SAS Nucleus IP Engine

UserGuide

Rev. 9, 6.15.2023

Table of Contents

Preface....4
Overview....5
Features:....6
Front Panel....6
Rear Panel....7
Getting Started....8
Network Configuration....10
Input Channel Configuration....11
Editing Input Channel Attributes....13
Output Channel Configuration....14
Editing Output Channel Attributes....16
Crosspoint Map....17
Mix Buses, Summing, and Gain....19
Onboard Web GUI Metering....20
GPIO....21
Setting Up DSP Effects....23
System Automation....24
Typical System Setup and Overview....26
Connecting SAS Guest Headphone Devices....27
Connecting SAS Remote and Ancillary Function Controllers....28
Web Browser Compatibility....29
SYSCFG.TXT....29
Appendix A: Support and Limited Warranty....30
Figure 1: Nucleus IP Engine Overview....5
Figure 2: Nucleus Front Panel....6
Figure 3: Nucleus Rear Panel Analog Section....7
Figure 4: SD Card SYSCFG File....8
Figure 5: Web Interface Access....9
Figure 6: Nucleus Web Server Menu....9
Figure 7: Network Config Screen....10
Figure 8: Input Channel Configuration View, Source Category....11
Figure 9: Input Channel Configuration View, Console Options Page....12
Figure 10: Edit Source Attributes Page....13
Figure 11: Output Channel Configuration View, Output Category....14
Figure 12: Output Channel Configuration View Basic Options Page....15
Figure 13: Edit Output Channel Attributes Page....16
Figure 14: System Crosspoint Map, Unity Gain Green and Blue Mapping....17
Figure 15 DSP Mix Bus Crosspoint Map....19
Figure 16: Crosspoint Map Web GUI Meter Outputs....20
Figure 17: GPIO alpha configuration....21
Figure 18: Fixed GPIO Control / Config....22

Figure 19: Adjust Effects Parameters 23
Figure 20: System Automation Control landing page 24
Figure 21: Automation event editor....25
Figure 22: Typical IP Console System Overview....26
Figure 23: SAS Guest Headphone Amplifier and Analog Output Wiring 27
Figure 24: SAS Controller Wiring....28

Preface

Thankyoufor purchasing the SAS Nucleus IP DSP Engine. The Nucleus was designed for high-quality audio switching, mixing, and processing with redundancy built in, suitable for critical no-fault operations. The following manual is an overview of the features and functions of the Nucleus IP engine along with typical applications that are tailored for radio and television broadcast operations.

ProprietaryNotice

Thisdocumentcontains proprietaryinformation,whichmaynotbe disclosedtoothersorusedinmanufacturing,or any otherpurpose,withoutwrittenpermissionfrom SierraAutomatedSystems&Engineering Corporation.Theinformationanddesigndisclosed hereinwereoriginatedbyand aretheproperty of SierraAutomatedSystems&Engineering Corporation.Allpatent,proprietarydesign, manufacturing,reproduction,useandsalesrights arereservedexceptwherethoserightsareexpressly grantedtoothers.

CopyrightNotice

Copyright2023bySierra AutomatedSystems&EngineeringCorporation, Burbank,California,USA.Allrightsreserved. Reproductioninwholeorinpartwithoutprior writtenpermissionfromSierraAutomatedSystems &EngineeringCorporationisprohibited.

LimitedWarranty

This product SAS Nucleus IP Engine of Sierra AutomatedSystems&EngineeringCorporation (SAS)iswarrantedtobefreefromdefectsin materialsandworkmanshipforaperiodoffiveyears fromthedateofsale(seeSupportandOther Informationfordetails.)

User GuideRevision

This Nucleus IP Engine User Guide ispublishedbytheEngineering DepartmentofSierraAutomatedSystems& EngineeringCorporation,whichisresponsiblefor its contents.SASreservestherighttorevisethis publicationandtomakechangesinthecontent hereofwithoutobligationtonotifyanypersonor organizationofsuchrevisionsorchanges

Who is the T-Rex?

In this manual you'll see some "T-Rex Tips" highlighting shortcuts and other "easy peasy" ways to accomplish your goals. Who is he and why is he here? We have had frequent sightings of him in the SAS office. Some swear they see him sketching out helpful hints and system diagrams on the whiteboard late at night, others recall his brilliant explanations of the inner workings of SAS gear. Still others say he makes a mean pizza and can play nearly anything on the piano. We don't really know for sure, but we can assure you that while his arms may be short, his brain is definitely *not* the size of walnut!

Overview

The Nucleus IP Engine is a fully-integrated DSP mixing engine housed in a 1 RU chassis. The high-capacity, small-footprint engine provides all functions necessary for a radio studio and many other audio mixing and routing applications. The Nucleus contains no fans and may be placed in a control room or studio environment. The Nucleus connects directly onto any Ethernet LAN and is controlled and configured using a standard HTML5 Web browser. The DSP engine is self-contained and provides analog and AES3 digital inputs and outputs in addition to Dante/AES67 audio-over-IP inputs and outputs. The Dante AoIP mechanism allows for direct connection to any other Dante or AES67 device, including numerous third-party devices and Audinate's Dante Virtual Soundcard (DVS) for Windows and macOS.

The Nucleus IP Engine can be integrated into SAS Digital Audio Networks such as the Core64, 32KD (with AoIP upgrade), and other SAS AoIP equipment such as additional Nucleus or RIO Bravo IP engines and Luna mic preamps.

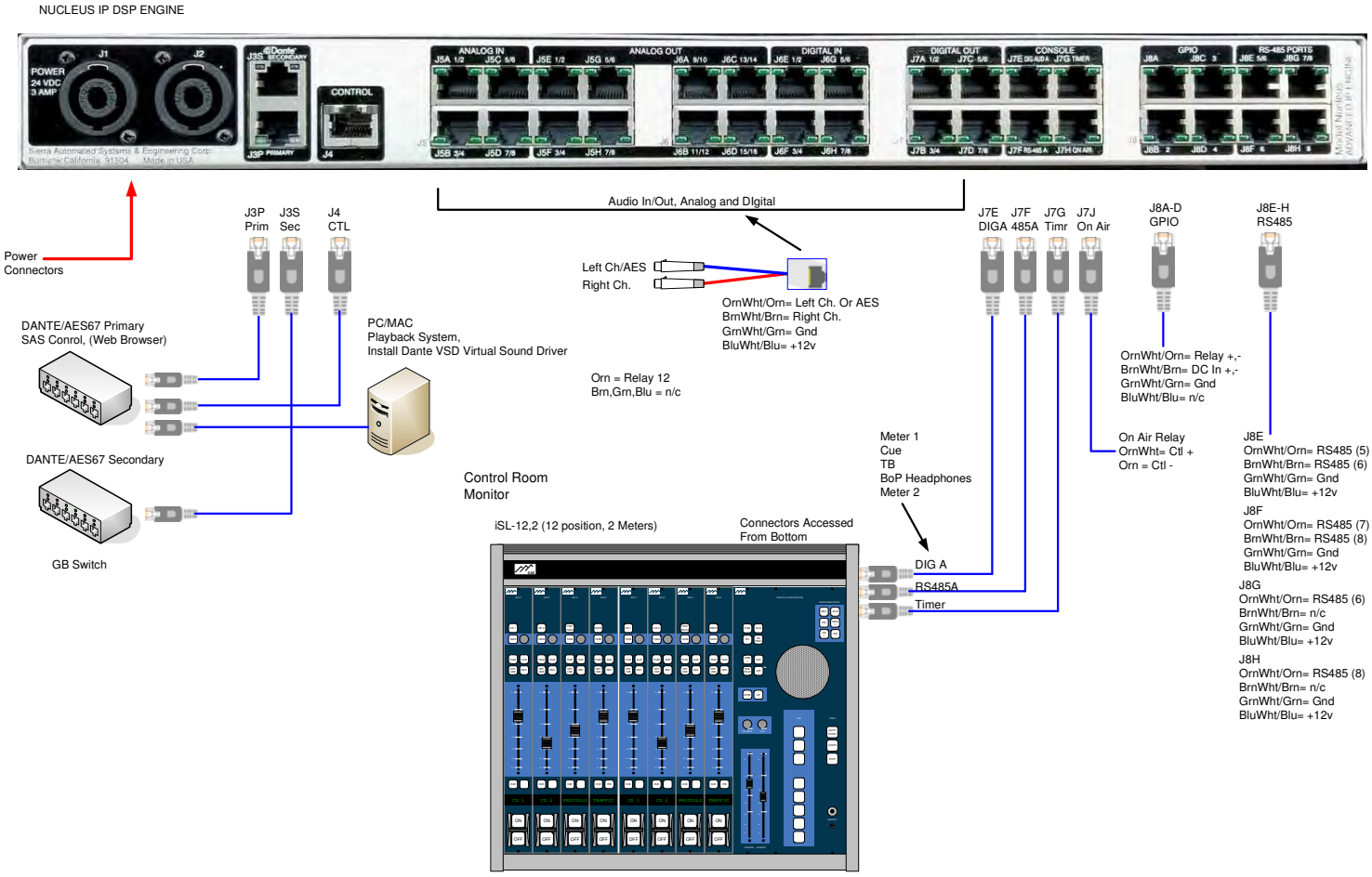


Figure 1: Nucleus IP Engine Overview

Features:

- Fully-integrated DSP mixing IP engine, up to 46 separate mixes (23 stereo or 46 mono)
- 8 analog input channels (4 stereo or 8 mono) and 16 analog output channels (8 stereo or 16 mono)
- 4 AES3 inputs (4 stereo or 8 mono) and 8 AES3 outputs (8 stereo or 16 mono)
- 64 Dante/AES67 AoIP input and output channels (32 stereo or 64 mono)
- Primary and synchronous secondary Dante network ports for redundant AoIP networking
- 6 stereo effects chains with windowed AGC, parametric EQ, and peak limiter
- 12 mono mic processing chains with downward expander, compressor, EQ, and AGC/peak limiter
- Silence and peak detection on audio I/O and mix buses
- HTML5 user interface for control and configuration
- Integrated automation for control room and show control
- Redundant power connectors, low voltage +24 VDC
- 2 direct Cat6 cables for console connections – audio (meters, board op headphones, and cue speaker) and data (faders and buttons)
- 4 additional data ports for guest turrets, router control panels, etc.
- Analog audio outputs and auxiliary data ports include +12VDC power for turrets, control panels, headphone amps, etc.

Front Panel

The Nucleus DSP IP Engine front panel shown in Figure 2 provides access to the System SD Memory module (for system backup) and has the following LED Indicators:

Figure 2: Nucleus Front Panel

V Digital	Lights blue to indicate that the power supply is functioning normally
V Analog	Lights blue to indicate that the power supply is functioning normally
Audio Link	Lights green to indicate that the Dante AoIP interface is functioning normally
Control Link	Lights green to indicate that the Control LAN is connected. Blinks with LAN activity.
Run	Blinks green every ¼ second to indicate that the unit's operating system is responding
Master	Lights green to indicate that the unit is providing master clock to the network
Message	Blinks green when a control message (e.g. a console button press) has been processed
Error	Blinks red when a command could not be processed; check the error log for details

Rear Panel

All installation and connection to ancillary devices for the Nucleus are accomplished using RJ-45 connectors located on the rear panel (see Figure 3). The connector detail is as follows:

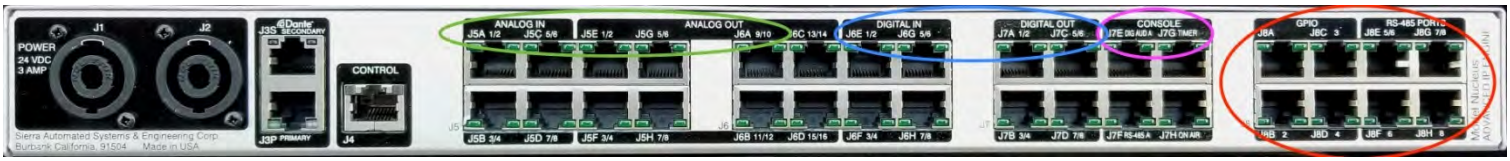


Figure 3: Nucleus Rear Panel Analog Section

J1 & J2 POWER: two connectors for feeding redundant power (+24 VDC) from SAS power supplies.

J3 DANTE PRIMARY & SECONDARY: dual RJ-45 for connection to the Dante/AES67 AoIP network. These ports can be operated in Redundant Network Mode or Switched Network Mode. Always start by using the Primary network interface for Dante AoIP. Sometimes the ports are set for Switched operation from the factory and a short cable from Control J4 to J3S Secondary allows one Cat6 cable connected to J3P Primary to connect both the Dante port and the Control port to the network switch. For more info see NETWORK CONFIGURATION on Page 9.

J4 CONTROL LAN: Connects to your control network. This can be on the same as the AoIP LAN but may be different if you are isolating control and audio. Use a Web browser on this Control LAN to access and configure the Nucleus IP Engine.

J5ANALOG INPUTS: J5A 1,2, **J5B** 3,4, **J5C** 5,6, **J5D** 7,8.
ORG = Odd channel, BRN = Even channel

J5 ANALOG OUTPUTS:J5E 1,2, **J5F** 3,4, **J5G** 5,6, **J5H** 7,8.
ORG = Odd channel, GRN = Ground, BLU = +12VDC, BRN = Even channel

J6 ANALOG OUTPUTS:J6A 9,10, **J6B** 11,12, **J6C** 13,14, **J6D** 15,16.
ORG = Odd channel, GRN = Ground, BLU = +12VDC, BRN = Even channel

J6 DIGITAL INPUTS:J6E 1,2, **J6F** 3,4, **J6G** 5,6, **J6H** 7,8.
ORG = AES3 audio (both channels)

J7 DIGITAL OUTPUTS:J7A 1,2, **J7B** 3,4, **J7C** 5,6, **J7D** 7,8.
ORG = AES3 audio (both channels)

J7 CONSOLE SYSTEM:
J7E Connects to console DIG AUD A port (Meter 1, Meter 2, Board Op Headphones, Cue/Talkback),
J7F Connects to Console RS-485 A port,
J7G Timer Start/Stop/Reset (system GPIO relays 5, 6, and 7 on ORG, GRN, BRN, respectively),
J7H "On-Air" light relay (system GPIO relay 8 on ORG pair)

J8A GPIO:GPIO 1-4. Relay output on ORG pair and opto input on BRN pair.

J8E RS485:RS-485 for SAS router controllers, button panels, intercoms, etc. Includes +12VDC to power these devices.

Getting Started

1. The Nucleus control LAN has a static IP address. The factory-set IP address is printed on a tag attached to the back of the unit. If the IP address must be changed before first boot, remove the SD memory card from the front panel "System Backup" slot and insert it into a standard PC card reader. Using your favorite plain-text editor (e.g. Notepad), open the SYSCFG.TXT file on the SD card. You should see data similar to Figure 4. Use the text editor to set the IP address, subnet mask, and default gateway as required. Then simply save your changes back to the SD card.
2. Re-install the SD card in the slot on the front panel, and be sure it clicks into place.
3. Connect the power cord supplied by SAS to the J1 or J2 connector (or both for dual power supply operation).
4. After 5-10 seconds, the boot process should complete and the front panel Run light will flash.
5. Connect the Nucleus to your IP network using the "CONTROL LAN" (J4) connector.
6. Open your Web browser and type the IP address.

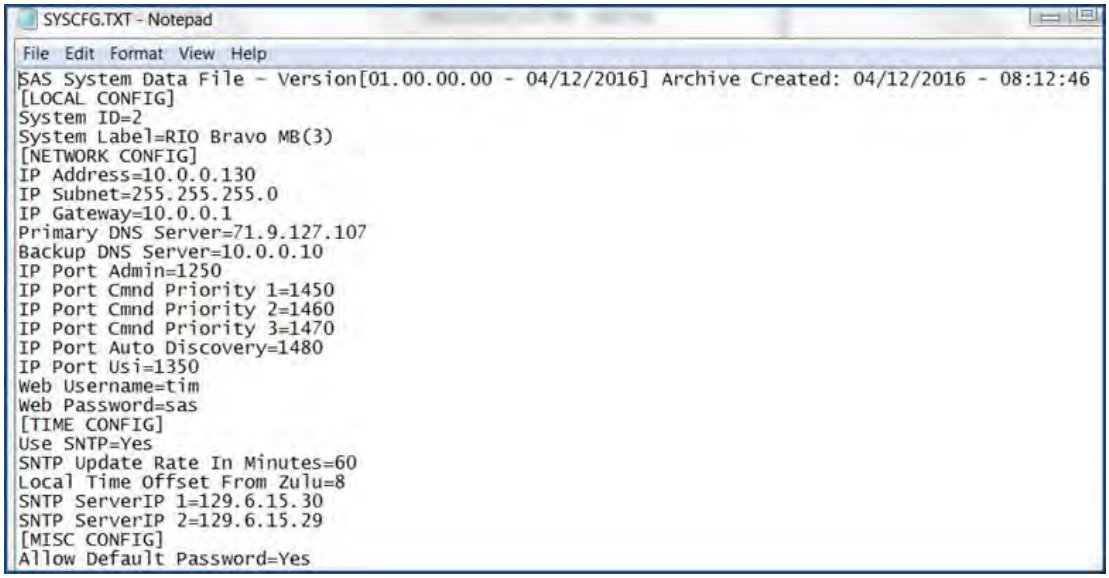


Figure 4: SD Card SYSCFG File

T-Rex Tip: If you can access the engine at its current IP address, you can also view and change it using the Network Configuration Menu described below.

T-Rex Tip 2: All engine configuration data is on the SD memory card in various files. You can back up an engine by copying the contents of the SD card to a folder on a PC, and restore by copying those files back to the SD card. You can even swap SD cards to keep a rotating back up. Just be sure to label them so you don't put the rock station on the classical station and news on the sports talk. More information on system backups will be described later in this manual.

7. Enter Username and Password and click Submit. The default user name and password from the factory is: User: **SASDefault,** Password: **sas** as shown in Figure 5 below. Y*ou can change both Username and Password if needed.*

Figure 5: Web Interface Access

8. The Web GUI will display the landing page, as shown in Figure 6.
9. You can navigate through the various pages using the gray buttons on the left (hover over them to display sub-menus where applicable)

Figure 6: Nucleus Web Server Menu

Network Configuration

Choose the **Network Config** tab to obtain a window similar to Figure 7 below. Here you can change any network-related settings in your system. When all the network configuration values are entered in the fields, press the Send button to push your changes to the system. Hover over each field to display an explanation of what each field requires. If the IP address of the Nucleus is known, it can be viewed and changed from this menu instead of modifying the SYSCFG.TXT file on the SD card.

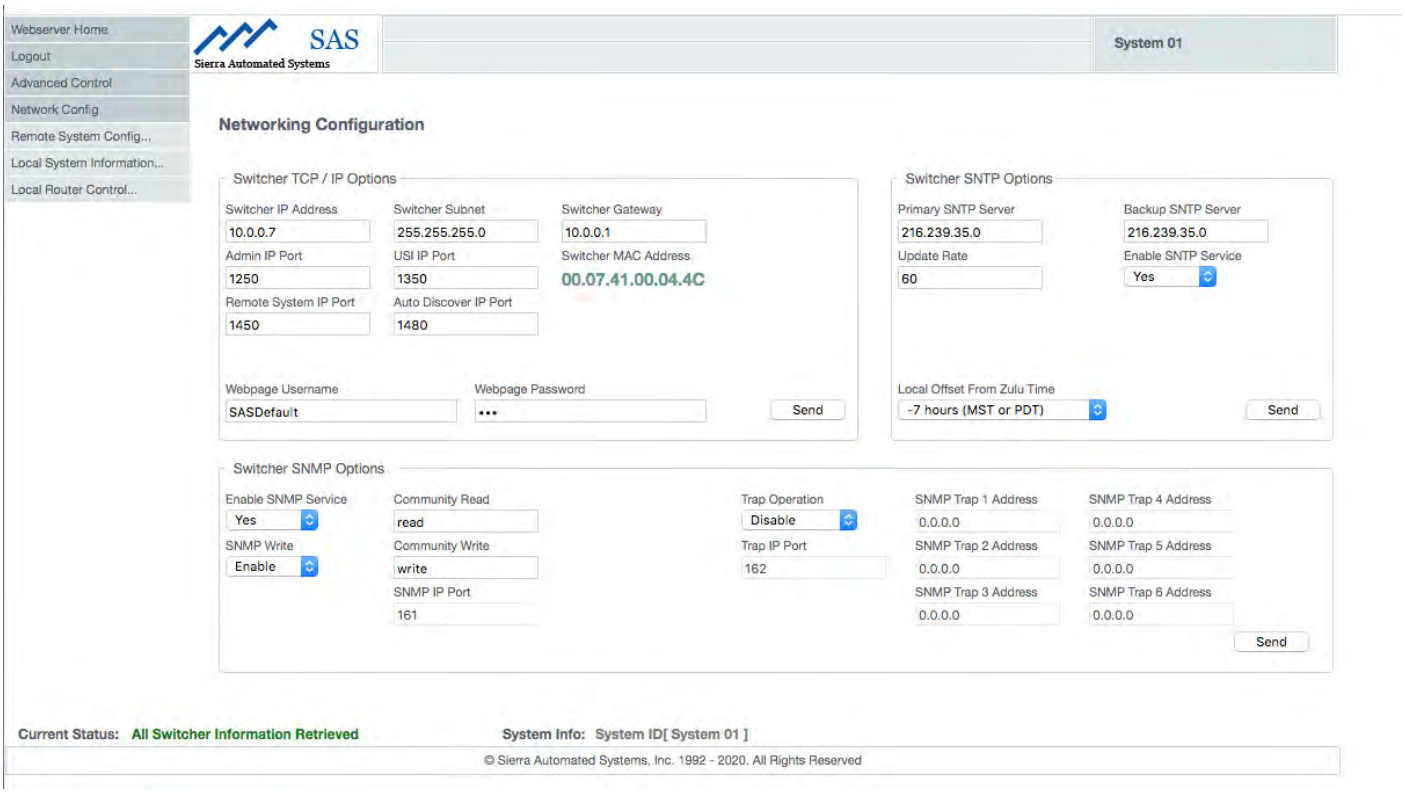


Figure 7: Network Config Screen

T-Rex Tip: This step shows how to set/change the Control LAN IP address of the Engine. While the Control LAN IP address is static, the Dante/AES67 LAN defaults to DHCP and is dynamic. However, the Dante/AES67 ports can be set to Static IP addresses. Use Dante Controller to set up the Dante port addresses and other parameters.

T-Rex Tip 2: The Dante/AES67 ports can operate in Redundant or Switched mode. Please use Dante Controller to set up the Dante ports. Note that AES67 can only use the Primary network. This document may reference technical details on Dante AoIP. For more in depth information on Dante please visit the Audinate website. They have great learning resources available. YouTube is also a great place to find Dante info, and of course you can pick our brains any time at SAS.

T-Rex Tip 3: Use this menu to configure an SNTP server for accurate time-of-day information. This ensures your system log messages have meaningful timestamps, among other things. Also set SNMP parameters if using an SNMP Manager to Monitor and Control the Nucleus. Please contact SAS Engineering for MIB tables (will also be posted on sasaudio.com).

Input Channel Configuration

The DSP engine allows a user to configure input source attributes using simple forms and pull down menus from the Web GUI. There are many attributes that can be assigned to each source. Hover over **Local Router Control** and then select **Input Channel Config** to get a form as shown in Figure 8 below: This form allows you to view the attributes of each source, including label, type (general, microphone, etc.), location, and more in a single screen.

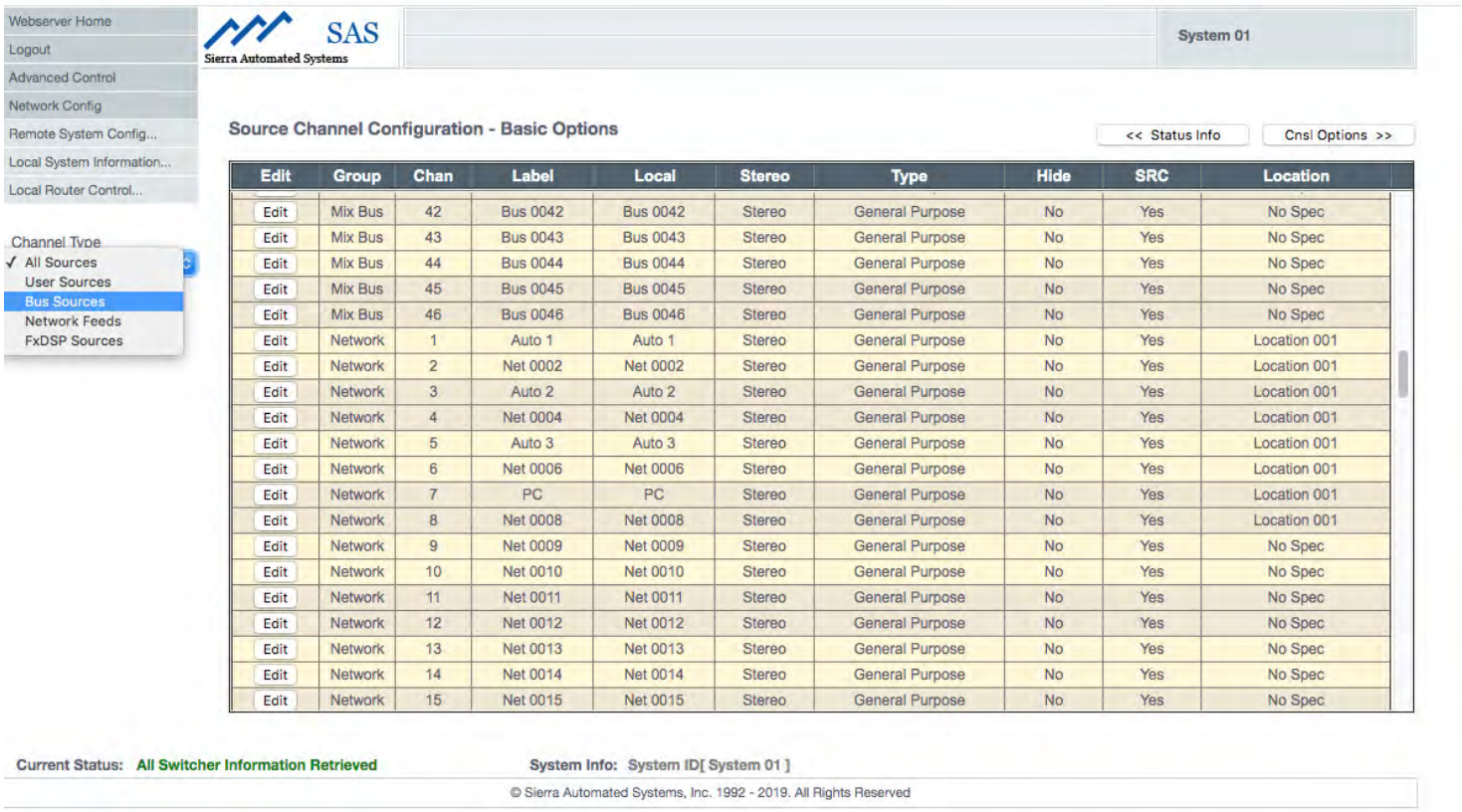


Figure 8: Input Channel Configuration View, Source Category

The Nucleus Engine Inputs are categorized in 4 Groups:

- 16 User (or Fixed): These are physical analog or AES3 inputs on the Nucleus
- 46 Mix Bus Sources: These are the mixes generated inside the Nucleus
- 64 Network: These are sources coming from Dante or AES67 devices
- 64 Effects Sources: These are returns from the Nucleus's internal effects chains

T-Rex Tip: Use the Channel Type menu on the left to help navigate to the category of interest to avoid scrolling around unnecessarily. With all the time you saved by not scrolling, you can treat yourself to a nice fresh donut and coffee. Or a steak. Maybe a rack of ribs and a side salad.

A single page (or form) cannot display all of the various attributes that can be associated with every source so the various groups of attributes are displayed in pages (Note: you *can* see all attributes for any one Source – click Edit. See next page). By clicking either of the two top-right buttons (see blue highlight): you can scroll through each page of attributes to be displayed; these pages are: Basic Options, Console Options, GPI Options, GPO Options, Silence Detect, Peak Detect, and Channel Status Info. The following diagram, Figure 9, shows the input configuration attributes for Console Options page. These are view-only forms; any setting of attribute values must be accomplished by clicking the Edit button for a specific channel.

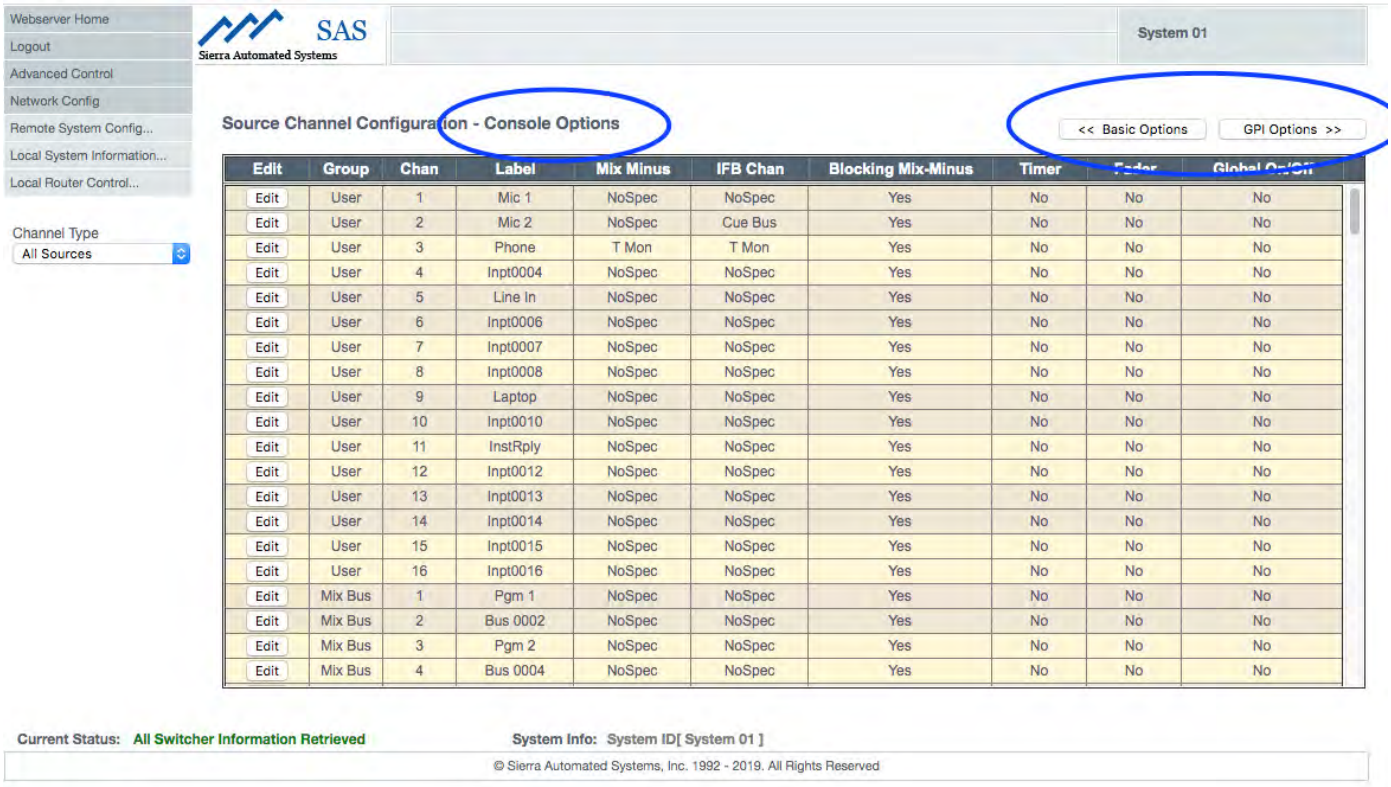


Figure 9: Input Channel Configuration View, Console Options Page

T-Rex Tip: Use the Page Scrolling buttons to help navigate to the Source Channel Attributes to view.

T-Rex Tip 2: Click Edit to go to the Edit Attributes screen from any page. Check out the next section that details all the information you can store for each channel.

Editing Input Channel Attributes

Attributes for each source can be configured by clicking the Edit button of the input channel. A new window will pop up as shown in Figure 10. This screen is used to set all of the attributes that can be associated with each input. Click Save and all of the fields that were entered will be stored in the engine.

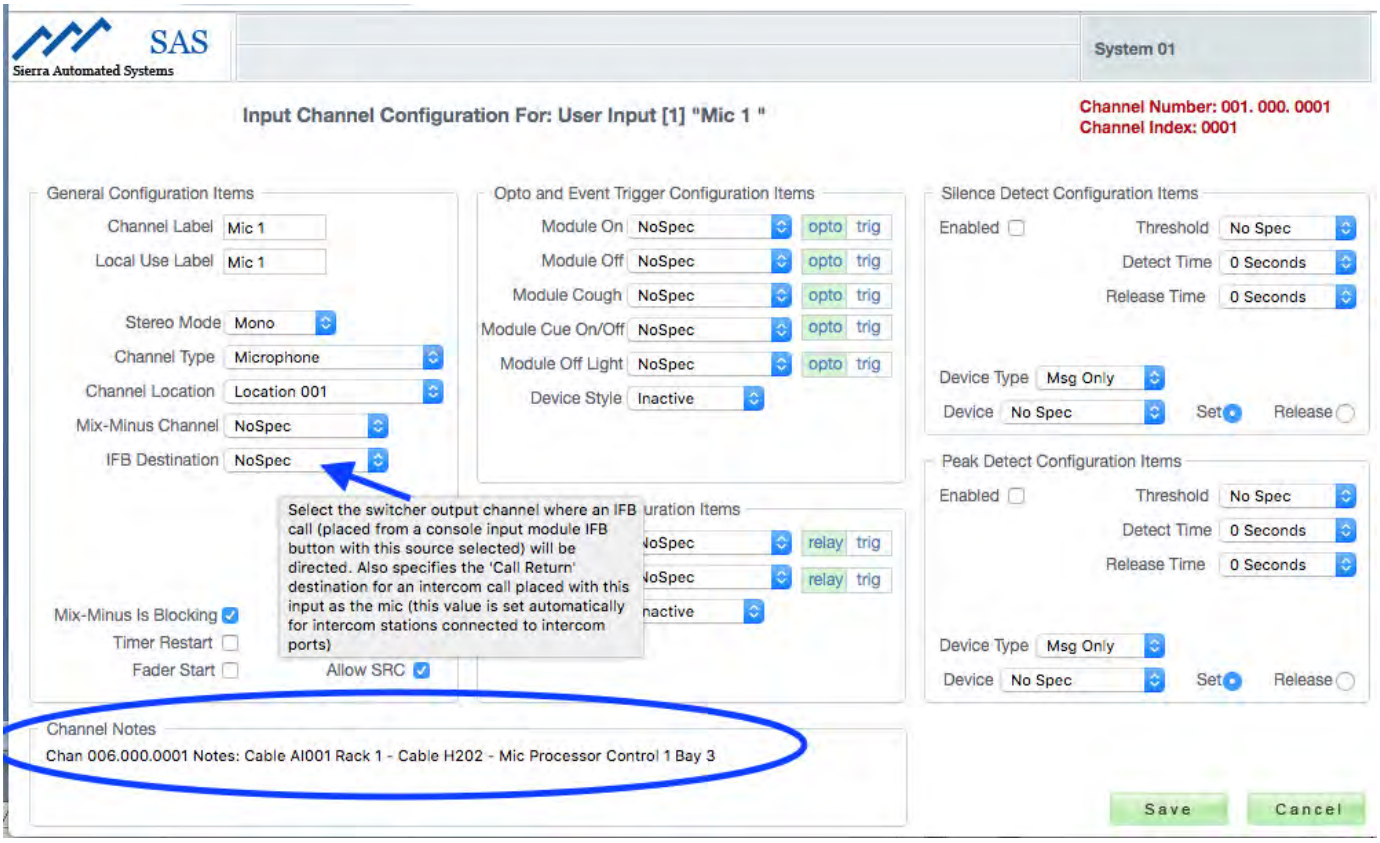


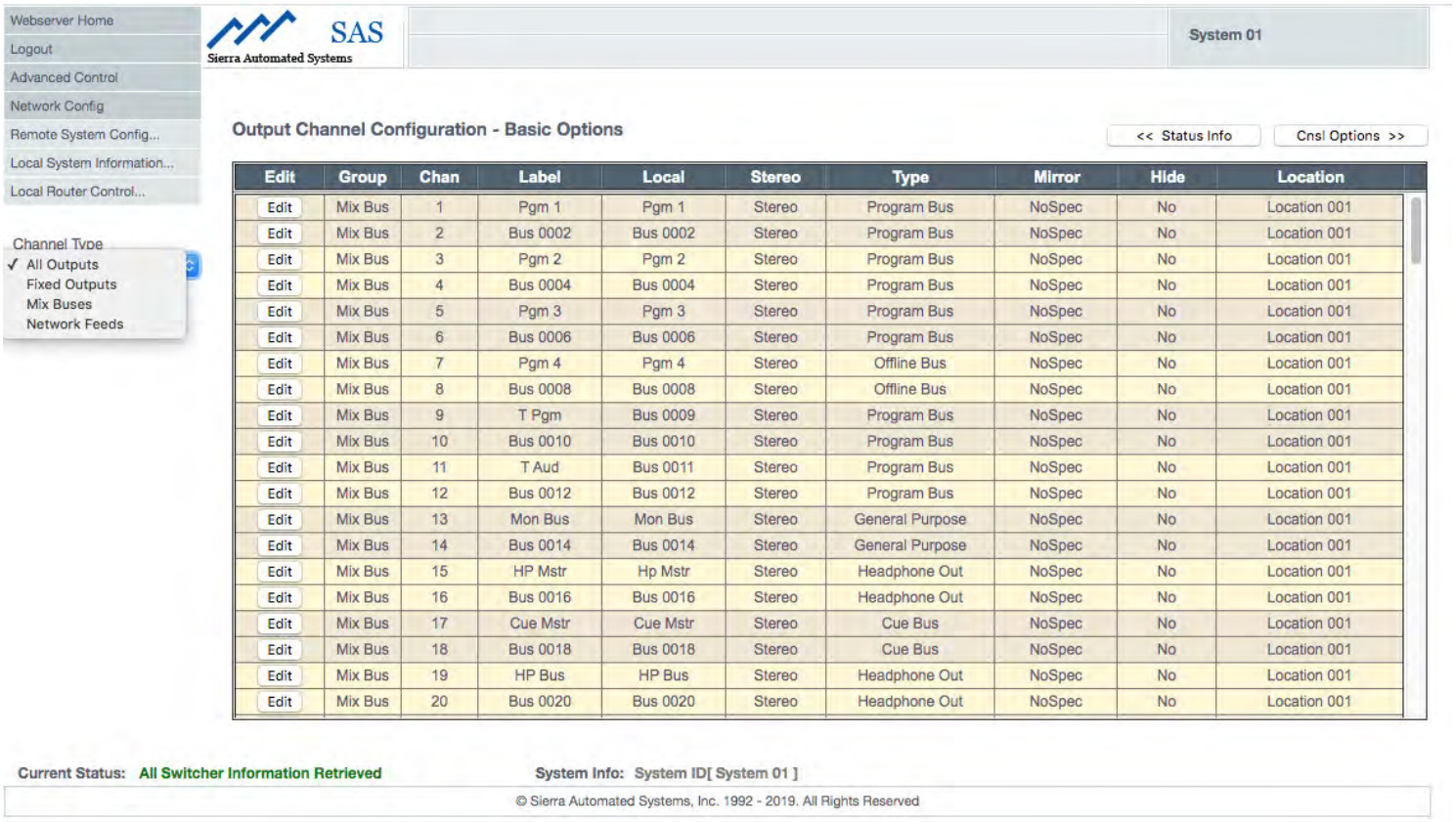
Figure 10: Edit Source Attributes Page

T-Rex Tip: Use the mouse pointer to *hover* over any programmable field to view a tool-tip to explain the attribute setting in more detail. There are helpful hints abound, try it out!

T-Rex Tip 2: Use the Channel Notes to help keep track of wiring runs and lists, to display even the external information related to that source. No more crumpled legal pads with coffee stained notes on what channels do what and go where!

Output Channel Configuration

The DSP engine allows a user to configure output attributes similar to those of the inputs, using simple forms and pages to view the attributes of each output. Hover over **Local Router Control** and then select **Output Channel Config** to get the form shown in Figure 11 below: This form allows you to view the attributes of each output such as: label, type (general, speaker, program bus, etc.), location, etc. in a single screen.



Edit	Group	Chan	Label	Local	Stereo	Type	Mirror	Hide	Location
Edit	Mix Bus	1	Pgm 1	Pgm 1	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	2	Bus 0002	Bus 0002	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	3	Pgm 2	Pgm 2	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	4	Bus 0004	Bus 0004	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	5	Pgm 3	Pgm 3	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	6	Bus 0006	Bus 0006	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	7	Pgm 4	Pgm 4	Stereo	Offline Bus	NoSpec	No	Location 001
Edit	Mix Bus	8	Bus 0008	Bus 0008	Stereo	Offline Bus	NoSpec	No	Location 001
Edit	Mix Bus	9	T Pgm	Bus 0009	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	10	Bus 0010	Bus 0010	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	11	T Aud	Bus 0011	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	12	Bus 0012	Bus 0012	Stereo	Program Bus	NoSpec	No	Location 001
Edit	Mix Bus	13	Mon Bus	Mon Bus	Stereo	General Purpose	NoSpec	No	Location 001
Edit	Mix Bus	14	Bus 0014	Bus 0014	Stereo	General Purpose	NoSpec	No	Location 001
Edit	Mix Bus	15	HP Mstr	Hp Mstr	Stereo	Headphone Out	NoSpec	No	Location 001
Edit	Mix Bus	16	Bus 0016	Bus 0016	Stereo	Headphone Out	NoSpec	No	Location 001
Edit	Mix Bus	17	Cue Mstr	Cue Mstr	Stereo	Cue Bus	NoSpec	No	Location 001
Edit	Mix Bus	18	Bus 0018	Bus 0018	Stereo	Cue Bus	NoSpec	No	Location 001
Edit	Mix Bus	19	HP Bus	HP Bus	Stereo	Headphone Out	NoSpec	No	Location 001
Edit	Mix Bus	20	Bus 0020	Bus 0020	Stereo	Headphone Out	NoSpec	No	Location 001

Figure 11: Output Channel Configuration View, Output Category

Outputs are categorized in 3 groups,

46 Mix Bus outputs: These are used to do all mixing within the engine.
32 Fixed Output (or User Outputs): These are the physical analog and AES3 outputs on the engine. Some of these are used to feed the console meters, cue speaker, headphones, etc.
64 Network Feeds: These are outputs to Dante and AES67 devices.
64 Sends to Effects: These outputs are used to feed the engine's onboard effects chains.

T-Rex Tip: Use the Channel Type to help navigate to the category of interest to avoid scrolling around unnecessarily. Because that could be habit forming and you'll never get the rest of your Nucleus set up.

Similar to the Input Config viewing screens a single table cannot display all of the various attributes that can be associated with every output, so the attributes are broken into different views. By clicking either of the two top-right buttons (see blue highlight), you can scroll through each page of attributes to be displayed. These pages are: Basic Options, Console Options, Silence Detect, Peak Detect, and Channel Status Info. The following diagram shows the output configuration attributes for Basic Options page. These are view-only forms; any setting of values must be accomplished by clicking the Edit Button for a specific channel. (Clicking Edit does allow you to see *all* attributes for the one selected Output.)

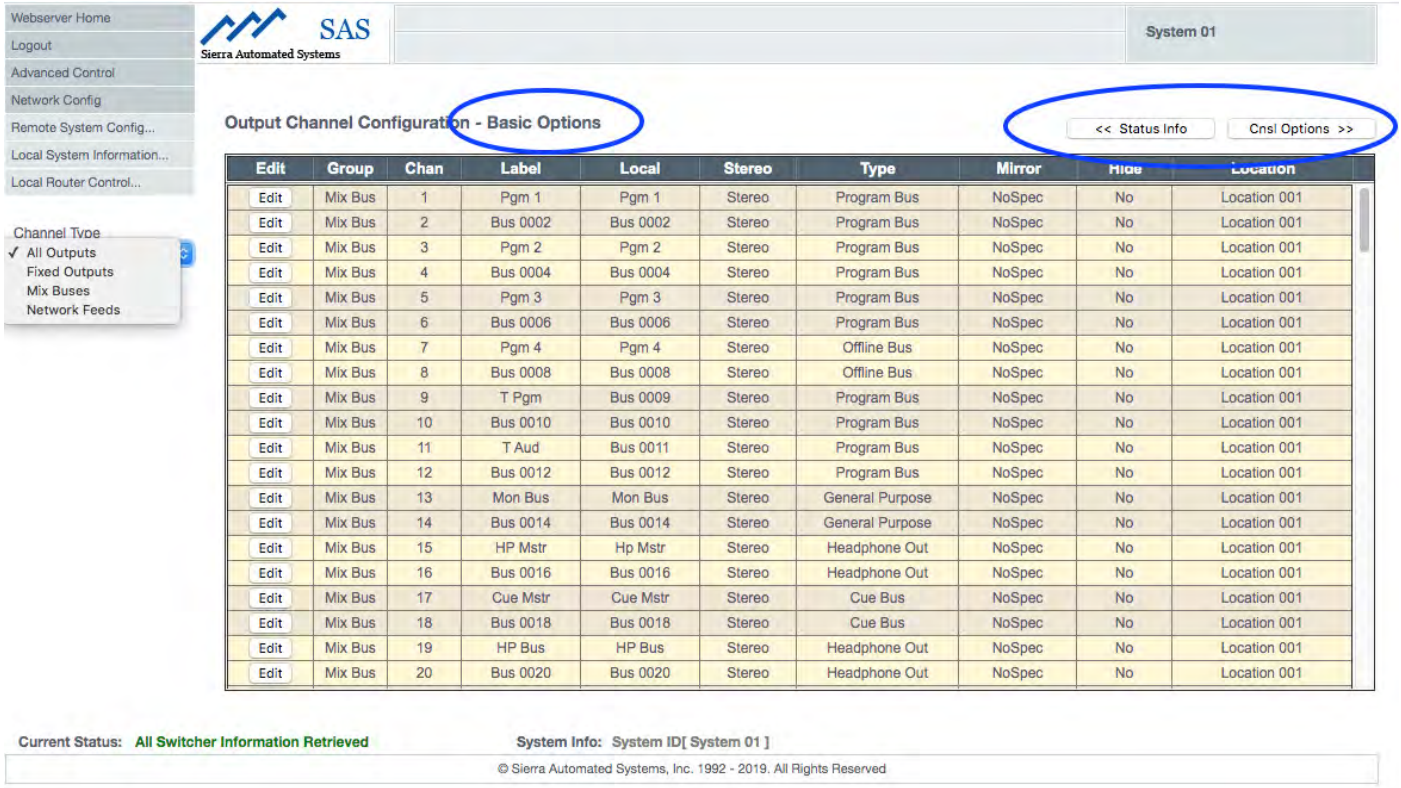


Figure 12: Output Channel Configuration View Basic Options Page

Editing Output Channel Attributes

Attributes for each Output can be configured by clicking the Edit button; a new window will pop up as shown in Figure 13. Hover over any field to display information on what that field does. Click Save and all of the fields that were entered will be stored in the Nucleus DSP Engine.

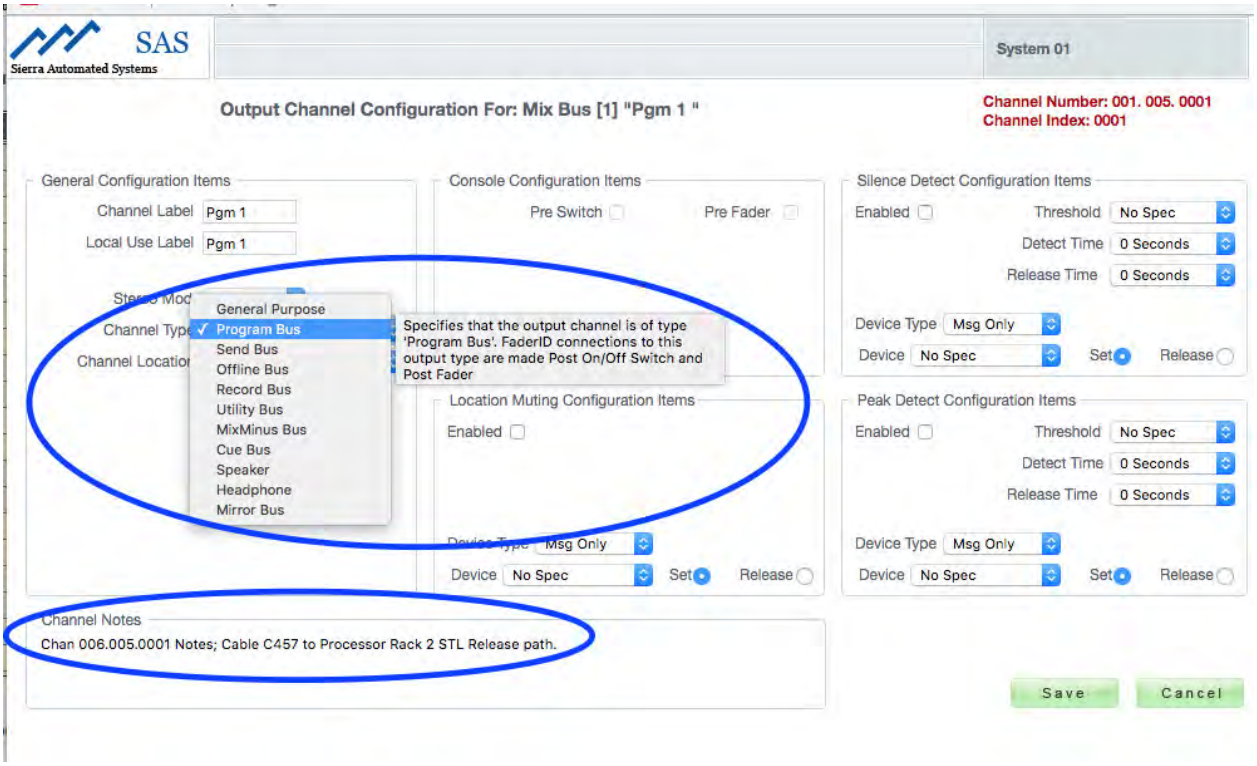


Figure 13: Edit Output Channel Attributes Page

T-Rex Tip: Use the mouse pointer to *hover* over any programmable field to view a tool-tip to explain the attribute setting in more detail. There are helpful hints abound, try it out!

T-Rex Tip 2: Use the Channel Notes to help keep track of wiring runs and lists, to display even the external information related to that source. No more crumpled legal pads with coffee stained notes on what channels do what and go where!

Crosspoint Map

The Nucleus DSP engine can operate as a console system, route sources to destinations, and distribute a single source to many outputs. A quick, "at a glance" picture of the system mapping can be viewed by hovering over **Local Router Control** and selecting **Crosspoint Map**. The screen in Figure 14 will appear. A tool-tip will appear when the mouse is hovered over any of the fields. Using the "Chan Block" fields, the map can be filtered by categories of inputs and outputs, similar to the input and output configuration pages.

Each cell on the crosspoint map represents a possible connection from an input to an output. Dots of various colors appear in these cells to indicate what connections have been made:

	Normal crosspoint
	Crosspoint with fader ID (created by a console module)
	High priority (IFB) crosspoint
	Inhibit (crosspoints are prohibited from being made in this cell)

Each dot represents one channel. Stereo connections are indicated by multiple dots in sequence.

To create or modify a crosspoint, left-click on the source-to-destination square to create a connection based on the settings of the "Crosspoint Command Options" fields at the left, or right-click on the square and choose the connection type from the pull down list. For stereo routes, make your changes to the left channel, and the right channel will follow automatically.

The Nucleus also supports a higher priority "IFB/Intercom" connection. This mode is used for talkback and similar functionality where a connection should temporarily interrupt any existing connections to an output and restore the output to its previous state when the high-priority connection is removed.

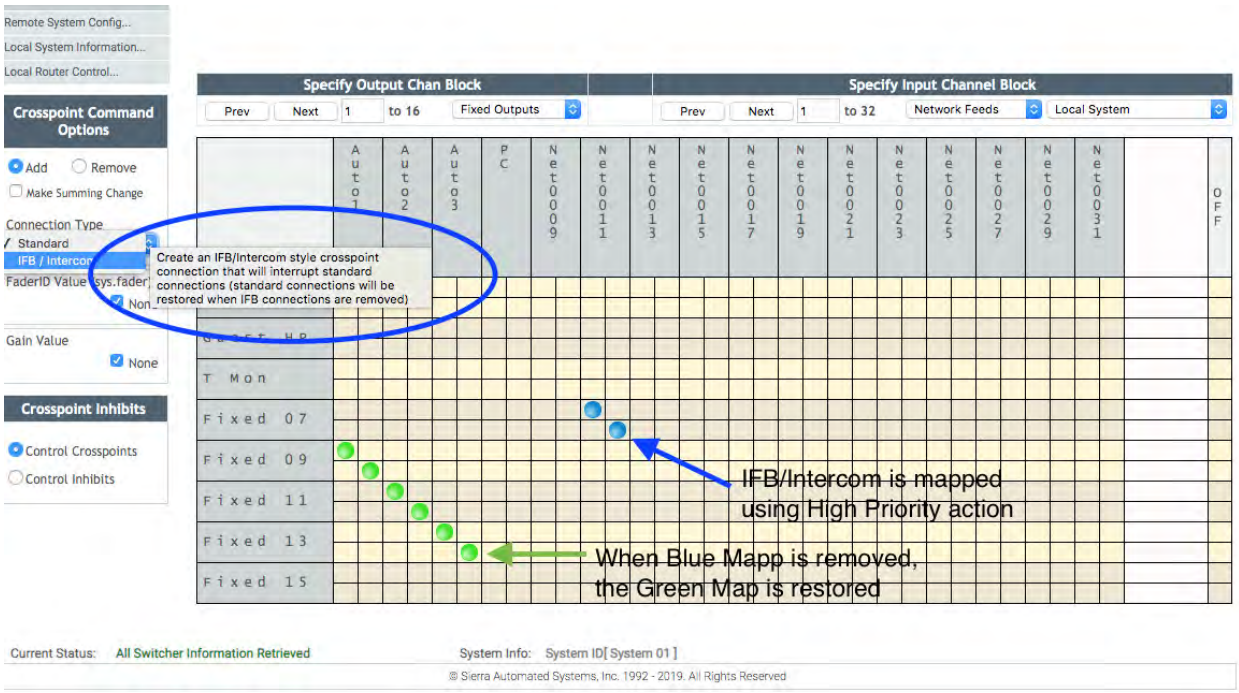


Figure 14: System Crosspoint Map, Unity Gain Green and Blue Mapping

T-Rex Tip: While the IFB priority level is mainly intended for talkback, it can be used for many other things as well. Use it to bypass part of an airchain during maintenance, override an automation system during a breaking news event, or even side-chain your EAS with the help of automation events (more on those later). Any normal crosspoint commands received while an IFB crosspoint is present will be processed in the background, but they won't take effect until the IFB crosspoint is removed.

Mix Buses, Summing, and Gain

Certain outputs of the system can have multiple sources "summed" onto them at once, creating a mix of those sources at the output. This is accomplished by using the "Make Summing Change" option under "Crosspoint Command Options", or using the "Sum On" function in the right-click menu. Fixed outputs can accommodate up to 2 sources (this is typically used to convert a stereo source to mono), while Mix Bus outputs can accommodate up to 64 sources at once.

You can find out what sources are currently connected to a given output by left-clicking the output name and choosing "Get Info". Likewise, you can find every output that's using a particular source by left-clicking the input name and choosing "Get Info" there.

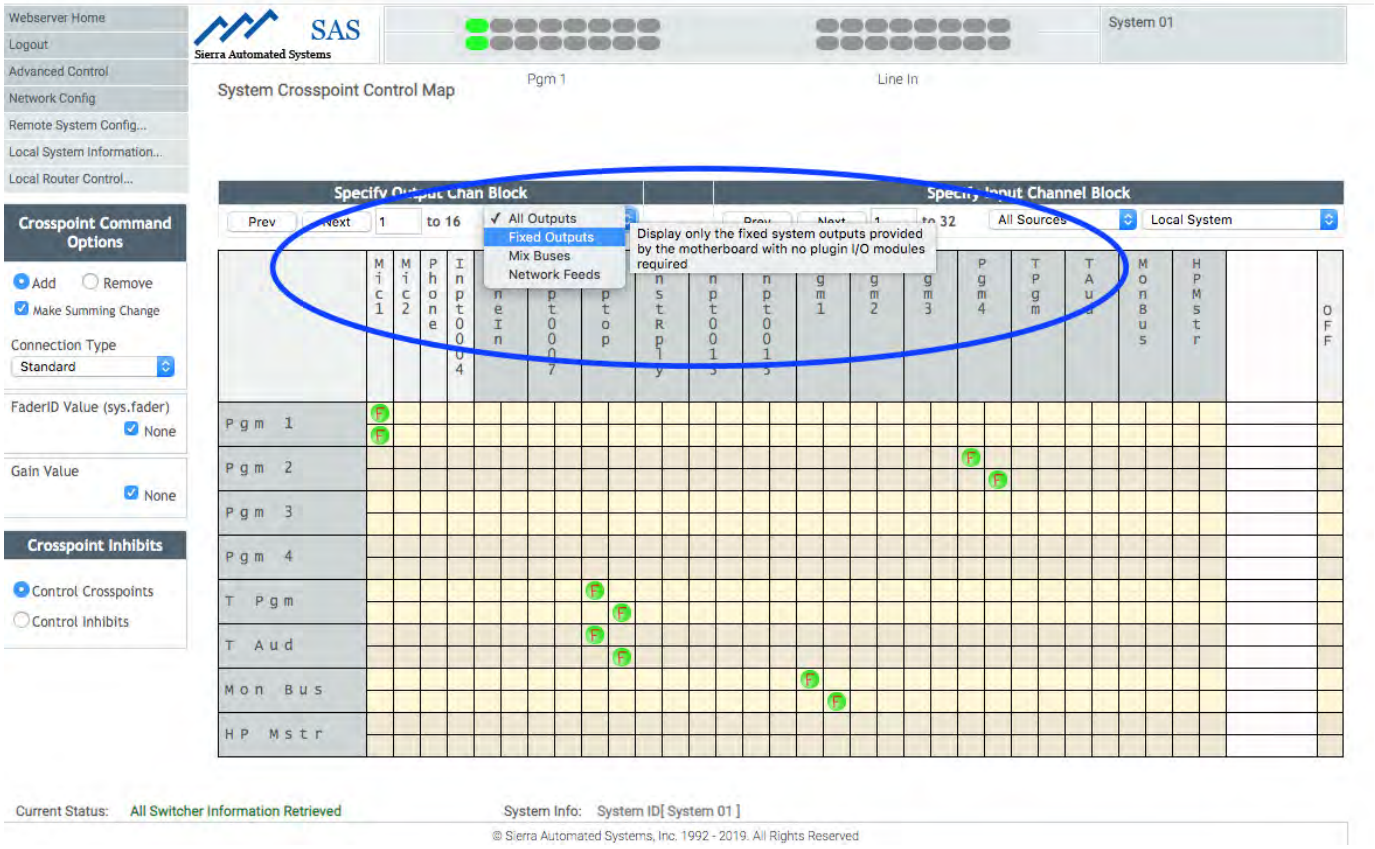


Figure 15 DSP Mix Bus Crosspoint Map

The crosspoint map also offers access to gain adjustments at several points in the audio routing path. These can be accessed by left-clicking on a source name, destination name, or crosspoint and clicking "Adjust Gain" (this option will be grayed out if it's not available in a particular context – for example, the gain of an individual crosspoint can only be changed on Mix Bus outputs).

T-Rex Tip: On any input name, output name, or crosspoint, you can also access the "Get Info" function via Ctrl+Click, and "Adjust Gain" via Alt+Click. Boom!

T-Rex Tip 2: Need to sum more inputs than your output can handle? Simply find an available mix bus, sum your inputs to that, then route that mix bus to your output!

Onboard Web GUI Metering

The Crosspoint map also displays 2 stereo audio meters. These meters are fed from the last four mix buses (two stereo pairs) in the system. You can choose what sources to monitor on the meters by routing them to these mix buses on the crosspoint map. Additionally, you can route a source to the right-hand meter by left-clicking on its name and choosing "Route to Meter".

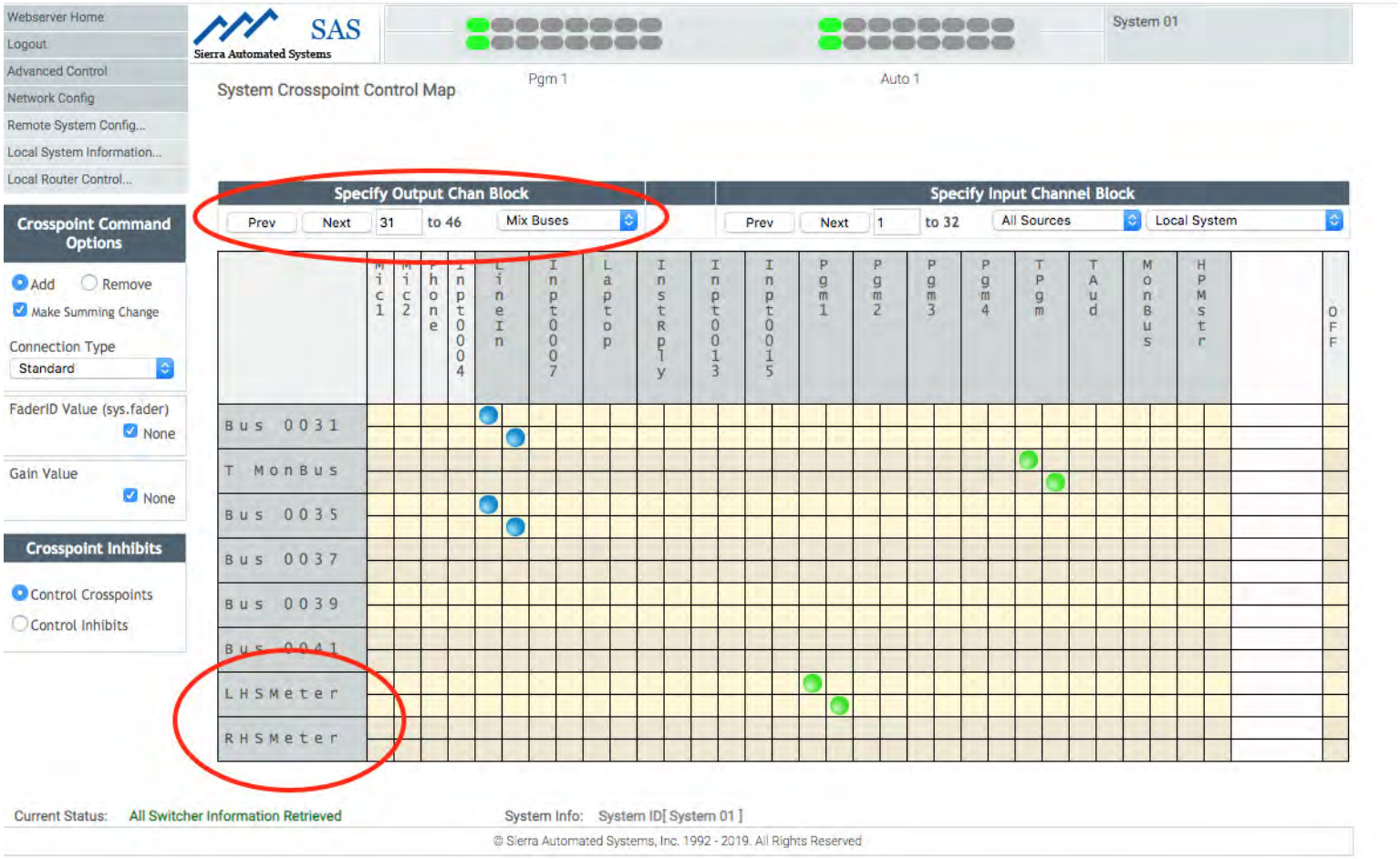


Figure 16: Crosspoint Map Web GUI Meter Outputs

T-Rex Tip: The Web GUI meter mix bus outputs are named by default from the SAS factory. Change the name to suit your need, but remember that the last 2 stereo mix bus pairs always feed the Web GUI meters. And those meters are great for troubleshooting an input. Don't be shy, select your sources to them and see what you're hearing!

GPIO

The Nucleus contains 3 types of general-purpose inputs and outputs (GPIO, or logic I/O):

- 4 optos (logic inputs)
- 8 relays ("dry closure" logic outputs) – 4 for general use, and 4 more to support console functions (timer and on-air light)
- 1024 event triggers (logic states represented in memory only, without physical I/O)

More optos and relays can be added by connecting a GPIO expansion unit (such as the SAS GPI-1600) to an available data port.

Any of these GPIOs may be used to trigger various actions in the Nucleus (and in the case of relays, allow the Nucleus to trigger actions on external devices). Many of these actions can be mapped using the options within the Input and Output Channel Configuration pages (e.g. remote start, silence detection tally, etc.). Others can be mapped using the System Automation feature (described later in this manual).

Like with audio I/O, GPIOs can be assigned labels. This is done by hovering over **Local Router Control** and selecting **Opto Alpha Config**, **Relay Alpha Config**, or **Event Trigger Alpha Config**.

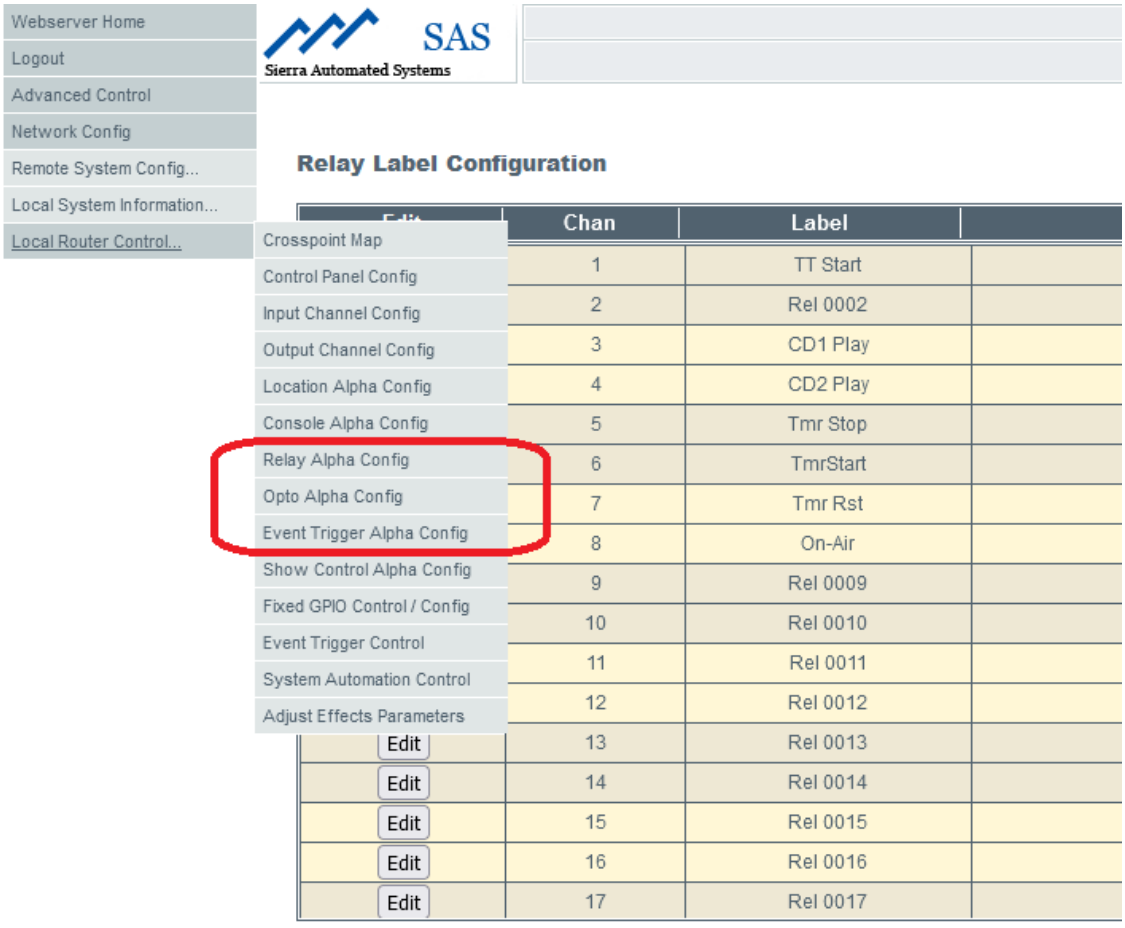


Figure 17: GPIO alpha configuration

GPIOs may be configured and monitored from the **Fixed GPIO Control/Config** and **Event Trigger Control** pages under **Local Router Control**.

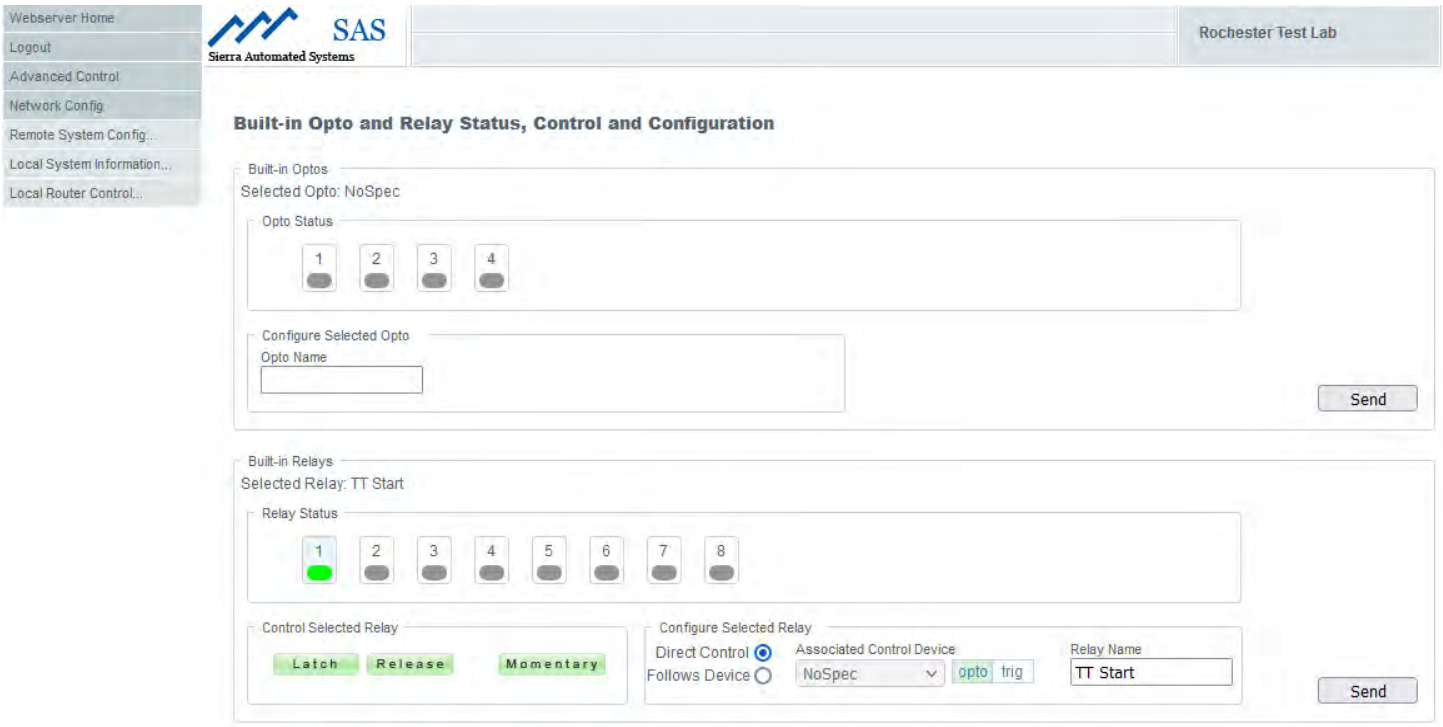


Figure 18: Fixed GPIO Control / Config

These pages function similarly for optos, relays, and event triggers. The dot below each GPIO channel number turns green if that GPIO is in the "on" state. For relays and triggers, you can also use the buttons at the bottom to manually latch and release the GPIOs for testing purposes (click the box around the channel number to select the one you want to control).

T-Rex Tip: You can also set the GPIO channels' labels from this screen, if you prefer to do everything in one place. Click the channel number, enter the name in the box, and click Send. Easy peasy!

T-Rex Tip 2: Relays can also be "linked" to an opto or event trigger, in cases where you want the relay state to always follow an associated logic input. Select the relay number you want, and under "Configure Selected Relay", choose "Follows Device" and select the opto or trigger you want to follow. Then click Send, and you're off to the races!

Setting Up DSP Effects

The Nucleus includes several different effects chains in its onboard DSP:

- 12 mono mic processing chains, each containing the following effects:
  - Mono expander/compressor with high-pass filter
  - High and low shelving EQ with 2 parametric mid bands
  - Mono automatic gain control (AGC) with adjustable peak limiting
- 6 stereo processing chains, each containing:
  - High and low shelving EQ with 2 parametric mid bands
  - Low-complexity stereo AGC with adjustable peak limiting
- 1 tone generator with adjustable frequency and level

Each of these chains is fed by one of the "Send to Effects" type outputs, and returns to the system as one of the "FxDSP Sources" type inputs. These function like any other audio I/O in the system: they can be named and configured as to how they behave via the Input Channel Configuration and Output Channel Configuration pages, and can be routed via the Crosspoint Map page.

To add effects to a source, use the crosspoint map to route that source into an available effects send. Then, simply select the associated effects return source wherever you would otherwise select the actual source. Now you can tweak the effects to your liking by hovering over **Local Router Control** and selecting **Adjust Effects Parameters**...

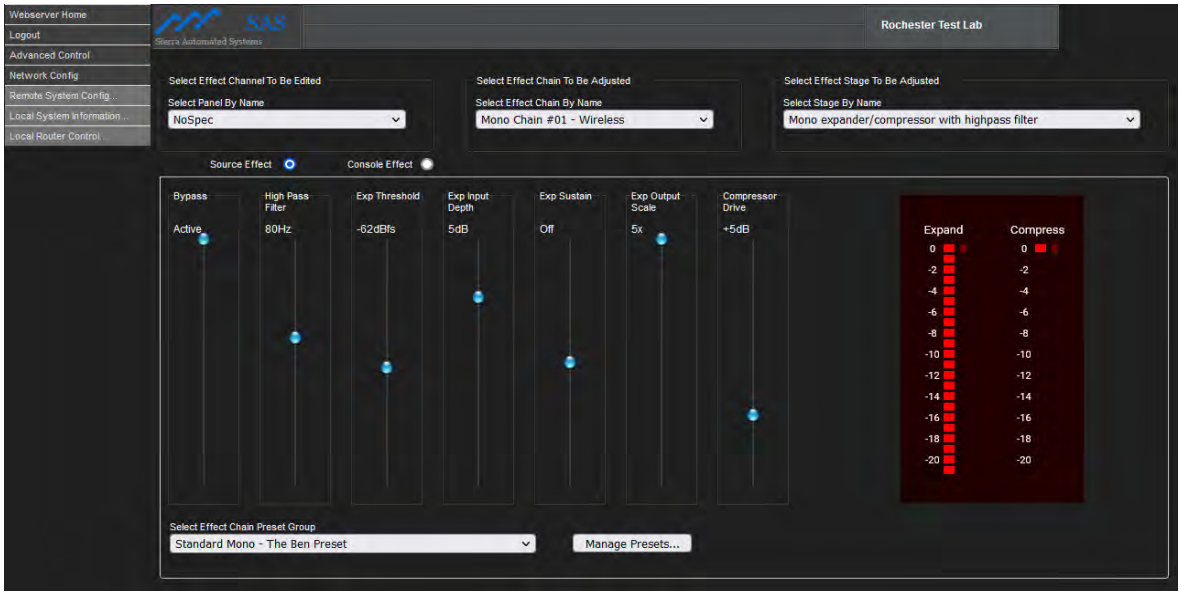


Figure 19: Adjust Effects Parameters

Using the drop-downs at the top, choose the effects chain to modify from the center box, then choose the individual effect to adjust from the right-hand box.

T-Rex Tip: Once you've set up an effects chain the way you want it, you can save your settings into a preset using the controls at the bottom of the page. Then you can recall that preset on other effects chains to quickly duplicate your settings. Now you can set up a talk studio full of mic processing with a fraction of the tedious labor!

System Automation

The Nucleus includes a built-in automation engine that allows for the creation of arbitrary "if this, then that" actions for the system to execute. To access this functionality, hover over **Local Router Control** and select **System Automation Control**.

Figure 20: System Automation Control landing page

To create an event, click "Create New Event" in the lower-left corner. On the window that appears, you will be presented with several tabs:

- **Basic Options**: Allows you to name your event (for your own reference), set whether it's enabled or not, and set what days of the week it should run on
- **Event Trigger**: Defines what event in the system (e.g. GPIO change, crosspoint change, etc.) should cause your automation event to run
- **Event Actions**: Defines what should happen when your automation event is executed. Fill out the fields at the top and click the **orange** "Save" button to add your action to the list. You can repeat this to add multiple actions to your event (up to 8).
- **Event Conditionals**: Defines additional conditions that must be met at the time the event is triggered in order for your event to execute. Like with the event actions, fill out the fields and click the **orange** "Save" button to add a conditional. If you don't need any pre-conditions for your event, simply leave this page blank.

Once you've filled everything out, click the **green** "Save" button to add your event to the system.

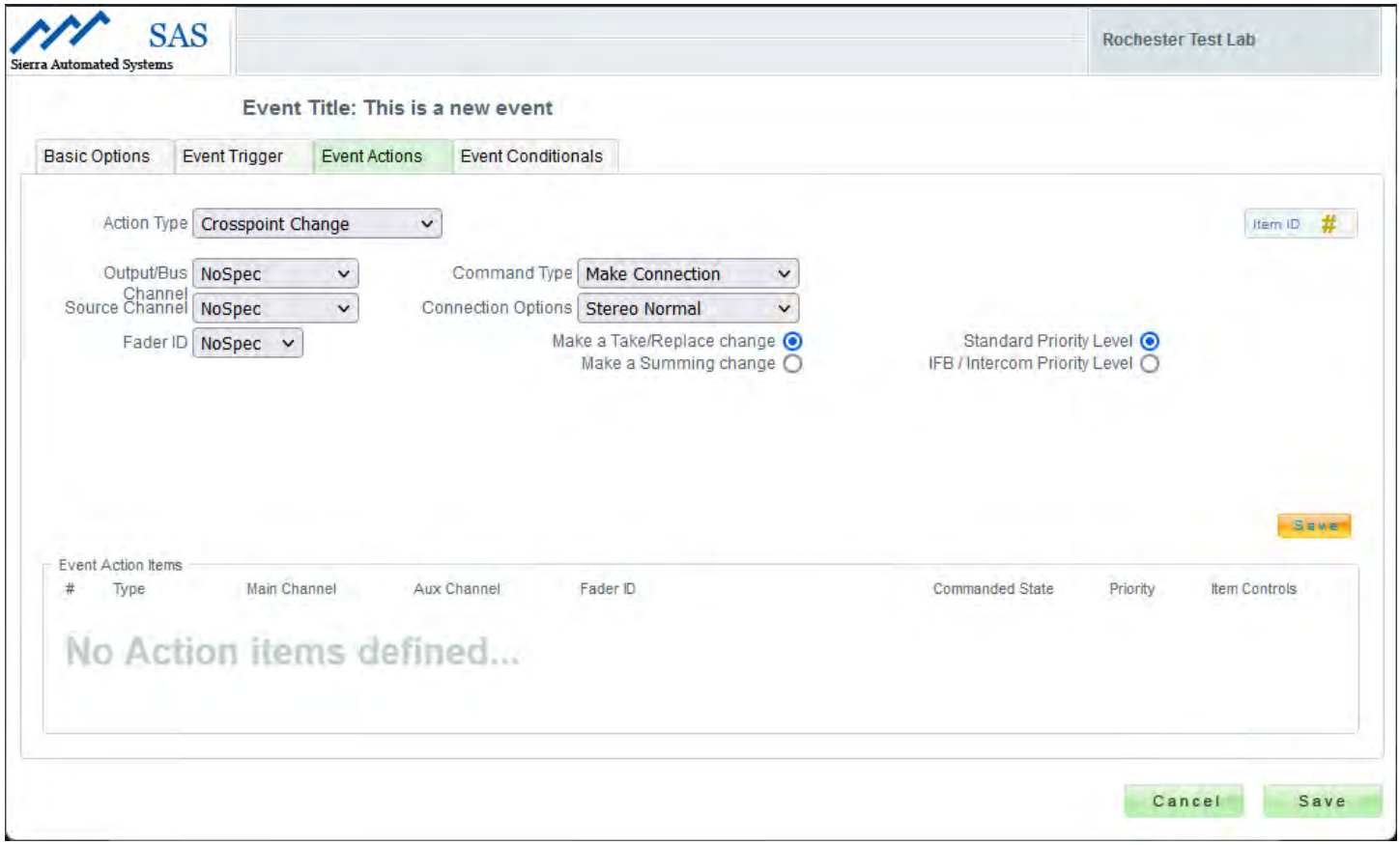


Figure 21: Automation event editor

T-Rex Tip: Of all the unique features we've packed into the Nucleus, System Automation may well be the single most powerful one. Use it to build macros for switching origination between studios, restrict the propagation of satellite closures to your playout system based on the presence of certain audio routes, or allow a single EAS unit to route itself to any of several stations just by producing opto closures. These ideas are only the tip of the iceberg; don't be afraid to be creative!

Typical System Setup and Overview

Figure 22 shows a detail of a multi-engine IP console system. Using SAS RIO Bravo and Nucleus IP DSP engines, 3 control rooms are fully networked to each other and can be optionally networked into an SAS Core64 high-density digital audio network, or into a legacy SAS 32KD router with Dante AoIP upgrade.

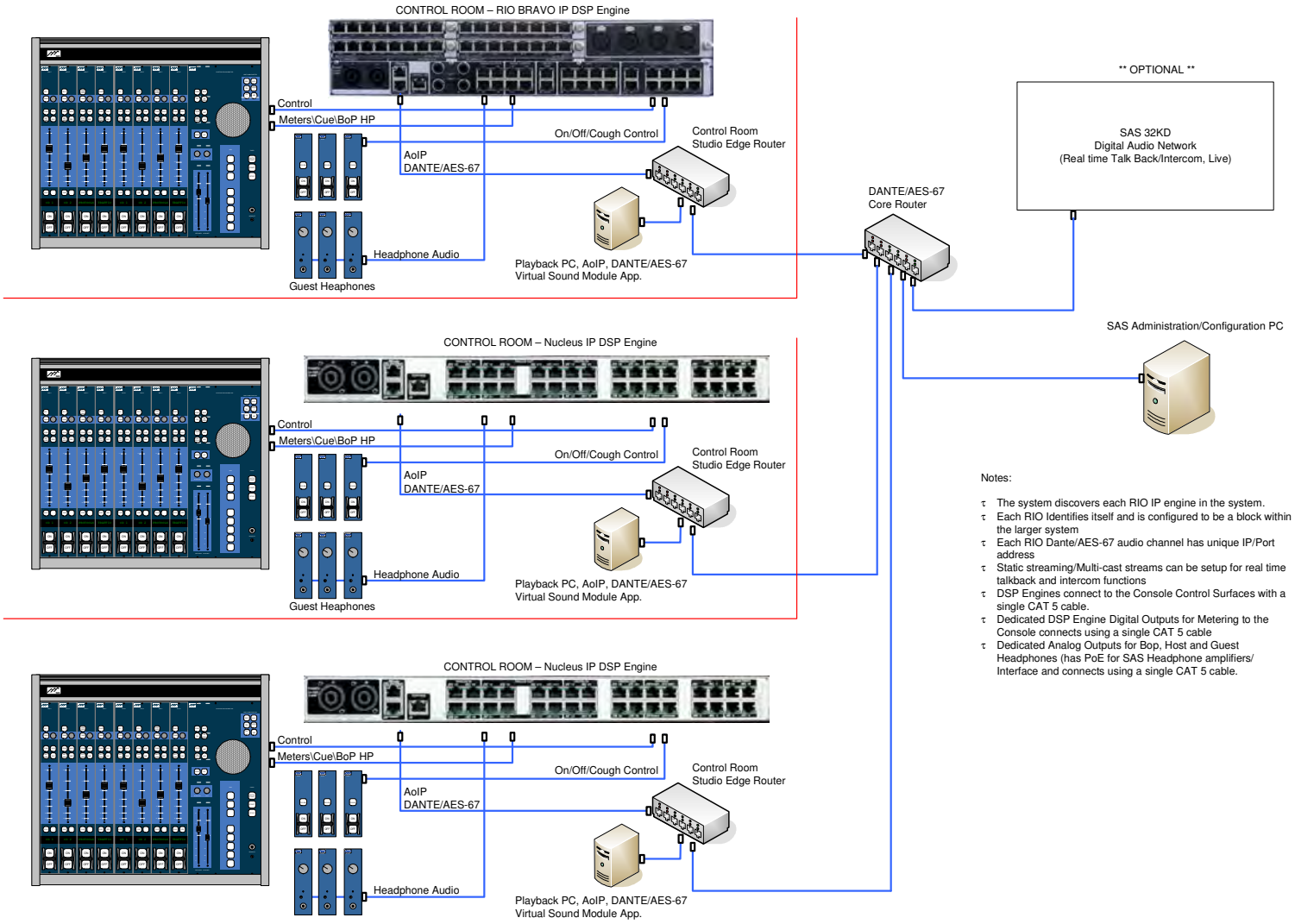


Figure 22: Typical IP Console System Overview

Connecting SAS Guest Headphone Devices

Figure 23 shows wiring detail for adding additional SAS headphone amplifiers to the system. These come in several mounting arrangements (under-counter, desktop turret, or cut-in turret), and can be used to feed headphones at guest positions in your studio. Similar wiring arrangements can also be used to feed turret-mounted meters, cue speakers, or timecode readers.

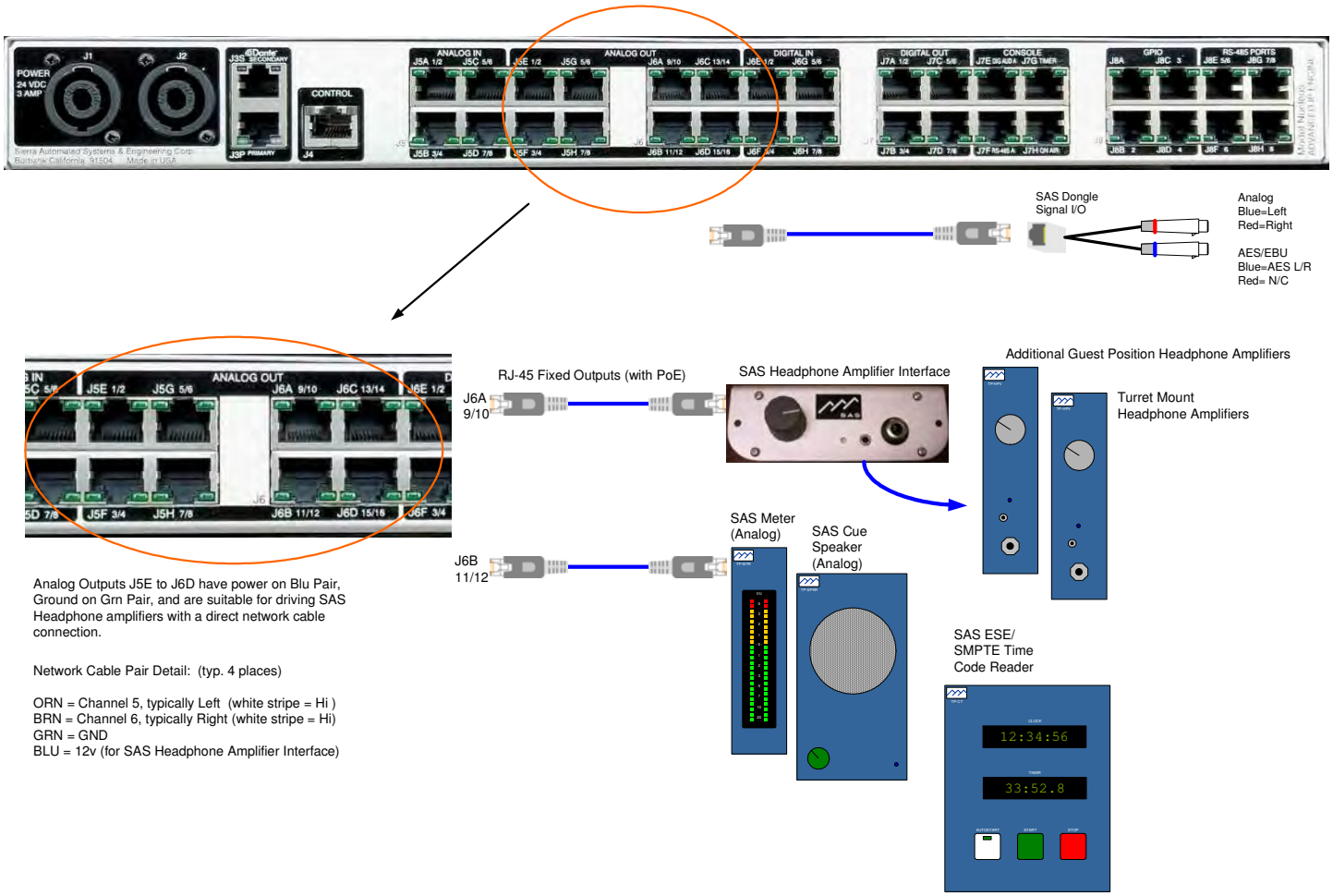


Figure 23: SAS Guest Headphone Amplifier and Analog Output Wiring

Connecting SAS Remote and Ancillary Function Controllers

Figure 24 shows wiring detail to rack-mount or turret-mount ancillary function controllers, such as guest microphone On/Off/Cough controls, programmable button panels, and router control panels. These are connected to the system via the RS-485 data ports, which also provide power to these panels.

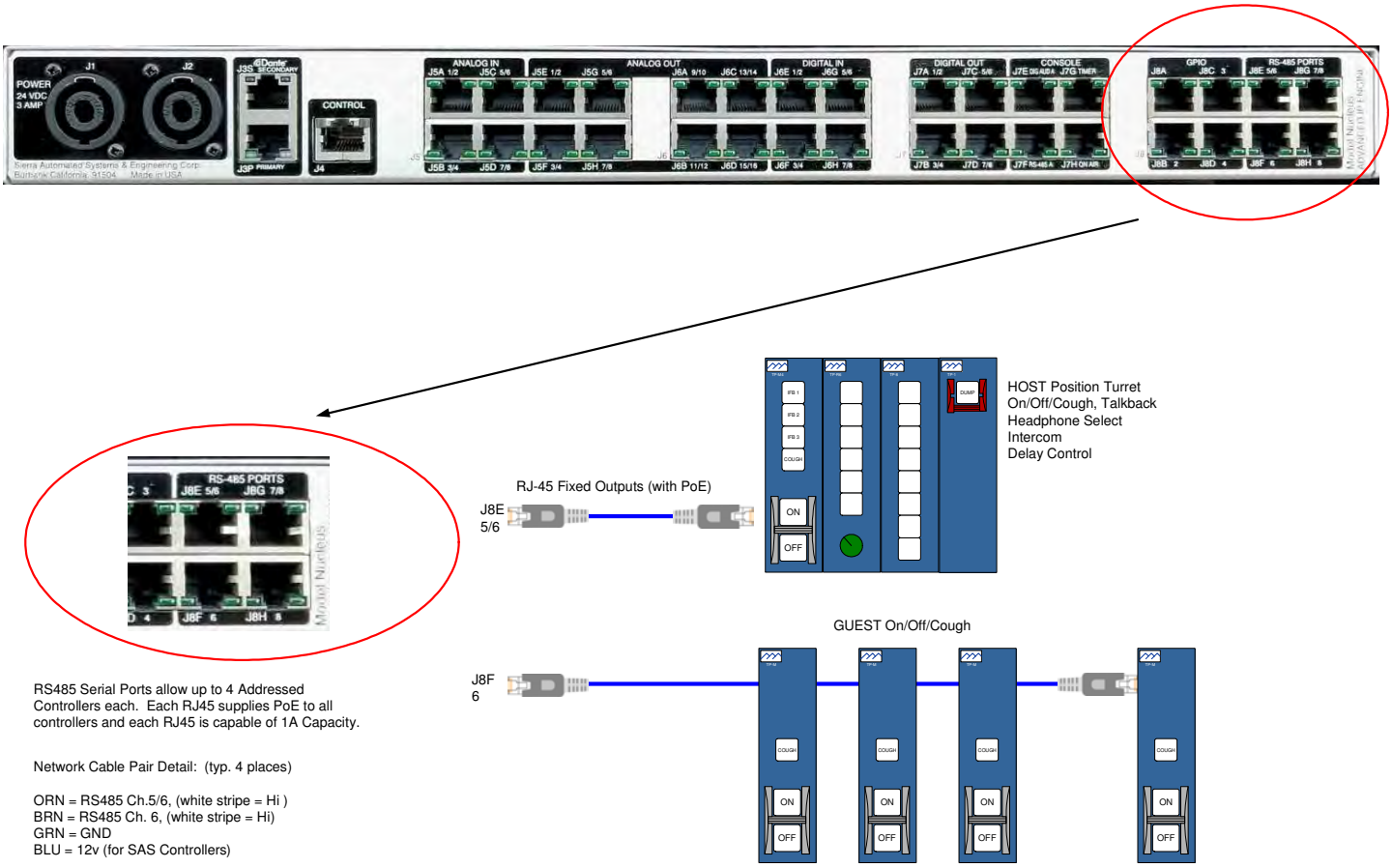


Figure 24: SAS Controller Wiring

Web Browser Compatibility

Web browsers currently tested compatible are:

1. Microsoft Internet Explorer and Edge
2. Google Chrome
3. Firefox
4. Safari

SYSCFG.TXT

For any change to take effect you must restart the Nucleus engine. This can be accomplished by cycling the power or clicking on Restart from the System Update page on the web browser interface.

1. Modify the IP address and other parameters as needed to work with your IP network and save the file. ***Caution****: do not change MAC Address under any circumstances!*
2. Install the SD card into the slot on the Nucleus front panel and restart if changes were made. The IP address is only established with a Restart.
3. When Power is applied to the Nucleus both blue Power lights will come on initially. After 10 to 15 seconds the unit will begin to operate and the Run light will blink green.

Appendix A: Support and Limited Warranty

Customers can contact Sierra Automated Systems & Engineering Corporation (SAS):
Phone: 818-840-6749
Fax: 818-840-6751
Website: http://www.sasaudio.com/

Our business hours are Monday through Friday, from 9am to 6pm Pacific Time. If you need to contact us after hours for emergency support, call us at (818) 840-6749 - please leave a message if you do not get an answer and we will be alerted.

If your SAS product needs to be returned to the factory, contact us to obtain an RA number.
SAS is located at:
2821 Burton Avenue
Burbank, California 91504.

Before you contact us about support or returns, please have the following ready:
• Model number of the product (ex: Nucleus)
• Serial Number (s/n number printed on a silver label)

Limited Warranty

The product Nucleus of Sierra Automated Systems & Engineering Corporation is warranted to be free from defects in materials and workmanship for a period of five years from the date of sale. Sierra Automated Systems & Engineering Corporation's sole obligation during the warranty period is to provide, without charge, parts and labor necessary to remedy covered defects appearing in products returned prepaid to Sierra Automated Systems & Engineering Corporation, 2821 Burton Avenue, Burbank, California, 91504, U.S.A.

This warranty does not cover any defect, malfunction or failure caused beyond the control of Sierra Automated Systems & Engineering Corporation, including unreasonable or negligent operation, abuse, accident, failure to follow instructions in the Technical Manual, Owner's Manual or User Guide, defective or improper associated equipment, attempts at modification and repair not authorized by Sierra Automated Systems & Engineering Corporation, and shipping damage. Products with their serial numbers removed or effaced are not covered by this warranty.

This warranty is the sole and exclusive express warranty given with respect to Sierra Automated Systems & Engineering Corporation products. It is the responsibility of the user to determine before purchase that this product is suitable for the user's intended purpose.

Any and all implied warranties, including the implied warranty of merchantability are limited to the duration of this express limited warranty. Sierra Automated Systems & Engineering Corporation is not liable for incidental or consequential damages of any kind.