Model 7465 HD/SD,
Model 9465 3G/HD/SD

Sync Changeover Switch
User Guide

Revision 1.1 SW v2.2.0

ENSEMBLE
DESIGNS

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.

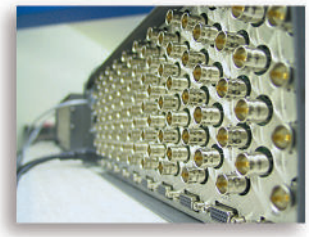
I'm really happy with the Avenue products and Ensemble's service, and even more important my engineers are happy. We've continued to upgrade the product and add more cards. We will be rebuilding our production control room and we will use Avenue again.

~ *Don McKay, Vice President Engineering, Oregon Public Broadcasting*

Who is Ensemble Designs?

By Engineers, For Engineers

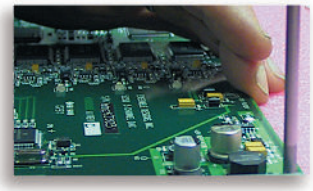
In 1989, a former television station engineer who loved designing and building video equipment, decided to start a new company. He relished the idea of taking an existing group of equipment and adding a few special pieces in order to create an even more elegant ensemble. So, he designed and built his 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.

Contents

Module Overview

Fail-Safe Protection Switch

The Avenue 7465 HD/SD Sync Changeover Switch module and Avenue 9465 3G/HD/SD Sync Changeover Switch module are fail-safe protection switches for monitoring and switching critical sync reference signals from any of Ensemble Designs' reference generators or third-party sync pulse generators. Ensemble Designs' generators include: Avenue 5400 Dual Sync Generator and Test Signal Generator, Avenue 7400 HD/SD Test Signal and Sync Pulse Generator, Avenue 7405 HD Test Signal Generator, and Avenue 9400 3G Test Signal and Sync Pulse Generator.

When a fault is detected in any of the Primary inputs and the Secondary inputs are verified as good, the protect switch will activate, causing all of the Secondary inputs to be switched simultaneously to the module's outputs, ensuring constant, stable references to a facility. Multiple changeover switches can be ganged together through the control system. Depending on the application, two or more Avenue 7465 or 9465 modules may be required to handle all signals that need to be protected.

Three Channels

As illustrated in the block diagram on page 6, these modules are divided into three channels, each with detection circuits which evaluate input source signal types as configured by the user. The signal type for each channel can be set locally or remotely. These three channels are referred to in the block diagram as Channels A, B, and C.

For the Avenue 7465, Channel A tests for HD SDI, SD SDI, ASI and SMPTE 310M signals in terms of presence and locking. For the Avenue 9465, Channel A tests for these same signals plus 3G. Channels B and C test for AES audio, Composite Video, Bi-Level Sync and Tri-Level Sync in terms of presence, low level, high level (overload), and error conditions.

The switch control uses the status of the signal condition from each channel's signal detector to determine if the switch will throw from Primary to Secondary. A drop in signal amplitude below a predetermined auto threshold will trigger the switch. All three channels switch together if any one signal fails a test.

The user may configure which channels contribute to the decision. Each channel can be disabled (meaning that it is not tested) if desired. Disabled channels will not test the signal but will still pass the signal to the output. This allows signals that cannot be tested by the Avenue 7465 or Avenue 9465 to be used if desired.

Auto Mode

When Auto mode is turned on, a fault in any one Primary signal will cause the switch to automatically throw to the Secondary signal. With Auto mode turned off, a fault in the Primary signal will generate an alarm but no switching will take place.

Restoring Primary Signals

Following a fault, the Auto Reset parameter governs how the switch behaves when the Primary signals are restored. With Auto Reset on, the switch will revert back to the restored Primary reference signals within a time period pre-set by the user. When Auto Reset is off, manual intervention is needed to throw the switch back to the Primary reference signals.

Monitoring

Fault conditions can be monitored with an external alarm system or other device through the 15-pin Control connector on the rear of the Avenue 7465 or Avenue 9465. Signal status from this connector can be monitored by a device to show Primary and Secondary signal status and the current position of the protect switch (Primary or Secondary). Two GPI Override Inputs are also available to allow changing switch position from an external device. This can be used to manually reset the switch after the Primary has recovered from a fault condition.

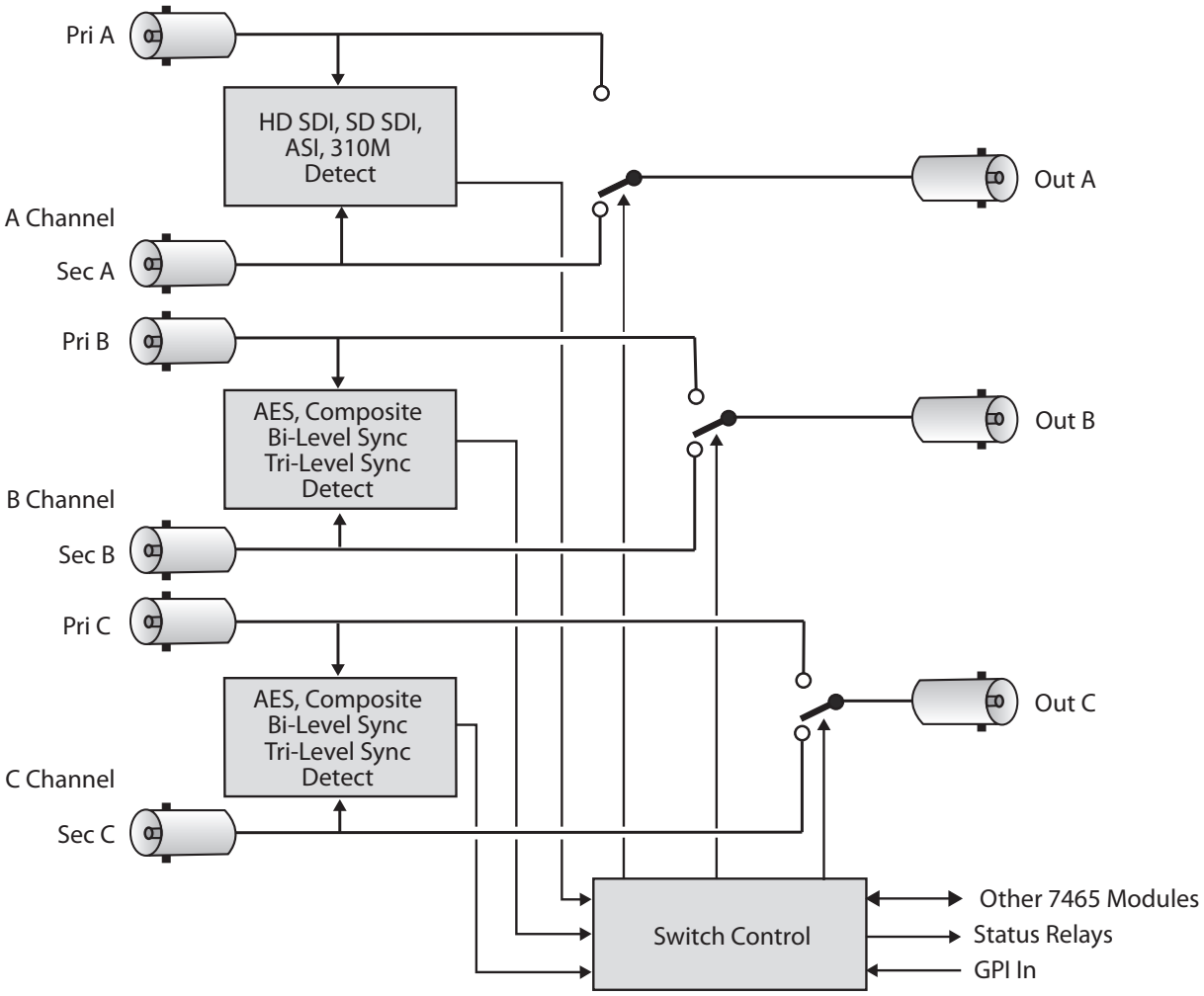
The on-board CPU can monitor and report module ID information (slot location, software version and board revision) and power status to the optional frame System Control module. This information can be accessed by the user or set to register an alarm if desired using the remote control options available.

Importance of Proper Output Termination

The sync changeover switch is designed to be a hard contact device. An input is directly connected to the output through a relay contact without buffering. Thus, a loss of proper termination of the output will be seen by the 7465 or 9465 circuitry. Failure of the output termination will cause the 7465 or 9465 to sense the signal as having a fault due to the improper termination. If the module is set for Auto Mode or Auto Reset, loss of proper termination will cause a flip-flopping of the sync changeover switch.

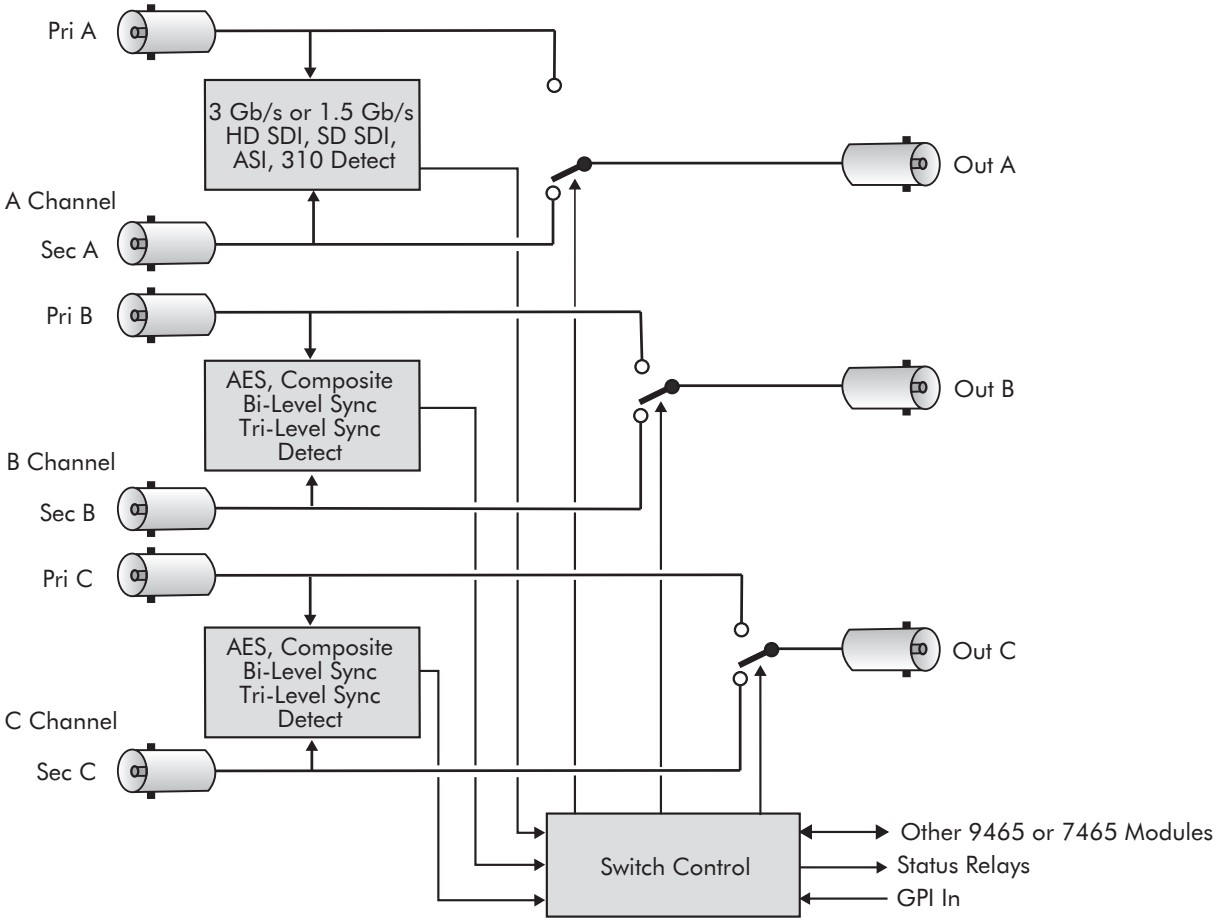
While this is usually not a matter of concern in daily operation as the output is properly terminated, it can produce unexpected results if the switch is installed and powered up without a properly terminated cable.

7465 Block Diagram



7465 Sync Changeover Switch

9465 Block Diagram



9465 Sync Changeover Switch

Applications

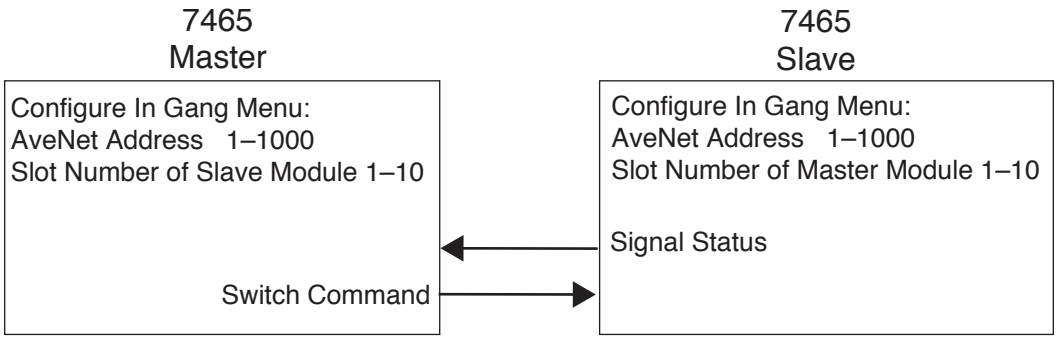
As shown in the application on the next page, different sync reference sources from Avenue or third-party sync pulse generators can be fed to the three channels on the 7465 or 9465 module. Each channel output can then be sent to a distribution amplifier to distribute the various sync signals throughout the facility. It is important that any unused inputs to distribution amplifiers or other destinations be properly terminated to maintain signal integrity.

Up to four 7465 or 9465 modules can be ganged together to take full advantage of protection for up to twelve signals. For gang operation, one of the 7465 or 9465 modules is configured as the Master and the other 7465 or 9465 modules (up to three) are configured as Slaves.

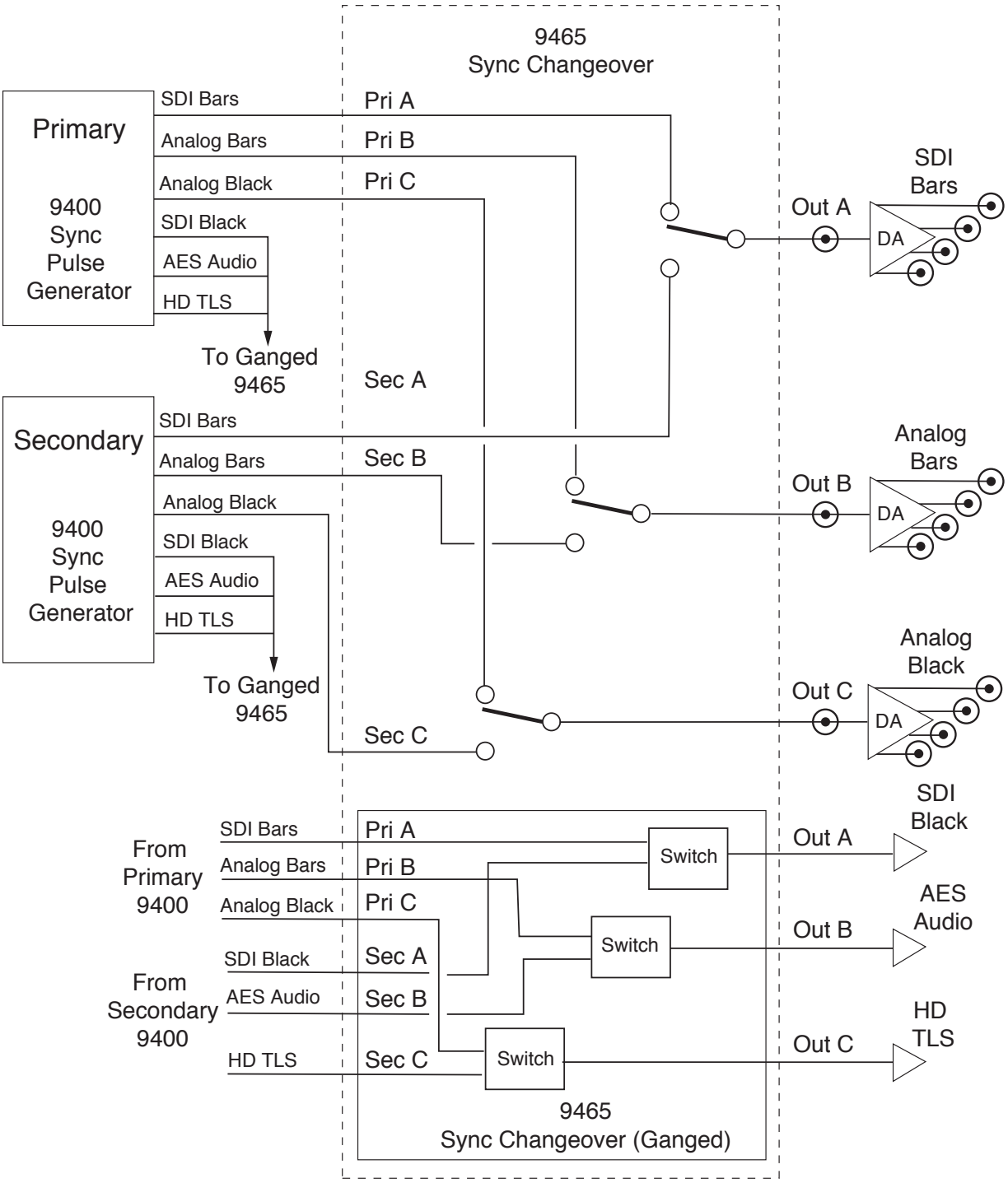
As shown in the illustration below, the Master module makes all decisions about switching based on signal status from its inputs and those from the Slave module(s). Channel A, B and C status signals from the Slave module(s) are reported back to the Master module on status indicators labeled **Slave Status** in the **Gang** menu.

The ganged 7465 or 9465 modules may reside in the same frame or in different frames but must be on the same AveNet network. The Master and Slave configurations are defined in the **Gang** remote control menu for each module. Each module is then identified to the other by its AveNet frame address and its slot location in that frame so the modules can communicate through the control system.

Relay circuits accessible from the 15-pin D Control connector on the rear backplane (not shown) can also be connected to alarms for monitoring Primary and Secondary status and switch position.



Master – Slave Relationship Between 7465 Ganged Modules



Ganged 9465 Modules Fed by Primary and Secondary 9400 Modules

Installation

Plug the 7465 or 9465 module into any one of the slots in the 1RU or 3RU frame and install the plastic overlay provided onto the corresponding group of rear BNC connectors associated with the module location. Note that the plastic overlay has an optional adhesive backing for securing it 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. This module may be hot-swapped (inserted or removed) without powering down or disturbing performance of the other modules in the system.

Cabling

Refer to the 1RU and 3RU backplane diagrams of the module on the following page for cabling instructions. Note that unless stated otherwise, the 1RU cabling explanations are identical to those given in the 3RU diagram.

Status and Alarm Cabling

In addition to full monitoring and access through the control system, the module provides contact closure status indications through the 15-pin D Control connector on the corresponding rear slot of the frame. These connections can drive an alarm system or other external monitoring devices including LEDs. Two override GPI Inputs can also be accessed through the connector. Pinouts for the status monitoring are given in the illustration on the next page.

Form C relay contacts provide both NO (Normally Open) and NC (Normally Closed) switching to indicate fault status of the Primary and Secondary inputs and the protection switch output. Both the NO and NC contacts are simultaneously available on the **Control** connector. Each output is independently strappable to provide Ground, current-limited +5V (1k Ω resistor), or a Common which appears on the D connector.

The three relay contacts provide the following status reporting:

- **Primary Good or Failed** – indicates Primary input status as Good when NO contact is active (switched to Common).
- **Secondary Good or Failed** – indicates Secondary input status as Good when NO contact is active (switched to Common).
- **Switch Position** – indicates the position of the protect switch as either Primary or Secondary selected. The normal position corresponds to the Primary feeding the output.

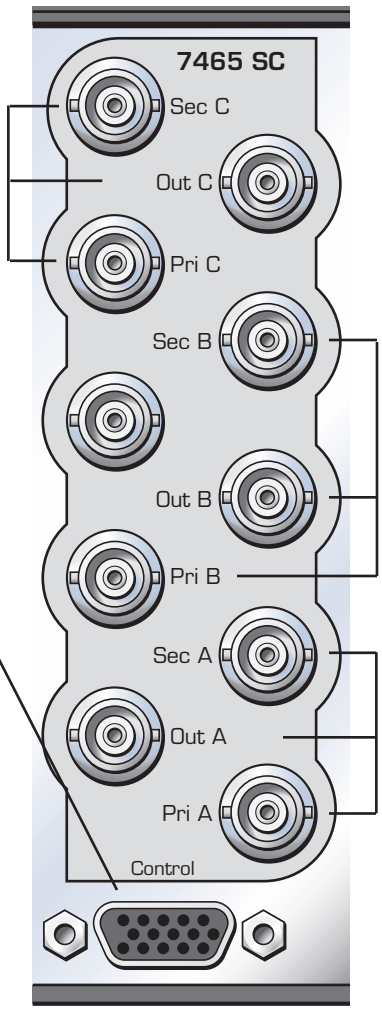
An individual common is provided to each of the relays. For each of the three status relays there is a 3-position jumper on the module which configures the common signal that will be used by that relay. The choices are as follows:

- **COM** – uses the user-provided common signal from the **Control** connector.
- **+5** – provides a +5V signal through a 1k Ω resistor to the relay common.
- **Gnd** – uses ground as the relay common.

7465 3RU and 1RU Backplane Diagrams

Channel C – AES audio, Composite, Bi-Level Sync, Tri-Level Sync Ref:
Connect a primary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Pri C**.
Connect a secondary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Sec C**.
Connect the Channel C output reference signal from **Out C** to a properly terminated distribution amplifier for feeding the signal throughout the facility.
NOTE: Tri-Level Sync is available only in Remote mode.

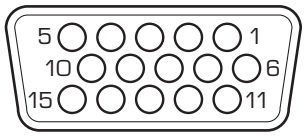
3RU Backplane



Channel B – AES audio, Composite, Bi-Level Sync, Tri-Level Sync Ref:
Connect a primary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Pri B**.
Connect a secondary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Sec B**.
Connect the Channel B output reference signal from **Out B** to a properly terminated distribution amplifier for feeding the signal throughout the facility.
NOTE: Tri-Level Sync is available only in Remote mode.

Channel A – HD SDI, SD SDI, ASI, 310:
Connect a primary HD SDI, SD SDI input signal to **Pri A**.
Connect a secondary HD SDI, SD SDI input signal to **Sec A**.
Connect the Channel A output reference signal from **Out A** to a properly terminated distribution amplifier for feeding the signal throughout the facility.

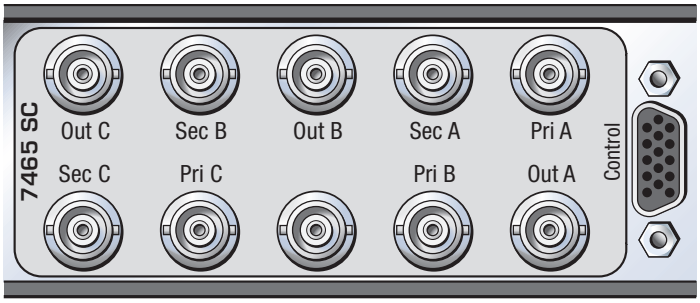
Control



PIN	FUNCTION
1	Pri NO
2	Pri NC
3	
4	Pri Com
5	Sec NO
6	
7	Sec NC
8	Sec Com
9	Prot NC
10	Prot NO
11	Prot Com
12	Pri Sel
13	
14	Sec Sel
15	

IMPORTANT NOTE: All channel output destinations must be terminated properly. Improper termination will affect the integrity of the sync signal and cause errors. Be sure any unused inputs to distribution amplifiers or other destinations are terminated.

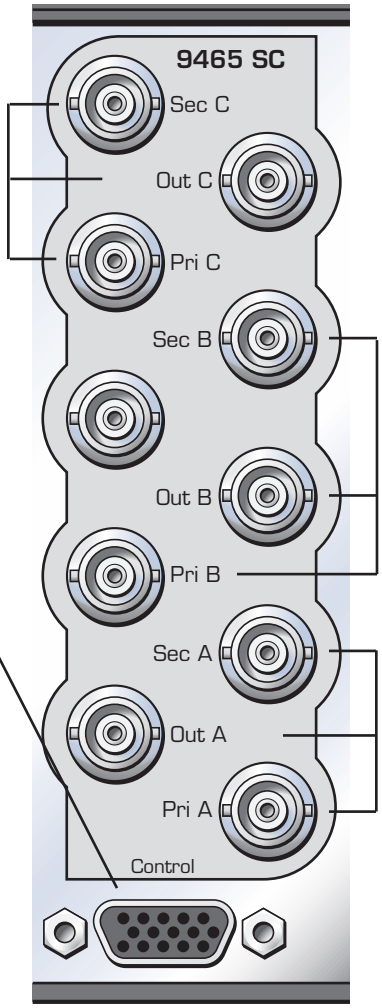
1RU Backplane



9465 3RU and 1RU Backplane Diagrams

Channel C – AES audio, Composite, Bi-Level Sync, Tri-Level Sync Ref:
Connect a primary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Pri C**. Connect a secondary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Sec C**. Connect the Channel C output reference signal from **Out C** to a properly terminated distribution amplifier for feeding the signal throughout the facility.
NOTE: Tri-Level Sync is available only in Remote mode.

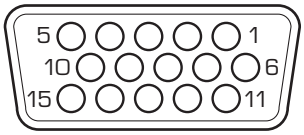
3RU Backplane



Channel B – AES audio, Composite, Bi-Level Sync, Tri-Level Sync Ref:
Connect a primary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Pri B**. Connect a secondary analog composite, AES digital audio, Bi-Level Sync or Tri-Level Sync reference input signal to **Sec B**. Connect the Channel B output reference signal from **Out B** to a properly terminated distribution amplifier for feeding the signal throughout the facility.
NOTE: Tri-Level Sync is available only in Remote mode.

Channel A – 3G, HD SDI, SD SDI, ASI, 310:
Connect a primary 3G, HD SDI, SD SDI input signal to **Pri A**. Connect a secondary 3G, HD SDI, SD SDI input signal to **Sec A**. Connect the Channel A output reference signal from **Out A** to a properly terminated distribution amplifier for feeding the signal throughout the facility.

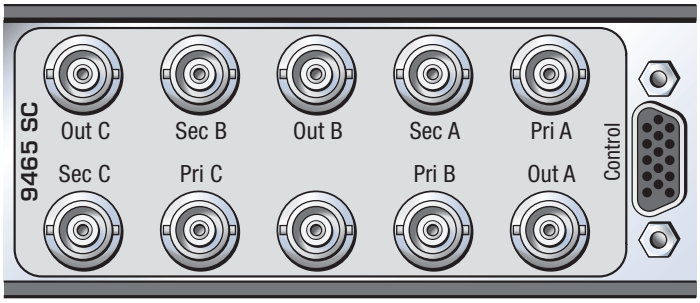
Control



PIN	FUNCTION
1	Pri NO
2	Pri NC
3	
4	Pri Com
5	Sec NO
6	
7	Sec NC
8	Sec Com
9	Prot NC
10	Prot NO
11	Prot Com
12	Pri Sel
13	
14	Sec Sel
15	

IMPORTANT NOTE: All channel output destinations must be terminated properly. Improper termination will affect the integrity of the sync signal and cause errors. Be sure any unused inputs to distribution amplifiers or other destinations are terminated.

1RU Backplane



Because both the NO and NC connections are provided, it is possible to have independent status lines for each of the two states of a status signal. For example, if the jumper is set to +5V, the Primary NO output will source +5V when the relay is in the normal position (Signal Failed) and the Primary NC output will source the +5V when the relay is closed (Signal Good). Additionally, in the case of selecting +5V as the common, the 1k Ω resistor on the module will act as a current limiter, allowing the direct connection of ordinary LEDs to each of these output pins. A green LED could be connected to the NC output and a red LED to the NO output. This would provide very complete and explicit indications to the operator as to the signal status.

Also available through the **Control** connector are two Override GPI inputs that when closed to ground, will force the switch to either Primary or Secondary. These inputs may also be used to reset the Primary after a fault has cleared.

Module Configuration and Control

The configuration parameters for each Avenue module must be selected after installation. This can be done remotely using one of the Avenue remote control options or locally using the module front panel controls. Each module has a **REMOTE/LOCAL** switch on the front edge of the circuit board which must first be set to the desired control mode.

The configuration parameter choices for the module will differ between **Remote** and **Local** modes. In **Remote** mode, the choices are made through software and more selections are available. The **7465 and 9465 Parameter Table** on the following page summarizes and compares the various configuration parameters that can be set remotely or locally and the default/factory settings.

If you are not using a remote control option, the module parameters must be configured from the front panel switches. Parameters that have no front panel control will be set to a default value. The **Local** switches are illustrated in the **Front Panel Controls and Indicators** section following the **7465 and 9465 Parameter Table**.

Avenue module parameters can be configured and controlled remotely from one or both of the remote control options, the Avenue Touch Screen or the Avenue PC Application. Once the module parameters have been set remotely, the information is stored on the module. This allows the module be moved to a different cell in the frame at your discretion without losing the stored information. Remote configuration will override whatever the switch settings are on the front edge of the module.

For setting the parameters remotely using the Avenue PC or Avenue Touch Screen option, refer to the **Avenue PC and Avenue Touch Screen Remote Configuration** section of this document.

7465 and 9465 Parameter Table

CONTROL	LOCAL	REMOTE	DEFAULT
Primary	Selected with Control Switch	Selects Primary	Selected
Secondary	Selected with Control Switch	Selects Secondary	Deselected
Auto	Selected with Control Switch	Selects Auto	Selected
Auto Reset	Switch 8: On (left) Off (right)	On Off	On
Reset Time	5 seconds	0 - 60 seconds	15 seconds
Ch A Mode	Switch 1 A Enable (left) A Disable (right)	Off Serial	Serial
Ch B Mode	Switch 3 B Enable (left) B Disable (right) Switch 4 Vid (left) AES (right)	Off Composite AES Tri-Level LTC	Composite
Ch C Mode	Switch 5 C Enable (left) C Disable (right) Switch 6 Vid (left) AES (right)	Off Composite AES Tri-Level LTC	Composite
Gang Enable	Off	Off Master Slave	Off
Slave Select	1	1 2 3	1
Slave Enable	Disabled	Enabled Disabled	Disabled
Frame Adr	1	1 - 1000	1
Slot Number	1	1 - 10	1

Front Panel Controls and Indicators

Each front edge indicator and switch setting of the 7465 and 9465 is shown in the diagram below. **Note:** The switches (**A Enable**, **B Enable**, **B Vid/AES**, **C Enable**, **C Vid/AES**, **Auto Reset**) are functional only in local mode. They have no effect when the module is in remote mode.

Pri In OK green LED:
ON when Primary input passes all enabled tests.
OFF when Primary input fails an enabled test.

Pri Active green LED:
ON when Primary input is feeding the output.
OFF when Primary input is not feeding the output.

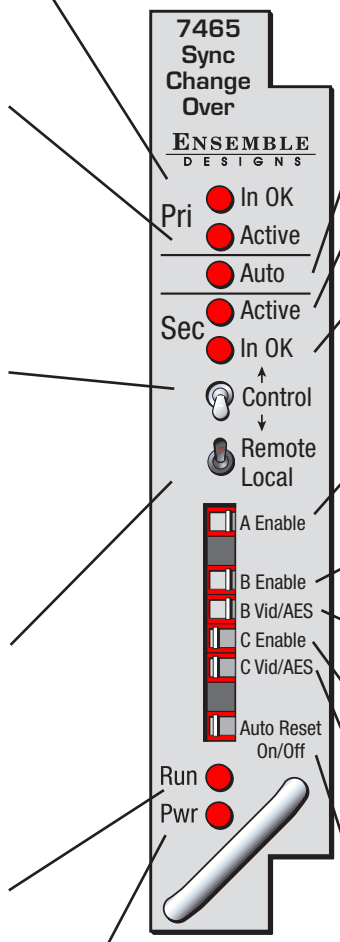
Control Switch has the following four settings:

1. Set Output to Primary and turn Auto Reset **OFF**.
2. Set Output to Primary and turn Auto Reset **ON**.
3. Set Output to Secondary and turn Auto Reset **ON**.
4. Set Output to Secondary and turn Auto Reset **OFF**.

Remote/Local switch:
Set to the mode you wish to use: Up for **Remote** mode and down for **Local** mode.

Run green LED:
OFF A power fault or halted CPU
ON A halted CPU
FAST BLINK CPU Run error
SLOW BLINK System OK. (If SPI control is active from the main frame System Control Module, all Run indicators will be synchronized.).

Pwr green LED:
Indicates the presence (**ON**) or absence (**OFF**) of power (+5V).



Auto green LED:
ON when Auto mode is active.
OFF when Auto mode is turned off.

Sec Active red LED:
ON when Secondary input is feeding the output.
OFF when Secondary input is not feeding the output.

Sec In OK green LED:
ON when Secondary input passes all enabled tests.
OFF when Secondary input fails an enabled test.

A Enable switch:
Select **ON** (left) to enable fault detection for Channel A or **OFF** (right) to disable fault detection.

B Enable switch:
Select **ON** (left) to enable fault detection for Channel B or **OFF** (right) to disable fault detection.

B Vid/AES switch:
Select **Vid** (left) to select analog composite video as Channel B signal type or **AES** (right) for AES digital audio as signal type.

C Enable switch:
Select **ON** (left) to enable fault detection for Channel C or **OFF** (right) to disable fault detection.

C Vid/AES switch:
Select **Vid** (left) to select analog composite video as Channel C signal type or **AES** (right) for AES digital audio as signal type.

Auto Reset switch:
Select **ON** (left) to enable module to auto reset when Primary input is restored or **OFF** (right) for manual reset when Primary input is restored.

Avenue PC and Avenue Touch Screen Remote Configuration

The Avenue PC remote control status menus for the 7465 and 9465 modules are illustrated and explained below. Refer to the 7465 and 9465 Parameter Table for a summary of available parameters that can be set remotely through the menus illustrated. For more information on using Avenue PC, refer to the Avenue PC Control Application Software data pack that came with the option.

Parameter fields that are grayed out can indicate one of the following conditions:

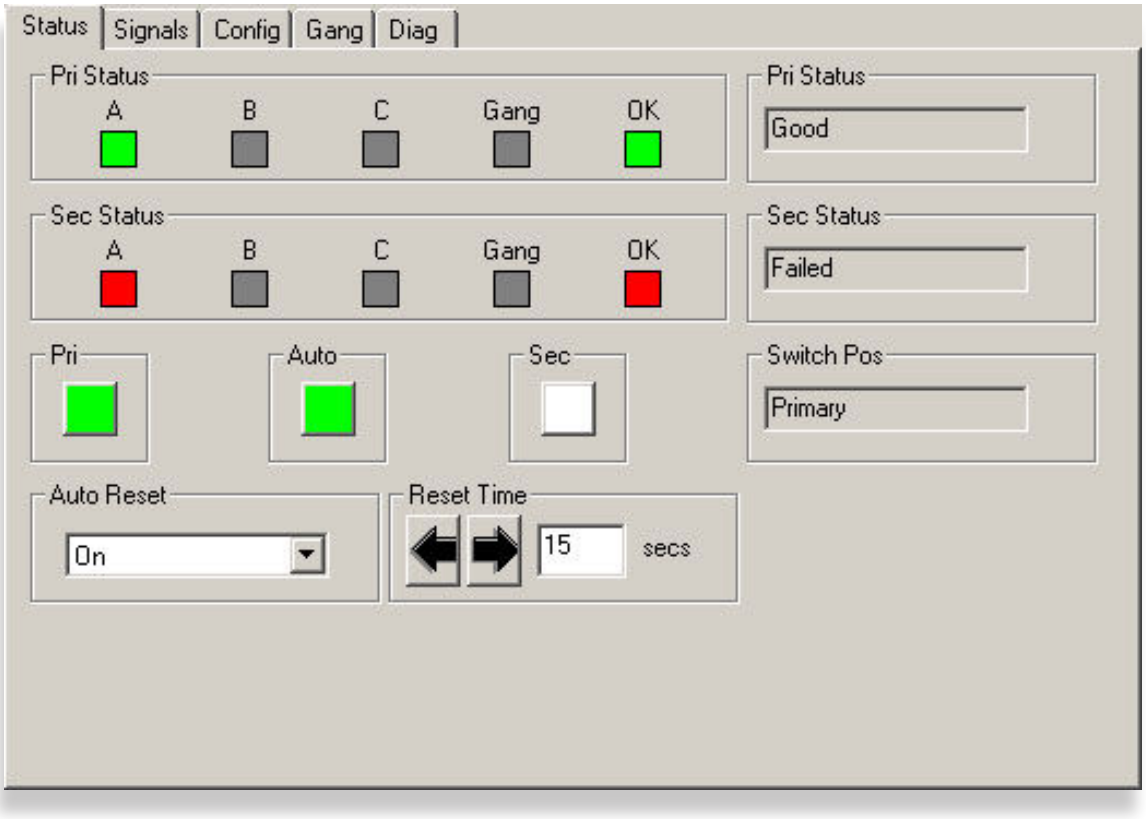
- An option is not installed.
- The function is not active.
- The module is locked.
- The User Level set with Avenue PC is not accessible from the current User Level.

7465 and 9465 Avenue PC Menus

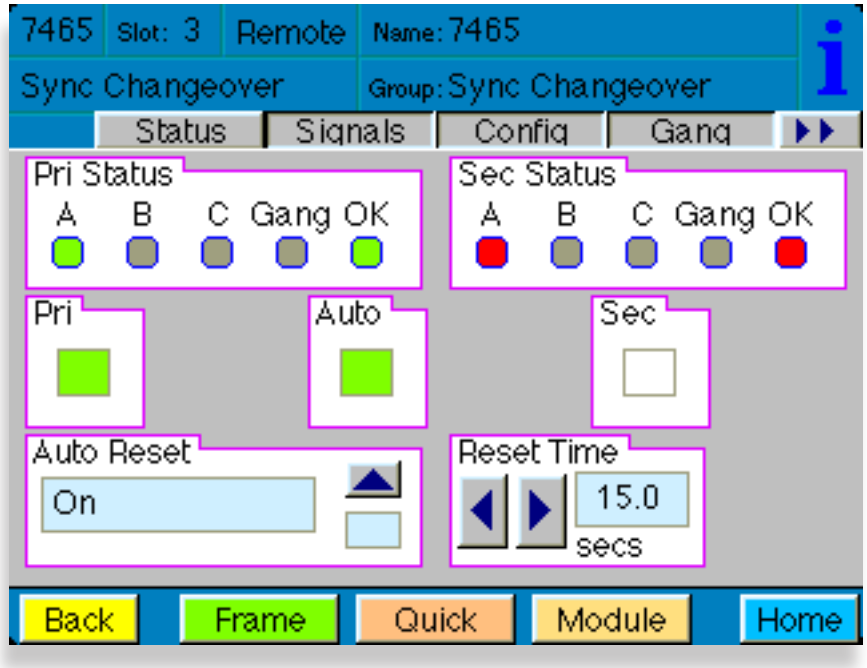
Status Menu

The **Status** menu screen shown below displays overall status of the Primary and Secondary channels, including the ganged channels (if present and enabled). Status indicators for each channel will light as follows: Green = Good, Red = Faulted, Gray = Not enabled. In addition, the text fields along the right side, **Pri Status** and **Sec Status**, indicate the channel status (Good or Failed). The **Switch Pos** text field indicates Primary or Secondary to reflect which input is feeding the output. Auto Reset and Reset Time controls for the switching function are also set with this menu.

- **Pri Status** – Shows the status of the Primary A, B and C channels and the ganged channel (if present and enabled in the **Gang** menu). The **OK** indicator will report a failure when any one channel has faulted.
- **Sec Status** – Shows the status of the Secondary A, B and C channels, and the ganged channel (if present and enabled in the **Gang** menu). The **OK** indicator will report a failure when any one channel has faulted.
- **Pri** – Lights green when the Primary inputs are feeding the output. Select this switch control to select the Primary as the output.
- **Auto** – Lights green when **Auto** is turned on. Switch **Auto** on and off with this switch control. When **Auto** is on, the module will automatically switch to the Secondary input if the Primary fails and the Secondary is good.
- **Sec** – Lights red when the Secondary inputs are feeding the output. Select this switch control to select the Secondary as the output.
- **Auto Reset** – Set to **On** or **Off** to determine if the switch will automatically switch back from Secondary to the Primary channel after it recovers.
- **Reset Time** – Set the amount of time the Primary signals must be good before the Auto Reset switches back to Primary from Secondary.



Status *Avenue PC Menu*

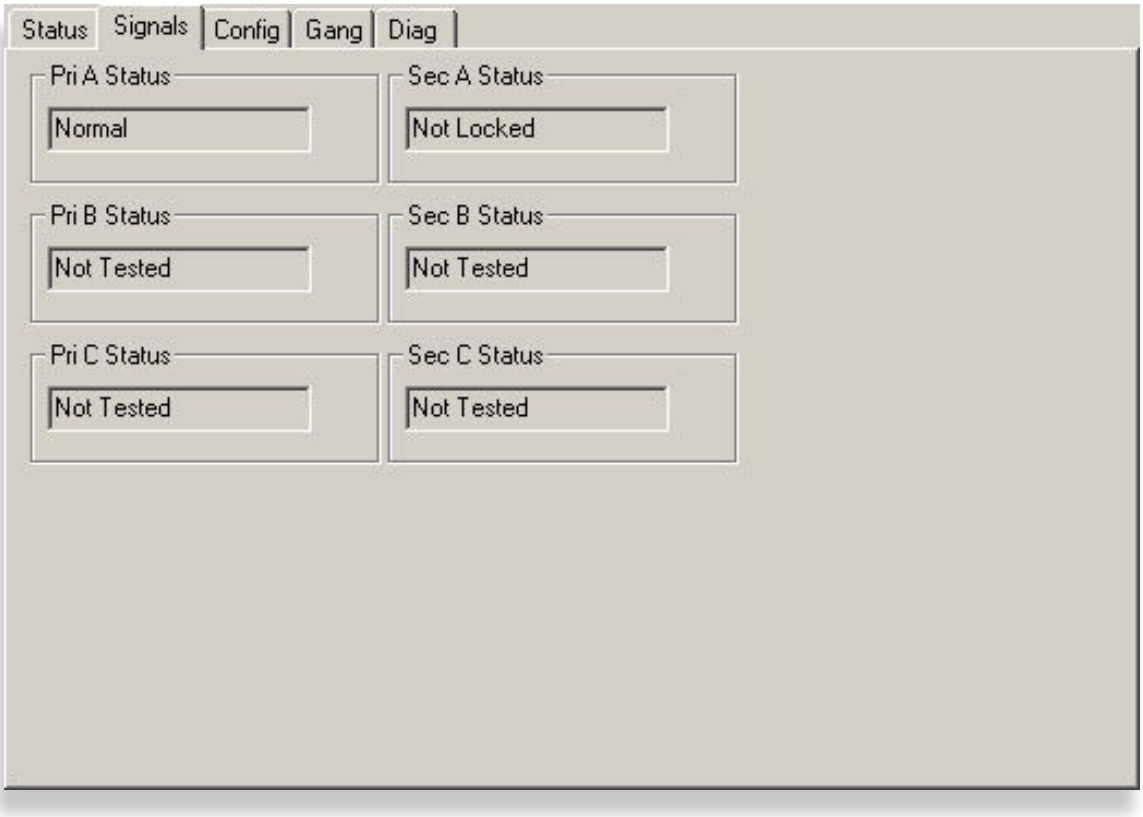


Status *Touch Screen Menu*

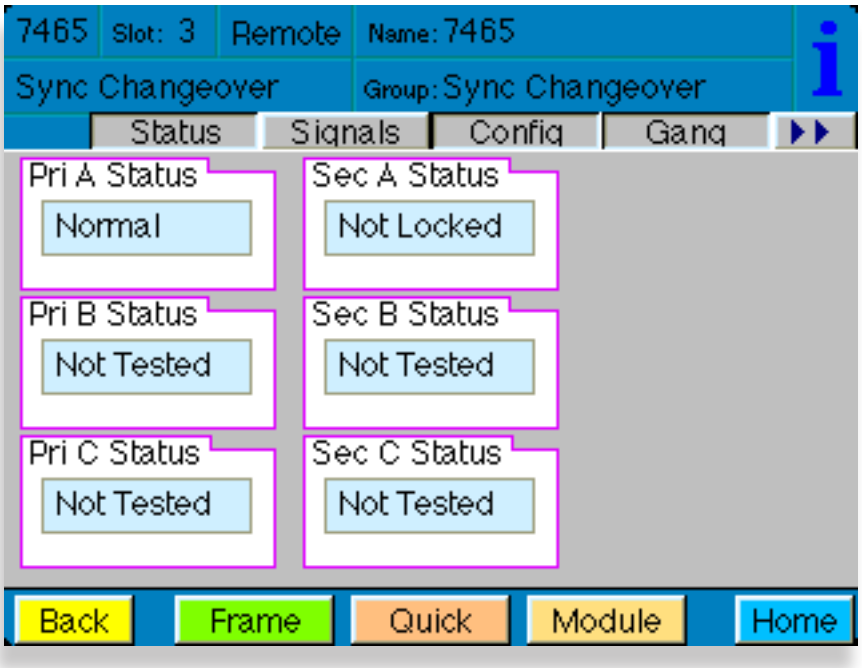
Signals Menu

The **Signals** menu shown below displays the status of each of the Primary and Secondary A, B and C channels. Signal status is reported as the following for each channel signal type:

- **Pri A Status** – Status indicators for SDI serial digital reference are **Not Tested**, **Not Locked** or **Normal**.
- **Pri B Status** – Status indicators for Analog Video, AES audio and Tri-Level Sync reference are **Not Tested**, **No Signal**, **Low Level**, **Normal**, **Overload** or **Error**.
- **Pri C Status** – Status indicators for Analog Video, AES audio and Tri-Level Sync reference are **Not Tested**, **No Signal**, **Low Level**, **Normal**, **Overload** or **Error**.
- **Sec A Status** – Status indicators for SDI serial digital reference are **Not Tested**, **Not Locked** or **Normal**.
- **Sec B Status** – Status indicators for Analog Video, AES audio and Tri-Level Sync reference are **Not Tested**, **No Signal**, **Low Level**, **Normal**, **Overload** or **Error**.
- **Sec C Status** – Status indicators for Analog Video, AES audio and Tri-Level Sync reference are **Not Tested**, **No Signal**, **Low Level**, **Normal**, **Overload** or **Error**.



***Signals** Avenue PC Menu*



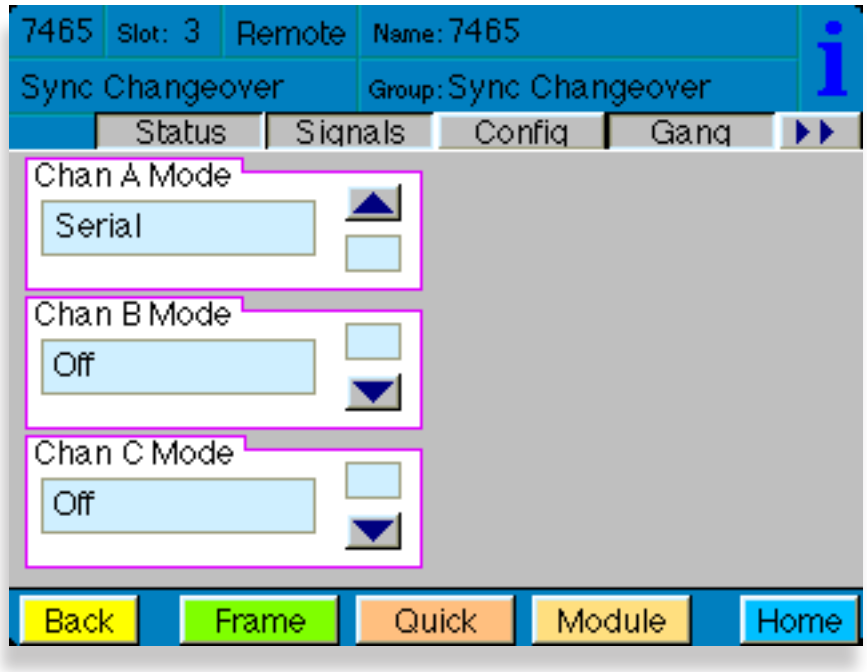
***Signals** Touch Screen Menu*

Config Menu

The **Config** menu shown below allows you to configure the signal type to be detected for each of the three channels:

- **Chan A Mode** – Set Channel A mode to **Off** or **Serial**.
- **Chan B Mode** – Set Channel B mode to **Off**, **Composite**, **AES, Tri-Level**, or **LTC**.
- **Chan C Mode** – Set Channel C mode to **Off**, **Composite**, **AES, Tri-Level**, or **LTC**.

***Config** Avenue PC Menu*

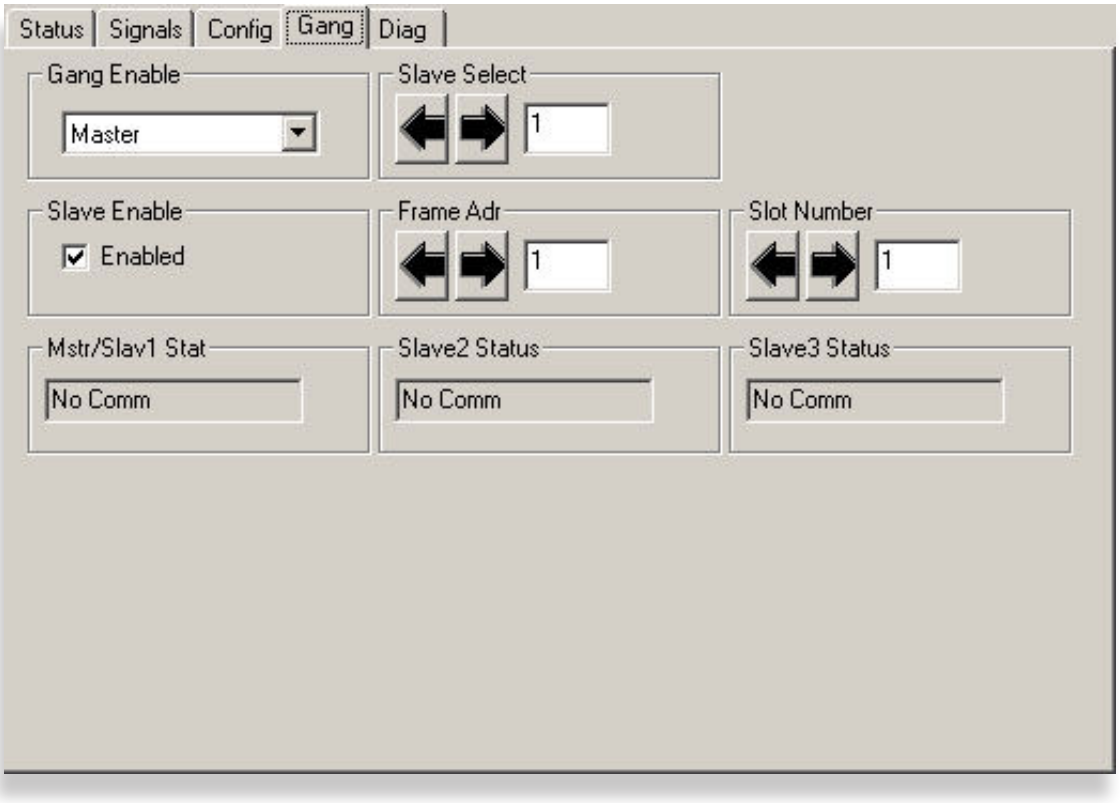


***Config** Touch Screen Menu*

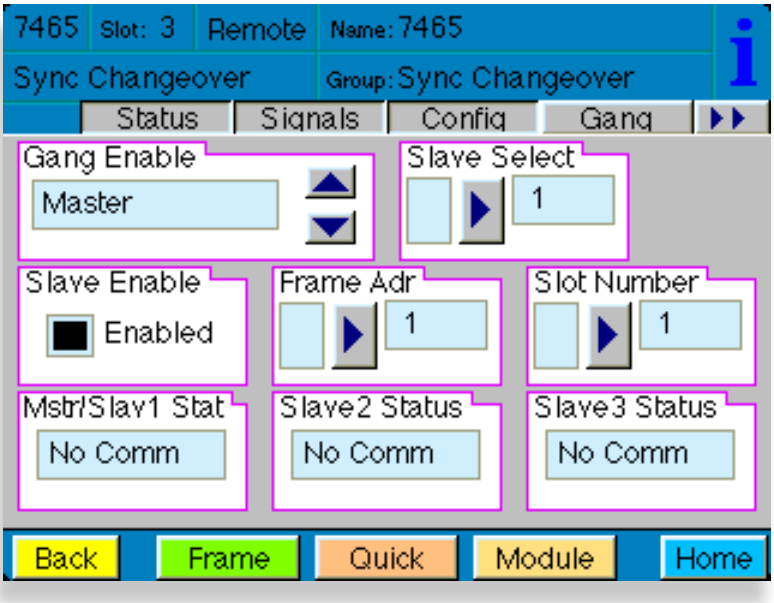
Gang Menu

The **Gang** menu shown below allows you to configure the 7465 or 9465 module for operating in a ganged mode in conjunction with another 7465 or 9465 module in an Avenue frame on the same AveNet network. Refer to the **Applications** explanation given earlier in this data pack for more details on how to gang modules.

- **Gang Enable** – If not using the module in ganged mode with another 7465 or 9465, set to **Off**. For ganged mode, set the module to act as **Master** or **Slave**. Note that to operate in ganged mode, one module must act as a **Master** and the other ganged 7465 or 9465 modules must be set to **Slave**.
- **Slave Select** – Note that this control is grayed out unless the module is set to **Master**. When the module is set to **Master**, use this control to select which slave you wish to configure (Slave 1, Slave 2 or Slave 3). Once you have selected a slave module, you can adjust settings for it using the controls **Slave Enable**, **Frame Adr** and **Slot Number**.
- **Slave Enable** – This control can either be **Enabled** or **Disabled**. Enable this control if you want to operate in ganged mode. If the module is functioning as a slave, the **Slave Enable** control will be grayed out.
- **Frame Adr** – Set the AveNet frame address to point to the ganged 7465 or 9465 module on the AveNet network. Enter a number from **1 through 1000**. Note that the other 7465 or 9465 module must also be configured to point back to the location of this module. A master can set up to 3 of these (one for each slave), while a slave can set up only one (for the associated master).
- **Slot Number** – Set the slot number of the frame where the ganged 7465 or 9465 module is installed. Select a number from **1 through 10**. Note that the other 7465 or 9465 module must also be configured to point back to the slot number of this module. A master can set up to 3 of these (one for each slave), while a slave can set up only one (for the associated master).
- **Mstr/Slav1 Stat, Slave2 Status, Slave3 Status** – The status of the ganged connection will be reported as **"---"** (meaning **"Off"**), **No Comm**, **Pri OK**, **Pri Failed**, **Comm OK**.



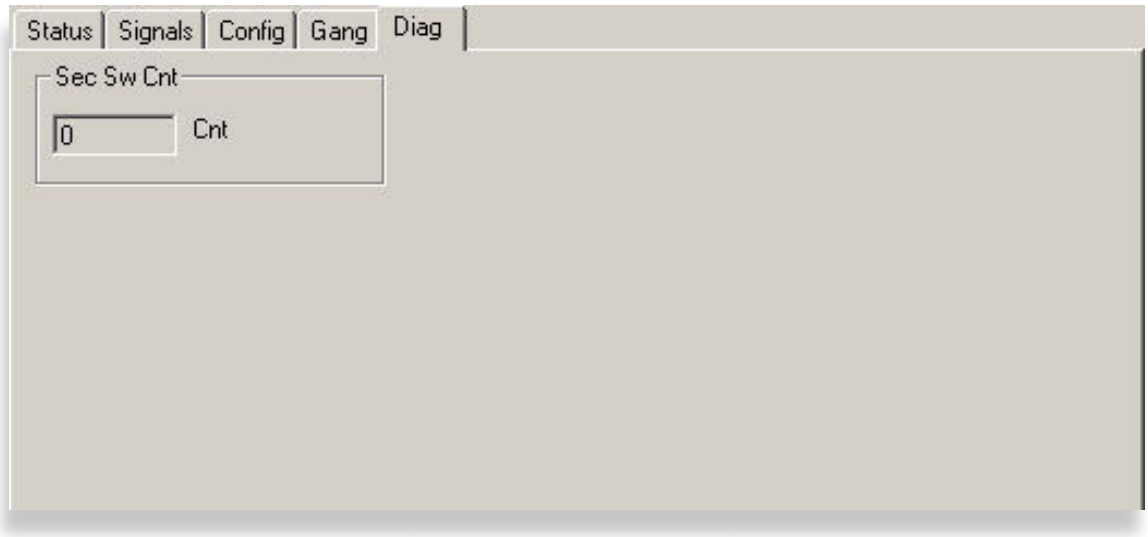
***Gang** Avenue PC Menu*



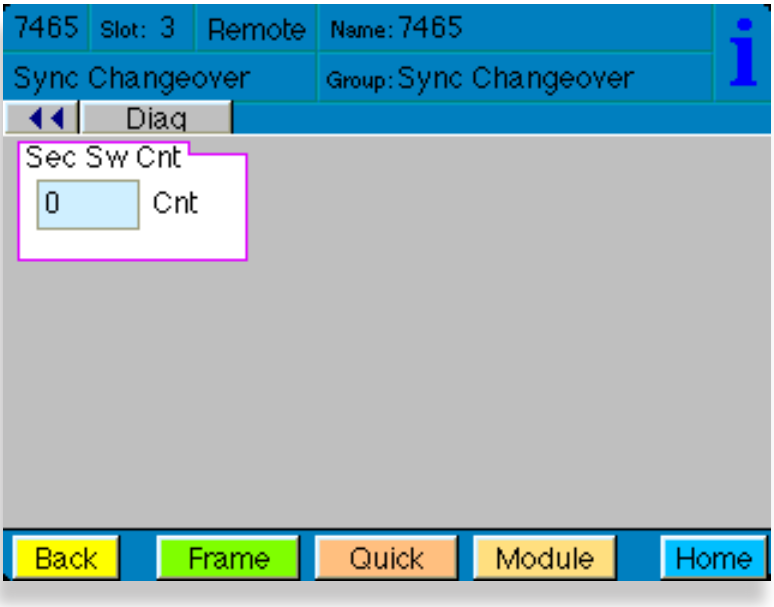
***Gang** Touch Screen Menu*

Diag Menu

The **Diag** menu provides a **Secondary Switch Count** field. It reports the number of times that the module has switched from the Primary to the Secondary signal. When desired, double-click the field to reset it to zero.



***Diag** Avenue PC Menu*



***Diag** Touch Screen Menu*

Troubleshooting

As a troubleshooting aid, reference signal status and presence, as well as power and CPU status can be easily monitored from the front panel of the 7465 or 9465 module using the front panel indicators.

Refer to the troubleshooting tips below:

Can't control module

- Check status of CPU Run green LED. Should be blinking slowly and in unison with other modules if System module is present. If not, try removing it and plugging it in again to be sure it is seated properly.
- System module may not be working properly if installed.

Module remote controls are grayed out

- Module is locked or access to module controls is restricted by User Level.

No signal out of module

- Check status of Active LEDs. Primary or Secondary should be lit. If not, check the inputs for signal presence and quality.
- Check cabling to input of the module.

Please also refer to the technical support section of the Ensemble Designs web site for the latest information on your equipment at the URL below:

http://www.ensembledesigns.com/support

Software Updates

Software updates for each module can be downloaded remotely if the optional System Control module is installed. These can be downloaded onto your PC, then Avenue PC will distribute the update to the individual module. Refer to the Avenue PC documentation for more information. Updates are periodically posted on the Ensemble Designs web site. If you do not have the required System Control Module and Avenue PC, modules can be sent back to the factory for software upgrades.

Warranty

This module is covered by a five-year limited warranty, as stated in the main Preface of this manual. 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 an opportunity to provide any other suggestions for identifying the problem and to recommend possible solutions.

Factory Service

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

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

tel +1 530.478.1830
fax +1 530.478.1832

service@ensembledesigns.com

www.ensembledesigns.com

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

7465 Specifications

Input Signals

Number	Six
Signal Type	HD Serial Digital 1.485 Gb/s SMPTE 274M, 292M or 296M SD Serial Digital 270 Mb/s SMPTE 259M, Analog Composite, AES Digital Audio, LTC, Bi-Level Sync or Tri-Level Sync, selectable
Impedance	75 Ω
Return Loss	>15 dB DC to 1.485 Gb/s

Automatic Cable Input Equalization

HD Standards Supported

1080i (SMPTE 274M -4, 5, 6) 50, 59.94 or 60 Hz
720p (SMPTE 296M -1, 2, 3) 50, 59.94 or 60 Hz
1080p (SMPTE 274M -9, 10, 11) 23.98, 24, 25 Hz
1080sF (RP211 -14, 15, 16) 23.98, 24, 25 Hz

Output Signals

Number	Three
Signal Type	Follows input
Impedance	75 Ω
Return Loss	>15 dB DC to 270 MHz

Switcher Characteristics

Type	75 Ω RF Relay
Insertion Loss	<0.5 dB

General Specifications

Connectors	BNC
Power Consumption	<7.0 watts
Temperature Range	0 to 40°C ambient (all specs met)
Relative Humidity	0 to 95% noncondensing
Altitude	0 to 10,000 ft
Fusing	1.5 Amp PTC resettable fuse

7465 module cannot be installed in slot 3 of a 1RU frame when 5035 System Control module is installed.

9465 Specifications

Input Signals

Number	Six
Signal Type	HD Serial Digital 2.97 Gb/s SMPTE 424M, 425M HD Serial Digital 1.485 Gb/s SMPTE 274M, 292M or 296M SD Serial Digital 270 Mb/s SMPTE 259M, Analog Composite, AES Digital Audio, LTC, Bi-Level Sync or Tri-Level Sync, selectable
Impedance	75 Ω
Return Loss	>15 dB DC to 1.485 Gb/s

Automatic Cable Input Equalization

HD Standards Supported

1080i (SMPTE 274M -4, 5, 6) 50, 59.94 or 60 Hz
720p (SMPTE 296M -1, 2, 3) 50, 59.94 or 60 Hz
1080p (SMPTE 274M -9, 10, 11) 23.98, 24, 25 Hz
1080sF (RP211 -14, 15, 16) 23.98, 24, 25 Hz

Output Signals

Number	Three
Signal Type	Follows input
Impedance	75 Ω
Return Loss	>15 dB DC to 270 MHz

Switcher Characteristics

Type	75 Ω RF Relay
Insertion Loss	<0.5 dB

General Specifications

Connectors	BNC
Power Consumption	<7.0 watts
Temperature Range	0 to 40°C ambient (all specs met)
Relative Humidity	0 to 95% noncondensing
Altitude	0 to 10,000 ft
Fusing	1.5 Amp PTC resettable fuse

9465 module cannot be installed in slot 3 of a 1RU frame when 5035 System Control module is installed.

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.

HDCP

HDCP (High-bandwidth Digital Content Protection) is a content encryption system for HDMI. It is meant to prevent copyrighted content from being copied. Protected content, like a movie on a Blu-Ray disc, is encrypted by its creator. Devices that want to display the protected content, like a television, must have an authorized key in order to decode the signal and display it. The entity that controls the HDCP standard strictly limits the kinds of devices that are allowed decryption keys. Devices that decrypt the content and provide an unencrypted copy are not allowed.

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.

LKFS

LKFS (Loudness K-weighted relative to Full Scale) is a loudness amplitude level based on the ITU-R BS.1770 Loudness Measurement Method. It is a scale for audio measurement similar to VU or Peak, but rather than measuring gain, it measures perceived loudness. Based on a complex algorithm, this method takes into account audio processing that increases perceived loudness without increasing gain. LKFS is the measurement method required to comply with the Calm Act.

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.

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.