BrightEye™ 54

Sync Generator and Test Signal Generator User Guide

ENSEMBLE DESIGNS

Revision 4.1 SW v1.0.3

This user guide provides detailed information for using the **BrightEye 54** Sync Generator and Test Signal Generator unit.

The information is organized into the following sections:

- Product Overview
- Functional Description
- Applications
- Rear Connectors
- Operation
  - Front Panel Controls and Indicators
  - Using the BrightEye Control Application
- Adjustments
- Warranty and Factory Service
- Specifications
- Glossary

PRODUCT OVERVIEW

BrightEye 54 is a master sync generator and test signal generator that is perfect as a master reference generator for remote trucks, desktop, and fly packs. It is a stable timing source, operating from an internal precision standard that meets full broadcast specifications.

Front panel controls select between NTSC and PAL standards, choose video patterns, toggle the identification slate, toggle audio tone, and select HD Tri Level Sync format. The BrightEye Control application is provided to allow more detailed control of the unit from a PC with USB support.

SDI (serial digital component) video, analog composite video, AES audio, analog audio, and HD Tri Level Sync are all generated simultaneously.

A glossary of commonly used video terms is provided at the end of this manual.

FUNCTIONAL DESCRIPTION

The fundamental clock source for BrightEye 54 is a temperature compensated oscillator which guarantees frequency accuracy to within 1 cycle of subcarrier (better than 0.2 ppm) across the full operating temperature range. In addition, because it does not require a crystal oven, BrightEye 54 is accurate to frequency immediately when powered up. This ensures that the BrightEye 54 outputs meet the most stringent standards.

This master clock drives the Sync Gen block. As user configured for 525 (NTSC) or 625 (PAL) line rates, standard definition output feeds horizontal and vertical sync to the internal Test Signal Generator.

The HD Tri Level Sync Gen block is further user configured in BrightEye PC or Mac to one of four HD formats (**1080i**, **1080p**, **720p**, or **1080sF**). The Tri Level Sync output frame rate can be selected from two choices in BrightEye PC or Mac, **23.98/50/59.94**, the most commonly used, and **24/30/60**, a frame rate reserved for use with special applications such as film.

The module will apply the selected TLS frame rates to specific formats and line rates as shown in the table below.

Frame Rate	23.98/50/59.94 Hz		24/30/60 Hz	
Line Rate	**NTSC**	**PAL**	**NTSC**	**PAL**
1080i	59.94	50	60	50
720p	59.94	50	60	50
1080p	23.98	25	24	25
1080sF	23.98	25	24	25

The Sync Gen section also has an output which indicates coincidence between the vertical intervals of the SD and HD outputs. In all formats except 1080sF/23.98, the vertical intervals will be coincidental in every field or frame. In 1080sF/23.98 that coincidence occurs once for every 4 sF frames and every 5 SD (NTSC) frames. Accordingly, this coincidence marker occurs at a 6 Hertz rate, and is commonly referred to as a 6 Hz pulse.

The digital Tone Generator is also locked to the master clock, so the 48 KHz AES output will be synchronous to the video outputs. In NTSC there are exactly 8008 audio samples in every 5 video frames. There will be exactly 1920 audio samples in every PAL video frame.

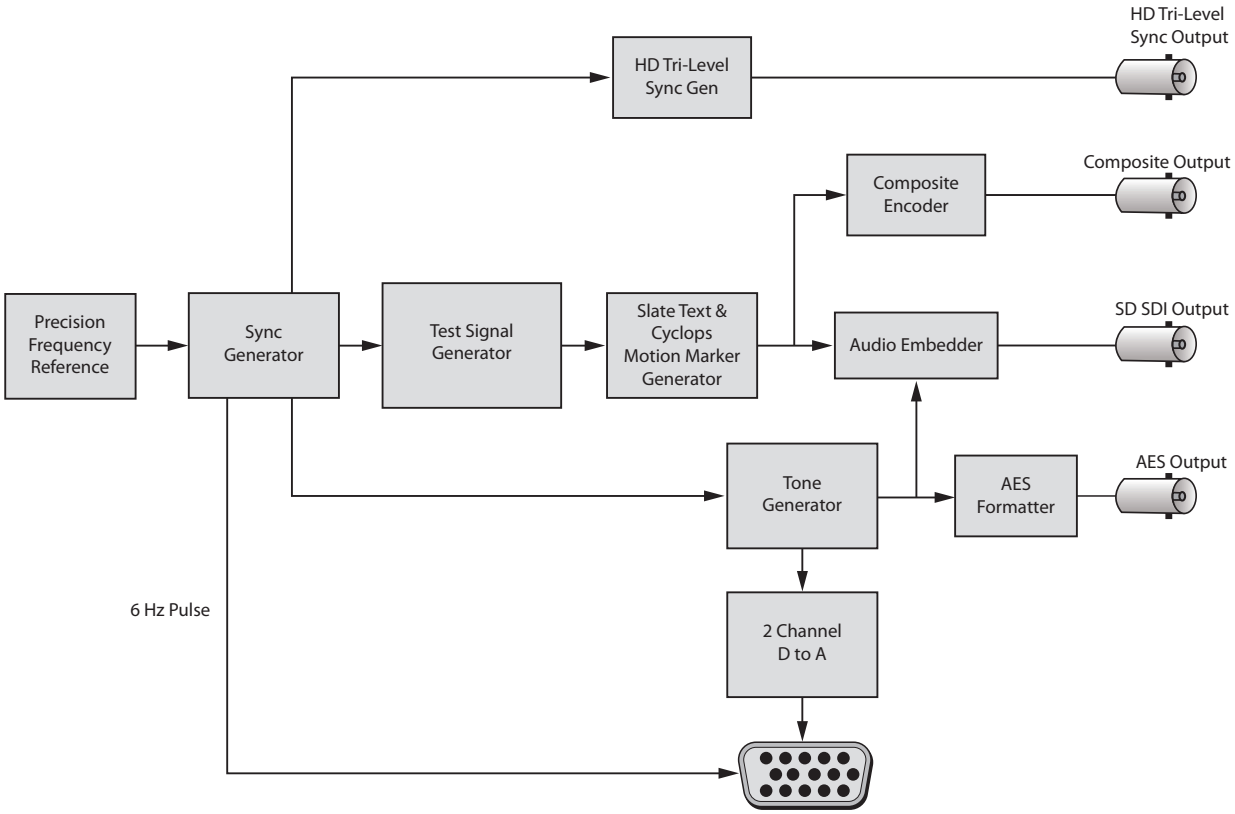
The Tone Generator can be configured for a 1.0 KHz continuous tone, or an interrupted tone which is coordinated with the Cyclops moving element. The Tone Generator feeds the Analog Audio outputs through a precision digital to analog converter. It feeds an AES formatter to produce a standard AES output. And finally, it is fed to an audio embedder so that it's present in the SDI output.

The user selected test signal is produced in the Test Signal Gen block. The test signal then passes to the Slate ID Text Generator which can overlay a line of user programmable text across the test pattern. This block also has the Cyclops Motion Marker which adds a moving element to the image.

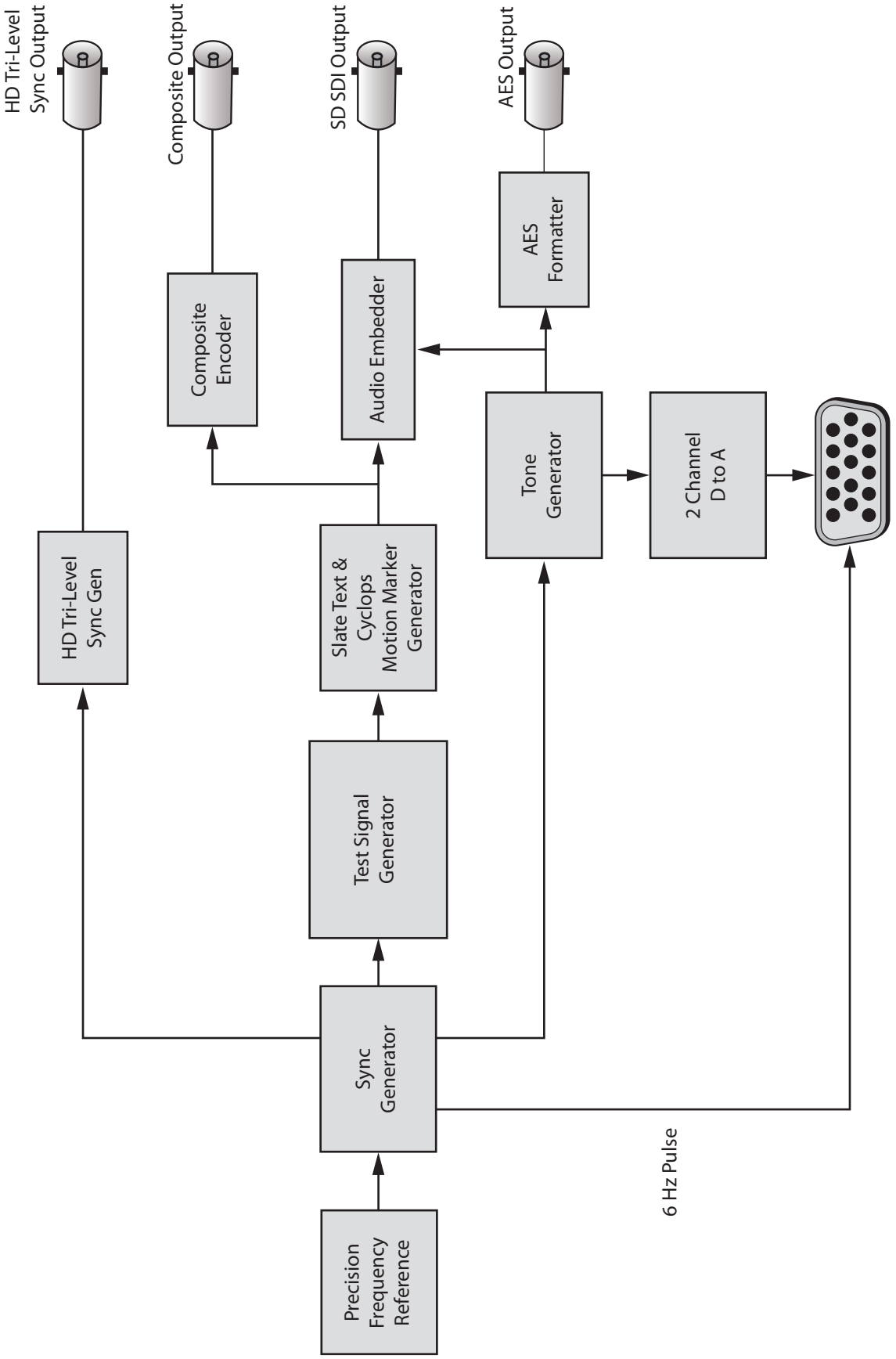
This video signal is combined with the output of the Tone Generator to produce a serial digital (SDI) output.

The same video signal is digitally encoded to composite video and converted to analog form to drive the Analog Composite output.

BrightEye 54 is powered by a 12 volt DC universal power supply. This power supply can accept an input voltage between 90 and 230 volts, at 50 or 60 Hertz. It uses a standard IEC line cord and can be used anywhere in the world. It is normal for the converter to be warm to the touch when operating.



BrightEye 54 Functional Block Diagram, Portrait View



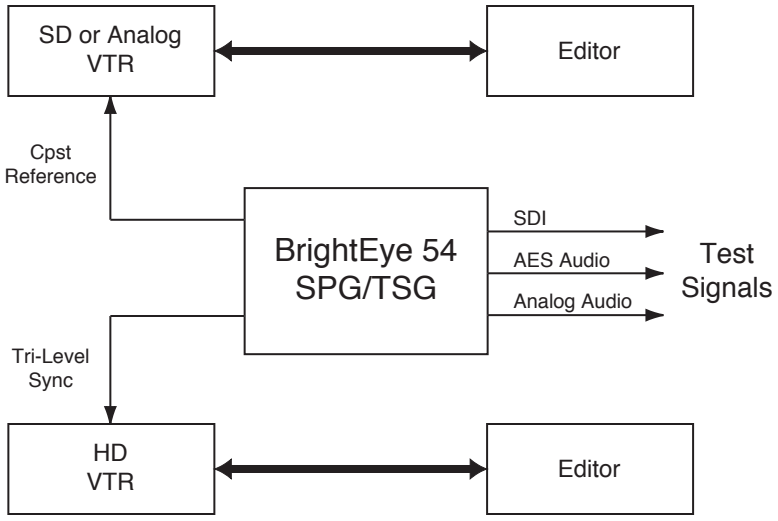
BrightEye 54 Functional Block Diagram, Landscape View

APPLICATIONS

BrightEye 54's small size and complete feature set make it a versatile sync and test signal generator. Some examples of possible BrightEye 54 applications are given below.

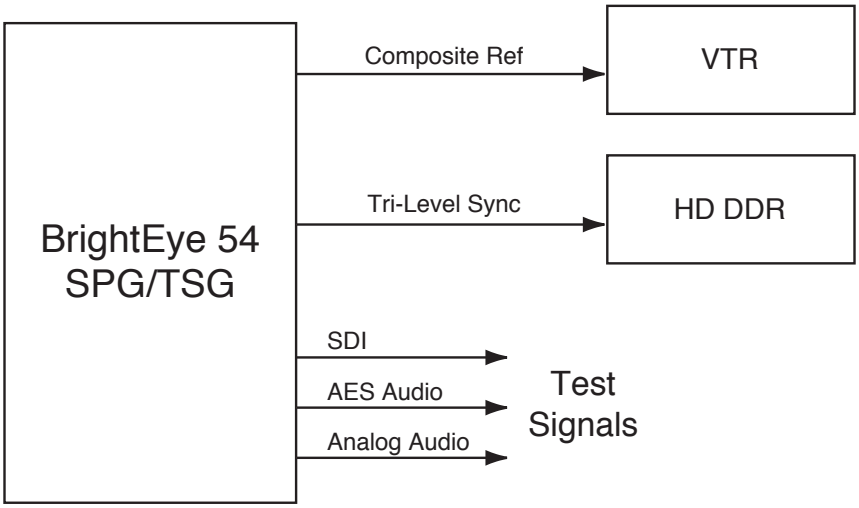
Desktop Application

BrightEye 54 is convenient for desktop and non-linear editing applications since it can provide reference for all types of VTRs and provides test signals as well.



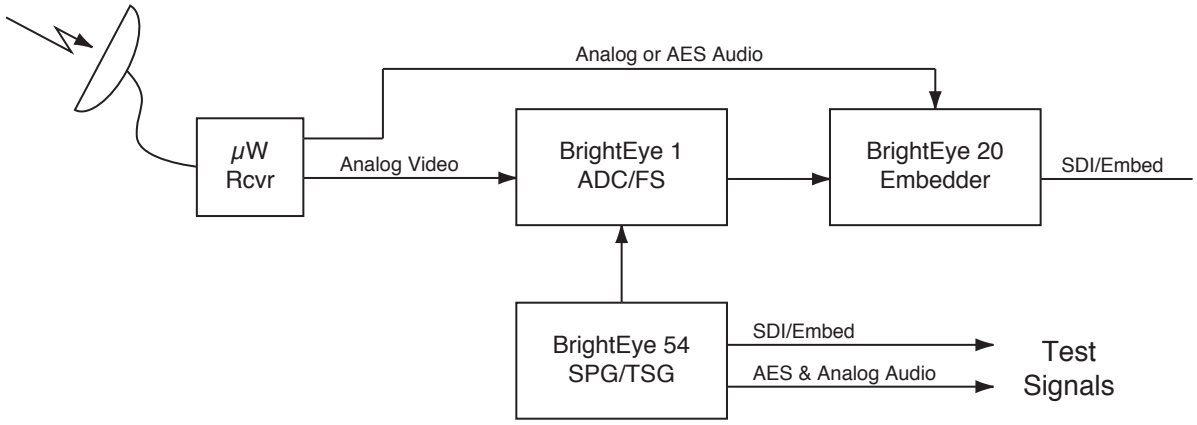
Truck/OB Van and Fly Pack

BrightEye 54's variety of video and audio outputs combined with its small size make it particularly useful for mobile applications. It can provide reference or test signals for any type of equipment making it a great asset in the dynamic applications found in mobile use.



Satellite or ENG Feeds

Use BrightEye 54 in conjunction with the BrightEye 20 embedder and BrightEye 1 converter and frame sync to manage satellite feeds and transmission signals.



REAR CONNECTORS

All connections to the BrightEye 54 converter are made on the rear of the unit. Refer to the illustration below.

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BrightEye 54 Rear Connectors

Power Connection

Connect a modular power supply to the 12 volt DC power input connection on the far left of the unit. Use the locking ring to secure it.

USB Connector

The USB connector is used to provide more comprehensive control, diagnostics, and upgrades to the unit from a PC or Mac. Use the BrightEye Control application included on CD-ROM to make adjustments as described in the **OPERATION** section of this user guide.

AES Out

The **AES Out** is a BNC connector that provides a digital audio output in the AES format. The AES Output can be configured from the front panel and from the BrightEye Control application.

HD Tri Level Sync Out

The **HD Sync Out** is a BNC connector that supplies HD Tri Level Sync in a number of user-selected formats. Either the front panel or the BrightEye PC or Mac can be used to select the desired format.

SDI Out

The **SDI Out** is a BNC connector that provides test patterns or black in serial digital component format. Test patterns and video standard can be selected from the front panel as well as the BrightEye Control application. This output conforms to the ITU-R 601 standard for serial digital video, with SMPTE 259M serialization at 270 Mb/s.

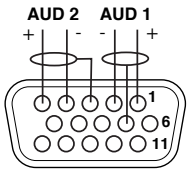
Analog Audio Out

The **Analog Audio Out** is a HD15 connector that can provide analog audio reference tone. Analog reference levels can be configured from the BrightEye Control application.

Composite Out

The **Composite Out** is a BNC connector that presents either NTSC or PAL composite output. This output provides the same test pattern as **SDI Out**, only in composite format. The pattern can be selected from the front panel or the BrightEye Control application.

Analog Audio Pinouts		
Signal	**Pins**	**Output**
Aud 1 +, –, G	1, 2, 7	Output 1
Aud 2 +, –, G	5, 4, 3	Output 2



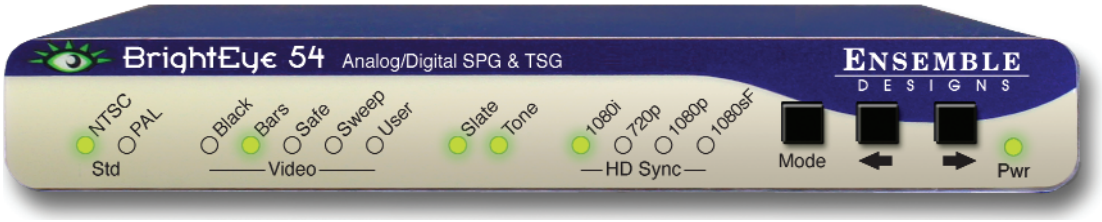
OPERATION

Control and operation of the BrightEye 54 is performed from the front panel or with the BrightEye Control application.

NOTE: *Some control settings are only available with BrightEye PC or Mac. These parameters cannot be monitored or controlled with the front panel.*

Front Panel Controls and Indicators

The front panel, as shown in the figure below, provides status indicators and control over video and audio output.



BrightEye 54 Front Panel

Status Indicators

The following status indicators are provided on the front panel:

Std (Standard)

The currently selected output standard (**NTSC** or **PAL**) will illuminate green.

Video

The currently selected video pattern **Black** (choices include **Black**, **Flat 20%**, **Flat 80%**), **Bars** (choices include **75% Bars**, **100% Bars**, **SMPTE Bars**), **Safe** (**Safe Title**), **Sweep** (choices include **Sweep, Mono Sweep, Multi Burst, Mono Burst**), or **User** (chosen in BrightEye PC or Mac) will illuminate green.

Slate

Illuminates green when the signal identification slate is enabled. To change the ID slate text, use BrightEye PC or Mac.

Tone

Illuminates green when analog audio tone is enabled.

HD Sync

The currently selected HD Tri Level Sync format (**1080i**, **720p**, **1080p**, or **1080sF**) is illuminated green. One of two different Tri Level Sync (TLS) frame rates can be selected in the **Config** menu of the BrightEye Control application as **23.98 / 50 / 59.94** (the most commonly used, default value) or **24 / 30 / 60** (for special applications such as film).

Pwr (Power)

Illuminates green when power is applied to the converter and the internal voltage regulator is functioning correctly.

ADJUSTING PARAMETERS FROM THE FRONT PANEL

Use the **Mode**, **Right Arrow,** and **Left Arrow** buttons to select and adjust parameters from the front panel.

Pressing the **Mode** button activates the front panel for editing and tabs between each section of editable parameters.

Pressing the **Right Arrow** or **Left Arrow** advances the selection within a given section of parameters, or increases (Right Arrow) or decreases (Left Arrow) the value of a selected parameter.

NOTE: The LED of an edited parameter will blink for 15 seconds, after which time its value is stored in memory. If power is interrupted before this 15 second timeout period has elapsed, the edited state will not be not saved.

The LED indicators will report the following:

- **Std (Standard) select** – currently selected video output standard blinks.
- **Video** – currently selected video pattern (or pattern group) output blinks.
- **Slate on/off** – blinks quickly when ID slate is enabled, slowly when disabled.
- **Tone on/off** – blinks quickly when tone is enabled, slowly when disabled.
- **HD Sync select** – currently selected HD Tri Level Sync format blinks.

The controls and their indicators are described below:

Std (Standard)

This control selects the video output standard with the following choices:

NTSC – 525 NTSC standard

PAL – 625 PAL standard

Video

This control selects the video test pattern with the following choices:

- Black choices:, **Black**, **Flat 20%**, or **Flat 80%**.
- Bar choices: **75% Bars**, **100% Bars**, or **SMPTE Bars**.
- Sweep choices: **Sweep**, **Mono Sweep**, **Multi Burst**, or **Mono Burst**.
- User choices **–** This pattern can be specified in the **Test Pattern** menu, providing over eight additional patterns (**Pathological**, **Pulse and Bar**, **Ramp**, **Digital Blanking**, **Analog Blanking**, **Interlace**, **Crosshatch**, and **Unit Circle**).

NOTE: Mono Sweep and Mono Burst are recommended for analog applications and Sweep and Multi Burst for SDI video applications.

Slate

This control allows the identification slate on the test signal output to be turned on and off. The content of the slate can be configured in the **Config** menu in the BrightEye Control application.

Tone

This control toggles the analog audio tone on and off. This applies to the analog audio out, the AES out, and the embedded tone on the SDI out. Advanced configuration of digital and analog audio reference levels is available in the **Config** menu.

HD Sync

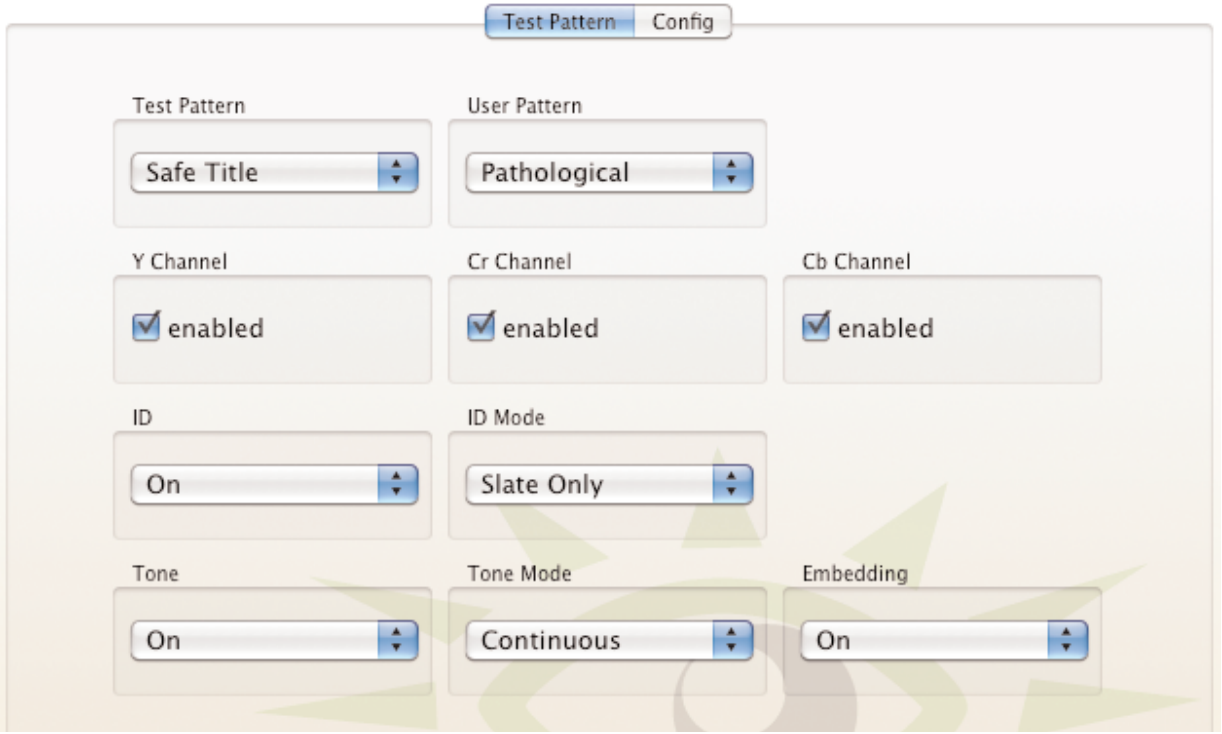
This control selects the HD Tri Level Sync standard. Select 1080i, 720p, 1080p, or 1080sF. This output also follows the output **Standard** selected, either 525 or 625. For more information, see the **FUNCTIONAL DESCRIPTION** section at the beginning of this manual.

USING THE BRIGHTEYE CONTROL APPLICATION

The BrightEye PC and BrightEye Mac applications included on CD-ROM are designed to allow you to configure and control the BrightEye 54 from a personal computer. Installation and instructions for using this software application are given in the PDF manual on disk. If the BrightEye 54 is connected to a computer running this software, the following menus are available for controlling and monitoring the unit:

Test Pattern Menu

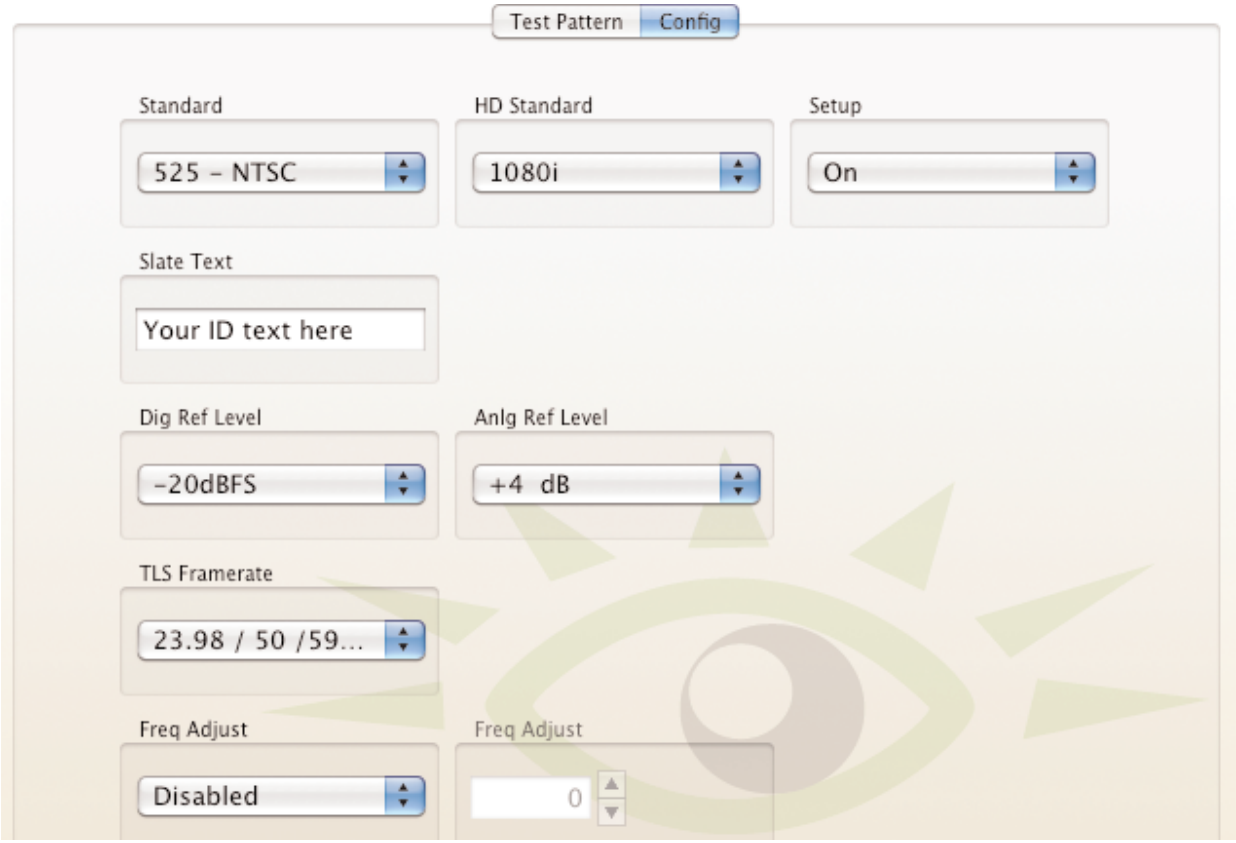
- **Test Pattern** – select the type of test pattern from the pulldown: **Black**, **Flat 20%**, **Flat 80%**, **75% Bars**, **100% Bars**, **SMPTE Bars**, **Safe Title**, **Sweep**, **Mono Sweep**, **Multi Burst**, **Mono Burst**, or **User** (defined under **User Pattern**).
- **User Pattern** – selects the pattern displayed when **Test Pattern** is set to **User**. This pulldown lets you chose between: **Pathological**, **Pulse and Bar**, **Ramp**, **Digital Blanking**, **Analog Blanking**, **Interlace**, **Crosshatch**, and **Unit Circle**.
- **Y, Cr, and Cb Channels** – these check boxes allow you to selectively disable the output in particular luminance and color channels.
- **ID and ID Mode** – these pulldowns control signal identification. Use **ID** to turn signal identification **On** or **Off**. **ID Mode** selects between **Slate Only**, **Cyclops Only**, or **Slate & Cyclops**. The content of the **ID Slate** can be controlled from the **Config Menu**.
- **Tone and Tone Mode** – these pulldowns control audio tone generation. **Tone** turns tone generation **On** or **Off**. **Tone Mode** selects the style of tone generated. Select between **Continuous**, **Pop**, or **Beep**.
- **Embedding** – turning this control **On** embeds the audio test tone into the SDI output. Turning it **Off**, does not embed the audio test tone.



Config Menu

Use the Config menu shown below to set the following parameters:

- **Standard** – select the output standard for SDI and composite video. This pulldown lets you chose between: **NTSC (525) and PAL (625)**.
- **HD Standard** – select the HD Tri Level Sync standard. This pulldown lets you choose between: **1080i**, **720p**, **1080p**, or **1080sF**.
- **Setup** – turn **Setup On** or **Off** for 525 60Hz signals.
- **Slate Text** - the contents of this text field will be displayed in the **ID Slate**. Enter up to 19 characters.
- **Dig Ref Level** – select the digital audio reference level. This pulldown lets you choose between: **-18dBFS** or **-20dBFS**.
- **Analog Ref Level** – select the analog audio reference level. This pulldown lets you choose between: **-10 dB**, **-6 dB**, **-4 dB**, **0 dB**, or **+4 dB**.
- **TLS Framerate** – this control allows selection of the Tri Level Sync frame rate output between **23.98/50/59.94 Hz** and **24/30/60 Hz**. Refer to the discussion of this functionality in the **FUNCTIONAL DESCRIPTION** at the front of this document.
- **Freq Adjust** – this control temporarily enables the **Freq Adjust** control. When this control is set to **Allowed** the user has 20 seconds to begin adjusting the internal clock frequency, after 20 seconds this **Freq Adjust** is disabled.
- **Freq Adjust** – this control allows the internal timing source to be adjusted. See the **ADJUSTMENTS** section near the end of this manual for more details and the adjustment procedure.



ADJUSTMENTS

Frequency Adjustment

The BrightEye 54 contains a precision timing source that is calibrated at the factory to meet full specifications for timing precision. However, because clock crystals shift frequency as they age, it may be necessary to adjust the frequency of the internal source. This adjustment should not be necessary until after several years of use.

Frequency Adjustment Procedure

Connect the BrightEye 54's composite output to a vector scope that is externally referenced to a known accurate source generator. With external reference enabled on the vectorscope, the vector display of the BrightEye 54 composite signal will slowly rotate.

At this point, use the BrightEye Control Application to enable **Freq Adjust** and adjust the frequency to bring the BrightEye 54 into spec by making the rotation of its vector slow or stop.

The specification of ±1Hz of subcarrier (in either PAL or NTSC) is met if the vector takes more than 1 second to make 1 full revolution.

The original factory adjustment is equal to a **Freq Adjust** value of 0.

WARRANTY AND FACTORY SERVICE

Warranty

Ensemble Designs, Inc. warrants this product to be free from defect in material and workmanship for a period of 5 years from the date of delivery. During this 5 year warranty period, Ensemble Designs, Inc. will repair any defective units at Ensemble's expense if the unit should be determined to be defective after consultation with a factory technician.

This warranty is not transferable. Any implied warranties expire at the expiration date of this warranty.

This warranty does not cover a defect that has resulted from improper or unreasonable use or maintenance as determined by us. This warranty is void if there is any attempt to dissemble or adjust factory set presets without factory authorization.

Factory Service

If you require service (under warranty or not), please contact Ensemble Designs and ask for Customer Service before you return the unit. This will allow the service technician to provide any other suggestions for identifying the problem and recommend possible solutions.

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

http://www.ensembledesigns.com/support

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
(530) 478-1830
Fax: (530) 478-1832
service@ensembledesigns.com
http://www.ensembledesigns.com

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

SPECIFICATIONS

Composite Output

Number	One
Signal Type	NTSC / PAL
Impedance	75 Ω
Return Loss:	> 40 dB to 5.5 MHz
Frequency Response	-0.1 dB 10 KHz to 5.0 MHz
Output DC	± 50 mV
K Factors	< 1.0%
Differential Phase	< 1.0 degree
ScH Phase	± 5 degrees

Accuracy and Timing Stability

Internal TCXO	
PAL Fsc	4.43361875 MHz +/- 1 Hz
NTSC Fsc	3.579545 MHz +/- 1 Hz
601 Fs	27.000000 MHz +/- 5 Hz
Long Term Drift	<1 ppm/year
Analog Jitter	<1 ns
Digital Jitter	<0.2 UI (0.13 UI typical)

Serial Digital Output

Number	One
Signal Type	Serial Digital (SMPTE 259M)
Return Loss	>15 dB, DC to 270 MHz

AES Audio Output

Number	One
Type	AES3id, 1 KHz tone
Resolution	24 bit

Analog Audio Output

Number	One stereo pair or two mono
Type	1 KHz tone
Impedance	30 Ω, balanced
Reference Level	-10 to + 4 dBu, adjustable

Tri Level Sync Output

Number	One, 75 Ω
Type	1080i (SMPTE 274M -5, 6) 59.94, 50, 60 Hz 720p (SMPTE 296M -2, 3) 59.94, 50, 60 Hz 1080p (SMPTE 274M -9, 11) 23.98, 24, 25 Hz 1080sF (RP211 -14, 16) 23.98, 24, 25 Hz
Output DC:	± 50 mV
Return Loss:	> 30 dB to 30 MHz

General Specifications

Size	5.625” W x 0.8” H x 5.5” D (143 mm x 20 mm x 140 mm) including connectors
Weight	1 lb
Power	12 volts, 4 watts (100-230 VAC modular power supply not included)
Temperature Range	0 to 40° C ambient
Relative Humidity	0 to 95%, non-condensing

Due to ongoing product development, all specifications subject to change.

BRIGHTEYE POWER SUPPLY INFORMATION

Below is a list of power supplies and optional items that may have come with your BrightEye:

BEPS BrightEye Individual Power Supply

BEPS-RP Redundant Power Supply for Individual and Spider Power Supply

BEPS6 Spider Power Supply powers 6 single high BrightEyes or 3 double high BrightEyes

BERKMT BrightEye Rack Mount (holds 3 to 6 BrightEyes) 1RU high, 6"/152.4 mm deep, 3 lbs/1.4 kg

BEBP BrightEye Blank Panel (single high, for empty slots in Rack Mount)

BEBPD BrightEye Blank Panel (double high, for empty slots in Rack Mount)

5082-I 1 Port AES 110 Ohm Adapter

BEAC Analog Audio Breakout Cable with Pigtail End

PHX15 Breakout Adapter with Phoenix Terminals

GLOSSARY

This is a brief glossary of commonly used terms associated with this product.

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.

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.

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 ration. 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.

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 an 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.

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.

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, bit 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 each digital transition. Although the signal may be at the correct frequency on average, in the interim it varies. Some bits come slightly early, other 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 video, the allowable jitter is 740 picoseconds, or 0.2 UI (Unit Interval – one bit width).

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.

Multimode

Multimode 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 multimode 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 Singlemode.

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 that can be reproduced by a given sample rate) much higher than the desired passband. This allows more easily realized anti-alias 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.

Progressive

An imaging scanning technique that progresses through all of the lines of 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 every 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.

SDI

Serial Digital Interface. This term refers to inputs and outputs of devices that support serial digital component video. This generally means standard definition at 270 Mb/s. The use of "HD-SDI" is beginning to appear to indicate High Definition Serial Digital Video at 1.485 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.

Singlemode

A Singlemode (or monomode) 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 singlemode fiber used in an optical SDI system can carry a signal for up to 20 kilometers. Singlemode fibers require particular care in their installation due to the extremely small optical aperture that they present at splice and connection points.

See also Multimode.

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.

Tri Level Sync

An analog sync reference signal that is used in High Definition systems. Tri Level Sync is constructed with three signal levels, the sync pulses extend above and below a mid-level average voltage (the blanking level). Unlike conventional analog sync which is bi-level, the proper 50% pickoff point is already identified in Tri Level Sync. This contributes to lower jitter in digital systems.

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.