was carried along the edge of the tape. This allowed it to be recovered in rewind and fast forward when the picture itself could not. Timecode continues to be useful today and is carried in the vertical interval as VITC, and as a digital packet as DVITC. Timecode is the true metadata.

Tri-Level Sync

For many, many years, television systems used composite black as a genlock reference source. This was a natural evolution from analog systems to digital implementations. With the advent of High Definition television, with even higher data rates and tighter jitter requirements, problems with this legacy genlock signal surfaced. Further, a reference signal with a 50 or 60 Hz frame rate was useless with 24 Hz HD systems running at film rates. Today we can think of composite black as a bi-level sync signal – it has two levels, one at sync tip and one at blanking. For HD systems, Tri-Level Sync, which has the same blanking level (at ground) of bi-level sync, but the sync pulse now has both a negative and a positive element. This keeps the signal symmetrically balanced so that its DC content is zero. And it also means that the timing pickoff point is now at the point where the signal crosses blanking and is no longer subject to variation with amplitude. This makes Tri-Level Sync a much more robust signal and one which can be delivered with less jitter.

USB

The Universal Serial Bus, developed in the computer industry to replace the previously ubiquitous RS-232 serial interface, now appears in many different forms and with many different uses. It actually forms a small local area network, allowing multiple devices to coexist on a single bus where they can be individually addressed and accessed.

VGA

Video Graphics Array. Traditional 15-pin, analog interface between a PC and monitor.

Word Clock

Use of Word Clock to genlock digital audio devices developed in the audio recording industry. Early digital audio products were interconnected with a massive parallel connector carrying a twisted pair for every bit in the digital audio word. A clock signal, which is a square wave at the audio sampling frequency, is carried on a 75 ohm coaxial cable. Early systems would daisychain this 44.1 or 48 kilohertz clock from one device to another with coax cable and Tee connectors. On the rising edge of this Work Clock these twisted pairs would carry the left channel, while on the falling edge, they would carry the right channel. In most television systems using digital audio, the audio sample clock frequency (and hence the 'genlock' between the audio and video worlds) is derived from the video genlock signal. But products that are purely audio, with no video reference capability, may still require Word Clock.

WSS

Wide Screen Signaling is used in the PAL/625 video standards, both in analog and digital form, to convey information about the aspect ratio and format of the transmitted signal. Carried in the vertical interval, much like closed captioning, it can be used to signal a television receiver to adjust its vertical or horizontal sizing to reflect incoming material. Although an NTSC specification for WSS exists, it never achieved any traction in the marketplace.

YUV

Strictly speaking, YUV does not apply to component video. The letters refer to the Luminance (Y), and the U and V encoding axes using in the PAL composite system. Since the U axis is very close to the B-Y axis, and the V axis is very close to the R-Y axis, YUV is often used as a sort of shorthand for the more long-winded "Y/R-Y/B-Y".

Y/Cr/Cb

In digital component video, the luminance component is Y, and the two color difference signals are Cr (R-Y) and Cb (B-Y).

Y/Pr/Pb

In analog component video, the image is carried in three components. The luminance is Y, the R-Y color difference signal is Pr, and the B-Y color difference signal is Pb.